They're Everywhere: Bacteria

Activity from *The Science of Food Teacher's Guide: From Ecosystems to Nutrition* and for *The Mysterious Marching Vegetables*

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The activities described in this book are intended for school-age children under direct supervision of adults. The authors and Baylor College of Medicine cannot be responsible for any accidents or injuries that may result from conduct of the activities, from not specifically following directions, or from ignoring cautions contained in the text.

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Food Safety and Nutrition

Environment and Health Basics

Food affects health and well-being in two important ways. First, we require appropriate amounts of different kinds of foods to supply the energy and nutrients we need for daily activities and for growth and maintenance of our bodies. Second, food can contain contaminants that can make us sick.

Carbohydrates, fats and proteins are our main sources of energy. Our bodies also need protein to maintain muscles and carry out many functions inside cells. Small amounts of vitamins and minerals also are necessary.

Food becomes available for use by the body through the process of digestion. Digestion breaks down large food molecules into smaller ones that can be transported and used by the body.

Many Americans eat too much refined sugar and unhealthy fats. Examples of foods with little nutritional value, or with too many added calories, are soft drinks, chips, greasy fried foods, candy and snack cakes. A diet that has a lot of "junk" foods is harmful in two ways. First, it does not provide all of the vitamins, minerals and other substances needed for growth and health. Second, a diet with many sweets and fatty foods often delivers too many calories. When a person eats more calories than he or she uses up through movement and exercise, the body stores the excess energy as fat. Excess body weight can contribute to a number of serious health problems, such as type 2 diabetes, heart disease and stroke.

How foods are grown and prepared also is important. Plants and animals can take in small amounts of pollutants (harmful chemicals) from water, food or soil. These pollutants can accumulate in the bodies of other living organisms that eat the smaller plants or animals—a process known as bioaccumulation. Food also can be spoiled by bacteria. Most bacteria that cause food-related illnesses are spread because hands and food preparation areas are not kept clean or because food is not kept at the proper temperature.

Simple actions, such as washing hands before eating or preparing food, help to reduce the possibility of spreading bacteria or other harmful substances to food.

Photo of handwashing courtesy of the U.S. Department of Health and Human Services. Photos of children © BrandXPictures.

CHILDREN'S ENVIRONMENTAL HEALTH

Children are particularly susceptible to contaminants in food and in the environment. Because their bodies are still growing and because they eat more fruits and vegetables (which may contain chemical residues) relative to their body weights, children are more vulnerable to the harmful effects of substances such as lead and pesticides. However, many researchers believe that a healthy diet, which provides recommended amounts of vitamins and minerals, may help protect children from potentially harmful chemicals.

AVOIDING SUGARY DRINKS

Many soft drinks have around 10 teaspoons of sugar in a 12-ounce can. These drinks, which have little nutritional value, contribute to the nationwide epidemic of overweight and obesity.

They're Everywhere: Bacteria

Environment and Health

CONCEPTS

- Bacteria are everywhere.
- Bacteria need food to grow.
- Bacteria are important decomposers, but they also can cause many different kinds of diseases.
- Bacteria are a major source of food contamination.

OVERVIEW

Students will grow bacteria from a variety of locations and compare the results.

SCIENCE, HEALTH & MATH SKILLS

- Designing an experiment
- Making observations
- Drawing conclusions

TIME

Preparation: 30 minutes for each session
Class: 30 minutes

MATERIALS

Each group will need:

- 6 cotton swabs
- 3 sterlized petri dishes (see Setup)
- Distilled water or boiled water (for swabs)
- Masking tape for labeling and sealing petri dishes
- Nutrient agar (order from a science supply vendor)
- Pen or markers

Bacteria are the most numerous of all things living on our planet. However, they are so tiny that it is not possible to see one without the aid of a microscope. Most bacteria must be magnified at least 400 times before they can be observed. Each bacterium (a single bacteria) consists of one cell capable of reproducing very rapidly. In fact, one bacterium cell can produce millions of others in just one day.

Unit Links

The Mysterious Marching Vegetables
Story, p. 27–31;
Science boxes, p. 15 and 34 (top)

Explorations
Tips for Healthy Living, p. 3; Not Such a New Issue, p. 6

Bacteria are essential in many ways. They are important decomposers in almost all ecosystems. Photosynthetic bacteria (also known as blue-green algae) are vital producers in aquatic ecosystems. Bacteria in the intestines of animals help break down some large food molecules during digestion.

Bacteria also can cause serious problems with food. Since bacteria are everywhere, it is easy for food to become contaminated by bacteria and begin to spoil. The slime you see on food that has been in the refrigerator too long is made of clumps of bacteria and, sometimes, fungi as well. Eating spoiled food can make humans and other animals sick.

Bacteria can be transferred to food when people do not wash their hands after using the bathroom, changing a diaper or playing with pets. Some foods, especially meats, can have bacteria on their outside surfaces. These bacteria can be transferred to other foods if knives, spoons and cutting boards used in preparing them are not washed with soap and water.

This activity allows students to observe bacteria and to compare relative amounts of bacteria living in different parts of the home, classroom or school.

Many common kinds of food poisoning are caused by bacteria. Sometimes bacteria are carried from food into the body, where they grow and cause disease. Other times, bacteria produce poisons that cause sickness when the food is eaten. Nausea, vomiting, abdominal cramps and diarrhea are common symptoms of many food related diseases.

SETUP

Prepare the petri dishes for students. Warm the nutrient agar until it melts (about 60° C) in a pan of boiling water or in the microwave. To avoid condensation in the dishes, let the agar cool slightly before use. Open each petri dish, pour in enough agar to cover the bottom and immediately replace the cover. Let the agar solidify before use. Store the petri dishes upside down. (See "Safety Issues," sidebar, p. 37).

As an alternative to using agar, bacteria also can be grown on potato slices. Boil whole potatoes until almost soft. Using a clean, dry knife, cut potatoes into 1/4-inch slices and place each slice in a petri dish or clean resealable plastic bag. Prepare the petri dishes for students. Warm the nutrient agar until it melts.

Have students work in teams of four to plan and carry out their experiments.

SAFETY

See "Safety Issues," right sidebar.

PROCEDURE

Session 1: Setting up

1. Tell students that they will be learning about bacteria—tiny microorganisms present everywhere. Ask students to mention what they know or have heard about bacteria. List their ideas on the board.
2. Point out that bacteria are a major source of food contamination, and that students will be investigating where bacteria might be present. Ask, *Can we see where bacteria are? How might we be able to find out where the most bacteria are in the room (school, etc.)?*
3. Tell students that one way to study bacteria is to let them grow until they form a clump that is large enough to see. Mention that they will be finding and growing bacteria.
4. Have students in each group select two places that they would like to test for the presence of bacteria. Possibilities include the floor, doorknob, unwashed hands, rinsed hands, hands washed with soap and water, etc. (See "Safety," above).
5. Have the groups write descriptions of the places they plan to test and to write predictions about what they expect to find. For example, a group might predict that a sample from unwashed hands will have more bacteria than from washed hands.
6. Give each group three petri dishes (see "Safety Note," p. 36). One dish will be a control. The remaining two will be used for sampling. Students should label all three dishes.
7. Direct students to sample the areas they have chosen using clean cotton swabs dipped in distilled or boiled water. They should rub the swab several times over the area to be tested and then gently rub the swab in a zig-zag pattern over the surface of the gel mixture in the bottom of the petri dish. Instruct students to open the dishes only enough to swab the gel surface. The control dish should be rubbed (inoculated) with a clean, moist swab.
8. Tape the dishes closed for students. Store the dishes upside down.

SAFETY ISSUES

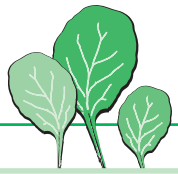
Most bacteria are harmless to healthy people. However, because some kinds of bacteria can cause disease, it is important that the Petri dishes remain closed after students have started the cultures.

Students should not collect or test saliva, tears or other body fluids.

Dispose of used cotton swabs by placing them in a resealable plastic bag. Cover swabs with a 10% bleach solution (10 mL chlorine bleach mixed with 90 mL water). Seal the bag and discard.

Dispose of cultures immediately after the activity. Carefully remove the tape used to seal each dish and place each closed Petri dish in a separate, resealable plastic bag. Pour about 20 mL of a 10% bleach solution in the plastic bag. Seal the bag. Through the sides of the closed bag, loosen the cover of the Petri dish enough to allow the bleach solution to move inside and completely cover the contents of the dish. Dispose of the plastic bag and its contents in the trash.

Follow all district and school science laboratory safety procedures. It is good laboratory practice to have students wash hands before and after any laboratory activity. Clean work areas with disinfectant.



BACTERIA BUSTERS!

- Wash hands with soap and water after using the restroom and before preparing or eating food.
- Wash cooking surfaces and utensils with warm water and soap. Use plastic or non-porous cutting boards and wash them in the dishwasher.
- Rinse fruits and vegetables under running water before cooking and eating them.
- Do not use the same knives and utensils for different kinds of meats, chicken or other cooked foods to avoid transferring bacteria from one food to another.
- Never place cooked foods on a plate which previously held raw meat, poultry or seafood.
- Do not wash raw poultry, beef, pork, lamb or veal before cooking. Any bacteria present on the surface of the meat is killed during cooking.
- Cook whole meats to an internal temperature of 145°F (3 minutes resting time), ground meats to 160°F and poultry to 165°F.
- Cook eggs until the yolk and white are firm, not runny. Don't use recipes that call for raw or partially cooked eggs.
- Refrigerate fresh foods and cooked foods promptly; keep the refrigerator temperature below 40°F.
- Pack lunches for school or work in portable coolers.
- Do not buy food in cans or jars with bulging or damaged lids.

* Source: USDA

Session 2: Observations

1. If possible, have students observe the cultures every day for 1–3 days. After about three days, have students make detailed observations. Ask, *What has changed inside the petri dishes?* Bacteria will discolor the surface of the gel and form smooth, wrinkly or slimy blotches (called colonies) of different colors. Fungi, which form fuzzy colonies, also may be present.
2. Have students decide how many different kinds of organisms might be growing on the gel, based on differences they can observe. Do not allow students to open the dishes.
3. Next, have students decide whether some sample sources had more bacteria than others by counting the number of colonies and/or by comparing the sizes of colonies. Have them record their observations and conclusions. Have the groups share their results with the rest of the class.
4. Based on the results, have students decide which locations have the most bacteria, and which the least. Ask, *If there are bacteria all around us, why aren't all of us sick? Do all bacteria make us sick? What about the gel in the petri dishes—would you want to eat it? Do you think that it is good to have bacteria growing in our food?*
5. Help students understand that contamination of food by bacteria can cause serious health problems. Ask for suggestions on how to keep food clean. Possibilities include: using clean hands and utensils for food preparation, keeping food covered and refrigerated until used, and cooking food thoroughly to kill bacteria that might be present (see "Bacteria Busters!" left sidebar).

VARIATIONS

- Design additional experiments to test for the presence of bacteria. You might test water from different sources or see which kinds of food grow the most kinds of bacteria or become spoiled most quickly by bacteria.
- Have students investigate what happens when similar samples are grown at room temperature and in the refrigerator.

QUESTIONS FOR STUDENTS TO THINK ABOUT

Bacteria are everywhere. They can be found on nearly every surface—including skin. They also are found inside the digestive tract, in the mouth, throat and intestines. However, they are not found anywhere inside the tissues of the body or in the blood of healthy persons. Bacteria inside the body can cause serious diseases if the body's immune system is not able to fight them off. Bacteria also are helpful. Ask, *How many good uses of bacteria can you find?* Look for information about bacteria in the library or on the Internet.