Thermal Insulators and Conductors

Grade 4: Temperature Probe

Aligned with National Standards

ward's science
Single Probes

overview

This is an activity where students demonstrate and observe the effects that different materials have on the transfer of heat. Students will make observations to provide evidence that energy can be transferred from place to place by heat.

This activity uses the WARD's Single Temperature Probe to collect data, allowing students to focus on the science discovery and leaving more time for learning and developing higher level thinking skills. If you prefer, a simple thermometer can be used in this activity.

time requirement:

This activity can be completed in one session of 45 - 60 minutes.

materials required for the activity:

Beaker(s)
Aluminum foil
Cardboard
Styrofoam or sheet of craft foam
Temperature probe or thermometer
Water
Heat source for water (i.e., microwave, hot plate, etc)
Timer/clock/stopwatch
Instructions - this guide and student prediction and data sheet (page 7)

safety precautions

general safety:

- Consider establishing a safety contract that students and their parents must read and sign. This is a good opportunity to identify students with allergies (e.g., latex) so that you (and they) will be reminded of specific lab materials that may pose risks to individuals.
- Remind students to read all instructions before starting the lab activities, and to ask questions about safety and safe laboratory procedures. For the early grades that may not be proficient in reading yet, review the safety and lab procedures together with your students.
- Students should take precautions around hot materials.
- Have students wash their hands after completing this and all lab activities.

framework for K-12 science education © 2012

DIMENSION 1 Science and Engineering Practices

×	Asking questions (for science) and defining problems (for engineering)		Use mathematics and computational thinking
	Developing and using models		Constructing explanations (for science) and designing solutions (for engineering)
	Planning and carrying out investigations		Engaging in argument from evidence
×	Analyzing and interpreting data	×	Obtaining, evaluating, and communicating information

DIMENSION 2 Cross Cutting Concepts

	Patterns		Energy and matter: Flows, cycles, and conservation
×	Cause and effect: Mechanism and explanation		Structure and function
	Scale, proportion, and quantity		Stability and change
	Systems and system models		

DIMENSION 3 Core Concepts

Discipline	Core Idea Focus
Physical Sciences	PS3.B: Conservation of Energy and Energy Transfer

next generation science standards © 2013

NGSS STANDARDS

Elementary School Standards Covered
4-PS3-2. Energy - Make observations to provide evidence that energy can be transferred from place to place by heat

national science education standards © 1996

Content Standards (K-12)			
	Systems, order, and organization		Evolution and equilibrium
×	Evidence, models, and explanation	×	Form and Function
	Constancy, change, and measurement		

Physical Science Standards Elementary School	
×	Light, Heat, Electricity, and Magnetism

× Indicates standards covered in activity

prior to class

- Determine the temperature of the classroom.
- Prepare and/or cut the test materials to wrap around the beaker(s).
- Review basic information about how to use and read a thermometer and/or the WARD's Single Temperature Probe.

objective

Students will understand that materials transfer heat.

background

Different materials transfer heat and keep things warm (or cool) in various ways. Some materials are good thermal **insulators**, which do not let heat pass through easily. Thermal insulators are good at keeping heat out and keeping heat in. A good example of a thermal insulator is your winter scarf because it stops the heat from your body escaping into the cold air. Plastic is another good example of a thermal insulator. It can be used as a handle on a saucepan - the plastic stops the heat from traveling to your hand.

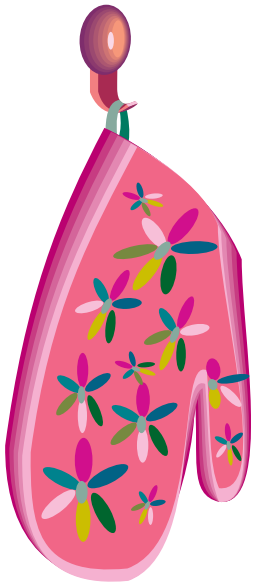
Other materials are good thermal **conductors** which do the opposite of insulators; they let heat pass through them with ease. Metals are a good example of thermal conductors; we use metals to make objects that need to conduct heat well. For example, metal pans conduct heat well so the food inside heats up quickly.

Well-insulated buildings need less energy for heating than buildings that have no insulation. There are two building materials that are being used more frequently worldwide: mineral wool and polystyrene (styrofoam). Mineral wool is a good insulator because it holds air still in the matrix of the wool so that heat is not lost. Since air is a poor conductor and a good insulator, this helps to keep energy within the building. Polystyrene is also a good insulator and is able to keep cool things cool and hot things hot. It has the added advantage of being resistant to moisture, mold and mildew.

build upon prior knowledge:

- Ask students if they had to pick up a hot object would it be safer to use a pot holder or a strong steel gauntlet, like what a knight might wear. *(Student response might include, the metal gauntlet because it is stronger.)*

Pot Holder



Knight's metal gauntlet

(continued on next page)

guiding questions

- What do you think will happen? (Hypothesis)
- What do you expect to learn?
- What tools are needed?
- How can we record our findings?

procedure

1. Show students the 3 materials that will be wrapped around a beaker of boiling water. Have students make and write predictions about which material will hold the heat the longest. *See next page for a sample tally sheet.*
2. Determine the temperature in the classroom and record. *See next page for a sample data sheet.*
3. Bring a measured amount of water in a beaker to a boil.
4. Remove the beaker from the heat source and take the initial temperature of the water and record. The thermometer should stay in the beaker for the students to observe the change in temperature as the water cools.
5. Have students note and record how long it takes for the boiling water to reach room temperature without any material around the beaker.
6. Bring the same amount of water to a boil again. When the beaker is removed from the heat source, put aluminum foil around the beaker and observe the temperature as the water cools to room temperature. Record how long it takes.
7. Boil the water again. This time put Styrofoam around the beaker when it is removed from the heat source. Observe the temperature as the water cools to room temperature. Record how long it takes.
8. Boil the water again. This time put cardboard around the beaker and observe the temperature as the water cools to room temperature. Record how long it takes.

summarize

Ask students what they have learned about the effect the test materials have on the release or retention of heat energy. *(Student responses may include: The Styrofoam holds in the heat the best. Cardboard and the foil do not hold in heat as long.)*

(continued on next page)

extension

Have students suggest other materials that may be thermal insulators or conductors. Allow students to test their theories and record the information to share with the rest of the class.

Sample Tally sheet	# of students who think this beaker will take the longest to reach room temperature
beaker with nothing on it	
beaker with aluminum foil	
beaker with Styrofoam	
beaker with cardboard	

Initial Temperature of Boiling Water _____

Room Temperature _____

Sample Data sheet	Time for temperature to return to room temperature
beaker with nothing on it	
beaker with aluminum foil	
beaker with Styrofoam	
beaker with cardboard	

teacher notes

- Review basic information about how to use and read a thermometer.
- This activity uses the Ward's Single Probe to collect data allowing students to focus on the science discovery, leaving more time for learning and developing higher level thinking skills.
- The activity can be done as a classroom demonstration or students can work in small groups.

5100 West Henrietta Rd • PO Box 92912 • Rochester, NY 14692-9012 • p: 800 962-2660 • f: 800 635-8439 • wardsci.com