

Microbes and Health



Indicators (Lesson Objectives)

1. Identify helpful uses of microorganisms (e.g., clean up oil spills, purify water, digest food in digestive tract, antibiotics) and the role of science in the development of understanding that led to positive uses (i.e., Pasteur established the existence, growth, and control of bacteria; Fleming isolated and developed penicillin).
2. Relate several diseases caused by microorganisms to the organism causing the disease (e.g., athlete's foot - fungi, streptococcus throat - bacteria, Giardia - protozoa).
3. Observe and report on microorganisms' harmful effects on food (e.g., causes fruits and vegetables to rot, destroys food bearing plants, makes milk sour).

Materials

Activity 1: How did I get sick?

Cups of water (one per student)
Calcium or sodium hydroxide*
phenolphthalein
eye dropper

*Can be purchased as lye from the grocery store

Activity 2: What is my diagnosis?

Copy of Symptoms Cards
Copies of Waterborne Disease Analysis Key (one per student)

Activity 3: Wash you hands!

Cooking spray or vegetable oil
Cinnamon
Soap
Paper towels
Warm faucet water
Cold faucet water

Time: One or two 50-minute class periods.

Utah Core Science Standard V:

Students will understand that microorganisms range from simple to complex, are found almost everywhere, and are both helpful and harmful.

Objective 3: Identify positive and negative effects of microorganisms and how science has developed positive uses for some microorganisms and overcome the negative effects of others.

Intended Learning Outcome:

Make observations and comparisons between different organisms; use classification system; predict results; demonstrate a sense of curiosity about science; seek and weigh evidence before drawing conclusions; cite examples about how science affects life; understand the nature of science and the scientific method.



Background

This lesson is designed to acquaint students with the concept of how microorganisms cause disease. The exploration sets the stage for learning about microorganisms. Many diseases are caused by microorganisms, little creatures too small to see. A large number of microorganisms thrive in water. They include bacteria, viruses, and protozoa. Infected people may pass them by sneezing, hand contact, or through sewage. Usually they cannot be seen, smelled, or tasted.

Many deaths in developing countries are caused by diarrhea and related dehydration. Poor sanitation contributes to the spread of bacterial disease, such as cholera, food poisoning, and shigella (*shigellosis*). Bacteria are everywhere, including our water supplies. Water supplies in the U.S. are tested and treated regularly, so we can normally drink water without concern. However, waterborne diseases are common in many other parts of the world where water is not tested and treated.

Grocery stores and restaurants in the United States must follow many health standards concerning food safety. They are responsible for providing us with quality, safe food. Health inspectors routinely inspect these to make sure they are following the guidelines. If health inspectors find that a business is not, they can penalize them by closing the business for a specific amount of time or perhaps indefinitely.

In the United States, we are fortunate to have a government that makes food safety a priority. In some countries, food may be produced or imported, but it is spoiled by pests or microorganisms due to poor storage. Pests (insects and rodents) and microorganisms (bacteria, mold, yeast) are the two chief causes of food spoilage. Food must be transported, stored, and prepared correctly to ensure safety. Agribusinesses that deal with food must know where their food is coming from. They must also know how their food was grown and how it was transported.

All food will spoil if it is not preserved in some way. Some foods such as nuts and grains can be stored for a long time without spoiling. Other foods such as bread and milk must be consumed quickly. Foods can be preserved in many ways. Canning, freezing, and dehydrating are just a few methods. Spoilage may occur before there is a change in taste or odor. Therefore, consumers should read expiration dates before eating food products bought from grocery stores.

People can reduce their risk of food-borne illness by handling it properly. Eighty-five percent of the cases of food-borne illness caused by bacteria, can be avoided with proper food handling. Keys to food safety are washing hands, checking expiration dates,



washing surfaces and utensils with hot, soapy water, refrigeration and freezing, rinsing fruits and vegetables, and storing foods in proper places.

Activity 1: How did I get sick?

The challenge of this activity is to identify the number one killer among people of the world and how we contact disease. *This activity could be assigned as homework the day before.*

1. Begin the lesson by discussing reasons why people die. This could be given as a homework assignment the day before starting the lesson. List student-suggested causes on the chalkboard. Indicate that the number one killer is diarrhea. Worldwide, thousands of children die of diarrhea each year. If someone guessed diarrhea, have that person come up to the front of the room; if not, ask for a volunteer.
2. Invite the volunteer to take a drink from either of two glasses of water. Indicate you spit into one glass before class. Discuss the responses and relate them to the discussion in Step 1. Make the point that disease-causing organisms are found all around us, even in our water.
3. Continue the exploration by indicating that the class is going to play a “kissing game.” Distribute the pre-prepared glasses of liquid to each member of the class. (Prior to class time, add 1/8 teaspoon of sodium hydroxide to two of the glasses of water. CAUTION: Warn students to not taste any of the samples.) Each student should have a glass of liquid. Indicate that you are going to exchange water from the cups (“kiss”). The procedure is to allow someone to pour some water from their glass into yours. For each amount added, each individual must pour this amount into another person’s glass. Continue this exchange for three minutes.
4. After the water exchange, indicate that two of the cups contained germs (a chemical, lye). As with most microorganisms, it is not easily seen but can be detected with a chemical. Speculate on how far you think the germ was spread during the three minutes.
5. Add a few drops of phenolphthalein to each glass. If the germ (lye) is present, the water will change color. Those with colored water will have been infected. Discuss the results.

Questions for Investigation or Assessment

1. What is can the bacteria responsible for diarrhea is found in? (*water and food*)
2. Viruses and bacteria cause more disease than any other microorganisms. Why are viruses not considered microorganisms? (*Viruses are not living, they do contain DNA, but do not reproduce. Viruses are able to cause infectious diseases from the common cold to rabies and AIDS. Viruses attach themselves to cells or other microorganisms that do reproduce and are alive.*)
3. Penicillin is a mold that is used as an antibiotic. What microorganism do antibiotics kill? (*bacteria*)

Activity 2: What is my diagnosis?

1. Indicate that some class members have exhibited some alarming symptoms or role play with students some “make believe” symptoms you are having. Let them know that you



have reason to believe that some microorganisms caused the diseases.

2. Form the class into seven cooperative learning groups. Distribute one Symptoms Card to each group and the Waterborne Disease Analysis Key to each student.

NOTE: *If students have not previously used dichotomous keys, acquaint them with procedures before continuing.*

3. Have a reporter from each group share their group's Symptom Card information with the entire class. Each group should then use this information to key the disease. Do this for all seven Symptom Cards.

Activity 3: Wash your hands!

1. Talk with the students about safe food handling practices at their homes. Do they thoroughly wash dishes? Do they refrigerate food properly? Do they look for expiration dates on packages? Do they wash their hands with soap and warm water?
2. Use this activity to show students the importance of washing hands with soap and warm water.
 - a. Apply cooking spray or vegetable oil to each student's hands. *(Or you may choose to use a couple of volunteers and to demonstrate the activity.)*
 - b. Sprinkle cinnamon on the palms, backs, and in-between each student's hands. The cinnamon represents germs that get on our hands.
 - c. Try to get rid of the cinnamon using only cold water. Discuss the results.
 - d. Try to get rid of the cinnamon using soap and cold water. Discuss the results.
 - e. Try to get rid of the cinnamon using soap and warm water. The cinnamon "germs" will rinse right off the student's hands and into the sink.
 - f. Ask the students why the cinnamon stayed on their hands until they used soap and warm water. How is this similar to washing germs off of our hands? Is it important to use soap and warm water for hand washing?

Questions for Investigation or Assessment

1. What are the chief causes of food spoilage?
2. What are some safe food handling practices that can be used in your home?
3. What are some food reservation methods that are used before foods reach the grocery store?
4. What responsibilities do agribusinesses such as grocery stores and restaurants have?
5. Why is it important to use soap and warm water when washing your hands?



Extensions, Adaptations, Integration

Activity 1a: Guess My Microbe

1. Explain to your students that they are going to design a "Get a Clue, Guess My Microbe" riddle.
2. Assign each student a disease caused by a microbe and ask

them to investigate their microbe by using the Internet or other library resources. Students should not tell each other what they have drawn out.

3. Ask student to read their clues out loud to the class and see if they can guess the disease.

Activity 2a: Other diseases for further research

Botulism, Campylobacteriosis, Listeriosis, Perfringens, Salmonellosis, Shigellosis, Staphylococcal, Boils, Gonorrhea, Meningitis, Pneumonia, Scarlet Fever, Strep Throat, Anthrax, Diphtheria, Plague, Tetanus, Typhoid Fever, Cholera, Syphilis, African Sleeping Sickness, Malaria.

Activity 3a: Show Them the Germs! Glo Germ™

1. Purchase Glo Germ™ oil liquid and or the powder and a UV lamp (order materials from Glo Germ™ 1-800-842-6622 www.glogerm.com) These materials illustrate (with the aid of a UV light) how germs are spread and emphasizes the importance of proper handwashing. Glo Germ™ can help student to visualize “germs.” Glo Germ™ products are made of tiny plastic particles that are only visible under an ultraviolet light. The florescent glowing particles represent “germs.”
2. Before class, rub some Glo Germ™ liquid or powder on your hands. Shake hands with students as they enter your classroom. About halfway through class, students should place their hands under an ultraviolet light. Their hands will be glowing, indicating that the teacher’s “germs” were passed to them. Furthermore, anything the students touched with their hands will be glowing and will show how quickly germs can spread.
3. As an exercise to teach proper hand washing students can rub some Glo Germ™ on their hands. Then, they should repeatedly wash their hands for varying lengths of time. After washing their hands, any remaining germs, especially under fingernails, will be visible under the ultraviolet light.
4. Tour a restaurant. What types of food safety precautions are used?

Resources

Infection Detection Protection, (student magazine), Published by the American Museum of Natural History, purchase a classroom set for \$25. E-mail your request to center@amnh.org, or visit www.amnh.org/nationalcenter/infection/ for an interactive microbe experience.



Wash Your Hands!

Disease Background Information

Enterotoxigenic *E. coli* Gastroenteritis, caused by *E. coli* bacteria:

Leading cause of infant death worldwide. Visitors to Latin American countries who partake of the food and water occasionally come down with “traveler’s diarrhea,” also known as “turista” or “Montezuma’s Revenge.” A large outbreak of this disease occurred in 1975 in Crater Lake National Park, Oregon. About 2,000 park visitors and about 200 park employees became ill after consuming water that had been contaminated by sewage. Campers who drink from springs frequently contract this disease.

Typhoid Fever, caused by *Salmonellatyphi* bacteria:

Now uncommon in the U.S., this is usually acquired during foreign travel. During the first half of this century it was the most commonly reported cause of waterborne disease in the U.S. It can be acquired by contact with contaminated water, swimming, etc. In 1907, Mary Mallon, nicknamed “Typhoid Mary,” was identified as a carrier of the disease. She transmitted the disease while working as a cook in restaurants and private homes in New York City. She escaped authorities for eight years, but was finally apprehended in 1915. She infected some 50 people, with three cases resulting in death. In 1973 a major outbreak of typhoid fever affected 225 people in a migrant labor camp in Dade County, Florida. The well that supplied water to the camp was contaminated by surface water.

Giardiasis, caused by *Giardia lamblia* protozoan:

Sickness results with only a low dose of the protozoan. Today it is the most commonly reported cause of waterborne diseases. Normal hosts for the parasite are mammals, such as beavers, muskrats, and raccoons. The giardia protozoan is killed by boiling water for at least five minutes.

Legionnaire’s Disease, caused by *Legionella pneumophilia* bacteria:

Found naturally in water environments; bacteria often colonized artificial water systems such as air conditioners and hot water heaters, and can be inhaled with aerosols produced by such systems. Smoking and lung disease increase susceptibility to disease.

Salmonellosis, caused by a species of *Salmonella* bacteria:

This is carried by humans and many animals; wastes from both can transmit the organism to water or food. The largest waterborne salmonella outbreak reported in the U.S. was in Riverside, California, in 1965 and affected over 16,000 people.

Shigellosis, caused by a species of *Shigella* bacteria:

Most infection is seen in children 1-10 years old; a very low dose can cause illness. Waterborne transmission is responsible for a majority of the outbreaks. It is quite common in the United States.

Hepatitis A, caused by *Hepatitis A* virus:

Third most common cause of waterborne disease in U.S. The term hepatitis relates to inflammation of the liver.

Symptom Cards for Activity 2, What is My Diagnosis?

Patient #1 Background

Just got back from vacation in Central America.
Problems started about 12 hours after drinking water in a restaurant.
Diarrhea causing dehydration.
Muscles are tender and sore.
Slight fever.
Some nausea and vomiting,
Stomach and abdominal cramps.

Gastroenteritis

Patient #2 Background

Problems started about ten days after returning from a camping trip.
The water supply on the trip was from springs. No chlorine tablets or boiling of water was used.
Two members of the group had recently recovered from typhoid fever that had been contracted on a trip in Africa.
It became an effort to do any physical work (lethargic) and there were general aches and pains.
Got weaker (malaise) and lost appetite.
Developed high fever and became delirious.
Developed rose-colored spots on skin and a tender abdomen

Typhoid Fever

Patient #3 Background

Symptoms started two weeks after a hike in the mountains.
Drank water from a clear, cold mountain stream that had evidence of beaver activity.
Abdominal cramps.
Greasy, foul-smelling bowel movements.
Excessive intestinal gas.
General weakness and discomfort (malaise).
Weight loss.

Giardiasis

Patient #4 Background

Heavy smoker.
Likes it cool, so uses the air conditioner and keeps the windows closed.
Sudden fever that went up to 1040 F, with chills.
Very rapid breathing and a cough.
Rattling sound in lungs and pain in chest.
General muscle pain and tenderness.
Mental confusion and severe headache.

Legionnaire's Disease

Patient #5 Background

Symptoms started about ten hours after eating a poorly cooked hamburger.
General discomfort and weakness (malaise).
Fever.
Stomach cramps and dysentery.
Nausea and vomiting.

Salmonellosis

Patient #6 Background

Four year old child.
Symptoms began the day after a friend's birthday party.
Shared food with others at the party.
Severe abdominal cramps.
Painful, frequent dysentery.
Blood and mucous in stool.
High fever, chills, dehydration.

Shigellosis

Patient #7 Background

Went swimming in the local river.
General weakness and discomfort (malaise).
Loss of appetite. Fever.
Mild diarrhea, nausea.
Yellowing of the skin and whites of the eyes (jaundice).
Sick for a week.

Hepatitis A

Waterborne Disease Analysis Key

- 1a. Recently visited a foreign country or associated with someone who had visited a foreign country. (Go to 2)
- 1b. Did not have contact with foreigners or people who had traveled to a foreign country. (Go to 3)
- 2a. Rose-colored spots on skin, malaise, loss of appetite, high fever, delirious, tender abdomen. (Typhoid Fever)
- 2b. No rose-colored spots on skin, diarrhea, tender and sore muscles, slight fever, stomach cramps, nausea, and vomiting. (Gastroenteritis)
- 3a. Went camping, hiking, or swimming. (Go to 4)
- 3b. Did not recently experience any outdoor activities. (Go to 5)
- 4a. Drank water from a spring, stream, or lake. Abdominal cramps, greasy, smelly bowel movements, excessive gas, and weight loss. (Giardiasis)
- 4b. Did not drink water, but spent time in the water. Malaise, anorexia, fever, nausea, jaundice. (Hepatitis A)
- 5a. Abdominal cramps. (Go to 6)
- 5b. No abdominal cramps, but fever, chills, cough, and rapid breathing. (Legionnaire's Disease)
- 6a. Recalls eating poorly cooked meat, malaise, fever, dysentery. (Salmonella)
- 6b. Blood and mucous in stool, generally that of a child who had contact with other children. (Shigella)

