SCIENTIFIC AMERICAN FRONTIERS

TEACHING GUIDE

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Hot Times in Alaska

Activity 2: Grades 5-8 and 9-12

Permafrost

Lakes are in a state of balance. In order to maintain the same volume, water input must equal water output. When water input is greater, the lake grows in size. When water loss is greater, the lake shrinks. As a result of global warming, several factors-including increased evaporation, reduced precipitation, and increased soil permeability-have shifted this balance. In Alaska, many lakes and wetland regions appear to be drying up. As they disappear, shifts in the ecology threaten delicate Alaskan ecosystems.

This activity page will offer:

- An introduction to permafrost
- The opportunity to create and examine a frozen soil
- A hands-on activity in quantifying the effects of frozen soil on water percolation

Seeping Through Soil

Permafrost is soil that becomes so cold that it remains frozen throughout the year. In this form, it can act as a barrier to the free flow of water. Found beneath Alaskan lakes, permafrost prevents lake water from seeping away into the deeper sediments. However, as temperatures heat up, permafrost melts. This makes soils more permeable, therefore increasing the rate at which a lake loses water. In this activity, you'll explore how frozen soil affects the percolation of water.

Materials

- Fine soil (packaged and sterile)
- Heavy stock plastic transparency sheets
- Rubber bands
- Food coloring 100 mL of ice water
- Beaker
- Water spray bottle
- Scissors

- Pans
- Access to a freezer

Procedure

1. Roll two sheets of clear plastic into two cylinders. Each cylinder should have a diameter of about 2 inches. Use rubber bands to secure their shape.
2. Use a scissors to make small cuts in the bottom of each tube as shown here. These cuts will allow water to pass out of the tube.
3. Lightly moisten the soil with a spray of water. Fill both tubes with moistened soil. Pack the soil as best as you can without damaging the plastic containers.
4. Place one of the containers in a freezer.
5. The next day, set both soil-filled containers upright in aluminum pie pans or similar containers.
6. Add several drops of food coloring to a beaker filled with ice water. Mix well.
7. Pour 50 mL of dyed water into both cylinders at the same time.
8. Observe the movement of water through the soil samples. Compare and contrast the speed at which the percolation occurs.

Questions

1. Why was water sprayed on the soil before it was placed into the freezer?
2. Why was ice water instead of tap water used in the percolation test?
3. Did you observe changes in the speed at which water seeped through the soil samples? Explain.

Critical Thinking

How might the particle size of the soil sample also affect percolation rate?

Local Effects

Most of us are aware of climatic change on the global scale. But what about local shifts in climate? Can evidence for global warming be uncovered in your locality? Use online and library sources to research average temperatures for your nearest city or weather station. Make a graph that displays this data. Did your research uncover any evidence for a local change in climate? Explain.

Fictional Future?

Imagine that global warming continues at its current rate. What will our world look like in 100 years? How will changes in climate affect our society? Will wars be fought over climate? How might warming trends affect the ecological balance of our planet? Which species would be most likely to suffer? Identify one issue of global warming concern. Write a science fiction story based on this theme. Remember, like all good science fiction, your story should integrate current science facts with fictional elements.

Take a Picture

Review library and online resources that illustrate historic images of local parks, green areas and open spaces in your immediate environment. On a class photo outing, locate those same areas and recapture images of these places. Compare and contrast the new and old views. How has the landscape changed? Can you observe any difference in the vegetation or plant populations? Do you think observed changes in your region were caused by global warming or are they the result of other processes? Explain.

Web Connection

Alaska Conservation Foundation

http://www.akcf.org/gw.htm
This site hosted by the Alaska conservation fund offers online versions of professional presentations and papers that address key issues in global warming.

Global Warming Links

http://www.autobahn.mb.ca/~het/globalwarming.html
The site presents a library of hyperlinks to global warming URLs.

Glacier and Permafrost Changes in High-Mountain Areas

http:// www.forestry.ubc.ca/alpine/highlights/ screen-pdfs/03-mountain-science-permafrost-view.pdf
This downloadable PDF file offers an overview of the effects of glacier and permafrost retreat in alpine regions.

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Questions

1. Why was water sprayed on the soil before it was placed into the freezer? **(To insure that there was enough moisture to produce a significant permafrost.)**
2. Why was ice water instead of tap water used in the percolation test? **(Ice water would melt less of the frozen soil as it moved down the column.)**
3. Did you observe changes in the speed at which water seeped through the soil samples? Explain. **(Yes. The water moved more quickly through the room temperature soil sample.)**

Critical Thinking

How might the particle size of the soil sample also affect percolation rate? **(Soils with larger size particles are likely to have faster percolation rates. That's because their particles aren't packed as densely and offer multiple paths for water flow.)**