Heating Up!

Summary

Students will measure the heat created at each center.

Materials

9 volt batteries
Christmas lights cut apart with 1/2 in of insulation stripped
Thermometers
Television
Popcorn popper
Eraser
Mechanical pencil sharpener
Flashlight
Book
Computer
Metal buttons
Stapler
Lamp
Wool fabric
Roller skate
Pennies
Scissors
Paper
Overhead projector
Nonexamples (e.g., cardboard box, plant, envelope, pencil, etc.)

- *Measuring Heat* worksheet
- *Sorting Heat Sources* worksheet
- *Sorting Heat Sources Pictures*

Additional Resources

Books

- *Keepers of the Earth: Native American Stories and Environmental Activities for Children* , by Michael J. Caduto and Joseph Bruchac; ISBN 1-55591-027-0
- *The Magic School Bus in the Arctic: A Book about Heat* , by Joanna Cole; ISBN 0-590-18724-4

Background for Teachers

Students will learn that heat is produced from human activities and mechanical and electrical machines. Heat is produced almost anywhere.

Heat is the random motion of molecules. A hot object is one whose atoms and molecules are excited and show rapid movement. A cooler object's molecules and atoms will be less excited and show less movement. When these molecules are in an excited state, they take up more space because they are moving around so fast. When molecules settle down, or cool down, they take up less space. If hot, high-energy atoms come into contact with cool, low-energy atoms, the excited atoms will loose some of their energy to the cool atoms. The two atoms will settle into an energy level that is between where they each started out. That level is called Thermal Equilibrium.

It is important for students to understand that situations that produce heat involve motion—either observable, such as activity-based (human or mechanical), or electrical. Simple, stationary objects do

not produce 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

Ask students to stand up and rub their hands together fast and hard for ten seconds.
Ask, “How do your hands feel right now? Why?”
When would you most likely do something like this? Why?
Why is rubbing your hands together useful or helpful?
To extend, have students either jog in place, stomp their feet, or do jumping jacks. After a period of time, have students stop and discuss their similar heat-based reactions. You need to give them the impression that they are “little heat producers” when they are physically active.
Give each group one 9 volt battery and one light bulb with wires Ask, “Can you make the light bulb light up? If so, does it get warm?” Point out that batteries are an electrical form of energy.
Can electricity produce heat or light?

Instructional Procedures

Set up and label centers where each group can discover the difference in temperature resulting from the following activities. If groups will be reporting their findings, mix the centers with combinations of the four types of activities.

Human-based activity (erasing the board, rubbing book on desk, rubbing wool and metal buttons, rubbing pennies on paper, etc.).
Electrical activity (computer, overhead projector, popcorn popper, lamp, flashlight, television, etc.).
Mechanical activity (sharpening pencil, spinning roller skate, etc.).
Stationary objects—Objects that do not move (cardboard box, plant, envelope, pencil, etc.).
Divide students into four groups. Give each student a *Measuring Heat* worksheet. Tell the students that are going to measure the heat created at each center. Have them answer the question and fill out their hypothesis before they go to their center. Discuss the expectations and procedures and then send to assigned centers.
Note: Mechanical heat and human activity will probably not be detectable on a thermometer. Use the sense of touch to determine “yes” or “no” if heat was produced. Use thermometers for electrical and nonexamples.
Students follow the directions and record the results.
Stop the action, turn off the machines, and discuss within groups what happened.
Proceed to the next center or have each group share their results with the class.

Extensions

Place students of different abilities in each group. Each student should have a meaningful role. Students could collaborate on the worksheet.
Have students use the Sorting Heating Sources worksheet and accompanying pictures to classify the objects.

Family Connections

Have students find mechanical and electrical examples at home.
Students measure the difference in heat of working and nonworking examples they find at home.

Assessment Plan

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
Adaptation—Student explains what they did and what they discovered.

Bibliography

Research Basis

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.
American Association for the Advancement of Science. (2001). Science for All Americans online. Chapter 4: The physical Setting
Heat energy is the random motion of molecules. Whenever the amount of energy in one place or form diminishes, the amount in another place or form increases. Heat always tends to diffuse from warmer places to cooler places.
Sillman, K. & Dana, T. (1999). Metaphor: A Tool for Monitoring Prospective Elementary Teachers' Developing Metacognitive Awareness of Learning and Teaching Science,
paper presented at the Annual Meeting of the National Association for Research in Science Teaching, Boston Massachutes.
Providing students with meaningful, hands-on activities is valuable. However, this is not enough; connections have to be made.

Authors

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