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A SEARCH FOR MISSING VOICES:
A NARRATIVE INQUIRY INTO THE LIVES
OF WOMEN SCIENCE TEACHERS

presented by

Lynnette Marie Cavazos

has been accepted towards fulfillment
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A SEARCH FOR MISSING VOICES:
A NARRATIVE INQUIRY INTO THE LIVES
OF WOMEN SCIENCE TEACHERS

By

Lynnette Marie Cavazos

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ABSTRACT

A SEARCH FOR MISSING VOICES: A NARRATIVE INQUIRY INTO THE LIVES OF WOMEN SCIENCE TEACHERS

By

Lynnette Marie Cavazos

The primary purpose of this study is to explore the personal and professional life experiences of women science teachers and to represent their voices, their stories in written text. Women teachers' knowledge, insights, and interpretations have been overlooked, unrecorded and often silenced in educational literature as well as in the larger public domain. Teachers' reflections about their personal experiences often remain invisible because educational researchers have not listened to the voices of teachers as they talk about their implicit theories and experiential knowledge.

Narrative inquiry, in the form of collaborative storytelling, is the research methodology used in this study. The researcher and the participating teachers were involved in mutual telling and retelling of personal experience stories. A number of different methods of data collection were used to gather a rich variety of stories and reflections: collaborative group conversations,

one-on-one interactive conversations and reflective journal writing. The narrative data is presented using an inductive mode of representation where the women speak for themselves through their individual and collective stories.

Four major themes emerged that highlight the distinctive struggles of women teachers who have been marginalized and silenced by the dominant members of the science education community: The Cultivation of Personal/Professional Voice, Uncertainty of Influence and Its Relationship to voice, The Problematic Nature of Change and The Reality of Being a Woman in "Women's True Profession."

The issues raised by the women storyteller have personal, political and professional implication for the educational community as we consider ways to reform science education and implement new guidelines for professionalizing the teaching profession. We are in the midst of sweeping reforms in science education in this country with the major focus on improving science education for all students. To accomplish this goal, we must broaden our conception of science and science education to include the unique perspective and insights of women science teachers.

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DEDICATION

To My Family, Friends, and Colleagues who
have supported my efforts to
cultivate a voice.

ACKNOWLEDGMENTS

To the women science teachers, Ruth, Sarah, Rachel, Marie, Clare and Jasmine, who courageously spoke from their hearts, I give my heartfelt thanks. Their trust and willingness to risk made this study possible.

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CHAPTER I

WHOSE STORY HAS BEEN TOLD?

A Hybrid of a Girl

"Thinking about what my daughter was like as a child, I remember what a contradiction she was to the familiar rhyme:

What are little girls made of, made of,
What are little girls made of?
Sugar and spice, and everything nice,
That's what little girls are made of?

What are little boys made of, made of,
What are little boys made of?
Snips, and snails, and puppy dog tails,
That's what little boys are made of.

She was always such a hybrid of a girl: a mix of "sugar and spice and everything nice" and "snips and snails and puppy dog tails."

I remember when she and a playmate decided to examine the toadstools out in the yard and proceeded to tear them apart and eat them as part of their investigation.

I remember when she would calmly and assuredly walk across the 2nd floor beams in her grandparent's barn and without a thought jump into the piles of hay below. Sure-footed, agile, daring.

I remember when she would uproot the flowers and vegetables in the garden just to see what the root systems were like and pull the big, green tomato caterpillars off the tomato plants and cut them in half with a hoe.

I remember her favorite haunt was woods across the road, where she would spend hours on end picking wildflowers, collecting specimens, tracking animals to find their secluded hiding spots. I loved the bouquets of flowers she brought home for me and for her May altar, and even came to appreciate all of the "critters" she kept alive in canning jars in her bedroom.

I remember when she would walk into rivers and lakes looking for clams and tadpoles but often came away instead with bloodsuckers stuck to her feet. I would be frantic and she would laugh as we doused them with salt to release their grip on her skin.

I remember buying her a microscope and chemistry set one Christmas, recognizing that she was more interested in messing around with what she could find outdoors than in playing with dolls and setting up "make-believe" tea parties.

As I look back at my daughter's life as a child growing up on the farm, I remember the experiences she had with "mother nature." I cannot explain why this daughter of mine developed into such a hybrid of a girl -- a mix of sugar, spice, snips, snails and puppy dog tails. Perhaps the girl within was predestined to develop a love of nature and the outdoors -- to develop into a 'woman of science' . . . (Stella Tate, Personal Communication, 1992)

What will become of such a hybrid of a girl? A girl who grew up during a time period, the 1950s and 60s, and in a place, rural America, where being a "woman of science" was peculiar and definitely out of the ordinary. What career choices could she pursue that would not conflict with the expectations of her culture? Bright females who excelled in science and math were encouraged to become teachers, nurses, or dental hygienists; they were not encouraged to become research scientists, astronauts, medical doctors and dentists, or college professors because young women growing up in rural Michigan were not thought capable of pursuing

elite careers in science. Those were reserved for the hard core scientists: the male academics who were better suited for the demands of traditional science and who would remain dedicated to science and their careers. I know this to be true, at least for the daughter described in the opening story, because I am the daughter and I did become a science teacher.

Growing up in the 1950s and 60s in rural Michigan was not a time of great liberation for young women. We were not told about the heroic work of women scientists like Barbara McClintock or Rachel Carson; the Equal Rights Amendment was yet to become an openly debated issue - patriarchy was alive and well in my hometown; the feminist writing of Kate Millet, Mary Daly, and Adrienne Rich were not on the recommended reading list for young Catholic girls at St. Gregory's School. I was a young female with an intense feeling for the organisms, a feeling of being connected to nature and to life, a feeling for scientific inquiry and no female heroes in the world of science to show me the way through the maze of artificial barriers constructed to keep women outside the "inner circle of science."

Acquired by a Culture

As children, we are born and raised in a particular culture of beliefs and biases, and to one degree or another we will be affected throughout our lives by what we believe, want or need to be true (Blier, 1986). The fact that I chose to become a teacher of science can be attributed in part to the beliefs and biases of the

generations of people who inhabited the rural farming community where I was born and raised. Those beliefs and biases were deeply embedded in stories - stories that I read, heard, whispered, chanted at home, in school, at church. Whatever their form or medium, these stories influenced every aspect of my life. They shaped, they molded and formed the person I am. Stories are fundamental to the way we live our lives and talk about our experiences with others. Storytelling feels so natural, so comfortable because it is so much a part of our everyday life. No culture, no civilization, no human group has ever been found that does not use story as its basic and usual means of communication (McConaghy, 1991). Not only are stories a means of communication, they are likewise a persuasive and subtle means of socialization into the culture. As a child, I was provided with a complete set of roles, expectations, labels, and myths to ensure that my beliefs, wants and needs would match the needs and beliefs of the patriarchal, Christian community where I lived.

I did not choose to acquire the culture that was I was born into - the culture acquired me. For the first forty years of my life, I didn't think much about this patriarchal culture that had acquired me. I had done as the culture had expected. I kept my reputation as a "good girl with potential" intact: I graduated from high school and college with honors, secured a full time job as a high school science teacher, and got married at twenty-four before I could be labeled an "old maid school teacher." Except for majoring in science in college, marrying a Hispanic man, and having no

children, I had done my best to assume the roles, meet the expectations, and amass labels that would match the needs and beliefs of the culture. What about the myths? I accepted those as well. I had been trained too well, socialized too completely to recognize the misconceptions, the distortions, the biases and the untruths that were the foundation of the myths put forth by the Catholic Church, the scientific community, and the "good old-boys" controlling educational institutions.

When I turned forty, divorced and skeptical, I began to discover that I had acquired a set of myths from my culture that no longer fit my beliefs, my wants or my needs. In fact, I uncovered so many myths over a two year span of time that I began to wonder if there was anything left in my life that was true and secure, tangible enough for me to hang on to. Not every woman becomes as perplexed in the middle of her life as I did, but given a chance I think many more women would and could. We have been told too many myths, accepted too many of them as truths without examining and questioning their authenticity, their value, their truthfulness.

As a woman, teacher, and a female scientist, I have been bombarded with stories that seek to define and explain who I am and what I should believe, need and want in order to be a successful, well adjusted member of society. I am not convinced that the authors of most of these stories know what I believe, need and want to be true. It is the male version of the story of science and science education that is accepted as the norm and the male story that has been published as the truthful, ideal interpretation of

reality. No one has ever asked me to tell stories about my life as a female science teacher. No one wanted to hear about my sense of what is real and meaningful, my perspectives on teaching and learning, my personal interpretation of the reality of life as a woman, teacher and scientist. How could anyone really know what the sounds and words of my voice might convey, if I was never asked?

I am a member of a silent group of women, whose knowledge, insights and experiences are missing from the knowledge base of science and science education. We have had little opportunity to have our version of the story published in professional journals or research documents. Women have not been in positions of power or had the authority to determine what pedagogical ideas would be endorsed and implemented within science classrooms. Women scientists and women science teachers are culturally in similar positions because our gender has often prevented us from being recognized as authoritative "fact-makers," the "knowers" in science (Hubbard, 1986). Women are generally viewed as "outsiders" within the scientific community and within science education departments because traditional science, in any form, is not considered "women's true profession."

In the twenty-two years I spent as a classroom science teacher, I was never the subject of any one's educational research project. Even if I had been, I am not convinced that traditional educational research practices involving fieldwork studies, open-ended research questions, and observations of a teacher's classrooms would have adequately captured the essence of my life experiences as a woman

science teacher. The knowledge I have as a woman science teacher is interwoven with the personal, professional and political experiences of my life. This experiential knowledge and the reality it represents will be revealed in the stories I tell from my vantage point as a woman, a scientist, a teacher and a researcher.

The truths that humans express through their stories are truths based on personal experiences, location in space and time, and the cultural beliefs and biases of their community. These stories are valuable precisely because they are subjective - - rooted in time, place and personal experience.
(Personal Narratives Group, 1989)

The Inner Voice

To truly capture a woman's sense of reality, she must be able to use her own voice and give others a context in which to interpret the meaning of her life experiences. When Carol Gilligan (1982) and other feminist writers talk about women speaking in a "different voice," the voice is both an expression of personal experiences and a choice of words unique to a woman's sense of self. Women do not experience life in exactly the same way as men, nor do all women share a common set of life experiences. As human beings, we are all unique, differing in genetic make-up, cultural indoctrination and exposure to and participation in social and historical events. Consequently, we interpret life's experiences, construct a personal version of reality, according to a set of socially constructed beliefs, values and biases that we acquire from the dominant culture. Women are above all else human; and therefore, interpret life from their subjective position in the world.

Nancy Harstock and other feminist theorists argue that in our patriarchal society, human activity is structured in fundamentally opposing ways for men and women and the "vision of each represents an inversion of the other" (as cited in Harding, 1991, p. 120). Within a system of domination, it is the masculine vision that has been captured in research with little attention given to women's different visions of reality. Harstock claims the visions provided by conventional research are "partial, perverse and distorted" because the research results are shaped by the male rulers and interpreted according to their masculine vision of nature and social relations (as cited in Harding, 1991, p. 120). If research begins to focus on women's vision of human activity rather than on men's will the picture be less partial and distorted? Will grounding research in women's different lives provide a more complete picture of nature and social life? I believe the answer to both questions is yes if we agree that in a gender-stratified society, such as ours, women and men are assigned to different kinds of activities, are responsible for uniquely different tasks; and therefore, lead significantly different lives (Harding, 1991, p. 121). According to Patricia Hills Collins:

Women are valuable "strangers" to the social order. As strangers they bring just the combination of nearness and remoteness, concern and indifference that are central to maximizing objectivity. The stranger can see patterns of belief or behaviors that are hard for those immersed in the culture to detect. (As cited in Harding, 1991, p. 124)

Women in science are in an inimitable position to provide a new insights and interpretations of the present conception of science

and science education. We are not complete strangers or outsiders to the culture of science, but rather "outsiders within" (Harding, 1991). From this position, we can deconstruct many of the ideological dualisms that have masculinized the culture of science: nature versus science, masculine objectivity versus feminine subjectivity, outsider versus insider, knower versus knowable. According to Sandra Harding (1991), we can provide a more objective view of life, not by eliminating objectivity but rather, by formulating a stronger notion of objectivity. One that "requires a commitment to acknowledge the historical character of every belief -- a commitment to cultural, sociological, historical relativism" (p. 156). It does make a difference who says what and when.

When people speak from the opposite side of power relations, the perspectives from the lives of the less powerful can provide a more objective view than from the lives of the more powerful. Until the less powerful raise their voices to articulate their experiences, none of us can find the perspective from their lives. (Harding, 1991, p. 269-270)

By speaking with our "different voices" and from our unique position, we can reveal new stories and seek out and retell old ones that present an alternate conception of femininity, masculine, science and nature. Stories which depict women as heroes within the field of science and demonstrate the ways in which feminine ways of knowing and understanding are valuable and necessary within the culture of schools and within the culture of science (Noddings, 1992). It is the uniqueness of women's individual perceptions of their lives as classroom science teachers that I want to capture in this book. I want to capture the words, the emotions, the meaning

women convey as they speak in their "different voices" - the emotional, subjective, often very defiant inner voice - about the beliefs, values and images that guide their practice and their lives.

I know that I have an inner voice that floats around in my head - the one that is often kept silent because I fear that my opinions will not be listened to, that I will not be taken seriously, that my words will be labeled as trivial compared to others with more authority. My experience is not uncommon to most women. Ask any woman how often she has not "told it like it was" because she wanted to keep the peace, avoid a confrontation, not be labeled as a trouble maker. This inner voice is a powerful voice, lying just below the surface, impatiently waiting for a time and a place safe enough for the voice to be heard. When this past year, 1993, was declared the "year of the woman," many women felt the time was finally right and the place safe enough for women's voices to be heard; for women to seize the opportunity to declare their right to public power. I likewise felt this was an ideal time to create a research study in which women science teachers could declare their right to public power within the science education community. Power, according to Carolyn Heilbrun (1990), is "the ability to take one's place in whatever discourse is essential to action and the right to have one's part matter "(p. 18).

In this study, I will use my power as a woman writer and researcher to bring the "different inner voices" of women science teachers into the educational discourse communities. We will

explore, through the use of narrative inquiry, the personal realities of our lives as women science teachers and speak in words that make clear and out in the open, those events, decisions and relationships that guide our work as women, as scientists, as teachers. This is a quest for our own story to be written and made visible - to have our part, our knowledge matter in the discourse about science education. Women teachers' own knowledge, insights, experiences and interpretations have been, until very recently, not only overlooked and unrecorded, but actually silenced in educational literature as well as in the larger public domain (Casey, 1993).

Marilyn Cochran-Smith and Susan Lytle (1990) point out that an important piece that is missing from the knowledge base for teaching is, "The voices of teachers themselves, the questions the teachers ask, the ways teachers use writing and intentionally talk in their work lives and the interpretive frames teachers use to understand their practice" (p. 2). William Schubert (1992) likewise suggests that teacher's voice, as a component of "teacher lore," is a neglected area in educational literature and educational research. "Teacher lore," as characterized by Schubert, is the study of the knowledge, ideas, perspectives and understanding of teachers. This study focuses on what teachers learn from experience and how they blend theory and practice to create a knowledge base about education. Teachers' reflections and thoughtful inquiries about their personal experiences often remain invisible because educational researchers tend to focus on the theories, knowledge and beliefs that are visible in observations of classroom teaching

instead of listening to the voices of teachers and pursuing the implicit theories and experiential knowledge that they hold.

We are in the midst of sweeping reforms in science education in this country with the major focus on providing science education for all students -- Science for All Americans (American Association for the Advancement of Science, 1989). To accomplish this goal, it is critical that we broaden our conception of science to include the unique perspectives and insights of women and minorities, who have been marginalized and kept outside the "inner circle" of science (Harding, 1991; Kass-Simon & Farnes, 1990). I believe that Evelyn Fox-Keller (1985) is correct in saying there is a multiplicity of goals and standards in science that need to be valued and included as we struggle to create a more inclusive vision of science and science education. Her vision of a "gender-free science" is not a juxtaposition of male and female perspective, but rather a transformation of the very categories of male and female and mind and nature. The first step, according to Keller (1985), will be to "undermine the commitment of scientists to the masculinity of their profession" which in turn will encourage participation of large numbers of women (p. 175). Paying attention to the experiences, perceptions and values of both women and men will help to develop a healthy science and a healthy earth out of the diverse spectrum of human experience rather than out of the narrow spectrum that our culture labels masculine (Keller, 1985, p. 176).

A healthy science is one that allows for the productive survival of diverse conceptions of mind and nature, and of correspondingly diverse strategies. In

my vision of science, it is not taming nature that is sought but the taming of hegemony. (Keller, 1985, p. 178)

An Identity Not of My Choosing

To write a new story about the lived experiences of women science teachers is a feminist undertaking. I am defining "feminist," using the words of Nancy Miller, as a wish to "articulate a self-consciousness about women's identity both as inherited cultural fact and as process of social construction and to protest against the available fiction of female becoming" (Heilbrun, 1990, p. 18). As a woman, a scientist and a teacher, I have inherited an identity that was not of my choosing but rather, one chosen and defined by others within the dominant culture. In our culture, males have historically been in the dominant position and have skillfully determined not only what women would be but who we would be. A woman's identity has been almost totally determined by what the dominant male culture believed it needed from women, and women have tried to fit the culture's grossly distorted definition (Baker Miller, 1986). I am mindful that I was not born a woman, a scientist, a teacher, I became a woman science teacher. I am also aware that the fictions that have been written about me and other women have generally not been articulated by a self-conscious female voice and therefore do not represent my vision of who I am and what I am.

Women live in a world where women's stories rarely have been told from their perspectives. The stories celebrated in culture are told by men. Thus men have actively shaped their experiences of self and world,

and their most profound stories orient them to what they perceive as the great powers of the universe. But since women have not told their own stories, they have not actively shaped their experiences of self and world nor named the great powers from their own perspective. (Christ, 1980, p. 4.)

It is not an easy task to write a new story about women's lives because we have been deprived of narratives in which women have taken control of their own lives and told their stories in the public domain using their own words and their own interpretations. Historically, men have had the advantage of telling their stories and representing the world because of their access to higher education and the pen having been placed in their hand. It is their version of history and human experiences that the culture recognizes as reasonable and credible and it has been told from the perspective of men's power (Christ, 1980). As Carolyn Heilbrun (1990) points out, women's lives and women's writing have a "vulnerable relation to our culture's notions of plausibility" (p. 18). We have been led to believe that what women say they mean or want could not possibly be what they mean or want.

Women's Talk

Much has been written about the problem women have in coping with a male language that does not have words to express what they wish to say. "It is difficult for a woman to define her feelings in a language which is chiefly made by men to express theirs" (Thomas Hardy, as cited in Heilbrun, 1990). It is even more difficult if women fail to speak profoundly and truthfully to one another. Women must choose to speak to each other using words and stories that are

meaningful and powerful in their own lives and that validate the significance of women's ways of knowing. Men do not control the meaning of words and stories unless we, as women, let them dictate what words will be spoken and what stories will be told (Heilbrun, 1990).

Men trivialize the talk of women not because they are afraid of any such talk, but in order to make women themselves down grade it. Women's talk will indeed be harmless as long as women consider it trivial compared to talk with men. (Heilbrun, p. 44.)

It is essential that women collectively, not individually, begin to share with each other the personal accounts of their lives and acknowledge the value of their "women's talk" and women's ways of knowing. We need to create female narratives in which women take control of their lives and publicly tell their stories for others to hear and to read: Women's stories written in a language that is their own, in a language linked to their identity, using their own words, in whatever form they chose to describe the reality of their lives to others. The choice of words, the way they are put together, the very subjectiveness of the thoughts are critical to a woman being able to articulate - "Who I am."

Starting From the 'Standpoint' of Women

Human experiences cannot be interpreted except from a standpoint, except as seen in a certain light, except as assessed in view of certain purposes, except as grasped in the context of experiences and insights and judgments accumulated to that point. (Novak, 1971, p. 55.)

In his book, Ascent of the Mountain. Flight of the Dove.

Michael Novak (1971) suggests that "a story is a linking of

standpoints; it is the 'who' at a given point in time/ (p. 53). For the reader to interpret my stories or any of the stories told by the women in the storytelling community, they will need to know some important aspects of our identities: race, social class, age, family background. They will need to get a sense of "who" is telling the story in order to understand the "reality" that is being described. The "who" is a complex of all those things that compose a standpoint. The who, the standpoint, is:

. . . a complex of past experience, a range of sensibility, accumulated images and imaginative patterns, and interests, bodies of insights already appropriated, purposes, structure and unstructured passions, criteria, evidence and relevance, the repertoires of already affirmed concrete judgments, values, goals, decisions. (Novak, 1971, p. 55.)

In more recent years, feminist scholars such as Frances Maher and Mary Kay Thompson Tetreault (1993) have reaffirmed the need for researchers and scholars to acknowledge their positionality within the context of their work. Positionality, according to Maher and Tetreault, refers to the "knower's specific position in any context as defined by gender, race, class and other variables" (p. 28). It identifies the ideological position and frame of reference from which scholars, writers, researchers, and informants present their data, interpretations, analysis, and their stories. These feminist scholars, along with others, contend that "knowledge is valid when it comes from an acknowledgment of the knower's specific position in any context," from the acknowledgment that "all perspectives are partial and particular" (p. 28).

Throughout this work, I will share stories of my life experiences and those of the women storytellers for three purposes. First, I believe that it does make a difference that I am the participant/researcher in this study. "Who am I?" is an indispensable question in this type of humanistic inquiry (Novak, 1971). I am not the replaceable experimenter in an objective, scientific experiment. My beliefs, values and ways of knowing will significantly influence how I organize the study: the questions I ask, the storytelling situations I create, the nature of the relationships between myself and the women storytellers, the stories selected for the reading audience, and the reflections I choose to share about my experiences as the participant researcher. Consequently, I believe it is essential that the reader have a sense of who I am and what my ideological positions are in relation to my life experiences.

Second, stories have the power to reach out and draw you into the situations, the experiences; they have an emotional dimension. Stories are compelling because their content is embedded with vivid events and images that carry strong emotional coloring (McConaghy, 1991). Involving the readers emotionally in our stories stimulates the memory and imagination. The reader's old rememberings and ways of knowing begin to surface and our stories become linked in some way to their own life stories. This blending of their rememberings and ours helps them to understand the meaning embedded within the stories; you have a standpoint from which to interpret this unique set of life experiences.

To tell a story is to formulate an interlocking set of meanings; to listen to one is in turn an active search for the teller's meaning via one's own; to retell a story is also to do just that because listening is a kind of retelling. (Rosen, 1986, as cited in McConaghy, p. 231.)

Third, our stories and reflections will help the reading audience understand why women science teachers feel they must have a time, a space and a supportive community of women colleagues available in order to cultivate their personal/professional voices and to recognize the value and legitimacy of their personal experiences and ways of knowing. A storytelling community provides a place for women to:

. . . vent frustration and focus anger, to reflect, to laugh, to store and distribute knowledge, to build the bonds that give strength and courage, and, ultimately to make it known to each woman that she is not alone in the struggle to make her world a place that is safe, responsive, just and liberating. (Traver, 1987, p. 447.)

In Chapters 2 and 3, I have provided the readers with excerpts from my life story. Each narrative focuses on a set of critical personal experiences that were influential in shaping the person that I am. Through these stories, I have revealed the "truths" of my experiences, not as they actually were, but as I remember and interpret them from my selective standpoint. The story line begins with my early childhood experiences and zig-zags through a series of transformative events and situations as I became socialized into the world of science, science education and the teaching profession. I have in a sense privileged my own story by providing the readers with a more complete and detailed description of my life experiences as compared to those of the six women storytellers. As the author

of this work, I feel it is important for the reading audience to have my autobiographic narrative told in enough detail to understand why certain issues are important to me and how my personal ways of knowing influence the decisions I make about this study.

In Chapter 4, the life story continues from my standpoint as a participant narrative researcher. In this section, I explain the importance of storytelling in teachers' lives and lay out my rationale for designing this study around an inclusive community of women science teachers. The design of study is presented along with my reflective thoughts about the choices I made and the dilemmas I've experienced in my role as a participating teacher and researcher in this study.

The six uniquely different women science teachers who joined me in the storytelling community are the focus of Chapter 5. In this chapter, I have included two sets of stories from each of the women storytellers. The first story, shared during our first group get-together, provides the reader with a sense of "who" each woman is; a glimpse of each woman's standpoint. The second story is from the participants' written/taped journals and captures their reflective thinking about: "What is Science?" and "How did I come to know it?" In spite of their differences, these women's stories have common threads of experience running through them -- growing up female, being educated in the traditions of science, and working in a profession that devalues feminine attributes.

Chapter 6 contains the collective stories we created as a storytelling community. In selecting excerpts for this chapter, I

aim to accomplish two goals: to represent the realities of women's lives from their standpoint and to give the readers a sense of the multiple nature of women's voices. In presenting the data from this study, I have used a more inductive form of representation, and let our individual and collective stories speak to the reader directly. By presenting our stories, as they originally were spoken or written, the reader has the opportunity to make her/his own interpretation and find meaning in the lived experiences.

Throughout this work, I have consciously chosen to limit my interpretations because I wanted the reading audience to have the freedom to generalize, to interpret and then decide what aspects of the data are meaningful and thought-provoking. In the final chapter, however, I break this interpretive silence and share my reflections about what I've learned from my experience as a participant researcher in a storytelling community and explore why it is such a struggle for women science teachers to transform the personal, professional, political reality they have inherited.

I hope that I have provided the readers with a narrative that truthfully acknowledges the ways in which family, work and political relationships are

intertwined and mirror each other within the context of women's lives (Christ, 1980). In the end, the reader will have a greater understanding of why the phrase: the professional is personal is political is a reality for women science teachers.

The personal is political is not a simile, not a metaphor, not an analogy . . . It means that women's distinctive experience as women occurs within that sphere that has been socially lived as the personal - -

private, emotional, interiorized, particular,
individuated, intimate -- so that what it is to know
the politics of a women's situation is to know women's
person lives. (Catherine MacKinnon, as cited in Fox
Keller, 1985, p. 8.)

CHAPTER II

CREATING THE STORY - STARTING WITH MY OWN

If you do not tell the truth about yourself you cannot tell it about other people. (Virginia Woolf, as cited in a Woman's Journal, 1985.)

For as long as I can remember, I have had difficulty expressing my "inner voice." It was such a risk: to speak or write the real thoughts that were running through my head. I believed, or perhaps was taught, that there was an acceptable, sanctioned way to represent my views and express my opinion. I did not trust the validity of my own feelings and experiences and did not realize that authority could come from within myself. The messages I absorbed from my cultural background were potent: "Listen to your elders," "Do not contradict someone in authority," "We will decide what is best for you - you are only a child." I was a good student and learned quickly from my parents, from the Dominican Sisters at my school, from the parish priest, that being able to speak and to write, in a literal sense, did not mean that I was free to use my "voice." Throughout my schooling, including my beginning years in the doctoral program, I was advised to only make claims and express thoughts that I could provide proper academic documentation for, meaning a citation of an approved author who had published her/his

work in a reputable source. What became even more silencing was the warning: Do not consider your personal experiences as valid, reliable sources for making claims about yourself, about others, about schools, about science, about teaching and learning.

This continual discounting of my personal experience and practical knowledge has been especially devastating because I interpreted this to mean my voice had no authority and that I would not be taken seriously by people in positions of power if I tried to use it. I learned to view my ways of knowing as less valuable, rational and conclusive because they were based on my personal way of knowing, my "woman's way of knowing." Within the academic community, experiential knowing is often discounted or granted less status because it is a form of common sense knowing, based on intuition and feelings. Since common sense and intuition can be acquired without rigorous academic training, it is not prestigious; it is in fact too common because it can be learned through family stories, from personal everyday experiences, from conversations with family and friends, from watching the nightly news on television. When I talk about my personal woman's ways of knowing, it is a combination of these different kinds of knowledge, personal experience, common sense, intuition, and academic learning. Together they are the basis for how I see the world and myself in it. At times, I'm sure my ways of knowing appear subjective and emotional and I am prone to taking things personally. But then, "women are always accused of taking things too personally, even though it is the most honest way of taking them (Mannes, 1985).

Belenky (1986) and her colleagues contend that a "woman's self concept and ways of knowing are intertwined," together they determine how she "views reality and draws conclusion about truth, knowledge, and authority" (p. 3).

In this culture, as in many others, an objective, rational, unemotional way of thinking and acting is desirable because it represents a "scientific way of knowing," the "male way of knowing." Women, like myself, who chose to become part of a scientific community were encouraged to discard our feminine ways of knowing and embrace the objective, impersonal, dispassionate ways of the dominant male model for science. We were asked to take on a masculine "identity," an identity that is not our own.

For many women in science, these two ways of knowing and being come into conflict. Who we are personally is not distinguishable from who we are professionally. Our lives as women are intertwined with our lives as science teachers - it is not a dualism. I am a woman science teacher, educated in the traditional academic disciplines of science and able to think rationally, formulate a hypothesis and draw objective conclusions following precisely the steps of the scientific method. I am also a woman - a female, possessing the qualities of subjectivity, the need for connections, and an emotional attachment to nature and to other living things. I am still, in my mother's words, a "hybrid of a girl."

From this hybrid of a girl, I have evolved into a scientifically literate "hybrid" with qualities of the feminine gender and the masculine gender intertwined in such a way that I

possess and have at my disposal a variety of characteristics through which to live my life and practice my profession. I do not believe that I represent a unique "hybrid" within the science teaching profession; however, it often feels that way. Our western culture, in subtle ways, continues to perpetuate the myth that the feminine gender is too subjective and emotional to handle the rigors of scientific thought. It is men who possess the desirable qualities of objectivity and rationality necessary to carry on rigorous scientific inquiry.

The scientific way to know has been labeled "objective" and identified as masculine; artistic, intuitive, and empathic ways of knowing are considered "subjective" and feminine. Thus knowledge has become gendered. And because the Western world-view values objectivity over subjectivity and men's knowledge over women's, "feminine" ways to know are by their nature inferior. (Hubbard, 1990, p. 8.)

For women, like myself, this sense of being a hybrid, of living a duality is very real, and often very confusing. I am well aware that what I feel and know about myself does not fit the myths of the culture.

The stories that have been written about women, about teachers, about scientists are problematic because they tend to portray individuals as identical clones of a man-made image. This image, more often than not, is decidedly masculine and stereotypic of a blend of Mr. Wizard and Albert Einstein. We are not all the same; and therefore, one image, one voice cannot represent all science teachers. But very few stories have been written about science teachers, specifically women science teachers, to dispel the myths. We need more stories that focus on the personal and professional

lives of women that provide a picture of real people, in real situations, struggling with real problems (Witherell & Noddings, 1991).

At the age of forty-five, I have come to terms with "who I am" and am following Gloria Steinem's (1992) advice to: "unlearn what I learned" about keeping silent, about always doing what is expected, about the importance of claiming authority. I am following my own interests and passions and letting my inner voice speak and write with authority. By transforming my silence into language, I am breaking one of the laws of patriarchy which demands that women be silent (Anzaldua, 1990). As I begin to write and speak with my own authority, an authority based on personal experiences and understanding, I can begin to dispel the myth that women have nothing of significance to say and are content to have no voice. We can train ourselves to respect our feelings and to transpose them into a language that can be shared (Christ, 1980).

The Girl Within - Is a Scientist

Everything else you grow out of, but you never recover from childhood. (Beryl Bainbridge, Woman's Journal 1985.)

Having grown up on a farm in rural Michigan and spending a great deal of time out of doors, in woods, and orchards, and in and around lakes, I always equated science with the natural world. When I think about science, I do not think about it as content in a textbook or as a particular process or procedure that one carries out in a laboratory setting of a corporation or a school with a lot

of equipment and chemicals. Although I would agree that science, at least descriptions of it, are found in books, movies, lab books and manuals, I don't value them as highly as first hand, inquiry-based experiences. Science for me has always involved exploration, investigation, hands-on experiencing. It might be exploring a particular habitat, investigating a living organism, or experiencing a natural phenomenon; whatever the context, I was involved personally and keenly interested in what was going on. Often it wasn't that I was looking for answers or hoping to discover the scientific explanation of what I was observing or experiencing. I just enjoyed being a part of the living world and feeling connected to it where I happened to be.

I have never recovered or outgrown my love of the science I knew as a child. What I remember best from my childhood science adventures was my solitary explorations of the woods across from the farmhouse where I lived. Since we lived in the country, with no children nearby, I did most of my exploration alone. Funny how I never was afraid to be in those woods alone, even if I couldn't see my home or my grandparents from where I was. Unfortunately, now I would probably be more hesitant about tramping around by myself for fear of who or what might be lurking around. Back then, there wasn't so much of a concern about children in rural areas exploring on their own. It was a good time to be a child.

This woods was a wondrous place, always changing as the seasons came and went. Unlike many children, my fascination was not with animals, it was with plants. I loved to look for wildflowers and be

the first to see them come up in the spring. I knew my favorites by their common names: spring beauties, blood roots, trilliums, dutchmen's britches, and jack in the pulpits. Their scientific names were not important, at least not until I took a college botany course. Now, I don't remember any of those Latin names. I'm embarrassed to say that I picked hundreds of these flowers when I was growing up, never realizing that most of them were "protected flowers" in the State of Michigan. My mother and grandmother loved them and were always so appreciative when I brought home spring bouquets. I'm sure "mother nature" has forgiven me.

For some unexplainable reason, I was also very fond of the fungi growing in this woods. Now, it seems like such an odd group of organisms to have developed a fascination with. Perhaps I thought I might catch a glimpse of the fairies and elves that supposedly used the fungus for umbrellas, drinking cups, and resting spots. Or maybe it is a family trait, passed on to me by my paternal grandparents. They also had this infatuation with fungi and frequently took me on hikes into new and unfamiliar woods to hunt for "morels," "puffballs," and "robin's drinking cups." The teaching and learning that occurred during these explorations of nature greatly influenced my perceptions of how one learns and the importance of personal, active involvement with real organisms, real places, and with real people. I am forever thankful that I came to know science as part of my everyday experiences rather than through textbooks in the classroom.

My other favorite haunt as a child was the expansive length of sea wall that formed a channel between Lake Michigan and Pentwater Lake. This sea wall formed a pair of piers that extended out into "The Big Lake" and for a short distance into Pentwater Lake. For "Michiganders" from the West side of the state, "the Big Lake" was the familiar and endearing nickname for our Great Lake - Lake Michigan. At the west end of the pier stood a small lighthouse that marked the pathway into the safe harbor of Pentwater Lake. I have very fond memories of that end of the pier: it was a special spot to watch thunderstorms roll in off the Big Lake; it was a challenging spot because I learned to be a senior life-saver off the end of the pier; it was a cherished spot that my father and I share.

I really was a fortunate child to have lived on a farm from October to May of each year and then move to a cottage near Lake Michigan from May to October. My summer months were a totally different way of life. There were other kids to play with, sand dunes to explore, and best of all multiple places to fish. I truly have no idea how I developed such an interest in fishing. Neither of my parents were into fishing, but I do remember having a special girlfriend who was "fishing-crazy" like me. We would spend hours fishing off the pier for perch and in the special shallow rocky areas near the end of the pier that extended into Pentwater Lake. It didn't matter what we caught or what we used for bait - we just loved to fish. I sure was never squeamish about baiting the hook - anything was fair game: worms, minnows, wigglers, grasshoppers, crayfish, even fish eyes if necessary. When the perch were running

off the pier, I would get my dad out to fish. He never really did become much of a fisherman but it was a special time for us to spend together and I was more than happy to help clean the fish as well. Just recently, my father commented that he just didn't know where I got this desire to cut things up and dissect them. It surely didn't come from him. As a boy, he never even liked to butcher on the farm with his father and brothers. He would make up excuses so he wouldn't have to watch or help.

School Science

A few people come to science by their contact with nature; most others are brought to science by their contact with nature in the classroom. (R. Hubbard, personal communication, 1990.)

If I had not come to science through my contact with nature, I may never have made the contact at all. Having grown up Catholic in a small rural town, the choice of grade schools to attend was limited but there was indeed a choice, the public school or the Catholic school. For devout Catholic parents, like mine, the choice was obvious. Their primary consideration was the cultivation of my religious beliefs and indoctrination into the culture of Catholicism. I attended our parish grade school, St. Gregory's, from the first grade through eighth grade with the exact same eighteen classmates, fourteen females and four males. Our school was reminiscent of a one room country school, except that we had three classrooms; one for first and second grades, a middle room for third, fourth and fifth, and a third for sixth, seventh and eighth. Our lives and our education were in the hands of three very saintly

and dedicated Dominican nuns who focused their teaching and our learning on the four "Rs," reading, writing, arithmetic, and religion. Science was not one of the basics. To the best of my recollection, we never had a science lesson for the entire eight years I was in grade school.

Consequently science continued to be an activity, an experience that I pursued outside of school, as part of my everyday life. When I was in the third grade, we did get our first television set and I remember watching a show called "The Wild, Wild Kingdom." My exposure to science began to expand and move beyond my immediate neighborhood. My mother also had a role to play in my everyday experiences with science. She worked outside the home as a grade school teacher throughout all my years of school. Although she was not trained in the sciences, she also grew up on a farm and seemed to have a feeling for nature as I did. Unlike the Dominican sisters, my mother did try to bring nature and science into her classroom. She and her students would study the seasons, would make leaf collections and do leaf pressings, and study the more common animals native to Michigan. I benefited from her lessons as well because she would bring materials home for me to use and experiment with. But this kind of science was not textbook science done in a classroom setting. It was so very natural and connected to the real world and my mother did not have to play the role of teacher at home; and therefore, never graded my projects or checked them as right or wrong.

I left the safety of St. Gregory's School to attend the public high school in my home town. My classmates now numbered over one hundred and were more heterogeneous in background and motivation. As a high school student, I was a typical female in an atypical program of study for a woman. For high school students in the 60s, pursuing a college education was the norm for high achieving students, like myself. Although my high school was small, approximately four hundred students, I was able to take the necessary college-prep type courses, including three years of science, four years of math and English, and Latin. Not surprisingly, I knew from the time I entered high school that I was going to find a career that would allow me to pursue my interest in nature. It never occurred to me back then that my chosen field of study might be out of the ordinary for a female.

Upon entering high school, "science" as presented in textbooks and lab manuals, became a part of my life and my schooling. Then, I got my first exposure to the "real thing," complete with correct terminology, the important theories and laws to memorize, the names of "men" who were important in science, and the proper way to do science using "the scientific method." My lack of science coursework in grade school was not a problem. I had been trained well by the Dominican sisters and entered high school with terrific study habits and a thorough drilling in the four "Rs." Since this was a small high school located in rural Michigan, we were not exposed to the then new and innovative "alphabet" science curricula designed to bring renewed intellectual vigor to school science

programs. Three of the more popular, new curricula used by public schools in the early 1960s were BSCS (Biological Sciences Curriculum Study - blue, green and yellow versions), CHEM Study (Chemical Education Materials Study Blue), PSSC (Physical Science Study Committee) were collaboratively developed by the National Academy of Sciences - National Research Council and the National Science Foundation (DeBoer, 1991).

My high school science program consisted of a series of traditional college prep courses: Biology in the 10th grade, followed by Chemistry in the 11th, topped off with the Physics in the 12th. Although I liked this sequence of science courses, I cannot say I developed a greater love for science because of them. The science curriculum adopted by my local school district can best be described as traditional and textbook-based, with content mastery the primary educational goal (DeBoer, 1991). Each of the courses I took were organized around the specific topics outlined in the textbook chapters and emphasized those concepts that good, well-rounded science students should be exposed to before entering college. I did not have the opportunity to participate in any science classes that emphasized "inquiry teaching and learning." In Biology and Chemistry, in particular, the instructional pattern consisted of reading the text for homework and answering the review questions at the end of the chapter, followed by a summary lecture by Mr. J and a brief period of time at the end of class to ask questions. Interspersed within this pattern were occasional hands-on laboratory activities, during which we would collect data

and submit our results as part of a formal lab write-up. I did commit to memory the steps of the "scientific method" because Mr. J told us over and over again that this method was integral to the work of being a scientist. If we followed the steps, in order, we could be assured that our way of doing science was objective, neutral and correct.

I don't ever remember actually following all of the steps of the scientific method in "school science." We seemed to concentrate on verifying the results of a well known scientific experiments. We always worked in pairs when doing lab activities but I never got the feeling it was because doing science was a collaborative adventure. It was for more practical purposes - there was not enough space, equipment or materials for each of us to work alone. The only variation from this instructional pattern occurred in high school physics. Instead of working on verification activities with a partner, we observed and discussed whatever demonstrations the teacher, Mr. H devised to help us visualize and verify the physical laws of nature. Most of our "inquiry" involved trying to figure out what went wrong with Mr. H's demonstrations and why things didn't seem to work out as neatly and ideally as they did in the physics textbook.

Once again, the steps of the scientific method were introduced and in a "second-hand" manner and I observed how to verify scientific facts. Being engaged with science in a more self-directed way was not part of my "school science" experience. We experienced science by simply reproducing, in a step by step

manner, what other scientists had already investigated and published as absolute "truth." Like traditional scientists, we tried to minimize any personal feelings or involvement with the objects of study so that the experimental results would not be contaminated by human error and influence.

The Biology curriculum did include a few hands-on activities: the proverbial fall leaf collection with carefully pressed specimens, identified with scientific and common names; observations of pond water and newspaper print to acquaint us with our microscopes; and the mainstay of high school dissection - "the leopard frog." Although I enjoyed these opportunities, they were not new experiences for me. I had been collecting, investigating, doing hands-on science since I was seven years old and even had a small microscope of my own. What occurred during my year of high school chemistry class is a complete blur, almost non-existent in my memory. I presume we did hands-on experiments throughout the year, but not one sticks out in my mind. It seems rather distressing, and a bit sad, that I remember so little about my classroom experiences in chemistry. Why are my memories of school biology so vague and unpassionate and, of chemistry, almost nonexistent? Perhaps, my loss of memory is due to the passing of time, it has been over twenty-nine years since I was a high school science student. Or perhaps the experiences just did not kindle in me a new and intense passion for science; they were simply the required courses I was advised to take so I would be ready for college.

My teacher for both Biology and Chemistry was a traditional male science teacher complete with a white lab coat, a short brush cut and a persistent drive to cover the required content in our textbooks. I have two remembrances of this brisk, Scottish man, nicknamed "Blue Jay," and his class. Both left a lasting impression and continue to influence my perceptions of classroom science and science teaching. First, I remember that when it came time for the class to study the human reproductive system, he passed out a small paper booklet and stated: "Read this on your own but don't ask me any questions about it." I was not surprised by this announcement, my mother handled the topic of menstruation and reproduction in just the same way. The message was clear and easily understood: The more personal aspects of life science were not up for discussion. We could make sense of it on our own. Not that I would have dared to ask a question, but I would have been all ears if one of my classmates had taken the lead.

Secondly, we were required to memorize the following short verse that Mr. J. claimed was an old and famous Scottish proverb: "Oh would some power the giftie gie us, to see ourselves as others see us, it would from many a blunder free us, and end devotion. It wasn't until I was in the doctoral program that I discovered that this was not a Scottish proverb at all, it was a verse from one of Robert Burns's poems. I can't explain why this verse has stayed with me for the past thirty years but I suspect it is because this unscientific verse represents such a break from the traditional, elitist information we learned in science classes. For me, it is a

piece of personal practical knowledge from the heart of Mr. J. and therefore I feel connected to him, even now, because he shared that part of himself with all of us. I admire this teacher, Mr. J. not so much for his science teaching but for his efforts to extend science into our everyday lives.

It was not until my senior year of high school, in Physics, that I realized I was an atypical female. I was back in a class of eighteen again, the same size as my grade school class. But this time there were sixteen males and only two females. We were the same eighteen students that had made it through four years of high school math together. Of my three high school science courses, physics was the furthest removed from my conception of everyday science. I simply did not have any personal experiences as a self-made scientist to relate to this type of science, this way of thinking. My physics teacher struggled as well because he was not trained as a physicist, he was a mathematician. Consequently, we focused on those concepts of physics that emphasized manipulations of numbers and problems-solving with formulas. In some ways, I suppose that was what I liked about class. I was an excellent math student in high school, having been finely drilled and tuned as a competitive mathematician in grade school. If Mr. H. had utilized a more "conceptual" approach to physics emphasizing how much of our everyday life involves the laws and the formulas we were using, I might have been able to make the connections. But as it was, I didn't. Although I did not excel in high school physics, I wasn't discouraged. I just considered Physics to be an abstract kind of

science that I wasn't very good at. Besides, this was not the kind of science I had envisioned studying in the future and I didn't have a passion for all of those formulas.

I left high school with a clear realization that my everyday experiences with nature and my common sense understanding of science was not what "school science" was all about. A distinct dichotomy existed between the objective, textbook science of the classroom and the subjective, discovery science of my personal experience. In all three of my science classes, the traditional scientific method was represented as the idealized way of coming to know science and clearly superior to my common sense ways of knowing. Scientific reasoning was portrayed as the objective, value-free, neutral way to search for knowledge; whereas, my intuitive, common sense reasoning was subjective, biased and emotional in comparison. School science was traditional science and, as a student, I was expected to learn the concepts, the laws, the vocabulary found in the textbook regardless of its relevance or connections to my life. I was to be a "consumer" of someone else's knowledge of science not a "producer" of original ideas, or alternate ways of knowing. It was time to set aside my personal ways of knowing science; the way I loved and felt connected to. In its place, I would learn to practice science and to think about science in a more detached, unemotional way. A science without a soul, without feelings, without everyday people.

Many years later, I came to understand why this dichotomy exists within the field of science, but for now I was off to college. Well trained and indoctrinated in the proper, correct way

to learn and practice science. Little did I realize what was in store for me as I left high school to enter the world of "academia."

Onward and Upward to the Hallowed Halls of Science

While I was still in high school, the celebrated scientific event of the decade occurred - the launch of Russia's sputnik. As disconcerting as that accomplishment by the Russians was for the United States, it did provide a renewed interest in science and technology education. It was a perfect time to be in college with aspirations of becoming a scientist and becoming part of the "inner circle" of science. I was ready to move onward and upward.

Much to the dismay of my high school counselor, I chose to move onward and upward at Michigan State University. It seemed like a perfect place to develop my interests in science and the campus reminded me of a woods. My counselor, however, was convinced that a "big ten" school was far too large and impersonal for a young female from rural Michigan, even if I was an honor student with "good potential." His advice was stay closer to home and go to a small college where you won't get lost in the crowd. Fortunately and amazingly, my parents supported my headstrong wish to go to MSU and I entered as a freshman in the fall of 1965. Once again, the "hybrid of a girl" from Hart made a most atypical choice, not only about what college to attend, but also about the program of study to pursue while at MSU. I chose to enroll in Michigan State's first residential college, Justin Morrill College, designed to educate students interested in careers related to international studies and

foreign affairs. It sounded like such an exciting, unique, experimental adventure for this university and I wanted to be a member of this first class. I had no intention of abandoning my interest in a career in science - I would just become a different kind of hybrid, an international scientifically literate liberal arts kind of person. At the time, it seemed like a good compromise and I didn't have many role models to follow when it came to being a woman in science.

Thus my traditional science training became intertwined with the liberal, socially situated curriculum of Justin Morrill College. The liberal arts curriculum of Justin Morrill combined with my science major and minor from the university at large provided me with an amazingly diverse and enriched college experience. Within JMC, I studied Russian and Russian history, the geographical and cultural characteristics of Africa, political and economic issues of urban societies, and art and religion of Asia. My scientific mind was beginning to become liberalized, and issues outside the area of science became of interest to me. I didn't become a radical, free-spirited liberal but I began to realize that "being educated" meant more than solving math problems and running experiments in a lab.

One experience in particular opened my eyes to life in the real world and forced me to confront my own tolerance and acceptance of injustice. Caesar Chavez arrived on campus to speak to the student body about the need for fair pay, sanitary housing and fair labor practices for field laborers in the United States. For many of my

classmates, Chavez's appeal had very little meaning and was not connected in anyway to their backgrounds or life experiences. But for me, his message was loud and clear and painful. I grew up in a rural, farming area that hired large numbers of migrant workers to harvest the crops. A number of my high school classmates were from Hispanic families who had been seasonal migrant workers following the crops from Texas to Michigan and back again. Now they were settled permanently in my home town. In fact, throughout my senior year of high school and into college, I dated a young man from a migrant family. I began to understand how difficult their earlier life had been as - the Mexican migrant laborers. (I would eventually marry this man, but not for many years later.)

The migrant laborer's pay was minimal, dependent primarily on the size of the crop and the price set by the canning factories, and the housing and living conditions were tolerable at best. Both sets of my grandparents hired migrant laborers to pick crops and I never gave it much thought as to whether they were paying the laborers fairly and providing clean, sanitary living conditions for all of the women, men and children they were responsible for. I responded by boycotting California grown products, and more importantly I confronted my father and challenged him to do something for the migrant workers whom he and my relatives hired back home. This confrontation was quite a shock to my father and perhaps marked one of the first times I had allowed my "inner voice" to come to the surface and be heard. From that point on, I took an intense interest in the work of Caesar Chavez and other national leaders who

were challenging the economic and political injustices of our elitist, capitalistic society. I was beginning to see through the myths that I learned as a child in rural Michigan and finding new stories that would help me to become the person I wanted to be. It is ironic that now, thirty-years after, I am living in Ventura County in California where Caesar Chavez lived his life and fought his cause.

In the midst of all of the social turmoil of the middle and late 60s, I was learning to be a scientist. What a contradiction! The country and the campus were in a constant state of flux. The dominant cultural traditions of American society were being challenged and attacked by peaceful and militant groups representing the disadvantaged, under-represented, and disenfranchised in our society. The hallowed halls of science, at least and Michigan State, seemed to be unaffected and impervious to the turmoil going on around them. I realize that this may not have been the case. But from my vantage point as a college student, the traditional ways of knowing and doing science remained unchallenged and unchanged. It was as if "science" as an institution could claim itself to be "neutral" and not responsible for any of the conflicts that were surfacing at the time. This was not the case within Justin Morrill College. The College, the program of study, the content to be learned was always in flux. The faculty and students together were involved in creating a new approach to teaching and learning and expressing one's opinions was expected and respected.

I was living a duality again. One part of my life, the life at JMC, focused on social issues and international concerns and involved examining and exploring alternate ways of knowing and understanding. I was expected to be creative and to be a "producer" of ideas and to analyze issues from diverse points of view. The other part of my life, the life of a scientist, focused on quite the opposite. I was programmed into a traditional curriculum for a science major and required to take the prescribed set of pre-requisite courses: three terms of chemistry, three terms of physics, three terms of biology and three terms of math, to prove that I was bright enough and disciplined enough to "do science." Once I successfully completed those preliminary classes, I was free to focus on more advanced courses that would meet the established requirements of my major and minor.

Academic Science

Science is a system of procedures for gathering, verifying, and systematizing information about reality. The knowledge that has been developed in fields such as physics, astronomy, biology through scientific procedures is fascinating, awe inspiring, a tribute to human creativity and perseverance. Applied in technologies, scientific information creates powerful tools for creative use and devastating misuses. In and of itself, none of this should lead us to think of science as inherently masculine. Yet, because science evolved within patriarchal society, it took on a decidedly masculine tone and became burdened and distorted by a pervasive male bias. (Namenworth, 1991, p. 18.)

Certainly the transition from high school to college involved change, adjustment and reassessment. In a matter of a few months, I went from being a student in a class of one hundred to being a

student in a class of almost ten thousand. I moved from a rural farming community of two thousand to an urban campus community of forty thousand. I left the security of a conservative, homogeneous culture to become a member of a liberal, diverse, internationally mixed culture. But the one area of my life that remained unchanged and required the least amount of adjustment was the transition from "school science" to "academic science." The traditional, patriarchal structuring of science was the same. The world of science was still the world of men and the philosophy and practices of the institution of science continued to be shaped and defined by the established male authorities.

I soon discovered that self-directed inquiry was not going to be part of learning and practicing "academic science" either. Academic science was presented as an even larger body of factual knowledge: more laws and theories, more extensive terminology, and more detailed descriptions of proper use of the scientific method. The social/historical/cultural context of the knowledge was still missing. The facts of science continued to be presented as if they occurred without human intervention, as if they were discovered simply by careful observations and not through human social activity, which includes individual bias, prejudice and historical influences (Lemke, 1990). The objective facts of science were represented as objective truths backed by impeccable observations and extensive experimental evidence. I was taught that evidence and logical argument are the basis for the authority of science and the facts of science should be considered established, permanent, and

incontrovertible. I certainly was not encouraged to question the "facts" because I was not an expert scientist and had no authority to dispute or question the evidence provided by generations of knowledgeable scientists. Although this is inconsistent with the true nature of science and scientific discovery, it was the view presented to me as an academic student of science. According to George DeBoer (1990) the nature of science, scientific discovery and thinking is ". . . not just a series of steps that lead inevitably to new discoveries, but rather as a general form of inquiry that has many variations and a distinctly human character" (p. 229).

The textbook continued to be the bearer of the comprehensive factual knowledge. The only significant difference was the textbooks were much thicker now, and I was responsible for the content of every chapter and any accompanying information provided during lectures and labs. It was not important if the "facts" were not connected to my personal experiences or ways of knowing. Personal experience and common sense ways of knowing were not represented as the truthful way to investigate and understand science. The truth of science is portrayed as special and contrary to common sense, accessible only to experts (Lempke, 1990). If I wanted to become an expert in science, then I would have to learn to depend more on the "facts," as discovered by the scientifically approved method, and less on common sense and experience.

Once again, the sanctioned set of rules, "the scientific method of inquiry," was the basis for the practical, hands-on experiences I encountered in almost all of my "academic science" courses. As a

biology major and physical science minor, I spent hundreds of hours in the lab collecting and analyzing data, making scientific drawings, and completing the traditional five part lab report (purpose, equipment and materials, procedure, data and observations and conclusion). It was important for me to learn how to follow directions, to become efficient at setting up laboratory equipment and materials, and to collect and analyze data. However, the emphasis on following a set procedure and coming up with the correct results and interpretations just reinforced my belief and perception that there was only one correct way to learn and do science. Preferably, this correct way would be objective, rational, and without feeling. Personal feelings and relationships are impediments to objectivity, not ingredients of discovery (Barton, 1992).

Most of the academic science courses at MSU were taught by male professors who employed traditional approaches to teaching and learning. Each course consisted of a lecture section with a corresponding laboratory section designed to give us both theoretical and practical experiences. I was required to memorize pages of detailed facts and formulas, scientific theories, laws and principles and be able to identify by name hundreds of different species of plants and animals in different stages of development. My knowledge and understanding of all of this scientific information was evaluated through written tests that primarily consisted of multiple choice and fill in the blank questions. In addition, I had the opportunity to test my recall skills further by taking timed lab

practicals in which I was asked to identify the specimens we had seen during our lab activities or on field trips.

Unlike my high schools science courses, the laboratory sections that complemented the lecture were usually "hands-on" and I was encouraged to be inquisitive and resourceful about my learning. However, we followed the same traditional format for scientific investigation that had been used for years: make observations, form a hypothesis from the observations, test the validity of the hypothesis with experiments or further observations. Most often, we did not formulate our own hypothesis or design the experiments conducted. Instead, we repeated experiments with known, predictable results. Our primary responsibility was to follow the set procedure and formulate "the correct" conclusions from our data. Our methods of investigation did not resemble the kind of "discovery learning" I had done on my own as a child where I really "messed about" with science. I messed about as I was directed and learned to follow directions and to reproduce someone else's knowledge. I was very successful at this kind of "guided messing about" and enjoyed getting my hands on the scientific equipment and working with specimens, both living and non-living, that were available for observations and experimentation. Much to my surprise, I became an exemplary student in the lab sections of chemistry and physics even though I had very little intuitive understanding about how the experimental results related to the natural world.

Traditional science was alive and well at Michigan State and I had no choice but to accept that I was a "consumer" of someone

else's knowledge. My university professors determined what knowledge was important to know, what questions were worth asking, and how we were to interpret the results of our scientific inquiries. My task was to follow the rules, acquire the knowledge presented, learn to think objectively and rationally, and pursue those questions that were important to my professors. I did not question this traditional approach to learning science. After all, throughout high school and college, I had been taught that scientists must follow certain rules and go about the task of fact-making in a particular, professionally sanctioned way. "Individuals cannot just go off by themselves and come up with their own brand of facts" (Hubbard, 1986). As long as I followed the proper procedures and learned the correct brand of facts, I could become a scientist.

I remember one course in particular in which attention to the details of the textbook and acquiring a certain brands of facts was imperative and compulsory for passing. During my junior year of college, I took Ornithology (study of birds) from an elderly, eccentric professor known as Dr. Birdwatcher. I realized the course was going to be a real challenge since Dr. Birdwatcher had written the required textbook and was enamored with every word, every diagram, every picture that was printed in his book. We followed the textbook to the letter and were responsible not only for what he said in class but also for any and all information found between the covers of this book. It was not unusual, on a test, for Dr. B to ask us to "identify" the specific bird nest found on a page in the

textbook. In addition, the class went on early morning (6:00 a.m.) bird watching expeditions three days a week. We were quite a sight: walking around campus with our heads tilted back, looking up into the air with our binoculars and listening to our professor imitate bird calls to attract species for us to see. We learned to be awake and alert during those expeditions because any bird we saw or heard would be fair game for the next test. "What bird did we see on the morning of May 6th that had a repeating song that ended in a loud shrill and was sitting on top of Sparty's helmet?" This Ornithology course could have been an inquiry-based, self-discovery type of course with the professor taking on the role of guide and facilitator rather than a lecturer and transmitter of factual knowledge. But it wasn't. Dr. Birdwatcher chose to follow the traditions of "academic science," dispensing information through non-interactive lectures and assessing our knowledge of Ornithology by requiring us to memorize an immense amount of factual information and data from field notes. At times, I saw glimpses of the kind of science I remembered from my days early days of tramping around in the woods exploring nature, especially when we went on our early morning walks on campus or ventured out into the countryside around East Lansing to look for "bluebirds" and "purple gallanules." The glimpses only lasted for a few minutes, then we were back to taking down detailed notes about the birds we spotted, the sound of their songs, and their natural habitats. I loved this course not because of the lecturers or the detailed factual information, but because the birds we studied were connected to my everyday life experiences.

They are part of my image of science and nature. Despite the compelling topic, the traditional, authoritarian method of instruction used by Dr. B continued to reinforce my belief that science was a large body of factual knowledge that should be committed to memory. If I took on the role of a secondary science teacher then it would be my responsibility to pass on this body of knowledge to all of my students.

Only once during my college career do I remember having the opportunity to be a "producer" of scientific knowledge. As you might expect, the course was not classified as a traditional "hard" core science class, it was "Population Ecology." Finally, finally - a professor who encouraged me to be intuitive and thoughtful about the ecological theories we were studying. My common sense understandings of the natural world were valuable and useful in this setting and I felt there was a real connection between my everyday experiences and the scientific knowledge we were learning. I knew from my first hand experiences, on the farm and in the woods, the importance of relationships between living organisms and how delicate the balance is between survival and death.

The assigned project for this senior level course was to create an experimental design for studying "plant competition" among different species. We worked in groups and were given complete freedom to follow the scientific method as we wished. It was exciting and self-motivating to have a chance to be innovative and take some control over our own learning. Even though most of the plants in our plot died before the end of the term, it didn't

matter. What was important was our willingness to be experimental, to use the scientific method as it was meant to be used - to create new knowledge related to our own questions and based on our own experimental data. One thing for sure, my group clearly demonstrated that scientific experiments in real life can and do fail. We should expect that. I discovered, through the death of our plot, that scientific discovery is not about right answers; it is about taking risks and learning from mistakes. It has been twenty-four years since I took that ecology class and I still remember that one learning experience more clearly than any of the others. If I had taken this course earlier in my college career, I might have chosen a different career path.

The Choice: Teacher or Researcher

Reality is never just simply the objective datum, the concrete fact, but is also a people's perception of it. (Freire, as cited in Hubbard, 1985.)

Throughout high school and college, I had first hand experience with male authority figures and the masculine representation of doing and learning science. Science, "school" and "academic," was portrayed as a large body of factual knowledge that included laws, theories, definitions and representative examples of the contributions of important scientists that should be committed to memory. There was minimal concern about students' understanding the social/historical/cultural context of this knowledge or what role human idiosyncrasy, error and confusion played in the scientific discoveries represented in the text (Kuhn,

1970). Scientific resource books, including textbooks, implicitly denies the relevance of time, place, social context, authorship, and personal responsibility (Hubbard, 1990), they omit the human elements of science -- the personalities of the scientists, their day to day life experiences, the dilemmas they faced personally and professionally. Science textbooks are not about real people, they are about universal principles and detached scientific observations that seem to happen out of context.

As a student, I was not encouraged to look beyond the literal meaning of the textbook, to consider who created this body of knowledge and why or how it might connect to my everyday life experiences. We never talked about scientists in the context of their lives. They were always portrayed as "insiders" that were clearly outside the social/cultural/ historical context of everyday life. I was told to learn the facts, become fluent and articulate in the "language of science," and become skillful in conducting scientific experiments using acceptable methods and procedures. This kind of learning experience was imperative if I was going to be competitive in "academic science" and accepted into the "elite" inner circle of science. Yes, I played by the rules. I learned the "truths of science," learned the appropriate way to "talk science," and felt very optimistic that I was "smart enough" to become a successful woman in science. I was rational, objective, self-disciplined, a scientifically literate hybrid of a girl.

Did I enjoy this kind of science? Was it the best way for me to learn considering my personal learning experiences in my

childhood? To be honest, at that point in my life, I didn't know a choice could be made. I never considered that there was a right way or a wrong way to learn or do science. If this was the way all of my male science teachers and professors chose to represent science, and their representation was reinforced by the written text, then it must be the right way, the accepted way to learn and understand scientific phenomena. These "men of science" were authority figures, teachers of science, who were trained in the ways of traditional science. Who was I to question what kind of knowledge was important for me to know, what problems were important to investigation, what methods should be followed to produce the correct answers? My interactions and under-standings of the natural world did not fit into the world of traditional science. My ways of knowing did not meet the criteria established by the dominant authorities within the scientific community. I accepted that fact and did not battle the system. I wanted to do well in "academic science" so I could complete a science degree and become a successful woman in science.

When I reached the point in my academic schooling, when science majors had to begin preparation for a specific profession, I had narrowed down my career choices to two, a secondary science teacher or a scientific researcher. What a narrow range of choices I laid out for myself. One would think that the career possibilities in science, during the 1960s, would be extensive. After all, we were engaged in an all-out battle with the Russians to regain supremacy in the field of science and technology. The United States needed

scientists, top-notch scientists, capable of moving the country into the new age of scientific technology. "The vitality of the United States scientific community is considered to be essential to its economic and military competitiveness" (Brickhouse, in press). Why wasn't I more aware of the expansive career possibilities open to "women in science?" To best answer that question, I will share my perception of the "traditions of science" I inherited and how those perceptions influenced the choice I made.

The Traditions

The Patriarchal Structuring of Science

Representation of the world, like the world itself, is the work of men; they describe it from their own point of view, which they confuse with the absolute truth. (DeBeauvoir, as cited in Fox Keller, 1989, p. 3.)

Science, as a practice and a body of knowledge, is a socially constructed institution. As a cultural institution, it reflects the social political, ideological and conceptual experiences of the dominant authority figures within society. Historically the dominant authority figures within the institution of science have been men; and therefore, the world of nature and the world of science have been described from their masculine point of view. The "prominent men of science," most notably the Baconian scientists of 17th century, were extremely instrumental in the institutionalization of science and in choosing to establish male authority as integral to the practice and philosophy of science (Blier, 1986). Science was constructed from the masculine

perspective of reality and defined according to the qualities and values of the established "male authority;" that is: objective, value-free, individualistic, and disinterested (Brickhouse, undated). Although many of the goals of Baconian science have been discarded, this masculinization of the structure and practices of science has not (Blier, 1986, p. 6).

In this country, as in others that subscribe to the Western Industrial version of science, the dominant categories of cultural experience and authority continue to be white, male, middle/upper class, and heterosexual (Blier, 1986). Consequently, the structure, theories, concepts, values, ideologies, and practices of the institution of science remain, as they have for centuries, man's conception of what nature is and how "she" should be named. Science is not an entity in and of itself even though descriptions of science give that illusion (Hubbard, 1990). Science is the activity of scientists, most notably male scientists. It is scientists who determine what specific problems will be investigated, what facts will be discovered, what knowledge will be used to shape and define scientific theory and be passed on to future generations of students as the "truth."

How these facts, these truths are discovered is by no means arbitrary. Scientists must follow certain rules and go about their task of fact-making in a particular, professionally sanctioned ways (Hubbard, 1986). The most professional way to be scientific and sanctioned is to follow the set of idealized practices known as the scientific method, which includes: "making observations, forming

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hypotheses or tentative explanations for the observations, and then testing the validity of the hypothesis by further observations or experiments" (Blier, 1986, p. 3). Scientists are considered accredited fact-makers if they follow this traditional, masculine-defined method of investigation. This way of thinking and doing science is sanctioned by the "established male authority" because it protects against rampant subjectiveness and guarantees that the scientific knowledge obtained is objective, valid and neutral (Blier, 1986). To further guarantee objectivity and neutrality, traditional scientists generally distance themselves from the objects they study and do not acknowledge that they have any connection or relationships to these objects. By controlling both the environmental conditions and the objects of study, scientists assert that neither they, nor the objects they study, interact to influence the outcomes of their observations or experiment findings (Barton, 1992).

Natural scientists achieve their objectivity by looking at nature (including other people) in small chunks, which they treat as though they are isolated objects. And they usually do not acknowledge their own relationship to the "objects." In other words, natural scientists describe their observations and achievements as though they exist in a vacuum. (Hubbard, 1990, p. 29.)

Some philosophers and scientists, Thomas Kuhn and Karl Popper in particular, would argue that science is not practiced in the ways that Ruth Blier (1986), Ruth Hubbard (199) and Angie Calabrese Barton (1992) have portrayed it. Regardless of this debate, it is important to note, however, that "school science" and "academic science" are portrayed from an inductivist, positivist, empiricist

point of view (Kaufmann, 1989), which leads most students to believe in a narrow conception of science and the processes of science. According to George Kaufmann (1989), science education at all levels has not kept up with the modern practices of science. Contemporary science is not oriented exclusively toward finding the scientific truth through empirical observations.

Nonetheless, the isolated, separatist way of studying the natural world has been the accepted method of scientific inquiry and is highly valued in our society (Hubbard, 1990). Many people, both inside and outside of science, believe that the isolated pieces of knowledge produced by science will lead to desirable technological and medical advances that will assure the United States of scientific and economic dominance in the world (Namenworth, 1992). If enough money is poured into scientific research, any problem can be solved and answers to nature's most perplexing questions can be discovered (Hubbard, 1986). Science is a powerful tool and as an institution exemplifies those qualities that our Western society holds in high esteem: intelligence, rationality, perseverance, dominance, objectivity and control of nature.

Women: Unsuitable for "Penetrating"
the Mysteries of Nature

To be a scientist one must be objective - woman is incapable of objectivity. A scientist must make rational judgments - woman is incapable of reason. A scientist desires the truth - woman desire's only truth's opposite, passion. This conception of woman's nature has excluded us from the very process of defining ourselves. Our silence is dictated; we are made into objects of study. (Tuana, 1989, vii.)

Who is responsible for defining woman as "unsuitable" for scientific inquiry? What was the basis for the "facts" discovered about woman's nature by the accredited "fact-makers" within society? Numerous books have been written by philosophers, historians, and feminist scholars about the "unsuitable nature of woman" and her exclusion from science (DeBeauvoir, 1952; Millett, 1969; Kuhn, 1970; Rich, 1979; Fox Keller, 1985; Hubbard, 1990; Jacob, 1988; Harding, 1991; Noble, 1992). What is clear from these varying accounts is that "the who" responsible for defining and excluding women has been an elite group of male scientists and "the what" is their masculine bias and selective rendering of the truth (Hubbard, 1990; Keller, 1985; Noble, 1992).

Throughout history, a small group of economically and socially privileged white male scientists (and philosophers) have had the power and authority to make "facts" and "definitions" about woman's human nature. These facts not only define the attributes of a woman's biological make-up and social nature; but also, what is normal for her to do and not do and what she can do and be (Hubbard, 1990). We can find early evidence of this selective, biased "fact-making" in the writings of Aristotle:

The female is a female by virtue of certain lack of qualities. We should regard the female nature as afflicted with a natural defectiveness. (DeBeauvoir, 1952, p. xxii.)

Women are weaker and colder by nature than man. We should look upon the female state as being as it were a deformity, though one which occurs in the ordinary course of nature. (Noble, 1992, p. 157.)

Following the work of Aristotle, St. Thomas Aquinas incorporated similar biased views of women in his book *Summa Theologica*.

Since the male seed produced a "perfect likeness" - that is, a boy child - a girl child results only from a defective seed. Women are "deficient and misbegotten," inferior to men by nature except for purposes of procreation, and naturally subordinate to men because of their more limited capacity for reason. (Noble, 1992, p. 157.)

The prejudice against women has roots in the biased perceptions of ancient medical and scientific scholars, Aristotle and his followers, and in medieval beliefs and doctrines of the Catholic theologians, like Thomas Aquinas. According to Noble (1992), Western science has always been in essence a religious calling, a continuation rather than a departure from Christian tradition. The culture of science evolved as a religious activity and therefore is embedded with traditions, beliefs, and prejudices of the early Christian Church. Over time the culture of science was shaped by the "scholasticism of the High Middle Ages" and the "evolution of the Latin Church and its clerical ascetic culture of its male hierarchy" (Noble, 1992, p. xv). The culture of science became the culture of the ecclesiastical academy and, hence a world without women emerged. "A society composed exclusively of men, forged in flight from women, and intent upon remaking the world in its own half-human image" (Noble, 1992, p. xvi). Early modern science was molded into an exclusively male culture that was characteristically celibate, homosocial and misogynous (Noble, 1992, p. 163). From the twelfth century on, the clerical culture of science separated itself from society and male scientists carried on their work as if it were

a religious calling -- free of the influences of "earthy" women and of other worldly corruptions that would interfere with their authority and power to make facts and control nature.

From this clerical culture, modern Western Science has inherited and retained a number of characteristics that serve to perpetuate the myth that science is for men and that women are unsuitable to penetrate nature's mysteries. Noble (1992) summarizes these characteristics as follows:

- o the strict separation of subject and object,
- o priority of the objective over the subjective,
- o depersonalized and disembodied discourse,
- o elevation of the abstract over the concrete,
- o asocial self-identity of the scientist,
- o total commitment to the calling,
- o the incompatibility between scientific career and family life,
- o and the alienation from and dread of women (p. 281)

Frances Bacon and his followers are credited with further influencing and molding science into the image and likeness of men during the 17th century by introducing and elaborating metaphors for science that were gendered, sexual and divisive to the institution of science (Blier, 1986; Fox Keller, 1985). In his writings, Bacon identified man as the thinker epitomizing objectivity, rationality, culture and control; and woman as the reproductive being embodying the natural, the disorder, the emotional, the irrational (Blier, 1986). This dualism, as defined

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by Bacon, sets up women in opposition to men. Man is self and woman is the other. Being the other, according to Simone DeBeauvoir (1952), means being viewed as incidental, inessential as opposed to the essential. Because, according to Bacon, woman possesses none of the qualities necessary for practicing science, she is not suited to conquering and dominating a "feminized" nature. It was his belief that science should, through objective scientific reasoning, control the world.

The aim of science is not to violate but to master nature by the following dictates of the truly natural. That is, it is "natural" to guide, shape, hound, conquer, and subdue her - only in that way is the true nature of things revealed. Science controls by following the dictates of nature but these dictates include the requirement, even, demand for domination. (Keller, 1985, p. 36.)

As a social institution, the structure and practices of science evolved according to the needs, wants, and beliefs of men like Bacon who were interested in taking command of nature and controlling her. It was in their best interest to associate science with men and nature with women so that the practices of science would be theirs to control and would be clearly separate and disconnected from everyday life and common ways of knowing. Likewise only certain educated, economically independent men had the necessary masculine qualities to become members of the inner circle of science and carry out authentic scientific inquiry. Baconian science and science as we know it today:

. . . evolved within a patriarchal society and developed a decidedly masculine tone, became distorted by a pervasive male bias, systematically excluded women from training and participating in science (as in all other professional and public activities), and was

furthermore, most effective in propagating stereotypes of "the feminine" that made it seem self-evident that women were totally unsuited for "penetrating" nature's mysteries. (Blier, 1986, p. 7.)

The gender metaphors of Bacon and others have become embedded within the institution of science and continue to shape the ways in which our social system divides the human qualities between males and females. Young men are instructed and socialized to believe that they are naturally intelligent, logical, objective, active, independent, forceful, risk-taking and courageous. Young women, however, are socialized to believe that they naturally have a different set of qualities: sensitivity, emotional responsiveness, obedience, kindness, dependence, timidity, self-doubt, self sacrifice (Namenworth, 1991, p. 18).

The world appears to be clearly divided into two parts: the "knower" characterized by the masculine mind and the "knowable" assigned to the feminine gender and to nature (Sloat, 1990). By designating "mind" as a masculine quality and "nature" as a feminine quality, our society and the institutions of science perpetuate the myth that scientific thought and scientific ways of knowing are reserved for males. Acquiring scientific knowledge and using that knowledge in the sanctioned experimental way is natural for the masculine gender but not for the feminine; therefore, males are naturally suited for the rigors of scientific discovery and have access to the "inner circle." Females, in contrast, are not suited for penetrating nature's mysteries and are kept on the fringes of science, in the "outer circle." Even when women do follow the scientific method and rigorously pursue the goals of modern-day

science, they are still women working within a profession that is predominantly viewed as the male domain. Women are the "outsiders" (Harding, 1991).

It's Hard to Fight an Enemy
Who Has Outposts in Your Head

Because science continues to be identified as a masculine enterprise, women who enter the culture of science have to mediate between two worlds and learn to live with their dual identity: "to be a real woman is to be nonscientific; to be a real scientist is to be non-feminine" (Blier, 1986, p. 45). In this day and age, people no longer openly say that women should not and cannot do science. However, during the 1960s when I first came to know and understand the traditions of science, the gendered language and metaphors of science were clearly spoken and believed by almost everyone. In spite of my outstanding academic accomplishments in high school science and mathematics, I too believed that males and females were not created equal when it came to utilizing the skills of objectivity, rationality, and scientific ways of knowing. I recognized that I and a few of my female friends had by some fluke of nature evolved into genderized hybrids with a mixture of feminine and masculine qualities. I knew I was a capable, rational student. The question was "Was I good enough, bright enough to make it through a university program of study and become a scientist?"

During my first two years of science at Michigan State, I discovered the answer to my question. I was a good, average "B" student; nothing more, nothing less. As my academic grades

indicated, I was clearly not an aspiring genius in science or math and was not labeled as one of the "cream of the crop" by any of my professors or teaching assistants. Consequently, no one really paid much attention to me, not even my college advisor. I went through college as a biology major making selections based on what seemed to be a good blend of biological and physical sciences. No one ever advised me to specialize in a particular area of biology or get involved in a sanctioned research project or field study. I didn't see myself as one of the "knowers" within the culture of science. Instead, I felt like one of the "followers; " capable of following the steps of the scientific method but not creative enough or masculine enough to become a "fact-maker."

I have often wondered if my experiences in academic science would have been different if I had interacted and associated with any female role models. As it was, I never had a female teacher or female professor for any mathematics or science courses throughout my four years of high school and my four years of college. Women in science were not part of my everyday experience; in fact, they were not represented as part of the culture of science at all. From my perspectives as a science student in the 1960s, science was conceived and constructed by "founding fathers" with little or no assistance from "founding mothers." The stories that were told in textbooks, journals, and novels portrayed science and scientists according to men's perception of what counts as significant, valuable scientific work. Male scientists were portrayed as heroes within the scientific community. They were the intellectual,

objective and powerfully creative individuals. Women, if they are mentioned at all, were portrayed as subordinate helpers responsible for nurturing and assisting the hard-working scientist as he carried on his important investigative research (Blier, 1986).

One story, in particular, I remember was extremely influential in its portrayal of women in science. While I was still an undergraduate student, I read James Watson's novel The Double Helix. I found the book exciting and revolutionary because it was an emotional story about the life experiences of creative scientists who were about the business of doing science. The four main characters in the book, Jim Watson, Francis Crick, Maurice Wilkins, and Rosalind Franklin, were portrayed as real people with personality quirks, obsessive human behaviors, and a passion for their work.

Watson:	a bit frivolous, problematic, clearly extraordinary;
Crick:	loud, exuberant, brilliant;
Wilkins:	serious and a bit musty, often unenthusiastic;
Franklin:	dowdy, impatient, prickly and at times belligerent. (Hubbard, 1990, p. 55.)

At the time, I did not realize how biased and skewed this science story was. From Watson's account, Rosalind Franklin, whom he nicknamed "Rosy," was involved in the DNA project because Wilkins needed some professional help and "Rosy," a trained crystallographer, could assist in speeding up "his" research (Hubbard, 1990). Rosalind was not portrayed as an ingenious, qualified scientist instrumental in their quest to unravel the

structure of DNA. Instead, she was represented as just another female research assistant; a technician who was asked to come to King's College in London to build an x-ray diffraction unit. In fact it was quite evident throughout the book that:

The real science - good science - is done by bright, ambitious men. Women can be a damned nuisance if they aren't sufficiently helpful and especially if they try to be scientists and have their own ideas. (Hubbard, 1990, p. 56.)

As the story goes, Watson and Crick were in a frantic race with Linus Pauling and his colleagues at Cal Tech and did eventually beat out their competitors and build the helical model of DNA. They won the race and designed the famous "double helix" model primarily because they had access to Franklin's best x-ray diffraction pictures of DNA and to a copy of a privileged research report that Rosalind had submitted to the Medical Research Council at King's (Hubbard, 1990).

In 1953, a historic set of three papers appeared in print in the journal "Nature": one by Watson and Crick describing the structure of DNA; two others, one by Wilkins, Stokes and Wilson and another by Franklin and Gosling, providing the supporting x-ray evidence. These papers were of historic significance, and as a result, Watson, Crick and Wilkins were awarded the Nobel Prize in 1962. And what about Rosalind Franklin and her crucial experimental contributions to cracking the structure of DNA? Her contributions were overlooked, discounted and she was written out of the historical account of the final chapter of the story.

Watson, Crick and Wilkins' three Nobel Prize lectures contained a total of 98 references, and not one of Franklin's papers is specifically mentioned. Wilkins makes the only textual reference in this casual remark: Rosalind Franklin made some very valuable contributions to the x-ray analysis. (Kass-Simon & Farnes, 1990, p. 237.)

What did I learn about women in science from reading Watson's version of The Double Helix (1968)? At the time, I learned that women who become actively involved in the field of science are treated with contempt if they do not look and act stereotypically female. In the case of Rosalind Franklin, she was belittled not because of her lack of scientific expertise but because her hair, her clothes, her demeanor were unfeminine. She was not a beautiful, charming, doting female willing to accept a role as a cleaning woman, technician, secretary, or wife. Rosalind wanted to work on the theoretical structure of DNA on her own; she certainly was not interested in being an assistant to Maurice Wilkins or any other male scientists in the laboratory. Because Rosalind did not want to play by the "rules" set up by this group of male scientists, she paid the price. Her scientific work was used without her knowledge or consent by her more powerful male colleagues and she was written out of the heroic event - kept invisible. In all honesty, I don't remember being appalled or infuriated by Watson's sexist treatment of Rosalind Franklin as a woman and a scientist. His version of the story fit my image of the male-dominated culture of science, and I was accustomed to the invisibility of women in science.

Before I leave this story, let me assure you that I learned "the rest of the story" from feminist portrayal of Rosalind

Franklin's life as a scientist (Sayre, 1975; Blier, 1986; Hubbard, 1990). Franklin was indeed treated with contempt by the male scientists while she was at King's College. Not only was she ridiculed because of her lack of femininity but she was also treated as a second class citizen. It was the common practice at King's to not allow women in science to relax and socialize with their male colleagues over morning coffee or afternoon tea (Hubbard, 1990, p. 58). They were to be served separately in less accommodating rooms because it was tradition within the male culture of science. Considering the sexist attitude of the scientific community at King's, it is not surprising that Rosalind Franklin was treated as an assistant and kept in her place by the dominant males she worked with. Many historians believe Franklin was not awarded the Nobel Prize along with Watson, Crick and Wilkins because she was a woman working with a group of male colleagues in a masculine-controlled Laboratory. She was viewed as less than equal by her male colleagues and consequently they felt no obligation to acknowledge her contributions or include her in the final version of the story (Sayre, 1975; Hubbard, 1990). Isaac Asimov's new book entitled Chronology of Science & Discovery (1991) also acknowledges that "Franklin's co-workers tended to ignore her because she was a woman and therefore the fruits of her labors were used to benefit others" (p. 576).

I wish that I could report that the case of Rosalind Franklin was unique and not representative of women's experiences in science. But in fact, it seems to be more the rule than a rare occurrence.

With few exceptions, women have been left out of most historical accounts of science, engineering, mathematics, medicine and the social sciences (Harding, 1991). Substantial numbers of women scientists have been productive within the field of science but the majority have been kept at the lower echelons of the profession and are often deprived of the recognition and influence they deserve (Blier, 1986). Women continue to be viewed as the "foot-soldiers" of science, able to carry out the routine work of laboratory research, but lacking the creativity, intellect and analytical expertise necessary to do innovative research (Blier, 1986).

This is how Rosalind Franklin came to have her extraordinarily fine analysis of the structure of DNA pirated and appropriated by Wilkins, Watson, and Crick, who then explained to the world that "Rosy" was really good at taking X-ray pictures but would surely not have been capable of interpreting them. (Blier, 1986, p. 21.)

This hegemonic practice of ignoring and misrepresenting women's work makes it extremely difficult for women, like myself, to imagine choosing a life-long career within the institution of science.

Role Models for Women of the 60s

For the most part, women's contributions to the field of science were not acknowledged in print during the time that I was pursuing a degree in biology during the late 1960s. Other than Rosalind Franklin, I can only recall one other woman being publicly acknowledged as a "distinguished" scientist who made significant and notable contributions to the institution of science. Marie Curie was portrayed as a "hero," a woman of extraordinary talent who

accomplished her exemplary scientific work in partnership with her husband. She was represented as a "star" in the male-dominated field of chemistry primarily because she subscribed to the sanctioned traditions of science, abiding by the masculine-defined rules for knowing and doing science. Her personal life and her personal ways of knowing were never mentioned in my textbooks and I did not realize, until later, how much of her life story was missing. I never knew until recently that Marie Curie was not only intelligent and ambitious but also a woman who led a colorful, romantic life as a mother, a widow, and a scientist (Kass-Simon & Farnes, 1990). I suspect this occurred because textbooks and other science reference books are factual documents written from the male perspective. The social/historical/cultural aspects of science and scientists' lives are too subjective and too connected to everyday life to be part of any factual story about the activities of science.

G. Kass-Simon and Patricia Farnes (1990) in their book Women of Science believe that the absence of women in historical accounts of the creation of science occur because women have functioned within the scientific community but outside of the realm of history. Women's lives and their contributions to science have generally been ignored and therefore excluded from books that recount the deeds of heroes in science. For example, in Asimov's Biographic Encyclopedia of Science and Technology published in 1976, only 10 women were listed among the 1,195 scientists whose work is described. Likewise

in Singer's Classical History of Biology (1950) no women scientists were included (Kass-Simon & Farnes, 1990).

The recent publication of books about women in science such as: Women in Science (1990) by G. Kass-Simon and Patricia Farnes, Women in Science (1983) by Vivian Gornick, Four Lives in Science (1984) by Lois Arber Arnold, Uneasy Careers and Intimate Lives (1987) by Pnina G. Abir-Am and Dorina Outram, Women as a Force in History (1946) by Mary Beard, A Midwife's Tale (1990) by Laurel Thatcher Ulrich, and Hypatia's Heritage: A History of Women in Science from Antiquity to the Late Nineteenth Century (1986) by Margaret Alic, indicate that women have been influencing the development of science throughout history, from antiquity to the present time. According to these accounts, women have been actively practicing science for well over 3,000 years and among these women were a number of world-class scientists as well as many more ordinary women scientists (Herzenberg, 1987). Many of the names of the ancient women in science are missing. Prior to 3100 BC. there are no records of individually identified women scientists, but starting in 600 BC. women scientists start to be individually identified: Arete of Cyrene, Pythias of Assos (Aristotle's wife), Maria of Alexandria, Hypatia, Anna Commena, Hildegard of Bingen, Dorotea Bocchi, and the list goes on. Throughout the Middle Ages and the Renaissance, women continued to be active in science even during the time period when no fewer than 40,000 women were executed and tortured for witchcraft. Included in this number were women of science like Martine De Bertereau, Baroness of Beausoleil, a mineralogist who was

France's first mining engineer (Herzenberg, 1987). These women are the "heroes," the role models for modern women of science. Despite the centuries of adversity, including torture and burning, these women paved the way for future women to continue in the field of science.

I feel anger and frustration that such an important piece of history was kept a secret from me. The total misrepresentation of women's influence and participation in science throughout history left me with the impression that women did not play a prominent role in the development of science and scientific knowledge. The biased and inaccurate stories that were passed on to me by the male authorities of science did me a great disservice. Throughout my educational experience, it was always the male version of science and scientific inquiry that was accepted as the norm and the male version published as the factual version of reality. Consequently it was hard to imagine what qualities a successful women scientist might have and how she would mediate between the masculine world of science and the feminine world of nature. How would a woman of science live with her dual identity : a real woman and a real scientist? Might she feel like a scientifically literate hybrid, as I did?

Where was Barbara McClintock when I really needed her? She was a successful, practicing scientist when I was a student at Michigan State but her unique ways of knowing and doing science were not outlined in my genetics textbook or discussed by my male professors as an alternative way to interact with and explore nature. In fact,

many of McClintock's extraordinary scientific accomplishments were not revealed until the early 1980s when Evelyn Fox Keller published the biographical study of her life, A Feeling for the Organism: The Life and Work of Barbara McClintock (1983). McClintock developed a distinctive approach to scientific research in genetics that emphasizes the "complexity of interacting systems and the interrelationship between the observer and the observed/ (Blier, 1986, p. 48). Barbara McClintock did not view nature as a "passive, mechanical object" to be conquered and subdued. Nature for her was alive and growing, internally ordered and resourceful (Blier, 1986). Her relationship with the organisms she studied can best be described as subjective, emotional and intimate - a total contradiction to the traditional objective, detached, distant relationship of the male scientist and his objects of study. McClintock calls her method a "feeling for the organism" (Hynes, 1989). She expressed her deep satisfaction with her research when she said, "I know every plant in the field. I know them intimately and I find it a great pleasure to know them" (Hynes, 1989, p. 57). McClintock's intimate words express her profound love of nature and take me back to the woods and to my childhood way of knowing and doing science. I believe I could have, and perhaps would have, become involved in scientific research if Barbara McClintock's way of knowing and doing science had been an option. I also had a real "feeling for the organisms." I interacted with the trilliums, the robin's drinking cups, the morels, and, like McClintock, I was never

able to maintain the proper distance away from the "objects" I studied.

Being a Scientist Means to Forget Being a Woman

The exclusion of the feminine from science has pertained to a particular definition of science: science as incontrovertibly objective, universal, impersonal - - and also masculine. Such a definition both helps insure the invulnerability of science in the face of social criticism, and serves to demarcate male from female. It is a definition that sustains and is sustained by a division of emotional and intellectual labor - - a division along the lines of sex. (Fox Keller, 1986.).

According to Vivian Gornick (1983) and Evelyn Fox Keller (1985), 20th century science in the United States continues as a masculine enterprise. Women who want to become successful scientists must view the world from the male perspective and sacrifice their personal goals as women in favor of a life dedicated to the institution of science.

What does it mean for a woman to view the world from the male perspective? Within the scientific community, it means being motivated as a scientist to seek personal power, prestige, authority and control over property and personnel (office and lab space, equipment, technicians, graduate students, grants) (Blier, 1986). In time, having finally achieved tenure, it means striving to continue to climb the ladder of success: actively seeking promotions, acquiring larger and more extensive grants, receiving invitations to speak at influential meetings and conferences and eventually becoming established at a prestigious research site. Being successful in the world of science is a lot like being

successful in the world of business and politics. It requires personal drive, a motivation to be competitive and authoritative, and at times totally detached from the everyday routines of personal life.

For a woman seeing the world from the male perspective is problematic primarily because in our Western culture, females are socialized to be quite the opposite of the qualities held in high regard by the scientific community. Even when young women are recognized as intelligent, logical, independent and forceful; they are often discouraged by parents, counselors, boyfriends, even girlfriends from pursuing a career in the "hard sciences" (physics, chemistry, medicine, engineering) because it is unfeminine and unnatural. Females who are too assertive, too uncompromising are often viewed as "out of sync" with society's image of what a female should be or want to be.

You might be thinking *--this was the way it was back in the 1960s when "babyboomers" were in school; the culture has changed. Society and the institutions of science are different now --we aren't discriminating by sex in the '90s. Women have come along way: They can do whatever they want to do, become whatever they want to become, they can have it all - marriage, a family, a career and a personal life.*

From my perspective, as a woman, a scientist and a teacher, this is just not the case. Society and the culture of science have changed very little over the past twenty-five years. Women are still feeling the impact of society's efforts to mold them into the

masculine conception of what they should be. Within the institutions of science, girls and women are subtly discouraged from fully developing their intellectual and creative potential and from seeking positions of power and prestige (Blier, 1986). Perhaps we have such small numbers of great women scientists because too many bright, self-determined young women are being told they must develop a split personality: a masculine version for their professional life and a feminine version for their personal life. This recent quote taken from Gornick's 1983 research work suggests that this generation of women is still being encouraged to forget about "being a woman" if they expect to have a successful life in science.

The only way to be a woman in science is to forget about being a woman. It is impossible to live in a world of contemporary professional science, and rise to the top of the profession, and still be a woman in old-fashioned terms - that is, have a family. She says it can't be done, and points out that the majority of women in science are unmarried, or married with no children, or divorced with no intentions of remarrying. (Gornick, as quoted by Blier, 1986, p. 167.)

Women in science are often pressured, by their mentors within the field, to make a choice between a life as a woman and a life as a scientist. Good science, from the traditional masculine perspective, should and will require all of one's energy and all of one's time (Blier, 1986). How can a woman realistically believe she can have a personal, family-oriented life and a successful career in science when the rules seem to prevent it? These rules are established from the male perspective but often enforced by a successful female mentor and role model in the field. This quote from a successful woman scientist exemplifies the dilemma female

graduate students face when they try to blend personal and professional goals.

She's as interested in her upcoming wedding as she is in the experiments she's doing. I can't believe it. She'll never make it. That's not what it's all about. At this point in her life she should have nothing -nothing on her mind but the lab. She should be killing herself with work. There should be absolutely nothing else in her head. (Gornick, as quoted by Blier, 1986, p. 167.)

The Choice: Can I Be a "Wo/Man" Scientist?

It was hard to imagine transforming myself into an academic, masculine version of a scientist. I grew up in a rural farming community that adhered to the traditional values of Christianity and patriarchy. I was socialized into a culture that valued the traditions of heterosexual marriage, family life, devotion to church, hard work, and male authority. My life was controlled and guided by these traditions. Throughout my childhood and early adult life, I learned where and how women fit into these traditions and what the consequences were should I decide to deviate from the accepted system of beliefs. I envisioned having a conventional kind of life: marriage, children, and a career in science. A life in which my personal life and professional career would coexist peacefully and successfully. Of course, I had no conception of what it would mean to combine the roles of wife, mother and woman in science. I knew mothers and wives but I did not know any women who were scientists. I never even visited a research laboratory or academic institution of science to see what traditional science was all about. My image of a woman in science was based strictly on

how they were portrayed in my science textbooks, novels like The Double Helix, research articles from National Geographic, by the media (newspapers and television) and of course by my male teachers and professors in science. The one characteristic that all women in science seemed to have in common was the desire and the ability to complete years of education in science: college, graduate school and post graduate training.

From my very limited perspective, there were two kinds of highly educated women within the institution of science: those who exemplified the masculine qualities, followed the traditions of science and were successful; and those who didn't and consequently were less successful and usually treated as subordinates to their male colleagues. As I mentioned earlier, Marie Curie exemplified my image of a successful woman in science. Her work was well known, she was well respected and publicly recognized as a genius in the field of chemistry, and her name and picture appeared in my science textbooks and other reference documents. Rosalind Franklin, on the other hand, fit my image of the less successful woman in science. She was portrayed as an argumentative, difficult unmarried woman. Her research was the focus of her life, but in the end her exemplary work was pirated by several of her male colleagues within the science community and she was "erased," until recently, as a hero in science.

These early perspectives were certainly a narrow and simplistic way to classify the range of women working the fields of science. But with so few women visibly recognized as scientists and their

lives kept invisible, I found it difficult to be fair and unbiased about my hypothetical views of women in science. Marie Curie and Rosalind Franklin were not role models that I felt connected to. Their personal qualities and ways of life did not match my vision of who I was and what I wanted for my life. I saw myself as a different kind of hybrid: objectively subjective, intuitively rational, a creative thinker, a "wo/man" kind of scientist.

During the 1960s, there was another highly publicized woman by the name of Rachel Carson, who appeared to be involved in science but from a totally different perspective. In my mind, she was a different kind of scientist, more of a scientifically literate hybrid, like myself. She was a trained marine biologist with a master's degree from John Hopkins but she was definitely an "outsider" to the inner circle of science because she worked for the Fish and Wildlife Department of the federal government. Her research work was unique, unorthodox and definitely controversial because she was conducting investigations of the indiscriminate use of pesticides by agencies of the federal government in a supposedly unscientific, emotional way. She was criticized for not being scientific enough and conducting her research without following the prescribed steps of the scientific method. Her critics within the scientific community claimed that she should not be conducting research on the misuse of chemicals and publishing the results without having legitimate, certifiable degree in chemistry.

It was her book Silent Spring, published in 1962, that brought her notoriety. Although it was based on scientific research, Rachel

wrote it for the general public not just for scientists. It was an emotional, poetic, shocking book that forever altered how the people of the United States and the world would treat nature (Hynes, 1989). It was because of the controversy surrounding the publications of Silent Spring that I became aware of another famous woman involved in knowing and doing work in science. It was not a required text for any of my science courses in college and not an influential book until later in my career as a teacher.

What was problematic about Rachel Carson was that she did not fit my image of a research scientist or a typical woman. And because of the controversy that surrounded her life and her work, I could never imagine following in her footsteps or making the sacrifices she made. Rachel Carson was a scientist but she was so much more. A crusader, a poetic writer, an activist - she was a truly courageous, passionate woman who antagonized the culture of science by not playing by the rules and by challenging the traditional ways of knowing and doing science. This was my vision of Rachel Carson. It was not however, the image portrayed by her opponents and critics within the Agriculture Department, the AMA, and the owners of chemical companies. They described her as a hysterical, hallucinating spinster (PBS, 2/8/93); a lonely woman who lived a full professional life because of her books but who was unfulfilled because she never married (Hynes, 1989, p. 9). She was a woman, a scientist, a hero; and like many women before her, Carson was misrepresented and at times denigrated by the male

biographers who wrote accounts of her life and her work (Hynes, 1989).

Beliefs, Wants, and Needs

Women are like everyone else: they are born and raised in a particular culture of beliefs and biases, and to one degree or another will be affected in their work by what they believe, want, or need to be true. (Blier, 1986.)

I looked upon these three women, Marie Curie, Rosalind Franklin, and Rachel Carson, as my female role models in science. However, each woman, in a different way, left me with a nagging suspicion that to have a career in science as a researcher would mean sacrificing part of "who I was" or "who I eventually wanted to be." All of these women had struggled with the one or more of the masculine traditions of science and, to one degree or another, their lives as women and their work as scientists were impacted by beliefs and biases of our patriarchal society and the masculinization of science. Marie Curie, Rachel Carson, and Rosalind Franklin were not just average, typical women in science and yet they still struggled and, at times, seemed to make choices that perhaps were not their own. I had no reason to believe that my life or my work would be impacted any differently. In fact, because I viewed myself as just an average science student and a typical woman, I suspected that my life and work would be impacted even more.

And so I chose, during my junior year of college, to become a teacher of science rather than a scientific researcher. I was hoping that the traditions of teaching would be more compatible with

my ways of doing and knowing science and that my wants, needs and beliefs as a woman and a scientist would be met. I considered this to be a choice that I was making freely, with my best interests in mind. Teaching, as a profession, was part of the culture I was raised in. Research scientists were not part of the farming community where I grew up. Their lives and their work were only fictions, partial stories that I had read or heard about. I could not use my intuition or pass judgment based on my own personal experiences and ways of knowing, I was left with my own narrow, simplistic and rather biased views of the culture of science.

In my mind, teaching would allow me to remain a scientifically literate hybrid. I would not have to live a duality, with my personal life and my professional career constantly in conflict. As a teacher, I could be a whole person and not feel required to split my personality: masculine scientist, feminine woman, as many women in traditional science institutions seem compelled to do. My beliefs, wants and needs would not have to be compromised and altered.

I believed that the "traditions of science" would act as obstacles and would prevent me from becoming a successful woman in science. I could not commit myself to a life that did not fit who I was as a person.

I wanted a life that included a husband, children and time for relaxation and recreation. I did not want to spend all of my time and energy on just the professional aspects of my life. I wanted to climb mountains, swim rivers, go barefoot in the sand, and pick more daisies.

I needed to remain a scientifically literate hybrid and be able to use all of my qualities, both masculine and feminine, in my personal professional

life. I wasn't out to change the world, I just wanted to stay connected to nature and not control and abuse her.

Are Choices Ever Freely Made?

In retrospect, I can look back on my career choice and recognize that as a young woman I did not have the capacity to freely choose a career in science. I, like so many other women, had internalized the beliefs of the dominant male culture and of the institution of science and learned to devalue my own worth and capabilities. As Kathleen Weiler (1988) points out in her book, Women Teaching for Change, even when women freely make choices, they are choices made within a kind of logic of existing social structures and ideologies. Women learn this logic very early in their lives and it is continually reinforced by whatever cultural institutions are prominent in their lives. For myself, the cultural institutions of daily life included the Catholic Church, the private and public schools, the science department at Michigan State; each proving to be powerful and convincing. Although I thought I was acting "freely," I was greatly affected and limited by the hegemonic ideology of each of the masculine-constructed institutions that comprise our patriarchal society. As Antonio Gramsci reminds us:

Hegemony is always being reimposed and human being are always mediating and resisting the social forces that shape their lives. We must acknowledge the degree to which historical and objective forces leave their ideological imprint on the psyche itself. To do so is to lay the groundwork for a critical encounter between oneself and the dominant society. (Weiler, 1988, p. 74.)

If we analyze the life experiences and choices I have revealed thus far, it is clear that I was deeply influenced by the beliefs and biases of the dominant institutions present within our culture. Their imprint seems etched in my "psyche." I had unconsciously allowed myself to be shaped and limited by the existing social expectations and structural forces around me. Through my own choice, I was about to do the work that is traditionally accepted as appropriate for women and become part of a profession that is culturally designated as "women's true profession." But in doing so, I was also laying the groundwork for a critical encounter; an encounter between my beliefs, wants and needs as a woman, a scientist and a teacher and those of the dominant institutions within society. "Cultural norms and expectations often impact the lives of women teachers and create tensions to which they must respond in their attempts to transform the reality they inherited" (Weiler, 1988, p. 73).

By choosing to become a science teacher, I was defying cultural norms and expectations. In this country, science teaching is not considered "women's true profession," it is a male profession. Traditionally, science is an area of teaching where men have consistently outnumbered women and have consequently been afforded the opportunity to construct science education according to their ways of knowing and doing science. In science education as in science, women have not been in positions of power, have not had the authority to determine what ideas would be recognized and how those ideas would be interpreted and implemented. Women science teachers

and women scientists are in culturally similar positions because their ways of knowing and doing science and their qualities as women are not valued. Gender is an issue in science education just as it is within the institution of science. Women are often the "outsiders" within a science department; frequently viewed as the "token" female, the anomaly in a male domain.

As a scientifically literate hybrid, I should have foreseen that my identity as a woman, my images of teaching and teachers and my aspirations to be a different kind of science teacher would create tensions for me. I would not be able to leave behind and ignore the traditions of science because many of those same traditions have been used to construct and define science education for public schools. But I was young and optimistic and not worldly wise about the history of science education. It was not one of my undergraduate education courses, but it should have been. For then I would have known right from the start that science education, like the field of science, was primarily defined and constructed according to a masculine interpretation of society's goals for education. Women had not had an equal voice in defining and constructing science education; their contribution and ideas were often overlooked and ignored because men's knowledge and ways of knowing are valued over women's knowledge and ways of knowing.

In The History of Ideas in Science Education by George DeBoer (1989), it is quite obvious that women's voices have not been heard; they have not been involved in the decision-making process from the beginning. Although women have been involved in science education

since its creation in the 1800s, their knowledge, ideas and experiences have for the most part been kept invisible. Educational historians, like DeBoer (1989) and Barber & Hirsch (1962), have not recounted women's contributions, creating an image of science education that is distorted and inadequate. This image blinds our vision. We do not see women portrayed as heroes in science education because historically women's contributions have not been taken seriously. Women science teachers are continuously battling the "lies, secrets, and silence" that permeate the discipline they teach.

The entire history of women's struggle for self-determination has been muffled in silence over and over. It is as if each of us had lived, thought, and worked without any historical past or contextual present. This is one of the ways in which women's work and thinking has been made to seem sporadic, errant, orphaned of any tradition of its own. (Rich, 1979, p. 11)

As my story progresses, I will share with you what happened to me when I became an active member of the teaching profession -- How it has been possible for me to alter the "etchings" in my psyche, to resist the social forces that try to shape who I am and what I can do, to take control of my life. A life that I was choosing to reinterpret, adapt and reconstruct as I encountered new experiences and new ways of knowing. I have grown professionally and personally because I have been able to maintain what Gramsci calls "good sense," which is "the ability to critique and understand what has happened in the past, what is happening in the present and what might happen in the future if a different social world exists" (Weiler, 1988, p. 90).

CHAPTER III

TRANSFORMING AN INHERITED REALITY

What we understand to be "reality" is interpreted or reflected-on experience. We live in continuing transactions with the natural and human world around us. As we begin moving into the life of language, thematizing, symbolizing, making sense, we begin to single out certain profiles, certain aspects of the flux of things to attend to and to name. (Merleau-Ponty, as cited by Greene, 1979)

I entered teaching with two serious misconceptions: a belief that the traditions of science teaching were less biased toward women than the traditions of the institution of science; and that science teaching would give me the opportunity to dabble in science on my own terms with less expectation of conformity. I don't think I realized, in a purely mathematical sense, that there would be so few women teaching science at the high school level. Certainly, I knew from my high school and college experience that science teaching was a niche that men tended to fill. But the reality of the situation had not sunk in. I was still clinging to the notion that science teaching, like teaching in general, was a niche well suited for a scientifically literate hybrid women -- a "true woman's profession." I did not realize that I had inherited an image of teachers and teaching that would conflict with the vision I had constructed for myself.

The Image of a Teacher

According to Piaget, humans construct knowledge by organizing their experiences according to some pre-existing mental structure or scheme. We each use an internal self-regulating mechanism that helps us use our mental scheme or structure to interpret the sensory data we receive. In this way, we are able to find meaning in what we are told or read or experience by fitting it into our view of reality. Constructing knowledge and meaning is a search for a fit rather than a match with reality. Each of us builds our own view of reality by trying to find order in the chaos of signals that impinge on our senses. We assimilate the world in the sense that we come to see it in our way (Bodner, undated manuscript).

A particular mental image forms when I think "elementary school teacher, "high school science teacher," "college professor." These mental pictures are created from personal experience as well as from stories we've read or been told and movies we have seen. All of these images become part of our knowledge base about teachers. We use them, the authentic as well as the fictional and idealized, to construct a meaningful, understandable interpretation of the word "teacher."

What kind of mental picture do people have of a high school science teacher? It is perplexing when people say: "She doesn't look like a science teacher," or "I never imagined her in that role." What is a science teacher supposed to look like, be like? Who is the model for the mental image most people have? Albert Einstein, Mr. Wizard, or is it Rosalind Franklin? There are so many

models to choose from: men and women of every race, physical stature, mental capability and socio/economic standard. Why, in this society, is the culturally defined image of a science teacher most often: an intelligent, eccentric white male wearing glasses and a lab coat? I don't get this same mental picture when I think of a first grade teacher, a junior high English teacher, or the high school physical education teacher. Those pictures have been created using a different set of criteria, different expectations that coincide with our culture's norms.

Before I became a character called teacher, I used other people as models to help me decide what a teacher should look like, what qualities she/he should have, and what would count as meaningful teaching. What did I actually know about the role of a teacher before I stepped into the classroom and became one? What stories had I heard and absorbed? What image was etched in my psyche when I closed my eyes and envisioned myself as a science teacher? I wish I could travel back in time and replay in sequence all of those memories I once had, in their original untampered form. Since I cannot actually separate what I know now from what I knew then, I reconstruct my combined version of the reality I inherited -- a mixture of my recollection of the past and my understandings in the present. A collective remembering of the images I had of teachers and teaching. Images that were often shrouded in lies and secrets which I accepted in silence and with blind faith not realizing that later on in my life they would be sources of conflict and tension, personally and professionally.

Images that Blind

In School Teacher, Dan Lortie (1975) suggests that many of us experienced three stages of socialization as we prepared to enter the teaching profession: (1) formal schooling, (2) mediated entry, and (3) learning-while-doing. As I read over Lortie's analysis of the stages, my mind began to race, flipping through the cumulative collection of mental pictures I had stored of people, places, experiences that were linked in some way to each of the stages. My searching and sorting uncovered a diverse set of images of memorable people, teachers who were prominent, influential role models for me as I went through the early stages of socialization. They were the important characters that shaped my vision, my mental image, of teachers and teaching as I became socialized into the profession.

I did not acquire a singular image of a teacher, but a set of images that overlap and appear as a triple exposure photograph in my mind. Upon close examination, I can distinguish the three images: teacher, the dedicated caretaker; teacher, the objective professional; and teacher, mentor and role model. Each is distinctly different, created by patching together bits and pieces of personal experience and stories, and characterized by a set of norms and expectations that define and label the character to be played. My mental photograph is unique and personal because "socialization is a subjective process" (Lortie, 1975). We each move through the stages of structured experiences in uniquely different ways and with distinctly different frames of reference.

The images we create fit our own sense of reality - - our own interpreted or reflected-on experience.

Teacher: The Dedicated Caretaker

To care for another person, in the most significant sense, is to help her grow and actualize herself. (Mayeroff, as quoted by Noddings, 1984).

In the 1950s and '60s, teaching was considered one of "women's true professions." Teaching was a viable option for an educated woman wishing to have a career and become part of the American work force. Coming from a rural community of working, middle class citizens, teaching as a career was considered progressive, sensible, and a cut above the kind of work that many women were doing. Teaching was represented as an ideal profession for a woman because the role of a teacher did not conflict with the cultural norms and expectations American society had for career-oriented women. It was, and still is, compatible with family life and draws upon the qualities traditionally associated with women - nurturance, receptivity, and passivity (Feimen-Nemser & Floden, 1986).

I never viewed the work of teachers as ordinary and low status. In my hometown this kind of work was noteworthy and high status. Teachers generally had the highest paying jobs, comprehensive health benefits, reasonable working hours and summer vacations. With the exception of the handful of men -- doctors, lawyers and the bank president -- teachers were near the top of the social hierarchy in my farming community. In rural farming communities, teachers are respected because they have more academic schooling, possess a

professional body of knowledge and skills to educate youth, and are financially secure because the pay stays consistent even when the crops fail or the market price for fruit is low. I absorbed these beliefs about the teaching profession because they were part of the culture that acquired me. The stories I heard about teaching and teachers were certainly biased, primarily coming from my mother, who was herself a teacher, and from the Dominican sisters at St. Gregory's School. Their version of the reality of teaching and being a teacher imprinted my mind long before I ever entered the classroom as a woman science teacher.

These female elementary classroom teacher match my image of teacher as the dedicated caretaker. From the time I entered school as a kindergartner until I completed the eighth grade, I interacted with only women teachers, four to be exact. All four women, I realize now, do resemble the traditional image documented in research: passive, silent, submissive individuals whose actions seemed to be based on intuition and feeling rather than reason and who showed little concern for honors, recognition or upward mobility (Feimen-Nemser & Floden, 1986).

Teachers were not a mystery to me; they had always been prominent role models in my life. I observed, imitated, admired and respected teachers; some more than others of course, but without question women teachers provided a view of the role and life of a teacher that I found appealing and challenging and certainly acceptable. Consequently, I did not perceive the teaching profession as low status or an undesirable option for a future

career. When I was growing up, I did not realize that teaching was considered a second class profession because it was labeled as "women's work."

According to Dan Lortie (1975), American students see teachers at work more than they see any other occupational group. I was certainly no exception. In fact, I spent many more hours with teachers than the average student. When I started school, I went to a rural public school where my mother was teaching. This district required kindergartners to stay in class all day, not just the usual half-day sessions we have now. I always arrived early with my mother and stayed at school until she was ready to go home. Going to school that first year was more than just adjusting to my new life as a student. I spent time visiting my mother's colleagues in their classrooms and discovered that teachers were real people, just like my mother. School was a comfortable, special place for me because it was my mother's special place.

I have vague recollections of my kindergarten teacher, Mrs. Weeks: an older woman with a friendly smile and pleasant disposition; short in stature and quite round, a grandmotherly kind of woman. I learned to read in her class, play games with other children, and take naps on a rug. After forty years, I can still reconstruct this old image of my first dedicated caretaker.

When I entered the Catholic grade school, my mother took a job in a school district about twenty miles from where we lived. In order to get to work on time, she made arrangements for my sister and I to arrive at our elementary school early and stay late every

day until her teaching day was finished. I realize now that this arrangement was rather unusual and could only have occurred because the teachers at St. Gregory's school were Dominican sisters who lived in the convent directly connected to the school. Teaching was more than a job for the Sisters; it was their calling, a way of paying homage to God. They were obligated to take care of both our minds and our souls so we would grow up to be devout, practicing believers of the Catholic faith - in the image of Christ. Sister Monica, Sister David Therese, and Sister John the Baptist represent my images of women teachers. With the long white habits, black veils, and rosaries around their waists, these three women were my role models. They shaped my beliefs, my expectations and my mental picture of a woman teacher - the dedicated caretaker who put the needs of her students above her own. In the eight years that I attended St. Gregory's school, I don't remember having a substitute teacher. The "sisters" were always available -- they never took days off to go to workshops, attend in-services, or take a "mental health" day to recover from the stresses of school life. They even played softball and "red-rover" with us during recess and after school and never had an uninterrupted lunch period away from their students.

I was so infatuated with their life style and their dedication to teaching, that I wanted to join a convent and become a nun. All of the horror stories associated with growing up Catholic and attending parochial schools taught by nuns contradict my experiences. I never had my knuckles cracked with a ruler, or was

sent to the parish priest for being disobedient. Instead, my memories are of helping the sisters prepare the altar for Mass; eating powdered donuts after Mass on the first Friday of every month, and dressing up as a saint on All Saints Day. (We didn't celebrate Halloween - that was not a holy holiday.) Even though I had to wear a navy blue uniform and beanie and go to Mass every school day for eight years, I thought it was a small price to pay. These women were always there for me and surely took seriously the "Cs of education - care, concern, and connection" (Martin, as cited in Laird, 1988). I never felt isolated or ignored as a student because the Sisters took seriously the needs I had as a whole person. They were concerned about preparing me intellectually, spiritually and physically for real life on earth and "everlasting" life in heaven.

I likewise had an insider's perspective on the role of a teacher; living with a teacher gave me that advantage. My mother taught elementary school for forty-one years with minimal time off for her two pregnancy leaves. In all of those years, I never observed my mother teach. What I know about my mother as a teacher comes from stories she has told me, from short essays she's written and from her previous students. She was indeed a dedicated caretaker, but in a different way than others I've described thus far. What she cared most about was her students' learning, not just in one subject area but in all of the diverse content areas represented in the elementary curriculum. She was a caring "task-master" who pushed students to do their work, be responsible

and well-mannered. Although I never watched my mother teach, I observed her doing the endless work of a teacher outside of the classroom setting: planning lessons, designing activities and preparing materials for student use, checking papers and filling out report cards: all of the extra work that stretches a teacher's working day well into the evening. I learned from my mother that being a good teacher meant putting in extra time that you don't get paid for and taking seriously the responsibilities you have to help students learn meaningful things about subjects and about themselves. My mother often would talk to me about the lessons she designed and explain why it was important for students to learn about a variety of topics, and develop reading, writing and arithmetic skills. She also felt strongly that students needed opportunities to be creative and incorporated art and poetry into her lessons. I benefited as much as her students because I would do the arts and crafts projects at home.

I was fortunate to have had this "apprenticeship of observation" that included not only a view of teachers doing the work of teaching in their classrooms but also a "behind the scenes" view of the role. But as Lortie (1975) points out, as a student, I was witnessing teachers and teaching from a student-oriented perspective. I was the "target" of my teachers' efforts and therefore could not stand back and make an objective evaluation of my teachers' actions and assess the quality of their performances. Even with access to some of my mother's private intentions and personal reflections about her teaching, I never discussed with her

why she did what she did or what her explicit goals were for the lessons she taught. What I learned about teachers and teaching was "intuitive and imitative rather than explicit and analytical" (Lortie, 1975, p. 62). I constructed my image of teacher as the dedicated caretaker on the basis of my personal experiences and interactions with the prominent, influential women who were the real characters in my life story.

But I was blind to the hidden meanings attached to the slogan "women's true profession." As Susan Laird (1988) points out: even though women's true profession is considered an empty slogan, it carries with it meanings that are harmful and conflicting to the image of teachers and teaching. In particular, Laird highlights five interrelated theses in this slogan that make teaching difficult and problematic for many women in the profession.

- (1) The Descriptive Thesis: That the vast majority of American schoolteachers are women.
- (2) The Normative Thesis: That school teaching, on account of its nature and women's nature, should be women's work.
- (3) The Problematic Thesis: That intelligent women somehow become devalued by school teaching.
- (4) The Negative Thesis: That school teaching somehow becomes devalued through its identification with women.
- (5) The Critical Thesis: That schoolteachers' own public, collaborative, self-definitive responses to the other four theses are crucial to a reconception of teaching.

For many women entering the teaching profession as I did in the late 1960s, the truths behind this slogan were a well kept secret. No one deliberately lied about its meaning. We just were not told

the whole story. Instead we focused on Laird's first two theses, the Descriptive and the Normative, because they provided convincing evidence that teaching was an ideal job for a woman. The assumptions that were problematic and negative were not introduced for discussion, nor did any of us question their omission. Everyone was silent about such issues. But as Adrienne Rich (1979) points out, lying can be done with silence as well as with words. "Patriarchal lying has manipulated women both through falsehood and through silence. Facts we needed have been withheld from us. False witness has been borne against us" (p. 189).

When I went through the Teacher Education program at Michigan State, I was unaware of the assumptions and conflicting messages that were associated with school teaching as a profession fit for women. I had been sheltered from the truth, or perhaps prevented from seeing the truth, because what was "real" in my life was not representative of reality within the context of a larger sphere of American culture. The teaching life, as represented by my mother and other women teachers, was portrayed as a worthwhile, respected career choice for a intelligent, capable female. I assumed that what was true in my home town would be true elsewhere. I had constructed a mental scheme that worked for me when I was at home in rural Michigan, but it was too narrow and unrealistic for use in other settings, and with other groups of people. And of course, I never asked questions, never challenged the dominant ideology that named and defined teaching as women's work. I was content and took comfort in knowing that I was joining a profession in which women

were in the majority and the work was well suited to women's nature and capabilities. It wasn't until I read Susan Laird's article, Reforming "Woman's True Profession": A case for "Feminist Pedagogy" that I grasped the real significance of the word "woman's" in the slogan and understood why using that label has historically kept the profession from gaining prestige and recognition within American society.

Teacher II: The Objective Professional

<i>objective:</i>	<i>calm, detached, equitable, fair, impersonal, sensible, sober, unemotional, just, open-minded, judicial.</i>
<i>professional:</i>	<i>adept, competent, efficient, expert, polished, skilled, proficient, masterly, virtuouse, slick.</i>

(Webster's New Dictionary & Thesaurus, 1990.)

Margret Buchmann (1986) claims that when a person chooses to become a teacher she/he is making "the most significant choice a professional can make" (p. 530). The significance of the choice is directly related to the fact that in this culture "teacher is a role word" and therefore carries with it society's highest expectations and constraints (Buchmann, 1986). By accepting the professional role of a teacher, I was agreeing to perform particular actions and to maintain a disposition that conformed to the established goals and standards of the educational community and of society. According to Buchmann, if you choose to become a teacher, you are obligated to teach school and obligated to help students learn

worthwhile things in the social context of classrooms and schools. In looking after the educational interests of students, teachers are likewise obligated to recognize and respect the disciplines of knowledge and accept the constraints imposed upon them by the structure and traditions of the different disciplines they teach (Buchmann, 1986, p. 531). This is the part teachers play in society, a part that has been socially constructed and defined according to the expectations of the dominant institutions within society, a part that by definition includes distinctive obligations, responsibilities, and role orientation.

Teacher obligations - those behaviors and dispositions that students and the public have a right to expect of teachers - has three important aspects that have no personal reference or connection. First, these obligations do not depend on any particular individuals. Second, they apply regardless of personal opinions, likes or dislikes. Third, they are related to what is taught and learned. (Buchmann, 1986, p. 531.)

When I made the decision to become a science teacher rather than a research scientist, I did not realize the extent to which these obligations had been molded, shaped and ultimately defined according to the want, needs and beliefs of our patriarchal society and the institution of science. I was naive and to some extent narrow-minded about a teacher's role within the broader social institution of education. My perceptions of the obligations, the expectations, the joys of being a teacher came from first-hand observations of the teachers I knew in real life: my mother, the Dominican sisters and a few public schoolteachers.

My mother had been a teacher for seven years prior to my birth and continued to teach for an additional thirty-three years. Throughout my childhood, there was never a doubt in my mind that my mother was committed to her career and willingly made personal sacrifices in order to balance her family obligations with her professional obligations. I likewise never questioned the commitment and dedication of the Dominican sisters or my high school science teachers. These women and men, like my mother, reinforced Buchmann's contention that "to take on the role of a teacher" meant accepting the professional obligations of teaching that included making personal sacrifices, adhering to certain ethical and moral codes of conduct and being responsible for providing students with the "sanctioned" subject matter knowledge. From my vantage point, teachers appeared to have some flexibility in meeting the demands of their role but were obligated to adhere to district-wide policies and conform to state mandated goals and standards. Intuition, creativity and individual ways of knowing were important inside the classroom but were of secondary importance in terms of accountability and assessment outside the classroom. My mother frequently talked about classroom teachers being evaluated on the basis of their ability to implement board approved curricula and prepare students to achieve above average scores on district and state achievement tests. She would be recognized as an outstanding teacher if her students performed well and she adhered to the professional standards and goals of the school district. Her

evaluation form consisted of a check-off list that could be easily assessed during a one hour visit by the building principal.

My observations, however, provided mere glimpses of the professional obligations of practicing teachers since they were never explicitly stated or discussed. As a student, I knew that a teacher's primary responsibility, legally and ethically, was to teach class in such a way that students would learn something worthwhile in particular content areas. I likewise knew that teachers were obligated to fairly assess each student's progress and to assign impartially letter grades at the end of each marking period. These notions I had about a teacher/s responsibilities and obligations I learned from listening to my mother and her colleagues talk and from having conversations with my mother about my own experiences in school. Who decided what was worthwhile and what standards were used for evaluating student progress were not clear from my observations of teachers. In all honesty, I don't suppose I had any reason to raise questions about who was establishing the goals and standards for teachers and what impact these goals and standards had on teachers' lives and their work. I wasn't a teacher, I was just a student. Consequently, I was content to construct my own set of beliefs and biases about what it meant to "take on the role of a teacher" from observations and impressions gleaned from my diverse set of role models. These were purely intuitive impressions since I never discussed this topic with any of my teachers or my mother, or had any opportunities to practice the art of teaching for myself. Like most everyone, I accumulated an

abundant store of knowledge about teachers and their work from being a watchful student both in the classroom and at home.

This image of a teacher as an objective professional became clearer and more concrete during the final stage of my formal schooling when I began taking Teacher Education courses in preparation for student teaching. It was in these education courses that I learned what professionalism meant within the context of public education. To be professional would mean: conforming to a set of technical and ethical standards, acquiring competencies and skills in the disciplines of knowledge, developing and maintaining authentic, collegial relationships with other professionals within the school community. And I also learned (without being explicitly taught) that a professional teacher adheres to a set of values that reflect and perpetuate masculine ways of thinking and being.

In my teacher education classes, the feminine qualities of care, concern, and connection were generally excluded as necessary attributes for carrying out the role of high school science teacher, as were the idiosyncratic, personal, self-realizing elements of teaching. Personal habits, beliefs, opinions and ways of knowing were viewed as problematic because they promoted individualism and encouraged teachers to place their interests and beliefs ahead of the goals and standards of the profession (Buchmann, 1986). The textbooks, the seminar sessions, our field instructors for teacher education emphasized the importance of teachers implementing the approved curriculum of the district, developing and maintaining a well disciplined, orderly classroom, and paying close attention to

meeting the expectations of the general public. The public image of schools and schooling is directly related to the image they have of classroom teachers educating their children. I was strongly encouraged to view my role as a science teacher in gender-neutral terms: a science teacher is a science teacher. It does not matter if you are female or male, the traditions of science are gender-neutral as is the subject matter to be taught. My obligations as a teacher of science should extend far beyond my own personal actions and inclinations to include the expectations of the general public, the professional educational community and, even more importantly, the institution of science.

This was a new way for me to think about teachers and teaching. It was a scholarly, more objective representation of the role of a teacher and one that did not quite match the image I had of the dedicated caretakers. I don't mean to imply that my elementary and secondary teachers were unprofessional, but rather, they seemed less focused on the professional expectations and obligations of their work. At least that was my perception before I became involved in education as a perspective teacher. Consequently, I found a new set of role models, people who exemplified these qualities of professionalism within the teaching community.

The most objective, professional teachers I encountered during my formal schooling were the science professors at Michigan State. In my mind, they epitomized "teacher as the objective professional." In fact, the role of a science professor seemed comparable to the role of a scientist in that both represented themselves as:

gender-neutral and open-minded, objective and unbiased with an unwavering dedication to the goals and aspirations of a professional institution constructed and defined by male authority figures. Thus, my image of the "objective professional" was gender-biased. From my distorted perception, it appeared that the objective professional should possess those attributes and qualities that historically are associated with men: detached, neutral, unbiased, possessing a high degree of individualism, and well-schooled in the scholarly disciplines.

Women could be both objective and professional but it would require, for many, a shift away from women's ways of knowing and being. Since I viewed myself as a scientifically literate hybrid, I was not discouraged or distraught about this professional model. I knew how to play the role -- I had been practicing it for years even before I entered MSU as a science major. Part of my identity, or at least how I defined myself, included some of the qualities that are assigned to the masculine gender. I've never been completely alienated from institutions or disciplines that required objective, rational thinking or dedication to a masculine defined value system. Although I was not totally comfortable with all aspects of professionalism, I knew that I possessed, to some degree, most of the qualities and dispositions needed to be a professional educator, as determined by masculine standards.

What I failed to realize during my early stages of socialization was that professionalism and "womanism" do not have to be set up in opposition to one another. "Womanism" is an old term

that was used before the term "feminism" gained acceptance in the 1890s. According to Lisa Tuttle (1986), the term means " . . . advocacy for women's rights; enthusiasm for women's achievement, abilities, and qualities, the belief in women's superiority to men; any positive, pro-woman stance" (p. 352). It is a wonderful word that resonates with many women, especially black feminists, because it feels more holistic and has roots in black folklore and culture. Although I am not black, I resonate with the word "womanism" and appreciate what Alice Walker means when she says that the word sounds, feels, and fits her experience as a woman (Tuttle, 1988).

Because of my experiences in science, I seem compelled to view any issue that involves gender as a dualism, with clear boundaries established between masculine and feminine qualities. Science and the processes of science were male-defined and practiced from a masculine perspective. As a student, I did not realize that authentic science, that is real-life science, would involve a blending of masculine and feminine qualities. Since being a professional was most often portrayed using masculine qualities and values, it was quite natural for me to assume that unprofessional would be characterized using feminine attributes and values. I'm not sure if I was taught to be this narrow-minded or if I simply absorbed it by being a woman and living in a world controlled by men. Whatever the cause, I know now that there are other dimensions that should be added to the concept of professionalism, dimensions that will view teaching as an authentic, moral profession and incorporate the attributes of womanism. Adding these dimensions

will help shatter the traditional masculine version of professionalism that I once had.

Earlier in this chapter, I defined the role of a professional from Margret Buchmann's perspective without explaining that there was more to her story. I purposefully gave a partial image of professionalism because I wanted to help my readers visualize the image I inherited as a beginning teacher. That was perhaps unfair because Buchmann is not a one-dimensional educator and her article, "Role over Person: Morality and Authenticity in Teaching" (1986) provides a vision of professionalism that is not in opposition to womanism. She suggests that teaching, as a profession, should be viewed as a moral community where people have conversations, reflect upon their work, both alone and together, and encourage collegiality and experimentation by all of the members. Professionalism should not prohibit teachers from testing their beliefs and practices and sharing what they learn with colleagues. Teaching is not about competition and getting to the top of the hierarchy, it is not a business venture with some teachers and students winning and others losing. Teaching is about establishing communities, about sharing strategies, methods and materials, about everyone achieving success by the end of the school year. This is an image of the profession that contrasts with my masculine-defined view which stressed the importance of competition, isolation, pursuit of profit and power (Laird, 1988).

I did not read this article as an undergraduate student in teacher education. I would have benefited from Buchmann's portrayal

of professionalism and her efforts to connect community, morality and authenticity - - feminine characteristics -- with the professional role of a teacher.

It is the teacher's responsibility to coordinate, stimulate, and shepherd the immature workers in her charge. Expressive leadership in the classroom must emanate from the teacher. The austere virtues, moreover, must be complemented by warmer qualities of empathy and patience. It becomes clear, then, that the self of the teacher, her very personality, is deeply engaged in classroom work; the self must be used and disciplined as a tool necessary for achieving results and earning gratification (p. 327-238).

Teacher III: Mentor and Role Model

Many women have known the figure of the male "mentor" who guides and protects his female colleague tenderly, opening doors for her into the common world of men. He seems willing to share his power, to conspire with her in stealing the 'sacred fire" of work. Yet what can he really bestow but the illusion of power, a power stolen from the mass of women by men. He can teach her to name her experience in a language that may allow her to live, work and perhaps succeed in the common world of men. But he has no key to the powers she might share with other women. (Rich, 1979, p. 209)

I remember being very optimistic about being a science teacher. If I wasn't cut out for a career in research science or medicine at least teaching would give me the opportunity to be a whole person, utilizing all of my qualities as a woman, a scientist and an educator. As a teacher, I would be able to create a niche for myself, weaving together my personal practical knowledge, my beliefs and values into a curriculum that would reflect a more meaningful, personal kind of science education. Somehow my version of science education would fit into the existing framework established within

secondary public schools. My personal aspirations as a teacher would mesh with my professional obligations, and the "dualism" that I had struggled with as a science major in college would fade into the background, and become a silenced issue.

This was my idealized vision, one I constructed without much concern about its fit with the reality of life in public schools. My introduction to the real life of a teacher during my ten weeks of "mediated entry" as a student teacher was not about reality. It was about surviving -- the "sink or swim" approach to learning to teach. There was not time to reflect on what "reality" was for an ordinary, experienced teacher. There was only time to plan lessons, prepare labs, raise rats for dissection, and check stacks and stacks of papers. For me, student teaching was an "unreal" experience that provided only a glimpse of the cultural norms and expectations of a school community. How much could I hope to learn about the role of a science teacher in ten weeks? How well could my mentors prepare me for the reality of life as a woman science teacher?

Since my cooperating teachers, my mentors, were all men, they represented and talked about the role of a science teacher using their language and their ways of understanding the world. In Windows into Science Classrooms, Kenneth Tobin and James Gallagher provide an illuminating portrayal of traditional high school science teachers. Although they do not specifically link their portrayal with male teachers, their description accurately represents how my mentors talked about their role.

High school science teachers emphasize activities which focus on rote learning of science facts and algorithms to solve quantitative problems. They are concerned mainly with covering the course content in the time allocated. Little concern is shown for teaching or learning with understanding and the driving force exerted on the implemented curriculum is external examinations and teachers test which emphasize recall of science facts and the solving of quantitative problems.

Students are placed most often in a situation in which they listen to the teacher or a peer, copied down notes or worked from the textbook. Opportunities to elaborate, evaluate, synthesize, resolve conflict and reflect on what was being learned were limited. Laboratory activities usually were not intended to generate new knowledge, but rather, they were designed to confirm knowledge with students following a recipe to collect data which confirmed content covered earlier in the course. (Tobin, Kahle, & Butler, 1990, p. 33-34)

The fact that I was a woman was of little consequence because science was viewed as a "gender-neutral" discipline. In scientific thinking and the ideal practices of science, the gender of the scientist is irrelevant.

It is crucial in scientific thinking to formulate the experimental evidence is such as way that the experimenter is replaceable. It is even important to formulate the experiment in terms that make the particularities of time and space irrelevant: anyone of requisite skill should be able to repeat the experiment by re-creating the requisite conditions at any point in time or space. (Noble, 1992, p. 54)

But in reality, there is only one way of understanding the world of science, from the male perspective. I was taught how to live, work and succeed in the common world of men because science education, in public schools, is a masculine structured domain. Science is an area of teaching where men have been free to create a niche for themselves, constructing and defining the discipline to fit their

conception of scientific truth utilizing their ways of knowing and doing science. Certainly my male mentors were willing to guide my socialization into the world of traditional classroom science. If I followed in their footsteps, modeled my teaching style after theirs, then nothing would have to change. My colleagues and I would fit the traditional stereotype:

Most science teachers have a cultural transmission view of teaching in which the teacher is mainly a transmitter of information, rules or values. According to this view, the learner acquires "absolute truth" by a process of iterative accumulation or absorption. (Tobin, Kahle, & Fraser, 1990, p. 34)

I could become one of them, a transmitter of masculine defined scientific knowledge. It would only require my becoming a male impersonator. Since I had never been taught by a woman science teacher, or had the opportunity to meet one before I began teaching, I didn't question the model I was presented and did not resist the socialization process. I wanted to be viewed as a successful, effective science teacher; therefore, my best option was to learn the ropes from my colleagues, who were male, and attempt to acquire some of their wealth of personal practice knowledge.

As science teachers in the late 60s, we had been given a mandate: implement more rigorous science courses to improve American students' skills and knowledge in science; prepare the best and brightest to become the new generation of scientists so the United States can move ahead of the Soviet Union in space exploration, technology and research; and implement the new curriculums developed by the leading professional science educators.

This was not a good time to question the traditional standards and goals of the institution of science.

Socialization into Science Teaching:
Compelling, Challenging, Intense

A woman's life can really be a succession of lives, each revolving around some compelling situation or challenge, and each marked by some intense experience. (Wallis Simpson, Duchess of Windsor, 1985)

Although my childhood and early educational experiences were influential in shaping my perceptions of teaching and teachers, they did not compare to the powerful learning experience I encountered during my first year as a teacher. My professional socialization into full time teaching was to be entirely orchestrated by men. During this process, I would learn to model the values, language, behavior patterns, and beliefs of my experienced male colleagues and in time, with their guidance and support, experience a moral transformation that would solidify my emotional commitment to the teaching community (Light, 1980).

As a first year teacher, the social group responsible for my socialization into the science teaching community consisted of seven experienced male teachers. These seven seasoned veterans had been in the district for years and were comfortably settled into their roles and established routines; most had reached the "stabilization phase of their career" (Huberman, 1989). This all-male science department had worked as a collaborative group over the years and had developed a shared set of goals and beliefs about the teaching and learning of science. When I signed a contract to teach at

Douglas MacArthur High School, I automatically became a member of this group. Unlike many new teachers, I was not left alone or kept isolated. These men, my mentors, were most anxious to have me assimilate their values and beliefs about teaching and learning. They were eager to guide and protect me as I learned the behavior patterns of practicing science teachers.

School administrators expect department members to take care of their own. It is one of those "hidden responsibilities" that most teachers are not adequately trained for or given adequate compensation. As a department, it was in my mentors' best interest that I succeed so I could perform the various roles I had been assigned. If I failed, their image as a department would be tarnished; their ability to provide adequate mentorship would be questioned. Although I came to this first job with a personal set of values and beliefs and biases about the teaching profession, they were not grounded in practical experience and therefore not so firmly planted. I was quite malleable as a first year teacher, as I think most beginning teachers are. So much for me to learn in such a short span of time. Consequently, I listened to my older, more experienced colleagues and assimilated their ways of knowing and doing science.

I followed their lead and taught my classes using the required textbook and laboratory manuals. I kept pace with my colleagues and conformed to the weekly routine which included: lecture, seat work, lab activities, and a test. My mentors encouraged me to work with the class as a whole group, rather than small group, because that

was the most effect way to manage student behavior and cover the content. We primarily worked from the textbook, the published laboratory manuals and mimeographed sheets. Rarely were the students involved in small group activities or cooperative learning experiences because that required excessive use of class time and time was of the essence.

The pattern was repeating itself once again. I was being introduced to the "traditions of science teaching" in the same way I had been introduced to the "traditions of science": from a male perspective and according to an established, sanctioned, masculine way of knowing, learning and teaching science. My mentors had been trained, as I had, to accept the validity of the scientific facts discovered and recorded by the "heroes" of science and to hold in high regard the methods that had been used to discover these "truths," the invincible scientific method. I did not know how much I didn't know. My induction into teaching was, sad to say, filled with "lies, secrets and silences" (Rich, 1978).

I know now that the models, the theories, the practices of science are just man's conception of what nature is and how "she" should be named. Science is not an entity in and of itself; it is the activity of scientists (Hubbard, 1990). Scientists determine the content of scientific activities: what scientific problems will be investigated, what facts will be discovered, what knowledge will be used to shape scientific theory. In our culture, scientists are often regarded as heroes because their work and methods of inquiry often result in cures, inventions, understandings of the universe

that have altered the quality of human life (Kass-Simon & Farnes, 1990). People believe that science and scientists can and do provide a source of knowledge and information that is value-free, objective, and without political or social bias (The Brighton Women & Science Group, 1980). We often take for granted the validity of information and data collected using the scientific method. If the results are labeled as scientifically proven, the information is assumed to be true -- an accepted fact.

As a society, we overlook the fact that scientists are humans beings, like ourselves, and therefore there is a subjective element to the decisions and choices they make. When it comes to defining science and naming nature, scientists do not work in a social vacuum. As professionals, they must compete for positions in the job markets and obtain funding for their research from organizations and commercial enterprises that are interested in more than the pursuit of truth and knowledge - - they are interested in using science and its technology to make money. According to Sandra Harding (1991), all scientific knowledge is socially situated and socially constructed. Scientists and the knowledge they produce should not be considered impartial, disinterested and value neutral because science is an abstraction of what scientists observe - - their selective representation of nature (Hubbard, 1990), their version of reality.

My Year as a Male Impersonator

I suspect that I began my science teaching career like many of my colleagues: assigned to teach a course for which I had minimal content knowledge and even less common sense experience to support the subject matter and make it real for my students. Physics, the most traditional of high school science courses, was one of the courses I was assigned to teach my first year: a course that I survived in high school and college but did not grow to love. As a biology major and a physical science minor, I was not confident about my subject matter knowledge in physics and, quite honestly, I had never imagined myself teaching this level of physical science to a class of seniors. I did not dislike physics, I just never felt close to the subject matter -- it wasn't a part of who I was. But as fate or luck would have it, it would become a part of me.

The head of the science department was the veteran physics teacher at Douglas MacArthur High School. Mr. S. was the most experienced teacher in this department, a quiet, soft-spoken man with a friendly smile and a very traditional brush-cut, popular in the 1960s. Mr. S. was elated when I accepted the position and inherited his extra physics class; he wasn't at all anxious to teach six sections. We decided that if I came in every day during my planning period and observed while he taught the class, I would be able to keep up with him and give my students the same learning experiences in physics that his were getting. He assured me that by working together, we could carry out this amazing transformation. I would become a real physics teacher with true feeling for this

subject matter. This almost felt like a religious experience! I was being transformed into the image and likeness of Mr. S. For the entire school year, I sat in Mr. S's class and became a watchful, observant student, learning to impersonate his style, his techniques, his ways of knowing and doing science. He was a masterful "sage on the stage" - - lecturer, storyteller, demonstrator, entertainer; skillful in presenting detailed explanations of the laws of physics, providing the historical background for scientific discoveries in Physics, and connecting theoretical physics to students' everyday lives. I tried to be Mr. S. even though he was a fifty-five year old man with twenty five years of teaching experience and I was a twenty-one year old woman just learning to teach. No one would ever have confused the two of us.

Although my evaluations that first year were excellent and my students did not appear to suffer greatly from my inexperience, I knew that I did not understand physics well enough, or feel strongly enough, to make the subject matter come alive for my students. I did not understand how all the electrical appliances in their homes worked; how jet airplanes were able to get off the ground and stay airborne, or how scientists were able to calculate the speed of light and tell the ages of stars. Ripple tanks, volt meters and ticker-tape cars just did not have the same significance to me as robin's drinking cups, dutchmen's britches and swallowtail butterflies. It was not that Physics was too difficult for me; it was that I could not seem to value something that I felt so apart

from -- the concepts were detached and isolated were not connected to my experiences and did not appeal to me.

My year impersonating Mr. S. was my first and last attempt at teaching physics to twelfth grade science students. I learned two very valuable lessons from that experience. The first lesson was to recognize the importance of collegiality and collaboration between teachers within the profession. Beginning teachers do need help, support, and guidance. It was my good fortune, at least for the sake of survival, that Mr. S and the male members of the science department took their role as mentors seriously and gave me unlimited support and guidance.

The second lesson I learned was to recognize, at least for myself, the importance of having a true, emotional connection to the subject matter I was responsible to teach. I was capable of teaching physics to my class of high school students that first year but only by mimicking the behavior and procedures that Mr. S. demonstrated for me each day. I never deviated from Mr. S's established routine or tried to be creative and strike out on my own. I did not have a well of personal practical knowledge and depth of feeling to draw from to help my students connect physics to their personal lives.

We do not acquire personal practical knowledge from textbooks or from performing experiments designed by college professors for the purpose of verifying well documented concepts. This type of knowledge is built over time and involves a synthesis and integration of a variety of knowledge orientations and personal

experiences. In her work on practical knowledge, Freema Elbaz (1981) suggests that a teacher's knowledge is structured and shaped by five experiential orientations: personal, situational, social, experiential and theoretical.

- o *Personal orientation* is used to express the self and give meaning to experiences.
- o *Situational orientation* emphasizes that teachers knowing is constructed in response to a variety of situations in schools.
- o *Social orientation* refers to the fact that all knowledge is socially conditioned and used to structure social reality.
- o *Experiential orientation* is tied to the experiences through which knowledge is acquired.
- o *Theoretical orientation* refers to a teacher's understand of what theory is and how it will influence knowledge and knowing in all other areas. (Hirsch, 1991, p. 101)

When faced with a task or a problem, a teacher will draw upon these knowledge orientations and use them to guide her practice. According to Gail Hirsch (1991) a teacher's personal practical knowledge is "rooted in experience" (Dewey, 1938) and evolves from confrontations with experience and from reflection-in-action (Schon, 1983) (p. 99). This form of knowledge is "embedded in a teacher's perceptions, understandings, beliefs, insights and images and is continuously shaped and reshaped by a her/his personal history and ideological perspectives.

I did not have an in-depth knowledge of physics, theoretically or practically; therefore, I was incapable of providing my students with a variety of explanations or examples to help them connect the concepts of physics to their everyday lives. Physics was not rooted

in my personal experiences and I had not spent time reflecting on the practical applications of physics laws and concepts during my academic schooling. Consequently, the ripple tanks, the voltage meters and the ticker-tape cars were tools my students and I used to learn scientific concepts but they had minimal significance or importance in our lives outside the classroom.

The Cost of Apprenticeship

As I think back to my first year of teaching, I realize now that there were a number of other lessons of a more personal nature that I learned from my experiences of teaching physics, of impersonating Mr. S. for an entire school year, and from being guided and initiated into the science teaching profession by an all male-science department.

What comes to mind most vividly about that first year in the classroom is how little of myself was evident in my teaching practice. For not only was I following Mr. S. every step of the way in teaching physics, I was also following another male colleague as I learned the strategies for teaching Introduction to Physical Science (IPS). On paper I was qualified to teach physics and physical science but in my heart I knew I was only going through the motions, copying what my male colleagues felt to be efficient and meaningful without really thinking about whether their style and methods were compatible with my style and philosophy of teaching and learning as a young female educator.

This kind of teaching follows the "mimetic" tradition of educational thought and practice because it "gives a central place to the transmission of factual and procedural knowledge from one person to another, through an essentially imitative process " (Jackson, 1986, p. 117). Within the "mimetic" tradition, the teacher is considered an expert in two ways. First, she has command of a body of knowledge or set of skills that can be transmitted to students. Second, she knows how to transmit a significant portion of knowledge to the students (Jackson, 1986).

As a first year physical science teacher, I was not an expert in either category, the body of knowledge or the know-how. I felt very inept as a teacher because I was mimicking another person's way of teaching and knowing scientific concepts. What I was attempting to teach was not the science that I had learned as a child on the farm and in the woods but an abstract, remote form of scientific inquiry that had little to do with my own personal experiences, my needs as an educator or my students' needs as learners. My vision of good science teaching involved more than transmitting factual knowledge and laboratory skills. I imagined that I would be a "transformative" teacher -- "capable of accomplishing a transformation of one kind or another in my students" (Jackson, 1986, p. 120). I wanted to provide learning experiences for my students that would actually bring about changes in their way of thinking about and doing science. As Jackson (1983) suggests, a transformative teacher wants to help students become better persons, closer to what humans are capable of becoming, not

simply more knowledgeable or more skillful in the disciplines of science (p. 127).

When I began my first teaching job, I was twenty-one years old, single and looked very much like the two young females in the physics class I was teaching. I certainly did not look the part of a seasoned physics teacher, nor did my predominantly male physics class see me as such. What worked for Mr. S., in terms of classroom style and decorum, was not easy for me emulate. He was a fifty-five year old veteran teacher, reminiscent of my students' grandfathers. And I was a twenty-one year old novice who resembled the girl next door. Teaching a class of intelligent, virile young men was by far a greater challenge than I or Mr. S. had originally imagined. I learned, even more quickly than Mr. S., that my male students could very easily misinterpret my expressions of care and concern for their learning, transforming my good intention into something more personal and intimate. I can remember one male physics student in particular who became quite emotionally attached to me during that year. He would stay after class, come in for extra help and volunteer to help with demonstrations. It required careful foresight and conscientious planning on my part to keep this student focused on physics instead of on me. I remember feeling anxious and uncertain about how to present myself as a compassionate, caring teacher within the boundaries of acceptable, professional decorum. It is still a dilemma that complicates many teachers' efforts to have sincere, meaningful relationships with students. Although I

must admit that I have less of a problem now that I am older. Aging does have its advantages.

A Time of Transition

I know I'm in a time of transition, being somewhere between vaguely and acutely disrupted; I know the old ways I've lived are no longer adequate and the new stage of life has not yet emerged. It's a painful yet challenging place to be. (Marsha, From Reflections - A Woman's Own Journal, 1987)

I think I have been in transition ever since my first year of teaching, "being somewhere between vaguely and acutely disrupted" by the conflicts, the tensions and contradictions that were part of the reality of life as a teacher. The set of images I had acquired -- teachers as the dedicated caretaker, the objective professional, the mentor and role model -- have not eased my disruptions. Instead, they've added to the confusion and the tension because of the mixed messages they contain. I've found it exceedingly difficult to blend my three images, to combine them in such a way that there is a single character to be played, a character that represents who I am and who I want to be. I am ready to be in a new stage of life as a teacher, but three conflicting images keep getting in the way, disrupting my re-visioning.

I continue to struggle with the traditional image of a science teacher as the professional transmitter of knowledge. My role is not simply to transmit scientific information: the facts, formulas, theories, and laws of traditional science, according to a predetermined time table which coincides with marking periods and semester exams. The old ways of teaching and learning science as

portrayed by my male mentors are no longer adequate, they do not fit my vision of what science education could and should be in the classroom setting. The "sage on the stage" model for teaching and learning does not give students an opportunity to become actively engaged in experimental problem solving, to work independently and collaboratively with peers and with the teacher to construct their own meaning and understanding of scientific phenomena, to be a self-directed learner. I want to relinquish the stage and become a "guide on the side," a facilitator rather than a provider.

Successful science teaching is more than just imitating strategies developed by older, more experienced colleagues. Students need more than just a fact-giver, a transmitter of knowledge. They need a teacher who cares: cares about the subject matter being taught, cares about the personal success of her students, cares enough to speak out and initiate change when the system is not meeting the needs of students or teachers.

But an unwritten law, a hidden mandate, exists within school cultures that discourages teachers, especially women teachers, from being too outspoken, too demanding, too political. At the high school level, the proper forum for speaking up and making demands is at the department level. The department is responsible for setting goals, establishing standards, making decisions about purchasing textbooks and materials and designing new courses. As a science teacher, I could not make my own decisions. I was expected to be a team player and abide by the agreed upon norms and standards of the department. Since most science departments are dominated by men,

the established norms and standards are well suited to masculine ways of knowing and being in the world. Women science teachers often feel and are obligated to play by the rules, to fit into the existing departmental culture. Sandra Harding (1991) provides this explanation.

Women feel obliged to speak and act in ways that inaccurately reflect what they would say and do if they did not so constantly meet with negative cultural sanctions. The socially induced need for women always to consider 'what men (or others) will think' lead to a larger gap between their observable behavior and speech and their thoughts and judgments (p. 125).

Let me provide you with a vivid example of how this scenario gets played out in a school setting. The following story comes from a journal entry, written by one of the women science teachers in the storytelling community:

The interaction in our textbook selection meeting was interesting because several of the men had their own personal agendas. Which is not why I attend a meeting. I attend a meeting to gather information -- unless I am asked for my input -- I go with an open mind, ready to take notes. Most of the men show up without any writing implement or paper. They just sit there and posture and offer their most important opinions. Most of the women, all of the women at the meeting today, had pencil and paper, ready to write down anything important that gets said. The conversation is never directed. A general question is offered to the group and the men immediately respond. And then if I offer a comment, I get the glares like are you butting in or what. I think that is the usual response. So not wanting to be labeled a "pushy bitch" over and over again, I withdraw because I don't want to deal with it. Then I don't get what I need out of the meeting. I get labeled and lose even more face. So that is one of the biggest hurdles, you are not accepted as an equal. A women's place is to shut up and listen.

Women science teachers are the minority and the minority does not rule in the school setting. I was well aware of the

consequences of not following the rules or blending in: teaching assignments requiring four or five different preparations, requests for supplies and materials ignored or tabled indefinitely, information about conference and workshops withheld, isolation from the group. This tactic was frequently used by a building administrators I worked under. The results were as expected and as he intended. The teacher involved would eventually ask for a building transfer, voluntarily retire or leave teaching completely.

Such an unequal balance of power often compels the few women within the department to seek safety in silence. It is safer for a woman to go "off" her voice -- modulate the sound, to diminish its clarity and power-- than to have her natural, transparent voice be labeled rude, angry, assertive, painfully repudiated (Rogers, 1993).

Reading the following passage from Adrienne Rich's "Taking Women Students Seriously," speaks to me about the silencing of women within male-dominated departments and points out to me how difficult it is for a woman to think like a woman in a man's world, and to speak with authority. Unless you transform yourself into a male impersonator.

Look at the many kinds of women's faces, postures, expressions. Listen to the women's voices. Listen to the silences, the unasked questions, the blanks. Listen to the small voices, often courageously trying to speak up, voices of women taught early that tones of confidence, challenge, anger, or assertiveness, are strident and unfeminine. Listen to the voices of women and the voices of men; observe the space men allow themselves, physically and verbally, the male assumption that people will listen. Look at the faces of the silent, and of those who speak (p. 243).

This is a time of transition for women science teachers. For centuries women have been defined by others, given labels without their consent, been written about in words that were not their own. The old ways of defining and portraying women's personal and professional lives are no longer adequate. The historical image of women teachers as passive, silent, powerless, voiceless, is a myth, an untruth. It is a lie that persists because women's voices have not been heard by ears that will take what they say seriously. Women teachers can no longer allow "others" to make generalizations about them without challenging the source of information or the interpretations that are drawn. We cannot let others misrepresent the professional nature of teaching by presenting a singular image of what a professional teacher should, an image based on masculine model which eliminates those qualities of women teachers that most students and parents desire and seek out.

Taking on the role of a teacher can also be disruptive, problematic, demeaning, for women as well as men, because of the subordinate nature of being a teacher. We are identified as professionals but are treated as subordinates, assigned to occupy the bottom position within the school hierarchy. As subordinates, we are expected to be submissive, silent and passive because historically that has been the norm for anyone choosing a career in a profession labeled "women's work." Consequently, it is difficult for an individual teacher, or even a group of teachers, to change radically the structure and function of the educational system at any level. I was able to initiate changes within my own classroom,

to be a catalyst for school improvement at the building level, and to actively support creative student teachers and novice teachers, but I had minimal impact when it came to transforming the discipline of science or altering the public's distorted perception of women and men who teach science. My voice of experience did not have authority or power outside the school setting. Personal practical knowledge becomes devalued as it moves up the levels of the educational hierarchy. The insights and understandings of classroom teachers are often disregarded as inappropriate forms of data by researchers and independent documentors because these are embedded within personal stories of experience. Stories are perceived as situational, relational and rarely generalizable. Consequently, the experienced voice of a classroom teacher is not taken seriously because their personal practical knowledge is considered too idiosyncratic, subjective and situational.

Susan Laird (1988) suggests that any school teacher, whether female or male, who forgoes the upward movement into administration will not be taken seriously, will be treated as "the other, the defined, the object, the victim" within a school's social hierarchy (p. 461). To remain in the classroom, working with children on a day to day basis, does not fit the masculine scheme of professionalism. Some current reform efforts, such as those undertaken by the Carnegie Task Force on Teaching and the Holmes Group are pushing for a transformation of the teaching profession into a male model of detached professionalism. A model that emphasizes those aspect of teaching that are most male-identified:

the cognitive, intellectual, and technical aspect of teaching to the exclusion of the affective, intuitive, and artistic aspects of teaching (Hulsebosch, 1992). A "true professional" should desire to advance in prestige and governing power, should seek ambition and accomplishment rather than tend to the work of caring for children, making connections with parents, building a secure, learning community within the classroom. If we use male professionals and business men as templates, the primary goal for a successful practicing teacher would be to leave the classroom and move upward into the school hierarchy, into an administrative position (Feimen-Nemser & Floden, 1986), or to achieve higher status within the school hierarchy by achieving the position of "career professional teacher" as outlined by the Holmes Group (1986, p. 37). Career ambition and single-minded devotion are of primary importance in the male model of professionalism.

American society aggressively encourages all women to pursue "real work" - work in the market - place, work based on the male model that emphasizes rationality, order, detachment and the pursuit of profit/power above personal and emotional attachment. The role of a woman primarily as caretaker and nurturer is seen as a relic of a best forgotten past. (S. Freedman, as cited by Laird, 1988, p. 458)

Perhaps the masculine scheme of professionalism is not the proper model for the teaching profession since school teaching, in this country, is a major cultural context for childrearing (Laird, 1988). If we exclude the three "C's" -- care, concern, and connection -- from the essential attributes of the "real work" of teachers, we are discounting the importance of love "that is so much a part of serious and careful thought" (Greene, as cited in Laird,

p. 460). By giving priority to reason over love, in teaching and learning, we are neglecting an important fact: that the mind of every student resides in a body. The body and the mind of a student need to be cared for and nurtured if intellectual growth is going to occur within the context of a classroom setting. A classroom is not just a teacher and her students, it is a "group of persons in a net of relationships with people who care about each other's learning as well as their own" (Shrewsbury, as cited in Laird, 1988, p 460). Teaching is not about detachment; it is about making connections with students, parents, and colleagues. It is, as Adrienne Rich points out, about taking people seriously, teachers and students, and acknowledging the value and significance of experience, traditions and perceptions (Laird, 1988).

During my twenty-two years as a secondary science teacher, I never had a student tell me that what they appreciated most was my objectivity, my detachment, my business-like approach to working with students. What they most often said was: "Thank your for caring about me, for taking time to find out what I needed, for seeing me as a person and not just a face in the crowd." The following affirms my beliefs about the importance of care.

Letter received on May 20, 1991

Dear Lynne,

We've gone over the results of Marty's paper with him - your comments and grade. We would like to thank you for bringing things into focus for Marty. We're sure that the talk you had with him was not in vain and will have an impact on him for a long time to come. Your taking the time to talk personally with him and your thoughtful consideration in allowing him to even turn in the paper have impressed upon all of what we already knew - - you are not only a fine teacher in your subject area, you are also a very fair person. You are a teacher in the true sense in that you are concerned about the "whole" person. Thank you for all you've done - - we are appreciative.

Sincerely,

Lynne and Harley

The three "C's" of care, concern and connection are qualities that I believe a teacher needs "not merely to exercise, but also to study, learn, know, and actually teach" (J. R. Martin as cited in Laird, 1988, p. 460).

A woman will need to prize her tenderness and be able to display it at appropriate times in order to prevent toughness from gaining total authority and to avoid becoming a mirror image of those men who value power above life, and control over love. (Angelou, as cited by Colford, 1993.)

Re-visioning: Looking Back with a Fresh Eye

Storytelling is an act of re-visioning; an "act of looking back, of seeing with fresh eye, of entering an old text from a critical direction" (Rich, 1978, p. 35). By telling stories, we are "looking back with a new eye" and putting together a conceptualization of our personal visions. Our conceptions represent an authentic reflection, a subjective rendering of the truth, about the personal experiences we've had and how we feel and

think about those experiences. The way that we choose to conceptualize our experience is part of our socialization into a culture. We learn how to think and feel, even learn what thinking and feeling are within the context of a social community. For many people, myself included, it is difficult to find words to express how we think and feel about our personal experiences. Women in particular have difficulty describing their personal experiences because personal ways of knowing and being do not carry weight in our patriarchal society. If a woman says, "I know this to be true because of personal experience," she is likely to be told: "You don't have the authority to make such a claim." You need documentation, proof, supporting evidence to make such an assertion.

To tell your own story means speaking with authority from personal experience. It means daring to be authentic, creative, and self-determined when cultural norms and expectations continually strive to prevent women from doing so.

Storytelling has given me a way to speak with authority, to put into words my authentic reflections about the experiences I've had, the cultural beliefs and values I've absorbed, the reality I've inherited. By telling personal narratives, I am able to structure my experiences in such a way that hidden meanings become illuminated. My remembering help the readers interpret and make sense of the stories I've shared and find whatever connections are possible between their life experiences and mine. For some readers, these stories may seem pointless, just women's talk - subjective, emotional, and ordinary. But it is precisely because they are

written in my own ordinary words, told in a voice that represents my perspective as a woman science teacher, that they need to be told.

Writing about ordinary women's lives is difficult precisely because "ordinariness" is not considered a valuable, promising theme for stories in our society. People expect books to be written about prominent, famous women, not about servants, secretaries, factory workers, prostitutes, homemakers, teachers. I suspect that many people within the educational research community will have difficulty understanding why I chose to gather stories about ordinary women teacher's lives. Why didn't I seek out exemplary, nationally recognized women in the field of science education? Why ordinary science teachers like me?

When Daphni Patai (1988), author of Brazilian Women Speak, was asked "What is the point of writing about these women's' lives?" Why write about ordinary women in Brazil? She replied:

Our task is precisely to move beyond this question. There are no pointless lives, and there are no pointless life stories. There are only life stories we have not yet bothered to consider and whose revelations (including, at times, those of staggering ordinariness) therefore remain hidden from our view. Until recently the prism of androcentrism has distorted most of our knowledge about women, and the lives of ordinary women have been seen as unimportant, even trivial. One cause of this distorted view is that our image of women has been formed from the representation of privileged artists and scholars, usually male. (p. 1)

This dissertation study is about re-visioning: re-visioning for me and for the six women who came together to share stories about the realities of our lives as women science teachers. By looking back with a fresh eye and examining the text from our

critical perspective as women, we hope to transform the public image of women science teachers, to reveal a version of teachers and teaching that challenges the cultural norms and expectations and truthfully and self-consciously acknowledges the ways in which family, work and political relationship are intertwined with and mirror each other (Christ, 1980). For women science teachers the phrase: the professional is personal is political is a reality.

It is not a simile, not a metaphor, not an analogy . . . It means that women's distinctive experience as women occurs within that sphere that has been socially lived as the personal -- private, emotional, interiorized, particular, individuated, intimate -- so that what it is to know the politics of a women's situation is to know women's person lives. (Catherine MacKinnon, as cited in Fox Keller, 1989, p. 8)

To understand the professional, personal, political nature of women's lives, we must look at the text from the critical direction of "insiders" who inherited the old text and have been forced to deal with the tensions and conflicts inherent in the stories and myths it contains. In the chapters that follow, I will be sharing with you our collective interpretation- of the text: the images of teachers and teaching that we have absorbed during our socialization into the teaching profession, the tensions and conflicts that continue to arise whenever our version clashes with society's version, and how it has been possible for each of us to alter the "etchings," to resist the social forces that try to shape who we are and limit what we can do.

This old text needs revisions. The stories it contains and the traditions it perpetuates do not present the multiple versions of reality that exist. As a researcher and a woman, it is my

responsibility to write a new chapter for this text, to alter the story in such a way that the untold truths about women teachers will be brought out in the open. This is a challenging task, finding the right words to describe a set of experiences that very few authors have chosen to write about. This is a dangerous undertaking, a clear and direct risk, because I am choosing to take seriously my own and my colleagues' experiences as women. It is a risk to act and react, to speak out in an authoritative voice and break a culturally imposed vow of silence. Speaking authentically, openly and honestly "flies in the face of woman's appointed definition and prescribed way of living" (Baker Miller, 1986). By speaking out as a woman, I am making what Adrienne Rich (1987) calls a "quantum leap," a leap in which I am "imagining a future in which women are powerful, full of our own power, the power to create, the power to think, power to articulate and concretize our visions" (Rich, p. 271-272).

I am making this leap: recognizing that women's ways of knowing and explaining the world are valuable and powerful, even if they are not valued by most of the powerful institutions within our society, envisioning a world in which women can "act and react out of their own being" (Baker Miller, p. 113). I must make the leap, take the risk, because to do otherwise would simply perpetuate the myth that characterizes women teachers as passive, submissive, silent and voiceless.

CHAPTER IV

STORYTELLING - A PRACTICE OF COURAGE

Speaking One's Mind by Telling One's Heart

To learn this practice of courage women need time and space to breathe freely, to be vulnerable, to speak honestly with one another. This means having time in the structure of our work -- as teachers -- to engage in this kind of connected relationship. (Rogers, 1993, p. 291)

It takes courage to speak truthfully about one's own life. It takes courage for a woman to speak with authority about her personal experiences and to reveal the "true I" that has been carefully hidden and silenced. As a young girl, I learned that it was not always wise to speak my mind, to reveal what was deep within my heart. Especially if the words that were spoken challenged the beliefs and biases of the patriarchal culture that acquired me. I was taught to respect my elders, to be seen and not heard, to obediently follow school rules and church doctrines, and to never talk back to an adult. Any attempt, on my part, to alter these expectations was met with painful, stinging words of reprimand. Nothing was more demeaning to me, and exceedingly effective in changing my behavior, than a severe "tongue-lashing" by someone in a position of authority. And so I learned to repress my inclinations to be bold and spirited, courageous and outspoken, speaking my mind

only when I was in the company of female friends I could trust. I consciously elected to "go off my voice" whenever I felt my opinions, values and beliefs would conflict with the established norms within my social setting. The "real I" could easily be camouflaged, concealed, if I modulated my voice and put on a mask, preventing people from seeing my face and knowing what was in my heart.

The world knows us by our faces, the most naked, most vulnerable, exposed and significant topography of the body. When our *caras* do not live up to the "image" that the family or community wants us to wear, we experience ostracism, alienation, isolation and shame. To become less vulnerable to our oppressors, we have had to "change" faces, to acquire the ability, like a chameleon, to change when the dangers are many and the options are few. (Anzaldua, 1990, p. xv)

For years now, I have been trying to find the courage to stay "on my voice" and discard my mask even when my words and facial expressions are not welcome and my message is not taken seriously. It is so much easier to compromise: modulating my voice, speaking softly and unassertively using carefully chosen, neutral words, so that colleagues and acquaintances will not take offense or be shocked by the intensity of my emotions and the assertiveness of my inner feelings, hiding behind an expressionless face that does not reveal the courageous, assertive woman within. I often feel like I'm waging a mental battle with myself to speak or not to speak, to let my natural voice be heard or keep it muffled and disguised, to expose my natural face or keep my "intersubjective personhood" (Anzaldua, p. xv) hidden from the world.

I'm finding, as I get older and more courageous, that going "off my voice" and wearing a "mask" is no longer a comfortable alternative and certainly does not help discourage the myth that women are silent, passive, voiceless and faceless. Perhaps Carolyn Heilbrun (1990) is right when she states, "Acting to confront society's expectation for oneself requires either the mad daring of youth, or the colder determination of middle age" (p. 118).

In my youth, I was not daring and courageous, not "mad" enough unfortunately, to confront society's expectation of me. But now I am middle aged and coldly determined to create a new story. A story that comes from the hearts of women, a narrative that strips off the masks that hide women's real identities as courageous, professional leaders. With this story, we will be "making faces" as women science teachers, faces that represent our real personas. "Making faces" is Gloria Anzaldua's (1990) metaphor for constructing one's identity. "You are the shaper of your flesh as well as of your soul; the one who invents herself or himself" (p. xvi).

This dissertation is my practice of courage, a determined effort to help myself and other women science teachers stay on our voices and speak our minds. As a group, we came together in good company as a community of storytellers, not only to find and use our natural voices but also to create a set of "faces" that would represent the multi-layered identity of a woman science teacher. We discovered that it was not too late to recover our courage, to rediscover our natural voices, to construct our identities. What it required was: "time and space to breathe freely and to speak

honestly with one another" about the realities of our lives as women (Rogers, 1993, p. 291). By talking to each other, telling our life stories, sharing our ways of knowing, analyzing the language that has lied to us, we began the slow process of transforming the culture we inherited and finding new ways to lead our lives.

Having the opportunity to talk about one's life, to give an account of it, to interpret it, is integral to leading that life rather than being led through it. (Lugones & Spelman, as cited in Chambers, 1992, p. 1.)

Making Connections by Sharing Our Lives

Stories are about interconnections -- connections between my life and someone else's; between the past and present; between the stories of our lives and the stories of our teaching; between the larger narratives which make up life. These connections make up stories our lives tell. (Chambers, 1992, p. 15)

Storytelling is part of the daily lives of teachers. As a group, we share a myriad of stories. It is the most common way we communicate with one another about our evolving, personal, practical knowledge. Telling stories, sharing experiences of daily life, is how we make connections with one another and are able to build a feeling of community and shared purpose. Teachers' stories are part of the living conversation of a school community and sharing them is a natural way for teachers to enter into one another's lives. When a teacher shares a story, it is a "password" into an inclusive community of school folklorists, and known only to those who belong to the same social horizon (Casey, 1993). The personal experience stories teachers share and pass on from one generation to the next are a form of folklore. This unofficial, informal, idiosyncratic

knowledge that teaching colleagues share, as they go about their daily work of teaching, is a force that links teachers together as members of a common social group. Teachers are likewise bound together by geographic location, their commitment to the teaching profession, their interests in helping children learn and often by gender and social class. The folklore of teachers, referred to by Shubert and Ayers (1992) as "teacher lore," is a means of identification which reveals the common threads that weave together the practical life experiences of teachers and highlight the knowledges and ways of knowing they share and understand.

For many teachers, especially women science teachers, time and space for breathing freely, speaking honestly, and sharing stories with women colleagues are not part of the structure of schools. It is not unusual for a woman science teacher to work in a department with all male colleagues and have limited contact with other female teachers in the building. Schools are designed to isolate teachers from one another. The classroom walls act as boundary lines marking off each teacher's territory within the school building. For the most part, teachers spend their teaching hours within their classrooms; perhaps venturing out during their half-hour lunch break or during their planning period. Even if two teachers share a classroom, there is rarely time for breathing and speaking let alone sharing stories in the three to five minutes of passing time between classes. Life in a high schools is a whirlwind of students coming and going; a new flock descending upon each teacher with the ring of the bell. In "The Persistence of Privacy: Autonomy and Initiative

in Teachers' Professional Relations," Judith Warren Little (1990) suggests that the organization of space, time and tasks for teachers seriously hinders their ability to have meaningful conversations about their stories of teaching.

The stories that teachers share are often told indirectly and informally during moments between classes, over lunch, or during extra-curricular activities after school hours. It would be more accurate to call these brief exchanges of information "snippets - little clipped versions of teaching and learning" (Schubert & Ayers, 1992, p. 12) in progress rather than stories since they are often incomplete, fragmented, and lacking the traditional elements of a story: time, place, plot and scene (Connelly & Clandinin, 1990). Rarely does a teacher have the time or the space to retell and expand one of these clipped versions of personal experience, consequently, the significance of these snippets of knowledge are left unexplored, their underlying meaning unrevealed. In many schools, there is not a private space, risk-free setting for two or more teachers to share their knowledge, raise questions, and examine current pedagogical strategies. The faculty lounge, staff lunch room, even a teacher's classrooms can resemble a busy hotel lobby; a constant stream of people in and out asking questions, making phone calls, looking for lost items, catching up on the latest bits of news from the morning new cast or local paper. For a teacher to become a reflective practitioner, the setting has to feel safe and she must trust that her colleagues will be supportive and non-judgmental if conversations are to take place.

As a classroom teacher, I felt a need to make connections on a daily basis with my teaching colleagues. I wanted to form collaborative relationships with my colleagues and felt that I should take the initiative to share my ideas, ask for advice and see how their classes were progressing. To accomplish this, I would purposely leave my room between classes to share tidbits of information with other teachers, even if we only had time for a one minute conversation. Throughout my teaching day, I fought against the inherent isolation by spending my planning period and my lunch period in the faculty lounge or media center so I would have an opportunities to interact with my colleagues. Although this satisfied my need to communicate and exchange information with other teachers, the school setting was not always a safe and secure place to share personal stories about my life and my teaching with other women. "Women's talk" is often misconstrued or misinterpreted when overheard by others, especially if the conversations deal with issues of sexual harassment, conflicts with teaching colleagues, or difficulties with students and parents. I frequently went to school an hour early and left an hour late just so I would have uninterrupted time and a secure space to talk with women colleagues, who were not members of the science department.

The Design of the Study:
Empowering Teachers to Tell Their Stories

Empowering relationships develop over time and it takes time for participants to recognize the value that the relationship holds. Empowering relationships involve feelings of "connectedness" that are developed

in situation of equality, caring and mutual purpose and intention. (Hogan, as cited in Connelly & Clandinin, 1990, p. 4)

Women science teachers have rarely been the subject of educational research studies; their knowledge, insights, experiences and contributions have been overlooked and often ignored in descriptive accounts of science education. As a group, their voices have not been heard; their stories have not become documented as a part of the knowledge base for teaching. A variety of reasons have been offered to explain why teachers' stories are often ignored and excluded from data. Why are the stories often discounted or considered less important than other forms of knowledge?

Judith Warren Little (1990) suggests that some educational researchers denigrate storytelling because it appears as a weak substitute for more rigorously structured collaboration about teaching practice. From these researchers' perspectives:

. . . teachers use stories to gain information indirectly when they are confronted with powerful occupational norms that suppress more instrumental forms of help-seeking. Such stories have been characterized as offering only incomplete accounts of subtle performance, exacerbating rather than relieving the endemic uncertainties of the classroom. To the extent that stories comprise no more than a litany of complaints, they may act to inhibit analysis and inventiveness, and by placing a premium on the concrete details of daily classroom life, stories act as a reinforcer that sustains a conservative and present-oriented perspective. (p. 514)

Susan Threatt (1989), a classroom teacher and researcher, provides quite a different explanation for why teachers' voices have been silenced and their stories dismissed. First, she contends that "the traditional, positivist philosophy of knowledge sets up a

hierarchical continuum which places the basic science theory at the top and an applied science of doing at the bottom" (p. 6). Since the educational research community tends to adhere to this philosophy, those who are at the top, the theoretical researchers, are generally viewed as more intelligent and therefore better able to tell the "truth." The practitioners, the classroom teachers, are at the opposite end of the spectrum; consequently, they are not expected to speak, nor are they listened to by those at the top.

Second, Threatt cites the historical connection between classroom teaching and women's roles in our society as a plausible explanation for public silence among women teachers. Historically, there has been a defined range of acceptable behavior for women, including teachers, that is clearly linked to gender stereotyping. Women are expected to be passive and subordinate in public settings, to receive their knowledge from others, in contrast, men could actively speak, think and create knowledge for others.

The third explanation is based on her belief that "until recently, there has not been any attempt to develop or explain an epistemology of practice, or how teachers come to know in the classroom" (p. 7). Practicing teachers do their own form of research when and while they are teaching, but much of this form of problem-solving, spur-of-the-moment research occurs within the mind of the teacher and is not verbalized to others. It has been and continues to be difficult for outside researchers to collect data about teachers' personal practical knowledge of teaching.

The fourth factor that contributes to the silencing of teachers is "the constraints of public schools. The lack of time, the volume of paperwork and the number of students impinge upon a teacher's time to reflect as well as communicate" (p. 7). Because of these constraints, many classroom teachers do not talk about their teaching practices, nor are they encouraged to express their opinions or voice their concerns outside the school setting. At times, it is risky for an individual teacher to stand up and be heard.

The explanations offered by Judith Warren Little and Susan Threatt were especially important to me as I conceptualized a plan for a collaborative research study with classroom teachers. If I expected women science teachers to participate actively in a storytelling community, I would need to alter or eliminate those factors which have historically kept teachers silenced and storyless. Nel Noddling's (1986) advice was helpful as I thought through this dilemma and struggled with how to cultivate an empowering relationship between the participating storytellers and me. She suggests that, ". . . we approach our goal by living with those whom we do research within a caring community, through modeling, dialogue, practice and confirmation" (p. 502). P. Hogan and Nel Noddings also highlight the "necessity of time, relationship, space and voice in establishing a collaborative relationship in which both researcher and practitioners have voice" (as cited in Connelly & Clandinin, 1990, p. 4).

What does an "empowering relationship" look like in a research setting? What kind of methodology fosters care, concern and connections within a researcher-participant relationship? I found the answers to these questions in several research studies conducted by feminist researchers who were using methodologies that were "voice centered and relational" in approach and firmly grounded in girls' and women's lives and ways of knowing.

In a Different Voice (Gilligan, 1982), Making Connections (Gilligan, et al., 1990,) and Women's Ways of Knowing (Belenky, et al., 1986) were three influential research studies I read early in my doctoral work that pushed my thinking on how to empower girls and women to talk with courage about their life experiences. Their approaches entailed "listening to girls and women as authorities about their own experiences and representing their voices in a written text" (Rogers, 1993, p. 267). The relationship was empowering for the participants because they were given the freedom to speak their minds and to have their words, their interpretations, represent the truth within the written study. The work of these women researchers gave me the confidence and the support I needed to break away from tradition and envision a more feminist approach to research within the context of science education.

As I began to think more seriously about feminist approaches to science and to research, I discovered the work of Evelyn Fox Keller (1985), Ruth Hubbard (1990), Sandra Harding (1991) and Ruth Blier (1991). What an amazing revelation! How exhilarating it was to read their critiques of science and scientific research and to

recognize that their ways of knowing were so closely aligned with my own. These feminist scholars and scientists have been my "authoritative female interlocutors" (deLaurentis, 1987). Their perceptions, theories and beliefs seemed to match and validate my own. These researchers and authors, with whom I feel a close personal connection, have been my mediators, helping me interpret my experiences in the world of science and find ways to challenge the traditional view of science and science education. As female authorities in the field of science, they empowered me to take a stand and create a research study that would broaden our conception of science education to include the perspectives and insights of women who traditionally have been silenced.

In their work on narrative inquiry, Michael Connelly & Jean Clandinin (1990) emphasize the importance of teachers finding their voices and exploring their beliefs about teaching and learning within a community setting. Although "voice is meaning that resides within the individual, the struggle for voice begins when we try to communicate meaning to someone else" (Britzmann, as cited in Connelly & Clandinin, p. 4). In designing this study, I felt that women science teachers would welcome an opportunity to share their personal experiences and explore their sense of self in a supportive storytelling community with other women. Certainly the composition of the group would play an important part in our efforts to establish a caring community that would encourage serious, thoughtful reflection about our lives as women, as scientists, as teachers. I relied on my own intuition and recommendations from

friends when I invited a select group of women science teachers to join this community of storytellers. As the organizer of this study, I did have twinges of fear and some anxious moments before our first group meeting. My greatest fear was that I had inadvertently brought together individuals who might not value other women's experiences and ways of knowing or would be fearful of exposing their own inner-thinking, their inner voice to teachers working in their own district. I was also concerned about how long it might take the group to establish feelings of connectedness and a shared sense of equality between all of the women, regardless of age or years of teaching experience.

The storytelling that occurred during our group and individual conversations involved stories that are categorized by folklorists as "personal experience stories." According to Sandra Stahl (1983), a personal experience story is a "first person narrative composed orally by a teller and based on real incidents in their lives" (p. 268). The raw material for these stories arise from the experience of daily living and become "story worthy" and therefore "meaningful" to both the teller and the listener when they have cultural and social significance to those involved in the storytelling community (McConaghy, 1991). Our personal experience stories provided opportunities for us to enter into each other's lives because we had time and space to explore the plots, the settings, the characters, the incidents that were meaningful in the context of our lives as science teachers and women. The stories were more than just the retelling of a particular incident or observation. They had an

emotional dimension that drew us into the stories and involved us personally, stimulating our imaginations and our memories (McConaghy, 1991). By blending together our personal experiences and images with the story being told, we were able to connect the story to our own lives in ways that helped us to learn about ourselves and to think about our own experiences in new ways.

Stories allow us to enter empathetically into another's life and being - - to join a living conversation. In this sense it serves as a means of inclusion, inviting the reader, the listener, writer, or teller as a companion along another's journey. In the process, we may find ourselves wiser, more receptive, more understanding, nurtured, and sometimes even healed. (Witherell, et al., 1993, p. 5)

An Inclusive Community of Women Storytellers

Throughout my teaching career, I had to actively seek out women teachers and staff members with whom to share my personal stories. Although my male colleagues and I would frequently exchange snippets of information about the joys and sorrows of teaching, I needed the "good company" of other women in order to speak my mind and tell stories from the heart. In particular, I valued conversations with other women science teachers because we shared a common set concerns about science teaching and learning. Because of my own beliefs and biases, I designed this dissertation study around an inclusive community of women storytellers because I felt we could be more courageous, outspoken and honest in the good company of supportive women science teachers. Marni Pearce (1993) provides an image of an ideal inclusive place:

Inclusion

Inclusion is not 'us and them'
or even 'you and me.'

It is a smile of recognition, a reassuring touch,
a sense of genuine belonging.

It is a place where souls can meet
and share and experience
and lives can intermingle.

It is identity.
It is acceptance.
It is a haven for all.

Take my hand;
We can go there together.

Our storytelling community became such a place. A place where we could meet, share, experience and intermingle. It was a place where our "women's talk" was accepted and respected; where women's stories and ways of talking were the dominant discourse; where new narratives of women's lives emerged as we exchanged stories and talk collectively about our ambitions, possibilities, accomplishments. Over time, our storytelling community became a source of empowerment. We provided support and encouragement for one another and shared with one another insights, skills and strategies for dealing with problematic situations and dilemmas. Together we created a collective sense of power and authority. It was an exciting revelation for all of us.

Carolyn Heilbrun's (1990) book, Writing a Woman's Life, convinced me that I made a wise decision in keeping the storytelling community exclusively female. According to Heilbrun:

. . . female narratives will not find their way into texts if they do not begin in oral exchanges among women in groups hearing and talking to one another. As long as women are isolated one from the other, not allowed to offer other women the most personal accounts of their lives; they will not be part of any narrative of their own (p. 46).

Although I think it might be possible for female narratives to emerge from gender-mixed storytelling communities, I know that many women will not risk telling a personal experience story for fear of being "put-down" by a sarcastic male colleague or administrator. Women have the impression, and often justifiably so, that men are unable or unwilling to take them seriously. This is especially true in situations where women are greatly outnumbered by men, as is the case in most science departmental meetings. This is not to say that women never share personal stories with men; however, if they do it is because they have a close bond with that individual and have developed a relationship of care and equality.

Margaret Yocum (1985) contends that finding women's personal narratives does not depend on physical location or sexual exclusivity. It depends on:

. . . a mode of social interaction, a space where none need fear ridicule or embarrassment, where participants feel they all share several bonds, where narratives emphasize those bonds, and where each participant is seen as equally capable of and willing to contribute personal information (p. 52).

At one point during this study, I asked the women in the storytelling community how they felt about our group being exclusively female. Their responses support the value of creating space for women to tell their stories. Time, relationship, and space are required for their real voices to emerge.

I think having all women in our group was essential, otherwise we would not have been as open to discuss some of the issues we did. We had a very relaxed atmosphere that was never judgmental or critical. We were free to talk about anything. I think having men in the group may have steered conversations in the wrong direction, or may have made comments seem competitive. (Marie, Journal Entry, 1993)

We have a hard time in our department with a couple of the men. We want to be real honest and talk about the curriculum and air our feelings and frustrations. But we can't have that discussion because several of the men get very defensive and automatically think we are judging them. They have trouble thinking about the curriculum or departmental issues as ours instead of mine. (Marie, Group Conversation, May 1993)

It was really comfortable and supportive and the fact that we were all women was significant because we were not here to prove anything. We weren't out here to compete and did not look at each other critically. Whatever anybody said was of equal value, no more important than anybody else. Just because someone had more years of experience, than someone else. There was no difference, we were just bringing our experiences together to share, no matter where or how it happened. (Jasmine, Group Conversation, May 1993.)

I think we've touched on this before, the difference between how men talk in a group versus how women talk in a group. Men tell a story and if someone interrupts them, they wait. They don't hear what the other person says, they just continue right on from the comma. It is always a "prowess," like wasn't I good. Whereas, women relate better to relational kinds of discussions and I think that is probably why support groups ever got started. (Sarah, Group Conversation, May 1993.)

Establishing a Community of Storytellers with Unknown Participants. in an Unknown Setting

Until I moved to California in August of 1992, I had never set foot inside a secondary public school in California, nor had I spoken to any women science teachers about science education in

their state. I just took for granted that teaching science in California was comparable to teaching science in Michigan and that many women science teachers were experiencing the isolation and lack of voice that I had experienced as a classroom teacher.

When I proposed to establish a collaborative storytelling community in an unknown state with unknown women teachers, I made another one of those "quantum leaps" -- imaging that I had the power to bring a diverse set of women teachers together and collectively create through storytelling a new image of science teachers and science teaching (Rich, 1979).

Prior to moving to California, I had completed a brief pilot study with a group of four women science teachers in Michigan. Establishing a time and a space for these women to talk about their lives as teachers and women was a welcome opportunity and the collaborative storytelling proved to be an extremely useful way for us to talk about our experiences. I left Michigan, confident that I could use "narratives" as a research tool in a community setting for my dissertation study.

Did I make too great a leap? Could this research design be used with an unknown set of teachers in another part of the country? The answer is "yes" to both questions. But there were lessons to be learned first.

Establishing a community of storytellers was more difficult than I had anticipated. The difficulty was not due to lack of organization or a lackadaisical approach to research. I simply overlooked the importance of the 3 "Cs," care, concern and

connection in establishing a collaborative group of women science teachers. In retrospect it seems so obvious. How could I have been so insensitive to these qualities in women's lives?

Learning to Be a Collaborative Researcher

Let me begin by saying that I think I was a bit too anxious to get the storytelling group organized and made some decisions early in September that I didn't need to make. But this is part of my nature; I always think I have to be overly organized and be right on top of things. I can never seem to wait -- I want to plan and know far ahead of time what is going to happen.

Since I did not know any California science teachers where I proposed to do my study, I went to the County Superintendent's Office and got the names, school addresses and school phone numbers of all the women science teachers currently teaching in the county's public schools. I came away with a list of thirty-four potential storyteller to contact. I was hopeful and confident that six -- the optimum number of participants -- of the thirty-four would be interested in participating.

After calling each high school on my list, verifying names and teaching assignments, I composed a letter that I hoped would spark interest and convince these teachers to participate. Since teachers receive many pieces of "junk mail" in white envelopes, I determined to catch their attention with an ivory envelope containing the letter printed on matching stationary. A self-addressed, stamped envelope was included so respondents could conveniently reply.

I selected the names of eighteen women who lived closest to my residence and mailed each the letter on September 16th. Each was asked to respond, "yes I am interested" or "no I am not," by September 30. Several replies were returned the first week: all "no's." Several women wrote that they were too busy taking classes or had young children at home. In all, I received five responses to the initial eighteen letters. Everyone declined the invitation. I was disheartened.

Obviously this was not the way to invite women to participate in a research study. I don't know why I was surprised, after all, they did not know me and I wasn't even from California. In hindsight, I know my initial contact should have been more personal, perhaps I could have made an appointment to meet each woman at their school. I didn't see any reason to contact the remaining sixteen women who lived even farther away. If I couldn't get women to participate who worked less than five miles from where I lived, I was certain no one would drive thirty miles out of their way.

My research was at a standstill. The Dissertation proposal approved, "Human Subjects Approval received," I was ready to listen to stories. But I could not find women who would share their stories. Perhaps I had been mistaken. Perhaps women science teachers in California were different from those I had worked with in Michigan. Perhaps these teachers already have multiple opportunities to voice their opinions and make connections with other women science teachers. Or perhaps I just used a cold,

impersonal way to invite participation in an experience that I wanted to be warm, supportive and very person.

All Dressed up and No Stories to Hear!

Somewhere there had to be women science teachers interested in participating, in making connections with the group that I envisioned. I had met a number of women science teachers through my work as a supervisor for science students teachers at UC, sixty miles from my home. Several were cooperating teachers for the Teacher Education Program at UC. Eight were possibilities; perhaps I could interest five or six in the project.

This time I talked with the teachers personally, briefly explaining what this study was about and what their involvement would be. Much to my surprise and delight, the first three teacher I talked with said "yes," they wanted to participate, that sounded like an interesting idea. Over the next few days, two more women responded favorably as well. Now we were six, including me as the participant researcher.

In October, one of the response forms I had mailed out earlier in September was returned by a woman who wanted to be part of the study. By then, I had already committed to establishing the community of storytellers in Redwood, sixty miles from her school. She was currently the only female in a science department of thirteen. In addition, she was a minority, of Chinese descent, and teaching in a high school that was 85% minority. Our seventh storyteller was willing to drive sixty miles -- both ways -- just to

meet with other women science teachers. The three "Cs" made a difference. Although the women who agreed to join the study did not know me well, they knew me well enough to know that I was a trustworthy person, connected to them through my experiences as a classroom science teacher, and concerned about making visible the realities of their lives as women and as teachers.

Recovering The Stories - Capturing The Voices

In the process of living the narrative inquiry, the place and voice of researcher and teacher become less defined by role. Our concern is to have a place for the voice of each participant. The question of who is researcher and who is teacher becomes less important as we concern ourselves with questions of collaboration, trust, and relationship as we live, story and restory our collaborative research life. (Connelly & Clandinin, 1990, p. 5)

As a research methodology, "narrative inquiry" empowers both the researcher and the participating teachers to focus on the actions of their own lives, on their intentions, goals and experiences (Vitz, 1990). In this form of inquiry, personal experience stories are the valued form of data; they are not denigrated, dismissed or ignored. The stories themselves are the powerful research tool, providing a picture of real people, in real situations, struggling with real problems (Witherell & Noddings, 1991).

In designing this study, I found the work of Jean Clandinin and Michael Connelly (1990) to be the most helpful as I made decisions about what type of narrative data sources to collect and how to insure that the participants would have the time, space and

incentive to tell their stories. In particular, their article "Stories of Experience and Narrative Inquiry" (1990) provided a clear and encompassing set of choices about collection methods and sources.

I made use of a number of different methods of data collection in order to gather a rich variety of stories about our life experiences as women science teachers and to provide different storytelling situations for the participants and myself. The following is a summary of the multiple forms of narrative sources we collected and a description of the settings in which the stories were told.

Community Storytelling - Collaborative Conversations

No utterance in general can be attributed to the speaker exclusively; it is the product of the interactions of the interlocutions, and broadly speaking, the product of the whole complex social situation in which it occurred. (Thompson, as cited in Casey, 1993, p. 26)

During this research study, we met together as a storytelling community once a month for six months, beginning in December, 1992 and ending in June, 1993. We decided to have our collaborative conversations in a setting that was informal, relaxed and safe. "Safe" in the sense that the setting would be private and we felt free to use "women's talk" and not have to worry about "outsiders" overhearing our conversations and questioning what we were doing. Four of our sessions were in homes, one was at a restaurant, and our final session was a picnic at the beach. The group sessions would begin at 4:30 p.m. and finish around 8:00 in the evening. Dinner

and snacks were always part of our meetings which added to the camaraderie of the sessions and gave us a genuine sense of community and collegiality. The tape recorder did not seem to change the atmosphere or make individuals feel self-conscious, or prevent people from "telling it like it is." Though we frequently joked about turning the recorder off whenever someone in the group started critiquing colleagues or school administrators.

Our collaborative group conversations were designed to be interactive, where one person's story would frequently trigger questions, comments or another story from the group. Our conversations resembled "women's talk" in the sense that we would freely interject ideas, opinions, supporting comments, and advice as a story was being told. One story would evolve into a shared collective story that included bits and pieces of other stories, ideas and thoughts created during the collaborative process. These collective stories had a life of their own; we were never sure where the conversation was heading or when it would end. Our conversations did, as Hans-Georg Gadamer (1982) suggests have a "spirit of their own" and participants are do not direct the conversation, but rather are led by the topic or story being shared. I'm convinced that none of our stories actually came to an end on their own; it was hunger that compelled us to draw our conversation to and end.

In thinking about how to keep these storytelling sessions collaborative and empowering for the participants, I opted to have the group negotiate the topics for our monthly group get-togethers.

My original plan was to have the group, at the first meeting, jointly construct a list of possible topics important in women's lives and select from the list. Instead, we decided to take one person's suggestion and construct a set of questions for the next group conversation. About a week prior to our group meetings, I sent out a reminder of the date, place and the suggested topic (a series of questions) for the evening. This was not a problem, because a conversation -- especially a collaborative conversation -- seems to have a spirit of its own. No one needed to lead. The selected topic led us in a multitude of directions, backward, forward, inward and outward. Chapters 5 and 6 will help the reader visualize collective storytelling through excerpts from our conversations. The following is a summary of the topics used to get our conversations started:

First Group Session: Making Personal Connections

Where were we born and raised? What have our school experiences been (K-12 and beyond)? How did we come to be science teachers?

Second Group Session: Role of Administrators and Their Demands

What is the role of administrators (all levels) in science education?

How much and what do we put up with as women in the teaching profession?

Do women teachers have more demands made on them or do we seem to accept decisions more readily?

Third Group Session: Gender and Racial Issues in the Science Classroom

Do we favor one sex over the other and should we? Do we bend the rules?

Do we encourage minority students differently? Do we bend the rules in favor(or not in favor) of certain groups?

Is there gender/ and or racial bias in our classrooms?
(Conscious or unconscious? Necessary or unnecessary?)

Fourth Group Session: Feedback and Uncertainty of Influence

I requested feedback from the group about the process in which they were involved: Is it valuable to you? Does it provide learning opportunities? Are there benefits you gain from meeting with other women in science?

How has being a woman science teacher influenced: your personal life, your students' lives, your department/school?

Fifth Group Session: Changes in Science Education

What changes would you like to see in science education and why?

What role should women play in making changes in science education? What role do you want to play?

Sixth Group Session: Overall Evaluation

Overall evaluation of their involvement in this collaborative research project.

What are the collective stories we have constructed? Which ones do we want to share with the readers of this dissertation study?

One-on-One Conversations

The first condition of the art of conversation is to ensure that the other person is with us . . . It requires that one not try to out-argue the other person, but that one really considers the weight of the other's opinion. (Gadamer, as cited in McConaghy, 1991, p. 75)

Making space and providing time for each member of the storytelling community to share their stories and reflect on their life experiences was an issue that I felt could become problematic with a community of seven women. This would be especially problematic if I expected each woman to have equal access to "voice" and have uninterrupted time to speak and to be heard. To assure that each woman in the group, myself included, had an opportunity to talk about their life experiences and to have "center stage," I scheduled three one-on-one conversations between each of the women in the group and me. Because I was also a participating member of this storytelling community, I asked three of the group members to take the role of researcher for the day.

These conversations were more structured than our group conversations and focused on several of the interview questions used by Mary Belenky and her colleagues when they collected data for their book Women's Ways of Knowing : The Development of Self, Voice and Mind. Once again, the questions posed were merely starting points for our conversation, but were designed to help focus our attention on issues of self-identity and voice.

First Conversation:

Looking back over your life, what relationships have been important to you? Why?

Have you had a relationship(s) with someone who helped shape the person you have become?

Second Conversation:

What does having a "voice" mean to you?

Do you feel you have "voice" in your personal life and/or your professional life?

Third Conversation:

What characteristics or qualities do you encourage your science students to develop?

How would you describe or define the goals you personally have for science education and for your science students?

The one-on-one conversations took place at the participant's home or on a quiet restaurant where we had our conversations over lunch or dinner. Generally these conversations would last for about an hour and a half and were very interactive in nature. I did not just sit back and listen; I interjected comments, asked questions, at times contributed my own stories just as I do whenever I am having a conversation with a good friend. For several of the women, these conversations were a challenge because the questions I posed required them to look back over their lives, both personally and professionally, and to create a story that perhaps had never been told or conceptualized before that day.

Journal Writing as Telling

Writing a journal is a powerful form of narrative in which we tell our own stories, allowing us to rethink our past, our present, and our future selves. It is a kind of journey from one moment to the next, from one entry to the next. We literally write our own stories, simultaneously incorporating our own future, as we reconstruct our past. Telling our stories through journal writing becomes a quest for understanding and integration, a bridging of the inner mindscape and outer landscape. (Culley, 1985 as cited in J. E. Cooper, 1991, p. 98)

Without a doubt, the reflective journal writing was the most difficult request I made of this group of women. Of course, time was an issue, since everyone in the group was teaching full-time and

several women had additional responsibilities outside of the classroom that put even greater demands on their leisure time. More pressing than time, however, was the fear, or perhaps dread, of having to put into words the private thoughts that run through one's mind. We all carry on conversations with ourselves as a way to organize our daily lives and deal with the various problems we are forced to solve. But a mental journal is quite different from a written one. Spelling, punctuation or rules of grammar is not an issue in a mental journal, and there will be no document for others to read. Several of the women expressed their anxiety over their inability to write creatively, in a free-flowing style. I suspect part of this anxiety comes from the fact that we were all trained to be scientific writers: direct, brief and to the point with minimal use of subjective interpretations of data. Anyone who has ever read a scientific laboratory report would recognize the dry, unemotional style we were taught to use.

At the time of this study, no one in the group was keeping a journal or diary, although everyone had at some time in their life been forced to do so, for example as a course requirement with minimal freedom to be creative, personally thoughtful, and honest. What I proposed to the group was the option to write a journal entry once a month for five months. I would suggest topics for them to reflect on and write about with the understanding that they were free to modify the topic or write about something entirely different. The entries could be hand written, typed, computer

printed, or even tape recorded if that was a better option and would save time for them. I received all of these variations.

I was confident that the stories created during the journal writing would be quite different from those told during the group sessions and in the one-on-one conversations. These entries are thought-provoking and insightful, written in the present but intermingled with glimpses of the past and of the future. As a participant in the group, I also kept a journal and reflected on the agreed upon topics. In addition, I also wrote about my impressions of the research process and summarized my impressions of each of our group sessions.

Several of the topic used for journal writing coincide with the topics of our group storytelling sessions. This was a decision the group made, once well into the study, because we didn't always have time to fit everyone's stories into the conversation. It also became apparent that our group conversations triggered "food for thought" and writing our reflections afterward was a helpful way to process the stories, opinions, and questions raised.

First Journal Reflection:

What is science for you? How did you come to know science?

Second Journal Reflection:

What difficulties or conflicts did you encounter, as a woman, while preparing to enter the field of science education?

Have these difficulties persisted, changed, or disappeared now that you are part of a school system/department?
Alternate possibilities if one felt she had not encountered any difficulties or conflicts as a woman:

Describe your experiences in preparing to become a teacher (preparation in content areas, credential program, or student teaching).

Describe your experiences in finding a teaching job, choices of teaching assignments, and your role within the science department.

Third Journal Reflection:

How has being a woman science teacher influenced: your personal life? Your students' lives? Your teaching colleagues?

Fourth Journal Reflection:

What changes would you like to see in science education and why?

What role do you feel women should play in making changes in science education? What role do you want to play?

Fifth Journal Reflection:

In what ways have you benefited from being involved in this study with women science teachers, personally or professionally?

What are your thoughts about the different storytelling situations in which you were involved in? (Include group conversations, One-on-One conversations, and individual journal reflections)

What do you see is the value of sharing stories about teaching and learning in science? What did you personally learn?

How would you evaluate this process in terms of it being a form of professional development? In what ways did you grow as a teacher?

The Dual Role of a Participant/Researcher

I entered into this study feeling confident that I could be both the researcher and a participant in this storytelling community

because of my twenty-two years of classroom experience and my desire to engage in the collaborative process of narrative inquiry. I still view myself as an ideal candidate for such a role but I recognize how conflicting the roles can be and that I must at times choose the role of researcher over the role of participant.

In reflecting on the dual role, I must first examine my responsibilities as the researcher in this community of storytellers. From the start, certain responsibilities were mine because I designed the study and invited these teachers to share stories about their lives. I was viewed as the leader, the organizer, the social director for the group because it was my idea to meet, as a group and individually, to tell stories. I was not free to simply be a participant because I needed to orchestrate and direct the various storytelling events so our time together would be productive and enjoyable. The length of time we talked, when we would eat, setting up the next meeting time, providing journal topics were decision that I made. I suppose I could have delegated the responsibility, but somehow it seemed like part of my role as the researcher. Perhaps I was reluctant or unsure about how productive the groups sessions would be if I didn't keep us on task and focused. I have a lot to learn about the nature of collaborative research with teachers and how to give up power in order to empower others.

In addition to being the planner and organizer of each "get-together," I also felt I was responsible for getting our conversations started. I did not feel that I had to tell the first

story or choose the topic for discussion, but I did feel it was my responsibility to bring the group together around the tape recorder and get the storytelling session started.

As much as I wanted to be just a participant in our storytelling conversations, I never had the freedom to do so. I wanted this group of women to feel that they were part of a community in which personal experiences were valued and their insights and opinions were important to other members. I constantly paid attention to issues of care, equality, and connectedness. One of the major conflicts I experienced during our group conversations centered on the issue of equality. What should I do if one member of the group tended to dominate the conversation? Was it my responsibility to get everyone involved and sharing stories? For the most part, I did not directly interfere or purposefully influence the nature of the group conversations. If I noticed a particular woman had been silent for an extended period of time, I directed a question to her. I still struggle with issues of equality within a group setting, unsure if it is realistic to expect that all women will interact and respond equally in terms of sharing stories, asking questions, and finding voice.

This study was not designed to be an intervention form of research project, even though it would have been exciting to have introduced this group of women to feminist literature and feminist's critiques of science, science education. I was interested in how this particular group women thought about their lives from their standpoint, not mine. If feminist issues came up as part of their

life stories then we talked about it and I offered my interpretation and insights. If not, I withheld my views and tried not to change their ways of thinking or force my beliefs and values upon them.

My greatest sense of conflict as a researcher and a participant came when I was involved in the one-on-one conversations. I clearly had a research agenda in mind since I proposed that we meet and talk about several of the questions raised in Women's Ways of Knowing (Belenky, et al., 1986). It was an intentional and agenda-driven move on my part. The questions were not selected at random. I wanted to engage each of the women in a conversation that was personal in nature and value-laden. The questions were selected to stretch their thinking and require serious reflections about images of people, places and experiences from the past. What became a conflict for me in these conversations was my intense desire to interact with each of the women and interject and intermingle my stories with theirs. I wanted to participate in their stories, not merely pose questions as an interviewer. It was their stories and their voices that need to be heard, not mine. I should not to become the dominant voice. I learned to be an attentive and careful listener. As I reflect back on these conversations, two questions still come to mind: "Whose story was being told in these conversations? Did I really give these women an opportunity to use their own voices and tell their own stories?"

As a participant/researcher, I often felt that I was speaking with two voices. At times I could hear myself using my researcher voice and at other times speaking as a participating high school

science teacher. Perhaps what is most critical is understanding and accepting the dual nature of the role of a participant-researcher. At times, it was essential that I carry out my role as researcher and organizer of the community of storytellers. At other times, I could relax and be the science teacher I've always been. Playing this dual role for the first time was a challenge primarily because I had only suggested guidelines to follow. No one could tell me exactly how to create a collaborative relationship with the women in the group. I had to use my ways of knowing as a woman and a science teacher to build a community of storytellers that would take seriously the issues of care, equality, and common purpose and empowerment.

Empowering relationships develop over time and it takes time for participants to recognize the value that the relationship holds. Empowering relationships involve equality between participants, a caring and mutual purpose and intention and the feeling of connectedness. (Hogan, as cited by Connelly & Clandinin, 1990, p. 4)

Grounding Research in Women's Everyday Lives

Starting from the "standpoint of women" in this organization of social activity enables us to recover the processes through which social life has taken the forms we see around us. If we start from the dailiness of women's lives, we will come to some understandings of both women's and men's lives different from the accounts favored in conventional social theory. (Smith & Aptheker, as cited in Harding, 1991, p. 128-129)

I never appreciated the significance of the word "standpoint" until I began defending the inclusiveness of our storytelling community and justifying why it was essential that this work start

from a more "objective location, "the location of women's lives (Harding, 1991). My first introduction to the word "standpoint" came when I read Sandra Harding's book Whose Science. Whose Knowledge? Thinking from Women's Lives. In her writing, Harding uses the word "standpoint" to provide a theoretical framework and rationale for conducting research about women from women's perspectives, from their experiences and their ways of speaking and knowing. She asserts that greater objectivity can be attained by grounding research in women's lives.

Starting thought from women's lives increases the objectivity of the results of research by bringing scientific observation and the perception of the need for explanation to bear on assumptions and practices that appear natural or unremarkable from the perspective of the lives of men in the dominant groups. Thinking from the perspective of women's lives makes strange what had appeared familiar, which is the beginning of any scientific inquiry (p. 150).

Not surprisingly, her standpoint has caused great controversy and heated debate within the scientific community. Sandra Harding was one of their own, a trained scientist, publicly challenging the value-neutral, male-defined traditions of the scientific method of inquiry. As a graduate student, I became immersed in the controversy over "standpoints" without fully understanding how the research would be conducted or which methodology would value women's experiences and their ways of knowing. I was struggling to understand and verbalize my own standpoint, my version of reality. I wasn't ready to think like a researcher, to look beyond my own life to the lives of other women.

Having spent seven months sharing stories with the women in the storytelling community and reflecting on the nature of our conversations, I now understand that through our storytelling we were defining our individual standpoints and creating a collective standpoint as women. I came to this realization by revisiting and revisioning Sandra Harding's interpretation of "standpoint theory." By rereading her book Whose Science? Whose Knowledge, with a "fresh eye" and from a new direction, I found a theoretical base to support my research into the reality of women's lives. I know now why research about women must start from the standpoint of women, the "valuable strangers;" the "outsiders" within in the dominant institution of society. I know now why this kind of research will create a less distorted, less biased view of women's lives and women's ways of knowing and understanding the daily lives they lead. As Dorothy Smith suggests:

No one expected the "natives" to write books about the anthropologists or sociologists (let alone be expected to sit on their tenure and promotion committees). Yet "studying up" and "studying oneself" as outsiders within will help decrease the partiality and distortions of researchers who have tended to restrict their work to "studying down." Objectivity is increased by thinking out of the gap between the lives of outsiders and the lives of insiders. (Harding, 1991, p. 132)

Women science teachers are in a sense "outsiders" twice over. As women and scientists they are often excluded from centers of power, from having the authority to control the decision-making process. Human activity, the dailiness of one's life, often is structured in opposing ways for women and men. The gender-stratification that exists within our society creates a

social order in which women and men are assigned different kinds of social activities, different kinds of work, different kinds of roles; consequently, they lead lives that have significantly different contours and patterns (Harding, 1991).

To discover these different contours and patterns, I listened to my voice and the voices of the women in the storytelling group, as we spoke about our life experiences, as we put into words descriptions of our visions of reality. By looking at the contours and patterns of our different life stories, we have been able to find meaning in the patterns and start connecting those meanings to one another and lay out for ourselves a different way of "seeing reality." We discovered our collective standpoint as women, a way of seeing that Bettina Aptheker identifies as "women's standpoint" (Harding, 1991).

In "The Question of Personal Reality," Maxine Greene (1979) specifically urges women teachers to recover their standpoints by "looking back and recapturing their stories in whatever 'web of relationship' they find themselves" (p.33). By interpreting the texts of their life stories and listening to others' stories, women teachers can acquire multiple perspectives about the realities of teaching and "choose themselves anew in the light of an expanded interest, and enriched sense of reality" (p. 33).

Meaning Lies in the Eye of the Reader

Knowledge and meaning lie in the eye of the reader who I trust has the spectacular capacity to go beyond the information given, to fill in gaps, to generate

interpretations, to extrapolate, and to make inferences in order to construe meanings. (Eisner, as cited by Kagan, 1993, p. 17.)

In presenting the narrative data from this study, I am following the advice of Elliot Eisner (1982) and experimenting with an "inductive mode" of representation. Traditionally, narratives have been written in a demonstration mode which is the more standard social scientific representation. In this mode, the researcher generally uses the narrative data to express her/his thoughts and interpretations without allowing the narratives to speak for themselves. In an inductive mode of representation, however, the narrative stories speak for themselves and "more clearly tell their own story" (Connelly & Clandinin, 1990, p. 11).

By using an inductive form of representation, I have been able to let our individual and collective stories speak to the reader directly with voices that are natural, transparent and honest. By presenting our stories as they originally were spoken or written, and without replacing the words with psychological interpretations, the reader can make her/his own interpretation and find meaning in the lived experiences of this unique group of women science teachers. This research study was undertaken not to justify a particular educational practice or theory but to extend our understanding of the subjective realities of women's lives. After all, it is the reader of the research, not only the author, who does the generalizing, the interpreting, the sense-making. It is up to the reader to decide what aspects of the data apply and are

meaningful within the context of her/his life and her/his standpoint (Peshkin, 1993).

Although this form of representation is risky and perhaps less acceptable to the traditional research community, it is more true to the original purpose of this study which is:

To listen to women science teachers as authorities about their own lived experiences and to represent their voices, their stories in the written text.

In his book, The Enlightened Eye: Qualitative Inquiry and the Enhancement of Education Practice, Elliot Eisner (1991) emphasizes the need for readers of research to build connections and formulate her/his own generalizations:

. . . if what we generate through inquiry into educational matters are ideas that contribute to the development or refinement of conceptual frameworks, perspectives, or metaphors through which the world is viewed. We learn . . . to work with and shift those perspectives, to examine situations from multiple perspectives . . . knowledge accumulation is an expansion of our kit of conceptual tools . . . Connections have to be built by readers, who must also make generalizations by analogy and extrapolation, not by watertight logic applied to a common language. Problems in the social science are more complex than putting the piece of a puzzle together to create a single, unified picture. Given the diversity of methods, concepts, and theories, it's more a matter of seeing what works, what appears right for particular settings, and creating different perspectives from which the situation can be construed (p. 110-111).

As the author of this research study, I ask the reader, to be an active participant in this study and use their "kit of conceptual tools" to make whatever connections are possible between your experiences and those of the storytellers, to become a reflective listener with an open, inquiring mind. As the reader of these narratives, try to connect the people, the events, the setting, the

plot to your own life, imagining how you might have reacted, what choices you might have made, how you might have felt. "To be a reader of a narrative is to be drawn into a story, to find a place or way of seeing through participating in the story" (Clandinin & Connelly, 1990, p. 25).

Teachers' stories help us unlock assumptions we have about teaching and learning, about roles and responsibilities, about hidden biases and misconceptions. They likewise create opportunities for us to explore our ways of knowing and to understand the choices we have made in the past, in the present, and perhaps in the future.

Dewey says we learn from reflecting on experience; such reflections give meaning and direction to our lives. As we encounter dilemmas we shape them into problems so they can be articulated. As we articulate them, make them public to significant others, we learn that others have experienced similar problems and as we probe them more deeply we see that our dilemmas are part of the great human dilemmas about life, death, love, freedom, and so on. (Shubert, 1992, p. 141.)

All of this is possible, if you make a genuine effort to let yourself be drawn into the stories and imagine what the experiences might have been for the different women in the storytelling community. Elbow (1986) refers to this process as the "believing game," where one insert oneself into another person's story as a way of coming to know and understand how she/he might be thinking or perceiving their situation or experience (Clandinin & Connelly, 1990, p. 4). By playing this "believing game," it becomes possible for the reader to see and interpret the possible meanings embedded

within the stories and come to understand how each woman envisions her reality.

To construct an interpretation of human life is to weave a complicated, carefully discriminating story. For a human life manifests growth; growth is not merely organic and direct progression but a transformation; and transformation is described by moves from standpoint to standpoint, through long and intimate struggling, that constitutes both human liberation and human story. (Novak, 1971, p. 87.)

The primary purpose of this study is to construct multiple stories that will help the readers of this work understand the standpoint from which women science teachers interpret the experiences of their lives. "A standpoint is not a theory," it is the subjective context in which a person interprets and understands her life experiences (Novak, 1971, p. 53). To understand why a woman acts, feels, thinks as she does, we must listen to her stories and try to discover who is she and what transformations have taken place over the course of her life to move her from standpoint to standpoint.'

The secondary purpose of this narrative inquiry is to involve the reading audience in the work so they can begin to conceptualize their personal standpoints. According to Novak, "human experience cannot be interpreted except from a standpoint. We cannot stand outside the arena of human life," nor do we have the ability to understand a life from all perspectives. We make interpretations about ourselves and others from a personally constructed standpoint, from our private universes. Listening and reading are not, according to Kathleen Casey (1993) passive, neutral activities

because narratives draw us into a dialogue with ourselves and others.

While we read or listen, we continually make judgments on what we see or hear; we make sense through a process of selection and rejection. And what we select and reject very much depends on who we are, who is speaking to us, what they say, how they say it, and where and when we are listening (p. 7).

I hope that in the process of reading this work and listening to the courageous voices of women, the reader will become reflective about her/his own stories about teaching and learning and begin to question your own assumptions about science, science teaching, and the women who are actively living their lives as science teachers.

CHAPTER V

WHO ARE WE? ARE WE ONE OR MANY?

It is time to introduce the reading audience to the six women who, for six months, came together to share stories about the realities of their lives, to listen to each other's different inner voices, and to articulate a collective standpoint as women science teachers.

To help the reading audience get to know these women storytellers, I am sharing two sets of their stories. The first set of individual stories were told during our first get-together as a storytelling community. As the organizer of the group, I took the initiative and suggested that we each share a story about "who we are:" our family background, educational experiences, how we came to be science teachers. I had imagined that we would each talk about ten minutes, plus have an additional few minutes devoted to questions and comments as we listened to each other's stories. Two and a half hours later, we finished our first sharing of stories. It was quite amazing and compelling. Once we each got started, there were so many rememberings to share and connect with. The second set of stories includes excerpts from the participants' journals that captured their reflections about: "What is science?"

and "How did I come to know it?" My stories are not included in this section because they appear in the earlier chapters of this study. Chapters 2 and 3 are expanded versions of the narratives I shared in the group storytelling sessions, the one-on-one conversations and my reflective journal writings.

I have done minimal editing of the women's stories except to remove references to specific people and places that might reveal the identities of the participants. Although these "Who am I" stories are quite lengthy, I wanted to leave them intact so you could get to know these women as we got to know each other on that first night of storytelling. More extensive editing would provide a neater, more readable version of the narrative but then the distinctive style and linguistic features of each narrator's voice would be obscured (Etter-Lewis, 1993).

My primary purpose for sharing these particular stories is to provide the reader with a sense of who "each woman is; a glimpse of her standpoint, her positionality. Knowing important aspects of each women's identity: race, social class, age and family background, help the reader to interpret the stories and better understand the "reality" being described. After each story, I will help the reader make connections back to my life experiences by highlighting the significant factors that appear to have influenced each of the women storytellers to choose, freely or otherwise, the life of a science teacher.

As individuals, we represent a diverse cross-section of women science teachers, differing in age, ethnicity, family background,

religious affiliation, and life styles. Each person possesses certain beliefs, values, wants, and needs acquired over the course of a life time from a cultural heritage. In turn, this cultural heritage is extremely influential in shaping each of us and how we each interpret the realities of our lives. In spite of our differences, we shared common threads of experience -- growing up female, being educated in the traditions of science and working in a profession that devalues feminine attributes.

Our memories are always reconstructions, purposeful forgettings, partial truths. Writing them is a reconstruction as well. Putting words, and interpretations, structure to that which is formless, a slide show of images and moments. There is a story but it lurks not always ready to present itself as a complete picture. There are only previews of the coming attractions. (Chambers, 1992, p. 17.)

Preview of Coming Attractions

RUTH

Ruth was the first woman to join the storytelling community. We met early in the fall of 1992 when I was making placements for the secondary science student teachers. I knew immediately that her life story would be complex and intriguing. Ruth is 53 years old; a wife, a mother of three sons, a grandmother, a teacher, a real estate agent, a gardener, a tennis player, an aspiring writer.

"I was never, ever going to teach"....

I was born in Nevada in a copper smelting town. My mother was from Montana. Her parents were Irish immigrants so she is 100% Irish. She points that out to all of us: we are not thoroughbreds like herself and she married an "other." Her father was a copper miner; my father's parents and great grandparents were also in the mining business in California. My grandfather was born in Angel's Camp, California. His father came from Wales and his mother was French - from French Coral, California.

My father was an accountant but he wasn't a CPA. He had gone to business college - not to a formal 4-year college -- and worked as an accountant for his company. He went on the road setting up their offices. My mother went to a Normal School and became a

primary school teacher. I know one of her assignments was in a one room school teaching all eight grades. She was married when she was 23, my father was five years older. They had been engaged since she was 18, however. They met and got engaged and then went to two different states and never saw each other.

I was born at the end of the Depression so my parents were running around trying to find jobs. My sister was born in Los Angeles, my brother in San Francisco. My father was raised in Nevada and thought it was a wonderful place. We left when I was 18 months old and came back to Los Angeles because job opportunities were better in a big town like that. So I spent the beginning years of my life in California and went to several different elementary schools. The first three years I must have gone to 10 schools. We lived for a while out in Buena Park, which was in the country and then went to a little public school, and then when I was in second grade we moved. I went to 5 or 6 schools that year. I don't even remember all the different ones. We even stayed in a hotel for several months because there was a terrible housing crunch after the war. Eventually we settled in a suburb of Los Angeles and then I went to a parochial school until 8th grade followed by four years in a parochial high school.

I graduated from Sacred Heart and I had a scholarship. I went to a Catholic College for three years. My sister graduated from the same college and was a Chemistry Major. And I majored in Chemistry as well. I've thought to myself: "You dummy you seem to always go with the flow and not make up your mind about what is important."

That is sort of true. I won a 4 year scholarship to college on the basis of a test we took. I remember them telling me I had a very high but I don't think they ever told me the score. But I really hadn't thought about what I was going to major in. I remember when I walked in to register; there were all these strange people. And then I saw the Chemistry Department. They were all waving at me because they knew me through my sister. So I wandered over there and the next thing I knew I was going to be majoring in Chemistry. I became a Chemistry major although I always had a bent towards English. I had one teacher there, a nun that I liked very much, who wanted me to switch my major and go into the English Department. I never did because I couldn't quite see what you did with English. Besides teaching was something I was never going to do -- I was never, ever going to teach. My father said major in something so that if you don't want to teach you don't have to. Because in our generation, you were teachers or nurses. My mother said nursing was too messy and I didn't really want to be a teacher. Chemistry was one thing in Los Angeles that you could get a job in with a BA. This college had a very good reputation and there was no problem in getting a job. There were a lot of different areas that you could get into and start working. So there was a possibility for doing that.

I liked Chemistry. I liked Biology too but it was not one of those that you could graduate with and not teach. I didn't major in Biology because it would take at least another year. I certainly was not going to spend anymore time in school also I thought

Chemistry was challenging. I was always looking for a challenge and it seemed like English, in my mind, was sort of old hat. Although, now I look at it differently. I think I would have majored in English.

I went three years to the Catholic College. During my freshman year, I met my husband through my sister. My sister and I ended up marrying brothers, which is not a good idea, believe me. It makes for shared in-laws and the circle gets very tight. I was married just before my senior year in college. We moved to Redwood and I transferred to the University of California for my senior year and graduated as a Chemistry major. It was quite a surprise to go from an all-girl's college to a large university. I thought I was very well prepared from my background at the Catholic College. What I missed was really the sense of caring that you have in a small college. As far as I can see, there is nothing colder than a University. I don't belong to the alumni and I don't have any strong sense of loyalty to them.

After graduation, I did go and take a few classes. Well I did have some children in there. I had three sons. Once you get married, I hate to say this -- What are you going to do? In Redwood, you are either going to teach or you are going to do nothing. So I started to take a few classes here and there towards my credential. Actually I was going to wait until my youngest son was in kindergarten and then go back and get my credential. But when I went out to talk to Dr. Taylor, he signed me up while I was talking to him about getting into the credential program. So when I said I wanted to do the credential program next year, he said: What do you mean? I just registered you. So there I was -- registered.

Actually I taught one year before I got my credential. I taught chemistry at a school for the severely emotionally impaired. One incident I remember from that year was when one student, who was classified as criminally insane, broke in and stole the fuming sulfuric acid. The bottle was found smashed in a field nearby. Luckily no one was hurt. I ended up getting my credential in 1969. There was absolutely no jobs that fall. Such a glut of teachers and you couldn't even get on the substitute list until November. I did three or four substitute jobs and then ended up taking a long-term subbing position at Maplewood Junior High and that was where I ended up. I taught there "temporarily" for 8 years because I never wanted to be a junior high teacher. With my wide background, I was able to teach English, Science and Math with my credential. I was the "plug" at Maplewood. You know how they schedule the left-over classes last. Every year I taught, I alternated. The first year I took over a math class for a teacher that was ill. Then the next year, I taught an English and math combination. The following year, I taught math and science and then eventually I taught all science.

In 1978, I took a personal leave for a semester to decide if there was something more in life than teaching. I went into real estate. That was not it. I did real estate for a semester and then I was all lined up to teach science at Maplewood again. Three weeks before I was to come back, I got a notice that I was being

transferred to Oakwood Junior High and would be teaching math. So I taught there from 1978-81. Each year I applied for inter-district transfer to the high school. They never even looked at it. Then in 1981, the 9th graders were moved into the high school and I moved in with them. From 1981-90, I taught at Redwood High School. In 1990 there was a big crisis in the science department and I was right in the middle of it. It was bad and very stressful so I left. I requested a transfer and went back to Maplewood Junior High and have been there ever since. (1990- present)

I much prefer the high school kids but I also prefer my sanity. I was a chemistry major and I really liked working with the high school kids teaching chemistry. You have to be a martyr to teach junior high. The only thing is -- I had done it before. I think that junior high school teachers ought to be able to retire at about 55 - - that would be reasonable. It certainly takes 5 years off your life. It is very difficult to be older and teach that age group.

Growing Up Catholic

Ruth and I share a unique set of common experiences because we were raised in the traditional Catholic households by feisty, dominant mothers. Growing up Catholic is more than attending Mass each Sunday; it is way of life that prescribes a full set of standards, expectations and roles for participating members. Although Ruth does not share many details about her religious upbringing, I suspect the traditions she acquired influenced her decision to pursue a career that would accommodate her need to be a responsible mother and wife. I've never gotten the feeling from Ruth that teaching chemistry was her passion, her ultimate goal in life. She talks about it more as a compromise women are forced to make in order to meet the needs of others, children and husband.

Women born in the 1940s to working class parents seem to have gotten the same message: choose a career that will accommodate marriage, children and work without breaking from tradition. For

Ruth and I the recommended choices were limited to teaching, nursing or secretarial work.

Despite our similar backgrounds, Ruth and I appear to have distinctly different reasons for pursuing careers in teaching. The explanation Ruth gives directly reflects the dual obligation women feel as mothers and professional workers: "Being a mother led me to teaching because it was the most compatible career with children." I suspect, teaching is still one of the most compatible careers for working mothers because their time at school coincides with their children's school day. This raises an important question. Should this be the critical deciding factor that compels women trained in science to enter the teaching profession?

When I chose to become a teacher, I wasn't concerned about finding a work schedule that was compatible with raising children. I was primarily concerned with finding a career where I could utilize my interests and talent to help other people's children come to know science as I had and develop a passion for the nature. Since I've never had children, I tend to overlook or underestimate how important that aspect of teaching is to a working mother. Would other professions be as appealing to women if they were designed around children's school schedules and holiday vacations?

SARAH

Sarah is one of the veteran teachers in the district with a keen sense of the political dynamics inherent in a school district. She is the Science Department Chairperson in her building and therefore must interact with the "elite" of the school hierarchy. Sarah is wise and cynical, straightforward and honest about her teaching life and the choices she has made. She is 47 years old;

single and seems to be in the "serenity - conservative" stage of her teaching career, which means she is confident about her role in the classroom and the strategies she has developed over the years.

"It was Either a Nurse or a Teacher"....

I was born in Los Angeles in 1945 but grew up in Pacific Palisades. I went to a Catholic school there just like Ruth and Lynne. I went to kindergarten where we did a lot of fun things and then I went immediately to a private school for first grade. There were sixty kids in the room and we sat two in a desk. I have a scar from being hit with a ruler because I was so bad. The nun would come by and whack you.

As I was going into fifth grade, we moved to northern California. I guess we couldn't afford the private school anymore because then I went to public schools. I didn't have to study really during that period of time up until I was a sophomore or junior. I just went on what I had learned those first four years. I was always ahead, especially in math, until Algebra. Then things finally started to catch up with me and I had to start studying. By then, I was a pretty lousy student.

I do remember my 7th grade science teacher. That was when I decided to become a teacher, somewhere between 7th and 9th grade. Well of course I didn't have too many options. I can distinctly remember, several times when I was 10 or 11, my father said: "When you are deciding on a job -- first you are going to get married and you always want a job that you can fall back on. So you can either be a nurse or a teacher." I didn't want to deal with bed pans so teaching seemed the best. I thought that school seemed like a nice relaxed environment and people were always happy. At least those were my thoughts back then.

I went to a three year high school near Stanford that was very experimental. It was a fun high school because we tried something new every year. In science, we were exposed to all of the different version of BSCS. I took as many of them as I could. In fact I got out of all kinds of other classes and volunteered to take science classes because it was so much fun. We were doing double periods and rotating the periods. It was really exciting in those days. The teachers were confused but the students knew what was happening. During the early '60s, people were protesting a lot. As students, we were doing a lot of protesting too, for a senior court or for turning on the lights earlier or anything that was "controversial." We thought that we were very avant-garde. I was also into sports at the time which were my savior from home. (We never had official teams for girls.) We wore pinny's, all got in the same car, and went to different places to play. Of course --the boys were having their big football and baseball teams.

Going to Stanford was not an option, my parents could not pay the tuition. I spent my first two years at a junior college. Of course there were no organized sports teams for girls there. I did well those two years, especially in science courses. It was during that first year, I decided on teaching PE as a career. I felt that

there was a place for women in sports and I could make a difference. I knew I would be comfortable in coaching and PE. When I decided on PE, teaching science faded into the background. I thought that all you could do with science was teach and I did not feel comfortable with the concept of "me" teaching science. I had no real clear guidance. My decisions were really based on my own stereotypes. I had always wanted to go to one of the University of California campuses and so in my junior year, 1965, I transferred to UC and graduated in 1967 with a degree in Physical Education and Biology. My teaching credential followed in 1968, and I started teaching that fall.

My parents did not help me during my graduate year at UC. I worked a lot. When you are working and paying for yourself, you have to get out of school fast with no messing around. I am the oldest and I think that had a lot to do with the way I think about things, and the choices I made. Always being the oldest and in charge definitely made me more assertive. It has affected how I relate to others throughout my teaching career.

In '68, I applied for two teaching jobs at two junior highs. I wanted to stay in Redwood so I went to the principal and said: "I've got this other job offer but I would rather teach here. I really need to know by Friday." So he said OK, I will call you tomorrow and he did. I got a PE job which was what I really wanted to teach. In those days, women PE teachers had to get dressed in skirts and nylons, and go to school, and then change into your PE clothes. You could not come onto campus or exit campus without being appropriately dressed.

I taught at Oakwood Junior High for 21 years. I taught PE full time until 1980/81. Then my principal said: "You have a minor in Biology so you will have to teach science classes." That was when things in the district were starting to change. I decided to cut back on coaching, so instead of coaching four sports a year, I only coached two. I was transferred to the Alternative Continuation High School and taught science and health in the morning, and physical education at the junior high in the afternoon. It was a good experience really. I realized that I really liked teaching science. I did not like teaching high school kids. I didn't like it because they are so covert. They still are covert. I like junior high students because they tell you what they are thinking, then it is over. They don't hold a grudge as long as high school students do. I am definitely a junior high teacher. I got tired of teaching the split schedule. I told my new principal that I wanted either full time science or full time PE, and she wouldn't give it to me. I disagreed with her on lots of other things. Unless you agree with her you are not good for her school. I decided to transfer to another school because of something personal that she had said about me in public. It was very fortuitous that a friend of mine was leaving her position. I knew she was leaving and so the day before school was out, I just went to her principal and said, "I am ready to request a transfer" and he said, "fine." So things really worked out.

As Teachers We Can Initiate Change

As we were sharing our "who am I" stories, we began to wonder if all women science teachers had some connection to Catholicism since four of the seven group members were raised in traditional Catholic homes. I don't know statistically how our numbers compare to the national average but I believe, after reading Noble's (1992) book, A World Without Women: The Christian Clerical Culture of Western Science, that it is more than coincidental. The Catholic Church and our western culture advocate a common set of expectations about the roles and responsibilities of women in our society. When Sarah's father advised her to go into teaching or nursing in case she needed to have a career to fall back on if something happens to her husband, I thought about the traditional Catholic view of a woman's role as mother and wife, not career professional.

Sarah and I had strikingly different educational experiences in junior high and high school. She had the benefit of a strong junior high science program which prepared her for the experimental alphabet curricula funded by NSF in the 1960s. Sarah came to know and love science because of her rich and diverse high school science experiences. In contrast, I did not have a science course until high school and then it was the traditional text-driven version of school science implemented in the 1920s. Unlike Sarah, I did not acquire my love of science from compelling and intriguing school science courses. My passion for science evolved as a result of the personal, practical experiences I had with nature and the outdoors.

Since Sarah and I were single and childless when we decided to enter the teaching profession, the school calendar and convenient work day were not as important to us as they were to Ruth. Our decision was influenced more by our desire to make a difference and initiate change within our subject areas. Sarah's decision to major in PE and minor in biology is closely linked to her belief that as a PE teacher she could make a difference in women's sports ; coaching and teaching physical education would give her an opportunity to initiate change. Similarly, I thought I could make a difference in science education if I became a teacher and brought my ways of knowing doing science into the classroom.

RACHEL

Rachel brought a unique perspective to the storytelling group because she is both a teacher and a teacher educator. She tended to be our theoretical, more idealistic member. Her views provided a balance between the old, experienced ways of knowing (Ruth, Sarah & Lynne) and the new ideals of the younger teachers (Jasmine & Clare). Rachel is 34 years old; married with no children. Her husband is a math teacher as well as a basketball & baseball coach.

"I was sure I wanted to get a Ph.D. in Oceanography and be like Jacques Cousteau"....

I was born in Almagorte, Texas. My dad was a veterinarian for the Air Force and worked with the animals in the space exploration program (such as chimpanzees and the bears). My mom was a dedicated mother and stayed at home with the kids until my younger sister was in high school. I have an older sister (2 yrs. older) and a younger sister (3 yrs. younger) who I consider to be two of my best friends.

Our family moved to Lompoc when I was three months old. My dad built an animal hospital and began his first veterinary practice. We then moved to Denver for only a year when I was five years old, and then lived in San Diego for the remainder of my years at home.

However, when I was thirteen, our family moved to England because my parents, especially my mom, wanted us to have the experience of living in another country. There, we lived in a five hundred year old farmhouse with stables in the back. The farmhouse was located in the countryside , outside the town of Weymouth.

After school was over, we traveled throughout Europe in a thirteen year old Bedford van which we named "Puffin" - - partly after a species of bird we tried to see in Scotland, but were unable to because of the weather, and partly because this is what the van did "puffed up the mountain roads, and barreled down the hills" (a phrase from the chorus of a family song we made up along the way - - our dad made up a verse about our exploits for just about every country we visited). Our family trip throughout Europe influenced my love for both the outdoors and traveling.

When we came back to San Diego, I finished the 9th grade. Then when I went into high school I ended up taking as many science classes as I could. This was in part because of a friend I was dating at the time, who invited me to visit some of his courses in chemistry and computers science at UC San Diego. I clearly saw how important the courses were that I was taking in high school. I ended up taking biology, chemistry, advanced chemistry, physics, algebra, geometry, trigonometry along with what was required for English and social sciences. I was also on the women's softball and swim teams.

When it came time to apply for college, I decided to apply to Berkeley because this was the college my friends were going to go to. My dad said fine, that would be great. So, I had applied and never gave it another thought. Later on, my older sister was the one who mentioned it might be a good idea if I applied to another college in case I didn't get into Berkeley. So I pulled out all the pamphlets I had on universities. At the time, I was sure I wanted to be a marine biologist, and so I found the two universities with "oceanography" as a major - - Long Beach and Humboldt. I quickly decided Long Beach was too close to home (I guess I was looking for an adventure) so I picked Humboldt.

In the end, I was accepted to both universities, so my older sister and I went on a trip to find out which one I wanted to go to. We first visited Berkeley where a professor frankly told us that at Berkeley they cared more about their graduate students than their undergraduates. At Humboldt, I got a very different message. There, they said their main concern was teaching undergraduates, not doing research. So I decided to go to Humboldt.

Actually, it was after I had been there for almost a year that I found out that oceanography was very different from marine biology. Oceanography is a study of the physics and chemistry of the ocean, where marine biology is a study of the living organisms in the ocean. I began to wonder if I was at the right school. In addition, I went to Scripps Institute of Oceanography, when I was home in San Diego during vacation (since this was where I had envisioned myself going to graduate school to get my Ph. D. in marine biology). I said to the receptionist at the institute, " I was just wondering if you have ever accepted anybody into your program from Humboldt?" Her response made me question where I was going to school even further, "Hmmm -- yes, we did about nine years ago, but it was a fluke!" She recommended I attend a UC school --

but not UCSD. I ended up taking her advice and made a transfer to UC Santa Barbara with the intent majoring in Aquatic Biology the winter quarter of my sophomore year.

The summer after my sophomore year, when I was nineteen years old, I met the person that is now my husband. We were camp counselors together and we were great friends. At the time, he was planning a trip to Europe and Israel. One day, when we were walking along the beach talking about his trip, he said, "You know, you are more than welcome to come along if you'd like." And I jokingly replied, "Right, what if I said yes?" He said, "Actually that would be fun."

To make a long story short, after discussing this over with my parents on a family vacation at the end of the summer, listening to what they had to say, as well as what my sisters had to say -- I decided to go ahead and go. My mom's reaction was very supportive (she was always a traveler at heart) and my dad express his support and trust in my decision while at the same time letting me know that if at any time I wanted to end the trip "early" and come home -- I would be welcomed how with open arms with out any judgment that I had not completed the journey. My parent's trust and support made a huge impact on me at that time.

For four and a half months we hitchhiked throughout Europe (we told our parents we were on trains) and then we spent four and a half months living, working, and studying Hebrew on a Kibbutz in Israel. This trip influenced me a great deal in deciding what I wanted to do for a career. That really affected my whole idea of what I wanted to do for my career. Up to that time I had been sure that I wanted to get a Ph.D. in Oceanography and be like Jacques Cousteau -- even after my dad had sat me down to explain that: First, you had to be a very special individual to be a researcher because you could work on something your entire life without the guarantee that it would fulfill your intended purpose, and second, being a researcher in this field would require me to be away from my family doing research on a boat. He said it would be a very independent, individual experience.

While traveling, I quickly learned that in order to get directions and relate to people, I couldn't be shy. In fact, I was surprised to find myself being more open and friendly with people than I had ever been before. By the end of our trip, I came back a more confident person, with a different idea of what I wanted to do in life. I realized that I really enjoyed being with people. This made me reconsider my previous thoughts about being a researcher. At that time, I didn't know I wanted to teach. I just knew I wanted to work with people.

So I came back to UCSB and pursued a previous interest I had developed at Humboldt, "alternative technology," and enrolled in some environmental studies courses while continuing to take science courses. I also found I could become involved with teaching at a local middle school and get internship credit. I ended up observing and teaching in a science class for one quarter and observed and taught in an environmental studies for the entire year. This was when I got my first taste of environmental education and found that

I thoroughly enjoyed it! I decided to change my major to Environmental Biology and enjoyed taking courses in botany and zoology. As a senior, I became a Discussion Leader for a course in the Los Padres National Forest in the environmental studies program. I planned and taught my section on the possibilities for environmental education in the National Forest. I had my students (10) plan and implement nature hikes for a group of sixty sixth graders on their two and a half day science trip. It was a huge success. I was convinced I wanted to pursue a career in teaching other about the environment. Therefore, I thought it would be a good idea if I got a teaching credential. At the time, I did not see myself ever teaching in a classroom, only outdoors.

However, during my student teaching year, I realized how much you could teach others about the environment while teaching science courses. I found, I actually did enjoy formal teaching in schools.

I taught for my first year in Houston in an Environmental Studies Center. I was a resource science teacher and taught the fourth grade program on herptiles, the fifth grade program on oceanography, and the seventh program on botany. This involved doing school presentations to all the elementary and junior high schools in the district and then the next day doing activities with them at the Science Center. The Science Center was like a Natural History Museum with an arboretum in the back.

Then I came back to Redwood and got a job at a private high school teaching math and science. I taught algebra, biology, ecology, advanced environmental issues, outdoor leadership and sewing. After four years of teaching there, I felt the desire to get a graduate degree so that I could expand my understanding in areas other than science -- areas such as international politics, inter-cultural communications and economics. This stemmed from my experiences in teaching about global environmental issues and finding that, although I could explain and discuss the scientific aspects of the issues, I always drew a blank when it came to explaining the cultural, political, or economic reasons behind why people did things that, from a scientific point of view, did not make sense.

I decided to get a Master's in Instruction and the Use of Technology in Education while simultaneously taking courses in other departments. I took courses in international politics and inter-cultural communication. I sat in on history courses about China and Africa, religious studies courses on the Vietnam War, and various religions of the worlds, and an anthropology course. At this time, I was very interest in Global Education.

During my first year, I was asked by the Director of the Teacher Education Program if I would be interested in supervising secondary science student teachers. My immediate response was to question why they were asking me since I had only taught for four years at the secondary level. How could I help student teachers? The Director wanted me to work with the person who had been supervising the science student teachers for the last four years and then see if I liked it. If I did, then the Director said he would want me to work with the supervisor for a year and then take over

the supervisor and teaching the secondary science methods course myself. I told him I would think about it, go out supervising with the supervisor to see what he did, and then possibly do it with him the next year. However, I couldn't promise anything beyond that -- I couldn't promise I would then take over the teaching and supervisions the next year.

In the end, I have supervised for three years and taught the science methods course for the last four years. In the mean time, I finished my Master's and am now working on my Ph.D. in Education.

At the end of the summer of 1992, I received a phone call from a woman who was one of my Master Teachers when I was getting my teaching credential. I taught one of her marine biology courses. She asked if I would be interested, or knew of anyone who might be interested, in teaching her biology classes and AP biology class while she was away for the first semester. As we talked, I realized this would be a great experience for me to get back into the classroom and implement and experience first hand many of the teaching strategies I had been teaching student teachers but had not had the opportunity try myself in a secondary classroom.

I was interviewed and offered the position to teach her four classes from 8:00 am - 12:00 pm -- three first year biology's and one AP biology. It has been very good for me to get back in touch with what teaching in high school is all about. Also, to get in touch with what is going on in public schools versus private schools. I have learned a great deal, especially about public school administration. I feel very grateful for the opportunity. The things that I have to say now are coming from real experiences that I am having. My teaching is different than it was before I went to the graduate program. Now I am teaching in ways that I have told students to teach but had not really had the chance to try myself. So it has been a wonderful, wonderful experience.

Freedom to Explore and Discover

Of the personal experiences shared by the women storytellers, Rachel's family life and upbringing seem the most foreign to me, quite opposite in several ways. Rachel's mother and father seem so adventuresome and free-spirited, eager to travel and experience new cultures and ways of thinking. When Rachel shared the details of their year-long family trip to Europe, we were absolutely amazed. It seemed like such an extraordinary undertaking; a fantasy that would only happen in the movies. I can't imagine my parents moving

to a foreign country for a year so my sister and I could have the benefit of living in a another country. This kind of family adventure is not part of the cultural norms of the rural, midwest community where I grew up. Although we did some traveling as a family within the U.S. when I was a child, my parents have never been to continental Europe nor do they wish to become world travelers now that they are retired.

Rachel's love of nature, the outdoors, and animal life are closely linked to the experiences she had growing up in a family that cultivated self-discovery and exploration of the unknown. Although my family was supportive, we did not experience nature and science together to the extend that Rachel and her family did. My parents gave me the freedom to explore and discover nature on my own and on rare occasions did they plan outdoor adventures for me that would expand my knowledge or increase my awareness.

Why Rachel and I chose careers in science education rather than in research science are similar. We both discovered that a career in traditional research would not fit our wants and needs as women and scientists. Rachel wanted a profession that would allow her to stay near family, work directly with people and not be forced to spend long hours in isolation. I wanted a profession that would allow me to spend time with family and friends and remain a scientifically literate hybrid in my personal professional life and stay connected to nature.

MARIE

Marie doesn't fit the traditional image of science teacher but her philosophy of science education and her goals for students do.. Although she grew up on the beaches as a "surfer-girl," her experiences with nature and the outdoors were quite similar to my own. As a teacher, Marie has experienced the best working conditions as a science teacher followed by perhaps the worst. Like all of us, she is struggling to get the "others" to take her seriously. Marie is 31 years old; married with no children. Her husband is a marine biologist.

"It still didn't dawn on me that maybe I should go into teaching"....

My story parallels Rachel's a lot, which is kind of weird. I was born and raised in San Diego, California and went to all public schools. My education was pretty typical of the public school system, some good teachers and some bad. Having an older brother and sister gave my mom the opportunity to scope out the best teachers for me. My mother was very involved in my education, from choosing my teachers to becoming PTA president.

Looking back on high school, I realize I made some poor decisions. If I could do it over again, I would take more classes to prepare myself for college. My high school counselor wanted me to enjoy high school more than he wanted me to get a good education. I can remember him telling me, "you only need two years of math, to be an oceanographer you don't need to take anymore." He also instructed me not to take chemistry or physics. I never understood his rationale.

Most of my childhood memories are of the beach. I grew up surfing, swimming and shell collecting. All through high school, I worked at a YMCA camp called Camp SURF. For eight summers I lived on the beach, which directed my college goals toward becoming an oceanographer. I never thought about teaching, although my favorite part of summer camp was taking kids on beach walks and teaching them about the tide pool animals. I did a lot of studying on my own in high school because I wanted to share with the kids everything I knew.

While I was in high school my parents went through a divorce. My dad left my mom after twenty-two years and married his secretary. High school was still a very positive experience for me. I was on the swim and track team, and involved in student leadership. I enjoyed high school, although I was not a good student, athletics were my primary focus. My older brother and sister both attempted to go to college, but weren't very successful. My sister went to a private college, which took a large chunk of money. My mom just wanted us to be happy and didn't think of her finances much. My brother went to community college for awhile. They both dropped out and took miscellaneous part time jobs. I was never encouraged to go to college. Most of my friends went and so did I. I didn't want to go to community college, because that seemed like an extension of

high school. I took the SAT and I'm sure I did terrible, I never paid much attention to my score. I really didn't know what the test was for. My friends said I had to take it to go to college, so I did. I went to San Diego State University. I did all my general education classes and realized that I did not want to be an oceanographer. I wanted to be a marine biologist. I took many classes that were not pre-requisites for a marine biology major. Which meant more school. I really didn't have much guidance on all the options that were available to me. I had to work all through college. I started a long list of jobs by being a waitress at Bob's Big Boy restaurant.

After my general education was complete, I realized that SDSU did not offer a marine biology program. So I looked at a college catalog and found programs at Humbolt, UC Santa Barbara, and Cal State Long Beach. I ended up going to Long Beach because they had more "marine science" classes in their program than the other campuses. I didn't know anything about the school, or the city. I had a friend considering the campus for psychology. We both decided we should go. I got another job waitressing, then moved up to a print shop. Long Beach turned out to be an excellent choice. The upper division classes were small, 8 to 12 students, and the marine biology program had wonderful courses.

I was at CSULB from 1982-88. It actually took me two and a half years once I got to Long Beach to graduate with my BS in Marine Biology. I spent the first year retaking general education classes like chemistry and physics. While I was working on my bachelors, I spent five more summers on Catalina Island at summer camp. After growing up on the beaches of San Diego, and working at camp, I really thought I would end up with a college degree in recreation. Although I enjoyed science, I felt I didn't have enough math in school, or the academic background to handle it. I continued to take recreation courses along with the science, and honestly felt that recreation was my safety net for when I failed out of science. I didn't consider myself a science person.

Eventually I did graduate, but still never thought about teaching. Even after I graduated I worked that summer on Catalina Island as an instructor. We had ideal marine biology and oceanography classes at the camp. When we studied currents, you said "lets get in the boat, and go cruise around on the ocean." When it was marine biology, it was "grab your scuba gear." You couldn't find a more perfect teaching environment.

My last couple of years of college I tutored for the Huntington Beach District and worked at Jordan High School in North Long Beach. Jordan was a predominantly black high school, that many people might find a little unsafe. There were guns and gang problems on campus. The security routinely carried guns within the protective fences. I thought, well, I've been out of high school for awhile, I guess this is just the way high schools are these days. The Huntington District was a bit different, less guns and more drugs. I substituted the last year I was in school and loved it. It was a great opportunity, I got to work at all seven high schools, watch how they operated and work on my discipline skills at the same time. After all this, it

still didn't dawn on me that maybe I should go into teaching. I applied to the credential program so I could keep substituting. Substitute teaching was good money, and some of my friends were sorting samples at the museum for minimum wage. During the summer, while I was working on the island, I got a phone call from the ABC School District. There was a new internship program, that hired teachers straight out of college and allowed them to go to school at night to finish their credential. I went to the interview and got a job at Cerritos High School. I happened to step into a wonderful school. The school had very strong academics, and I had a terrific master "teacher". My first year I taught three biology and two life science classes. It was early August when I got hired. The seven biology teachers at the school and I got together and decided before school started that we would make our biology curriculum the 'best of the best.' We all shared our ideas and our labs and picked out which labs were best for each unit. We made our own lab book for the course. We all gave the same exams, and used the same worksheets. It was a wonderful learning experience for me being able to step into a situation like that. That is how I think ultimately we should set up our teaching - and our curriculum.

The internship was a two year program. I worked full time teaching five classes, with full benefits and full salary. I took all the education courses at night. I honestly do not feel I learned much from the college courses. I remember taking my methods class during my second year of teaching. One lesson in the class consisted of what to do on the first day of school, which of course I already experienced, twice!

While at Cerritos High, there was always the perpetual dilemma of being laid off, because I was a new teacher with little seniority. When I started my third year the possibility of a lay off became very real. With my little seniority, my job became very appealing to other teachers in the district. There were a few teachers who wanted to transfer. My principal suggested I take an assignment of four biology classes and yearbook, so the school would be able to keep me. I knew very little about creating a yearbook, but I accepted the challenge in order to keep my job. I found yearbook took an incredible amount of work and added stress to my life, but I really enjoyed it. At the end of the school year I made plans to leave the LA area. My future husband had just finished his Master's in Marine Biology at Cal State Long Beach. He was accepted into Ph.D. programs at USC and UC. It was a hard decision for him because if he had stayed at USC I could have continued to work at Cerritos. UC had the better program, so we lived apart for a year and started planning a wedding. After the wedding I gave up my wonderful job and moved to Redwood with my husband.

I think I went to all the schools in several counties inquiring about a job. It was interesting to hear all the principals points of view. I applied every where, and when the time came for me to move, there was no jobs available. It was getting later and later, so I applied to be a substitute teacher. Then the week before school started, Pinewood High School hired me. I was thrilled even if it was only a

3/5 position or possible 4/5 by the end of the year; two continuation high school classes and one or two physical science classes.

After getting the job I went to withdraw my substitute application and was told that they were interviewing for a full time job at Redwood High, 5 periods of chemistry. I went in for the interview. I was told if I did not hear anything by the end of the day, I did not get the job. The day before school started I went to Pinewood High and introduced myself as the new science teacher. We had a three hour break before the science department meeting, so I decided to go home for a while. When I got home, I had a message from Redwood School District, they wanted to know where I was because they wanted to offer me a job. It was a hard decision because it was a full time position, but I took it. It was strange how it all worked out. Anyway, I took the craziest job of my like. I taught one period of chemistry at one high school, then traveled during my planning period to a different high school where I taught physical science, biology and chemistry. It was a miserable job. I wasn't even a new teacher, this was my fourth year. I couldn't believe anyone in their right mind would give someone a schedule like that. It didn't make sense because I had to prepare all my labs after school, then put them in boxes and take them over to the other high school in the morning. It was a nightmare. My only hope was that things were going to get better.

The following year, I went to school the Wednesday before classes started to get things ready for the opening of the school year. When I went to the principals office I found out my name was not on the schedule. The new woman principal said, "Oh, we had to transfer a science teacher, sorry." She didn't even call and tell me. I went to the personnel director and he said, "You have been transferred to one of the junior highs. You'll like it, my wife taught at the junior high. If you want a job that is where you will be." I did not want to teach junior high! I went to the principal at Redwood High School and convinced him that he needed me on his staff. I would help with yearbook and whatever else they needed. The Friday before school started, the personnel director finally said OK and I moved to Redwood High School. I was supposed to teach 5 periods of physical science, which I was not happy with because my degree is in marine biology, but I really had no right to complain. As it turned out, I switched assignment with one of the men in the department and ended up with four chemistry, and only one physical science class. The principal said we could not switch but we did it anyway. We just put signs on the doors and switched the kids.

I ended up using my conference period to do the yearbook with another teacher and coaching varsity track on a volunteer basis. I really did volunteer because I did not get paid. At the end of the school year the yearbook teacher and I approached the administration about working together the following year. The principal's response was, since I had little seniority I'd probably be transferred. I was not about to move, and did end up staying. I am still teaching, doing the yearbook and coaching track.

The Surfer Girl and the Beach Girl

What makes large bodies of water alluring and compelling, a source of adventure, discovery and freedom? For Marie and I the answer seems closely linked to the kinds of physical activities we enjoyed doing in and on the water. Marie describes herself as a "blond-haired surfer girl" who grew up on the beach and considered the ocean a giant outdoor laboratory. I likewise grew up on the beach along Lake Michigan and became an avid swimmer, water-skier and fisher-person and fresh-water explorer.

I think Marie's love of the ocean and its inhabitants were motivating factors that eventually led her to chose a career in science education. Unlike Sarah and Ruth, Marie's experiences with school science were uneventful and did not adequately prepare her for the challenges of academic science. Fortunately, her self-motivation and interest in teaching younger children about tide pools kept her interest in science alive. Throughout college, Marie continued to think of herself as a "recreation person" not a "science person" even though her major in college was Biology. Perhaps that explains why she was uncertain about taking on the role of a science teacher.

Even when Marie entered the Internship program she wasn't convinced about teaching. "She just enjoyed science." Like Rachel and I, Marie chose a career in teaching because she loved the everyday, natural world of outdoor science. Being a teacher would give her a chance to help kids learn to love science as she did, not

textbook science, but the hands-on, inquiry based science she had experienced growing up on the beaches in California.

CLARE

Clare was the youngest member of our storytelling group and at times was a bit reluctant , at first, to talk about her personal life with women she did not know well. It was a struggle for her to get her "voice" heard during our group session. The journal writing and the one-on-one conversations seemed to give Clare a safer place to speak from the heart. Clare is 28 years old; married without children. Her husband is finishing his Ph.D. in Chemical Engineering.

"It was not the "white collar" type job my dad had in mind for me"....

Well mine is going to be shorter than everyone else's because I'm the youngest. I was born in Chicago in 1965. I started out going to the kindergarten school two or three doors down from our house. Then my parents sent me to an Experimental School for 1st through 3rd grades. Part of the experiment was the smaller classes and trying to teach three different languages in the primary grades. I remember seeing all these little houses of different colors and you flipped the house -- and it would be in Spanish or English. Then my dad, who was working as a civil engineer for the State of Illinois, had his office moved to the suburbs of Chicago. At that point there was no train running out to the suburbs where the offices were located. Since my dad wanted to take the train to avoid traffic, we ended up moving out to the suburbs.

You know I always wondered how parents found out about where are the good schools. My parents consciously looked for a place to live that had really good public school. And they found that the best public schools were on the North Shore of Chicago. We ended up moving to an upper middle class suburb of about 30,000 people. I went to grade school, junior high and high school there. The schools were typically very college prep. It was such a rarity not to go onto college from this area. Because this was a middle to upper middle class area, it was a given that your kids were going on to college. Even to the point of counselors having fights about how many of their kids got into Harvard and stuff like that.

My mother is a nurse and my father is an engineer. They both are from the Philippines and immigrated to the United States after World War II. You say nurse and people say - Filipino. At that point in time there was also a lot of Civil Engineers coming in from the Philippines. My parents were very much into schooling. Go to school- Go to college- Get a good job. It was very much the expected. So my dad said well these are your choices: Engineering, Science, Pre-med, that is it. English is good but that is not

something you go to college and major in. Music is good - we had the piano lessons, the violin lessons, cello lessons. Whenever I went to piano recitals, I would look around at all the other kids and think: There are a lot of Asian kids here. I know that it's a very stereotypic thing to say.

At least where I grew up that was what it seemed like. So anyway, my parents said music is fine but you don't major in music. History was fine but you don't major in history in college because you can't get a job after that. So my parents said: "You can't just do Biology, it has to be pre-med. If you get a biology degree that is not going to lead to a job." So then I said: "How about a Hybrid? How about Bio-Engineering?" Well my parents said: Are you sure you don't play with genetics? You know my parents were Catholic! "No - no that isn't what this is. It is not slicing up genes and making some weird kind of animal. It is just finding ways to look at the body." Then they said: "Are you sure you can get a job?" I said: "I think so." Then My dad said: "Is it an engineering degree?" I said, "well no, it is actually a biology degree." "Well, can you get a job in it?" "Yes," I said. I could probably get a pretty good job. Periodically, when I was going through college my dad would ask: "What kind of job can you get with this degree?" And I would always say - "Don't worry, don't worry."

I went to the University of Illinois, one of the "Big Ten" schools. Instead of taking the usual Biology classes, I took the honors classes which were limited to 30 students and included really intense labs. Living in the labs for days on end watching your "frogs" hatch. It wasn't really that bad it was only 48-72 hours. I did that and eventually graduated.

I did mess up one year. I flunked a class and got put on probation. That year was an interesting year because I decided to move in with a bunch of seniors I'd met through the Biology program. For the Biomedical Engineering program, I had to take a lot of electrical engineering and physics classes, to go along with my biology, chemistry and physics. The only problem was I was living with a bunch of Seniors and they had already taken all of their M-Cats and were pretty much were ready to go on to med school. They had to just do their rounds and were taking it pretty easy. And so did I. That was my problem. You couldn't really do that in electrical engineering. So I bombed my Circuit Class, was on probation and almost bombed it again. I did finally get through it.

I ended up graduating one semester later than I ideally should have. So then I was floating around and needed to find a job. I moved back home and started applying around. Did the old job search but not much was available. I was applying to medical equipment type firms because I was really thinking about getting into "medical imaging."

Meanwhile, during my senior year I started going out with the person that is now my husband. He graduated one semester before I finished. And he came out to UC to start a Ph.D. program in Electrical Engineering. I was back in Illinois - living with my parents and trying to find a job. My parents were asking: 'What kind of job are you getting?' I finally took a temporary job and

for a year and a half was a temporary clerk in a factory. It was an interesting time and I learned a lot about what happens in factory, how things actually get manufactured and a lot of terms about manufacturing. It helped me to become organized because this job required that I be organized. I also found out that I really hate working in an office.

I found that going out with these people -- for movies or after work -- there was no real intellectual stimulation other than did you see such and such show on TV, very much mass media type people. So I finally said enough of this. I better find something else to do, maybe I should go into teaching. I did some tutoring when I was at U of I. So I decided to go and check that out with my parents. My dad is saying "teaching?" Let me put it this way he tried to discourage me from going into teaching for a while. He said: "You don't get paid much; you have to deal with kids all day."

It was not the "white collar type job" that he had in mind. My parents figured that their kids would go off to college and would get a good white collar job. A desk job that you didn't have to work too much with your hands. They were kind of upset with the idea of teaching. I said: "It sounds pretty good to me and I think I can handle it." So I ended up going to Cal State for a year.

My first year out of Cal State, I applied all around the Redwood area. I ended up at Palm Tree High School in Ventura. Every time I have ever been hired for a teaching job it has been one week before school starts and it is always some weird schedule like: IPS physical science, life science, physical science I and Physical science II and IPS at the end of the day.

Half-way through that year, we got married so I was in Redwood. I commuted in a car pool which meant I couldn't stay after school very long. But it was very nice because the person who left that job was the assistant principal. I could go to him and ask how he taught the different concepts. It was survivable and I only had to stay up until midnight every night. The problem was it was a temporary position. His position in the school was temporary and I got booted out at the end of the year. So I did the old round-robin thing -- apply here and there and everywhere again. I heard rumblings that school is going to be starting in two weeks. So sure enough, I ended up being hired as a 4/5 person teaching 2 Chemistry, a biology and life science. And then of course one day they just ship in another chemistry class during my 2nd period and then I was full time.

This semester I'm teaching chemistry and physics but who knows what will happen next semester.

Uncertainty about a Career in Science

Unlike the other storytellers, Clare's parents were determined that she would one day become a woman of science. Perhaps not a research scientists, but definitely they expected that she would:

go to school, go to college, get a good job in either engineering, a branch of science or medicine. Clare followed their advice to the letter until the critical time came when she needed to find a job. Like me, Clare discovered that acquiring a position in a traditional fields of science, required a particular kind of background and way of knowing. Having a degree in Biomedical Engineering does not guarantee entry into that professional domain, even for a minority woman like Clare. I was disappointed, but not surprised, that Clare did not receive more support and guidance from professors while at the University of Illinois. Perhaps, like me, she was not viewed as one of the "cream of the crop," destined to become a hero in the world of research and technology. An average science student, even one of high potential, can get lost in the shuffle and not get the attention needed in order to enter the inner circle of science.

Clare/s decision to become a teacher was influenced, at least in part, by her uncertainty about being able to make it in her chosen field, biomedical engineering. I/m not convinced that she would have entered the teaching profession if she had been able to pursue a career in /medical imaging./ Clare chose to become a science teacher because she needed to find a job and wanted a career where she could utilize her scientific background and expertise. She was not fulfilling a life long dream or a visionary goal.

JASMINE

Jasmine was the only teacher who responded to my original letter in the fall of 1992. She wanted to join the storytelling group, even if she had to drive an hour to get there, because she had never had the opportunity to interact with other women science teachers. Jasmine brought to the group an "outsiders" perspective since she was teaching in a different county than the others. She has the most isolated situation, being the only female in a science department with 12 men. She loves to teach but hates to grade papers. Jasmine reminds me a lot of the women in the "Joy Luck Club."

"Remember that was the 1980s and there were no jobs!"....

All four of my grandparents came from China and they all ended up in San Francisco. Both of my parents were born in San Francisco and so were all of their children, myself and my brother and sisters. We all lived in Chinatown and where born in the "Chinese Hospital."

I spent five years in East Palo Alto and went to all 6 years of elementary school there. Then we moved to San Jose and I went to Jr. High and High School. I participated in every sport that ever was except swimming.

It was in the first grade that I decided I wanted to be a teacher. Then in junior high, I decided I wanted to be a PE teacher. So when it came time to go to college, it was either San Jose State or Long Beach State. We had just recently gotten a new teacher from Long Beach so I looked into that program and also into the program at San Jose. Since I lived in San Jose, I didn't really want to go stay there to go to college. I never had been south of Monterey - - until I went away to college.

My brother did not go to college. He has been working in the same company, in San Jose, for over 20 years. All of my family is in San Jose now. I was basically the first one in my family to go to college, complete it, and graduate with a degree in PE. So all my training was in Physical Education, from 1974 - 78. Then I went up to Sacramento State to do my credential work because their program gave you training in elementary as well as secondary. I didn't know what grade levels I wanted to teach so I went there for both.

I graduated from the credential program in 1980 and then substituted. I ran a recreation day-care center for the city of Davis for K-6 for a year and a half. Then I went to Illinois for a year to be with a friend who was completing an internship in nearby Urbana. I worked as a cook for 90 young men at the University of Illinois. I cooked lunch and dinner Monday - Friday and then on the weekends I traveled with the women's soccer team as the assistant coach. I played with them also. So I got to do a lot of traveling in the Midwest with the soccer team and - they paid for food, gas and lodging so it was a golden opportunity for me to see a lot. And I also knew I was only going to be there for a year.

Then I came back to California and lived in Antioch and I worked in a private elementary school teaching PE and supervising recess and whatever else. I only did that for 6 months because it was a private K-6th grade program and the director needed to be in a mental institution. So one day I went in and quit. In that same year, twelve other people had already quit or got fired or replaced. So I didn't feel badly.

After that, I moved to Grover City substituting and working with the girl's volleyball team at "Arroyo Grande." I finally made my way down to Valley View in December of '84 and I have been here for 8 years now. This is the longest I have stayed anywhere and now I am going to moving again at the end of the school year to the state of Washington.

When I moved to Valley View there were no jobs in PE. Remember that was the '80s and there were no jobs. So I said, "My God what am I going to teach." I decided to go the local community college to pick up a regular biology class and a human biology class so I could get an "add on" to my credential. As a PE major you take Anatomy & Physiology, Biology, kinesiology and all of those kinds of courses so all I needed was 6 more units of Biology. (In California, teachers can add on to their credential by taking courses or passing a competency test).

I had been subbing for a year and a half in Valley View, when they said, "we have a long term sub position for you." So I said, "Great." They said well it is in social studies and I said, "OK, no problem." Then right before school started, this other teacher quits and his assignment was 1/2 English and 1/2 Science. I said, "Well, I can do that." And I started out as a long term substitute in English and Science. Then by October they hired me as a temporary, added another English teacher, and I ended up with all these "put together" science classes.

I had two periods of "put-togethers". I said to myself: "What are you doing in a classroom?" Actually I got the job because I volunteered to coach the volleyball team. The Varsity and Jr. Varsity positions were both open and I said, "I'll take Jr. Varsity." But they called back two days later and said, "you have to take Varsity." I said, "but I can't do it," and they said, "you are going to do it." So I coached Varsity Volleyball for 5 years, JV softball for 2 years and varsity softball for 2 and then I quit coaching.

I have even had to teach Physical science. They get me board approval every year by sending in my name. The administration just states that I can do it. Now I have been given five periods of health classes to teach. Some are bilingual and some are regular. When I teach the bilingual class, I teach them just like I would teach my other classes, the same words come out of my mouth. Some of my bilingual students will respond in Spanish on their tests and that is fine. I just get someone else to grade them. One of my girls, who is in 101 which is first level Spanish, is getting a B in the class. She is doing all the work, turning it all in and getting the concepts across. With our classification of bilingual, they have to be Spanish speaking to get into the bilingual class.

Because we have Vietnamese, they are stuck in my regular class and they are failing. There are thirty-eight kids in there and I only have sixteen in my bilingual class.

Science, Sports and Coaching - A Natural Blend

Jasmine became a teacher to fulfill a dream, a goal that she set for herself in the seventh grade -- to be a physical education teacher and a soccer coach. In order to reach her goal, she entered into the world of academic science and became well versed in the human sciences. Not because she loved science and had a real passion for nature but because anatomy, physiology and Kinesiology are required courses for PE majors.

Jasmine never intended to be a high school science teacher. It was a matter of necessity and it was a way for her to get a coaching position. In my case, I wanted to be a science teacher and volunteered to coach women/s sports because I never had a chance to compete inter-scholastically as a student. Do science, sports and coaching naturally fit together? Are women science teachers more interested sports than teachers of other disciplines? Judging from the experiences of the women in the storytelling group, many women science teachers are involved in athletics in high school and willingly accepted coaching assignments as part of their teaching load.

The most striking difference between Jasmine and I and the other women in the group is her willingness to let go of science content. She clearly is less concerned about how much factual information her students acquire in her classes because she views teaching, in any subject area, as an opportunity to help kids

develop life skills rather than science skills. More than anyone else in the group, Jasmine is a student-centered teacher. She focus her lessons on what students need to survive and live better lives rather than worrying about their content knowledge in science.

"We Don't See Things As They Are.
We see Them As We Are"

(Anais Nin, Woman's Journal, 1985)

I believe everyone comes to "know science" through personal experiences. Regardless of the kind of experiences, hands-on experiments, nature hikes, television specials, or books, and the context in which they occur, at school, in the out of doors, at home, the memories we've stored greatly influence our perceptions of what science is and what it should be.

Women science teachers, like everyone else, have acquired a particular image of science from the life experiences they found memorable and noteworthy, positive as well as negative. The image a science teacher creates in her mind will greatly affect the goals she sets for herself and her students and the kinds of learning opportunities she provides to help students reach those goals.

The women storytellers did have strong opinions about "what science is" both as a body of knowledge and as a ways of thinking and solving problems. Their opinions represent the values and beliefs they hold, which in turn are translated into the educational philosophy that guides their teaching practice.

When I asked each of the women storytellers to reflect on the question: What is science and how did you come to know it?, I hoped to discover for myself and for the readers of this work the values and beliefs underlying each women' educational philosophy and how those values and beliefs relate to the personal experiences they each have had. How did they come to know science as they do?

While reading the following journal reflections, think about the questions raised by Michael Novak (1971).

To grasp consciously the story one is trying to live out at this stage of one's life, is to cast an illuminating light over one's whole past. How did one come to this story? What instincts, hunches, and inhibitions were operating before the pattern became conscious? What chance events interrupted, generated, or reinforced the basic story? What subplot and loose ends have there been? (p. 64).

Ruth: *"Science is Challenging and Intellectually Stimulating"....*

Science for me is an area of knowledge where discoveries are constantly being made, where progress for the betterment of mankind is possible, where all things and the laws governing all things are studied. Science has such infinite variety of subject matter, such challenging problems to deal with, and is so intellectually stimulating that I have found it to be the most interesting area of study.

My knowledge of science began in high school where some very good teachers passed on their love of science. Through college, I found some areas more interesting and understandable than others. I have always enjoyed biology, earth science, and chemistry. Chemistry as a major developed for me so that, as my father advised, I could do something other than teach if I wanted to. I never really planned to be a teacher. Being a mother led me to teaching as the most compatible career with rearing children. I think if I had never had children, I probably would have worked in some other capacity in science.

Sarah: *"I think I live in fear that someone will come in and say: You are not really qualified"....*

When I was forced to teach science and health at the Alternative Continuation High School, I realized that I still knew a lot of science and I hadn't done anything in it for 14 years. I still was at least thinking and had kept up enough in my own

personal life to be up with the other teachers. My background was negligent because I had gotten out of every possible class that I hadn't wanted to take. So I was really narrow - - only life science and then primarily Botany and Biology because those were the areas I liked. After the involuntary transfer, they wanted me to come back to the junior high and I was basically forced to teach a junior high science class. I really enjoyed it. I don't think I taught the curriculum the first year because no one paid any attention to me. I just came in 6th period of the day, opened the book and had worksheet and fun activities and games that I thought would make their minds work better. I taught them the things that I thought were interesting. I just kind of started a second career in science. I realized that PE was a lost cause, although it is my first love.

So I guess it has been 13 years now, since science has been the main focus of my teaching. I think I have earned the respect of a few people in the district although I have kept to myself. Kept up with as much current stuff as possible. I think I live in fear that someone will come in and say: "You are not really qualified." So I'm sure that is why I work as hard as I do. Although I can feel that I am losing my edge. I can see that I don't want to put the work in. I think it has to do with two things. First, I don't have someone I work with who is pushing me; I can slide by if I want to. Second, this probably should be number one. I am getting older and I want to play. I want to play golf and go home and mess around. I can remember sitting in my very first staff meeting at the junior high thinking: I don't want to become one of those old people. I thought I would get married or something but I never found an aggressive man that could deal with an assertive woman like me. So I am still teaching.

So now I am old and I pretty much know what my bag of tricks is. It is not like anyone else's and it is probably not as good as it should be. But it is mine. I can get through the year without too much hassle and now I can see why people don't want to change. It is too much work.

I think I have pretty much covered how and why I got into science. One of the problems with this question is that "male dominance" is insidious. It has been and will continue to be for thousands of years, unless we stop raising our sons to be just like their fathers; which is what most women do. I know I have mentioned several times that my father saw only two possible choices for me, nursing and teaching. I don't think I would have gone into teaching if I had a chance to be exposed to different possibilities for women. Girls today are beginning to be exposed to a great variety of possibilities but many still see the same narrow options we saw in the early '60s such as nursing, teaching or mothering. The stereotypes of powerful, successful people in our society are the dominant males. You can't see a news cast or anything that doesn't have mostly males in it. I think the perfect example of what an intelligent, successful woman has to go through is Hillary Clinton. I don't know if I like everything she does but she is intelligent. I heard someone comment: Hillary is called bright but you don't

hear anyone call the male Cabinet Members bright. They are described as intelligent, decisive, and incisive. I would like to be described that way. Any assertive woman is a threat to the male position. Men feel threatened when a woman could possibly take their job. Overall our culture is still hurting women. It is so subversive and ingrained, even in the women. We want to please and succeed; please while succeeding. Men don't have to do that. They just get what they want and keep working at it. They have long term goals. I think women don't make long terms goals, they make short term goals. My goal was to teach for a few years. I had promised my grandfather I wouldn't get married until I was twenty-five. So when I got to be twenty five, I was done mentally.

It took me longer than many to reach the goals I set, after I was twenty-five. For me, short terms goals are so much easier to visualize and realize. Now I'm trying to set real long term goals, ones for the rest of my life, I assume. But always in the back of my mind is the worry that someone is going to get in my way, that some male will interfere with the goals I have set and know I can achieve.

Rachel: *"My favorite set of books was a series entitled, Tell Me Why". . . .*

Science has been something I have always had an interest in. As a child, I would often go back to my dad's animal hospital and standing on a foot stool, look over his shoulder as he operated on animals. I could never watch the first part, when he made the incision, but after that I would watch entire operations as he spayed a cat or did any one of a number of other procedures. He would often answer my questions as I pointed to different organs and ask what they were. I still remember one evening, when I asked one too many questions during an operation that I found out later was particularly difficult, my dad stopped what he was doing, calmly looked up at me and said, "Rachel, I think its time for you to go back into the house."

My favorite set of books was a series entitled, Tell Me Why. I would often randomly open the volumes to find out "Why people sneeze?" or "What are UFO's?" I was truly intrigued by the natural world.

My interest in the world of nature was piqued during a summer trip through Europe with my family when I was fourteen years old. On this trip we snorkeled many days through the warm, clear waters of the Mediterranean Sea. I was deeply awed by the undersea world, and to this day have a special interest in the marine world.

Growing up, I would have been considered a "tom-boy." I thoroughly enjoyed playing outside -- taking hikes with friends into the canyon at the back of our house, making forts, playing softball, baseball, hockey, and four-square with all the neighborhood kids.

Science to me has always been an adventure. It has included doing what you might call "experiments" such as finding grasshoppers and putting them in spider's webs to see what would happen; watching cats chase and catch a lizards by their tail and seeing what the

cats would do when they found that all they had was the lizard's tail; figuring out what plant made our clothes smell like the "canyon" every time we went hiking (turned out to be "sagebrush"); seeing what kinds of tide pool animals would eat the bread balls we would feed them -- watching the hermit and line-shore crabs pick at them ever so delicately, while the sea anemones would at first curl their tentacles around the bread balls and then let them go -- putting my fingers in anemones in California, only to find out that when I did the same to the ones in the Mediterranean Sea, I was stung by their sticky tentacles! Yes -- as I grew up, science was the world of exploration.

At the same time, it was a world where I learned about the wonders of nature. I loved going to science museums where I learned about light and sound (San Diego's science museum), and about sea life (Scripps Institute of Oceanography).

As I grew older and was able to take classes in science, I became intrigued with the problem-solving nature of scientific experiments in chemistry and physics. This was true in both high school and college.

Science has given me a way to understand the order of the universe. At the same time, it has provided me with an avenue filled with intrigue and wonder where I have been able to freely explore and discover new things. Both of these aspects of science have been equally important to me throughout my life.

Marie: *"Science comes from inside us"....*

Science is a process, a way of learning or discovering and solving problems. It's a way of applying curiosity to some type of methodology. It comes from inside of us, it's the innate desire to ask why.

I cannot pinpoint how I came to know science. I think it came from a love of the outdoors. I was probably always a curious and adventurous kid. Looking under every rock and crevice and asking what everything was in the world around me. It started very young in the Girl Scouts (2nd grade). In scouts, I was always encouraged to explore new territories. I felt very comfortable in open surroundings. I'd love to hike through the forest and deserts, swim in the oceans and rivers. I always loved animals and was fascinated by plants and insects. I think Girl Scouts probably reinforced the learning process of science. Instead of maybe just observing the stars and wildlife, I was encouraged to learn all the names of the constellations, plants and animals. I received positive reinforcement for it, by the way of badges. This probably stimulated me to continue learning, instead of being told that girls didn't belong in the outdoor wilderness, or in science. Of course at the time no one thought of investigations of ecosystems as science. We were just kids wanting to know why certain trees by the river were different than the trees on the top of the hills.

In high school, I finally realized that this fascination with the outdoors was a part of science. By this time, I was obsessed with the ocean. Surfing almost every day, watching tides

change, learning where the best rip tides were so I didn't have to paddle too hard to get out beyond the surf. My summers were spent on the beaches at the YMCA CAMP SURF. I spent many hours studying the tide pools. Learning names of organisms and any stories so I could find out about the individual critters. I wanted to teach all the little kids at camp the fascinating stuff about the crazy organisms in the water, from barnacles to dinoflagellates. My last year in high school I finally got to take biology and oceanography, two courses in which my counselor never recommended to me but I thought might be of some interest. I drilled my teachers with questions. I wanted to know about anything that affected me directly. The animals I would come into contact with in the mountains, streams, and oceans, visible and microscopic. I found it all fascinating, so I figured they would too.

Throughout high school, I still had this image that all the science I had learned was just part of recreation. I wanted to grow up and give nature walks at some type of recreational facility. Yet somehow I knew in college I would have to major in science.

While in college, I not only took classes to complete a degree in marine biology, but also worked toward completing a certificate in outdoor recreation. I guess down in my heart I really never thought I would "make it" in science. That was only for smart people. I was actually told many times that science was not a place for some blond haired surfer girl. The courses were very tough for me; high school did not prepare me for college. I got a "D" in my first chemistry course. No one told me in high school that chemistry was a pre-requisite for college chemistry. I took a refresher chem. course and a few extra math classes, then tried again and got a B (only because I was lazy).

It wasn't until I was probably a senior in college that I felt the real impact of what I would call "science." I started to attend conferences and realized what researches did and the problems that they solved. My whole perspective on science changed. It was not just learning and sharing knowledge, nor was it a game of collecting facts and figures. It was actually solving complex problems, or coming up with a new way to interpret experimental data. It involved an incredible amount of originality, creative abilities and knowledge. Science involved the ability to think and solve problems.

Now that I feel I have come to know science, I can't really say that I am a part of it any more. My job as a teacher is to stimulate students' minds to think scientifically, not necessarily to make every student a scientist. Although I would not be upset if I motivated one or two into science as a career. I no longer feel I am a scientist, but a mouth piece of science.

Clare: *"Science is experiencing and learning about how things work"....*

Science has always been at the front of education for me. My parents, specifically my father, always emphasized the importance of science and math. I guess you might say that since my parents valued science and math, I valued science and math.

I came from a science/math family. My uncle who lived close by was a doctor. Listening to my "elders" talk, they always spoke about medical issues or how to build something or how to fix something. Most of my relatives were born "questioners" and "answerers".

Since I came from what started as a lower middle class family, I always watched my father and brother fix things: leaky faucets, cars, lamps, toys. I always wanted to help, but I was always too short, or young or weak, which was very irritating. I guess this would explain why I am pretty good at watching and learning, and then imitating. I also sometimes feel I approach problems and situations "like a man," which leads to other problems. I found that growing up in a Filipino/American culture was irritating because I was treated as if I couldn't or didn't know how to do things. My brothers were taught to do the things I wanted to learn. It wasn't until I kept on tagging along or complained that I was taught the "man's chores." "Woman's chores" were in the house: cleaning floors, dusting furniture, cooking, washing dishes and laundry. "Man chores" were: cutting the lawn, fixing broken furniture or appliances, taking out the garbage, shoveling snow. I wanted to be outside, not inside the house. I thought the "man's chores" were more interesting, especially taking things apart or figuring out how it worked and fixing it. Enough of the inequalities in raising children, but I do think that it has a significant bearing on how people choose what they want to be. By teaching my brother how to put in an electrical system, insulation, flooring, walls, in our cottage, my father gave my brothers an education I did not get. Practice in spatial analysis, continuity in electrical systems and hand-eye coordination. At least I had the experience of watching and learning from their myriad of mistakes.

Science for me has been experiencing, learning about an object, then changing something to make it work. I learned this while trying to maintain my family's old car. My parents started moving up the monetary ladder and could afford to have a car available for the kids to use. As each sibling went away to college, the old car progressed down the ladder of kids. No one, except my brother, had use of a car in college and so eventually I ended up maintaining the old car during my high school years. I became more adept at reading the car manuals and figuring out what was wrong. My brothers taught me a lot and still do, about car maintenance.

I feel that experiencing and learning about how things work is truly what science is about. Sure, the traditional science classes in school were interesting but they were so abstract. I saw school as an exercise that had to be done, as a means to get to the next higher step, college. Once in college, I found science classes were really exercises to the next step, medical school. After my freshman year at college, I gave up on the medical school dream. I

did not have the stamina to go on with the exercises. When would I reach the point that I could enjoy learning about things and solving problems?

Like many people, I dreamed of helping mankind (womankind also) by finding the cure for cancer. Why? It was a noble thing to do. It sounded exciting! Interesting! The ultimate reward of being famous for doing something good. This idea stuck with me through college. What a problem to solve! I eventually came to the conclusion that the problem was too large and difficult for me to solve. Plus I knew that medical school was not in my future; not with some of my grades.

I really felt that most of the science courses in college were meant to weed people out instead of having people enjoy learning more. It was a game. Who had someone else's homework set from last year? The same homework sets were even, even down to the same exams for a couple of professors. I found myself enjoying the upper division, specialized classes. The medical imaging engineering class was the most enjoyable. I learned, experimented and got results.

The honors biology class I took was interesting in that it went into detail about the working of the cell and organism development. Lots of facts but I finally was finding out how the cell worked. The facts are useless without a means of tying it together for a larger picture. Maybe part of the fault is with me for not seeing the big picture, or the application of facts. Although I don't recall the teachers pointing these things out clearly.

Jasmine: *"What I teach may not be as important as how I teach"....*

Science is a vast subject to me. It encompasses all things from the very onset of time (whenever that was). It includes all the living and non-living things on earth, in this universe. It is so vast a topic that I cannot imagine knowing even half of the information that is available. Science for me has been what I have learned in my 37 years that is related to my schooling in biology, the human body, and in living things. I have also learned a little bit about physical science but this all seems so vague. I guess it's an area that is so vast that I cannot explain it well enough to tell you what it is to me.

I know that what I teach in terms of science, biology and physical science, may not be as important to me as how I teach. When it comes to health, however, content is almost as important.

I believe that my teaching comes from the heart. I know that throughout my teaching career there have been times where there was not much heart in it and I know sometimes I pour my heart out to make a connection with someone. I have faith in most all of these kids. I believe they all want to learn but some have faced such adversity in their lives that concentrating in school may be the last thing on their mind. I can only imagine some of the hardships that many of my students have gone through thus far in their short lives. I know that I have an impact on their lives. I can make a kid's day or I can break it. I truly have the power to change some

of them and it is exciting when the light clicks and they get excited about learning. I feel that I have gotten better as each semester rolls by. I continue to strive for improvement in my teaching skills never being complacent in what or how I teach. I am always willing to try something new. I have no fear of trying because if I feel that this new thing has not worked for me I can always go back or try something else. I can look back and see the growth I have made in my ability to teach. I can see all that I have learned from my colleagues and from my students. I have a great relationship with my students and I will miss them when I go. I know I can probably get a job in Washington but I'm not sure I can really be the wild and crazy teacher that I am here. I believe that since I am a minority that I can relate better to the minority (85%) population here at my school. I know that if I were in a place that was predominately white, I would approach the students in a different way. How I'm not sure. But I feel it will be different. I know this is all jumbled up but my thoughts are just flying around.

I think I came to know science in a round-about way. I decided early on that I wanted to be a teacher. I didn't know what kind of teacher but around junior high, I decided I wanted to be a PE teacher. My focus from then on was sports. I spent each day after school participating in various sports. I knew that to be a good PE teacher I needed to know the human body. I did well in Biology and Physiology. It was interesting in high school. My teacher's name was Mr. Wong and I used to tell everyone he was my uncle. He was a terrific teacher who made science fun and exciting. After graduating from high school I went to college at Long Beach. I majored in Physical Education and graduated with my BA in 1978. As requirements for PE, I took anatomy, physiology, Kinesiology, and exercise physiology.

My true dream was to become a physical education teacher and soccer coach at the high school level. I traveled around a lot due to personal circumstances, someone led and I followed. I decided that I needed to make myself more marketable and therefore took some more science classes to get a supplemental credential in biology. Basically, that is how I came to know science.

I came to know more about science by the mere fact that I was thrust into the classroom in 1986 and given a couple of Science 9 classes, a couple of standard biology classes and a basic biology class to teach. I learned many things the hard way, a lot by trial and error. I have become better and better each year not only with curriculum but the methods. I have progressed from my first semester assignment through general physical science -standard, general physical science -basic, health - basic, health- standard, bilingual biology, to currently teaching non-tracked health and bilingual health.

We Never Recover from Childhood

In thinking about these women's reflections and my own, I've come to understand the power of personal experience and its lasting influence. I believe now, more than ever, that we may grow out of everything else, but "we never recover from childhood" (Beryl Brainbridge, *Woman's Journal*, 1985). In this context, I'm using the word "childhood" to include all of those experiences we've had beginning at birth until we've reached adulthood and completed our formal education.

Ruth and Sarah came to know science primarily through their interactions with influential teachers in high school and professors at the college level. School and academic science were challenging and exciting for them because they had an opportunity to be problem solvers and to experience science by doing it, not just reading about it.

Rachel, Marie and I came to know science through our experiences with nature and the out of doors. In our own ways, we each broke from feminine tradition and participated in activities that were adventuresome, experimental and "tom-boyish." For example:

- Rachel: found grasshoppers and put them in spider webs just to see what would happen.
- Marie: surfed every day and learned how to judge the best rip tides through self-discovery.
- Lynne: hiked through the woods alone to search for wildflowers and different kinds of fungi.

Clare came to know science through daily interaction with her parents and other family members. By listening to her "elders" talk about medical issues, watching and learning how to fix household objects and maintaining the old family car, she developed her own common sense understanding of what counts as science. Although she was continually frustrated by having to learn "woman's chores" rather than "man's chores," Clare was able to watch and learn from her father and brothers and then imitate the skills and ways of knowing. When she states, science is about "experiencing and learning how things work, " I can understand why chemistry and physics are so appealing to her, while biology seems so boring.

Unlike the other storytellers, Jasmine seems to have come to know science by a twist of fate rather than by a pure love for the subject matter or the processes of science. As a PE major, her background in science developed because she had to complete the required coursework, anatomy, physiology and kinesiology, for a degree in Physical Education. Her interest in science is specifically related to developing and maintaining a physically and mentally fit human body. Being an athlete herself, Jasmine's image of science is more closely linked to health and physical education than to the more traditional sciences of biology, chemistry and physics. In some respects, Jasmine and Sarah have come to know science following a similar pattern except that Sarah focused on both physical education and biology in high school and college and maintained an interest in science throughout her teaching career.

I wonder if it is a coincidence that five of us were involved in competitive athletics while growing up and four went on to become coaches for women's sports. It is a stereotype usually associated with male science teachers, who pick up a minor in biology or health because their real interest and love is physical education and coaching.

Do we as a group of women science teachers share a common standpoint on what science is? Or have we come to know science in such a way that our position is uniquely personal and individual?

We do share a common understanding of what constitutes the knowledge base for science, specifically factual information about earth, physical and life science, and we agree that all students need to acquire a basic core of this scientific knowledge in order to successfully participate in this technologically advanced society. We also agree that the processes involved in doing science are as important as the content itself. For students to come to know science, they must become active participants in the problem-solving strategies of science. Marie's words summarize our a version of our collective standpoint. "Science is a process, a way of learning, discovering and solving problems. It's a way of applying curiosity to some type of methodology. It comes from inside us it's the innate desire to ask why."

Although we share a basic set of beliefs about what knowledge and methodologies constitute the discipline of science we do not share a common vision of what science is or should be for all students. As a group we are struggling with the meaning of the

phrase "scientific literacy for all students" and have not reached consensus on how we can reach this goal for all students currently attending public schools in this country. We need to find ways to blend our individual experiences and ways of knowing science with the new initiatives and recommendations proposed for reforming the teaching and learning of science. What we each value most about our personal experiences in science will determine the qualities, skills and knowledge we will strive to develop in the students we teach. As teachers, we do not see science as it is, we see science as we are and want it to be.



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A SEARCH FOR MISSING VOICES:
A NARRATIVE INQUIRY INTO THE LIVES
OF WOMEN SCIENCE TEACHERS

By

Lynnette Marie Cavazos

A DISSERTATION

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CHAPTER VI

LISTEN TO THE VOICES OF LIFE

Because we are engaged in a day-by-day process of self-invention -- not discovery, for what we search for does not exist until we find it -- both the past and the future are raw materials, shaped and reshaped by each individual. None of us has completed her story. (Bateson, 1990, p. 28.)

Creating a New Kind of Story

In this chapter, I am creating a new kind of story that interweaves the life experiences of a diverse set of characters who are engaged in the day-by-day process of shaping and reshaping their lives as women science teachers. Although the times and places, plots and scenes are each unique. The stories have common themes, patterns and tensions running throughout. We often commented on how similar our life experiences have been, considering the differences in our ages as well as our social, historical and cultural backgrounds. One person's story could easily be linked to another as part of an "on-going," timeless autobiographical narrative about growing up female, educated in the traditions of science and experiencing life as a woman science teacher. As we exchanged information about our lives and absorbed knowledge from each other's lived experiences, a new collective story emerged. New in the sense

that it contained our unique perspectives and interpretations; collective because it was jointly constructed and shaped by the community of women storytellers rather than by any one individual.

As the participant researcher of this group, I have the responsibility, as well as the challenge, of putting into words a version of this collective story that reveals the multiple truths and the diverse perspectives inherent in our lives. This version however must not come from just my heart and mind but also from the hearts and minds of the six women who courageously agreed to speak their minds (Rogers, 1993). I cannot let the participants of this research be represented as the objects of this study; they are not characters in some fictional story that I created from my interpretations of their lives as women science teachers. My aim is to have the women's voices, as represented in their stories, portray a vision of the uniqueness of each woman's life as well as a more holistic view of the kinds of lives women are compelled to live in this society. Therefore, the women's stories will be told as much as possible in their own voices, without attempts on my part to interpret their stories. My voice will emerge as a connector between the stories -- helping the reader to see how the set of individual stories formed a jointly constructed narrative with shared themes of voice and authority, uncertainty of influence and perils of change. In this way, I am making a sincere effort to follow in the footsteps of Adrienne Rich and other feminist scholars who have taken seriously the authority of women's experiences and their different voices.

I cannot incorporate into this work all of the stories that we created during the seven months of data collection. Having collected stories in three different settings, the group conversations, the one-on-one conversations, and the journal reflections, I accumulated a rich source of narratives that represent the multiple forms of voice used by each woman storyteller. The stories and excerpts I've selected for this chapter highlight the distinctive struggles and challenges women teachers face in their personal and professional lives. Each of the four themes is the topic of a passage.

Passage I: Cultivated Silence or Cultivated Voice

Passage II: Uncertainty of Influence

Passage III: Breaking the Silence - Unleashing the Voices

Passage IV: Taking Seriously the Need for Care, Concern & Connection

In each passage, I hope to accomplish two goals. The first goal is the driving force of this study, which is to represent the realities of women's lives from their standpoints. The second goal is less obvious, but equally important from my perspective as a narrative researcher. I hope to give the readers of this work a sense of the multiple forms of voice used by each storyteller and demonstrate how each woman's story and her voice are affected by the context and formats of the storytelling situation.

For each of the collective and individual stories, I will provide specific background information to help identify the context for the storytelling event and assist you in discovering "in which

sense, where and for what purpose" these rememberings have been shared as truths. At times, it may be necessary to refer back to the "Who am I" narratives in chapter 5 as a reminder of the storyteller's unique standpoint. My voice will also be present in these collective and individual stories both as a participant and as the researcher orchestrating these storytelling events.

a powerful research tool precisely because it allows individuals to create and share stories in multiple ways, using different voices and different rememberings. A story shared orally with a group will sound and feel different from a story shared through a written journal entry or in a one-on-one conversation. This is true for the teller as well as the listeners, the reader as well as the author. In each case, the storyteller is attempting to reveal truths about her life, not as it actually was, but as she perceives it to be. According to The Personal Narratives Group (1989), the listener task is to try to understand and interpret these "truths" by "paying careful attention to the contexts that shape their creation and to the world views that inform them" (p. 261). Even when the storyteller forgets certain details about events, exaggerates others, or becomes confused about times and places, she is still revealing a subjective form of truth. Luisa Passerinin (1989) asserts that "all autobiographic memory is true. It is up to the interpreter to discover in which sense, where and for what purpose" (as cited by Personal Narratives Group, p. 261).

Passage I: Cultivated Silence or Cultivated Voice?

Voice is meaning that resides in the individual and enables that individual to participate in a community . . . The struggle for voice begins when a person attempts to communicate meaning to someone else. Finding the words, speaking for oneself, and feeling heard by others are all a part of this process. (Britzman, as cited in Connelly & Clandinin, 1990, p. 4)

What does it mean for a woman to have a voice? Is it an acquired attribute that all women have but learn from experience not to use? If one loses voice early in life, is it possible to rediscover it or cultivate a new one? I am raising these questions for you to ponder because "voice" was a common theme and an identified tension that emerged within our stories and as part of the storytelling process.

"Having a voice" is a complex phenomena that is challenging to define and characterize. It certainly is more than the sounds made by human vocal chords and more than the common phrases and words exchanged during conversations. Annie Rogers (1993) describes voice as a psycho-physical quality that links breathing and sounds to a person's real feelings. One's natural voice is uniquely personal both in quality and tone and in the choice of words spoken and written to communicate meaning and signature. What it means to have a voice, professionally and personally, was the topic of the second one-on-one conversation I had with each of the women storytellers. The following excerpts are from these conversations and represent the uniquely personal ways each woman talked about the psycho-physical sensation of "having a voice." What factors influence a woman to cultivate a voice rather than to cultivate

silence, I hope will be evident as we each attempt to examine our past experiences as children and as adults and answer the question: "What does having a voice mean to you?"

Clare: *"I'm the rookie on the block"*

Clare was the youngest member of our storytelling group and at times was a bit reluctant, at first, to talk about her personal life with women she did not know well. It was a struggle for her to get her "voice" heard during our group session. The journal writing and the one-on-one conversations seemed to give Clare a safer place to speak from the heart. Clare is 28 years old; married without children. Her husband is finishing his Ph.D. in chemical engineering.

Clare: As a newer teacher, I really didn't have much of a voice as far as the classes I teach. I don't know if anybody really does have a voice about what classes they teach, except for a few. Which I think is a problem with a department allowing it to happen more than anything else.

I've had two first years so far, one at Palm Tree High School and one at Eucalyptus. Both times, I didn't feel I had much of a voice in what was said or done within the department. I sat through most of the meetings and said nothing, unless I was asked a direct question. Mostly because I didn't know what was happening, the politics, the flow of things, all the history behind what happened last year. Well, I didn't know what happened last year and so it was really hard to give an opinion or advice on what should be done because I had no idea what happened. So I don't think first year teachers have much of a voice. The only voice you might hear are standard procedural questions like: Where do I get this from? How do I get this done? Very basic questions, it's almost like the pyramid of needs. First you have to get this need fulfilled before you can move up to the next level. The basic level is where the first year teacher is fighting at - How do I get through my day without messing up or how do I get through this week or year. What things do I have to get done?

The first one or two years all you are trying to do is keep your head above water. Get your lesson plans done, get your grades done and that is about as far as you get.

Lynne: Do you feel better this year or do you still feel like you are treading water?

Clare: I more frustrated this year. Part of it is because I'm getting the hang of what is happening and it frustrates me to see what has been happening for so long.

Lynne: Now you know, and it's worse?

Clare: I'm saying, maybe it was better when I was ignorant. It is just so frustrating and plus with restructuring, I'm getting the overall view of how things flow in this school. How does one change affect other aspects of school. Now I'm looking beyond my classes and what I teach. This is a science department and how does the movement of kids through a department affect class size, the quality of students in class.

Lynne: With this restructuring committee you are on, do you feel like you can speak up? And do you want to speak up?

Clare: That has also been part of my frustration. The way we do things and the way they are done is so idiotic. The school is so laid-back, it is ridiculous. When I taught at Palm Tree, there was a strict attendance policy. Last year when I got here, I had a strict attendance policy for my classroom. At one point, I sent a referral up to the assistant principal and explained that the student hadn't followed my direction and then didn't come to detention. She replied: You mean you give detentions? I looked at her and said: Is this so unusual? She said: Well you are probably one of the only teachers here that does. I thought this is sick.

Going back to the curriculum committee, to tell you the truth I haven't been saying much until last week. Maybe I just hit my peak of frustration at school, so I lashed out everywhere. I was on a rampage. I didn't really say much because I was still learning and I'm still confused about a lot of things. I'm wondering where do I fit in here and why am I on this committee? Again, I was the rookie on the block again.

Lynne: It's interesting that at the university level, we think we can send out new teachers and they are going to be the "change-makers." There is no way that first year. Granted, beginning teachers can come in with new ideas and over a period of time can bring about change if they can survive. It is just like you are saying, people don't tell the "rookies" what is going on.

In terms of your classroom, do you feel that you have the freedom to do what you want?

Clare: That is probably the biggest freedom you have, which is why I went into teaching anyway. If someone is going to sit there and tell me, this is what you are going to do day in and day out, I wouldn't have become a teacher. Because then it means that you can't personalize your teaching. In other words, you are the master of your room and you have the flexibility to make your schedule. I still need ideas and I go over and ask one of my colleagues how to do certain things.

Lynne: But that ought to happen. It's not that anyone comes out of a teacher education program with as many ideas and strategies as you need.

Prior to teaching, would you say that you were vocal or not vocal in high school and college? Do you think of yourself as having a voice in your younger years?

Clare: I have to tell you first of all that I come from a very quiet family. Communication isn't big in my family.

Lynne: So it is not like you grew up in a situation where you voiced a lot of opinions?

Clare: No, it is not like my family would sit down and talk about politics or current issues. If anything, our choices for majors, for example, were based on what my dad thought. We had a couple of options - you could be an engineer or medicine. I didn't question it either because throughout my entire life, my parents stressed - - science is very important, math is very important. Getting a professional job is very important. When I told my parents I wanted to go back to school to get a teaching credential, they did not want to go along with it. Until I made a very firm commitment and did all the applications and tests to get into a credential program. Then they did help me monetarily.

I didn't have the confidence to go out and find a job in biotechnology. My educational background was pretty broad and general. I didn't specialize in a particular area. I didn't really dig deep into electrical engineering, biology or chemistry. So when I went out to look for a job, I was thinking "What do I really know?"

Lynne: When you finally got this teaching degree, what did your parents say then? or what do they say now?

Clare: They want to know if I have a job next year. I mean the whole point of them funding my education through college was - - my dad basically said, "Look the reason that we sent you to college was so we would know that you could get a good job and make a decent living. We don't want you working in a sales job in a department store." When I said, I wanted to teach they didn't really like the idea. They tried to discourage me because of the money and the working conditions. He wanted me to do something with my engineering degree.

Lynne: When you have conversations with teachers in the department, do you feel like they listen to you?

Clare: Yes and no. I think sometimes they just look at me and say, "Well she doesn't know enough to know what is really happening." I would have to admit, maybe I don't. But the biggest problem is that some of the teachers can't precisely say what they mean. They go on for half and hour about some issue and they never get to the point.

When we have department meetings, it is like a two person show, the department chairperson and one of the experienced male teachers. Most of the teachers don't talk because they are afraid we won't get out of the meeting until midnight. If we start talking, it will just be adding more time to the "Mutt and Jeff" show. Our department chairperson controls the meetings and controls the conversations by talking and talking so no one else will want to speak up.

Lynne: Let me ask you a more personal question. Do you have a chance when you are with your husband to talk through some of your frustrations and voice some of your concerns?

Clare: Yes, it lets me blow off some steam. It helps him to see where I am coming from when I get home and I'm ready to strangle someone. It is like getting some sympathy vibes from somebody; somebody who will listen to you and give you a nice neck rub so you can relax. But it's not like he can do anything about my frustrations.

Lynne: But you do need to talk it through with someone, especially if you don't have time to talk to colleagues at school.

Clare: I don't even have time to talk to my teaching colleagues about what we are doing in class and how to teach certain concepts. I have to catch some of them during the school day, between classes or during nutrition break.

Marie: "The harder I work, the more I have a voice"

Marie doesn't fit the traditional image of science teacher but her philosophy of science education and her goals for students do. Although she grew up on the beaches as a "surfer-girl," her experiences with nature and the outdoors were quite similar to my own. Marie has experienced the best working conditions as a science teacher followed by perhaps the worst. Like all of us, she is struggling to get the "others" to take her seriously. Marie is 31 years old; married with no children. Her husband is a marine biologist.

Marie: I guess in my personal life voice is probably the easiest; they all are pretty cut and dried for me. But in my personal life, Phil and I have always communicated really well because we were best friends before we ever got married. I realize that with his job and both of our careers that sometimes having a voice is not necessarily the relevant issue. It is -- Can you support yourself and do what you want to do? If we both agree on something that is great. If we move to Texas, is it realistic to think that I can get a job there? Well in my case, it is. Other places where he may want to move, it is not. So this has never been a point of discussion - do I have a voice in the matter?

Lynne: Have you felt when you were growing up that voice was always there for you? That you always felt you could say what you wanted to say?

Marie: Yes, I think so. I grew up with my mother always encouraging me to think that my voice could be heard. I was never shy; I was always very vocal. My mom always encouraged all of us to peak out and get involved. I think when I was in junior high was the first time that I got involved in an issue. I didn't want to take Home Economics. I thought it was so dumb because I could already sew and cook. I wanted to take something that I didn't know anything about like wood shop or metal shop. So one of my friends from Girls Scouts and I got together and wrote a petition and went to the administration. They said fine, "The only reason you haven't been able to take metal shop is because the teacher didn't want girls. We will just tell him he has to take girls in his class next semester." We had a great time.

All through high school, I ran for class offices. Even as a freshman I was the vice president of the class, then I was vice president again as a sophomore and president during my junior year. I always was involved so I probably always thought I had a voice. I probably never

felt I could control my family. They were always the authority figures. But as far as my peers or influencing my own life - yes I had a voice.

I think one of the reasons that I have so much input in my relationship with Phil is because I have been the supportive one, financially for the past few years. I could care less because I have actually saved more with him than I've ever saved. I wasn't very good with my finances.

The funny thing is I grew up with the idea that money was not an issue at all. My mom always impressed on me -- you just need to be happy which is probably why I am in the teaching profession where I can be taken advantage of. Although it seems like I am supporting him, really I'm not because I'm saving more now than I ever was. Of course we don't have kids or anything like that. It is fun to rub it in when his friends are around. It gives me more of a voice.

Lynne: So, when you were starting in your first teaching job as an intern, did you feel even at that point that you were comfortable voicing opinions and speaking out?

Marie: I did. The staff I worked with was so supportive. They knew that the intern program brought money to the science department. The administration actually said, "Your department can have the money from the state if you participate in this program." It wasn't even the head of the department that wrote the proposal, it was one of the biology teachers, who got excited and wrote the proposal to the state to get an intern into the school. So they were thrilled I was there because I brought money and they all wanted to make it work so they could continue the program the next year. All of them made me feel like I was part of the department and encouraged me to speak up and give my viewpoints. Of course I was always pretty intimidated. I think that I felt like student teachers do: I will do whatever they say, follow whatever their way is.

Lynne: It seems like you had a more ideal situation that first year teachers than most beginning teachers. Many people come into the profession and don't have anyone to talk to.

Marie: I think that is why I have continued in teaching and so many don't. Those first few years are so critical. It worked well for me and I took on the class advisorship for three years which actually gave me my own voice again because it got me more involved with school and I could do what I wanted with that group of kids. Then when they

thought my job would get cut, the whole administration was so supportive. They said, "We will do whatever we can so you can keep your job. Tell us what you want." They were very honest and up-front about it.

Lynne: That is a pleasant change, isn't it?

Marie: So I really got these false hopes about how the reality of the world works in schools. It wasn't until I came up here that I was a nobody. I kind of felt, gosh I am a good teacher, at least that is what the other school felt. I got no appreciation here.

Lynne: It is interesting from what you have described before that it was eventually your willingness to use a strong voice, to do some pushing that got you into a sane teaching situation in this district.

Marie: I think part of it was being supported earlier on, I wasn't afraid to speak up. Once I got here, I was so miserable that I decided I would speak out. What are they going to do, fire me? No one in their right mind is going to take the job I had.

I think maybe somebody new coming in, like Clare or Jasmine, maybe wouldn't speak up. People told me here, "Don't speak up let the union back you. You don't have a voice." I said, "I sure do." This district is in such shambles there is no way that they will be able to pull together and fire me. They don't have the organization.

Lynne: I think the issue is, too -- how much of yourself do you sacrifice without saying anything? I was always real up front with my principal where I taught. I always found it real interesting - how many people would say to me, I would never go in and tell the principal what I really thought. How can we get anything done if teachers won't even say how they honestly feel?

Marie: I guess I have the confidence and I don't really care. My job is not that important. It is just a job; it is not my life. I am happy with what I am doing, but if they have complaints they can fire me. I have always been on the edge of a complainer. Instead of being someone who was afraid to tell them what I think.

Lynne: So in science education, do you feel like you have any input outside of Redwood High School?

Marie: Yes I do. But I think it boils down to how much you want to be taken advantage of. Because the harder I work, the more I have a voice and I love the work at the summer institute. Its fun and I have an influence there with the students I work with. If I wanted to get the community involved in education, I think I could go out and organize a high school science fair and run a science week. I've thought about that, if I wasn't already so involved. It would be great to get all three high schools and the junior highs and have a science week during the year. There are a lot of projects I could do if I wanted to be more of an influence. But it is a lot of work and time. It seems like the harder you work the more stumbling blocks are put in front of you, instead of the support that needs to be there. You can do this at school but we aren't going to give you any keys, or a room or any supplies. Most people just choose not to do things. It is not worth it.

Lynne: Would you ever be interested in trying to have an influence at the state level?

Marie: No probably not. I don't like politics. I think the higher up you move, the more you have to get involved in political situations.

Having a voice in the school is a matter of how much you want to complain. If you want to be strong, you can join the union and be vocal or call school board members and voice your opinions. If you don't make noise, you don't get results.

It is somewhat different being a woman and having an all male administration. I don't think I am taken seriously, especially with the old administration. They were trying to be patronizing whenever I would talk to any of them. I really felt like a whiner and a complainer whenever I tried to voice my opinion. This is an issue that is important to me and they would just pat you on the back and say "Oh- we'll fix it for you."

I feel like every time I approach an administrator, they think I'm just starting out. I'm not just starting out, I've been teaching for seven years.

Rachel: *"Voice needs to be built"*

Rachel brought a unique perspective to the storytelling group because she is both a teacher and a teacher educator. She tended to be our theoretical, more idealistic member. Her views provided a balance between the old, experienced ways of knowing (Ruth, Sarah

and Lynne) and the new ideals of the younger teachers (Jasmine and Clare). Rachel is 34 years old; married with no children. Her husband is a math teacher as well as a basketball and baseball coach.

Rachel: I don't think I actually have a clear idea of what you mean by the question, What does having a voice mean?

Lynne: For me, having a voice means you have formed some very definite opinions and views about a variety of issues. And then to have voice means not only that you have formulated what these are but that you have ways to express your views in situations that are important to you. They can be expressed personally or professionally but either way, someone does in fact listen to what you say.

Rachel: I have some real definite ideas when it comes down to core values about things in my life. I do feel like I have a strong voice in my personal life, whether it be with my husband, with friends, or my family. When I have something to say, people respectfully listen. I think in order to have voice you also have to be a good listener. I can't just go out and spout out my ideas and expect everybody to listen if I'm not listening to them. Those two things go hand and hand in my personal life. If I have something to say, and I've thought it through, both my sisters and my dad are ready and willing to listen.

I think voice can come out in different ways. There is an emotional voice, there is a voice that can come out when you have really thought through something very deeply, and there is an intellectual voice that can come out at times. I think my "voice" varies with different situations. I am most successful with my voice when I have thought about what I am going to say and have considered the underlying principles that guide my thoughts for a particular situation. When I am coming from that perspective, I feel more confident about what I am going to say and also feel that I am being listened to.

For example today in our staff meeting, my voice was coming from emotion. I don't really expect my emotional voice to be listened to and, therefore, I'm not hurt if no one listens to my emotionalism. With that group, I feel free to be emotional. I risked a lot today because some of things I had to say were not things that I had put a lot of thought into. I feel close enough to that group that I could have things come out from my heart. I could raise my voice and say things and it would not be held against me. There are inner things going on within our

group and I think that influences voice. Voice is not just a single thing -- there are a lot of variables that influence it.

When I was teaching at Sagebrush as a full time teacher, I did not suddenly get involved and start talking right away. I tend to sit back and see what is going on, make observations and really get a sense of the whole. Then I'll make my contribution. And so at Sagebrush there was a lot of learning going on. It was during my third year that my voice was really heard. I was asked to be on the board of directors and give input. Then again, it was when I would think more clearly about the principles of life that I would have more to say and was respected. I think I was a big part of that school. Professionally in that setting, I felt I had a voice. I don't think I could work in a place where I didn't have voice; it would be too frustrating.

Lynne: Do you think you could have developed a voice if you had stayed at Eucalyptus High School?

Rachel: I think I could have gotten a voice there, over time. You have to build up respect. You can't expect to have it in the beginning. Respect comes in different ways - - different people have different value systems. If I started producing AP students that were all passing the exam, I would gain the respect of the department chair. I think I already had respect from some of the teachers; I was building rapport with them. I would have to have been like Marie and decide what things are important to me and just use my voice even it offends somebody. Marie is smart in that she offends and then she doesn't offend. I think I would at times play the game and at other times not play the game.

Lynne: Do you think that people learn early on how to develop a voice and can develop them (different voices) for different situations?

Rachel: When I was a student teacher, people used to say to me, "You must really have problems with control because you look so young." But I didn't because I wore outfits that looked teacherly; I went in with the attitude that I was the teacher and this is the way it is.

You are the way you see yourself. We need to come from a point of strength not from a point of weakness. You can't let other people's perceptions of you cloud the way you perceive yourself. I think you can have as much voice as you want. But maybe you would need to have come from a

family where you were allowed to speak. But there are other factors that influence your willingness to speak. Voice needs to be built. People need to get to know you and that takes time.

Lynne: I think for a lot of people, myself included, there needs to be a part of your life in which you definitely feel you are free to express an opinion and are listened to for the comments that you make. I think it can be either professionally or personally. Ideally, it would be both, but if it is neither then it is critical. I would say right now that I am at a critical point in my life. Because professionally my voice is tenuous at best, and personally it fluctuates up and down. It is frustrating for me because I don't function best in tenuous situations. Some people are at their best when everything seems to be in turmoil and in flux. I know that about myself. I know that I need to be organized and have a sense of where things are going. I think the issue of voice differs for different people. You make a great many decisions about when you use it and when you don't, how you feel about being heard or not heard. I think for many women it is absent in both places.

Rachel: I don't choose to have voice in some situations. I think you have to be really committed to something if you expect to have voice in that setting. I am committed to my family, to my friends and to my husband.

I am also committed to the work I am doing at the high school and at the university. In all of these settings I feel I have a "voice." At the state or national level of science education, I haven't chosen to become involved, yet, therefore at these levels, I don't have a voice. I still am developing my understanding of the field.

Lynne : I think classroom teachers can influence science education in their buildings, if they choose to do so. They can choose to have voice within their own classrooms or as a department. It is a matter of choice. I have heard many teachers say they don't want to have voice outside their classroom because then they might have to negotiate with people and be obligated to change.

Jasmine: *"I can only do what I can do . . ."*

Jasmine was the only teacher who responded to my original letter in the fall of 1992. She wanted to join the storytelling group, even if she had to drive an hour to get there, because she had never had the opportunity to interact with other women science teachers. Jasmine brought to the group an "outsider's" perspective,

since she was teaching in a different county than the others. She has the most isolated situation being the only female in a science department with 12 men. She loves to teach but hates to grade papers. Jasmine reminds me a lot of the women in the "Joy Luck Club."

Jasmine: Voice means that if you have a concern or you want to say something, that you are heard; not just heard but people listen. Listen with an open mind and consider whatever you have to say before jumping to any conclusions or making decisions. Voice is no less because I am a woman or no more because I am a woman.

I think I have a pretty strong voice. In my personal life, with my mom and dad and sisters, I am my mom's right hand. Whenever something comes up, she looks for me to be there. My sister too, like when my dad had his stroke. It was like: You need to be here.

Lynne: Did that just develop?

Jasmine: I am the oldest daughter and my mom's family has basically been a matriarchy. Behind closed doors, the women run the families. Out in public, the men are allowed to look like they are in control, but when they get home it is the women who are in control. So being the oldest girl, I wielded a little power, even now with my sisters and their husbands.

Lynne: Is the relationship you are in right now a situation where you are equal?

Jasmine: Definitely. I have been in relationships where I felt like I was in the shadow of something greater. I didn't necessarily not have a voice - I just didn't voice an opinion. A lot of things just didn't matter. I went into this relationship knowing it would be fifty-fifty or else it wasn't going to happen at all. We make jokes about on the odd days I am the boss and on the even days she is the boss.

Lynne: Have you over time developed this need to have a more equal relationship? Is it something you feel pretty strongly about?

Jasmine: Yes definitely. I spent a year and a half on my own and I set some criteria for myself and for the person I was going to become involved in. I wrote things down that I expected and what I wanted; what I would compromise on and what I wouldn't. In this relationship, we have done a lot of growing. I really have had to push her to stand on her own two feet. Her whole family only lives five

minutes away and she has leaned on them a lot. Moving up to Washington on her own for six months, making decisions and discovering more about herself, is good for her and for us.

Lynne: I think you have to learn that you can be perfectly fine on your own. I didn't learn that lesson until I got divorced. You don't really have to because all the way along you are in connected relationships. I think it's a real important thing for women to find out. Perhaps that's why so many women stay in relationships that are harmful because they don't think they can stand on their own.

Jasmine: They don't think they can stand on their own two feet. They lack self-confidence and self-esteem. So in my time alone, I really grew a lot.

Lynne: Let's think about your professional life and your role in science. Since you have been teaching, has this issue of having people hear you and listen to you been part of your professional life as a teacher or has that grown over time also?

Jasmine: That has grown over time too. I think in the beginning, I was very intimidated. I was new and had been thrown into a science classroom having only twenty units in "quasi biology." Here I am teaching five classes and I don't know anything. Over time, I have grown in confidence about the kind of teacher that I am. Not necessarily that I have to focus so much on content but directing these kids on how to learn, to get along with each other, to be responsible, to have better manners. Just to be a better human being period.

I have been such a perfectionist because I expected myself to be the best. Then thinking, I don't know this stuff. It was a big conflict, until I finally said, "I can only do what I can do." When that day finally came, life has been so much easier.

So I never really spoke up much during our department meetings or faculty meetings. I hung back and when we went to seminars together, I would just sit back and listen and absorb every thing. It took me about three years before I started to chip in and say what I wanted to say. Now, I will say anything at any time.

Lynne: What do you think about this department of all males that you are in? Do you have any sense of how they think about you?

Jasmine: In terms of the personal, I think they all like me for the human being that I am. As a teacher, I think most of them respect me. Those that take the time to think about it. I have even had some come and ask me what I would do in certain situations or ask if I had any suggestions for this kind of lesson. That feels good. When people are looking for someone to volunteer to work on committees, I'm often asked and I'm flattered by that.

In term of my department, I think they think of me as a good teacher. I don't know if they think of me that way in science, but in terms of health they know that I do a damn good job.

Lynne: Within your department, do you think that everyone pretty much has equal voice?

Jasmine: Yes, we have two department chairs now and they act as "co- chairs." One is in charge one semester and the other is in charge the second semester but they share all the leadership duties. One is from life science and one is from physical science. We didn't really plan it that way, it just worked out.

Lynne: I think that is wise because sometimes things come up between the two branches even when you don't intend it to. I remember in our school, for instance, one of the things that would always be out of balance was expenditures. We always spent more on life science classes than on physical science classes.

Jasmine: I have never really paid attention to our budget. I guess because I always taught in a room with carpeting and desks. I wasn't going to order lab equipment because there was no gas or water in the room. It would have been more headache than it was worth to have switched rooms a couple times a week. We just did what we could with what I would bring from home. We did fun stuff - - never dissected anything; we classified toys instead.

Lynne: What do you think about your voice within the whole school?

Jasmine: I don't know what to say about that one. I know in terms of my colleagues that I am highly respected. I've been involved in our student assistance program and have gone through two intensive weeks of training to work with groups of kids with problems. Groups of kids who are users and abusers of alcohol or drugs, or groups where the kids are recovering and dealing with day to day school. Kids who are trying to stay clean without having gone

through a rehab program. I worked with them for a year developing a program and facilitating with groups of students.

I was also asked to become involved in the Renaissance program. We have had this program for three years in our school to help recognize academic improvement for all students from your A to your F students. We have had kids go from 0.0 grade points up to 3.0s. It is outstanding to recognize them and have kids start to feel better about themselves.

Lynne: Do you have any interest in state level education?

Jasmine: No. I don't even have it on the district level. I like my classroom because that is where my connection is, with the kids. Whoever comes into my classroom, I am going to do something with them. I don't believe a school can mandate the curriculum, it is up to the teacher.

Lynne: Do you think that it has made a difference to your students that you are a woman?

Jasmine: I think so even for both sexes. I think it allows the boys to express more kindness and caring than they would with a man teacher. I have boys that come up and hug me and say, "Have a good weekend," or give me their "homeboy" handshake, or pat me on the back. They let me touch them and I do. I put my hands on their shoulders and touch their hair. I get close to them and I think it gives them comfort. In turn, they can show more feeling and caring.

With the girls, I tell them, "There is nothing he can do that you can't do; and there is nothing you can do that he can't do." If you want to be an engineer, veterinarian, mechanic - whatever you want to do is OK. To the boys, I say just because you are a male doesn't mean that you can't clean, or cook or do dishes.

Lynne: What do you think about your being a minority and working with a minority population of students?

Jasmine: I think the kids can really relate to me. I tell them my family background and how my grandparents came over from China and grew up in San Francisco, how my family is very much inter-twined like many of the Hispanic families. They can see that my family means a lot and they can relate to me because I'm dark haired and brown skinned like they are. Some kid will say, /Ms. W. you are prejudiced, you are discriminating./ I say, /Yes! I hate people with dark hair and brown eyes!/

I sometimes have conflicts with very macho males. Very seldom do I have conflict with girls; they have to be really bold to stand up to me. I've had a few. For the most part, immaturity gets more boys in trouble than anything else. They just are too stupid to know any better, being 9th graders with hormones flying all over.

The home life of a lot of these kids is so bad. It is amazing that some of them get through the day. Some of them come to school just to survive, to be away from the house for seven hours.

For this particular one-on-one-conversation, Jasmine offered to switch roles with me and be the sounding board as I talked with her about voice. In this next segment, my voice will be more dominant because I am the one struggling to find the words and communicate meaning.

Lynne: *"It has been a major challenge to develop a whole voice . . ."*

Lynne: I think of it much the same way you did. Voice means that you have an opinion, a sense of what you believe in and real strong feelings about what those opinions are. And then being in situations where you are confident enough to voice the opinions you have. But like you were saying, you do not extend yourself if you find out that nobody listens, or that when you speak all you get is put-downs. Then you really have no voice, even when you speak, it is like you are silent.

When I chose the title for this dissertation, "A Search for Missing Voices," it was because I felt women's voices were not being represented in research literature about science and science education in schools. There is a science voice but whether that voice represents women is a big question for me. Certainly in literature it doesn't. It suggests that only men were involved in making decisions about science education.

Growing up, I didn't use my voice much. I only used it if the situations were non-confrontational. The way we dealt with confrontational issues in my family was not to talk about them. My sister and I learned to work around situations, which is a very unfortunate thing to do. Even

in my marriage, my husband and I were close friends but we likewise didn't say what we meant. We would walk around each other's feelings, walk around the conflicts with my family. I didn't take hold of things very well.

I was a successful teacher and I had voice in my professional life. I was willing to voice there. It wasn't until I got divorced that I finally had to deal with the fact that I didn't have a complete voice. It has been a major challenge for me to develop a whole voice and address all the issues that are important to me and stand up for them.

I think women, in particular, are made to feel that they shouldn't say what they believe if it is confrontational or if it is going to cause hurt to people. I don't like to hurt people, but you hurt yourself more when you never say what you think.

Jasmine: I think I learned that in the relationship I was in for eight and a half years. I never really said what I meant. I think that is where my depressive episodes manifested themselves when things would get to a boiling point and I couldn't take it any longer. I would just burst out in tears and name everything that had gone on for the last three months, why I was angry, why things weren't working.

Lynne: It is so hard to get out of the pattern because it feels so normal. I've been working on breaking this pattern for the last five years.

Jasmine: It is very similar for me. I need to analyze and discern what is really bothering me when I'm upset. Now, when I get into a mood I have to just take my time and figure out what I want to say. I've read books that keep saying start with "I." I've also learned it is better to ask forgiveness rather than permission.

Lynne: Now that's a motto I should learn to live by!

For the first eight years I taught, I only worked with men. The funny thing about those eight years is that I made lots of decisions on my own and voiced lots of opinions, but I was never in a position to have much control over things. I was not the department chair and schools were pretty much set up so you could do what you wanted in your classroom.

In the last school I taught in, I felt like I had a lot of voice. When I was hired, after my ninth year of teaching, the science department had lost all of their biology

teachers. I was hired along with two first year men. I had tremendous voice because they really didn't have a good sense of what needed to be done. They were more than happy to let me lead the way. It was an interesting and unique situation because from the time I started at that school, I had a lot of control over the biology portion of the science curriculum and could act on my own beliefs. The science department chairperson for the district was a physics teacher in our building. He was pretty comfortable letting me decide what needed to be done with biology and gave me freedom to take it in whatever direction I wanted to. Eventually, the two men hired with me left, one was pink-slipped and the other released, and two women came in to take their place. It was wonderful having women colleagues to work with in science.

Within that department, I felt comfortable and did have a chance to voice my opinions and initiate change. At the building level, I likewise had a chance to become vocal and be influential because I was asked to be the chairperson for our North Central Accreditation study. I found out that I worked well with teachers and could speak on their behalf.

We did have a very strong female component on our staff. As a group, we voiced a lot of opinions and got a lot of things going. From that standpoint, we didn't feel entirely silenced. Although at times, it was a real battle to get ideas implemented within a "good old boy" school system.

At the district level, I had some influence because what happened in our building often influenced what went on in other science departments at other schools. I never wanted to be an administrator either. I can't think of anything worse than being a principal or assistant principal at a high school.

Like you, I never paid much attention to what was going on at the State level. I knew all these decisions were made and come down, sometimes they affect you and sometimes they don't. While I was in the doctoral program at Michigan State, I found out how state level policies were constructed and implemented. It appeared that a group of male professors at Michigan State in science education had a whole lot to do with what was happening at the State Level in science education. It was a bit unsettling to me because it seemed like a small group of people, pretty much men, wielding some power and could dictate the direction science education would take. It still seems that most decisions and most policies coming down the

tubes are being formulated by a small, select group of individuals. I'm not totally convinced that women and minorities have had much to say about State and National Level policy.

Its not so much that I think women have such drastically different ideas but we may make different decisions and we may not talk about it in quite the same way. It is just like you and I saying that "care" is an important component of any classroom, especially in science. I have a tendency to think that "care" would not be foremost in science education reformers' minds.

In most schools, it has to be people from within that initiate the changes if change is going to happen. As a whole, I think that teachers could cause a lot more waves. It is a matter of taking the time and taking a stand on what you believe in.

Jasmine: Some teachers have just "settled in." I'm glad to say that I'm not one of them.

Sarah: *"The most frustrating things was that no one would listen . . ."*

Sarah is one of the veteran teachers in the district with a keen sense of the political dynamics inherent in a school district. She is the Science Department Chairperson in her building and therefore must interact with the "elite" of the school hierarchy. Sarah is wise and cynical, straightforward and honest about her teaching life and the choices she has made. She is 47 years old; single and seems to be in the "serenity - conservative" stage of her teaching career, which means she is confident about her role in the classroom and the strategies she has developed over the years.

Sarah: I always have had opinions. I can remember when my brother was born, I was mad and had an opinion about that. Ever since then, I've wanted to have a voice.

Lynne: Did you always have a voice?

Sarah: In my mind, I always had something to say about most things, had an opinion. No, I think one of the most frustrating things was that no one would listen to me about my opinions.

Lynne: Did you ever say that to people?

Sarah: Sometimes I would but I would get in a lot of trouble when I was a kid at home for saying anything that wasn't just "yes" or "no." I didn't want to make an unstable family more unstable. So I didn't ever want to rock the boat, even though I totally disagreed with some things. I even tried to impress that on my brother, physically, but he wouldn't do it. He would always talk back and say things. Seeing what would happen when he stirred things up, I think I was really cautious with my opinions.

I was very quiet during my junior high years. I just used sports for my outlet. I could stay away from home and not be threatened physically and have fun too and feel success. Then I got to high school. Things were not going quite the way I thought they should. So right way, I got into the sports world. Instead of getting involved in student government, I got involved in the politics of GAA (Girl's Athletic Association) and scholastic teams. I had real strong opinions and I was the president of GAA because I was so vocal and I worked hard. I was vocal about what should be done a certain way and I got things done. I remember getting complemented in a meeting, by an adult, for my ability to "compromise." So I thought maybe I better pay more attention to what I am doing. In high school, I got to voice my opinion through those organizations, and of course the teams.

In high school classes, the places I felt most comfortable were in art and in the science classes because you could ask questions and no one laughed. Either it was the right environment because of the teacher or they were OK questions. Who knows? So I felt OK about that. I can remember where it wasn't OK was in my speech class. The teacher said, "Oh don't make that face and put me down in front of the whole class." So then I became totally silent. It was easy to shut me down and for me to stop making opinions. I was always good at being sort of sarcastic and joking. Teachers did not want to be my adversary. Actually it was all very quietly done, but I wasn't always a nice person all the time. Especially to adults that I did not like. I supported a lot of teachers that I did like and worked really hard for some people.

I certainly didn't regret leaving. I could never understand how people could cry at graduation and why they were so upset. I was ready to get on with it and go to college.

Lynne: I can't say that I thought graduating from high school was sad either. I guess I was ready to be out of a very limiting situation. I spent most of my life figuring that

I shouldn't say anything, more in my personal life than my professional life. It has taken me a long time to figure out that its OK to say what you think.

Sarah: I think your place in the family and the responsibility you think you have as head of the children makes a difference. That is how I saw myself. When my mother would throw these "fits," my siblings would all look to me for support. I would say, get behind me or go over there and hide. It was like a war tactic.

When I got to college, there was freedom for the first time in my life. It was wonderful. I had to go to a junior college because of money; I hadn't really planned well enough to get myself out of there fast enough. So for two years, I went to a junior college and got such good grades. I couldn't believe it because I hadn't worked very hard in high school. I decided I must be pretty good and people would come and ask me questions and get advice on how to do things in lab. Then the final notch that convinced me to do something in science as well as Physical Education was in an Anatomy & Physiology class. The first lab day, the cat was sitting in front of us on the table. We all had these brand new dissecting kits and I just got right in there and cut. It was really exciting and I understood what we were doing.

I also found that I didn't mind giving my opinion or being wrong in class after that either. Before being wrong meant months of quiet. And it doesn't matter how you tell a student they are wrong, they are wrong and some of them really get hurt by that. I've never figured out, as a teacher, how to respond. Even when you say "Oh, good answer." It still indicates that they are wrong; they didn't give me what I wanted.

Lynne: So the fact that you changed during college and were able to give answers that were wrong, did that just happen?

Sarah: I think it was because I was being successful everywhere in my life at that particular time. I felt healthy and my parents were under control. I had a very close boyfriend who would come to the house and take me away. I finally didn't feel so responsible for my brother and sister anymore. Then I transferred to UC when I was nineteen and never moved back to my parents home, except to visit.

When I got to UC, it was obvious that I had OK ideas and people would follow me. If I was careful when I expressed my opinions and pushed them. And I also learned at that time that I wasn't a good "convincer." If I say an idea

and people like it and follow me, I'm good at that but I'm not good at argument. I'll keep my point of view but I won't argue for it. I'll listen to other people and if I like parts of their idea I'll accept it.

So for me, to have a voice is to present an idea clearly, have people really want to listen to what I have to say and like all of the parts of it so they will assimilate it into their thinking.

Lynne: If they don't, that doesn't necessarily make you change?

Sarah: No, not at all. Unless it is obviously on purpose and consistently against me. I've been in situations like that before.

If I had known that I was going to be at the top of my profession, the first year of teaching, I don't know if I would have stayed. I always thought there would be room for advancement, whatever that meant.

Lynne: It is a problem because there really isn't, other than if you consider moving from junior high to high school and advancement, or from one subject area to another.

Sarah: Some people thought that moving to administration, the dark side, would be an advancement. I can't see that - - I don't want to do that, that's not teaching.

Lynne: I don't see it as an advancement. It is a change because then you don't have to deal with the classroom and they do make more money. But it is not that they are in a better position as far as public opinion is concerned.

So in the two positions you have been in, where you were primarily a physical education person versus a science person, have those two been comparable in terms of the influence you think you have had?

Sarah: First, I became interdepartmental chairperson of the physical education department here for about fifty teachers. I was very effective in bringing about change and representing the younger staff members. But I couldn't get to be chairperson at my school and I couldn't figure that out. Why if I could run an entire interdepartmental program, couldn't I do it at my own school? Finally my very best friend said, you have got to learn to be more diplomatic and don't say things as they are. And of course I said, "What do you mean I'm not diplomatic?"

So I finally learned and then I became chairperson and then I didn't want to be. It is more like being the secretary and treasurer than a power wielding person.

We are beginning to change now in science and I feel like my ideas are being listened to. Just because we are all trying to use a fairly new approach, although it is really the old approach.

All of the department chairpersons are supposed to meet once a month, from the four junior highs and three high schools. Most of the time, it is just the four junior high people that meet, sometimes one or two of the high school chairs. Usually it is myself meeting with four or five men. Recently, I wasn't invited to an event at City College in which the department chairs were going to discuss what was going to go on this summer. I said to the group, "Why wasn't I invited?/ I wanted my own chance to say what I thought. They said, /We figured you wouldn't want to come./

Lynne: Who do you think will make the most decisions about how these changes in science will take place?

Sarah: Right now, department chairpersons at the junior highs.

Lynne: Do you think you will be here long enough to get change underway?

Sarah: Yes. I was thinking of the last three years, I have really worked hard to change my teaching. I haven't changed the big projects but my techniques and strategies I've worked on. I think people are beginning to realize that I have a little different approach than some of the other junior highs. The high schools could (not) care less and I don't really care.

Ruth: *"I don't have a voice here because I'm not political . ."*

Ruth was the first woman to join the storytelling community. We met early in the fall of 1992 when I was making limited placements for the secondary science student teachers. I knew immediately that her life story would be complex and intriguing. Ruth is 53 years old; a wife, a mother of three sons, a grandmother, a teacher, a real estate agent, a gardener, a tennis player, an aspiring writer.

Ruth: Having a voice is being part of the decision- making process.

In my personal life, I think it has a lot to do with your placement in the family. I am the youngest and I think the youngest child always feels somewhat put upon. They aren't always given a voice in matters of importance. So perhaps, you come into adulthood feeling that you have not been equally treated, although; I'm not sure that my brother and sister, who are older, had any more say in those days.

In my married life, I think I probably have a voice, however, it is ignored a great deal more than I would like. How can I best put it. My husband is extremely easy going, very "do what you want, my dear" attitude. However, many times when I say what I want, that isn't what I get. I think that goes along with being married.

For example, I remember when we were building this room, I wanted this couch to fit in that corner. So I said, leave us enough space so it will. And as you can see, from where it is, that it didn't fit. This has happened in numerous remodels, where I look at it in terms of placement of furniture and he looks at it terms of wanting a big window with a big view. He "ah-ha's" me a lot and does as he pleases. I always get a kick when people say I am the domineering one. If this is domineering, it isn't what it's cracked up to be.

They used to always say in the midwest, you can tell who is the boss by the size of the house versus the size of the barn. Did you ever hear that one? I just want to point out that we have an eight car garage sitting out there in a residential area and plus he added that crazy tent for two more.

Aside from that, I have felt very free to do what I wanted. I don't think that either of us have ever felt intimidated or threatened. For instance, he has hobbies, cars and different things. At one point, when the children were more involved in schools, I decided that I really needed a hobby and I got into tennis. So I became very involved in tennis and he did not. Occasionally he will play with me, but I developed a whole set of friends, acquaintances and things to do that centered around tennis. Many times he was included, but a lot of times he wasn't and that was not a problem. From that point of view, I think I have voice.

I think he listens to me a great deal in terms of the upbringing of the children and relies on me. When you teach science, you are also everybody's doctor. I also have voice then.

In my professional life, and I use that term loosely because I don't think that teaching is much of a profession, for two or three reasons. First, there is not respect for this profession. A profession implies that an educated person is doing a job that is useful. I have seen over the years the respect for teachers going down lower and lower. You get more respect as a good plumber than you get as a teacher. The second reason is the pay is lousy. If it is truly a profession, you should be repaid in kind or at least for your time in college. When you compare your salary to the bus driver, garbage man and don't even compare yourself to the trades people, because they are making one and a half times more although I don't think of that as much of a profession.

I think over the years I have become embittered about it. I really have felt that it is a losing proposition from all sides. It hasn't improved since I entered in 1970 and we were complaining then. By comparison, the situation in 1970s was probably ten to twenty times better than it is now.

Lynne: I came in 1969 and I agree that we were doing better then.

Ruth: Within the classroom, I do have voice and I do rule. Although I do it perhaps in too "hang-loose of a way." I'm not terribly disturbed by what kids might say because I've heard it all a million times at home and at school. I've always rather liked children, although I'm finding that is changing which probably means its time to leave.

In terms of voice within a department, no I don't think I've ever had a voice particularly. Not in any department I've been in, except for maybe one. Partly because I don't think I have played the game. Teachers are not a particularly generous group of people. I don't think they are even though they should be, in terms of fairness and sharing. It is basically a "whoever knows how it works gets what they need." I see that over and over again.

Except for during the time that we were redesigning the upstairs science classrooms at the high school. I was given full sway to go ahead, spend my own time and effort, to design those physical science classrooms. So I worked with the architect on designing those rooms. I was interested and tried to figure out what was best, considering the structural limitations of the building. So from that point of view, I guess I had some voice.

Lynne: At that time where you the only Chemistry teacher?

Ruth: No, I've never been the only chemistry teacher. There were always two of us. Eventually, I shared a room with another male teacher. He and I worked together, not so well the first year, but after that it was an excellent experience. We got along really well and totally shared back and forth. I really enjoyed that.

Then he left and another woman came in. We did not do well together. Even though I had her over to my house and gave her the first two weeks of lesson plans. Perhaps I overwhelmed her with everything. I spent a lot of time with her and offered to help her as much as she wanted. But we seemed to have conflicts over issues that came up. We got along and were friends but we each did our own thing. This can happen very easily in a high school: teachers become isolated.

Lynne: I think the district that you are teaching in is as extreme as I have ever seen with science teachers not talking to each other. Even within the same building and the same department, teachers are not communicating with one another.

Ruth: This is part of our problem. There are no channels of communication set up. We should have meetings. There should be shortened days where you get together with your department to talk. If they give us a minimum day or a whole day off, the district feels like they must fill up every minute or these teachers will "cut class." The administrators treat us like children. I don't think it is the building administrators, it is the downtown administrators. They do not believe that teachers would profitably use a day off to talk. Granted some teachers wouldn't use the time well because they have been treated that way for so long. The situation here is strange.

Lynne: Sometimes it is hard to know if some of what you feel as a science person is unique to our particular discipline or if it is consistent in all subject areas.

Ruth: I think it is consistent in all subject areas, especially in the sharing of ideas.

I don't have voice here. But then again, why don't I? I think it's because I'm not political. Were you raised that way? I think I was raised to be good and everything will come your way.

Lynne: I was raised in a family where I learned that one should probably not use their voice. I learned to be quiet so no one would know what I was thinking. That way I wouldn't

get in trouble. Of course, I went to a Catholic grade school and you never disputed the nuns that were your teachers.

Ruth: I think that my problem is two fold. I have the same background you have and I seem to remember being taught that "goodness is its own reward." If you are very good, people will notice and things will come your way. That is not true.

Lynne: I can remember my mother saying, "You are never to talk back to me or to any other adult." So it was very difficult for me to confront people. Now I am older and willing to talk back.

Ruth: I think the other issue for me was in my upbringing. My mother is a real "fighting Irishwoman." She is very war-like. We went to Catholic schools and were told to be good little girls but my mother basically told us "if anyone steps out of line with you just hit them." I literally was told to hit them. I do have a terrible temper and I let things stew and then I erupt. I put up with things for a long time and then that is it. I probably made my own bed in a lot of cases.

Lynne: I think the hardest thing for a lot of women, including myself, is trying to get out of this mode of not saying what we think. I did the same thing, I would go and go and go. My difficulty was half of the time I never did explode. So that is what I have been working on the last five years: Say what I think both personally and professionally, not just sitting back and keeping silent.

Ruth: I have finally gotten to the point where I don't care; partly because of my age and because I don't have long to go in this business. I finally can say exactly what I feel and if they don't like it they can lump it. I don't even care what anyone says to me.

The Struggle For Voice In A School Community

Having voice in a professional setting can often be more challenging than having voice in the context of one's personal life. Women science teachers continually struggle to have their voice heard and their opinions taken seriously by department chairpersons and building administrators who represent power and authority with

the school setting. All of the women in the storytelling group expressed frustration and anger about the lack of communication within their schools. At times, we agreed that authority figures within schools, specifically chairpersons and administrators, purposely withhold information to ensure that teachers' voices would remain silent. By sharing stories about our encounters with authority figures within schools and collectively using our experiences and ways of knowing, we discussed how to become more vocal and work within the system to initiate change.

The following excerpt was taken from our second group conversation in which we were reflectively exploring why it is so difficult for women teachers, especially young, inexperienced teachers, to have a voice outside their classroom and what it takes to be "in the know" in a school setting.

Jasmine: I am in a high school and in a department which consists of me, the one female, and twelve men. Our administration is a male principal and for two years we had a female vice principal and now we have a male vice principal. I think they abuse me all the same. Being that my credential in physical education with a supplemental in life science, I have taught physical science five out of seven years. I don't know why. I don't know if it has to do with my being at the bottom of the totem pole when I started or being at the bottom of the life science totem pole. I guess they needed people to teach physical science and I was nominated.

Finally this year, I went in the first week of school and said I don't have a credential to teach physical science. The principal said, "You don't? Then why have you been doing it for the last five years?" I said, /I don't know. They just work magic; they put my name in and send it to the board and the board says, Jasmine can do it./ So I do it. I've never taken a class in physical science. The

last class I had was chemistry in high school which was twenty years ago. So no college courses, nothing after that.

Lynne: In your particular school, who has control over the schedule?

Jasmine: The vice principal will say the department chair does; the department chair will say the vice principal does; and then they both pass the buck and say the counselors have control over the master schedule.

Lynne: Do you as a teacher have any say at all about your schedule?

Ruth: You could file a grievance.

Jasmine: I could have filed a grievance every year. But as I said to one vice principal, "I like my job here and I don't want to rock the boat in water I can't swim in."

Ruth: I think the state has a law that says you are only allowed to do one year without a credential. If you continue to do so, they are breaking the law.

Sarah: But not if the board keeps giving her a waiver.

Marie: I think you have to be showing progress. The state says they will waiver one year but you have to show that you are making progress toward getting that credential.

Jasmine: I show no progress; I've been regressing.

Ruth: Have you been able to check to see if anybody else could teach the physical science? That's the first thing you want to check on.

Jasmine: Yes, I have, but we seem to have a department full of life science people.

Lynne: Who would you say in your building has the most control over what happens in science education? In terms of what happens in science classes.

Jasmine: I think it is most up to individual teachers. If we want something we ask for it or we demand it in terms of books, equipment. There are plenty of people who vocalize and I've made my voice heard plenty of times, too. I don't think there is any one person who has control of our department. Because we have a split department chair with two of the men sharing the duties. So there is no one figurehead -- we like it that way.

Clare: Department wise - chairpersons. This is my second year and one of the things that I have noticed is that there is a total lack of communication. It is a "black-hole" -- he is a black hole for communication. Information goes in there and it never comes out.

Marie: I don't know how you deal with him.

Clare: Ever since we got back from Christmas break, I started wondering what my schedule was going to look like for second semester. So I trot down to the assistant principal's office and look on her board. And see: Life Science - Prep - Physics - Physics - Lunch - Chemistry - Life Science. Now, as far as the life science is concerned I can teach it. But the only problem I have is if you leave equipment out in your room, the student will touch it no matter how often you tell them not to. Next semester, we are going to be doing acids and bases and I'm wondering how am I going to be able to get things cleaned up and put away in five minutes before the Life Science class starts.

Rachel: Tell them when you found out about this schedule.

Clare: I found out about this schedule one week after we got back from Christmas vacation. I just happened to go in because I was getting this bad feeling because we are near the end of the semester. In talking to the assistant principal, I said that this schedule would cause an unsafe situation to have chemistry followed by a life science class. So I suggested that we switch the schedule around so that my two life science classes would be together or at least not have one follow chemistry. Then I asked, how come we haven't heard about this. She said, "What do you mean, I sent out this schedule to the Department Chairs the week before Christmas vacation and told them to talk to their departments about the schedule and see if there are any problems with it." I didn't hear anything from the department chair. His claim was that he never saw the schedule -- the assistant principal never tells him anything.

It's the peon in the department that gets stomped on and I happen to be the peon and nobody else happens to care.

Rachel: And also when you asked about putting the chemistry first period and then have the life science together, didn't she say "no" we can't do that because the department chairperson refused to switch any of his chemistry classes.

- Lynne: So would you say in your department, there isn't any effort to talk about your schedules and see what would work? You don't do that, do you?
- Clare: That is a nice way of putting it. There is zero communication about scheduling.
- Marie: What about support from the rest of your department?
- Clare: The only problem is this, nobody wants to spend time in meetings. No one wants to meet after school and therefore the only time that people want to meet is during lunch because the department chair teaches "early bird" (7:00 a.m.). There isn't enough time for the rest of us to talk after the "Mutt and Jeff show." So we never seem to get anywhere at meetings.
- Jasmine: I think that the social studies department at our school does their schedule by having all of the teachers sit around and pick one class at a time. Like a "round robin" kind of event. Everybody gets to have a choice. I've wondered why we don't do that in our science department.
- Clare: At least for me, it seems like the assistant principal decides and unless your department chair does anything about the schedule, it is there and it's just tough luck. That really makes me angry. If I had known ahead of time, I would have gone around and tried to get it changed. By the time I was able to find out and get it changed, it was too late.
- Marie: If you went in April would you have any influence with your principal for the next school year? Could you go in and say what you wanted to teach? Would the assistant principal listen to you?
- Clare: Yes, I think she probably would especially with all the talking I have done about this next semester's schedule.
- Sarah: I think this is really important. I have met your assistant principal and she is extremely dynamic and so on, but I'm not sure if she hasn't fallen over into the "male-side" of thinking. How do you feel about that? Is talking to her like dealing with a man?
- Clare: I haven't had a problem in dealing with her at all. The problem is timing and a problem at the department chair level.
- Lynne: If you knew on Tuesday, the decision could still have been made to switch your schedule. That is not a big deal. It really just involves making changes on paper.

Clare: Exactly, but the department chairperson refused to change it because it would mean making a change in his schedule.

Rachel: It is similar to what he told me when I went to him about the forty-three students in my class. No one else really wants to help you because it is not their problem. I went to a department meeting the second week of school and I said to the group: "I have a problem. I am new here; I don't know the ropes; I don't know how you organize things and I have forty-three people in my advanced placement biology class. Can somebody help me or tell me what to do?"

One of the teachers told me later, "I couldn't believe you said that. When everybody feels OK about their class size, they aren't going to get up in arms about your situation."

It was like I shouldn't have expected anyone to help. I knew many of the people in the department and they are nice people, but they were not interested in getting involved.

Then I had a one-on-one with the department chair and he told me that I hadn't gotten those kids out of my class soon enough. I looked him right in the eyes and said, "You know what, I have gotten no support here. I've only been here a week and a half and I barely know who to talk to."

Group: Good for you.

Rachel: All of sudden, I think he realized that this was his job. Then he said, "Look this is the way I do it. I tell them I won't have more than thirty-five kids in class; I won't teach that class. I go down there and I tell them." I said, "Great, you are the department chair and I just arrived on the scene. I'm not going to go down there and say that." But I said OK, if that is what he is telling me to do as the department chair. Then he said, "There are three ways that you can get kids out of your class."

Sarah: Which are the three ways? We'd like to know how he does it.

Rachel: One, you can basically pull them out of a hat, just randomly. Two, you can base it on the last test score, that can be your criterion. But I wasn't comfortable with that since the students didn't know that would be the criterion, so that's not really fair. Or three, you can ask if they will leave. I said, well I have some suggestions. He said, "Go down and tell the principal."

So I went to the principal and I said, "I was informed by my department chair that I can remove three students from my class, and I want them to come out of my AP class." The principal said, "What, who told you that? He is wrong, he doesn't know what he is talking about. We have five weeks to get you under the one hundred and thirty-five you are suppose to have as a part-time teacher. They will come out of your biology class, not your AP class. I said, "So what you are telling me is that I am going to continue to have these forty-three students in my AP class." He said, "Yes." That was all I needed to hear, at least I knew that this was the way it was going to be and I would have to deal with it.

Then on the Friday of the fifth week of the class the principal comes into my class and says, "You have too many people in your classes, you need to drop four students from your classes, but give us a list of eight to choose from, and I need the list by the end of lunch today." I said, /Well, let me just ask you this: How am I supposed to pick these people?/ He said, "Those who are the least likely to succeed." I said, "How do you define that, what is your criterion for that?" He said, "You make that definition, whatever you think." I was very frustrated, but I finally did come up with a list. Some students were from the regular biology classes and a few were from the AP biology class.

Marie: Let me tell you about the one big conflict I had at Eucalyptus when I was split between two high schools, Sequoia and Eucalyptus. The department chair at Eucalyptus wanted me to use the textbook they were using. I said, "No I can't. I already have three preps and that would make a fourth prep if I have to use a different textbook than the one I'm using at Sequoia." He said, "You are going to use our textbook." I said, "No, I'm not. I'm sorry but I am going to use Sequoia's book."

Group: (Laughter) Good for you.

Marie: So he marched down to the principal's office and said, this new teacher is going use her own textbook. The principal called me in and said, "I don't want the department chair on my back all semester so you have to conform." I said, "I'm sorry, I can't. I physically can't do this; I'm doing two schools and three preps. So he said, "OK." So I guess I won.

Sarah: How did your department chair find out what book you were planning to use? Did you say something to him about it?

- Marie: No, not really. That's a really good question.
- Sarah: I wanted to asked you, "Has he discussed with you the adoption of new books for next year?"
- Clare: Well, he has said to check out the books and suggested that I have some of my better students critique a part of each of the books.
- Sarah: Do you know that he has already said, in our interdepartmental meeting, that he knows what books you are going to choose?
- Clare: Like I said, lack of communication.
- Sarah: And also, you should know that if you want to have input you should come to our next meeting or talk to other people in your area.
- Marie: Talk to us, if we get the other chemistry teachers to agree on a textbook, your department chair will be the "odd-man" out. That's the only way that we did the chemistry alignment, we all ganged up on him and got through what we wanted because he only teaches four classes compared to all of ours.
- Clare: He makes decisions and doesn't tell people what decisions he's made. Then it is too late and I'm screwed again.
- Rachel: You know he has gotten in a bunch of books but he hasn't really given us much direction.
- Marie: You should call the publishers yourself, Clare, if you don't have the samples you want to look at.
- Clare: I don't have tenure so I am in a tenuous position. I am in my second year and therefore, what I do in the second year may determine what I do in my third year, if there is a third year.
- Sarah: The seventh month of your second year is when you really get tenure. If you are not fired or let go by that March 15th, it means that you are hired for the next year.
- Ruth: Officially, it is the first day of your third year.
- Sarah: So it really works out after a year and half of teaching you can become tenured.
- Marie: Well, they sure don't tell you. It's not like there are any forms or an official letter that notifies you of that.

- Ruth: What is really apparent from all of this, is such a lack of communication and a lot of it is not accidental.
- Jasmine: I don't get that feeling in my school district. There doesn't seem to be such a power-play between teachers and between the teachers and administrators.
- Ruth: What they have done here is given up to the most offensive person, or the squeaky wheel.
- Rachel: Sarah, how do you know all of this?
- Ruth: Sarah knows her way in and out and all around. I'm not saying that to be negative. I think it is a smart way to be.
- Sarah: In my early days, I was very active with Title 9 and with the association and I got a "Big Red Letter" on my forehead for that. But a lot of people still talk to me and tell me what goes on. But I'm starting to lose touch now.
- Jasmine: She's been nosing around.
- Lynne: I used to nose around a lot, too, because it was the only way you made sure what was going on. You have to learn to do that so you can voice your opinions and concerns before it is too late.

One of the principal values of oral storytelling is that the information shared comes complete with evaluations and explanations, with selective rememberings and subjective interpretations. The stories shared in the one-on-one conversations and within the group session enabled us to articulate and communicate what we believe about the issue of voice. We need to recognize stories as "little factories of understanding" and use them to illuminate relevant issues in our professional lives (Hughes, as cited in Jalongo, 1992, p. 68). By listening to each others' stories and providing support and encouragement for one another, we began the long-term process of cultivating an empowering voice that colleagues, friends and

relatives will listen to and take seriously the opinions expressed. Finding and using one's whole voice takes time and practice. The group storytelling session provided the women storytellers with a time and a space to practice with concerned colleagues who listened and offered support and advice.

For women as well as men, what matters most is that all ways of knowing can be used in the expression of authentic voice. This is dependent on connected relationships, mutual understanding, collaboration and trust of personal experience. (Allender, 1992, p. 24-25)

Passage II: Uncertainty of Influence

A teacher affects eternity, she can never tell where her influence stops. (Henry Adam, as cited by Jackson, 1986, p. 53).

Teaching takes a tremendous amount of time and energy if you do it well. A continuous cycle of papers to check and lessons to plan, meetings to attend and committees to serve on, parental contacts to make, support people to confer with, and extra curricular activities to support and be involved in. This is the reality of living and working within the culture of school, of being caught in a complex web of relationships and commitments. Taking on the role of a teacher does affect a person's life because teaching is a way of life. For most women and men, teaching is more than a job, more than a career because they become emotionally involved in other people's lives. Not just their students' lives, but also the lives of parents and guardians, their teaching colleagues and administrators, the entire support staff within the school community. Teachers do not do their work isolated from other human

beings; they do it with them and as a result their lives become entangled and intertwined with many others. In this sense, Margret Buchmann (1986) was right when she claimed that becoming a teacher is "the most significant choice a professional can make" (p. 530.) because it carries with it society's highest expectations and constraints. When you choose to become a teacher, you are obligated to teach school, obligated to help students learn worthwhile things, and obligated to become an active member of the school community as a colleague and as a role model for students.

Exploring and sharing the reality of life as a secondary science teacher was a topic that we addressed in a group conversation as well as in our journals. The question "How does being a woman science teacher affect your life, your students lives, your department and your school?" is especially relevant for understanding how women live their lives as teachers and how they carry out the professional and moral responsibilities they are obligated to meet. There is no simple answer to this question or a single generalization to be made. The answers are as unique as the individual women who have chosen the teaching life.

The following excerpts were taken from our reflective journals. I am sharing these passages because they resonate with me and portray authentically the joys and the sorrows of life as a public school teacher.

Influence of Teaching on a Woman's Personal Life

Clare. Journal Entry. February 1993: Teaching makes nine and a half months of my life extremely hectic and two and a half months

relaxing. Trying to balance cooking, cleaning, exercise and work is difficult. John, my husband, understands my time constraint and helps with cooking and dish washing. But cleaning house and grocery shopping chews up a lot of my time which is in short supply during the school year. Normally we do not have friends over during the week or on most weekends, just because entertaining burns up too much time. During the summer, when I have more time, I do more reading and socializing with friends.

Marie. Journal Entry. March 1993: Sometimes being a woman science teacher can be advantageous and other times it might be considered degrading. First the benefits. I think being a woman in science has helped me to obtain jobs. Most school employers are not only looking for science people, but consider it a plus to hire a woman. Maybe being a woman helps to fill quotas. Also in my personal life, I usually feel pride in telling people I teach science. Most people look upon teachers either with respect or sympathy. When I tell people I teach chemistry and biology, I usually get this reaction, "I hated science in school; how could you teach that." This type of remark tends to give me satisfaction and a sense of accomplishment as well as motivation to change this attitude in my students. The disadvantage in being a high school science teacher is when I associate with some of my husband's friends or colleagues who have Ph.D.s in a specialized area of science. Some people in science research are very arrogant and look down on me because I am only a high school teacher. You also get this attitude from some students, "You are only a teacher because you can't get a real job." Somehow you just have to rise above it all.

Ruth. Journal Entry. April 1993: To a certain extent being a woman science teacher causes people to treat you with more respect than being another type of teacher. Most people find science difficult and therefore think you must be intelligent if you are able to teach it. On the other hand, being a teacher of any kind rarely gains you lasting respect, even in science. Most of my acquaintances, who are not teachers, chide me for working at such a thankless job, and I agree with them. At the very least the public should give teachers respect. The pay is abominable for the amount of education and the amount of time good teaching takes. Without some reward, and with women finding other fields besides teaching and nursing open to them, I feel that the future of the teaching profession is in grave jeopardy.

Sarah. Journal Entry. April. 1993: I never consciously meant to be a woman science teacher. I never really meant to be a teacher very long at all. I can remember when I was thirteen, my grandfather saying, "Make me a promise, that you will not get married until you are twenty-five." When I was sixteen, I made sure

that my goals were to complete college, and I did. Then when I got to be twenty-five I thought, gosh I'm just getting going, who wants to get married. So it has just gone on from there. Then last weekend, when I was up to see my parents, I must have said that I was getting a little burned out on teaching. I said, "I wished I had chosen another profession so that I could get money based on how hard I work, not on how long I have been working." And my grandfather said, "Well, you know that's partially my fault." I thought, my god, he actually remembers. Then he told me the story from his point of view. It was funny, I don't remember it the way he did. I remember him telling me that teaching or nursing were the things I should do. What he remembers happening, when I was thirteen, was taking me into the front yard and showing me the old man that was living diagonally across the street who had been fired from his job. (I say he was old, but he was really only about forty-five.) He had been fired but they hadn't lost their house or anything because his wife was supporting the family because she was a teacher. And he remembers saying, "You should always remember that you need to be able to go back to work and support yourself." That was good thinking on his part. Unfortunately, why didn't he say, "so you should be a doctor or a lawyer."

Being the dutiful daughter and the oldest, I was always the most responsible and had to fix things up. I wanted things to go smoothly within my family so I was always organizing things. When I started teaching, I used those organizational skill, caring skills, and listening skills I had developed. I think I learned how to listen, to be aware of what the mood was going to be, because my family was so erratic and dysfunctional. Once I started teaching, it was easy for me to pick up on people's body language and all those little things that tell you if a student is with you or against you, or if an adult is with you or against you. Little intonations give you a cue. If something is not working in your classroom, you had better fix it. That's why I've never done the same thing with my classes, two years in a row.

Lynne. Journal Entry. March. 1993: For a variety of reasons, I have never been able to keep my teaching life separate from my personal life. Of course, when I was married, my husband was also a teacher and a coach and so it was doubly true. We were a teaching/coaching family and we both viewed teaching as a commitment, not just a job. I spend a tremendous amount of my own money on teaching, buying books, specimens, materials that would make the class better. Many of us just did it because we wanted the students to have the best possible experience. So what if we didn't get reimbursed or a return from state and federal income tax. Yes, that did impact my life because I could have spent the money elsewhere. I viewed the students as more than just a group of people who whisked through my classroom once a day, for an hour. They became a part of my life, sort of like adopted children in some cases.

Teachers tend to be viewed as teachers outside of school as well. I was always aware that people were expecting high standards from me because I worked with their children. Teachers are supposed to be a cut above the norm and that expectation affects one's life every single day. If a teacher does something that is immoral, illegal or a little risque - - it is viewed more harshly by the public because we are to be role models and exemplary citizens. I have generally accepted that this is part of the job and part of the expectation people have for the position and the influence you have.

Teaching Is A Way Of Thinking And Being

In her work on teacher knowledge, Jean Clandinin (1985) suggests that teachers combine their personal and professional ways of knowing into a form of knowledge that she characterizes as "personal practical knowledge." This form of knowledge is derived from a person's experiential history both professional and personal and is embedded with all the experiences that make up a person. A teacher's actions, knowledge, images, beliefs, and perceptions thus become a part of who she is personally and professionally.

When women teachers talk about the personal and professional aspects of their teaching, they do not distinguish one from the other. Who they are personally is not distinguishable from who they are professionally. Their lives as women are intertwined with their lives as science teachers - - it is not a dualism. Clandinin and Connelly (1993) make this same point in reference to Seymour Sarason.

His life as a psychologist and his life at large are intertwined. It is not that he fails to make a distinction between his job as a psychologist and the rest of his life. Rather, it is impossible to separate them in practice: he is a human being as a psychologist and a psychologist as a human being (p. 7).

It is likewise impossible for a woman science teacher to separate her life as teacher from her life at large. In the following conversation, taken from one of our storytelling sessions, the intertwining of knowledge, images, and beliefs becomes visible as we talked about our personal practical knowledge and how that knowledge influences not only our own lives but the lives of the many people with whom we interact.

Lynne: When I decided to become a science teacher and got really into it, my whole life was being a "science teacher." I would look for specimens on the weekend, and everything seemed to revolve around my teaching. We couldn't even go out on the lake without my saying, "I wonder if there is something here I could collect."

My personal and professional lives were never separate; I never left my teaching at school, even in the summer. I would always be thinking about what I should be doing in the summer to get ready for next year.

Marie: I think it is a profession that you can't leave at the end of the day. I don't know how people can leave every day at 3:00 and not take anything home. It is beyond me.

Jasmine: I wanted to be in PE so I could do that. Honestly, I didn't want to grade papers and I loved sports a lot. Going through college and having to do all that paper work and lesson planning, convinced me that if I went into PE I wouldn't have so much of that. Then my first teaching job was loads of paper work. I think I wrote in my journal, my epitaph should be "I have papers to grade." Everyone always asks me, what are you doing this weekend and I always say, "I have papers to grade." It becomes a part of your life. It is like you mentioned, everywhere you go, whatever you do, you are collecting. I go to the county fair and I'm collecting all these pamphlets about health, heart attacks, bicycling, physical fitness.

Clare: You turn into a pack-rat almost.

Rachel: I think being a teacher of science helps me to better understand science in my personal life. It was one thing to study science as student, but now that I am a teacher I have to know it so much better. So in that sense, I have become more aware of science.

I have to be honest and say, I think science teaching is a means to an end. And that end for me is not that my students become the best scientist in the world. For me, my end is that the students get excited about the world around them, that they find they are able to do something that they have never done before, that they develop skills that improve their ability to observe and see, as wishy-washy as that sounds.

Marie: I hope that even my basic students can vote intelligently; that they will have some kind of scientific literacy and be able to read a newspaper or an article and go "Oh, I understand what this issue is about."

Rachel: I've noticed that my personal life tends to be influenced by my students. Not just my science students, but students who come back to talk with me about what is going on in their lives. That has influenced my personal life in terms of who the people are that I interact with. I understand the collecting thing too. Like today, we were out by Silver Lake and I saw these perfect "sporophyte moss." There were tons of them and I thought "Where were they when I was doing my moss lesson?" So I do proceeded to do a little lesson on "gametophytes and sporophytes" for the two people I was walking with.

Are We Influencing Students' Lives?

Marie. Journal Entry. March. 1993: I guess we all down deep hope that we are a positive influence on all of our students, but unfortunately there really is no way to know just how we've effected our students' lives. I'd love to say I've changed students' attitudes toward science and have influenced some of them to pursue careers in science. But I don't know for sure how many that might be.

Clare. Journal Entry. February. 1993: I hope having a woman science teacher is a positive and encouraging experience for my students. I usually pepper my discussion and lectures with comments that point out the inequalities that exist between the genders. I try to call on the females of the class more often, even though I must admit that the less mature, unruly males are a dominating factor in class, at times. I like to ask my older students about their plans for the future and rally behind them if they are thinking about pursuing a career in a science related profession. I must admit that I talk to many more females about their future than males. Perhaps it is because more females talk to me. I also tend to push my minority students to challenge themselves more by taking a higher level science class. For the summer engineering program, I

try to actively "recruit" two or three females to participate in this unique opportunity. Does a female teacher make a difference? I do not know. I do believe that students need to see more female teachers in science. They need to see that women can be successful in physics, chemistry and biology.

Lynne, Journal Entry, March, 1993: I have always felt that it was important that my female students view me as just an ordinary person who did well in science - - which meant they could do well also. I encouraged all of my students to think about going into a science-related career, but most especially I encouraged the female students to consider it. I hoped that because I was a woman, it would be easier for them to envision themselves being a science major in college and doing science as a career. If students only see male math and science teachers in high school, I believe a subtle message gets transmitted; a message that implies that math and science are subject areas that women do not choose to enter or perhaps do not excel in. I'm sure that there were some students that I affected negatively because of my teaching style or personality. In particular, I know that some of my male students really struggled because I represented a female authority figure. In fact, I had one mother tell me that the problems I was having with her son were occurring because I was too much like her and the hostility just transferred over.

Lynne: When students do come back you start to realize that you do make a difference. Maybe not for everybody, but a few, and I think that makes me take my role pretty seriously, as far as the kinds of things I do and say and the choices I make.

Rachel: I think it tells you something about yourself when you see what types of students are coming back to see you. For me, the types of students who come back are not the A+, content focused individuals. That tells me something about my focus. The people that come back to me are people who said, "I didn't think I'd really like science."

Marie: I think the A+ students, or the kids we work with in the summer program, are already motivated and already into science. Someone, somewhere along the line touched them years ago. We aren't going to influence them. It is the border-line students, the lower-achieving ones that never thought about science.

Rachel: You're right. I think that is a really good point.

Clare: But usually you do end up just getting the A+ ones to participate in summer enrichment programs.

- Marie: They are the only ones that are interested enough in science to give up their summer.
- Rachel: Or even know enough, or are confident enough to get involved in a summer program at a University. That is a big leap for some of these students.
- Marie: Part of that is going to be the teacher input this year. Can we get those border-line students to apply, can I get the girl who got an A in Chemistry, that has a two year old child at home, to apply. She is going to be working at McDonald's otherwise, she might just as well apply and work in our program.
- Lynne: I think it is difficult too, when programs are set up where students end up going by themselves. If you are bringing in a group, it is a little safer. Students have to be pretty secure and confident to apply to a program on their own, not knowing who will be there and who they have to interact with.
- Jasmine: I know that I have influence because part of their final exam is to write a letter to me. It's not graded but it can persuade me to give them a higher grade if they are close to it. What I do, is to list the major topic we have covered for the semester in Health, and ask them to talk about what they have learned in each of the topics and how it has helped them in their life. Each and every student has to write one.

Even in the smallest way, I know I have made a difference when a lot of the girls will say, "I learned to feel better about myself. I am me and I will make my decisions and not let other people persuade me to do otherwise." The power in that, itself, is incredible for me as a teacher. It makes you go away, at the end of the semester feeling that you have done a good job.

I had a boy in tears last week. He came in with his "Raiders" black jacket and black Nikes. We are talking "don't meet him in a back alley" type of guy. I made him come back at lunch to finish an assignment that he was really confused about, how to write a menu for a class project. I said to him, "You have it right here. I want you to get this A; you have these good ideas right here." I could see his eyes getting red and he was blinking back the tears. Somebody finally touched him and said, "you can do this, I believe in you." Now, he's turning his work in.

Lynne: It is similar to what Rachel said, caring really isn't the fluffy part of science classes. Wanting them to care about outdoors and have good feelings about themselves. I think that may be more important long term than the content, even for people who are going to be science majors. We all know that they are going to get plenty of content in college.

Rachel: Well, I don't know. I taught with someone who was a very content-oriented type of teacher. He attracted kids who were really content-oriented. They wanted to come in at lunch and talk about the "theory of relativity," they loved that. But that wasn't the kind of student I attracted. So that was a realization for me - - I don't think that one is better than another.

Jasmine: Do you think we are more nurturing, just because we are women?

Rachel: I don't know, I don't have enough experience to say that.

Marie: I think you can actually pick the kids you want to reach. In my class, I have thirty-seven Physical Science students. Well, perhaps there are five of them I think I can reach and I will target them. Maybe the "gang kid" who at least shows up everyday. You can actually make a conscious effort everyday day to say, "How are you doing?" Try to keep them going and motivated. Then there are the students that you never know if you reach.

I had one student, who was my teaching assistant, that I though was bright. I encouraged him along the way. He did well in Biology. Then the gang he was in beat up a kid so bad, they thought he was going to die. That scared him and finally he got "jumped out."

Lynne: What does that mean, "jumped out?"

Rachel: If you "jump-in" you get beat up and when you "jump-out" you get beat up.

Marie: But he went on, and I encouraged him to take calculus during the summer. Although he dropped it, he did take it again in the fall. Then he took physics and chemistry and really liked it. He actually got an appointment to the Air Force Academy because he was an excellent football player. He didn't last because he said it was too cold and regimented; remember he was a gang-boy from LA. I

hadn't heard from him for three years, and then he finally called me last Christmas and said that he was playing football at Fresno state and majoring in mathematics.

Rachel: One of the first things that we do when the student teachers come in, during their orientation, is to have them think about the teacher who has influenced them the most. We ask them to write a letter to that influential teacher. Nine times out of ten, they had never told that person how inspiring they were. Usually teachers have no idea how much they may have influenced a student because they don't tell you.

Ruth: I had one girl, the last semester I was teaching at the high school, that was a match to your boy; she was a "gang-girl." I flunked her in physical science because she never did anything and only came to class half of the time. Then she became my aide; the best aide I'd ever had. She took over and ran the show and just turned her life around. She graduated last year and did very well. I really didn't do as much for her. Sometimes the students you do the most for you never hear from and then other times, you find out how much you mean to someone who never said anything.

Marie: A lot of times you hear through parents how much your class meant to their child and what a positive influence you had been.

Ruth: I have another student I just heard about that was really an upper. It involves a student in my first period class for disabled students. The special education teacher of these students came and wanted me to know how well things were going for one of the students in my first period class. The little girl in a wheel chair with cerebral palsy has been invited for a sleep over with the girl she is doing her science fair project with. The student was so excited to be invited over and be treated like other girls her age.

Ruth: On a personal level, I think science teachers are often viewed as the expert. The expert on everything and I'm also the "doctor." I'm expected to diagnose illnesses in my family. Even other people will ask me questions just because I have a science background.

On a social level, it makes a big difference to people that you are teaching science. I think in a way, you get a little more respect because people assume you must have a brain.

Marie: The woman I do yearbook with is a PE teacher and she seems to be treated differently. The staff and students seem to respond to her differently. I'm not sure why but I think it is because we are in different content areas.

Rachel: Do you notice a difference if you tell people you are a PE teacher versus if you tell them you are a science teacher?

Jasmine: I guess all of my friends know I do both, because I also coach.

Marie: My kids that I coach freak out when they see me in the hallway for the first time. They see me in heels and a skirt and they are amazed that I am a teacher. Yes, I teach chemistry. They are so surprised because they just assumed all I did was coach.

Ruth: Another thing that I think is important is to wear your lab coat. I'm not kidding. Especially women because so many times they think that only the men are science teachers. I can remember one time I was walking down the hall at the high school, with my lab coat on, and some woman came up and asked me if I was the /school nurse./ I went back to one of my male colleagues and said, "Boy, that really gets me. She asked if I was the school nurse. If you had stepped out in the hall with your lab coat on, she would have asked you if you were the 'doctor.'" "Oh no", he said, "she would tell me, deliver the meat to the rear."

To my way of thinking, it was important for students to see me in that role, as the science person. I used to always say, I am a scientist as well as a teacher.

Marie: Some of the really bright kids kind of look down on you and say, "Yea, you couldn't do anything else with your life and that's why you are a teacher."

Ruth: I point out to them that I could have gone on and done something else with my major. I do try to get respect with the lab coat. Of course, after a few years it has holes and stains and it may not work as well. Except it looked like I have years of experience.

Marie: I think in my personal life, I might get respect at the school but not when I'm socializing with my husband's doctoral friends and professors. They say; "Oh, you are a teacher." All of a sudden, I realize that they don't see me as a science person. I probably know basic biology and chemistry better than they do. But it is a very different attitude.

Ruth: But that is education for you. Out in the public world, being a teacher may not be so good, but being a science teacher is better than other disciplines.

Rachel: That's interesting. That's why I think it is important for people to see teachers who are very committed to what they do, who take what they do very seriously, who are very intelligent and are not the complaining, whining type. Even in the Graduate School of Education, the professors who do research are looked upon with higher regard than those who are working within the Teacher Education Program. It is an attitude again.

But on the other hand, it is how you choose to be. Are you going to assume because someone sees me as something less, I'm going to be something less or are you going to ignore them and let it be their problem?

Marie: It takes a lot of confidence though.

Clare: It's interesting because the people that I socialize with, that are involved with the students in the Summer Institute, are curious to know what I am teaching. They often talk "shop," just like we do.

Marie: Do you feel that you can't talk with them?

Clare: No, I feel like I can. My background is in engineering and so I have a basic idea of what they are doing with their research projects. I actually understand the topics they discuss so I can contribute.

Marie: Friends that know us really well, that we do a lot with, know I am a science teacher and I can talk with them. The other ones who just think of me as Jeff's wife, they actually act differently. They don't necessarily know that I teach science.

Clare: Its also strange that someone, who is a science researcher like my husband, has never had a biology class. I asked him, "How could you go through your whole life and not have a biology class." He says, "Well, I did it." Most of the men in his doctoral program don't have a biological background -- they pour all their energy into "semi-conductors."

Marie: You never really leave science when your husband is involved in it as well.

- Ruth: The other thing that comes to mind, is the real excitement you get on certain things. For instance, today Sarah had purchased some cultures for us to use when we do our pond water lab. She came running into my room and said, "Come, come, come!" So I ran back to see what is going on and she had found some "paramecium in conjugation" and we had never seen that before.
- Marie: Yes, and all the wacky science teachers got excited.
- Ruth: It was fun and we both got so excited watching them swim together.
- Lynne: I think it really helps the students to see us get excited about science and be so enthusiastic about what we will be doing in class with them.
- Ruth: The other thing I wanted to bring up is as a mother, the influence I have had on my children. I was watching a video recently of my little grandson and my son turning over rocks down by the tide pool. I can remember taking my sons down to the beach after school and we would go tide-pooling. They still have that interest and curiosity in science. I'm sure that I have influenced them some. My children have gone more into science professions (a doctor and a pharmacist) than my brother's or sister's children.
- Marie: I think the most frustration I feel in school is when we can't influence students. We have so many kids or it is not an ideal teaching situation. You want to be able to do that - - to stimulate students' curiosity.
- Rachel: You know, Marie, how you said that you wanted to get the kids involved who were border-line or didn't have a good home environment. Going back to Lynne's question, "Do you think that the men in your department have that same attitude about whom they want to affect?"
- Marie: I would say no. I would say that they don't consciously think about it, but I would say neither do a lot of the women. I think it is the individual teacher who really thinks about influencing those students. Most of the teachers who work with the "basic students" all day, are more aware of helping them and keeping them motivated.
- Ruth: Going back to whether it is a male or a female, the fellow that I worked with had a wonderful rapport with students and he had a tremendous influence on all kinds of kids. I think, Marie is right, it is the teacher. But I think

every teacher, even the ones that we think aren't very effective, do influence some of the students in their class.

Marie: You hate to lose them, just because of class size or not having an ideal teaching situation. You think, "I could have influenced that student, but you lose them."

I had a really good kid, who walked in one day and said, "I'm leaving. My gang is down in LA on Hollywood Blvd. and I'm going to go hang out with them. So here is my book, I thought I would give it to you." So I said, "Let's sit down and talk about this." I even had some students trying to talk him out of it. But he said, "Sorry, I'm out of here."

Lynne: I don't think that a lot of people take seriously the importance of "care" in teaching. It sounds too feminine and its also not one of those factors that can influence a school district to reduce class size. It is an issue that we all know is an important component of teaching, but researchers and administrators tend to overlook it because it is difficult to describe and difficult to measure and evaluate.

Ruth: It's funny, that is one area that we are never measured on, what influence we have on our students.

Clare: Administrators just come in and fill out their little forms, leave and have their secretary type it up.

Can We Reach Our Minority Students?

All of the women in the storytelling group, with the exception of me, are teaching in schools with high percentages of minority students, primarily Hispanic and Filipino. They all expressed concern about how to reach this group of students, who traditionally have not found science welcoming or accessible, and give them the support they need to take advanced science course and perhaps pursue a science-related career. At one point in our conversations about "teachers influencing students," we discussed the dilemma of providing a supportive, connected role model for minority students.

Can any teacher serve as a role model or do minority students respond more favorably to someone from their own culture, someone who can speak the language and make connections for them?

Ruth: As a teacher, when you run into a minority student that is capable, you wonder why they aren't taking the more challenging science courses. They should be because of the law of averages -- you should have basically the same percentage of intelligence amongst all students, regardless of race or ethnicity. But a lot of times, it is tied to their early preparation in science and school in general.

So many times, in Hispanic families, the attitude at home is "bear with this schooling, it will be over soon, and then you will be out working with me."

Jasmine: For many of these students, family comes first.

I think our Filipino families provide excellent support. Right now, we have three Filipino girls that are straight A students and at the top of their graduating class.

Marie: At our school, we have a complete separation of our students, with most of the minority students ending up in the "lower-level" science courses (life science & physical science). So Jasmine, how are your students at Cherrywood able to handle it and ours are not? Do they get tracked differently in elementary or junior high school?

Jasmine: I don't know. I don't know what the elementary and junior highs do because we are not unified. Since our student body is 85% minority, we don't have the separation you have. If we offer upper level science courses, we just assume that our minority students will fill those classes and as a teaching staff, we actively push them to do so.

Marie: Did you see the recent article in the newspaper, the breakdown of ethnicity in the elementary schools in Redwood? They were about 90% minority.

Clare: And what ethnicity are their teachers?

Rachel: You wonder about how much that makes a difference too.

Marie: Do they have role models?

Ruth: There are a variety of teachers in the elementary schools in Redwood. I know of several black and Hispanic teachers in our district.

Lynne: It is very difficult to find people of color going into science education. They are not going into teaching - they have other more attractive opportunities.

I know that schools desperately are trying to find minority teachers or even teachers who are bilingual. Jasmine, do you have a lot of people in your science department that are minorities?

Jasmine: Me, Chinese and the only female.

Ruth: (Laughingly) They got a "double token" with you.

Jasmine: We have one male who is Brazilian and he teaches the bilingual biology and physical science as well as an honors biology class too. We have two other Hispanic males that teach physical science and the other eight are white.

Marie: We have one Hispanic teacher at our school, that the students say "doesn't count." I've commented to them before about, "Isn't it wonderful having Mr. S for class." The students don't see him as a role model because they say, "Mr. S has left his barrio and he's never gone back, so he doesn't count." He's from the Lemon Grove area in LA and when he left for college he never went back and now he lives in Redwood, which is white and rich.

Rachel: And those students don't like that?

Marie: No, they don't see him as a role model.

Ruth: You also have at your school Mr. S, who is from Mexico.

Marie: He's had a lot of trouble and has been accused a number of times of being "racist."

Lynne: You mean, the other way?

Marie: No, against the Hispanics. He has said, "Excuse me, my name is Amado Salizar."

Ruth: His accent is so thick, it is even hard to understand him sometimes. But you know why? I think it is because he doesn't want to be stuck with all of the ESL kids; he would like some of the bright kids to teach.

Marie: I'm not sure that's it. He does feel the connection. But he pushes the Hispanic kids and they get upset. He doesn't let them speak Spanish in his class, even though it is ESL, because he wants them to speak English and learn the language. He is a very tough teacher. I know that he often uses college notes to present content.

Ruth: I remember, one time he was having his students learn all of the spinal nerves and their locations and also all the markings on the bones associated with them.

Mr. S is from the very poor area of Mexico. He came up here as a longshoreman and got into teaching later.

Lynne: We have a Hispanic student teacher in our program this year who is from Channel View, which is a community with a high percentage of minority families. He wants to go back to his home school in Channel View to teach but he doesn't know any Spanish at all. I have thought that it will be a big disadvantage for him because the students will expect him to be able to speak Spanish.

Jasmine: The other two males in our department, that are Hispanic, do not speak Spanish. They aren't fluent, they just know a few words.

Marie: Mr. S. is not fluent either.

Ruth: I had a student teacher one year, who was Hispanic and didn't speak any Spanish, and what would happen is the Hispanic kids would speak to him in Spanish and "wink" at him. He would fake it with them and say, "I know enough to know what you are saying." He was taking Spanish on the side and learning the language, but it was a real disadvantage because they sometimes felt he wasn't "one of them."

Ruth: But at the same time, think of the teacher from "Stand and Deliver," the math teacher from LA. You need a good role model. We've talked a lot about people who are Hispanic but maybe they aren't serving as effective role models. Student need any role model, regardless of their color.

Marie: They need women in science also.

The teacher from "Stand and Deliver" did leave LA and went up by Sacramento. They paid him a lot of money to go there and went through a lot of special channels to get him. Think about how the teachers at that school feel, when a teacher comes in, from another district, and is paid twice as much as everyone else.

- Ruth: It was amazing what Jaime Escalante was able to do. It is the two things together.
- Marie: It was what he was able to accomplish over a four year period, even though the movie portrayed it over a one year time span.
- Lynne: Look at the time and dedication he put into that endeavor. That is part of it also - - are you willing to have teaching be your life. It almost has to be if you are dedicated to a very tough situation.
- Ruth: Again, I think you may have to be the same ethnicity to accomplish what he did.
- Group: I don't think so.
- Rachel: I think so, at least how it was portrayed in the movie. I think he understood his students better than someone from "outside" of that culture. What was the word he used?
- Clare: Ganas.
- Rachel: Yes, that word. I don't know that word; I wouldn't have been able to give those students that "drive."
- Marie: I think the problem is you really don't know what will inspire these students. He reached them because he did know how to motivate them.
- Rachel: I know as a woman, I really appreciate having a role model that is a woman. As a female student, I would appreciate a role model that was another female.
- Marie: Last summer at our Institute, Redwood High School had the most girls applying to the program. Well, we have four women in our science department. There are Isabelle in biology, Sally and I in chemistry and Carrie in physics. The girls that actually applied had one of us as a teacher. At Eucalyptus High, we had Clare who had two girls apply and one was Clare's. From Sequoia High, I think there were two girls. The ironic thing was one of the girls had biology from me as a freshman and the other had taken chemistry from me at Redwood and then transferred to Sequoia.
- It is very interesting to look at who applied and why they applied. Maybe the other girls were intimidated since they don't see women actively involved in science.
- How many women math teachers do you have in your schools?

Clare: We have one in our school, Theresa.

Rachel: Theresa says it is very frustrating to be the only woman. And she was even on the men's football team in high school. So she is used to dealing with men. She has said, "You know when I really want to talk to somebody, there is nobody in the department to talk to."

Lynne: I think it makes a big difference to have women in math and science. But there doesn't seem to be convincing evidence to support the need for more women teachers in math and science.

Even when I took a leave of absence from my school, I had a terrible time convincing the female assistant principal that a woman should be hired to take my place. She said, "I don't think it is an issue at all. You are being entirely too biased." I said, "Yes, I am."

Rachel: I remember when I was hired to take Jean's position here this fall, Clare said, "I'm so glad they hired a female otherwise I would have been the only female in the science department."

Marie: I want to know how the guys are influenced. My husband was talking to one of his colleagues, who has a son going to Redwood. He was saying that his son had Isabelle for biology, me for chemistry, and now he has Carrie for Physics. That was really strange -- this male student had all women teachers for science.

Lynne: I can't even think of what a percentage that might be, that a student could go through three upper level science classes in high school and have all women.

Marie: I wonder when he goes into college if he will be more accepting and less concerned about stereotypes.

Clare: When the two speakers came to my classes to talk about the Summer Institution, it was really funny and I thought now they are going to think there are no white males in science either. One of the speakers was Rea, who is an Indian female and Al, who is a black male. This is totally different, to have two minorities represent science. I wondered if they picked them for that reason.

Marie: I think there is a lot of opportunity for minority students in science. There are a lot of scholarships available, even if they are just a small percent minority. Whereas the white kids are just out of luck.

It is a disadvantage now to be a white male like my husband, especially now that he is job hunting. But somehow, we have to break the mold and help our minority students break into science, even at the expense of white males.

Ruth: It shouldn't really have to be at their expense.

Marie: Even if it takes extra tutoring in high school or whatever support we can give them.

Are We Influencing Administrators and Teaching Colleagues?

Marie. Journal Entry. February. 1993: I feel most of my colleagues respect me, as I respect them. All of us work hard, and for the most part work together. There are a few men that not only respect me but also have encouraged me in my teaching and motivated me to become even better. A few women have supported me as well. It was because of these people that I made it through my first few years of teaching. They modeled good teaching for me, gave me advice when I asked and even watched me teach just to let me know I was doing OK. Unfortunately I have worked with colleagues whom I did not respect. Some were poor teachers with whom I had little association. One in particular I had trouble with because I was a woman. It's unusual to have conflict with other women just because of gender, but I honestly think the head of our department and I had conflicts because of it. I often felt that she was constantly competing with all of the women at our school. She seemed to have the attitude that because she was a woman in science that she had to work twice as hard as any man, and any woman under her would also have to work as hard as she did. She never made anyone's life easy. Every conversation had to be a battle. It took a couple of years to actually come to a peaceful compromise and convince her that the women in our department were not out to get her. Our relationship got better because I made an effort to involve her when important decisions needed to be made, whether they affected our department or not. I also tried to seek her advice more often so she felt a part of the department and not threatened by any of us. It took some work, but finally I think she is at ease with the women in the department.

Working with our administration is a completely different story. All of our administrators are male. I can say, very definitely, that two of our administrators treat me with respect and two don't. There is nothing more humiliating than an administrator who will not listen and who treats you in a condescending manner. I often feel that several of the administrators only pretend to listen just to humor me. Many times one of them has patted me on the back

and said, "Oh Marie, what are you complaining about this time?" It is very humiliating and indicates that no matter what I say, I won't be taken seriously.

Ruth. Journal Entry. April. 1993: As far as my fellow teachers are concerned, I have found some a joy to work with and inspirational and others have been difficult, petty and poor examples of what education should be. Male or female made no difference. For my part, I have tried to give my best and be generous with my time, talents, and supplies. As I reach the final years of my teaching career, I am less generous especially with my time and often feel that working by myself is probably better than trying to work within a department.

Clare. Journal Entry. February. 1993: Teaching can be an isolating profession. Most teachers close their doors and that's the last you see of them. I can go for weeks without seeing some of my fellow science teachers. Most of the teachers I work with are old enough to be my parents. Relating to them, after they have spent years in public education, is difficult. Giving the youngest teacher the worst schedule seems to be a tradition that gets passed on. No one really cares about helping the new person. I can name, on one hand, the number of times a veteran teacher has shared a great idea with me, much less asked me how I'm doing. Why is it that teachers really try hard to nurture and help students to grow but neglect their own colleagues? This trend is extremely negative and doesn't help the students or the school.

Sarah. Journal Entry. April 1993: I think before I realized that I never wanted to be an administrator, I started being involved in the "Mentor Teacher Program." I had been the curriculum coordinator; I had been all these different things. I really felt that teachers in the district were important and had a lot to offer so I got volunteered to become a mentor teacher. In the end, I got the job as mentor coordinator for the district for elementary and secondary. I think that a lot of that came from the respect I had earned over the years. I think all of it goes back to fact that I listen to people more and try to make them happy and organized. I try to show them that there are easier and better ways to do things and to do your best so that you can get the most out a situation that you possibly can. I think that is a positive impact. And I worked really hard for three years as the "mentor coordinator." I think I became totally frustrated about my inability to convince people. I knew all a long that I hated to argue my point of view and perspective and convince people I was right. My tendency is when people say, "You are wrong," then I back down and say, "Oh really, OK, I'll try again and get it from your point of view." Men don't do that. They just keep pushing their perspective. So after three years of arguing with men and women about the "mentor

program," which was more difficult than I ever imagined, I quit after being with the program seven years. So this is just my second year of being a five period, full-time science teacher again.

Lynne, Journal Entry, March, 1993: In the teaching assignments I have had, I was conscientious, hardworking and took my job very seriously. I think that my dedication to teaching influenced those I worked with. I was viewed as someone who could be depended and I was never willing to let responsibilities slide. Within a school, administrators, guidance counselors, and teachers know who students like and who is doing an effective job in the classroom. If you are doing a great job, people tend to listen to you more and take seriously the concerns that you have. I felt that I was well respected by my teaching colleagues and the administrative staff and therefore was comfortable pushing for change and being vocal about the need for improvement within my department and within the school as a whole. Needless to say, not everyone I worked with supported my initiative and often resented the leadership roles I played. Many staff members wanted to maintain the status quo within the school and were not eager to venture into unknown territory, especially if the final outcome was uncertain.

Collective Problem Solving - Collective Solutions

It is clear from both the journal entries and this conversation segment that women science teachers are frustrated with their colleagues who will not share equipment, materials and ideas or respond to the needs of younger teachers. How can a teacher develop collegial relationships with staff members who prefer to "close their doors" and remain isolated in their personally constructed niche? Everyone in the group expressed a desire to collaborate with other science teachers and be colleagues, in the true sense of the word. Roland Barth's (1992) summary of Judith Warren Little's (1982) definition of collegiality in schools closely resembles what the women science teachers wish to have. Collegiality is:

- o Adults in schools talk about practice. These conversations about teaching and learning are frequent, continuous, concrete and precise.
- o Adults in schools observe each other engaged in the practice of teaching and administration. These observations become the practice to reflect on and talk about.
- o Adults engage together in work on curriculum by planning, designing, researching and evaluating curriculum.

Adults in schools teach each other what they know about teaching, learning, and leading. Craft knowledge is revealed, articulated and shared.
(as cited on p. 31.)

As a result of our group conversation about the influence or lack of influence we have with students and teaching colleagues, an important transformation occurred within the group. Instead of being simply a supportive, listening storytelling community, we became a community of collaborative colleagues who willingly provided not only advice and suggestions but also supplies, equipment and lesson plans.

Sharing:

- o Jasmine donated five hundred petri dishes to Ruth and Sarah for their junior high classes along with two complete curriculum units on cancer produced by the American Cancer Society.
- o Marie contributed six boxes of supplies and equipment to supplement and restock the junior high science stockroom.

Observing:

- o I spent a day in Jasmine classroom observing her health classes to give her support and feedback and to learn new strategies for working with culturally diverse students.

Teaching:

- o Marie worked with Sarah to arrange a demonstration at the junior high using "electronic circuit boards" from the summer institute program and provided follow-up support later in the year.

Engaging:

- o Rachel shared with Sarah a plant unit she had developed, which Sarah in turn adapted for her and Ruth's junior high classes. I benefited as well -- Sarah gave me copies of her unit to share with the science student teachers I was working with.

"Collegiality is nice -- but it is extremely difficult to introduce into the persistent culture of schools" (Barth, 1990, p. 31). Changing the culture of schools from an isolated "I" to a collaborative "We" is a challenge but not unattainable. The first step is encouraging teachers to talk to one another, observe one another and help one another. Within our collaborative storytelling sessions we began the process of moving from an "I" way of thinking and doing to a "We," from merely talking as congenial friends to acting as reflective collaborative colleagues.

Passage III: Breaking the Silence
- Unleashing Women/s Voices

I believe that Evelyn Fox Keller (1985) is correct in saying there are a multiplicity of goals and standards in science and science education that need to be blended together. The experiences, perceptions, and values of both women and men are necessary for the development of a healthy science and a healthy earth. Keller is also correct when she proposed that creating a

healthy science, a healthy earth and a revitalized version of science education will not be possible unless we recognize "science as a human project instead of a masculine project, and the renunciation of the division of emotional and intellectual labor that maintains science as a male preserve" (p. 178).

We need to recognize the enormous variability, both culturally and individually, that exists among men and women that goes beyond gender and beyond biological differences. Variability is what fosters and encourages the "having of wonderful ideas" (Duckworth, 1987). The diversity within the human race extends into every classroom in this country. We are not teaching just a single type of student in our science classrooms and therefore we cannot allow science and science education to be defined by a single goal or a single standard. It must be broadened to encompass a diverse spectrum of human experiences, values, and ways of knowing so that science can be for all not just for a select few. We have the ability to make thoughtful decisions and wise choices about nature, about science education, about the kinds of learning experiences and learning communities we provide for our students. Will we pay attention and listen to the many voices of experience, those of classroom science teachers, and utilize their wisdom as we initiate new reforms in science education? Will women science teachers be empowered to take a pro-active role in the reform process and overcome their resistance to change?

The Problematic Nature of Change

When these women science teachers begin to talk about the changes they would like to see in science education, they find it is exceedingly difficult to envision a science education program designed specifically to meet the needs of all students and teachers rather than the needs of district administrators, State Department of Education, and the University of California Admissions Department. For years, public school teachers have been told what the goals of education would be in this country and how these goals should be attained. Rarely are classroom teachers given the opportunity to express their opinions or are asked for significant input when policies are created at the local, state and national levels. Edicts come down from above and teachers, who occupy a low level position in the school hierarchy, are expected to passively implement someone else's goals and objectives.

To understand the dilemma women science teachers face when they are asked to initiate change, we need to listen to their description of being caught in the middle of a game of tug-of-war, where they feel they can't win. The following excerpt is from a group conversation in which the initial topic was: What changes would you like to see in science education and what role do you want to play?

Marie: I can say first that I would like to see the basic science classes changed into a vocational track. Jasmine, you are seeing some of it because you have integrated your basic classes. We meet the needs of our college prep students because we are fundamentally preparing them for college. It is very rigorous, the course of study is biology, chemistry, physics. The other 50% of our school is lost, the students who don't go onto college. We don't meet

their needs; they are learning things they don't need to know. We are losing that percentage of our population. Somehow we have got to meet their needs.

Lynne: Do you see their needs as distinctly different from how we see college prep students?

Clare: Yes. They don't need to have all of the nitty-gritty details. For instance in Life Science, they don't need to know every single part of the earthworm and how each part works. They just need a general idea of how what they do affects their body and their environment.

Ruth: One of the problems is imaging what they might be doing in the future because careers are constantly changing.

I'm sitting here thinking, I wonder why they do the "earthworm" in high school when we do it in junior high. Why keep going over and over the same information?

I think we also need to take a look at safety, the handling of chemicals and dangerous materials. I remember the UPS man dropped a container of nitric acid right in the middle of the street. All of a sudden, here is this box giving off chemical fumes. This UPS fellow had no idea what to do with this disaster.

Marie: Our UPS man dropped a bottle of carbon tetrachloride. He said, "Don't worry, I'll clean it up." So he proceeds to clean it up and throws it in the school trash can. He didn't have any idea what it was or how to handle it.

Ruth: It is likely that some of our students will be in jobs where it is important that they know safety around chemicals and science materials.

It would be nice if we had some articulation between junior highs and senior highs so we don't recreate the wheel. Let us, at the junior high, do some of the basic activities and labs to keep them interested and busy.

Sarah: What I hear us talking about is a real major change in the definition of science? I don't see anything wrong with teaching them how to be Consumer Report product testers.

Lynne: If we are trying to give all students an equal exposure to all of the sciences, which includes physical, earth and life, the question I have is: Do you see that having a course that integrates all of the sciences will be an important step toward helping students have a diverse enough background to understand science as a whole?

Is there a basic scientific background that we would like everyone to have?

- Ruth: What would we agree on? It would be interesting and we have been trying to do that with life and physical science.
- Jasmine: If we ultimately consider that 50% of the student population is going to go through twelve grades and never go any farther than that with their education, what would we want them to know in the field of science?
- Marie: You still have to separate, unfortunately, the college prep from the non-college prep.
- Jasmine: You can still do that, like we are doing with our integration class for 9th and 10th graders. It is a two year class to satisfy their graduation requirement for science.
- Marie: One of the problems with our college-prep curriculum is that the students are not getting any geology or astronomy. I remember when we went through our accreditation study in L.A. and we were told you have to incorporate geology and astronomy. We said, "Fine, here is our curriculum. You tell us where we can fit in those two content areas." You can't do it -- you can't take a quarter out of chemistry and teach geology or a quarter out of physics to do astronomy. Because if you do, you are not preparing them for college. They have to have all the "basics" in every area.
- Lynne: Well, it depends. It's not that you can't; it's a matter of deciding what the proportions should be and what needs to be covered. For a long time everyone has said, geology and earth science are not that important. It's not a big deal if students don't have a background in those two area. But in fact, I think it is a big deal if you consider all the natural events that occur as part of a student's daily life. It seems that geology and earth science are always at the bottom of the hierarchy. I think part of it is an issue of whether you are trying to graduate a well-rounded science student. Is that what we are doing?
- Sarah: First of all that is the wrong premise because we are not driven by our own desires. We are driven by the state and by university mandates. So what they request is what we do.
- Jasmine: Who makes the changes?

Sarah: It comes at the university and state level.

Jasmine: Why can't there be a combination within a high school to meet all the criteria?

Sarah: I'm not saying there couldn't be, all I'm saying is that what has been going on is the standard traditional, A-F requirements. That is all they think about.

Marie: When you look at what you teach, every year you are cramming in so much. There is no way that I can fit anything else into that curriculum. I am preparing them for college. Now I could easily change that curriculum and be very well rounded. But is that fair to the student who has to compete in college with students from L.A. and Northern California that are better prepared because they have had "kinetics" and "equilibrium" and everything else? I don't want my students to get to college and have no idea what the professors are talking about.

Jasmine: Right, but I think we are confusing the issue of students going to college and students just graduating from the twelfth grade.

Marie: We have a curriculum and a set of objectives to follow. But no one ever follows them or checks to see if what we are doing matches up.

Our assistant superintendent wants us to revamp the entire physical science program. He has said it for the last three years, "Why doesn't anyone care about this? I want to see it become more consumer oriented and applicable to their everyday lives." We said, "That's a great idea but no way, not on our own time."

Sarah: Aren't there available "Eisenhower Funds" to rewrite curriculum? That's what we are using to re-write our junior high curriculum.

You know what else needs to change and what really drives the district is the State Framework.

Lynne: I will be interested to see how the state reconciles the fact that most schools have geared their science curriculum for college prep students while the Framework is recommending a more balanced approach for all students. They seem to be on opposing paths. The Framework is really emphasizing integration of all of the sciences and equal representation of earth, life and physical in the curriculum for all students.

- Marie: They recommend we do 60% hands-on lab activities in all high school science classes. If we follow the Framework, students will be not prepared for college, they will be lost.
- Sarah: If you look at the Framework carefully, it stops at the 6th grade. Then it goes back to 101 questions that a students should be able to answer by the time they leave the secondary school system. You know what it breaks down to? chemistry, physics and biology.
- Marie: Is it all geared to low-level information?
- Sarah: No, not at all. It depends on how you decide to teach the students the answer to that question. You can make it as complex as you wish.
- Marie: I hear what Lynne is saying though. The philosophy we are getting from our district level administrators is that the State of California is recommending that we integrate all of our students, advanced placement with lower levels. All of the classes should be 60% hands-on work and involve cooperative learning. I think it is unrealistic in college prep courses.
- Sarah: Why is it unrealistic to do hands-on activities in college prep courses?
- Marie: Because 60% of class time spent on hands-on activities would mean you wouldn't be able to get enough information out to the students.
- Jasmine: Whose responsibility is it to get information? Are we not teaching kids to seek information, to find information and be able to put it all together?
- Marie: We are, but inquiry lessons take three time longer than a straight lecture.
- Sarah: That's what I would like to know. Why does it have to be lecture anymore? If they are AP students or college prep students they should be able to read and glean.
- Jasmine: We are talking about A and B students with above average intelligence.
- Marie: But they don't always understand, you have to teach them. Somewhere along the way you have to lecture and get the information out and allow students time to ask questions. Even if you only lecture fifteen minutes a day and then do

cooperative group activities. I still think you have to present the material or they won't be prepared for college.

Jasmine: But in what detail do we have to present the material? Every biology class in college is going to start with the basics and go on to more complex concepts.

Marie: Well, I can tell you from experience. I never had chemistry in high school and I got a D in my first college chemistry course. I did not know anything and I couldn't put it all together in a college chemistry class.

Ruth: The problem is that colleges use freshman chemistry as the clearing house for students. If you look at the number of students who flunk freshman chemistry at four-year universities, it is very high. When you are teaching chemistry at the high school level, you have to design your course so that your students will be able to survive a college chemistry course.

Breaking Traditions - Removing Restrictions and Mandates

During the second half of our group conversation on "Ways to Improve Science Education," I deliberately pushed the storytelling group to think beyond the State Framework and beyond the traditional norms that have been established for science. As classroom teachers, we tend to restrict our thinking to what is not possible rather than envisioning what is possible if conditions are ideal. I think that is why it's often difficult for a school or a department to have a "vision" for their students and for themselves as teachers. We tend to dwell on old experiences and let ourselves be bound and constrained by the restrictions others have put upon us.

In the following segment of conversation, the women are specifically responding to a question I raised. I wanted to hear their description of an ideal science program from their

perspectives as practicing science teachers. Without thinking about all of the restrictions that make us angry, what would you like to see in a science education program, if you didn't have to worry about the State of California or the UC system?

Marie: I'll start with elementary level first because I see it as very important. I'd like to see the elementary teachers, even if they don't have a knowledge of science, not to be afraid of science, not distinguish between girls and boys doing all of the sciences. Somewhere there is still an influence on these kids, whether it is home or their teachers at the elementary level. They have got to avoid this, they've got to encourage more girls and minority students to do electronics, and physics type stuff.

I see it in my classes right now, a lot of talented Hispanic students who would never dream of taking chemistry, biology or physics. Why should they? The counselors encourage them to take the lower level classes and their parents think it is fine and so no one has pushed them. They don't go on. I think some important changes have to take place in elementary school if we are going to break this pattern.

Ruth: It seems to me that elementary schools need to emphasize the basics. So many of our junior high students cannot read. We have students who cannot read their textbook or spell words correctly. Once you start putting students in a six period day with rotating classes and teachers, they are not going to have reading emphasized again.

If they can read, they can do a lot by themselves. They arrive at the junior high without those skills. We have this notion that we should not label students, but students are labeling themselves by not being able to read or keep up with the other students. We have special programs at the junior high level but they are tightly controlled by special rules that make no sense and exclude a lot of the students.

I think if a student is testing below average, then they should have an opportunity to work, for a half a day, until they can catch up.

- Marie: I would like to see parents involved in the educational process. Perhaps our whole society would have to change in order for parents to get off work to do that. But I still think that should be a requirement, as part of the elementary education. Parents spend time in school and we could educate some of our parents that way as well.
- Sarah: You know that we have an "Alternative School" for K-8 in this district. When we get students from that program, it doesn't seem to have affected their reading ability and it certainly hasn't helped their social skills. They don't do well in cooperative learning groups. Our alternative elementary program does involve the parents; the parents have to participate.
- Lynne: So anyone could enroll their child in this alternate school if they wished to. Is it non-graded?
- Ruth: Yes, but there is a waiting list. Usually these students are behind the students that are in traditional elementary schools.
- Marie: I would like to see parents involved in the child's homework in the evening.
- Ruth: I think schools in the future will end up running from 7:00 a.m. until 6:00 p.m. in the evening. We will get the students in the morning and feed them breakfast, teach them some nutrition during breakfast and lunch, then they will be in their classes and after school we would offer sports, homework sessions, and maybe food preparation classes so they can help with meals at home. It is amazing to me how little some of these students see their parents, except on the weekend.
- Marie: I think you can design a curriculum where you incorporate homework that is designed for students and parents to do together. The parent can model how to do the problems.
- Ruth: Some of our parents won't be able to do the problems.
- Sarah: I'll tell you about one program at the junior high I was involved in that focused on spelling. We did try to involve the parents and they revolted. They did not want to even sign the bottom of the paper to say they had quizzed their child. More than half said they did not feel they should be forced to work with their students at home.
- Lynne: So Ruth, this sequence that you just laid out. Would you consider that desirable? Do you want that to happen?

- Ruth: Compared to what we presently have, I think it would be better. I don't think it is right or fair that kids leave junior high school at 2:20 in the afternoon, although they can stay after to do homework and get special help, and be on the streets until their parent or parents get home in the evening. We have a lot of single parents who are working one or two jobs and some are then going to school at night.
- Marie: What about the student who goes to work at 2:00 in the afternoon until 10:00 at night to support the family. He's too tired to do homework and doesn't want to study at night.
- Ruth: It seems to me, in this country, if it is taking two salaries to support most families, we have to be realistic about that. Somebody needs to be doing what "dear old mom" used to do. Mom is not home anymore, she is often out working long hours.
- Lynne: We don't have a society that has extended families either. So there are not other family members available to help supervise the children.
- Ruth: I don't see the money for it, but maybe somewhere down the road it will be a priority. I can't see this going on forever, where kids are coming home to empty houses.
- Sarah: So getting back to science education, ideally we would like to have two full years of science at the junior high level. Then we could spread out the life science and physical science so students could understand the material better.
- Ruth: I would like to see a little money where their mouth is. They always tell us that we are going to do this and that but there is never any money to support new programs. What's wrong with a field trip once in a while -- so we can take the students to see something? It is such a major ordeal, we don't even try to organize one.
- If we are going to develop a well-rounded science student we need money for things like that and a manageable number of students in our classes.
- Sarah: In this district, I think their approach to junior high is to let the students have electives. I don't think electives are necessary at this level. There should be a "core curriculum" that every student takes and every student learns. Let them choose in high school.

- Lynne: In this district, it seems like you have the junior high students tracked so early.
- Sarah: Well the mathematics and the GATE (Gifted and Talented Education) classes do that. If it wasn't for GATE, they would be tracked because of their math ability.
- Marie: I think the GATE classes are "bogus" at that level. Those students that are identified as GATE in junior high are going to be my regular, average college prep students. There are very few that are exceptional and will be in AP classes. They come in with a real funny attitude.
- Jasmine: This is where I think we've lost focus of what these students are going to be doing in the real world. The relationship between a 9th grade student who says, "I want to be doctor," but they can't even write a sentence. But yet, in this country, we tell students they can be anybody they want to be. Students don't seem to have a realistic idea of what it is going to be like once they graduate from high school.
- Lynne: Those of you that have been teaching high school, how would you like high schools to be set up?
- Marie: Definitely vocational, although I hate to track them. We have got to have something for the non-college bound students.
- Clare: Why not an integrated science for all levels? Why can't we integrate?
- Marie: I can't integrate my physical science students and my chemistry students.
- Clare: I don't mean integrate levels, I mean integrate within the college prep courses. I would love to be able to teach a class that closely connects biology and chemistry. I find that biology is so boring to teach. I love biology but it is too hard to teach it as a separate course.
- Sarah: In real life, it is not biology, it is biochemistry and biophysics.
- Clare: That's what I'm saying. If you are teaching some concept in chemistry, you should teach the biology connection, for example, with acid and bases.
- Lynne: Because we teach it the way we do, we make biology seem like the chemistry is there but we can't talk about it.

Jasmine: If we had better college training, to develop teachers that would be educated in all the sciences. If we redid the whole entire educational system from top to bottom, we aren't talking about stopping at 12th grade.

Marie: So how would you separate it? My dilemma is: I don't like physics and I'm not comfortable teaching physics because I don't have a physics degree or have a love for it. What do you do? Teach the same students for three years?

Clare: No, you have Integrated Science 1, 2, and 3.

Marie: So I would never get to teach all the biology. I would have to make a choice of what content I would want to teach. The other idea floating around is that we would teach quarters. So I would teach a quarter of biology and then the next quarter I'd get another whole set of different kids.

Clare: No, no. You would kill it again. You still wouldn't be integrating the different content areas.

Lynne: One of the programs that has been recommended is to have students take biology, chemistry, physics and earth science every year for seven years, starting in the 6th grade. There are lot of unanswered questions about whether the content areas should be integrated or fused, or taught in small segments.

Marie: I don't see what the difference is. I think they are going to get it whether it is year by year or integrated. I think if we integrate science, we will end up going back to our favorite specialties.

Clare: That is one of the problems. Teachers are not being trained to do this kind of teaching.

Sarah: I think college students should have to declare by the beginning of their junior year that they are going to become a secondary science teacher. Then they would be prepared according to what they will teach and how to teach it. It would be a three year preparation program then.

Lynne: I think if we are going to seriously try to train teachers to be an integrated teachers, you are not going to be able to be a Life Science graduate or a Physical Science graduate. You will have to have a balance in all of the areas, life, physical and earth sciences.

Marie: I think that is unfortunate. If I look at biology, I can spend my life keeping up with the current literature and staying up-to-date in the field. If I have to spread myself between biology, chemistry, physics and earth science, I can't keep up with the technology and new advances; I don't have the same concrete background in all of those areas.

You have to have a good, solid background in order to teach science for understanding at any level. Science is changing so fast you cannot keep up with four different areas.

Lynne: One of the ways to look at this dilemma, instead of thinking about individual teachers having mastery of all these areas, is think of yourself as part of a team. There would be a biology specialist, a chemistry specialist, an earth science specialist and a physics specialist. As a team, you would be in charge of a group of students. Then you would be able to focus on your specialty.

Jasmine: When someone graduates from college as a mathematics major, they are expected to teach all levels of math.

Marie: But they supposedly do have a background in all of the areas of math.

Lynne: Historically, we have allowed science to splinter and become different subject areas.

Jasmine: This is my idea. I'm going to market this. We go to our big name athletes and say, "You build the science wing at this school, and we will call it The Michael Jordan Science Center; Joe Montana, you build this English wing and outfit it with up-to-date equipment and it will be named The Joe Montana English Center. The kids would be so excited about going to such a prestigious school.

Marie: Then maybe we can get Michael Jackson to contribute and have The Michael Jackson Liberal Arts Center.

Sarah: I think it's a great idea. I want to see you go out and get these celebrities to participate.

Marie: Heck, our new science wing was only 1.5 million.

Jasmine: The money for this project would be nothing for these people, it is a drop in the bucket.

This was a spirited conversation that highlighted our hopes along with our continual frustrations about trying to create an ideal situation for science teachers to teach and students to learn. We discovered that although this was an exclusive group of women science teachers, we did not agree on how to improve science education or what changes should be made to address the needs of all of our students. The fact that we were all women educated in the traditions of science did not mean that we shared a common set of values and beliefs about science education. I discovered rather quickly that this group of women science teachers were not as liberal, non-traditional and feminist as I considered myself to be. In fact, very few of the storytellers have read any of the current feminist literature that focuses on gender issues in science. They were not familiar with the writings of Evelyn Fox Keller, Sandra Harding, Kathleen Weiler, Adrienne Rich and therefore were often quite amazed at the beliefs I held about the nature of science and its negative effect on women. Sarah was the only exception. Her views often did coincide with mine, although not necessarily for the same reasons. Since my goal for the study was not to convert the women storytellers to my way of thinking, I tried not to bring up my feminist point of view too strongly during the conversations or push the conversation into an area of study that this group of women might not be familiar with or were not ready to struggle with.

Women science teachers need to participate in conversations where they honestly express their opinions and beliefs and risk having other colleagues challenge their ways of knowing and thinking

about controversial issues in science education. Teachers will not grow professionally if they do not have the time and space to talk about their beliefs and have their opinions challenged by a supportive and trusted group of colleagues.

It was not possible for me to include the entire two hour group conversation the storytelling group had about problematic nature of change. I hope that the excerpt included in this study gives the reader a glimpse of the kind of authentic conversations teachers can have when they begin to seriously question their teaching practice and the long established traditions of public education. We took an important step toward envisioning a new kind of science education program for the 21st Century when we began to explore possible alternative for improving the teaching and learning of science K-12. We can't have a vision for science education if we don't think beyond the immediate day- to-day struggles. In this setting, we needed to think beyond the state legislature and the university requirements; we actually needed to eliminate them entirely in order to begin to find answers to the question: What kind of science education do we want, as women science teachers, for all students and how can we help them develop into the well-rounded, scientifically literate citizens we?

Passage IV: Taking Seriously the Need
for Care, Concern and Connection

This final passage consists of a set of stories taken from our last one-on- one conversation, in which I asked each of the women to talk about those qualities they hoped to develop in their science

students. What attributes or "habits of mind" are essential for a student to acquire as a result of being a student of science? The excerpts I've selected reflect a condensed version of the goals and personal values guiding each woman's practice.

Ruth (High School Chemistry & Junior High Science Teacher):

As a chemistry teacher, my goals were pretty specific: my goal was to educate the students so they could pass a freshman chemistry class at any UC campus because that is a clearing house for science students. For chemistry students in particular, they needed to be exposed to certain content areas: emphasize the mathematics of chemistry as well as the major concepts such as equilibrium, molarity. In terms of what I was trying to develop in the students, of course good study habits absolutely, also ways of thinking on their feet. I tried to teach the student not to panic. It's not a matter of memorizing formulas, it's being able to "eye-ball" a problem: what should an answer look like, what is reasonable, what are they asking for in this problem. I was trying to teach them to be thinking students. I have to admit that a lot of our students were male, especially in chemistry, and so we tried to keep them involved and interested in the field. Many of them worked as student aides and set up the demonstrations and worked with computer programs. I think my junior high experience helped me to relate to some of the lower ability students. I was able to help them because I knew what their background was, from teaching science in the junior high, and I could explain the material in less complicated ways and at their level.

At the junior high school, science is a subject among many subjects the students are taking. You hope they will find it interesting and want to continue with it. I did not feel the pressure to cover a certain amount of material. It is more important to give them a feeling for science and for major concepts at this age. I'm trying to teach the threads that run through science along with some scientific vocabulary. At this age, they need to work on spelling and understanding the meaning of scientific words, helping them to understand the prefixes and suffixes and how to relate them to other words. They need to get a feeling for the language of science. These students are just developing and they need to increase their vocabulary and an understanding of the English language. A lot of it is based on prefixes and suffixes from Latin, for example: Gastropoda, Cephalopoda, Pelecepoda.

I think for junior high students it is a "taste of science," a taste also of what is in your everyday world that related to science. Also increasing their general understanding and knowledge

and link it into other areas of their life and their schooling. To a certain extent it is preparing them for high school, however, if I didn't get to chapter such and such, it is not any life threatening thing. Good study habits are certainly important to develop in junior high students because they come to us as such "babies" from the elementary schools. Many of them haven't even been getting letter grades up until now and are not used to time lines and schedules.

Sarah (Junior High Science and Physical Education Teacher)

My major goal is that they will have changed their attitude toward science by the end of the year. When they come to me, most of them, especially the girls, think science is hard and they don't like science. More than 50% of the girls come in thinking in that way. I want them to be curious, in other words ask the question, "Why?" Then have a logical approach to try to find out why and also be willing to risk trying out new solutions to problems. Hopefully feel confident enough, at least in my classroom, to bring up their ideas and then of course have the security to know that they won't get laughed at or made fun of. I also try to help my students break the barriers, tear down the walls that prevent them from getting involved in science, digging in and really experiencing science.

At this level, I think there is some place for factual information that becomes ingrained in their mind, it becomes part of them not just a factoid, like the ABC's, and reading and math skills. For example, the atomic structure which basically rules the universe; it is the major theme that runs through my curriculum.

I work with my students to help them learn to follow directions and be able to complete experiments but I still haven't figured out how to teach my students how to draw conclusions, that highest level of thinking. I wish someone would write a book on how to do that. I'd love to have my students be able to look at something and say, "Oh, well if it does that then this must be the case." I want them to be able to make a generalization. The new CLAS Test (California Learning Assessment System) will be emphasizing students' ability to make generalizations.

Jasmine (High School Life Science, Physical Science, Health Teacher)

I do a lot that goes beyond the line that most teachers could go to because I am a minority and so are most of my students. I can be who I am with my students because I am one of them.

In my health classes this year, I have all extremes in my class. I have special education students, bilingual students, honors, college prep and basic students all in the same classroom.

They sit next to each other and work together in cooperative groups. The leaders need to learn how to lead and the followers need to learn to follow directions and complete tasks. How do kids that are "honors type kids" ever learn leadership skills if they are always around students like themselves? It is difficult a lot of the time but they can learn to do it.

I think the biggest thing that I want to do and work on is trying to let these students know they can do anything that they want to do. If they decide they want to do it, in terms of getting a good education and obtaining the goals they set for themselves. They don't have to be the smartest person on earth, all they have to do is try their very best. I really try to teach that we should not discriminate against any kind of people, in terms of how smart they are or how smart they are not, their socio/economic background, their race or culture, and their gender. Gender is a big one for me. I've just seen so much inequality in terms of what women have had to go through, have done and how far they have gotten, but also how far they haven't gotten. We are supposed to be a nation where everyone is created equal. But it often feels like it is "all men are created equal." Once they change that to all humans are created equal then I will be happy. I truly encourage my female students to stand up and believe in themselves. I think I do a real good job there. In the final letter they write, the females have told me the influence I have had. Nine out ten girls will write, "I now feel better about myself, I accept my body as it is. If people don't like it that's too bad." That is the bottom line, helping students to be happy with themselves. That is not to downplay anything about males either because so many of these boys live in a world where they are pounded down. I think a lot of them get into trouble because they have poor self-esteem. So I encourage and work on building theirs also. Anything males can do females can do and anything females can do males can do.

I would hope that I instill a value in them to respect other people no matter who they are or what they are. Even those who chose other life styles. The kids get the message that I care about them and love them regardless of the choices they make. I also encourage students to form opinions and be able to support the opinions they have with concrete information.

Skillwise, I hope my students learn how to gather information, whether it be from friends, teachers, the library, television, newspaper or magazines. If they want to know something, I hope they will know where to go to find information they need. I tell them that health is a course of choices and life is about making choices. I provide them with a lot of opportunities to make choices, in terms of the kinds of activities we do and the projects I assign. In the end, we need to help students learn to use the tools and skills they have or have access to in order to accomplish a task as well as they can. We need to help students learn how to do quality work.

Rachel (High School Science and Math Teacher, Environmental Education and Teacher Education Instructor)

Theoretically, I would hope that the qualities I encourage my students to develop would have to do both with science and with their own personal growth. And also qualities that have to do with a critical way of thinking. For me some of what goes on in a science classroom has to do with science but most of it has to do with the development of a whole student and not just a science student.

Starting with personal qualities, I encourage honesty, integrity, a desire to question and be curious, confidence, intelligence. I also hope they will express qualities of respect towards each other and a willingness to listen and share ideas.

I think in science we have the luxury of focusing on certain things: an appreciation for life, an enthusiasm for how wonderful life is, the incredible organization and order of life. I prefer to look at order of systems within life rather than a classification order and try to help my students think about life in that way. I emphasize the importance of interactions and relationships. I also try to help my students develop an ability to inquire, to ask why and find out why, to gain confidence in the fact that they can actually find out why. When they have a question they can pursue the question and gather data that will support or refute an idea. I feel that is an empowering thing for a student to be able to do; it gives them a sense of control of their ability to construct knowledge. Students need to learn that they can have a question, gather data and find answers. We have a responsibility as science teachers to build those skills for how to do that.

One of my goals is to help students, who previously did not enjoy science, to realize that they can understand science and feel they are able to be scientific. That was one of my goals as a math teacher as well, I tried to help students prove to themselves that they could understand and be successful in math. I also believe that students have an inner desire to learn and if I can give students an opportunity to learn, they will feel compensated and rewarded for what they have accomplished.

Let me share what I don't encourage as well. I recognize in my experience of teaching that I am not a content-driven person. If I look over my teaching, I don't emphasize that, and therefore, I have better rapport with students who want to understand the interrelationships between things. I frustrate students who want to focus on content and are interested in accumulating facts and covering a lot of information.

Marie (High School Chemistry, Physical Science, Biology Teacher)

I have to separate my students into physical science and chemistry because they are different classes. In physical science my goals for students are: to learn some consumer science, to be scientifically literate, to be able to vote on current issues, problem-solving skills and practical application type skills. When I talk about scientific literacy, I'm referring to a common sense background of how the world works, the laws of nature and how they affect our lives.

I'm trying to teach my physical science students very diverse skills that they can apply to their everyday lives. I try to bring current events into our class discussions and help them see the importance of science within our society.

For my chemistry students, I am more concerned about them taking responsibility for their own learning. Content is an important goal for my chemistry students although I don't agree with the objectives laid down by the district. I want them to be prepared for college in such a way that they know how to do homework, they have study skills and know how to prepare for a final exam, they can do a term paper and use computer technology. When these students go to college, they need to be able to work on computers, even though that technically is not considered part of science. They need to be computer literate. I do have my physical science students use computers but I don't expect them to be able to do write a term paper on their own. I want them to have hands-on experience with computers but they don't seem to respect the equipment.

I do try to push my students, especially females and minority students, to realize that anyone can do chemistry. I want all my students to have a positive attitude, whether it is in physical science or chemistry. Hopefully, students will discover that they really enjoy science and will continue on with it, perhaps even pursue a career in a science related field.

Clare (High School Chemistry, Physics, Physical Science, Life Science Teacher)

For college prep students, I feel that part of my duty is to help them learn how to study without having someone looking over their shoulder, to help them learn some time-management skills. I want them to start to develop the habits now so they know what works for them and what doesn't before they get to college. Otherwise, the first year of college will be a real loss. So part of my goals is to get college bound students used to doing some problems, working on their own, learning to read a textbook and get information from it. I hope they will leave my classes with a certain amount of content knowledge and the mathematical concepts involved with chemistry and physics. College professors assume that

the students they get in their classes will have a background in physics; they do not expect to have to start from scratch with beginners.

I would hope that my students would learn how to think through a problem, not memorize the names and formulas for everything, but at least to be able to apply them and find solutions. With my chemistry students, I know that I have to prepare them to survive college chemistry because it really is a "weed- out" class, along with college calculus.

With my life science students, I want them to be able to look at a problem and analyze it. I'd like them to be able to see how science fits into their lives and how interesting it can be. Just think about the brain and how it relates to psychology and their everyday life. We don't give out textbooks to our life science students so I can't give them homework. But I do try to help them develop a work ethic during class and learn to complete assignments on time.

Overall, I'm trying to emphasize application and integration within the different science content areas for all of my students.

Lynne (High School Science Teacher, Teacher Educator, Researcher)

I had one major goal for all of the science students I worked with, and that goal was to have science become a relevant part of their everyday life. I wanted my students to experience science the way I had through discovery learning and active inquiry with extensive hands-on experiences with naturally occurring organisms and common scientific phenomena. I wanted them to feel a part of nature, directly connected to it. Optimistically, I hoped that my students would acquire a diverse core of knowledge in science, life or physical, so they would be successful in more advanced science courses, if they chose to take them, as well as be adequately prepared to make wise decisions about science related issues in their everyday life. In my mind, the worst comment a student could make about their experience in my science class was: "It was so boring -- I don't know why we had to learn that stuff."

All of my science teaching assignments were in public high schools whose primary task was to prepare students to go on for further education, two year or four year colleges/universities. In fact, the percentage of college bound students in the high schools where I taught was about 85%. Consequently, I felt it was my responsibility to help my students develop adequate study skills, learn time management and organization strategies, and take the initiative to be responsible for their own learning. I worked to develop these skills in my college-bound students as well as my non-college bound because I felt they would help students develop self-esteem and self-confidence as a learner. I do believe that all

students can learn scientific concepts and be successful in an academic setting if they can acquire problem solving strategies that fit their style of learning and way of organizing information.

But the science courses I taught were not the same for all students. As a department, my colleagues and I implemented different levels of science classes, higher track classes for college bound and lower track classes for the non-college bound. In the higher track classes, we covered more content, gave the students more hands-on experiences, required more outside homework, and involved them in long term projects. In the lower track classes, the pace was much slower and the content was covered in less detail. Students were involved in hands-on activities but they were shorter in duration and rarely required much higher level thinking or reflective writing. Our rationale for offering these distinctly different courses was to give students more of a choice about level of difficulty and options for matching their academic goals to our requirements. I used to think we were meeting the needs of "all students" by making this distinction; I used to think that we actually were doing students a favor when we offered different courses for the college-bound and the non-college bound.

I am not at all sure that I was meeting the needs of either group of students. All students will eventually be ordinary citizens, living ordinary lives. They will all need to learn how to relate and interact with diverse neighbors and co-workers, communicate and work in cooperative groups, and make wise choices about science issues that effect their everyday life. I know for a fact that whenever I was in a "time crunch" and had a lot of content to cover with my college bound students, I would stick to factual information and not worry about connecting the concepts to everyday life or give students time to work in groups or have discussions. This was not the case with my non-college bound students. Certainly, we covered content but I was less compulsive about getting through the material and focused more on providing them ample time to process the information and make connections.

Perhaps a strong background in content knowledge is more important for a college bound student, but who knows when a non-college bound student will change her/his focus and decide to become a college bound student. As teachers, we know that a fourteen year old student is not ready to make a final decision about a career choice. We also know, from recent employment surveys, that an average person will change careers five to seven time during her/his life time. It seems likely that one of those career changes might involve going back to school for more education. If we don't provide all students with a strong, diverse background in science, they will not have the necessary skills or the subject matter knowledge to pursue a career in science or a science related field if the opportunity arises.

Stories invite us to come to know the world and our place in it. Whether narratives of history, present experience, or the imagination, stories call us to consider what we know, what we hope for, who we are, and what and whom we care about. Stories have a certain engaging power -- a ring of truth; they enable us to become the friends of one another's minds in ever-increasing circle of inclusion. (Witherell, et al., 1993, p. 4.)

CHAPTER VII

A TIME FOR REFLECTION

One's personal story carries with it one's internalized experience, reflection, and sensitivity developed over the years. One comes to a situation, not newborn, but already in mid-course. One's tone of voice, intuitions, and sensitivities reveal the "role" one is implicitly playing out. (Novak, 1971, p. 67.)

In this study, I have played the "role" of a participating science teacher and a narrative researcher. The stories I've shared reveal the experiences, reflections and ways of knowing I have developed over the years as I have played out my roles as a woman, a scientist, a teacher, and now a researcher. As Novak suggests, I did not come to this study, this research situation, as a newborn. I came at the mid-point of my life with a variety of issues, concerns and questions about what it means to be a woman within the fields of science and science education and how a woman's life, my own and those of other woman colleagues, have been influenced and manipulated by the beliefs, wants and needs of the culture that acquired us.

From the beginning, my purpose has been to explore, through the use of narrative inquiry, the personal realities of women who have chosen, freely or otherwise, to live their lives as science teachers. My desire to focus on the "reality" of women's lives has

been cultivated and affirmed by the work of Maxine Greene. In particular, her article *The Question of Personal Reality* helped me to understand that "reality is interpreted or reflected-on experience" (p. 24). We orient ourselves to what we think is "real" by making sense of the transactions and interactions we have with both the living and non-living components of the world around us. According to Greene (1979), to talk about the reality of teachers' lives is ". . . to consider their lived lives and their pursuits of meaning in a context that includes a concern for the social dimension of teaching, for the strategies, for the existentially unique" (p. 24).

Reality is often an elusive state of mind that shifts, becomes transformed, as we encounter new experiences and alternate ways of knowing and being that prove to be more satisfactory and consistent with what feels "real." What each of us interprets as reality is dependent upon the patterns, the schemes, the traditions passed on by our predecessors and contemporaries; we are "functions of the culture" (Greene, 1979, p. 24). According to George Herbert Mead each of us is both an "I," a self-conscious existentially unique human being and a "me," which represents the shared social reality we acquire and respond to as we live our lives (as cited in Greene, 1979, p. 24). "Each of us has distinctive biography, a singular life history" which we use to interpret the social reality we've acquired (Greene, 1979, p. 24)

What has been missing from our knowledge base about science teaching and learning are these distinctive, singular life stories

of classroom science teachers in which women have told stories from their perspectives as both a unique "I" and as a social "me." For the six months that I was in the "good company" of women storytellers, I listened, shared and collected personal experience stories about our social reality from our standpoints as women science teachers. We struggled at first, but gradually learned to speak truthfully and honestly to one another, to challenge and push each other's thinking and recognize the value of each woman's ways of knowing. I am confident that I found the missing voices I set out to find and that these women's voices have important insights, professional experiences and concerns to share with the science education community.

But as I finish this book, I'm not as confident that I've presented my readers with a written text that captures the joy, the laughter, the frustration and the anger of our stories. Virginia Woolf once said that:

. . . the translation of women's speech into writing would require the introduction of a new sentence. Women's experience does not fit neatly into the rhythms of dominant and subordinate clauses that were patterned after the ordered and hierarchical world of upper-class white men. (as cited by Christ, 1980, p. 101)

The women in the storytelling group often spoke in a stream-of-consciousness. Their thoughts were not always expressed in complete sentences with precise beginnings and endings. Their stories, as told, were filled with pauses and sighs, dangling phrases and unfinished sentences. Women tell their stories as they speak. As the author of this work, I have felt confined by our

traditional academic style of writing because I've had to adapt our words to fit conventional grammar and punctuation. Although I have conformed, it has not been without reservation. Perhaps this is why it is difficult for women to write what they think, and to feel that any written text represents what they have said and mean. We are in need of a "new language to express women's experience and insights, new metaphors and new themes" that express more accurately women's stories and points of view (Christ, 1980, p. 7).

In spite of the difficulties I have encountered in putting our women's talk into writing, I hope the readers of this work have become "friends of mind" with the women of the storytelling community and benefited as well as learned from the lived experiences we've shared. Throughout this work, I have consciously chosen to highlight the women's conversations and stories without disturbing or revising them. I want the reading audience to have the freedom to generalize, to interpret, to reflect and then decide what aspects of the data apply and are meaningful within the context of their lives and their standpoints (Peshkin, 1993).

But now I would like to continue my personal story by sharing the ways in which these women's stories have helped me to place myself within the larger community of women science teachers. How is my personal voice strengthened by identifying and examining the shared themes with other women science teachers? How can analysis of the themes that permeate our stories enable us to cultivate more powerful personal/professional voices? I hope that this sharing of the lessons I've learned will support my assertion that women

teachers have important things to say to the science education community and that it is important to incorporate teachers' voices into the knowledge base about the teaching and learning of science. In addition, I hope that the reading audience will recognize how these women's stories have influenced my personal growth and gain an appreciation for the potential power of narrative inquiry as a research methodology and vehicle for teachers' professional growth.

Reflecting - a Form of Good Sense Making

Reflection occurs when we turn back our thoughts and think seriously about a past experience we've had. Dewey (1938) suggests that reflection is a form of inquiry: we ask ourselves questions about the experience we've had in order to better understand it. If we examine our past experiences in a focused way, we can learn and grow as a result of our reflective thinking.

Being reflective also involves using what Gramsci calls "good sense," which is "the ability to critique and understand what has happened in the past, what is happening in the present and what might happen in the future if a different social world exists" (as cited by Weiler, 1988, p. 90). I believe I can use my "good sense" to: critique the stories we created and the lessons I've learned, to project what might happen if women's stories are taken seriously, and to expand our understanding of narrative inquiry.

Following Dewey's advice, let me begin my reflection by asking myself a series of questions about this work, what I have learned

and how this collaborative work has transformed how I see myself as a unique "I" and a social "me."

- (1) What did I learn from listening to and reflecting on women science teachers' stories?
- (2) What did I learn about collaborative storytelling from the "invited reflections" of the women storytellers?
- (3) What new insights do I have about collaborative storytelling in a community setting?
- (4) What can the educational community learn from these women's stories and ways of knowing?
- (5) What did I learn about myself that helps me to better understand who I am and the roles I wish to play as a teacher educator and researcher?

What Can be Learned by Reflecting on Women Stories?

The life of a woman teacher is a struggle, at times a worthwhile and gratifying labor of love, but nonetheless a struggle. As diverse a group as we were, I am still amazed at the common threads that run through each of our lives, common threads of conflicts, tensions and challenges. No matter where we grew up or what social/cultural experiences we've had, each of our lives have been and continue to be shaped and molded by a shared set of experiences: growing up and living life as a female, teaching in a male-dominated discipline and a patriarchal institution, and working in a profession that devalues female attributes and women's ways of knowing. Although the storytellers did not share my background in feminist theory, they all recognized the significant role their gender has played in their life experiences.

Many of the struggles discussed in our storytelling group are directly related to the fact that we are women. Each of us learned to accept the restrictions and limitations placed upon us because of our gender and consequently rarely thought about why we have adapted our goals and compromised our needs. Is being a woman a major factor for why women teachers are not listened to when they speak, are not taken seriously by male authority figures, are not considered for administrative positions, and experience various forms of sexual harassment in the work place? Although the women came into the group without a definite answer to the questions, the process of storytelling and discussion enabled each member to see that the answer is definitely "yes." I am convinced that the answer did not emerge because I "pushed" my feminist agenda but rather it surfaced through the hearing of repeated themes across all of our stories. The process of storytelling forced us to think about why we have adapted our goals and compromised our needs. And that thinking led each of us to a consideration of our lives as women.

If a woman has little or no economic or political power, or achieves little of what she wants to achieve, a major causal factor in this is that she is a woman. For any woman of any race or economic class, being a woman is significantly attached to whatever disadvantages and deprivations she suffers, be they great or small. (Frye, 1983, p. 16).

For example, an unmistakable -- and to us, surprising -- theme that emerged in our stories was how influential men have been in all of our lives. For Rachel, Sarah and Clare, it was their father or husband, for Ruth and Marie it was been a male professor, colleague or mentor. I expected the male influence to be central for Ruth,

Sarah and myself because we are older (ages 53, 47 and 46 respectively). We are part of the generation in which male authority figures were extremely dominant and women were expected to conform and assume traditional roles. But I did not expect male authority figures to remain so influential for the younger women. I thought the younger women in the group might have had influential women teachers, or famous female heroes after which to model their lives. Although Rachel and Marie were extremely close to their mothers and were given tremendous support by them, men still seem to have played an important role in the professional and personal decisions they made. Both of them had considered pursuing careers in oceanography and marine biology, but in the end they chose to enter the teaching profession because of the way scientific careers were portrayed to them in a female-unfriendly way. I'm wondering if that choice was freely made or if they -- like Ruth and Sarah and me -- made the choice because of stories they were told and the roles they had acquired from their cultures.

I found Clare and Jasmine's life stories to be the most culturally revealing, providing examples of how cultural expectations -- not just gender -- influenced their life decisions. When I listened to Clare talk about her family background (Catholic, Filipino, scientifically trained parents) and the demands placed upon her to pursue a career in pre-med, I remember Kathleen Weiler's question: *Are the choices women make ever freely made?* Would Clare have chosen to pursue a career in teaching if a professional job had been available in biomedical technology when she finished her

degree? Would she have focused so heavily on math and science if her parents had given her a free reign to experiment with other options?

Jasmine is a unique case because of her cultural background (Chinese, with a strong matriarchal family structure) and because she was not trained in the traditions of science, but rather came from a physical education back-ground. Perhaps her minimal exposure to academic science was a blessing in disguise since she seems to be the most open to adapting science education to meet the needs of students rather than molding students to fit the needs of science and science teachers. Jasmine's life is an interesting paradox in that her personal life centers almost exclusively around women but in her professional life she works almost exclusively with men as the only female in an all male science department of twelve. Outside the school setting, Jasmine prefers socializing with women and currently lives with another women in a supportive, loving lesbian relationship. Who Jasmine is personally cannot be visible in her professional life. A lesbian-life style does not coincide with the norms and expectations of women teachers. Although she is feisty and outspoken, her teaching life and her role within the department are still greatly influenced by the male colleagues with whom she works, and as the youngest person in the department she has limited power because she lacks seniority. Like the other women in the group, many of Jasmine's early career choices were determined by someone other than herself. In her case, however, her early career

choices were made to accommodate the needs of a more dominant female partner.

Yes, it mattered that the storytellers were women -- women working in the male-dominated field of science education. Although the women would not describe themselves as "feminist" or "oppressed," their stories reveal many feminist issues and themes of oppression. Through the process of storytelling, this theme of "oppression" became more visible to the members of the group. When I think about all of our lives, I'm reminded of the following quote by Rosario Morales. "The personal is political . . . What seem to be 'personal' problems of women have their roots in the political system which oppresses women."

In our society, we often overlook the fact that women -- even privileged, successful women -- are oppressed. And this group of women storytellers was no different at the outset. In the past, I would not have used that label for myself. During my doctoral work, I was fortunate to have taken a "Feminist Theory" course from Marilyn Frye. Her course and her book, The Politics of Reality: essays in feminist theory changed my "standpoint," altered my interpretation of the reality of being a woman. In Chapter 3 of her book, Marilyn Frye provides this explanation for why most people overlook women's oppression:

A great many people, female and male and of every race and class, simply do not believe that "woman" is a category of oppressed people, and I think that is in part because they have been fooled by the dispersal and assimilation of women throughout and into the systems of class and race which organize men. Our simply being dispersed makes it difficult for women to have knowledge of each other and hence difficult to

recognize the shape of our common cage. The dispersal and assimilation of women throughout economic classes and races also divides us against each other practically and economically. (p. 9)

While I learned about female oppression in the context of a feminist theory class, the women storyteller learned about oppression through listening to each other's stories and hearing the common themes. Although they would not use the word "oppression" to characterize their experience, they do now have a heightened awareness of their gendered experience and the ways those experiences have constrained and limited the full development of their voices. This suggests the power of such a storytelling context -- enabling participants to see themselves in new ways and to better understand the ways in which their inherited reality has shaped and molded their lives. Such understanding can enable the storytellers to take charge of challenging those inherited realities that do not fit them.

What have I learned about reality of being a woman from listening to the voices of women science teachers? I've learned how perceptive George Hubert Mead was when he said that "each of us is both an 'I' and a 'me'" (as cited in Greene, 1979, p. 24). For myself and the women in the storytelling group, the "me" is the shared social reality we have inherited. We share the same "common cage." As science teachers, the "me" has been socially constructed and defined according to the expectations of the dominant institutions within a society; the "me" is the role we are expected to play because we are women working in a low status profession. All of the women in the group, from the youngest member (Clare) to

the oldest member (Ruth), learned to adapt their lives to meet the expectations of others. Most of the decisions and choices we've made in our lives were not freely chosen, not freely made without considering the wants and needs of those people with whom we have relationships. Margaret Yocum (1985) suggests that all women share many common bonds because of what we are expected to do and expected to be. She likewise asserts that we also are bonded together because of what we do not or cannot do. Our cage, as Marilyn Frye (1983) suggests, has a common shape with individual bars representing a "network of systematically related barriers" which act to restrict the motion, mobility and freedom of women in this society (p. 5).

I also discovered that my interpretation of the "I" part of my reality was more in line with feminist ways of thinking than most of the women in the storytelling group. Over the past five years, I've been quite immersed in feminist literature and done extensive reading on gender issues in science and science education. In the process, I have come to understand just how much of my life has been controlled and defined by authority figures within male defined institutions. My mid-life crisis came when I discovered that I had acquired a set of myths from my culture that no longer fit my beliefs, my wants or my needs. What I learned from my storytelling colleagues was that not all women science teachers critique their lives as I did, from a feminist perspective. My "standpoint" seemed foreign to the women in the group, with the exception of Sarah, and my experiences appeared unique and unusual rather than the norm

encountered by most females. I suggested to the women that perhaps they had overlooked many of the subtle ways that their lives are controlled by more dominant males and their institutions. Nonetheless most of my storytelling colleagues assured me that they did not find the masculine traditions of science as problematic as I did, did not feel they were voiceless or had been deliberately silenced, and were not certain they were ready to make the "quantum leap" (Rich, 1979) that I had, or to "act and react out of their own being" (Baker Miller, 1986, p. 113).

Why should my perspective be so radically different from this group of women science teachers, a group that I share so many common bonds with? I understand, more clearly now, that the reality of my life or any woman's life is uniquely personal and dependent upon a lifetime of experiences that no one else has had or ever will have again. In the beginning of Chapter 5, I posed the question, "Are we one or many?" I know, now, that we are many. Many diverse hybrids, all scientifically literate, but with a wide range of beliefs, values and principles that influence the choices we make and the lives we live. And that is why I have resisted making interpretations and generalizations about these women's life experiences. I can make interpretations about my own life and explain reality from my subjective point of view, but I'm not certain I should or am entitled to do so for others. The only story I can authentically tell is my own.

Reflecting back on Rosario Morales' quote, I'd like to suggest a revised version of her statement that summarizes the struggles I

feel women science teachers face even if they do not recognize the roots of their struggles:

The professional is personal is political . . .
What seem to be the personal and professional problems of women teachers have their roots in a political system that oppresses all women, of any race or economic class.

What Can Be Learned from Participating
in "Women's Invited Reflections"

All we have is the story because our lives are made of Such stories allow us to explore our lives, to try out alternative possible ways of acting and being in the world, and indeed to help shape future actions. (Jalongo, 1992, p. 72.)

To better understand the overall effect of this research study, I followed Dewey's advice, once again, and invited the women storytellers to be reflective and to think seriously about the following questions.

- (1) In what ways have you benefited from being involved in this study, personally or professionally?
- (2) What do you see is the value of sharing stories about teaching and learning in science education?
- (3) What are your thoughts about the different storytelling situations, the group conversations, the one-on-one's and the reflective journal writing? Where they equally beneficial to you professionally and personally?

Their responses to these reflective questions provide not only concrete feedback about their experiences with narrative inquiry but also provide the readers of this work with a wider range of perspectives from which to evaluate the significance of this study for the participants and for this type of research. Again, I

present their unedited perspectives, welcoming them as co-authors in this collaborative venture, rather than treating them as subject whose perspectives need to be interpreted by the researcher before they can be heard.

Personal and Professional
Benefits of Sharing Stories:

Sarah, 1993: I would like to thank all of you for helping me feel confident. I don't think you realize just how much this group has helped. I work closely with the six men who teach junior high science in our district and I've have been viewed as the junior member because I am a woman. I have never felt that I was listened to seriously in our meetings. Spending time this year with this group has been good for me. I've gotten a chance to voice my opinions about science and that has given me confidence to speak up more in our interdepartmental district meetings.

Jasmine, 1993: I like coming and talking to all of you even though I don't know the schools or the people you work with. But just to feel strength in what I do and to hear your stories of teaching. It's nice to know I'm not the only one out there. I don't have any relationships with other women in my district. Being the only woman in my department, its nice to come to a group of women and know that I'm not alone. I admire so much what all of you have gone through -- so much training and experience in science. I've been thrown into science, rather than selecting as a career choices. You have all chosen this as your career path. I admire your intelligence and fortitude. It gives me courage to stand up even more, not just in my classroom but with my colleagues.

Rachel, 1993: I've really appreciated the process for a variety of reasons. First, when I was teaching at Eucalyptus, it was helpful for me to have a group of people that I could discuss some issues with that knew what I was talking about. Even though I can talk to my husband, who is a math teacher at the same school, it was nice to talk to science teachers. I've really never made big issues about whether I was talking to men or to women. At first I thought, this whole male and female thing was not an issue. I grew up a tomboy and so I know how to talk in certain situations if the group is all men, and sometimes you talk a bit differently when you're with groups of women. I never had this feeling that I couldn't do things because I was a female. But being in this group has helped me to see, that there are certain areas where I am wondering how much I've approached things because I'm a female. Would it be

different if I was a male? It also helps me to learn how other people deal with problem situations they come across in teaching science. It's also been beneficial for me, as a person interested in science education, to know what is going on in different classrooms and different schools. It has been very helpful to have such a diverse group; people who have taught for a while and people who are new; people who are in different locations; people with personalities that are more feisty and other people with personalities that do things in a more subtle way but still get things done. That has helped me to become a better problem-solver. Just to think how other people solve problems. One time I was talking to Lynne, and I referred to Marie, and I said "I handled it like Marie would have." I did a Marie! In other situations, I might deal with it like Ruth, Jasmine or Clare did. There are different ways to go about problem solving and so that has been real helpful.

Marie, 1993: I think it has been exceptionally insightful. It has just been so great to hear everyone's backgrounds, where they have come from, and how they brought that into their teaching of science. It interesting to see how our backgrounds reflect in our teaching, what we teach and how we deal with the situations we encounter. It is so helpful to hear about what other people are dealing with. Like Clare said, in dealing with the district and setting your goals for where you want to go, you never quite know how to approach it until you hear someone talk about it who has been here for a while and knows the "ins and outs" of the district. It has been very important to hear what is going on in Jasmine's district. We would be able to come up with some great curriculum ideas if we got together with science teachers from other districts outside of Redwood.

I have really benefited from the problem solving and discussions about how we approach things differently. But we all have the same dilemmas, all the time, regardless of school, or whether we are dealing with males or females. Like Rachel, I never felt there was a difference between males or females, but at my school "they do" for some reason. It is an all-male administration and I've never really dealt with that until I met this "good-old boy" administration. All of a sudden it is another wall, so hearing how people surpass that wall has been especially helpful.

Ruth, 1993: I think too that it is interesting for me, as the senior citizen of the group, to see the cross-age comparisons and to see the problems from a younger teacher's perspective rather than my own. There is a difference, after you have been into it awhile, so it's enlightening to see how younger teachers are going to handle the same kinds of situations. I've enjoyed getting to know the people. The high school district never puts any money into going to conferences where you get to know some of the teachers in the

district who are teaching the same subject. We don't even talk within our own district. It would be nice to get together with science teachers from other districts. I think that teachers do get "jaded" and sort of burned out when it's you and the kids day after day. I think there is a fear in this district, of what teachers might talk about if we are allowed to get together and talk. I think it is really important for teachers to get together and share information, especially within science.

Clare, 1993: I feel like I'm the little soldier down in the trenches, trying to battle back the papers. So I never stick my head out to look around and see what is going on around me. Listening to people who have been in the district longer, I'm hearing what is happening at the higher levels and I'm able to see the district in a broader sense. It gives me a wider perspective of what is happening in education at the district level and in individual schools. For me, it has opened my eyes to what is happening outside of my classroom and outside of my dealings with my department chair and the administration in my building.

Storytelling as Opportunities for Growth

Marie, 1993: I think the group conversations were the most beneficial. It was refreshing just to have a social group for dinner once a month, but also informative, thought-provoking and educational. Every month we had a focus and the question we discussed made us dig deep and deal with some of the issues affecting our daily lives. Many times we would like to ignore the things that concern us the most because they are problems that are not easy to deal with. I think it was incredibly reassuring to know we all have the same concerns and together we became a force to face our problems. I didn't realize how comforting it can be to have professionals you respect agree with some of your decisions or just to help you take pride in your work. It's a good feeling to know you're not alone, and you are experiencing the same dilemmas as other professionals in your field.

Jasmine, 1993: I think both the group conversations and the one-on-ones were valuable because when we get together, all seven of us or just two, we trigger each other's ideas and thoughts come into our minds that we share. It's exciting and everybody gets to have input. Sometimes it was hard because we want to be polite and let somebody finish. But we are so anxious to say what we want to say and contribute -- we kept jumping in on each other and interrupting. I think there was value to the one-on-one because you got to be in the spotlight and say whatever you wanted to say without interruptions.

Marie, 1993: I really enjoyed the one-on-one conversations because it gave me a chance to go into more depth on some of your questions. It made me feel important that someone would want to hear my life story or my view on education in today's society. Most of all it gave me a chance to hear from you, Lynne. You have such a wonderful insight on teaching, women's roles in society and in dealing with people and their problems. It was encouraging for me to hear your stories of where you taught and the changes you have gone through. I admire you for picking up, going back to school, moving away and starting again. You are a role model for me as I go through my own change and move to Texas.

Rachel, 1993: I appreciated the one-on-one conversations that we've had because you asked questions that really made me think in a different way than when I am in the group. Your questions and my responses makes me more conscious of what I say and do in a work setting.

Marie, 1993: The reflective journal writing was probably essential for you because it allowed you to get a lot more feedback and information from us in a written form. I know that when I write, I try to think about what I'm going to say. I go back and edit and change things around so it sounds more like what I want to say. I think I am a slow thinker. When I'm alone - - I go off in a daze. When I am around people, they stimulate me and I actually think more, more ideas come into my head. Whereas when I sit at home, I can just sit and day-dream and never get anything down on paper.

Jasmine, 1993: I think that the difficulty some people had with the journal writing is not being used to writing what you think. When I started college, I used to use writing as a way to blow off steam whenever I would get really mad. When I took women's studies class, we always kept journals and so I learned how to keep one. I learn a lot by writing, it helps me look within myself. How do I really feel and how do I think about a certain situation or question? And then I can organize my thought and tell you what I really feel as opposed to just having it just pop-off the top of my head. Even now, I still like to write a lot but I just don't find the time.

Sarah, 1993: I did learn some things when I was making lists of people who had influenced me. I went on and on about those people that I viewed as being a negative influence. I couldn't believe it. I was really shocked myself at how many really negative men I had on my list and have dealt with throughout my teaching career. I thought to myself- no wonder I'm such a bitter old

person. I liked taping my journal entries because I could just ramble. I could just say whatever I was thinking. I have never ever written a journal. I avoided all writing classes.

Rachel, 1993: The journal writing, I look forward to doing at a later time. It may have been helpful, in the middle of the study, for us to talk about what it has been like to write our reflections about the process. I hate to write, I just hate it. I think it is because I don't value it myself. So I don't know or appreciate the value of it. Although I know when I sit down and actually write, I always get new insights. But getting myself to sit down and do it is very difficult. I can think of a thousand other things I have to do. I'm really bad. I wonder how you could motivate people, like me, to keep a reflective journal?

New Insights about Collaborative Storytelling

Classroom teachers are skeptical about the proposed intentions of educational researchers. Perhaps their skepticism is warranted since academic researchers often represent themselves as "outside experts," highly qualified to make observations of classrooms, draw conclusions about what they see, and publish their findings in scholarly journals. What is written about classroom teachers can be uncomplementary, biased and too often is written and published without teacher input or insights. I respect the concern teachers have about academic research and believe it is our responsibility as educational researchers to listen to the voices of practicing teachers and create spaces, within our projects, for them to talk about their experiential knowledge, insights and ways of knowing.

A collaborative storytelling group can provide teachers with a space and the time to talk, to share, and to listen, if the setting is comfortable and the participants feel it is a safe haven in which to speak open and honestly about issues and concerns. Rachel, one

of the women storytellers from this study, specifically commented about the element of risk: "There are risks in saying certain things about your school, about your teaching and not knowing how it is going to be perceived or interpreted by other people." She went on to say that the storytelling community was a comfortable place to talk; therefore, she was willing to take risks and be vulnerable with this group of women she trusted. In this kind of a research study, it is absolutely essential that the participants feel they are in the "good company" of supportive colleagues.

It does make a difference who the researcher is and how she/he related to the participating storytellers. Collaborative storytelling is a strategy that will work well if the storytelling group is be built around the 3 Cs of care, concern and connection. It is up to the researcher to model those qualities during the early stages of the study and acknowledge the experiential knowing and ways of knowing the participants possess.

I believe there is an optimum size for a collaborative storytelling group, and a desirable combination of storytellers for this type of study. Both factors will significantly affect the success of the storytelling process. Five or six storytellers, including the researcher, is optimum size. Teachers rarely have a chance to get together to share ideas, concerns and stories; consequently, when the opportunity arises, they want to contribute. Although we managed with seven, it was difficult for everyone to contribute to the conversations. I often opted to sit back and let others speak, feeling it was more important for the participating

teachers' voices to be heard than mine. My stories would surface in the writing of the study even if my voice wasn't always present in the group stories.

The composition of the group is the single most important decision I made. From my perspective, diversity is essential for professional growth and learning. In organizing our group, I selected participants who differed in age, ethnicity, years of experience and teaching assignments. Considering the criteria, I was fortunate to bring together such a unique group of women science teachers, which may not always be possible considering the limited number of women teaching science in some parts of the country. One important consideration in forming a long-term storytelling group is the working relationship of the participants. If the group includes teachers who work together in the same science department, personal conflicts or tensions that occur in the workplace may carry over to the storytelling sessions. This situation occurred midway through the research study between Ruth and Sarah, who teach in adjoining rooms and represent the entire science department for their school. As the researcher, I was aware that there was tension between them because each had spoken to me separately about their conflict. At one point late in the study, I wasn't sure if either would finish their commitment to the discussion group. Fortunately, they each missed only one group session and, for the most part, the storytelling process was not adversely effected. I should point out that Clare and Rachel were also from the same high school science department, but they rarely saw each other because they taught

different courses in science rooms that were in opposite wings of the building.

Time is a critical factor in the storytelling process. We always ran out of time before we ever ran out of stories. This was true for both the group conversations and the one-on-one sessions. Even though we had six group sessions, each lasting three to four hours, and I met with each teacher for three one-hour conversations over the course of five months, there was still not enough time to hear everyone's voice, listen to all of the stories, or to adequately discuss the concerns and issues we each had. How much time would be sufficient for this type of narrative research? I'm certainly not qualified, at this point, to set a definite standard, but I will offer my suggestions. We met together as a storytelling community for a period of six months and that time period is the minimum amount of time a researcher should plan on. An entire year would have been ideal, especially if we could have had group sessions during the summer when teachers are less pressed for time. For this study, I was fortunate to have this busy group of science teachers meet as often and as long as they did. Educational researchers need to consider that most classroom teachers are busy from morning until night with personal and professional obligations. It is unrealistic to plan too many sessions or expect participants to keep extensive written journals for an extended period of time.

Topics of Conversation:

As the researcher, I brought to this research study a set of questions that I hoped would be answered as we shared stories about our lives as women science teachers.

- o What do women's stories tell us about the reality of their lives as women and educators within the field of science education?
- o What are the professional needs, wants, and beliefs of women science teachers?
- o In what ways do teachers' stories contribute to our understanding of teaching and learning with science education?
- o In what ways do women grow professionally and personally through the sharing of their stories within a collaborative community of women storytellers?

During the first group session, I was open and honest with the participating women about my interest in women's issues in science and my concerns about women science teachers' experiences and ways of knowing being overlooked and not taken seriously within the profession. I shared these four questions with the whole group to help them imagine how their personal experience stories would provide enlightening data about the lives they have led, the choices they've made, and the knowledge and insights they have accumulated over the course of a lifetime. After my initial introduction of the project, these four questions were never discussed again. Instead, I gave the women storytellers the freedom to initiate their own questions, and to focus their storytelling around topics, issues and concerns they felt strongly about in the context of their own lives.

As a woman science teacher, I was confident the questions generated by the group would directly or indirectly relate to the questions of concern to me. My intuition was right. The topics did focus on personal /professional / political issues: power, authority, equity, professionalism, collegiality, respect, relationships, voice, commitment, and purposes of science education. When women come together to talk in this kind of setting about the reality of their lives, their "women's talk" is enlightening, powerful and revealing. It is not trivial, not a litany of complaints, not just anecdotal tales about classroom life. The stories teachers tell, the questions they ask, the insights they share, the experiential knowledge they possess are what Cochran-Smith and Lytle (1990) and Shubert (1992) point out has been missing from educational literature and educational research.

Although it may not be apparent from the conversational segments and the descriptions I've shared in Chapter 6, the group sessions were not free of conflicts and tensions for the participating storytellers. We were all women and science teachers, but our ages, cultural backgrounds and personal experiences are uniquely different. The personal history narratives accentuate the different life experiences that have been influential in shaping our individual goals, beliefs, and values. Even Ruth, Sarah and I, who are the closest in age and religious upbringing, have extremely different ways of seeing the world and the people in it. From my perspective, diversity within a storytelling group, in terms of age, ethnicity, and experience, is highly desirable and amiable conflict

has the potential to open minds to new ways of thinking and interpreting one's experiences.

Collaborative storytelling is more than an opportunity for teachers to find their voices and communicate meaning to a supportive group of colleagues. It has the potential to push women's thinking and to provide alternative ways of acting and being in the world, especially if we aren't afraid to expose our views and have them challenged by members of the group. The following story illustrates this point:

One of the most controversial and hotly debated issues in science education today is the issue of "tracking" students into college-bound versus non-college bound classes. Most teachers, beginning as well as experienced, have extremely strong opinions about the advantages and disadvantages of grouping students according to their ability levels and career aspirations. Within the group, it was quite apparent that we represented the complete range of opinions on this issue, with Marie being on one end of the spectrum and Jasmine at the other end. All of the women in the group had experience in teaching both college-bound and non-college bound classes and agreed that "tracking" made lives easier as teachers because we could adapt the content materials to a smaller range of ability levels. During our conversations, it became apparent that in the Redwood School District, where all of the teachers but Jasmine and I worked, the non-college bound science classes were filled almost exclusively with Hispanic and Latino students. It was rare for minority students to enroll in the

college bound courses of biology, chemistry and physics. After hearing many stories about the benefits of this segregation, Jasmine posed this question to the group: "Why are the college-bound classes in my school filled with minority students and yours are not? Are the Hispanic and Latino students in Valley View different from your minority student population at Redwood, or is it that our expectations are higher and we work harder to counsel them into college-bound classes?" (Redwood and Valley View are less than forty-five miles apart, with Redwood being a highly affluent, resort area and Valley View being primarily an agricultural area.) As science teachers, we need to ask each other tough questions and push each other to think hard about the choices we make for ourselves and for our students. This question was the catalyst for a highly emotional conversation about our personal goals for students and, more generally the purposes for education in this country. Did we come to a consensus about the issue of tracking? No, we did not, but I was proud of Jasmine for challenging the group to look beyond their own classrooms and rethink the stories they've used to guide and support their teaching practices. We listened to each other, seriously considered the alternative options, and didn't become defensive if our ideas or opinions were challenged.

Listening to the Voices -- Collecting the Stories

By using three different forms of data collection, I was able to give this diverse group of women an opportunity to find their voices, to feel listened to, to put into words that silent inner

voice that continuously speaks but is rarely ever heard. Many of the choices I have made in designing this study were based on my personal experiences. I am confident that the decisions made also fit the needs of the participating women.

Most of us have learned to be selective about what we say and how we say it, even when we are with other women. We've been taught to be especially careful about the vocabulary used, the tone of voice, and the response of the listener. In looking over the transcripts of the group conversations, the individual one-on-one conversations, and the reflective journals, I'm aware of how different the individual voices are in each of the settings. The choice of words, the amount of personal disclosure, the depth of emotion, can be amazingly different. All "women's talk" is not identical.

Some of the women were extremely vocal in the group conversations and willingly told detailed stories about their personal experiences. Throughout the study, Ruth, Marie and Sarah contributed extensively during the group conversations, and seemed to be the most comfortable interacting in a collaborative group setting. Clare, Jasmine and Rachel tended to sit back and listen before jumping into the conversations. If I had just used group storytelling as the basis for collecting stories, I would never have heard the stories Clare shared in her journal about growing up female, and her frustration at having to learn male tasks by watching her brothers. I would never have known all of the qualities Rachel tries to develop in her biology students. I would

never have had the opportunity to have a heart-to-heart conversation with Jasmine about her lesbian lifestyle and how that has influenced the choices she has made.

With the exception of Jasmine, the women science teachers were not enthusiastic about being reflective writers. Their resistance to this form of storytelling occurred because they find writing to be a struggle. Writing is not a natural part of their daily lives. It takes time to put into words what one is thinking. Although I found their journal entries to be insightful and revealing, filled with interesting stories and reflections, the participants did not see the value for themselves. They felt the reflective writing was for my benefit, a form of concrete data that did not need to be transcribed. Everyone had the option to tape their reflections rather than write them, if that would save time and be a more gratifying experience. Only Sarah chose that option. She provided me with two full tapes of reflections recorded while she commuted to her teaching job. In the end, I transcribed twenty single-spaced pages of her reflective thoughts. Her taped ramblings, as she describes them, have been extremely helpful to me and quite enlightening to her.

All women are unique and have different needs when cultivating a voice. Some women need just one supportive, trusting listener; others may develop a voice in the process of doing reflective writing or tape recordings by themselves. Still others are able to find the words and speak for themselves in a group situation where other people are asking questions and stories build upon one

another. Based on the group's evaluation, there is not a single way to collect stories that works best for everyone and meets the needs of both the researcher and the women storytellers. For this study, the multiple forms of data collection gave all of the participants, myself included, the opportunity to talk, share, be supported and learn from each other. It is up to the researcher and the participating teachers to decide what the overall goal of the project will be and then collaboratively develop a scheme that fits the needs of everyone involved.

Is collaborative storytelling a research strategy that can meet the needs of women science teachers and the educational research community? Were we able, in the six months we were together, to meet our goals as a community of colleagues? If we agree that one of the goals of educational research is to link teachers' and children's lives with the concept of education, then the answer to both questions is yes. Involving women science teachers in collaborative research acknowledges the value of their experiential knowledge and ways of knowing, and provides a setting for their voices to be heard and their points of view to be represented in research findings. As educational researchers, we need to find ways to work with practicing teachers in collaborative relationships where their needs and those of their students take priority, and their personal, professional knowledge is recognized as a valuable addition to our knowledge base about science teaching and learning.

What Can the Educational Community Learn
from Women's Stories?

Re-visioning -- the act of looking back, of seeing with fresh eyes, of entering an old text from a new critical direction -- is for women more than a chapter in cultural history: it is an act of survival. Until we can understand the assumptions in which we are drenched we cannot know ourselves. And this drive to self-knowledge, for women, is more than a search for identity: it is part of our refusal of the self-destructiveness of male-dominated society. We need to know the writing of the past, and know it differently than we have ever known it; not to pass on a tradition but to break its hold over us. (Adrienne Rich, 1979, p. 35.)

This study, A Search For Missing Voices, has been a drive toward self-knowledge for me and for the six women who came together to share stories about our lives as women science teachers. We have been looking back with fresh eyes at our life experiences with the hope that together we could better understand the social, cultural, and historical traditions that we've inherited and break the hold they have over us.

Breaking the hold of traditions is a difficult undertaking for women. As women and teachers, we have inherited an identity defined almost entirely by the values and traditions of our male-dominated society (Baker-Miller, 1986). Personally, professionally, and politically, women are bound by established norms and expectations which often prevent them from freely choosing what they want to do, or be, or say. Over the years, these norms and expectations are passed on from one generation to the next through the stories that are shared. From early childhood, we hear stories which act as guides to live by. We, in turn, use these inherited stories to explore our lives, to understand life's experiences, to try out

alternative ways of acting and being in the world (Jalongo, 1992). Stories shape future actions by helping us imagine how we want to lead our lives, what options we have, and what role models to emulate.

What happens if the stories we have inherited from the old traditional texts need re-visioning? What if the characters, the plots, and the settings in those stories are represented from a distorted point of view? And most importantly, what if the story perpetuates a myth that is self-destructive to the women who read or hear it? If women repeatedly hear and read stories that misrepresent the value of feminine qualities and women's ways of knowing, deny the importance of women's work and accomplishments with science and science education, and suggest that women are less able to pursue rigorous, demanding professional careers, they will begin to distrust their intuition and devalue the strengths and knowledge they possess. Then, I believe it is time to change the story and offer women a new version that includes new characters, a new plot, and a change of scenery.

Michael Connelly and Jean Clandinin (1992) assert that the form and kind of stories will continue to be repeated unless storytellers, particularly women storytellers, insert their different stories into the cultural and social stories. They propose to change the stories by:

. . . inserting the personal into the cultural and have the stories retold outside social contexts. The retelling of a story is cultural bound but the retelling, the reimagining of a story, is a freeing from the cultural story. The retold, reimagined story makes it possible to make a difference to the social and

cultural conditions which gave form to the lived and told story in the first place. In this way there is possibility for new imagined stories to change the cultural and social stories (p. 16).

I hope the retelling of our stories, outside the social context of our lives, will free women from the cultural and social stories that misrepresent our strengths and accomplishments. I likewise hope that as a community of storytellers we have been successful in creating a story that honestly and openly focuses on issues that are important to women science teachers, as well as to others within the educational community, who are eager to listen and work collaboratively with classroom teachers to incorporate their experiential wisdom into the knowledge base of teaching and learning of science.

In writing this dissertation, my primary concern has been to provide pre-service and experienced science teachers with a set of narratives that will enhance their efforts to be reflective and revisionary about the personal experiences that have influenced and shaped their lives. The issues the women storytellers and I have raised have personal, political, and professional implications for the entire educational community because our concerns represent the concerns of thousands of ordinary, dedicated classroom teachers whose lives are directly affected by the social, cultural and historical traditions established and maintained by the dominant institutions of this society.

Therefore, it is my hope that issues raised and the concerns expressed within the chapters of this work will extend beyond the immediate lives of women science teachers. As unique as this group

of women storytellers is, our concerns, conflicts, dilemmas, aspirations and hopes for the future are not insignificant, inconsequential or trivial. There is a great deal to be learned from listening to teachers' voices. It is not just their words, however, that are important. Equally important are the topics they choose to focus on when given the freedom to speak courageously from their hearts and their minds.

In this section, I would like reflect upon our efforts to be re-visionary and share a final set of reflections about the struggles and dilemmas women teachers face when they begin to break traditions and consider possible strategies for transforming an inherited reality. In particular, I want to focus on the major themes represented in the Passages I, II, III, IV of Chapter 6 and raise issues for the reading audience to consider and reflect upon as we consider ways to reform science education and "women's true profession."

- Passage I: The Cultivation of a
 Personal/Professional Voice
- Passage II: Uncertainty of Influence - Its
 Relationship to Voice
- Passage III: The Problematic Nature of Change
- Passage IV: The Reality of Being a Woman in "Women's
 True Profession"

I. The Struggle for Personal/Professional Voice

When I asked the women in the storytelling group if they felt they had a "voice" in their personal and professional lives, I was struck by how problematic the question was to answer and the

challenge each of the women faced as they searched for words to frame their response. Most women do not confront this issue directly, but rather have learned to adjust and adapt their voices and figure out ways to get their wants and needs met. Consequently, when I asked the question, "Do you have a voice?", they did not seem to have a clear, well-thought out response to give. In fact, before we could even have a conversation about this topic, we found it was necessary for each woman to explain what the word "voice" means within the context of her own life.

Although the explanations given by the women storytellers were related, their interpretations of this word provides an expanded image, a broader set of meanings for "voice." Let me briefly summarize the meanings expressed to help illustrate this point.

Ruth: Having voice is being part of the decision-making process.

Sarah: For me having a voice means being able to present an idea clearly and have people really want to listen to what you say, like all of the parts of it and assimilate that into their thinking.

Jasmine: Voice means that if you have a concern or you want to say something, that you are heard, not just heard but people listen. Listen with an open mind and take into consideration whatever you have to say before jumping to any conclusions or making decisions.

Rachel: I have some real definite ideas when it comes to core value in life. I do feel I have a strong voice in those values and in my personal life. When I have something to say, people respectfully listen. In order to have a voice you have to be a good listener; you can't just spout out your ideas and expect everyone to listen, if you are not listening to them.

Marie: Growing up, I was always encouraged to think that my voice could be heard. I was never shy and was always vocal. Having a voice is getting involved and speaking out. If I get involved then I feel like I have a voice.

Clare: I don't know if anyone really does have a voice in the context of my department, except for a few.

Lynne: Voice means that you have formed very definite opinions and views on a variety of issues. To have a voice means not only that you have formulated these views but you have ways to express them in situations that are important to you, personally and professionally.

When I think about how these explanations are framed, it is apparent to me that voice is a term directly connected to particular kinds of relationships in which a woman has the freedom to express her opinions, speak her mind and be taken seriously. /Voice/ is a relational issue, not a strictly individual matter or quality, and involves having others take seriously the views she expresses. Most of the women in the group talked about currently being in personal relationships with other people, women and men, in which they have a voice. In the past, this may not have been true, but these women appear to have learned how to cultivate a voice within their personal lives. I must admit that this was a surprise for me, but I was happy to know that not everyone felt as "silenced" as I had by loved ones and friends.

Because the issue of voice has played such a prominent role in my life and in my efforts to establish an identity for myself personally and professionally, I expected this to be true for all women. I assumed that their interpreted realities would closely

match mine. In fact, they did not. What did match, however, was the concern we all had about our lack of professional voice and our inability to get teaching colleagues, department chairpersons, and administrators to listen to what we had to say with open minds and take seriously the knowledge and expertise we possess.

Professionally, what this group of women science teachers wants above all else is to have a voice within their departments and within their schools. They want to have multiple opportunities to talk and to be listened to; to have their ideas, concerns and suggestions taken seriously by their colleagues, department chairpersons, and by administrative personnel. It continues to be a struggle and source of conflict for women science teachers who work in school settings in which their expertise and ways of knowing are disregarded and often treated as inferior.

Why is it so difficult for women to have a voice in a school setting? If we take seriously what the storytellers claim, it is because they do not have a safe, supportive setting in which to come together to talk, to share ideas, to work as a team of collaborative problem-solvers, to be colleagues. Even the women teachers who claim to have cultivated a voice within the context of their families, and who use that voice during their school experiences, are finding it difficult to have a voice in the hierarchical setting of the public school. If we go back to comments shared by Marie and Sarah in Chapter 6, it is clear that women science teachers feel constrained and silenced by their male colleagues.

We have a hard time in our department with a couple of the men. We want to be real honest and talk about the curriculum and air our feelings and frustrations. But we can't have that discussion because several of the men get very defensive and automatically think we are judging them. They have trouble thinking about the curriculum or departmental issues as "ours" instead of "mine." (Marie, Group Conversation, May 1993.)

I think we've touched on this before, the difference between how men talk in a group versus how women talk in a group. Men tell a story and if someone interrupts them, they wait. They don't hear what the other person says, they just continue right on from the comma. It is always a "prowess," like "wasn't I good," whereas women relate better to relational kinds of discussions and I think that is probably why support groups got started. (Sarah, Group Conversation, May 1993.)

Several women likewise voiced dismay and frustration about the manner in which certain administrators dismiss and disregard their efforts to express opinions and raise concerns about educational problems and dilemmas. Marie was the most vocal about this pattern and clearly has felt the brunt of being a young female teacher whom experienced male administrators treat as less than an equal professional educator. In the course of our conversations, we labeled this behavior the "good old boy mentality" frequently exhibited by school administrators.

All of our administrators are male. I can say, very definitely, that two of our administrators treat me with respect and two do not. There is nothing more humiliating than an administrator who will not listen and treats you in a condescending manner. I feel that several of the administrators only pretend to listen, just to humor me. Many times one of them has patted me on the back and said, "Oh Marie, why are you complaining about this time?" It is very humiliating and indicates that no matter what I say, I won't be taken seriously. (Marie, Journal Entry, 1993.)

The difficulty women encounter when trying to cultivate their professional voices goes beyond the apparent differences in women's and men's conversational styles and the lack of respect exhibited by administrators who truly do not view women teachers as colleagues and experienced professionals. It is also influenced by a self-destructive behavior that most women have learned as part of the cultural norms and expectations of our patriarchal society. Early in our lives, we are taught that females should not be argumentative, assertive, or outspoken in their manner of speech. It is not "lady-like" or acceptable for women to be loud and vocal, to demand that our views be given priority, to interrupt or dismiss the concerns expressed by others. In mixed groups of men and women, we have also learned that a certain kind of voice will be listened to, whereas other forms of talk will not. The distinction Rachel makes between her "intellectual voice" versus her "emotional voice" indicates that her different voices are not equally heard. She feels "more confident and is listened to better" when she uses her intellectual voice -- her comments are well thought out, well structured and her style is more rational and articulate. When she uses her emotional voice -- spontaneous, threaded with feelings, fragmented, coming from her heart -- she does not expect to be listened to. "No one is going to listen to my emotionalism" (One-on-one conversation, 1993). Why doesn't Rachel expect people to listen when she is emotional? Why shouldn't a woman feel that she can "speak her mind by telling her heart" in any kind of conversation, in any situation (Rogers, 1993, p. 291)?

I believe women think in this self-destructive manner because, socially and culturally, we have learned that "women's talk" is of less importance, carries less authority, than "men's talk." This distinction between "women's talk" and women's ways of speaking versus "men's talk" and men's ways of speaking is part of the cultural norms of this society. We all know that when women get together to talk, it is often characterized as a "gossip session," even when the conversation deals with current events, political and social issues, teaching strategies, child abuse or sexual harassment. The women in the storytelling group wondered at times if our conversations would be labeled as "gossip" because we frequently talked about the tenuous and problematic relationships we've had with certain teaching colleagues and administrators. This is an example of the way in which women can often be their own worst enemies, contributing to the silencing of their voices. If we trivialize and demean our own ways of talking, it seems likely that other groups, namely men, will follow our lead. Men do not control the meaning of words and stories unless we, as women, let them dictate what words will be spoken and what stories will be told (Heilbrun, 1990). Consider again Carolyn Heilbrun's words:

Men trivialize the talk of women not because they are afraid of any such talk, but in order to make women themselves downgrade it. Women's talk will indeed be harmless as long as women consider it trivial compared to talk with men. (Heilbrun, p. 44.)

As a group, women must take the initiative to speak up and speak out in situations where their voices will make a difference, specifically in department meetings and staff meetings, and in

conversations with department chairs and building administrators where critical decisions are made. When Marie states that she can have as much voice as she wants as long as she is willing to work hard and get involved, we can assume that there are opportunities for women to be influential and vocal. "Having a voice is a matter of how much you want to complain. If you don't make noise, you don't get results" (One-on-one conversations, 1993). Women cannot sit back and wait for other to "invite" them to speak. They must take the initiative and have faith that their personal, practical knowledge and ways of knowing give them the authority to speak their minds. They do not have to remain silent until they have cultivated the "appropriate," male-defined intellectual way of speaking. What will it take for women to cultivate their professional voices? Clearly the women in the storytelling group indicate that they can develop a confident, assertive voice if they have a space to practice and the support of caring, non-judgmental colleagues. For women in science, an inclusive community of women was a place where their "women's talk" was respected and they could share knowledge, insights and experiences without fear of ridicule or sarcastic put-downs.

One of the concerns the women science teachers expressed was that a mandate could be issued from the administration stating that all teachers should become involved in conversational storytelling groups with their teaching colleagues as a strategy for developing collaboration and a sense of community within the school. Several of the women stated that it would be extremely difficult to be

outspoken and honest with teaching colleagues they did not respect or trust. The essential qualities needed for a successful collaborative conversations are not organizational factors that can easily be controlled. Rather, the qualities and personal characteristics of the individuals involved in the conversations determine whether or not an empowering relationship will develop.

As secondary school districts consider various options for professional development and teacher in-service, it is essential that building administrators and central administration listen to voices of teachers and provide "options" that meet the needs of all teachers, especially women science teachers. "Recent research studies on staff development point strongly to the power of teacher-teacher professional collegiality as a key to school success and effective school change" (Liebermann as cited by Griffin, 1991, p. 250). Gary Griffin (1991) suggests that all teachers need opportunities to be involved in "interactive staff development," where teachers are involved in "ongoing reflections, using judgments about their own practices as a basis for working toward improving educational opportunities for students" (p. 248).

The stories teachers tell, the successes they recount, the frustrations and dilemmas they face would become a significant source of ideas for improvement or change or "reform activities." Teachers' thoughts and personal accounts of their work would influence the process of formulating rather than mandating ways to act toward school change. (Griffin, 1991, p. 248).

II. The Uncertainty of Influence

Women science teachers are by no means alone when it comes to the issue of influence. Rarely do secondary public school teachers have an accurate perception of the influence they exert on their students, teaching colleagues, administrative staff, or the community at large. I am purposely not including elementary classroom teachers because I have a sense that they get more feedback and are able to develop a closer connection to students and parents over the course of a school year. Life as a secondary science teacher is a whirlwind of students coming and going; a new flock descending upon a teacher with the ring of the bell, five times a day and a hundred and eighty plus days a year. Although teachers have daily contact with these students there is rarely time for conversations to take place in which students have the opportunity to give feedback and to let teachers know how influential and necessary they are. Marie's comment summarizes the dilemma.

We all down deep hope that we are a positive influence on all of our students, but unfortunately there really is no way to know just how we've affected our students' lives. I'd love to say that I've changed students' attitudes toward science and have influenced some to pursue careers in science. But I don't know for sure how many that might be. (Journal Entry, 1993.)

Once in a while, a student will come back to visit or write a letter to a favorite teacher explaining how valuable a certain course was or how much they appreciate the support and guidance they received. All of the women storytellers talked about how valuable that kind of feedback is to a teacher and what they learned about

their teaching style, not just what worked and what didn't but also what kind of students seemed to benefit most and why. How many students does a teacher actually hear from? In my case, I would estimate five to ten students a year, which includes recent graduates and students currently attending high school. If a teacher is an athletic coach or an advisor to club or organization, they generally are more aware of their influence because the relationship allows for more contact in a situation where a teacher and a student may work together for several years.

At the junior high/middle school level, there seems to be even less opportunity for students to provide teachers with feedback. Both Sarah and Ruth expressed concerns over the difficulties they face because twelve- and thirteen-year old students are quite changeable and unpredictable. It is a real challenge to evaluate how effective a particular lesson is and what changes should be made to meet the rapidly fluctuating needs and maturity levels of all adolescent students.

What does this uncertainty of influence have to do with the struggles women teachers face when trying to break traditions or push for change? For women science teachers, the uncertainty seems to prevent them from taking an assertive stand on proposed curriculum changes, implementation of new school policies or programs, directives handed down from department chairpersons and administrators. Most schools do not have an organized plan for evaluating the overall effectiveness of the courses being taught or the strategies being used by teachers to help students acquire

competency in the subject areas. Every two or three years, a teacher is observed by a school administrator and forms are filled out to indicate if the person is meeting the established expectations of the school district. For many teachers this is simply a formality to be endured; it has no real bearing on their teaching or their students/ learning. Since teachers are rarely observed by their colleagues, they do not have the benefit of having someone else critique their teaching or offering suggestions and alternative options for working with students. Many teachers rely on personal experience and experiential knowledge when making decisions about what to teach and how to teach it. Their decisions are generally not based on any particular educational theory or developmental concept. It just feels right and the students seem to be engaged and learning. But just feeling right is not conclusive evidence when a teacher is trying to persuade colleagues or administrators to adapt a new curriculum or to change the sequence of science courses currently being taught. Within male-dominated science departments, women are often less willing to exert pressure on the group. Sarah is currently the department chairperson for her building. Although she has years of experience and is in a position of power, she is still reluctant to argue and push her views.

I am totally frustrated about my inability to convince people. I hate to argue my point of view and try to convince people I'm right. When people say, "You are wrong," my tendency is to back down and say, "OK, I'll try again and get it from your point of view." Men don't do that. (Journal Entry, 1993.)

Is this a female versus male issue? In this situation, I'm convinced Sarah is reacting in this manner because women tend to

look at all sides of an issue, consider the complexities of a situation, rather than view life as black and white (Tannen, 1990). When confronted with a complex problem or a situation, women are more likely than men to be uncertain or unwilling to take a firm stand. It is a dilemma that many teachers face because they are not willing or able to present a convincing argument that is substantiated by objective data and concrete test results. This issue of uncertainty appears to affect women teachers' willingness to voice their opinions and stand up for their point of view in professional situations. Perhaps this is what Rachel meant when she said, "I am most successful with my voice when I have thought about what I am going to say and have underlying principles that guide the decisions I make" (One-on-one conversation, 1993).

If Rachel uses certain well-thought out principles to guide her work and they are the basis for the decisions she makes, then her uncertainty is diminished and she is more confident about speaking up and expecting that her words will be listened to and her comments taken seriously. If a teacher does not have a set of principles or a well-developed educational philosophy, she is less likely to speak up in a department meeting or faculty meeting where there is often little time to plan a convincing argument or form an articulate speech.

The women in the storytelling group often did not have the opportunity to discuss important educational issues in science education with supportive colleagues and therefore have not developed an in-depth educational philosophy. Our group discussion

about "integration of the sciences" was an example of the kind of philosophy-developing conversation that could help women science teachers strengthen their voices by providing a safe place to discuss, debate and construct their own educational philosophy and principles of teaching and learning science. This storytelling group was just beginning to develop into a site for philosophy revision and development for the participants.

This uncertainty of influence also affects the relationships classroom teachers have with the administrative staff. Many teachers, women and men alike, do not view building administrators as collaborative colleagues who will listen to their concerns and welcome their suggestions. It is unfortunate that public schools are organized in a top-down hierarchy, with administrators positioned at the top and the teaching staff assigned to the bottom. With this kind of organizational strategy, many decisions are made at the top with minimal input from those at the bottom. The mandates or directives seem to trickle down and classroom teachers are expected to implement new policies whether they agree with them or not. This is especially apparent in large high schools and junior highs where the teaching staff includes over one hundred individuals. Monthly faculty meetings are primarily used to dispense information not to give teachers an opportunity to talk with one another or to have a serious discussion about current school policy or curriculum development.

In the high school where I taught in from 1977-1991, we would go for months without ever having a faculty meeting. Our principal

would alert us to upcoming deadlines, mandates from central administration, changes in school policies, and student disciplinary concerns through "memos" in our mailboxes. We rarely had opportunities to share ideas, make suggestions, or vent frustrations and concerns as a staff. In many ways, it appeared to be an intentional move on the part of the principal to eliminate or curtail teacher involvement in the decision-making process of the school. After years of frustration with this impersonal form of communication, several women faculty members and I proposed a plan for monthly staff meetings which would include the secretaries, custodians and hall monitors. We volunteered to organize these meetings with different departments acting as hosts and updating the staff on their current programs of study. From my perspective, this was an important step toward unifying the staff and providing opportunities for everyone to influence the overall effectiveness of the school.

Unfortunately, many science department meetings follow a similar format, with the majority of the time spent on dispensing information and attending to questions and concerns posed by the administrative staff. I was fortunate to have been a member of several science departments that met on a monthly basis, junior high and senior high teachers together, to discuss curricular and budgetary issues. We rarely, however, had serious discussions about our teaching strategies, articulation of the content covered in grades 7-12, or the overall effectiveness of our program for providing all students a well-rounded background in science. Our

meetings were always held at the end of the day when everyone was tired and unenthused about having extended, challenging conversations. Time for teachers to talk about serious educational concerns is rarely built into the busy school day; consequently, an individual teacher's knowledge, expertise and ways of knowing are rarely shared with other colleagues, and her influence is minimized.

III. The Problematic Nature of Change

Why is it so difficult for classroom teachers to change? Why do they seem to resist any reform initiatives that seek to alter the traditional curriculum, the organization of the school, the expectations of both teachers and students?

For science education teachers, the problem of change involves several different components. The women storytellers highlighted three key obstacles that act as barriers in their efforts to rethink science education for the twenty-first century.

- o Constraints imposed by the California State Board of Education
- o Demands imposed on high schools by institutions of higher education, university and college systems.
- o Traditional views of who needs science and for what purposes -- conflicting demands.

As we think about how to reform and improve science education in this country, we need to take a closer look at practicing science teachers' views and consider what might be done to lower or remove these barriers so that progress can be made.

The Constraints Imposed: The first obstacle seems to be of monumental concern for classroom teachers in California. I don't believe that they are unique in this regard. Teachers in Michigan and across the country are equally concerned about the continual stream of mandates issued by State Boards of Education. Because this research study was conducted in California, I'll confine my remarks to the current situation that exists in this state.

This group of women science teachers feels strongly that the California State Board of Education limits, rather than encourages, teachers' efforts to be creative and innovative. In particular, they are opposed to state-mandated assessment tests that focus on specific pieces of knowledge, "factoids," rather than on the overall experience of doing science. Although the newest assessment test, The California Learning Assessment System (CLAS), features performance assessment in science and incorporates extensive "hands-on" activities for students, classroom teachers still view it as just another strategy being used by the State Board to control how science is taught, what teachers will emphasize, and what criteria will be used to evaluate student learning. Many teachers enter the teaching profession with the belief that they are free to choose what content will be covered, how their classrooms will be organized, and what will be important for students to learn and understand as high school graduates. This is an age-old tradition in public education which teachers treasure because it gives them some control over their professional lives. In a sense, it is a key component of making their jobs "professional." When the State Board

of Education proposes changes that will infringe on this perceived professional right, teachers react with contempt and distrust. The most experienced group member, Sarah, shared her frustration about this infringement.

First of all, it is not what we are trying to do that is the question; that is the wrong premise. We are not driven by our own desires; we are driven by the State and by university mandates. What they request is what we do. Changes are initiated at the university and state level, not at the school level. What really drives the district to change is the State Framework. (Group Conversation, 1993.)

The California State Framework for Science, a state approved K-12 science curriculum document, is likewise viewed by the women science teachers as an infringement on their right to design and implement their own version of science curriculum. Marie, in particular, is opposed to implementing the State Framework because it would interfere with science teachers' ability to prepare students for college. "If I spend 60% of class time on hands-on activities, I won't be able to get enough information out to the students. They wouldn't be prepared; they have to have the basics in every area" (Marie, Group Conversation, 1993).

Interestingly, the revised "Framework" is encouraging science teachers to break with tradition by emphasizing less content and more depth, by greatly increasing the amount of time students spend doing hands-on, inquiry based learning and by recommending an integration of the basic sciences, with equal representation of life, earth and physical (State of California, Science Framework, 1991). Although the women storytellers seem to be opposed the goals of this curriculum Framework, I recognize it as a real opportunity

for classroom teachers to be innovative and to move away from "content-driven" science education of the past one hundred years. I believe the key issue is not the Framework itself, but the lack of voice the majority of teachers have had in creating it. In the past the State Department of Education has not provided adequate funding for the innovations and reforms they have mandated, nor have teachers been offered meaningful professional development for implementing the recommended changes.

University Demands: High school science teachers in California feel a tremendous amount of pressure from the University of California System. One of the pieces of feedback that science teachers receive from the universities is how well their students have done in introductory level college courses. If a student fails an introductory chemistry, physics or biology course at one of the UC campuses, the most common conclusion drawn is that they were not well prepared in high school; the high school course was not rigorous enough, or the teacher didn't adequately prepare the class in the basic concepts of the discipline. All three of the physical science teachers in this study, Ruth, Marie and Clare, mention the pressure they feel from the university to prepare students "not to fail."

Every year I am cramming in so much. There is no way I can fit anything else into the curriculum. I am responsible for preparing them for college. Now I could easily change the curriculum to focus on preparing more well-rounded student. But is that fair to the student who has to compete in college with students from Los Angeles or Northern California that are better prepared because they've studied "kinetics"

and "equilibrium" more in-depth? I don't want my students to get to college and have no idea what the science professors are talking about. (Marie, Group Conversation, 1993.)

The problem is that universities use the Introductory chemistry as the clearing house for students. If you look at the number of students who flunk freshman chemistry at four-year universities, it is extremely high. When I was teaching chemistry at the high school level, I had to design my course so that students will be able to survive college chemistry. (Ruth, Group Conversation, 1993.)

For college prep students, it is part of my duty to help them learn how to solve problems on their own and to be able to read a technical science textbook and glean information from it. I want students to leave my science classes with a certain amount of content knowledge and the mathematical concepts involved with chemistry and physics. College professors assume that the students they get in their courses will have a background in physics and chemistry. They do not expect to have to start from scratch with beginners. (Clare, One-on-One Conversation, 1993.)

Rethinking the Traditions of Science Education: Based on the autobiographical narratives of the women storytellers, it appears that we all learned "school science" in traditional school settings and were exposed to traditional models of science teaching. Sarah might be the exception since her high school was located near Stanford University, and they apparently implemented many of the new and innovative "alphabet curricula programs" designed in the early 1960s (DeBoer, 1991). Nonetheless, we were all educated in college and university settings where the patriarchal traditions of science education prevailed. Our impressions of science and scientific method were shaped and molded by a variety of mostly male professors who were our mentors and teachers.

As a group, science teachers continue to wrestle with the inequities of tracking students within secondary science programs, the problem of effectively preparing students for future careers that may not even have names today, and the difficulties of meeting the scientific literacy needs of all students. It is not surprising that our storytelling community struggled with these same issues and were not able to design a plan to solve the problems or even reach consensus on how to best serve the needs of all students. Until science educators, at all levels, agree on the goals and objectives for science education and have seriously developed a realistic strategy for meeting the needs of the diverse student population currently enrolled in American schools, classroom science teachers will continue to struggle and resist making drastic changes in their teaching practices.

Experienced science teachers are not interested in changing just for the sake of change. If the educational research community can provide concrete evidence to support the newest wave of reform efforts, veteran teachers claim they will then be willing to do the hard work of rethinking and reevaluating their teaching and students' learning of science. Until then, science education will continue to follow the familiar pattern of "reforming, again, again, and again" (Cuban, 1990).

One of the more intriguing issues discussed by the storytelling group was the different goals teachers had for their college-bound students versus their non-college-bound students. Like my colleagues, my experiences in teaching science were exclusively in a

tracked system where students were separated according to academic performance and career aspirations. I was quite blind to the built-in inequities of the system because I never seriously thought about whose needs were being met, the students' or the teachers/. As I listened to the descriptions of the goals for different levels of students, the inequities became more apparent to me. Through selectively tracking students, we provide one group with academic skills and the other group with practical skills for living in society. Many students don't seem to have the benefit of acquiring both sets of skills in the same course. Consider the following two sets of goals Marie (1993) has outlined for her college-bound chemistry class and for the non-college bound physical science.

In physical science, the goals for students are:

- (1) to learn basic consumer science,
- (2) to be scientifically literate with a common sense background of how the world works and the ways in which the laws of nature affect a person's life,
- (3) to be able to understand current issues in science so they can vote wisely,
- (4) to develop problem-solving skills that will be useful in everyday life,
- (5) to acquire hands-on experience with basic computer programs.

In Chemistry, the goals for students are:

- (1) to take responsibility for their own learning, (2) to develop good study skills for independent learning and for successfully preparing for final exams,
- (3) to acquire a solid foundation in basic chemistry

- (4) to have the necessary skills to do research and write a term paper,
- (5) to be familiar with computer technology.

How can we possibly know what the future holds for any of today's students? Why don't all students need a basic core of knowledge in all of the sciences and an exposure to current science issues of importance to society? Won't all students eventually leave school -- high school or college -- and live life as ordinary citizens in diverse communities?

The women teachers in the group, including myself, are finding it exceedingly difficult to imagine what an ideal science education program should look like. We are so used to working with minimal financial resources, uninspiring, and poorly designed curriculum materials, inadequate equipment and laboratory facilities, and an inflexible school schedule, that it is truly hard to dream, picturing what reality would be like if education was the country's first priority.

I did not begin to imagine a vision of what might be possible until I had the opportunity to visit other schools and talk with innovative, visionary teachers about their science programs and the strategies they had developed for helping students experience science, not just take it as a class. I became even more aware of the possibilities when I entered the doctoral program and had access to a wider range of curricular materials and school improvement plans from across the country and from foreign countries. But the other women in the group, with the exception of Rachel, had more difficulty creating a "vision" for themselves or their students

because they rarely had the opportunity to explore new programs, observe other teachers using new strategies and techniques, have conversations and share ideas with other professionals within the educational community.

We don't have a clear idea of what a reconceptualized educational system would look like. Myrna Cooper (1991) suggests that we don't even have the right vocabulary to express what a truly visionary, liberating school system would be like. The absence of such a vocabulary makes it difficult for teachers and administrators to articulate their vision and develop a plan of action for transforming the present educational system. School personnel, teachers, administrators, and support staff can create a new language and find new ways to talk about their dreams and goals just as we did within our storytelling community. Cooper (1991) recommends cultivating skills that are directed at:

. . . creating expertise among practitioners in collaboration, consensus building, communication among and within groups, self-study, decision making, problem solving, and developing vision and mission statements, and action plans necessary to achieve them (p. 90).

These are tools that I believe will help women science teachers develop an innovative, equitable plan for rethinking science education for the 21st Century. It is difficult for experienced classroom science teachers to overcome the perceived constraints imposed by the California State Legislature and the University of California system. But I believe women can overcome these constraints by utilizing their personal knowledge and experience to create an ideal learning community for teachers and students.

Successful reform in science education will occur when teachers have time and space for authentic conversations and begin to "think differently about environments, social, economic, and political constraints, themselves, and others -- especially children" (Cooper, 1991, p. 91). Myrna Cooper suggests that:

Reform lies in altering assumption. It lies in a meaningful empowerment of practitioners who will use responsibility, authority, knowledge and collaboration to make schools humane places for learning. (Cooper, 1991, p. 91.)

IV. The Reality of Being a Woman in "Woman's True Profession"

The professional nature of a teacher's role creates tensions and conflicts for women precisely because it discounts the importance of feminine ways of knowing and devalues those attributes that many women feel are essential qualities for a classroom teacher to cultivate (Laird, 1988). There is an inherent contradiction in how we define the obligations and expectations for women teachers. On one hand, women are encouraged to become teachers because they possess certain qualities that are essential for teaching: personal caring, knowledge of and interest in students, ability to establish and maintain relationships (Feiman-Nemser & Floden, 1988). They are then discouraged from emphasizing these same qualities because subjectiveness and attachment diminish the professional nature of teaching.

Since the middle of the 19th century, teaching has not been a gender-neutral profession (Feiman-Nemser & Floden, 1988). With the feminization of teaching, there evolved a set of cultural

stereotypes that prescribed an additional set of expectations and obligations for women. This set of stereotypes clearly reflects society's image of the teacher as woman and teaching as woman's work.

Teaching is considered an ideal job for women not only because it is compatible with family life, but because it draws on qualities thought to be associated with women - "the traditional womanly dimensions of nurturance, receptivity, passivity." (Lightfoot as cited in Feiman-Nemser & Floden, 1986, p. 519.)

This traditional image of women, although challenged by new scholarship on women who teach, assumes that women teachers are drawn to teaching because of their emotions rather than their intellect (Feiman-Nemser & Floden, 1988). If a woman chooses a career in science teaching, the general public and the scientific community assume it is because she could not compete intellectually or emotionally in other more rigorous science-related professions. All of the women in the storytelling community talked about the lack of respect the general public has for anyone who takes on the role of teacher. Although they agree that women science teachers are granted slightly higher status because of the kinds of knowledge they possess, they are still using their knowledge to do "women's work."

In our capitalistic society, identifying teaching as "women's work" is not a compliment. Instead, it is a strategy used to demean and devalue the nature of teaching and the role of teachers (Laird, 1988). "Women's work" is not synonymous with "professional work." If it were, the current reform efforts by the Carnegie Forum's Task Force on Teaching and the Holmes Group would not be stressing the

importance of professionalizing school teaching, and raising the standards for prospective teachers. They would not be emphasizing those aspects of teaching that are most male-identified: the cognitive, intellectual, and technical aspects of teaching, to the exclusion of the affective, intuitive, and artistic aspects of teaching (Hulsebosch, 1992). As it is, the reform efforts of both groups seem to be pushing for a transformation of the teaching profession into a male model of detached professionalism. This male model favors enhancing the status of teaching by establishing a new idealized image of schools teachers as people of substantial intellectual accomplishment, capable of professional autonomy, "true" professionals that desire to advance in prestige and governing power rather than advancing a concern for children and community. This "new" image calls for a "new" kind of professional: an individual who will exhibit the professional values traditionally defined by men rather so-called "feminine values" associated with child rearing (Laird, 1988, p. 458). Essentially women teachers will become male impersonators playing a dual role, as I did when I impersonated a male physics teacher during my first year of teaching.

The women in this group convinced me that the elite members of the educational community are mistaken in thinking women teachers wish to separate their personal identities from their professional identities. These women do not want to eliminate their feminine values and ways of knowing in order to fit the idealized image of a masculine career professional. They do not want to advance to more

prestigious positions that might take them out of the classroom and reduce their contact with children.

I know that when I enter a classroom as a teacher, I do not take on a whole new set of values and beliefs. Who I am personally is who I am professionally and politically. How I think about science teaching is represented by the choices I make, the scientific knowledge and content that I incorporate into my lessons, and the goals that I have for all of my students. This intertwining of a woman's personal and professional identity is a thread that runs throughout my stories and the life stories of the six women in the storytelling community.

The current reform efforts proposed by the Holmes Group, The Carnegie Task Force, and others within the educational community raise a number of serious questions. These questions, I believe, need to be answered by women and men who are doing the work of teaching in public school classrooms. What is the "real work" of a teacher? What are the incentives, the benefits of teaching that keep women in the profession? Will eliminating all references to care and nurturance improve the quality of education in this country, as the Holmes Group and Carnegie Task Force imply? We need to listen to teachers' voices and consider how they view their role and what is important and meaningful in their lives, both personally and professionally.

During our final meeting as a storytelling community, one of the women posed this question: What really motivates teachers to stay in the classroom day after day despite the low status and

continual frustrations? Their oral descriptions are powerful and enlightening. Listen to the emotional, spontaneous voices of these women and compare their words to those of the Holmes Group and the Carnegie Task Force. Whose needs are being met by the current initiatives, those of classroom teachers and students or of the elite members of the academic community, the Deans of the Colleges of Education, throughout the country?

Carnegie Task Force

The Task force proposes creation of a National Board for Professional Teaching. The Board/s primary function would be to establish standards for high professional teaching competence and issue certificates to people who meet those standards.

The Board would also have other responsibilities: to develop a code of ethics for the profession; discipline people violating the code; and maintain a register of "teachers" and "advanced teachers."

The Board will assess the quality of teachers/ general education, their mastery of subjects they teach, their knowledge of good teaching practice and their mastery of techniques required to teach specific subjects. (A Nation Prepared, 1986, p. 66.)

Rachel

The joy of teaching comes from the interaction with the students. Being at the University, I realized that I was missing that piece. When I went back to the classroom this fall, I would come home and think about how I laughed with these kids and joked around with them. I listened to someone's heartfelt story as to why their aunt doesn't respect them or what kinds of things they are working on to improve themselves. When I think about what keeps me in science teaching, it isn't really the science. Science is really a means to a greater end, which is the students. They make a real difference in my life. For me, it happens most in a high school classroom. That is where I feel the most centered and I'm able to be myself.

(Group conversation, 1993.)

The Holmes Group

Competent teachers have knowledge, skill, and professional commitments that avoid the problems of the /bright person/ version of the teaching-learning process. The professional knowledge these teachers possess goes beyond a strong liberal education. It is not merely common sense, nor is it learned only through trial-and-error teaching or experience of being a student. Rather, it includes academic and clinical learning that prepares one to manage both majority of content and the complex social relations of the classroom in a way that foster student learning as well as an attachment to learning. (Tomorrow's Teachers, 1986, p. 29.)

Carnegie Task Force

American schools also need to produce a higher quality product with greater efficiency, but are not subject to market forces. As we have noted, educators work in a highly regulated industry that often penalizes efficiency and provides mixed incentives, at best, for improving quality. (A Nation Prepared, 1986, p. 89.)

Carnegie Task Force

Dramatic improvement for teachers are not likely unless teachers clearly meet high standards of preparation and skill. As teaching makes the transition from occupation to profession, it can draw for inspiration on the experience of

Marie

I can be in the worst mood and walk into a classroom and the students just humor and entertain me. I can laugh all period long. They make me feel glad to be there. For me, it's more than just science. I love to see them question and ask why. I love to see them gain the knowledge, be successful in college or whatever career path they choose and have an understanding of science and the world around them. That is rewarding but it has never been enough. I've always been a class advisor, a coach or the yearbook advisor, and I've had a chance to get to know students outside of the academic realm. It is extremely rewarding for me to have a relationship with a student in the classroom and out on the track. We've been nervous together at the biggest meet of the year, and we've also studied together at lunch time for an important exam. Or I sit and cry with them when a parent dies or counsel them when they are pregnant, all those kinds of things that are part of a high school student's life. I am there for them. Most of the time I leave school each day knowing I've made a difference, but there are days when I leave depressed and frustrated because I can't save them all. But the ones I do are so rewarding. It makes me want to go to school each day so I can get to that one student who is really having trouble and needs me. (Group Conversation, 1993.)

other professions. In no area is this more true than with respect to professional standards.

Virtually every occupation regarded by the public as a true profession has codified the knowledge, the specific expertise, required by its practitioners, and has required that those who wish to practice that profession with the sanction of its members demonstrate that they have a command of the needed knowledge and the ability to apply it. That is, the leading members of the profession decide what professionals in that area need to know and be able to do. They capture that knowledge in an assessment or examination and administer that examination to people who want a certificate saying they pass the assessment. (A Nation Prepared, 1986, p. 65.)

The Holmes Group

Differentiating the teaching career would be advantageous to individuals, public schools, and professional schools of education. It would make it possible for districts to go beyond the limited financial incentives and to challenge and reward commitment. This is essential to encourage teachers to reinvest in their work, and earn rewards while remaining in their classrooms; it will also counter-balance the defection of talented, committed teachers into administration. Some occupational mobility and choice would help to ease many of the frustrations that drive talented teachers from their classrooms.

Jasmine

I just like to make my students laugh. A teenager has so much shit to face. I want them to come into my room and feel comfortable and laugh and smile. I just want them to open their eyes and take a look at the world and everyone around them and not be so close-minded. What's really important to me is the interaction with the kids. When I come home every day excited about who I've finally gotten to or the student who has been lost and everything finally clicks. I've been out in the business world and worked in an office all day; you don't get those kinds of rewards. Even though I get bogged down with all the papers to check, I check them for the students. I have them write what they think and what they feel rather than do multiple choice tests because health is about them. To watch students grow over an eighteen week period and learn to make better decisions in their lives is awesome. (Jasmine, 1993.)

Sarah

It is seeing the light go on, more than anything, that keeps me going. When I show my students a liver and all their hands go up and everyone has a question, or when I see how excited a student gets when they finally figure out how to use "subscripts" in chemistry. That's the most exciting part for me. Plus they still like science at the end. Junior high students are always so afraid of science at the beginning of the year. They have been challenged and pushed to their limits, some

A number of vital institutional goals could be accomplished through differentiated professional staffing. Remediation and the improvement of teaching would be efficiently handled through the constructive supervision that specialized, differentiated roles in school would make possible. (Tomorrow/s Teachers, 1986, p. 36-37.)

of them beyond, but they still love the experiences they've had. I don't get a chance to see them really grow up. They come to me "hormonally diverse." From one day to the next, they don't remember what they've talked to you about or what you said to them in class, but they're always ready to be a part of the next new experience. (Sarah, 1993.)

As I listened to these women/s stories, I remember what motivated me to spend twenty-two years of my life as a classroom science teacher. For me, it was the joy of interacting with my students and finding ways to help them develop a /real feeling/ for the natural world. In the process of exploring and investigating science, I was able to cultivate caring relationships with many students that lasted throughout their high school years and beyond.

Like Marie, I wanted to be a positive influence in my students/ lives and be available to meet their needs, academically and personally, whenever possible. Because of the students, leaving the classroom to become a full-time doctoral student was one of the hardest decisions I've had to make. I still hope to have the opportunity to teach science again, perhaps in collaboration with a junior high or senior high science teacher, or in a summer enrichment program. Although I am in the process of creating a new identity as a teacher educator and researcher, in my heart I will always be a science teacher.

It takes courage for women teachers to speak with authority about what is meaningful and rewarding about their work when what matters most to them is invisible in the official pronouncements of their profession. It takes courage for women teachers to stand up to the "elite" members of our profession and renounce the new "identity" they are trying to impose. Will our opinions be disregarded as unprofessional, too emotional, if we speak about loving to laugh with kids and touching their lives? Will we be ridiculed for our non-academic ways of thinking? As female members of "women's true profession," we do not wish to eliminate those qualities that make schools a caring learning community in favor of a more "professional," intellectual research-based institution.

For the women storytellers, the ideal learning community is similar to our storytelling community. It is an inclusive place where there is:

a sense of genuine belonging,
a smile of recognition
a reassuring touch.

It is a place where souls can meet
and share and experience
and lives can intermingle.
(Marni Pearce, 1993.)

It is the kind of place where women science teachers are free to express genuine concern for students, to cultivate caring relationship with students, colleagues and administrators and staff, and to share in the sadness and fear, joy and laughter of community life.

The Hybrid of a Girl is Now a Hybrid of a Woman
- - Learning from Other Women Hybrids

I have always thought of myself as a hybrid, never quite fitting all of the criteria for any particular role or image that was prescribed by the culture that acquired me. Early in my life, as I described in Chapters 1 and 2, I thought of myself as a scientifically literate hybrid of a girl with a blend of feminine, masculine and scientific qualities that seemed unusual but at the same time comfortable and satisfying to me. Fortunately, I did not feel pressured to abandon this hybrid image, although I did learn to keep it masked, and continued throughout my years of schooling and later on as a classroom science teacher to think of myself as possessing a unique blend of characteristics and qualities that represent the person I am. I am, as George Mead suggests, an "existentially unique human being," a hybrid that cannot be replicated or reproduced (as cited by Greene, 1979, p. 24). Uniqueness is the beauty of being a human organism rather than a clone of a one-celled organism.

At times in my life, however, my desire to be unique was problematic, and efforts were made by family, friends and mentors to shape and mold me into a clone that matched the beliefs and biases of my particular midwestern, middle-class culture. I complied for the first forty years of my life and allowed myself to be shaped and molded without offering visible resistance. But when the most unexpected event occurred in my life -- a divorce -- I was forced to look at myself and find answers to the questions: *Who am I?* and *What do I want out of my life?*

In my case, Carolyn Heilbrun (1990) was right when she said that "Acting to confront society's expectation for oneself requires either the mad daring of youth, or the colder determination of middle age" (p. 118). I wasn't able to confront society's expectation in my youth, but I certainly was ready as an educated, middle-aged woman. Entering the doctoral program was my first major step toward confronting society's expectations for me. I was determined to change my career path and create a new image for myself, an image with a new face. I was doing what Gloria Anzaldua (1990) and other women of color call "making a face," which means to construct one's identity (p. xvi). I wanted to construct an identity that complemented my wants, needs and goals rather than those of others.

I entered the doctoral program with two goals. The first was to prepare for a career in teacher preparation and staff development where I could utilize my teaching and communication skills and personal practical knowledge of science education. The second was to explore in more depth a wide range of women's issues for the purpose of understanding myself and finding the voice I had lost. I did not enter the doctoral program with a feminist perspective, but I certainly acquired one.

I can still remember the first women's conference I attended in East Lansing in 1989 and how empowered I felt after listening to emotionally charged talks by Carol Gilligan and Ruth Hubbard. Their words sparked the beginning of my transformation and a realization that my ways of knowing and understanding were not so unique after

all. Many women grew up feeling as I had and were now trying to come to terms with the culture that had acquired them. I had finally found women in academia that were addressing many of the issues that I was struggling with but didn't know how to make sense of. The authors cited throughout this work -- Carol Gilligan, Ruth Hubbard, Ruth Blier, Carolyn Heilbrun, Kathleen Weiler, Jean Baker Miller, Mary Beth Belenky -- to name a few, I credit with helping me to understand what it means to be a woman in this culture and how to blend together the different attributes that make me the unique hybrid that I am: an international, scientifically literate, liberal arts, feminist person with a rural, middle-class, Christian set of values and beliefs. I'm sure there are other attributes that I could add to this list of descriptors, but for now they provide a summary of my sense of identity.

Because science and science education have played such a prominent role in both my personal life and professional career, I identify most closely with feminist writers and philosophers who are exploring how "gender and science inform each other in their mutual construction and how that construction affects women, men, science and nature" (Fox Keller, 1984, p. 8). My academic training as a scientist has, in the past, acted as a blindfold, preventing me from recognizing how biased and distorted scientific fact-finding is when it comes to identifying and characterizing women's qualities and capabilities. I have scientific "outposts" in my head that have the potential to be an "enemy," but this knowledge of science is also a friend, helping me to sort through much of the technical, scientific

jargon I hear and read and make decisions about the validity and accuracy of research findings and scientific theories, helping me understand and appreciate in deeper ways the world in which I live.

Although I share common threads of experience with my storytelling colleagues -- growing up female, being educated in the traditions of science, and working in a profession that devalues feminine attributes -- I came to understand during the six months we were together that I am also different from the women in the group. I view science, science education and my reality as a woman through a very different set of lenses. My coursework in feminist theory and extensive reading of feminist perspectives on science and science education provide me with a more critical set of filters to examine women's role within science education and to understand why we haven't made significant progress in our effort to reform the teaching and learning of science in this country. We need to create a new vision for science and science education that is gender free and includes the unique perspectives and insights of a wide range of people, including women and minorities as well as men.

My feminist view of science and science education posed dilemmas for me in the storytelling group since I wanted to hear and value the women's stories while also wanting to be a full participant, sharing my unique perspectives. Since I was the researcher and the organizer of the group, I was worried about the extent to which I should let my own newly-found voice be heard.

On the other hand, I cannot deny my own voice and perspective. Recently a friend asked me if I always looked at issues from a

feminist perspective. My reply was, "I try to, because it helps me to evaluate issues from the opposite side of power and provide an alternate perspective, rather than interpreting reality from the pervasive view of the more dominant members of our culture." We need consider, when looking at any issue, theory or generalization, who is asking the questions, what information has been collected and by whom, who is interpreting the information and from what vantage point. I have learned how difficult it is to recognize the bias and misrepresentation of information and generalizations because I am part of the dominant culture, as a white, middle-class, Christian citizen of this country. I now see that I am responsible for perpetuating many of the traditions I believe need to change: traditions that guarantee privileges to members of my race and class while denying those same privileges to women and men of color and lower socio-economic position. And so I feel passionately about my responsibility to speak up. When I go along with accepted traditions and practices and don't make a greater effort to change people's ways of thinking and acting, I hear my inner voice reminding me to speak up and be heard. I have an obligation as well as a responsibility to act in accordance with my beliefs and values. If I expect to be a facilitator of change within science education, I must take on that role and act accordingly.

On the other hand, I wanted to liberate the true voices of my storytelling colleagues and felt that my perspectives -- being alien to theirs -- would become the dominant ideology in the group, an ideology that might be frightening and stifling to the others.

Throughout the dissertation study, I struggled to find a balance between supporting and acknowledging the women storytellers' ways of knowing and personal experiences, and feeling the need to introduce new ideas and feminist perspectives related to science and science education. I often compromised and kept silent, not wanting my storytelling colleagues to feel threatened by my perspectives, which often contradict their traditional views, beliefs and values. I likewise did not want to give the impression that I considered myself an authority on women/s reality because of my academic background or newly acquired feminist perspectives. My ways of knowing represent a personal, not a universal, reality. I learned to look for overlapping standpoints among our group of seven storytellers, while also acknowledging each person as a unique hybrid with differing beliefs, wants, and needs and interpretations of reality. I learned to use my voice and not silence myself while also learning how to support others in developing and using their own unique voices. As a researcher and participant in this study, I acquired new perspectives, shared in new experiences, discovered alternate ways of knowing that help me update my vision of reality. What did I learn about myself . . . ? I learned that I am not the same hybrid I used to be and my story is continually changing. I know I'm still in a time of transition but now it feels less painful because it is a challenging, exciting place to be at this point in my life. I am confident about the value of my personal experience and ways of knowing and willing to speak with authority on issues that affect my life and those of others with whom I have personal

and professional relationships. Perhaps, this is what Mary

Catherine Bateson (1990) meant when she said:

Because we are engaged in a day-by-day process of self-invention -- not discovery, for what we search for does not exist until we find it -- both the past and the future are raw materials, shaped and reshaped by each individual. None of us has completed her story (p. 28).

I am inventing the person I wish to be by using all of the raw materials that I have acquired over the past forty-six years. Now when I think about who I am, I focus less on the individual qualities and attributes I possess and more on the "roles" I am playing out as a teacher educator, researcher and staff developer. In many ways, I continue to feel like a unique hybrid within the academic community because I am interested in exploring a variety of issues: ways to improve science education from within, altering the traditions to include alternate ways of knowing and doing science, acknowledging the importance of teachers' stories and ways of knowing, and creating meaningful and empowering professional development opportunities for teachers.

When I leave the doctoral program, I know I will not find the ideal career; I will need to create it for myself. My aspirations and goals do not fit the job description for a tenured track science education professor nor do they match the description for a career in professional development. I wish to combine my interest in narrative research and teachers' voices, preparation of innovative pre-service science teachers and professional development for practicing teachers interested in reforming their practice and their science programs. This will be a "hybrid career" with the roles of

teacher, researcher and facilitator interwoven within the context of science education, women's issues and staff development. In particular, I will emphasize in my work:

- (1) the importance of teachers cultivating a voice within science education and providing opportunities for teachers voices to be heard within the education community;
- (2) the need for teachers to cultivate skills which will empower them to become actively involved in creating an innovative, equitable plan for reforming science education;
- (3) the importance of reemphasizing the 3 Cs of care, concern and connection as we strive to make school's more humane places for teachers to work and students to learn.

I see my role within the educational community as one of "re-visioning," in which I must look with a fresh eye at the current dilemmas within science education and strive to work with pre-service and veteran teachers to create innovative science programs that meet the needs of all our students. The slogan /Science for All Americans" has greater meaning for me now that I am working with schools districts in California, whose student populations are exceedingly diverse ethnically and socially. This adds an additional challenge for all of us who are trying to create a new vision for science education that will meet the needs of a generation of students whose goals, values and beliefs are different from mine and from many of the teachers who work with them.

What will it take for me to be a "revisionary" teacher, researcher and facilitator of change? First, I must maintain a strong belief in myself and trust that my teaching experiences, my

feminist perspectives, and my ways of knowing science will provide valuable insights as we attempt to make changes in science education. Second, I must have a vision for science education that is articulate, thoughtful and attainable. As a veteran science teacher, I am well aware that experienced secondary science teachers will resist any changes that seek to mandate course content or a prescribed way in which content should be covered. If I hope to be a facilitator for change, my primary task is to work with groups of science teachers to develop vision statements and action plans that match the needs of the school districts they service. Third, I have to speak courageously from the heart and be willing to visibly take a stand on controversial problems that need to be discussed and solved. We will not see significant changes in science education if teachers and administrators do not have meaningful conversations about the personal, professional and political issues that impact what happens within schools. Fourth, I need the support of colleagues, teachers, professors, and researchers who are also working to facilitate change. I do not see myself working independently, in an isolated office in some remote building on a college campus. Education is a joint effort; therefore, any attempts to reform it will require collaborative problem-solving at the local level with teachers, administrators, support staff, parents and students being actively involved.

I have much to learn about the role of a revisionary teacher educator and facilitator in science education, but the work of Roland Barth (1990) provides valuable advice. His words are

etched in my mind as a guide for my work with practitioners seeking to improve science education:

Changes in schools may be initiated from without, but the most important and most lasting changes will come from within. Schools are capable of improving themselves. If the conditions are right, I am confident that teachers and principals and parents can work together to influence schools in ways others cannot. One of these conditions is the creation of visions. The Old Testament tells us that "a people without a vision shall perish." The same can be said about schools and school people without visions (p. 159-160).

EPILOGUE

When I speak words,
they sound a meaning for
a story that's inside me.

When I speak,
I am aware that the meaning
in my words is my story.

When you hear me,
listen for the meaning that I speak
for the words sound a meaning for
a story that's inside you.

(Adapted from a Poem by Rosalie Young)

On February 22nd, I shared this dissertation story, "A Search For Missing Voices" with my doctoral committee, friends and colleagues from the Education community at Michigan State University. It was a day of celebration -- defending my work signifies the culmination of years of study and long hours of thoughtful writing. I had prepared well for this day and was confident that I could speak in words that would help my audience understand that women's talk -- their stories, conversations, dialogues and reflections -- represents their voices. Women's talk is not simply raw data to be edited and refined, it is the inner story to be captured in written words and shared with others.

Sometimes women/s voices in our storytelling group communicated anger and frustration, sometimes joy and optimism, and at other times melancholy blended with feelings of resignation. All of these natural voices I heard but was uncertain how to capture in a written text. How could I express on paper, the tone, the emotion, the rhythm and meaning so the readers would have a sense of "being there." Even my own voice, which is an intrinsic part of who I am, was difficult to capture and accurately represent. We need a new language, new metaphors and themes, perhaps a creative set of symbols to represent the emotions, feelings and understandings women express. We need to create more words like "womanish" to explain the multiple pieces of a woman's identity.

When I was asked during my defense to explain, "Who are you now?" and "How have you changed?", I was compelled to use culturally defined labels embedded with multiple meanings and interpretations to describe my identity. When I identify myself as a "feminist," I open myself up to criticism because my definition of feminism is personal, based on experiences I've had, and therefore, may not fit someone else's understanding of the term. When I state that I feel like a "scientifically literate hybrid," people respond with, "Well isn't everybody a hybrid of sorts? What makes you different?" Whatever words I choose are problematic for someone because labels are words that have multiple meanings depending on the "standpoint" of the listener. As listeners, we make interpretations of words, images, and experiences from our personally constructed standpoint, our private mental universe. I

understand now, why Virginia Woolf claimed years ago, that women's experiences do not fit neatly into the rhythms of dominant and subordinate clauses patterned after the hierarchical world of upper-class white men. I also understand now, that a woman/s identity cannot be neatly explained using words and phrases that misrepresent her reality and do not convey the complexities of who she is. How could I convey a descriptive image of my sense of self? What words could I use that would be personal, colorful, passionate and free from bias? Perhaps I should use more of the innovative words created and used by Mary Daly in her work or maybe new writers, like me, will need to become adventuresome and daring, inventing new words not even imagined yet.

Part of the dilemma in telling this story was this narrative is a doctoral dissertation, and therefore, should be written in an academic, scholarly style, following traditional APA format with proper references and theoretical support. Throughout the writing of this book, my committee and I struggled and pondered about: How much of my personal story should be included? Which "voice" would be compelling to the reading audience yet meet the standards for scholarly writing? How can I honor and represent the multiple voices of the women storytellers in the written text? We did not have clear guidelines to follow which, I realize now, was a blessing in disguise. I did not need another "outpost" in my head directing me to be cautious and careful, to adhere to the traditional models for representing qualitative data.

I was encouraged to be revisionary and accept Elliot Eisner's (1993) challenge, "to bypass familiar port, explore the new seas" and create a more innovative imaginative dissertation story (p. 10). A narrative which would represents an entirely new presentational form and style of writing. As Eisner points out, we don't now how to do this yet but the times are a-changing and so are we. I didn't know how to do this innovative kind of research and simultaneously be an analytical, creative writer, but I followed my intuition and wrote courageously from the heart. Even now, I am not sure if I succeeded, but it was a goal I set for myself.

Another goal I set was to write in a style that was compelling, thought-provoking and accessible to readers outside the academic research community. I chose to write this dissertation as a story and speak in the first person as the identifiable researcher and woman science teacher. I purposely did not alter the personalized grammar in our conversations and included the reflective journal writings exactly as they were written by the women storytellers, hoping the reading audience would feel more like a participant in the conversation or story, not a detached, distanced reader of text.

I elected to intersperse my 'selective literature review' throughout the chapters of the dissertation as a more effective way to help the readers make connections between my work and other well known writers, and to clarify terms and points of view related to the stories we constructed. As a writer, it was exciting and challenging to create my story and interweave the knowledge and insights of other authors whose ways of knowing help to support and

explain my personal experiences and professional dilemmas. The quotes cited in this work are especially meaningful and inspired me to be more courageous and outspoken about my life and the lives of other women. I also felt the messages embedded within the quotes would encourage readers to be reflective about their own experiences and rememberings, perhaps even spark new images and ways of thinking. I included the first names of the women and men referenced in this work because I want the readers to know each authors' gender and consider how that might affect the meaning of the words. It does make a difference who says what and for what purpose. Anonymous quotes or quotes that appear to be gender-neutral are meaningful but are not as inspiring and compelling as those I can connect to a real person. I have never felt comfortable referring to people by their last names -- it feels impersonal and cold. It also makes the author more invisible and detached from the work -- a tradition that feels very "scientific."

Part way through the writing of this story, several of my committee members advised me to leave my personal story and get on with the actual research study, which was the exploration of women's lives through collaborative storytelling. Beginning with chapter 4, I began taking myself out of the text and focused more on the research strategy and the data I collected during our group conversations, one-on-ones and reflective journal writings. Although I was a part of the group, as a participant researcher, I purposely changed my voice in chapters 5, 6 and 7 and became less emotional and personal in my writing. I took on the role of the

researcher presenting the narrative data, our conversations and stories, without adding extensive personal commentary and reflections. This did not happen accidentally. It was a purposeful decision I made for two reasons. First, I knew my committee was concerned about my story and voice becoming too dominant, and fearful that I might shortchange the other storytellers if I wasn't careful. Second, I wanted the readers to hear, through my words, the other facets of my voice and recognize that "voice" is a complex phenomena with multiple components. Like Rachel, I have several kinds of voices and each serves a different purpose. Sometimes the emotional, personal voice is most compelling and readers will be drawn into the story because they feel a connection to my words, they can imagine themselves in my situation. But at other times, a more intellectual, detached voice will give the reader an opportunity to make her/his own interpretations and find different connections than I would have made.

In writing this dissertation story, I discovered that "finding a voice" means learning to speak and write with multiple voices, using different words, styles and intonations to communicate meaning to others. As Annie Rogers (1993) suggests, voice is a psycho-physical quality that links breaking and sounds to a person's real feelings. I have a range of feelings and emotional commitments to the different stories I share in this work; consequently, the quality of my voice changes as I present the different narratives. I am learning to cultivate a whole voice, one that is multi-dimensional with a full range of emotions and sounds. I

lived the first forty years of my life with a one-dimensional voice which prevented me from honestly speaking my mind and telling my heart. I do not intend to let that happen again as I enter into this new stage of my life as a teacher educator, researcher and writer.

Ironically during the defense of this dissertation, one of the major dilemmas my committee and I struggled with was my voice: Which voice should be represented in my work? Which voice is most compelling and insightful for the reading audience? Could I retain my emotional voice throughout the entire dissertation? Although I would agree with the committee, that the emotional, personal voice I used in the early chapter of this work is more captivating and revealing than the detached, less personalized voice in chapter 7, I recognize that both voices came from inside of me. Each voice represents a story to be told, a story that is meaningful and representative of my inner voice. I want the readers of my work to hear each voice and benefit from my different ways of knowing and understanding, to listen to the words those different voices sound and discover their own inner stories.

How does the writer of a research study decide which voice to use in representing narrative data for herself and others? Who should decide what voices and what stories will be incorporated into the written text and according to what criteria? Are teachers' stories, conversations and reflective journal writings simply raw data or do they represent valuable sources of knowledge that need to be incorporated into our knowledge base of teaching and learning?

These are questions I struggled with throughout this dissertation study as did the members of my doctoral committee who encouraged and supported my efforts to break new ground. They are challenging questions which the educational research community is grappling with as well. This is a time of transition for all of us -- being somewhere between vaguely and acutely disrupted about the purposes of educational researcher and the role research will play in helping improve educational practices for teachers and students. The transition is difficult, frustrating and sometimes painful. Yet, it is exciting to be navigating new seas and finding new ways to expand our understanding of the realities of women teacher's lives and the stories our lives tell.

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