

National Park Service
U.S. Department of the Interior

Zion National Park



Microorganisms

The Good, the Bad, and the Ugly



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Introduction

This guide contains background information about how microorganisms can be both good and bad, and directions for three activities that will help students better understand how microorganisms can be helpful and harmful. The activities are most beneficial to students when completed in order. This guide is specifically designed for sixth grade classrooms, but the activities can be modified for students at other levels. A separate activity guide, titled “What is a Microorganism?” provides a general introduction of microorganisms and their role in Zion National Park.

Theme

Microorganisms perform a variety of functions on Earth, both positive and negative.

Focus

This activity guide explores the good that microorganisms do in food production and the harm they can do in causing disease.

Activities

The Good Microorganisms in My Lunch

Students will discover some of the microorganisms that they eat in foods every day by comparing their lunches to a list of microorganisms present in different foods.

The Bad Microorganisms and Disease

Each of the nine diseases listed in this activity will be matched with their preventions and treatments. Students will receive a short explanation of a disease, prevention, or treatment and will find their two matching components of their group.

The Ugly Bighorn Sheep Mystery

Students will read and analyze information about an outbreak of disease in a population of bighorn sheep at Zion National Park and answer questions to identify the disease and its consequences.

Background

Just as there are millions of different species of plants and animals in the world, there are millions of different species of microorganisms. Microorganisms can survive in environments where humans are unable

to live. Microorganisms exist throughout the world, from Antarctica to your kitchen, from inside animals (like humans), to the expanse of wilderness in Zion National Park. Most are good, others are bad, and a few are just plain ugly.

A microorganism is defined as a living thing that is so small it must be viewed with a microscope. Some microorganisms like viruses are so small they can only be seen with special electron microscopes. Note: the Zion National Park curriculum guide “What is a Microorganism?” is available online for teachers. It provides background information and three activities for introducing the idea of what microorganisms are.

Many people are most familiar with the microorganisms that cause diseases, such as certain types of bacteria and viruses. “Germs” is a general term for any type of microorganism (bacteria, protozoa, fungus, or virus) that can harm people or other animals. However, there are many good microorganisms such as those that help us digest food, and those that are in food themselves.

Microorganisms of all kinds can be found in Zion National Park and southern Utah. Some microorganisms can actually be seen at work. Biological soil crust is built up into fragile spires from fungi, algae, and bacteria. Algae can also be seen tinting water green, such as in the Emerald Pools. In other cases, microorganisms cannot be seen, such as Giardia which lives in the Virgin River.

Core Connections

Utah Core Curriculum
Sixth Grade Science

Standard 5: 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.



The Good Microorganisms in My Lunch

Duration

60 Minutes, over two days

Location

Inside or outside

Key Vocabulary

microorganism, bacteria, fungi, algae

Objectives

Students will be able to list at least two foods that require microorganisms and become aware of how many types of foods rely on microorganisms.

Method

Students will discover some of the microorganisms that they eat in foods every day by comparing their own lunch to a list of microorganisms present in different foods.

Background

Microorganisms are commonly found in foods we eat. Often, microorganisms help create the foods themselves, such as the many different types of bacteria that turn milk into cheese or yogurt. Commonly-known microorganisms that help create food include the fungi used in breads, cheeses, and beer. Lesser known microorganisms include the algae used as a thickener in dairy products, the fungi used to preserve meats, and some bacteria used to develop flavor.

There are no protozoa or viruses used in food production, though protozoa, like most microorganisms, can positively affect our food supply. Along with types of bacteria, protozoa are important decomposers, turning organic material into rich soil for plants to use.

Materials

- Microorganisms in My Lunch Images (optional)
- Microorganisms in My Lunch worksheet and reference list
- Lunch food and picnic supplies (to be brought in by students)

Suggested Procedure

1. On the first day, tell students you are going to have a picnic lunch in class the next day.

Have students plan to pack a lunch, or arrange for pickup from the cafeteria, and bring their lunch to class. You can pretend you are taking a virtual field trip to Zion National Park and tell students to bring blankets or other props for the picnic.

2. On the second day, before the students pull out their lunches, decorate the classroom as if having a picnic (or go outside during nice weather). Lay out blankets or tablecloths, put up a picture of Zion on the screen, and let students bring out things they like to have on picnics.
3. Have students brainstorm ways in which microorganisms are important (decomposers, producers, part of food chain, cause disease, etc.). Mention that while sometimes microorganisms are feared, most of them are helpful—and most of us wouldn't want to live in a world without microorganisms. Explain how microorganisms are even in the food we eat. Explain that they will explore their lunch looking for items that required a microorganism to make it.
4. Pass out a Microorganisms in My Lunch reference sheet and worksheet to each student. Have them go through the list and write down which foods in their own lunch are made using microorganisms. Students may eat their lunch as they work or the teacher can have the entire class eat at the same time after the activity.
5. Have students share with a partner and then with the class. Ask students which foods and microorganisms surprised them the most.

Extension

Have students try to plan a meal that doesn't include foods that need microorganisms. When completed (it will probably involve either pasta or rice and beans), remind students that even if a microorganism is not directly involved in food production, microorganisms such as bacteria and protozoa play an important role in the food chain, acting as decomposers and adding nutrients to the soil—nutrients that plants need to grow.



Edible mushrooms are usually the product of a larger underground fungus.

Bacteria and fungi are required to create most cheeses.

Sandwich bread utilizes yeast, a type of fungi, to rise. Jellies sometimes require the use of algae as a thickener.

The Bad Microorganisms and Disease

Duration

45 Minutes

Location

Inside

Key Vocabulary

microorganism, single-celled, protozoa, virus, bacteria, fungi, germ, antibiotic, vaccine

Objectives

Students will learn that a diversity of microorganisms can cause disease. As a result, prevention and treatment for these diseases will also vary.

Method

Each of the nine diseases listed in this activity will be matched with their prevention and treatment. Students will receive a short explanation of the disease, or prevention, or treatment. Then they will find their two matching components and form a group.

Background

Many different types of microorganisms cause a variety of diseases. The most common way of getting a bad microorganism in your body is by drinking contaminated water, eating

food that has not been handled properly, or breathing in the microorganism (i.e. standing next to someone while they cough). We commonly refer to these disease-causing microorganisms as germs.

Generally, microorganisms are broken into five categories (simpler definitions are located in the glossary for student use):

Bacteria: Bacteria come in a variety of shapes (spheres, rods, or spirals) and are a diverse group of organisms. Many cause disease, such as some strains of *E. coli*, while others actually help support life, such as the bacteria inside our intestines which break down our food. Bacteria is plural, bacterium is singular.

Algae: While not all algae are green, all are capable of photosynthesizing and considered producers. Algae can be single-celled or multicelled and only a very small number can cause disease. Algae mostly grow in water and include seaweed and “pond scum.” Algae is plural, alga is singular.

Fungi: All fungi are decomposers, breaking down dead matter for nutrients, and they cannot produce their own food. Common diseases caused by fungi include athlete’s foot in humans and white nose syndrome in bats, but the type of fungi known as penicillium is one of the main antibiotics used to fight other



Students look for microorganisms and insects in the Virgin River.

NPS/BRYANNA PLOG

infections. Fungi is plural, fungus is singular.

Protozoa: The name protozoa means “first animal,” and describes this microorganism’s ability to move and hunt. Most protozoa do not cause disease but there are a few that cause harm to humans, including *Plasmodium* (malaria) and Giardia. These protozoa are considered parasites. Protozoa is plural, protozoan is singular.

Viruses: There is some debate on whether viruses are actually organisms at all; that is whether they are alive or not. While they have DNA or RNA and infect a host like other parasites, viruses have no true cells and cannot reproduce on their own. Viruses is plural, virus is singular.

Because of the diversity of microorganisms, the diseases that they cause can be prevented and treated in different and specific ways. For instance, diseases caused by bacteria can be treated with antibiotics since they are caused by a living thing. Since viruses are not alive, antibiotics do not work for things such as smallpox, HIV, the flu, or the common cold. However, many viruses can be prevented with a vaccine, which usually involves giving a tiny amount of the virus to a person to make them immune.

Materials

- Diseases, Prevention, and Treatment Activity Sheet
- Diseases, Prevention, and Treatment Answer Key
- tape

Suggested Procedure

1. Before class, print off the Diseases, Prevention, and Treatment Activity Sheet. Cut out each entry so there are 27 slips of paper (9 each for the disease, prevention, and treatment). Use the teacher’s guide to help check student answers.
2. Review the definitions of the different types of microorganisms so students understand the differences between them. Emphasize that while most microorganisms are helpful, several microorganisms can cause disease, including bacteria, fungi, protozoa, and viruses.

3. Explain that the class is going to investigate the causes of nine different diseases and see how they can be prevented and treated. Emphasize that because diseases are caused by different types of microorganisms, they must be treated in different ways.
4. Hand out one slip of paper from the activity sheet to each student (if the class is larger than 27, have students pair up. If a class is not divisible by three, the teacher can provide one or two answers).
5. Have students walk around the classroom, trying to match up the disease with the prevention and with the treatment. Some will overlap (there are multiple diseases that can be treated with an antibiotic; see the Answer Key) but most will have a specific set that goes with each disease. Give students around 10 to 15 minutes to talk to everyone and get together with their group of three. If students think they are properly matched up, have them share with other groups who have finished and check to see if both make sense.
6. Have students tape their three slips of paper together. When everyone is matched up, have students present their disease, prevention, and treatment to the class.
7. Note that some treatments are also from microorganisms (penicillin is derived from the fungus penicillium) and that we also need good bacteria in our systems (such as good strains of *E. coli*).

Extension

On paper, have students explain why they chose the preventions and treatments they did. Have the students write down some of the other options they considered and why they decided those answers did not work. Which diseases do they think they could contract by being in Zion National Park or around their neighborhood?

The Ugly

Bighorn Sheep Mystery

Duration

45 Minutes

Location

Inside

Key Vocabulary

antibiotic, infectious, virus

Objectives

Students will be able to apply what they know about different microorganisms to correctly identify which microorganism is causing a disease, and analyze different effects and consequences of the disease.

Method

Students will read and analyze information about an outbreak of disease in a population of bighorn sheep at Zion National Park and answer questions to identify the disease and its consequences.

Background

Desert bighorn sheep are a distinctive species of mammal that live on rocky slopes in the eastern part of Zion National Park. Not to be confused with the white and shaggy mountain goat, bighorn sheep have long horns and thin, tan coats. Both males and females have horns, but the horns of older males (rams) grow much larger and longer and curve around their head.

Bighorn sheep have been living in southern Utah for at least a few thousand years; pictographs and petroglyphs found in the area depict bighorn sheep and the animals were probably hunted by the American Indians who lived in the area. Because of habitat loss, overhunting, and livestock grazing, bighorn sheep disappeared from the area by the mid 1950s. In the late 1970s, there were several reintroduction efforts and bighorn sheep were brought back to Zion National Park. The herd in and around the park is now estimated to be over 500 sheep.

The bighorn sheep in Zion National Park are generally healthy, but diseases such as contagious ecthema (explained in the Bighorn Sheep Mystery Answer Key) occasionally run



A bighorn sheep browses on Utah serviceberry (*Amelanchier utahensis*).

through the population. The greatest risk is from diseases brought from contact between domesticated sheep and wild bighorn sheep.

Materials

- Bighorn Sheep Mystery Images
- Bighorn Sheep Mystery Worksheet
- Bighorn Sheep Mystery Answer Key

Suggested Procedure

1. Show photos of desert bighorn sheep to class and ask if anyone has seen them in Zion National Park or other areas. Explain to the class that they are going to read a story about some of the bighorn sheep in the park and use the story to answer questions.
2. Break the class into groups of four or five and hand a bighorn sheep activity sheet to each student, every other student or each group. Have students read out loud in their groups so everyone hears the story. Give students 15 to 20 minutes to individually answer the questions on a separate sheet.
3. When all students are finished, review the answers together as a class using the Bighorn Sheep Mystery Answer Key to guide the discussion.

Glossary

algae: single-celled plant-like organisms. They produce their own food using photosynthesis.

antibiotic: a medicine such as penicillin that comes from a microorganism and can be used to destroy bacteria, fungi, or protozoa, thus treating or preventing many diseases.

bacteria: single-celled organisms that belong to the Monera Kingdom. They can be shaped like spheres, rods, or spirals and can do everything from decompose dead leaves to cause disease.

fungi: a type of decomposer that reproduces through tiny seed-like cells called spores. While some fungi like mushrooms and molds are large, other types of fungi are single-celled.

germ: any microorganism that can cause disease.

infectious: able to cause an infection or disease by spreading between living things.

microorganism: an organism that is so small it can only be viewed under a microscope (not with the naked eye). They are usually not plants or animals and come in a variety of types, species, sizes, and shapes.

organism: any living thing, large or small. All organisms need air, water, and energy and can grow and reproduce.

protozoa: single-celled parasites that act like animals (feed on and destroy other microorganisms).

single-celled: an organism that is made up of only one cell; in contrast, humans are made up of trillions of cells.

vaccine: a preparation of a weakened virus given to a person to protect them against future infections of a disease. For example, if you have had a chicken pox vaccine, you cannot get chicken pox.

virus: non-living agent of disease. Can multiply and cause harm to the living thing it infects.

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