IS PERMAFROST PERMANENT?

INSTRUCTIONS
Grade 8

Prep Time: 30 minutes
Teaching Time: 3 hours (may be covered over several class periods)

Science Concept:

Permafrost thawing is affected by the surface insulating layer.
(NOTE: Students should have some experience designing and conducting controlled experiments before this lesson.)

Objectives:

The student will:

- describe the flow of energy needed to melt ice;
- make an inference from a provided scenario; and
- describe how to repair damage to the tundra.

GLEs Addressed:

Science

[8] SB2.1 The student demonstrates an understanding of how energy can be transformed, transferred, and conserved by identifying the initial source and resulting change in forms of energy in common phenomena (e.g., sun to tree to wood to stove to cabin heat)

[8] 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.

Writing

[8] W3.2.2 The student writes for a variety of purposes and audiences by writing in a variety of nonfiction forms (e.g., letter, report, biography, and/or autobiography) to inform, describe, or persuade.

Vocabulary:

insulation – a covering, linking or separating something with a material that prevents or reduces the passage, transfer or leakage of heat, electricity, or sound

permafrost – a thick subsurface layer of soil that remains below freezing point (0˚C or 32˚F) for at least two consecutive years, occurring chiefly in polar regions

Materials:

- Ice cube trays
- Water source
- Towels
- Resealable plastic baggies
- Graduated cylinders, 100 millileter (1 per group)
- Fiberglass insulation
- Gloves (for use when handling fiberglass insulation)
- Styrofoam
- Cardboard
- Moss (fresh and dried)
- Brown paper towels
- Science journals

Activity Preparation:

At least one day before teaching this lesson, make enough ice cubes for each student in the class to have two or three ice cubes (1 for Explore, 1 or 2 for Experiment). When the ice cubes are frozen, place each ice cube in a resealable plastic baggie (for easy cleanup). Store ice cubes in baggies in the freezer until teaching the lesson.

Activity Procedure:

Please refer to the assessment task and scoring rubric located at the end of these instructions. Discuss the assessment descriptors with the class before teaching this lesson.

Gear Up

Process Skills: observing and predicting

1. Set two ice cubes underneath a lamp (turned off) on a flat surface for all students to observe. Leave one ice cube uncovered. Place a brown paper towel on top of the other ice cube. Turn on the lamp and ask students which ice cube will melt first. Provide students with time to explain their choice. Discuss the purpose of insulation and the flow of energy needed to melt the ice. Ask a student to make a diagram of the energy flow on the board.

Explore

Process Skills: questioning, communicating, and observing

2. Distribute an ice cube (in baggie for easy cleanup), towels, fiberglass insulation, gloves, Styrofoam, cardboard, and moss to each student. Ask students to determine which material will insulate the ice cube so that it melts slowest. To determine this, students will need to choose one or more of the materials provided to insulate the ice cube. After 40 minutes have passed, students should use a graduated cylinder to measure the amount of water in the ziplock bag and record the information in their science journals. Allow students to work with the materials, providing minimal instruction. As students are exploring, ask the following questions:
   a. What effect will the insulation have on the ice cube?
   b. What happens if there is no insulation for the ice cube?
   c. What materials make good insulators? Poor insulators?

Generalize

Process Skill: communicating

3. Ask students the following questions and discuss as a class:
   a. Which insulator worked the best? How could you tell?
   b. What is permafrost? Do we need permafrost? Why?
   c. What is the effect of permafrost on flooding? Weather? Erosion?

Experiment

Process Skills: observing, controlling variables

4. Ask students to design an experiment to find out how ground cover affects permafrost. Explain that the testable questions for students' experiments will be: What will prevent permafrost from thawing? What will slow down the thawing of the permafrost?
5. Students should investigate variables such as depth of insulation, moisture in ground cover, and if the ground cover is living or dead. Ask students to compare two or three types of insulation. Distribute additional ice cubes in baggies. Encourage students to try uncovered, covered, and dead or dry ground cover. Check students' experimental designs before letting them proceed. Students' experimental designs should include a hypothesis, list of materials, and a data table to record measurements. (NOTE: You may want to allow students to investigate outdoors.)

Interpret

Process Skill: communicating

6. Ask students to describe to the class what happened when they used the different variables to test their hypothesis.

7. Ask students to answer the following questions and discuss as a class:
   a. Do your results match your predictions? Why or why not?
   b. How did the different types of insulation affect the melting of ice?
   c. What other variables affected the melting of the ice?
8. In their science journals, ask students to describe the source of energy that caused the ice to melt. Explain that students also may include a diagram of the flow of energy used to melt the ice.

Apply

Process Skill: communicating

9. Instruct students to write a description of how this information might be used in our lives and answer the question: Does global climate change affect permafrost?

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RUBRIC

Assessment Task

Ask students to imagine they have been driving a four-wheeler on the tundra over the same path daily. They notice over time water is accumulating in the tracks left by the four-wheeler. Ask students to write an inference explaining why this is happening. They may include diagrams and data from the lesson to support their inference. Ask them to describe how they would repair the tracks and explain why they chose that method. Students may include data from their own experiment or another group's experiment.

Rubric

Objective	GLE	Below Proficient	Proficient	Above Proficient
The student will describe the flow of energy needed to melt ice.	[8] SB2.1	The student does not describe the flow of energy needed to melt ice.	The student correctly describes the flow of energy needed to melt ice.	The student correctly describes the flow of energy needed to melt ice, and includes a diagram of the flow of energy.
The student will make an inference from a provided scenario.	[8] SA1.1	The student does not make an inference as to why the water is accumulating in the tracks.	The student makes a logical inference as to why the water is accumulating in the tracks.	The student makes a logical inference as to why the water is accumulating in the tracks and supports the inference with diagrams and/or data from the lesson.
The student will describe how to repair damage to the tundra.	[8] W3.2.2	The student does not describe how to repair the tracks and/ or does not give any explanation why the method was chosen.	The student describes how to repair the tracks and gives an explanation of why the method was chosen.	The student describes how to repair the tracks and gives an explanation of why the method would be used. The student's response includes data from their own, or another group's experiment.