Make a Refrigerator

Summary

Students will learn heat transfer by designing a refrigerator and wearing winter clothing.

Main Core Tie

Science - 3rd Grade

Standard 5 Objective 1

Materials

Design a Refrigerator

For the class:

- Platform scale

For each group:

- Small plastic cup
- 2 ice cubes
- 2 paper towels
- 12" wax paper
- 12" tin foil
- Ziploc® bag

Optional:

- Cotton balls
- Newspaper
- Fabric scraps

Does Winter Clothing Create Heat?

- Mittens/gloves
- Hats
- Coats
- Thermometers (6-8)

Additional Resources

Books

- *Experiments with Heat*, by Walter Olesky; ISBN 0-516-01277-0
- *Temperature*, by Joy Frisch; ISBN 1-58340-159-8
- *Heat*, by Graham Peacock; ISBN 1-56847-075-4
- *Forest Fire!*, by Mary Ann Fraser; ISBN 0-8167-4962-0

Video

- *Heat*, by Bill Nye (Disney Educational Productions, 1-800-295-5010, http://www.dep-store.com/ProductDetails.asp?ProductCode=77C20VL00); Product ID: VHS 68A71VL00, DVD 77C20VL00

Background for Teachers

The sun is the main source of heat and light for organisms living on Earth. Plants need sunlight to make food. Animals cannot make their own food. They must eat plants or other animals in order to

live.
Without sunlight there would be no living things on Earth. Anything that gives off heat is a heat source. You can measure the difference in temperature with a thermometer. A thermometer uses a scale with each unit called a degree. When you place an ice cube in a glass of water, the ice cube takes heat from the water as it cools.
Many students have the misconception that coats and gloves give off heat. Heat is the flow of energy from hotter to cooler objects. Coats and gloves help stop that flow of energy and trap or hold the heat. Insulators are materials that block the flow of heat so warm things tend to stay warm, or cold items stay cool longer. Good insulators are plastics, air, fabrics that hold air, feathers, etc.
Temperature is a measurement of how much heat an object has. Thermometers can be used to dispel the misconception that clothing gives off heat. Measuring mittens, gloves, and coats before they are worn and while a person is wearing them teaches students that heat from their hands or bodies is trapped by the clothing.
Science Words to Know
Electrical—uses electricity or batteries
Lubricate—to make a surface slippery
Machines—tools with fixed or moving parts for doing work
Mechanical—does not use electricity (uses burning fuel, human energy, flowing water, or even horse power) to give energy
Heat source—makes things warm
Temperature—how warm or cold
Degree—unit of measure for temperature on a thermometer
Misconception—misunderstanding

Intended Learning Outcomes
1. Use Science Process and Thinking Skills
3. Understand Science Concepts and Principles
4. Communicate Effectively Using Science Language and Reasoning

Instructional Procedures
Invitation to Learn
Invite two students come to front of the class and give each of them an ice cube in a sealable bag. Have the students hold the ice cube and ask, “What is happening?”
Clarify that the ice did not bring cold to the hand, but the heat from the hands moved to the ice cube, until they finally became the same temperature.
Instructional Procedures
Design a Refrigerator
Tell the students that today they are going to design a refrigerator. The goal is to keep their ice cube from melting. They may use one paper towel, one piece of waxed paper, one piece of tin foil, and one plastic container (and any of the optional materials they want). Explain that they will have five minutes to assemble their refrigerator. At the end of the five minutes, they must wait 20 minutes before they may open their refrigerator and discover how well it worked.

Gather materials.
Weigh and record the weight of each ice cube.
Place one ice cube on a paper towel on a desk out of the sun (do not touch or disturb in any way). Use the materials any way you choose to try to keep the ice cube from melting as much as possible.
Wait 20 minutes. Open your refrigerator and compare the two ice cubes. Is there any difference? Record what happened.

Which design seemed to work best? Why do you think that is? Clarify that the refrigerator insulated the ice cube and stopped the transfer of heat.

Does Winter Clothing Create Heat?

Invite students to come to the front of the class and put on a coat, hat, and mittens/gloves. Ask them what is happening to them.

Ask the class, “Do you think that outdoor winter clothing makes you warm?” “Is there heat in the coat, the hat, or the mittens?’’

Show different types of gloves, mittens, coats, and hats. Have students predict if the clothing items will warm up the body and if they think one will warm better than another.

Journal—Teachers predict what students will say.

Divide students into groups of three. Give each group an item of clothing. Allow students to select their role in the group:

Time Keeper—tells the temperature reader when to read the temperature

Temperature Reader—tells the data recorder what the temperature is at the time

Data Recorder—writes the temperature in the data chart

Check the temperature on the thermometer after sitting on a desk for two minutes. Record the temperature.

Put the thermometer inside the article of clothing and check the temperature after two minutes. Record the temperature.

Have one student put the clothing on with the thermometer touching the person inside the glove, coat, or hat. Record the temperature after five minutes.

Remove the clothing. Set it on a desk out of the sun, put the thermometer inside and wait five minutes. Record the temperature again.

What happened? Does a coat give off heat? Do gloves give off heat?

Journal—Teachers need to write themselves a reminder to check for student misconceptions.

Extensions

Place students of different abilities in each group. Each student should have a meaningful role.

Have students explain/tell what they discovered.

Use explicit instruction to teach vocabulary.

Use pictures and other visual aids to assist comprehension.

Have students create a graph for the *Winter Clothing* activity.

Extension I

Materials

3 two quart bowls

Ice cubes

Place water with ice cubes in one bowl, warm water (not above 118° F) in one bowl, and room temperature water (or an equal mixture of the cold and warm water) in the third bow.

Call on one student to place one hand in the cold and the other in the warm water. After minute place both hands in the medium temperature bowl.

Ask, “What do you feel?”

(The hand that was in warm water should feel cooler and the hand that was in cold water should feel warmer than the other hand.)

Extension II

Cut a piece of foil larger that your foot.

Place the foil and the carpet sample on a tile floor. Allow them to remain undisturbed for ten minutes.

Put one bare foot on the foil and the other bare foot on the carpet.

Observe any difference between the feel of the temperature of each foot.

(The metal foil feels colder than the carpet because a good conductor [foil] allows heat to move through it, while the carpet [a good insulator] blocks the flow of heat from your foot. Things feel cooler when heat energy is drawn away from your skin.)

Family Connections

Have students bring materials from home to make another refrigerator.

Have students design a refrigerator at home and bring to share with the class.

Assessment Plan

Rubric for *Winter Clothing*

4 correct, complete, detailed

3 partially correct, complete, detailed

2 partially correct or complete, lacks some detail

1 incorrect or incomplete, missing data, needs help

0 no attempt

Bibliography

Research Basis

National Academics Press, (1996). *National Science Education Standards*, pp 123

Full Inquiry involves asking a simple question, completing an investigation, answering a question, and presenting the results to others.

American Association for the Advancement of Science: Project 2061. (1994). *Benchmarks for Science Literacy*. ISBN 0195089863

Tools such as thermometers, magnifiers, rulers, and balances often give more information than can be obtained through observation.

Gerber, B.L., Brovey, A.J., & Price, C.B. (2002). Site-Based Professional Development: Learning Cycle and Technology Integration. Research report.

Learning cycles consist of three phases: exploration, concept invention where teachers guide students in interpreting data, and expansion (application of new concept; may include additional lab investigations, textual readings, and/or audio visual aids).

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