Solar Energy and Color

Student Objectives
The student:
- will explain how different colors affect the amount of thermal (heat) energy absorbed from the Sun
- can 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
- plastic bottle, painted black
- 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.

Key Words and Definitions

- **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.

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 Related 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 desert and in colder climates. Does the color you wear affect how comfortable you feel?

Related Reading

- ***Catch the Wind, Harness the Sun: 22 Super-Charged Projects for Kids*** by Michael Caduto (Storey Publishing, 2011)
  Twenty-two projects plus stories, background information, cartoons and photos covering solar thermal, photovoltaics, solar cooking, climate change, energy production and energy conservations–plus wind energy!
- ***Energy From the Sun (Rookie Read-About Science)*** by Allan Fowler (Children's Press, 1998)
  This book defines energy and examines how energy from the sun provides us with heat, light, plants, food and other things necessary for life on Earth. This book is particularly suited for the young reader and remedial readers.

- ***The Kid's Solar Energy Book*** by Tilly Spetgang (Imagine, 2009)
  Cleverly intertwined with the science of solar thermal 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.

Internet Sites

http://www.eia.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.

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Florida NGS 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**		
Earth Structures	**Big Idea 6**	**SC.3.E.6**	**X**							
Forms of Energy	**Big Idea 10**	**SC.3.P.10**	**X**							
Energy Transfer & Transformation	**Big Idea 11**	**SC.3.P.11**	**X**							
Grade 4										
The Practice of Science	**Big Idea 1**	**SC.4.N.1**	**X**			**X**		**X**		
Forms of Energy	**Big Idea 10**	**SC.4.P.10**	**X**							
Energy Transfer & Transformations	**Big Idea 11**	**SC.4.P.11**		**X**						
Grade 5										
The Practice of Science	**Big Idea 1**	**SC.5.N.1**	**X**							
Forms of Energy	**Big Idea 10**	**SC.5.P.10**	**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.1.3 - Keep records as appropriate, such as pictorial, written, or simple charts and graphs, of investigations conducted.
- SC.3.N.1.6 - Infer based on observation.

Science–Big Idea 6: Earth Structures

- SC.3.E.6.1 - Demonstrate that radiant energy from the Sun can heat objects and when the Sun is not present, heat may be lost.

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.

Science–Big Idea 11: Energy Transfer and Transformations

- SC.3.P.11.1 - Investigate, observe, and explain that things that give off light often also give off heat.

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.1.4 - Attempt reasonable answers to scientific questions and cite evidence in support.
- SC.4.N.1.6 - Keep records that describe observations made, carefully distinguishing actual observations from ideas and inferences about the observations.

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.

Science–Big Idea 11: Energy Transfer and Transformations

- 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 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.

National Next Generation Science Standards

Fourth Grade Standards

Science–Energy

- 4-PS3-2 - Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat and electric currents.

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. Describe the weather and the amount of sunlight and clouds today.

_____

_____

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 _____