Managing Heat

Summary

Group activities help students understand the role of the sun as the source of heat and light for living things on Earth. They will also understand the role of friction in creating heat.

Group Size

Small Groups

Materials

Race Some Beads

- *Race Some Beads*

Glass jars
Plastic beads
Nail
Wooden dowel
Vinyl Tubing
Copper Tubing
Glass Rod
Butter
Plastic Knife
Plate
Timer
Plastic Beaker
Hot water

Bottling Heat

Jars with lids

- *Bottling Heat*

Aluminum foil
Cork
Scissors
Tape
Thermometers
Timer
Hot water

Polar Padding

- *Polar Padding*

Pellon interfacing
Various Insulating Material
Quilting needles
Yarn
Thermometers
Ziplock bags
Ice
Hot water

Additional Resources

Books

Cold, Colder, Coldest, by Michael Dahl (Animal Extremes Series); Children Library Resources Item

#GK923763
Experiments with Heat, by Salvatore Tocci (A True Books Series); ISBN 0-516-22510-3
The Magic School Bus in the Arctic, by Joanna Cole; ISBN 0-590-18724-4
Temperature, by Brenda Walpole (Measure Up With Science); ISBN 0-8368-1363-4
Temperature, by Navin Sullivan; ISBN 918-0-7614-2322-5
Polar Bears, by Ann O. Squire (A True Books Series); ISBN 0-516-25473-1
Polar Bears, by Julia Barnes (100 Facts About Predators); ISBN 0-8368-4038-0
Polar Bears, by Timothy Levi Biel (Zoobooks); ISBN 0-88682-414-1
Media
Heat, Bill Nye the Science Guy Series Three, (Disney Educational Productions) Library Video Company VHS DN2226, DVD DW0577
Heat, The Way Things Work Video Series, by David Magaulay (Schlessinger Media) Library Video Company VHS DK7849, DVD DV6014
Animal Adaptations, (Discovery Channel School Series) Teacher's Media Company VHS TBRR-354074

Background for Teachers

Something that is hot, like a hot drink, feels very different from something cold, like ice cream. Both sensations are caused by the same thing: heat. The difference is that the cold object contains less heat than the hot ones. Our bodies make heat from our food. We also get heat from the Sun and from burning fuels. The heat of an object is measured using temperature. A thermometer measures temperature.

Many students have the misconception that a coat or glove can produce heat. Heat is the flow of energy from hotter to cooler objects. Coats and gloves help stop the 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 while cold items stay cool longer. Good insulators are plastic, feathers, air, and materials that hold air. Heat conductors are materials that allow the flow of heat energy to move easily from one source to another. Good conductors are solid materials such as metals.

The body of a polar bear is made for living in its harsh, cold environment. Among land animals, the polar bear is the largest predator in the world, with an average male measuring about 8 feet long and weighing between 800 to 1300 pounds. Large bodies usually hold heat much better than smaller ones. But the bear's large body also has extra layers of protection against the cold. Although a polar bear looks white, its skin is black, and its hair has no color at all. Its thick coat is really two layers of fur: a waterproof undercoat of short hair and a layer of guard hair 6 inches in length. Each hair is really a hollow tube that you can see right through. Some of the sunlight bounces off the hair, making the bear appear white; but most of the sun's rays pass through the hollow hairs and are trapped by the bear's black skin. Underneath this fur coat, the polar bear has a layer of fat that can be 4 inches thick. The polar bear can survive even when the outside temperature drops to -70 degrees F because this fat and layers of fur act as insulators, trapping its body heat.

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
Pass the Penny
Heat is the flow of energy from hotter to cooler objects. Temperature is a measure of how much heat

energy an object has.

Prior to this activity, mark a penny with a small, flat dot of fingernail polish. Provide each group of 4 or 5 students with a small cloth bag containing 5 pennies. Have a member of the group remove the marked penny and hold it for approximately 10 seconds in their closed fist. Quickly pass the penny on to the next group member, allowing them to hold the penny for about 10 seconds. Continue this process until the penny has gone around the group once or twice. (You may notice that the penny has become warm). Replace this penny quickly with the others in the bag and shake them up. Ask a volunteer to reach into the bag and pull out the marked penny. How could they recognize which penny to choose? Why did this penny feel different than the others? What was the penny's heat source? What causes the temperature change of the penny? You might also try this activity by allowing the marked penny to lie in direct sunlight (or under a heat lamp) for 30 seconds, and repeat the activity. Were the results similar?

As a differentiated variation, students could choose the objects put into the bag for this activity according to their understanding of materials as heat conductors. They could also vary the number of objects used.

Instructional Procedures

Race Some Beads

This activity will demonstrate how well some materials conduct heat.

Cut the wooden dowel, copper tubing, and vinyl tubing to lengths of 4 inches.

Attach one bead on the end of the glass rod, nail, and the 3 types of tubing using a small dab of butter. The beads should be attached using similar amounts of butter and the same distance from the end of each rod.

Stand each rod up in a small glass jar so the bead on each rod is extending out of the container. Each rod will act as a conductor of heat. Predict the order of rod materials as heat conductors on your *Race Some Beads* recording sheet.

Pour hot water in the glass jar and begin a timer.

Heat will move from the water, into each rod, and melt the butter. The bead that falls first was attached to the best heat conductor.

Record the amount of time it takes for each bead to fall.

Compare the activity results to your prediction.

Complete the *Race Some Beads* recording sheet showing the results of your learning and attach it into your journal.

Bottling Heat

Wrap two layers of aluminum foil tightly around one of the small jars with the shiny side of the foil facing in.

Fasten the foil to the bottle with tape.

Place the cork in the bottom of the larger jar.

Fill both of the small jars with hot water of the same temperature.

Record the temperature of the water in these jars in your journal.

Place the lid on the small jar wrapped with foil. Do not put the lid on the other small jar.

Place the closed jar in the bottom of the larger jar, standing it on the cork.

Put the lid on the larger jar.

Leave the other small, open jar exposed to the air.

After 5 minutes, take the small jar out of the larger jar, open the lid, and record the water temperature.

Record the temperature of the water in the open jar.

Repeat steps 6-9. Wait 5 minutes and record the temperature of both jars.

Repeat steps 6-10 once again and take a final reading.

Draw and graph your results using the *Bottling Heat* worksheet. Attach it in your journal.

Compare the difference in the temperature of the two bottles and explain your results in your journal.

What happened to the temperature of the water in the open jar? Where did the heat go? What has insulated the water in the closed inner jar?

Heat does not pass easily through the insulated jar, the cork, and the air in the large jar. Water in the open jar loses heat more quickly. A Thermos flask keeps drinks hot or cold. It is made using two containers with a tight lid, like your heat store. The inner container has shiny sides and a double wall with a "vacuum" or empty space inside. It is so difficult for heat to leave or enter the flask that its contents stay hot, or remain cold, for a long time.

You may wish to use this differentiated variation for this activity. When students have a good knowledge of how materials can be used as insulators, they could design their own insulating devises. Allow them to select containers and insulating materials they wish to use. You could allow them to choose different substances to test, rather than hot water.

Polar Padding

Have the students collect materials they feel could be used as good heat insulators.

Trace both sides of the polar bear on a piece of lightweight Pellon (9 in. X 11 in.) using the *Polar Padding Pattern*.

Fold the bear to form a pocket.

Sew 2 sides of the bear using large eyed quilting needles and yarn or string. Leave the mouth end of the bear unsewn for stuffing.

Students may insulate their bear choosing 3 layers of material.

Place a thermometer inside their bear. Allow a few minutes and take the temperature of their insulated bear and record it in their journal.

Pour hot water into a Ziplock bag and place this "body" inside the bear on top of the thermometer.

After a few minutes record the bear's new temperature.

Place your bear in its cold environment. You could take it outside on a cold, wintery day, place it in a freezer, or place it between two large zip-lock bags containing ice.

Record the temperature of your bear every 5 minutes for 15 minutes.

Graph and journal the results of the activity. Compare your findings with bears insulated using different materials.

Extensions

Curriculum Extensions/Adaptations/ Integration

This activity could be adapted for a small group with each member selecting an insulating material. They could collectively construct their body, each contributing their insulating layer. Their group findings could be recorded and compared with other group results.

Select a variety of warm-blooded animals from various biomes: whale, walrus, lion, kangaroo mouse, wolf, etc. Identify how the insulating layers of these warm-blooded animals help to maintain a constant body temperature. Construct a body using insulating materials for one of these animals following the procedures above and record your findings.

As a differentiated activity, replace the polar bear with a picture of a lizard or another cold-blooded animal. Fill the baggie for the body of this animal with water at room temperature. Place materials inside its body that will act as heat conductor. Place our lizard in the sun or under a heat lamp. Record the temperature every 5 minutes as it absorbs the sun's heat. Place your lizard in the shade and record the temperature changes showing how it retains body heat.

After reading the book *The Magic School Bus in the Arctic* by Joanna Cole as a class, each student would research on a polar animal and how layers of their body act as insulators against freezing Arctic temperatures. Posters displaying their findings could be shared and assessed.

Have the students construct a class quilt. What considerations should be made it choosing the materials for their quilt? How does the weight of the batting and the fabric affect the quilt's efficiency for retaining body heat?

Family Connections

Have students visit a local sporting goods store to observe and compare the weight, efficiency, and cost of various sleeping bags. What materials were used as insulators and how are they constructed?

Using the Thermos company website, research what materials are used in making Thermos bottles and coolers. How can you select the best product when comparing product use and its efficiency?

Looking at labels, identify the materials used in students' winter clothes: coats, mittens, boots, etc. Compare them to the materials used in summer clothing. Determine which are made using natural fibers compared to man-made products.

Compare the materials used as handles, lids, and cooking surfaces of pans in your kitchen. When are heat conducting materials used, and when is it important that the material serve as heat insulators.

Assessment Plan

Check student temperature charts, drawings, and journals for student understanding.

Students will share activity results orally with those in their group or give a presentation to the class.

Use a rubric for scoring the Bottling Heat activity.

4 correct, complete, detailed

3 mostly correct & complete, fairly detailed

2 partially correct & complete, lacks some detail

1 incorrect, incomplete, missing important detail

0 no attempt

Bibliography

Research Basis

Tomlinson, C.A. (1999) *The Differentiated Classroom, Responding to the Needs of All Learners* pp7-8.

Differentiated classrooms feel right to students who learn in different ways and at different rates and who bring to school different talents and interests. More significantly, such classrooms work better for a full range of students than do one-size-fits-all settings. Teachers in differentiated classrooms are more in touch with their students and approach teaching more as an art than as a mechanical exercise.

Kesidou, S. & Roseman, J. E., (2002), *How Well Do Middle School Science Programs Measure Up?* Findings from Project 2061's Curriculum Review.

Programs rarely provided students with a sense of purpose for the units of study. This program took account of student's beliefs that interfere with learning. It modeled the use of scientific knowledge so that students could apply what they learned in everyday situations. Floden, R. A., Buchmann, M., and J. Schwille, J., (1987). "Breaking with Everyday Experiences" Teachers College Record 88, p. 263.

Representations of the subject need to take into account what learners are already likely to know and understand about the subject matter as well as the experiences and knowledge they bring with them from their environment.

Authors

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