



Photo by Dr. Todd Parker, courtesy of CDC. Public domain.

**They're Everywhere:
Bacteria**

The Science of Food:
Activity 8

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They're Everywhere: Bacteria

This activity's objectives are aligned with the National Science Education Standards, specifically those related to Science as Inquiry and Physical Science. In this activity, students will grow and observe bacteria collected from a variety of locations, and then compare relative amounts of bacteria living in different parts of their homes, classroom, or school. Students will design an experiment, make observations, and draw conclusions.

The following science concepts are addressed in this activity.

- 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.

Student Worksheets

Student pages in the teacher's guide are provided in English and in Spanish.

Reference

Moreno N., and B. Tharp. (2011). *The Science of Food: Teacher's Guide*. Fourth edition. Baylor College of Medicine. ISBN: 978-1-888997-76-7. Development of this student activity was supported, in part, by grant numbers R25 ES06932 and

R2510698 from the National Institute of Environmental Health Sciences of the National Institutes of Health to Baylor College of Medicine.

Image Reference

Photo of Brucella bacteria (which can be found in contaminated milk) by Dr. Todd Parker. Image courtesy of the CDC\12289. Public domain. <http://www.cdc.gov>

Key Words

food, food safety, bacteria, illness, food-borne illness, sick, infection, infect,

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Materials



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Materials

Have students work in groups 2-4.

Per Group of Students

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

Setup

•Prepare the petri dishes for students before class begins. Warm the nutrient agar in a pan of boiling water or in a microwave oven until it melts (about 60° C). 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. Store the petri dishes upside down, and let the agar solidify before use.

•As an alternative to agar, bacteria can be grown on potato slices. Boil whole potatoes until they are almost soft. Using a clean, dry knife, cut potatoes into 1/4-inch slices and place each slice in a petri dish or a clean re-sealable plastic bag.

Safety Notes

1. Do not let students test saliva, tears or any other body fluids.
2. Do not let students open the petri dishes once they have been closed.
3. Refer to the teacher's guide for proper disposal of materials.

Reference

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Image Reference

Photo by Christopher Burnett © Baylor College of Medicine.

Key Words

materials list, materials needed,

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Science Safety Considerations

- Follow all instructions.
- Begin the investigation only when instructed.
- Report accidents.
- Do not eat or drink during the experiment.
- Do not open the petri dishes after you have begun your experiment.
- Wash hands thoroughly after the investigation.



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Science Safety Considerations

Students always must think about safety when conducting science investigations. This slide may be used to review safety with your class prior to beginning the activity.

Safety first!

- Always school district and school science laboratory safety guidelines.
- Have a clear understanding of the investigation in advance.
- Practice any investigation with which you are not familiar before conducting it with the class.
- Make sure appropriate safety equipment, such as safety goggles, is available.
- Continually monitor the area where the investigation is being conducted.

Safety Notes

1. Do not let students test saliva, tears or any other body fluids.
2. Do not let students open the petri dishes once they have been closed.

References

1. Dean R., M. Dean, and L. Motz. (2003). *Safety in the Elementary Science Classroom*. National Science Teachers Association.

2. Moreno N, and B. Tharp. (2011). *The Science of Food Teacher's Guide*. Fourth edition. Baylor College of Medicine. ISBN: 978-1-888997-76-7. Development of this student activity was supported, in part, by grant numbers R25 ES06932 and R2510698 from the National Institute of Environmental Health Sciences of the National Institutes of Health to Baylor College of Medicine.

Key Words

food, bacteria, bacterium, contaminate, contaminated, contamination, spoil, spoiled, slime, sick, sickness, food poisoning, food safety, E. coli,

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Are Bacteria Good or Bad?

- Where are bacteria found?
- What do bacteria look like?
- Are bacteria important for digesting food?
- Can bacteria make us sick?
- Why is important to wash our hands?



Bacteria must be magnified at least 400 times to be visible. Each bacterium consists of one cell capable of reproducing very rapidly. Shown above are *E. coli* bacteria.



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Are Bacteria Good or Bad?

Begin this activity by asking the class, *Are bacteria good or bad?* Help students understand that some bacteria can be harmful to humans and animals, while other bacteria are helpful. For example, bacteria growing on spoiled food might make us sick. However, bacteria in our intestines play an important role in helping to break down large food molecules during digestion.

Tell students that this activity will focus on bacteria—tiny microorganisms present everywhere. Ask students to mention what they know or have heard about bacteria. List their ideas on the board.

Point out that bacteria are a major source of food contamination, and mention that students will grow bacteria and investigate where they might be present. Ask, *Can we see bacteria? How might we be able to find out where in the classroom or the school has the most bacteria?* Tell students that one way to study bacteria is to let them grow until they form a clump that is large enough to see.

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Image Reference

Photo of E. coli courtesy of the Rocky Mountain Laboratories, National Institute of Allergy and Infectious Diseases, NIH. Public domain.

http://commons.wikimedia.org/wiki/File:EscherichiaColi_NIAID.jpg

Key Words

food, bacteria, bacterium, contaminate, contaminated, contamination, spoil, spoiled, slime, sick, sickness, food poisoning, food safety, E. coli,

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Session 1: Setting Up

- Select 2 places in the classroom or in the school to test for the presence of bacteria.
- Record your predictions of what you expect to find in each place.
- Label 3 petri dishes: one for each test location and one as a control.



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Session 1: Setting Up

In this activity, students will observe bacteria and compare relative amounts of bacteria living in different parts of the classroom or the school. Overall, students will discover that bacteria grow in many locations.

Safety Notes

1. Do not let students test saliva, tears or any other body fluids.
2. Do not let students open the petri dishes once they have been closed.

Have each student group select two places of the classroom or school 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.

Have each group list the places it plans to test and write a prediction of what it expects to find in those locations. For example, a group might predict that a sample from unwashed hands will have more bacteria than a sample from washed hands.

Give each group three petri dishes. Two dishes will be used for studying bacterial samples; these should be labeled with the locations from which the samples will be collected. The third dish will be a control, and should be labeled as such.

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Image Reference

Microsoft Office Clip Art.

Key Words

lesson, experiment, food, bacteria, bacterium, contaminate, contaminated, contamination, spoil, spoiled, slime, sick, sickness, food poisoning, food safety, E. coli,

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Session 2: Procedure and Observations

- Rub a clean cotton swab dipped in distilled water over each area you picked to test.
- Gently rub each swab in a zig-zag pattern over the surface of the agar in the appropriate petri dish.
- Rub the control dish with a clean swab.
- Cover the petri dishes with lids and tape them closed. *Do not open the petri dishes.*
- Store your petri dishes upside down.
- Record your observations for 1–3 days.



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Session 2: Procedure and Observations

Safety Notes

1. Do not let students test saliva, tears or any other body fluids.
2. Do not let students open the petri dishes once they have been shut.

Direct students to collect samples from the areas they have chosen using clean cotton swabs dipped in distilled or boiled water. Students should rub each 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 appropriate 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.

Tape each group's petri dishes closed and store the dishes upside down. If possible, have students observe their cultures every day for 1–3 days. After about three days, have students record their detailed observations.

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Let's Talk About It

- What has changed inside your petri dishes?
- How many kinds of bacteria are growing?
- Which locations have the MOST bacteria?
- Which locations have the LEAST bacteria?
- Do all bacteria make us sick?
- Do you think it is safe to have bacteria growing on our food?



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Let's Talk About It

This activity allows students to observe bacteria and to compare relative amounts of bacteria living in a variety of common places. Students will discover that bacteria grow almost everywhere.

Ask, *What has changed inside your 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. Have students decide how many different kinds of organisms might be growing on their gels, based on differences they can observe. Do not allow students to open the dishes.

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 in each petri dish. Have groups record their observations and conclusions, and then share their results with the rest of the class. Based on the results, instruct students to decide which locations have the most bacteria, and which have the least.

Ask, *If there are bacteria all around us, why aren't we all sick? Do all bacteria make us sick? What about the gel in the petri dishes—would you want to eat it? Do you think it is good (safe? healthy?) to have bacteria growing in our food?* Help students understand that contamination of food by bacteria can cause serious health problems.

Ask students for suggestions about 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!" in the sidebar of the teacher's guide)

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Image Reference

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Key Words

lesson, experiment, bacteria, bacterium, food, fungi,

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The Science of Bacteria

- Bacteria can be found in many places, including:
 - Skin
 - Intestines
 - Doorknobs
 - Food
- 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.



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The Science of Bacteria

In this activity, students observed the following properties of bacteria and how it relates to food-borne illnesses.

- **Bacteria are everywhere.** Bacteria are the most numerous of all things living on our planet. However, they are so tiny that it is not possible to see a bacterium (a single bacteria) without the aid of a microscope. Most bacteria must be magnified at least 400 time to be seen with the naked eye. Each bacterium consists of one cell capable of reproducing very rapidly. In fact, one bacterium cell can produce millions of others in just one day. Bacteria are everywhere. They can be found on nearly every surface—including skin. They also are found in the digestive tract, 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 need food to grow.** In the laboratory, bacteria are grown in nutrient agar, a medium derived from algae which provides bacteria with the sugars and nutrients needed to survive in a petri dish.
- **Bacteria are important decomposers, but they also can cause many different diseases.** 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. However,

bacteria also can cause serious problems with food. Since they are everywhere, it is easy for bacteria to contaminate food and cause it 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 are a major source of food contamination.** 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 utensils and cutting boards used in food preparation are not washed with soap and water.

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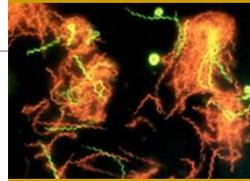
Key Words

bacteria, skin, intestines, food, disease, food-borne illness, food contamination, stomach, digestive tract,

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Extensions

- Design additional experiments to test for the presence of bacteria. For example, try the following.
 - Test water from different sources.
 - Test which kinds of food grow the most kinds of bacteria.
 - Test to determine which foods spoil most quickly.
- Use the library or Internet to find some helpful uses of bacteria.



Bacteria come in different shapes and sizes. Shown above are bacteria from the genus *Spirochaeta* that live in Mono Lake. While some *Spirochaeta* live in freshwater mud, others live in extreme, sulfur-containing muds without oxygen.



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Extensions

•Design additional experiments to test for the presence of bacteria. For example, students can test bacteria levels in water from different sources. Or, they can conduct an experiment to see which kinds of food grow the most kinds of bacteria or become spoiled most quickly by bacteria.

•Have students investigate two similar samples, with one sample grown at room temperature and the other grown in a refrigerator.

•Have students do research in the library or on the Internet to answer the question, “How many good uses of bacteria can you find?”

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Image Reference

Photo courtesy of NASA. <http://science1.nasa.gov/science-news/science-at->

nasa/2003/30jul_monolake/

Key Words

lesson, experiment, extensions, bacteria, bacterium, food-borne illness, food safety, food contamination, E. coli,

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