National Park Service
U.S. Department of the Interior

Zion National Park

What is a Microorganism?

Introduction to Microorganisms

NPS/MARC NEIDIG

Contents

Introduction

This guide contains background information about what microorganisms are and directions for three activities that will help students better understand microorganisms and how they relate to everyday life and Zion National Park. 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.

Theme

Though they cannot be seen with the naked eye, there are millions of diverse microorganisms living everywhere around us, performing a variety of important functions.

Focus

This activity guide provides the definition, and explores examples of microorganisms, and the places microorganisms are found.

Activities

How Small is Small?
By using a large scale, students will be able model the size of specific microorganisms and compare them with the size of a human hair.

Mystery Microorganisms
Students will learn about the five categories of microorganisms by classifying a set of species (their "Mystery Microorganisms").

Microorganisms Are Everywhere – Even in Zion National Park!
Students will use a description and photo to categorize a species of microorganism and determine where it might live in Zion National Park.

Activity Materials

Corresponding materials which may include images, worksheets, and answer keys are available for each activity. Materials can be downloaded from the lesson plan webpage, found here.

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 1: Observe and summarize information about microorganisms.

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.

Background

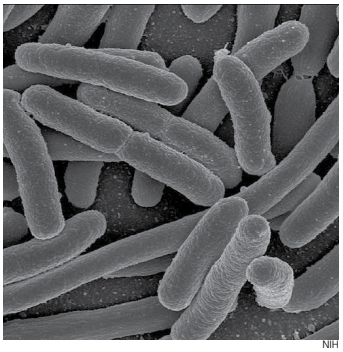
Just as there are millions of different species of plants and animals in the world, there are millions of different species of microorganisms. Microorganisms can survive in environments where humans are unable to live. Microorganisms exist throughout the world, from Antarctica to your kitchen, from inside animals, like humans, to the expansive wilderness in Zion National Park.

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.

There are five different categories of microorganisms—bacteria, algae, protozoa, fungi, and viruses—explained in further detail in Mystery Microorganisms. Microorganisms cover almost all the kingdoms of life. Bacteria and some algae are in the Monera kingdom (sometimes divided into the separate Eubacteria and Archaebacteria kingdoms), algae and protozoa are in the Protista kingdom, and fungi make up their own kingdom. There is ongoing debate about how to classify most microorganisms (for instance, some scientists put some types of algae in the Plant kingdom while others do not).

Microorganisms of all kinds can be found in Zion National Park and southern Utah. In many cases, these microorganisms can actually be seen at work, such as the fungi, algae, and bacteria that build up the fragile spires of biological soil crust, or the algae which gives the Emerald Pools a green color.

Microorganisms are also prevalent inside us. While we like to think of ourselves as being made up of human cells, we are actually 90% microbial: there are 10 times more cells from microorganisms in our bodies than human cells. That means there are trillions of microorganisms living inside us every day. Most are helpful to us, such as bacteria that help us digest our food. Scientists now think that a diversity of microorganisms inside of us help us resist many diseases.



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The rod shape of *E. coli* can be clearly seen under a scanning electron microscope.

***Micrasterias americana* algae at 400x magnification.**

How Small is Small?

Duration
45 Minutes

Location
Outside or inside area with a large open space

Key Vocabulary
organism, microorganism, single-celled, algae, bacteria, fungi, protozoa, virus

Objectives
Students will be able to conceptualize the size of microorganisms and give a definition of what a microorganism is.

Method
By using a large scale, students will be able model the size of specific microorganisms and compare them with the size of a human hair.

Background
The average human hair is 0.1 millimeters wide, and barely discernable with the naked eye. Microorganisms are many hundreds to thousands of times smaller and by definition can only be seen under a microscope. Most microorganisms consists of only one cell and they are known as single-celled organisms (in comparison, humans consist of trillions of different cells). Different species of microorganisms vary in size, shape, appearance, and way of surviving.

The largest microorganisms are most fungi and many species of protozoa. Viruses are by far the smallest of all microorganisms. If a virus was the size of a baseball, an average bacterium would be the size of a pitcher's mound, and one single human cell would be the size of the entire stadium!

Materials
- meter stick or ruler
- magnifying glass
- marking material for ground (i.e. sidewalk chalk, markers, or string)
- a hair from a human head
- 5 meters of butcher paper (if inside)

Suggested Procedure
1. Introduce the idea of what microorganisms are and that they cannot be seen with the naked eye.
2. Have students examine a human hair (one can be passed around and/or students can examine their own). Students can look at how thin the hair is with and without magnifying glasses.
3. Go outside or into your open space, and use the meter stick to measure an area 1 meter long. Mark it with chalk, string, or tape (depending on your location). One meter represents the 0.1 millimeter width of a hair using the scale of 10,000 :1.
4. Using the information below, add different microorganisms to the ground or paper. Students can measure out the size and label the different cells and microorganisms:

   Human red blood cell (.01 mm) = 10 cm

   Paramecium (protozoa) (0.2 mm) = 2 m

   Euglenoids (algae) (0.4 mm) = 4 m

   Scenedesmus (algae) (0.03 mm) = 30 cm

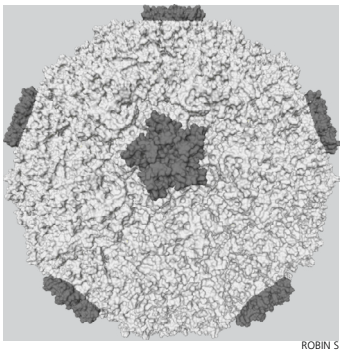
   E. coli bacteria (.002 mm) = 2 cm

   Staphylococcus bacteria (.0005 mm) = 0.5 cm

   Polio virus (.00002) = .2 mm (a tiny dot)
5. When finished measuring out all the microorganisms, compare their sizes. Notice how viruses are the smallest type but other types vary in size depending on the species. Students can draw their own reference models on paper to keep.
6. Finish by asking students (verbally or in writing) why scientists have to use models like this (because some microorganisms are too small to be seen under regular microscopes and it is difficult to compare sizes and features of a variety of microorganisms because of their size).

Extension
Have students research the size of other microorganisms to compare size and practice math skills using the 10,000:1 scale.

Find large items to compare microorganisms to such as a pencil, a school bus, or a football field. For instance, if the 2,000 foot tall cliffs of Zion Canyon were on the scale, they would be over 3,800 miles long, the distance from Las Vegas to Chicago and back!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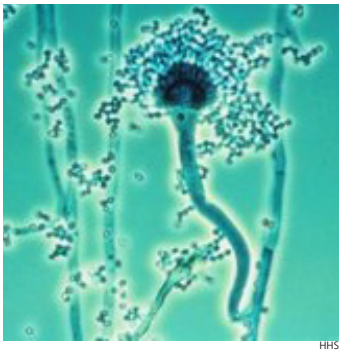
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NPS/BRYANNA PLOG

Digital interpretation of rhinovirus.

***Aspergillus fumigatusas*, a fungi, visible under a microscope.**

Algae color the water green at the Emerald Pools.

Mystery Microorganisms

Duration
45 Minutes

Location
Inside

Key Vocabulary
organism, microorganism, single-celled, algae, bacteria, fungi, protozoa, virus, producer, decomposer

Objectives
Students will be able to list the five different types of microorganisms and share the specific attributes of at least one type.

Method
Students will learn about the five categories of microorganisms by classifying a set of species (their "Mystery Microorganisms") as one of the types of microorganisms.

Background
Generally, there are five categories of microorganisms (simpler definitions are located in the glossary for student use):

Bacteria: These microorganisms are the oldest living things on Earth, and have been around an estimated 3 billion years (scientists have found fossils of cyanobacteria). They come in a variety of shapes (spheres, rods, or spirals) and are a diverse set of organisms. However, all of them are prokaryotes (they lack a nucleus). Bacteria is plural, bacterium is singular.

Algae: While not all algae are green, all algae are capable of photosynthesizing and are producers. However, most algae are not plants, and the majority are in the Protista kingdom. Like plants, algae produce oxygen and account for about 70% of all the oxygen produced on Earth. Algae can be single-celled or multicelled. 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. Fungi are distinguished from other decomposers in that they reproduce using spores, tiny, seed-like cells. Most fungi are multicellular, but others such as yeast are single-celled. Most cells of fungi are loosely connected through thread-like filaments called hyphae. Fungi is plural, fungus is singular.

Protozoa: The name protozoa means "first animal," and describes this microorganism's ability to move and hunt. Protozoa are members of the Protista kingdom. Ciliates, amoebae, and flagellates all are categories of protozoa and all are single-celled. 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.

Materials
- Mystery Microorganism Clues sheets
- Large (8.5 x 11) envelopes

Suggested Procedure
1. Prepare "mystery packets" ahead of time using the Mystery Microorganism Clues sheets. Print one set of each and put them in large envelopes labeling them "Mystery Microorganism #1," etc. Each packet should have two or three photos all from the same grouping (virus, bacteria, etc.). If students have access to laptop computers or tablets, photos could be loaded and viewed digitally.

   Mystery Microorganism #1 (Virus)
   - HIV/AIDS
   - The common cold
   - Chickenpox

   Mystery Microorganism #2 (Bacteria)
   - Yogurt
   - *E. Coli*
   - *Streptococcus*

Mystery Microorganism #3 (Protozoa)
- Malaria (*Plasmodium*)
- *Amoeba proteus*

Mystery Microorganism #4 (Fungi)
- Bread mold
- Penicillin
- Mushrooms

Mystery Microorganism #5 (Algae)
- Algae on a pond
- Algae (microscope photos)

2. Write the five different categories of microorganisms on the board, with the definition underneath (write on a white board or print out and put up). Go over the definition of each type of microorganism with the class:

   Bacteria: single-celled organisms that are shaped like spheres, rods or spirals

   Protozoa: single-celled parasites that act like animals (feed on and destroy bacteria and other organisms)

   Fungi: decomposers that break down matter, including bacteria

   Algae: single-celled and plant-like

   Viruses: non-living; cause many diseases

3. Divide the class into five groups and give each group one of the mystery packets. Each group has to figure out the category for their microorganisms. Give each group a few minutes to determine which category of microorganism they think they have. Tell them to be prepared to share their reasoning with the class.

4. Once allotted time is up (5 minutes or when all groups are finished), groups will share their conclusions. You can go group by group (i.e. which microorganism do you think your group has?), or by the type of microorganism (which group thinks they have algae?). Have each group come to the front and explain how their examples fit the definition for their microorganism. If there is room on the board, have each group place their photos up under the correct label and definition.

Extension

Ask the class a question to help further define the different categories and have the group stand up if the description fits their microorganism. Questions could include: Is yours a decomposer? A producer? Which ones are alive? Which ones can cause disease? Which can be treated by antibiotics?

Have students explore different types of organisms online. Suggested site: "What and where are micro-organisms" on: http://www.childrensuniversity.manchester.ac.uk/interactives/science/microorganisms/micro-organisms/

Microorganisms Are Everywhere Even in Zion National Park!

Duration
45 Minutes

Location
Inside

Key Vocabulary
algae, bacteria, fungi, protozoa, virus, decomposer, producer

Objectives
Students will be able to use their knowledge of different types of microorganisms to successfully categorize and describe specific microorganisms and infer what type of environment they might live in.

Method
Students will use a description and photo to categorize a species of microorganism and determine where it might live in Zion National Park.

Background
Microorganisms are found all over the world and can survive in a variety of extreme conditions. They are found in steam vents, boiling mud pots, and Antarctica. Some can even survive radiation levels 10,000 times higher than humans. Certain microorganisms prefer water, others soil, and still others live inside other living things.

Trillions of microorganisms live inside humans and other animals. Most microorganisms are helpful to us (and other animals), such as the bacteria that help us digest food. Scientists now think that a diversity of microorganisms inside our bodies help us resist many diseases.

One reason microorganisms have been around for billions of years is because they are able to thrive in all types of environments. In one gram of soil, for instance, there are around 40 million individual bacteria.

In dry areas like Zion National Park, bacteria pair with cyanobacteria (blue-green algae), fungi, algae, lichens, and mosses to create a fragile soil crust called biological soil crust. Biological soil crusts help prevent erosion and retain water and serve many important functions in Zion National Park and other desert areas. Microorganisms can also be seen in Zion National Park in areas like the Emerald Pools where algae grow in abundance.

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Grand Prismatic Spring in Yellowstone National Park

Biological soil crust forms when bacteria, algae, and fungi combine.

Materials

- Microorganisms Are Everywhere photos and reference sheet
- Microorganisms in Zion Descriptions and Worksheet

Suggested Procedure

1. Go over and show some of the different and extreme places microorganisms can live throughout the world ("Where Microorganism Live" document). Explain that microorganisms thrive everywhere: some can live in the most extreme of environments, but different species thrive in different environments. Alternatively, students could present each environment in turn instead of the teacher.

2. Randomly assign students one of the five microorganisms on the Microorganism Descriptions sheets (Rhizobia, *Streptococcus bovis*, Spirogyra, Aspergillus, and Giardia). Hand out printed copies or display the "Microorganism Descriptions" sheets about each microorganism so students can see the information.

3. Give each student a "Microorganisms in Zion" worksheet and have them use the information from the Microorganism Descriptions sheets to complete the information. Allow them around 15 minutes to work.

4. Once students are done, group them together by the microorganism. Allow them time to discuss their answers with each other and sort out any disagreements.

5. Have each group present their findings and their microorganism.

Extension

Students can further research their microorganism and write or share more information about it with the class (e.g. why the role of nitrogen-fixing bacteria like Rhizobia is important or how to prevent getting sick from Giardia).

Glossary

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

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.

decomposer: an organism that feeds on dead or decaying organisms. They cannot produce their own food but get their energy from breaking down dead organisms.

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.

microorganism: an organism that is so small it can only be viewed under a microscope (not with the naked eye). They usually are 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.

producer: an organism which can produce its own food using the energy from the sun to photosynthesize.

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.

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

References

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