

Insulation

Student Objective

The student:

- will be able to explain how insulation is used to decrease heat transfer
- given a list of insulation materials will be able to tell their relative insulation properties

Materials:

- small paper cups with 50 ml water, frozen (one per group)
- small paper cups, empty (one per group)
- scissors
- tape
- various materials including cotton, shredded paper, aluminum foil, paper towels, bubble wrap, styrofoam, etc.
- graduated cylinders (enough for one for every two or three groups)

Procedure

1. Place the bin of various insulating materials at the front of the class.
2. Explain to the class that they will be trying to create the most efficient insulating device to keep their ice from melting.
3. Divide the class into groups of 2 students per group.
4. Explain the lab procedure:
 - students may use any combination of materials that they wish (you may want to set a limit on how much of the materials the students may use), to create an insulating device around an empty paper cup
 - the cup must be able to stand up securely during the trial so that the water doesn't spill
 - when their insulating device is built, they will then place a cup with 50 ml of frozen water inside and take periodic measurements of how much ice has melted (Note: Material that covers the top of the insulation device should be removable or flapped, so that the frozen cup can be inserted, and measurements can be taken.)

Key Words:

insulation r-factor thermal

Time:

15 minutes construction, (4) 5-minute data collecting sessions over a two hour time

- the insulation devices are then placed in the sun and the students complete the table in their Science Journal pages, draining and measuring the melted ice at the designated intervals.
4. Help students as needed during the construction process.
 5. After data collection, have the students share their results with the rest of the class, and lead a discussion on which materials and techniques worked best.
 6. Students should complete the conclusion section of their Science Journals.

Further Research

- Repeat the experiment with something warm. Heat a cup of 50 ml of water in a microwave. Place a thermometer in the water before closing the lid. Check at the same intervals for heat loss. Graph the results. Was your device better at keeping things cold or keeping things warm.
- What things need insulation? Make a list of things that need to be insulated to stay cold and a list of things that need to be insulated to stay warm.
- Research where insulation is used in the construction of a house.

Related Reading

- ***The New Way Things Work*** by David Macaulay
The New Way Things Work, like the best-selling original is a superb illustrated guide to the technical processes everyday devices and well-known machines work. The book is organized by the broad scientific principles that govern technology.
- ***The Magic School Bus In The Arctic: A Book About Heat*** by Joanna Cole, Art Ruiz and Bruce Degan
The Magic School Bus slides into the icy arctic to learn why people, animals, and things lose heat and how they preserve it--from house insulation to walrus blubber!

Internet Sites

<http://www.bbc.co.uk/schools/gcsebitesize/physics/energy/energytransferrev6.shtml>

BBC School site. These animated pictures show how heat is transferred. This is a good site for introducing elementary students to the different ways heat is transferred.

http://www.bbc.co.uk/schools/revisewise/science/materials/07b_act.shtml

BBC School site. This site has a movie, fact sheet and quiz about thermal conductors and insulators.

EnergyWhiz

How would you insulate a lunchbox to keep your lunch cold. Submit your drawing or diagram to the EnergyWhiz website at <http://energywhiz.com/>. If your drawing is used on the website, we will send you an EnergyWhiz t-shirt.

Insulation

			.1	.2	.3	.4	.5	.6
Nature of Matter	Standard 1	SC.A.1.2-		X				
	Standard 2	SC.A.2.2-						
Energy	Standard 1	SC.B.1.2-		X	X			X
	Standard 2	SC.B.2.2-						
Nature of Science	Standard 1	SC.H.1.2-	X	X	X	X		
	Standard 2	SC.H.2.2-						
	Standard 3	SC.H.3.2-		X				

Benchmark SC.A.1.2.2 - The student knows that common materials (e.g. water) can be changed from one state to another by heating and cooling.

Grade Level Expectations

The student:

Third

- understands that physical changes in the states of matter can be produced by heating and cooling.

Benchmark SC.B.1.2.2 - The student recognizes various forms of energy (e.g., heat).

Grade Level Expectations

The student:

Third

- knows objects that emit heat and light
- knows different forms of energy.

Benchmark SC.B.1.2.3 - The student knows that most things that emit light also emit heat.

Grade Level Expectations

The student:

Third

- knows that the Sun provides energy for the earth in the form of heat and light

Fourth

- knows that most objects that emit light also emit heat.

Benchmark SC.A.1.2.4 - The student knows the many ways in which energy can be transformed from one type to another.

Grade Level Expectations

The student:

Fourth

- knows ways that energy can be transformed.

Benchmark SC.A.1.2.5 - The student knows that various forms of energy can be measured in ways that make it possible to determine the amount of energy that is transformed.

Grade Level Expectations

The student:

Third

- uses a variety of tools to measure the gain or loss of energy

Fourth

- extends and refines use of a variety of tools to measure the gain or loss of energy

Fifth

- extends and refines use of a variety of tools to measure the gain or loss of energy.

Benchmark SC.B.1.2.6 - The student knows ways that heat can move from one object to another.

Grade Level Expectations

The student:

Fifth

- knows that some materials conduct heat better than others
- understands that convection, radiation and conduction are methods of heat transfer.

Benchmark SC.H.1.2.1 - The student knows that it is important to keep accurate records and descriptions to provide information and clues on causes of discrepancies in repeated experiments.

Grade Level Expectations

The student:

Third

- knows that it is important to keep accurate records and descriptions to provide information and clues on causes of discrepancies in repeated experiments

Fourth

- knows that scientists make the results of their investigations public, and they describe the investigations in ways that enable others to repeat the investigation

Fifth

- understand that although the same scientific investigation may give slightly different results when it is carried out by different persons or at different times or places, the general evidence collected from the investigation should be replicable by others.

Benchmark SC.H.1.2.2 - The student knows that a successful method to explore the natural world is to observe and record, and then analyze and communicate the results.

Grade Level Expectations

The student:

Third

- plans and investigates an experiment that defines a problem, proposes a solution, identifies variables, collects and organizes data, interprets data in tables, charts and graphs, analyzes information, makes predictions, and presents and supports findings

Fourth

- plans and investigates experiments in which hypotheses are formulated based on cause and effect relationships; distinctions are made among observations, conclusions/inferences and predictions; a limited number of variables are controlled; and numerical data are contradictory or unusual in experimental results are recognized

Fifth

- understands that scientists use different kinds of investigations depending on the questions they are trying to answer
- Understand the importance of accuracy in conducting measurements and uses estimation when exact measurements are not possible.

Benchmark SC.H.1.2.3 - The student knows that to work collaboratively, all team members should be free to reach, explain, and justify their own individual conclusions.

Grade Level Expectations

The student:

Third

- knows that to work collaboratively, all teams members should be free to reach, explain, and justify their own individual concerns

Fourth

- works collaboratively to collect, share and record information for a scientific investigation.

Benchmark SC.H.1.2.4 - The students knows that to compare and contrast observations and results is an essential skill in science.

Grade Level Expectations

The student:

Third

- knows that to compare and contrast observations and results is an essential skill in science

Fourth

- knows that comparisons between experiments can be made when conditions are the same

Fifth

- uses strategies to review, compare and contrast, and critique scientific investigations
- knows that an experiment must be repeated many times and yield consistent results before the results are accepted.

Benchmark SC.H.3.2.2 - The student knows that data are collected and interpreted in order to explain an event or concept.

Grade Level Expectations

The student:

Third

- knows that data are collected and interpreted in order to explain an event or concept.

Insulation

insulation - the process of keeping heat or cold in one place and preventing it from escaping with little or no air movement

r-factor - In simple terms an R value is a internationally accepted measure of resistance to heat flow—the higher the R value the greater the resistance

thermal - intended in such a way as to either retain heat or cold

Insulation

1. Describe the insulation device you created and the materials that you used.

2. Complete the table below

Total Time	Amount of water in device
30 minutes (½ hour)	
60 minutes (1 hour)	
90 minutes (1½ hour)	
120 minutes (2 hours)	

Questions and Conclusion:

3. Which material(s) and construction techniques worked the best in keeping the ice?

4. Which material(s) and construction techniques were the worst in keeping the ice cube?

5. If your lunchbox does not keep your lunch cold, what could you do to it to make it better at keeping your food cold?
