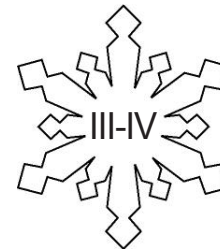


Keep It Cool _____

Levels



Grades 5-8

Overview:

Snow and the active layer of permafrost insulate the frozen ground, slowing the escape of heat and helping to keep the permafrost frozen. In this lesson, students explore insulation and heat transfer by designing and testing a soda insulator.

Objectives:

The student will:

- design and test a soda insulator;
- identify snow as insulating permafrost; and
- explain insulation slows the transfer of heat.

GLEs Addressed:

Science

- [5-8] 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.
- [6] SD3.2 The student demonstrates an understanding of cycles influenced by energy from the sun and by Earth's position and motion in our solar system by identifying that energy transfer is affected by surface conditions (e.g., snow cover, asphalt, vegetation) and that this affects weather.
- [6-7] SE2.2 The student demonstrates an understanding that solving problems involves different ways of thinking by comparing the student's work to the work of peers in order to identify multiple paths that can be used to investigate a question or problem.

Math

- [5] S&P-1 The student demonstrates an ability to classify and organize data by designing an investigation and collecting, organizing, or displaying, using appropriate scale, data in real-world problems (e.g., social studies, friends, or school) using bar graphs, tables, charts, diagrams, or line graphs with whole numbers up to 50.
- [6] S&P-1 The student demonstrates an ability to classify and organize data by designing an investigation and collecting, organizing, or displaying, using appropriate scale for data displays, data in real-world problems (e.g., social studies, friends, or school) using bar graphs, tables, charts, diagrams, line graphs, or circle graphs with whole numbers up to 100.

Whole Picture:

Permafrost is frozen ground. The top layer of the permafrost is called the active layer. This layer thaws and refreezes in an annual cycle, while the permafrost underneath stays frozen throughout the year. The active layer also serves as insulation for the permafrost, slowing the rate of heat transfer from the atmosphere. Snow and organic material on the surface of the ground also serve as insulators, slowing heat transfer.

Materials:

- Soda can, full, refrigerated (five per group)
- Resealable sandwich bags (10 per group)
- Thermometers (five per group)
- Newspaper

- Felt
- Cotton balls
- Feathers
- STUDENT WORKSHEET: “Soda Insulator”

NOTE: Materials used in the “Design an Insulator” portion of the activity will vary based on students’ experimental design and will need to be supplied by the school or furnished by the student.

Activity Preparation:

1. Turn a resealable bag inside out and place it inside a second bag so that the seals line up.
2. Place a soda can inside the two bags.
3. Fill the space between the two bags with cotton balls, so it is as full as possible. Make sure the soda can stands upright. When the bags are as full as possible, remove and store the cans for use during the activity procedure.
4. Repeat steps 1-3, filling the bags with crumpled newspaper, felt, feathers, and air (control). Prepare one set of five bags for each group of students.

Activity Procedure:

Exploring with Insulators

1. Show students a set of bags (from Activity Preparation) and a can of soda. Ask students to predict which bag will keep the soda cool the longest.
2. Allow students to put their hands in the bags and/or feel the materials to help them make a prediction.
3. Divide the class into small groups. Distribute a set of five bags, five thermometers, and five soda cans (directly from the refrigerator) to each group. Distribute the STUDENT WORKSHEET: “Soda Insulator” to each student.
4. Ask groups to open the cans (or open the cans for them), measure the initial temperature of each can, and record it on their chart.
5. Ask groups to place their cans in the bags, carefully so that they do not spill. Instruct groups to measure the temperature every 5 minutes for 25 minutes or until the cans are all equal temperature. Students should record all data on the chart on their worksheet.
6. Instruct students to graph their results and complete the remainder of their worksheets.
7. As a class, graph the results and discuss the following:
 - a. Which insulator kept the soda coolest longest?
 - b. Was your prediction correct?
 - c. Could the investigation have been improved?
 - d. What else could you test as insulation material?

Permafrost

8. Ask students to imagine it is winter and there is a thick blanket of snow on the ground. Ask students if they think it is warmer on the top of the snow or at the surface of the ground and why.
9. Ask students how they could find out. If it is winter and equipment is available (temperature sensor), test student hypotheses by placing a temperature sensor on the top of the snow and at the ground level. Collect temperature data over the course of several hours.

10. Explain snow, just like cotton balls or felt, can be an insulator. The snow slows the transfer of heat from between the ground and the air. If there is permafrost in the ground, the snow can help to keep the permafrost cold, just like cotton balls around a soda can help keep the soda can cold.

Critical Thinking Question: Voting Method. Explain during the summer, when there is no snow on the ground, the top few feet of ground thaws. Ask students what would happen if it was summer all year and there was no snow to insulate the ground. Select two possible scenarios from the class discussion, and ask students to vote between the alternatives. Discuss the results.

11. Explain (or remind students) permafrost has an active layer, a layer that thaws and freezes in an annual cycle. This layer of soil and organic material (plants) also helps insulate the permafrost from the atmosphere and slows the transfer of heat from the atmosphere to the permafrost.

Design an Insulator

12. Divide students into small groups. Ask groups to design an improved soda insulator based on the results of their investigation. Ask groups to draw and write an explanation of their proposed design.
13. After reviewing student designs, help students obtain the necessary materials to create their soda insulator. (NOTE: Materials used in this portion of the activity will vary based on students' experimental design and will need to be supplied by the school or furnished by the student.)
14. Repeat the exploration, this time using each group's soda insulator in the test. Discuss results.

Answers:

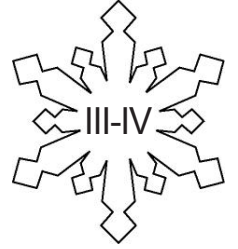
1. Answers will vary.
2. D. An item that slows the transfer of heat.
3. Answers may vary.
4. Answers may vary, but should be an accurate reflection of the data recorded in Question 3. A key should be present and the axes labeled.
5. Answers will vary.
6. Answers will vary.
7. Answers will vary.
8. D. All of the above.
9. Answers will vary, but should indicate the permafrost would thaw from lack of insulation.

Name: _____

Soda Insulator

Student Worksheet (page 1 of 3)

Levels



Directions: Answer the following questions.

1. Make a prediction. Which insulator do you think will keep the soda the coolest longest?
 - A. Feathers
 - B. Cotton balls
 - C. Air
 - D. Newspaper
 - E. Felt

2. What is an insulator?
 - A. An item that traps heat.
 - B. An item that cools another object.
 - C. An item that gives off heat.
 - D. An item that slows the transfer of heat.

3. Place a soda can in each insulator and open the cans. Place a thermometer in each can. Use the chart below to record the temperature of each can every 5 minutes.

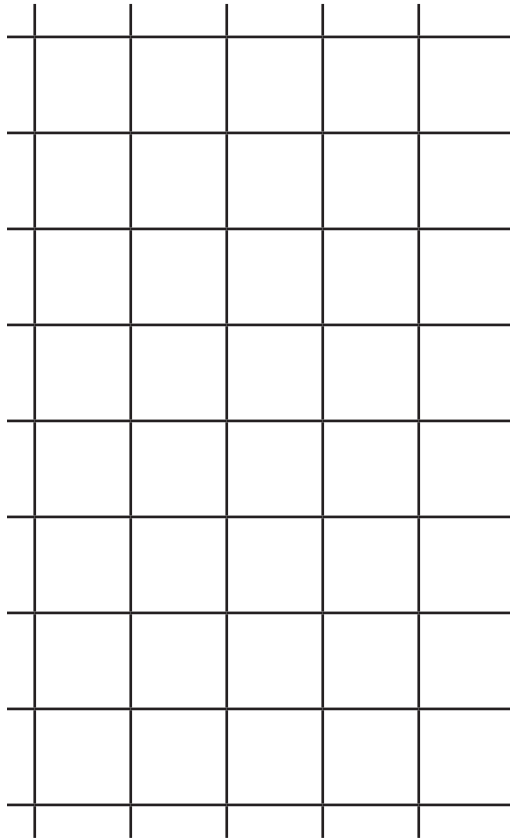
Insulator	0 minutes	5 minutes	10 minutes	15 minutes	20 minutes	25 minutes
Feathers						
Cotton balls						
Air						
Newspaper						
Felt						

Name: _____

Soda Insulator

Student Worksheet (page 2 of 3)

4. Graph your data. Be sure to fill in the key and label your x- and y-axis.



Key
Feathers
Cotton balls
Air
Newspaper
Felt

5. Explain what the graph above shows. Which insulator was the most effective? Why?

Name: _____

Soda Insulator

Student Worksheet (page 3 of 3)

6. Was your prediction correct? _____

7. What else could you test as an insulation material?

8. Which of the following insulates the permafrost?

- A. Snow
- B. Active Layer
- C. Plants
- D. All of the above

9. What do you think would happen to the permafrost if all the snow melted and the ground stayed uncovered? Explain.

