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By

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ABSTRACT

TEACHING MICROBIOLOGY THROUGH VOCATIONAL TRAINING OF FOOD SAFETY

By

Karen Sue MacArthur

This project documents study of the implementation of a vocational training program authored by the National Restaurant Foundation and supplemented with various lab activities and demonstrations developed by myself. The goal of the training was to improve the comprehension of important concepts of microbiology that would ultimately lead to improved retention of food safety guidelines and successful completion of the National Restaurant Association's ServSafe certification test.

The students were from the Hospitality services program at the Van Buren Technology Center. A fraction of the vocational curriculum included sanitation and the opportunity for national certification. The data collected and studied includes pre-tests, post-tests, and clinical interviews to determine the effectiveness of supplemental exercises, the time and location format, and the presentation format of the training. The data reflects the results of adjustments and improvements spanning a 3 ½ year period.

Major findings of the study included a higher percentage of students earning national certification than in previous years, despite generally poor performance in conventional academia for the typical food service student, and more complete understanding of fundamental microbiology concepts.

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Thank you for making the graduate experience at Michigan State University a rewarding and challenging one.

TABLE OF CONTENTS

LIST OF TABLES....iv

LIST OF FIQURES....v

INTRODUCTION....1 - 10

TRAINING OBJECTIVES....11 - 13

SUMMARY OF CONCEPTS BEHIND OBJECTIVES....14 - 16

IMPLEMENTATION OF COURSE....17 - 19
- Outline of training delivery....17
- List of field trips and speakers....18
- List of audiovisual material....18 - 19

SUMMARY OF TRAINING ACTIVITIES....20 - 22

EVALUATION OF STUDENT RESULTS....23 - 32
- Pre-test and Post-test Statistics....29 - 30
- Attitudinal Survey....31 - 32

CONCLUSIONS....33 - 35
- What was effective in training....33 - 34
- What needs improvement....34 - 35

BIBLIOGRAPHY....36 - 37

APPENDICES....38 - 67
- APPENDIX A
- The Rest of the Story investigation
- Glo-germ demonstration directions
- Bacterial Culture Exercise*
- Unlabeled White Powder*
- Using a microscope properly*
- Observing pathogens found in food
- Logarithmic Growth of Microorganisms
- Investigation FATTOM
- Measuring pH of common foods*
- APPENDIX B
- Prior Knowledge of Microbiology Questionnaire

Attitudinal Survey
Results of Prior Knowledge Questionnaire
APPENDIX C
Practice Certification Exam*
APPENDIX D
Consent Letter for Student Release

LIST OF TABLES

Table 1 - Training Format Transgression Over Three Years.....8

Table 2 - Pre-Test and Post-Test Cumulative Class Sample Results.....23

Table 3 - T-test Values for Each Year's Pre and Post Test Comparisons.....30

LIST OF FIGURES

Figure 1 - 1997 Pre & Post Test Comparison.....25

Figure 2 - 1996 Pre & Post Test Comparison.....26

Figure 3 - 1995 Pre & Post Test Comparison.....27

Figure 4 - Pre & Post Test Mean Score Comparison 1995, 1996, 1997.....28

INTRODUCTION

Due to the Carl D. Perkins Act, the School-to-Work initiative, and its emphasis for competency in core academic skills of communications, math and science, our vocational center implemented curriculum changes. Thus four years ago, an academic instructor was assigned to work with each vocational instructor to develop and implement a plan to integrate National Academic Standards or state objectives into their vocational curriculum. Once a plan was in place, academic instructors worked on integrating academics with students in the vocational program on a weekly basis. Thus, the term, "integrated academics" was coined to describe our center's new initiative. Integrated academics is putting the knowledge of core academic skills in math, science and communications into the context of what is needed in vocational training or on the job. The momentum behind this change is the unfortunate scenario of high school graduates who can not complete a job application correctly, calculate correct change in a restaurant or work well with co-workers. Therefore, many businesses and schools are working together to prepare students for the workplace.

Since our curriculum changes started over four years ago, the staff's biggest task has been determining just what is 'good' integrated academics. All of our integrated staff have visited and interviewed worksites and spent time in the vocational areas to get more familiar with what academic skills were needed.

In an interview with business and industry by the *Techniques* journal (May 1997), Fred Paul, from Rockewell Automotive Special Axles said, "Sometimes I think the academic side is maybe too focused on learning for learning, rather than learning for doing". This was a paradigm that the academic instructors had to be aware of while they

were designing the curriculum. For example, a degree can be earned in food science. However, I needed to determine what science was important for the beginning hospitality student. Rather than teach material about basic food chemistry, microbiological concepts related to food safety were determined to be more important.

Another important point by Jack Smith, Jr., president and CEO of General Motors was quoted in that same article,

> "Young people need more than a four-year college degree...they need transferable career skills, practical answers to the question, "Why do I need to learn this?" and opportunities to learn at actual workplaces. Educational programs should focus on contextual learning, covering math, science, reading and writing, in a way that puts this knowledge in context of what's needed on the job." (*Techniques*, 1997)

Our facility houses over 27 vocational training programs for the students in rural Van Buren Intermediate School District. Our average enrollment is approximately 900 students, split between morning and afternoon sessions. The typical vocational student is in the 11th or 12th grade and is bussed from one of the area's 12 local schools. Over 70% of the student population are at the point of career exploration while enrolled in the programs and do not have plans to attend a four year college. Many will enroll in one of the local community colleges or attend a technical training institute. Our goal is to help them focus their career goal by finding what it is they like and where their talents lie.

Traditionally our center has not attracted the "college bound student", therefore, in addition to our integrated academics focus, our center has started three new academies (pre-engineering, marketing and health occupations). We have also implemented a credit substitution program for students who are college bound and find it hard to fit a vocational program into their schedule.

The vocational program of focus for this study was the Foods and Hospitality class. Since I am certified in biological science, I was assigned to work with vocational programs related to bio-technology, hence Foods and Hospitality was one of my assignments.

Class sizes range from 25-35 students a session. At all times, at least five of the students are working co-op in a commercial food service establishment. Generally, many of the students in the hospitality services program are not college prep students and have not had much "academic success" at their local school. Each year approximately 20% of the students enrolled in the program have some sort of learning disability. Despite the frequent moans and groans during kitchen assignment of clean-up, most students enjoy their experience and all of the students have been placed in the program as a result of their vocational testing and the match of their aptitudes and desires with the job characteristics of the food service industry.

Obviously there is a tremendous amount of science that applies to food service and food technology. Many different topics could be taught from basic chemistry for food science to more innovative research like the field of food biotechnology and engineering. But, keeping in mind our philosophy of using contextual learning, and the fact that our Hospitality instructor was already trying to establish a comprehensive certification course for food sanitation, it was obvious for me to team up with her and help teach the sanitation training component of the Hospitality Services curriculum and incorporate microbiology and microtechniques where appropriate.

Sanitation training is part of many introductory food service college courses. Therefore, if our students pursued a career in food service, and successfully completed

the National Restaurant Association's sanitation certification test, with 80% or better, they could waiver an introductory college course. Since few of our students go to college, not all students attempt to take the sanitation training certification test. Ninety-five percent of the students are exposed to the basics of food safety, but approximately only sixty percent of the program enrollees complete the training by attempting the certification test. Since the test costs our center over $45 per student, each student must pass a sample certification test prior to attempting the official test. Another motivator for students to become sanitation certified is the credibility added to their resume if they pursue food service careers.

The sanitation training prior to our team approach was not as structured and consistent as the instructor desired. Since she was the only instructor and the kitchen was always in full production due to student and employee meals, problems existed. The difficulties were insufficient time, the need of an additional instructor, not being able to pull students from food production, and simply needing time for teaching specialty skills of food preparation. She had never been able to complete the whole certification text due to these problems and the difficult reading level of textbooks used prior to the existing text, *Serving Safe Food, A Practical Approach to Food Safety*. She had introduced the personal hygiene training, but she was never able to establish a workable plan for consistent and thorough training. Since she had just started the training two years ago and no students had passed the certification test, we decided there needed to be some changes. After looking over the coursebook, we decided that I could assume the primary trainer position. Since most of the procedures of food safety have to do with time and

temperature in regards to microbial growth, I found a niche to integrate science into the curriculum.

I chose to study this curriculum implementation in the Foods and Hospitality program rather than in my other vocational areas (child and adult care services, laboratory occupations, cosmetology, graphic arts) for four reasons:

- this training continued throughout the whole year, whereas in my other vocational programs, I facilitated smaller units for topics of particular interest;
- the course certification proved to be very useful to these students if they did pursue a career in food service. For example, two of our students this year will be attending Grand Rapids Junior College. Since they have already passed the food sanitation certification test, they will waiver two classes in the curriculum at Grand Rapids Junior College;
- I had worked in food service as a high school student and I never knew the scientific reasoning behind many of our procedures and policies, therefore, I didn't follow them; and
- lastly, I've enjoyed the difference in integrating science concepts in vocational training and watching them be applied in production. Students practice their new skills daily by role-playing the job of the facility's sanitarian for the cafeteria, sanitizing food contact surfaces properly, operating the automatic washers, and a list of other duties.

My only experience in food service was as a McDonald's crew member in high school, I needed to familiarize myself with the food service industry. I completed work-site visits and interviews of local establishments like McDonald's and Little Caesar's

Pizza, a National Restaurant Association ServSafe trainer course and I interviewed guest speakers, such as the local sanitarian from the Michigan Department of Agriculture. The most instrumental resource was the vocational instructor. She routinely provided examples of workplace scenarios as I tried to teach microbiological concepts within their workplace context.

Another prerequisite for the assignment of integrated academic instructor, was flexibility. This sanitation training has been taught in three different formats, my first attempt to teach the material was throughout the entire school year approximately once each week for 1½ hours. Unfortunately, class could not proceed as planned many times. Since the class is production based and deadlines for food must be met, our time slot for sanitation training was cancelled. We should have had approximately 33 class sessions from September to May, but were left with approximately 22 sessions and failed to cover the whole course. When I first taught the course, I was still getting accustomed to the curriculum, so I followed the book. The second year I added other aids, such as speakers, videos, worksheets and laboratory investigations. Also in this year, the coursebook changed and the second edition proved to be more user-friendly with a 7th grade reading level. The third year continued with the same supplemented activities, with deletions and additions where I believed the students needed more emphasis on specific concepts. For example, I added a logarithmic growth activity which helped reinforce the log phase of growth when bacteria are kept in the temperature danger zone for an extended period of time. I also added a video from an *Oprah* show which highlighted the different strains of bacteria found in common everyday places, like movie seats, bowling balls or shoes, shopping carts, etc.

Since these students are normally preparing food all class period, to sit in a classroom for sanitation training would be a change for them. The activities and audiovisual materials chosen for supplementation had relevance to their learning context of food production and management. For example, instead of loaning a video on bacteria from REMC that may give characteristics and great pictures of specimens, I believed the *Oprah* video caught the student's attention by showing examples relevant to them as well as showing clips of the specimens under the microscope.

The following table briefly sketches how the course timelines, content and activities changed throughout the 3 ½ years of this study.

Table 1 - Training Format Transformation Over Three Years

	HOSPITALITY AND FOOD SERVICES TRAINING FORMAT		
	YEAR	YEAR	YEAR
	1994-1995	1995-1996	1996-1997
Training Timeline	Each Monday for 1 ½ hours, often breaks in the weekly schedule due to production demands	Each Monday for 1 ½ hours, only 4 cancelled sessions due to food production or maternity leave	4 ½ continuous weeks for 2 ½ hours each day, a new training session started each semester
Training Material Used	Applied FoodService Sanitation, A Certification Coursebook, fourth edition only	Serving Safe Food, A Practical Approach to Food Safety, Certification coursebook, first edition	Serving Safe Food, A Practical Approach to Food Safety, Certification coursebook, first edition
Number of Students in Training	15 morning 12 afternoon	22 morning 23 afternoon	24 morning 19 afternoon
Total Number of Students Attempting Certification Test	3 total	20 total	27 total
Total Number of Students that Successfully Passed the Certification Test	1	8	18
Additional Learning Activities Implemented	none/ strictly text	listed in appendix A with an "*"	all listed in appendix A

Another influence on my decision making about what to add to the class was from the research disseminated at the University of Michigan's *Project-Based Science* seminar in the Spring of 1994. One quote sums it up well, "Critics of contemporary education have claimed that students have not mastered basic concepts and principles, they cannot apply what they learn to everyday life, and frequently see school as irrelevant."(Finn,1991) This was one critique I did not want of my training. The main focus from the workshop training in *Project-Based Science* was that

> "The current view of learning pictures students as actively constructing their knowledge by working with and using ideas..... integrated and usable knowledge is possible when learners develop multiple representations of ideas and, through their work in school and beyond, are engaged in activities that require them to use this knowledge."(Brown, Collins & Duguid, 1989)

Since I knew many of these students did not "sit" well in a conventional classroom, we needed to connect the content to the everyday world and engage them in more activities than what the textbook and training manual included. Therefore, what could take as little as two full days of training for a typical employee training, I developed into a five week unit with added activities. One activity I added was the FATTOM activity (refer to Appendix A) which emphasized the factors bacteria need for survival. (Food, Alkalinity, Time, Temperature, Oxygen and Moisture). I figured that if my students mastered the first three chapters of the text, (related to basic microbiology) the rest would make sense since it all related back to time, temperature and cross-contamination principles.

A few reasons why I changed the course over the three years were:

- I remembered the scarce information I understood about microbes when I was a high school, college-prep student.

- I worked at a local McDonald's restaurant through high school I never appreciated the training they offered us and I never knew the reasoning behind a lot of it (i.e. Why isn't washing your hands with soap and cold water enough? Why do we have to throw away a drive-thru order that is packaged in a bag, if it falls on the floor? Why can burgers only stay in the bin for 10 minutes after preparation? Why do we have to rotate the stock?)
- My family eats at food service establishments regularly and I wanted to help make the industry safer for the public.
- Basically a lot of the rules and procedures required throughout the cycle of food service (purchasing, receiving, storing, preparing, cooking, serving, holding) depend on time, temperature and cross-contamination principles. Therefore, supplementing the first part of the training to emphasize the microbiology of biological hazards in food service seemed to make sense.
- We needed to help the students grasp and retain the material so they could earn certification.

In summary, the activities presented and discussed in this thesis were made to supplement the certification training material so that the students could better understand bacteria and be able to transfer that knowledge to their work setting. Ultimately, they may take more pride in their work and train fellow employees since many food service establishments could benefit with more sanitation trained employees.

TRAINING OBJECTIVES

The following are the learning objectives listed in the *Serving Safe Food, A Practical Approach to Food Safety Certification Coursebook* by the Educational Foundation of the National Restaurant Association (objectives related directly to microbiology have an asterisk*):

The Challenge to Food Safety (Chapters 1-3)

- Recognize challenges to food safety*
- Discuss main types of contamination (chemical, biological and physical)*
- Identify the foods most likely to become contaminated*
- Recognize how food becomes contaminated*
- Identify biological, chemical and physical hazards*
- Describe how bacteria reproduce and grow*
- Discuss the factors needed for bacteria to grow*
- Know why it is important to keep foods out of the temperature danger zone*
- Describe the link between personal hygiene and food-borne illness*
- Set up basic standards for personal hygiene
- Show support for good personal hygiene by setting an example

Development of a Food Safety System - HACCP (Hazard Analysis Critical Control Point) Chapters 4-5

- Describe and identify the main principles of a HACCP system
- Identify the basic needs of quick service, full service and institutional service operations

- Adapt HACCP principles to the types of service your operation provides

The Flow of Food Chapters 6-8

- Set up purchasing and receiving standards and procedures
- Choose reliable facilities and equipment
- Use food thermometers
- Purchase and inspect specific foods
- Reject shipments*
- Set up storage procedures and guidelines
- Provide storage equipment and facilities
- Use the different types of storage facilities appropriately
- Store foods safely*
- Be able to keep food safe throughout thawing, preparing, cooking, holding, serving, cooling and reheating*

Maintaining Sanitary Facilities and Equipment Ch. 9-12

- Describe a well-designed restaurant
- Select proper equipment
- Review utilities, lighting, and ventilation
- Arrange for careful handling of garbage and solid waste
- Supervise cleaning and sanitizing throughout your operation
- Ensure safe machine and manual ware washing
- Provide safe storage for clean and sanitized items
- Train employees to safely handle cleaning supplies, including hazardous materials

- Organize, implement and monitor a cleaning program
- Set up an integrated pest management (IPM) program
- Use methods to keep pests out of the building and off the grounds
- Select methods for detecting pests
- Identify methods to control pests
- Work with a pest control operator (PCO)
- Understand the roles of federal, state, and local regulatory agencies
- Prepare for various types of inspections
- Work well with a sanitarian during an inspection
- Record and make good use of inspection findings

As you can see, most of the objectives do not directly relate to microbiology. However, the safety guidelines can all be explained by relating back to time, temperature and cross-contamination. For example, the safety guideline requiring stock to be shelved six inches above the floor and away from the wall is due to the concept of cross-contamination. Pest and rodents can infest the stock if able to reach it and bacteria and viruses are carried by these unwanted visitors.

SUMMARY OF CONCEPTS PRESENTED IN THE TRAINING

Part I - The Challenge to Food Safety

It is obvious after scanning the previous list of objectives, that the heavy emphasis for this project deals in the first part of the training - *The Challenge to Food Safety*. The first three chapters introduce the need for safety in food service and the hazards which threaten food. The training manual uses only five pages to cover identification of different pathogens, how bacteria reproduce, what they need to grow, barriers to growth, illnesses caused by bacteria and viruses, parasites, fungi (molds and yeast) and fish and plant toxins. The training material offers no activities except for a few figures and tables in the five pages of text. Therefore most of my project involves supplementing this part of the training with the following exercises:

- glow-germ activity
- exponential growth demonstration
- water activity demonstration
- reading degrees, a temperature go and seek game
- taking cultures/ time and temperature controls
- observing bacteria shapes under the microscope (different types of food infectious organisms)
- testing foods for pH
- using and calibrating a food thermometer
- interviewing restaurant managers about their sanitation program
- writing the health department for inspection results

Part II - Developing a Food Safety System

These chapters cover the basics of a Hazard Analysis Critical Control Point (HACCP) food safety system and methods for training employees to run the system. HACCP was first developed for the space program by NASA, and is a system for preventing foodborne illness in space.

This scientific process of monitoring normal food preparation insure that the safety guidelines for time and temperature abuse or cross contamination are kept in check. The training material offers recipes with and without the critical control points highlighted. Critical control points are points in production where a biological hazard can be eliminated or reduced. For example, cooking meat to 165 F will kill bacteria and eliminate a hazard. However, the students have difficulty grasping the concept, so I added an additional exercise to create a flowchart adapted for their particular type of operation. In the exercise, students work on setting up monitoring procedures for their daily routine of preparing student sandwiches and delivering fresh milk.

Part III - The Flow of Food

These chapters cover safety guidelines for purchasing, receiving, storing, preparing, cooking, holding, serving, cooling and reheating food safely. Here again, the training manual does not provide any hands-on activities. I constructed a scenario of an employee responsible for ordering, purchasing and receiving various food items. The important concepts reinforced here were purchasing appropriate volumes, purchasing from a reputable distributor and checking for food quality upon receipt of product. Again, all these guidelines are determined by the concepts of time, temperature and cross-contamination. Another activity gave a scenario of a specific type of food establishment.

The students had to identify special procedures to follow due to the specific hazards and needs of that type of operation. For example, if a person were setting up a mobile food station, such as a Polish sausage vendor at the county fair, what must be considered to comply with the health code.

Part IV - Maintaining Sanitary Facilities and Equipment

These chapters cover designing facilities and choosing equipment, cleaning and sanitizing, and controlling pests. Students look over floor plans for a restaurant and point out hazards as well as important "musts" in a restaurant, to comply to health codes. I did not supplement this section with any written work, I simply had the students view a short video titled, *Microbes in the House*. This video revealed some of the microscopic pests we have inhabiting our house, for example, it showed the organisms living in a sponge and the mites living in your carpet.

IMPLEMENTATION OF THE COURSE - THE THIRD YEAR

The following schedule is the timeline of training for our third year of implementation.

Week One:

- pre-test administered along with the microbiology prior knowledge survey
- Why study sanitation lecture / health inspection activity/glow-germ demonstration
- *Dateline* video behind the scenes of restaurants
- What are the hazards lecture/glow-germ/bacterial culture
- What are biological hazards lecture/identifying bacteria under microscope/making virus/bacteria models
- How do bacteria multiply lecture/ logarithmic growth activity / *Dateline* video on Jack-in-the-Box and E. coli outbreak
- review questions and worksheets assigned for homework throughout the week

Week Two:

- FATTOM lecture and exercises - control measures
- Time and Temperature - using thermometers and the exponential growth demonstration
- Personal hygiene lecture / introductory video / *Oprah* video
- Introducing HACCP lecture
- Create your own HACCP checklist for your operation

Week Three:

- Purchasing and receiving guidelines lecture / video
- Receiving and Storing guidelines lecture / video / worksheet
- Preparing / Cooking / Holding / Serving / Cooling and Reheating Food Safely video

Week Four:

- Design of facilities lecture
- Cleaning and Sanitizing lecture / video
- Integrated Pest Management / *Microbes in the Home* video

Week Five:

- Review
- post test
- follow-up on prior knowledge survey and attitudinal survey

LIST OF FIELD TRIPS AND GUEST SPEAKERS

- National Restaurant Association, National Restaurant Show, Chicago, IL, May 19-22, 1997
- Grand Rapids Junior College, Hospitality Services Open House, October, 1997
- Guest consultant, "How To Implement a HACCP Food Safety System" , Food Service Associates, Educators and Consultants to the FoodService Industry, May 23, 1997
- Guest speaker, Mr. Scott Kay, Sanitarian, Michigan Department of Agriculture, November 1995 and 1996

LIST OF AUDIO VISUAL MATERIAL

- ***ServSafe Introduction to Food Safety*** - Introduces students to the reasons why practicing food safety is beneficial to an organization by using a scenario of a foodborne illness outbreak at a small restaurant. The video's scenario stresses the importance of guarding ourselves and customers of biological hazards - bacteria. The 2nd part of the video stresses the importance of personal hygiene of the food service employee.
- ***ServSafe Managing Food Safety*** - Introduces the points of the flow of food that the food manager can make a difference to eliminate the biological, chemical and physical hazards in a food service setting.
- ***ServSafe Receiving and Storage*** - Reviews the important guidelines to follow when accepting shipments and how to properly store food after it is received. Different foods have different packaging which also requires different use-by dates and storage procedures.
- ***ServSafe Preparation, Cooking and Service*** - Reviews important guidelines in preparation to avoid cross-contamination and the abuse of foods in the temperature

danger zone. It also reinforces the procedures for safely thawing foods, safe cooking temperatures and the proper way to hold hot and cold foods.

- ***ServSafe Proper Cleaning and Sanitizing*** - Explains the difference between cleaning and sanitizing and when to do either. Explains how to use automatic washers as well as how to manually sanitize items. Also explains how to clean and sanitize stationary equipment.
- ***Dateline Investigative Report, "E. coli and the Monster Burger"*** - Documents the E. coli outbreak from tainted hamburgers at a Jack-in-the-Box restaurant in Washington state. The video includes interviews with representatives from each point in the flow of food production.
- ***Dateline Investigative Report, "Behind the Scenes"*** - Behind the scenes, undercover cameras are used to videotape the grotesque and unsanitary practices that happen in restaurants around the nation. It is a great resource for reinforcing the importance of training employees in food safety.
- ***OPRAH special*** - Oprah hosts a microbiologist who helps a mother and teenager undercover the microbes that live on surfaces they have contact with daily. For example, the microbiologist swabs various surfaces in the mother's home like a high-chair tray, toys and table. He also swabs the surfaces that the teenager comes into contact with on a night out on the town, like a bowling ball, movie theatre seats and a swingset.
- ***Microbes in the Home,*** source unknown - Starts with the microscopic "bugs" that normally inhabit our home, from bacteria on the kitchen sponge to the termites living in our walls.

SUMMARIES OF LABS AND TRAINING ACTIVITIES

Glow-germ demonstration/learning activity - by using the UV sensitive gel called Glo-Germ from Fisher-Scientific, I started out the class by putting it on all the pencils. After students watched an opening video of why we should be concerned with food safety, I had each student place their hands under the UV light, a real attention grabber. Students are actually amazed at how quickly and easily the "contamination" spreads. This activity really helped in grounding us to the fact that germs are everywhere and washing your hands is a must.

Bacteria Culture - "The Hazards Among Us" - this simple collection of microorganisms on petri dishes gave students the chance to discover just how widespread microorganisms really are and how quickly they reproduce. Students were "grossed out" by the results of green, white and brown fuzzy growths and "slimy" cultures of bacteria. We did not examine the cultures under the microscope for safety reasons, but the students were able to observe prepared slides of food pathogens.

Observing bacteria under the microscope - This exercise was a great method for introducing microscope skills and to see the different organisms causing food-borne illness. Some of the pathogens observed were; *E. coli, Shigellosis, Salmonella, Staphylococcus aureus, Clostridium perfringens* and *Trichinella spiralis*. Students also browsed through a software program, called "*Pathogens*" (IBM,1992), which shows the different shapes of bacteria and modes of infection.

Building models of bacteria, models of viruses, samples of mold and fungus - This activity was a creative break for the students, allowing them to artistically design their models of microorganisms. I provided gel caps from the pharmacist, pipe cleaners, fish

line, Vitamin E capsules and other miscellaneous items to help represent the main structures of the bacteria and virus. The emphasis of this exercise was to distinguish between the structure and function of viruses and bacteria.

Logarithmic growth of bacteria - The main comment from students after this activity was "Boy, I can't believe that ." To truly comprehend the exponential reproduction of bacteria is difficult for all of us. However, after the students computed their monthly salary beginning with a one penny a day doubled, they can relate to exponential growth when we discuss the "log phase" of bacterial reproduction when left in the temperature danger zone for too long.

Videos - Each one of the videos I used helped reinforce the material covered as stated in the certification coursebook or reinforced the material in a different context. The ServSafe videos viewed after each subsection of the book, reinforce the course's key points using the scenarios of common food service problems. The videos that I selected to supplement the ServSafe videos are explained earlier in this paper. These videos were all well received by students, most students' responses were of disgust and amazement.

Health inspection requests for Van Buren County food service operations, The Rest of the Story exercise - Students were required to write a letter requesting inspection results from area food service establishments. The students really enjoyed getting results from their establishments and then comparing them with other classmates. I made sure students did not duplicate requests so that we had a greater variety. One of the best points of this investigation is that the students can decipher the results and comprehend the severity of different violations. For example, one franchise operation had three minor violations of incorrect placement of waste dispensers, while another private

operation had one severe violation of not keeping their cooked chicken within the proper holding temperature.

Measuring pH of Common Foods - Students enjoyed watching red cabbage juice turn neon pink color whenever it indicated an acidic item. Their understanding of pH after this exercise expanded to the awareness of the range of pH in common food items, but I did not test them over the chemistry of pH. The common foods that are used as a preservative, such as relish or citrus juice helped reinforce the fact that a low pH is outside of the range that bacteria thrive and reproduce.

Michigan Department of Agriculture Sanitarian Guest Speaker - The students were most impressed with the salary of a sanitarian. Many students were interested in job shadowing with the sanitarian for a day. However, after investigating the matter, bureaucratic restrictions prevented the potentially valuable experience. Mr. Kay provided some "graphic" stories of poor sanitation practices and he made sure to list the important behaviors to exhibit during a facility inspection. After finishing, he complimented the students on how important the material was that they were learning and that they could make his job easier by training their fellow employees out in industry.

EVALUATION OF STUDENT RESULTS

The statistics presented in this study reflect the relationship between my trainees' success at certification and the format of sanitation training. I believe the results of the 3 ½ year study indicate that a relationship does exist. The sample of 1997 with the continuous five week training including all supplemental activities, has achieved the highest rate of certification success thus far.

The descriptive statistics of the mean score of each year's pre & post test results of the sample certification test (refer to Appendix C) have been calculated and represented in Table 2 below.

Table 2. PRE-TEST AND POST-TEST CUMULATIVE CLASS SAMPLE RESULTS

Class Sample N = number of students	Pre-test Mean (x)	Pre-test Standard Deviation (Sx)	Post-test Mean (x)	Post-test Standard Deviation (Sx)
1995 N=27	16.48	4.68	22.18	4.77
1996 N=45	19	5.82	27.9	5.78
1997 N= 43	17.88	5.52	31.60	5.49

The following pages include figures (Figures 1-3) that graphically depict the pre and post test scores for each year individually. The pre test and post test are samples of certification test questions from previous years. The National Restaurant Association's Educational Foundation has very strict regulations to secure their tests. Therefore, we can not administer an official certification test for pre and post test purposes, only a sample. The figures' graphic representations show how the range of the pre-test scores for each year were similar. However, as each year's training improved, the amount of students achieving scores of 80% (a score of 32) or above on the post-test increased. Reviewing the ranges of post-test scores, you can see how each year had more scores between 32 and 40 as the study progressed.

Figure 1 - 1997 Pre & Post Test Comparison

Figure 2 - 1996 Pre & Post Test Comparison

Figure 3 - 1995 Pre & Post Test Comparison

Figure 4 - Pre & Post Test Mean Score Representation

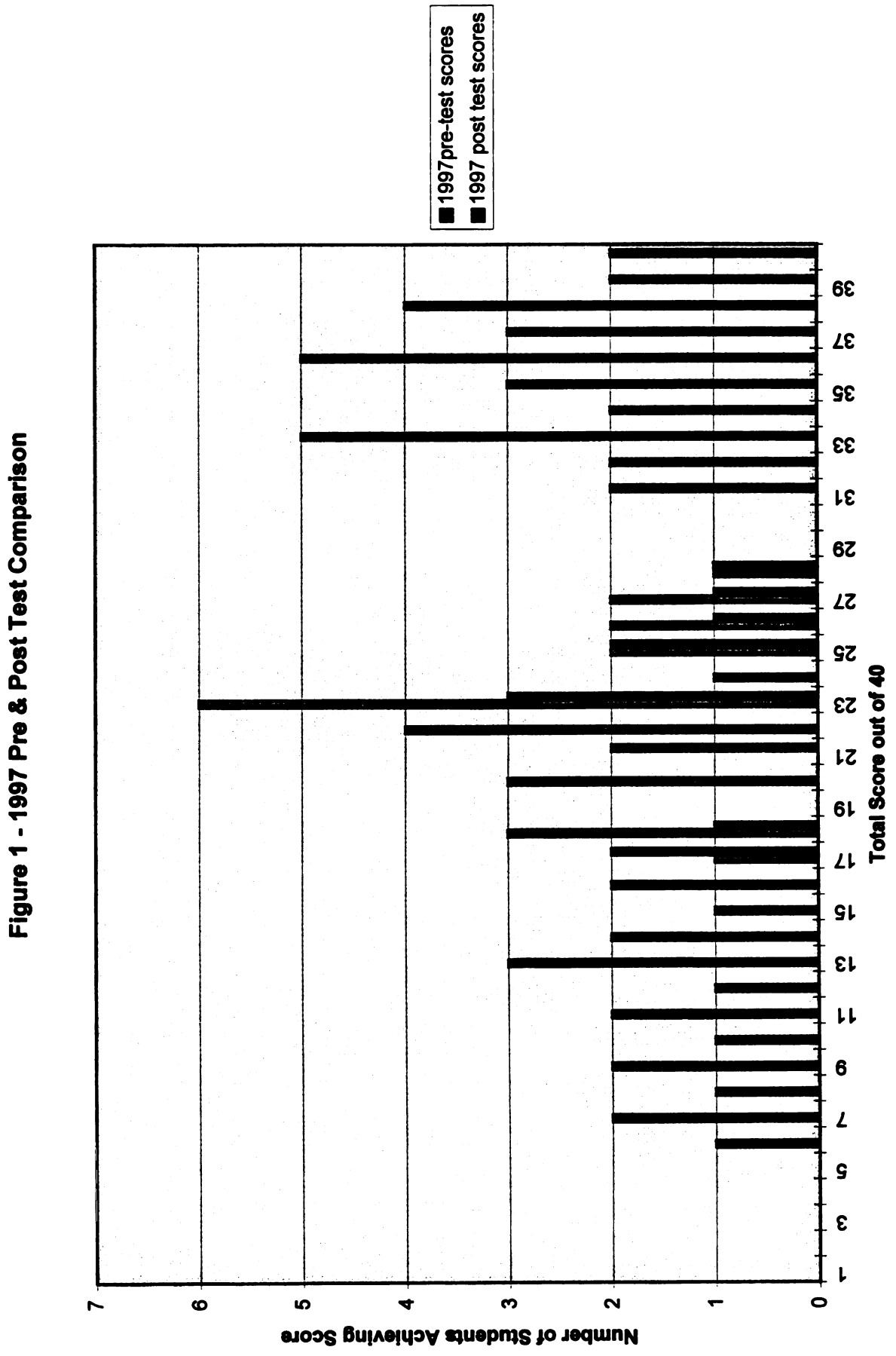


Figure 1 - 1997 Pre & Post Test Comparison

Figure 2 - 1996 Pre & Post Test Comparison

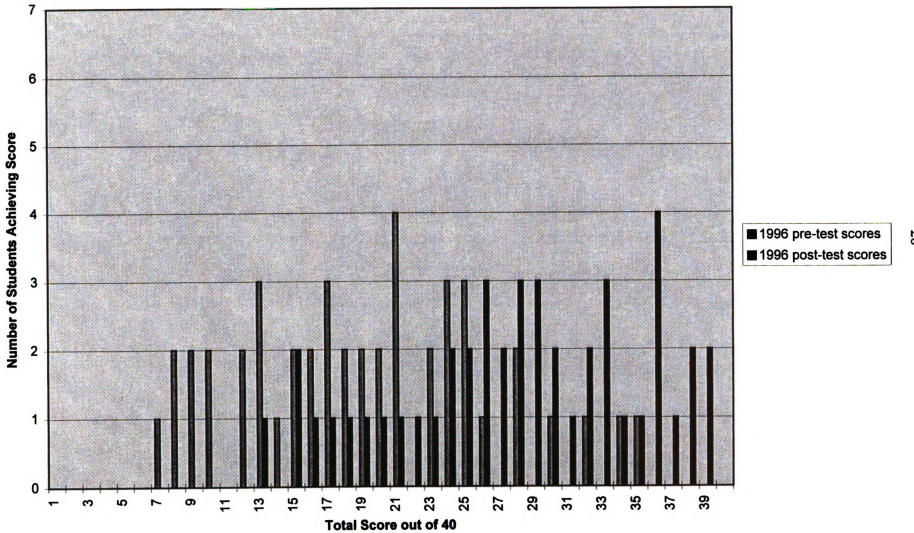


Figure 3 - 1995 Pre & Post Test Comparison

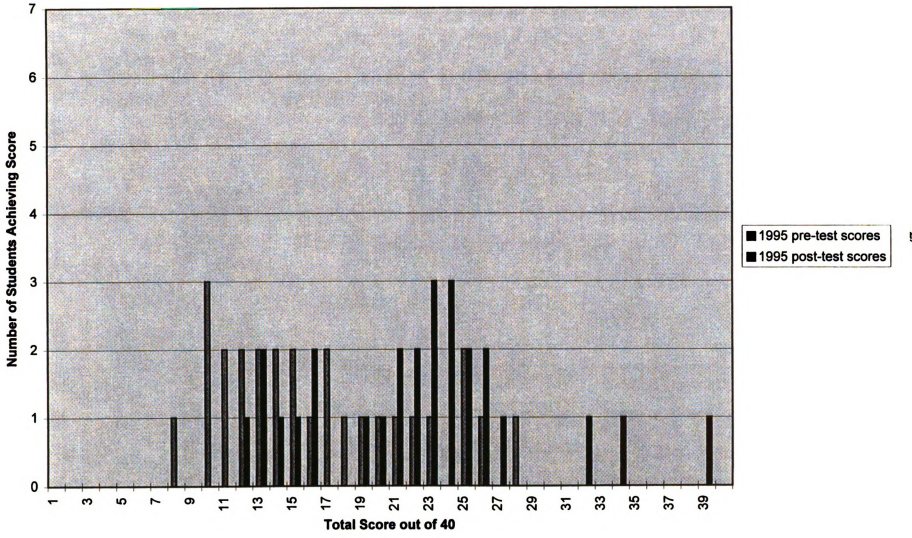
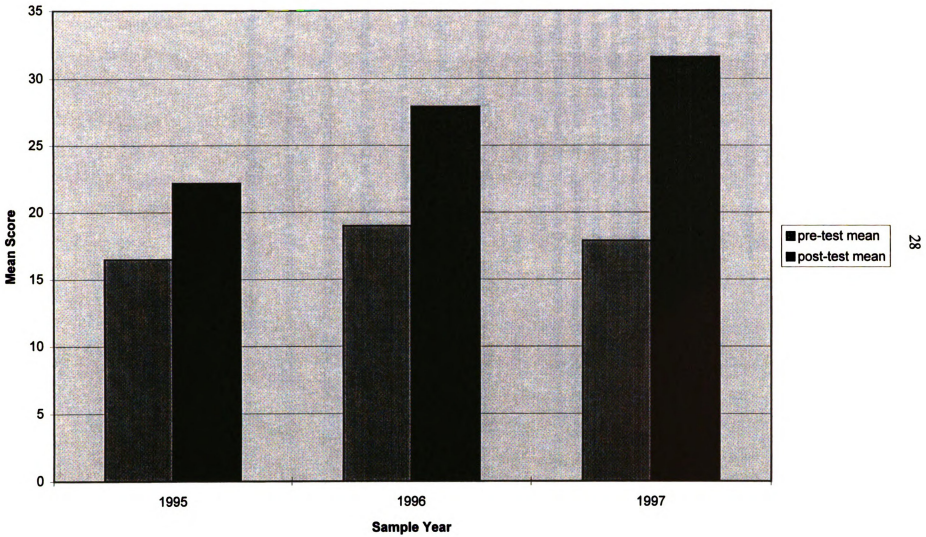


Figure 4 - Pre & Post test Mean Score Representation



I. Pre-test and Post-test Statistics

Students in the sanitation training from a given year improved their scores on the post test on the whole. The greatest improvement occurred in the 1997 sample (refer to Figure 1), reinforcing the statement made earlier.

I included the standard deviation in the previous table because,

> " the standard deviation indicates how broadly the scores in a distribution are spread one from another, the deviation of each score from the mean contributing its bit. Hence a class that is heterogeneous in ability will have a large standard deviation on the ability measure, whereas one that has been grouped by ability to reduce the differences among students will have a much smaller one.....and because the standard deviation is the average of the squared deviations, it is even more sensitive than the mean to extreme cases." (Krathwohl,1993)

As described earlier in the introduction, the majority of food service students are not highly talented in traditional academia, therefore these samples are fairly homogenous having a smaller standard deviation.

I completed a t-test (refer to Table 3 below) to examine the differences between the means of the pre and post tests. Since this is a relatively simple design involving a comparison of an experimental treatment such as a pre and post test, the t test tested the difference between the two means for statistical significance.

Table 3 - T-test Values for Each Year's Pre and Post Test Comparisons

Measurement	1994-1995	1995-1996	1996-1997
Pre - Test Mean	16.48	19	17.88
Post - Test Mean	22.18	27.9	31.6
T- test value	4.43	7.32	11.54

Clearly the students learned some material in each year of the training. A quick glance at the previous figures of individual scores (Figures 1-3) reflect that statement and the higher t values in comparing the pre and post test means from each year in Table 3 defend a similar conclusion. When the t-values are as high as the values in Table 3, one can conclude that there is enough statistical significance to reflect a difference from before and after the experimental treatment, i.e. sanitation training. The increasing value of each t-test throughout the 3 ½ year study reflects the increasing rate of student success. This also supports the conclusion that the students were able to comprehend and retain the material easier as I supplemented the original training with relevant activities and materials.

II. Discussion of the Attitudinal Survey

The results of the survey (refer to Appendix B) reflect the attitudes of the 1997 class about activities we did in class and how the training has changed their thinking.

Question 1. Doing the laboratories and activities helped me understand how bacteria survive and reproduce.
87% agreed.
13% neither agreed nor disagreed

Question 2. The activities and videos were a waste of time.
62% disagreed
20% agreed
18% neither agreed nor disagreed

Question 3. I enjoyed being able to practice what we learned in the kitchen
60% neither agreed nor disagreed
30% agreed
10% agreed

Question 4. I pay more attention to the food service establishment I am dining at now, than before I took this training.
68% agreed
15% strongly agreed
17% neither agreed nor disagreed

Question5. I wash my hands much more frequently and I believe it is important.
72% agreed
8% disagreed
20% neither agreed nor disagreed

Question 6. The videos helped reinforce the material presented in lecture and the book.
88% agreed
12% neither agreed nor disagreed

Question 7. I have used the information I've learned from class at home or at my worksite.
71% agreed
23% disagreed
6% neither agreed nor disagreed

Question 8. I most enjoy learning new ideas by reading about them and having classroom lectures.

54% disagreed
24% agreed
22% neither agreed nor disagreed

Overwhelming, each survey question received over 60% positive feedback, which is encouraging when deciding which activities should remain and how to design the training timeline. Many students agreed that the videos and activities were instrumental in helping reinforce concepts. Inspiring for the instructor is that they reported that their awareness of food safety improved outside the classroom, such as paying attention to dining facilities as well as washing their hands more frequently. Over half of the students disagreed about enjoying reading and lecture as means of learning new material, but at least most of their lecture and slide presentation time is discussed with reference to their daily jobs in the facility.

In the category of "neither agreed nor disagreed", the percentage of students ranges from 6% to as high as 22% depending on the statement. However, with regards to the questions that refer to helpfulness of the supplemental activities or the effectiveness of their results in changed behaviors, only a smaller percentage of students seem to not feel strongly one way or the other.

CONCLUSIONS

What Was Effective in ServSafe Training?

1. The change in the training time schedule for 1997 provided continuity to the whole curriculum and better retention by the students as shown by results of pre and post comparisons of prior knowledge survey and attitudinal survey (refer to Appendix B for both). Changing from once a week for the whole school year to a continuous five week training seminar added more professionalism to the training and may have emphasized how very important the vocational instructor views it as a job skill prior to co-op placement. Some of the aesthetic differences that we instituted added to the formality and professionalism of the training. Some examples were: organization of the dining room seats in a seminar format, water and mints available at each seat, training breaks with snacks provided, and use of technical equipment such as the VCR, overhead and LCD panel, rather than a blackboard like a regular classroom.

2. Administering the official certification test to qualifying students immediately after the training, added to the continuity and reinforced the value of the opportunity to attain free certification.

3. The curriculum content that I added seemed to be well received. Even though the training took more time, students impressions to demonstrations like the glo-germ would be permanent. After observing their cultures from swabs they did personally, the students also proved to themselves that microbes exist everywhere. The construction of the microbe models was valuable for students to better understand the differences in function as well as structure of the bacterium and virus. The videos created by ServSafe

were an excellent tool for reinforcement; and for students who are challenged in reading and listening to lecture.

4. Our guest speaker from the Michigan Department of Agriculture is definitely a sure spot in future training sessions. Not only did the students meet a sanitarian and hear his viewpoint and what he looks for, but they also were exposed to career options. Obviously with the barrage of career exploration programs in schools, this activity was very appropriate.

5. The annual field trip to the National Restaurant Association Annual Restaurant Show is a great way to wind down the year by reaffirming everything the students have been learning in sanitation and other foodservice areas. One of the big name chemical supply companies hosted a mock jeopardy game quizzing contestants about sanitation. Our students who participated won and received complimentary prizes like rubber cockroaches. Students also saw first hand that a lot of money is spent on chemical sanitizers and equipment in an operation.

What Needs Improvement in ServSafe Training?

1. Presently, these students do not receive a sanitation grade for the training, simply a participation and dependability score. Besides the fact that certification adds credibility to their resume and possibly saves time and money in college, some students may possibly improve their score and effort extended, if more grade weight was assigned to sanitation training. That is a formality that the vocational instructor and I are still working out. Since all vocational programs have integrated academic instructors working in their classrooms, many different credit systems have been devised.

2. The vocational instructor and I would like to see more student driven activities be created from this training. Since a few of the students remain in the program for a second year, we could use them as teacher assistants or have them create a training video for students on a specific component of food safety. The certified students could also help with students who are mentally challenged or students in the class who are attempting to earn a science credit substitution.

3. From the prior knowledge survey, (appendix B) the misconceptions that students have about microbes should be directly addressed and then a check for understanding may be more effective through personal interviews with students. Possibly extra time at the end of the training would allow for one on one interviews.

4. Obviously, we would like to see every student earn national certification, but the standards of the course need to be kept high and some students' reading and comprehension abilities are a stumbling block. The certification is also above and beyond what some of our students will ever require. For some of these students, I am planning a "watered down, basic" training course that ServSafe has designed for short employee training sessions.

Overall, I believe the training format is improving steadily with each new session. Considering the dynamics of two teachers learning to work together and familiarize themselves with new material and methods, that is a feat in itself. I believe the majority of the students were able to perform better in the last year of training due to the supplemental activities and the improved familiarity with the material by the instructor.

BIBLIOGRAPHY

Andrews, S. Microorganisms in Food - Their Significance and Methods of Enumeration, *SASTA Journal*, n802 (43-46).

Burkitt, D.P. Your Health in Your Hands. *School Science Review*. Dec, 1983 (264-269)

Cook, Charlotte. Assessment of a Foodservice Management Sanitation Course. *Journal of Environmental Health*. 41(5) (281-284)

Turning Up the Heat on E.coli 0157:H7. *Food Insight Reports*. Sep/Oct. 1994

Food Service Associates. *How to Implement a HACCP Food Safety System*. Food Service Associates, Dunkirk, NY 14048. (1994)

Food Science and You. Glencoe, Macmillan/McGraw-Hill. 1994

Gillen, Alan L. Why Do We Keep Catching the Common Cold. *American Biology Teacher* . 57(6) (336-342)

Interview with Business and Industry, What Do Employers Want? *Techniques Journal*. 97(5) (22-25)

Krajcik, Joseph S. A Collaborative Model for Helping Science Teachers Learn Project-based Instruction. *Elementary School Journal*. Dec. 1993

Krajcik, Joseph S. A Middle Grade Science Teacher's Emerging Understanding of Project-based Instruction. *Elementary School Journal*. Dec. 1993

Krathwohl, David R.. *Methods of Educational and Social Science Research, An Integrated Approach*. White Plains, N.Y: Longman Publishing Group. (1993)

Lambert, Lisa A.. Disease Detective: A Game Simulation of a Food Poisoning Investigation, *American Biology Teacher* , 51 (7) (429-432) 1989

The Educational Foundation. *Serving Safe Food, A Practical Approach to Food Safety, Certification Coursebook*. Chicago, IL: The Educational Foundation of the National Restaurant Association. (1994)

The Educational Foundation. *Applied FoodService Sanitation, A Certification Coursebook*. Chicago, IL: The Educational Foundation of the National Restaurant Association. (1992)

USDA (1996). *Food Safety for Persons with AIDS*. Food Safety and Inspection Service, Consumer Publications. Http://www.usda.gov/agency/fsis/aids.htm, January, 1997.

USDA (1994). *Focus On: Cutting Board Safety.* Food Safety and Inspection Service, Consumer Publications. Http://www.usda.gov/agency/fsis/cutboard.htm, January 1997.

USDA (1994). *Focus On: Safe Food To Go.* Food Safety and Inspection Service, Consumer Publications. Http://www.usda.gov/agency/fsis/foodtogo.htm, January, 1997.

USDA (1996). *Focus On: Ground Beef, 20 Questions.* Food Safety and Inspection Service, Consumer Publications. Http://www.usda.gov/agency/fsis/beef20.htm, January, 1997.

USDA (1994). *Focus On: Summer Food Handling.* Food Safety and Inspection Service, Consumer Publications. Http://www.usda.gov/agency/fsis/sumrfood.htm, January, 1997.

USDA (1996). *The Big Thaw- Safe Defrosting Methods.* Food Safety and Inspection Service, Consumer Publications. Http://www.usda.gov/agency/fsis/bigthaw.htm, January, 1997.

USDA (1995). *Food and Water Borne Bacterial Diseases, Botulism.* Centers for Disease Control and Prevention.
Http://www.cdc.gov/ncidod/diseases/foodborn/botulism.htm, January, 1997.

Robbins, Marsha. Sanitation Doesn't Cost. It Pays! It is True and Can We Prove It. *Journal of Environmental Health.* Dec 1994 (14-20).

We say we wash our hands after using bathroom, but many don't. *Associated Press.* Oct 1996

APPENDICES

APPENDIX A

Glow germ demonstration

Background Information:
Glo-germ is a florescent liquid that you can apply to any surface, and is non-toxic and non-staining. The liquid will fluoresce under ultra-violet light. This feature is great for tracking the spread of the liquid through a population or room for instructional purposes. By applying the glo-germ liquid on a surface that will be touched by someone else, the glo-germ can be spread if adequate contact and transfer was possible. Be sure the ultra-violet light is not directed towards people's eyes or avoid having people look into the light.
If eye protection is available, it is a valuable lesson to show how we make hand contact on our face frequently and unknowingly. Our face, nasal passages, eye area are obvious places for transmission of germs.

Materials needed:
glo-germ (available from Fisher-Scientific)
ultraviolet light
items or hands to apply glo-germ

Procedures:
1. Apply glo-germ generously on hands or item to be the contamination source.
2. Be sure it is an adequate application, but the orange color should not be too obvious.
3. Continue the normal procedures for the day, making sure contact is made with the contaminated source.
4. Reveal any contamination by exposing item or hands under ultra-violet light.

The Hazards Among Us

Exercise adapted from Food Science and You
By Susie MacArthur

The biological hazards (bacteria, viruses, molds, fungus) are all around us, on the tabletop, in the air, on your hands and on the water fountain. If you don't believe in what you can't see, then just do this exercise to prove it to yourself. Although single microorganisms are not visible, colonies of microorganisms, called cultures can be seen. Cultures are grown in the laboratory on a gelatin-like substance called nutrient agar, which is made to promote microbial growth. In this experiment, you will have the chance to discover just how widespread microorganisms really are.

PROCEDURE:

1. On the bottom of each petri dish with nutrient agar and the one without, use a wax pencil to draw a line to divide the dish in quarters, mark each quarter 1-4.
2. Using the procedure outline in steps 3-7 below, test three surfaces of your choice. Use the same three surfaces for each dish.
3. For each sample surface, obtain a sterile swab from your teacher. Be sure to hold the wooden handle, do not touch the swab end.
4. Swipe the surface of your choice with the cotton end, quickly lift the top of your petri dish and rub your "contaminated swab" in a zig-zag motion on one quadrant of the dish.
5. In your data table record the source from which you took the sample and the number of the area in the dish in which you put it.
6. Repeat step 3,4,5 for the other surfaces, putting the other sample in the other quadrants of the dish.
7. As a control, obtain a fourth swab and touch it to the agar without letting the end that touches the agar touch any other surface, including your fingers. Repeat step 5.
8. Incubate the dish at room temperature for three or four days in the place designated by your teacher.
9. Observe your growing cultures daily. Describe in your data table any growths that have appeared on the agar.

The Hazards Among Us

Surface tested	Area number	Agar Day 1	Agar Day 2	Agar Day 3	Agar Day 4

Conclusion Questions:

1. Was the swab itself free of microorganisms?

2. Were any of the surfaces tested free of microorganisms? Which ones?

3. Which surface produced the most bacterial growth? Why do you think this occurred?

4. How can you minimize the likelihood of food poisoning?

Teacher's Guide
Making sense of FATTOM (Food, Alkalinity, Time, Temperature, Oxygen and Moisture)

Exercise adapted from Food Science and You
Adapted by Susie MacArthur

Teacher's Note: This form is similar to the earlier laboratory exercise for growing cultures. The procedures are the same, once a student determines what variable they are testing and how they will test for it. The student's form provides space for the student to add procedures and rationale for their procedure. Students will be able to fill out their form, once you help them through in a class discussion and give them an example of one biological variable, such as food.

Student Directions: The hazards (bacteria, viruses, molds, fungus) are all around us, you proved it by taking swabs and culturing your own sample of them. We've been discussing about the factors bacteria need to grow, the factors needed for bacterial growth can best be remembered by using the acronym, FATTOM. Now let's put our acronym to the test and see just what it takes for bacteria to survive. In the procedures below, you need to fill in the missing procedures, this will make your lab exercise authentic to you. You need to test for time and temperature, moisture, food and acidity. Each variable has its own set of procedures, so try to set up your own exercise. The first one is completed for you to help you get started:

PROCEDURE:
TESTING for "F" in FATTOM (food):

1. Ask yourself the first question, what role does food play in survival for bacteria, do they need a specific type of food? Yes, bacteria need food that is moist and rich in protein. Food items such as meats, poultry, cooked veggies and rice, tofu and beans. I could use one completely empty petri dish and one dish filled with nutrient agar, which is rich in protein.
2. On the bottom of each petri dish with agar and the one without, use a wax pencil to draw a line to divide the dish in quarters, mark each quarter 1-4.
3. Using the procedure outline in steps 3-7 below, test three surfaces of your choice. Use the same three surfaces for each dish.
4. For each sample surface, obtain a sterile swab from your teacher, be sure to hold the wooden handle, do not touch the swab end.
5. Swipe the surface of your choice with the cotton end, quickly lift the top of your petri dish and rub your "contaminated swab" in a zig-zag motion on one quadrant of the dish.
6. In your data table record the source from which you took the sample and the number of the area in the dish in which you put it.
7. Repeat step 3,4,5 for the other surfaces, putting the other sample in the other quadrants of the dish.

8. As a control, obtain a fourth swab and touch it to the agar without letting the end that touches the agar touch any other surface, including your fingers. Repeat step 5.
9. Incubate the dish at room temperature for three or four days in the place designated by your teacher.
10. Observe your growing cultures daily. Describe in your data table any growths that have appeared on the agar.
11. Be sure to include the variable you are testing for in your data table. See below.

Surface tested	Area number	Agar Day 1	Agar Day 2	Agar Day 3	Agar Day 4

Observing Bacteria Under the Microscope

Purpose:
Given prepared slides of common foodborne illness specimens, students will observe the specimen with an oil immersion lens to become familiar with the specimens.

Materials needed:
Microscope with 100X objective
prepared slides of food pathogens (provided by teacher)
oil
pencil

Procedures:
1. Place your slide on the microscope stage and begin the process of focusing using the 10X objective first.
2. Before using the 100X objective, be sure to deposit one drop of immersion oil on the center of the prepared slide.
3. Once you achieve a focused image, sketch each specimen you observe below, be sure to include the name of the specimen and the magnification used for sketch.

Sketches:

.....The Rest of the Story

Since you have been studying food sanitation, you should understand the importance of food safety and following the health guidelines. Your assignment is find out the rest of the story by contacting the local environmental health department and requesting a copy of the last 3 years' inspections for any two restaurants in the county. Of the two restaurants, pick your favorite, maybe one that you think would do poorly and possibly one that you believe would work up to health standards. A sample letter is provided for you.

Date

Van Buren County Environmental Health Department
Food Service Establishment Inspections
address
city, state zip code

Dear Sir:

State why you are writing this letter.
State what you would like to request from their office.
Be sure to include the full name of each food service establishment and the address.
Include a return address of the center with your name.
End with an acknowledgement of their time in attending to your request.(i.e. Thank you)

Sincerely,

Your name

Logarithmic reproduction of bacteria

Trying to imagine the exponential growth of bacteria during the log phase of growth can be difficult for all of us. To make it more meaningful to you, let's put it another way: what if I said that a new pay schedule was going to be offered to employees who were willing and who practiced and modeled proper food safety work habits during hours of employment for the next month. The two options to choose from would be the following:

1. Accept an hourly wage of minimum wage, with each day the opportunity for a 10 cent /hour raise if you have excellent work reviews previous days.
2. Accept 1 penny for the first day's wage. Each day thereafter, you double your wage each day from the previous day if good reviews were established from the previous day.

Assuming all of you would earn excellent ratings each day due to your experience and knowledge in food safety, calculate your first month's salary for each pay option.

Working Day	Salary Option #1	Salary Option #2
1st		
2nd		
3rd		
4th		
5th		
6th		
7th		
8th		
9th		
10th		
11th		
12th		
13th		
14th		
15th		
16th		
17th		
18th		

19th		
20th		
21st		
22nd		
23rd		
24th		
25th		
26th		
27th		
28th		
29th		
30th		
Total salary		

Students will be amazed at the results of salary option #2, it will result in over $10 million dollars/day by the 31st day of work.

The pH of Common Foods

Objective:
Students will measure the pH of various food samples with red cabbage juice and pH indicator paper.

Materials Needed:
13 test tubes
test tube rack
disposable 10 ml pipettes
pH paper
red cabbage juice sample bottle
food samples

Procedures:
1. Gather and number with a wax pencil, 13 test tubes, 1-13.
2. Pipette 5ml of a food sample into a numbered test tube. Record the type of food and the test tube # on your data sheet
3. Record the pH of each food sample with indicator paper first
4. Record whether a food sample is acidic based on the red cabbage juice test. Add 5 ml of juice into each food sample.

Test tube #	Food sample	Assumed pH	pH paper results	Red Cabbage juice results
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				

Conclusion questions:

1. What made you decide/assume if a food was acidic or basic, the smell, the taste, the look?
2. What types of food had the highest acidity?
3. What is the pH scale range?
4. What range can bacteria grow best at?

APPENDIX B

Introductory Microbiology Prior Knowledge Survey

Please answer the following questions to the best of your knowledge. You will not be graded on your accuracy, but rather for your full participation. I will be using this information to customize sanitation training. Thank you.

Student: _____

1. List all the types of microorganisms you know (germs)

2. What does bacteria look like

3. Where can you find bacteria

4. What do bacteria need to grow

5. What is a virus

6. How can certain types of bacteria be hazardous to public health

7. How can food be contaminated with bacteria

8. Why is it important to wash your hands before handling food?

ATTITUDINAL QUESTIONNAIRE

Please answer the following statements by circling one number on the 1-5 continuum:
1 - strongly disagree
2 - disagree
3 - no opinion
4 - agree
5 - strongly agree
Also, please feel free to comment following each statement to clarify or expand on your opinion.

1. Doing the laboratories and activities helped me understand how bacteria survive and reproduce.

   1 2 3 4 5

---

2. The activities and videos were a waste of time.

   1 2 3 4 5

---

3. I enjoyed being able to practice what we learned in the kitchen.

   1 2 3 4 5

---

4. I pay more attention to the food service establishment I am patronizing more than before I took this training.

   1 2 3 4 5

---

5. I wash my hands much more frequently and I believe it is important.

   1 2 3 4 5

---

6. The videos helped reinforce the material presented in lecture and the book.

1 2 3 4 5

---

7. I have used the information I've learned from class at home or at my worksite.

1 2 3 4 5

---

8. I most enjoy learning new ideas by reading about them and having classroom lectures.

1 2 3 4 5

RESULTS OF INTRODUCTORY MICROBIOLOGY PRIOR KNOWLEDGE SURVEY
1996-97 Class

List all the types of microorganisms you know (germs)

Over 85% of the students listed bacteria as one of the germs they know. However a small percentage will list other pathogens as viruses, molds yeast or fungus

What does bacteria look like

Practically all students do well enough to draw a blob or some concentric shape. However, few show the flagellum or are detailed enough to draw the 3 basic shapes of bacteria, cocci, bacilli, and spirilli

Where can you find bacteria

Only a handful of students listed "practically everywhere". Most students listed items such as dirty places, bathrooms, dirt, moldy showers, sinks, rotten food, stinky garbage, toilets, showers, feet, armpits

What do bacteria need to grow

Food was the most popular answer. No student was clear enough to list what type of food. Roughly, 30% of the students interviewed also listed moisture/water as a need for survival or warmth.

What is a virus

At least 85% of the students answered a bug that can make you sick. Only 5% were closer to the actual explanation of its structure containing genetic material that requires a host for infection and reproduction.

How can certain types of bacteria be hazardous to public health

They can infect you and make you sick, this was the overwhelming response. No students knew about the 2 different types of bacterial attacks either infectious, intoxicating or both.

How can food be contaminated with bacteria

Food can get old and moldy, if someone coughs on it, if someone does not wash their hands after going to the bathroom

Why is it important to wash your hands before handling food?

So you don't get any nasty germs in your food was the overwhelming response. No student could actually describe how the bacteria could possibly survive if given the right temperatures and time and then multiply to make someone sick or create toxins to create an illness

What are the hazards that you need to watch for in food preparation

Washing your hands, using clean utensils, cooking food properly, using food of good quality to begin with

APPENDIX C

Practice Exam

You are the manager of a food service establishment in which egg salad is implicated in an outbreak of foodborne illness. Investigators discover that the source of contamination was a foodhandler with two cuts on his hands. Which of the following is your best course of action to prevent a similar outbreak?

You require all employees to be treated with antibiotics to reduce the possibility of infection.

You tell foodhandlers to bandage all cuts and to wear disposable plastic gloves over the bandage when preparing foods.

You purchase eggs only from approved, reputable suppliers who provide refrigerated delivery.

You exclude egg salad and all other offerings containing eggs from your menu.

Which one of the following procedures is the most important in the control of Clostridium perfringens?

Thoroughly wash vegetables that will be used in soups and stews.

Do not thaw frozen meats at room temperature.

Supervise the personal hygiene habits of all employees.

Prevent bacterial growth in cooked foods through proper chilling, holding, reheating.

Which one of the following best guards against cross-contamination?

Separate cutting boards for cooked and raw foods.

The time and temperature principle

An integrated pest management (IPM) program.

The exclusion of infected employees from food preparation duties.

In maintaining program of good personal hygiene, management's most important responsibility is to:

provide hand soap at all sinks.

set an example for all employees to follow.

yell at any employees who do not follow the rules.

provide a designated break area for employees.

Which of the following describes the proper way to dry hands after they have been washed?

Dry the hands thoroughly with a hot-air dryer or single-service towel.

Dry the hands by wiping them vigorously on an apron or handkerchief.

Dry them with a cloth towel that is kept in the restrooms.

Wave hands briskly back and forth to air dry them.

The initials HACCP stand for:
- Hazard Assessment Critical Control Procedures.
- Hazard Assessment Crisis Control Point.
- Hazard Analysis Critical Control Point.
- Hazard Analysis Critical Control Procedures.

A risk is the probability that:
- spoilage will occur.
- a condition will lead to a hazard.
- the flow of foods will stop.
- a critical control point will fail.

For which one of the following foods would it be the most important for you to design a flowchart?
- Fruit salad with raspberry vinaigrette dressing.
- Hot cheese puffs.
- Cream of broccoli soup.
- Peppermints.

A critical control point is an operation by which:
- monitoring considered unnecessary.
- Hazards can be eliminated, minimized, or prevented.
- Contamination becomes certain.
- All risk can be completely eliminated.

Which one of the following is a step used in setting up a HACCP system?
- Developing control procedures and standards for critical control points.
- Taking disciplinary actions if there is a break from procedures.
- Developing a flowchart for all foods received in the operation.
- Eliminating contamination completely during preparation.

Which one of the following is an example of a critical control point that an operation has established?
- A menu item has been removed because it is too difficult for the operation to prepare.
- A recipe reads, "Bake casserole in a 325 F(161 C) oven until the center of the food reaches 165 F (73.9 C)."
- A manager has devised a corrective procedure upon learning that the previous procedure is not working.
- A system of supervisory spot-checks of temperatures and a written log has been set up.

Which one of the following is an example of how an operation might monitor its critical control points?

By making sure that no contaminated food is ever received in the operation.
By observing its sources of supply, its equipment, and its employees to determine which items should be on the menu.
By supplying specific directions for the cleaning and sanitizing of all utensils used.
By using a written log to compare the operation's actual performance against the established standards.

You discover that your chef has been preparing all of the turkey breasts at one time, which exceeds your time and temperature requirements. Which one of the following is a proper corrective action?

You tell your chef to do a flowchart of the preparation steps.
You tell your chef to speed up the process.
You tell your chef to prepare the turkey breasts in small batches.
You tell your chef to leave the turkey breasts for you to prepare.

The Time Temperature Indicator (TTI) is frequently used to:

measure temperatures of incoming dairy products.
measure the temperature of hot foods during preparation.
monitor temperatures of modified atmosphere packaged foods during transportation.
monitor the temperature of candy to achieve the proper texture.

USDA grades on meat products provide information concerning the:

absence of disease-causing organisms.
sanitary condition of the meat.
wholesomeness of the meat.
quality or palatability of the meat.

The presence of large ice crystals in a frozen food product often indicates that the product has undergone which of the following:

cook-chill.
blast chilling.
flash freezing.
freezing.

While preparing the evening meal, you discover the liquid in one of the cans o f tomatoes that you have opened is foamy. You should:

sample the tomatoes to see if they taste sour.
throw away the can of tomatoes.
smell the tomatoes and if there is no odor, cook them to 165 F (73.9 C).
chill the tomatoes below 40 F(4.4 C) before cooking them.

Which of the following is the first step in implementing the FIFO rule?
Date food supplies as they are received.
Place new deliveries in front of previous deliveries.
Do not keep food past the expiration or use-by-date.
Keep all foods in original packages.

The time and temperature principle, a primary rule of food protection, requires that potentially hazardous foods must be:
served within four hours at a temperature of 120 F(48.9 C).
frozen at 0 F(-17.8 C) until one hour before preparation and service.
only exposed to temperatures between 40 to 140 F for a total of six hours during transport, storage, handling, preparation, display, and service.
only exposed to temperatures between 40 to 140 F for a total of four hours during transport, storage, handling, preparation, display, and service.

When using a microwave oven for thawing, you must:
thaw only large food items.
refrigerate the food immediately after it is thawed.
cook the food immediately.
cut the food into smaller portions before thawing it.

Without any interruption of the cooking process, poultry, stuffed meat, and the stuffing should be cooked to a minimum internal temperature of:
140 F (60 C).
150 F (65.6 C).
165 F (73.9 C)
170 F (76.7 C)

You have determined that your employees and facilities can maintain a clean and sanitary food bar. Which of the following practices encourages a sanitary food bar?
Employees handing out fresh plates for return visits by customers.
Strongly worded signs for the customers about their behavior.
Providing a hand wash sink for customers.
Employees assigned to follow customers through the food bar.

Which of the following is the correct method for a server to hold a plate being presented to a guest?
The server should put his or her fingers on the top of the plate and his or her thumb on the bottom.
The server should never make any hand contact with any part of the guest's plate.
The server should hold the edge or the bottom of the plate.
The server should hold the plate in the palm of one hand and keep it in place by pressing on it with the other hand.

Which one of the following materials is acceptable for use on floors in food-preparation areas?

Ceramic tile.
Quarry tile.
Carpet.
Unsealed concrete.

When coving is installed at the joint where a wall and a floor meet:

the installation and maintenance of equipment is easier.
sharp corners or gaps that would be uncleanable are eliminated.
the gap formed must be between ½ and ¾ of an inch.
entry for pests is effectively denied.

An effective food service ventilation system:

removes smoke, steam, and exhaust and replaced them with clean air.
is a central air conditioning unit.
creates a strong air draft to flow through the establishment to eliminate smoke and exhaust.
takes in new air through the use of open windows and doors.

An important rule for kitchen cleaning requires the cleaning and sanitizing of utensils, equipment, and food-contact surfaces:

once a day, usually when beginning operations.
twice a day, once before opening and once after closing.
after each use or at regularly scheduled intervals when in constant use.
whenever employees decide it is necessary.

Effective cleaning requires a suitable cleaning agent that is applied for an adequate length of time with sufficient:

wetting agents.
drying agents.
acid or alkaline cleansers.
agitation or pressure.

Which of the following is not acceptable for chemical sanitizing on a food-contact surface?

Quaternary ammonium.
Iodine.
Scented bleach.
Detergent sanitizer.

What is the proper way to dry tableware and equipment after cleaning and sanitizing?
Air drying.
Using a cloth towel.
Using disposable paper towels.
Putting it under an air vent.

Which of the following is information that needs to be supplied on a Material Safety Data Sheet (MSDS)?
The necessary training to implement for employees using the product.
The type of label that should be on the container.
The physical hazards of the product.
Where in the establishment the product is to be used and stored.

The definition of integrated pest management(IPM) is a system of:
control methods to fight pests after an infestation is established.
preventive methods to stop pests from entering the facility.
methods that combine preventive and control steps to reduce pest infestations and keep pests from entering a facility.
applying chemicals to get rid of pests.

Which of the following is a preventive practice in an IPM program?
Store pesticides in your facility.
Keep all food and supplies at least six inches off the floor.
Store all recyclables close to the establishments.
Clean up food and beverage spills at the end of each day.

A fly is capable of transmitting disease to human beings primarily because it:
carries disease-causing fleas on its feet and wings.
carries bacteria on its body from human and animal waste.
thrives in places commonly favored by humans.
lays millions of eggs that hatch and mature quickly.

The presence of rats in an operation can be detected by:
the presence of mice.
a strong, oily odor.
gnaw marks and holes along the foundation.
maggots in garbage cans.

In order to market sanitaion both internally and externally, management must address the:
kitchen and the dining room employees only.
regulatory agencies and the media
employees and the public
local and national television and radio stations

The microorganisms of greatest concern to the food service manager are:
- parasites.
- molds.
- viruses.
- bacteria.

Which of the following is an important guideline for freezer storage?
- Foods should be packaged tightly into the freezer.
- Freezer temperatures should be maintained at 32 F (0 C).
- Freezer temperatures should be maintained at 0 F (-17.8 C).
- Frozen food inventories do not need to be marked with a date of entry.

A foodborne intoxication results when food contains:
- toxins produced by micro-organisms.
- parasites.
- living micro-organisms in food.
- pieces of broken glass.

Staphylococcal intoxication is usually characterized by the symptoms of:
- nausea, vomiting, diarrhea, and dehydration.
- headache, double vision, and difficulty breathing.
- diarrhea, abdominal cramps, and chills.
- high fever, fatigue, and jaundice.

In recent years, the potential for food contamination has been increased by:
- multiple handling of food all along the chain of supply, from production to final customer.
- desire of customers to experiment with thoroughly cooked foods.
- decrease of overall quality of foods in the United States.
- lack of federal, state and local government regulations of food products.

Which of the following is an example of a disease-causing parasite?
- Campylobacter jejuni.
- Salmonella enteritidus.
- Clostridium perfringens.
- Trichinella spiralis.

Food that contains molds that are not a natural part of the item should be:
- frozen.
- discarded.
- saved, since the food is acceptable after the mold is scraped off the surface.
- cooked to 165 F (73.9 C) for 10 minutes.

An example of a biological hazard to safe food is a:
foodhandler sneezing on food.
chip of glass that falls into food.
cleaning agent that is added to food accidentally.
pesticide that come into contact with food.

A foodborne infection results from eating:
toxins that are present in food.
molds that grow on cheeses.
food that contains harmful micro-organisms that are dead.
food that contains live, harmful micro-organisms.

A foodborne intoxication results when food contains:
toxins produced by micro-organisms.
parasites.
living micro-organisms in food.
pieces of broken glass.

APPENDIX D

Student Consent Letter
September 1996

Dear Hospitality and Foods Student:

As part of my graduate program through Michigan State University, I am required to teach a unit and record the results. Since I will be working with you for the year in food sanitation, I have chosen to study the effectiveness of our training together. I will be taking observations and data from your reactions and results of various activities we do throughout the training. Your identity will be kept confidential and only the results of your tests will be recorded. Please sign your name at the appropriate line below.

Thank you for your cooperation.

I give Mrs. MacArthur permission to use my results in her study for Michigan State University.

Student
Signature_____

I do not give Mrs. MacArthur permission to use my results in her study for Michigan State University.

Student
Signature_____