Solar Energy and Color

Student Objective
The student:
- will be able to explain how different colors affect the amount of thermal (heat) energy absorbed from the sun
- discuss the benefits of solar energy for meeting the energy needs of the world.

Key Words:
color
heat
insulation
solar thermal energy

Time:
½ hour

Materials (for each group):
- plastic bottle, painted white (1 per group)
- plastic bottle, painted black (1 per group)
- small balloons (2 of the same color for each group)
- Science Journal

Procedure
1. This experiment should be done outside on a sunny day.
2. Explain the procedure to the class
   - each group will have a black and a white bottle
   - a balloon will be placed over the top of each bottle
   - the bottles will then be placed in the sun
3. Have the students write a hypothesis in their Science Journal.
4. Divide the class into groups of two or three students.
5. Hand out the bottles so that each group has a black bottle and a white bottle. Help the students as necessary to set up their experiments
6. Place the bottles in a sunny area. They should be placed close together, but not shading each other.
7. Students should observe what happens to the balloons over a period of time. *(Within a few minutes the balloon attached to the black bottle will begin to inflate slightly. The balloon attached to the white bottle will remain limp.)*
8. Have the students touch each bottle and record what they feel. *(The black bottle will be warmer than the white bottle.)*
9. Lead the class in a discussion of what is occurring. Direct the discussion toward heat and solar energy.
10. The students should then complete their Science Journal.

Further Research

1. Experiment with covered and uncovered containers. Which collects the most solar energy?
   - Spray paint four disposable microwave containers--two white and two black..
   - Place the same amount of water in each container.
   - Place a thermometer in each container.
   - Cover one black container and one white container, and seal securely.
   - Place all four containers in the Sun.
   - Record the temperature of the containers after 30 - 45 minutes on the Further Research Data Sheet.
2. Experiment with other colors such as read, green or blue. Graph your results
3. Try a similar experiment with a liquid instead of a gas. Paint soup cans different colors, fill with water, put a thermometer in each and place them in the sun. Does the water heat up? Do the different colors heat up at different rates or to different final temperatures? Graph your results.
4. Research the color of most of the solar thermal water heaters and pool heaters. Why do you think this is so?
5. Research what colors people traditionally wear in the dessert and in colder climates. Does the color you wear affect how comfortable you feel?

Related Reading

- ***Solar Power (True Books)*** by Christine Petersen (Children's Press, 2004)
  This book provides readers with a lucid picture of the sun and wind as natural forces before introducing some of the technology (windmills, turbines, solar panels) used to harness energy on a large scale. The captioned photos are well chosen, and the science and the explanations of the technology are eminently clear. Peterson ends the book with a forecast of the future that informs kids about the advantages and disadvantages of such renewable resources and speculates on their use in years to come

Internet Sites

http://www.eere.energy.gov/kids/

US Department of Energy, Energy Efficiency and Renewable Energy student site, Dr. E's Energy Lab, has activities in solar, wind and geothermal energy, as well as alternative fuels and energy efficiency tips.

EnergyWhiz

We are looking for EnergyWhiz stars! Submit a photograph of your class performing the Solar Energy and Color activity to the Energy Whiz web site, **http://energywhiz.com/**

Solar Energy and Color

			.1	.2	.3	.4	.5	.6
Energy	**Standard 1**	**SC.B.1.2-**	**X**	**X**	**X**	**X**	**X**	**X**
	Standard 2	**SC.B.2.2-**						
Earth and Space	**Standard 1**	**SC.E.1.2-**			**X**			
	Standard 2	**SC.E.2.2-**						

Benchmark SC.B.1.2.1 - The student knows how to trace the flow of energy in a system.
Grade Level Expectations
The student:
Fourth
- knows how to trace the flow of energy in a system

Fifth
- knows how to trace the flow of energy in a system.

Benchmark SC.B.1.2.2 - The student recognizes various forms of energy.
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.

Benchmark SC.B.1.2.4 - The student knows the many ways in which energy can be transformed from on type to another.
Grade Level Expectations
The student:
Fourth
- knows ways that energy can be transformed.

Benchmark SC.B.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
- knows that convection, radiation, and conduction are methods of heat transfer.

Benchmark SC.E.1.2.3 - The student knows that the Sun is a star and that its energy can be captured or concentrated to generate heat and light for work on Earth.

Grade Level Expectations

The student:

Fourth

- knows how the energy of the Sun can be captured as a source of heat and light on Earth.

Solar Energy and Color

color - the aspect of things that is caused by differing qualities of the light reflected, defined by the observer.

heat - a form of energy associated with the motion of atoms or molecules and capable of being transmitted through solid and fluid media by conduction, through fluid media by convection, and through empty space through radiation.

insulation - the process of keeping heat or cold in one place and preventing it from escaping by conduction or convection.

solar thermal energy - energy derived from the sun to heat something–common uses include water heaters and pool heaters.

Solar Energy and Color

1. Hypothesis: I think this will happen during the experiment: _____

_____

_____

After you have done your experiment, answer the questions below:

2. What did you see happening? _____

_____

_____

_____

3. What do you think caused this? _____

_____

_____

_____

4. Which bottle felt warmer? _____

_____

_____

_____

5. Why do you think the one bottle felt warmer? _____

_____

_____

_____

6. How did your results compare with your hypothesis? _____

_____

_____

_____

7. What happens to the gas molecules as they heat up? _____

_____

_____

_____

8. What does this tell you about the relationship between the volume of the gas and the temperature? _____

_____

_____

_____

_____

_____

Covered or Uncovered – Data Sheet

Weather

1. How much sun is there today? Describe the weather and the amount of sun and clouds.

_____

_____

Hypothesis

2. Which color will collect the most solar heat? Will the uncovered or the covered container get the hottest? Circle the one that you think will have the highest temperature after sitting in the sun.

White covered

White uncovered

Black covered

Black uncovered

Collect data

3, Record the temperature of each container below:

Container	Temperature
White covered	
White uncovered	
Black covered	
Black uncovered	

Date _____ Time _____