Insulation

Student Objectives
The student:
- will explain how insulation is used to decrease heat transfer
- given a list of insulation materials, will be able to explain their relative insulation properties.

Key Words:
insulation
thermal

Time:
20 minutes construction
(4) 5-minute data collecting sessions over an hour

Materials:
- small paper cups (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 (prior to class)
1. Pour 50 ml of water into small paper cups (1 per lab group).
2. Freeze until solid.

Procedure (during class)
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 two 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 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.)
    - 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.

Key Words and Definitions

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

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 Kid's Solar Energy Book*** by Tilly Spetgang (Imagine, 2009)
  Cleverly intertwined with the science of solar thermal, insulation and photovoltaics are economics lessons about the cost advantages of energy efficient buildings and the production and price of solar cells. Illustrated with cartoon figures and set in a classroom, this book is appealing to students.
- ***The Magic School Bus In The Arctic: A Book About Heat*** by Joanna Cole, Art Ruiz and Bruce Degan (Scholastic, 1998)
  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

https://www.steampoweredfamily.com/activities/heat-transfer-projects-for-kids-stem-activities/

STEAM Powered Family site includes easy and fun heat transfer activities for young students.

Insulation

Florida NGSS Standards & Related Subject Common Core

			.1	.2	.3	.4	.5	.6	.7	.8
Grade 3										
The Practice of Science	**Big Idea 1**	**SC.3.N.1**	**X**	**X**	**X**		**X**	**X**		
The Role of Theories	**Big Idea 3**	**SC.3.N.3**	**X**							
Properties of Matter	**Big Idea 8**	**SC.3.P.8**	**X**							
Changes in Matter	**Big Idea 9**	**SC.3.P.9**	**X**							
Forms of Energy	**Big Idea 10**	**SC.3.P.10**	**X**	**X**						
Grade 4										
The Practice of Science	**Big Idea 1**	**SC.4.N.1**	**X**	**X**			**X**	**X**		**X**
Forms of Energy	**Big Idea 10**	**SC.4.P.10**	**X**	**X**						
Energy Transfer & Transformations	**Big Idea 11**	**SC.4.P.11**	**X**	**X**						
Grade 5										
The Practice of Science	**Big Idea 1**	**SC.5.N.1**	**X**							
Changes in Matter	**Big Idea 9**	**SC.5.P.9**	**X**							
Forms of Energy	**Big Idea 10**	**SC.5.P.10**	**X**	**X**						

Third Grade Benchmarks

Science–Big Idea 1: The Practice of Science

- SC.3.N.1.1 - Raise questions about the natural world, investigate them individually and in teams through free exploration and systematic investigations, and generate appropriate explanations based on those explorations.
- SC.3.N.1.2 - Compare the observations made by different groups using the same tools and seek reasons to explain the differences across groups.
- SC.3.N.1.3 - Keep records as appropriate, such as pictorial, written, or simple charts and graphs, of investigations conducted.
- SC.3.N.1.5 - Recognize that scientists question, discuss, and check each others; evidence and explanations.
- SC.3.N.1.6 - Infer based on observation.

Science–Big Idea 3: The Role of Theories, Laws, Hypotheses, and Models

- SC.3.N.3.1 - Recognize that words in science can have different or more specific meanings than their use in everyday language; for example, energy, cell, heat/cold, and evidence.

Science–Big Idea 8: Properties of Matter

- SC.3.P.8.1 - Measure and compare temperatures of various samples of solids and liquids.

Science–Big Idea 9: Changes in Matter

- SC.3.P.9.1 - Describe the changes water undergoes when it changes state through heating and cooling by using familiar scientific teams such as melting, freezing, boiling, evaporation, and condensation.

Science–Big Idea 10: Forms of Energy

- SC.3.P.10.1 - Identify some basic forms of energy such as light, heat, sound, electrical, and mechanical.
- SC.3.P.10.2 - Recognize that energy has the ability to cause motion or create change.

Fourth Grade Benchmarks

Science–Big Idea 1: The Practice of Science

- SC.4.N.1.1 - Raise questions about the natural world, use appropriate reference materials that support understanding to obtain information (identifying the source), conduct both individual and team investigations through free exploration and systematic investigations, and generate appropriate explanations based on those explorations.
- SC.4.N.1.2 - Compare the observations made by different groups using multiple tools and seek reasons to explain the differences across groups.
- SC.4.N.1.5 - Compare the methods and results of investigations done by other classmates.
- SC.4.N.1.6 - Keep records that describe observations made, carefully distinguishing actual observations from ideas and inferences about the observations.
- SC.4.N.1.7 - Recognize and explain that scientist base their explanations on evidence.
- SC.4.N.1.8 - Recognize that science involves creativity in designing experiments.

Science–Big Idea 10: Forms of Energy

- SC.4.P.10.1 - Observe and describe some basic forms of energy, including light, heat, sound, electrical, and the energy of motion.
- SC.4.P.10.2 - Investigate and describe that energy has the ability to cause motion or create change.

Science–Big Idea 11: Energy Transfer and Transformations

- SC.4.P.11.1 - Recognize that heat flows from a hot object to a cold object and that heat flow may cause materials to change temperatures
- SC.4.P.11.2 - Identify common materials that conduct heat well or poorly.

Fifth Grade Benchmarks

Science–Big Idea 1: The Practice of Science

- SC.5.N.1.1 - Define a problem, use appropriate reference materials to support scientific understanding, plan and carry out scientific investigations of various types such as: systematic observations, experiments requiring the identification of variables, collecting and organizing data, interpreting data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions.

Science–Big Idea 9: Changes in Matter

- SC.5.P.9.1 - Investigate and describe that many physical and chemical changes are

affected by temperature.

Science–Big Idea 10: Forms of Energy

- SC.5.P.10.1 - Investigate and describe some basic forms of energy, including light, heat, sound, electrical, chemical, and mechanical.
- SC.5.P.10.2 - Investigate and explain that energy has the ability to cause motion or create change.

National Next Generation Science Standards

Third Grade

Science–Engineering Design

- 3-ETS1-1 - Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- 3-ETS1-2 - Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- 3-ETS1-3 - Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Fourth Grade

Science–Engineering Design

- 4-ETS1-1 - Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- 4-ETS1-2 - Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- 4-ETS1-3 - Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Fifth Grade

Science–Engineering Design

- 5-ETS1-1 - Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- 5-ETS1-2 - Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- 5-ETS1-3 - Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Insulation

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

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2. Complete the table below.

Total Time	Amount of water in device
30 minutes (½ hour)	
60 minutes (1hour)	
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 frozen?

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

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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?

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