

Permafrost: Permanently Frozen Ground

Levels



Grades K-4

Overview:

Students explore freezing and thawing and relate frozen water to permafrost.
(NOTE: This lesson may require more than one day.)

Objectives:

The student will:

- freeze and thaw water;
- freeze and thaw soil;
- measure temperature with a thermometer; and
- define permafrost.

GLEs Addressed:

Science

- [3-4] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating.
- [3] SA2.1 The student demonstrates an understanding of the attitudes and approaches to scientific inquiry by answering “how do you know?” questions with reasonable answers.
- [3] SB1.1 The student demonstrates an understanding of the structure and properties of matter by classifying matter according to physical properties (i.e., color, size, shape, weight, texture, flexibility).
- [3] SB3.1 The student demonstrates an understanding of the interactions between matter and energy and the effects of these interactions on systems by recognizing that temperature changes cause changes in phases of substances (e.g., ice changing to liquid, water changing to water vapor, and vice versa).

Vocabulary:

Permafrost – permanently frozen subsoil, occurring throughout the polar regions and locally in perennially frigid areas.

Whole Picture:

Permafrost is soil, semi-decomposed vegetation, a dead woolly mammoth buried in the ground, or any other material that has remained frozen for more than two years. Permafrost is a function of frigid winters or cold periods powerful enough to outweigh the thawing power of summers. Permafrost forms on Earth in cold places when the mean annual temperature is close to 27°F (-3°C) or below.

Much of the permafrost in Alaska was established during a much colder period more than 20,000 thousands of years ago, when air temperatures were so cold they penetrated deep into soil, sucking out heat year after year and leaving places, such as Alaska’s North Slope, with frozen soil several thousands of feet deep.

People have paid attention to permafrost because of how it affects our buildings, roadways, and pipelines when it thaws and causes the ground to slump. When kept frozen, permafrost provides a strong foundation, but when ice-rich permafrost thaws, settling occurs, buckling roadways and forcing people to repair unstable foundations.

Materials:

- Water
- Paper cups (2 per small group)

- Soil
- 3 containers of different shapes
- Ice
- Plastic bottle or aluminum can
- Scissors
- Lamp or other heat source
- OVERHEAD: “Solids and Liquids” or display of various solids and liquids
- STUDENT WORKSHEET: “Chilling”

Activity Procedure:

Day 1

1. Show OVERHEAD: “Solids and Liquids” or display various objects to students. Ask students to name which items are solids and which are liquids. Ask students to explain how they know which is which. Keep a list of student responses on the board.
2. Explain solids keep their shape. Show students several examples of solids from the classroom. Ask students to name adjectives to describe solids. Make sure students understand that solids do not have to be hard; they can be soft or fluffy.
3. Explain liquids change based on the shape of the container they are in. Show students how the shape of the liquid changes in different containers by pouring a moderate amount of liquid (water) into three or four differently shaped containers. Make sure students understand that the amount of liquid hasn’t changed, only its shape. If necessary, mark the level of the liquid in the original container and pour the liquid back into its original container between each other container to demonstrate that its volume has not changed.
4. Ask students what will make a solid melt. List answers on the board or paper. Explain heat is what makes a solid melt. This can be demonstrated by placing ice on a plate under a lamp or near a heat source and instructing students to watch it melt for 30 minutes, checking it every 10 minutes. Ask students what other solids melt when they are heated. (*butter, chocolate, etc.*). If time and resources allow, demonstrate melting with other substances.
5. Ask students what happens when liquids are cooled. If students do not mention that some liquids may become solids, lead them to this discussion. (NOTE: This can be demonstrated by placing water in the freezer and asking students to observe it the following day after it has frozen or melting chocolate and allowing it to cool and harden.)
6. Ask students to define permafrost. If necessary, explain that it is permanently frozen ground. This means the ground never thaws or melts, even in the summer. Ask students how frozen ground differs from non-frozen ground. (*Frozen ground is hard, cold and can be used to keep things cold; non-frozen ground can be softer, warmer, and may be wet.*)
7. Divide students into small groups. Fill two paper cups for each group with soil and add a small, but equal amount of water to each cup. Ask students to describe the soil and water mixture. Ask students to predict what will happen to the mixture if it is placed in the freezer (Activity Procedure 9). List all student ideas on the board or chart paper.
8. Place one cup from each group in the freezer.

Day 2

9. Remind students of their predictions. Remove the soil and water mixture from the freezer. Distribute STUDENT WORKSHEET: “Chilling” and ask students to draw a picture of both the frozen and non-frozen mixtures and write about what they see. As a class, discuss student observations and remind students that permafrost is permanently frozen ground, or ground that is always frozen, even in the summer.

Extension Ideas: (1) Invite students to create a collage and write a poem to accompany it in “I Spy” fashion. Provide magazines and scissors, or pre-cut pictures of liquids and solids, construction paper and glue for the collage. After students have finished their collage, instruct them to write a poem. Older students can create a riddle, such as for orange juice and socks, “I spy a liquid that’s orange and sweet and a solid that’s smells like my brother’s feet.” Younger students may identify the liquids and solids in their collage without the riddle, such as “I spy some juice, a rake, and a brush, a goose, a cake, and a plate of mush.” If appropriate, introduce or encourage rhyming. *([3-4] SB1.1)*

(2) Put small quantities of different substances (e.g., chocolate, wax, butter, ice cube, cheese) into small plastic or foil containers (such as tart tins) and stand them or float them in hot water. Ask students to observe the changes. Do they all melt? Why or why not? Remove the containers and place them in cold water or on a bed of ice and ask students to observe them solidifying. Older children can investigate that materials melt at different temperatures or time how long it takes for each substance to melt, collecting and graphing their data. *([3-4] SB3.1)*

Answers:

Answers will vary.

Name: _____

Chilling Student Worksheet

Levels



Directions: Draw and describe your water and soil mixtures as directed below.

1. A. Draw the water and soil mixture.



B. Describe the mixture.

2. A. Draw the FROZEN water and soil mixture.



B. Describe the mixture.
