

THAWING PERMAFROST

Prep Time: 45 minutes
Teaching Time: 3 hours

INSTRUCTIONS
Grade 6



Science Concept:

Insulators and conduction affect energy transfer to and from Earth's surface.

Objectives:

The student will:

- describe how insulators slow the rate of energy transfer and how conduction increases the rate of energy transfer;
- state inferences and predictions based on quantitative and qualitative observations; and
- use appropriate vocabulary for comparison/contrast.

GLEs Addressed:

Science

- [6] SD3.2 The student demonstrates an understanding of cycles influences 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] 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

- [6] W2.1.3 The student writes about a topic by organizing and sequencing ideas logically to establish clear relationships within and between paragraphs (e.g., using transition words or phrases that reveal order or chronology, comparison/contrast).

Vocabulary:

conduction - the transmission of heat through a substance, resulting from a difference in temperature between different parts of the substance; the transmission of electricity through a substance resulting from a difference in electric potential between different parts of the substance

degree – a unit of measure used in several scales of temperature; the symbol ° is usually used, followed by the initial letter of the unit, for example: "°C" for degree(s) Celsius and "°F" for degree(s) Fahrenheit

heat – thermal energy that flows from an object or substance at a higher temperature toward an object or substance at a lower temperature

heat transfer – the passage of thermal energy from a hot to a colder object (through conduction, convection, radiation)

insulator - a substance that blocks or retards the flow of heat or electric current

liquid – one of the three states or phases of matter; a substance that flows and takes on the shape of the container it is in, but maintains a specific volume; particles in a liquid are not as closely bound together as they are when the substance is in a solid state

solid – one of the three states or phases of matter; does not flow or take on the shape of the container in which it is contained, but maintains a fixed shape and size even if force is applied

temperature – a measurement of the amount of heat a substance contains; three major temperature scales are Fahrenheit, Celsius, and Kelvin

thermal energy – energy that is released when an object is heated; when thermal energy is applied to a substance, the average velocity of the particles or molecules which make up the substance increases and the temperature increases

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Materials:

- Shoeboxes (two per group)
- Scissors
- Sawdust
- Styrofoam cups (two per group)
- Resealable plastic bags (two per group)
- Water
- Styrofoam packaging peanuts
- Various insulating materials available locally (snow, soil, cloth, crumpled up newspaper, etc.)
- Photos showing areas where permafrost has thawed
- Science journals
- Graduated cylinder (one per group)
- Computer with Internet access (optional)

Activity Preparation:

1. Fill Styrofoam cups with water and place in freezer. There should be two cups per small group. Each cup should hold the same volume of water.
2. Use *Google Images* (<http://www.images.google.com>) to locate photos showing areas where permafrost is thawing or has thawed.

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: communicating, describing, brainstorming, recording, and investigating

1. Create a K-W-L chart (see matrix at the end of this lesson). Ask students to share their knowledge, interests, and experiences regarding heat transfer. Write students answers in the K column of the K-W-L chart. Instruct students to take notes during discussion.
2. Display some photos of permafrost thawing (located during Activity Preparation), and discuss the photos with students, asking them to speculate what happened before and after the photo was taken. Ask students to consider what will happen if the holes generated by the thawing permafrost become filled with water.
3. Divide students into pairs and assign them to computers with Internet access. Ask students to research permafrost thaw by searching MSNBC (<http://www.msnbc.msn.com/>). Alternatively, provide students with copies of downloaded articles to read. Discuss the costs of repairing buildings, structures, and public transportation systems.
4. Review vocabulary words with the class.

Explore

Process Skills: communicating, designing, predicting, inferring, and collecting data

4. Explain students will be participating in a hands on activity related to permafrost thawing. Divide students into groups, and explain and discuss the proper use and care of supplies. Instruct students to keep notes during the activity.
5. Distribute two shoeboxes, scissors, two cups of ice (see Activity Preparation), two resealable bags, and insulation materials (sawdust, Styrofoam packing peanuts) to each group. Explain these tools will be used to explore how heat is transferred to Earth's surface.
6. Instruct students to cut one hole in the top of each shoebox to act as a tray for the cups. Instruct students to poke an equal number of drainage holes in the bottom of each cup and to put each cup

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into a resealable bag to catch melting liquid. Ask students to place sawdust in the top of each cup. Ask students to place the cups into the shoebox holes, so only the tops are exposed to outside air, and to place their choice of insulation material, filling the entire shoebox. Each box should have a different insulation material.

7. Explain that students should record all observations and inferences in their science journals as they continue with the activity. They should include specific data about the thickness of insulation for each cup of ice and about the amount of water that melted during the energy transfer. Students can measure the amount of melted ice (water) by pouring the water from the resealable bags into a graduated cylinder at regular intervals (i.e. every 30 minutes) over the next four hours or until the ice is completely melted. Remind them to place the cups in the resealable bags and put them back in the shoeboxes immediately after pouring the water into the graduated cylinder. Ask students to create a data table in their science journals to record their results.

Generalize

Process Skills: inferring, communicating, and describing

8. Ask students the following questions and discuss:
 - a. What did you observe?
 - b. How long did it take to notice a difference in melting?
 - c. How did the thickness of the insulation affect heat transfer (melting)?
 - d. What would happen if more insulation were used?
 - e. What other kinds of material could you have used for insulation?
 - f. What other applications can you think of that require insulation?
 - g. What would happen with less insulation used?
 - h. What might you expect to happen over a longer period of time?
 - i. What deductions or conclusions can you make concerning heat transfer?

Apply

Process Skills: predicting, inferring, and communicating

9. As a class, take a brief walk around the school or surrounding community; bring a digital camera and journal or notebook to record observations. Check for signs of permafrost thaw. Instruct students to record observations in writing and through photographs. After returning to the classroom, ask students to make a PowerPoint presentation about the classroom activity and observations of nature.

Extension Ideas:

1. Ask students to write a fiction story on the damaging effects of thawing permafrost.
2. Invite an Elder to the classroom to share any traditional uses for permafrost/moss.
3. As a class, build a freezer out of natural insulators to preserve food at fish camp.

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RUBRIC

Assessment Task

1. In their science journals, as students to compare and contrast the transfer of heat using two separate insulation models. Based on their observations during the Explore, ask students to make an inference about the conduction of heat with the models they used.
2. As students to describe in their science journals how insulators slow down, and conductors increase, the transfer of heat. Ask them to give examples of each.

Rubric

Objective	GLE	Below Proficient	Proficient	Above Proficient
The student describes how insulation slows down energy transfer and how conduction helps energy transfer.	[6] SD3.2	The student describes how insulation or conduction slows or increases the rate of energy transfer.	The student describes how insulation slows down energy transfer and how conduction increases the rate of energy transfer, and provides an example of each.	The student describes how insulation slows down energy transfer and how conduction expedites energy transfer and provides multiple examples of each.
The student states inferences and predictions based on quantitative and qualitative observations.	[6] SA1.1	The student does not make an inference.	The student states an inference based on both quantitative and qualitative observations.	The student states more than one inference clearly and concisely, using appropriate vocabulary, based on quantitative and qualitative observations.
The student writes, using appropriate vocabulary for comparison/contrast.	[6] W2.1.3	The student does not write a comparison or a contrast.	The student writes at least four sentences to compare and contrast the insulation models .	The student writes more than four sentences to compare and contrast the insulation models.



THAWING PERMAFROST K-W-L CHART MATRIX



K What I KNOW	W What I WANT to Know	L What I LEARNED
K	W	L
___ 1. ___ 2. ___ 3. ___ 4. ___ 5.	___ 1. ___ 2. ___ 3. ___ 4. ___ 5.	<p>After reading, creating, and “learning” the material, go back to the “K” column and see if any of your prior knowledge was inaccurate.</p> <p>Check and rewrite your statements that were inaccurate so they are correct. Then go to the “W” column and check any of your questions that the text did not answer.</p> <p>Be prepared to bring these unanswered questions up in class, or tell how you will find answers to them and where you will look to get the answers.</p>