PUTNAM

Microbes Adventure Post-Visit

Thank you for your visit to the Putnam Museum. We strive to provide high quality programs and hope that you and your students enjoyed your time with us. We appreciate your time and all you do for your students. Thank you for letting us be a part of their learning.

Sincerely,
Jennifer Ong
Education Specialist

Microbe Towers

Objective
Students will learn that...
• a variety of microbes live in different environments.
• some microbes can grow in environments that have no oxygen.

Background Information
In mud or soil, different microbes live at different levels because environmental conditions at each level are different. At the surface, oxygen dissolves from the air into water overlaying the soil, or into water in the soil. Deeper down, oxygen levels decrease until they disappear completely. The microbes in the upper oxygen-rich layers are like animals: they need oxygen to live. Deeper down, where oxygen levels are low or nonexistent, the microbes are more like the microbes that first lived on Earth. They can survive without oxygen, and for many, oxygen is a poison. The zone where oxygen is present is called the aerobic zone, and microbes found there are called aerobes. The zone where no oxygen is present is the anaerobic zone. Microbes there are called anaerobes.
Sulfur levels vary opposite to oxygen levels. Where oxygen concentrations are low, sulfur concentrations are high. Sulfur, in the form of hydrogen sulfide, is released as bacteria and fungi decompose dead plant and animals. In the Microbe Towers, which your class will be building as part of this activity, sulfur levels are highest at the bottom. You can't mistake hydrogen sulfide-it smells like rotten eggs. A sulfur smell indicates anaerobic conditions. Some bacteria live where sulfur concentrations are high. Others can't tolerate any sulfur in the environment.

As your microbe towers mature, colorful areas will develop. The colors come from photosynthetic
bacteria-bacteria that make their own food from carbon dioxide, water and sunlight, just like green plants. The bacteria are different colors because they're using different wavelengths of light to produce food. Some of the anaerobic bacteria make their own food, like the photosynthetic bacteria in the upper layers. Except they use sulfur from hydrogen sulfide instead of carbon from carbon dioxide to do so.

Activity Materials

• transparent containers over 6-inches (15-cm) tall. Clear plastic soft-drink containers will do.
• sharp scissors
• large bucket of soil, mud or sand from a nearby pond or salt marsh; you can also use
• soil from a garden, forest or field. You'll need enough to fill all the plastic bottles.
• water (use pond water if you're using pond mud or soil; tap water is OK if you let it sit
• two days to let the chlorine escape. If you're using salt marsh mud, use salt water.)
• boiled egg yolks or entire raw eggs
• shredded newspaper as a source of carbon
• calcium carbonate (lime) (optional)
• masking tape
• eyedropper
• clear plastic wrap
• rubber bands
• several 40- or 60-watt incandescent light bulbs (optional)

Questions to Begin

• Do all organisms need oxygen to survive?
• Why do stagnant pools sometimes smell like rotten eggs?

Adapted from
Zook, Dr. Douglas, ed.The Microcosmos Curriculum Guide to Exploring Microbial Space. Dubuque, IA: Kendall/Hunt Publishing Company, 1992.

Procedure

1. Begin by making the microbe towers containers. Each student can make his or her own, or you can make them ahead of time. In either case, you'll make the first cut. With sharp scissors, make a small cut near the top of each plastic bottle, at the level where the bottle becomes its widest. Then you or the students can finish cutting the tops off the bottles.
2. If you can, take the class on a mud- and water-gathering field trip. Collect mud and water in buckets with lids. If a field trip is not feasible, collect the water and mud ahead of time yourself.
3. When you return to the classroom, choose a well-ventilated area. Open all windows or find a place outside to set up the microbe towers. (Warning: the experiment will get smelly.)
4. In an extra bucket, mix soil or mud with water so that it's as thick as heavy cream. Remove any rocks, sticks or leaves. Pour a portion into another container and mix in the eggs, newspaper and calcium carbonate. This will become the bottom layer. Pour the smelly mixture into each container until it makes a layer 2 or 3 inches (5 to 7 cm) deep. You can use the cut-off top of a bottle as a funnel. Tap each bottle gently to remove any air bubbles (trapped air will prevent the layer from becoming anaerobic) and to flatten the layers.
5. To each container add 2 or 3 inches (5 to 7 cm) of mud with no egg or newspaper and tap them again. Continue filling the containers layer by layer until they are filled to about 2 inches (5 cm) from the top.
6. Each student should write his or her name and the date on a small piece of masking tape and label his or her microbe tower with it.
7. Place the microbe towers in a well-lit place out of direct sunlight and let settle overnight. A counter near a north-facing window works well. By morning there should be a half-inch (1 cm) of water on the surface. You can remove any extra water or add a little if you need to with an eyedropper.
8. Cover each container with clear plastic wrap and secure with a rubber band. If you can, set up 40- or 60-watt incandescent light bulbs so they shine on the tops and sides of the towers, but don't heat them. Turn on the bulbs every day or let them shine continuously.
9. In the coming weeks the bacteria in your microbe towers will bloom with color as colonies sprout and grow.
10. If you like, you can collect mud from different environments (pond, salt marsh, river, etc.) and build a few towers with each. Then the students can take notes and compare what grows in each container. The class may have some ideas of experiments they can do. Be sure they form a hypothesis as part of designing the experiment.
11. Each student can make daily observations of his or her tower and keep track of them in a notebook or use the Microbial Towers Worksheet (attached).They can diagram the microbe tower, the different layers and the bacteria growth in each layer helps.
12. The students can place towers in different environments (warm, cool, sunny or dark) and compare bacterial growth in each.

Questions to Close

- In which layers are aerobic bacteria growing?
- In which layers are the anaerobic bacteria growing?
- Which layer has the highest sulfur concentrations?

Microbes Tower Worksheet

Name _____
Soil source _____
Date microbe tower was built _____
Date first colors were seen _____

Week One
Number of inches (or cm) from top_____Color observed _____
Number of inches (or cm) from top_____Color observed _____
Number of inches (or cm) from top_____Color observed _____
Number of inches (or cm) from top_____Color observed _____
Number of inches (or cm) from top_____Color observed _____
Notes:
_____
_____
_____

Week Three
Number of inches (or cm) from top_____Color observed _____
Number of inches (or cm) from top_____Color observed _____
Number of inches (or cm) from top_____Color observed _____
Number of inches (or cm) from top_____Color observed _____
Number of inches (or cm) from top_____Color observed _____
Notes:
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Week Five
Number of inches (or cm) from top_____Color observed _____
Number of inches (or cm) from top_____Color observed _____
Number of inches (or cm) from top_____Color observed _____
Number of inches (or cm) from top_____Color observed _____
Number of inches (or cm) from top_____ Color observed _____
Notes:
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