Attending the Educators' Science and Math Institute Series (ESMIS) program upon completion of my student teaching experience proved to be an invaluable experience. By sharing teaching ideas with other educators and developing my context area I returned to my classroom inspired with new activities. In an effort to make learning meaningful and interesting I wanted to incorporate an area of study that was always intriguing to me. Even though this unit is geared towards the middle school level, it could easily be adapted for any level.

The objective of this unit is to educate students about diseases and the agents causing those diseases in order to become a less-friendly "host". Informed hosts are better prepared for the attacking agents of disease. (Note I am using the term "host" loosely.) After looking at general facts and examples students should realize the wide variety of organisms our immune system works to protect us from. This broad topic is broken down into three categories with examples: bacteria, viruses, and flatworms.

Evaluation is an important tool for monitoring progress in any educational setting; therefore, three means of evaluation were used. Students completed an evaluation of personal beliefs and opinions regarding science (provided by ESMIS) before and after the unit. An alternative method of evaluation, the KWL chart, was used to informally measure student's knowledge before and after the unit. Also, the traditional method of testing students was used to evaluate knowledge and understanding.

Lesson Plans

Day One

10 minutes
ESMIS Evaluation of attitudes and beliefs towards science.

10 minutes
KWL Chart - filling in only the "Know" and "Want to know" blocks, leaving the "Learned" block blank until after the unit.

Less than 5 minutes
Students wrote detailed descriptions how they wash their hands (water temperature, how long, how thoroughly, how often). Students predicted what, if any variables made a difference in how germ-free their hands were after washing.

15-20 minutes
Demonstration (taken from website www.fightbac.org)

Materials: Cooking oil, Cinnamon, Measuring spoons (teaspoon, tablespoon), Accessible sink to wash hands, and Volunteers.

Procedure: 1) Volunteers rub 1 tablespoon of cooking oil over hands until completely coated. 2) Sprinkle 1 teaspoon of cinnamon on hands and evenly distribute it by rubbing it around. The cinnamon, just like bacteria, will be all over the hands! 3) Wash hands for 20 seconds by rubbing briskly. Volunteers should wash as instructed for optimal comparison. Change the combination of variables for each volunteer - temperature (hot or cold) and soap (used or not). For example: Student #1 washes with cold water and no soap; Student #2 warm water and no soap; Student #3 cold water and soap; Student #4 warm water and soap. 4) Observe the hand-washing methods and record the results.

Less than 5 minutes
Students conclude by answering the following questions: Which method removed the most `bacteria' and the least `bacteria'? Analyze your own method of washing to conclude how effective you are at reducing germs.
5-10 minutes
Discuss, based on answering questions about the demonstration and the KWL chart. Discuss the role of bacteria as “germs”.

• **Homework:** Hunt 2-3 bacteria found in food or other products. List the bacteria (from labels) and state the sources. Also create a “top ten” list of where you host germs in your home with #1 being the best place to find germs.

**Day Two**

10 minutes
Briefly share and discuss homework in class, listing responses on the overhead.

20-30 minutes
Bacteria (Kingdom Monera or Prokaryota) - Chapter 5 in text.

1) General facts about bacteria: tiny unicellular organisms, lack a nucleus and other cell structures, most numerous organisms, come in varied shapes, colors, sizes, and growth patterns.

2) Describe the structure: cell wall, cell membrane, cytoplasm, no nucleus, optional flagella and possible capsule. Sketch and label in notes.

3) Life functions: Oxygen requirements vary - may be necessary or may be fatal upon exposure. Energy mechanisms vary - may be heterotrophs (parasites, decomposers); autotrophs (sunlight, iron); endospores (unfavorable conditions).

5-15 minutes
Diagram a web (concept map) to review concepts and terminology

• **Homework:** Reading and questions in text (p. 137-140).

**Day Three**

20-30 minutes

4) Bacteria in nature: Essential part of food and energy relationships; Oxygen production; Changing environments; Symbiotic relationships.

5) Bacteria and humans: Helpful in producing food, fuel, medicines, other products; Harmful in spoiled food, contaminated water, infectious diseases; Prevention includes pasteurization, antibiotics.

6) Characteristics of organisms, “good” and “bad” bacteria and where to find some examples: *Lactobacillus acidophilus* in yogurt; *Eschericia coli* in feces and contaminated foods (meat); *Mycobacterium bovis* or *M. tuberculosis* in lungs of infected individuals.

15 minutes
Discuss *E.coli*, referencing the article about food poisoning from TIME magazine and reading relevant parts of the article. Often, due to negative publicity, positive affects of certain bacteria are forgotten. Looking at the negative and positive affects of *E.coli* for example promotes a realistic appreciation for these tiny yet influential creatures.

5 minutes
Summarize by adding new information to yesterday's web.

• **Homework:** Reading and questions in text (p. 147 1-3).

**Day Four**

50 minutes
Take a virtual trip to the “Microbe Zoo” (see website). Certain criteria were outlined for the students and specific questions were assigned for students to answer. Students were required to summarize three of the five locations, which included the animal pavilion, snack bar, space adventure, dirt land, and water world. Students also named and described at least five microbes they encountered, focusing on bacteria
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(for the assignment). Discussion in class followed.

- **Homework:** Start bacteria “wanted” poster or brochure

Day Five

**15 minutes**

Tuberculosis (TB) is caused when bacteria attack the respiratory system. There are three types of TB based on the species that are specifically infected by and able to transmit TB (human, bovine, and avian). Because of this, humans rarely contract bovine or avian tuberculosis. Read and discuss Bovine Tuberculosis in Michigan pamphlet, which conveniently applied to the upcoming hunting season.

Recent cases of Tuberculosis happened to be reported in the local news after a few students in nearby schools tested positive for TB.

**30-35 minutes**

Library for research and reference on bacteria

- **Homework:** Continue working on wanted poster or brochure.

Day Six

**50 minutes**

**Lab Activity: YUCK! WHAT ARE THOSE BACTERIA DOING IN MY YOGURT?** (Taken from Exploring Life Science. Prentice Hall.) Students will test the pH of various substances and relate pH to the role of Lactobacillus in yogurt.

**Materials** (for one group): 50 mL milk, 10 mL diluted chocolate syrup, 10 mL lemon juice, 10 mL tea, 10 mL vinegar, 10 mL water, pH paper, 5 paper cups, graduated cylinder, 5 spoons.

**Pre-Lab Discussion:** 1) What is pH? 2) What is an acid? List examples. 3) What is a base? List examples. 4) What is the pH scale? What is the significance of the number 7 on the scale? Following the procedure on pages 794-795 of the text, each group gathers data and each student answers the lab questions in notebook.

**Procedure:** 1) Students in each group have roles assigned such as Recorder, Materials, Clean-up, Instructions, or Tester. 2) Prepare a data table in notes, listing horizontally “Liquid, pH Before, Observations, pH After” and listing vertically “Chocolate, Lemon, Tea, Vinegar, Water”. 3) Label paper cups with Chocolate, Lemon, Tea, Vinegar, Water. Pour the appropriate liquid (10 mL) into each cup. 4) Test the pH of each liquid by dipping the pH strip into each liquid then record the data. 5) Pour 10 mL of milk into each cup and mix. (Use different spoons for each cup.) Then record any observations. 6) Measure the pH of each mixture and record the data.

**Post-Lab Discussion:** 1) What happened when milk was added to vinegar? How might the substances formed (when milk reacted with the vinegar) relate to the production of yogurt? 2) Did the milk change the same way (as the vinegar) when added to any other liquid? 3) State a relationship between pH of the liquids and the way it reacts with milk. 4) Based on what you learned in this activity, explain why yogurt is thick and almost solid but milk is just a thin liquid. (What ingredient must yogurt have in order to curdle?) 5) What is the specific purpose of bacteria? (Without bacteria yogurt would be fruit-flavored milk.)

- **Homework:** Finish your wanted poster. Summarize lab results and answer lab questions.

Day Seven

**5-10 minutes**

Viruses - are they alive? Students provide reasons supporting their answer, preparing to participate in a short discussion.

**20-25 minutes**

Lecture/Recitation on Viruses - Chapter 5 in text.

1) General facts about viruses: tiny particles that invade living cells (hosts), parasites that are classified by which of the kingdoms they invade - plants, animals, bacteria.

2) Describe the structure: Head - core of hereditary material (DNA or RNA) and capsid, a protein
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A coat that protects the virus and gives it shape. Tail with tail fibers serve as landing gear allowing nucleic acid to enter the host.


20-25 minutes

Video called “Viruses: What They Are and How They Work”. The objectives are 1) Describe the structure, function, and reproduction of viruses and examine their effect on organisms; 2) Explain how vaccines are produced and how they work in combating viruses; 3) Review the research on viral diseases such as AIDS and polio.

Each student answered the following questions from the video for discussion afterwards: 1) What is a virus? How do scientists (use technology to) study viruses? 2) Explain the lytic cycle of viruses. 3) How is a virus similar to a parasite? 4) How does the body protect itself from viral infections? 5) What are vaccines and how are they made? 6) Explain how vaccines combat viruses. 7) How have humans stopped the spread of polio? 8) How can you avoid a cold or the flu, infections by viruses? 9) Scientists are still looking for a way to battle the AIDS virus. Until they find a cure, what can people do to combat AIDS?

Summarize by returning to the question “Are viruses alive?” and discuss any changes in students’ answers after learning more about viruses and how they work. Students should explain themselves using details about structure and reproduction of viruses.

- Homework: Chapter review (bacteria and viruses) pages 150-151

Day Eight

10-15 minutes

Briefly discuss “Are if viruses alive?” and provide examples of viruses (mainly Rabies, Chicken Pox and AIDS).

10-15 minutes

Correct review in class - focus on short answer section.

25-30 minutes

Students write short stories from the perspective of either a bacterium or virus. In-class time was provided for brainstorming before beginning the writing process, according to the criteria used in English. Guidelines include a main character (either bacteria or virus), problem, conflict and resolution. The creative writing should be descriptive yet based on factual information.

- Homework: Begin rough drafts of short stories.

Day Nine

15-20 minutes

Review in class. Refer to webs created in class for summary

15-20 minutes

Video on Flatworms (Planaria, Fluke, Tapeworm). Objectives are 1) Recognize differences and similarities between examples of flatworm species such as structures and functions. 2) Explain general life cycles, including reproduction. 3) Describe how to acquire these organisms and ways to reduce your risk of infection.

The following questions were answered by each student: 1) Planaria - Describe what these structures are used for (which makes them important): eye, ear-like structure, mouth. 2) Planaria can regenerate when cut into pieces. What does this say about their cells? 3) Name two examples of flukes inside the dissected frog. 4) What is the purpose of the sucker found in some flukes? 5) How does a tapeworm (parasite) get food? 6) Describe the scolex and proglottid of a tapeworm. 7) How could you acquire a tapeworm?

The class discussed parasites from the video as well as other examples, concentrating on parasites most applicable to humans, and ways to prevent infections of those organisms.

10-15 minutes

Students viewed examples of parasites borrowed from Michigan Technological University's Biology
Department. Each student viewed the slides under the microscope and sketched the organisms.

- **Homework:** Continue working on short stories.

Day Ten

20-30 minutes, as needed
Evaluation - Test (Bacteria/Virus)

10 minutes
ESMIS post-evaluation of attitudes and beliefs towards science

10 minutes
Fill in the “Learned” block of KWL chart (no resources needed) and turn in.

- **Homework:** Short stories, neat and complete.

Additional (uncompleted) plans

Field trip to a hospital or an environmental laboratory to actual technology used
Protists (Kingdom Protista), example *Giardia*
Discussion of article (Advance magazine) about *Giardia* in contaminated water

Analysis

This teaching unit emphasized bacterial germs rather than a broader range of ‘host-able’ organisms. Overall, students seemed very enthusiastic to learn about this topic and impressed me by remembering some bacteria by name. *Lactobacillus* in yogurt seemed to be a very popular organism! Based on the KWL chart, the majority of students showed improvement in knowledge and understanding.

Originally I intended bacteria, viruses, and protists in my unit plan. Since my students already knew about protists, so I substituted flatworms instead. They enjoyed viewing organisms under the microscope, though many preferred not to sketch. Sketching is a skill that should be developed and therefore will be used in the future.

The hand-washing demonstration was effective and seemed to motivate hand-washing with warm soapy water! Increasing real-world awareness by discussing relevant articles, especially those in the local news created a personal interest in the transmission and affects of TB.

Students impressed me with their illustrations of “wanted” posters or brochures. Not only was I very pleased with the overall effort on this project, many parents expressed positive comments about them during conferences as well.

The Microbe Zoo was a good idea but should have more guidance in order to maintain focus on what students would see. The website was terrific for introducing a variety of organisms, but I realized afterwards that many students failed describe exactly as I outlined. Perhaps reminding students about differences between bacteria, protests, etc. would be more helpful.

I also had very creative and interesting stories from my class. I would like to incorporate more brainstorming in smaller groups. Perhaps I could present an opportunity to share or act out stories in the future.

Unfortunately, I was unable to arrange a short field trip to either a clinical or environmental laboratory to show students practical applications for this knowledge. This would have illustrated applications of technology more efficiently than discussion, which incorporates the benchmarks more thoroughly.

*Benchmarks addressed*
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"Describe the life cycle of an organism associated with human disease." (Infection process, host, parasite, disease, infection)

"Describe the technology used in prevention, diagnosis, and treatment of diseases." (Available technologies, sanitation, adequate food and water supplies, inoculation, antibodies, biochemistry, medicines, organ transplants)

Bibliography


Partnership for Food Safety Education, The. www.fightbac.org

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