

Cynde Hill

4th Grade

Title: Keepin' the Heat! (an insulation lesson)

GLEs Addressed:

Alaska State Science GLE: [4] SB2.1

The student demonstrates an understanding of how energy can be transformed, transferred and conserved by investigating the effectiveness of different insulating and conducting materials with respect to heat flow and record the results.

Science Process GLE [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.

Writing GLE [4] W2.1.1

The student writes about a topic by writing a paragraph that maintains a focused idea and includes details that support the main idea.

Cultural Standard B2

Culturally knowledgeable students are able to build on the knowledge and skills of the local cultural community as a foundation from which to achieve personal and academic success throughout life. Students who meet this cultural standard are able to make effective use of the knowledge, skills and ways of knowing from their own cultural traditions to learn about the larger world in which they live.

Science Concept: Different materials act as insulators and/or conductors.

*****The scoring guide and assessment task are located at the end of the lesson. Please share them with your students before beginning the lesson.**

Materials

Student Notebooks-one per student

For Gear Up:

- Three copper wires
- Two bottle corks
- One candle or sterno burner
- Sticky notes, enough for whole class

For Explore:

- 3 Unwaxed paper cups (per student group)
- Candy thermometer (1 per group)
- Tape (to hold materials around cups)
- Hot tap water
- Insulating or conducting materials to test, cut into rectangles that will wrap around cups:
 - Wool fabric
 - aluminum foil
 - Polar fleece fabric
 - newspaper
 - Plastic wrap
 - cotton fabric
 - rubber bands
 - Data collection worksheet

Keep the Heat Homework worksheet

Resources

Liem, Tik L. Invitations to Science Inquiry, 2nd ed., p. 202

<http://www.merriam-webster.com/dictionary>

Vocabulary

- insulator - to separate from conducting bodies by means of nonconductors so as to prevent transfer of electricity, heat, or sound
- conductor - a material capable of transmitting another form of energy (as heat or sound)
- thermometer - an instrument for determining temperature

Gear Up **Process Skills:** Predict, Observe, Infer, Communicate

Pre-assessment: Each student will have two large sticky notes. The student will write information he/she knows about materials that are insulators on one sticky note and on the 2nd sticky note write information about materials that are conductors. Students will write their names on the back and stick them on a T chart written on the board. (insulator info on one side/conductor info on the other) The teacher will skim over these to assess class knowledge in aggregate, and be able to assess each individual's understanding of these key vocabulary words.

Discrepant Event: "The Heat Race" The teacher will demonstrate this discrepant event for the class about heat conductors. The teacher will show how copper wires heat up when held over a flame. Two people (Student A and Student B) each hold his/her own wire stuck through a cork in the middle. One person holds one end of the cork and wire set, and the other end is held over a flame. The secret that you don't tell the students is that one of the wire and cork sets actually has a separated wire inside the cork, so the cork insulates the second half of the wire a person is holding.

- Before lighting the flame, the teacher elicits predictions about what will happen as the wire is held over the flame.
- Teacher will ask students to observe what happens and be able to share those observations with the class. Students will record their observations and inferences in their science notebooks.
- Students share their science notebook entries with their cooperative learning group and add information, if desired, after hearing each other's ideas.
- Discussion Questions:
 - Why did Student A have to let go of the wire?
 - Why can Student B keep on holding the wire in cork B?
 - What can you infer about the wire in cork B?
 - By what means was the heat transferred to Student A's fingers?
 - What would Student A have to do in order to be able to further heat cork A?
- Review the vocabulary words with the students. (Option: Have students record vocabulary words in their science notebooks.)

Explore **Process Skills:** observe, communicate, predict

Students will explore water temperature changes where the cups are wrapped with different materials to find out which materials act as insulators or conductors. Once they get their materials students will predict which material will be the best insulator or conductor before they start their investigation.

Students will work in teams to explore materials for their ability to conduct or insulate heat.

1. Each team will be given the following set of materials:
 - a. 3 wax-free paper cups
 - b. Three different materials to test for insulating/conducting properties (e.g. wool fabric, cotton fabric, polar fleece, aluminum foil, plastic wrap, etc.)
 - c. 3 candy thermometers
 - d. Tape to hold material in place around the cups
 - e. Very hot tap water (Note: The water should be over 125 degrees Fahrenheit to start with.)
2. Each team will wrap their cups with their testing materials and tape or rubber band in place.
3. Teams will pour the hot water into the cups
4. Every two minutes students will check the temperatures of the water using the candy thermometers. Students will repeat this process for 10 minutes.
5. Students will record their observations in their Science Notebooks.
6. Students will record their temperature information on the data collection sheet. (

Generalize Process Skills: communicate, predict

Class discussion - Students will verbalize their new discoveries.

Through table group discussion, groups will determine answers to the following questions and record them in their science notebooks to report. During whole class synthesis discussion, groups will report and the class will determine some explanations to fit their observations and experiences.

- What different materials acted as an insulator? How could you tell?
- What materials acted as a conductor? How could you tell?
- What materials transferred heat energy? Where did the heat energy go?
- How did your observations compare to your predictions about the insulation qualities of the various materials? What have you learned that made a difference?
- What would happen to the temperature of the water if the top of the cups were covered?
- Based on your explorations today can you predict other materials that might be good insulators or conductors? (Create a prediction T-chart on the board for conducting and insulating materials to test later.)

Apply Process Skills: communicate, observe, predict

Homework assignment:

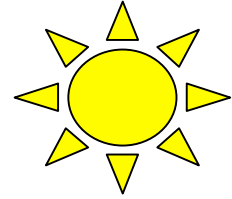
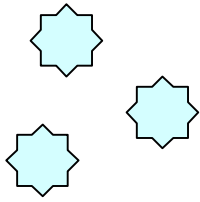
- Interview an adult family member or friend using the Keep the Heat homework worksheet.
- Test one possible insulating material you have at home to see how long it will keep an ice cube frozen on your kitchen counter. Write your observations on the homework sheet.

Scoring Guide/Rubric

GLE/Standard	Below Proficient	Proficient	Above Proficient
Science Content GLE SB2.1	Student is unable to describe or describes how 1 or 2 materials act as insulators or conductors.	Student is able to describe how to keep ice cream from melting during a hot summer day using 3 insulating materials.	Student describes how 4 or more materials act as insulators or conductors.
Science Process GLE SA1.1	Student makes zero or one correct inference about why a material might be an insulator or conductor.	Student makes two correct inferences about why a material might be an insulator or conductor.	Student makes three or more correct inferences about why a material might be an insulator or conductor.
Writing GLE W 2.1.1	Student writes a paragraph of at least 4 sentences about the topic (how ice cream is kept frozen) that maintains a focused idea with a topic sentence and 0-2 details that support the main idea.	Student writes a paragraph of at least 4 sentences about the topic (how ice cream is kept frozen) that maintains a focused idea with a topic sentence and 3 details that support the main idea.	Student writes a paragraph of at least 4 sentences about the topic (how ice cream is kept frozen) that maintains a focused idea with a topic sentence and 4 or more details that support the main idea.
Cultural Standard B.2	Student lists 0-1 insulating materials they use to stay warm in local winter conditions and no insulating material they use to keep foods from spoiling.	Student lists 2 insulating materials they use to stay warm in local winter conditions and 1 insulating material they use to keep foods from spoiling.	Student lists 3 or more insulating materials they use to stay warm in local winter conditions and 2 or more insulating materials they use to keep foods from spoiling.

Assessment Task

Each student will explain how to keep ice cream frozen on a long trip home in the summer time. The student will write a paragraph that includes a topic sentence and at least 4 sentences that will support the main idea with details, explanations, or reasons listing at least 3 different insulating materials that could work and at least two correct inferences about why a material might be an insulator or conductor. Each student will list at least 2 insulating materials they use to stay warm in local winter conditions and 1 insulating material they use to keep foods from spoiling.



Data Collection Sheet

Team Names _____ Date _____

Times	Material #1 _____ Temperatures	Material #2 _____ Temperatures	Material #3 _____ Temperatures

Conclusions:

"Keep the Heat" Homework Assignment

Name _____ Date _____

Interview an adult family member by asking the following questions.
Write their answers in the spaces below.

1. What types of materials do you use to insulate your home?

2. What types of insulating materials do you use to keep foods from spoiling?

Exploration

- A. Wrap a single ice cube with a material you think will keep an ice cube frozen for a long time. My insulating material _____

- B. Record how long it takes to completely melt. (Check by squeezing it every 5 minutes until it is completely melted.) _____ minutes

	Start time	+ 5 min.	+ 5 min.	+ 5 min.	+ 5 min.	+ 5 min.	+ 5 min.	+ 5 min.	+ 5 min.	+ 5 min.	+ 5 min.
Times											
Frozen (F) or Melted (M) ?											

Reflection

- A. Based on your explorations today predict one other material that might be a good insulator or conductor? _____

- B. Is there something the same about the insulators that have worked well? _____
