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BETWEEN A ROCK AND A HARD PLACE: LEARNING TO TEACH SCIENCE-FOR-ALL IN AN URBAN DISTRICT

VOLUME I

By

Jodie A. Galosy

A DISSERTATION

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ABSTRACT

BETWEEN A ROCK AND A HARD PLACE: LEARNING TO TEACH SCIENCE-FOR-ALL IN AN URBAN DISTRICT

By

Jodie A. Galosy

Science-for-all, a contemporary science education reform initiative, envisions US public school science classrooms where all students have opportunities to deepen their understanding of scientific concepts and practices. However, national science achievement tests indicate that excellence and equity—the vision of science-for-all—is still very much a work-in-progress. Reform documents (e.g., *National Science Education Standards*, *Benchmarks for Science Literacy*) recognize that science-for-all demands much of teachers, especially those working with student populations typically underserved by science education—students of color, students with limited English proficiency, and those from families with limited economic means. A large proportion of those students attend urban districts where they are likely to encounter novice science teachers.

This qualitative study investigated learning to teach science-for-all in an urban school district in California. Seven early career middle and high school science teachers participated in the study. Data collection took place over a period of fourteen months, through interviews and observations with teacher participants, their schools, and in their professional development activities (including new teacher support/induction programs).

The study examines how new teachers' use of their personal, social, and conventional resources influenced their beliefs and practices relative to science-for-all.

Three reform ideals serve as the study's focal points: content goals that emphasize understanding scientific concepts and practices, hands-on activities that support students' intellectual engagement, and literacy strategies that provide access for all students to scientific content.

Few novices developed beliefs and practices that supported science-for-all. Those who did brought several key personal resources to their teaching—knowledge of science content and practices, beliefs that all students were capable science learners, and commitments to teaching in an urban setting. While these personal resources were important for teacher development, they were not sufficient; novices needed additional resources to support their development. Some teachers had access to reform-based curriculum materials, supplies, and facilities others did not have. However, personal and social resources shaped how novices used conventional resources and, in turn, the beliefs about students and teaching practices they developed. More resources did not necessarily amount to better use. School resources favored traditional science instruction while resources for reform-based science teaching, from outside schools, often did not pay sufficient attention to diverse learners. Context-specific assistance from someone knowledgeable about teaching science-for-all was a particularly important social resource that was in short supply for most novices.

The study provides evidence that progress towards science-for-all will require substantial attention to, and investment in, teacher learning across all dimensions of the professional continuum—pre-service, induction, and in-service. The study also provides insights in two critical areas: strengthening the resources available to early career urban science teachers and shaping resource use towards the goals envisioned in science-for all.

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2005

This dissertation is dedicated to the seven teacher participants with gratitude for their generosity, honesty, good company, and the valuable lessons learned.

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I take full responsibility for this work. At the same time, it does not solely belong to me. Mary, one of the study participants, pointed out that the help her colleagues provided meant she could do things that would have otherwise been impossible. I make the same claim here. I am indebted to many; the work would have been impoverished without their assistance.

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Chapter 1

Hard Problems:
Learning to Teach in Unsettled Times[1]

> In surgery, as in anything else, skill, judgment, and confidence are learned through experience, haltingly and humiliatingly. Like the tennis player and the oboist and the guy who fixes hard drives, we need practice to get good at what we do. There is one difference, though, we [doctors] practice on people. (Gawande, 2003, p. 54)

Situating the Study

Novice science teachers share the same occupational hazard as young surgeons; they, too, practice on people. Although the stakes are not life or death, they are, nonetheless, significant. Spiraling technological and scientific advancements make science education a gatekeeper—for future education, career advancement and, more importantly, civic participation (Hurd, 1998; Rutherford & Ahlgren, 1990). In the past two decades, excellence and equity have been the dual focus of nation-wide efforts to reform science education, a reform movement dubbed "science-for-all" (Lee & Fradd, 1998; Lynch, 2001; Rutherford & Ahlgren, 1990).

Initiated by the report, *Science for All Americans* (Rutherford & Ahlgren, 1990), these reforms envision new possibilities for all science students: rich knowledge of science content (both its principles and practices), and challenging opportunities to encounter that knowledge (AAAS, 1993; National Research Council, 1996). Reformers drew their vision in contrast with traditional science instruction. They believed the content and methods typically found in science classrooms served students poorly—an emphasis on facts rather than understanding, a formulaic scientific method, and teaching methods that lacked the discipline's rigor and imagination (Bransford & Donovan, 2005;

[1] Swidler (1986) makes a distinction between the role values play in settled and unsettled lives. She argues: "In unsettled lives, values are unlikely to be good predictors of action, or indeed of future values" (p. 282).

National Research Council, 2000). This new vision of science was also more inclusive than the past; all students could, and should, have the opportunity to achieve scientific literacy.

The reform movement led to the development of national science education standards; blueprints for moving the vision of science-for-all into reality (AAAS, 1993; National Research Council, 1996). However, the present reality (often referred to as standards-based reforms) has taken on another life, instantiated in the No Child Left Behind Act (NCLB). While championing the principles of equity and excellence, many fear the high stakes accountability of NCLB presses for tradition rather than change (American Federation of Teachers, 2001). After all, there is much yet to learn; we are just beginning to build the knowledge base needed to support teachers' efforts, especially with linguistically and culturally diverse students (Atwater, 2000; Bransford & Donovan, 2005; Gamoran et al., 2003; Lynch, 2001). Yet, these are the same students likely to score poorly on high stakes tests. The situation is potentially demoralizing for teachers and their students (Settlage & Meadows, 2002).

These unsettled times in science education put the study participants between a rock and a hard place. There is a press to teach traditional science—after all, that is what is familiar to these new teachers; increased calls for accountability sometimes result in retrenchment into the tried-and-true. On the other hand, novice teachers enter a world in which the expectations for them and for their students are higher: intellectually rich science content and immersion in scientific practices, especially for those who have historically dropped by the wayside in traditional instruction.

Learning to teach is daunting, learning to teach in new and more "quality ways" must be even more so. Recognizing these challenges, state policymakers have also increased the call for professional development and, in the special case of new teachers, early career support. California, where the study is situated, mandates induction support for early career teachers (California Department of Education, 2002); districts pair novices with experienced teacher-mentors. Moreover, educational institutions invested in science reforms (e.g., districts, universities, science museums) offer assistance; providing curriculum materials, mentors, content experts, and supplies. The purpose of this study is to describe and explain what novice teachers learned during one year of their practice, and to examine whether, and how the resources available to new teachers shape their efforts to teach science-for-all.

In this study, I bring together two strands of scholarship: science education reform and new teacher learning. Each contributes to the framework I developed for the analysis. In this chapter, I examine science-for-all reform, both the ideals that underpin it and the demands on teacher learning. I then provide an overview of two venues novices have for learning, induction programs and science professional development. Finally, I describe the resulting conceptual framework for the study.

Mapping the Rock and the Hard Place

Science-for-All

The phrase "science for all" is adapted from a national report entitled *Science for All Americans* (Rutherford & Ahlgren, 1990). The report lays out "a set of recommendations on what understandings and ways of thinking are essential for all citizens in a world shaped by science and technology" (p. v). The recommendations, a

synthesis of ideas from panels of scientists, mathematicians, and engineers, laid the foundation for Project 2061, an ambitious initiative to reshape K-12 science education. To date, the project has produced a set of science curriculum standards, *Benchmarks for Science Literacy* (AAAS, 1993), tools for curriculum planning, and an evaluation system for determining the quality of curriculum materials. Furthermore, Project 2061 produces its own curriculum materials and resources for teachers and science teacher educators.[2]

In addition to Project 2061, another major reform initiative began to take shape; this one engineered by the National Research Council. Their efforts produced *National Science Education Standards* (National Research Council, 1996). Like Project 2061, The *National Science Education Standards* (*NSES*) promoted equity and excellence as its goals:

> The intent of the *Standards* can be expressed in a single phrase: Science standards for all students. The phrase embodies both excellence and equity. The *Standards* apply to all students, regardless of age, gender, cultural or ethnic background, disabilities, aspirations, or interest and motivation in science. Different students will achieve understanding in different ways, and different students will achieve different degrees of depth and breadth of understanding depending on interest, ability, and context. But all students can develop the knowledge and skills described in the Standards, even as some students go well beyond these levels. (p.1)

The standards movement swept through the country; states and districts developed science curriculum standards and frameworks. Many drew from *Benchmarks* and *NSES* (although there was also controversy and critique[3]). Let us look, then, at the instructional reforms that *Benchmarks* and *NSES* propose.

Both documents criticize traditional K-12 science classrooms on two major

---

[2] http://www.project2061.org

[3] California had "science wars;" battles over what should be included or eliminated from state standards Cf., an editorial in *Science* magazine, 'Science Wars' in California? [*Science* (1997), 278 (5345) p. 1885]

points: (1) a disjointed curriculum heavy with factual knowledge and (2) instruction that fails to engage students or connect them with the practices that constitute science as a discipline. I offer a few examples from *NSES* to illustrate some proffered solutions, as well as the challenges, these reforms present to science teachers.

Ambitious content goals. Standards documents are blueprints of what makes a scientifically literate citizen. Content is not limited only to the facts, principles, and theories usually associated with school science but broadened to "include specific capacities, understandings, and abilities in science" (*NSES*, p. 3). *NSES* emphasizes the need for student understanding. The authors argue that understanding scientific concepts requires complex mental work. The skills described go well beyond memorizing and reciting basic facts:

> [S]cience requires that an individual integrate a complex structure of many types of knowledge, including the ideas of science, relationships between ideas, reasons for these relationships, ways to use these ideas to explain and predict other natural phenomenon, and ways to apply them to many events. (p. 4)

Why haven't students in the past developed this level of understanding? In part, due to poorly conceptualized curricula, heavy with facts and light on understanding scientific practices. More ambitious goals for all students place heavy demands on what teachers need to know as well; for example, they too must understand scientific content and practices (Ball & Cohen, 1999; Kuerbis & Micikas, 1996; Little, 1993; Shugart & Hounshell, 1995). It is difficult to imagine how teachers could help fifth-graders understand force and motion, or how to investigate momentum, if they do not understand it themselves. Yet, today's novice teachers were likely educated with the poor curricula reformers condemn. This means, then, that novice teachers will need opportunities to enrich their own content understanding as they learn to teach. Yet, we know little about what those content-rich teacher learning opportunities entail (Wilson & Berne, 1999; Wilson, Miller, & Yerkes, 1993; Wilson, Peterson, Ball, & Cohen, 1996). A massive

enough undertaking itself, ambitious content outcomes are just one piece of science-for-all. I now describe the instructional methods advocated. They are equally challenging.

Complex pedagogical demands. The word most often associated with reform-based science is "inquiry" (DeBoer, 1991). Although inquiry stands as a marker of reform pedagogy, it is a complex notion, neither uniformly understood nor easily translated into classroom practices (National Research Council, 2000) As such, inquiry is a good place to explore the complexity of science-for-all

References to inquiry abound in *NSES.* For instance, the section on teaching uses the word 33 times in approximately 20 pages of text. However, *NSES* authors apparently felt inquiry needed additional clarification. Shortly after they published *NSES,* a committee authored an "addendum" to explain inquiry further. The resulting document—*Inquiry and the National Science Education Standards* (National Research Council, 2000)—also provides concrete examples of inquiry teaching and learning in classrooms. The addendum blames confusion about what "inquiry" is on its double meaning in the original document. *NSES* used inquiry in two ways—as a learning goal for students and as a teaching strategy or method:

> When educators see or hear the word "inquiry," many think of a particular way of teaching and learning science. Although this is one important application for the word, inquiry in the Standards is far more fundamental. It encompasses not only an ability to engage in inquiry but an understanding of inquiry and of how inquiry results in scientific knowledge. (NRC, 2002, p. 13)

As already discussed, as content, inquiry means students demonstrate practices that are the hallmark of science: investigation of phenomenon that can be tested by observation and experimentation (Rutherford & Ahlgren, 1990). As an instructional method, inquiry means teachers provide students with opportunities to learn content by engaging in these scientific practices. To that end, the addendum recommends a significant portion of science instruction should include the kinds of activities that characterize scientific practices (e.g., conducting scientific investigations, considering data, debating alternative

explanations). These activities, sometimes called "hands-on," generally involve encounters with physical or natural phenomenon.

Hands-on and inquiry-based teaching poses difficulties for teachers, especially novices, on several fronts. I use an example—a hypothetical stream study (see Fig. 1) drawn from my own experience as a veteran middle school science teacher—to illustrate two of these challenges: Inquiry-based teaching has a narrow margin for error; it is difficult to do well and when poorly done loses its educative intent (Thompson, Zeuli, & Borman, 1997). Moreover, it increases the risk that teachers will feel incompetent and/or appear incompetent to others (Cohen, 1988; Wilson et al., 1993). Both issues point to the substantive support teachers, especially novices, will need if inquiry is to become a regular part of all students' school science experience.

Revising a chemistry unit that relied heavily on scripted, in-class "experiments," a 7th grade middle school science teacher designs a study of a nearby stream. With funding from a local ecology center, the students make regular field trips to the stream to collect data on indicators of water quality like dissolved oxygen, chlorine, etc. The students work in teams, learning about the chemistry involved, as they verify their results, draw conclusions about the streams' condition, and write reports for the ecology center.

Figure 1.1: A Hypothetical Middle School Inquiry Activity

A stream-study might seem like an inquiry activity simply because it brings students in physical contact with scientific phenomenon—a stream and chemical test kits. Although inquiry-based teaching often involves direct exploration of the physical environment, it is much more than that (Haury, 1993/2003). The field trip is not an end in itself; it is just one piece in a larger disciplinary structure—building and defending a reasonable case about the stream with evidence from the analysis. It is also learning about chemical reactions

Yet, the closer teachers and students get to inquiry, the farther the teacher may find herself from curricular goals she is charged to accomplish; what (and whether) students are learning about chemistry becomes more difficult to control. Problems students encounter or findings they develop might lead in directions (however valuable) that diverge drastically from what the teacher set out to accomplish and/or what her curriculum mandated. Students might discover interesting creatures in the stream, like wriggling invertebrates under rocks, eager to explore and find out more about them. Now the teacher must decide: stay with the chemistry lesson, follow the students' interests and cross over into biology, or find a way to meld the two; each "solution" has its own benefits and costs.

Content goals can be untracked in another way, as well; hands-on can stay just that. Although collecting water samples may make science class more fun, interesting, or active for students, it does guarantee understanding. Students get wet, splash their friends, enjoy the sunshine, get muddy—like "real scientists." Yet that does not constitute inquiry. Unfortunately, much inquiry in schools stays at that level, and the activities become symbols, that is, students manipulating things becomes a proxy for inquiry, even though understanding science and its practices is missing.

A lack of quality curriculum materials exacerbates this problem. Teachers encounter reforms second-hand—filtered through curriculum frameworks, textbooks, and other resources that often cloud, rather than clarify, reform goals. When AAAS (Roseman, Kulm, & Shuttleworth, 2001) conducted a recent analysis of popular curriculum materials, they found very few matched the criteria established for quality inquiry-based teaching. This leaves novices in a difficult spot: they must settle for what is available or create their own materials—a process that takes time teachers, especially beginners, are unlikely to have and expertise they have yet to acquire.

Now we consider the toll on teachers' confidence, something already in short supply for novices. Inquiry-based teaching is a pedagogical ideal teachers might not

enthusiastically embrace because it requires them to engage in what some call "adventurous teaching" (Cohen, 1988; Wilson et al., 1993). By adventurous teaching, Cohen was describing instruction—like inquiry-based teaching—that increases the interdependence of teachers and students. Teachers have to rely on students to "do the right thing." As we see in the stream study, the teacher cannot necessarily count on students to do so. Inquiry-based teaching requires active intellectual engagement from students who may or may not want to work hard (e.g., taking dissolved oxygen readings instead of splashing their friends). Teachers might be willing to take on the challenge of adventurous teaching if they were certain it was best for their students. However, whether, and how, inquiry-based teaching benefits all students remains contested. I briefly explore those arguments.

Inquiry and student diversity. As noted earlier, studies continue to show that African-American, Hispanic, and students from families classified as low-income do not perform as well, on average, as students from other racial and economic groups (Lynch, 2000). These achievement gaps are deeply rooted in economic and social structures over which a classroom teacher may feel she has little control. However, accountability policies such as No Child Left Behind and scholarship on multicultural science education (Atwater, 2000; Calabrese Barton, 1998; Lipman, 1998; Oakes, 1990) argue that teachers, and teaching, can make a difference.

Science reform documents insist that students' interests and ideas play a critical role in how they learn science content; teachers must pay careful attention to both (Bransford & Donovan, 2005; National Research Council, 2000). However, some scholars (Atwater, 2000; Calabrese Barton, 2000; Seiler, 2001; Tobin & Sokolic, 2001) point out that cultural mismatches between science teachers and students make this difficult in practice. For example, Roth and Tobin (2002) found that new teachers—mostly middle class and white—in their urban teacher education program had much greater success (and were more willing to stick with) inquiry-based teaching with middle-

class suburban students than with less affluent African-American students in the inner city. Teachers tended to have lower expectations and use didactic teaching methods. The researchers attributed the difference to cultural dynamics between teachers and students. Teachers did not know how to make sense of the ideas/interests of students who were culturally different from them; conversely, students could not decipher what their teachers expected.

Fradd and Lee (1999) suggest a similar dynamic for science students who are English language learners. They propose that the cultural mismatch between the norms of inquiry teaching (e.g., skepticism, argument) and the family/community norms of many English language learners (e.g., acceptance of, and compliance with, authority) may interfere with opportunities for these students to learn science. Atwater (2000) also believes cultural misunderstandings between science teachers and their Black students results in lower science achievement and science career aspirations. She proposes greater equity in science education is possible with "multicultural science teachers":

> These teachers think strategically about: (1) learners – their differences and their different needs; (2) the interactions of Black American learners with science, the particular school, and community context; and (3) ways to engage their learners with important substantive scientific ideas. (p. 170)

Other scholars blame cultural disconnections on Western science, arguing scientific practices—male and Eurocentric—marginalize students outside the mainstream (Calabrese Barton, 1998; Calabrese Barton, 2000). Still others disagree, insisting all students, regardless of linguistic, cultural, or socioeconomic background, think in "everyday" ways compatible with those practiced by scientists (Warren, Ballenger, Ogonowski, Rosebery, & Hudicourt-Barnes, 2001). As these multiple perspectives suggest, "There is still much that science educators do not know about science for all" (Atwater, 2000).

In sum, science-for-all envisions ambitious content goals and engaging intellectual practices for all students. As I have explained, there remains much to learn in theory and in practice. Nevertheless, I found the ideals of science-for-all—demanding and engaging science teaching and learning for all students—useful to map the territory of new teacher learning. Explaining how they might learn was another matter. For clues to that, let us consider the literature on teacher learning, professional development, and new teacher support.

Teacher Learning in the Workplace

Troubled territory. Teacher educators as far back as John Dewey (1904/1965) have argued that the organization and professional culture of most schools restrict what new teachers learn on the job (Little, 1999). There are several contributing factors. The first is teacher isolation. New teachers spend most of the day alone in their classrooms (Jackson, 1968). They seldom (never?) observe their more experienced colleagues teach; they have few—if any—opportunities to co-plan lessons or discuss the content they teach (Little, 1990). When teachers interact with one another, it is typically on a lunch break, when the topic of conversation could as easily be the latest school rumor or movie seen. Moreover, teachers seldom have time to reflect on, or process, their experience in meaningful ways (Little, 1990; Lortie, 1975). Consequently, although new teachers acquire much experience daily as they try to teach their students, that experience does not necessarily lead to learning to teach.

Teacher experience, then, tends to be a conservative force; limiting, rather than broadening, what new teachers learn (Britzman, 1991; Dewey, 1904/1965). For instance, novices, distracted by managing groups of (at times) unwilling learners, can lose sight of

their major responsibility—engaging students with subject matter. A science lab activity, for example, involves attending to safety precautions, managing equipment, and just keeping track of whether some thirty bodies are following directions. The content of the lab may slip from the teacher's view in the interest of keeping the situation under control.

Teacher educators, researchers, and others concerned with teacher learning have long struggled with a theory into practice model that includes multiple learning opportunities; teachers need to learn both in university classrooms (subject-matter and education courses) and in schools, observing other teachers or practice teaching in K-12 classrooms (Lanier & Little, 1986; Zeichner, 2002). Prospective and new teachers often criticize their education courses as too theoretical or irrelevant to real classrooms (Britzman, 1986; Lanier & Little, 1986; Tom, 1997). At the same time, teacher educators complain that most (conservative) university and K-12 science classrooms are not compatible with the educational practices and outcomes teacher education espouses (Lanier & Little, 1986). It is, in some ways, a Catch 22: New teachers need to learn while teaching in real classrooms, but schools—historically and now—favor traditional practices. If new teachers only learn by working in current schools, they run the risk of replicating the status quo. All too often, teacher educators watch their influence slip away as new teachers exit teacher preparation and enter their own classroom, convinced that experience alone will be their best teacher (Britzman, 1986).

Of course, they are right. Experience is a powerful teacher. However, harnessing its potential for teacher *learning*—changing knowledge or beliefs, acquiring new skills or concepts—is no easy task (Fishman, Best, Marx, & Tal, 2001). As I have already noted, relying solely on practical experience may direct new teachers' attention to the technical

aspects of teaching, at the expense of their own learning (Britzman, Dippo, Searle, & Pitt, 1998; Dewey, 1904/1965). Britzman (1991) sums up the situation in the title of her book on the socialization of secondary school teachers: *Practice makes Practice*. Dewey (1904/1965) made the point when he contrasted the learning trajectory of the *apprenticeship* model with what he called the *laboratory method.*

Dewey argued that a novice, immersed in the demands of classroom teaching for the first time, understandably grabs for whatever works to manage the classroom, with little regard for assessing the underlying principles of the "devices and methods" adopted. Consequently, management issues take precedence over instructional issues. While Dewey recognized that teaching is at once both technical and intellectual work, he cautioned that a primary focus on "immediate skill may be got at the cost of power to go on growing" (p. 320). Dewey proposed that power comes not from a new teacher's management techniques, imitation of another teacher's methods, or advice from others on how to teach; it comes from the "intellectual vitality" of thoughtful inquiry, rooted in a commitment to a set of educational principles. However, overwhelmed by multiple tasks and expectations for classroom control, it is hard for new teachers to resist the immediate gratification of what works in the moment, rather than struggle with principles that are difficult to put into practice. As discussed earlier, the risks of appearing less capable are too great.

Dewey warned that once a teacher fixes attention on method and technique, imitation takes precedence over initiative. Rather than develop the intellectual tools that allow a teacher to become "an independent judge and critic" (p. 323) of her teaching, the push is towards perfecting a particular strategy. Consequently, what the teacher (and

those around her) are presently doing bounds future learning; limiting the potential for inventiveness, critique, or change. As Dewey put it, the new teacher "seem[s] to strike twelve at the start" (p. 321).

Britzman and her colleagues (1998) extend Dewey's concerns about technique-driven practice. They argue that technical knowledge alone does not account for students' diverse learning needs; it is "one size fits all" knowledge:

> If technical knowledge is thought of as the only knowledge – indeed as a cause or justification as opposed to one possible strategy determined by context or judgment – a technocratic instrumentalism inevitably results. This critique is not new...What is new in this research and what is now being engaged by research on anti-racist and feminist pedagogies in education is that a narrow instrumentalist approach to teaching works to maintain inequality in education. This is so because from an instrumentalist perspective, social life is viewed as irrelevant to the capacity to learn, and classrooms are essentially places to practice techniques without regard to the complexities of student's life (Delpit, 1986; Simon, 1992). (p. 16)

Technical knowledge, then, without knowledge of students (or subject) cannot support democratic education as envisioned in science-for-all. What does it mean for something to work in a classroom? An efficiently run classroom where students are compliant but experience little relevance or connection to science may appear to be working but for whom and for what purposes?—perhaps not science-for-all. If a teacher takes up a particular technique wholesale, what students are actually doing (and learning) can easily go unexamined. I offer group work, sometimes called cooperative learning, as an example.

Studies of group work in science classrooms show teachers need opportunities to examine their practices—reform or traditional—with a critical eye. While classroom groups can be intellectually productive (van Zee, Iwasyk, Kurose, Simpson, & Wild, 2001), they can also exclude students and/or constrain intellectual engagement. Consider

two instances observed in a group of elementary school science students. Two Caucasian students pushed an agenda focused on getting the group assignment completed on time and done right. In the process, they shut out the ideas of the other two members, an African-American girl (Kurth, Anderson, & Palincsar, 2002) and a Hispanic boy (Anderson, Holland, & Palincsar, 1997). Looking at the finished product—a poster and group explanation of an activity on density—the teacher might judge that the lesson and group work was successful. Yet, if the same teacher viewed a video of the students (as the research team did), she might have noticed the African-American girl gradually pushed her chair away from the table and put her head down and the Hispanic boy wandered the room during the lesson. If learning for all is the goal (here we see the need for principles, rather than method, as the rationale), the teacher might consider how to make group work more inclusive.

However, teachers rarely have such opportunities in their professional learning. Most novice public school teachers still enter a workplace poorly designed to support learning that goes beyond technical tinkering (Ball & Cohen, 1999; (Little, 1999). Reforms like science-for-all complicate learning to teach because the instructional content and methods recommended are a major departure from traditional science education. These instructional reforms, still in development, are akin to experimental medical procedures; best not attempted by novices without supervision, if at all. Yet, new teachers typically do not have that leeway. Unlike surgeons, they do not pass through lengthy internship or residency phases to hone their practice. At best, some have a few months of supervised "student teaching" or, perhaps, prior experience as a substitute

teacher. Moreover, innovation means there are few experts in the workplace to support their learning.

New teachers in urban districts, like the seven new teachers who volunteered to participate in this study, encounter further complications. Large, urban school districts educate the largest proportion of groups historically underserved by science education; African-American and Latina/o students, especially those from lower socio-economic circumstances (Doolittle, Herlihy, & Snipes, 2002; Lynch, 2001). These districts also employ more than the usual share of new science teachers (Ingersoll, 2004). Consequently, beginners teach many students whom traditional science instruction has failed.

Yet, tradition still dominates middle and high school science classrooms. NCLB brought its own version of standards-based reforms that included sanctions, tied to state tests. These punitive measured undermine high expectations for students; setting the bar low increases the probability of success (American Federation of Teachers, 2001; Settlage & Meadows, 2002). Teachers "hedge their bets" (Wilson & Floden, 2001). Consequently, innovation tends to occur in pockets here and there, tied to individuals or pilot projects (Fishman, Soloway, Krajcik, Marx, & Blemenfeld, 2001; Fullan, 1998; Gamoran et al., 2003)..

High teacher attrition in urban districts (Ingersoll, 2004) also makes it difficult to sustain new projects. Given the history and reality of urban schools, how, and from whom, will novice science teachers learn to teach science-for-all? I explore two possible venues in this study—new teacher support (induction) and science professional development. I briefly consider each before moving to the conceptual framework.

New teacher support programs. Recent surveys of states and local districts indicate that new teacher support programs are becoming a more common feature of new teachers' workplaces (Fideler & Haselkorn, 1999; Moskowitz & Stephens, 1997; Potts, Blank, & Williams, 2002). Though these programs —induction, new teacher orientation, novice teacher institutes— vary considerably in title, structure, content, and sponsor; they share a general commitment to the improvement of novice teachers (Feiman-Nemser & Parker, 1993; Tickle, 2000).

California mandates support for early career teachers as part of its credentialing process. The system is quite complicated, at the minimum it pairs novices with an experienced teacher-mentor. I provide details for the Bayline district,[4] the focus of this study, in chapter 4. The question I raise here is whether, and how, new teacher support contributes to learning to teach science-for-all.

The varied forms of support induction programs offer and their diverse content reflect the many goals induction programs have. Certification, retention, affective support, strategies for classroom management, understanding special education learners, subject matter knowledge—the list is long and all may feel equally important for programs to address (Stansbury & Zimmerman, 2000; State Higher Education Executive Officers, 1999; Weiss & Weis, 1999). Most emphasize learning the ropes—school procedures, district policies, teacher responsibilities and the like; fewer focus on content and/or instruction or reforms (Berry, Hopkins-Thompson, & Hoke, 2002; National Education Association, 2002). One exception is a new *science* teacher program offered to Bayline teachers through the Exploratorium, an interactive science museum in San

[4] Bayline is a pseudonym.

Francisco (I describe this program in Chapter 4).

Despite the growth in new teacher support, empirical studies of what teachers learn from their induction experiences are scarce. Most studies of induction address either program satisfaction, teacher retention, or job satisfaction (National Education Association, 2002). While these are important to consider when designing and evaluating programs, they do not help us understand how induction experiences contribute to teacher learning, especially the learning required to enact science-for-all.

Not only are studies of teacher learning scarce, studies of what *science* teachers learn from induction programs are also very rare. In reviewing past issues of the Journal of Research in Science Teaching, I found only one article that specifically addressed novice science teacher learning. Luft, Roehrig, and Patterson (2003) investigated beliefs and classroom practices of secondary science teachers who participated in one of three matched groups (n=6/group): no formal induction program, a general induction program, or a content-specific program. Based on both teacher reports of classroom practices and researcher observations of teaching, they found that the group that participated in content-specific induction offered more laboratory activities, less seatwork, and more group work than the teachers in the other two groups did. Luft et al. propose science teachers may learn more about teaching *science* from an induction program that specifically targets their learning.

However, advocating science induction programs does not address how those experiences interact with other learning opportunities teachers have; school-level staff development efforts, informal teacher exchanges, classroom experiences, and the school's curriculum, to name a few. Yet, here too there has been little empirical work

with *new* science teachers.

Science teacher professional development. As I have argued, high goals for all students demands equally challenging expectations for teacher learning (Little, 1993; Thompson & Zeuli, 1999). Reformers advocated that professional learning should be restructured as an ongoing enterprise; teachers could study a lesson over time, immerse themselves in science, or partner with colleagues to study their practices (Loucks-Horsley, Love, Stiles, Mundry, & Hewson, 2003). Traditional professional development—often referred to as the one shot workshop—would not get the job done (Fullan, 1998; Loucks-Horsley et al., 2003; Thompson & Zeuli, 1999; Wilson et al., 1996).

Funding agencies (e.g., the National Science Foundation, AAAS) sponsored broad initiatives—local systemic reform—especially in urban districts. Given the need for varying expertise, sponsors encouraged partnerships—between universities (e.g., colleges of education, science departments, medical schools), other educational institutions (e.g., science museums), political bodies (e.g., state departments of education), districts, and schools (Loucks-Horsley et al., 2003, 2000). As we will see in Bayline, new visions for professional development were a major component of district professional development work.

Early research paid little attention to what teachers learned from the content or form of redesigned professional development (Wilson & Berne, 1999). More recent work has done so (Desimone, Porter, Garet, Yoon, & Birman, 2002; Francke, Carpenter, Levi, & Fennema, 2001; Gamoran et al., 2003). Yet, these studies generally do not distinguish between novices and veterans in their findings. We cannot assume novices follow the

same learning path as veterans. Grossman and Thompson (2004) argue that novices "are still in the process of developing their ideas about teaching, which may make their beliefs and their practices more malleable" (p. 298). Although this study does not compare novices with veterans, it does investigate how malleable new teachers are.

Summary. This study, then, brings together several lines of inquiry; generally treated separately in the extant literature: science-for-all and standards-based reforms, new teachers and science professional development, along with induction and new science teachers. The conceptual framework I developed had to be broad enough to hold these lines together. I close the chapter with a discussion of that framework.

Conceptual Framework

The Three Ideals of Science-for-all

Mary Kennedy (2004) proposes that, throughout the twentieth century, three broad ideas or themes consistently emerge as goals for educational reform: (1) the need to offer students more rigorous and important content, (2) the need for more intellectual engagement of students, and (3) the need to make knowledge accessible to all students. In her research with teachers, Kennedy used the reform ideals as a "...benchmark against which to array the ideas that guide teaching practices" (p. 7).

I use these three ideals—ambitious curriculum, student intellectual engagement, and access for all students to science—in a similar way in this study. Of course, science-for-all is not broken neatly into the three components. In reality, there is likely a synergistic relationship between these ideals. It seems disjointed to think about intellectual engagement apart from the demands of the content or of equitable access without attention to what students have access to. However, for analytic purposes, it is

helpful to take a complex agenda like science-for-all and make it more manageable by parsing it into a few ideals; undoubtedly, they will bleed into each other along the way.

With that caveat, these three ideals capture the basic principles of science-for-all. I looked for evidence of each in the study participants' instructional practices; both what they said and what they did in their classrooms. I describe what I looked for, respective to each ideal, in chapters 5-7. Chapter 5 examines what teachers learned about ambitious curriculum outcomes, chapter 6 looks at intellectual engagement, and chapter 7 explores access to science. I now turn to describe the conceptual framework I used for examining what study participants learned about these ideals.

A Framework for Teacher Learning

Given the multiple institutions in which novice science teachers participate, a sociocultural approach was appropriate for the work. The analytic lens I take in this work draws on perspectives, indebted to Vygotsky (1978), that view learning as both *situated* and *mediated*. By *situated*, I mean learning takes place through individual participation in social institutions (Billett, 2000; Engestrom, 1999; Lave, 1995). That is, individuals develop ways of doing (being) as they interact within organizations and communities in which they participate; a district, school, or induction program, for instance. The institutional tools and norms individuals encounter as part of their interactions shape—*mediate*—what they can do. At the same time, individuals shape the tools and norms by virtue of their participation (Engestrom, 1999; Rogoff, 1995; Wertsch, Del Rio, & Alvarex, 1995). In other words, mutual shaping occurs between individuals and social institutions. A textbook, long associated with school science, may direct teachers' attention towards particular content, for example. However, the teacher's knowledge and

preferences also influences how she uses the text.

Tools are conceptual as well as physical; conceptual tools include ideas about how students learn or what science is, for example. Institutional norms are particular ways of doing things, patterns of actions developed over time. For example, one research study found novices encountered three very different professional cultures in their schools: veteran-oriented, novice-oriented, and integrated; each shaped new teacher support in different ways. Keep in mind, however, the individual is equally influential. Rogoff (1995) calls the process *participatory appropriation*:

> Appropriation occurs in the process of participation, as the individual changes through involvement in the situation at hand, and this participation contributes both to the direction of the evolving event and to the individual's preparation for involvement in other similar events. (p. 153)

In the case of novice teachers, for instance, an unsuccessful attempt at inquiry-based teaching may dissuade them from such work in the future, even though the professional development program they participate in encourages them to do so.

An analytic approach that accounts for both individual agency and structure is complex; but that is the charge of sociocultural theory:

> Fundamental to sociological theorizing are the concepts of agency and structure. Agency denotes the fact that human beings are inherently imbued with the power to act. Power to act means that all human beings can appropriate available resources and, in doing so, change rather than merely react to the currently existing social and material conditions....Structure requires agency to become salient and operative, but agency requires structure to accomplish anything. (Roth & Tobin, 2002)

Cohen, Raudenbush, and Ball (2003) offer a model of instruction that helps frame the influence of agency and structure. In their model, teaching is a set of relationships between teacher, learner, and content; those mutually reinforcing relationships are

situated in environments (see Fig.1.1). Resources influence these relationships and the relationships influence the use of resources:

> Instruction is a stream, not an event, and it flows in and draws on environments—including other teachers and students, school leaders, parents, professions, local districts, state agencies, and test and text publishers. This view of instruction had roots in early 19th century ideas; yet, many researchers and practitioners still refer to teaching as though it was something done by teachers to learners. (Cohen et al., 2003)

This study investigates the stream of instruction; it extends from the study participants classrooms to educational institutions well beyond their schoolhouse walls. Resources populate the environment; as teachers notice and use them, they influence the shape instruction takes.

The authors describe three groups of influential resources: personal, conventional, and social.

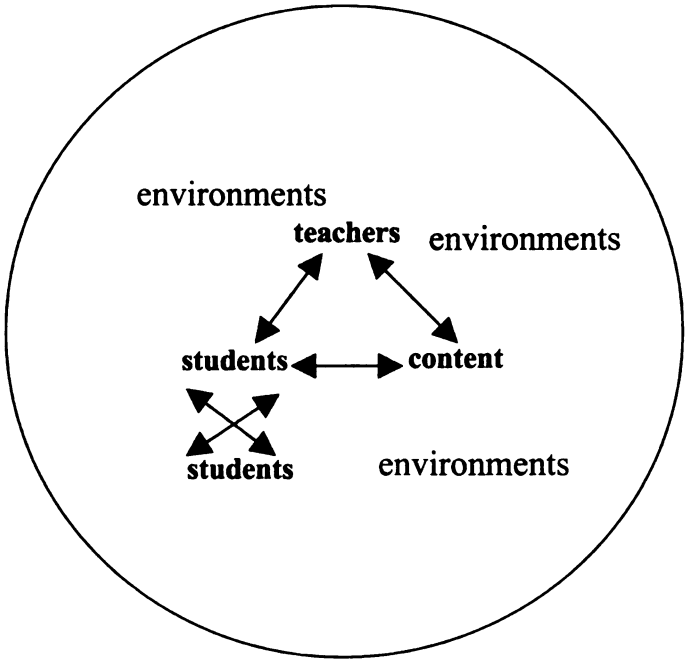

Figure 1.2 Instruction as Interaction (Cohen et al., 2003)

Personal resources account for individual agency; they include a teacher's knowledge, skill, and will. Conventional and social resources are structural. These are the things we usually associate with schools—curriculum materials, credentials, time, class size, to name a few. Social resources (the authors also use the term environmental) include people—colleagues, students, science educators, and other individuals who influence instruction. Norms are expectations, implicit or explicit rules, and routines such as state guidance for instruction, patterns of collegial interaction, or models of professional development.

Cohen et al. (2003) note that it is not the resources alone that shape learning. Of course, what resources teachers have access to matters; they cannot use what is not there. However, equally important, is how teachers *use* the resources they have. For instance, rich curriculum materials may not help teachers with limited subject matter knowledge improve their instruction. Resources and their use, then, influence teacher development.

An Overview of the Dissertation

In chapter 2, I describe the methodology used to study resources, their use, and teacher development. In chapter 3, I describe the personal resources each teacher brought to his/her work. In chapter 4, I examine the conventional and social resources available to teachers through new teacher support and science professional development. In chapters 5-7, I analyze how those sets of resources, along with the resources available in their schools, shaped teachers' instructional practices in relation to the three reform ideals of science-for-all—ambitious curriculum, intellectual engagement, and access for all students. In chapter 8, I draw conclusions and implications for learning to teach science-for-all.

Chapter 2
Methodology: Studying the Stream

> But of one thing at least I am quite convinced. You cannot strip learning of its context, nor study it in a 'neutral' context. It is always situated, always related to some ongoing enterprise. (Bruner, 2004, p 20)

In this chapter, I describe and explain the research methods used for the study. I first discuss the research design. In the next three sections, I discuss sampling, data collection, and instrument development, respectively. In sections five and six, I review the techniques used for data analysis for new teachers and educational institutions/programs. I conclude the chapter with a discussion of the challenges of the study and limitations of the findings.

Study Design

In the Fall of 2003, the seven novice science teachers began the school year. As I described in chapter 1, they brought personal resources—their knowledge, skill, and will—to their work. They would also encounter various conventional and social resources during the year: textbooks, mentors, and students, to name a few. These resources—personal, conventional, and social—would shape their instruction: how they thought about science content and what they expected from themselves and their students. This qualitative, longitudinal case study of a urban California district—Bayline—examines what novice middle and high school science teachers learned as they located and used those resources.

Specifically, I examined whether, and how, resources contributed to dispositions, knowledge, and skills that supported the reform ideals of science-for-all: ambitious

curriculum goals, intellectual engagement, and access for all students to science. The major research questions were:

- What do early career middle and high school science teachers in an urban school district learn about teaching science-for-all?
- What resources do teacher have access to and how do they use those resources?
- How do these resources shape what teachers learn about teaching science-for-all?

Context: Bayline School District[5]

Bayline School District (BSD) enrolls about 60,000 students. African-Americans, Latinos, and Chinese-Americans comprise two-thirds of the student population. Approximately 30% of students are English Language Learners (ELL). A little over 50% of the students qualify for free or reduced lunch—a proxy for family economic need. There are approximately 15 middle schools and 20 high schools (five are "alternative" high schools for students unsuccessful in other schools) with approximately 30,000 students. Based on student scores on state achievement tests, ten of the middle schools and seven of the high schools are classified "low-performing" schools and participate in some form of intervention administrated through the state/district.

As in other major US cities, BSD struggles with issues of racial and economic segregation and educational quality. BSD recently developed a comprehensive plan in response to legal judgments that the district did not serve all students equitably.

[5] I use approximations for district and school statistics to protect confidentiality. However, the none of the changes I made altered district/school characteristics.

Specifically the judgments documented lax attendance policies, uncertified teachers, and low expectations, especially in schools that primarily served African-American and Latino students.

BSD employs approximately 3300 classroom teachers; over half are Caucasian. I was not able to obtain the total number of middle and high school science teachers in the district. The district high school science specialist provided a list of approximately 110 high school science teachers; however he noted the list was likely incomplete. The district middle school science specialist did not provide a similar list.

The district also could not provide data on teacher attrition, other statistics indicated approximately one-fourth of teachers have two years or less experience. The district science specialist estimated a slightly higher number; he indicated about 30–40% of science teachers fit that criterion (personal communication, 2/25/03). In the Fall of 2003, the district was still in the midst of reorganizing its new teacher support system; this included developing a database that helped track new teachers. Teacher support personnel were also redesigning programs to fit new state credentialing requirements. I provide additional information about new teacher support and professional development in chapter 4.

Sampling

District

I selected BSD as a site to study new science teachers, teacher learning, and science-for-all for several reasons. First, the majority of the students in BSD are students of color from low-income families; these are the very students science education has

historically underserved. Science achievement, as measured by recent state tests, show this trend continues in BSD; two-thirds of the students did not meet "proficient" standards; half of those students score in the "below basic" or "far below basic" range (the lowest ratings). Secondly, the district employs a significant number of novice teachers at a time when credential and new teacher support requirements have tightened. Moreover, as indicated earlier, NCLB accountability policies placed a number of the schools under sanctions. These policies—teacher quality and students achievement—added a mix of resources and regulations to schools. Third, there are a number of science professional development opportunities available to teachers, including one—the Exploratorium new teacher program—that is designed for new science teachers. Both new teacher and professional development programs provided resources that potentially support science education reforms.

The final reason was access. This study is part of a larger study of new science teacher learning.[6] As a research associate on that study, I developed relationships with several key BSD personnel as well as Exploratorium staff; all proved very helpful for district permission to conduct the study, and make contacts with schools, new science teachers, and other Bayline educational institutions.

Within the district

The original sampling design for within district cases was purposeful and stratified (Miles & Huberman, 1994). This would allow me to develop hypothesis about what, and how, new science teachers in BSD learned about teaching science for all. I

[6] Learning to Teach Inquiry-based Science, an NSF-funded summative evaluation of the Exploratorium New Teacher Institute (Award #9910207: Content, Coaching, and Acculturation: A New Community of Practice for Beginning Teachers). Any opinions, findings, and conclusions or recommendations expressed in this material are mine, as the author, and do not reflect the views of the National Science Foundation.

intended to select my sample carefully so that it represented a typical range of learning conditions secondary science teachers encountered in the district. I set the upper limit of experience at 3 years. I would also include a mix of high school and middle school teachers.

I chose several characteristics intended to maximize difference in personal, conventional, and social resources. I wanted a mix of first and second year teachers. Some new teacher support programs extended over a two-year period: How did a year of teaching experience influence the resources available and the ways teachers used them? I would select teachers with varied credentials—professional clear, preliminary, and Intern. I intended to include several participants the Exploratorium new teacher program so that I could investigate how that unique blend of resources influenced teacher development.

Schools were an additional (and very important) variable to consider; I knew from experience that conditions differed between district schools; some were considered more academic, had more problems with attendance or school violence, or served different socioeconomic groups. I would select participants from schools that represented a range of conditions for teacher learning in the district: test scores, student population (race/ethnicity, English language learners, socioeconomics), enrollment/class sizes, and experienced teachers were relevant to the conceptual framework. I suspected, given those criteria, that I might not be able to impose demographic stipulations; however, I hoped to have a mix of age, gender, and race among the participants.

I originally intended to have six participants ("informants"): three middle school and three high school science teachers from a mix of schools, half from the Exploratorium. Since I planned on extensive data collection over a two-year period (I use

the year one data in this study), I estimated the maximum amount of data I could reasonably collect and analyze at six teachers.

Within-district sampling frame

Despite my sampling intentions, I had very few teachers to choose from for the study. The district Intern director, my research contact in BSD, requested a list of new science teachers from the district personnel office in September of 2003. However, they did not have records of new science teachers available. The office depended on schools to provide that information; it was too early in the year for them to submit the information; moreover, they still had not filled all staff positions.

Consequently, I used the only lists of teachers I could get; there were three of them. The Exploratorium provided a list of teachers in their program; eight were BSD teachers. I eliminated one who had five years prior experience in another subject area. As noted earlier, the high science instructional specialist supplied a list of science teachers but cautioned it was incomplete. The list had 109 teachers; ten of them listed less that three years experience. However, 37 teachers had a blank entry for years of experience. I included all 47 as potential participants. The third list included six teachers the Intern director named as possible participants, from the new teacher support program's records (which were also incomplete).

Selection and characteristics of study participants

I contacted teachers in several different ways—in person, by phone, and/or by email. The Exploratorium program had an orientation session for its program, which I attended, late in September. I explained the study and invited participation. Two teachers—Felicia and Rita (see Table 2.1)—indicated interest and, two weeks later,

agreed to participate. I sent an email to the 53 teachers from the district lists. The instructional specialist also emailed information about the study to all high school science department chairpersons. The Intern director contacted all of her science interns. She also asked the director of non-intern new teacher support to distribute information about the study. All of this communication resulted in five potential participants; the Intern director provided phone numbers and email for each. She also indicated many new teachers were probably too overwhelmed, especially at the start of the year, to volunteer for a research study (personal communication, September 23, 2003).

I contacted all five teachers by phone and email. One, a late admission to the Exploratorium program—Mary—immediately agreed. A male non-Exploratorium high school teacher, declined; explaining it was his first year and he was just too overwhelmed (personal communication, October 22, 2003). However, another Intern, from the same school, who was not a participant in the Exploratorium—Mark—did agree to participate. The other two teachers did not respond immediately. I contacted them by phone and email, again, in mid November.

In the meantime, when I conducted an in-person initial interview with Felicia in early November, another Exploratorium teacher, Steven (who taught in the room next door to her) indicated interest in the study. I agreed; his participation would allow me to compare how two teachers used similar resources. Finally, in late November, the remaining two teachers—Olivia and Joseph—from the Intern director's list contacted me and joined the study. One of the teachers—Joseph, a special education science teacher—had two years of prior experience in the district. However, during his first year, he was a substitute and then an emergency credentialed teacher; I decided including a special

education teacher in the study outweighed the extra year of experience. Consequently, I had seven study participants. I summarize their characteristics in Table 2.1. I provide further details about their backgrounds when I discuss personal resources in chapter 3.

Table 2.1
Characteristics of Study Participants

Teacher[7a]	Experience (yrs)[b]	Grade/subject[c]	Credential	Exploratorium	Other	Sex	Race[e]	Age Range (yrs.)
Felicia Baker (T6)	0	10/Biology	Clear Professional	Yes		F	C	25–30
Rita Magano (T2)	1	7/Life Science	Clear Professional	Yes		F	C	25–30
Mary Andrews (T1)	1	8/Physical Science	Intern	Yes	TFA[d]	F	C	20–25
Mark Bonner (T7)	1	11-12/ Conceptual Physics	Intern	No		M	C	20–25
Steven Anderson (T5)	0	10/Biology	Out-of - State	Yes		M	C	25–30
Olivia Langston (T4)	0	10/Biology	Out-of- State	No		F	C	25–30
Joseph Strobinski (I3)	2	7-8/ Special Education General Science	Intern	No		M	C	25–30

[a] The parenthesis encloses the code used for citations from teachers in the text. [b] Years teaching experience as of Fall 2003. [c] Each teacher selected one focal class for the study. [d] Teach for America.
[e] C = Caucasian.

Situating the participants within the district

Teacher characteristics. Since I had so few teachers volunteer, I ended up accepting all those who did. Consequently, I questioned to what extent they and their schools represented the mix of resources I intended to select. This required

[7] All names are pseudonyms.

"backmapping" characteristics onto my intended criteria. I was fortunate; comparisons of teachers and schools matched most of the original criteria. I now provide that evidence.

First, participants conform to the major selection characteristics I intended—almost evenly split on experience and Exploratorium participation. Moreover, the Intern director indicated the credentials approximated the proportion she estimated for new teachers in the district (personal communication, December 12, 2003). However, I could not confirm those numbers, although I tried. Even at the end of the school year, none of the district offices could disaggregate teachers by experience and subject matter from their database.

As suspected, with the exception of gender, demographic characteristics most likely do not represent the overall population. Since I could not obtain accurate records of novice science teachers, the only comparisons I can make are to middle school and high school teachers overall: 51% are female and 56% are Caucasian. Although the gender proportion of the sample matches those in the district, clearly the proportion for race/ethnicity (100% Caucasian) is not representative, only 56% of district teachers are Caucasian. The age proportion is also probably not typical of all teachers. I met several novices during earlier work in the district who were pursuing second careers as science teachers; most well over 40 years old. I discuss the implications of these demographic differences in the limitations of the study at the end of this chapter.

Teaching situations. As I indicated earlier, I knew school conditions (and resources) varied. In Table 2.2, I present a comparison between the participants' schools and those in the district on several relevant dimensions. Overall, the participants' schools represent the range of schools on most measures. For instance, Fernandez High enrolls

one of the largest numbers of English language learners and students who qualify for free/reduced lunch in the district; Adams Middle School enrolls some of the lowest numbers of those students. I draw particular attention to correlation of those values with test scores. Note that Fernandez also has some of the lowest test scores among district, while Adams ranks much higher in comparison with other middle schools. However, I also point out that Joseph teaches special education at Adams; a population that scores below average on the test.

The state rankings on the API tend to be in the mid or lower range. None of the schools ranked higher than eight, even though there are a few schools in the district that do. I suspect that these schools do not employ many new teachers. Notice on Table 2.2 the average years of experience. With the exception of Evers Middle School, these numbers are well below average, suggesting a large proportion of inexperienced faculty. By comparison, one middle school, API=10, had an average of 19 years of experience; the average in one high school, API=10, was 17 years. This suggests veteran teachers comprise the largest proportion of staff in those schools. Teachers I spoke with referred to these schools as "elite" schools; they had the plum jobs everyone wanted. I return to this difference when I discuss the limitations of the study.

In sum, then, the participants reasonably approximate the characteristics of new science teachers in BSD with two noticeable demographic exceptions, race and age. Moreover, although none of the teachers taught in "elite' schools, their schools likely represented the range of workplace earning conditions for novice science teachers in BSD. Having situated the within-district sample, I now turn to data collection.

Table 2.2
Situating Participants' Schools Within the District

	Middle Schools				High Schools			
	District Middle Schools[a]	Meriweather Lewis Middle School	Medgar Evers Middle School	Adams Middle School	District High Schools	Baycrest High School	Fernandez High School	Frederick Douglass High School
Study participant		Mary	Rita	Joseph		Olivia	Felicia and Steven	Mark
Number of students	200–1200	500	600	900†	400–2500	2000†	900	1000
Average class size, all classes	20–34 (25)	20‡	24	34†	18–29 (25)	27†	22	25
Average class size, science	29	27	27	34	31	32	26	28
Percentage of students who qualify for free/reduced lunch	40–100 (67)	75	80	60‡	30–86 (50)	40	75†	55
Percentage who are English Language Learners	4–50 (22)	25	22	15	17–35 (19)	15	35†	18
Student Ethnic diversity index[b]	20–66	46 (Hispanic)	58 (Asian)	66 (Asian)†	32–72	66 (Asian)	58 (Hispanic)	51 (Asian)
Percentage of Caucasian teachers	56	55	41	52	56	46	60	47

Table 2.2 (cont'd)

	Middle Schools				High Schools			
	District Middle Schools[a]	Meriweather Lewis Middle School	Medgar Evers Middle School	Adams Middle School	District High Schools	Baycrest High School	Fernandez High School	Frederick Douglass High School
Science achievement test: Percentage at or above proficient (CST)					50 Life science	25 Life science	16 Life science‡	N/A
Science achievement test: Percentage above 50th percentile (CAT/6)	50	35	54	23 Special education	52	41 Life science	10 Life science‡	44 Physics
State ranking on California Academic Performance Index[c]	1–10	1‡	5	7	1–10	5	1‡	3
Similar schools ranking on California Academic Performance Index	1–10	1‡	7	8	1–10	8	2	2

SOURCES: Ed-Data 2003-2004; BSD website

Note. † indicates the school ranks within the five highest schools in the district ‡ indicates the school ranks within the five lowest schools in the district

[a] When available, I provide the range of values. The average value follows in parenthesis.

[b] Numbers close to 100 on the Ethnicity Diversity Index indicate that a school has a fairly even distribution of students among the ethnic categories in California. Numbers closer to 0 indicate that students are predominately from a single ethnic group. The ethnicity in parenthesis is the largest ethnic group.

[c] The California Academic Performance Indicator (API) ranks schools according to test scores from 1 (the lowest score) to 10. API provides two rankings: the state ranking compares schools with other schools of similar grade level (e.g., middle or high) in the state. The similar schools ranking compares schools to 100 schools with similar characteristics (e.g., students population, size, etc.) in the state.

Data Collection

I collected the data for this study between September 15, 2003 and November 15, 2004.[8] Data collection included interviews, observations, questionnaires, and classroom/program artifacts. I describe each in more detail for new teacher participants and for educational institutions/programs.

New teacher participants

Interviews. I conducted interviews with teachers for two major purposes, to trace the development of: (1) their beliefs (especially their goals), knowledge, and skills for science teaching and (2) their resources—what they were, how they used them, and for what purposes. I conducted seven semi-structured interviews with each teacher (I also interviewed them about specific lessons; I discuss those with observations). Unless otherwise noted, all interviews were in person with the exception of the check-in interviews, those took place by telephone. I audio-recorded all of the interviews except for the summer interview (I recorded hand-written notes for that interview). I summarize the eight interviews in Table 2.3.

Observations of teaching. I summarize the number of teaching observations in Table 2.4. I observed and recorded enthnographic field notes during two-four class sessions per teacher. Whenever possible, I conducted a 15–20 minute pre-observation and post-observation interview with the teacher; either on tape or documented in writing. I also collected teacher materials from the observed lessons.

[8] Interview w/BSU science methods instructor

Table 2.3
Description of New Teacher Interviews

Interview	Time frame	Purpose	General Description	Approximate Length
Initial (I1)	10/03–12/03	Introduce teacher and support	Teachers describe their teaching preparation, teaching situation, support; and confidence/concerns	50–60 minutes
Check-in (I2)	1/04–2/04	Update information	Teachers discuss their progress in teaching, support, and confidence/concerns	15–20 minutes
Resources (I3)	2/04–3/1/04	Map teacher goals and resources	Teachers sort card with teaching goals, identify knowledgeable others and immediate sources of support	60–75 minutes
Subject matter (I4) [a]	3/1/04–4/1/04	Identify teacher content goals, attitudes towards content, and instructional preferences	Teachers discuss content, curriculum planning, strengths, and concerns. They also react to students' responses on an open-ended task.	40–45 minutes
Year-end (I5)	5/10/04–5/20/04	Identify helpful and not so helpful resources	Teachers react to a resources timeline, discuss what they have learned, and their future plans.	50–60 minutes
Summer [b](I6)	6/10/04–6/30/03	Map resources and learning from summer pd	Teachers discuss their summer learning opportunities.	30–45 minutes
Fall two [c] (I7)	10/15/04–11/4/04	Update teaching situation, goals for the year, and resources.	Teachers discuss their assignment, any changes, and support.	60–75 minutes

Note. I audiotaped all interviews except for the summer interview.
[a] Steven's interview was completed by phone. [b] Mark did not do a summer interview; Felicia's occurred by phone. [c] Joseph did not participate in fall two

A local videographer (or I) videotaped two–six class sessions per teacher (see Table 2.4). The videotaped session included collection of other data as well, adapted from

the TIMSS video study[9]—teacher materials, students work, and a teacher questionnaire. I requested teachers provide lessons plans, copies of curriculum materials, and any other handouts from the class. For student work, I asked teachers to select six students—two high, middle, and low achieving—and provide copies of their work for each lesson. I also requested teachers complete a questionnaire (VQ) for each lesson that situated the lesson, indicated the goals and resources used, and evaluated whether the lesson accomplished what the teacher intended. Although well intentioned and often apologetic, most teachers did not submit these accompanying materials; only one submitted a full packet of materials for every lesson. With everything else they had going on it was difficult, as Joseph put it, "to get it together."

Table 2.4
Observations of Classroom Teaching

Teacher	Participant Observation (FN)[a] (# of class sessions)	Videotape (min) (CT)[b]
Mary[c]	2	100
Rita	4	350
Joseph	3	200
Olivia	3	300
Steven	2	240
Felicia	3	360
Mark	3	210

Note. Class duration varied between 51–90 minutes
[a] FN=field notes when cited in the text. [b] CT=classroom transcription when cited in the text. [c] Mary suspended observations and videotapes in spring because she felt they disrupted students' behavior (personal communication, 3/11/04).

[9] The Trends in International Mathematics and Science Study (1999) http://nces.ed.gov/timss/

Survey questionnaire. I also invited teachers to participate in a survey of new science teachers in the Bayline area (the survey is part of the larger study in which this one is nested). Four of the teachers completed the survey questionnaire (SQ). The questionnaire asked teachers to provide background information, describe and evaluate their new teacher support, their teaching situation, their confidence in their knowledge and skills for teaching, and their teaching practices. Teachers' responses added another source of data to confirm impressions from interviews and observations.

Educational Institutions and Programs

Interviews. I conducted semi-structured interviews and informal discussions with program and school staff, I summarize the number of interviews in Table 2.5. Although I had hoped to interview a school administrator, the science department chair, and the district mentor for each teacher, I was not able to arrange those meetings for all participants. In two schools, for instance, there were student deaths due to gang violence on the streets; I did not impose on those administrators for interviews.

Observations of educational institutions/programs. During school visits, I wrote field notes about the school; what I observed and the conversations I overheard in the hallways, faculty rooms, and school office. Even though I was not able to interview all principals, I did spent sufficient time in each school to see the principal or assistant "in action" at least once. I also observed at least one "instance" from each new teacher support and professional development program in which new teachers participated, recording ethnographic field notes. I summarize those observations in Table 2.5.

Documents. I collected numerous documents from educational institutions and programs throughout the year, during observations, from novices and program staff. I

also used web-based resources for the state, district, schools, and programs for additional information and materials; including public reports. I also regularly consulted the Bayline newspaper for stories about the district, schools, and teachers.

Table 2.5
Educational Institution/Program Interviews and Observations

Institution/Program [a]	Staff/support provider interviews [b]	Observations
District new teacher program (D)	4	(2) District support provider meetings (1) Mentoring session
Credential programs (CP)	1[c] (2)	(1) Credential advising session
Exploratorium new teacher program (EP)	5 (2)	(1) Orientation session (1) Observation of mentor teacher lesson (4) Saturday workshops (4) Days of Summer 2004 institute
District science professional development programs (DS)	1 (2)	(1) After-school workshop
Other programs	(2)	(3) Sessions in teacher classrooms (1) After-school session
School administration	2 (1)	

Note. All interviews were with different individuals; the number of interviews equals the number of people interviewed.
[a] The initial(s) in parenthesis indicate the citation code used in the text.
[b] Interviews were semi-structured. Those in parenthesis were informal discussions with program staff before, during, and/or after observations.
[c] I did not conduct this interview. I used a transcribed interview from September 2000.

Instrument Development

Interview protocols. I adapted the majority of interview protocols from two other studies of new science teachers; making only minor revisions to suit the context of this study (see Appendix A).[10] I did develop one interview specifically for this study—the resources interview. The purpose of the interview was to collect data on new science teachers' instructional and professional priorities and the social resources (e.g., organizations, mentors, coaches) available to assist them in their work. This would allow me to triangulate teacher reports and my observations. I drew on social network methods to construct the interview, especially measures of individual social capital (Van der Gaag & Snijders, 2004).

The interview has three parts. In part 1, teachers prioritize their instructional and professional goals by sorting 29 cards into five categories, from most to least focused. Each card contains an instructional or professional goal as expressed in the California Teaching Standards. In the second part of the interview, I asked participants to identify someone who is knowledgeable in areas related to a selection of the goals (e.g., Do you know someone you consider knowledgeable or an expert at modifying science instruction to support the special needs of students with limited literacy/math skills? If so, who?). In the final portion of the interview, the teachers return to the cards and identify people they would go to if they needed assistance with a particular goal. For the analysis in this study, I selected twelve cards that corresponded to the reform ideals of science-for-all; the cards used for the study are bold-faced on the protocol included in Appendix A.

[10] Learning to Teach Inquiry-based Science (PI, Suzanne Wilson) and Mathematics and Science Teacher Induction Study (PI, Lynn Painne)

Questionnaires. As indicated previously, I adapted the teacher questionnaire for videotaped lessons from the TIMSS video; a large-scale international study of mathematics and science teaching practices. The survey questionnaire I developed for new science teachers in the Bay area included a panel review and pilot test before using with new teachers. Since only four teachers completed the questionnaire, the data is supplemental, and the survey results are not included in this analysis; I will omit details about instrument development.[11]

Data Analysis

There were three overarching (and connected) tasks in the data analysis: mapping resources (personal, conventional, and social) and determining how teachers used them, mapping science-for-all, and looking for connections between the two. I will address each, respectively. For all tasks, the process was non- linear, iterative, and recursive (Miles & Huberman, 1994). For instance, when what I saw in the field did not confirm initial impressions from earlier interview data, I then went back to that data, and reconsidered my initial impressions in light of fieldwork. This often led me to other data sources, revising my impressions, and/or confirming my findings with participants.

In chapters 5–7, I describe the data analyses I used to construct the arguments in the chapter. Here, I present an overview and some specific examples of the analyses, along with a glimpse into my intellectual journey through the work. I relied heavily on data reduction, display, and interpretive methods as described in Miles and Huberman (1994).

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[11] I provide details of instrument development for the survey in Wilson, Shouse, and Galosy (2001). Year 2: Report to the Exploratorium. Unpublished document.

Mapping resources

Mapping resources had three phases occurring simultaneously. I compiled lists of resources teachers had access to and programs provided, developed cross- teacher and cross-institutional comparisons, and selected resources for further examination. I selected those resources based on review of the literature, salience to teachers, and prominence in programs. The latter two criteria meant I would have richer data since teachers and program staff focused on those resources during interviews and observations.

Personal resources. I reduced and displayed the data from the initial interview in four graphic organizers: teacher background, teaching situation, teaching practices, and support (samples of two organizers are in Appendix B). I selected quotations from teachers and summarized the information they provided (e.g., college, prior career, etc.) during the interview. This led to initial impressions about what teachers felt well (or ill) prepared to do. Subject matter, teacher preparation, and credentials were initially my focus. However, as I looked across teachers, their varied reasons for coming to teaching and, in particular, to BSD struck me as potentially significant. As I read (and reread) literature about teachers and diverse students, especially in urban districts (Bryk & Schneider, 2002; Lipman, 1998), commitment to students as capable learners was clearly important to high expectations. I re-examined teachers' stories about their arrival in BSD, and filled in missing pieces from several teachers in subsequent interviews. I then went back to the data, looking for evidence of strengthening or waning commitments to teaching, especially teaching in an urban district. I also re-examined the interviews, selecting and coding those segments that provided evidence of teachers' views of students over time.

Similarly, I checked and re-checked teacher's confidence in subject matter—at the subject matter interview, in the survey questionnaire, during observations, and at the end of the year. As I did, another potentially important resource relevant to teacher knowledge of scientific practices emerged; previous experience as a scientist or with inquiry practices. Again, after consulting the literature to find support for this hunch, I filled in missing data about teachers' prior experiences in subsequent interviews.

The final step in mapping personal resources was selecting key pieces of evidence to support profiles of each teacher's personal resources in four areas—knowledge of subject matter, knowledge of scientific practices, views of students as capable learners, and commitments to teaching/urban situation—that process resulted in Table 3.1. In subsequent analyses of resource use, I targeted those four areas.

Conventional resources. I initially collected data about conventional resources, broadly, from teachers and programs. I displayed the data in written summaries of school/classroom facilities and lists of curriculum resources. I then compared these lists across teachers; some definitely seemed in better school circumstances then others. I checked out teachers' perceptions of school-based resources in several ways—in interviews and in the survey and videotape questionnaires. Early on, I earmarked class size; it seemed plausible that large class sizes favored traditional teaching. However, class size was difficult to pin down. Teachers had high absentee rates; as the school year neared the end, teachers reported that failing students simply stopped coming to class. Some teachers had class attendance drop by as much as one-third. Although I would address the issue, I put further analyses of class size aside.

As with school resources, I used multiple sources to construct lists of the conventional resources other educational institutions offered—staff interviews, observations of program activities, and (in some cases) internet descriptions. I consulted literature on new teacher support and professional development to identify a smaller set of resources for cross-institutional comparisons; those included credentials, curriculum materials, classroom supplies, stipends, and release time.

Three conventional resources—standards, textbooks, and hands-on activities—emerged as particularly salient across teachers; they also were present to different degrees in schools and other educational institutions. As I will explain shortly, I pursued analysis of use for all three; the analysis of textbooks shifted my attention to another resource, literacy strategies.

Social resources. I mapped social resources from the teacher and the program perspective. In order to make the task manageable, I divided social resources into three categories: new teacher support, science professional development, and science department and/or grade-level team. I then divided each of those into people and norms; that is, I wanted to find out what kind(s) of expertise people had and what activities teachers participated in; this was the raw material for making claims about the learning opportunities educational institutions/programs offered.

I added to, and revised, lists of social resources on an ongoing basis; confirming them with teachers at three time points: late fall, early spring, late spring. For instance, to prepare for the end of the year interview, I constructed what I called a "PD (professional development) timeline" for each teacher. Teachers verified these list of resources, making changes where needed (see Appendix B3 for a sample). I also constructed cross-teacher

comparisons, noting differences between them. Appendix B4 includes a cross-teacher comparison from the resources interview; I asked teachers to identify individuals they knew who had expertise in areas relevant to science-for-all.

I used a similar process for characterizing the social resources institutions offered; building lists from interviews and observations, confirming them with program staff. I constructed cross-institutional comparisons (again, after consulting teacher support and professional development literature) for people and for activities. For people, I focused heavily on science; noting whether institutions always, sometimes, or never gave novices opportunities to interact with scientists or experienced science teachers. Finally, I selected ten learning opportunities for cross-institutional comparisons (see Table 4.4). I made that determination based on recommendations and empirical support for professional learning that (potentially) supports high expectations and intellectual engagement for all students (e.g., analysis of student work).

Use of resources. The framework of this study does not draw a straight line from resources to learning; rather, the *use* of resources shapes development. I examined use of selected resources (as described above, e.g., activities) throughout the course of the study. These ongoing analyses helped build fuller descriptions of use. I constructed those descriptions from interviews, observations of teaching, and questionnaires. I provide an example here that describes one such analysis and, more importantly, how an analysis can lead in very different (but sometimes richer) places than originally intended.

As indicated earlier, I initially selected the textbook as one of the resources for further study. Participants complained that students could not read the text. Moreover, some teachers did not use the textbook much while others used it more often; were

students' ability to read the text and frequency of use related? I chose two teachers—Olivia and Felicia— to explore this question further. Both had the same biology textbook; Felicia rarely used it, Olivia regularly did. I developed an in-depth analysis of their lessons; pouring over videotapes, examining what they did with the book, what they had their students do, and the percentage of time they used the textbook during class (a sample of those analyses are in Appendix B5–6).

However, after completing the analysis, I seemed in no better place. I had just proven what I already knew—Felicia used the book very little and Olivia used it a lot. I knew I had sufficient evidence trace those differences to patterns in their departments. However, frequency of use seemed rather trivial, so what? How did that relate to science-for-all? Is using a textbook students cannot read better than using it less often? I went back and looked at the tapes again and it struck me: It was not how often they used the textbook that really mattered; more importantly, what they were using the text for? Felicia used the book to teach her students how to read; Olivia did not.

I saw literacy as a potential issue of access. I had originally thought I might address attendance, test scores, or failure rates. However, the data there was rather thin; teachers did not discuss those issues until late in the year. However, as I looked over the data, I saw literacy in numerous places—in programs as well as teachers. Literacy was also conspicuously absent in other places. I substituted literacy strategies for the textbook; cataloging what teachers used and how they used them. I selected and transcribed clips from videotapes, and coded interview segments for literacy concerns and literacy strategies. I also developed 'timelines of use" for literacy strategies; I

selected a particular strategy and traced it throughout the year (See Appendix B7 for a sample timeline of a strategy Felicia used—a word wall).

As I analyzed literacy, something troubled me. I looked again at the third reform ideal; access for all students to *science*. I was not seeing science in these literacy segments; it seemed more like reading class. Fortuitously, I attended a symposium (albeit guilty, knowing I should be writing the dissertation). Nancy Brickhouse, a science educator, reported similar findings in her analysis of young adolescent girls' science reading habits at home and at school. Nancy argues that science has a rich tradition of literacy practices, yet students generally do not find those in schools. Her comments helped me decide to leave the third reform ideal as originally stated and raise the issue of science-less literacy in the discussion.

Now that I have described some aspects of mapping resources and their use, I turn to the second task—mapping science-for-all.

Mapping Science-for-all

I decided to do one in-depth cross-teacher analysis for each reform ideal—ambitious curriculum goals, intellectual engagement, and access to science; each would be a chapter. As described above, I examined whether or not novices taught literacy skills as a proxy for access (chapter 7 provides more details of that analysis). For intellectual engagement, I examined teachers' purposes when using activities (chapter 6). I also defined ambitious curriculum goals in terms of purposes; were teachers' curriculum goals directed towards *understanding* scientific concepts and practices? (chapter 5).

I emphasized *goals*, rather than practices for one primary reason; these teachers were novices. As described in the introduction, learning to teach science-for-all has a

steep learning curve. It is hard to imagine any of them could come close to the ideals of science-for-all in practice, experienced practitioners often cannot. Yet, if novices can sustain goals headed in that direction, they might establish a learning trajectory that supports science-for-all. Of course, I used analyses of practice to enhance my understanding their goals, asking for clarification or pointing out contradictions. I also looked to their practice—planning, evaluating their teaching, and designing learning tasks—for evidence of their goals. That is, I did not rely only on their self-report; I made judgments about what they seemed to be trying to do in their practice. I also checked those hunches with teachers and support providers.

Consider my work with ambitious curriculum goals as an example here. For my first pass through the data, I coded teacher transcripts (using Atlas Ti), marking anything related to content, planning, teaching, evaluating, resources, etc. I pulled those excerpts for my second pass, coding only those segments that stated some kind of content goal. I then used an in vivo coding method, applying significant words/phrases that teachers used to describe their goals (e.g., understanding, recognition). I made initial guesses about goal: How did teachers describe what they wanted students to learn? How did those expectations compare with understanding science content? Were scientific practices included as content? I used the in-vivo codes to characterize teachers' goals—recognition, skills, information, or disciplinary.

I went back through the data again to look for disconfirming evidence; also to video clips. I looked for opportunities teachers had to demand more or less; what they emphasized in their assignments. I consulted the questionnaires from the videotapes; examining the goals teachers stated for the lesson. In some cases, everything seemed to

fall in line. In other cases, the picture was not clear. For instance, Joseph talked about high expectations for his students, yet, his goals for his lessons seemed focused on life skills. I checked with him again in a later interview, "What do you think is most important for your students to learn in science class?" I rephrased his response, "So, life skills, that seems most important; more important than science content?" He replied, "Yes," and then explained why (3/7/04).

Based on these analyses, I characterized each teacher's curriculum goals in two dimensions; scientific knowledge and practices. I also looked for differences in goals as the year progressed. We now come to the final analytic task: linking resources and their use to science for all.

Connecting Resources to Science-for All

I relied primarily on three data display methods to draw relationships between resources and teacher goals: side-by-side descriptions and cross-teacher matrices, and timelines. The purpose of these methods was to juxtaposition resources and science-for-all next to each other in order to investigate patterns. (See Appendix B8–9 for an example of a side-by-side description and a matrix for curriculum goals). If goals were relatively stable, I looked, in particular, at resources teachers highlighted as most helpful and those they indicated were least helpful; and then looked for patterns in cross-teacher comparisons (e.g., Did teachers with high/low expectations have/not have similar kinds of resources?). If teacher goals/practices showed a shift over time, I tried to locate the shift on the resource timeline; where did a new conventional or social resource enter the scene that could be traced to the shift?

The final patterns I looked for were instances when teachers with the same resources had different outcomes. Then, I carefully investigated use. When a teacher with limited personal resources accomplished something unexpected, I looked for explanations in social or conventional resources. Similarly, when the same social resource helped one teacher but not another, I looked at differences in use, often tracing those differences back to personal resources. When conventional resources had different effects, I suspected social or personal resources influenced use. Again, in each case, I looked for disconfirming, as well as confirming, evidence.

Teachers fell into patterns across the ideals. Concerned that I may have allowed an analysis from one chapter to influence another unfairly, I checked the emerging patterns with the novices; even when the pattern was not very flattering to them, they confirmed the explanation. Finally, I examined these cross-teacher patterns to see how resources interacted, how they influenced each other and shaped learning; results of those analyses appear in chapters 5–7. I now conclude the chapter with a discussion of the challenges and limitations of the study.

Conclusion

Any analysis of new teacher learning in a district as large and diverse as Bayline is partial. Although the mix of teachers and schools offered rich opportunities to explore teacher learning across a variety of conditions, the pool of volunteers was, in reality, a puddle (and a small one at that). Moreover, any research with volunteers is always subject to selection bias. For instance, a study of differences between volunteer and non-volunteers for intensive professional development showed the latter preferred traditional "one shot" workshops; the former were already predisposed to learning in other ways

(Supovitz & Zief, 2000). Other researchers also note that reliance on volunteers limits what we know, more broadly, about how all teachers learn (Bobrowsky, Marx, & Fishman, 2001).

While acknowledging limitations—indeed these teachers may be "special' cases— I have shown that they do represent a range of teacher characteristics and schools within the district, with several exceptions that must be taken into account. First, there is no racial diversity among the participants. Second, there is little age diversity. A more diverse sample may have directed attention to other personal resources than those I considered for the study (e.g., shared teacher-student ethnic/cultural identity or experience raising children). The other concern has to do with learning conditions in schools. I did not investigate the high AYP schools in the district. I do not know about new teachers or resources there; perhaps they have more, or different, conventional and social resources to support new teacher learning—technology, experienced teachers, or staff development, for instance. However, whether additional resources would alter the argument I make about the overall dynamics between resources is speculative.

The relationships between resources and learning hypothesized from this study, then, are tentative. After all, the sociocultural frame of this study contends learning is context-bound; adding different resources or examining different outcomes might alter the patterns observed. Nevertheless, the participants in this study did provide access to a good-sized portion of the instructional streams flowing in BSD, as well as insights into what it might take to change the course of those streams.

Chapter 3

Personal Resources: Considering the Hard Place

When the seven novice science teachers came to their classrooms in Bayline School District (BSD) in Fall 2003, they did not come as blank slates. Each brought what Cohen, Ball, and Raudenbush (2003) call personal resources – knowledge, skill, and will. In this chapter, I describe the study participants' personal resources; some were better prepared than others were to take on the difficult work of teaching science-for-all. The chapter also serves as an introduction to the teachers themselves.

Cohen, Raudenbush, and Ball (2003) contend, "Teachers calibrate instruction to their view of students' capabilities, and their own capabilities to teach" (p. 132). Those capabilities are the focus of this chapter. The aims of science-for-all bring a long list of competencies to mind: content knowledge, pedagogical content knowledge, knowledge of students, instructional skills, and resiliency to name just a few. It is beyond the scope of this study to address all of them. Four significant concerns, drawn for the literature reviewed in chapter 1, serve as a framework: (1) knowing subject matter, (2) understanding scientific practices, (3) viewing students as capable science learners, and (4) desire to teach in an urban setting. The teacher descriptions pay particular attention to those four areas.

The chapter has three major sections. The first describes the framework and data used for the analysis of personal resources. The second part profiles each teacher, including descriptions of their personal characteristics and interests, undergraduate preparation, pathway to teaching, credential status, prior teaching experience, and application and hiring by BSD. Each description concludes with a summary of personal

resources in the four key areas indicated above. The concluding section considers how personal resources positioned teachers for learning to teach science-for-all.

Personal Resources and Learning to Teach Science-for-All

For this analysis, I draw primarily on teachers' initial interviews, which included information about their background, pathways into teaching, and perceptions of their teacher preparation. Questions from the subject matter interview provided further evidence for assessing content knowledge. A set of survey items—teacher ratings of their knowledge and skills in a number of different areas—provided a third source of data.[12] Interviews with program/school personnel supplied supporting evidence whenever possible.

The first key resource is subject matter knowledge. In some ways, claiming that teachers need subject matter knowledge is a logical claim: Teachers cannot teach what they do not know. Indeed, there is significant belief (especially among critics of traditional teacher preparation) that teachers need content knowledge above everything else. Research supports this claim, although the research evidence suggests that subject matter knowledge (smk) is a necessary, although not sufficient, resource for teaching science (Abel, in press). I used participants' undergraduate preparation (a major in science) and subject matter certification as one approximation of smk and teachers' perceptions of their content strengths and weaknesses as an additional measure.

The second key personal resource is knowledge of the disciplinary practices of science. This is also a logical claim; teachers cannot teach students about scientific practices they do not understand themselves. It is not surprisingly, then, that some science teacher educators recommend specific attention to scientific practices in methods courses

[12] Four teachers – Mary, Joseph, Olivia, and Felicia - completed the survey questionnaire.

(Abd-El-Khalick & BouJaoude, 1997; Gess-Newsome, 1999; Lederman, 1999; Palmquist & Finley, 1997). Career experiences with scientific practices might also provide usefuo knowledge for teaching. In a study of 14 pre-service secondary science teachers, Windschitl (2004) found those with "significant undergraduate or career experiences with authentic science research experiences" (p. 485) taught scientific inquiry in their classrooms.In this study, I relied on two kinds of evidence to assess teachers' views of science: their prior experiences with scientific research and attention to inquiry in their science methods courses.[13]

As noted previously, knowledge of content and scientific practices alone does not provide sufficient foundation for teaching. Knowledge of learners and their development can temper what Nathan and Petrosino (2003) refer to as the "expert blind spot:" : "[Expertise in science] may blind [teachers] to certain developmental needs of novice learners. Domain experts may forget what students find easy and difficult to learn" (p. 921). The blind spot may not only apply to learning content but also to scientific ways of thinking.

With the expert blind spot in mind, knowledge of diverse learners undergirds the third key personal resource – teachers' assessments of their students' capabilities. Teachers unfamiliar with populations of students like those in Bayside – students of color, poor students, English language Learners – often have difficulty setting high expectations. These teachers treat social and cultural constraints as obstacles to learning, presuming students cannot achieve ambitious learning goals (Atwater, 2000; Kozol, 1991; Ladson-Billings, 1994; Lee & Fradd, 1998; Roth & Calabrese Barton, 2004). In

[13] I was able to confirm teacher reports about their science methods classes from web-based information about their programs. Olivia is the one exception; the materials available did not provide information about the methods course.

addition, without cultural sensitivity, teachers tend not to consider how science, their teaching methods, or curriculum materials might conflict with some students' cultural norms (Atwater, 2000; Ladson-Billings, 1994; Lee & Fradd, 1998). Finally, cultural awareness helps teachers better understand and build on their students' ideas and experiences (Nieto, 1999; Roth & Calabrese Barton, 2004; Warren, Ballenger, Ogonowski, Rosebery, & Hudicourt-Barnes, 2001)

Teachers also need ways to connect with English language learners (Lee & Fradd, 1998; Warren et al., 2001). Otherwise, they might easily write them off as the "wrong kind of students" to learn science (Shulman, 1989). For these reasons, teacher preparation and certification programs often include courses to address diverse learners; course titles vary: *Culturally Sensitive Teaching, Teaching Diverse Learners, and Teaching Literacy across the Content Areas*, to name a few. Some teacher education institutions also offer urban teacher preparation programs specifically designed for teachers who want to work in those settings (Quartz, 2003; Sleeter, 2001; Villegas & Lucas, 2002).

This line of work, then, suggests opportunities to learn about, and work with, diverse populations can be beneficial, especially when those opportunities portray urban students as capable science learners. These opportunities - teacher preparation/ coursework on diverse learners and/or literacy, specialized programs for urban teachers, student teaching, or other life/work experiences with urban and/or diverse populations – served as one piece of evidence that teachers perceived their students as academically

capable.[14] Teachers' discussions of their students, particularly whether they focused on deficits or capabilities, provided additional evidence of teachers' views.

The fourth key personal resource – commitment to teaching – relates to the third. Cohen et al. (2003) designated "will" as a personal resource. The dictionary defines will as "diligent purposefulness or determination" to do something; for example, as just discussed, to ensure diverse students experience success as learners. An equally important (and potentially connected) resource is commitment to teaching, especially an urban situation. Teachers come to teaching for many reasons – to work with children, to contribute to society, to have meaningful work for a few years before pursuing another degree, and/or to share knowledge of subject matter (National Education Association, 2003). Similarly, there are many reasons new teachers choose urban settings; some intend to make urban teaching their career, others are there temporarily (Peske, Liu, Johnson, Kauffman, & Kardos, 2001). One could imagine that new teachers whose commitments are fragile or temporary might approach the work differently from those with more stable commitments, perhaps placing different kinds of demands on themselves or their students. I looked for evidence of commitment in several places, including the teachers' pathway into teaching, selection of a teacher preparation/certification program, and reasons teachers chose Bayline for employment.

I now turn to describing the study participants, focusing on these four domains – knowing subject matter, understanding scientific practices, viewing students as capable science learners, and desire to teach in an urban situation.

[14] It is possible that teachers did not take a positive view of students' capabilities away from those experiences. However, the experiences offer potential for learning. The second piece of data – discussions of students – confirms what teachers learned.

Mary Andrews[15] - *"Lost at sea"*[16]

Mary Andrews is a single, white female in her mid 20s who grew up on the East Coast and attended a private, competitive university where she completed an undergraduate degree with a dual major in economics and sociology. Mary originally intended to pursue a career in investment banking. However, during her senior year, as she began to apply for jobs, Mary "woke up one day and realized [she] would be miserable" as a banker (I1).[17] Mary described herself as someone who "cannot be happy as a person unless [she] is helping people." For Mary, investment banking was not going to do that.

Mary began a job search, trying to find something that involved working with people:

> So, I was looking at the Peace Corps... and then Teach for America came up... I have always been so involved with everything with kids... I was like, "Boy, this sounds pretty good." The application is due in a week... I fill it out and...in January they sent me a letter...that they have accepted me to be a teacher in the [Bayline] area...It was amazing how fast things happened. So, I graduated and went to the Bronx with Teach for America where they train you for six weeks...this massive...intense training.

During her training, Mary taught summer school to young students in the morning and took courses in the evening on the basics of teaching. Mary explained the coursework: "It's a curriculum [TFA] developed of what they think people ought to know in order to teach...many things [including] literacy and lots on classroom management."

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[15] All names used are pseudonyms.

[16] I borrowed this phrase from the title of an article authored by (Kauffman, Johnson, Kardos, Liu, & Peske, 2002)

[17] All quotations in the teacher descriptions come from their initial interview – I1 - unless otherwise noted.

In the Fall of 2002 (the year prior to the study), Mary and a cohort of 150 teachers came to the Bayline area to take positions in hard-to-staff schools in urban, high poverty districts. Thirty TFA participants, including Mary, received teaching assignments in BSD. Since TFA participants do not have teaching credentials, BSD hired them through the district intern program, a program that helps teachers obtain their credential within two years of employment.

Mary expected to be teaching lower elementary students; initially BSD assigned her a position in second grade. However, in October, she lost that position when the district redistributed students and teachers to better equalize class sizes and minimize teaching positions, a process called "consolidation." Due to collective bargaining agreements, a teacher displaced from her classroom during consolidation has the right to take the position of a less senior teacher like Mary.

Mary found the next month was nothing like what she expected when she came to Bayline:

> So, I kind of literally hung out for three weeks. [The district] would...send me to different schools and I would play secretary...I [thought], "This is ridiculous"...I'm about to quit. Then, I got this job...teaching fifth grade. [A teacher quit] because it was such a crazy class. So, last year was like basically behavior management, a struggle all year. I mean...it was a nightmare.

Mary felt like a sinking ship: "I found myself drowning last year; literally, calling the district people: "I'm going to quit, I'm so out of my league." Calling Teach for America, she told them, "I'm going to quit;" they gave no assistance.

As Mary put it, she "survived" the year, only to face another curve ball from the district:

> At the end of last year every Teach for America teacher, along with a hundred other teachers in BSD, got laid off...pink slipped... So, I [thought], "Well, I think

> I'll go to Spain for the summer because I'm not going to sit around here and wait for what I know is not going to happen. I know it's not going to be until right before school if I get rehired, if I do." I came back from Spain and, of course, [the district] told me nothing. I thought, "OK...once the first day of school starts, I'm really going to look for another job."

At the last minute, a friend and TFA colleague spared Mary from looking for other employment. A former assistant principal, now principal, at Meriwether Lewis Middle School, called, desperately looking for a science teacher to fill two vacant math/science positions, and the friend referred Mary. Laughing rather sarcastically, Mary noted her friend's recommendation was not based on "any qualifications [to teach middle school math and science]," rather, "because she is my friend and she knew me."

The principal contacted Mary the Thursday before school started to set up an interview. Mary "got a great feeling from the school." Consequently, when the principal offered Mary a position teaching two sixth-grade math/science core classes and one eighth-grade physical science class, she accepted. With her economics background, Mary thought she could handle the mathematics; math had always come easily to her. However, she had real misgivings about teaching science.

Mary rated her subject matter knowledge "poor" (SQ), she took only one science class – ecology – as an undergraduate. Like many other new teachers, Mary felt she would have to "learn the science at the same time [she was] trying to teach it," a task she anticipated would be much more difficult for eighth grade physical science than for sixth grade earth science. As Mary put it, physical science was "harder and more abstract." Despite her lack of confidence, Mary selected the 8th grade science class as her focus class for the study because she thought it was important that a research study of new teachers include "what really happens to [new teachers]."

Mary had other concerns, as well. She gave her TFA teacher preparation low marks; indicating she was poorly prepared to plan instruction, not at all prepared to understand her students' social, emotional, physical, and cognitive development, and not at all prepared to motivate students to learn (SQ). Mary also felt her credential program, to date, had not prepared her for teaching middle school or science. Her elementary credential courses emphasized young children and multiple subjects – poor preparation for teaching physical science to young adolescents.

Although Mary found her first year of teaching very stressful and knew her assignment for Fall 2003 would be difficult, she intended to "do the best job she could under the circumstances." Mary's intention was to teach for another year or two, and then use that experience as data for future graduate work in educational policy. She was particularly interested in educational interventions sponsored by corporate and other business leaders (e.g., charter schools) and in teacher recruitment programs like TFA.

Mary's first year had stretched her to the limit. The second did not look much better:

> It's just been too much. You know, I've always been the kind of person who is always doing more than everyone around me. In college...my friends always said, "I don't know how you do all that." I've always felt I can do it...but, I can't do all this...I'm at a point where it's just too much. (I8)

Mary summed her experience up succinctly, sighing, "You know, it's just such a bad situation" (I1). She felt no more prepared to take on the eighth grade class than she had been to teach her fifth graders the year before; once again, she was lost at sea.

As I show in Table 3.1, Mary's personal resources were insufficient for the demands of science-for-all. She could only hope that her intellect and stamina would get her through the year. Given her limited content knowledge, inexperience with science,

and her negative first impressions of BSD students, it was unlikely she would take on ambitious goals without substantial support. Even then, her limited knowledge and skills, coupled with temporary commitments to teaching, might prevent her from making productive use of that support.

Rita Magano – An Accidental Tourist

Rita Magano is a married, white female in her late 20s. Rita grew up in a university town near Bayline, moving back there after completing a degree with a double major in marine biology and neuroscience at a large competitive public university in southern California. Like Mary, Rita shifted her career plans during her senior year:

> I was going to be a marine biologist and that is what I was going to do. And then...I got really involved in teaching scuba...I realized...in the process that I did not like research that much...I really got much more excited about teaching people how to scuba dive and about the physics behind scuba diving than I did about...researching what I was working on. So, I decided to change my focus and went back to [the university in my hometown] to get my Masters in Education. (I1)

After completing her master's program, Rita and her then-boyfriend (now husband), also a teacher, decided to attend a "teacher fair" sponsored by BSD. Rita laughed as she recounted the story: "So we made our resumes that night and then brought them to the teacher fair the next day and got hired. And we said, OK, I guess we'll go teach in Bayline School District." They took advantage of a district program subsidizing the purchase price of a home for teachers and moved to Bayline in Fall 2002.

During her first year, Rita taught eighth grade physical science and reading at Medgar Evers Middle School. That first year "went okay," although she would have preferred to teach life science. Rita felt the year went as well as it did because of her teacher preparation: "I didn't get in here and flounder. I knew what some good strategies

were for management, although I'm still learning...I knew how to put together a lesson plan...So, I didn't feel like I was just thrown in there."

Even though Rita did not feel set adrift (as Mary did), she wished for more experience planning lessons. Rita felt her student teaching assignment did not prepare her for sufficiently for that task. Instead, like many student teachers, Rita modeled her own class closely after her supervising teacher's lessons. Rita would have preferred to have more control; she thought that would have given her more experience planning units, as well as individual lessons.

However, Rita felt the program, which specialized in preparing science and mathematics teachers, helped her in other ways. It was there Rita learned about inquiry-based teaching, the teaching method her science methods course emphasized (I1). Rita also felt her experiences supported teaching diverse learners: "I knew that people learn differently and to have a range of different activities so that children could learn what they needed." Her program also required a literacy course; something she felt was important to help the many English Language Learners she taught (I1).

After completing her first year in eighth grade, Rita was relieved to find out her teaching assignment for Fall 2003 would be seventh grade life science—her "passion." She felt reasonably well prepared to teach life science—she "just needed to review a bit to make sure [she] wasn't teaching anything wrong" (I3). The only topic Rita was concerned about was light – something usually associated with physical science – that was now part of the seventh grade curriculum, and a topic that she was "super not comfortable" teaching (I4).

Even though Rita looked forward to teaching life science, she was uncertain about her future as a teacher. On one hand, she enjoyed middle-school aged children because they gave her the opportunity to "have fun and be goofy." On the other hand, she found them "all hormone-ed up" and like "popcorn kernels; popping up all over the place." Comparing notes with her husband, a high school mathematics teacher, Rita suspected older students might be a little easier to handle.

Rita also was concerned about a heightened air of accountability in her school, now under state sanctions for poor test scores. The rumblings among her colleagues, especially her first-year support provider, a special education teacher she deeply admired, made her nervous. The tension was palpable; faculty and administrators were uncertain about what the sanctions would require. Rita decided to take a wait-and-see attitude. In her words, she was "considering her options" – they included teaching in another middle school in the district, teaching at the high school level, leaving the district, or leaving teaching altogether. Rita came to teaching as an accidental tourist; intrigued by the possibilities, still uncertain she had found her place.

In summary, Rita had personal resources in three key areas (see Table 3.1): strong subject matter knowledge, teacher preparation that emphasized inquiry, and experience with urban students, both as a student teacher and during her first year at Evers. It was difficult to tell from Rita's comments about her middle-schoolers how she assessed their academic capabilities. Regardless, Rita was uncertain if she wanted to continue teaching. Equally uncertain was how her own waning interest and/or the impending school sanctions would influence whether, and how, she used her other personal resources.

Table 3.1
Summary of Personal Resources

Teacher	Focus class	Teaching experience (yrs)	Credential	Subject matter knowledge			Knowledge of scientific practices	
				Science major	In field[a]	Confidence[b]	Scientific research experience	Inquiry in science methods[c]
Mary	8th/ Physical science	1	Intern/ Elementary	No	No	Low	No	No
Rita	7th/Life science	1	Preliminary/ Biology	Yes	Yes	High	No	Yes
Joseph	7-8/General science	2	Intern/ Biology & Special Education	Yes	Yes	High	No	Yes
Olivia	10th/Biology	0	Out of State/ Biology	Yes	Yes	Medium	No	?[d]
Felicia	10th/Biology	0	Preliminary/ Biology	Yes	Yes	High	No	Yes
Steven	10th/Biology	0	Out of State/ Biology	Yes	Yes	Medium	Yes	Yes
Mark	12th/ Physics	1	Intern/ Physics	Yes	Yes	High	No	No

[a]Yes" indicates the teaching credential is appropriate for the focal class.
[b] Confidence rates teachers' subject matter knowledge (low, medium, or high) based on survey responses and interview questions.
[c] "Yes" indicates the teachers' science methods course emphasized inquiry-based teaching.
[d] Olivia did not mention inquiry as part of her post BA program; web-based materials also did not supply information about methods courses.

Table 3.1(cont'd)

Teacher	Focus class	Teaching experience (yrs)	Credential	Students as capable learners		Commitments to:	
				Educational or other experiences[e]	Academically capable[f]	Teaching	Urban situation
Mary	8th/ Physical science	1	Intern/ Elementary	Yes	No	Low	Low
Rita	7th/Life science	1	Preliminary/ Biology	Yes	?	Medium	Medium
Joseph	7-8/General science	2	Intern/ Biology & Special Education	Yes	No	High	Medium
Olivia	10th/Biology	0	Out of State/ Biology	Yes	No	Medium	Medium
Felicia	10th/Biology	0	Preliminary/ Biology	Yes	Yes	High	High
Steven	10th/Biology	0	Out of State/ Biology	Yes	No	Medium	Low
Mark	12th/ Physics	1	Intern/ Physics	No	Yes	High	High

Note. "?" indicates insufficient data to make a determination.

[e] "Yes" indicates the teacher had previous non-teaching and/or teaching experience with diverse, urban communities.

[f] "Yes" indicates the teacher had positive views of students' academic potential.

Joseph Strobinski – Blue Collar Meets Hip-Hop

In Fall 2003, Joseph Strobinski began his third year of teaching science and mathematics "core" to special education students at Adams Middle School. Joseph's focus class combined seventh and eighth grade students; the curriculum included topics from earth, life, and physical science.

Joseph, a single white male in his late twenties, moved to the Bayline area five years earlier, shortly after he completed his undergraduate degree in biology at a state university a few hours from his hometown, an industrial city in the East that was "mostly blue collar." When he entered college, Joseph "absolutely did not want to be a teacher whatsoever." Both of his parents were public school teachers, he had seen them "plan and work so hard and complain about kids;" Joseph "wanted no part of [teaching]."

Joseph originally majored in engineering but found it "much too dry," and so he switched his major to biology because he "fell in love with biology" and hoped to go on to medical school. However, his grade point average ("about a 3.0") was below the requirement for U. S. medical schools. After graduation, Joseph returned to his hometown, waiting tables at night for a year. He decided to move to Bayline, even though he did not know anyone or have a job lined up:

> I didn't know anyone but came to one of the most expensive cities in the world. I waited tables here at fancy, expensive restaurants. I was lucky. I never had to wait tables at Denny's or anywhere like that...I fudged my experience enough to say, "Oh yeah, I've done this before." You pick it up fast on the job. The same way the kids learn the hidden rules of the middle class, I learned the hidden rules of the upper class, which I never knew. I never knew which side you had to serve from or clear from or which order the wine glasses go in from white to red... but now I do. Have you ever seen the one where the waiter pulls down the dessert forks? [He demonstrates]. I'm good at that, too.

Although Joseph found work as an evening waiter, expenses meant he also had to find a day job. Substitute teaching was his solution.

Joseph began substituting because, as he put it, he "could control his own schedule." He established what he called "good rapport" with teachers in Bayline; several regularly called him as their preferred substitute. Joseph continued to substitute teach and wait tables for two years until, he "finally got so tired of waiting tables and hated it so very much" he quit. However, he enjoyed substitute teaching and decided to do that full time while continuing to teach evening computer courses –HTML, Photoshop, and Flash – to adults at Bayline State University (a third job he picked up when waiting tables). In the Fall of 2001 (two years prior to the study), Joseph substituted in two special education math/science classes at Adams Middle School; a teacher quit three weeks into the school year, and Joseph, who picked up the classes as a substitute thought: "These kids are fine. There's nothing wrong with these kids." After the first week, the principal offered him the job: "Sure, why not?" he thought. Joseph has been at Adams ever since.

Since Joseph was not a certified teacher, the state granted him a temporary "emergency" permit during his first year. In order to satisfy requirements for teacher qualifications, BSD re-hired Joseph in Fall 2002 through the district's intern program; he began coursework for a single subject life science (secondary) and a special education credential at Bayline State University.

Joseph felt the credential program coursework, combined with his biology degree, prepared him well to teach "every aspect of science;" something he was expected to do (I5). Unlike single grade level teachers, teaching multiple grades meant Joseph taught some earth, life, and physical science. Since Fall 2002, Joseph has completed courses in

geology, astronomy, and meteorology, as required for his credential. He felt taking these courses so recently gave him an advantage—the knowledge was "fresh in his mind."

In addition to learning content, Joseph felt his credential program helped him learn how to plan instruction; he was particularly impressed with the science methods course he took in Spring 2003:

> [The science methods instructor] was the most incredible teacher...The first day, I'm like, "Oh my God I'm so scared of this lady." You know, she's up there...she didn't crack a smile until the third class... She made us do so much work, the most ridiculously lengthy lesson plans...everything had to be timed out - two minutes, watch kids sit down, 5 minutes pass out papers, 3 minutes, ask kids prompt or something on the board....We had to script it all out and match it up with the standards and line up all the assessment outcomes with our student learning outcomes....It was like, over the top. I would never do that detailed of a plan ever....I would spend my whole life writing lesson plans...five, six pages for one day....But...I am very much able to take what she taught us how to do and pare it down into something I could use. When I'm being evaluated by my assistant principal, I can make the most beautiful lesson plan in BSD because of what she taught me.

Joseph appreciated something else he learned in the course as well – it was his first introduction to inquiry-based science teaching:

> [The science methods instructor] was all....about inquiry. That was all she advocated. She made us buy the inquiry- based book, NSES, all of our lesson plans had to be inquiry-based. So that's where it was drilled into our head.... We would have to...redo...this giant long plan if it wasn't inquiry-based. So you made sure it was...the first time...It was great, you know, because it got me thinking, "Well, yeah, I guess if a kid creates his own universe it's going to be a lot better than me telling them what the universe is like" . . . Everything she said made a lot of sense.

Like his methods instructor, Joseph was now an advocate of inquiry-based science; he wanted to provide more of these opportunities for his students than he had in the past. He especially wanted his students to formulate hypotheses, to predict what was going to happen prior to an investigation. Joseph summed up his views, saying, "It's science...You can't just talk about it, you have to do it."

Joseph's only objection to the credential program was the student teaching requirement. The Bayline State program administrator refused to let Joseph's special education class count for both his secondary science and his special education credential. After much haggling, they reached a compromise; Joseph gave up a planning period to student teach in an eighth grade classroom at Adams. That meant he would complete his secondary science credential at the end of the school year, the special education certificate a year after that.

One of Joseph's greatest strengths was his connection with his students; he genuinely enjoyed spending time with them:

> You can talk to a lot of other teachers who don't like their job or are burned out...I genuinely love my job. I love these kids....They know I love them.... It's really amazing. That's why I love going to work every week.

Joseph was not simply committed to students, he also made it his business to know them. He pointed with pride to the homes he had visited, the individual male students he mentored, and the families he knew. Joseph felt he had "street knowledge" – he understood (and enjoyed) his students' language, interests, and music:

> I got up with the security guard last year at the Faculty Follies, the teachers' talent show, and did freestyle hip hop. They put our beats on and I was rapping about how good it is to be in school and read books and other stuff....Kids were like (opens his mouth wide to show astonishment). Mr. S can rap? Mr. S?!? I didn't know!

Joseph also sponsored several clubs after school – students particularly enjoyed his hip hop and animation clubs. Joseph used his knowledge of technology for the animation club. He bought old computers and repaired them for use in his classroom. Using his experience teaching adults how to build websites and how to use digital imaging and

animation software, Joseph offered these opportunities to his middle schools students as well

Joseph believed that the interest he showed in his students' lives had benefits for their behavior and motivation:

> I just went to a kid's birthday party last weekend. You know, there's only a couple of kids that ever invited me to something like that so I had to go...Got him a little gift...this was a really, really misbehaving kid, the worse I've ever had. But I figure...the closer I get to this kid and the closer in his life I am... the more he's going to respond and work for me and the less impulsive he's going to be in the class.

Joseph noted that his male students needed positive role models; many had estranged relationships with their fathers. Joseph hoped his care and concern would help fill that void.

Yet, even though Joseph insisted he loved the students he taught and felt very committed to them, once he earned his science credential he was not sure if he would continue to teach special education or middle school students. Joseph wanted to stay in the district but was drawn to teaching biology (his "passion") in high school. As the 2003 school year began, Joseph said he was "in a quandary" about what to do about his present teaching situation. He described himself as being "at a crossroads;" his dilemma involved working with kids who needed him or teaching more academically motivated students:

> I love teaching, I want to keep doing it, no matter what... I love these kids. Do I want to deal with kids that...chances are might not have another me come into their lives? But, at the same time, I want to teach [in high school], where I could convey my love of science to students that want to learn.

Joseph was not sure what he would decide about his future at Adams Middle School. He spoke about opening his own school "ten years from now for this population of kids I'm dealing with." He imagined a school where poor students and students of color would

have access to top line technology. For the present, though, the promise of academically proficient students and the chance to teach biology tempted him and Joseph had his eye on a couple of biology positions he heard might be opening up at two of, what he called, the district's "more academic" high schools;.

Joseph had considerable personal resources to draw from (see Table 3.1 two years of experience, solid subject matter preparation, a fascination with inquiry-based teaching, and obvious affection for his special education students. Yet, Joseph intended to teach mainstream students as soon as he earned his credential; suggesting he had reservations about his special education students' academic capabilities or motivation. It was possible those reservations might temper his curricular expectations; falling short of ambitious intellectual outcomes for all students.

Olivia Langston – Bridget Jones' Diary (of Teaching)

Olivia Langston taught two biology classes to tenth graders and three general science courses to ninth graders at Baycrest High School. One biology class was designated "ELL" (English Language Learners); the other was "Regular." Olivia chose the regular biology as her focus class for this study.

Olivia, a single white female in her late twenties, graduated in 2000 with a degree in health education from a small, private college in the large, Midwestern city where she grew up. Olivia began her undergraduate program in nursing but soon decided it was not for her; she sensed a trend towards more paperwork and less patient care. Olivia started to consider other careers:

> I had a lot of people tell me that you should be a teacher, which seemed odd to me because I hadn't thought about it... I really considered it and I thought, "You know, I could be teacher." When I took some education courses and actually had some interactions with students in the classroom, it felt very natural.

In spring 2001, Olivia completed her undergraduate program with a credential in K-12 health education. To her surprise, she could not find a job and, eventually, ended up back in school for another credential:

> The schools had been over budget for many years...so many jobs were cut...I just had health education...I didn't realize that I should have picked something else in addition to that or maybe something else that would have been more marketable. So, I subbed for about a year and a half and, after [still] not getting a job, I decided I need to pick something else...I liked science and I had taken a lot of science...I decided that would fit the best.

Olivia also wanted a master's degree, so she enrolled in a nearby private university that offered a program where she could earn a teaching credential in biology and a Master's degree. The program included science courses (including astronomy, geology, environmental science, general biology, cell biology, and organic chemistry - a course she described as "awful") as well as education coursework. Despite her coursework, Olivia was not very confident about her subject matter knowledge (SQ). She found her biology program emphasized some topics and not others. For instance, Olivia felt she knew cellular biology, anatomy, and physiology well; she was less certain about biochemical processes (e.g., photosynthesis, respiration) (I4).

Master's degree and biology credential in hand, Olivia went back on the job market. However, she was still unable to find a teaching position in her hometown area, for teaching jobs were a hot commodity. In Spring 2003, Olivia decided to apply for teaching positions in BSD; she laughed when she gave her primary reason for choosing Bayline:

> A friend of mine from [college] moved [to Bayline] a year and a half ago...He's an adaptive physical education teacher, special ed...he could probably get a job anywhere.... He really liked it and I thought, "You know, I'm just graduating and

> I might as well try something new for a year, see how I like it, and have a little adventure."

In the Summer of 2003, she moved to Bayline; a month later, she began her first full-time teaching position. Unexpectedly, her first adventure was with the BSD human resources department.

Olivia initially applied to Bayline through the centralized on-line application process. She received a few rejection letters and never received any calls for interviews. As the school year approached, Olivia decided to take matters into her own hands and began calling schools, including Baycrest High:

> I just kept calling the school and one day I asked to talk to [the principal] and she was the one who happened to answer the phone although I didn't know who she was. I explained myself and said I really wanted to come in for an interview. [The principal] said, "OK, come in on Monday."

Olivia's interview with the department chair, who hired her, took place on Monday a week before the start of school. Then she had to persuade the district's human resources department that she had been hired, something that took the better part of two days. The whole experience was nightmarish, and "left a terrible taste in [her] mouth" for the way the district functioned. Olivia began to wonder whether moving to Bayline had been a mistake, a self-described "Midwestern girl," she already missed family and friends back home (I1).

Olivia had other misgivings, as well. She did not feel well prepared to work with urban students. She was concerned about motivational issues, poor reading skills, and weak family support - problems she associated with inner city schools (I1). Olivia preferred the kind of community where she did her student teaching:

> [The school] wasn't really suburban but it wasn't urban....It was more blue collar, so my students were all pretty good and the parents were really supportive and

> involved...It was really refreshing. If I could work at a school like that I would take it in a second. I mean it wasn't like I want to work in a whole suburban, Abercrombie thing...but the inner city sometimes feels like a little much. So, if I could find a balance that would probably suit me the best.

Although Olivia did not feel well prepared to motivate reluctant students (SQ), she felt she was the kind of "good teacher the city really needs...I know that I care and not all teachers do. So I have that."

Despite her misgivings and the hassles with human resources, Olivia was happy she finally had a full-time teaching position. However, she was not sure how long her adventure in Bayline would last. Yet, she did not regret giving Bayline schools a try: "[Laughing] Bloom where you are planted...That's what I think."

Olivia's personal resources were modest. Her preparation to teach biology was adequate for some topics but not for others. She did not have teacher preparation that emphasized inquiry-science teaching or urban learners. Her encounters with urban settings as a substitute teacher convinced her she would find significant problems there, including unmotivated learners with limited academic ability. Olivia hoped caring for her students would see them (and her) through. Given those moderate resources, it seemed unlikely Olivia would take on the risks of ambitious teaching; moving to Bayline might be enough adventure for this Midwestern girl.

Felicia Baker – An Intentional Chooser

Felicia Baker, a married white female in her late twenties, taught three biology classes, one chemistry course, and one advisory class at Fernandez High School. Felicia grew up in the East and attended a small, very selective, private university there, where she majored in neuroscience and behavior and Spanish language and literature. Attending a magnet school, Felicia was a strong high school science student. Her undergraduate

coursework included the same courses pre-medical students took: physics, chemistry, and specialized life science classes. Felicia pointed to her subject matter knowledge as one of her strongest assets for teaching; she felt well prepared to teach the content high school biology included (I4; SQ).

Prior to leaving college, Felicia acknowledged she "had always considered teaching but hadn't considered it seriously." Felicia began what she thought would become a career in public health education because she was interested in health and medicine (I1). Working for about two years in the East while providing health education services primarily to Latina women, Felicia eventually began to get itchy for change and, in Summer 2001, took a position in a genetics information start-up company in the Bayline area.

Felicia quickly grew tired of that position. A chance encounter with a college friend gave her the impetus to leave that job and become a substitute teacher:

> I was starting to more seriously consider teaching as I was becoming a little more disillusioned with health care...I happened to run into someone I had gone to college with who was the principal of a new small school...They were looking for a long term substitute teacher, what they call a STIP sub. So, three days later I actually started as a STIP sub there. That was October [of 2001]...As it turned out, a biotechnology and physiology teacher went on maternity leave that March. So, I took over her class for the rest of the school year. It gave me a better sense of what it was like to really teach...Over the course of that spring, I decided that I wanted to go back and get my credential full time and become a teacher.

Felicia wanted to teach, but not just in any school. The vision of the school – Catalyst High School - where she subbed also caught her attention.

Catalyst High specialized in the health sciences. The school, located in an urban area similar to Bayline, served students who were unsuccessful in larger high schools in the district; most were Latino or African-American; many were English language

learners. The rigorous science curriculum impressed Felicia, as did the school's mission to support urban students' success in science. She began investigating teacher credential programs; one at a small, private university nearby seemed a perfect fit. The one-year program specifically prepared math and science teachers for urban settings.

That summer, Felicia also began a new teacher program offered through the Exploratorium, an interactive science museum in the Bayline area. She attended a 4-week institute focused on what Felicia called "hands on" and "inquiry-based" ways of teaching biology. However, Felicia had to suspend further participation in the program for a year, until she had a teaching position. Since the credential program she selected was full-time she would have to complete that first – in Fall 2002, Felicia began her post-BA work.

Felicia described her credential program as "high quality...with a strong philosophy of social justice and inquiry based learning." Felicia found the teacher preparation coursework, which included seminars on curriculum and instruction specifically for science teachers, "helpful as a foundation" for teaching. Felicia described an assignment -- a study of an African-American high school student -- as particularly eye opening; she conducted an interview, visited the family, and followed the student through an entire school day from one class to the next. Felicia claimed the experience helped her see what school was like from the student's perspective, how confusing, frustrating, and difficult it could be.

When Felicia completed the program, she had earned a preliminary single subject credential in biology with a supplemental credential in Spanish. Felicia was committed to teaching science in an urban public school in the Bayline area. However, between completing her credential program and planning for her wedding, Felicia had little time to

apply for positions before leaving on an extended trip—her honeymoon—for the summer. Before she left, Felicia learned about the open biology position at Baycrest High School (the opening Olivia later filled) when Baycrest's math department chair, an alumnus of her credential program, posted a notice to the program's listserv. Felicia interviewed for the position with the science department chair and two other science teachers in late spring and felt "the job was hers if she wanted it" but had "mixed feelings" about the school. Three things "sent up red flags" for her: the dress code for teachers, comments about the principal, and the workload for new teachers.

Felicia felt the department chair spent too much time during the interview explaining the dress code that required female teachers to wear pantyhose when they wore skirts. Although Felicia believed in the importance of looking professional for students, she found explicit administrative directives about dress "patronizing." Felicia worried that the dress code signaled misplaced school priorities. As she put it, "If [the dress code was] a focus of the school or the department, it's probably not going to jive with my values as far as what's important to me for teaching." Felicia suspected she might also have trouble with the principal's administrative stance (which the department chair described as "top down"), for she wanted to teach in an environment where administrators treated faculty as professionals and welcomed their input. However, according to the science department chair, the principal at Baycrest "made decisions about things and told the rest of the staff that this is the way it was going to be and people were just expected to fall in line and implement it." Finally, Felicia worried that the expectation to teach five or six classes and take on at least one extracurricular activity would be too heavy a workload for her to manage as a new teacher.

After her Baycrest interview, Felicia completed the paperwork for Bayline's centralized online application process through the human resources office. She received no offers and left for the summer without having secured a teaching position. When she returned, Felicia took matters into her own hands:

> I got back from [my honeymoon] in early August. I knew school was going to be starting around the last weekend of August. I knew I had a narrow window of opportunity...So, I took out the phone book and I literally called every middle school and high school in Bayline...When I [called Fernandez], I happened to get the assistant principal on the phone and they happened to be desperately looking for a science teacher...She said, "As soon as you can get me your resume, we'll get started looking at your application."...So, the next morning, I marched my resume down to them...I was interviewed within a day. (I6)

Felicia's perception of Fernandez was much more positive than her reaction to the Baycrest interview:

> [Fernandez] just felt more like it fit for me. I liked the way the school and the department handled themselves...There was an interview panel...they had a [number] of faculty present I would be working with...and, then, there were three students, who were also asked to be there...That just seemed like such a good thing...It felt like [it communicated] "this is a process we're taking seriously"...I appreciated that. (I6)

During the interview, Felicia also taught a brief demonstration lesson, presented her teaching portfolio, and answered the panel's questions. Within the week, Felicia accepted the position.

Looking back, Felicia was convinced that if she had not made the phone calls herself, she would not have been hired: "I don't think the district would have helped me find a position. I would have just been lost in the paperwork" (I6). Although the school hired Felicia two weeks before the start of the school year, like Olivia, she spent a week getting through the official process with human resources; an experience Felicia also

found both frustrating and a waste of valuable time. Once she was officially hired, Felicia had less than one week to prepare for the first day of school.

Despite the hiring snafus, Felicia did not express any reservations about continuing in teaching or in her present position. She did, however, admit to feeling very much the novice at teaching. Confident of her subject matter mastery, Felicia pointed out that knowing something herself was very different from knowing how to teach someone else about it. Still, she felt her undergraduate and credential programs had prepared her well. Now, experience would be her teacher; helping her hone her knowledge and skills.

Felicia had a very strong set of personal resources (see Table 3.1). She had solid subject matter and teacher preparation; the latter in a program specifically designed to support science-for-all reforms. Felicia had experience working with urban communities, with Latinas in health education and student teaching diverse learners. She also had a supplemental authorization in Spanish, useful for communicating with the substantial Latino population in Bayline. Perhaps most importantly, Felicia intentionally chose, and intended to remain, in an urban setting. Despite this substantial set of personal qualities, she understandably had beginners' nerves. How would her sensitivity as a novice influence whether, and how, she mobilized her personal resources for ambitious academic ends? Time would tell.

Steven Anderson – Expert Eyes That Blind

Steven Anderson, a single white male in his late twenties, also taught biology at Fernandez High School. The principal assigned Steven four biology classes and one advisory course. From the outset of his undergraduate education in a private, selective, Midwestern university in his home state, Steven was not certain what he wanted to do

after completing his biology degree. During his senior year, he began working on a global warming research project that led to summer work in Alaska as a research assistant. Steven worked on the project for four years; in between his research responsibilities, he took several jobs as a substitute teacher. Steven found his substitute teaching positions through his older brother, a high school teacher in the rural area where Steven grew up. Eventually, Steven decided to apply to the Master's program in teaching at his undergraduate institution as he put it, "by default" (I1).

Steven explained that he hesitated to pursue teaching because he did not want to follow in his older brother's footsteps: "There are quite a few teachers in my family...and my brother actually did it right out of college. He's four years older than I am and, if anything, I think maybe the fact that my brother did it kept me from doing it [sooner]." Steven also felt if he ever needed a job that he could turn to teaching in the future: "I think I always knew I could go back to teaching, that it was a pretty easy profession to go back to and get the further degree." Steven admitted he did not think about teaching as a career, just something that fit him well for the moment:

> Teaching was never like a given for me. I never assumed and I don't now that I will get a pension from it. [Teaching] wasn't a career move for me as much as it was a natural fit for all the things I enjoy doing...I like the variety of teaching...variety of a given day, variety of a given year, and the opportunity to share knowledge.

Once Steven decided to pursue his credential, he took what he considered was the most expedient route, a Master's program he could complete quickly:

> I think the one thing that put [the program] over the top was that it was a one year program. Even though it was really extensive, it was a short time commitment...I knew that I could get work right away and would have a Master's in Education and not just in teaching...So, I knew that would open up a lot...of avenues for me if I chose not to teach.

Steven characterized the master's program he began in Fall 2002 as "very social justice oriented." The program emphasized preparing teachers to teach students in high poverty, urban areas. Steven described the coursework: "Some of it was theory...We had an ed psych class. We had a literacy class. We had a pretty intensive technology class - integrating technology into teaching...We had a pretty good emphasis in...social justice issues."

Steven spoke very favorably about his science methods course, especially the instructor: "We took one course in science methods...[The instructor] was an excellent, excellent individual...He was a good methods teacher. Wonderful... job, very much along the lines of student led investigation and [problem based learning] type formats" (I3). Steven's only disappointment with the coursework was due to scheduling conflicts; he was unable to take additional science content courses. He took a history course instead because he felt he was very weak in history and a GIS mapping course he called "just kind of a joke."

In addition to coursework, the program included a semester-long student teaching experience that Steven held in high regard. He taught two high school biology classes and one ecology class in a suburb that was part of a larger urban area:

> [The students] were, for the most part, low to middle class working families predominantly....There was a fair share of outside troubles and influences there... probably 80% white...African-American made up most of the other....Overall, I felt like I connected with them all right. My supervising teacher was really supportive. We had a very similar teaching style....I'm much more of a lecturer. That's my default...if I was to explain something to somebody I would explain things verbally.

Although the master's program advocated what Steven called a more "hands-on" approach for students, he admitted he was not particularly interested in learning to teach that way.

While Steven worked towards his graduate degree, he also began to consider where he wanted to look for a teaching position:

> I wanted some place liberal-minded, to find a place that was not huge, relatively cosmopolitan, very close to all of the things I like to do...outdoor activities, mountain biking, windsurfing...a little better weather, and just something that was different...I wanted to spread out a lot more. (I7)

Steven focused his attention on Bayline, a location that fit all of his criteria.

In Spring 2003, Steven made a last minute trip to Bayline to look for a teaching position. Although he had applied through the district centralized on-line application system, Steven claimed he never got any feedback from human resources; branding the system "an absolute debacle" (I7). Frustrated by the lack of response from human resources, he—like Olivia and Felicia—decided to take matters into his own hands and visit schools himself. Unfortunately, Bayline was on spring break when he visited and "very few people around...[for] direct conversations or interviews." By chance, he walked into an open door at Fernandez High and introduced himself to the sole person in the building—the principal. That meeting led to what Steven called "an unofficial interview" with a panel that included several teachers who were his potential team members.

The panel made it clear he was "the best candidate for the job" and recommended Steven to human resources where he once again encountered "a huge runaround." He made another trip to Bayline to try to finalize things; he also interviewed for a position at an elite private high school in a wealthy community in the Bayline area. They offered

Steven the job but, after finalizing his position at Fernandez, Steven returned several days later in person to turn down their offer:

> You should have seen the look on her face when I told her I was turning them down to work at Fernandez. She said, "Is it the money?" I said, "No, it's not the money"...The look on her face was hilarious.

Steven chose the Fernandez position for several reasons. First, the "social justice orientation" of his teacher preparation program had made him aware of the need for qualified teachers in urban areas:

> I thought if I didn't start in urban education I never would. I thought if I started in the suburbs, if I started private, I would never teach urban. I thought it was pretty important to me as a person and as a teacher to do that.

Steven noted that his rural upbringing left him feeling "a little disconnected from that whole [urban] scene; he "wanted to get a real feel for what it was like." Steven preferred living in the city himself; he could not imagine himself in the upscale suburbs surrounding the private school. If he took that job, he would have to commute; something he did not want to do. Finally, Steven pointed to what he called "the allure" of the Fernandez High itself, an old mission-style building with "gorgeous" tile work. After Steven explained his reasons for choosing Fernandez he paused a moment and said he "didn't want to be talking [himself] up too much here," admitting if the private school had been located in the city, he would have "chosen it in a heartbeat."

As Steven thought about his preparation for his teaching position at Fernandez, he believed that his knowledge of the science content he would teach was "strong enough for the level he was teaching" (I2). Although Steven majored in biology, he "\took the absolute bare minimum of cellular biology classes [needed] to graduate and...maxed out all the ecology" in his undergraduate program. As a result, Steven felt he had very strong

preparation for teaching some biology topics, like ecology, but weaker preparation in other areas like cellular biology or genetics. In terms of the practice of science, Steven regarded his experience as a research assistant as an asset that gave him a realistic perspective on the work scientists do.

Steven considered himself "passionate about science," especially ecology and pursued his passions in many ways. He was a devoted reader of *National Geographic*. He advocated for environmental responsibility; especially reducing fossil fuels consumption (he wrote his bicycle to work). And he spent as much time as he could in the mountains, water, and forests surrounding Bayline. And he taught science.

Despite his passion for science, in Fall 2003, Steven's commitment to teaching was, at best, tenuous. Steven was not at all certain teaching was the best way for him to express his intellectual, personal, and political passions. He was concerned about teaching the diverse students who attended Fernandez; noting he had little experience teaching Latina/o students or English language learners. Steven was not sure he would be able to draw on his experiences and interests to connect with students as he had during his student teaching. Steven had expertise in science and scientific research; yet, in his case, that expertise seemed to blind him from seeing his students' developmental and emotional needs – the condition referred to earlier as the "expert blind spot" (Nathan & Petrosino, 2003)

Steven was especially apprehensive about dealing with "language and student-to-student contact" he associated with urban students; behavior he found "overly aggressive." Steven found such behavior disturbing and shocking, admitting his rural upbringing contributed to his discomfort:

> Things are just...more hostile...like the language...is disturbing...That could stem from my personality or where I grew up, it could just be a cultural difference from what I'm used to or it could speak to something much deeper in my inner self, I don't know, but I [am not] all that comfortable.

Even if Steven decided to continue teaching, he was not convinced that his present position was necessarily the right niche in terms of the type and grade level of students, or the subject matter that he would teach. Time would tell, but Steven suspected the writing was already on the wall – his foray into urban education would be short lived (I1).

Steven had limited personal resources for learning to teach science-for-all. His biology content preparation was spotty - strong in ecology, less so in other areas. His strongest asset was his experience with scientific inquiry – doing research in Alaska on global warming—and his positive experience student-teaching during his post-BA teacher preparation. Yet, he did not see those experiences fitting with his preferred teaching style. Steven had no experience working with poor students or students of color and already experienced a cultural mismatch. With one foot already out the door, it appeared unlikely Steven would hold high expectations for himself or his students.

Mark Bonner – Expert Eyes That See

Mark Bonner, a single, white male in his mid-twenties, taught two conceptual physics classes to seniors and three pre-engineering classes to ninth graders at Frederick Douglass High School. Mark began his second year at Douglass in Fall 2003. The prior year, he taught pre-engineering and biotechnology.

Mark's personality is a good match for his bright red hair. He talks very fast, moves quickly, and, within a few minutes of our introduction, demonstrated a wry sense of humor. Mark grew up in the Midwest and went East to do his undergraduate work in

physics at a small, private, selective university. Not surprisingly then, Mark felt well prepared to address the concepts, knowledge, and skills included in his physics curriculum; he had a strong grasp of "physics proper" – theoretical physics – that gave him a good handle on the content included in conceptual physics (I3).

Although Mark majored in physics and took no education courses during his undergraduate program, he always considered teaching a possible career:

> My dad is a college professor...Early on, I admired the profession...I sort of always worked in tutoring - nothing very formal. But, I always imagined myself as a teacher...I was a teaching assistant [TA] [in college]...I was pretty certain around my senior year when I was doing some TA'ing that I was going to teach the next year, high school physics, public school. I was pretty certain of that. So, I looked into some various programs, like Teach for America.

In the process of looking into programs, Mark found out about BSD's intern credential.[18]

In spring of 2002, Mark contacted the director of the program and informed her that he was a physics major and he wanted to teach high school physics. The director assured him that physics was a shortage area. However, when Mark flew out to California for an interview, the district was unable to offer him a position. Although human resources tried to reassure Mark they would hire him "eventually," he found the situation "not too great." Yet, as Mark put it: "For some reason I moved out here anyway;" certainly he could find employment as a substitute teacher in the district. Again, he—like the other teachers – had difficulties with the bureaucracy and the necessary paperwork. Mark laughed as he recounted the situation: "One week in to the school year and [no job]. I started interviewing to... cook at a barbeque place."

Mark was relieved to get a phone call from the intern program director who told him about a teaching position that had opened up at Frederick Douglass. She explained

[18] Mark applied to Teach for America but they did not accept him; he did not know why.

that the teacher assigned to the position did not have the subject matter competency needed to teach the pre-engineering courses. Mark called the interview process at Douglass "laughable" because the questions seemed "very random and technical." At one point, an assistant principal asked him "What is PCR?" Mark knew what it was – polymer chain reaction- but found the question not connected in any way to other questions in the interview. It felt more like a pop quiz of random questions. However, when he received a job offer, Mark accepted it and began teaching two weeks into the school year.

Mark laughed again as he tried to capture his first days of teaching: "I can't describe what it like to walk into a class and have kids laughing at you because...you're the next one. We already went through [the last teacher]." Mark admitted he had some major difficulties with classroom management in the ninth grade. He found his senior biotechnology students, however, much easier to manage. Regardless, Mark enjoyed teaching both courses. He talked enthusiastically about the kinds of projects he assigned the pre-engineering students –building mousetrap cars and spaghetti bridges.

As an intern, Mark enrolled in the credential program for single subject physics at Bayline State University but soon transferred to one offered through Bayline Teachers Center (BTC), a program connected to the university through its Extension Office. Mark selected the BTC program, at the recommendation of another new teacher at Douglass, because of its "flexibility." He made the change to BTC after he enrolled in his first class at Bayline State; they changed the day of the first course he signed up for and the new date conflicted with his homework club. Mark felt the Bayline State program was not open to the responsibilities and demands teachers had to fulfill. He branded the program's

behavior "unacceptable" and "inappropriate" because they placed him in a position where he had to choose between his obligation to his students and the requirements of the program. For Mark, his students took priority every time. Mark also found the nighttime classes at BTC, condensed chunks offered once a week, fit his schedule well. The BTC program seemed more sensitive to working teachers; they tried to make things more convenient.

During his first year of teaching, Mark completed his student teaching requirement (someone observed his teaching several times), a government course (to fulfill the Constitution requirement), and a curriculum and instruction course. Mark found the coursework beneficial; it provided fuel for examining his practice:

> I think it's helpful...A lot of what we did, in the framework of theory, we discussed things. My benefit wasn't in applying... I don't do things just because of what I [am] shown in class. I do it from reflecting on my own teaching. However, a lot of that reflection happens as a result of going to class and hearing what other teachers do. So, I haven't had something where I take it from a course and...say I'm going to do that in my class and boom, I do it. But there are ideas that I develop in some way resulting from the course.

One disappointment Mark had with his BTC courses was insufficient attention to adapting instruction to diverse learners, especially English language learners and special education students (I1). For that, Mark leaned on the district science curriculum specialist.

Although confident in his own knowledge of physics, Mark quickly found out learned that the strength of his content knowledge "[did not] always turn into teaching effectiveness." He had to know more about his students, especially what they needed to learn physics. His biggest challenges included finding ways to modify the curriculum for special education students and to support students with limited math and literacy skills.

During his first year of teaching, the district's science curriculum specialist helped Mark develop some literacy strategies, and Mark wanted to do more of that kind of work, seeing that literacy support as "very salient" for the majority of his students.

Despite the challenges Mark encountered, he felt very fortunate to teach at Douglass, for him, the ideal situation:

> I wanted to teach in a particularly urban setting....It was completely random that I got this school but had I been able to choose any school in the city, I would have absolutely chosen this school...It fit every criterion (counts on fingers), it's an urban school serving primarily disadvantaged kids...It's a science and tech school. We're the only school that teaches pre-engineering. We added biotech last year. There are a lot of resources.

Mark also found the school's historical mission compelling:

> It was set up as a magnet school in response to [Gifted High], the really flagship magnet school in the district. But that one is performance-based to get in...you need test scores, grades. For [Douglass], it was always you had to want to come here. So, you'd have to apply...but the selection was not based on ability...There were [also] incentives to gather people from the local area... the, quote unquote, ghetto of Bayline.

The mission Mark shared in common with Douglass sustained him when he was pink-slipped at the end of his first year; to his relief, the district rehired him just a few weeks before school began.

Despite the perfect fit with Douglass, Mark admitted that he missed the Midwest and would not rule out returning there someday; noting he would want to find a school similar to Douglass. Although Mark entertained the possibility of changing locations (but not the characteristics of his teaching situation), he expected to be teaching physics in an urban high school in the future. The only reason he would ever leave teaching would be to get an advanced degree: "the absolutely only reason I would leave teaching would be to go back and get a Ph.D. in physics." Mark explained that he would get the degree to

bolster his subject matter knowledge and then return to teaching high school physics, describing a chemistry teacher at his school with "serious degrees...an undergrad at Harvard and [a] Ph. D. at Rice" who decided to teach high school rather than college-level chemistry. Mark said he admired and shared her commitment to teaching at the high school level: "[T]hat was her life's work, her life's work was teaching chemistry at this high school. I have no problem [with that]. I think that's excellent." Mark's commitments ran in similar directions.

Mark had a substantial set of personal resources (see Table 3.1) – strong content preparation and experience as a teaching assistant for college-level physics, a year of experience with Douglass students, solid commitments to teaching diverse students physical science. Although, like some of the other teachers, Mark considered relocating, his desire to teach urban students would likely sustain ambitious goals for his present students. However, given his inexperience, it was equally likely he would need support to accomplish those aims.

Summary

Despite hiring procedures that tried their patience, these seven novices persisted and found jobs in BSD. Their students were among those public science education has historically underserved. Each teacher came to the 2003-2004 school year with varied sets of personal resources for learning to teach those students; difficult, demanding work, even for seasoned veterans. Four key personal resources - (1) subject matter knowledge (2) familiarity with scientific practices, (3) perception of students' capabilities, and (4) desire to teach in an urban setting – would help shape what they learned.

The purpose of subsequent chapters (five, six, and seven) is to understand how these personal resources bear on learning to teach science-for-all. Spillane (1999) placed personal resources at the center of teacher learning, arguing that they act as a filter for "noticing opportunities for learning" (p. 169): "[Teachers] process new information and ideas about practice through their existing knowledge, beliefs, and convictions" (p. 169). Spillane referred to the use of personal resources as "sense-making" (p. 169). The novices' personal resources, then, can be thought of as a sense-making system for the information and ideas they encountered – from their students, colleagues, induction programs, professional development experiences, and the like.

If personal resources help teachers notice, and make sense of, learning opportunities, problems seemed imminent. Mary, who desperately needed a better grasp of content, might not be able to acquire it. Her insufficient knowledge might limit what she noticed and learned about subject matter. Steven, who needed help connecting with his students, might not respond favorably to resources trying to help him do so. In short, even if the novices had the same learning opportunities available, they would make use of them to different degrees. As Cohen et al.(2003) propose; they would calibrate what they did using their perceptions of capabilities - their own and their students. Using that logic, then, we can assume Mark is in the best position for learning to teach science-for-all.

Yet, sociocultural theory proposes resources—personal, conventional, social—mutually shape each other. We must also, then, take into account the other resources available to teachers. Novices cannot make use of what they do not have. For example, if Steven does not have exemplars of urban students engaged with learning science, there is little possibility for a change of heart. The explanation for what teachers learn lies within

mutual shaping. Yet, if Spillane and Cohen et al. are correct, it is not a chicken and an egg situation – personal resources come first, noticing, interpreting. However, what there is to notice and interpret matters—significantly. Social and conventional resources provide fodder—opportunities for learning—for personal resources; occasions that may or may not support science-for-all. In chapter 4, we turn to consider the social and conventional resources available to these seven new science teachers through their districts and other professional education venues.

Chapter 4

Social and Conventional Resources: Making the Difficult Seem Possible

> Learning is like mapmaking...to learn is to organize things in the light of their ability for achieving ends. (Bruner, commenting on Edward Tolman's work, 2004, p.18)

During the 2003-2004 school year, the seven early-career science teachers had access to a variety of resources through their districts and other institutions. The purpose of this chapter is to provide general descriptions of the educational institutions (besides their respective schools) in which the new teachers participated (school-level resources will be detailed in subsequent chapters). Educational institutions—a district, a university credential program, a science museum—have cultures, cultures developed over time. As new science teachers made their place within and across these institutions, their participation shaped, and was shaped by, the institutional resources available there. This chapter, along with the previous chapter on personal resources, can be thought of as setting the stage for the teacher development that takes place during the 2003-2004 school year, development examined in chapters 4-6.

The chapter explores two groups of resources – conventional and social – available to study participants. Conventional resources include instructional tools: teacher certification, stipends, planning time, curriculum materials, laboratory facilities, and the like. Social resources include two domains: people and institutional norms. The former takes account of institutional leaders and participants; the latter involves established patterns for working with teachers - goals, program content, and professional development strategies, for instance. Teachers, especially novices, rely on these

resources for instructional purposes; setting goals, planning lessons, designing tasks, and interpreting student work, to name a few (Cohen et al., 2003).

Just as the description of personal resources in chapter 3 introduced the teachers, this chapter presents the educational institutions (other than individual schools) and the conventional and social resources they offered. The chapter divisions also mirror the previous one. The first section describes the data and framework used for the analysis. The second profiles the resources each institution offered, looking first at the district and then outside the district. The concluding section examines how the resources available to teachers potentially supported learning to teach science-for-all.

People, Places, and Things: Characterizing Educational Institutions

I constructed the institutional descriptions from interviews with teacher participants, interviews with program and district personnel (e.g., mentors, science curriculum specialists), observations, and institutional artifacts available on the internet, in print, and/or provided by study participants. The descriptions have three components: the conventional resources ("tools") available, the co-participants, and the institutional norms. The first corresponds to conventional resources; the latter two encompass social resources. By norms, I mean typical ways the institution worked with teachers; for instance, through one-to-one mentoring, classroom assistance, or cohort groups.

The novices had access to an array of initiatives intended to support science reform in urban schools—alternative credential programs, induction support, district professional development, and science associations, to name a few. Many, funded by the National Science Foundation, capitalized on calls for reforming science education. These programs paid attention to inquiry-based teaching and learning, urban learners, and

improved curriculum materials. Program goals included expanding teacher knowledge and skills, making quality science education available to all students, and/or providing hands-on science activities

Although the goals of programs often sounded similar, each offered their own institutional brand of resources; medical schools provided specimens and medical students, a science museum invited teachers inside to explore their interactive displays, district professional development introduced novices to their more experienced counterparts. Incentives differed; stipends, release time, and/or free materials sweetened the pot. Some programs guaranteed science mentors and materials while others, strapped for funds or personnel, could not make those promises.

I used the literature on new teacher support, described in chapter 1 (e.g., (Britton, Paine, Pimm, & Raizen, 2003), to develop the framework for characterizing institutional resources. I also focused on features of professional development widely advocated for science teachers, especially those recommended by *NSES* (National Research Council, 1996) and studies of educational reform (e.g., Gamoran et al., (2003). Based on recommendations for subject-specific induction support (Luft et al., 2003), I paid particular attention to resources for teaching science, rather than those directed towards general instructional concerns (e.g., classroom management). I omitted two recommended resources – reduced teaching loads and common planning time with grade/subject level teachers - from this chapter. Local schools in Bayline controlled those resources;[19] subsequent chapters address school-based resources.

[19] It is important to point out that leaving control of new teachers' schedule to local schools is a district norm with implications for access to resources. As subsequent chapters show, this policy meant uneven teaching loads for new teachers. Felicia and Steven, for example, taught four science courses; Olivia taught five. Some teachers, like Steven, had one preparation; others like Mary and Olivia had two. Time is golden

Based on that literature, I included these conventional resources: whether the program provided a degree or credential, science curriculum materials, classroom supplies, stipends, and/or release time to observe other teachers (see Table 4.2). Social resources, as indicated earlier, included people and norms. For people, the descriptions focused on whether the program included planned interaction with any of the following: new teacher support providers, experienced science teachers, new science teachers, and/or science content experts/specialists (see Table 4.3).

For norms, I highlighted the type and content of learning opportunities offered (see Table 4.4). The former included opportunities for group interaction, intensive learning (e.g., institutes, lesson study), and analysis of student work. The latter targeted science reform initiatives: attention to standards, emphasis on teaching diverse students in urban settings, science-specific focus, opportunities to learn science content, opportunities for scientific investigation, and emphasis on inquiry or hands-on science teaching. I added one additional feature - whether the program had an evaluation (of the new teacher) component - as it seemed likely that novices might interact differently with a program or support providers who evaluated them than those who did not (Stansbury & Zimmerman, 2000).

The narrative descriptions in the following section support the summary of resources in Tables 4.2-4.4. The section begins with a closer look at district hiring practices. As I described in chapter 3, the majority of study participants felt like they started the year already behind—and several literally did, hired at the last moment. The, I turn to new teacher programs, a complicated landscape with implications for the

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for all teachers, especially novices. Fewer preparations potentially gives more time for planning and reflection.

resources available to teachers. I follow with descriptions of professional development programs sponsored by educational institutions (other than schools). As we will see, these institutions were interested in promoting science education reform.

Conventional and Social Resources: Reform Comes in Many Shapes and Sizes

In this section, I describe three types of institutional practices: district hiring policies, new teacher programs, and professional development opportunities. Each of these policies and practices moderated the resources available to study participants. Three district offices were involved; Human Resources (HR),[20] which was responsible for teacher contracts; the Teacher Development Office (TDO) for new teacher programs; and the Curriculum and Instruction Office (CIO) for professional development. Varied institutions – universities, museums, and subject matter associations - sponsored the remaining programs. I describe each, in turn, including a summary of the resources offered.

BSD Hiring Practices

As described in chapter 3, the new teachers reported various levels of difficulty in dealing with the district employment system. Hiring practices within a district are particularly relevant to this study; indeed, they are the focus of much commentary and criticism in discussions of recruitment and retention of high quality teachers (Levin & Quinn, 2003). When districts hire teachers and/or inform them of the courses they are to teach close to the beginning, or after the start, of the school year, there is little time for teachers to familiarize themselves with the community, their colleagues, the curriculum,

[20] To protect confidentiality, names of district offices, partnerships, and personnel are pseudonyms and the url of websites that would compromise teacher confidentiality are not provided.

or resources for teaching. This creates a challenge for careful planning, especially for teachers who are new to teaching, the district, and/or the school. Novices who are "late hires" are positioned poorly to create long-range goals and plans. If school starts tomorrow (or started yesterday), tomorrow takes precedence.

There are several reasons why districts, like BSD, hire teachers close to the beginning of the school year. According to a report issued by The New Teacher Project (Levin & Quinn, 2003), three policies—typical of most urban districts (and in force at BSD)—are primarily responsible for late hiring practices: late vacancy notification policies for resigning and retiring teachers; union transfer policies that give currently employed teachers "first pick" of job openings; and late state budget timelines. In BSD, these policies not only resulted in late hiring but also led to "pink slips" for the majority of new science teachers in spring 2003, followed by late rehiring (D1/I1).

Interviews with teachers and district personnel suggest additional reasons for late hires. One is the policy of consolidation (discussed in chapter 3) that shifts teachers and students to create comparable class sizes across district schools and minimize teaching positions. Another is a shortage of suitable applicants for vacant positions. In such cases, the district has little choice other than to fill positions with substitute teachers until they can find qualified (or nearly qualified) teachers. BSD also hires teachers after the school year to replace teachers with improper credentials or those who left for personal reasons.

Regardless of reason, new teachers who are "late hires" or who receive late notification of their teaching assignment have less time to prepare for their positions than colleagues hired in a more timely fashion. The Intern Program Director, Dana Marley, described the late hiring experiences described by six out of the seven study participants

as "typical" (I1). However, she also pointed out that the district was aware of some of the problems and was working to improve the situation in the future (I1). Dana hoped for improvements; late-hires made her job, as a support provider, much more difficult. She often could not even locate the new teachers who she was to support. Moreover, when she did find them, Dana had to scramble to find a support provider, often settling for less than ideal matches (I1). We now turn to take a closer look at new teacher support.

New Teacher Support Programs

Four types of new teacher programs assisted BSD novice science teachers: (1) those administered through the district; (2) an induction program offered by the Exploratorium,[21] an interactive science museum in San Francisco; (3) university credential programs; and (4) Teach for America (TFA). The district programs were state mandated. Teachers with a preliminary credential or Intern status had to participate in order to remain employed. Intern teachers also had to complete credential courses as part of their contractual obligations. The Exploratorium Beginning Teacher Induction Program (BTIP) was an optional program; any new science teacher in the Bay area could apply. TFA was only available to teachers who completed their training; Mary was the sole TFA participant in the study. I now describe the resources available through these programs, beginning with the district, followed by the university credential programs, the Exploratorium BTIP, and, finally, TFA.

District new teacher support: Overview. As already noted, the district assigned teachers to different versions of new teacher support based on their credential status. In order to understand placement in these programs, a brief (and over-simplified) explanation of the teacher credential system in California is in order. In this age of

[21] The Exploratorium is not a pseudonym, all staff and participant names, however, are pseudonyms.

heightened concerns about teacher quality, teacher credential status has become increasingly important, especially in districts like BSD that experience chronic teacher shortage areas; they must now comply with teacher quality mandates incorporated in the No Child Left Behind Act. The California Commission on Teacher Credentialing controls the credentialing process. For example, the Commission specifies the length of time a credential is valid and sets the requirements for updating or renewing a credential.

New science teachers could potentially hold one of three credentials: district internship, preliminary, or professional clear. The professional clear license is the credential teachers must obtain (and renew every 5 years) for continued employment in the district as a "highly qualified' teacher. Internship and preliminary credentials give teachers time to complete the requirements for the professional clear license. The internship credential, issued to teachers who have met minimum requirements (a relevant bachelor's degree, subject matter competence, and security screening), but have not completed an approved teacher preparation program, is only valid for two years. Interns are restricted to teaching in the district sponsoring their application.

Teachers with bachelors' degrees, who have successfully completed approved teacher preparation programs, generally receive a "preliminary" credential.[22] The preliminary credential gives teachers a five-year window to complete a sequence of requirements to earn a professional clear credential. Because teachers can hold a preliminary credential before obtaining a professional clear license, the Commission

[22] There are some exceptions to this rule. California teacher preparation programs recommend the credential that should be issued to teachers who complete their program. Although alternative credential programs generally recommend interns receive the preliminary credential, some full-time post-BA programs incorporate requirements for a professional clear license into their program and recommend their graduates immediately receive a professional clear credential. Felicia, for instance, graduated from such a program – she had her professional clear license, even though she was a first year teacher.

describes the initial credentialing process in California as having "a two-tiered credential structure" (CTC[23])

There are eight requirements teachers must satisfy to earn a professional clear credential. These include: (1) a basic educational skills test, (2) coursework in developing English language skills, (3) a US Constitution requirement, (4) subject matter competence, (5) a health education requirement, (6) a "special populations" requirement, (7) requirements in foundational and advanced computer education, and (8) a fifth year of study "designed to improve teacher competence and skill." The Commission established several options for completing requirements 3-8. For example, subject matter competence can be demonstrated through transcript review or passing a subject matter test. There are three ways a teacher can satisfy the requirement to complete a fifth year of study: transcript review of post graduate studies, completion of at least one year of graduate study in a Commission-approved teacher preparation program, or completion of a Commission-approved teacher induction program.

Although these requirements may appear straightforward, new teachers and district personnel who administer new teacher programs admit that, "in the real world"—where teachers are at a myriad of stages in credential completion—they find the requirements "very confusing" (DFN1). For example, while in-state teacher education and certification programs make recommendations for credentials to the Commission, teachers who hold out-of-state credentials apply individually to the CTC for credentialing. In that case, the teacher (with the assistance of the district new teacher support program) has the burden of providing evidence that they have completed

[23] http://www.ctc.ca.gov/

requirements for the professional clear license. The district reviews transcripts for subject matter competency and completion of required coursework, course descriptions submitted, and test results considered before a new teacher knows where s/he stands in the credentialing process.

The Teacher Development Office designed programs, in compliance with state requirements, to help new teachers through the maze of credentialing (DFN1). Teachers in this study participated in one of two district programs for new teachers: the Intern program or the New Teacher Induction Program (NTIP). Federal requirements for NCLB's "highly qualified" teachers and California's 20-year history of state-mandated and -funded mentoring programs heavily influenced both programs. The Intern program is geared towards areas of teacher shortage, specifically mathematics, science, and special education. As discussed previously, new teachers hired through the Intern program teach full-time and attend classes to earn a preliminary credential. NTIP, on the other hand, provides support to teachers with preliminary or out-of-state credentials. Figure 4.1 illustrates how the district assigns support providers. Dependent on the program, - Intern or NTIP - support providers differ in their designated names, training, responsibilities, and work with new teachers. I highlight those differences in the following discussion of each program.

District new teacher support: Intern program. The purpose of the Intern program is to "make certain that every teacher in the program ends up with a [preliminary] credential in their subject matter area and to support their efforts to attain it" (D1/I1). As previously indicated, the program makes it possible for the district to fill shortage areas with teachers who do not have credentials. Dana, the program director, estimated that

interns fill approximately 60% percent of the district's vacant positions in middle and high school science each year (I1).

The district hired Dana several years ago to develop the Intern program in compliance with teacher quality provisions of NCLB. Prior to that time, the district hired teachers without credentials on "emergency waivers," sometimes indefinitely. A co-existing difficulty involved the hiring of teachers whose undergraduate degree, GPA, and/or classroom experience did not meet the requirements for acceptance into university post-BA credential programs. The restructuring of the program, still a work-in-progress in fall 2003, eliminated emergency waivers and established stringent requirements for hiring teachers as interns. Interns now had to demonstrate subject matter competency (through a test or transcript review) in the subject area they were hired to teach, have an undergraduate GPA of at least 2.7 (the requirement for acceptance into BSU's post-BA credential program), and agree to complete a district-approved credential program within two years.

As Figure 4.1 illustrates, the primary support for Interns is the coach or mentor; for NTIP, the support provider. Dana explained that all support providers share two basic responsibilities: keeping track of the interns' progress towards their credential and "see[ing] that teachers are teaching to the standards for their content area" (D1/I1).

Depending on the school employing the intern, the coach is either a Peer Assistance and Review (PAR) coach or an Intern program mentor. Non-credentialed teachers (including interns) who are first-year teachers at a school under certain accountability sanctions (e.g., failure to improve scores on state tests) - ironically

designated as ELATE schools (Eliminating Low Achievement Test Evaluations) - work with a PAR coach.

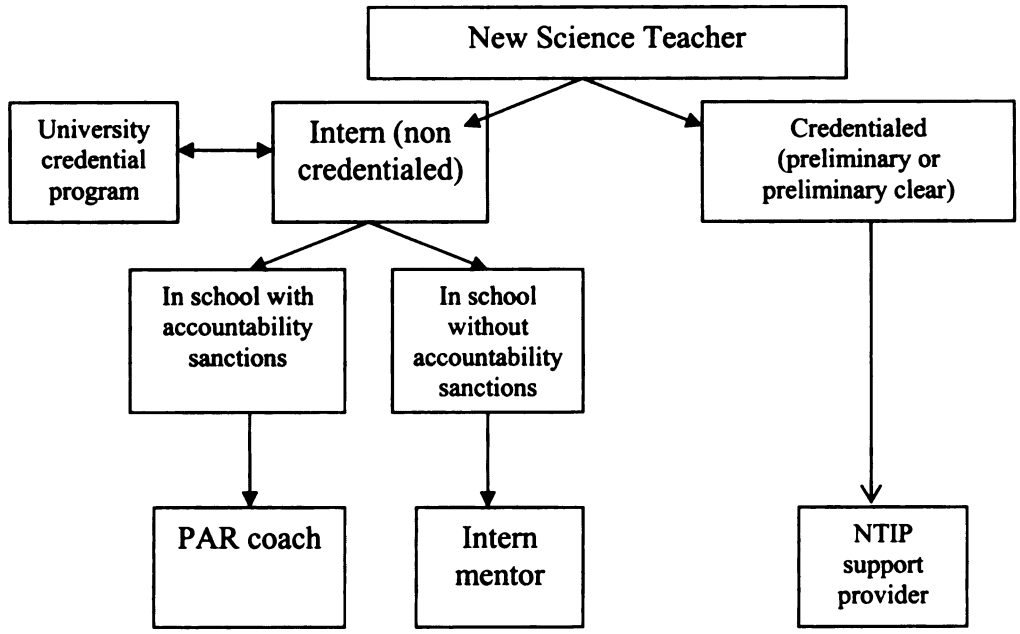


Figure 4.1 Assignment of New Teacher Support Providers

PAR coaches are experienced district teachers employed full-time to work one-to-one with non-credentialed first-year teachers in ELATE schools and any teacher with unsatisfactory performance. Due to shortages of PAR coaches with science content background, new science teachers generally do not work with coaches experienced in science teaching, although the coach may have prior experience at the new teacher's school (D1/I1). In the Fall of 2003, none of the five PAR coaches were experienced science teachers (DFN1).

In contrast with PAR coaches, Intern mentors provide one-to-one assistance to teachers in schools not under accountability sanctions. Intern mentors generally work full-time in other capacities as teachers, instructional specialists, or university instructors. New science teachers assigned an Intern mentor are more likely than those assigned a PAR coach to work with an experienced science teacher, although the mentor often is not in the same school as their novice and their attention is more often divided between mentoring and their other work (D1/I1).

Dana acknowledged significant differences in what Intern mentors and PAR coaches expected from new teachers; PAR coaches are "highly trained" by the district and have more time to work with new teachers than Intern mentors who "have a two or three hour session for training and have to find time for mentoring during the day or after school" (D1/I1). Moreover, PAR coaches have specific tasks they complete with interns; in fact, each receives substantial paperwork to fill out. They use these tasks to assess whether or not the intern meets the standards set out in the California Standards for the Teaching Profession (CSTP). [24]

By comparison, Intern mentors do not work with new teachers "as intensely" as PAR coaches do; they do not complete a prescribed set of tasks with their interns (D1/I1). For example, PAR coaches must observe and discuss teaching observation with new teachers. Intern mentors are encouraged to observe novices, but they are not required to do so. Another major difference between the two programs concerns the support provider's role regarding teacher evaluation. PAR coaches document the Intern's progress for evaluation purposes using CSTP-based protocols adopted by the PAR

[24] http://www.ctc.ca.gov/reports/cstpreport.pdf

program such as an Individual Learning Plan (IL) and other teacher performance indicators (DFN1). A district panel reviews that documentation to inform decisions concerning the continued employment of the teacher. In comparison, the Intern mentors serve in a non-evaluative capacity. They are not required to document their work with their Interns. The mentor is only expected to "provide whatever support [new teachers] need" (D1/I1).

The study participants provide helpful examples of the varied support available to Interns (see Table 4.1). Mary, Joseph, and Mark were Interns. None had a PAR coach, (although Mark was at an ELATE school). Recall from chapter 2 that Mary, lost in consolidation, did not have a mentor her first year. Dana remedied the situation Mary's second year, assigning her a sixth grade science colleague, Judy. It was a convenient match since Mary met with Judy and the other sixth grade science teachers regularly to plan curriculum anyway. Dana assumed Judy would let Mary know about the arrangement; apparently, she did not. Mary thought she did not have a mentor until, much to her surprise, Judy mentioned the extra pay she received for mentoring Mary. (I4).

Joseph's situation was equally confusing. He did not have a mentor his first year of teaching. During his second year, he regularly met with someone he called his "pseudo-mentor," a high school biology teacher Dana assigned to help Joseph study for the subject matter test.[25] Dana taught at Gifted High (the district flagship high school Mark referred to in chapter 2) located across town from Joseph's school. Then, at the start of his third year, Joseph discovered--to his surprise—that he did have an Intern mentor, a biology teacher at another high school across town, who was actually assigned

[25] Joseph subsequently decided (with his pseudo-mentor's advice) to take additional courses and have his transcript reviewed instead. Recall from chapter 2 the courses (Astronomy, Geology) he took that kept science content "fresh in his mind" (I1).

to him during his first year. However, she did not contact him until fall 2003 – the beginning of his third year of teaching (I1). Even then, they just corresponded a few times by email (I2). Mark had an entirely different situation than either Mary or Joseph. As a late-hire his first year, he initially did not have a mentor. When Dana finally found out about this, she asked the district science instructional specialist, Eric, to be his mentor. Eric and Mark met a few times during Mark's first year. Eric also agreed to be Mark's mentor for the 2003-2004 school year (D2/I1).

The credentialed teachers – Rita, Olivia, Steven, and Felicia – also had major differences in support. Olivia and Steven were both in NTIP, the program we turn to next.

District new teacher support: NTIP. First or second year science teachers with preliminary or out-of-state credentials participate in the district New Teacher Induction Program (NTIP). As noted previously, one option for completing the requirements to move from a preliminary to a professional clear credential is completion of a state-approved induction program. The BSD NTIP program is one such program.

The BSD website reports that the NTIP program has a four-fold purpose: to help beginning teachers teach culturally, linguistically, and academically diverse students; improve student performance, implement the state teacher-quality standards; and improve new teacher retention. NTIP offers three kinds of new teacher activities: one-to-one interaction with a support provider; group meetings with other BSD new teachers and NTIP staff; and two professional days that new teachers can use to plan lessons or observe other teachers (D3/I1).

Table 4.1
District New Teacher Support Programs and Providers

Teacher	Full-time teaching experience (yrs)	Credential as of fall 2003	Support program	Support provider	Support provider content match[a]
Mary Andrews	1	Internship	Intern	In-school mentor	No
Rita Magano	1	Professional Clear	None (NTIP year one)	-	-
Joseph Strobinski	2	Internship	Intern	Out-of-school mentor	Yes
Olivia Langston	0	Out-of-state	NTIP support provider	Dept. chair	Yes
Felicia Baker	0	Professional Clear	None	-	-
Steven Anderson	0	Out-of-state	NTIP support provider	District NTIP	No
Mark Bonner	1	Internship	Intern	District science instructional specialist	Yes

[a] "Yes" indicates the support provider teaches, or has taught, the content of the focus class

As Table 4.1 shows, the program assigned each NTIP participant a "support provider," district teachers who have been relieved of their classroom responsibilities or full-time teachers paid to take on additional mentoring responsibilities. Maura Landry, who worked with Steven, was a full-time NTIP support provider as well as PAR coach. Maura admitted that, although preferable, content matches between NTIP support providers and new science teachers do not always occur: "There are not enough...coaches in [science] content areas to go around" (I1). Maura, herself, was an example; she was a former language arts teacher at Fernandez High, working with Steven, a biology teacher. When asked how NTIP coaches/support providers without science content expertise handle working with teachers on subject matter standards, Maura responded: "When coaches do not have science content background, we rely on [new teachers] to pair up with department chairs or with other colleagues [for work] on their content standards" (I1).

Resources differ dependent on the support provider assigned. Full-time NTIP support providers, like Maura, work with teachers similarly to PAR coaches but with a "formative" rather than "summative" evaluation purpose (D3/I1). New teachers complete a set of tasks, based on the California Standards for the Teaching Profession and developed by the New Teacher Center at University of California, Santa Cruz, called the Formative Assessment System (FAS).[26] The tasks—FAS tools—include setting goals for teacher learning, mentor observations of the teacher, and analysis of student work. Mentors have a binder full of material: conversation guides (suggestions for how to discuss the tasks with novices); samples of completed tasks; and forms to complete (in triplicate) to document the work. Novices (and mentors) compiled the tasks in a binder, dubbed the "padfolio"[27].

Teachers prepare a lesson plan for each FAS observation; among the elements expected in the plan are content standards, a connecting activity, an opening activity, independent practice, review, closure, and homework. The support provider uses the lesson plan as the basis for a pre-observation discussion, refers to it during the observation, and makes suggestions for amending the plan during the post-observation conference (D3/I1). In addition, new teachers attend monthly new teacher meetings, organized by the Teacher Development Office, where they work together on tasks and share their experiences as new teachers. The NTIP support provider and new teacher document task completion in a portfolio, evidence that the teacher qualifies for professional credential status. Maura described the purpose and scope of the portfolio

[26] http://www.newteachercenter.org

[27] See http://www.newteachercenter.org/pdfs/FAS_Brochure_W04.pdf for a description of the FAS tasks.

("padfolio") work: "The padfolio is for...credentialing. The [support provider] is the one who signs off... [as] evidence that the FAS tools have been completed" (I1).

NTIP support providers who are full-time teachers in the school take a less structured approach to work with their novices. Ed Wong, Olivia's NTIP support provider, described his responsibilities as "observation, feedback, and general help with everyday concerns" (I1). Ed taught biology and was Olivia's department chair. However, although Ed described his work with new science teachers as having a more fluid agenda than the FAS process (I1), he pointed out that his responsibilities mirrored FAS in terms of the documentation required. Ed did a lot of record keeping, documenting when he met with new science teachers and what they did during the meetings (I1). However, unlike Maura's view of the FAS process, Ed did not perceive the purpose of his record keeping as related to obtaining a professional clear credential; it was simply a record for the district (I1).

Although Olivia and Steven both had similar out-of-state licenses, they had different social resources through NTIP. Steven did not have a science teacher as his support provider; Olivia did. Steven had to complete a portfolio while Olivia did not. Furthermore, while Steven was aware of new teacher meetings as part of his NTIP work, Olivia was not (I2).

Two teachers remain unaccounted for – Rita and Felicia. They did not participate in any district new teacher program (see Table 4.1). Although Felicia was a first-year teacher, her post-BA program qualified its teacher candidates for a professional clear license upon completion. Consequently, she was not eligible for district new teacher support (D3/I1). Rita, a second year teacher, participated in NTIP during her first year

and completed requirements for a professional clear credential; she was not eligible for new teacher support either.

We see, then, that district new teacher programs provided a potpourri of possibilities for novices – full-time coaches, part-time mentors, school colleagues, department chairs, non-school colleagues, content matches or not (see Tables 4.2-4.4). These differences, then, meant differences in the resources available to novices. A language arts teacher is an unlikely resource for advice about teaching genetics; a mentor with little training may not be familiar with the credentialing process; and a biology teacher at Gifted High perhaps not the best person for advice on working with learning and behavioral disabilities. And new teachers who had satisfied the bureaucratic requirements for credentials were not seen as needing any resources at all.

On the positive side, all of the teachers who qualified for district new teacher programs, except Steven, did have an experienced science teacher assigned as support providers, something Maura indicated was unusual (I1). Although Steven's mentor was not familiar with science, she did know the school well and its students. In addition, NTIP was the only program that provided release days to observe other teachers (see table 4.2). These opportunities had potential for helping novices develop their science curricula, engage students, and support learners' diverse needs.

These district new teacher programs, however, were not the only programs that assisted new teachers. Interns – Mary, Joseph, and Mark – also attended credential courses. In chapter 2, I mentioned some of the resources available, especially science methods and literacy requirements. However, a brief review is in order.

University credential programs. As previously noted, in order to continue employment with the district, all interns must earn a preliminary credential within 2 years of full-time district employment. Although there are several approved institutions in the Bayline area, the intern teachers in this study selected programs offered through Bayline State University (BSU). Recall from chapter 2 that Mary and Joseph took courses at the university, while Mark attended a partnership program (administered through the Bayline Teachers Center (BTC)) that he found more convenient.

Regardless of location, the credential programs had two major components: coursework and supervised teaching ("student teaching"). Since interns are full-time teachers, the student teaching requirement is satisfied by having a university instructor (not necessarily a science/science education instructor) observe and evaluate their teaching during one semester (B1/I1). The coursework varies dependent on the type of credential. One primary difference between the secondary (single subject) and elementary (multiple subject) program is that the latter includes curriculum and instruction courses in reading/language arts, mathematics, science, and social studies, while curriculum and instruction coursework for the secondary credential requires two methods courses in the content area (e.g., science).

In addition to coursework in curriculum and instruction (addressed in more detail below), teachers take courses in literacy (*Literacy across the Curriculum*, *Second Language Acquisition*), child/adolescent development, educational theory and practice (*Social, Cultural, and Historical Foundations of Education*), student motivation/management (*Classroom Environment*), and professional practice (*Teaching Seminar on Professional Growth*).

It was neither possible to interview all program instructors nor to observe credential classes. Consequently, my program description relies heavily on teachers' reports. However, an interview with Joseph's science methods instructor as well as her syllabus provides a sense of the resources available; it also confirms Joseph's report of his experiences there. A central task of the methods course is the production of curriculum units and lesson plans. For example, five of 10 major assignments involve writing unit or lesson plans. The course description states curriculum plans are developed "with consideration of student learning of state standards" (BP1). The emphasis on state standards is also evident in the course texts: *National Science Education Standards* (National Research Council, 1996), *Science for All Americans* (Rutherford & Ahlgren, 1990), and *Benchmarks for Science Literacy* (American Association for the Advancement of Science: Project 2061, 1993).

As Joseph described in chapter 2, scientific inquiry was also highly visible. The first 3 of 14 sessions "examine the nature of science and its implications for the teaching of science. [S]cience as inquiry, unifying themes and processes, habits of mind, science in personal, social, and historical perspectives, and content are examined" (BP1). The course also includes three sessions devoted to "laboratory teaching," with the rationale that "Laboratory experiences involving data collection and analysis are essential for student learning of inquiry skills and fundamental content" (BP1). In short, the course incorporates concepts and tools associated with science education reform, including curriculum content standards, an orientation towards inquiry skills, and science as a socially constructed enterprise.

The credential program, then, offers a number of resources that potentially support learning to teach science for all (see Tables 4.2–4.4), including courses on literacy and cultural diversity, an emphasis on scientific inquiry, and lesson plans for teaching science. An observer, although not necessarily a science educator, visits classrooms, provides feedback, and evaluates teachers' performance, providing another opportunity for learning. Of course, it is also important to keep in mind that these experiences took place alongside full-time teaching, something that likely influenced teachers' perceptions of their credential work. In the dizzying, most-times overwhelming world of beginning teachers, these opportunities might just as easily have felt like one more thing they had to do.

The new teacher programs discussed so far are required; the two remaining are optional – the Exploratorium Beginning Teacher Program (BTIP) and Teach for America (TFA). Four teachers – Mary, Rita, Steven, and Felicia – were in the fall 2003 cohort of BTIP; the program I describe next.

The Exploratorium Beginning Teacher Program. The Exploratorium is an interactive museum of science and perception. Exhibits—designed for active participation—fill the cavernous building full of swinging pendulums, perplexing optical illusions, leaping colored shadows. Written explanations describe the scientific principles behind each exhibit. The museum is a special place for parents, teachers, and students to explore scientific phenomenon. When compared to the institutions already discussed—district offices, university and school classrooms—the Exploratorium stands apart as the playground and place of wonder, the others are starkly institutional in comparison and feel much more like traditional school (EFN2).

The Exploratorium has a long history of working with BSD middle and high school science teachers through their Teacher Institute (TI). More recently, TI began an induction program, BTIP, for new teachers, funded in large part through another NSF grant (Exploratorium Teacher Institute, 2002).[28] BTIP is a two-year program. Upon completion, teachers become "life-long members of TI" (EP2). Teachers, in their first or second year of teaching, apply to the program in the fall and go through as a cohort; because the Exploratorium believes that all teachers need to be treated like professionals, the new teachers receive a stipend for their participation.

During the school year, new teachers can work with a classroom coach, participate in a mentoring group, attend Saturday new teacher and science content workshops, communicate with other teachers over a list-serve, and access a library of science curriculum materials housed at the Exploratorium. In the summer, novices attend a four-week institute at the museum where they interact with more experienced teachers. During the institute, they attend content workshops, develop a standards-relevant curriculum unit with staff and mentors, and build classroom-sized versions of museum exhibits.

The program provides access to a host of conventional and social resources for science curricula (see Table 4.2 - 4.4). First and foremost is the Exploratorium facility itself; TI staff members regularly explore these exhibits with teachers during Saturday content workshops and the summer institute. During the 2003-2004 school year, new teacher Saturday workshops included *Getting a Grip on Grading*, *Questioning Techniques*, and *Lab organization and Safety.* Content workshops (which were also open to experienced teachers) included *Body Mechanics and You*, *Carnival Science*, and

[28] www.exploratorium.edu/ti

Visualizing Cell Biology. As the titles suggest, new teacher workshops focused on practical aspects and general issues related to teaching. Content workshops explored activities for teaching subject matter (see Appendix C2 for a complete list of workshops for the 2003-2004 school year).

New teachers also have access to hundreds of science activities for classroom use. The activities, developed by Exploratorium staff, involve investigating scientific phenomenon (like those featured in the exhibits) using easily obtained and inexpensive supplies. Activities are available online, through the curriculum library, at workshops, and at the summer institute. In addition to activities, other materials useful for teaching science - science books and magazines, videotapes, computer software – fill the curriculum library.

Teachers participating in TI and BTIP also exchange classroom curriculum materials (e.g., lesson plans and activities) at workshops, mentor meetings, coaching sessions, and the summer institute. In addition, TI regularly provides teachers with supplies for activities used in workshops and institutes. For example, when teachers put together their curriculum unit during the summer institute, they have a small stipend to purchase some of the classroom supplies needed for the activities they choose.[29]

Novices also have access to TI staff, experienced science teachers knowledgeable in their subject matter. Each staff member is an expert in some way (often, more than one) - mathematics, life science, physical science, earth science, middle school science, high school science. Some are also practicing or retired scientists. Other social resources

[29] The Exploratorium staff are especially sensitive to the financial straits that new teachers in the Bay area find themselves in. Young, inexperienced, in their first jobs, these new teachers struggle to find affordable housing on their teacher salaries. And like their more experienced peers, they also need to spend substantial resources on instructional materials.

for new teachers are the TI and BTIP participants themselves – experienced and new science teachers from the Bayline area.

In addition to staff, some experienced TI teachers become coaches or mentors for new teachers. The Exploratorium has designed professional development for these mentors and coaches, which takes place during a weeklong session just prior to, and during, the summer institute. TI uses mentoring and coaching in different ways from the district programs. Coaches come to new teachers' classrooms when invited; providing assistance with lesson(s) using Exploratorium activities. The coach may model the lesson first and/or co-teach with the new teacher. Coaches also observe new teachers and provide suggestions for improvement (E2/I1). In many ways, when and what new teachers are mentored about is under their control, and there is a remarkable lack of bureaucratic paperwork of associated with their role; no triplicate forms (rather, a simple reporting form they can access online), no "padfolios," and no need to fathom what comes next on the novice's credential ladder.

Mentors meet with a small group (8-10) of new teachers on a regular basis, collaboratively constructing the structure and agendas for their meetings. They may have a lesson exchange, present and discuss problems in teaching, discuss ways to grade student papers, or other topics of interest. Mentors are also available for individual assistance with lessons or other concerns. The listserv, "Pinhole," providess another opportunity for exchanging ideas for lessons, finding out where to get supplies, and getting assistance with science content the teacher finds difficult or confusing (EP1).

Unlike some of the district programs, BTIP has few requirements: two content and two new teacher workshops each semester and the summer institute. Mentoring is

optional, based on the teacher's schedule and needs. For instance, new teachers who are interns attend classes most evenings when mentoring meetings also occur; they often cannot attend. Coaching is also optional, although at least one coaching session per semester is "recommended" with more "encouraged" (EFN5). TI staff pride themselves on the "flexibility" and "informality" of program sessions; they consider this a sign of "respect [they] show for teachers" (EFN5). And staff make new teachers feel welcome, connected, and part of "the Exploratorium family" (E7/I1).

BTIP promotes a science curriculum built around "inquiry" teaching and learning (E1/I1). The program "models the kind of challenging, hands-on teaching and learning it promotes" in workshops and institutes (EFN5). The TI mission statement also reflects this orientation: "Our mission is to help [participating] teachers infuse their classes with hands-on activities, scientific inquiry, and strong content" (p. 5).

I now turn to the final new teacher program – Teach for America. Since Mary was the only participant, and my only informant about the program, I offer a brief and narrow (since it is seen through the eyes of one teacher) description of the resources TFA offered.

Teach for America. TFA, an affiliate of AmeriCorps, is a program designed to attract graduates of prestigious universities to teach in low-income urban and rural school districts. Participants "make a commitment to teach for two years in the school in which they are placed" (TFA).[30] As Mary described in chapter 2, corps members attend a five-week summer institute; they teach in a summer school program followed by "discussions, workshops, and other professional development activities" (TFA). Six courses comprise the TFA curriculum: *Teaching as Leadership*; *Instructional Planning and Delivery*;

[30] http://www.teachforamerica.org

Classroom Management and Culture; *Literacy Development*; *Learning Theory*; and *Diversity, Community, and Achievement* (TFA website).

Corps members teaching in BSD can attend optional, monthly meetings with other TFA teachers in the district for "corps building and professional development activities" (TFA). The district TFA coordinator invites new teachers to "reflect on their teaching practice...share classroom concerns, and get ideas for teaching" (T1/I1). In established TFA locations, these meetings generally include experienced TFA participants who lend support and provide ideas to their newer colleagues; however, since TFA was new to Bayline (T1/I1) the meetings did not have that flavor and were only attended by new TFA recruits. TFA also requires the director to observe each teacher three times during the year and provide feedback. Those observations are for TFA documentation only and have no bearing on school performance evaluations (T1/I1).

According to Mary, TFA experienced major problems setting up in BSD; just like Mary, the entire cohort struggled to find appropriate positions:

> Teach for America faced two unprecedented problems [in BSD]...One, we were new in [BSD] and there wasn't already the infrastructure. If I had decided to do Teach for America... in New York, it would have been a completely different situation...They've been doing it for years...They have really good relationships with human resources and with the people in the school district...ways of working things out. [BSD] said that they needed all these people but then they didn't...So, that was one reason it was very confusing. The other reason was that Teach for America doubled in size the year I went into it. Because of that, they didn't have the infrastructure as an organization to handle the needs of that many people. So, our cohort was in a bad situation [but] there were not enough people in an administrative position to help us work through it.

TFA had such a difficult experience with the school district, the BSD program coordinator quit after the first year. Moreover, half of the BSD corps left for other

districts (recall from chapter 2 that all of them received pink slips after their first year). Subsequently, TFA no longer places teachers in BSD schools (FN10).

As Mary pointed out, TFA has established resources in other locations to support novices. However, resources were limited in BSD. Cohort meetings often conflicted with evening credential classes; the director faced major infrastructural constraints (e.g., the nightmare of BSD human resources), and TFA had not yet built a cadre of experienced teachers to assist novices (T1/I1). Consequently, TFA was in a poor position to support ambitious teaching in urban science classrooms.

Recall, however, that TFA was not Mary's only new teacher program. Before turning to professional development opportunities, it is worth pausing to acknowledge the multiple programs in which some teachers participated (see Tables 4.2-4.4). Rita, Felicia, and Olivia participated in only program; Rita and Felicia participated in BTIP while Olivia was in only in NTIP. Joseph, Mark, and Steven each participated in two programs - Joseph and Mark were in Intern and credential programs; Steven had support from both NTIP and the Exploratorium. Mary was in four programs – Intern, credential, BTIP, and TFA. Each teacher, then, had access to opportunities that supported science-for-all – science content, scientific practices, and supporting diverse learners. For instance, although Steven's NTIP mentor could not assist him with science or scientific practices, the Exploratorium was well equipped to do so.

There are several different ways to think about this diversity of resources. Perhaps multiple programs make more expertise available - for science content, supporting diverse learners, and lessons or activities, for instance. Alternatively, multiple programs might overwhelm offering new teachers too many options, ideas, and resources

to sift through—a situation that software designers call "useless help" (Raeithel & Velichkovsky, 1996):

> Despite the best intentions of designers, [Help functions] show the unconstrained, abstract freedom of choice that a disconcerted and nervous user just does not want, at least not at the moment when [s/he] needs help most urgently...with every mouse move there is a strange new description, housed in a balloon, attached to some object on the screen. (p. 202)

While software designers acknowledge those balloons can be quite helpful as a learning tool, they also warn that in times of crisis, they are more distraction than assistance; adding to the user's anxiety:

> This surely is a nice way for a novice to learn about the abstract possibilities of the software when there is no pressing task to do, but it takes too much self-control to ignore all the irrelevant balloons that only add to the optical and conceptual clutter, until [s/he] finally finds the important piece. (p. 216)

One can imagine that multiple opportunities for mentoring, coaching, teacher meetings, credential courses/tasks (with incumbent reading and writing obligations), workshops, and curriculum materials might prove to be that kind of clutter for novice teachers as well, despite the good intentions of support program designers. There is a potential irony here –new teachers no longer have to "sink or swim" (Britton, Raizen, Paine, & Huntley, 2000); yet, there is more than one way to drown—under one's own weight or weighted down by an overwhelming amount of well-intended assistance.

We now add to the mix--professional development available for science teachers, first, through the district, and then through programs with sponsors outside the district.

Professional Development Programs for Science Teachers

The BSD Curriculum and Instruction Office, in partnership with other district offices such as Teacher Development, coordinate professional development opportunities for district teachers. District professional development experiences generally take the

form of single or multiple session workshops or multi-day summer institutes. Workshops range from several hours (typically after school) to full-day sessions. The majority of professional development is optional; teachers may select sessions they wish to attend. However, the district calendar also includes three mandatory days for professional development during the school year; regular school days when students do not attend and teachers attend workshops and meetings (BSD website).

The majority of these professional development opportunities are available to teachers regardless of their experience. Notable exceptions are two institutes held in mid-August: a four-day new teacher summer institute to introduce new teachers to district procedures, curriculum, and expectations and a two-day training session for full-time experienced teachers who will be support providers for new teachers. Note that the new teachers hired after the mid-August date were not able to attend the district new teacher institute. None of the study participants participated in that institute.

Other BSD professional development opportunities address a wide variety of issues, ranging from classroom management to working with English language learners to subject matter curriculum and instruction. Each year, the Board of Education establishes district goals that guide professional development plans; for 2003-2004, their goals "emphasized implementation of a standards-based approach to instruction and professional development...that focused on high expectations and effective teaching strategies for all students" (DP1).

The district offered professional development in science curriculum and instruction primarily through the Urban Systemic Program, an NSF-funded initiative to support science achievement in large city school districts primarily serving poor students

and students of color. Rather than discuss all of the district's offerings, I focus here on opportunities offered through the USP. (I discuss other district professional development, when relevant, in subsequent chapters, both in terms of what teachers selected and bypassed and how they made use of the professional development in which they chose to participate).

District professional development: USP. Science curriculum and instruction work in BSD is historically rooted in initiatives funded by the National Science Foundation (NSF) under the Urban Systemic Program for Science, Mathematics, and Technology Education (USP). The USP was a "K-12-based program that promoted systemic reform of science and mathematics education for all students" (National Science Foundation, 2000). BSD used the five-year award to create programs intended to: (1) establish coherent standards-based science curriculum and instruction across the district, and (2) provide professional development support focused on science inquiry as a framework for teaching and learning (BSD website). As required by the grant, BSD established partnerships with local universities to provide human and material resources for science teaching and learning. The district also hired elementary, middle, and high school "science instructional specialists" to facilitate the partnership work and act as district liaisons for K-12 science teachers. Over time, funding cuts reduced the number of specialists; in the fall of 2003, there was one high school science instructional specialist, Eric Ceresi, and one middle school science specialist, Linda Sayers (D2/I1).

Eric and Linda were both experienced science teachers in the district before they became instructional specialists. Both were also involved with state and national science education reform efforts like Project 2061. Moreover, Eric had extensive experience

teaching science to English language learners. As the high school science instructional specialist, Eric maintains a list of new high school science teachers, notifies teachers through email and their department chairs of science professional development opportunities available in the district and elsewhere, and coordinates USP for the district high schools (I1). He also works as a support provider for new teachers when needed (recall that Eric was Mark's mentor). Linda serves in a similar capacity for district middle school science teachers (D2/I1).

Eric described the approach both specialists take towards science teaching as "hands-on," encouraging teachers through professional development to get students actively involved in learning with investigations and other kinds of activities (I1). However, the activities each program selected differed. The high school emphasized investigations that fit within a single lesson – a DNA extraction or a simulation of natural selection, for instance. The middle school focused on student-designed inquiries that extended over time. For instance, students could choose an environmental variable (e.g., amount of sunlight) and then design and conduct a controlled experiment to see how the amount of light affected seedling growth.

Although the activities differed, Eric and Linda shared similar views when it came to the model of professional development they wanted to design – ongoing experiences with a few carefully selected activities, led by teachers experienced using them. He stressed the need for "sustained professional development," pointing out that "most . . . research shows that stand-alone workshops don't work very well" (I1). Yet, in practice, he found those kinds of opportunities a tough sell; he had to revise the program requirements each year because the high school teachers did not want to commit to a

professional development series. For example, the prior year, he required teachers attend four sessions after school in order to receive a stipend. However, Eric found they "were losing too many [teachers]...because they just couldn't make it." Consequently, he redefined the high school series for fall 2003 as two after-school sessions and one release day.

The teacher-leader model Eric and Linda designed had several steps intended to pass expertise from teacher leaders to participants, who would then assist teachers in their home schools. First, experienced science teachers helped Eric choose core activities "based on the standards [rather than] just anything that the teacher happened to think was good" (I1). They tried activities out and shared their experiences, noting management issues and potential for students learning. Then, the experienced teachers facilitated USP sessions, modeling how they used the activities, advising participants, and discussing student work they brought in from their lessons. Finally, the teacher participants went back to their home school, using their experience to help colleagues incorporate core activities into their classroom practice.

District science teachers can participate in a USP series regardless of their years of experience; participation is voluntary and, as mentioned earlier, involved a stipend for attendance outside of regular school hours. During the sessions, participants meet together in grade level/course groupings. During the first two after-school sessions (and in the middle school institute), the teachers receive the supplies needed for the core activities. A science content specialist provides background information on the relevant science. For example, a geologist from a nearby university explained how rocks provided

evidence of changes in the earth over time. The teachers then work together, trying out the core activities themselves. Eric described the process:

> The presenter presents at least one or two activities [followed by a] discussion as to how to implement it in the classroom. Because, of course, the presenter has a way of doing it but the teachers have to make it their own. Really, the only way to do that is to have a discussion about how it will work in their own classrooms versus just doing what was done in the presentation. (I1)

After the initial sessions, teachers use the lesson in their classrooms, collecting packets of student work. They then return to a release day session with the student work to discuss what they did and evaluate what students learned. For the high school teachers, Eric structures the discussion using a "tuning protocol," a series of questions designed to facilitate conversation about how to improve a lesson (I1). The high school sessions for the 2003-2004 school year included a fall and spring series in three areas: biology, chemistry, and physics; middle school had earth science (sixth and ninth grades), life science (seventh grade), or physical science (eighth grade) workshops planned (I1).

In sum, BSD science professional development reflected norms of collegiality, attention to state standards, teaching though hands-on science activities, instructional development with a few targeted activities and ongoing inquiry into practice based on evaluation of student work. During the sessions, new science teachers have opportunities to interact with experienced district science teachers, district science instructional specialists, and content specialists. The conventional resources included money (stipends), time (release days), core activities, supplies, and student work (see Tables 4.2–4.4).

Four teachers—Mary, Rita, Olivia, and Mark—participated in USP sessions: Mary attended a density workshop and the 2004 earth science summer institute; Rita, the

2004 life science summer institute; Olivia, the spring biology series, and Mark went to the spring physics series. We are now ready for the final set of programs – science professional development sponsored by institutions not affiliated with the district.

Non-district sponsored professional development: Overview. The Bayline area has a number of institutions, many specializing in science-related fields, with a history of educational programs for teachers. These include universities, museums (e.g., the Exploratorium), medical institutions, science laboratories, and professional teacher organizations. Here I describe the resources available to study participants through these institutions. I only focus on institutions that study participants used extensively. For instance, the National Science Teachers Association (NSTA) and its California branch (CSTA) offer a variety of resources that support science education reform, including annual conferences, teacher publications, curriculum materials, and websites. However, these professional organizations did not play a significant role in the new teachers' development. Fernandez High paid for Steven and Felicia to attend the NSTA conference; they enjoyed the experience but did not take much away from it other than some textbooks (I1). The other teachers did not use any of the resources NSTA or CSTA provided. Therefore, I chose not to include them in the descriptions here.

I now briefly describe three programs teachers did use. Joseph, Felicia, and Steven invited the University Medical School Partnership (USMP) to visit their classrooms several times during the year. Mark attended the Physics Teachers Resource Association (PTRA) and QuarkNet, both professional development opportunities for physics teachers.

The University Medical School Partnership: UMSP.[31] Life science teachers in BSD have access to a variety of curriculum resources through a partnership between the district and a nearby university medical school. The University Medical School Partnership (UMSP) pairs medical school volunteers with BSD middle and high school science teachers to "support high quality science education for K-12 students" (UMSP website). To that end, UMSP promotes curriculum activity that emphasizes "understanding science as a creative discipline, a process, and a body of integrated concepts" (UMSP website).

Teachers, novice and experienced, must attend an orientation session at the beginning of the year in order to participate. The orientation takes place at a teacher resource center at the medical school; teachers can obtain curriculum materials there, including specimens, models, books, lesson plans, videos, scientific equipment, and other supplies (T3/I1). The director explains the program and provides an overview of UMSP resources. Following the introduction, the medical school students collaborate with teachers to plan and co-teach "hands–on" science lessons relevant to the teachers' curricula. The lessons incorporate resources UMSP volunteers might bring; preserved human organs for students to examine, animal organs to dissect, or medical equipment to measure vital signs like blood pressure.

Tables 4.2–4.4 summarize the resources available through UMSP, including access to curriculum materials and supplies, collaboration with content experts, and attention to standards and hands-on activities. UMSP resources clearly support the ideals of science education reform, for they offer students opportunities to engage with science

[31] To protect confidentiality, UMSP is a pseudonym. I draw the description of UMSP from their web page, observation of UMSP activity in schools, and informal interviews with UMSP instructors.

content and practices in ways that awaken imagination and interest. Of course, the resources also reflect their sponsor – the medical school. As we will now see, the final two programs also reflect their institutional affiliation, this time with physics. Given that Mark is the only teacher involved with these programs, I limit their descriptions to an overview, leaving the details to subsequent chapters that examine Mark's use of these resources.

Non-district professional development: PTRA and QuarkNet. Like UMSP, the Physics Teachers Resource Association (PTRA) and QuarkNet both link science teachers with resources available in institutions of higher education. Lawrence Hall of Science (at University of California at Berkeley) sponsors the Bayline chapter of PTRA, a national program developed by the American Association of Physics Teachers (AAPT). The program's purpose is "to provide sustained professional development to teachers of physics and physical science." The program does so by "maintaining a nationwide cadre of over 100 accomplished high school teacher-leaders trained and updated yearly to conduct extensive series of workshops in their local regions throughout the U.S." (PTRA website).[32] Monthly workshops take place in the evening at a BSD private school. Workshops focus on improving science teacher content knowledge, as well as providing teachers with lesson plans and other curriculum materials. Past topics included force, energy, motion, and the physics of toys (T7/I1).

The Stanford Linear Accelerator Center (SLAC) offers QuarkNet, an educational program "designed to involve high school physics and chemistry teachers in cutting-edge high energy physics research" (QuarkNet website).[33] Like PTRA, QuarkNet is part of a

[32] http://www.aapt.org/PTRA/index.cfm
[33] http://www.slac.stanford.edu/quarknet/

national network; there are over 50 such centers. The teachers, novice and experienced, ome from all over the Bayline area to SLAC three times during the school year, and in the summer for a four-week institute. The purpose is well articulated: "to bring their experiences back to their classrooms, exposing students to the physics and technology of particle physics" (QuarkNet website). To that end, teacher-participants design and develop curriculum projects for teaching modern physics. During the school year, participants meet at SLAC from Friday evening until Sunday, listening to research presentations on particle physics and continuing their curriculum work (I7/I5). During the summer, they attend lectures, work alongside SLAC scientists as research assistants, and develop curriculum materials for their own classrooms and for use by other teachers; the resulting materials are available through the project website.

In sum, PTRA primarily offers opportunities to learn subject matter, work with other physics teachers, and obtain hands-on curriculum materials. QuarkNet offers these opportunities as well. Moreover, QuarkNet gives teachers the chance to engage in scientific research, as well as design their own curriculum materials (see Tables 4.2 – 4.4). Again, each program bears the mark of its institutional sponsor. PTRA, held in schools, uses Lawrence Hall of Science curriculum materials and focuses primarily on teaching. QuarkNet, located in a research facility at Stanford, combines teaching and scientific research, a unique feature not offered in other programs described.

Social and Conventional Resources: Pushing for Change in Science Education

All of the program descriptions have a common thread – improving the quality of science education for students. Most programs thought about doing so in similar ways, using mentors, encouraging collaborations with experienced teachers and/or science

content experts, and introducing teachers to hands-on curriculum materials. There were unique features as well: the opportunity to examine student work in district USP, to conduct scientific research in QuarkNet, to receive formative evaluation in NTIP, or to gain a credential.

District new teacher programs were thinner on science content and practices than others. The rich array of opportunities available through science institutions suggests those resources fill voids that districts, hurting for funds and teachers, simply cannot. Yet, the district USP work with core activities was one of the few programs where novices had opportunities to work on curriculum with other BSD science teachers, who share similar students and concerns. However, opportunities to work with teachers outside the district may be just as important for broadening horizons.

New teacher evaluation was not a component of most programs. Novices did get feedback; coaches and mentors commented after observations, pointing out what went well and offering a few suggestions for improvement. Novices were under no obligation to implement those suggestions. The stakes increase slightly for NTIP participants who must complete the FAS process for their next credential; as we saw some do receive written commentaries about their teaching. Still, in most programs teachers do not have access to concrete summative feedback about their teaching.

The focus on credentialing raises a red flag about district new teacher support. Support providers were confused about who should have support and who should not, what kind of support provider they should assign, and what evidence they needed to recommend teachers for the next certification step. In the end, credential programs offered support to teachers without credentials, not to new teachers more generally. This

practice ignores the fact that every first or second year teacher is still a novice practitioner in need of substantial assistance.

Regardless of the sponsoring institution, programs focused on science teaching had similar ways of describing the kind of teaching they wanted to encourage in classrooms – hands-on and/or inquiry. However, those terms meant different things within or across institutions: inquiry as a cycle of doing and learning, an instructional activity, an exploration of phenomenon, or a prescribed investigation with scripted steps, to name a few versions. However, the common terminology suggests that programs had, at the very least, adopted the rhetoric of reform. Another prominent reform feature in the majority of programs was attention to state and district science standards; the adjective "standards-based" was a common program descriptor. In sum, institutions shared common tools; among them were state/district science standards and hands-on activities.

Attention to diverse learners was not as common; it is most obvious in alternative certification courses that included "diversity" in their titles. Although less explicit, improving the science achievement of urban learners is certainly an undercurrent in the Exploratorium BTIP, district science programs, and the medical school partnership. Student work is a potential resource for generating discussions about what diverse students learn from instruction, but opportunities to learn by examining student work were rare. In March 2004, six of the seven teachers indicated that they never had the experience (I4).

Finally, most programs share two other characteristics – they are collegial (in the sense of working with others) and intensive (prolonged over time.). In terms of collegiality, most programs involve groups of participants working together. The

exceptions are the district new teacher programs that predominantly rely on one-to-one interaction between a support provider and a new teacher. Most programs also offer intensive learning experiences, through a series of workshops, an institute, or a study of a lesson. Both of these features – collegiality and intensive learning opportunities- reflect changes advocated in much of the professional development literature.[34]

In conclusion, most study participants began the year already short on one resource – time. District hiring practices left little time for planning prior to the start of the school year and, for some teachers, obligations to attend credential courses meant giving over large chunks of their evenings. However, teachers did have access to a number of conventional and social resources that potentially supported the work of science-for-all: content experts, engaging activities, and, to a lesser extent, assistance for diverse learners.

Resources were distributed unevenly among the new teachers. However, although it is tempting to assume more resources mean enhanced development that is not necessarily the case. As proposed in chapter 2, teachers' personal resources influence how they use other resources – they select, modify, and ignore (Brown & Edelson, 2003; Cohen et al., 2003; Spillane, 1999). The same resource can look very different in one classroom than another; for instance, a textbook omnipresent or rarely seen. Furthermore, the descriptions provided in this chapter demonstrate that conventional and social resources themselves afford different kinds of opportunities for learning, for instance, a mentor who knows science and one who does not.

Flooding new teachers with resources does not guarantee whether, or what, beliefs, knowledge, or skills they develop. What teachers learn resides in a more complex

[34] Cf., Gamoran et al. (2003); Harcombe (2001)

space – in the dynamics of resource use (Cohen et al., 2003). We turn, then, to classrooms, to examine those dynamics. In doing so, we encounter another set of resources, those available in schools, complicating the scene even further.

Chapter 5

Curriculum Goals: Beyond Science as Facts and Formulas

> Observation is the generative act in scientific discovery. For all its aberrations, the evidence of the senses is essentially to be relied upon—provided we observe nature as a child does, without prejudices and preconceptions, but with that clear and candid vision which adults lose and scientists must strive to regain (Medawar, 1982, p. 99)

Science for All Americans (Rutherford & Ahlgren, 1990) and national science standards documents (e.g., *NSES*, *Benchmarks*) resulted from efforts to identify science content that is *important* (necessary for informed and responsible citizenship) and *rigorous* (embodies the intellectual challenge of science as a discipline). For example, *NSES* (National Research Council, 1996) proposed less emphasis on "knowing scientific facts and information" and more emphasis on "understanding scientific concepts and developing abilities of inquiry" (p. 10). As I argued in chapter 1, these are ambitious goals, and they represent a departure from traditional science education which has been portrayed as "a mile wide and an inch deep" (Schmidt, McKnight, & Raizen, 1997).

Bayline schools had a history of traditional science teaching (D2/I1). More recently, the district implemented state science standards, curriculum frameworks, and assessments; the high-stakes accountability that came with them favored the tried-and-true (D2/I1). As we saw in chapter 4, other educational institutions wanted more—curriculum rich with scientific understanding and practices. This caught teachers, then, in the middle—between the pull of traditional science education in schools and the push for change from outside.

In this chapter, I examine the relationship between teachers' curriculum goals and their institutional curriculum work. Most teachers developed goals that fell short of ambitious outcomes. Resources—personal, social, and conventional—positioned teachers more or less favorably to adopt ambitious goals, and as will be seen, personal and workplace resources were particularly powerful mediators.

Resources and Curriculum Goals

One obvious question the study participants had to address was "What am I going to teach today?" The new teachers confronted this question with little (sometimes no) teaching experience to guide them. Decisions about content selection, emphasis, and cognitive demand rested on their curriculum goals, goals they did not develop in isolation. They relied on other resources to guide their work—science department colleagues, students, grade-level science content standards, and district-adopted textbooks. As the teachers drew on these resources, they oriented themselves to science curriculum in particular ways. For example, teachers assessed students' capabilities and pitched their curriculum goals accordingly.

It is important to point out that this analysis focuses on teachers' perceptions of their curriculum goals and makes no claims about the relationships between their perceived goals, classroom practices, and/or what students learned. The latter requires extensive and ongoing collection of teacher and student data only partially available for this study.[35] Nevertheless, teachers' perceptions of their goals do provide a window into their curricular ambitions.

[35] Although videotaped observations included teacher questionnaires and requested student work from the lessons, the teachers did not consistently provide those materials. They were apologetic but indicated they simply felt too overwhelmed with demands on their time and could not get the materials together.

For this analysis, I focus only on goals that addressed science *content*—outcomes related to scientific knowledge and practices. The teachers also discussed goals that addressed student engagement (science as "interesting" or "fun") or access (e.g., literacy). Those will serve as the foci for the following two chapters respectively.

I drew the description of the teachers' goals primarily from two interviews: the subject matter interview in late spring and the end of the year interview. In the subject matter interview, teachers responded to a set of prompts that addressed learning outcomes: "What are your goals for your students in this class for this year? What do you hope they will learn? What is the most important thing that students can learn about science at this grade level?" (MSTI, 2003). The end of the year interview asked teachers to identify what they had learned and what they might want to learn in the future. Some of those responses addressed curricular aims.

Resources for curriculum—personal, conventional, and social—were the other variables of interest. For those I looked into activities where teachers worked with curriculum in some way—figuring out what to teach, planning, and/or teaching their focal class. Several data sources contributed to the descriptions of school-based resources. These included information available publicly (school website and accountability documents), interviews of teachers and school personnel (department chair, principal), and school/classroom observations. Similar data sources and on-site observations contributed to descriptions of non school-based resources (described in chapter 4).

I divided the chapter into three major parts. In the first section, I analyze each teacher's curriculum goal(s) and the resources that shaped them. In the second section I

examine patterns across teachers. The final section presents conclusions and implications for learning to teach science for all.

Teachers' Curriculum Goals and the Resources That Shaped Them

On a teacher-by-teacher basis, this section (1) describes the teachers' goals and their curriculum resources and (2) argues how resources—personal, social, and conventional—shaped their goals.

Mary Andrews

> [This is] kind of an exposure class. It's hard stuff. I have low kids. I don't expect them to become masters at it. (T1/I4)

Mary's curriculum goals. Mary Andrews, the second-year TFA teacher in the study, did not have very demanding expectations for her eighth grade physical science curriculum. Primarily, she wanted to expose students to physical science vocabulary they would encounter later in high school: "I want to expose [them] to some things of physical science so when they get to high school...they've heard of Newton before, they've heard of the periodic table... they've heard of the term atomic number" (I4). Note that this curriculum outcome does not include understanding physical science concepts or the scientific practices that led to those concepts. Mary's comments about her students' progress provide further evidence of less than ambitious outcomes:

> I look at these 8th graders and at what we've done this year and what they've learned and...no, they can't fill out an empty periodic table or calculate these crazy things but at the minimum they've been introduced to a lot of things that they were never introduced to before. (I8)

Mary's goals of teaching for "introduction, recognition, and exposure" suggest that her learning goals fall short of the ambitious goals laid out in many contemporary curricula expectations (Bransford & Donovan, 2005; Gamoran et al., 2003)

School-based curriculum resources. As described in chapter 3, Mary taught two sixth-grade math/science "core" classes and one eighth-grade physical science class (her focus class) at Meriwether Lewis Middle School. From the beginning, the 8th grade class occupied a solitary and unwelcome position in Mary's schedule. Mary described her assignment to physical science as "horrible" and "unjust" (I1). Mary had never even taken a physical science course and she felt the "only reason [she] got stuck" teaching the class was "that she came in late and they didn't have anyone else to teach it" (I1). According to Mary, the assistant principal apologized repeatedly for assigning her the class (FN3). Mary continually weighed how much time and energy she wanted to invest in this one class (I1). Early on, she decided: "There's only so much you can do with it" (I1).

Mary saw a lack of in-school curriculum support compounded her difficulties. The principal told Mary that an experienced teacher would give her substantial curriculum guidance but Mary found the teacher "unfriendly" - they never worked together (I1). In January, the experienced teacher left the school for family reasons. A novice teacher, who had just completed a student teaching assignment at Meriweather, replaced her (I2); so no help there. As if to take their share of the blame, administrators did not hold Mary accountable for the eighth grade class. For instance, the principal responsible for Mary's evaluation only observed her sixth grade classes and never the eighth grade (FN2).

The situation in the eighth grade was quite different from Mary's experience with the sixth grade where she worked closely with her team members and the other sixth grade math/science teachers to plan curriculum. The contrast heightened her insecurity about teaching the eighth grade class. Mary found her sixth grade colleagues helped her "do things that [she] would never be able to do [her] first year" (I8). Mary explained: "Planning with others...took away so much stress;" it gave her a sense of confidence about the questions that nagged at her as a new teacher: "Am I doing this right? Am I teaching the right thing? Am I on track?" (I8). Mary was never sure about what to do when it came to her eighth grade class; she resigned herself to simply struggling through as best she could (I1).

Mary attempted to use the textbook as a curriculum guide. However, she found the 800-page physical science text "confusing and so intense" (I1). The textbook, a constant reminder of what she did not know and yet was expected to teach, intimidated her. Mary tended to "jump around" a lot in the book and generally included only "the first section of the chapter [because] it usually [made] sense" (I1). Given Mary's knowledge of physical science, the textbook limited, rather than expanded, what Mary felt she could do. Given the lack of school-based resources, Mary might have leaned heavily on curriculum resources outside of her school. Yet, the situation was not that simple.

Non school-based curriculum activities. Mary had access to instructional resources through her elementary credential program, district inquiry-based professional development (USP), and the Exploratorium new teacher program—she rarely used them. The university coursework emphasized working with lower elementary students (I1);

"irrelevant," as Mary pointed out, to eighth graders (I4). Mary did not get assistance from her university supervisor—an experienced science educator who might have been helpful—either. The supervisor only observed the sixth grade at the end of the school day. When class was over, Mary had to leave immediately, dashing across town to her university class (I8). Consequently, Mary had little time to debrief about the sixth grade, let alone discuss the eighth grade.

Other resources had greater potential to support physical science curriculum, yet Mary did not make use of them either. For example, Mary attended a USP workshop on density led by a middle school science instructor from a nearby district she thought "was great," that "really got her excited." Mary found out that the district would pay her to write a density unit, based on the workshop, to share with the other eighth grade teachers in her school. And while she planned to spend part of her winter break working on the curriculum, she "didn't get around to it" because she assumed she would not teach the eighth grade course again (I2).

Mary also made limited use of the Exploratorium. Initially Mary was happy to participate in the Exploratorium new teacher program because, as she said, "the Exploratorium is strong in physical science" (initial interview, 12/15/04). However, she eventually dropped out of the program, balking at the promised work with the coach; she did not want to have to worry about someone coming to watch her teach "in such a difficult situation" (I2). When the coach offered to plan with her, as Mary requested, they met one time and Mary did not follow up (E3/I1).

Further, Mary stopped attending Exploratorium workshops: "I haven't gotten that much out of it. It's just something I have to do on Saturday morning at 8:30, at this point"

(I2). Mary also did not attend the summer institute because of family obligations (I2). In short, Mary dropped out of the program that offered the most opportunities for curriculum support in her physical science class (I5). Limited subject matter knowledge , her sense that she would not teach the eighth grade class, and her general avoidance of all occasions that might further expose her vulnerabilities as a teacher of this class apparently restricted her use of the Exploratorium.

Mary readily admitted, as she put it, that "there were resources out there," but she "didn't know how to make then work" (I2. Mary captured her situation with a plaintive question: "How do you take that support and make it feel like its working for you and that it's not a burden?" (I2). Several factors contributed to Mary's assessment of resources as "burdens" rather than support. Most notably, Mary did not have sufficient subject matter knowledge, needed in-school support she did not have, and did not have the knowledge or the will to make use of the resources available outside the workplace.

Summary: Insufficient personal resources. Thus, it appears that insufficient personal resources restricted Mary's use of other resources and limited her curricular ambitions. Mary could not count on her subject matter knowledge as a resource for teaching. Consequently, by limiting her curriculum aim to exposure, she made the situation more manageable. While Mary might have pushed on other resources more, for instance, insisting the more experienced eighth grade science teacher meet with her or getting more help from the Exploratorium, her failure to do so is understandable. Begging for help from a senior staff member who seemed uninterested in providing assistance was not an attractive proposition. Exploratorium workshops on science topics Mary did not

understand (e.g., chemistry) were overwhelming, no matter how informal or family-like the program tried to make the atmosphere.

Workplace resources reinforced Mary's inattention to eighth grade. She knew her assignment to teach the class was a fluke and that, in all likelihood, she would not teach it again. Mary turned her attention to her sixth grade assignment, investing her energy where she felt she had support, and felt successful. Others—the administration, her colleagues, and her credential supervisor—took a similar view and pretended Mary's eighth grade class did not exist. They only observed the sixth grade where Mary received very positive ratings about her teaching, even though she felt things were not going well with the eighth grade (I2). It is not surprising, then, that Mary settled on "exposure" as her curriculum goal; that was the most Mary thought she, and her students, could handle.

Rita Magano

"It's all about the standards." (Rita, I5)

Rita's curriculum goals. When Rita, the accidental tourist we firs met in chapter 3, talked about her curriculum goals, she immediately pointed to the science standards, saying, "I hope [my students] will get the standards" (I5). However, as Rita elaborated on what it meant to "get the standards," she described expectations that echoed Mary's "I hope, at least...when [the students] go to high school, they say: 'Oh yeah, I learned about that.' Maybe they don't know exactly what it [is] but it's not totally foreign to them" (I5). Rita expected what she called "recognition" of terminology like DNA or evolution. She did not expect students to "remember the vocabulary but...[to] have an idea or picture in their head about what it is" (I4). Rita gave examples of recognition for evolution

("Something to do with animals and change over time) and cells ("They have stuff in them").

In addition to goals—tuned to recognition—Rita also discussed other goals that targeted skill development. Rita wanted the curriculum to support students learning two kinds of skills. The first set involved "how to be a student": taking notes, organization, and working in groups (I1). Later in the year, Rita added another set of skills she felt she "hadn't done enough with" and "wanted to do more with in the future" (I5); skills that were related to "the part [of science] with the theories" (I5). Rita included "hypothesizing, making inferences, and drawing conclusions" within this set of skills (I5). The science skills are of particular interest here because they represent curriculum goals associated with scientific practices.

Rita's goals were an amalgam of the social resources available to her. Rita's personal resources appeared sufficient to support ambitious learning outcomes. She had subject matter background that matched her teaching assignment. Rita also assessed her students' capabilities in a positive light, describing them as "kids who worked very hard" (I1). Yet, Rita did not stress scientific understanding in her goals. However, she did pay attention to skills associated with scientific practices, especially later in the school year. I now consider how Rita developed her unique mix of goals.

School-based curriculum activities. Recall that Rita taught four sections of seventh grade life science at Evers Middle School. Certified to teach life science, it was her second year at the school but her first year teaching seventh grade. Rita's greatest concern about her curriculum stemmed from what she called a "very stressful"

atmosphere in her school (I1): the school, which had not made sufficient progress to improve test scores, was under "state sanctions."

Rita found the "corrective actions" associated with these sanctions required a lot of additional paperwork from teachers (I1). For example, the administration now expected teachers to turn in detailed daily lesson plans. Although Rita did not welcome the additional paperwork, she could see the value in that kind of planning (I1). However, Rita found the lack of feedback teachers received on their lesson plans troubling:

> I'm frustrated because as long as they're asking us to do this, I want to know whether or not what I am doing is what they want me to be doing...at least give me some feedback about whether or not my assessment was appropriate according to the standards." (I1)

Although Rita resisted much of the administrative paperwork imposed by state sanctions, she did closely follow two aspects of the corrective actions – the Blackboard Configuration (BBC) and explicit direct instruction (EDI). The BBC required teachers to have the following information on their black (or white) boards every day:

- a 'do now" (something for students to work on at the beginning of class while the teacher took attendance, etc.)
- the targeted learning objectives
- the standards addressed in the lesson,
- the agenda for the day, and
- the assigned homework.

Rita made sure she wrote the BBC each day because "inspectors" associated with the sanctions could "peek in anytime" and would "reprimand" the administration if teachers were not in compliance (FN8). The BBC filled most of the two large white boards at the front of Rita's classroom (FN8). As Rita put it: "It's a lot of text" (I9).

The BBC seemed to intensify Rita's focus on the state science standards (check-in interview, 1/26/04). Rita prominently displayed a stapled packet of papers with the title "Our California Science Standards" on a cabinet in her classroom (FN8), and the standards often took center stage when Rita discussed her curriculum. For example, summarizing a lesson she taught by referencing the standards, Rita noted: "We just talked about differentiation and it's a small standard so I introduced mitosis and the term daughter cells, that's another standard" (I2). In another instance, Rita described how the standards informed her learning goals for a unit on the cell: "The standards aren't to know every inch of the cell or every detail of the cell so I'm not looking for that" (I1). The standards also influenced what Rita covered in the science textbook: "I'm trying to address what the standards are addressing. There are whole sections of the book that we are not going to go through because it has nothing to do with the standards" (I5). In short, the standards were Rita's curriculum authority.

Although the standards clearly had Rita's attention, they served primarily as a checklist. As such, they likely contributed to Rita's focus on covering, rather than understanding, science content. Rita's close partnership with Mr. Trenton,[36] the other seventh grade science teacher, also emphasized coverage. Like Rita, Mr. Trenton was a second-year teacher at Medgar Evers. However, he had prior experience as a science teacher and school administrator elsewhere in the district. The two met regularly during a mutual prep period and after school, planning their units and lessons together, sharing materials they needed, and keeping pace with each other. Rita described their work as

[36] Rita addressed her colleagues by their surname "out of the habit" because she was "so much younger than some of them," even though they invited her to address them by their first name (post observation interview, 12/16/03).

"close collaboration" (I1), acknowledging that Mr. Trenton was "very helpful to [her] development" (I5).

Nevertheless, as much as Rita appreciated opportunities to plan curriculum and instruction with Mr. Trenton, she also found their close working relationship "caused some pressure" (I8). Rita admitted she sometimes felt she "needed to slow down a bit to make sure students understood" the material. Yet, she also wanted to "keep on the same page" and "not let Mr. Trenton down" (I8). If she prioritized understanding, Rita worried that she might compromise her working relationship with Mr. Trenton. A less ambitious goal, like recognition of vocabulary, would not.

The other corrective action—explicit direct instruction (EDI)—focused Rita's attention on thinking skills, as reflected in her second curriculum goal. Under state sanctions, Bayline schools were required to adopt EDI to improve instruction. The EDI " cycle" has several components : explaining, modeling, demonstrating, checking for understanding, guided practice, and closure (Ybarra & Hollingsworth, 2004).[37]

Rita attended several faculty workshops to learn about EDI (I1) and came away from the workshops with the impression that "There's a whole circle of things you're supposed to be doing if you're doing direct explicit instruction...and there's a certain amount of time you should spend on each" (I8). Rita thought the staff agreed to practice two strategies: checking for understanding and modeling. She was also under the impression that "the principal was going to come around and have observations and look for checking for understanding [during the first] week and the second week would be

[37] See http://www.dataworks2.com/pdf/EDI_page.pdf for a diagram of the EDI cycle and http://www.dataworks2.com/docs/Lesson_Plan_Template.doc for an EDI lesson plan template.

modeling" (I8). However, Rita reported that although she "practiced checking for understanding diligently...nobody came in and checked" (I8).

Despite the lack of monitoring, Rita remained relatively positive about using EDI strategies. Checking for understanding—she thought—was something she already did, drawing popsicle sticks with students' names on them, for instance, to call on "non-volunteers to spit back what [the teacher] said" (I8). Modeling was also something she "did constantly," providing students with examples of what she expected on assignments (I8). The difference between what she previously had done and EDI was explicitness. As the year progressed, Rita reported she "tried more" to tell her students what she was doing (e.g., "I am modeling this for you now"), something she left implicit before: "I would have done the same thing, but now I'm sneaking in the—this is me and I'm doing this now for you" (I9).

Non school-based curriculum activities. Rita's school-based immersion in the standards appeared to influence her use of resources outside of the school. Rita worked on developing a curriculum using "fast plants" through the USP professional development series; she also participated in the Exploratorium new teacher program, working with her coach regularly, attending the maximum number of workshops, all of the mentoring group sessions, and the summer institute. Rita spoke well of both programs, noting they fit one of her primary criteria for professional development – "providing classroom activities" (I1) (These activities are the focus of the next chapter on intellectual engagement). However, the programs did not necessarily fare as well when judged against her second benchmark – relevance to the standards.

Rita praised USP because she found it "directly applicable" to, and grounded in, the seventh-grade plant biology standards (I1), but she did not always find the Exploratorium program directly applicable (I1), especially when it came to standards. Rita initially indicated she enjoyed learning about new and interesting topics like astronomy, regardless of their connection to her curriculum standards (I1). However, as Rita's focus on the standards intensified, they served as a benchmark in her later evaluations of Exploratorium activities.

Some topics addressed in Exploratorium workshops and the TI summer institute were directly relevant to Rita's curriculum. She especially appreciated the opportunity to develop a teaching unit on light during the summer institute. Light was one of the few physical science topics included in the seventh grade curriculum standards that focused heavily on life science and Rita was not confident she knew enough about light to teach it well (I5).

During the TI summer institute, Rita worked on the unit with another new teacher guided by a mentor, an experienced high school science teacher (EFN3). Rita found the mentor very knowledgeable "about light and about how to teach it" (I6). Rita judged the time spent working on the unit as "very worthwhile" and "absolutely, totally useful," in large part because it "addressed the standards on color" for the seventh grade (I6).

Other activities—especially those with less direct connection to relevant standards—fared less well in Rita's estimation. When TIP participants went on a field trip to a nearby bay and learned how to count marine invertebrates used in water quality studies, Rita thought the activity was "fun...and a good time at the beach," but she could not see how the activity related to the seventh grade standards. Hence, she questioned the

value of the experience: "In my school, we cannot do anything without justifying it by the standards it addressed.... "[If TI] had a way to explicitly link it to some standard that I'm working on, that would make it more valuable" (FN6). Without a direct relation to the standards she had to write on her white board everyday, Rita was much less interested in learning about new curricular options, no matter how personally pleasurable they might be.

When it came to scientific practices, Rita did not use the standards, even thought there are a set of seventh grade standards (at the back of the document) entitled *Investigation and Experimentation.* Instead, Rita paid attention to resources available through the district USP and the Exploratorium. As described in chapter 4, both programs emphasized an inquiry-based approach to curriculum and instruction. At the beginning of the year, Rita expressed an interest in scientific thinking skills. She tried to get her students "thinking like scientists" (I1), but found it very difficult to teach "how to think critically, how to analyze something, how to come up with a conclusion based on data, or make a hypothesis" (I5). Rita attributed her struggles to inexperience ("I guess I just haven't practiced it that much") and insufficient curriculum materials, pointing out that while she had "all this stuff on how to teach [science] topics," she had "less curriculum for how you get kids to start thinking about what they're looking at" (I5).

Rita looked for help from USP and the Exploratorium program; she preferred the Exploratorium approach. Rita resisted the conception of inquiry she encountered in USP; claiming their approach involved "huge projects" (FN6). The experience reminded Rita (unpleasantly) of her teacher preparation program where she first learned about "this whole big inquiry cycle...where students first pose a question and then decide how to

investigate it" (FN6). These lengthy projects intimidated her; Rita felt she lacked the time or the experience required to pull them off (FN6).

Rita 's reaction to the ways that inquiry was presented in the Exploratorium program was different. Rita noted that, while inquiry was all she heard at USP, she could not recall the TI staff using the word "inquiry" even once during the first two weeks of the summer institute (FN6). Yet, Rita quickly added, "[In TI] we're always trying to figure things out, looking at things or at data and that seems like inquiry" (FN6).

Her experiences at the Exploratorium made Rita "rethink inquiry as a whole big cycle" that would "only fit in the curriculum a few times a year." Even the name the Exploratorium gave their classroom activities—snacks—meant that "inquiry didn't have to be a big deal" (FN):"When students look at data, even if they didn't get it themselves, and draw conclusions, that could be inquiry" (FN6)

Over time, Rita began conceptualizing her own view of inquiry. For Rita, inquiry was "a cycle with...components or parts" that she could address on a daily basis (FN6). Her model sounded very similar to the components of the EDI cycle , a connection that Rita herself made: "That makes [inquiry] less scary and more doable...I could make it explicit with my students, say now we are doing this, like hypothesizing, or gathering evidence" (FN6). Rita imagined treating inquiry as a set of skills (e.g., hypothesizing, gathering evidence) in the same way EDI approached instruction (e.g., checking for understanding or modeling) and she reshaped inquiry to fit the model that the corrective actions provided.

Summary: The power of strong workplace tools and norms. Workplace resources played the most prominent role in shaping the development of Rita's goals. One influence

seemed to be Rita's assumptions about *middle* schools. Rita associated rigor with high school science, and she felt that she could count on the high school biology teachers to address concepts again. Rita admitted she had little faith her students would remember much of their middle school science; in fact, she expected them "to forget most of what they learned...[because] they will not see it again...for a long time...until biology in ninth or tenth grade" (I5).

Another influence was the high alert status in her school; communicated as "sanctions" and "corrective actions," where "inspectors" walked the halls. These school demands seemed to overwhelm other resources; especially her personal ones. Rita had a clear credential, sufficient subject matter background, and viewed her students as "hard workers" (I1). Nevertheless, she felt very uncertain about her abilities. She attributed her insecurities to being a novice teacher: "I don't like not being good at things...and I don't think I'm good at [teaching] yet...That makes me feel really uncomfortable about myself (I5); working in a school under state sanctions did little to build her confidence. The conditions were hardly conducive to taking on ambitious goals; compliance was the name of the game.

Hence, Rita had few incentives to expect more than "recognition" from her students. As long as state testing accountability weighed reading and mathematics more heavily than science, Rita felt "safe...test-wise" (I1); why venture outside that safety zone? Rita implemented corrective actions, like EDI, in an outcomes vacuum, where she "had no idea" whether the strategies she used affected what students learned; even though she hoped that administrators would provide suggestions she could learn from, that was not the case. The sanctions did not seem intellectually challenging—for students or

teachers—they were routines to learn and execute faithfully. Consequently, making standards physically visible in the classroom by posting them on a cabinet or writing them on the board each day passed as good teaching and learning. As long as Rita could check each standard off on her list, she satisfied the inspectors, administrators, and her colleague, Mr. Trenton.

Rita's version of scientific practices also had the distinct markings of corrective actions; she used EDI to resolve two conflicting views of inquiry; one—the district science program for teachers—urged "full cycles;" the Exploratorium version offered "snacks." The former seemed too ambitious, the latter more inviting; moreover, she had a model—EDI—to work from that combined both. Rita would teach scientific practices by rehearsing one skill at a time; a version of science that fell short of the more holistic understanding of the discipline science-for-all envisions.

In Mary's case, we saw personal resources dominate in a workplace that did not exert pressure on curriculum goals. With Rita, the power of strong, negative messages from the workplace overpowered personal resources, undermining her confidence and neutralizing reform-based resources from outside the schoolhouse walls.

Joseph Strobinski

> If they can remember...a few things they learned from me and carry that to high school and when they see it again, learn it even better the next time, then that's what I want...And I want them to question, question the universe, not just questioning in science but questioning the media, questioning everything around them. (Joseph, I5)

Joseph's curriculum goals. Joseph 's goals were similar to Mary and Rita, the two other middle school teachers. He wanted his students to recognize a few things when they

got to high school. However, when asked to elaborate, Joseph shifted his focus to another goal he considered equally important:

> Subject matter is important to me but my students need life skills...I'm more worried about...waking up questions in their mind about the universe, cells, and life, creation, and reproduction and all the different cool stuff that's out there with science. (I5)

Questioning was an important life skill that Joseph believed that students could borrow from science and its practice. To him, scientific knowledge was dynamic, growing and changing due to "people...testing things and disproving things" (I5) and he wanted his students to take a similar approach to everything around them (I5. For example, Joseph pointed out that he wanted his students to "question...what they see on television...and not just be mindless slaves to the television" (I5).

Joseph did not expect his students to remember much of the content they encountered. "I don't remember a damn thing I learned in middle school... I could make them regurgitate vocabulary words on a test...But are they going to remember those words over the summer? No!" (I1). However, Joseph did expect his students to take a more skeptical stance towards the world, something he considered more valuable.

In part, Joseph's curriculum goals reflected the challenges of teaching special education. While he did not expect his students to remember much science content—after all, they were middle school and special education students—but he was keenly aware of race and class issues that negatively affected his students. As we will see, this awareness, strengthened by his credential courses, shaped the way Joseph viewed schooling, in general, and his school-based resources, in particular.

School-based curriculum activities. Recall that Joseph, the hip-hop fan with blue collar roots, had an Intern credential and was entering his third year of teaching Joseph

had seven students in his seventh/eighth grade focal class: three African-American males, two African-America females, two Latino students, and one Latina student.

Joseph had sole responsibility for developing his science curriculum. He determined how much time to spend on math or science (or whatever else he chose) during the 90-minute block period. Joseph also decided what science content he would teach. Unlike teachers who taught a single grade level, Joseph was expected to cover all of the science standards for sixth, seventh, and eighth grade with his students, something he acknowledged was "impossible" (I1). Consequently, when Joseph decided what to teach, he "paid attention to standards, but did not marry [himself] to them" (I5), selecting what he called "big, big things" or "major themes" from earth, life, and physical science (I5.

Joseph protected his autonomy to construct curriculum goals as he saw fit. For example, Joseph wanted his students to develop technological skills he thought important to their future and drew on his expertise, spending several weeks teaching them how to design websites (I5). Joseph included other topics in the curriculum as well, like current events: "I also teach [my students] about life. I teach them that Bush lost the [first] election, technically, on votes. I teach them about the electoral college" (I1).

Joseph believed the educational system had failed his students; he wanted to give them opportunities they might no otherwise have:

> I have a learning handicapped, an LH class, which a lot of it is just behaviorally unmanageable black and Latino kids because other teachers...can't deal, so they say this must be a special ed kid, we better test him...instead of trying to deal with that kid who is probably brilliant. Many of my kids are brilliant kids...They've just been out of the system, falling through the cracks all these years. (I1)

Joseph saw himself as one of the few advocates his students had, believing that "many other teachers" would prefer to work with gifted students and "not to have to deal" with special education students (I1). He was particularly concerned about his "partner teacher," a woman he felt alienated his students from school (I5).

Joseph had two in-school colleagues he worked with regularly. The first, his "partner teacher," taught the same students language arts and social studies. Joseph found her "really hard to talk to" because she had very different views about teaching than Joseph. Joseph worried that she "was oppressive" and "did not like kids": "I don't like her and she doesn't like me" (I5). Nonetheless, he insisted they "collaborated" when they needed to track student progress (I5).

Joseph had a much more positive view of the other colleague he worked closely with; Mr. Durban, the "master teacher" for his student teaching assignment. In order to earn his secondary science credential, Joseph gave up one of his planning periods to fulfill the student teaching requirement with "regular" students (I1). Mr. Durban was an eighth grade science teacher with seven years of experience, all at Adams Middle School, and as Joseph described him, "a really good teacher" who "does a lot of labs and activities, not much lecture" (I1). Joseph described their working relationship as "co-teaching" lessons his master teacher had developed over the years. Joseph found the eighth grade class was "a real contrast" to his special education classes; he could "do a whole lot more teaching" and a "whole lot less discipline" with the regular education students (I2).

Joseph's comments about the difference between his special and regular education classes suggest a conflicted view of his students' abilities. On one hand, Joseph viewed

his students as more capable than their special education label implied. Yet, he did a "whole lot more teaching" with his regular students. Joseph's comments suggested that behavior problems lowered his expectations for the special education students:

> I can't get that specific. I try to keep it simple. These are complex topics. The book has lots of big words [my students] can barely read as it is...I don't get too complex. If I was in high school teaching general ed, it would be a totally different story. (I5)

Like Mary and Rita, Joseph's limited expectations seemed related to his ideas about middle schools. He did not expect his middle schoolers to remember much—recall the remarks quoted earlier: After all, he did not remember much from middle school, why should they? However, unlike Mary and Rita, Joseph used this point to emphasize the importance of teaching the "bigger things" that he wanted them to remember (I5), including attention to their special education identities: "It's my job to build them up every day. Every day I [say] 'I love you kids...I am so lucky to have you in my class...I'm so glad you're here...You're so smart'" (I5.

On one hand, Joseph did not expect much, yet, he wanted to build his students up; the juxtaposition is striking, and illuminates the paradox of Joseph's experiences teaching special education. He kept content simple, worrying that if things were too "complex" it would turn students off to school. That limited his expectations. Yet, Joseph also wanted to convey to his students that they were smart and capable. He seemed to manage this dilemma with his two curriculum goals: He would not expect his students to remember much factual knowledge, but he could set the stage for high school by shoring up his students' interest in learning; he would focus on stimulating his student's curiosity. For that, he relied on educational institutions apart from his school.

Non school-based curriculum activities. Aside from the contrast his student teaching assignment provided, Joseph did not draw from his partner teacher or Mr. Durban for his special education class. He seemed to assume what he learned there did not apply to his students. Joseph relied instead on two non school-based curriculum resources: his credential coursework and the University Medical School Partnership (UMSP). Both provided opportunities Joseph used to develop his curricular aims.

Several courses Joseph took heightened his attention to issues of social justice. These classes "touched his soul" (I1), in particular, a course on teaching culturally diverse learners and two seminars on schools as political systems:

> Its probably the best class I've ever taken...I'd like to take part two because I just want to know more...Everybody is racist whether they know it or not, whether its subtle or overt, whether its not even intended. Even I who I thought never had a drop of racism in me, I grew up in a black neighborhood and I'm not black...I thought I'm no racist. But ...I'm starting to realize that everyone has a prejudice...no matter how altruistic, no matter how kind and wonderful we think we are. (I1)

Joseph credited the class with heightening his sensitivity to his own racism and that of his colleagues (I1). And during that school year, Joseph brought up racism in several faculty meetings, even though he felt that the topic was not generally well received by his colleagues (FN6).

The education and politics seminars contributed to Joseph's convictions that the educational system needed reform. Joseph described the instructors as "cagy old 40-year veterans who bare all" (I2). Class discussions centered on "how the system is screwed up" (I2), and Joseph said that he learned the educational system was biased against poor or working class students. His students, for example, had to take the same standardized tests as regular students even though many could not read the questions (I5).

Joseph's sensitivity to racism and the broken educational system strengthened his convictions about his teaching responsibilities. He felt even more obligated to provide his students a different kind of school experience:

> I try to reach inside and touch their soul and their spirit and lift them up...to make school...a positive experience as opposed to the jail like feeling school gets...The whole building looks like a jail...It feels like a jail...We move back and forth to bells and it's so penitentiary like...I try to break them out of that...and add some fun and color and spice (I5).

Joseph relied on the University Medical School Partnership (UMSP) and his science methods instructor for resources that supported him as he tried to create a more joyful school experience for his special education students; both helped him "relate [science] topics to his students' lives" (I5). For example, Joseph included extensive treatment of the cardiovascular system because he wanted to address nutrition:

> [My students] go to Burger King. They go to McDonald's every day. They go to Taco Bell after school every day. They bring flaming hot Cheetos to school every day. Let's look at the ingredients...Look at this web site. It tells you the number one top five ingredients that cause heart attack and death. (I5)

He also included the unit because he knew he could rely on UMSP to bring heart specimens, sphygmomanometers, and stethoscopes that would interest his students.

Joseph pointed out proudly that USMP activities let his students escape the bookwork and worksheets they hated (I1). Joseph created posters of his students in medical garb dissecting fetal pigs (FN8). He got permission from teachers along the hallway so his students could race up and down, elevating their heart rates (FN8). His students' enthusiastic response strengthened Joseph's commitment to capturing their interest. (In the chapter that follows, I describe this in more detail.)

Joseph consulted his science methods instructor —a woman he held in high regard because of her focus on inquiry-based science teaching—for similar reasons (I1).

Indeed, it was in her class that he first learned about, and experienced, inquiry teaching. An introductory lesson captivated him:

> I'm really excited about inquiry learning, especially after...seeing how it worked on me. The first day she brought this box in...She said we'd have to wait three years to find out what's in it...She brings this cardboard box in and she makes us go around the room and ask yes or no questions...We're all trying to use our scientific minds to figure out what's in this damn box...I remember thinking my head off. What the hell is in that box? I've got to know! (I5)

The lesson served as a powerful example for Joseph. He too wanted to "make [his students] that damn curious...about what they're learning about (subject matter interview, 3/7/04). Joseph's fascination with inquiry became a commitment to questioning as a learning outcome for his students. Joseph subsumed inquiry within a life skill he considered essential for his students' political and social well-being. And so Joseph met with his instructor to map out his curriculum, consult about inquiry-based lessons, and collect curriculum materials, including a book of human body activities he displayed prominently on the sill of the whiteboard at the front of the room (FN1).

Summary: The importance of personal resources. Joseph relied primarily on personal convictions to develop his goals. His students and his credential courses shaped those convictions. Joseph wanted to provide a different kind of school experience for his students. Consequently, he de-emphasized factual knowledge in exchange for something he associated with scientific practice and everyday life – questioning everything.

Joseph was free to construct whatever curriculum goals he saw fit. As long as he turned his paperwork in on time, the administration left him alone (FN4). With an eye clearly on his students—who he saw as special education students and students of color and poverty living in a racist and classist society—Joseph created a classroom as a safe haven, protecting his students from his partner teacher and others in the school he viewed

as unfriendly and intolerant towards his students. Even the large, comfortable futon Joseph placed on one wall of his classroom communicated his intentions to provide friendly space.

He also had resources he could count on, and he used them to develop curriculum goals that opposed the "many ways school acted to oppress students" (I1). Joseph acknowledged his students needed to "know some important things in science" (I5). However, scientific knowledge was not the major learning outcome he intended for students whom the "system ha[d] failed" (I5).

I pause here for a moment to look back at Mary and Rita in comparison with Joseph. Mary's personal and workplace resources were limited; she could not make use of stronger outside resources. Rita's workplace influences—the sanctions—were so powerful they overshadowed her personal and non school-based resources. Not so with Joseph, his personal resources dominated. They shaped his negative perception of his school, fueling his activism and search for outside resources; at the same time, they limited his curricular expectations for his students. The dynamics thus far suggests getting to the hard place requires strong personal resources—knowledge of science and its practices, certainty that learners can achieve high expectations and professional commitments to stay the course— otherwise, the rock prevails. It remains to be seen whether similar dynamics influence the goals of the high school teachers.

Olivia Langston

> I hope they have a basic understanding about the most important things in biology, cells, photosynthesis, DNA, probably some ecology, evolution. (Olivia, I5)

Olivia's curriculum goals. Olivia Langston wanted her students to developed a "basic understanding" (I5). When asked to elaborate , she explained that she did not expect them to "know every single detail...because the human mind is not set up to remember thousands of specifics" (I5). Instead, she hoped that students would know "important information" about the "major themes in biology" (I5), including terminology and biological processes like photosynthesis and cell division (I1).

"Basic understanding"—as a goal—while still sounding minimal, is a bit more ambitious than the "exposure' or "recognition" aims of our middle school teachers, Mary, Rita, and Joseph.. While Olivia wanted students to remember "important information," her emphasis was on factual knowledge. Further, this did not include attention to scientific practices. Teaching "the facts" is commonly associated with traditional science education (National Research Council, 2000); it also reflected the long-standing priorities of her high school science department. I begin with Olivia—Bridget Jones—who headed west for a little adventure.

School-based curriculum activities. Olivia taught three classes of integrated science to 9th graders, one biology class to English Language Learners (ELL), and one biology class to 10th graders (her focus class for the study) at Baycrest High School. Her students were, in her words, "typical of urban schools": "Some kids...just absolutely remarkable and so into it...other kids [who] just don't care" (I1). With 40 students in her focal class, Olivia admitted that, "There were always going to be a few students who don't get it"; she just could not "do it all" (I5).

Although her department chair met with her weekly, Olivia viewed his advice somewhat skeptically since, as she said, "His classes are all honors and AP, so he has the best and the brightest and the kids who want to be there" (I1). The department chair also assigned another experienced biology teacher as Olivia's "biology mentor" whom Olivia met with a few times early in the year. However, both had so much to do and so little times, they soon stopped meeting (I1).

Olivia did consult with another biology teacher new to Baycrest, Mr. Patterson.[38] They sometimes carpooled, talking about what to teach, and occasionally even exchanging worksheets or other materials. But Mr. Patterson did not know any more about curriculum expectations at Baycrest than Olivia did, so both tried to get information and materials from more experienced department members. To their surprise, they had to "fight" to get that kind of support (I1).

Olivia felt that many of her department members were "not very friendly" and hesitated to ask them for assistance (I1). Eventually, she came to her own conclusions about their lack of support:

> I think it's due to people being busy themselves. They also had a teacher last year that was absolutely terrible and a lot of the teachers here don't stay for more than one year. I mean they have some core people, but Patterson and I were obviously new...I think it was just maybe a lack of motivation to help us because they think maybe that we're not going to stick around or we're going to be, terrible. (I1)

Not surprisingly, Olivia's perception of her colleagues shaped how she used them as resources. She avoided personal interaction, relying instead on curriculum materials she requested or found in her classroom files. Olivia regularly used a "binder" of materials that a former biology teacher in the department finally gave her, noting that it

[38] The department chair, Mr. Wong, insisted the teachers address each other by their surname as a sign of professional respect. To Olivia, the practice seemed "formal" and off-putting (initial interview, 12/9/03)

felt like dealing in "Black Market" goods (I2), when she finally got her hands on the binder, chockfull as it was with notes, tests, worksheets, laboratory activities, and tests keyed to the textbook.

The notes presented the textbook chapters in outline form (see Figure 5.1), and emphasized factual knowledge, the basic information Olivia referred to when she described her curriculum goal.

Chapter 7 ~ Mendel and Heredity

I. Vocabulary Terms
   A. Genetics: the study of heredity
   B. Heredity: the passing of traits from parents to offspring by means of genes located on chromosomes
   C. Genotype: the alleles that an organism possesses
      EXAMPLES: aa, HH, Cc
   D. Phenotype: the physical expression of an organism's alleles
      EXAMPLES: curly hair, brown eyes, freckles
   E. Homozygous: both alleles are the same
      EX: AA or aa
      - An organism can be homozygous dominant or homozygous recessive
   F. Heterozygous: the alleles are different
      EX: Aa
      - An organism can also be heterozygous for a particular trait

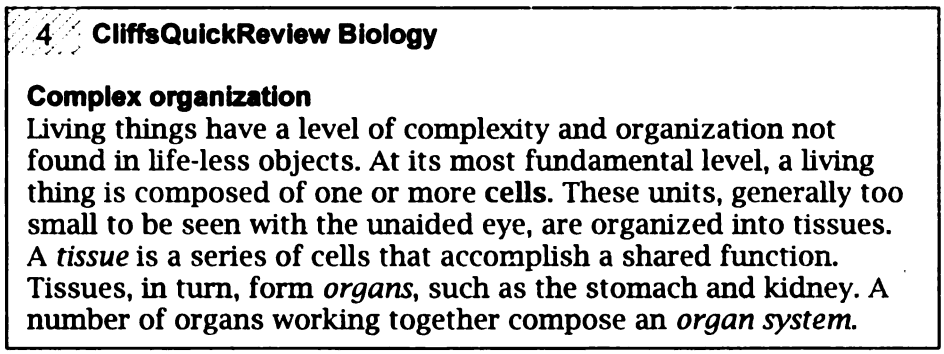
Figure 5.1 Notes from Olivia's Colleague's Binder

Initially Olivia hesitated to use the binder. She thought she should produce her own materials (I2). Soon she changed her mind: "Reinventing the wheel day after day... was adding a lot more stress...It got to be too much...So I just started to use more of her

resources" (I2). Although Olivia seemed apologetic about relying on the binder, she used the notes faithfully because, as she put it, "I decided every new teacher has to start somewhere" (I2).

Olivia relied heavily on the notes for another reason as well: she found the 1000+ page textbook difficult to use as a resource. The book had more information than she could possibly cover:[39] "I feel like [everything is] important and I need to find a way to cut it down because it's too much...for tenth graders" (I5). Olivia used the notes as a filter; she selected only the portions of the text covered in the notes indicated.

Olivia also purchased the Cliffs' Notes of Biology (no date) to condense the textbook into more manageable chunks (I5). The Cliffs' Notes emphasized the same type of information (e.g., definitions) as the binder notes but provided brief explanations of what one needed to know about the relevant information.


4 **CliffsQuickReview Biology**

Complex organization
Living things have a level of complexity and organization not found in life-less objects. At its most fundamental level, a living thing is composed of one or more **cells.** These units, generally too small to be seen with the unaided eye, are organized into tissues. A *tissue* is a series of cells that accomplish a shared function. Tissues, in turn, form *organs,* such as the stomach and kidney. A number of organs working together compose an *organ system.*

Figure 5.2 Excerpt from Biology Cliffs Notes used by Olivia

Although Olivia found the textbook difficult to use, she felt obligated to follow the lead of her science department colleagues paid little attention to other curriculum guides, like the standards (I1). Instead, they sequenced topics based on the textbook chapters and the state test, making sure to teach textbook chapters emphasized in the test

[39]Olivia's assessment is supported by Project 2061's reviews of high school biology textbooks, including Olivia's (American Association for the Advancement of Science, 2000).

(e.g., genetics) prior to the spring testing date. Olivia (and Mr. Patterson) followed suit (I1).

It also seemed to Olivia that the other science teachers used the textbook to pace themselves; measuring their progress through the year based on what chapter they were on: "As long as you are at chapter six by the end of the semester, you are fine" (I1). Olivia adopted this approach as well, criticizing a colleague who was on chapter seven when Olivia was on chapter ten (I2).

Non school-based curriculum activity. Olivia had few non-school resources for assistance. Mr. Wong reported he did not encourage Olivia to participate in the medical school partnership or the Exploratorium's TIP because he thought the programs "were mostly for middle school teachers" (I5). Thus, Olivia remained unaware of programs that might have served as important resources.

There was one exception. In January 2004, Olivia found about the district science professional development series (the "core activities" work—USP—described in chapter 4) from a professional development catalogue—a compendium the district published of professional development opportunities in the Bayline area. The 50-page booklet listed workshops, resources for field trips, museums and other cultural venues of interest to teachers (DA1). The catalogue arrived in Olivia's faculty mailbox in October; but she just had not had time to look at it until winter break; when she could finally decompress from her hectic last-minute start to the school year (I1).

USP caught Olivia's attention; she welcomed the opportunity to meet some new faces—other biology teachers in the district—and get few curriculum activities to augment the binder (I2). Olivia thought of herself as a "creative" person—she wanted to

have a little variety and spice in her teaching--but the rush to start the year and the materials she had meant putting creativity on hold (I2). Olivia attended two after school and one release full-day session; learning about the two core activities she would teach, using them in her classroom, and reviewing student work with her district colleagues afterwards. Olivia liked her USP work very much; she found meeting non-school colleagues "refreshing" and treasured the "creative, hands-on activities" (I5). (I return to those activities in Chapter 6 when discussing student engagement.)

Although the USP work intended to focus teacher discussion on scientific practices, Olivia seemed more focused on checking out her department chair's requirement that students type lab reports. Mr. Wong patiently explained to her—and later, to me (I1)—that he had "high standards for student work." (I5). Unsure of the necessity of the typing requirement, Olivia checked with her USP counterparts for alternative approaches:

> Instead of having her students type up labs, [one teacher] has them buy a composition book at the beginning of the school year... she has them write their labs out in there... That's one thing I would consider doing because...for a lot of students [typing the report] just seems like a really big hassle...and you don't have to deal with students try[ing] to print up copies for their friends. (I6)

Although USP work offered opportunities for rich discussions about content—scientific knowledge and practices—the experience did not appear to enrich Olivia's curricular expectations; she did not talk about content differently, did not address scientific practices in new ways. The few labs she did afterwards were still formulaic, recipes students followed and wrote up—the "scientific method" in Chapter 1 of the text; six steps, no deviations except for one, they no longer had to type them (I5/CA1). No doubt, this was not the outcome Eric Ceresi—the district science curriculum specialist—

envisioned as he carefully designed the USP series using all the "right" models of reform-based professional development—the sessions were ongoing, intensive, collegial, and focused on big ideas, inquiry, and student thinking.

What explains the limited influence USP had on Olivia's curriculum goals? It certainly is possible that the workshops Olivia attended paled in comparison to the vision of the designer; reality is seldom quite as spectacular. I did not attend any of the biology sessions myself; the physics session (I observed one after-school session) did involve rich discussions of content. That said, for the sake of furthering the argument, let us assume those session did provide such opportunities; I suspect the outcome would have been the same: Why?

Recall from chapter 2 that Olivia was not very confident about her subject matter knowledge—it was adequate, but she was certainly not on fire (as Joseph was) nor did she have a passion for inquiry or scientific practices as he did; Olivia was salt-of-the-earth, not a revolutionary. Her solidly middle-of-the-road personal resources and the bureaucratic, unfriendly atmosphere Olivia encountered in her school seemed to dull her experience with USP; washing any potential intellectual vitality away. There was also no one in Olivia's workplace that encouraged her energize her practice or try new things; certainly no one to "run home to" with new ideas, fresh approaches, higher expectations for students (for instance, Olivia kept her relaxed rules about typing lab reports to herself). For Olivia, USP was another little adventure, a bit of fresh air from her restrictive workplace environment.

Summary: Confinement to the workplace. As a first-year teacher, Olivia was hesitant to trust her own judgments about what she should teach. Uncertain, about what to

teach and what to expect from students, the colleague she could count on most--Mr. Patterson—was in the same fix. Thus, workplace resources shaped Olivia's curricular goals by prioritizing factual knowledge. All of those resources—textbook, notes, colleagues—pointed her in the same direction: → the rock of basic information.

These resources also explain why Olivia did not mention scientific practices among her goals. Following department norms, she leaned heavily on the textbook version of the scientific method. In doing so, she treated scientific practices as procedural knowledge, steps to memorize. The scientific "method" became basic information for students to memorize. This perspective, combined with her personal resources, shaping her participation in USP.

Although heavily influenced by her department colleagues, Olivia felt like she was working alone. She used their materials, but did not feel personally connected to any of her colleagues. "It really bothered me at the beginning of the school year that people were so resistant and so unhelpful. But now it's fine because I'm developing my own things and I'm going to do it my way and be good at what I'm doing" (I5). Yet, Olivia's "own" way seemed remarkably similar to that of her unhelpful colleagues, suggesting the powerful—if sometimes invisible—effects of institutional norms.

Steven Anderson

> I feel biology in general is...a lot of background information...you have to lay the groundwork first. (Steven, I1)

Steven's curriculum goals. Biology, to Steven Anderson, was background information. Although he seemed rather unclear about what he meant by "background information," Steven appeared to mean something akin to Olivia's focus on definitions

and facts. Steven explained that "mastering the background" meant "having the vocabulary...[and] getting the details of biology" (I7). The example Steven provided – knowing the steps involved in cellular respiration and photosynthesis (I7)—also suggested factual and/or procedural knowledge.

Steven had a somewhat conflicted stance towards his curriculum goals: "The back of my mind...is screaming – 'Biology does not need to be rote memorization!'...but it really kind of does" (I7). He admitted that his views were "a lot different than most people who think that biology...can be really fun and interesting (I7). For Steven, "the real beauty [of science] lies in understanding the details" (I7): "Once the details are taken care of, you can go on to synthesize, get more global...or draw more connections" (I7).

Steven maintained that he could only make those connections in advanced science courses. Consequently, he found ecology, for example, much more interesting and satisfying to teach than biology (I1). To illustrate his point, Steven compared his experience teaching biology and ecology as a student teacher:

> I [felt] like I was teaching when I was teaching ecology ...I have an understanding of ecology. I have a passion for ecology...I think that you can apply a lot more things...the sort of real issues...that are important...When it comes to teaching biology, as much as I love it and I understand it, its harder...[not to] see it as a bunch of information which gives you background in order to appreciate all these other things. (I1)

Despite access to resources that offered alternative curricular perspectives, Steven held to his conviction, equating biology with factual knowledge, the "basics." These personal views shaped his curriculum goals.

School-based resources. Recall from chapter 2 that Steven—the former research assistant on a global warming project in Alaska, avid outdoor athlete, and environmentalist—taught 10th grade biology at Fernandez High School. Remember also

that he was uncomfortable with what he called his students' "overly-aggressive behavior" (I1). Steven admitted, apologetically, that he did not give his students "much credit for having very good critical thinking skills" (I1). As the year progressed, Steven had continuing difficulties connecting with his students—personally and professionally. He was "intolerant of the excuses...for not getting [work] done and the behavioral problems" (I5), and while he acknowledged "how hard many of [his] students have it," he could not "see [himself] getting used to dealing with...so much emotional baggage" (I5).

Although Steven was uncomfortable with his students, he appreciated the opportunities he had at Fernandez to work with colleagues. The school ran on a block schedule, grouping students and teachers into teams; five teachers (English, Mathematics, Science, Social studies, and Foreign Language) shared a little over 100 students. The schedule afforded Steven two planning periods. One coincided with his "teach alike," Felicia; the other was used for team members to co-plan. Steven had additional time after school on Wednesdays, an "early release" day, for faculty meetings, science department meetings, or to work with Felicia.

Steven planned his curriculum primarily with Felicia on, noting that the team "talked more about individual students" and the science department "dealt with general science issues" (I1). Felicia and Steven planned their lessons together, shared materials and responsibilities preparing them, and kept pace with each other throughout the year. Since Steven and Felicia were both first-year teachers—like Olivia and Sanderson, two beginners trying to figure things out on their own—they often were not sure "exactly how much content to include" (I1) and relied on their department chair, a five-year veteran at

the school, for advice. The department chair, Larry West, gave Steven and Felicia the curriculum materials he used when he taught the course.

While Steven indicated the materials he and Felicia inherited from Larry were "definitely helpful," he also found "the lesson plans [were] not really explicit" (I1). Consequently, Steven and Felicia developed many of their own materials (e.g., handouts, overheads, homework) for the course. Steven indicated he would have liked more opportunities to plan lessons with Larry but "did not expect that" (I1). According to Steven, Larry was "plenty supportive" and someone who "would probably do anything [Steven and Felicia] asked him" (I5). Nevertheless, he hesitated to impose on Larry's time (I5). Although Steven's situation might have made non school-based resources more influential, that was not the case.

Non school-based resources. Steven admitted he made limited use of the non school-based curriculum resources available to him. Steven did not respond to emails offering assistance from Eric Ceresi, the district high school science specialist although he "meant to" (I1). He did not "get along" with his NTIP mentor, Maura Landry, explaining that he "did not find [Maura] helpful in terms of ...classroom teaching" (I1). Maura sensed Steven's resistance, especially to feedback she provided after lesson observations (I1).

Steven gave three reasons for his reluctance to work with Maura: (1) She was not a science teacher, which made Steven doubt the "credibility" of her assistance, (2) Their personalities "just didn't mesh" (I5), and (3) he found the FAS process less than intriguing, to say the least. For instance, Steven called the term used for the collection of his work—padfolio—"sickening" and 'professionally insulting" (I7).

Steven was, however, well aware that he needed Maura to "sign off" on the induction tasks required to clear his credential, and he approached the tasks and Maura with that attitude: "Let's just get these things checked off and get through this" (I10). Although Steven admitted if he was "more receptive" he might "have gotten more out of" the NTIP program, he maintained, "At this time, I don't really see any other benefit to doing this" (I10).

Steven gave the Exploratorium TIP more favorable reviews, describing it as "great for hands-on activities, finding science materials and other resources for teaching, and providing models and representations" (I2). At one TIP meeting, Steven and Felicia worked with the mentor, a veteran biology teacher, to map out their curriculum sequence for the year. Yet, despite Steven's favorable outlook on the Exploratorium program, he described his participation as "pretty minimal" (I5). Steven selected a few workshops to attend and participated in the summer institute.

If anything, Steven's association with the Exploratorium (along with his memories of his teacher preparation program) appeared to contribute to a negative assessment of himself as a teacher. Steven often spoke apologetically about his approach to the curriculum as an "information giver," even though he had "seen the statistics...and knew kids don't learn best that way" (I5). Steven viewed his teacher preparation program and the Exploratorium as encouraging "active learning" goals for students, goals that he did not associate with his stance as an "information giver" (I1). Yet his focus on information as his curricular priority did not appear to lessen. Steven admitted this and attributed it to his "stubbornness" (I5).

Steven's goal appeared to stem from other sources, in addition to his "stubbornness." As his assessment of his students indicated, Steven did not think they could handle ambitious work. Yet, Steven sensed his teacher preparation program and the Exploratorium pressed for more than factual knowledge. This created a conflict for Steven that troubled him and, as he put it, made him feel "inept" (I1). This was a new experience for Steven. During his student teaching, his supervising teacher had "a similar teaching style" to his own (I1). Steven began to suspect his teaching style—the information giver—was not compatible with his Fernandez students or with the goals of others whom he encountered in his school and in professional development opportunities.

Summary: Personal resources take precedence. Rather than reach outside his comfort zone, Steven appeared to pull further inward, admitting that he occupied a rather solitary position with views "different than a lot of other people" (I7). Steven also acknowledged he "kind of knew coming in" to his first teaching position that he "enclosed [himself] quite a bit in [his] teaching" (I5). As Steven put it: "I shut my door for a reason and I'm OK with that" (I5).

Early in the year, Steven himself predicted the outcome of his tendency to prioritize personal convictions: "That's just the way that I am and do and have operated... it's not serving me well but I'm still sticking with it" (I1). It is not surprising, then, that his curriculum goals did not advance beyond those he brought through the classroom door in the fall.

Felicia Baker

> [Biology] is both teaching about [a] body of knowledge...[a] history of all of the things that we've figured out up to this point as a society. But it's also about doing science...discovering things, making hypothesis, then making observations, drawing conclusions. (Felicia Baker, I7)

Felicia's curriculum goals. Felicia described two things she wanted her students to learn – factual knowledge and something she tentatively called "doing science" (I7). Felicia struggled to elaborate on what she called a "more balanced" approach to curriculum than the one she developed with Steven:

> I don't think I'm describing it very well...what this balance is. But when it came down to it a lot of [our curriculum] was based on words and memorizing facts...But [biology] is also about teaching ...how scientists find things out. (I7)

Felicia went on to explain that, although "high school students could not just look at a plant and discover the Krebs Cycle," they could learn how to "discover [other things]...by watching a plant grow" (I6). As Felicia acknowledged, she was not yet able to describe what she meant very well. However, in attempting to do so, she seemed to point towards curriculum goals related to scientific practices.

Felicia's reliance on school-based curriculum resources contributed to her curricular aims. As in Olivia's case, these resources (e.g., her planning partner, Steven) emphasized factual and procedural knowledge. However, her goals also suggest Felicia developed in a different direction from either Olivia or Steven, for her goals included learning about science as a process of 'finding things out." These goals reflected differences in resources and Felicia's use of those resources; most notably, her commitments to scientific inquiry, views of her students' capabilities, and use of resources focused on inquiry-based science teaching.

School-based resources. Recall that Felicia, the intentional chooser we first encountered in chapter 3, elected to teach biology at Fernandez because she preferred the professional conditions to Baycrest (Olivia's school). Like Steven, Felicia had two planning periods to meet with Steven (her "teach-alike"), the science department, and her

team. Felicia reported that she primarily worked on her science curriculum with Steven I1). When Felicia described how she and Steven planned their curriculum, she noted the state science standards were a guide but not a driving force for their work:

> When we start to plan a new unit we'll go back to the standards and take a look at them and make sure we are generally in line with them...We probably should be aligning our daily objectives more closely with the standards but we don't. (I1)

In lieu of the standards, Felicia pointed to two other resources she and Steven regularly used: the biology textbook and Larry West's biology syllabus, which provided a "skeleton outline" of topics to include (I1). Just as Steven reported, Felicia said that they planned lessons and developed additional materials "pretty much on [their] own "because the department chair—whom Felicia also admired—"was pretty busy" (I1).

Even though Larry was often unavailable, Felicia did have occasions to talk with him; she took those moments as opportunities to discuss ideas about science and teaching. For instance, when Felicia, Larry, and Steven attended the NSTA yearly conference together, she vetted her ideas about science content—as knowledge and practices—with him; he encouraged her and her participation in the Exploratorium—Larry was a former Exploratorium new teacher participant himself (I1). On another occasion, Felicia, concerned about teaching evolution—with its attendant controversies—consulted Larry; he was generous with his time and guided her with his own experience. Felicia left the discussion, reassured, she would use the occasion to address what constitutes scientific evidence as well as teaching one of the central theorems of biology—change over time (I10).

These opportunities to work with Larry were, perhaps, too few and far in between to influence Felicia's curriculum goals appreciably. Felicia had little to go on other than

topics listed in the textbook, inherited curriculum materials, and the standards. Her primary collaborator for curriculum was Steven, who, as already described, viewed biology as background information. However, unlike Olivia, Felicia and Steven did not indicate any press by their department colleagues to approach the curriculum in a particular way. This left open the possibility that these two new teachers could develop in their own way. In contrast with Steven, Felicia relied on other resources, and her development reflects those differences.

One resource was in her school. When Felicia described her ideal classroom, she referred to the Active Science Project (ASP),[40] a classroom just down the hall from her own. There, Felicia had daily opportunities to see students, including some of her biology students, busily engaged in all kinds of science activities. She saw them designing model cars, working with chemicals, and exploring magnets (I7), and she equated this activity with "doing science." As Felicia watched students absorbed in doing science, it reinforced Felicia's commitment to do more science in her classroom as well.

Non school-based resources. Felicia's growing concern that she should attend more to science as a process reflected the norms of her teacher preparation program, the Active Science Project, the Exploratorium TIP, and the University Medical School Partnership. Felicia said that these resources reminded her that science was not only a body of knowledge but also a process of discovery (I7). She used these resources as benchmarks for evaluating herself as a teacher. However, when she noticed

[40] Active Science Project (ASP; a pseudonym) was part of the NSF-funded local change initiatives; several schools in Bayline had a classroom designated for Active Science staffed by a full-time "director"—an adult, not necessarily a certified teacher, experienced in leading inquiry-based activities. Teachers could bring their students to the classroom for inquiry-based activities; students also went to ASP after school. In addition, the ASP director provided teachers with activities and supplies to use in their classrooms. ASP had presence in two participant schools, Meriweather (Mary) and Fernandez (Steven/Felicia). The influence of ASP is discussed in more depth in the next chapter on intellectual engagement.

discrepancies, in contrast with Steven, Felicia's subsequent discomfort strengthened her resolve to expand her goals.

Felicia was critical of her teaching, she "was not the teacher she would be five years from now" (I7). Her main self-criticism was her heavy emphasis on "memorizing facts" and not enough attention on "doing science" (I7). Felicia evaluated herself based on what she called "the strong philosophy of...inquiry-based learning" promoted by her teacher preparation program (I1). She found it "very difficult to incorporate much of what she learned from [her teacher preparation program] into her teaching" (I1), and she made similar comments about the Exploratorium TIP. While she valued the program's focus on exploration and discovery, she knew she was not living up to Exploratorium TIP standards in her own teaching (I1).

When Felicia described the teacher she wanted to be in the future, she used these institutions as markers for what her teaching would look like. She would include more "hands on work," "project-based work," and "inquiry activities" (I7)—these are the focus of the next chapter. And she drew on these resources to strengthen her conviction that a strong science curriculum included attention to science as a body of knowledge and a process.

Summary: Keeping the faith, the interaction of personal and social resources. Felicia believed experience would help her develop "better abilities to manage the classroom" so she could create a "better . . . environment" (I1). Experience also would provide both the time ("I will already have a curriculum to work from"), and the familiarity with materials and resources necessary to support her emergent "doing science" goal (I1).

Others supported her views about experience. For example, after an observation by her Exploratorium coach, Felicia "had the impression" her coach also felt the students "were difficult to manage, especially for a new teacher" (FN9). In another instance, Felicia recounted advice she received during a meeting with alumnae of her teacher preparation program. The alums encouraged the novices to view their teacher preparation as a resource for future development, "Think of your preparation here as a foundation," they advised, "Hold on to this education. It will be useful later even if it doesn't feel like it's useful now" (I1). Felicia interpreted these comments as evidence that, "It's virtually impossible to be a good teacher as a first year teacher" (I1). She also used those remarks to push herself to do more.

At the end of the school year, Felicia said that one of the most important things she learned was "a better idea of the kind of teacher I want to be in the future" (I7). Felicia described that teacher as someone who "focus[ed] more on having kids do science and still maintain[ed] a certain amount of teaching them about science" (I7). Although Felicia did not yet have a firm grasp on how she intended to address "doing science," she appeared to link it with activities (the focus of chapter 6) (I7).

Felicia's attention towards doing science seemed to heighten throughout the year as she participated in programs outside of school that emphasized scientific practices. Felicia leaned towards doing science but was uncertain how to go about it. It seemed too much to take on her first year. Nevertheless, she kept her commitment alive, observing her students doing science in ASP and engaging in scientific practices herself at the Exploratorium. She was encouraged to be patient and keep working towards her goals. Unlike Olivia, Felicia had department chair—Larry—that she respected, someone she

could run home to and share ideas with, even though he was often busy. These opportunities apparently convinced Felicia she would gradually find the "right balance" between scientific knowledge and practices.

Mark Bonner

> My goal is that [my students] will come to look at the world and see that it's not just something that provides them with stuff but it's something they can understand on a deep basis...and they should learn about the process by which scientific knowledge is obtained. (Mark Bonner, I4)

Mark's curriculum goals. Mark Bonner's goals for his conceptual physics classes were different than those of other study participants and more closely matched with the ambitions of science-for-all, for he emphasized both understanding (rather than information) and disciplinary practices of science.

Mark used some examples to explain what he meant by deep understanding, "So, when my students see an ice skater twirling...it makes sense to them. Or, something dropping and heating up...they can make sense of what's going on there" (I4). Mark did not seem to view understanding of phenomenon as preparation for another science course, college, or a career. Instead, he framed his curriculum goals in terms of understanding phenomenon encountered in the everyday, ice skaters twirling or objects dropping through the air (I4).

Mark's goals involved scientific practices. He explained his commitments: "In a science class [students] should learn about the process...by which scientific knowledge is attained, the process by which we come to know" (I4). Mark admitted he had "not done a great job" with that goal but wanted to focus more on it in the future. Mark contended "he

had to get [his students] to understand science [as a process by which we come to know] so [the students] would be able to understand the limitations of science" (I5).

Mark's ambitious goals reflected reforms supported by his personal, school-based, and non school-based resources. He paid particular attention to curriculum resources focused on physics. Resources Mark perceived were not physics-based, like his credential program at the Bayline Teachers' Cooperative, appeared to play a minimal role in shaping his content goals.

School-based resources. Recall from chapter 3, Mark, the study's physics expert, taught Conceptual Physics (CP) at Frederick Douglass High Douglass, a science and engineering-focused academic school with commitments to teach all students science; Mark felt privileged to teach there, rather than at one of the selective high schools in the district.

Douglass had a block schedule similar to that at Fernandez. Mark's CP students were primarily seniors. CP was not a required course, although Mark said many students enrolled to add a third science lab course to their transcript. Students took CP, rather than "regular" physics, because CP was not as math-intensive (I1). Mark noted with pride that the students enrolled in his class typically were not represented in physics classes. Mark pointed out he had "never had a white student" and most of his students were from low-income families (I1).

Mark acknowledged that his students had a "wide range of ability levels" (I1). However, he did not see this as a deterrent to learning physics; recall Mark's stance form chapter 3: "Everybody has lots of experience in physics. They just don't know it" (I8), He viewed his role as one of "tighten[ing] the bond between the terms and all the

...formalism of physics and [his students] everyday experience" (I8). Mark also respected the "specialized knowledge... a lot of [his] students brought" to the classroom (I4). For example, Mark found many students were much more familiar with engines than he was (I4).

Mark drew on three resources in crafting the curriculum for this course. The state physics standards were a "baseline" I4); the textbook (a well-reviewed conceptual physics text) and an "excellent" curriculum he inherited from the prior CP teacher were also important resources. Mark used these resources so as to "make sure [that he] didn't forget anything important" (I4), but he also felt free to add things he "thought it was important for [students] to know" (I4).

Mark regularly consulted with his science and math colleagues as well (I8). Mark "worked closely... with the physics teacher...because she taught [conceptual physics] before" (I8). While he considered it his responsibility to create his own materials, Mark relied on the physics teacher because she was "familiar with the aptitude of a typical conceptual physics class" (I8). Her commitments for helping all students understand physics were similar to his own (FN8), which also made him open to her ideas and experiences. Mark also reported working with a colleague who taught mathematics, often consulting her for ideas about how to support his students' abilities to utilize formulas and other mathematical representation common in physics (I5).

Non school-based resources. Mark concentrated his efforts during the year on curriculum resources he perceived would benefit his students and/or enrich his knowledge and skills for teaching physics. For example, Mark arranged his credential courses around after-school times he spent preparing students for the AP physics exam

(I1). He also helped students after school with engineering and science competitions (FN8).

Mark had two criteria for judging the physics-based programs he participated in: (1) how well they helped him "figure out how to teach" CP topics, and (2) the sophistication of the content. When he attended an after-school USP workshop on optics—to "get ideas on how to teach it"—he appeared more knowledgeable about using the equipment than the workshop leaders; often taking the lead in their discussions of light and lenses (DFN2). It was not surprising, then, that Mark did not return to the release day follow-up because he did not want to leave his students with a substitute. He suspected, based on previous experience, "they wouldn't learn anything" (FN10) and neither would he.

Recall from chapter 4, the two physics professional development groups mark attended—the Physics Teachers Resource Association (PTRA), a refional physics teachers group and QuarkNET at the Stanford accelerator facility (SLAC). Mark was not as happy with PTRA as he had been the year before; attributing changes to a shift in leadership and participants (I5). Mark found "things moved a little slowly [for him at PTRA meetings]...because of a group of teachers in there who aren't really comfortable with physics" (I5). On the other hand, Mark rated QUARKNET "excellent" because it provided him "more knowledge...really good activities...[and] idea sharing" (I5). Mark summed up his experiences at QUARKNET with a simple statement, "It gets me excited to teach" (I5).

Summary: Syzygy[41] *of resources*. The goals Mark developed over the first years of his teaching reflected a strong alignment of personal, school-based, and non school-based resources. He entered teaching with strong subject matter knowledge, and although he had no coursework in teaching physics, Mark consistently drew on his undergraduate physics education and experience as a teaching assistant. Mark was committed to his students as capable physics learners, and the school mission—and his colleagues—were aligned with his own ambitious goals. Even the title of the course – conceptual physics -- emphasized understanding. Finally, Mark carefully selected resources to support teaching for understanding; unlike Mary, he had the expertise to do so.

Mark's sense that he needed to focus more on science as "a process by which we come to know" reflected his personal resources and his involvement with QUARKNET (where he participated in scientific research). Mark pointed out that his experience as a physics major impressed upon him the importance of helping students connect the practices of science with the knowledge science produces (FN5). Mark also reported regular discussions with QUARKNET participants about the practices of scientific research and implications for the classroom (I5).

Mark's background in physics and his participation in QUARKNET appeared to heighten his attention to shortcomings in his conceptual physics curriculum. Mark sensed he had not sufficiently emphasized the disciplinary practices of science. He feared his intense focus on conceptual understanding obscured the processes that informed the development of those concepts. Mark went on at length about his views:

> You know, if my conceptual physics course is the basis for ...educat[ing] people for science it would be a very dangerous thing because it's sort of observe and

[41] Syzygy - The nearly straight configuration of three celestial bodies (as the sun, moon and earth during a solar or lunar eclipse) in a gravitational system (Merriam-Webster online dictionary)

> learn...and that's how science is done. But there's [also] making hypotheses...deciding how to test something, writing a procedure, setting it up, testing it, finding out it didn't work, finding out something broke, everything is screwed up, trying to figure out how to fix it, look[ing] back at the data. (I5)

Mark's rationale was not just about scientific practices, but just as importantly, involved disclosing the "limitations of science" (I5); for instance, error, testability, and technology. Mark pointed out that the disciplinary methods of science could not make claims about things that could not be observed or be subjected to experiments and science was not the only way (or most important way) of knowing. And while technology brought many advancements (e.g., engines), it also created problems (e.g., pollution).

Mark did not think he had sufficiently addressed scientific practices in his course, which limited what his students understood about science; he made this point by comparing his course to a field trip to the Exploratorium:

> [My] course was designed almost like a trip to the Exploratorium in a way...It's fun, hands-on, and you're learning a lot of science topics. You go through the Exploratorium and...it's a year in physics. But the problem is, you don't get any sense, nothing against the Exploratorium, I love it, would love to see it in every city in the world, but if you limited your science understanding to that you would never understand how science knowledge is acquired, and therefore, you'd never understand the limitations of science (I5).

Mark's personal resources, school-based resources, and non school-based resources all supported teaching for understanding and attention to the disciplinary practices of science. Mark used these strongly aligned resources to develop goals that (1) addressed understanding of physical phenomena, and (2) the practices of science that led to those understandings. Mark's personal resources meant that he could select and make use of other resources; these, in turn, reinforced his goals and directed him → to the hard place.

Patterns Across Teachers:

A Little More to Give, A Little More To Get

Only one of the study participants, Mark, developed the ambitious curriculum goals that science-for-all reformers advocate. Mark wanted his students to understand important scientific ideas and disciplinary practices. None of the other teachers addressed understanding. They limited their expectations to recognition or factual knowledge.[42] However, several teachers did address scientific practices. Yet, their versions seemed less rigorous than reform documents propose. Rita took a skills-based approach. Joseph targeted curiosity and questioning. Felicia's notion of "doing science" was difficult to assess because it was still emergent.

As (Cohen et al., 2003) proposed, the differences in resources available to the teachers and how they made use of them explain the goals they developed. Personal resources that participants brought to their curricular work provided a starting point for their goals. These influenced how they interpreted and used other resources. Their use of other resources, in turn, influenced the goals they developed.

Mary interpreted other resources through the lens of her limited personal resources. Mary had neither the content knowledge nor the will to expand her curriculum goals. Steven's deep-seated beliefs about high school biology as an information course focused his attention solely on factual knowledge. Joseph interpreted his curriculum work in light of strong convictions about schooling and oppression. Felicia's and Rita's interests in scientific inquiry drew them to inquiry-based teaching and learning resources.

[42] It is important to point out that understanding important scientific ideas includes factual knowledge. However, factual knowledge alone does not imply understanding. Lists of disconnected facts are of little use for tasks that rely on more than memory. Understanding requires organization of factual knowledge into what Bransford, Brown, and Cocking (2000) call "usable knowledge" (p.9).

Olivia's uncertainty about what to include in her curriculum fueled her dependence on others. Mark's passion for teaching physics focused him on physics-based teaching resources.

The central role personal resources played in shaping teachers' use of other resources is similar to Spillane's (1999) findings about mathematics instructional reform policies and teachers' classroom practices. Based on his findings, Spillane suggested "[T]he potency of [policy] incentives in getting teachers to reform the core of their practice, absent some threshold of knowledge and skill, is limited" (p. 169). In the model he developed, Spillane placed personal resources at the center of teacher learning because they acted as a filter for "noticing opportunities for learning" (p. 169). Spillane contended " [teachers] process new information and ideas about practice through their existing knowledge, beliefs, and convictions" (p. 169). Spillane referred to the use of personal resources as "sense-making" (p. 169).

The findings from this study suggest personal resources played a similar role as study participants developed their goals. Personal resources directed their attention in curriculum activity. They made sense of social and conventional resources consistent with their beliefs, knowledge, skills, and will. In some cases, personal resources directed them towards resources that supported ambitious curriculum goals. For example, Rita interest in scientific inquiry drew her to USP and the Exploratorium. In other cases, personal resources focused attention in different directions. Steven, for instance, did not have the will or skills to use resources that required more than information transmission.

While personal resources filtered what teachers noticed and used, social and conventional resources enabled or constrained their goals. Students and colleagues were

important social resources. School norms varied in strength and focus. Conventional resources typically involved standards, textbooks, and inherited curriculum materials. Very few teachers encountered school-based resources that supported ambitious goals. A comparison across teachers clarifies differences in workplace resources and their use.

Students were significant, most notably influencing the teachers' expectations. Teachers interpreted student aptitudes, work habits, and/or behaviors in light of their personal beliefs about students' abilities, their past experiences, and their current ones. For instance, Joseph pitched his curriculum goals within the confines of his students' reading difficulties. Steven used his students poor work habits and behavior to justify his limited demands. Watching her students in the ASP classroom reassured Felicia they were up to the challenge of doing science.

With the exception of Mark, collaboration with colleagues supported traditional curricular aims; few inspired or encouraged new ways of thinking and doing. Olivia, Rita, Felicia, and Steven all had regular opportunities to plan curriculum with others. However, these collaborations tended to reinforce traditional goals. It is worth noting that each of these teachers primarily planned lessons with another novice teacher. While this may have contributed to conservative goals, working with experienced colleagues may have had a similar outcome. Olivia had such opportunities, as did Mark. Olivia's goals reflected her colleagues' traditional approach. Mark's goals were consistent with his colleagues' commitments to science-for-all. The contrast between Felicia's department chair—busy as he was—and Olivia's, who met with her regularly, is a reminder that the intellectual quality of conversations with colleagues, not necessarily their frequency, matters most.

School-based conventional resources also favored traditional goals. Teachers primarily relied on three resources: textbooks, standards, and inherited curriculum materials. Textbooks and standards were at opposite ends of the spectrum. Textbooks were tomes of factual knowledge. Standards were lists of important topics and ideas. The former told too much, the latter too little. Inherited materials primarily consisted of factual knowledge tools, outlines, syllabi, and notes. No wonder, then, that recognition and information acquisition prevailed. Only Mark had access to tools better suited for ambitious ends (and resources to use them for those ends).

Accountability measures also influenced what teachers expected from students Middle school science tests were not yet in place. However, high school students did take state science tests. The differences in test accountability help explain the differences between middle school and high school expectations. The middle school teachers did not expect students to remember much, and their high school counterparts favored the factual knowledge emphasized on the state examination.

The influence of workplace norms was especially noticeable when teachers perceived a strong directional pull. Mark sensed a school commitment to ambitious outcomes. Compliance with state sanctions was tangible in Rita's school, enforced in the BBC and EDI. Olivia and Rita's colleagues gauged progress by the number of textbook chapters they covered. Mary's administrators did not hold her accountable for the eighth grade. Again, with the exception of Mark, these norms favored traditional goals.

Curriculum resources outside the workplace were more likely to promote educational reform. Department chairs acted as brokers, informing teachers of professional development opportunities; encouraging them to participate, or sometimes,

as in Olivia's case, deciding for novices what they should, or should not, do. When teachers perceived a strong curricular direction in their workplace, they reshaped outside resources, if necessary, to fit. Mark changed his credential program so he could work with students after school. Rita used the standards to evaluate outside resources and construct a version of inquiry compatible with EDI. Olivia molded USP discussions into conversations about traditional tools, like the surface features of lab reports.

"Outsiders" did have influence, but only when personal resources helped teachers notice opportunities; even then, outside resources were molded to the workplace; amalgams formed that often bore a pale resemblance to what designers intended. Mary, Felicia, Steven, and Joseph, who did not perceive a strong curricular direction in their workplace, tempered outside resources with personal preferences. Mary and Steven limited their use of reform-minded tools and norms. Their traditional curricular goals reflected those limits. Felicia leaned favorably towards the Medical School Partnership and the Exploratorium, resources promoting hands-on exploration; resources that strengthened her focus on doing science. Joseph's goals reflected the compatibility between his own convictions and the social justice/inquiry perspectives his credential program offered.

Conclusion and Implications

The curriculum goals teachers developed suggest personal resources—understanding scientific knowledge and practices, certainty that all students are capable learners, and strong commitments to teaching in urban schools—play a primary role in drawing attention to other resources. These resources form a "sense-making" system

(Spillane, 1999); directing teachers attention to some learning opportunities and away from others.

School-based curriculum activity typically provided weak support for ambitious goals. Billett (2000) identified three "key contributors" to workplace development: "engagement in everyday work tasks, direct guidance [by] co-workers, and indirect guidance provided by the workplace itself and others in the workplace" (p. 64). Most of the teachers relied on everyday work tasks and indirect guidance. Rita and Olivia also had direct guidance from others. Regardless, with the exception of Mark and Felicia, these key contributors favored traditional curriculum goals. Resources to support ambitious undertakings were not available or rendered useless, important ideas highlighted by the standards were covered rather than understood. Attention to scientific practices was, largely, non-existent.

Reform-minded curriculum activity took place outside of schools. Teachers participated with an eye to their personal and workplace resources. They selected resources consistent with their personal resources. Outside resources also had to pass workplace screening. If reform-minded resources matched workplace goals (Mark) or did not conflict (Felicia), teachers were able to use them to support ambitious goals. When they conflicted with personal resources, teachers made little use of them (Mary, Steven). When they conflicted with workplace resources, teacher reshaped them to fit (Rita, Olivia, Joseph). Ironically, since traditional practices predominated, minimal school-based curriculum guidance made the workplace more fertile for reform-based goals.

These findings suggest that institutions located outside of schools (including districts) hoping to support new science teachers with resources for ambitious curriculum

goals need to attend closely to both teacher and workplace. As novices with thin resources banks, new teachers may be particularly vulnerable to the press of curriculum activity in the school, rather than the district, as Grossman and Thompson hypothesized (2004). When outside institutions interface with schools through new teachers, their resources face double verification. Teachers measure them by their own and their workplace standards. The predominance of traditional science in schools suggests the need for systemic interventions; coordinating curriculum activities between outside educational institutions, districts, *and* individual schools in directions that support science-for-all—exciting places for teachers to learn, opportunities to explore inquiry teaching with district colleagues, and department chairs with time to discuss content and high expectations for all students. Mark's case supports that conjecture, he was the only teacher with resources fully aligned towards high expectations.

These findings trouble, as other studies have, the capacity of school/district-based induction, mentoring, or other school-based collaborations to support ambitious goals for science learners. Accountability structures, science department norms, and curriculum resources blunted teachers' ambitions. Resources developed in reform-friendly environments offered possibilities not realized in schools. Nevertheless, outside resources could not keep their distance and expect to influence workplace activities. Mark's case suggests influencing the ambitions of new teachers requires substantial support from three directions – new teachers themselves, their workplace, and reform-minded institutions. If not, the best-case scenario is Felicia, who was focused on factual knowledge, tentative about doing science, and convinced she has to wait five years to become a good teacher.

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BETWEEN A ROCK AND A HARD PLACE: LEARNING TO TEACH SCIENCE-FOR-ALL IN AN URBAN DISTRICT

VOLUME II

By

Jodie A. Galosy

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Chapter 6
Intellectual Engagement: Breathing Life into Curriculum

> I had discovered that learning something, no matter how complex, wasn't hard when I had a reason to want to know it." (Hickman, 1998, p.143)

As described in chapter 1, the second core reform ideal targets intellectual engagement. Intellectual engagement represents a particular kind of relationship between learners and content. It intertwines emotional and cognitive dimensions. Intellectual engagement occurs when subject matter provokes curiosity and interest, drawing students into learning. The content itself motivates students to do the work required and sustains them when they encounter difficulties (Kennedy, 2004). In short, intellectual engagement is about falling in love with ideas.

Intellectual engagement is not the typical fare of traditional science classrooms. To the contrary, disengagement better describes the relationship between many students and science content (Project 2061, 1998). Reform initiatives advocate intellectual engagement through active, hands-on, or inquiry-based teaching (National Research Council, 2000). These methods also pose significant challenges, especially for new teachers. Management is trickier, outcomes less predictable (Cohen, 1988; Doyle, 1983). Study participants were well aware of stark contrasts drawn between traditional and reform approaches - the former dull and boring, the latter engaging and exciting. The situation caught them, again, in the middle, between secure traditional instruction – the status quo -- and the risker teaching involved in teaching science for all students in substantively challenging, personally engaging ways.

The study participants all reported difficulties engaging students with content. They also seemed convinced that activities held promise for motivating students. In this chapter, I chronicle the novice' attempts to use activities as tools for intellectual engagement.[43] Few met with success. I then examine how resources - personal, conventional, and social - enhanced or impeded their efforts. Non school-based institutions were prominent activity suppliers. Personal and workplace resources shaped how teachers used them in their classrooms. Although teachers found logistical support, they had few opportunities for learning how to maximize the intellectual potential of hands-on work.

The chapter has four major divisions. In the first section, I briefly frame the analyses. In the second, I explore teachers' responses to difficulties encountered using activities. I then examine how resources shaped those responses. Finally, I consider some of the implications these results have for how we help new teachers learn to use activities for intellectual engagement.

Activities and Student Engagement

To an observer, it may appear that teachers decide what they want to teach and students decide what they want to learn. However, in practice, the teacher, student, and content mutually influence each other (Cohen et al., 2003). For example, in chapter 5, teachers adjusted content to fit perceived student capabilities. Here I explore their attempts to influence the student-content relationship in another way, with activities.

[43] It is important to note that the selection of activities is not an endorsement of them as the only means for intellectual engagement. They were the primary tools teachers discussed. Other tools - text, a scientific problem, media, classroom discussions, for instance - have potential for intellectual work. However, participants reported few opportunities to explore those possibilities. Chapter seven considers teachers experiences with textbooks.

Study participants used the term "activities" interchangeably with others – "inquiry", "hands-on," "doing science." When participants discussed activities, they typically pointed to tasks that involved students physically manipulating materials (other than a pen or a pencil). These included working with laboratory equipment (e.g., microscopes), examining specimens (e.g., cow eye dissection), and simulating theoretical models (e.g., using a slinky to model wave motion).

Like many complex human behaviors, intellectual engagement is difficult to pin down. Activities certainly offer opportunities for physical activity, enjoyment, or fun. They also provide possible connections with students' interests or experience. As Schwab (1978) contended, intellectual work requires personal attraction. However, the attraction is not an end in itself, for physical activity can be a distraction from, as well as an invitation to, content.. Intellectual engagement is a complex mix:it involves passion, reason, and tools for sensemaking. It demands much from teachers, simultaneous attention to emotion and intellect, interest and ideas (Rion & Alvarez, 2002). Consequently, many reformers now make the distinction between "minds-on" and "hands-on" activities, with the minds-on component highlighting the importance of using activities not for activities' sake, but because those materials and that work lead to intellectual engagement. Intellectually engaging tasks have sufficient challenge to intrigue and, yet, ensure the content is within the learners' reach (Ball, 1999).

I used these two dimensions—teachers attention to scientific ideas as well as interest—to craft the working definition of intellectual engagement for this analysis. Classroom and program observations, participant interviews, lesson videotapes, and

classroom artifacts provided the bulk of the data. When available, interviews with school/program personnel substantiate claims.

Teachers and Activities – A Difficult Terrain

The novice teachers quickly learned that many of their students were reluctant science learners. Early on in the study, each teacher reported that one of their most difficult challenges was learning how to motivate students. Some found this shocking, for they had assumed students would be interested in learning science, perhaps because the novice teachers thought science was exciting. Their students taught them otherwise. Mark laughed at himself when he recalled his first days of class:

> I walked into my conceptual physics class thinking, "All right, this will be great. I'm going to treat them like adults and I'm going to teach 'em physics." Whoops!...I could not get the students to listen...It was chaos. (I1)

Felicia described similar difficulties. She struggled to keep her students' attention and involve them productively in class discussions. She interpreted their behavior as lack of interest in the subject matter, a problem she had not anticipated (I5).

The teachers were right to be worried. As we documented teaching, through observations and videotapes we saw a young woman applying make-up, two friends whispering about their weekend plans, another putting his head down on his desk, yet another rummaging in her backpack. In some cases, teachers noticed these behaviors. In others, they did not. When teachers did notice, they used similar means to bring students back, awarding or penalizing them with points, assigning after-school or lunch detentions, keeping the whole group after class.

These classroom management systems typically resembled those used by teachers' instructional teams or departments. For example, in keeping with her mentor's system, Olivia posted "participation points "on bright-pink slips of paper in at least twenty spots in her classroom, on cabinets, windows, bulletin boards, and lab tables (See Figure 6.1).

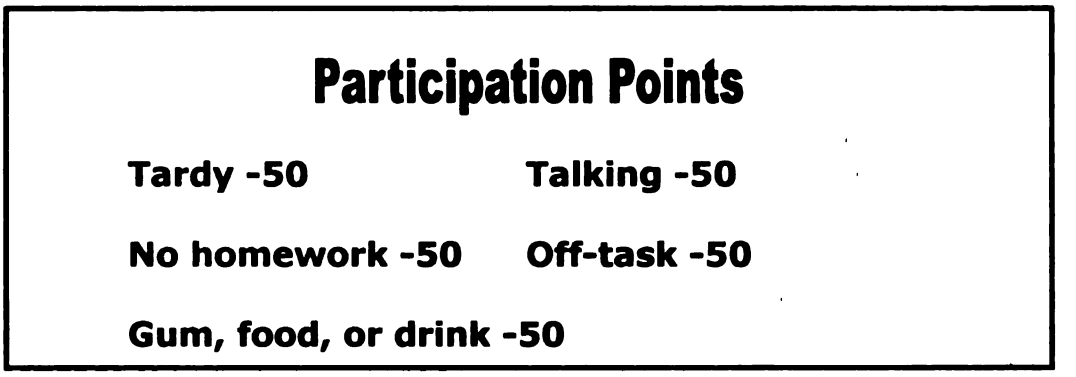

Figure 6.1 Olivia's Point System

While all used similar penalty systems, most of the teachers were not happy with them. First, the systems created more work for them. Felicia and Steven complained about the time it took at the beginning of class to assign points and maintain accurate records (I8). Mary and Olivia quickly grew tired of running after students, reminding them about detentions and spending their lunch hours in the classroom monitoring them (I1, I8). Second, the systems did not allow the flexibility some teachers, like Olivia, wanted for students who were not repeat offenders or might just be having a bad day (I1).

In September, teachers were worried about management. By December, they were worried with motivation. As Felicia put it: "[My concerns] are mostly about how to bring the subject to life for [the students]" (I8). While the teachers admitted that the classroom management systems helped keep students quiet, they worried that these systems offered little for student interest or engagement. In fact, the management systems might have

been squelching student enthusiasm. Mark and Olivia blamed their point systems for an "us against them" atmosphere in their classrooms that failed to invite students to learn (I1,I8).

The Promise of Activities

Looking for keys to motivation, teachers turned their attention to instruction. They associated lectures, note taking, worksheets, and the textbook with student boredom. Olivia complained, "I don't want to be boring and just do book work and be a paper pusher" (I5). Joseph apologized for including lectures, "I have to lecture sometimes, I just have to do it" (I1). Steven described himself as a "lecturer" and then followed quickly with the admission, "I know that's not the best way that kids learn" (I1).

The majority of teachers wanted to counteract science's boring reputation. Mary wanted her students to be "excited" about science (I4). Rita wanted hers "not to freak out when they see something about science...to be...oh yeah, science that's fun" (I4). Joseph hoped his students would "love science so much that they're just going to want to stay in school period" (I4). Motivation was also Felicia's concern, she wanted "to make science interesting to [students because] once they're motivated to learn, they'll do so much more" (I5).

Teachers seemed convinced that activities were inherently more interesting than other instructional tools. Felicia criticized her teaching because it was not "more activity oriented" (I5). Mary expressed regret that she was not able to do more of "the cool activities" that would "interest" students (I4). Teachers brought this faith in activities from their own experiences as students and/or their teacher preparation/certification programs. Steven admired how his former science methods instructor modeled hands-on

methods of teaching (I3). Olivia's teacher preparation program taught her hands-on work was especially important for "kinesthetic learners," a label she ascribed to herself and many of her students (I2). Rita and Felicia both described themselves, in alignment with their teacher preparation program, as advocates of hands-on science teaching (I1). As described in chapter 5, Joseph's engagement with activities, encountered in his science methods course, persuaded him they were effective (I4). Similarly, Mark's personal experience as an undergraduate and teaching assistant convinced him that connecting with physics meant interacting with physical phenomenon (I4).

The teachers all complained that their textbook and other inherited curriculum resources did not supply them with more engaging materials. Not surprisingly, then, they became avid collectors of such materials. Rita said, "I am always looking forward to anything that involves activities...Sure, sign me up and I'll go and do that" (I1). All had access to activities from at least one program. Olivia organized the activities from district science professional development (USP) in a notebook and suggested other teachers in her department do the same.[44] Rita sorted Exploratorium materials into several cardboard boxes based on their relevance to her curriculum.

In short, teachers wanted activities and had a ready supply of them. Yet, when they used them in their classrooms, they often had difficulty getting any mileage for learning. The teachers responded to this disappointment in different ways. Some shrugged it off. Others tried to figure out what went wrong. Resources – personal, conventional, and social – shaped those responses and, therefore, the possibilities for

[44] In chapter 5, I described Olivia's relationship with her colleagues in detail. One additional note here - Olivia's colleagues did not view her suggestion that the biology teachers keep and exchange notebooks of activities favorably. Olivia reported her department chair (and mentor) asked skeptically, "Who would that be useful for? Who's going to maintain it?" Olivia dropped the idea (I5).

what new teachers might learn from their experiences with those materials. Personal resources and resources from activity-based science programs dominated.

The Trouble with Activities

When teachers discussed hands-on work, they noted logistical challenges. The first was materials. They had to get materials, set them up, and clean up afterwards. They often had to pay for materials themselves. Mary sighed and summed it up, "It's so hard to get the supplies...and get them organized....hands-on [is better] but it means time, money, energy" (I5). Teachers also found it more difficult to supervise active students. Steven captured their sentiments:

> The management aspect of it...acted as a deterrent to a lot of the things that we really want to do...everything from going to computer labs and doing some more activities.... At this point it's a valid concern for us, you know? (I1).

The second concern teachers mentioned was curricular time. Activities not only took longer to plan, they often involved large chunks of instructional time. They worried they would fall behind: "The little time that I have to make sure I cover everything....It's really challenging" (T4, I1).

Yet, the teachers did use activities, albeit more or less frequently. Mark reported the highest frequency of hands-on work in his instruction, on average, several times a week (I5). Rita and Joseph included activities about once or twice a week, Mary, Olivia, Felicia, and Steven about once or twice a month (SQ).

The teachers who used hands-on activities most frequently (Mark, Rita, and Joseph) were not first year teachers. With one exception, the teachers who reported occasional use of activities (Olivia, Felicia, and Steven) were all first-year teachers. The exception was Mary, technically a second-year teacher, but teaching a class she felt

unprepared to teach, physical science. The positive correlation of experience with frequency suggests that new teachers need to build their competencies for hands-on work. Inexperience also helps explain why, with few exceptions, these novices ran into trouble leveraging activities for learning. Yet, it does not explain differences in how they diagnosed and responded to their difficulties. Resources are keys for understanding those responses. Teachers generally had to rely on their personal resources to figure out what went wrong. Let us begin by considering the kinds of difficulties teachers encountered.

After a couple of frustrating experiences working with activities on her own; for instance, trying to get students to understand how to balance chemical equations using paper clips as "atoms," paper clips dropping, thirty students at once calling for help, and patience wearing thin, Mary gladly accepted the Active Science Project director's offer for assistance:

> It's great, [the ASP director] comes in and I don't have to plan...She comes with all of the supplies ...We did acids and bases and she'll come in with all the trays set up with 20 different things to test on three different trays. She does these amazing experiments that I could never plan myself. (I2)

However, despite these "amazing experiments," Mary had problems when it came to facilitating the ensuing discussions with students. She recounted a typical situation

> The day after the acids and bases experiments, I tried to talk to [my students] about acids and bases. They were just not there with it. They did not want to listen. It was so frustrating. I just felt like giving them worksheets since they don't listen when I teach anyway. (I2)

Although Mary had assistance with the hands-on aspects of the activities, she could not figure out how to use them for learning, nor did she get support for learning how to turn those experiences into minds-on work. She had ASP assistance for the former but not for the latter.

Rita used hands-on lessons from the district middle school Urban Systemic Program (USP) to teach about the life cycle of plants. Students grew fast plants[45] and collected data (i.e., visual descriptions, measurements) on their growth patterns (FN6). When Rita evaluated the lessons, she viewed her use of the fast plant activities favorably even though they did not meet her content goals:

> I liked the fast plants because the kids got really excited about it....[The students] thought that was the funnest thing. I don't know how much they got from it...But they enjoyed it. I didn't get as much out of them as I hoped I would get out of them...in their journals. But it was fun and they enjoyed it and...I'd use it next year. (I5)

As in Mary's case, Rita had the materials and the students' interest. However, she could not figure out how to take the experience further. Recall Rita's complaint from chapter five, "I have all [these activities] but I don't know how you get kids to start thinking about what they're looking at" (I5).

Joseph expressed similar frustration. He could see how activities from the University Medical School Partnership captured his students' interest:

> [The USMP staff] brought lungs in...They had a healthy lung and a diseased lung...The kids got to put on rubber gloves and hold [the lungs] and look at them and touch the different parts of the bronchi and the different lobes of the lung. They got to go, "Eww," and smell formaldehyde for the first time...[We] also built those artificial lungs...with the plastic bottles and the balloons, and then...they took their pulse and used the stethoscopes and the lung capacitors [to] measure [their] lung capacity...It was so great. (I2)

While Joseph saw how much his students enjoyed their experience, he was troubled because they resisted the follow-up assignment: "The hardest thing in the world was trying to get them to write even a half-page about what they learned" (I2). Joseph's experience echoes Mary's and Rita's: the materials, activities (and even extra hands)

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[45] Wisconsin Fast Plants complete their life cycle in approximately 40 days. http://www.fastplants.org/home_flash.asp

were there, but helping students use those encounters to learn science remained elusive. Although their activities suppliers covered the logistics, the novices needed more help than that.

Consider Felicia's and Steven's experience with an activity intended to introduce students to the nervous system. During a lesson Felicia and Steven co-planned, they both used a hands-on activity that they had obtained from the Active Science Project director in their school. The ASP director provided all of the materials, ready to go.

Students cut out a circular piece of paper with a pattern, glued the pattern to a CD, and attached a large marble to the disc's center. The students spun the CDs to observe the optical illusions created by the spinning patterns. Felicia and Steven found their students willing to make and spin the discs. They cut, glued, and pasted. They puzzled over what they were supposed to see. Mutters of "weird," "cool," and "tight" spread around the room as students watched the patterns change. However, when the teachers asked them to describe and explain the illusions they observed, most seemed uninterested (FN2).

Felicia's students were very talkative, but not about the activity. When Felicia invited the students to share their observations and suggest explanations for what they observed, she struggled to get their attention, threatened to hold them after class, and admonished them: "If you all just do the activities and pay absolutely no attention to why you're doing it then you're not learning. You're just cutting and pasting and you can do that in kindergarten" (CT2). In the end, Felicia provided the students with a quick summative explanation for one of the illusions, before dismissing them: "What's happening here, your eye gets tired of seeing the swirls and it starts to play tricks on itself" (CT2).

Felicia puzzled over how to help students learn from activities. She pieced together a motivational theory. Felicia maintained students needed a "hook," something to arouse their interest. She pointed out several examples of hooks she used: a DNA extraction and a heart dissection (UMSP activities), the optical illusions from ASP. Felicia added that although hooks caught students' interest, they did not always "open up space to teach about it" (I6). Interest often faded. For instance, she did not think students learned enough from the heart dissection. She also maintained the DNA students carefully extracted impressed them only because it "looked like snot" (I6).

Felicia seemed in the same fix as the teachers already described - plenty of activities but little help getting mileage from them. However, consistent with her views of ambitious curriculum goals, Felicia felt she just needed more experience:

> For me, it is figuring out how to leverage [the students'] knowledge and skills to get them to do the work I want them to do....As you notice, my students really got something out of the discovery-based [activities]...that was an important hook and without that they weren't really into learning the rest of it....At the beginning of the year, I didn't really know they needed that hook to want to learn about the organelles of the cell or evolution or whatever else it might have been. (I6)

Felicia's observations of her students assured her that they benefited from activities. Just as it took time for her to learn students needed a hook, Felicia was convinced she would figure out how to leverage more learning in the future.

When Steven used the CD spinners, he had the same trouble Felicia did. His students cut, pasted, and spun the discs. They talked with each other and individually with Steven about what they saw. The room was abuzz, élan seemed high. But things changed when it came time for large group discussion. While Steven's students were not as boisterous as Felicia's were—Steven did not have to constantly ask for quiet or threaten to keep them after class—they were just as reluctant as Felicia's students to

participate in the discussion. The few students who did volunteer gave explanations that were incorrect ("the optic nerve") or incomplete ("the eye sends messages to the brain") (FN1). After a few minutes, Steven concluded the discussion with his own explanation:

> You're confusing your own brain...Your brain wants to try to make sense of what it is seeing. So, it tries to get used to this pattern. It's thinking, "All right, what's going on here? I need to try to see something and I need to see something even when you look away." It takes it a while to say, "I'm not looking at that pattern anymore." It's confused...The brain does an awful good job at an awful lot of things, but you can trick it. (CT1)

Although Steven's experience with activities appeared similar to Felicia's, he seemed satisfied with the outcome, untroubled with thoughts about how to improve on its educative potential. The activity gave his students a break during the ninety-minute block period from listening to student presentations (FN2). Unlike the other teachers, Steven did not appear to expect more. Even when directly prodded – for example, when his NTIP mentor suggested Steven could use activities more fruitfully—Steven held fast and did not agree.

Olivia rarely used activities for reasons described earlier: materials, curricular time, and management concerns (I1,I5). However, recall from chapter 5 that Olivia joined the district biology professional development series during the last half of the school year; the work focused on two activities; both were simulations of natural selection: the "clip bird" activity and the "peppered moth" activity (I5). In the clip bird activity, students used binder clips as "bird beaks" to procure changing "food" supplies like seeds or marbles. In the peppered moth activity, students picked up small circles of white or newsprint paper from a white background and a newsprint background. In both cases, the activities illustrated the effect of changing environmental conditions (e.g., food supply or the background color of a tree) on species with diverse characteristics (e.g., beak shape or

body color). Certain conditions favored (selected for) individuals with characteristics that helped them survive (I5). .

Olivia met with other district biology teachers after school where she received copies of the activities and all the necessary supplies; but that was not all. She also practiced the activities with other teachers—"You should have seen us with those clips...it reminded me of when I was little, the Hungry, Hungry Hippos [game], I loved that!"(I6)—followed by a discussion of how they would use the activities in their own particular context. After using both activities with her students, Olivia brought back student work to discuss what she, and her students, learned.

Olivia reported that her students enjoyed both activities and had a lot of fun, but she preferred the peppered moth activity because it made ideas about natural selection more visible to students. She described the difference:

> On paper, [the clip bird activity] seems like such a great activity. But it's just too chaotic...[The] students got so excited with...eating the marbles and eating the seeds that they just really missed the point of the activity...With the peppered moth activity, [the students] really got into it...and they got it...They got from it that the moths that blended in were less likely to be eaten...That it's the environment that dictates the change that occurs. (I5)

Based on these experiences, Olivia judged the peppered moth activity "more academic" (I5). From her perspective, it supported a stronger connection between her students and the subject matter, in this case, ideas about natural selection. Olivia ascribed the difficulty to features of the activity that distracted students from the task's academic point. Olivia's diagnosis resembles Felicia's ideas about activities as hooks that open up space for teaching. The clip bird task provided a barb-less hook that did not lead to substantive learning, while the peppered moth activity a hook of intellectual engagement that led to learning.

Mark was also the only teacher who felt he was regularly able to leverage activities for learning, and he used such activities much more often than the other novice teachers. Mark favored hands-on experiences where students encountered something "counterintuitive": "[The activity has to] do something non-intuitively, like blowing, when your air comes out cold even though your breath is hot inside. That's something that interests [students]...more because their brain actually wants to get to the reason for that" (I4). Mark often used counterintuitive events to provoke interest in a way that motivated students to find explanations. For example, when studying motion, Mark had his students produce effects that seemed improbable, like using a string tied around the axle of a bicycle tire to spin it like a gyroscope (I4).

Another way Mark used hands-on work was to assess student understanding. For instance, Mark had his students use slinkies to model wave motion. He found the slinky a useful tool for making their knowledge of wave motion visible:

> [The students] had to demonstrate 15 things for me. They had to do these certain things with a wave...like increase the frequency or show a kind of wave. I asked them, "Is that it?" Maybe they just got it as a shot in the dark, so... then I made them demonstrate something that wasn't it...When they were done I had the idea that [the students] pretty much knew it. (I5)

He used a similar strategy when teaching electricity. The students worked with balloons and various kinds of materials (e.g., glass, plastic, felt) to investigate electrostatics. Mark circulated around the room, asking students to rub the balloon with a particular material and explain their observations in terms of electron movement. For Mark, this hands-on work allowed him, in varied ways, to discuss with students the ideas he wanted them to learn about electrostatics (FN4).

Like Felicia and Olivia, Mark evaluated activities based on their ability to interest students in ideas. In addition, he identified a characteristic (counterintuitive experiences) that supported intellectual engagement. He purposefully selected activities with that criterion in mind. Other aspects of Mark's hands-on work set him apart from the other teachers. Most notably, he did not have the difficulties other teachers reported using activities for learning.[46] Nonetheless, Mark did feel that his activity-based approach had shortcomings. However, it was not because students did not learn from them. To the contrary, Mark felt his students could provide scientific explanations for everyday phenomenon (e.g., twirling skaters). However, Mark wanted to include lengthier investigations that engaged students in scientific practices; snacks were not satisfying to Mark, he wanted students to experience science practice in more depth.

Resources: Abundant Activities, Lean Support for Learning

As with curriculum goals, the teachers' responses reflect dynamics between their access to and use of personal and institutional resources. All of the study participants sized up the situation that confronted them similarly. They came to their teaching assignments convinced hands-on work was the preferred path to motivate student learning. They sensed that using such activities required additional demands for lesson preparation, materials, management, and student participation than worksheets, notes, or textbook exercises. They saw interest in science as a major challenge for teaching their students. Hands-on work was the answer.

[46] This is not to say Mark did not have problems with activities. During large group discussion, he often had to ask for quiet or prod a sleepy student. However, in general, students' questions and participation showed interest in learning about the concepts (e.g., electricity, the second law of thermodynamics) they investigated or modeled.

But those activities represented a two-edged sword. Using these promising activities meant adding to the already overwhelming knowledge and skills they had yet to develop. Moreover, the activities ate into curricular time: a press for all teachers, no matter how experienced. Teachers could only use activities as tools for intellectual engagement to the extent that they had the resources to do so. Here I analyze how resources—personal, conventional, and social—influence what teachers did and learned from the use of these activities. Personal resources moderated teachers' use of activities. Social resources—reform-based science programs, in particular—provided logistical assistance. When resources directed attention to student learning, teachers focused on intellectual engagement.

Personal Resources – Limits and Possibilities

As posited in chapter 5, personal resources filtered teachers' use of other resources. This, in turn, influenced their use of activities. Steven, for example, was convinced that activities did not fit with his teaching style. Steven's NTIP mentor described it this way:

> I think his own personality prevents a lot of the stuff happening that might be less teacher-directed and more student-directed...Everything is him doing it, him lecturing...and he's very loath to listen to suggestions and doesn't basically want to change. (I1)

Steven corroborated her view when he described himself as a teacher ("the information giver"):

> [I am] relatively engaging, but I do talk too much. I don't plan to, but I just start to ramble. I try to come up with situations or real life experiences...to use anecdotes [when I] explain. It's interesting. I give examples and start grabbing stuff from all over the place...Some kids really listen and I tend to make eye contact with them. (I5)

Steven referred to his preference for talking as his "teaching style" (I5), and he filtered the activity-based programs in which he participated through the lens of that style. In his school, for example, he regularly interacted with Evan, the Active Science Project director. Steven described Evan as "an interesting, hands-on individual" (I3). For Steven, Evan was proof that certain kinds of people were more personally suited to activity-based teaching.

Steven took a similar stance with the Exploratorium TIP. On a personal level, Steven enjoyed his participation in the program, after all, he loved science and the museum is all about science. However, he saw the staff as people with talents for and personal dispositions toward using hands-on activities. He could not (or would not) be that kind of person (I3). Without his close lesson-planning partnership with Felicia, Steven likely would have used those materials even more sparingly. He used activities because Felicia did, not because he saw himself as a teacher who could (or would) use activities as tools for intellectual work. Consequently, Steven calibrated his use of activities to another purpose, providing an occasional break and a little variety for his students during the block period. This explains why Steven did not express the frustrations Felicia did with the CD spinners. For Steven, activities were filler, not the real meat of learning.

Personal resources likely also distracted Mary from both doing activities and helping students make sense of them. For her, hands-on activities required time, energy, and materials she did not have for the eighth grade class (I1). Since Mary doubted her own ability to teach physical science and her students' capabilities as science learners, she suspected she could not successfully engage her students in hands-on work. Mary's

lack of confidence also kept her from getting assistance. Recall that Mary did not want anyone from the Exploratorium observing her class. Apparently, the same was true for the ASP director. The director conducted the activities and then left Mary alone to follow-up. Of course, Mary's limited content knowledge constrained her ability to do so. Consequently, when Mary encountered frustrating experiences - as she did when she tried to process the ASP acids/bases activities with her students - she quickly became discouraged. Thus, in both Mary's and Steve's cases, the new teachers are proactively mediating the opportunities to learn that exist in their professional worlds. The help is there—in materials and in people—to help them learn. But personal resources – their ideas about their teaching identities or their lack of confidence and subsequent need for privacy in learning to teach – act as obstacles between them and the available resources.

Felicia's case is muddier than Steven or Mary's situation. Felicia's knowledge and skills seemed to help her productively diagnose her situation. Felicia apparently had sufficient personal resources to piece together an analysis of her problem, and she concluded that some activities provided more powerful hooks for learning than others. Felicia arrived at her conclusion after cautiously tinkering with a few activities during the year. Careful observation of her students – an important social resource – provided data for her analysis. (I return to the important role of students as a social resource for new teacher learning momentarily.)

Given her personal resources, Felicia's infrequent use of activities is puzzling. Moreover, she shied away from resources that might have helped her be more effective. While those resources might have been partly to blame, Felicia's lack of confidence also played a significant role. Felicia admitted she hesitated to use activities (I1, I5). She

found it very difficult to establish the kind of classroom environment she felt necessary for hands-on work. Felicia associated hands-on work with more freedom for students, freedom she thought many would not use for academic purposes (I1).

On one hand, Felicia wanted help with this problem. On the other hand, admitting to this weakness made her feel vulnerable, for she viewed limited skill at providing students with more classroom freedom as personal failure (I8). When Felicia did get assistance, she struggled to make sense of feedback. Moreover, like Mary, the presence of other eyes in her classroom seemed to exacerbate hers sense of inadequacy:

> What I'm not clear on is how much is my students and how much is me....After my principal and [my Exploratorium coach] and, even you, observe the class, [I want to know] where am I in terms of where a first year teacher with this population of students is supposed to be? If I'm sort of in the middle of the curve, then I can live with the fact that your first year of teaching is very hard and it will get better. If I'm way behind the curve, and my next year of teaching is going to be easier to manage than this, but I'm still going to be doing what I think of as being a relatively ineffectual job of teaching, then that...feels like why am I wasting my time? (I8)

Felicia's sense of ineffectiveness and her need for reassurance come through in her comments. By her own standards, she was "ineffectual." She wanted an external benchmark she did not have. Consequently, when Felicia got feedback from support providers or evaluators, it felt like pouring salt on a wound. This influenced Felicia's future use of those resources.

Consider two examples. Early in the year, Felicia's Exploratorium coach observed and then taught a lesson about cell division (I1). After a hands-on lesson Felicia thought did not go well, she dismissed positive comments from her Exploratorium coach, Rachel, as "just being nice" (I8). Rachel also offered a number of suggestions for classroom management (e.g., "Never turn your back on your students") (I1). On one hand, Felicia

found some comfort in what she perceived as Rachel's view of the students:[47] they were a difficult group who would try the patience of even the most experienced teacher (I8). On the other hand, that assessment left Felicia with little direction about what to do, other than impose management strategies that limited students' freedom (I8). However, Felicia did not see how those strategies could facilitate hands-on work (I6).

Felicia's first observation by her principal also exacerbated her insecurity. Felicia had the principal observe her most difficult class, per the principal's suggestion, so she could "give helpful suggestions rather than just saying 'Great job!'" (I8). Afterwards, the principal had many suggestions: relocate the overhead so all students can see, walk the room, give points when students are working (and say aloud, "5 points for Maria" when doing so), and let students know when they will have time to talk and when they have to listen, to name a few. Felicia found "the laundry list of suggestions," discouraging, to say the least: "It was...harder for me to hear than I had expected because what I heard was your kids aren't learning anything...you've got a long way to go" (I8).

These kinds of experiences discouraged Felicia from working too extensively with activities, for she needed to stay within her comfort zone (I5). When Rachel contacted her again, Felicia did not schedule any other visits, although Felicia did note that, if Rachel had "pushed more," she might have arranged another coaching session (I5).

Mark stands apart from the other teachers as someone with the knowledge, skills, and will necessary to use activities as tools for intellectual engagement. Eric Ceresi, the

[47] Rachel corroborated Felicia's perception. She described the students' behaviors as "very immature" (I1). Rachel also confirmed their discussions centered on classroom management (I1).

district science specialist, found Mark's confident approach to hands-on work atypical of most new science teachers in Bayline:

> I am very impressed by [Mark]...His entire thinking process is "How do I get these kids to learn in a hands-on way topics that are interesting and relevant to them?" He doesn't even consider trying to step back...[Mark sees] that hands-on activities are...a better way of managing kids...[Most new science teachers] worry about, "How do I spend even more energy to get [the students] to listen to me?" (I1)

Mark's confidence in the personal resources he had available for hands-on work helped him make use of other resources to accomplish his goal, hands-on learning; he pulled supplies from the impressive storage area next to his classroom—frictionless tracks, slinkies, bicycle tires and set up demonstrations and work stations. He took the train to QuarkNet, came back with new ideas, and tried them out at the next opportunity. He got his students up, moving, and interested: "Put the plastic figure on the car and run it down the track, stop, whoa, what happened? [The figure] went forward? Yours went back? Wait, wait! Let's see if we can figure out why" (FN11).

Mary's, Steven's, Felicia's, and Mark's personal resources exerted considerable influence on their use of activities. All believed that hands-on learning was desirable. However, their personal resources shaped what they did in practice. In some cases, personal resources pulled teachers away from activities. Mary, Steven, and Felicia did not have sufficient knowledge, skill, and/or will to use activities effectively. This also limited their use of activity-based resources. In other cases, personal resources pulled teachers towards activities. Mark had personal resources – strong content knowledge, belief in hands-on work, and commitments to learners - that provided substantial support. Paradoxically, Felicia's knowledge and determination compensated for her lack of

confidence. She did not use activities often, but when she did, she focused on helping students learn from them.

The other three teachers–Rita, Joseph, and Olivia—did not lean as strongly on personal resources. They had the will for activities, but needed support to use then effectively. Rita and Joseph often used activities; they had substantial will. However, they could not quite get what they wanted out of them. They hooked students but could not get them further. Nor, as we will see shortly, did their resources help them do so. In Olivia's case, social resources strengthened what she was able to do.

In summary, then, personal resources leaned teachers towards or away from activities and activity-based resources. They also set limits for what teachers could do with activities on their own. I now consider how social and conventional resources expanded or restricted those possibilities.

Conventional resources

As indicated earlier, teachers complained that they lacked the conventional resources needed for activity-based instruction. First, they wanted activities. They also needed the supplies and time activities required.

Finding and using activities. Teachers valued resources that supplied activities. As discussed in chapter 3, all the reform-based science programs supplied activities. Consequently, all of the teachers, except Olivia (who participated only in USP[48]), had activities coming at them from multiple directions. Felicia, a participant in three programs, felt she had such a steady stream of activities that if she only used one tenth of

[48] Recall, again from chapter five, Olivia's department chair did not acquaint her with the Exploratorium or the medical school partnership because he thought they were geared towards middle school teachers.

them, she would still have an ample supply (I8). Choosing amongst them, at times, presented a challenge.

Although Mark pulled activities from many sources, Quarknet stood out because they helped him fill gaps in his activity stockpile:

> I had some difficulty finding something to do for E & M radiation. What do you do other than visible light? But they had this thing where you took...your remote control [which] works on infrared radiation ...You take a bunch of things and put it between the remote and the receptor to see what blocks infrared radiation....You do the same with a black light to see what blocks ultraviolet radiation....You take a radio and wrap it in a plastic bag. You wrap it in aluminum foil. You wrap it in wire mesh [to see what blocks radio waves]. (I5)

In addition to electromagnetic radiation, Mark found Quarknet filled other gaps in his stockpile, especially for modern physics (e.g., relativity theory) (I5).

The volume of activities Rita amassed from the Exploratorium, district science professional development (USP), and her own pursuits threatened to overwhelm her (I8). In defense, she developed a three-box storage system:

> In one box, I have [activities] that I will get to this year...In another, things that I will not teach this year, but may be interesting down the road. And [now I have] a new box, which is a recycling box, things I will never get to do. (I8)

As Mark's and Rita's comments illustrate, teachers selected activities with an eye to their present curriculum. They tended to use things that slid easily into their plans. As might be expected, Rita (in keeping with corrective actions) looked for an explicit link with standards (I6). As discussed in chapter 5, the USP core activities, designed to teach grade-level standards, always passed muster. On the other hand, Rita found Exploratorium activities often ranged outside her content standards. Those things wound up either in the "interesting down the road" or the "recycling" box.

Felicia described a similar difficulty with Exploratorium activities; relevance to biology was the benchmark:

> I feel the Exploratorium very much sort of mushes things together. A lot of the activities from the Exploratorium I couldn't classify as just one type of science or another. I feel I was so focused on biology this year that anything that wasn't 100% biology-related, I kind of wasn't interested in...[even though] I actually don't think science should be that way. (I6)

Although Felicia shared Rita's concern, her comment about "how science should be" hinted at a different outcome than Rita's. That proved to be the case. Felicia described future goals that reflected a broader view towards activities modeled after the Exploratorium, "After getting resources from the Exploratorium...I would...like my curriculum to be a little more integrated...There are a lot of fun activities you can do with kids that are just interesting science. I'd like to steer more towards that" (I6).

A comparison between the two teachers' uses of Exploratorium activities illustrates how personal and social resources shaped use of conventional ones. Corrective actions in Rita's school pulled standards front and center, overriding Exploratorium norms of "interesting science."[49] Felicia did not have that kind of pressure. Standards guided, rather than determined, what she taught. That opened up space for other influences. The Exploratorium approach fit with Felicia's sense of what science should be. Consequently, activities that fell outside biology's disciplinary boundaries were now fair game.

Lack of school supplies. In addition to activities, study participants also wanted supplies. Teachers hesitated to use activities when they required materials unavailable at

[49] It is important to note that Exploratorium program does attend to standards, increasingly so as accountability draws attention to them. Standards are prominent in TI classrooms. New teachers select standards to focus on when they construct their teaching boxes (EFN3). However, as Felicia pointed out, TI activities are not standards-driven; interesting science leads the way.

their schools. When it came to supplies, Mark was the exception. He had a storeroom of equipment and other materials at his disposal, a side benefit of teaching at a science, technology, and engineering high school. As Mark pointed out to his CP class, most Bayline students did not have the "privilege" of using expensive equipment, like frictionless tracks, found in his storeroom (FN6).

The other teachers' situations proved Mark correct. Olivia, for example, had access to microscopes but few prepared slides (I5). Joseph did not even have water in his classroom. That meant he lugged heavy buckets down the hall from the janitor's closet (FN2). Expendable materials were particularly difficult to acquire. Like teachers nationwide, these novice teachers often spent their own limited funds on pins, pipe cleaners, balloons, etc. They did so because budgets were tight and/or they found the reimbursement paperwork took more of their time than it was worth (TI/I1; T6/I5).

Time for planning. But more important than the money, finding equipment and purchasing materials took time, teachers' most precious commodity. Felicia's scenario captures their dilemma. She and Steven had two planning periods, more than other study participants did. However, meetings with team members and department colleagues filled those slots. Getting supplies together generally was an after-school chore. Yet, there was precious little of that to spare either. Felicia had meetings with administrators, teachers, parents, and/or students; offered students help sessions; made telephone calls to their homes; graded student work, and planned her biology and chemistry classes, as well as her advisory: "Thinking about shopping for materials when I leave school, which is generally about seven o'clock at night, is hard to do" (I1).

Shoring up supplies and time. Not surprisingly, teachers tended to use activities, then, that included supplies and/or minimized their planning time. Recall Mary's endorsement of the ASP director who came with everything needed for the acids/bases exploration. Felicia and Steven most often tapped Active Science or the medical school partnership, for both of those resources provided all the materials the teachers needed. In addition, medical school students provided extra hands for their activities, something Joseph also deeply appreciated (I3).

The Exploratorium had a special place in teachers' hearts. Even those who did not participate in BTIP, felt its reach. For example, when Mark (who was not a BTIP teacher) attended the district optics workshop, most of the activities had Exploratorium authors (E,FN2). Recall also, from chapter 5, Mark's wish that every city had an Exploratorium. Joseph, another non-BTIP participant, also used their resources. For example, the book of human body activities his science methods instructor gave him was an Exploratorium publication.

Those who did participate in BTIP, however, pointed out that the program did more than provide activities. BTIP helped them use activities. The affordable materials required were first on their list. For instance, Felicia learned how students could construct their own microscopes out of corks, mirrors, rubber bands, and film canisters (I5). During the summer institute, Rita went shopping at a warehouse filled with overstocked, recycled, and donated equipment and supplies from Silicon Valley. With $25 spending money from BTIP in hand, she loaded her cart with goodies, including paints, staplers, binders, donut magnets, and magnifying glasses (EFN4). Limited equipment and tight school budgets made inexpensive materials and the means to purchase them priceless.

BTIP participants found support for using activities in other program components as well. Coaches often brought supplies teachers requested (T2/I5; T6/I5). For instance, Rita's coach brought her a "question box," a large yellow cardboard container filled with assorted items including a deer antler, battery, and film canister. Rita selected one item, students asked yes and no questions and guessed what was in the box.[50] Rita said her students "loved" the mystery box, their reaction deepened Rita's appreciation for her coach's gift (I1). BTIP participants also had help from their mentors who pointed them towards supply sources; mentoring groups also shared materials (T2/I5; T6/I2). A third resource was the listserv, Pinhole, where teachers could inquire about activities or supplies. Felicia once asked advice about preservatives for biological specimens (EP1). Finally, BTIP participants noted numerous opportunities to try activities themselves, in workshops, mentoring groups, and the summer institute. As Rita pointed out, she was much more likely to use an activity in her classroom if she had tried it out with her Exploratorium colleagues first (I8).

Before closing this portion of the analysis of social resources, it is worth focusing for a moment on new teacher support programs. With the notable exception of the Exploratorium, teachers did not use support providers for assistance with activities. As we saw in chapter five, Mary had support for sixth grade, not for eighth. Olivia did not rely on Mr. Wong, her mentor, for help with activities (recall her impression that his advice did not apply to her "ordinary" students). Moreover, Olivia also did not perceive Mr. Wong as a hands-on kind of teacher (I1). As already noted, Steven's NTIP mentor encouraged him to use more activities, advice he resisted. Eric Ceresi, Mark's mentor, helped other new teachers with hands-on work, but, as described earlier, found Mark did

[50] Recall from chapter five a similar activity that captivated Joseph in his science method class.

not need that kind of assistance (I1). Eric and Mark focused on literacy instead (which I return to in chapter 7). As a reminder, Felicia's and Rita's clear credentials meant that they did not have district support providers (although they both had Exploratorium mentors/coaches). The minimal role these support providers played suggests that teachers judged resources based on expertise with science activities. Most located expertise outside of schools and district new teacher support.

Interactions – personal, social, and conventional resources. The majority of teachers had access to activities, support for supplies, and, in some cases, extra hands for planning and execution. These activities and supplies passed like (and sometimes as) currency. Program staff (a social resource) eased constraints by locating supplies, lending a hand, or teaching a lesson. Teachers selected and used activities based on their curriculum, and the materials, time, and assistance available.

While these conventional and social resources explain how teachers selected activities, they do not completely explain how frequently teachers used them. Olivia's infrequent use of hands-on work clearly reflected her limited conventional and social resources. However, Felicia and Steven, who had as much assistance available as Rita or Joseph, rarely included hands-on work; Rita and Joseph often did so.

Personal resources were at work here. Mark had a strong combination of personal resources. Not surprisingly, then, hands-on work was part of his regular routine. Rita and Joseph, intent of making science fun for their students, maximized their activity resources within workplace limits (corrective actions for Rita, facilities for Joseph). As already described, Mary and Steven leaned away from activities and activity-based resources for personal reasons. Felicia's lack of confidence influenced a guarded approach. She

included a few activities, with assistance from others, and closely watched what happened.

The analyses thus far, then, explain how resources influenced the activities teachers used and how often they used them. However, those analyses are not able to account for what teachers learned when they used them. Felicia's careful observations and personal resources likely helped her assess how to get more learning out of activities. Steven and Mary's personal resources accounted for why they did not have such insights. Surprisingly, Olivia had accomplishments similar to Felicia's, yet with fewer resources. Just as puzzling, Joseph and Rita could not turn loads of experience using activities into more effective lessons. The explanation of how these three teachers – Olivia, Rita, and Joseph - made sense of their experiences requires one further piece of analysis – a closer look at the learning opportunities that social resources provided.

Social resources – redirecting attention to learning

Students as social resources. Students were a major influence on what teachers learned from activities. They exerted their influence through their responses. Teachers noted their students' reactions; they learned to pick up on explicit and more unobtrusive cues about when students were interested, animated, enthusiastic, bored, lethargic, disruptive, impatient, blasé. Each teacher's classroom was a natural experiment unfolding, and the new teachers noticed--and took seriously--the contrast in students' responses. And the teachers' experiences largely seemed to reinforce their notions that activities were the key to more effective instruction. However, teachers did not always pay attention to what students were actually learning from the work; for that they needed access to students' ideas; something for which activities alone could not provide the key.

Distractions from student learning. Logistical concerns competed with learning for teachers' attention. The difficulty parallels the hands-on, minds-on distinction that I introduced early in this chapter. Activities can easily sidetrack teachers, as well as students, from the intended content. The demands of manipulating equipment or materials can be so distracting that students miss the intellectual point. Similarly, the demands of selecting, setting up, and supervising an activity can distract teachers from the educational purpose. New teachers—stretched by time, materials, and management concerns—may be particularly vulnerable to ideas slipping away from activities.[51] As we have already seen, the study participants were preoccupied with logistical concerns; activities, supplies, time, facilities. Digging through the box of activities, organizing materials, and figuring out crowd control often consumed their time and attention, leaving little left for learning outcomes.

Consider a few examples from the accounts provided earlier. Mary, who felt fortunate that some logistics were covered by the ASP director, said, "It great...I don't have to plan" (I2). Rita commented, "I don't know how much [the students] got out of [the fast plant study]" (I5). Joseph rearranged his room, got permission for students to run in the hallway, photographed, supervised, and cleaned up after the medical school visits. Small wonder he focused more on his students' enthusiasm than on what they learned. When the ASP director handed Felicia and Steven the discs, marbles, glue, paper patterns, scissors, and instructions, they felt ready to go. They had not anticipated (nor did the ASP director address) what a fruitful discussion of students' observations required. Naïve users of such materials, the new teachers seemed to presume that the materials carried the content. It was only after using them that the teacher began to

[51] Add references about this here

understand how much the good use of materials depended on the teachers' skill in eliciting student ideas and facilitating discussions.

Attention to student learning. Logistical concerns, then, coupled with students' obvious enjoyment, distracted teachers attention from content. They tended to choose activities almost for activities' sake, based on a topic (e.g., evolution), rather than because they had a clear sense of an activity's educative potential (What does this activity make clear or obscure? What will it help students understand? What support will they need?). When activities did not accomplish the learning goals they wanted, they tended not to push beyond student interest, enjoyment, enthusiasm. The teachers – Mark, Olivia, and Felicia - who pressed into that terrain had personal and/or social resources that directed attention there.

Olivia's experience with the district biology professional development (USP) offers insights on how a social resource directed attention towards learning. Two components of USP noticeably kept Olivia focused on content. First, USP carefully selected a few core activities and provided everything needed. Olivia was relieved that she did not have the burden of figuring out what to use (I2). Second, analysis of student work moved the focus from logistics to student learning. Olivia compared student work from both activities – clip bird and peppered moth - with her USP colleagues. The difference in results convinced her that not all hands-on activities were equally well suited for use as academic tasks. For Olivia, USP provided a reliable clearinghouse and test-bed for hands-on activities (I5). The opportunity to use an activity and compare notes with other teachers using the same materials -combined with a positive experience with her students - reassured Olivia that hands-on work had intellectual merit.

USP helped Olivia examine activities as tools for ideas as well as interest. This was the only activity-based program where teachers examined student work. This suggests teachers, like Joseph and Rita, might have been able to push further into intellectual engagement with similar opportunities..[52] Joseph did not have discussions of student work with medical school staff (I5). The middle school USP Rita participated in did not examine student work (I5). Nor did Rita's work with the Exploratorium provide that opportunity (I5).[53]

Using instances from practice. Olivia compared activities with an eye to student learning. This was something Mark and Felicia did as well. In fact, with hindsight, it seems clear that these three teachers could point to instances of learning from activities during our conversations. The other teachers could (or did) not.[54] It is possible that their personal resources filtered out attention to such instances; or that their activity suppliers did not tune them in to students learning. Regardless, these instances were potent resources for the three other teachers. Felicia and Mark used personal resources to notice and make sense of them; Olivia did so with USP's assistance.

When teachers were able to point to instances of learning, they had two advantages. First, these instances served as existence proofs for teachers—"My students can learn from activities."[55] Secondly, they afforded comparisons. Teachers could weigh differences: Why did learning occur with this activity and not that one? (Recall Olivia's musing about peppered moths and clipbirds.) An account from Felicia's practice offers

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[52] This is not to suggest that examination of student work is the only way to focus new teachers on student learning. (Rosebery & Puttick, 1998), for instance, found work focused on eliciting and understanding students' ideas also served that purpose.

[53] Although Rita did not examine student work, she did discuss students' ideas about light at length with her mentor at the summer institute. It remains to be seen whether that kind of learning opportunity influenced her use of activities. Data from year two teacher observations are not part of the analyses here.

[54] This is a tentative claim. I did not specifically ask teachers to provide such instances.

[55] Suzanne Wilson first suggested this idea to me during a discussion on 1/5/04

another example. Felicia described an activity that she believed helped her students understand the laws of independence and dominance in genetics:

> The kids worked in pairs and each one had a cup. Each cup had two beads, one each of two colors; let's say red and white. Without looking, the kids pulled a bead from each cup. They repeated it twenty times. There were seven pairs of students, 140 trials...We used the Punnett square and...figured out the ratio you should get is 25:50:25...so we should have gotten 35:70:35. We got 32:72:36...there were a lot of "ah-has" and "oh, I see." So, they could see [how it works]. (I8)

This experience, in comparison with less successful ones (e.g., the CD spinners) likely contributed to Felicia's emerging theory, some activities were hooks that opened up space for learning. Unlike the optical illusions activity, Felicia could see the lights go on in students' minds.

Mark's case was a bit different. His experience suggests instances of students' not-learning are as just as important as instances of learning. Perhaps teachers need both for productive work. As previously described, Mark had numerous successful experiences using activities. Recall, also, that one of Mark's future goals was to better acquaint his students with scientific practices. He recounted one experience that directed his attention there:

> [The students] measured... - the angle of incidence was 20 degrees and the angle of reflection was 22. So, my students concluded, rightfully so, that...the angle of reflection is 2 degrees from the angle of incidence. [They did not understand] that you have to make lots and lots of measurements and do it for a whole range of different things. That's why I want to do bigger labs. (I5)

Like Felicia and Olivia, Mark had two points of comparison; different kinds of activities resulted in different outcomes. One-shot activities—racing cars down tracks or spinning bicycle tire—gave students phenomenon to explore, but could be misleading; his students' errant conclusions brought Mark up short; he looked for a solution in more

extended investigations; he gets more sophisticated about what activities to use for what purposes. Rita and Joseph, who did not have these instances to work with, did not move further. Without these points of comparison, they only had student enthusiasm to go on.

In summary, then, social resources often distracted teachers' attention from student learning. Student enthusiasm and logistical concerns dominated. Activity-based programs primarily targeted logistics. In doing so, they may have inadvertently directed teachers' attention away from student learning. Teachers needed to notice instances of students' learning, as well as not learning, from activities. The former reassured teachers that activities could be intellectual tools. Examining student work with experienced colleagues helped one teacher notice and make sense of different results. Learning to use activities for intellectual engagement, then, meant trial and error: when teachers did not have sufficient personal resources to make sense of the situation, others—colleagues, support providers or activity suppliers—could (and did) help. Without such assistance, novices did not progress in their understanding; they could not get activities to light up their students minds as well as occupy their hands.

Conclusion and Implications

Regardless of their pathway into teaching, all seven teachers considered hands-on activities a key for engaging their students with science content. They are, it appears, receiving the message of K-12 science education reforms. Unlike other reforms, where the message was clear but no supports were available, these teachers existed in environments in which attention to hands-on work was central, including the Active Science Project, the district USP, and the Exploratorium's BTIP. It might seem this

alignment between teacher, program, and message would lead to more hands- and minds-on work in the new teachers' classrooms. The data, however, suggest otherwise.

The logistical challenges of activities drew teachers' attention. They all wanted activities; yet, many were hesitant to take on the demands of hands-on work. Personal, conventional, and social resources intervened in various ways that hampered or supported them. Activities were not the tool for intellectual engagement these novices expected. Few developed deeper understandings of how activities might become such a tool. The learning curve looks quite steep.

As with development of ambitious curriculum goals (described in chapter 5), personal resources acted as a primary filter for how teachers used hands-on activities. They shared the common belief that activities were good for students. However, some had a stronger will than others to take on the work required. Even when sufficient will was present, concerns about whether students could learn from activities moderated use.

Teachers' workplaces provided few supports. The conventional resources needed – activities, supplies, facilities, time – had limited availability in most schools. In order to find and use activities, teachers looked elsewhere.

Despite the fact that teachers considered activities to be a central part of teaching, with the notable exception of the Exploratorium BTIP, new teacher programs did not play a role in supporting teachers' use of activities. Even teachers who had a science teacher as a mentor reported no instances of working with activities, although some obtained activities from their support provider.

Students were the most influential social resource in the workplace. Even a modicum of success with student learning, as in Olivia and Felicia's cases, made future

use for intellectual engagement seem more likely. These successes acted as existence proofs that students could learn from activities. They also provided reference points for understanding when, and how, activities illuminated ideas, as well as aroused interest.

Teachers had substantial support for activities and supplies outside schools. Many felt overwhelmed by the flurry of activities swirling around them. Logistical concerns drew attention from content, for teachers and their activity suppliers. Without concentrated attention to student learning, it was likely hands-on/minds-on work would fall short of that goal. Moreover, unless assistance went beyond providing materials, novices seemed poorly positioned to figure out, on their own, how to mobilize learning. Although some had sufficient personal resources to draw on for this work, others needed more help. Programs effectively kept the focus on learning when they targeted specific topics in teachers' curricula, provided interactions with experienced teachers who used hands-on work successfully with similar students, compared successful and non-successful instances of learning, and examined student work.

Those characteristics may help form what Spillane (1999) calls a "zone of enactment" (p. 170) for new teachers. Spillane, borrowing from Vygotsky (1978) and other socio-cultural theorists coined the term to describe the social dimension of support he presumed necessary for teachers to substantially change their practice. These zones are spaces for learning, where social and conventional resources meet:

> Zones of enactment, then, are concerned with the distance between teachers' current practices and understandings of practice and levels of understanding and practice that can be accomplished through collaboration with others using a variety of material artifacts. (Spillane, 1999)

Using activities as tools for intellectual engagement required substantial work in novices' zones of enactment. The findings about resources – personal, conventional, and

social - suggest possibilities for better supporting that work. These include assessing personal resources, selecting activities carefully, finding mentors successfully using activities with similar students, examining student work. When intellectual engagement is the goal for using activities, novices need help staying focused on the prize. Support programs need to ensure they balance logistical support with deliberate attention to student learning, in short, to serve as activity sense-makers as well as suppliers.

Chapter 7
Access for All Students to Science

> All students, regardless of age, sex, cultural or ethnic background, disabilities, aspirations, or interest and motivation in science, should have the opportunity to attain high levels of scientific literacy. (National Research Council, 1996, p.235)

As described in chapter one, the third reform ideal – access for all students to science – draws attention to equity. The National Science Standards "emphatically reject any situation in science education where some people...are discouraged from pursuing science and excluded from opportunities to learn science" (p. 20). Reformers insist every student, regardless of ethnic or economic background, gender, English language fluency, learning proclivities, or career aspirations, has the opportunity to develop competencies in science (AAAS, NSES). In this chapter, I focus on how participants responded to problems with access they encountered in their practices. The teachers found students' wide range of academic skills, English fluency, and work habits made science more accessible for some than others. When teachers discussed access, they focused on three issues: limited literacy skills, poor attendance, and failing grades.

As argued in the two previous chapters, resources shaped teachers' responses to these issues. Some study participants explicitly addressed problems; others did not, and personal resources again were the primary filter for the approach they developed. Secondly, not all teachers had conventional and social resources that supported access. Furthermore, resources teachers judged were successful with urban science learners had the strongest influence.

In order to keep the chapter to a reasonable length, limited literacy skills ia addressed as an example of the larger category of providing access. Literacy, which offered the richest source of data, provides sufficient evidence to support the arguments forwarded in the chapter. An extended analysis of attendance and grades would neither add anything new nor contradict the claims made here. Moreover, sole attention to literacy provides space to explore concerns about whether literacy resources supported access to *science*, as expressed in NSES, or access to something else (this distinction will be come clearer later in the chapter).

The organization of the chapter follows the pattern of the two previous chapters. The first section frames the analyses. The second describes how teachers experienced, and responded to, problems with literacy. In the third section, I examine how resources shaped what teachers did. I conclude with a discussion of the implications for helping new teachers teach science-for-all.

Literacy as a Gatekeeper

> I think their book is very difficult. The reading level is very high...It's...a disservice to give them a book that's so difficult to read...It doesn't really give [the students] any incentive to read. (Olivia, I10)

As the quotation above illustrates, the new science teachers quickly realized problems with the textbook assigned for their course. They found the reading level too difficult for many students. Rita's assessment was typical, "It's so dense and there's so much vocabulary and...the sentence structure is so difficult for a lot of the kids" (I1). Olivia indicated the reading problem was common knowledge in her science department: "[Another science teacher from the department] was in a reading class and they analyzed

pieces of reading [from the textbook]...I can't remember the exact level but it's too high for them...a lot of them have lower reading skills" (I10).

The mismatch between students and textbooks presented a problem. What good was a textbook that many students could not comprehend? What could (should?) they, as teachers, do about the situation? Once again, the new teachers were caught in a difficult situation. The textbooks were the one curriculum resource all of their students had; it was ready-made and in their hands. Teachers could just say "Turn to page 52"—no worksheets to make up, no copies to run off (and subtract from their precious copy allocation), no search for alternative texts. Yet, if they did use the text, it meant many of their students would not succeed without extra help; either alternative meant more work for the teacher; not giving assistance meant students would have to struggle along as best they could on their own; survival of literacy-fittest.

During the year, the novices developed two different stances vis a vis what they should do. Three of the teachers – Rita, Felicia, and Mark – became what I call literacy instructors. They viewed literacy development as an important part of their role as classroom teachers. The literacy instructors did not leave their students' literacy competencies to chance. They intervened to make the textbook more accessible. Although the other four teachers also defined literacy skills as a problem, they did not solve the problem by taking on students' literacy development as one of their core instructional goals. For them, literacy was a barrier to access over which they, as science teachers, had little control.

Teacher interviews, especially those conducted at the close of the school year, and classroom observations provided data for constructing accounts of their responses to

literacy, videotapes and classroom artifacts were particularly useful. Interviews with school/program staff and program observations, along with teacher interviews provided the bulk of the data for the analyses of resources.

Teachers' Respond to Problems with Literacy

As previously noted, two characteristics distinguished literacy instructors. One, they stressed the importance of literacy in their instructional and their professional development goals. Furthermore, they developed a *strategic* approach to literacy in their practice. That is, they included literacy development as part of their planning and explicitly taught literacy skills to students. The other group did not indicate instructional and professional development goals geared towards literacy nor did they demonstrate a strategic approach. Resources – personal, conventional, and social – shaped the differences between the two groups. Literacy instructors had personal and/or social resources that encouraged them to reorient their conceptions of their instructional obligations and supported them as they learned to teach literacy.

In order to set up that argument, the following section provides detailed descriptions of the differences between teachers. The section first addresses instructional and professional development goals, then, strategic literacy practices.

Instructional and Professional Goals

As Rita looked back at her second year of teaching, she worried that her students had not developed the reading skills they needed. When she described her instructional and professional development goals, Rita took responsibility for improving the situation:

> [My students] are really bad at reading the textbook and understanding the textbook...It's atrocious. They just want to copy and copy and copy and they

> think that is learning something... but they don't really understand... I want to learn more about effective ways to help [my students] read for understanding. (I5)

Rita felt obligated to help her students improve their literacy skills. Moreover, she wanted to improve her own competencies for doing so.

Mark also reported literacy skills were a major focus (I5). When he explained his rationale, he talked about building skills students would need in college:

> What I'd like to do is...more literacy stuff. That's a really technical term, literacy stuff, straight out of the literature (laughs)...I say [to the students], "Look, you know, you're going to leave my class and a lot of you are going to go to college and you need to be able to extract information from non-fiction stuff...When you get to college, what you're going to be tested on and what you need to know isn't always going to be told to you in class"...So, we're developing reading strategies. (I2)

In addition to future success in college, Mark also pointed out that reading strategies were beneficial for students who missed class: "I think the textbook isn't the way to learn physics...But...seeing how often kids are absent or...they're pulled out of class, I want them to be able to supplement their classroom experience with the textbook" (I4). For Mark, improving literacy skills was essential. In doing so, he hoped to improve his students' chances of success in his class and in future courses.

As Felicia reflected on her first year of teaching, she emphasized the importance of what she learned about was literacy. Felicia expressed uncertainty about her skills for teaching literacy but stressed the importance of doing so:

> I don't know how I would do it exactly, but I now understand better how important it is to teach kids how to read science and how to be literate on top of just teaching them science...I would like to incorporate...more of that into my teaching. (I6)

Felicia referred back to something she talked about earlier in the year, comparing teaching science to teaching a foreign language:

> I think learning science, especially biology, is a lot like learning a foreign language. There's a huge amount of vocabulary [especially] for kids who aren't that strong with English language structure and syntax to begin with. If we are going to be able to expect them to use this vocabulary at all, they need a lot of support. So that's a theoretical focus of mine...I don't necessarily teach it this way but I'd like to do more in the future. (I8)

Similar to Rita and Mark, Felicia's statements reflected one characteristic of literacy instructors - literacy development as both an instructional and professional development goal.

These three teachers—Rita, Mark, and Felicia—all expressed a stance towards literacy development that obligated them, as science teachers, to attend to their students' literacy development. The other four teachers—Mary, Joseph, Steven, and Olivia—also discussed problems with literacy (e.g., Olivia's remarks about the textbook). However, they did not target literacy development in discussions about their teaching or improving their teaching. Of course, they may not have done so for other reasons; other concerns, perhaps, were more pressing in the moment. Another possibility is they may take literacy development as a given, something they already do. However, a closer examination of the differences in classroom practice between the teachers offers further evidence that Rita, Mark, and Felicia acted as literacy instructors for their students in ways the other teachers did not.

Strategic and Non-strategic Literacy Instruction

A cursory glance at how teachers tried to bridge the gap between students and the textbook reveal little difference between the two groups. For instance, Mary had her students make flashcards of definitions from the textbook chapters (I1). The flashcards looked similar to the "word wall" Felicia and Rita put up in their classrooms, an area where they posted definitions from the textbook. Olivia and Mark both had students

outline textbook chapters. Felicia and Steven used identical worksheets to structure their students' use of the textbook. Yet, there was a difference in what teachers did with those tools; the literacy instructors used them for explicit literacy development. Rita, Felicia, and Mark (1) targeted skills – how to find the main idea, how to summarize, how to use a pronunciation guide - and (2) explicitly taught those skills to their students. The other teachers did not. In the second part of the chapter, I attribute this difference to resources —both personal and social – but that is getting ahead of myself.

Let us consider a few examples to ground the later discussion. The examples present three contrasts between strategic and non-strategic use of a potential literacy development strategy: Mary's and Rita's uses of alternative texts, Olivia's and Mark's approaches to students' outlines, and Steven's and Felicia's assessments of the word wall. The analyses use the two features of strategic literacy - attention to literacy development and explicit teaching of literacy skills – to draw the contrasts.

Alternative readings assignments. Mary and Rita both provided students with reading assignments from sources other than the textbook. However, they did so for different reasons, and they used the alternative texts in different ways: Mary accommodated her students' poor reading skills, Rita wanted to improve them.

Mary did not let the students take their textbook home for two reasons: they had trouble reading it and they often forgot to bring it back to school (I1). Consequently, she sometimes used reading selections from other resources for homework. For example, during a unit on chemical bonding, Mary assigned several worksheets from a workbook entitled *Higher Scores on Standardized Tests* (Steck-Vaughn, no date). Mary selected worksheets that connected either to present (chemistry) or past (simple machines)

curriculum topics. She also made selections based on the reading level she thought her students could handle (I1). Figure 7.1 is a copy of one of the worksheets Mary assigned (CA1).

Physical Science, part 2 Your score: _____

Directions
Read the selection. Then, darken the circle by the answer that correctly completes the statement

Testing Tips
Look at the questions before you read the selection.
After you read the selection, read each question again.
Read all the answer choices.
Choose the answer that goes best with the selection.
Check your answers by looking back at the selection.

Now try these
You have 15 minutes

Matter is made up of basic units. Matter can be combined, separated, mixed, and altered.

The smallest building block of matter that retains the properties of matter is the atom. A single crystal of salt or grain of rice is made up of millions of atoms. Atoms are too small to be seen, except with very powerful microscopes.

An element is made up of only one kind of atom. Few of the things you see around you are pure elements. Wood, plastic, and steel are made up of molecules that consist of many kinds of atoms.

A substance made up of two or more elements chemically combined is called a compound. When two or more atoms combine, they form a molecule. A molecule is the smallest particle of matter that consists of more than one atom

1. The smallest building block of matter is
   a. A molecule
   b. An element
   c. An atom
   d. A compound

2 _____is made up of only one kind of atom
   a. A molecule
   b. An element
   c. An atom
   d. A compound

3. ____is a substance made of two or more elements chemically combined.
   a. A molecule
   b. An element
   c. An atom
   d. A compound

4. When two or more elements combine, they form_____
   a. A molecule
   b. An element
   c. An atom
   d. A compound

Figure 7.1 Mary's Alternative Reading Assignment

As figure 7.1 shows, the worksheet included a reading selection --a series of declarative statements—and four multiple-choice questions. Mary graded the worksheet based on the number of correct responses. Mary felt her students could manage the

reading selection and, therefore, could successfully complete the assignment (I1). Accommodating her students' literacy skills, she did not use the worksheet to *develop* their skills. Instead, she pitched the alternative reading to the low-level reading skills she perceived. The worksheet was a simplified substitute for the textbook she decided not to send home.

Like Mary, Rita selected readings from other sources based on topic and reading level. However, Rita also paid careful attention to the literacy skill(s) she wanted to teach. For example, she used a reading selection, from a curriculum resource on evolution, as a follow-up for the fork-bird activity (discussed in chapter 6). Figure 7.2 is a copy of a portion of that reading:

> In the unit on ecology, you learned that each species has a particular role within an ecosystem. A fish such as a freshwater angelfish (Pterophyllium scalare) is adapted to eating small aquatic worms. To people, most angelfish appear the same: they look similar, eat the same types of food, etc. However, there is some variation within the species; not every angelfish is identical. Think about other organisms that you might think are identical: what could you do to identify differences among individuals within the species?
>
> In Activity 100, "Battling Beaks," you modeled a forkbird population that showed genetic variation. Although they were all the same species (forkbirds), there were one-tines, two-tines, and four-tined forkbirds. How did they get to look so different? All genetic variation exists because of **mutation** (*mu*-TA-*shun*). Every so often, something happens differently during reproduction. As a result, the offspring has features that do not exist in the parent, or even in the rest of the species.

Figure 7.2. Rita's Alternative Reading on Genetic Mutations

As figure 7.2 illustrates, the reading addressed variation within species. In addition to criteria already mentioned, Rita selected it because the content referenced the

fork-bird activity. The textbook would not have done that (FN5). Rita explained, at length, her plans for using the reading:

> It works out pretty well that the activity [from the curriculum]...following the fork bird activity is a reading activity...[The students] were supposed to read it and answer a set of questions...Instead, they are going to read it and summarize it. So, we're breaking it up into two parts. We're going to read the first half of it which...talks about evolution... Then they are going to write their summaries...I'm going to look at it overnight...grade them on a rubric...and pick out some different sort of examples from their writing and show them....some exemplary and not so. Then give them the second half...which is about evidence for evolution and they'll write another summary about that. (I10)

Rita's intentions for the lesson clearly had literacy development as the purpose. Even though the curriculum guide provided questions for students to answer, she had another purpose in mind. She wanted to provide instruction, guidance, and practice for her students in reading and summarizing a piece of text. The focus on literacy development was equally evident when she used the alternative reading in the lesson.

As Rita indicated, she provided the students with a scoring rubric for their summary, a rubric the language arts teacher on her team shared with her (see figure 7.3)

Content:
4 The summary contains all of the main ideas and all of the important details from the original text
3 The summary contains most of the main ideas and most of the important details from the original text
2 The summary contains some of the main ideas and some of the important details from the original text
1 The summary contains only a few of the ideas and details from the original text
Organization:
4 The summary has a clear topic sentence and a clear conclusion sentence
3 The summary has an adequate topic sentence; may not have a conclusion sentence
2 The summary has as a sloppy or hard to recognize topic sentence and no conclusion sentence
1 The summary has no recognizable topic sentence or conclusion sentence
Language:
4 The summary is in formal English in your own words, and uses several transition words to guide the reader
3 The summary is in formal English in your own words, using one or two transition words to guide the reader
2 The summary is in informal English in your own words, using one or two several transition words to guide the reader
1 The summary is in informal English in your own words, and uses no transition words to guide the reader

Figure 7.3 Rubric Rita Used for Summaries

At the beginning of the lesson, Rita went through the rubric with the students. When she came to the rubric criteria for language, Rita emphasized that the students should write the summary in their own words. In the following excerpt from the lesson, Rita addressed the challenge she perceived this presented:

> Notice, this says, in your own words. I've noticed this is very hard for you. Formal English means how you write. Informal English mean how you talk. When you write your summary, write in formal English and in your own words...That's tough to figure out. I'm going to model it for you. [Rita reads the first paragraph from the selection]. How can I put the word variation in my own words and in formal English? [Writes variation on overhead]....I could write when there are differences [Writes on overhead]. It means the same thing as variation but it is in my own words and I use formal English. (FN5)

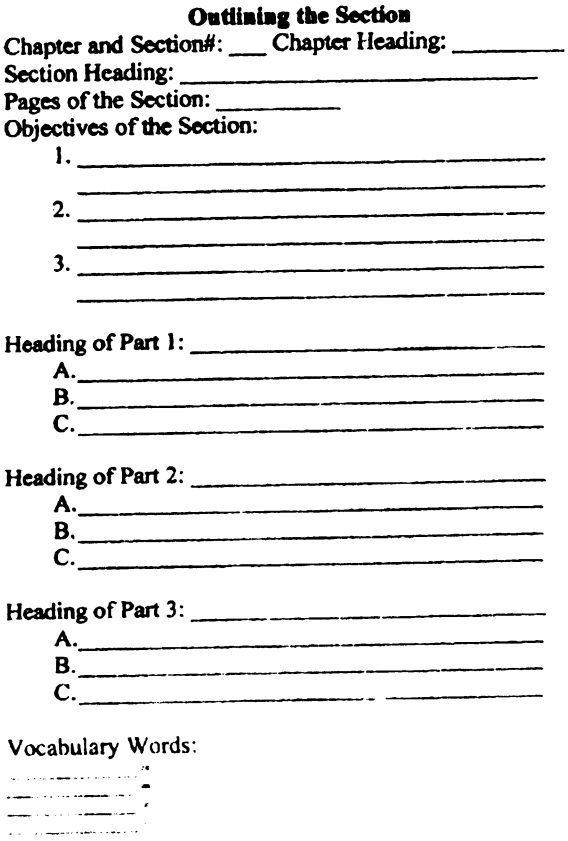
In the passage above, Rita explicitly taught her students how to take a scientific term – variation – and substitute an expression of their own that had a similar meaning. As the class continued, Rita monitored the summary writing, pointing out to individuals where they could improve relative to rubric criteria (FN5).

These vignettes from Mary and Rita's practice support the claim that Rita took a strategic approach to literacy issues while Mary did not. Rita's instructional purposes for the alternative reading assignment clearly targeted literacy development. Moreover, Rita explicitly taught a literacy skill – writing a summary – to her students, while also teaching the scientific content. Mary's use of the reading she assigned, on the other hand, exemplified a non-strategic approach to literacy concerns. Mary assigned something she thought her students could comprehend. As we will see, their different approaches reflected differences in resources.

Chapter outlines. Both Olivia and Mark had their students outline textbook chapters. Mark intended the outline to help his students become better readers. In addition, Mark explicitly taught skills he called "reading strategies" to prepare his

students to read and outline the chapters. Olivia's approach resembles Mary's use of alternative texts. The outline was a homework assignment she thought her students could accomplish. Furthermore, she structured the outline to minimize what students had to read. A closer examination of how Olivia and Mark used outlines lends support to the claim that Mark addresses literacy development strategically while Olivia did not.

Although Olivia often complained that the reading level of the biology textbook was too difficult, she regularly gave homework assignments from it (e.g., chapter review questions). These assignments included outlining chapter section(s). Olivia provided the students a template for their outline (see figure 7.4). The template provided space to write section headings, main ideas under each heading, and vocabulary words.



Outlining the Section

Chapter and Section#: ___ Chapter Heading: _____

Section Heading: _____

Pages of the Section: _____

Objectives of the Section:

1. _____
2. _____
3. _____

Heading of Part 1: _____

A. _____

B. _____

C. _____

Heading of Part 2: _____

A. _____

B. _____

C. _____

Heading of Part 3: _____

A. _____

B. _____

C. _____

Vocabulary Words:

Figure 7.4 Outline Template Olivia Used

Olivia seemed to approach the outline as an assignment to complete rather than as a strategy for literacy development. Prior to a lesson Olivia taught about the origin of life on earth, for example, she assigned a section outline on that topic from the textbook as homework. The section from the textbook had five objectives, five subheadings, and six vocabulary words. As figure 7.4 shows, the template only provided space for three objectives, three subheadings, and four vocabulary words. Olivia did not adjust the template to fit the assigned section from the textbook and gave full credit as long as students filled in all of the spaces on the worksheet (CA2). Other than reminding students to turn the outline in on her desk, Olivia did not refer to it during the lessons she taught on that section (CT 4-6). Moreover, Olivia did not indicate any literacy goals in her written analysis of the lessons (LQ 4-6). Olivia treated the outline as an exercise for students to complete. She did not use it to help them to learn how to identify major points and supporting ideas when they read the textbook.

Mark, on the other hand, used the outline as an opportunity for students to improve their reading skills. Initially, Mark did not provide a template to his students for outlining. He simply asked them to write the subheadings from the chapter on a piece of paper and identify two or three major points under each subheading. Prior to the assignment, Mark spent some time in class looking through the chapter with the students. Mark described the process he used to prepare them:

> If you look at [the conceptual physics] textbook, there's lots of drawings...so we look at the headings and what is underneath the drawings...We try to go through the chapter...and look at some of things and talk about, what does that show? What do you already know about that?...And then they read it that night and...outline the reading. (I2)

Mark referred to the preparatory questions he asked the students as "reading strategies" (I2). Mark wanted to teach those strategies to help students produce better outlines of the textbook material. In doing so, Mark hoped to improve his students' ability to comprehend the textbook (I4). However, Mark noticed students had difficulty completing the outlines and, when they did, often did not identify the main ideas as he had hoped (I4).

Mark then introduced two other types of outline assignments, one called a "guided reading outline" (I4). In these outlines, Mark provided the main points under each chapter subheading and the students responded to two questions for each section. Mark found the outline-imbedded questions were a better alternative for reading comprehension than the questions in the textbook:

> I made the outline and I asked pointed questions...one that was sort of pull out of the book and then one that required them to apply it a little bit...It was better than questions at the end of the chapter because they knew where to look so it encouraged them to read through the chapter. (I4)

As the excerpt above indicates, Mark clearly designed the guided reading outline to address literacy development and help his students make sense of the textbook.

Mark showed similar intentions with a graphic organizer he developed for part of the textbook chapter on sound. Again, Mark attended to developing literacy skills:

> I am using a graphical organizer...[for] the second half of the chapter...of sound...There's things like resonance and forced vibrations...and the other headings [from the textbook chapter]. Each of those phenomena is like a concept...[In the organizer] the students connect [the phenomenon] with a definition of it and an example of it. (I4)

As with the other outlines, Mark assigned the graphic organizer to help his students make sense of the textbook and teach them a strategy (e.g., graphic organizer) to organize and understand information presented therein. Mark also adjusted the method he used to fit

the chapter and topic; his instructional tools were not generic templates used across any and all contexts. Mark clearly had more than one outline strategy to pull from; Olivia appeared to rely on one generic method, regardless of its fit with the textbook or the content.

Mark's approach to the outline was strategic: he clearly targeted literacy goals and explicitly taught literacy skills to his students. He developed this strategic approach because he had social and conventional resources for literacy development that Olivia did not have. However, before providing evidence for that claim, one final contrast remains, Steven and Felicia. Recall they regularly planned lessons together. Despite their co-planning, they developed very different approaches to literacy.

Word wall. During a unit on genetics, Felicia posted vocabulary words from the chapter, their pronunciation, and their definitions on a section of the wall in her classroom (FN1). Felicia explained that she decided to put this "word wall" up because she found students struggled with the textbook's vocabulary (I8). [56] Figure 7.5 shows a portion of the word wall in Felicia's classroom. Felicia developed the word wall specifically to address difficulties she perceived her students had with scientific terminology. Felicia hoped the word wall would help students remember definitions; the pronunciation guides would help them use scientific vocabulary during class discussions (I8).

[56] Rita also had a similar area in her classroom (FN1). Felicia labeled hers a Word Net. She decorated one bulletin board with an ocean theme and attached a fishing net. Rita posted vocabulary words on the net. However, she did not included pronunciations or definitions.

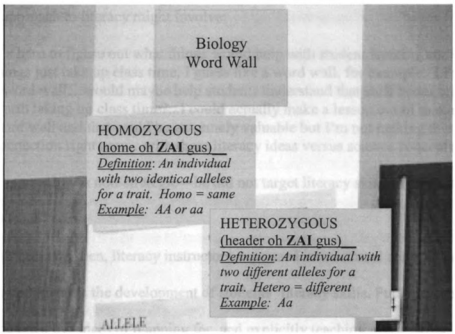


Figure 7.5 Felicia's Word Wall

In addition to specifically targeting literacy skills, Felicia's approach to the word wall showed the second attribute of a strategic approach – she explicitly taught the students about the word wall. She introduced it to students:

> Notice I added a word wall. A lot of the words we've been talking about are up on the wall there [points to word wall]. It has the spelling, the pronunciation, the definition, and then an example of each. So, as we talk about these words, you can use that word wall to help you. (CT1)

Throughout the class, Felicia directed students to the word wall when they struggled to pronounce a word (e.g., heterozygous) or could not explain what a word meant (e.g., allele) (CT1). Felicia referred to the word wall as a "scaffold," for she hoped that it provided assistance until students could use the words on their own (I6).

Steven, on the other hand, questioned the value of using literacy strategies like the word wall in his classroom. Although Steven acknowledged the vocabulary in the textbook was difficult for students to master, he trusted students would pick it up from

lectures and discussions (I1). Steven indicated he was hesitant to commit the class time a strategic approach to literacy might involve:

> It's hard to figure out what things would help with student learning and what things just take up class time. I guess like a word wall, for example. Like having a word wall...would maybe help students understand that stuff better but...is that worth taking up class time?...I could actually make a lesson out of making up our word wall and that could be extremely valuable but I'm not making that connection right now...with these literacy ideas versus science concepts. (I1)

Steven's approach was non-strategic—he did not target literacy skills in lessons nor explicitly teach them.

In summary, then, literacy instructors expressed instructional and professional goals directed towards the development of students' literacy skills. Furthermore, their lessons included instances of planning for, and explicitly teaching, those skills. With these comparisons in mind, I now turn to resources – personal, conventional, and social – that shaped teachers responses to literacy issues.

Resources – Shaping Teachers' Responses to Literacy Issues

Regardless of school, grade level, or science course, all of the teachers found the textbook – the primary instructional resource the district made available to students – difficult to use; many students could not decipher it. Despite the universal agreement concerning this problem, the teachers responded in very different ways, as we have seen. What explains the variation in their pedagogical responses?

Literacy instructors had resources that the other teachers either did not have or did not use. Surprisingly, coursework in literacy was not a predictor of whether or not the teacher acted as a literacy instructor. However, literacy instructors did have a common characteristic—they all had commitments to urban learners, and for them, literacy was a

gatekeeper for successful participation in school. However, personal commitments alone were not sufficient to support instructional and professional development goals or strategic classroom practices. Teachers who developed as literacy instructors also had access to someone they perceived knowledgeable about literacy and urban students. Furthermore, the extent to which teachers incorporated literacy instruction reflected (1) the strategies these knowledgeable others provided, and (2) the support they gave novices for using those strategies with students. The following analyses substantiate these claims; analyzing how resources – personal, conventional, and social - shaped responses to literacy concerns.

Personal Resources – Literacy Courses

In terms of personal resources, previous coursework or training in literacy was a logical place to look for differences among teachers. Rita, Olivia, Steven, and Felicia all completed teacher education programs that included at least one literacy course. Mary and Joseph took a literacy course as part of their credential program (discussed in social resources). Mark had not yet taken the literacy course – Reading in Every Classroom – required by his credential program. However, teacher background in literacy raised more questions than answers. For example, why did Mark, who had no coursework in literacy, act as a literacy instructor when Olivia who did have such background did not?

Recall Steven's provisional commitments to his students and teaching situation. He hesitated to take on responsibilities that did not fit within his preferences for students—highly motivated learners—and his perceived strengths as a teacher—giving information. Steven indicated he was aware of classroom strategies to support literacy. However, he dismissed them (I1). He was a science teacher, not a reading teacher. It is

not surprising, then, that Steven did not draw on the literacy course he took during his teacher preparation program.

In contrast, Felicia brought a number of personal resources to literacy work. In addition to a strong commitment to meet the academic needs of all of her students, Felicia thought highly of the literacy courses she took during her teacher preparation program. She considered the books she used for those courses—*Reading for Understanding*[57] for instance—valuable resources (I6). Felicia also had a supplemental authorization to teach Spanish, which likely helped her draw comparisons, as noted earlier, between learning scientific terminology and learning a foreign language.

Rita and Olivia both worried about their students' success without literacy support. Olivia felt that giving students a textbook many of them could not read was a social injustice, a sentiment Rita shared (I1). Yet, Rita and Olivia did not express confidence, as Felicia did, that their literacy courses provided sufficient knowledge and skills to help their students. Indeed, they lacked confidence in those abilities. Rita put it this way, "I felt absolutely unprepared [to teach reading]...I'm not a reading teacher. I don't know anything about language arts and I don't know anything about getting struggling readers to read" (I1). However, despite their similar lack of confidence, Rita provided literacy instruction, while Olivia did not; a difference accounted for by other resources Rita had that Olivia did not.

In summary, personal resources shaped whether teachers leaned towards or away from literacy instruction. Commitments to teaching all students supported teachers' attention to literacy as an issue of access. Surprisingly, literacy coursework did not play a

[57] Schoenbach, Greenleaf, Cziko, & Hurwitz (2000)

significant role as a personal resource for most of the teachers. Teachers who did not act as literacy instructors were just as likely to have coursework in literacy as those who took up literacy in their instructional goals and practices, notably, Mark, who had no literacy coursework to draw on. While Mark's commitments to his students account for his willingness to take on literacy instruction, it seems unlikely he could develop the range of reading strategies he used without further assistance. In the following section, I examine how resources – social and conventional - played a key role in shaping whether or not teachers were able to move beyond concerns about literacy to act as literacy instructors.

Social and conventional resources. The social and conventional resources available to teachers for literacy development help explain what personal resources alone cannot account for. In this section I consider social/conventional resources; in the next, I explore the interaction of resources. Two sources of data support the analyses here: (1) responses to a question about social resources for literacy development, and (2) observations and reports of programs in which teachers participated.

In Table 7.1, I summarize the response each teacher gave to the question: "Do you know someone you consider knowledgeable, or expert, in modifying instruction to support the needs of students with limited literacy skills?" (I3).

The results suggest that teachers who had access to someone they perceived supported students' literacy development were also the teachers who took on literacy instruction. All of the teachers who acted as literacy instructors identified at least one person they believed was knowledgeable about literacy instruction. The teachers who did not act as literacy instructors did not identify anyone who was knowledgeable about literacy instruction. Although the difference in availability of social resources seems

clear, the suspect nature of self-report warrants further evidence. A closer examination of social resources will help.

Table 7.1
Social Resources for Literacy Development

	Not literacy instructors				Literacy instructors		
Interview question	Mary	Joseph	Olivia	Steven	Rita	Felicia	Mark
Do you know someone you consider knowledgeable, or expert, in modifying instruction to support the needs of students with limited literacy skills?	No	No	No	No	Team colleague	Dept. chair	District mentor School colleague

Teachers without literacy resources. The teachers who were not literacy instructors did not have access to resources they perceived supported literacy instruction in their teaching situation. Mary's and Joseph's failure to identify a literacy expert appeared to run counter to the fact that they were taking a literacy course in their credential program. However, their responses makes sense given the mismatch they perceived between their teaching situations and the credential course. Mary described the time spent in her literacy course as tangential, at best, to her teaching assignment:

> It feels like a waste...I'll go tonight from four until ten to Bayline State to learn how to teach kindergartners to read. We'll practice doing things running records...where the kids read the line and the [teacher] checks [for errors] for six hours....It just seems so contradictory for [middle school] science. (I1)

The age of Mary's students and her assignment as a science teacher made literacy tools like a running record seem irrelevant to her. Although, in another situation, Mary might have considered the course useful, the mismatch between grade levels shaped Mary's

sense that the course provided little she could draw on for addressing literacy issues in her eighth grade classroom. Moreover, Mary's isolated position with the eighth grade meant she did not have other resources to draw from either.

Nor did Joseph find his literacy course, expressing views similar to Mary's. The mismatch for Joseph, however, was not due to grade level or subject but to the behavior of his special education students:

> Some of [the literacy course] is irrelevant in that...some of the strategies we are given are ridiculous...my kids would never be able to do a peer-led literature circle (laughs). They wouldn't know how to do that... they'd be throwing things at each other or fighting...or be bored and act out because they couldn't read the words and it would be mayhem...So, those strategies I've been given to use for literacy don't apply to special ed kids or special ed middle school kids or illiterate kids...Its mostly for kids that are good readers...to help them read better...In that class [the strategies]...have nothing to do with bringing kids that can't read to reading. (I1)

Joseph did not consider the strategies available through his literacy course as resources for literacy development because they appeared to conflict with his assessments of his own students' typical behavior and reading level. Thus, his views of students shaped his hesitancy to use the literacy strategies from his coursework. Consequently, Joseph did not draw on his literacy course for his practice.

Given Joseph's position as a special education teacher and his students' struggles to read, literacy strategies might have been a major preoccupation. However, Joseph seemed much more focused on teaching science and decision-making skills than reading skills. Joseph's partner teacher was designated the language arts teacher, so he may have left much of the literacy work to her. Furthermore, since Joseph did not admire or respect the way his partner teacher worked with his students, it was unlikely he would see her as a resource for his own teaching. Considering Joseph's assessment of his partner teacher

and his perception of his credential literacy course, it is not surprising that he was not able to identify someone whom he perceived knowledgeable in supporting literacy development.

It was also understandable that Olivia was not able to identify a social resource for support with literacy issues. Olivia's NTIP mentor did not refer to literacy when he discussed his work with Olivia; they focused primarily on classroom management, science curriculum, and district procedures (SP2/I1). The district USP focused on core activities for teaching science, not literacy (SP1/I1). The one opportunity Olivia did have was an afternoon session on literacy during a professional development day, a session missed because of a doctor's appointment (I2).

Steven's case was similar to Olivia's, for he too had few resources for literacy support. His NTIP mentor reported working primarily on classroom management and instructional style with him (SP3/I1). The Exploratorium TIP emphasized science activities and science curriculum materials. The new teacher workshops they offered did not include topics like literacy strategies or reading science textbooks (EPA2). In terms of school-based resources, Steven had the same department chair as Felicia. Unlike Felicia, however, he did not name the department chair as knowledgeable about supporting literacy development.

Steven's omission likely reflected his personal commitments. It appers that Steven's primary resource for literacy was Felicia who introduced him to the word wall, for example. However, given Felicia's status as another novice teacher, Steven most likely did not consider her a knowledgeable, or expert, source. But the trump card might have been his conception of his role as teacher. Even though Steven had access through

Felicia to literacy strategies, he did not use of them because he did not consider literacy instruction his responsibility as a science teacher.

Teachers with literacy sources. The literacy instructors had access to resources that they believed supported literacy instruction in their teaching situation. Two social resources played a substantial role: (1) work with someone they saw as knowledgeable about literacy instruction, and (2) favorable responses from students. As noted, the three teachers who acted as literacy instructors for their students could each point to one person in their school who was knowledgeable about supporting students with limited literacy skills. Mark also included a second individual as a knowledgeable source, his mentor, Eric Ceresi. The literacy strategies the novices used in their practice reflected the extent to which they worked with these knowledgeable others, and the conventional resources made available in that work. Furthermore, favorable responses from students strengthened teachers' attention to literacy development. To substantiate these claims, the following accounts provide evidence of the connection between the teachers' classroom literacy practices, their work with the literacy experts they named, and their students' responses.

Although Felicia, personally, had the strongest literacy resources, she was the most tentative of the three teachers in her literacy practices. She also had the least amount of assistance from the person she named as knowledgeable. Felicia relied on one literacy strategy in her practice—the word wall—which she adapted from one she saw her cooperating teacher use during student teaching (I8). However, Felicia "ran out of steam" (I6), and did use the word wall all year, but only for two units. Yet, at the end of the year, Felicia retained literacy as an instructional goal and planned to work with the English

teacher on her team over the summer to develop further methods to support her students' literacy skills (I6).

Felicia's limited use of literacy strategies in her practice reflected limited opportunities to work with her department chair, Larry. While Felicia indicated that she sometimes discussed literacy issues with him, she was also very sensitive to his busy schedule and tried not to impose too much (I1). Consequently, Felicia relied mainly on her personal resources. Felicia's continuing commitment to literacy appeared to stem primarily from her students' reactions to the word wall:

> The kids definitely noticed it, referred to it, used it...I could see them struggling with it but wanting to pronounce words like deoxyribonucleic acid...so [they used] the pronunciation guide...from the wall. (I5)

This experience reinforced for Felicia the need to support students' literacy development. Although Felicia had limited contact with her department chair, whom she saw as a resource, his presence and her students' use of the word wall were enough to convince her to continue working on her knowledge and skills for teaching literacy.

Rita used literacy strategies more extensively in her practice than Felicia did. Rita also had ongoing support Felicia did not have. Rita worked closely with Ms. Lubick, the language arts teacher on her team, to incorporate literacy strategies into science instruction (I9). Rita described Ms. Lubick's expertise in terms of both knowledge and tools: "[she] has a lot of really good ideas. She's really up on all the current research on learning...She [also] has a lot of organizers and techniques...that will help students read" (I10).

Ms. Lubick made the literacy strategies she used available to Rita and helped Rita use those strategies in her science class (I9). Rita provided an example of a reading strategy they shared:

> We did this pre-reading workshop to get [the students]to...look through the text first before they started reading to get ideas about what it was going to be about and start to ask questions and recognize things... It was [Ms. Lubick's] template...She taught [the students] how to use it and then I took it...I'm continuing to use it with them. (I9)

Rita's account illustrates how she adopted the tool Ms. Lubick provided. At the same, Rita also pointed to additional support Ms. Lubick gave; she taught the students to use the template prior to Rita's using it with them. Thus, Rita did not have to figure out how to use the strategy with the students on her own.

Rita also used strategies Ms. Lubick provided during the lesson described earlier. Ms. Lubick developed the rubric (see figure 7.3). Rita used with the students for writing the summary (I9). Prior to teaching the lesson, Rita admitted she lacked confidence in her ability to teach literacy skills. However, with Ms. Lubick's assistance, Rita felt she could support students' literacy development in her content area (I9). For instance, she described how she would tap Ms. Lubick's expertise to select the model summaries she would show the students:

> I'm going to use mostly positive examples....I'm going to ask Ms. Lubick for help in picking stuff out also because I don't know. I don't know what a good summary looks like. I know they have to have all the important points but did they use this word properly? I don't know, so I'm going to show them to her...we'll go through them at lunch or something. (I10)

Rita's comments provide evidence that Ms. Lubick, an experienced language arts teacher with expertise in literacy development, not only had literacy tools Rita shared but also helped Rita use those tools in her science classroom. Ms. Lubick's expertise and support

allowed Rita to provide literacy instruction even though, as Rita herself pointed out, she was a science teacher and not a language arts or reading teacher. Rita also perceived their work together consistent with explicit direct instruction in force at Medgar Evers, since they were explicitly teaching academic skills (I8).

Mark's case provides an even more potent example than Rita's of the way social and conventional resources shaped his development as a literacy instructor. Mark had not yet taken the literacy course required by his credential course and had no other background in literacy instruction. Yet, he regularly attended to literacy when he discussed his instructional goals and provided reading instruction to his conceptual physics students. Mark benefited from two resources: (1) his school climate and colleagues, and (2) ongoing support from Eric Ceresi, the district's science curriculum specialist.

It seemed that Mark almost could not escape attention to literacy in his school. Frederick Douglass High was on the verge of having state sanctions imposed due to poor test scores. In an effort to improve scores, the school instituted reading intervention classes. One of the classes took place in Mark's classroom during his prep period. Mark could not help but overhear the lessons and indicated an interest in what he described as the "highly scripted but very auditory" approach to reading instruction (I1). In addition, Mark was aware of school colleagues who provided literacy instruction even though they were not certified reading teachers (I2). However, while the focus on literacy at Frederick Douglass High explains Mark's attention to literacy, it does not explain the literacy instruction he developed in his practice, instruction that did not resemble the school-

based literacy classes. Instead, the instruction Mark provided his students very closely resembled the advice and tools provided by his mentor.

Mark discussed concerns about his students' reading skills with Eric, who advised Mark and provided strategies (I5). Eric's description of his literacy work with Mark matches the pre-reading strategy used with his students:

> [Mark] expressed to me...a general concern with the ability of his students to read the textbook...I...gave him some general ideas about things that he can do in the classroom with the textbook that would help their comprehension. Things like...when you assign something [to read], you would have all the students open up the textbook, and just look at it. [Look at the] title, have them predict what they are going to learn about, look at the sub-headings, have them predict...I suggested that he go through the reading first. (I1)

Further evidence of Eric's influence on Mark's practice comes from Eric's description of a book he provided:

> I gave [Mark] a resource...called "Teaching and Reading in the Content Area" in science. It's an excellent resource... I thought the resource was so good I was able to get someone else to buy it [for Mark]. It has lots of different graphic organizers and different techniques of getting the students to comprehend the reading in the content area better. For example, a definition concept map where they write the word in the middle and then they look for examples of what that word meant. What is the meaning of the word? What are some examples and some non-examples? (I1)

The graphic organizer Mark developed for his students mimicked the organizer Eric pointed to from the book he provided. Mark's approach to outlines clearly reflected his work with Eric - work that focused on literacy development as a classroom goal, utilized Eric's expertise as a bilingual science teacher, and made tools for literacy development available to Mark. It seems quite unlikely that Mark would have developed the instructional strategies for teaching reading he did without Eric's assistance.

Interaction between resources. The claims made about literacy instruction echo those of the two preceding chapters. Resources—personal, social, and conventional—

shaped literacy instruction. Personal resources acted as primary filters for the approaches teachers developed. In other words, teachers had to have prior beliefs, knowledge, or skills that made it possible for them to become literacy instructors. Steven was the one person who filtered out literacy instruction because he did not want to assume that role as a teacher. The remaining six teachers did not openly dismiss literacy instruction. However, they differed markedly in the resources for available to them in, and outside of, their schools; those differences account for what they did.

The three literacy instructors had social and conventional resources, the other four teachers did not have. First, they had access to a knowledgeable person. Felicia's case suggests the teacher apparently did not even have to work extensively with the knowledgeable other. Felicia's department chair seemed to serve primarily as a reminder that literacy could (or should?) be taught in science classrooms. Felicia had sufficient belief, knowledge, skill, and will to try one literacy strategy on her own. However, it is important to point out that, in comparison with Rita and Mark who had direct, ongoing assistance, Felicia was not able to sustain her efforts. As Felicia aptly put it, she ran out of steam.

Despite her limited use of literacy strategies, Felicia's interest in literacy development stayed alive, fed by her students' positive response to the word wall kept her interest in literacy development alive. However, Felicia could not use her students' responses as a resource to develop her literacy instruction, only to maintain her interest. As Felicia considered improving her literacy skills, she requested the assistance of the English teacher on her team (I6). Felicia recognized the need for additional assistance

from someone knowledgeable in literacy instruction if she was to move beyond her own capabilities.

Rita's and Mark's cases provide further evidence about resources needed to stretch personal limits. Rita and Mark not only sustained interest in literacy but also kept literacy instruction visible in their practice. They did so because their interaction with someone knowledgeable in literacy instruction differed from Felicia's in several respects. Rita's and Mark's experts were not simply existence proofs; they played a much more active role, providing the new teachers with tools for teaching literacy (e.g., outline templates) and helping them use those tools with students. Consequently, Rita and Mark were able to bring literacy instruction into their practice.

The importance of teaching context to resource use. Teaching context was another critical factor in how novices judged resources for literacy instruction. Joseph's and Mary's assessments of their literacy courses were negative examples of this claim. They dismissed their literacy course because the context did not fit their teaching situation. Rita's first account is also a negative example; the second is a positive one.

In the first instance, Rita contrasted her teaching situation unfavorably with that of another teacher she met during a USP workshop. One of the things that Rita particularly enjoyed about USP was the opportunity to work with other middle school science teachers from the district. In the course of her discussions with some of them, the differences between schools within the district, especially regarding literacy, surprised her. Rita described her response to a conversation with another teacher from an area that Rita portrayed as "more middle and upper class":

> I was talking to this woman who teaches at [Kennedy Middle School]. [Kennedy] is apparently this great school...We were talking about literacy and she said, "Oh,

> you just give them the stuff [to do]"...I thought, that would take my kids a week to do. [The other teacher] said, "[My students] have no real troubles reading the book." I thought, "What planet do you teach on?" (I6)

Rita attributed the differences between her students' literacy capabilities and those at Kennedy High to social class differences (I6). Her classroom experiences with literacy acted as a screen for sifting what she could or could not do. For Rita, the differences in literacy skills meant she could not assume what worked at Kennedy would work at Medgar Evers. Consequently, Rita reported she tended to expect little from her students when it came to reading or writing (I6).

However, Rita's experience in the Exploratorium summer institute, which took place shortly after USP, expanded her expectations. As Rita worked with her mentor, Gavin, to put together a unit on light (the teaching box), she learned about his teaching situation and how he worked with his students. Gavin taught science in an alternative high school in nearby urban district. Rita described Gavin's teaching situation as even more challenging than her own.

> [Gavin] teaches in a...continuation school...They have a big range of kids. Some are transfers from another district or state and they go there for a semester to catch up or get the requirements met. But then there are also kids that don't often go to classes or can't read and so they'll go there to finish up, or kids that have been kicked out of so many schools, they can't go anywhere but there...It's a very transient community because people come and go all of the time. (I6)

Rita seemed to identify with Gavin's context because she also taught students with wide-ranging abilities, many of whom had limited literacy skills. Her perception that she and Gavin shared similar kinds of students appeared to give his classroom practices credibility. This credibility shaped her sense that perhaps she could expect more from her students than she had previously anticipated:

> [Gavin] really focuses a lot on writing... That's nice to see... I've been trying to get more [writing] but I've been...operating under the assumption that its hard for [students] to do so I'm going to focus on other things. But [Gavin's] really focusing on writing...He makes them write paragraphs and stuff like that...So that's...inspiring. I think, "OK, I can expect that." (I6)

Rita's interaction with Gavin provided a different benchmark for her students. As a new teacher, Rita was not certain of what she could or could not expect from students who struggled with reading and writing (I1). Gavin's experience with students similar to her own gave his literacy practices a credibility that a teacher from a different context (e.g., the teacher from Kennedy) likely would not have had. The comparison of these two accounts, then, provides further evidence that the context of social resources matters. The new teachers looked for a correspondence between their teaching situation and the one in which the social resource was situated.

Conclusions and Implications

The study participants primarily discussed access in terms of literacy rather than science. The teachers' perception of one resource – a textbook many of their students could not read – directed their attention to literacy. Three of the seven teachers included literacy as part of their instructional and professional learning goals and provided literacy instruction. These teachers were committed to teaching urban science learners and had access to someone they considered knowledgeable about literacy instruction. A literacy-focused school climate and/or positive student response to literacy strategies heightened teachers' attention to literacy instruction but did not enrich their classroom practices. The extent to which the teachers incorporated literacy instruction within their practice was associated with opportunities to acquire literacy strategies (tools) and support for using those tools with their students (or students similar to their own).

The analysis presented in this chapter provides evidence that resources for literacy instruction were not equally available to Bayline science teachers nor equally valued when they were available. The analyses also show that new science teachers do not necessarily view opportunities typically made available to them through literacy courses or workshops as resources. As pointed out in the two previous chapters, for teachers, the proving ground for tools they acquire are their own students. Context matters. This helps explain why the people teachers identified as knowledgeable about literacy instruction tended to be colleagues who taught students identical, or similar, to their own students. The presence of these teachers acted as existence proofs for the new teachers that literacy instruction was a worthwhile and possible pursuit to take up in their own classrooms.

Context also explains why teachers might dismiss tools like running records and peer-led literature circles, as Joseph and Mary did; the context in which they acquired the tools seemed too removed from their own teaching situation. When teachers perceived these differences, they could excuse themselves from adding literacy instruction to their practice. As new teachers, they already felt uncertain enough about their abilities and overwhelmed by responsibilities.

The uneven availability of personal, social, and conventional resources for literacy instruction created a situation where a teacher (like Mark) with no literacy training, developed skills as a literacy instructor while a teacher (like Steven) who had background in literacy, chose not to pursue literacy instruction. Meanwhile Steven's colleague, Felicia, in the classroom next door, attempted literacy instruction with minimal assistance.

As long as textbooks are the primary conventional resource shared between teachers and students, urban districts like Bayline that serve large numbers of students with poor reading scores can anticipate access will be a problem for teachers and students. While ignoring the textbook might circumvent the problem in the short run, it also leaves new teachers, who share this one resource in common with their students, out on a limb and does little to improve students' literacy skills. Without resources that provide alternatives to the textbook (e.g., the curriculum Rita used on evolution) and ways of using those resources with students, new science teachers have little choice but to rely on the textbook, even though they are well aware that it is not accessible to many students.

Mark and Rita illustrate that even though a new teacher lacks confidence or background knowledge and skills for literacy instruction, they can develop as literacy instructors, when they have opportunities to work with someone knowledgeable who provides tools, like literacy strategies, and ways of using those tools with students. Again, Spillane's (1999)construct of teachers' zones of enactment helps model the relationship – enriching "teachers' current practice and understandings of practice...through collaboration with others using a variety of material artifacts" (p. 171).

As discussed in the two previous chapters, Spillane models the enactment zone as a social dimension in which teachers gain access to resources that shape their practice. Personal resources are at the center of the model and mediate teachers' use of social and conventional resources. In terms of literacy, personal resources directed teachers' attention towards or away from literacy instruction as a response to the problem they perceived with their textbooks. For example, Steven did not notice opportunities to

develop competencies as a literacy instructor because his personal beliefs ruled out literacy instruction in science class.

Social resources provided incentives and opportunities to learn about literacy instruction, including material artifacts, like reading strategies, to enact literacy instruction in practice. Although Spillane used enactment zones to explain differences in how mathematics teachers enacted mathematics reforms in their practice, the characteristics he described of enactment zones that support teacher learning fit well with the findings of this study. Based on his findings, Spillane proposed the following features were critical for enactment of reforms into the core of teachers' practices:

> Whether teachers who do not have the requisite individual capacity enact reforms in ways that revise the core of their practice will depends on the extent to which their enactment zones are
> - social rather than individualistic;
> - involve rich deliberations about the substance of the reforms and the practicing of these reform ideas with other teachers and reform experts;
> - include material resources or artifacts that support deliberations about instruction and its improvement. (p. 171)

The description of learning opportunities available to Mark and Rita, the two teachers who incorporated literacy instruction most extensively in their practices, matched more closely than any of the other teachers, the characteristics Spillane identified. Based on this study, one additional characteristic seems necessary, that experienced others (e.g., mentors) are successful within a context similar to the teaching situation of the new teacher.

Spillane's attention to rich deliberations about the substance of reforms draws attention to a final point about literacy instruction and learning to teach science-for-all: to what extent did literacy instruction, when it did occur, address access to science as envisioned in science-for-all reforms? When NSES describes access, it does so in terms

of access to the knowledge and practices of science. However, the literacy instruction the new teachers developed seemed more focused on literacy than on science. Brickhouse (2005) observed literacy practices in science classrooms favor school competencies rather than science competencies. That is, rather than learning how science is written and read, students learn academic practices - summarizing paragraphs, outlining, and the like. Steven pointed to this tension when he puzzled over trading literacy strategies for science content. On one hand, improving reading skills potentially opens access to scientific knowledge as presented in the textbook. However, given negative assessments of the science textbooks regularly used in classrooms (American Association for the Advancement of Science, 2000, 2002), textbooks do not seem, in their present form, to be useful tools for accomplishing the aims of science-for-all. While some might remedy this by abandoning textbooks and concentrating on hands-on activities (as we saw in the previous chapter) as the basis for science instruction, such a move does not take in to account the substantial role of text in scientific practices (Brickhouse, 2005).

These concerns suggest literacy instruction in a science classroom does not necessarily provide access to science as envisioned in science-for-all. Resources for instruction in reading and writing were available; yet, when summaries and outlines were the focus, they overshadowed science. Capacity may be the primary issue, then, for improving access to literacy and science. The programs in which the novices participated provide resources that supported "rich deliberations with experts" in literacy practices associated with science. Those experts, along with tools to support their work, are critical for building enactment zones that help novices provide access for all students to science.

Chapter 8

The Impossible Will Take a Little While Longer: Learning From, and For, New Teachers

The study participants were caught between a rock, traditional science teaching with all the appropriate tools (textbooks, worksheets, lecture notes, and whiteboards) -- and a hard place, reform-minded instruction with other kinds of tools, (standards, hands-on activities, inquiry lessons, and supplies to support instructional reform). However, no matter which tools—traditional or reform—novices used, they ran into problems. Conventional science teaching failed to engage their students in learning. Engaging activities were just as difficult; they presented greater logistical demands for time, supplies, and management. Furthermore, activities often seemed a distraction from, rather than a vehicle for, learning.

Caught between a rock and a hard place, most held on to the rock; few ventured into the hard place. Those who did, often floundered, and struggled to make sense of their efforts. Some had sufficient personal resources to sustain their efforts; fewer found the assistance they needed elsewhere. Although educational institutions provided tools, novices had very few models of teaching science-for-all. Moreover, the organization of most schools supported conventional teaching. Reform-minded institutions, located outside of schools, did not (or could not) intervene and reorganize schools to better support science-for-all; thin social resources limited novices' development.

The argument, then, in its simplest form is this: If we are going to get serious about learning to teach science-for-all, we need to get serious about teacher learning. This means that researchers, teacher educators, and professional development leaders must get

serious about developing the personal, conventional, and social resources that we need to support new teacher learning. What lessons can these new science teachers teach us us about what it means to take their learning seriously? While there are many, I have chosen seven—one for each teacher—which form the nucleus of this final chapter.

Lesson 1: The Importance of Personal Resources

> You know, it's hard being a teacher, much harder than I thought. (Felicia, I6)

Numerous studies point out the strenuous demands instructional reforms, like science-for-all, exact from experienced teachers, let alone novices (Gamoran et al., 2003; Kennedy, 1998; National Research Council, 2000; Wilson, 2003). It is difficult, ongoing work—for teachers and researchers. Standards and inquiry-based reforms are fledglings; there is still much to learn about achieving excellence for all students (Atwater, 2000; Knapp & Plecki, 2001; Lee & Avalos, 2002; Lynch, 2001).

Given the expanse of what we do not yet know, science-for-all remains relatively unexplored territory. As such, it demands of teachers what any new frontier requires—a pioneering spirit:[58] willingness to work hard, stamina in the face of inevitable failures, a sense of adventure, a thirst for knowledge, and boundless creativity, to name a few. Yet, it did not seem that educational institutions communicated to novices the pioneering nature of the work and its incumbent requirements.

The difficulty of teaching surprised most of the teachers; they seemed to have the impression that learning to teach science-for-all was a fait accompli rather than pioneering work. A support provider, for example, who teaches a quick demonstration

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[58] Anderson (2003) used the term pioneer to refer to teachers who were learning to "teach for understanding." The metaphor described novices learning to teach science-for-all very well.

lesson and leaves or hands supplies over like silver bullets, glosses the difficulty, uncertainty, and ground-breaking nature of the work. Novices concluded they just needed a little more experience, a different teaching assignment, the right credential course, or better hands-on activities. I do not mean to imply that those kinds of resources are not important, but there are no shortcuts when it comes to learning something that, in Bayline School District at least, was much more rhetoric than reality. Thin social resources meant that novices had to rely heavily on their own resources to sustain reform-based goals.

As this study and others (Spillane, 1999; van Driel, Beijaard, & Verloop, 2001; Yerrick, Parke, & Nugent, 1997) suggest, teachers used their personal resources to notice and interpret, frame, and extend learning opportunities. Therefore, personal resources were critical contributors to what teachers were willing, and able, to learn. At the minimum, these resources included subject matter knowledge,[59] knowledge of scientific practices, beliefs that all students can learn science, and strong commitment to teaching in an urban setting.

Given the importance of personal resources for novice teacher-pioneers, rather than making entry into urban science teaching less selective, perhaps it should be more selective; carefully choosing those who have personal resources to support the work. Unless programs—credential and otherwise—are clear, themselves, on the nature of the work and its requirements, they may inadvertently contribute to the revolving door of teacher attrition (Ingersoll, 2004) they mean to address. Consider that only two of the teachers, Felicia and Mark, selected BSD because they wanted to teach long-term in urban schools. Tourists (accidental or otherwise), voyeurs, and opportunists (even well

[59] This study used undergraduate science degrees as a measure of subject matter knowledge; this is a minimal measure. Recent work by several of my colleagues (Olson, 2004; Shouse, 2005) investigates qualities of subject matter knowledge.

meaning ones) are unlikely to have what it takes to go the distance.[60] Yet, more long-distance teachers are what urban districts need (Ingersoll, 2004; Knapp & Plecki, 2001; Urban Teacher Collaborative, 2000). Thus, a program like Teach for America can be seen as both promising and not: Promising in the sense that the recruits often have considerable personal resources, at least by way of liberal arts and sciences education as undergraduates. But they do not have to be committed—long term—to urban schools.

Urban districts need teachers with personal resources and that commitment for two reasons. First, experience is one of the most reliable predictors of student achievement (Greenwald, Hedges, & Laine, 1996), improving student achievement means keeping good teachers; long-term commitments to urban learners increase the likelihood teachers will gain experience. Second, unless teachers remain in a district, there is little hope of developing the human capital necessary for learning—a cadre of effective teachers who hold high expectations for students, engage them with science, and reach all learners; professionals who are then available, in turn, to work with incoming novices. Contracts, like TFA, that obligate teachers for two years of service do provide badly needed teachers to urban districts, but do not necessarily resolve teacher quality issues. For instance, in Mary's case, her agreement with TFA required she take whatever position the district assigned her, even though she was not qualified for that position. Moreover, knowing she was soon leaving the eighth grade class, Mary minimized her investment in learning[61]

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[60] This also applies to researchers, teacher education programs, and other educational institutions; work in urban contexts requires a great deal of humility and considerable investment of resources.

[61] I am not implying that Mary is typical of TFA teachers, in general. As Mary pointed out, the situation in BSD (and TFA's subsequent pullout) was unusual for TFA. However, Mary indicated that her entire BSD cohort left teaching after two or three years (including Mary – see the Epilogue). Whether that attrition rate is unusual cannot be determined; TFA does not make that data available (Clewell & Forcier, 2000).

Personal resources, then, are central. What novices bring to their work shapes what they learn and what they need to learn. However, they also need ongoing opportunities to build their personal capital. Conventional and social resources were keys, expanding or limiting what novices' learned. The remaining lessons address what taking new teacher learning seriously means for conventional and social resources.

Lesson 2:
Conventional Resources Are A Necessary,
But Not Sufficient, Condition for Learning to Teach Science-for-All.

> Everybody is trying to do all this support...They want to know what can we do to be more supportive? I wish I knew what to tell you but...it just doesn't feel supportive. (Mary, I2)

Educational institutions in Bayline provided conventional resources, such as curriculum materials and instructional strategies. However, they were less able to help novices use those resources for equitable and ambitious science teaching. As noted in the previous section, few models of teaching science-for-all existed. Consequently, new teachers were often skeptical about what they, or their students, could do.

I draw two points about new teacher support from Mary's comments. First, when it comes to curriculum resources, such as activities, less is more. Flooding the educational system with tools (like hands-on science activities) does not account sufficiently for use. To the contrary, it only demoralized teachers, like Mary, Felicia, or Joseph, who felt guilty about not using more of the resources available to them, and Rita who could not decide how to select among them. While experienced teachers might be more adept at organizing and selecting instructional resources, most of these novices (Mark was an exception) were overwhelmed. Moreover, as we saw with activities, logistical details (again, necessary, but not sufficient) captured the attention of novices and institutions

alike. This distracted teachers from investigating whether, and how, activities supported demanding and equitable outcomes.

The process developed by the BSD science instructional coordinators suggests a way to cut through the clutter and keep the focus on teacher learning. They carefully selected a few activities matched to BSD curriculum units, had experienced teachers field-test them, let new teachers practice before taking them into the classroom, and then, with novices, evaluated the impact on student learning afterwards.

The second point Mary's comments suggest is the necessity of context-specific assistance. In other words, minimize the adaptations new teachers have to make—to the subject matter of their course, the grade level of their students, the supplies or facilities required, etc. I offer three examples to illustrate this point. The first has to do with supplies.

Teachers tended to implement hands-on work when they also received the supplies necessary (and, even better, extra hands). Understandably, teachers who have to tote water buckets down the hall, as Joseph did, are less likely to plan activities that require wet clean up. In contrast, someone like Mark, who has a storeroom of supplies next to his classroom, is in a much better position to plan hands-on work. Moreover, the storeroom itself communicated hands-on instruction was expected.

The second example involves explicit focus on subject matter. Mark and Rita, for instance, learned strategies (e.g., explicit direct instruction or literacy supports) outside the context of science instruction. Consequently, they did not adapt the strategies to the discipline; instead, science disappeared when they used those tools. For example, questioning is a critical component of science. However, scientific questions have

particular characteristics—they are discipline-specific, verifiable, and build on what is already known (Bransford & Donovan, 2005). Likewise, science has its own literary practices (Brickhouse, 2005). The new teachers needed help in making connections between generic ideas and their subject-specific implications.

The third example involves students. Novices paid more attention to resources when they clearly saw the fit between their student population and the resource. Felicia and Rita ignored advice from teachers they perceived had little experience with students like their own. Joseph suspected what worked at Gifted High would not work with his students. The closer the match, the more teachers paid attention; they used these occasions as existence proofs. Rita and Olivia listened carefully to experienced teachers who worked in similar classrooms. Felicia noticed her students working in the Active Science Project classroom after school, pausing to wonder how she might get similar results in her own classroom. Mark judged what he could expect from his students based on his colleagues' expectations.

These examples of context-specific assistance point out the kind of social resources needed to support learning to teach science-for-all; resources that teachers in BSD did not necessarily have. What teachers learned depended on their enactment zones—when social resources did not support science-for-all, novices' instructional practices followed suit. Most notably, they needed opportunities to learn from knowledgeable practitioners of science-for-all; practitioners who were in short supply in BSD.

This leads me to two suggestions for developing those social resources: (1) Build a strong knowledge base to support science-for-all instructional reforms, and (2) use a

combination of insider and outside expertise to develop that knowledge base. I briefly consider each.

Context-specific guidance requires a knowledge base that includes what some call craft knowledge (Hiebert, Gallimore, & Stigler, 2002; Kennedy, 2002), practical knowledge (van Driel et al., 2001), or pedagogical content knowledge (Hiebert et al., 2002; Wilson, Shulman, & Richert, 1987). Regardless of name, the concern here is for pedagogical reasoning—working through context-dependent instructional issues. For example, "Why choose this activity and not that one?" has a single, but not at all simple, answer: "It depends"—on learners, teacher knowledge and skills, the discipline, and the available resources, to name a few variables. Because of this host of factors, building a knowledge base requires careful, deliberate work in local contexts (Hiebert et al., 2002).

We saw Olivia develop craft knowledge as she worked with district teachers. She learned to select activities that would not distract students from learning.[62] As Olivia interacted with experienced teachers, she had opportunities to access their "wisdom of practice"(Shulman, 2004). The same was true of Rita's work with her mentor during the Exploratorium summer institute; Mark's support from his colleagues accomplished the same purpose. Even more reason, then, to develop such wisdom for teaching science-for-all. Otherwise, we leave to chance what practitioner wisdom novices may encounter. As we saw in many schools, new teachers were likely to encounter the wisdom of conventional teaching.

[62] Note, however, that Olivia primarily attended to management concerns, rather than student thinking, when she evaluated activities; attention to student thinking is addressed in a subsequent lesson. This speaks to the necessity of developing practitioner wisdom that supports the ideals of science-for-all. As we saw in some schools, practitioner wisdom, especially in a district entrenched in traditional science teaching, may run in conventional directions.

Anderson (2003) points out that teaching science for understanding (a component of science-for-all) has yet to develop a practitioner-friendly knowledge base:

> There is no set of readily available routinized "teaching for understanding" practices that are comparable to the routines of conventional teaching. That is, while conventional teaching has a well-developed body of technical knowledge, teaching for understanding does not....The lack of ready-made routines saddles teachers with the added burden of having to create and validate a new set of practices that support teaching for understanding. (p.14).

As Mary indicated, most novices are not in a good position to take on the added burden of developing these new routines and new technical knowledge. Yet, that was exactly what reform-minded educational institutions expected. No wonder, then, support did not feel helpful to her.

Developing the kind of knowledge base required to support novice science teachers in BSD is, of course, no easy task for educational institutions. Clearly, the district did not have sufficient resources to do the work alone. Recall that the district cut funding, eliminated instructional specialist positions, and teachers were reluctant to commit to a professional development series. Institutions devoted to science (e.g., the Exploratorium) were able to provide those resources. We saw how a science museum, a medical school, and a university research facility offered content expertise, experienced teachers who were passionate about science, as well as activities and supplies. Yet, when do such institutions support novices' *learning* to teach science-for-all? The findings from this study suggest when they examine what, and how, teachers and students are learning.

If the science classrooms in BSD are the test-bed, then that is where these institutions must interrogate their products and practices, shoulder-to-shoulder with novices. That is, going into BSD classrooms themselves, establishing relationships with students and teachers, and learning to teach science-for-all. It is unfair to saddle (as

Anderson puts it) novices with that work. It is incumbent on these institutions to develop the social (as well as conventional) resources to support teachers' efforts to pursue ambitious goals with all of their students. I describe critical characteristics of those resources in subsequent lessons. Here, I point out that "outsiders"—science (and other) educational institutions apart from schools—need to develop partnerships with insiders that share the burden with novices; these institutions will also need the pioneering spirit described earlier.

In sum, institutions partnering with schools need to be careful not to overwhelm novices with resources. Moreover, new teachers require assistance from others who are knowledgeable practitioners of science-for-all in similar contexts. Consequently, investment in teacher learning means that institutions must develop the expertise necessary to provide such assistance. Unless new teachers have robust social resources, including a context-sensitive knowledge base and knowledgeable practitioners to learn from, support may feel more like a lead weight than a life raft.

This second lesson provides the foundation for the remaining lessons. Lessons 3 through 7 expand on the characteristics of robust social resources.

Lesson 3:
Social Resources Must Help Novices See Students as Capable Science Learners

> Would I want to [teach] somewhere where when I put directions on the board everyone is going to follow it? Everyone's going to do their homework every night? Everyone's going to read quietly or read at home when I tell them to....Would I want to go to that situation? It would be an incredibly academic...I could really teach. (Joseph, I1)

Science-for-all hinges on teachers' perceptions that all students are capable science learners (American Association for the Advancement of Science: Project 2061, 1993; Atwater, 2000; Ladson-Billings, 1994; Lynch, 2001; National Research Council,

1996). Joseph, who taught special education students, gives voice to important relevant questions. What does it mean to "really teach" all students? Joseph loved his students, but their behavior did not fit with his perception of traditional academics: following directions, completing homework, reading quietly. Consequently, Joseph doubted his students' capabilities to achieve ambitious curriculum goals.

Other teachers had similar struggles. They were uncertain what they could expect from students. Moreover, their students did not seem particularly eager to take on difficult work. It was a rude awakening. Recall the come-uppance Mark's students gave him on his first day (and many afterwards); Felicia's realization that her students needed a hook for learning; and Steven's discomfort with the indifference he sensed in his classroom. Their dilemma was this: the more teachers demanded from students, the less likely they thought students would do the work. It was understandable, then, that they lowered their sights; their own success depended on student cooperation (Lortie, 1975). Teachers and students bargaining down curriculum demands has a long history in public school classrooms (Anyon, 1994; Sedlak, Wheeler, Pullin, & Cusick, 1986; Sizer, 1985).

The tendency to lower expectations undermines the ambitious goals science-for-all demands. Novices needed assistance setting goals that respected students' capabilities; assistance some did not have. Mark had colleagues as well as a school mission that supported high standards. Rita reconsidered her students' potential in light of her Exploratorium mentor's higher expectations for his students, students similar to her own. In the absence of such assistance, teachers tended to minimize demands. Novices were well intentioned, fearing they would turn their students off to science or make things too difficult; however, their goals often short-changed students.

These findings suggest, then, that novices need help holding high expectations, especially for students with cultural, academic, and linguistic skills that differ from those traditionally valued in schools. One possible course of action is intentional focus on students thinking; this is the subject of our next lesson.

Lesson 4:
Social Resources Must Help Novices Focus on Student Thinking

> Everybody has lots of experience in physics. They just don't know it. (Mark, I9)

Student thinking is critically important to student learning (Bransford & Donovan, 2005; Gamoran et al., 2003; Loucks-Horsley et al., 2003). Thus, teachers ought to pay close attention to what their students understand about science and its practices at all phases of instruction: before, during, and after teaching lessons. As Mark pointed out, his students already knew things about physics; things he could use for their learning.

We saw most teachers, especially when working with hands-on activities, lose sight of students' thinking. This is not surprising. Beginning teachers, coping with multiple demands, have many distractions. Learning to read what students think and how to use that thinking for instruction is difficult and complicated (Bransford & Donovan, 2005; Gamoran et al., 2003). Novices needed support that kept their attention focused on student learning.

Teachers had few opportunities to substantively explore, understand, and/or learn how to tap their students' experience and thinking; when they did, novices focused more on what students learned. Olivia, for instance, evaluated the two core activities she taught based on discussions with colleagues about what students learned. Mark had opportunities to discuss students' ideas about physics with colleagues and in QuarkNet;

his high expectations for teaching and learning reflected those conversations (as well as his own commitments).

Novice teachers, then, need occasions to investigate student thinking with others who are more knowledgeable. Possibilities for doing so include analysis of student work and lesson study (both observed in this study), as well as case studies, coaching, and demonstration lessons (Loucks-Horsley et al., 2003). Research investigating whether, when, and how these opportunities support teacher learning is an important piece for designing support that works for novices. Otherwise, as already discussed, there is the danger of overwhelming new teachers; this only distracts them from student thinking. Carefully designed support, then, finds ways to make student thinking visible. However, teachers also need access to another black box, teacher thinking.

Lesson 5: Social Resources Must Help Novices Make Sense of Failures and Question What Counts as Success

> I don't know. I have no idea. I don't know if [modeling] is helpful or not. (Rita, I11)

Rita implemented the tenets of Explicit Direct Instruction (EDI) quite faithfully; she mimicked what she saw and read. Yet, in her words, she "had no idea" whether modeling helped her students learn. This suggests Rita's knowledge of EDI was largely procedural; she knew the steps, but not the reasoning behind those steps, nor did she have evidence that the steps—with or without their rationale—led to increased student learning. However, procedural knowledge cannot support the goals of science-for-all. As already discussed, teachers need a deeper well of knowledge from which to draw, this

includes both deepening their understanding of the "whys" behind the choices they make as teachers, and helping them learn from their experience.

Science-for-all depends on what Shulman (2004) calls pedagogical reasoning. That is, teachers must pay attention to both ends and means (p. 234). Teachers cannot just assume students learn from activities, textbooks, outlines, or the like; nor can they be content when students do not learn, excuse themselves from knowing why, or place blame solely on students. Equally important, teachers must account for the means they use, whether an instructional strategy handicaps particular students while privileging others; or, as we saw earlier, bargains away substantive learning.

Remember, however, these are novices. Pedagogical reasoning is expertise they have yet to develop. They need assistance from consultants who can help make sense of failures, and question successes, in ways consistent with science-for-all. That kind of support was in short supply for the new teachers in this study. For instance, when things did not go as planned, Felicia's lack of confidence intensified, for she was at a loss what to expect from herself or her students. Recall also Rita wanted a better rational for sorting and selecting activities than just what topic they covered. And remember Olivia's relief when another teacher explained to her why the clip bird activity interfered with student learning.

It is not clear why that kind of expertise was in short supply. There are several possibilities: colleagues leaned towards traditional instruction, mentors needed training that supported science-for-all, and/or novices did not have support providers with that kind of expertise. There is much more to learn about mentors and novices in this area. How do support providers develop their own expertise, let alone make pedagogical

reasoning available to novices? In order to examine pedagogical reasoning that supports science-for-all, novices (and researchers) need access to teacher thinking.

The intense social resources novices require goes hand in hand with the difficulty of the work. When Shulman (2004) wrote, "Teaching is impossible" (p.151), science-for-all is just the kind of the teaching he had in mind. What sustains teachers just beginning this difficult work, especially as they begin to realize the enormity of the task? As we have seen, success with students and existence proofs are critical. Steven suggests an additional possibility in lesson 6.

Lesson 6:
Social resources must intellectually engage novices in learning to teach science-for-all

> It's not like I was a hard-core research scientist, but I did research, worked on some long-term projects...I hear the term "lab report" and I cringe. I really hate to call these things, which are barely activities, labs...The idea of a lab report is nothing more than regurgitation. (Steven, I1)

Steven did not find teaching or his induction tasks intellectually engaging. It would be easy to blame the problem on him since the evidence concerning his personal resources suggest that he was not interested in changing his views about science, students, or teaching.. However, the quotation above gives pause, especially in light of Rita's experience with state sanctions. Ambitious learning goals for students require intellectual engagement. The same applies to teachers.

Most of the novices described their interest in science as a "passion." Steven was one of those teachers. Yet, the quotation above offers a sharp contrast between his life as a scientist and as a teacher; the latter paled in comparison. Lab reports for research were rigoros, demanding; the "lab reports" that students completed were thin, a sham by comparison. Rita's enthusiasm for teaching also tempered, in her case due to state

sanctions. The paperwork, the daily grind of filling up the whiteboard, the grumbling colleagues, and the tense principal took the joy out of going to work each day. On the other hand, opportunities to engage in scientific inquiry—at the Exploratorium, district middle school science institutes, or QuarkNet—energized teachers.

These findings suggest that educational institutions must pay close attention to intellectually engaging teachers, with subject matter *and* with teaching. Keeping their minds alive kept them alive. If this is true for new teachers fresh out of disciplinary study, it might also be even more true for their more experienced colleagues. What kinds of learning opportunities do both? What combinations of tasks might be particularly powerful? Getting serious about teacher learning means new teacher support and professional development programs must investigate such questions, even when it means interrogating the sacred cow of new teacher support: one-to-one mentoring. The Exploratorium, for instance, offers multiple ways for learning: workshops, mentoring groups, coaching, institutes, and online. Their program appears to recognize that teachers, like students, have diverse learning modalities and that sometimes they need to be learning about content—immersed it all of its wonder—without thinking about teaching. Moreover, the balance between required and optional components not only respects differences; it also allows teachers to shape their own learning: both what is learned, and how. I suspect this combination—a mix of "have-to" and want-to"—contributed to intellectual engagement.

Before moving to the final lesson, I will sum up lessons 2-6. Novices are unlikely to use conventional resources—time, stipends, activities, credentials—for ambitious ends unless they have strong support from social resources. The latter includes experienced

practitioners, content specialists, and teacher educators. The work has the following characteristics: attention to student learning, teacher learning, and the ideals of science-for-all. Research on all aspects of the endeavor is necessary to build a knowledge base that supports novice science teacher learning, as well as development of expertise.

Clearly, learning to teach science-for-all is an undertaking well beyond the scope of any single teacher, school, or district. Yet, including others means the need for coordinating efforts, without losing sight of teacher learning or science-for-all. We come, then, to our final lesson, developing an infrastructure that supports the robust teacher learning science-for-all demands.

Lesson Seven:
Develop an Infrastructure to Support the Teacher Learning Science-for-all

> I bought a couple of books on the first year of teaching like *Rookie Teaching for Dummies*...I just copied basically what was in that and adjusted accordingly. (Olivia, I1)

New teacher support in urban districts must pursue ambitions for teacher learning that equal those we have for students (Gamoran et al., 2003; Loucks-Horsley et al., 2003; National Research Council, 2000)—new teachers are not "dummies," teaching is not simple work. It is unlikely all teachers will have access to the conventional and social resources needed without a coordinated infrastructure. Loucks-Horsley (2003) compared the process of designing comprehensive professional development to bridge building: "Each bridge requires careful design that considers its purpose, who will use it, the conditions that exist at its anchor points (beginning, midway, and end), and the resources required to construct it" (p. 2).

But the educational system is difficult to engineer. New construction is rare. Instead, layering occurs: new policies, programs, and resources add to, rather than replace, the old (Tyack & Cuban, 1995). The classrooms I visited in BSD were reminders of this phenomenon. For instance, Fernandez High has a new computer lab with state-of-the-art equipment. Felicia and Steven both took their students there on several occasions. However, their classrooms also had older versions of computers taking up counter space. Obselete, covered with dust, they sat there, relics of an earlier time. Less visible were other vestiges of the past: policies layered upon other policies, old theories of student learning sitting side by side with newer ones.

The way the education system tends to operate—layering instead of building anew—means that progress tends to occur slowly over time:

> Although policy talk about reform has had a utopian ring, actual reforms have typically been gradual and incremental—tinkering with the system. It may be fashionable to decry such change as piecemeal and inadequate, but, over long periods of time such revisions of practice, adapted to local contexts, can substantially improve schools....Tinkering is one way of preserving what is valuable and reworking what is not. (Tyack & Cuban, 1995, p.5)

Induction policies and science education ideals both have a utopian ring. They promise ambitious learning outcomes for all teachers and all students. These reforms *have* added resources to BSD witnessed by a raft of new acronyms – TFA, NTIP, BTIP, USP, UMSP, and QuarkNet. Programs offer credentials, support providers, and activities. Yet, as we have seen, these resources did not replace traditional ones. Human Resources hired teachers at the last moment; colleagues handed over binders of lecture notes, textbooks presented dense information students could not comprehend. Moreover, programs and policies operated independently of each other, layer upon layer.

It is not surprising, then, that few teachers developed practices that reflected the ideals of science-for-all; the messages they received about science-for-all were filtered through a system that still clung to conventional teaching, a system that, in fact, sent multiple—often competing—messages to all of its teachers. Yet, this is not necessarily discouraging news. Tinkerers have more modest expectation than potters do; mending, rather than building, pots. Perhaps, then, it is a good time to pause and lock at how to make better connections between layers already present in BSD; building a more coherent structure to support teacher learning. I offer a few examples from Bayline about what connecting the layers might involve.

Institutions in which new teachers participated tended not to communicate with each other. This led to pockets of oversupply, undersupply, and useless help. For example, if Steven's NTIP and Exploratorium mentor communicated with each other, they might have coordinated their work so his FAS tasks focused on science teaching. Likewise, science methods instructors might communicate with the district science specialists; incorporating core activities into their coursework. The Intern director did establish links with credential programs and the Exploratorium; she wanted to develop small cohort groups of science Interns led by a trained science mentor. However, she ran into difficulty with the district new teacher office; they insisted on one-to-one mentoring. Perhaps one way of avoiding these turf wars is tightening requirements for coordination among programs, especially those with subject matter expertise, when funding new teacher support.

Establishing stronger links between institutions also create networks for research purposes. Investigating novice teacher learning requires their participation. However, as

we found in our work, learning to teach is overwhelming; another pair of eyes observing, a video camera, or, even, a survey questionnaire is just too much. We can minimize the burden on novices by building data collection into programs and schools. Furthermore, networks that bring together insider and outsider expertise promise to enrich the enterprise with views from the rock as well as the hard place. Finally, establishing local networks for science teacher learning make science-for-all shared, public work, rather than the domain of institutions who claim expertise.

Think of such a network as the tinkerer's workshop, where the day-to-day progress towards science-for-all is forged. Without that space, novices are likely to rely on resources that head them in very different directions. For instance, as Olivia told us, she relied on *Rookie Teaching for Dummies (Kelley, 2003).* The manual, written by a former teacher, has section titles like "*Bearing the Instructors' Burden, Facing Adverse Conditions*, and *Performing Six Shows a Day*"; all, perhaps, offered tongue-in-cheek. In addition to bashing schools of education, the book is full of tips about decorating classrooms, beginning the year, grading policies, and navigating school bureaucracies. For those unfamiliar with it, here are a few samples of the advice Olivia encountered:

> Remember: Everybody starts with the "less than ideal" classes, and if you lobby for better classes, you'll be labeled as a spoiled brat by your colleagues. No one gets the best schedule handed to him for the first few years he teaches; trust me, you wouldn't want those classes as a rookie, anyway. Think about it – if you start with great classes, there's nowhere to go but down for the rest of your career. (p. 209)

> Tip: If you're ever put in the unenviable position of having to present at an in-service meeting, remember these three words: *Keep it short.* No long set up or explanations about where the lesson plan came from or lengthy discussions of how much kids loved it. Get to the point, do your demonstration, and sit back down. If you talk longer than ten minutes, you'll feel hostility radiating toward you like the heat blown out of a space heater. (p. 269, emphasis in the original)

That kind of advice, let alone the title of the book, does little to support views of all students as capable learners, teachers as competent professionals, or teaching as intellectual and moral work (Ball & Wilson, 1996)

Conclusion

Mary, Rita, Joseph, Olivia, Steven, Felicia, and Mark may have been rookies, but they were certainly no dummies. The lessons their experiences can teach us do more than map the impossible terrain of learning to teach science-for-all. They teach us the personal resources needed—knowledge of science content and disciplinary practices, commitments to students as capable learners and to urban education. They teach us also about the importance of social resources, people knowledgeable enough to lead the way. Finally, through their experiences, we learn how institutions might become mutual partners in the work of learning to teach science-for-all. The impossible will take a little while longer, but there is hope.

Hope lies in placing teacher and student learning at the center of our agendas as teacher educators, educational researchers, and reformers. This study focused on the former. We need to get smarter about what that learning entails. That is the purpose of this study; a purpose I believe the seven teachers shared. I am indebted to them for their lessons; lessons Shulman (2004) sums up nicely. I will let him have the last word: "Unless we create the conditions for teacher learning, every single reform that we initiate, even if it looks like it is working at the beginning, will eventually erode and disappear" (p. 519).

Epilogue

When the school year begins for BSD students in Fall 2005, one of the study participants—Felicia—will still be teaching in the district. Here is what the rest of the teachers will do:

Mary will begin a graduate program in educational policy at either Vanderbilt or Harvard.

Rita begins a new position at a research associate in a marine mammal facility near Bayline.

Joseph left BSD in Fall 2004 to teach biology at a private, Catholic high school—St. Magnificent (SM)[63]. In summer 2003, Joseph taught computer classes to inner-city students at an SM summer "camp." I visited him there; the facilities were quite a contrast from Adams Middle School: abundant technology, new facilities, state of the art science classrooms, raised platform tennis courts (each with a donor name), and beautifully manicured, expansive athletic fields. When the science department chair offered Joseph a full-time position, he agonized about leaving his Adams students; however, he decided SM was an opportunity he could not pass up—he could "really teach." Joseph will return to SM in Fall 2005.

Olivia, newly engaged to a beau from her hometown, is looking for a teaching position back there; she would prefer not to teach in the inner city.

Steven is off to Australia for at least a year; he is not sure if he will ever return to teaching; if he does so, it will not be high school biology or at an inner city school.

Mark plans to move back east and pursue a graduate degree in physics; his fiancée is in school out east. Mark may do his graduate work at the Midwestern university where his father teaches. When he finishes his degree, Mark plans to return to teaching high school physics and would prefer an urban school district.

So, the good news is the two teachers with the strongest personal resources will continue to teach science and urban students. The bad news is five BSD science classrooms have turned over teachers in the past two years; those classrooms will likely be staffed with new teachers. Moreover, teachers on their "way out" told me they found it difficult to maintain enthusiasm and energy for their work in the waning months. Steven

[63] St. Magnificent is a pseudonym

said he was just "marking time" and Rita said she would "not miss one single thing" about teaching (personal communication, 3/14/05); hardly the commitments science-for-all requires.

Appendix A

Instruments

Appendix A1: Initial Interview

First Interview with New Teacher[64]
Fall 2003

NOTE: Throughout the interview, use the following probes to get more information:
Anything else?
Anything more?
I think I know what you are saying, but could you tell me more?
Can you give me an example of what you are talking about?

Part 1. Background

1. How did you end up becoming a teacher?
2. Where did you go to college?
   - What did you major in?
   - When did you graduate?
3. Did you participate in any preservice teacher education?
   - If so, when?
   - What did it consist of?
   - How long did it last?
   - What kind of courses did you take?
   - Did you do student teaching?
     - If so, can you tell me about that?
       - How much responsibility did you have?
       - What did you teach?
       - Did you have a supervising or collaborative teacher?
4. (If relevant) Did you have another career before entering teaching?
   - If so, can you tell me about that?
5. Are you certified to teach?
   - If so, what kind of certificate do you have?

Part 2. Teaching situation

1. Tell me about your assignment this year
   a. What are you teaching (subject matter, grade level)?
   b. How many classes do you have?
   c. What kinds of kids are in your classes?
   d. Was there any kind of new teacher orientation in your school/district?
2. Inquiries about relevant school policies
   a. Is there a school curriculum?
   b. Do you have assigned texts/what are they?
   c. What kinds of standardized tests do your students take? How does testing affect your teaching?

Part 3. Opportunities to Learn

Appendix A1 (cont'd)

1. Do you participate in any new teacher programs?

[64] Adapted from Mathematics and Science Teacher Induction Study (2003)

a. How did you get involved in this program?
b. What is the purpose of this program?
c. What does the program consist of?
    Are there requirements?
    Are there optional activities?
    Anything else?
d. What activities have you participated in thus far?
e. Can you give me a concrete example of something that you have done in the program that has been helpful to you as a new teacher?
f. Is there something that you have done in the program that has been less helpful?
    If so, can you describe that for me?
g. Do you have a mentor or coach assigned in this program?
    If so, can you tell me about who that person is?
    How do you work with your mentor/or coach?
    How often?
    Who determines what your contact and activities of mentoring are?
    Can you describe a time when the two of you worked together to give me a concrete example of what you do?
h. Are there parts of the program that you know about but that you have not participated in yet?
    If so, what are those?
    Will you participate in them?
        If so, when? If not, why not?

2. Is there anyone else who gives you support on a regular basis?
    If so, can you tell me about them and how often you see them and what you do?

Part 4. Other Resources

1. I am curious about anything else that you have already used or might use this year to help you with your teaching.
    Do you participate in any other professional development?
    Other induction experiences?
    Do you have friends who are teaching?
    Curriculum materials you might use
    The internet?
    Anything else?

Part 5. Confidence and Concerns

1. As you think about your first year of teaching, what do you feel most prepared to do/ready to do/confident about?
2. What are you less confident about? What do you think you will need the most help with?

Appendix A2: Check-in Telephone Interview

(January 2004)

1. How are things going in your teaching?
    a. Has anything changed since we last spoke? If so, how?
    b. How about [insert former concerns]; how is that now?
    c. Any new concerns?
    d. Anything that seems to be going better for you? If so, how; why do think it has improved?

2. How about your new teacher support?
    a. Have you met with your mentor? What did you do?
    b. Anything you have done with new teacher support? (Probe on particular aspects of programs)
    c. Has there been anything that has been particularly helpful to you?
    d. How about not so helpful? Or help you wish you had?

3. Other learning opportunities
    a. Have you participated in any other professional development since we last talked? (Probe on anything they said they planned on doing)
    b. If so, will you describe what you did? Was it helpful, how?

4. Is there anything else you think I should know to help me understand your situation; resources, plans for the future?

Appendix A3: Resources Interview Protocol

Mapping Teacher Goals and Support

There are three parts to his interview. Part I focuses on what you are trying to do in your teaching. Part II on who you know that you would consider an "expert" in some aspect of teaching and Part III on who resources you think would best support you if you needed help with you are trying to do in their teaching.

Part I: Card sort on learning to teach

Directions to teacher: There are lots of things teachers could be working on in their teaching, many at the same time. But there's only so much time and energy so some things may become more pressing than others. The cards I have here have some things written on them that new science teachers told me they are working on in their teaching. There are about 30 cards. I'm going to give you about five cards at a time and ask you to place them on a continuum from Most focused on to Least focused on (Put out sticky notes with Most focused, Somewhat focused, and Least focused). Think of the continuum as having five columns – you can use the space between most and somewhat and somewhat and least as well. You can have as many cards as you want at any position.

By "most focused on," I mean the things you keep coming back to, spend the most time and energy on – the things that keep you up at night. You are not making value judgments about importance. There are things you may consider very important but wind up in the least focused spot for a variety of reasons – it might be something you think you're already good at, it might not be a priority at your school, or there might be other skills and knowledge you think you might need first.

While you are sorting the cards, please "think aloud" as you decide where to place the cards. After you've finished sorting all the cards, you can change things around and I'll ask you if there is anything you are trying to do in your teaching that isn't there and we can add anything missing on these blank cards.

Part II: Do you know someone who

For the next part, I am going to ask you some questions about people you know that you would consider "experts" in doing some of the things teachers might be working on. If you answer, yes, I'll ask you to name that person.

Appendix A3 (cont'd)

Do you know someone who:

1. **Knows the communities where your students live really well**[65]
2. Works well with the parents and families of students
3. Knows the school/district policies, procedures, and contractual obligations well
4. Works well with administration
5. Works with colleagues to improve their teaching
6. **Uses a variety of instructional approaches in their teaching**
7. **Engage students in investigations**
8. **Knows (biology, physics, life science) well**
9. Uses models and/or other representations to explain phenomenon they're trying to teach
10. Reflects on their teaching
11. **Connects the science content they're trying to teach with the interests/experiences of their students**
12. **Modifies instruction to support the special needs of**
    a. **english language learners,**
    b. **special education students,**
    c. **or students with limited literacy/math skills**
13. **Finds and uses materials and other resources for teaching science**
14. Has a classroom climate that supports student learning
15. Creates meaningful assignments and assessment linked to instruction

Part III

For the last part of the interview, I'm going to give you a diagram with the names of people or other types of resources you've indicated are available to you. The first thing I'd like you to do is look over the list and see if there are any people or other resources missing.

Now let's go back through the cards and for each one indicate one or two resources that you think would be most helpful **if** you were working on that in your teaching (hypothetical; may not need help with that). If there isn't any resource available that you think would be helpful then just say so.

1. Looking at the position of the cards, if you had more time and support, would anything change?

2. Things can wind up under "more focused" because they are things you choose to focus on or because they are things you feel you have to focus on (and want to/have to can overlap). Looking at most focused (first two columns) – are there

[65] Only the responses for the bold-faced questions were analyzed for this study.

things that you feel wind up there **only** because you have to focus on them and not because you would choose to focus on it yourself?

3. People can be very different in their tendency to seek help. On a scale of 1 to 5, with 5 being very likely to seek help and 1 being not likely to seek help, where would you be? Talk a little bit aloud about why you chose that number.

Appendix A3 (cont'd)

Gaining local knowledge of students and school contexts (blue)	Designing responsive curriculum and instruction (purple)	Understanding and organizing subject matter knowledge (pink)	Creating and maintaining an effective environment for learning (green)	Developing a professional identity (yellow)
1a. Become familiar with the local communities where your students live	2a. Become familiar with district/school curriculum expectations for the courses you are expected to teach	3a. Develop your understanding of science and the science content you are expected to teach	4a. Set up a physical classroom environment that supports learning	5a. Reflect on teaching practices
1b. Get to know the interests, experiences and individual needs of the students you teach	2b. Finding and using science materials and resources for teaching	3b. Anticipate what students are likely to find difficult or confusing about the content you teach and plan instruction	4b. Promote individual student responsibility for learning	5b. Establish professional goals
1c. Work with families to better understand students and support their learning	2c. Plan course curriculum –what to teach, how much, and in what sequence	3c. Develop and use instructional approaches that engage all students in science as a discipline - questioning, investigation, scientific evidence, problem solving	4c Create a classroom learning community	5c. Work with colleagues to improve practice
1d. Become familiar with school/district policies, procedures, contractual obligations	2d. Use a variety of instructional approaches dependent on learning goals and students' needs	3d. Use a variety of models and representations to illustrate phenomenon students are learning about	4d. Establish a climate that is safe, respectful, and supports intellectual risk-taking	5d. Contribute to school/district planning and programs
1e. Become familiar with administrators and what's expected of you	2e. Use what students already know about the topics you teach to plan curriculum and instruction	3e. Connect science content with students' interests, life experience, and diverse perspectives	4e. Plan and implement classroom rules and routines that support learning and manage instruction	5e. Balance demands of teaching – fairness to all and individual needs; authority figure and friendly person; management and activity
1f. Become familiar with and use available technology	2f. Evaluate/modify curriculum/instruction based on student needs, response, and performance	3f. Create meaningful assignments and assessments linked to instruction		5f. Manage "paperwork" – document student progress, lesson plans, etc. as required

Appendix A4: Subject Matter Interview[66]

(Spring 2004)

NOTE: You will need two handouts for this interview that the interview will write on: One is a map of the program from the perspective of the new teacher; the other is the list of activities that mentors and new teachers might engage in (see last page for a clean copy of this list).

NOTE: Throughout the interview, use the following probes to get more information:
Anything else?
Anything more?
I think I know what you are saying, but could you tell me more?
Can you give me an example of what you are talking about?

Self Assessment

1. How would you describe yourself as a classroom teacher right now?
2. Teachers have to do many things – plan, assess students' learning, work with curriculum, etc. Is there anything that you feel particularly well prepared to do?
   Anything else?
3. Is there anything you feel less well prepared to do as a teacher?
   Anything else?
4. NOTE TO INTERVIEWER: Probe on any of the following that have not been mentioned:
   What about:

   Planning?
   Using a range of instructional strategies?
   Using formative and summative assessments?
   Building a classroom learning community?
   Understanding students?
   Learning about new curricula?
   Learning about the school and surrounding community?
   Working with parents?
5. What are the major things that you think you have learned this year as a teacher?
6. How would you like your mathematics/science teaching to look in a few years?
   NOTE: Probe on subject matter teaching if they talk about generic issues like classroom management.

Subject Matter Goals

1. How confident do you feel about your understanding of the subject matter you need to teach in this class?

[66] MSTI (2003)

2. What are your goals for your students in this class for this year?
   - What do you hope they will learn?
   - What is the most important thing that students can learn about mathematics/science at this grade level?
   - Have you noticed that your goals have changed at all this year?
     - If so, in what ways?
3. Are there areas of the curriculum in this class that you feel more or less confident in teaching?
   - If so, where do you feel more confident? Why?
   - Where do you feel less confident? Why?
4. How do you decide what to teach and what not to teach?
5. How do you decide when to move from one concept to another?
6. How do you know when your students understand a concept? Can you give me a concrete example from your teaching this year so far?

Subject Matter Knowledge
NOTE: Hand the teacher the subject matter packet for math or science

FOR SCIENCE: Now I am going to ask you to respond to some student work that is from a middle school science class. I have one task that concerns plants, and another that concerns condensation. Why don't you look at both and pick one that you would like to talk about. (NOTE: Let the NT decide which task to respond to.)

First, could you take a minute and look at this question and the student responses to it?

1. What do you think of the first student response?
   - Why do you think so?
   - What does this student understand?
2. What do you think of the second student response?
   - Why do you think so?
   - What does the student understand?
3. If you could imagine the ideal student response to this task, what would it be?
   - Can you write an example response that you would hope to see in the form?
4. What would your students need to know or be able to do to respond to this task well?

Appendix A4 (cont'd)

Science Teaching Conversation Starter

Condensation

Shawn took a cold Pepsi out of the refrigerator. He poured it into a glass and added some ice-cubes. After a while, he noticed that the outside of the glass was dripping with water.

Explain how you think the glass got wet. Where did this water come from?

A couple of sample student responses:

Student A: The glass was sweating just like people do. It was in the cold refrigerator and then Shawn brought it out into a warm room, so it sweat.

Student B: I think that it is condensation. Hydrogen and oxygen in the air are condensing into water (H_2O) on the side of the glass.

Appendix A4 (cont'd)

Science Teaching Conversation Starter

From seed to tree

Josh wanted to know how a seed became a big tree. He designed the following experiment:

1) He planted a seed in 1000 grams of dry soil in a pot.
2) He then added only water to the plant for the rest of the school year.
3) At the end of the year, he dried out the plant and the soil in the oven overnight to remove all the water.
4) He weighed the soil and the plant. The dried plant weighed 600 grams.

What do you think the soil might have weighed at the end of the experiment? Explain your thinking.

A couple of sample student responses:

Student A: I think that the soil would still weigh 1000 grams, because sunlight is food for the plant.

Student B: I think that the soil would weigh about 400 grams, because the plant took 600 grams for its own weight.

Appendix A5: End of Year Interview with New Teacher[67]

(Spring 2004)

NOTE: You will need two handouts (and a highlighter) for this interview that the interview will write on: One is a map of their professional opportunities to learn ("Pd timeline') from the perspective of the new teacher; the other is the list of activities that mentors and new teachers might engage in (see last page for a clean copy of this list).

NOTE: Throughout the interview, use the following probes to get more information:
Anything else?
Anything more?
I think I know what you are saying, but could you tell me more?
Can you give me an example of what you are talking about?

Self Assessment

7. What are the major things that you think you have learned this year as a teacher?
8. How would you like your science teaching to look in a few years?
   NOTE: Probe on subject matter teaching if they talk about generic issues like classroom management.

PD Timeline

Here is a timeline of the support and resources I think you have had this year (Hand them the timeline).

1. First, would you take a look at it and let me know if there is anything missing?
2. Now, would you just look it over and talk about anything that particularly strikes you? What you have helpful or not so helpful? Would you take this highlighter (hand them a highlighter) and highlight the things you found most helpful and say a little bit about why they were helpful?
3. Are there things that aren't there you wish had been? If so, why?
4. Here is a list of the things that we have learned that mentors and new teachers do together. (Hand them the list). Can you go down this list and check off the things that you and your mentor have done together this year?

   classroom observations of NT by mentor
   reciprocal classroom observations
   debriefing after visit
   consultation
   co-plan

[67] Adapted from MSTI (2003)

co-teach
demonstration lessons/demonstrate
help with certification/professional development needs
go together to observe another teacher's class
advise about district regulations and policies
provide formative and final assessment
help locate resources
work on classroom management issues
work on subject matter issues
help with instructional strategies
look together/study samples of student work
participate together in study group or book club
participate together in content-focused seminars or workshops
attend a conference together
regularly scheduled coaching/mentoring session
script lesson (have their lesson scripted, get given the script)
case discussions
participate in a lesson study group
developing assessments together or scoring student work with colleagues
engaging jointly in curriculum topic study
setting up new classroom together (or getting advice on this)
get newsletter from mentor with ideas/tips/information
get help with Praxis requirements and preparation
get advice about jobs/ job change
get moral support
get oriented to the building/district
help with time management

Of the things that you have done, which ones have you done most often?
Which things have been most helpful; would you please highlight those and say a little bit about why you found that activity helpful?

This summer and next year

1. How are you planning to spend the summer?
   Are you participating in any professional development activities?
2. Do you know whether you will be offered a position at this school next year?
   If so, what will influence your decision about whether you accept it?
   If not, are you looking for jobs in other places?
3. How can we stay in touch with you? This summer? Is the contact information that we have current? Will that change?

4. As you think about learning to teach next year, do you think that you will be focusing on new things? Is there anything in particular that you want to focus on in learning to teach in the coming years?

Appendix A6: Summer Interview
2004

The purpose of this interview is to find out what kinds of experiences teachers have in professional development/teacher support or other professional work during the summer.

1. Can you tell me about the kinds of things you have been doing in _____(program, summer school teaching, etc)?
2. Is there anything that has been particularly helpful? If so, why?
3. Are there things you are doing here that you can imagine using in the fall when you return to (school)?
4. is there anything you would change about (program, summer school, etc.)
5. Would you recommend this (experience) to other new science teachers? Why or why not?

Appendix A7: Interview with New Teacher[68]

(Fall 2004)

Throughout the interview, use the following probes to get more information:
Anything else?
Anything more?
I think I know what you are saying, but could you tell me more?
Can you give me an example of what you are talking about?

Catching Up

9. How was your summer?

10. Do you do anything related to teaching?
    a. If so, what was it?
    b. Did it help you in any way? If so, how?

11. What are you teaching right now?

    a. Has anything changed about the courses that you are teaching? Have you been reassigned to new classes? If so, what are those?

12. How would you describe yourself as a classroom teacher right now?

    a. As you reflect back on the last year, are there any things you think are different about the way that you are teaching?
       If so, can you tell me about those?

13. Teachers have to do many things – plan, assess students' learning, work with curriculum, etc. Is there anything that you feel particularly well prepared to do?
    Anything else?

14. Is there anything you feel less well prepared to do as a teacher?
    Anything else?
    What kinds of resources do you need in order to feel more prepared?

15. How confident do you feel about the subject matters and grade levels you have been assigned to teach?

Work with mentor and other people/resources

1. How are things going with your mentor this year?
   a. Do you have the same mentor? Do you have a new mentor?
   b. If so, have you met? What have you worked on?

2. What other kinds of resources have been helpful to you?

   Fill in here probes for each of the major program(s) components that are supposed to support the new teacher.

[68] **Adapted from MSTI (2004)**

Appendix A8: Mathematics and Science Teacher Induction Classroom Observation Protocol for Novice Teachers[69]

(October 2003)

Rationale

In observing a novice teacher, we are making a classroom visit that allows us a better chance to understand the beginning teacher, what she or he does in their classroom teaching, and the contexts in which they work. The classroom visit affords us a chance to have more concrete discussions with the teacher about issues in their teaching, their learners, and their own learning as novice teachers. In trying to understand learning to teach, we are interested in how novices learn to think and act like teachers. Classroom visits give us a context for understanding not just their actions but also their thinking.

A classroom visit would occur in the fall and spring of the 2003-2004 year. As is possible, any visit would include a short conversation with the teacher in advance of visiting the room. A visit would, as possible, be followed up with another conversation, but this conversation could also be combined with the new teacher interview protocol.

As you observe, keep in mind the interpretive questions we are trying to answer. They are listed at the end of this document. It will be helpful to review them before you begin your observation.

---

[69] This protocol draws heavily from several sources: The Developmental Teacher Education Program's Observation Guides, the NCRTE and NCRTL observation protocols for teacher education and mentoring, Sharon Feiman-Nemser's (et al.'s) Observation Guide for her Beginning Teacher Study, NCTAF's Observation Guide for the Exemplary Teacher Education Study, and Wilson, Galosy, and Shouse's work on the Exploratorium evaluation.

Pre-observation conversation

1. During the observation, will you be in your own classroom or in a room you use on an occasional basis?

2. During the observation, will any other adults be in the class during the observation?

   If yes, what is their role?

3. Where does the observed lesson "fit in" to an instructional/curricular flow?

   What came before? What will come after?

4. What is the purpose of this lesson? What do you hope students will learn?

5. Do you anticipate anything that will be difficult for students?

6. Where did you get the idea for this lesson?

   Did anyone help you prepare for this lesson? Did you talk with anyone about it?

7. Is there anything about the make-up of the class or particular student behavior patterns the observer should be aware of in order to understand the class (e.g., ability levels, special needs, physical handicaps, behavior patterns, special language needs, etc.)

   Are there special procedures in place to accommodate these?

8. Will the students be working in pairs or groups at any time in the lesson?

   If so, what will they be doing?
   Where would you like me to sit? Is there a particular group/pair that it would be good for me to sit with?[70]

9. Is there anything else that I should know about the students, the class, the room, recent events, etc.?

10. Can I get copies of many materials that you used in getting ready for this lesson?

---

[70] NOTE: Principles for observing. We are observing the teacher's teaching for two reasons: (1) to understand his/her classroom as a site for his/her learning as a new teacher and (2) to document the kind of teaching the teacher is currently able/inclined to do. If the teacher breaks the students into groups, heed the following principles. First, ask if the teacher has a preference for where you are to sit. Second, if the teacher stays in one place, be sure to try and stay near the teacher so that you can describe what s/he is doing while the students are in pairs/groups. Third, if the teacher is roaming during this time, try not to roam with the teacher. Instead, stay near a group where you can see both what the kids are doing and what the teacher does when s/he visits that group. Four, if you are clueless about what the children are doing, you can ask them to explain. But be sure not to derail the instruction. We want to understand the teaching and learning, not use the students as informants for other things.

Appendix A8 (cont'd)

Post-class conversation

Note: Try to ask questions as soon as possible after the observation. Tape the novice's answers. In addition to the questions below, ask about anything that struck you as important. At the same time, remember that this must be a short conversation, so exercise judgment in deciding what is most important to learn about at this point. Keep the tone of your questions interested and curious, not challenging.

1. How did you feel things went in class today? How did that compare with what you expected?

2. When we talked before, you thought (fill in from earlier conversation) would be hard for you. How did that go?

3. You also said that (fill in) might be hard for students. How did that go?

4. Which students seemed to understand the lesson? How could you tell?

5. Was anyone having trouble? How could you tell? What will you do about this?

6. How did you decide (ask about some of the main features of the lesson in order to get at the novice's reasoning about tasks, discourse, roles, expectations)
   a. How to group students?
   b. Whom to call on?
   c. Which tasks to assign?
   d. What to do when X said Y?
   e. How to use the equipment?

7. How typical was today's lesson?

8. Will you talk with anyone about the lesson? What sorts of issues or questions would you like to discuss?

9. Can I have copies of these other materials that you used? (Make sure to get copies of everything that is used during the lesson.)[71]

[71] NOTE; We do not have human subjects permission to videotape classes or to audiotape students or to collect student work. So collect all the materials the teacher uses or draws upon, but do not collect samples of student work.

Appendix A8 (cont'd)

Observation and Write Up

General Admonitions/Directions

- Find a place to sit where you can see and hear well. (Check out in advance with the new teacher if the activity will involve any group work and whether or not she/he is comfortable with your moving around during in individual or small group work.)

- At some point during the visit, sketch a map of the physical arrangement of the room. Note where students are sitting, how many are girls/boys, and keep some record of which students (in which spots in the room) are participating.

  - Since you will not be able to describe the activities and responses of all students, choose some group to focus on. Please try to include as much information as possible about the students.

  - As you take notes, describe what is going on in the class, getting as many direct quotes as possible. Describe student-student interaction as well as teacher-student interactions. Avoid summary statements in favor of descriptions of what people are saying and doing.

  - Please keep track of everything that is written on the board or all overheads, and insert these in the narrative write up. .

  - Indicate the time every 7-10 minutes or when the task or activity changes.

  - In conversations, follow-up on what does not seem to fit. Ask questions to understand, to clarify patterns.

  - Type up your observation notes as soon as possible after the observation.

The purpose of the narrative write-up is to provide as full a picture as possible of the teaching that you observed. Begin by describing the context, the physical setting as well as the number of students, a summary of the tasks and activities you observed, and the curriculum content. Note what materials and supplies were evident (and NOT evident) in the room. Note other adult support available in the classrooms and the roles they assumed. If possible, note whether they are volunteer or paid. Explain what you chose to pay more or less attention to during the observation. The purpose of this part of the write-up is to provide a roadmap of the teaching you observed.

Then provide a chronological timeline of the big "chunks" of the lesson.

In the body of the narrative, recreate the chronology of the observation with as much detail as possible. Describe how the teacher began the lesson, what students did and said, how the teacher handled transitions, disruptions, questions,

comments, how the lesson ended. Insert pictures of what was on the overhead, blackboard, or any other form of technology used (when appropriate). The narrative should be complete enough so that someone other than you could use it as data with which to answer the interpretive/analytical questions below. At the end of

Appendix A8 (cont'd)

the write-up, make a section called attachments in which you list all the documents collected that accompany the observation (e.g., lesson plans, handouts, textbook pages, etc.).

Pre-Observation Data

Teacher Name

_____

School Site/Location

_____

Observer

_____

Date/Time of Day _____

Grade Level/Subject matter _____

Time: Begin _____ End _____ Total Length _____

Classroom Context

Number of students _____
Number of free/reduced lunch students (from office) _____
Limited English proficient students (from office) _____
Racial/Ethnic make-up of classroom (from office):
European-American _____
African-American _____
Asian-American _____
Latino/Hispanic American _____

Special Needs Children (from office) _____

Male _____
Female _____

Community Description:

Narrative -- type of neighborhood -- e.g., industrial, commercial, residential (apartments or houses), urban/suburban/rural, etc.; history (how has it changed in past several decades); Socio-economic characteristics; Types of businesses; How connected with other neighborhoods/Permeability with other worlds (e.g., automobiles, mass transit, etc.); Do teachers live in neighborhood? Could they afford to if they wanted to? Do they want to?

Appendix A8 (cont'd)

Materials present:

Are there manipulatives or other instructional materials in the room?
Are there textbooks? If so, title: _____

Classroom Map:
(Include seating arrangements, what's on the walls, etc.)

Chronology of lesson:

Please list the individual "parts" of the lesson observed and approximate lengths (time) of each.

Narrative Summary of the Lesson's Content and Chronology

Appendix A8 (cont'd)

Interpretive/Analytical Questions

These questions should be answered after you finish the write-up of the observation. The "answers" can be based both on direct observation as well as conversations with the teachers and students. You most likely will not have sufficient evidence to address all questions.

1. Subject Matter

How and to what extent are curriculum goals (i.e., what teachers are trying to accomplish with a particular task/lesson/unit)

- linked to **important mathematical/scientific ideas and processes**?; and
- **connecting** important mathematical/scientific ideas?

To what extent did the teacher **select or develop** classroom tasks (i.e., focus on curriculum decision making rather than how they are being used) that

- engage students in thinking about important mathematics/science (foundational ideas, reasoning and communication skills, connected to real-world contexts)?;
- provide students opportunities to use their **previous knowledge** and skills to learn new mathematics/science?;
- are connected to students' **cultural experiences** and/or other experiences outside of school?; and
- spark student **interest** (i.e., focus on student motivation) and encourage student **sense-making** (i.e., focus on student thinking)?

Do the learning tasks and activities give students a chance to reason and evaluate ideas, arguments, and evidence?

Do the learning tasks and activities give students a chance to draw on their background and experience?

Did the teacher attempt to support their students' capacity to see mathematics/science as a connected and coherent human enterprise

2. Students

How and to what extent did the teacher

- structure and guide (i.e., **scaffolding**) the work of students; and
- support students **without removing the challenge**/difficulty embedded in classroom tasks; and
- develop strategies for **representing** challenging/difficult mathematical/scientific ideas in ways that support students' learning?

How and to what extent did the teacher

- assessing students' prior knowledge and using such assessments as a basis for teaching "new" content;
- developing assessment practices that enable them to examine how well their students are learning important mathematics ideas; and
- listening to students' ideas and thinking and making teaching decisions based on their knowledge of students' ideas and thinking? (assessment)

- To what extent do the classroom tasks selected, the mathematical/scientific thinking encouraged, and the mathematical/scientific discourse observed suggest that the teacher held high expectations for all their students?

Appendix A8 (cont'd)

2. Discourse

How are students organized for learning?
What happens when a student does not understand?
What happens when a student does not follow a rule?
What happens when a student provides a partial or incorrect answer?
How is knowledge constructed in this class?
How and to what extent did the teacher
- Guide and support classroom **discussions** focused on students' ideas and methods;
- **ask questions** that challenge students to think and speak mathematically/scientifically (e.g., make conjectures, provide justifications, prove, theorize, test theory with data); and
- encourage students to **make conjectures, justify** their reasoning, construct mathematical arguments, and respond to others' arguments?

How did the teacher respond **to unanticipated student responses** or difficulties that lead students into uncharted territory?
To what extent are **student mistakes** viewed as a normal, expected part of engaging in mathematics/science and as a site for learning?

3. Norms

Are students expected to contribute to each others' learning? What does the novice do to contribute to this?
Are students expected to challenge each other's ideas? What does the novice do to contribute to this?
Are students expected to listen and respond with respect? What does the novice do to contribute to this?

4. Reasoning about practice

How does the novice explain or justify decisions about learning tasks and student organization?
How does the novice explain particular interaction moves (e.g., whom to call on, how to respond to errors, etc.)? particular content choices?

5. Learning to teach

What is the novice working on in his/her teaching?
What influences seem to come into play in how the novice prepares for and carries out instruction?
Were there any materials or practices that were tied to the induction program?
Was there any evidence that the novice received support in planning or developing this lesson?

Appendix A9: Videotaped Lesson Protocol:
Teacher Instructions

Learning to Teach Inquiry-based Science
(A Bay Area Science Teacher Induction Study)

Instructions for teachers

In order for us to have a more accurate understanding of the lesson just videotaped, it would be helpful if you could provide copies of written documents such as handouts, lesson plans, tests, quizzes, etc.

In addition, please select 6 students *who have returned permission slips* of varying general performance levels (2 high, 2 medium, 2 low) for student work samples. Please use the SAME STUDENTS EACH TIME you are videotaped. You can leave the students name on the papers and we will give them an anonymous code. The first time you send the student work, please indicate the general performance level of the students (high, medium, low). Please include copies of all student work related to the lesson (homework, in class, tests/quizzes).

Please follow the instructions for each item listed below and fill out the second page (backside) of this form. Send the form, and all items that apply, back to us in the pre-addressed, pre-paid envelopes.

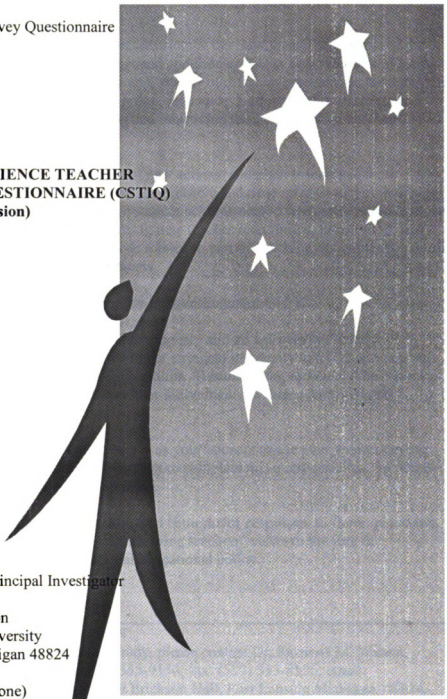
If you will not have a lesson or unit assessment ready until later, send the rest of the items NOW in the first envelope, and send the assessment later in the second envelope.

Appendix A10: Survey Questionnaire

Scarsdale Group

CALIFORNIA SCIENCE TEACHER INDUCTION QUESTIONNAIRE (CSTIQ)
(New Teacher Version)

SPRING 2004



Contact:
Suzanne Wilson, Principal Investigator
209 Erickson Hall
College of Education
Michigan State University
East Lansing, Michigan 48824
swilson@msu.edu
(517) 353-9150 (phone)
(517) 353-8595 (fax)

SURVEY INTRODUCTION

This survey is being conducted in several districts in the Bay Area. The purpose of the survey is to better understand the background and preparation of new science and math teachers and the support they receive from a variety of different programs in the area. The survey is administered by a consulting group, Scarsdale, a network of researchers and practitioners dedicated to understanding and improving teacher education and new teacher induction programs

The survey solicits the views of a range of new science and math teachers in these districts to determine the level of support they receive and need relative to their teaching assignments and their efforts to improve student achievement. The questions relate to the teacher's experiences and views concerning new teacher recruitment, preparation, and professional development as well as those related to current teaching assignments, school conditions, and district policy environments

Please allow about 45 minutes to complete the questionnaire.

The questionnaire is being completed anonymously and all answers are strictly confidential. This research is conducted under stringent university and U.S. government regulations governing confidentiality procedures. Results of the survey will be reported in summary or statistical form so that neither individuals nor their schools can be identified.

The completion of this questionnaire serves as your consent to use your answers in our survey analysis. You are under no obligation to complete this questionnaire. No penalty of any kind will result from non-completion.

Thank you for your time, cooperation, and thoughtful responses to these questions. Your participation in this research helps us bring teachers' views to the fore in consideration of local, state, and national educational policy.

FOR FURTHER INFORMATION

If you have any questions about this study, please contact Dr. Suzanne M. Wilson, Principal Investigator by phone: 517-353-9150; fax: (517) 353-8595; email: swilson@msu.edu; or postal mail: 209 Erickson Hall, East Lansing Michigan, 48824.

If you have any questions or concerns regarding your rights as a study participant, or are dissatisfied at any time with any aspect of this study, you may contact – anonymously if you wish- Peter Vasilenko, Ph.D. Chair of the Michigan State University Committee on Research Involving Human Subjects (UCRIHS) by phone: 517-355-2180; fax: (517) 432-4503; email: ucrihs@msu.edu; or postal mail: 202 Olds Hall, East Lansing, MI. 48824

PART I: NEW TEACHER SUPPORT

Directions: Questions 1-6 ask you to describe new teacher programs in which you have participated during your first few years of science teaching.

1. Which of the following kinds of support did you receive during your first three years of full-time science teaching? For each of the programs listed in the chart below, circle **No** if you did not participate in the program and **Yes** if you did participate in the program. If you did participate, please check the name of each program in which you participated and indicate the **date** (month and year) you **began** the program and the **date** (month and year) you **completed** it. If you haven't yet completed the program, leave the completed column blank

Program Type	Participated?	Name of Program (Check all that apply)	Date began	Date completed (if not yet completed leave blank)
a. District/school induction program	Yes No	☐ NTIP ☐ BTSA		
b. District STARR school new teacher support	Yes No	☐ PAR		
c. Alternative certification program	Yes No	☐ Pre-intern ☐ Intern		
d. Other new teacher program	Yes No	☐ Exploratorium New Teacher Program ☐ Teach for America		

2. A number of features that might be included in new teacher programs are listed below. For the programs in which you participated, please circle "Y" if the feature was offered as part of the program and "N" if the feature was not offered.

Note: If you DID NOT participate in any of the programs listed in Question 1, check this box ☐ and skip to Part II, question 7 on page 10. Otherwise, continue with question 2.

The new teacher support program:	*NTIP/BTSA*	*PAR*	*Pre-Intern/Intern Program support*	*Teach for America*	*Exploratorium New Teacher Program*
a. Formally assigns a mentor or coach	*Y N*	*Y N*	*Y N*	*Y N*	*Y N*
b. Provides release time to observe other teachers	*Y N*	*Y N*	*Y N*	*Y N*	*Y N*
c. Provides materials or money to buy materials	*Y N*	*Y N*	*Y N*	*Y N*	*Y N*
d. Provides a stipend for participation	*Y N*	*Y N*	*Y N*	*Y N*	*Y N*
e. Provides a reduced teaching schedule	*Y N*	*Y N*	*Y N*	*Y N*	*Y N*
f. Takes place primarily within my school/district	*Y N*	*Y N*	*Y N*	*Y N*	*Y N*
g. Provides a reduced number of preparations	*Y N*	*Y N*	*Y N*	*Y N*	*Y N*
h. Provides common planning time with teachers in your subject or grade level	*Y N*	*Y N*	*Y N*	*Y N*	*Y N*
i. Offers seminars or classes for beginning teachers	*Y N*	*Y N*	*Y N*	*Y N*	*Y N*
j. Focuses on subject matter content	*Y N*	*Y N*	*Y N*	*Y N*	*Y N*
k. Focuses on general teaching techniques	*Y N*	*Y N*	*Y N*	*Y N*	*Y N*
l. Focuses on teaching techniques specific to subject matter	*Y N*	*Y N*	*Y N*	*Y N*	*Y N*
m. Provides peer coaching in teaching					
i. From teachers in my school	*Y N*	*Y N*	*Y N*	*Y N*	*Y N*
ii. From teachers in other schools	*Y N*	*Y N*	*Y N*	*Y N*	*Y N*
iii. Extra classroom assistance from administrat	*Y N*	*Y N*	*Y N*	*Y N*	*Y N*

The new teacher support program:	*NTIP/BTSA*	*PAR*	*Pre-Intern/Intern Program support*	*Teach for America*	*Exploratorium New Teacher Program*
ors/staff					
n. Provides regular supportive communication with principal, other administrator, department chair, or staff	*Y N*	*Y N*	*Y N*	*Y N*	*Y N*
o. Promotes collaboration and joint work					
i. With other new teachers	*Y N*	*Y N*	*Y N*	*Y N*	*Y N*
ii. With experienced teachers	*Y N*	*Y N*	*Y N*	*Y N*	*Y N*
p. Provides regular opportunities to provide feedback on how well the program meets my needs	*Y N*	*Y N*	*Y N*	*Y N*	*Y N*
q. Provides regular opportunities for feedback from program leaders on the progress of my teaching	*Y N*	*Y N*	*Y N*	*Y N*	*Y N*
r. Recognizes and builds on individual teachers knowledge and experience	*Y N*	*Y N*	*Y N*	*Y N*	*Y N*
s. Provides assistance from science content experts or specialists	*Y N*	*Y N*	*Y N*	*Y N*	*Y N*
t. Provides science teaching resources (lesson plans, activities, etc.)	*Y N*	*Y N*	*Y N*	*Y N*	*Y N*
u. Provides intensive opportunities for learning how to teach (e.g. summer institute, ongoing workshops or study groups, etc.)	*Y N*	*Y N*	*Y N*	*Y N*	*Y N*
v. Other (please describe) _____	*Y N*	*Y N*	*Y N*	*Y N*	*Y N*

3. Using the program features *(a-v)* given in question **2** (on page 3-4),

a. Which <u>three</u> features *(a –v)* are the **most** important to you in a professional development program for new teachers?

____ ____ ____

b. Which three features *(a-v)* are the **least** important to you in a professional development program for new teachers?

____ ____ ____

4. Listed below are a number of possible goals for new teacher programs. Please rate the extent to which the **new teacher programs in which you participated** helped you develop knowledge and skills to improve your teaching:

Key:

1 =NOT AT ALL 2 = POORLY 3 = ADEQUATELY 4 = WELL 5 = VERY WELL

To what extent did the program help you to:	*BTSA/NTIP*	*PAR*	*Pre-Intern/Intern Program Support*	*Teach for America*	*Exploratorium New Teacher Program*
a. Know the concepts, knowledge, and skills of the subject matter you teach (e.g. science, math).	*1 2 3 4 5*	*1 2 3 4 5*	*1 2 3 4 5*	*1 2 3 4 5*	*1 2 3 4 5*
b. Use the state's curriculum frameworks and performance standards to plan instruction.	*1 2 3 4 5*	*1 2 3 4 5*	*1 2 3 4 5*	*1 2 3 4 5*	*1 2 3 4 5*
c. Evaluate science curriculum materials.	*1 2 3 4 5*	*1 2 3 4 5*	*1 2 3 4 5*	*1 2 3 4 5*	*1 2 3 4 5*
d. Use teaching strategies that promote student inquiry.	*1 2 3 4 5*	*1 2 3 4 5*	*1 2 3 4 5*	*1 2 3 4 5*	*1 2 3 4 5*
e. Choose different teaching strategies for different instructional purposes.	*1 2 3 4 5*	*1 2 3 4 5*	*1 2 3 4 5*	*1 2 3 4 5*	*1 2 3 4 5*
f. Plan instruction by using knowledge of learning, subject matter, curriculum, and student development.	*1 2 3 4 5*	*1 2 3 4 5*	*1 2 3 4 5*	*1 2 3 4 5*	*1 2 3 4 5*
g. Use a variety of assessment methods.	*1 2 3 4 5*	*1 2 3 4 5*	*1 2 3 4 5*	*1 2 3 4 5*	*1 2 3 4 5*
h. Know how to find/create resources for use in science teaching.	*1 2 3 4 5*	*1 2 3 4 5*	*1 2 3 4 5*	*1 2 3 4 5*	*1 2 3 4 5*
i. Evaluate and use technology to enhance science teaching/learning.	*1 2 3 4 5*	*1 2 3 4 5*	*1 2 3 4 5*	*1 2 3 4 5*	*1 2 3 4 5*

j.	Maintain an orderly, purposeful science learning environment.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
k.	Set appropriately challenging learning expectations for students.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
l.	Understand how different students learn science	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
m.	Help students become self-motivated and self-directed	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
n.	Develop science lessons and units that motivate students to learn.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
o.	Understand students' social, emotional, physical, and cognitive development.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
p.	Teach science in ways that support new English language learners.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
q.	Encourage students to see, question, and interpret ideas from diverse perspectives.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
r.	Tailor science teaching and curriculum to individual students' needs.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
s.	Teach in a high poverty, urban school.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
t.	Work with parents and families to better understand students and support their learning.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
u.	Other (please describe) _____ _____					

5. Using the program goals *(a-u)* given in question **4** (on pages 5-6),

a. Which <u>three</u> goals *(a – u)* do you think are the **most** important to include in a professional development program for new teachers?

____ ____ ____

b. Which <u>three</u> goals *(a - u)* do you think are the **least** important to include in a professional development program for new teachers?

____ ____ ____

6. Mentoring/coaching. Please answer the following questions about your mentoring/coaching in **all of the programs in which you participated**

	NTIP/BTSA	*PAR*	*Pre-Intern/Intern Support Provider*	*Teach for America*	*Exploratorium New Teacher Program*
6 a. Were you assigned a mentor and/or coach as part of the program?	Yes No	Yes No	Yes No	Yes No	Yes No

Note: If you answered **no** to <u>all</u> columns of 6a, skip to question 7, Part II, p. 10.
If you answered **yes** to any of the columns in 6a, answer the following questions about the mentor or coach you were assigned for <u>each</u> column in which you circled **yes** in 6a.

6 b. Was the mentor/coach	*NTIP/BTSA*	*PAR*	*Pre-Intern/Intern Support Provider*	*Teach for America*	*Exploratorium New Teacher Program*
i. A teacher in your school?	Yes No Don't Know	Yes No Don't Know	Yes No Don't Know	Yes No Don't Know	Yes No Don't Know
ii. A teacher in another school in the district?	Yes No Don't Know	Yes No Don't Know	Yes No Don't Know	Yes No Don't Know	Yes No Don't Know
iii. Someone with at least 5 years of teaching experience?	Yes No Don't Know	Yes No Don't Know	Yes No Don't Know	Yes No Don't Know	Yes No Don't Know

	NTIP/BTSA	*PAR*	*Pre-Intern/Intern Support Provider*	*Teach for America*	*Exploratorium New Teacher Program*
iv. Someone working **full-time** as a mentor/coach?	Yes No Don't Know	Yes No Don't Know	Yes No Don't Know	Yes No Don't Know	Yes No Don't Know
v. Your **science** department chair?	Yes No Don't Know	Yes No Don't Know	Yes No Don't Know	Yes No Don't Know	Yes No Don't Know
vi. A present or former **science** teacher?	Yes No Don't Know	Yes No Don't Know	Yes No Don't Know	Yes No Don't Know	Yes No Don't Know
vii. A **science** content specialist?	Yes No Don't Know	Yes No Don't Know	Yes No Don't Know	Yes No Don't Know	Yes No Don't Know
viii. Knowledgeable about teaching science to students with special educational needs?	Yes No Don't Know	Yes No Don't Know	Yes No Don't Know	Yes No Don't Know	Yes No Don't Know
ix. Knowledgeable about teaching science to culturally and linguistically diverse students ?	Yes No Don't Know	Yes No Don't Know	Yes No Don't Know	Yes No Don't Know	Yes No Don't Know
x. Knowledgeable about teaching science to students in high-poverty, urban schools?	Yes No Don't Know	Yes No Don't Know	Yes No Don't Know	Yes No Don't Know	Yes No Don't Know

6 c. Frequency of mentor/coach meetings – On average, about how often did you have contact with your mentor/coach *per school year*? Using the key below, *for each program in which you participated*, circle the number that corresponds to the average number of times you had contact with your coach/mentor per year.

Key:

1 = NEVER *2 = 1–5 TIMES/YEAR* *3 = 6–10 TIMES/YEAR* *4 = 11-15 TIMES/YEAR* *5 = MORE THAN 15 TIMES/YEAR*

NTIP/BTSA	*PAR*	*Pre-Intern/Intern Support Provider*	*Teach for America*	*Exploratorium New Teacher Program*
1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

6 d. Mentor/coach activities – On average, over the course of the school year, how often did your mentor/coach assist you in the following ways? Using the key below, for each program in which you participated, circle the number that corresponds to how often your mentor/coach assisted you in the following ways.

Key:

1 = NEVER 2 = RARELY 3 = SOMETIMES 4 = OFTEN

How often did your mentor/coach:	*NTIP/BTSA*	*PAR*	*Pre-Intern/Intern Support Provider*	*Teach for America*	*Exploratorium New Teacher Program*
i. Observe your teaching	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
ii. Co-plan a science lesson/unit with you	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
iii. Discuss your teaching	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
iv. Teach a "model" science lesson for you	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
v. Assist in analyzing student work	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
vi. Provide ideas for managing classrooms & students	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
vii. Assist with finding & using science materials	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
viii. Provide ideas for science lessons and activities	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
ix. Discuss science content	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
x. Help modify curriculum to meet students' needs	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4

6 e. Value of mentor/coach activities – On average, how valuable to your professional development did you find the activities in which you participated with your mentor/coach? Using the key below, for each program in which you participated, circle the number that corresponds to how valuable the activity was for your professional development.

Key:

0 = Does not apply (responded "1" in 6d) 1 = Not valuable 2 = Somewhat valuable 3 = Very valuable

How valuable was this mentor/coach activity?	*NTIP/BTSA*	*PAR*	*Pre-Intern/Intern Support Provider*	*Teach for America*	*Exploratorium NewTeacher Program*
i. Observe your teaching	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3
ii. Co-plan a science lesson/unit with you	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3
iii. Discuss your teaching	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3
iv. Teach a "model" science lesson for you	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3
v. Assist in analyzing student work	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3
vi. Provide ideas for managing classrooms & students	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3
vii. Assist with finding & using science materials	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3
viii. Provide ideas for science lessons and activities	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3
ix. Discuss science content	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3
x. Help modify curriculum to meet students' needs	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3

PART II: TEACHING KNOWLEDGE AND SKILLS
Directions: Question 7 asks you to assess your confidence in performing some common teaching tasks and responsibilities of science teaching

7. How confident are you in your **current** ability to:

		NOT CONFIDENT AT ALL	SLIGHTLY CONFIDENT	MODERATELY CONFIDENT	CONFIDENT	VERY CONFIDENT
a.	Handle a range of classroom management and discipline situations.	1	2	3	4	5
b.	Plan science lessons or units.	1	2	3	4	5
c.	Use a variety of instructional methods.	1	2	3	4	5
d.	Create your own science lessons.	1	2	3	4	5
e.	Understand the science topics you are assigned to teach.	1	2	3	4	5
f.	Teach the science topics you are assigned to teach.	1	2	3	4	5
g.	Teach in the grade level you are currently assigned.	1	2	3	4	5
h.	Use new technologies in classroom instruction.	1	2	3	4	5
i.	Assess students.	1	2	3	4	5
j.	Select and adapt curriculum and instructional materials.	1	2	3	4	5
k.	Ask for help from fellow teachers to plan instruction.	1	2	3	4	5
l.	Create equitable learning opportunities for students of diverse cultural backgrounds.	1	2	3	4	5
m.	Create equitable learning opportunities for students with diverse academic needs.	1	2	3	4	5
n.	Handle not always knowing the answers to students' questions.	1	2	3	4	5
o.	Engage students in activities that reflect the scientific process.	1	2	3	4	5
p.	Manage a classroom where students conduct their own explorations.	1	2	3	4	5
q.	Conduct guided lab lessons.	1	2	3	4	5
r.	Manage a safe classroom environment where students handle tools and lab materials appropriately.	1	2	3	4	5

PART III: Current Teaching Situation
Directions: Questions 8-19 ask you to describe important characteristics of your present teaching position

8. Teachers accept positions in the schools in which they teach for a variety of reasons. Please indicate your level of agreement or disagreement with the following statements about your decision to accept your present teaching position:

I accepted my present teaching position because...	STRONGLY DISAGREE	DISAGREE	NEITHER AGREE OR DISAGREE	AGREE	STRONGLY AGREE
a. The grade level/subject areas offered at this school matches my qualifications and goals.	1	2	3	4	5
b. This school has many resources (e.g., materials, technology).	1	2	3	4	5
c. This school offers support for professional learning (e.g., helpful colleagues, planning time, mentor, community of learners).	1	2	3	4	5
d. I value the philosophy of this school's leadership.	1	2	3	4	5
e. The district administration supports teachers as professionals.	1	2	3	4	5
f. I enjoy working with the population of students at this school.	1	2	3	4	5
g. This school is close to where I live.	1	2	3	4	5
h. This job offers a competitive salary.	1	2	3	4	5
i. This school or community is known to be safe.	1	2	3	4	5
j. This is a desirable district.	1	2	3	4	5
k. This is one of the only teaching jobs I was offered.	1	2	3	4	5
l. I feel like I can make a difference in this school/community.	1	2	3	4	5
m. My district assigned me to this school.	1	2	3	4	5
n. Other (please specify)	1	2	3	4	5

9. Using the choices in #8 above, which three reasons (letters a- n):

a. were the **most important** to you in your decision to accept your current position?

_____ _____ _____

b. were the **least important** to you in your decision to accept your current position?

_____ _____ _____

10. Please indicate the extent to which you agree or disagree with each of the following statements about the **students you teach.**

		DON'T KNOW	STRONGLY DISAGREE	DISAGREE	NEITHER AGREE NOR DISAGREE	AGREE	STRONGLY AGREE
a.	The attitudes and habits my students bring to class greatly enhance their chances for academic success.	0	1	2	3	4	5
b.	My students perform well on standardized assessments in the subject area(s) I teach.	0	1	2	3	4	5
c.	Most of the students I teach are ready to learn the material I am supposed to teach them.	0	1	2	3	4	5
d.	My students' behavior supports my teaching and their learning.	0	1	2	3	4	5
e.	Students work hard in this school.	0	1	2	3	4	5
f.	I have the knowledge and skills I need to help all of my students achieve at a high level	0	1	2	3	4	5

11. Now consider **the curriculum and instruction in your school**. Please indicate the extent to which you agree or disagree with the following statements.

		DON'T KNOW	STRONGLY DISAGREE	DISAGREE	NEITHER AGREE NOR DISAGREE	AGREE	STRONGLY AGREE
a.	This school has high quality school-wide curriculum plans.	0	1	2	3	4	5
b.	This school has well-defined learning expectations for all students.	0	1	2	3	4	5
c.	The curriculum is planned between and among grades to promote continuity.	0	1	2	3	4	5
d.	Teachers follow the school-wide curriculum plans.	0	1	2	3	4	5
e.	The curriculum is relevant for the population of students.	0	1	2	3	4	5
f.	This school has high standards for students' academic performance.	0	1	2	3	4	5
g.	The curriculum is aligned with established	0	1	2	3	4	5

	academic measures (e.g., standardized tests, rubrics, etc.).						
h.	Teachers are committed to improving student achievement.	0	1	2	3	4	5
i.	Students are well aware of the learning expectations of this school.	0	1	2	3	4	5
j.	Standards for student achievement are challenging, attainable, and measurable.	0	1	2	3	4	5
k.	Teachers provide a high quality of instruction.	0	1	2	3	4	5
l.	Quality resources for curriculum are available for use in my classroom	0	1	2	3	4	5
m.	Quality resources for instruction are available for use in my classroom	0	1	2	3	4	5

12. Now consider **the teachers at your school**. To what extent do you agree or disagree with the following statements?

The teachers in this school…	DON'T KNOW	STRONGLY DISAGREE	DISAGREE	NEITHER AGREE NOR DISAGREE	AGREE	STRONGLY AGREE
a. Are continually learning and seeking new ideas.	0	1	2	3	4	5
b. Are engaged in systematic analysis of student performance data.	0	1	2	3	4	5
c. Are encouraged to experiment with their teaching.	0	1	2	3	4	5
d. Trust each other.	0	1	2	3	4	5
e. Feel responsible to help each other do their best.	0	1	2	3	4	5
f. Share ideas and teaching practices.	0	1	2	3	4	5
g. Take an active role in school-wide decision making.	0	1	2	3	4	5
h. Experienced teachers at this school are **helpful to new teachers.**	0	1	2	3	4	5

13. Now consider **the administrators in your school**. To what extent do you agree or disagree with the following statements?

	DON'T KNOW	STRONGLY DISAGREE	DISAGREE	NEITHER AGREE NOR DISAGREE	AGREE	STRONGLY AGREE
a. The principal lets staff members know what is expected of them.	0	1	2	3	4	5
b. The school administration's behavior toward staff is supportive and encouraging.	0	1	2	3	4	5
Routine duties and paperwork rarely	0	1	2	3	4	5

c.	interfere with my teaching.						
d.	My principal or other administrators enforce school rules and back me up when I need it.	0	1	2	3	4	5
e.	The principal and/or other school administrators talk with me frequently about my instructional practices.	0	1	2	3	4	5
f.	The school administrators support new teachers	0	1	2	3	4	5

14. Please review the following list of possible **student lesson activities for science.** About how much time, if any, do **your** students engage in each of the following?

		NEVER	A FEW TIMES A YEAR	ONCE OR TWICE A MONTH	ONCE OR TWICE A WEEK	ALL OR ALMOST ALL SCIENCE LESSONS)
a.	Work individually on exercises, worksheets, or workbooks.	1	2	3	4	5
b.	Work on a project that requires data collection.	1	2	3	4	5
c.	Review and discuss the work of other students.	1	2	3	4	5
d.	Work on investigations that extend for several days.	1	2	3	4	5
e.	Listen to teacher presentations.	1	2	3	4	5
f.	Explain the reasoning behind an idea.	1	2	3	4	5
g.	Write explanations about what was observed and why it happened.	1	2	3	4	5
h.	Answer factual questions in a whole class setting.	1	2	3	4	5
i.	Take notes on material that is presented in print, lecture, video, etc.	1	2	3	4	5
j.	Represent and analyze relationships using tables, charts, or graphs.	1	2	3	4	5
k.	Reflect on their work and set future learning goals.	1	2	3	4	5
l.	Engage in hands-on science activities.	1	2	3	4	5
m	Conduct scientific inquiry.	1	2	3	4	5
n.	Construct and/or use models to investigate phenomenon.	1	2	3	4	5
o.	Work on problems for which there is no immediately obvious answer or method of solution.	1	2	3	4	5

15. Assessment takes a variety of forms, both formal and informal. How important are the following kinds of assessments for you in judging how well students are learning?

		Not Important At All	Slightly Important ce	Moderate ly Important	Importan t	Very Importan t
a.	Multiple-choice tests	1	2	3	4	5
b.	Essay tests	1	2	3	4	5
c.	Experiments	1	2	3	4	5
d.	Lab reports	1	2	3	4	5
e.	Portfolio of student work	1	2	3	4	5
f.	**Products of group projects**	**1**	**2**	**3**	**4**	**5**
g.	Standardized test results (e.g., SAT-9)	1	2	3	4	5
h.	**Informal observation while students are working**	**1**	**2**	**3**	**4**	**5**
i.	Listening to student discussion/questions	1	2	3	4	5
j.	Asking students questions during class discussion, independent/group work, etc.	1	2	3	4	5
k.	Other (please write in) _____	1	2	3	4	5

16. Please list the specific courses/subjects you teach. *(If you teach a self-contained class only or math/science core, indicate the number of students once)*

Course title	*Grade Level*	*# Students*

17. Is the school in which you are currently a teacher a(n): *(Circle all that apply)*

a. private school
b. public school
c. charter school
d. magnet school
e. elementary school
f. middle school
g. high school

18. What is the approximate number of total students in the school where you presently teach? *(Circle only one)*

a. <400
b. 401 – 800
c. 801 – 1200
d. 1201 – 1600
e. 1601 – 2000
f. >2000

19. Approximately what percentage of **<u>your</u>** students fall into each of the categories below?

<u>Ethnic/Racial Group</u>					
a. African American not Hispanic	Less than10%	10-24%	25-49%	50-74%	75-100%
b. American Indian or Alaska Native	Less than10%	10-24%	25-49%	50-74%	75-100%
c. Asian	Less than10%	10-24%	25-49%	50-74%	75-100%
d. Filipino or Pacific Islander	Less than10%	10-24%	25-49%	50-74%	75-100%
e. Hispanic or Latino	Less than10%	10-24%	25-49%	50-74%	75-100%
f. White not Hispanic	Less than10%	10-24%	25-49%	50-74%	75-100%
<u>SES</u>					
g. Participants in free/reduced lunch	Less than 10%	10-24%	25-49%	50-74%	75-100%
<u>Language</u>					
h. English Language Learners (ELL, LEP, ESL)	Less than10%	10-24%	25-49%	50-74%	75-100%

Gifted & Special Education

i. Identified as gifted students	Less than10%	10-24%	25-49%	50-74%	75-100%
j. Identified as Special Education students	Less than10%	10-24%	25-49%	50-74%	75-100%

PART IV: TEACHER EDUCATION & UNIVERSITY-BASED PREPARATION
Directions: Questions 20-26 ask you to describe your preparation for teaching science

20. What is the highest educational level you have completed? *(Circle only one)*

a. BA/BS degree
b. BA/BS degree + 15 units
c. BA/BS + 30 units
d. BA/BS + 60 units
e. MA/MS degree
f. MA/MS degree + 15 units
g. MA/MS + 30 units
h. MA/MS + 60 units
i. Ed.D./Ph.D

21. a. Where did you attend college for your undergraduate education?

*(Please specify)*_____

What was your undergraduate major?

_____

b. If applicable, where did/do you attend college for your graduate education? (Include only if you are working on a graduate degree/credits; not for basic credentialing purposes)

(Please specify)

_____

What was/is your graduate major/emphasis area?

_____

22. In your undergraduate/graduate education, how many courses have you completed in:

a. Science _____ b. Math _____

23. In your undergraduate/graduate education, how many courses have you completed in teaching methods:

a. Science teaching methods_____ b. Math teaching methods_____

24. Did you complete a college/university teacher preparation program?

a. Yes Where?
_____

b. No

Note: If you answered **"Yes"** to Question **24,** please answer questions 25 and 26. If you answered **"No"** to question 24, then skip to question **27** on page 19.

25. How long did you student teach? *(Circle one)*

a. I did not student teach

b. <3 months

c. 3-6 months

d. >6 months

26. Please evaluate the extent to which the college/university teacher preparation program that led to your certification prepared you for teaching.

When you left your teacher preparation program, how well were you prepared to:	*Not at all*	*Poorly*	*Adequately*	*Well*	*Very well*
a. Know the concepts, knowledge, and skills of the subject matter you teach (e.g., science, math).	*1*	*2*	*3*	*4*	*5*
b. Use the state's curriculum frameworks and performance standards to plan instruction.	*1*	*2*	*3*	*4*	*5*
c. Evaluate curriculum materials.	*1*	*2*	*3*	*4*	*5*
d. Use teaching strategies that promote student inquiry.	*1*	*2*	*3*	*4*	*5*
e. Choose different teaching strategies for different instructional purposes.	*1*	*2*	*3*	*4*	*5*
f. Plan instruction by using knowledge of learning, subject matter, curriculum, and student development.	*1*	*2*	*3*	*4*	*5*
g. Use a variety of assessment methods.	*1*	*2*	*3*	*4*	*5*
h. Know how to find/create resources for use in teaching.	*1*	*2*	*3*	*4*	*5*
i. Evaluate and use technology to enhance teaching/learning.	*1*	*2*	*3*	*4*	*5*
j. Maintain an orderly, purposeful learning environment.	*1*	*2*	*3*	*4*	*5*
k. Set appropriately challenging learning expectations for students.	*1*	*2*	*3*	*4*	*5*
l. Understand how different students learn.	*1*	*2*	*3*	*4*	*5*
m. Help students become self-motivated and self-directed.	*1*	*2*	*3*	*4*	*5*
n. Develop lessons and units that motivate students to learn.	*1*	*2*	*3*	*4*	*5*
o. Understand students' social, emotional, physical, and cognitive development.	*1*	*2*	*3*	*4*	*5*
p. Teach in ways that support new English language learners.	*1*	*2*	*3*	*4*	*5*
q. Encourage students to see, question, and interpret ideas from diverse perspectives.	*1*	*2*	*3*	*4*	*5*
r. Tailor teaching and curriculum to individual students' needs.	*1*	*2*	*3*	*4*	*5*
s. Teach in a high poverty, urban school.	*1*	*2*	*3*	*4*	*5*
t. Work with parents and families to better understand students and support their learning.	*1*	*2*	*3*	*4*	*5*

Part V: Background Information
Directions: Questions 27- 36 ask for information on teaching experience, credential status, and personal demographics.

27. Is your current teaching assignment your first teaching job (a job in which you are the sole or primary person responsible for teaching)? **(Circle only one)**

a. Yes
c. No, I taught in a private school prior to this.
d. No, I taught in another California public school prior to this.
e. No, I taught in a different state prior to this.
f. Other _____

28. Prior to **Fall 2002**, how many years will you have you been

a. a **full-time** teacher? _____years
b. a teacher **in this district**? _____years
c. a teacher **in your current school?** _____years

29. What were you doing immediately before you first entered teaching?

a. I was in college or graduate school
b. I was in a full time non-teaching job
Describe:_____
c. Other Describe:_____

30.. Please describe your participation in professional organizations and school leadership

a. Department Chair? N Y Department:
_____
b. Curriculum Committee? N Y
Specify:_____

c. Subject Matter associations? N Y Specify:

_____

d. Teacher Networks? N Y Specify:

_____

e. Other? Specify

_____

31. What is your teaching credential status?

a. California Teaching License	
License **(Circle all that apply)**	Content area of certification (specify math, science, multiple, etc.)
(1) Waiver permit	
(2) Emergency permit	
(3) Intern program	
(4) Preliminary license	
(5) Professional Clear license	
(6) No credential	

b. Do you hold a teaching credential from another state?

(1) No

(2) Yes If yes, please specify the state(s)

_____

c. Which "special" credential or certificates do you hold? **(Circle all that apply)**

(1) CLAD (4) Other (specify)

_____

(2) BCLAD

(3) Special Education

32. How would you describe your intention to remain: (circle <u>one</u> for each letter)

A. At your current school?	low	medium	high
B. In your current district?	low	medium	high
C. In the teaching profession?	low	medium	high

33. What is your gender? *(optional)*

a Female

b Male

34. What is your race/ethnicity?
(optional; Circle all that apply)

a. White/Caucasian (non-Hispanic)

b. Black/African American

c. Hispanic/Latino/a

d. Asian/Pacific Islander

e. American Indian/Alaska Native

f. Other (specify)

_____

35. *(optional)* What is your age? _____years

Additional comments on this survey, new teacher induction, your career in education, etc. are welcome.

THANK YOU FOR THE TIME AND THOUGHT YOU CONTRIBUTED TO THIS SURVEY

Appendix A11: Interview with Mentors[72]

(2003-2004)

Note: Prior to the face the face interview, there would be a brief telephone interview (see protocol, First Contact Mentor).

NOTE: Throughout the interview, use the following probes to get more information:
Anything else?
Anything more?
I think I know what you are saying, but could you tell me more?
Can you give me an example of what you are talking about?

Part 1. Background

NOTE: Throughout the interview, use the locally correct term for mentor.

1. How did you become a mentor?

2. Are you working with one or more beginning teachers this year?

3. Are you currently teaching as well? What classes/grades are you teaching? Do you receive additional pay or reduced workload as a mentor?

4. Do you work in the same school as the teacher(s) you mentor?

5. How long have you been teaching? How long have you been teaching here?

6. How long have you been involved with this induction program? In what capacities? How did you first get involved?

7. Had you done any mentoring before you became involved with this program? Tell me about that. Have you been a mentor other places or with other programs? Was your experience in different. schools different?

8. When you were a beginning teacher (or at some other time in your career), were you mentored?

Part 2. Views of mentoring[73]

1. What do you think makes a good mentor?

2. What are the most important things a new teacher needs to learn?

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[72] MSTI (2002)

[73] The purpose here is to begin to get a general sense of how this mentor thinks about their work before we get too deep into details of their work with this particular novice.

Can you think of a time when you were working with a novice teacher who needed help with his or her knowledge of mathematics/science? Describe it. What did you do it help?
Can you think of a time when you were working with a novice teacher who needed help with his or her knowledge of how to teacher mathematics/science? Describe it. What did you do it help?
Can you think of a time when you were working with a novice teacher who needed help learning how to work with students as learners of mathematic/science? Describe it. What did you do it help?

3. What seem to be the hardest things your novices have to deal with?
Anything else?
What about subject matter?
What about using materials?
What about assessment?
What about discipline or classroom management?

Part 3. Working as a mentor: The practice of mentoring

1. How many novices do you work with?

2. What do you do with them? *Probe* for the range of kinds of activities—observation, joint work, co-teaching, observing others, demonstration teaching, planning, finding resources, etc.

How often do you meet?
Where?
How do you decide what to work on?

3. Do you make classroom visits as a mentor? If so, can you describe a typical visit to me?
When do you arrive?
What do you do?
Do you provide any feedback, and if so, what form does it take? Can you give me an example of the kind of feedback you might give after an observation?

4. Can you talk a bit about how you work with X (the novice who is a focal teacher for our study]?

What sorts of things do you do with her/him?
How often? Why?

5. Can you describe the last time you met?

What did you do?
What did you talk about?
Where did you meet?

Appendix A11 (cont'd)

6. Do you use any assessment protocols, observation protocols, or other instruments to guide your work with the beginning teachers? Please describe these.

   Is this instrument a formal part of the induction program? If not, how did you get or develop it?

7. How does your work with a novice change over the course of a year (or more)?

   What do you concentrate on in the beginning of the year? Midyear? Later?
   What different activities do you engage in/rely on? (ask for examples)
   Is this process over time something you've developed on your own, or is there a program curriculum for mentoring?

8. What kinds of other opportunities does the novice have to learn things beside her work with you? (courses somewhere else, other observation?)

   To what extent do you take these (other activities) into account in your work with the novice?

9. *If the mentor is working out of her subject area, ask about this and how they help the novice in the content area.* How do you help a beginner who is teaching out of your own content area? If they have any content-related problems, how do you help them?

10. Here is a list of the things that we have learned that mentors and new teachers do together. (Hand them the list). Can you go down this list and check off the things that you and your new teachers have done together this year?

    classroom observations of NT by mentor
    reciprocal classroom observations
    debriefing after visit
    consultation
    co-plan
    co-teach
    demonstration lessons/demonstrate
    help with certification/professional development needs
    go together to observe another teacher's class
    advise about district regulations and policies
    provide formative and final assessment
    help locate resources
    work on classroom management issues
    work on subject matter issues
    help with instructional strategies
    look together/study samples of student work
    participate together in study group or book club
    participate together in content-focused seminars or workshops
    attend a conference together
    regularly scheduled coaching/mentoring session
    script lesson (have their lesson scripted, get given the script)

case discussions
participate in a lesson study group
developing assessments together or scoring student work with colleagues
engaging jointly in curriculum topic study
setting up new classroom together (or getting advice on this)
get newsletter from mentor with ideas/tips/information
get help with Praxis requirements and preparation
get advice about jobs/ job change
get moral support
get oriented to the building/district
help with time management

Of the things that you have done, which ones have you done most often? Which things have been most helpful for the new teachers?

11. Which of the things on this list that you have checked to do feel better prepared to do? Why? Which ones do you feel less prepared to do? Why?

Part 4. Role of the induction program—infrastructure and supports

1. What sorts of guidelines, training and support does the induction provide mentors?

2. Do you receive any training from the program about being a mentor? Are there explicit expectations for your work as a mentor? How does a mentor learn about these?

   Do you or novice have a handbook, and what do you use it for?

3. Where did you learn how to be a mentor?

   Are there any texts or materials that have been important in shaping how you see your work as a mentor? Where and how did you come into contact with them?

4. Has your approach to mentoring changed over a time? Why and how?

   (How long have you been a mentor?)

5. How were you selected?

6. How were you assigned to the novices you have?

7. What contact do you have with the other mentors in the program? What difference does that make to you?

   What contact do you have with other providers in the program?

Appendix A11 (cont'd)

8. What role do you play in assessment? Why and how?
   Probe: what standards are in use? Benchmarks? Is assessment formative and/or summative? Who else is involved?

9. How does the curriculum of the school come into your work?

10. How about state and district teaching standards/content standards and pupil assessment? How do these affect your work as a mentor?

11. Are you ever evaluated as a mentor? Do you ever get any feedback about your work? If so, can you tell me about that?

Appendix A12: Interview of School Principal/administrator
Science teacher induction

Date of interview_____

Name of principal/administrator _____
Years as principal/administrator at this school _____
Principal elsewhere prior to this school? _____

Name of school:

Level of school: middle (6-8) high (9-12) other_____

Thank you for agreeing to meet with me today to talk about new science teachers in your school. As I explained, our research study, funded by the National Science Foundation, is interested in finding out about the kinds of support available to new science teachers in the Bay area. There are three areas I'd particularly like you to tell me about today: first, your school's situation for retaining quality science teachers; second, the formal and informal support you are aware of that is available to new science teachers in your school; and finally, your impressions of how the support available to new science teachers in your school helps the school develop and retain quality science teachers.

1. **The school's situation re: quality science teaching**
    a. How many science teachers do you have in your school?
    b. Have you had to hire many science teachers in the last couple of years?
    c. How difficult is it for your school to attract quality science teachers?
        (Probe on: in all areas/grades; how many new science teachers did you need this year?; Were you able to fill vacancies? (at beginning of the school year...later on)?; Sources for new science hires? Certification?)
    d. How difficult is it for your school to retain quality science teachers?
        (Probe on: in all areas/grades; what presents challenges and/or seems to help?)

2. New teacher learning

a. What do you think are the most important things that new science teachers need to learn in their early careers?

Probe on:

b. What about subject matter
c. What about working with students?
d. What about working with parents?
e. What about classroom management?
f. What about working with and using curriculum?
g. What about assessment?

3. Induction

Now, let's talk a bit about the current induction process(es), both formal and informal, for new science teachers in your school and your school system.

a. Are there any formal programs for science teacher induction in the school? These might include orientation meetings, assigned mentoring arrangements, workshops for new teachers, new teacher groups, etc. (Ask for description – if there is a mentoring program, ask what it consists of [how mentors are selected, how mentors/beginning teachers are matched, how often they meet, if mentors receive training, assessment/evaluation component, etc.]

(Also probe on principal's role if there is mentoring, ask if the principal is involved with selecting mentors, matching, supervision of mentors and/or new teachers, providing common release time)

NOTE: If there are co-existing induction programs, need to know about those as well . . .

b. How about informal support for new science teachers? (For example, unstructured, voluntary collaboration in planning; groups of teachers who get together for dinner and talk shop)

c. Are there other things in the school like faculty or department meetings that are used to support new science teachers?

d. Are there other forms of professional development that new science teachers participate in?

e. Are there other kinds of support/resources you can offer new science teachers? (release time, lab facilities, housing, etc.)

f. Are there any other supports/resources for new science teachers you are aware of that are offered in cooperation with, or apart from, the school/district? (If yes, ask to describe and also probe on how new science teachers find out about these resources)

d. What is your role in the support of new teachers?

4. Principal's evaluation of support

Now let's talk a bit about how you think the support available for new science teachers is working and what else you think might be needed.

a. **How successful do you feel the formal induction programs in which your new science teachers participate are in helping them become better science teachers? in their willingness to stay at this school?**

b. **What kinds of induction activities do you think are most beneficial for new science teachers? (Probe on evidence)**

c. **What kinds of supports/resources would you like to be able to offer your new science teachers in the future (probe on explanation)**

d. **Is there anything else you would like to add about support for new science teachers?**

Thank you for your time.

Appendix 13: Mathematics and Science Teacher Induction Study
Observation of induction activity
(Fall 2003)

Rationale

Observing induction activities allows us to look at practices of induction as activities and interactions that use tools, develop relationships, and deal with substantive foci. Our visits to these activities gives us an opportunity to see some facets of the program, to better understand what the induction provider does in her/his work, and how the new teachers present themselves as learners. These give us a chance for a more grounded interview with both providers and new teachers. Just like the classroom visit, visits to induction activities should help us gain insight not only into the activity of induction but the thinking that undergirds it—thinking about teacher learning, teaching, and subject matter. These visits give us a context for understanding not just induction participants' actions but their thinking as well.

While this will vary with each site, the expectation is that at least one visit to a key induction activity would occur in the fall and spring of the 2003-2004 year. As is possible, any visit would include a short conversation with the provider or workshop leader in advance of visiting the event. A visit would, as possible, be followed up with another conversation, but this conversation could also be combined with the provider interview protocol.

As you observe, keep in mind the interpretive questions we are trying to answer. They are listed at the end of this document. It will be helpful to review them before you begin your observation.

Guidelines:

1. do a brief pre-observation interview with the provider/staff running the activity
2. keep detailed notes of the event, including drawing a map and keeping a running log
3. follow up with a brief post-observation conversation
4. write up your notes and response to interpretive questions

Appendix A13 (cont'd)

Pre-observation Interview

1. What is the purpose of this activity [note: use locally correct term: workshop, session, etc.]?

2. What will the activity entail? Can you give me a quick rundown of what will happen?

3. What do you hope the participants will learn or accomplish?

4. How difficult will this be for them? Why? What would it depend on?

5. How did you decide on the activities and instructional approaches you'll be using?

   Did you consult with anyone else as you prepared for today/this event?
   Did anyone help you with the planning?

6. How does this activity fit in with larger program?

7. Is there anything else that I should know about the session?

11. Can I get copies of many materials that you used in getting ready for this session, as well as any handouts from the session?

Post-activity Interview[74]

10. How did you feel things went today? How did that compare with what you expected?

11. When we talked before, you thought (fill in from earlier conversation) would be hard for you. How did that go?

12. You also said that (fill in) might be hard for the participants. How did that go?

13. How did you decide (ask about some of the main features of the activity in order to get at the provider's reasoning about tasks, discourse, roles, expectations):

    a. how to group participants?
    b. Which tasks to assign?
    c. What to do when X said Y?
    d. What tools/materials to draw on or refer to?

14. How typical was today's event?

15. Will you talk with anyone about the session? What sorts of issues or questions would you like to discuss?

16. What will follow this activity? How will today's activity influence your work? How will it influence the next event or other planning in the program?

17. Can I have copies of these other materials that you used? (Make sure to get copies of everything that is used during the lesson.)

[74] Note: Try to ask questions as soon as possible after the observation. Tape the provider's answers if possible. In addition to the questions below, ask about anything that struck you as important. At the same time, remember that this must be a short conversation, so exercise judgment in deciding what is most important to learn about at this point. Keep the tone of your questions interested and curious, not challenging.

Observation Guidelines

Note: Taking careful and detailed field notes is a demanding and intensive task. It is impossible to write down everything that is going on, nor is it necessary, so you will have to use your judgment in deciding where to focus your attention.

1. Find a place to sit where you can see and hear well. (Check out in advance with the provider if the activity will involve any group work and whether or not she/he is comfortable with your moving around during in individual or small group work.)

2. At some point during the visit, sketch a map of the physical arrangement of the room. Note where people are sitting, how they group themselves (by subject, level, school, etc.) and keep some record of which teachers (in which spots in the room) are participating. Note if anyone (besides NTs) is participating or observing. If they come and go, note the timing of their presence.

3. Since you will not be able to describe the activities and responses of all participants, choose some group to focus on. If the activity includes breaking into groups, choose groups, which have mathematics/science teachers involved. If possible, choose a group with some of your focal teachers in it.

4. As you take notes, describe what is going on in the activity, getting as many direct quotes as possible. Describe interactions. Avoid summary statements in favor of descriptions of what people are saying and doing.

5. Indicate the time change regularly, especially when something (the task or activity) changes.

6. Type up your observation notes as soon as possible after the observation.

The purpose of the write-up is to provide as full a picture as possible of the slice of teaching that you observed.

1. Make sure to include identifying information: date, observer, place, provider (use code name) and activity.

2. Begin by describing the context—the physical context as well as the number of participants, the tasks and activities you observed, and the curriculum content. Here your purpose is to give a roadmap of the activity you observed. Explain what you chose to pay more or less attention to during the observation.

3. In the body of the narrative write-up, re-create the chronology of the lesson with as much detail as possible. Describe how the leader began the actvity, what participants did and said, how the provider used materials and equipment, how he/she handled transitions, disruptions, questions, comments, and how the event ended. The narrative should be complete enough so that someone other than yourself could use it as data with which to answer the interpretive questions at the end of this guide.

Appendix A13 (cont'd)

4. At the end of the write-up, make a section called "attachments" in which you list all the documents collected that accompany the observation (e.g., plans, handouts). Also note any other documents you have requested (e.g., the relevant pages from the providers' guide)

Observation Data

Leader(s) Names

_____

Location

_____

Observer

_____

Date/Time of Day _____

Grade Level/Subject matter of participating teachers_____

Time: Begin _____ End _____ Total Length _____

Classroom Context

Number of students _____
Racial/Ethnic make-up of group
European-American _____
African-American _____
Asian-American _____
Latino/Hispanic American _____

Male _____
Female _____

Materials present

What kinds of materials are present?

Classroom map

(Include seating arrangements, what's on the walls, etc.)

Chronology of Session

Please list the individual "parts" of the session observed and approximate lengths (time) of each.

Narrative Summary of the Lesson's Content and Chronology

Appendix A13 (cont'd)

Interpretive questions

These questions should be written after you have completed your write-up of the observation. Your responses should draw on both the observation and interviews. Answer questions you can and leave others.

1. The place and meaning of subject matter in the activity

What important ideas in the subject are embodied in the learning tasks/activities?
How were subject-specific issues raised--
Proactively
Responsively
Shared by all or for each subject?
How is subject matter identified—as a "course", school subject, discipline?
How central is it to the events of the activity? Where and how does it appear?
If there are many subject areas included in this activity, what is the relative presence of math and science?
What version of mathematics/science is espoused, articulated, and/or implicit?
Are there references to standards, and if so, which ones?
What tools related to math and science get used or referred to?

2. The provider's practice

Activities and tasks:

What were the core activities used? (small groups, sharing out, etc.)
How are participants organized for learning?
Do the learning tasks and activities give teachers a chance to reason and evaluate ideas, arguments, and evidence?
Do the learning tasks and activities give teachers a chance to draw on their background and experience?
How does the leader make connections between activities? Between activities and ideas?
How does the leader use resources and materials in the class?

Discourse and norms
Are there key phrases and terms that keep appearing? What local jargon is used?
Does the discourse explicitly connect to some broader discourse (of the state, of national standards, or a particular research community, etc.)?
What happens when a teacher does not understand?
What happens when a teacher disagrees or questions/challenges a claim?
How is knowledge constructed in this class?
Are teachers and/or leaders expected to contribute to each others' learning? What does the leader do to contribute to this?
Are participants and/or leaders expected to challenge each other's ideas? What does the leader do to contribute to this?

Are participants expected to listen and respond with respect? What does the novice do to contribute to this?
What does the use of time during the event say about priorities—e.g., the importance of building peer connections, chance to relax, opportunity to have problems resolved, etc.

Reasoning about practice
How does the leader explain or justify decisions about learning tasks and participant organization?
How does she/he explain particular interaction moves (e.g., whom to call on, how to respond to errors, etc.)? particular content choices?
To what extent is the event an opportunity to model kinds of instruction, ways of thinking, types of material use, etc?

3. Vision of teaching

What is the nature of teaching/ stance towards teaching? That is, is it seen as technical or open? Developed by each teacher or shared?
What is treated as the main source of knowledge/expertise in teaching? What is the role of personal experience? Of outside authority? Which authorities?
What is the role of reasoning?
Is there common language used?
What's seen as important in teaching?

4. Influences and connection to the program
What influences seem to come into play in how the leader prepares for and carries out the activity?
What explicit connections are made to other parts of the program?
How present are other members of the program staff?
How does the leader gather any data—as feedback, evaluation of the event or of learners—in this activity?

Appendix B
Sample Data Displays

Appendix B1: Data display: Mark Bonner's Pathway to Teaching

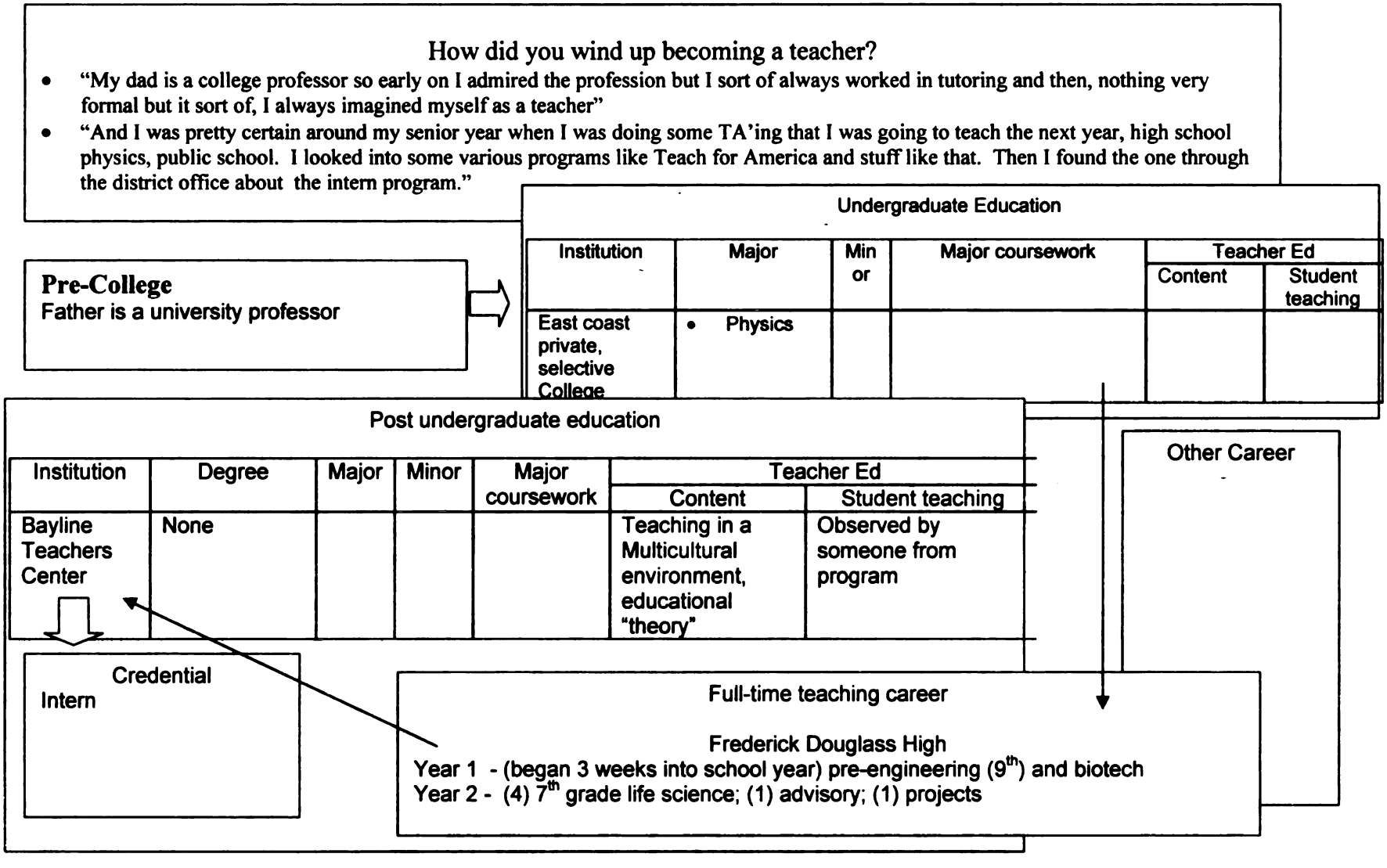

Figure B.1 Data Display of Mark Bonner's Pathway into Teaching

Appendix B2: Data Display: Mary Andrews Teaching Practices

Subject Matter Confidence

"I just don't know it right now. Also, in my physical science, it takes me a while. I think of myself as a fairly intelligent person... I've always been able to master most academic things that were given to me. [But] it takes me a while to get that eighth grade science, and...I can see people getting involved in teaching this. As a matter of fact, if you couldn't think that way, you couldn't grasp how, I mean it's hard stuff, all this physical science. Earth science is [sometimes hard for me to understand too] but more than I understand physical science [which is] more abstract."

"I feel very lucky because math was always a natural, like, I enjoy teaching math because it was just what I've always been able to be good at."

Instructional style

"What I'll do is have them make flashcards and they have to look in their book and they have to find the definitions and that kind of thing. So, I'll jump around. Usually the first section of a chapter makes sense and then it's just [too much]."

"I'm getting into the eighth grade science. I wish I taught more classes of it so that I could put more time into it because I teaching that one class, how much time do you have to just put into one class? And there's just so much you can do with it that's difficult. It's like you have to find a lot of materials and time"

"We try to do, well, just a mixture like, hands-on when we can, and then...sometimes [have them work with the] book."

Concerns

[After consolidation in my first year]... I kind of literally hung out for three weeks... they would ... send me to different schools and I would...play secretary and I was like, "This is ridiculous" ...I'm about to quit. And then I got this job at XXXX teaching fifth grade because they've been a crazy class. So last year was...basically behavior management, a struggle all year... But it's over now and... I look back and I can't believe I went through that. I'm a better person for it."

"I never [call people for help]. And I didn't do it for awhile, but I just got to this point where I [needed help]. I thought I'm not going to make it. ... Um, but I did make it somehow, but it was a struggle."

"You know there's a part of me that wishes –[My first school] was a very, very, very tough school and not only was it a tough school, it does not have the support of administration, does not have support of teachers that are there to help you. There are no resources. I found myself drowning last year literally and...calling the district people... "I'm going to quit, I'm so out of my league." Calling Teach for America, "I'm going to quit." Kind of nothing. This year, from the left and right I think, and...emotional support... "Do you want a PAR coach? Do you want someone to help you come in and help you do these kinds of things?" I don't know where those people were last year.

"That's what the problem with middle school is if you ask me in my opinion is because there's no credential for it ... You do get, because, I mean it's like a Catch-22, there is no credential for it and no one wants to teach it, so if they offer a credential for it would anybody specifically say "I'm going to get my middle school credential?" Because they don't [offer the credential], you get kind of the leftovers in a sense teaching there. I could perfectly admit saying that I am a leftover, you know, the less qualified people who... I am inexperienced, less credentialed, and I mean, I think luckily I'm working hard and trying hard and I think I'm doing an OK job but Inot all situations end up like that. Not all of the leftover people are always [like that]."

Approach to subject - ?????

Figure B.2 Data Display: Mary Andrews Teaching Practices

Appendix B3: Data display: PD timeline for Felicia Baker

Table B.1
Data Display: PD Timeline for Felicia Baker

		Sept – Nov. 2003	Dec 2003. – Feb. 2004	March – May 2004
Teaching Units		Cells, photosynthesis, cellular respiration, cell division, genetics	DNA, RNA, Human anatomy & physiology	Protein synthesis, evolution, ecology
EXPLO		(Summer Institute 2003)		
	Coaching	Rachel – observation; meiosis		
	Mentoring	Rick – mentor group; shared institute lessons	Rick – mentor group; curriculum work & binder of materials	
	Workshops	*The science of Harry Potter*	*What kind of teacher are you?*	*Teacher Institute Film Festival*
		Long-term planning	*Questioning techniques GraphaPalooza*	*Evolution*
		Chemi-palooza		
	List-serve	Read →		
			Asked about specimen preservative (no response)	
	Other			

Table B.1 (cont'd)

DISTRICT			
PAR	Met w/ (PAR) twice; clear credential did not qualify		
NTIP/BTSA			
		Chemistry workshop (didn't go); busy	
SCHOOL			
Administration	Observation by asst principal		Observation by assistant principal
Department	Went w/chair to SEP library Bio curriculum from dept chair → Emails about science "stuff" (department members list serve) →		Discussions about teaching evolution w/dept. chair
Team	Meetings 2x/week →		Cross curricular planning/math →
Other	Planning w/Steven	Planning w/Steven	Planning w/Steven
Colleagues		Met w/Susan – ESL bio teacher (materials)	
OTHER			
Texts (journals, articles, books, etc.)	Bio texts from NSTA →		
Internet	Content/teaching ideas (visuals) →		
University coursework			
Professional Organizations	NSTA conference/member →		
	Journal at school		
People			
Partnerships	Active Science	UMSP med school (help w/DNA extraction and models; heart/lung)	UMSP– evolution activities
		Active science DNA extraction & optical illusions	Pharmacist career

Note: Shaded terms indicate activities the teacher specified as highlights for their learning

Appendix B4: Data Display: Cross-Teacher Comparison resources Interview (Part II)

Table B.2
Data Display: Cross-Teacher Comparison resources Interview (Part II)

Goals	Steven (HS)	Felicia (HS)	Olivia (HS)	Mark (HS)	Mary (MS)	Rita (MS)	Joseph (MS)
1. Works with colleagues to improve their teaching	Exploratorium coach	Steven	No	Exp. Physics colleague; dept chair)	6th grade team	Grade level science colleague	Math dept. chair
2. Uses a variety of instructional approaches in their teaching	Dept chair; a school colleague	Team member (English teacher)	No	District science specialist	School Gear-Up teacher	No	Teacher cert science methods instructor
3. Engage students in investigations	Dept. chair; an exp. science colleague; Exploratorium coach; Teacher friends from pre-service Teacher educator from pre-service program	Exploratorium coach	No	District science specialist	No	District science pd program	No

Table B.2 (cont'd)

Goals	Steven (HS)	Felicia (HS)	Olivia (HS)	Mark (HS)	Mary (MS)	Rita (MS)	Joseph (MS)
4. Knows (biology, physics, life science) well	Undergrad profs	Steven; Dept. chair	Department chair	Adviser from undergrad	No	Non-district teacher friend	Teacher cert. science methods instructor; pre-intern district science coach
5. Connects the science content they're trying to teach with the interests/experiences of their students	Science methods teacher; Department chair; Exploratorium; experienced science colleague	Department chair	No	History colleague	No	No	No
12a. Modifies instruction to support the special needs of english language learners,	Teacher prep program prof	Special ed bio teacher	No	Department chair	No	No	Science for deaf/hearing impaired colleague

Appendix B5: Data Display: Felicia Baker's Textbook Use

Table B.3
Data Display: Felicia Baker's Textbook Use

Lesson date	Topic (10th grade Biology)	Videotape (V) Observed (O)	Teacher self-reported reliance on textbook for lesson[a]	Lesson component taken directly or adapted from textbook	Teacher holds and/or consults textbook during lesson[b]	Teacher refers students to textbook sections or pages during lesson	Textbooks visible on student's desk	Students directly use textbook during lesson	Students assigned homework that requires use of textbook[c]
12/11/03	Genetics	V/O	2c – n/a 4d– n/a 4e – n/a	(1)Textbook illustration	2	2	2	2	
3/4/04	Human body systems	V/O	2c – S 4d – S 4e - N		0	0	0	0	
5/18/04	Species interaction	V/O	2c – S 4d – S 4e - S	Textbook Illustrations	2	2	2	2	
5/25/04	Species interactions and biomes	V	2c – S 4d –S 4e - N		0	0	0	0	

[a] Questionnaire items: (2) Which of the following played a role in how you decided to teach this content? C. mandated textbook for your grade level – no role (N), small role (S), or major (M) role (4) To what extent did you use the following when planning the lesson? (d) student textbook - not at all (N), a little (L), some (S), quite a lot (QL), a great deal (GD) (e) Teacher's guide version of textbook - not at all, a little, some, quite a lot, a great deal
n/a – not available (did not complete questionnaire)

[b] 0 – never 1 – minimal (<25% of lesson time) 2 – moderate (25-50% of lesson time) 3 – high (> 50% of lesson time)

[c] X = yes; no entry = No

Appendix B6: Data Display: Olivia Langston's Textbook Use

Table B.4
Data Display: Olivia Langston's Textbook Use

Lesson date	Topic 10th grade Biology	Videotape (V) Observed (O)	Teacher self-reported reliance on textbook for lesson[a]	Lesson component taken directly or adapted from textbook	Teacher holds and/or consults textbook during lesson	Teacher refers students to textbook sections or pages during lesson[b]	Textbooks visible on student's desk	Students directly use textbook during lesson	Students assigned homework that requires use of textbook[c]
12/15/04	Mitosis	O	2c – n/a 4d – n/a 4e – n/a	Overheads & notes	0	2	3	1	X
3/5/04	Transcription of DNA to RNA	V	2c – M 4d – QL 4e - QL	Overheads & notes	0	2	3	2	X
3/8/04	Translation to protein	V/O	2c – M 4d – QL 4e – GD	Overheads & notes	2	2	3	2	X
3/9/04	Codons and anti-codons	V	2c – M 4d – S 4e - QL	Overheads & notes	0	0	3	0	X
5/11/04	History of Life on earth	V/O	2c – M 4d – QL 4e - QL	Notes (from student presentations)	3	2	3	3	X

Table B.4 (cont'd)

Lesson date	Topic 10th grade Biology	Videotape (V) Observed (O)	Teacher self-reported reliance on textbook for lesson[a]	Lesson component taken directly or adapted from textbook	Teacher holds and/or consults textbook during lesson	Teacher refers students to textbook sections or pages during lesson[b]	Textbooks visible on student's desk	Students directly use textbook during lesson	Students assigned homework that requires use of textbook[c]
5/12/04	History of life on earth	V	2c – M 4d – QL 4e - QL	Notes (from student presentations)	3	2	3	2	X
5/13/04	History of life on earth	V	2c – M 4d – QL 4e - QL	Notes (reads directly from text at one point)	3	2	3	1	X

[a] Questionnaire items: (2) Which of the following played in role in how you decided to teach this content? (c) mandated textbook for your grade level – no role (N), small role (S), or major (M) role (4) To what extent did you use the following when planning the lesson? (d) student textbook - not at all (N), a little (L), some (S), quite a lot (QL), a great deal (GD) (e) Teacher's guide version of textbook - not at all, a little, some, quite a lot, a great deal
n/a – not available (did not complete questionnaire)

[b] 0 – never 1 – minimal (<25% of lesson time) 2 – moderate (25-50% of lesson time) 3 – high (> 50% of lesson time) n/a – not available

[c] X = yes; no entry = No

Relevant Quotations

Olivia: "Do not leave that to tomorrow night...You are responsible for 6-1 and 6-2. Anything you have taken notes on in Chapter six is fair game...actually it would be better if you studied your notes because some of the things in section 6-2. I did not do in the notes and I don't want you wasting your time on things that I didn't cover. So please study your notes. That is what I'll make the test from. (observation field notes, 12/15/04)

Notes follow sequence presented in the book chapter. (But does not follow sequence of chapters themselves.

Appendix B7: Data display: Literacy strategy timeline: Word wall

Description

Tool: Word wall

Description: The word wall is an area of the classroom wall where 8.5. x 11 sheets of paper are posted, each containing a vocabulary word from the unit, its pronunciation, and its definition.

Type: Practical

Tool source: Adapted from middle school student teaching experience:

> Felicia: My cooperating teacher in middle school last year had a word wall where she wrote the words up [with definitions] but not with pronunciations. A lot of these are big words so when kids read I could see them struggling a lot with the pronunciation so I just figured I'd put the pronunciation up there too. I mean, in a lot of ways, and I don't necessarily teach it this way but I'd like to more so in the future. I think learning science, especially biology, is a lot like learning a foreign language.[75] There's a huge amount of vocabulary and for kids who aren't that strong with English language structure and syntax to begin with, if we are going to be able to expect them to use this vocabulary at all they need a lot of support (post observation interview 12.15.03).

Goal: Access (through support for literacy skills)

Trigger: How do I help students with a range of reading skills learn science?

[75] Note: Vygotsky uses the difference between learning a native and foreign language as an analogy for the difference between learning spontaneous and scientific concepts. He contends that learning a foreign language requires learning abstract or formal structures of vocabulary, grammar, etc. Becky seems to be implying something similar. Becky majored in neuroscience and Spanish in college. Learning a foreign language may serve as a "conceptual base" for this practical tool??

Appendix B7 (cont'd)

Felicia: You know it's a real mix of students. There's a very broad range of abilities. There are students that are at a tenth grade reading level and there are students that are at a third grade reading level and everything in between (Initial interview 11.11.03).

Timeline of use

Initially

Felicia used a word wall for the first time with her students during the unit on genetics (classroom observation 12.11.03).

Interviewer: You had the word wall there for them. Is that something new?

Felicia: Yes, that was brand new. That was the first day they were seeing that (Post observation interview 12.15.03)

See Video episode of classroom teaching (12.11.03)

During the school year

The words stayed up on the wall even when the unit topic changed and were still there when I observed the ecology unit in May

See Video episode of classroom teaching (3. 4.04 & 5.17.04)

Reflection at the end of the school year

Felicia indicated that she thought the word wall worked well for genetics and, although she didn't continue it throughout the year, she will pick it up again next year.

Felicia: I don't know how I would do it exactly but I now understand better how important it is to teach kids how to read science and how to be literate on top of just teaching them science.

Interviewer: And do you have some ways of doing that?

Appendix B7 (cont'd)

Felicia: I had some that I used this year. I had a word wall

Interviewer: Did you continue to use that after the genetics unit for other units

Felicia: I used it for the structure of DNA but then after that I kind of ran out of steam. So that is something I would actually continue with

Interviewer: So you thought that worked well with the students

Felicia: Yeah, The kids definitely noticed it, referred to it, used it. I forget if I did this when you were there but I had kids pronounce things from the wall. I had a pronunciation guide. I could see them struggling with it but wanting to pronounce words like deoxyribonucleic acid. (End of year interview 6.10.04)

Future trajectory

Felicia sets up future directions for expanding her goal of supporting her students' literacy skills as they learn science

Felicia: I would like to incorporate a little more in to the teaching. I talked to the English teacher that will be on my team and this summer we're going to talk about how set up a general pan for a vocabulary lesson at the very beginning of the year because I think kids don't understand things like the word process, structure, or function or hypothesis. And then maybe try to continue with those vocabulary lessons throughout the year as words come up.

Interviewer: So you would teach those lessons in the same way she would teach vocabulary to the kids?

Felicia: Right, [and] I'm planning on reading back through my books on literacy and see what I can come up with now that I have sort of a mental picture of what that would like in a classroom

Interviewer: And these books are from your work at [your teacher preparation institution]?

Appendix B7 (cont'd)

Felicia: Yeah

JG: So helping them or supporting their reading seems particularly important and is something you learned this year. You might have had an idea of this before but now is more salient

Felicia: Yeah, well put, you said it better than I did. (End of year interview 6.10.04)

Appendix B8: Data display: Coding strategy; curriculum

Felicia Baker
Date/Time: 09/20/04 02:51:00 PM **Bold** = curriculum resource
Underline = curriculum goal

Codes: [curriculum] [textbook use]
No memos

With **Biology** its much more, kind of, putting our own thing together with the **skeleton outline of the book** which is. **The department chair who used to teach biology** taught sort of in the same sequence as the book.

Codes: [curriculum]
No memos

JG: How about curriculum for science? How do you know what you're supposed to be teaching?

Well, that's an excellent question. Um, I'm not sure if this is planned or of its coincidence but **[Steven]** and I have fifth period in common for our prep period. So he **and I meet pretty regularly** and try to coordinate what we're teaching **but we're both new**. So, there's not a whole lot of supposed to, there's the **California state standards**

JG: Do you rely on those?

B: Uh, yes, **in theory.** I mean, I don't, you know when you go, well, when we start to plan a new unit we'll go back to the standards and take a look at them and make sure we are generally in line with them. Um, **we probably should be aligning our daily objectives more closely with the standards but we don't**

Codes: [curriculum]
No memos

There is a science department, yes and, um, so in addition to [Steven] and me meeting, our **department chair taught biology for, uh, six years, five years. So he has handed us his curriculum** and we have **the textbook** that, you know,

Codes: [curriculum]
[Notice the possible contradictions here – boiling down, basic essence, and understand basic concepts; what is basic? What does understand mean?]

I feel pretty comfortable as a student. It seems like a brand new thing to have to take all the information that I have, remember it in some cases, um, boil it down to really, a lot of times, its most basic essence and then figure out activities that will help students understand those basic concepts, you know. So that's the hard part for me, conceptualizing it as something to teach

Appendix B9: Data Display: Cross-Teacher Matrix of Curriculum Goals and Resources

Table B.5
Data Display: Cross-Teacher Matrix of Curriculum Goals and Resources

	Mary	Rita	Joseph	Olivia	Steven	Felicia	Mark
Curriculum goals							
Understanding important scientific ideas	Exposure	Recognition	Recognition	Factual knowledge	Factual knowledge	Factual knowledge	Explaining phenomenon
Understanding disciplinary practices of science		Science skills	Questioning			Doing science	Understanding how science is done
Non school-based tools/norms	? Elementary credential program + Exploratorium BTIP + District inquiry program (USP)	+ Exploratorium BTIP + District inquiry program (USP)	+ Secondary Credential program + Med school partnership (UMSP)	+ District inquiry program (USP)	+ Exploratorium BTIP + Med school partnership (UMSP)	+ Exploratorium BTIP + Med school partnership (UMSP)	+ District inquiry program (USP) + Physics teachers group + QUARKNET
School-based tools/norms	– Textbook – Orphan course – No help from colleagues/admin – Middle school accountability + Active Science Project	– Textbook – Corrective actions (BBC/EDI) + Standards – Keeping pace w/colleague – Middle school accountability – Planning w/novice	– Middle school accountability – Negative partner teacher	– Traditional science dept. – Dept. chair as mentor – Textbook – Traditional curriculum materials – Planning w/novice	– Busy dept. chair – Textbook – Traditional curriculum materials – Planning w/novice + Active Science Project	– Busy dept. chair – Textbook – Traditional curriculum materials – Planning w/novice + Active Science Project	+ Reform-minded colleagues + School mission + Textbook + Standards ? Inherited curriculum materials
Personal resources	– Content knowledge + Interest in reform – Student abilities – Teaching commitment	+ Content knowledge + Interest in reform + Student abilities – Teaching commitment	+ Content knowledge + + Interest in reform +/– Student abilities – Teaching commitment	+ Content knowledge – Interest in reform – Student abilities + Teaching commitment	++ Content knowledge – Interest in reform – Student abilities – Teaching commitment	+ Content knowledge + Interest in reform + Student abilities ++ Teaching commitment	+ + Content knowledge + Interest in reform + Student abilities + + Teaching commitment

Appendix C
Program Materials

Appendix C1: Spring Workshops: Exploratorium New Teacher Program[76]

Exploratorium NEW Teacher
Spring 2004 Workshops

Select** TWO or THREE **workshops and keep a copy for your records!

Sat., Feb. 7 1 pm - 3:30 pm
Getting a Grip on Grading

How to set up a system so priorities are straight and the mass of paperwork doesn't overwhelm you.

Sat., Feb. 14 1 pm - 3:30 pm
Art and Science

A marriage made in heaven! We have a lot of ideas for using art to enhance science content and comprehension.

Sat., Feb. 21 1 pm - 3:30 pm
Questioning Techniques

Sometimes the "right answer" is much less than it could be if the question had led in a different direction. There is a subtext in questions that can inspire or squash student motivation.

[76] Source: Exploratorium New Teacher Institute

Sat., Feb. 28 1 pm – 3:30 pm *(two workshops this afternoon)*

Your School Community, Your Contract, and You

How do you fit into the community you work in? What roles have you taken on, willingly or unwillingly? And what are your rights and obligations?

-or-

Academic Freedom

You CAN express yourself within the confines of the standards and in spite of "scripted" teaching. We all have unique ways to instruct and inspire our students.

Sat., March 6 8 am – 3:30 pm

CMSESMC Spring Conference

(meets at Canada College in Redwood City)

The Council of Math/Science Educators of San Mateo County Annual Spring Conference is for all Bay Area math and science teachers (K-12). Most of the Teacher Institute staff will be presenting at this one-day conference at Canada College in Redwood City. This is an excellent small conference – a great professional development opportunity and a way to get a lot of new ideas.

If you attend this conference, the Exploratorium will pay you a "New Teacher Workshop" stipend of $25. Your conference registration needs **to be paid by you ($50)**, so you end up paying $25 for your conference –which includes a continental breakfast and a catered lunch.

Appendix C1 (cont'd)

Sat., March 20 1 pm – 3:30 pm
The Evidence for Evolution

As biology teachers, how do we teach evolution thoroughly and accurately in a way that will communicate to students the overwhelming body of evidence that supports this important biological theory? Join us for an in-depth discussion and for a hands-on activity that will shed light on the evidence for evolution!

Sat., March 27 1 pm – 3:30 pm
Testing

How to prepare for standardized tests, and how to make your own tests reflect what you want your students to know.

Sat., April 10 1 pm – 3:30 pm
"Rube Goldberg Machines"

A way to incorporate a lot of science and to assess student learning!

Sat., May 1 10 am – 12:30 pm
Lab Organization and Safety
(meets at Piner High School in Santa Rosa)

Come to a model lab at Piner High School in Santa Rosa (beautiful wine country) and learn from a team of teachers who are masters at organizing their labs to make teaching more effective and life easier!
Continental breakfast provided.

Sat., May 1 *1 pm - 3:30 pm*

How Do I Teach Activity-rich Science in Short Classes/Long Blocks?

At this session we will share ideas about how to tailor your science curriculum to the time you have without giving up hands-on experiences.

Exploratorium Alumni

Spring 2004 Workshops

Select TWO alumni workshops and keep a copy for your records!

Sat., Feb. 7 ***8:30 am - 12:30 pm***

Popular Errors

We'll look at erroneous publications in science that were later found to be incorrect but which have lead to scientific laboratory legends. We'll look at polar bear fur and find that it is not a fiber optic, we'll see that glass is a solid not a liquid, we'll look at several published misconceptions about airplane lift, and we'll also examine heredity and molecular biology and more.

Appendix C1 (cont'd)

Sat., Feb. 14 8:30 am - 12:30 pm
The Heart

Join us for a very special Valentine's Day exploration of this vital organ. During the workshop, we will investigate the anatomy and function of the heart. You will also learn to read and interpret EKG's and you will investigate the mathematical curve known as "the cardioid." At the end of the workshop, there will also be a special Valentine's Day *Iron Science Teacher* broadcast. Chocolate will be served.

Sat., Feb. 21 8:30 am – 12:30 pm
Math + Science = GraphaPalooza

Integrate math and science with TI's favorite data generating activities. Help your students see math in the real world using data from science. Join us for a morning of physical and life science activities that generate data that show interesting graphs!

Sat., Mar. 13 1 pm – 5 pm
Teacher Institute Film Festival

Munch popcorn and watch movies! We will be showing classic and destined to be classic science videos and films (many of which are available from our library). Clips will be appropriate for all types of science classes as well as a few that are just plain cool.

Sat., Mar. 20 8:30 am – 12:30 pm
Exploratorium at Symphony Hall
(meets at Davies Symphony Hall)

Bring your instruments and play them on stage. We'll listen to the sound at different places in the auditorium. We'll also build simple musical instruments such as palm-pipes and clothespin harmonicas, and play them in the orchestra. *Due to Symphony's policies, only TI participants will be allowed. No guests or pets.*

Sat., Mar. 27 8:30 am – 12:30 pm
Running-Amok

Environmental disaster and how we humans are involved as problem causers and problem solvers. We will look at acid rain, global warming, and other environmental problems.

Sat., April 10 8:30 am – 12:30 pm
Body Mechanics and You

Bone up on muscles, joints, and their lever-like qualities in this merging of biology and physics. Use your own body, as well as typical TI materials, to elbow your way into this physical and anatomical adventure.

Sat., April 17 8:30 am – 12:30 pm
Visualizing Cell Biology

Want free access to fantastic microscopic images and videos? Need some new, exciting activities about cells and cell processes? In this session we'll try out some great new cell bio activities developed by our own TI staff. Our exhibit staff will lead a tour of the Exploratorium's new "Imaging Station" and you can provide them with suggestions on how to tailor the station to your classroom needs.

Sat., April 24 8:30 am – 12:30 pm
Carnival Science

Step right-up folks and win a prize. Excuse me, you look like some one that needs a hands-on activity for your science classroom. Yes, I'm talking to you! For just the price of signing-up you can find out the science secrets of carnival games. Find out about mechanics, optics, illusions, probability and more. These activities can be used for in-depth lessons as well as short science "fillers" and provocations. Be at the Exploratorium when the carnival arrives!

Sat., May 1 8:30 am – 12:30 pm
Action/Reaction

Join us as we explore this interesting facet of Newton's Laws. We'll look at friction, gravity, rockets and more. Then draw diagrams showing the forces. The key idea is that the action force and the reaction force are always on different objects.

Appendix C1 (cont'd)

Sun., May 2 10 am – 2 pm
Brunch among the Rocks
(meets at Bovine Bakery in Downtown Pt. Reyes)

Check out the geology of West Marin County. We will take an Earthquake walk at Pt. Reyes National Seashore, do a few hands-on activities, visit some pillow lavas, eat some croissants and more. Bring appropriate clothing, water, hiking shoes and your lunch or brunch. Heavy rain cancels.

We will meet at the Bovine Bakery in Downtown Pt. Reyes at 10:00 am (Located in the middle of the Pt. Reyes Business district - 11315 State Route 1).
There are many ways to get to Pt. Reyes. The easiest directions are:
From the Exploratorium, take US 101 north for about 15 miles. Get off at Sir Francis Drake in Larkspur and head west for about17 miles. In Olema, take Highway 1 north for about 3 miles.

Sat., May 8 8:30 am – 12:30 pm
Astronomy Day

Join us for our 9th Annual Astronomy Day, co-sponsored by the Exploratorium Teacher Institute and the Astronomical Society of the Pacific. The workshop will include a talk by a surprise guest and hands-on activities to help translate the content of the lecture into exciting classroom lessons. Past lecturers have been Geoff Marcy (discover of extra-solar planets), Jill Tarter (director, SETI Project), and Alex Filippenko (the discovery of the accelerating universe).

Appendix C1 (cont'd)

Sat., May 15 8:30 am – 12:30 pm

Pool Science

(location to be determined)

Got water? If you have access to a pool, or even if you don't, you'll find boatloads of pool based activities. Learn about chemistry, density, buoyancy, math, waves and more. Don't be all wet; see all the science that you can get out of pool supplies, pool maintenance and just using a large volume of water. No bathing suit required (unless you really, really want to jump in).

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