SCIENCE OF ENERGY

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RADIANT ENERGY 3

Time Frame:	Standards:
40-50 minutes	8-9.PS(ES).1.2.1 Use observations and data as evidence on which to base scientific explanations 8-9.PS(ES).1.6.3 Use appropriate technology and mathematics to make investigations. 7.S.1.2.2 Use observations to make defendable inferences 7.S.1.6.2 Use appropriate tools and techniques to gather and display data 7.S.1.6.3 Evaluate data in order to form conclusions 7.S.1.6.4 Use evidence and critical thinking to accept or reject a hypothesis

Objectives:

To explore how radiant energy is changed into thermal energy (heat).
To discover what colors are best at converting radiant energy into measureable thermal energy.

Background Information:

What is energy?

Energy is the ability to do work, the ability to make a change. Everything that happens in the world involves a change of some kind, the exchange of energy in some way. The total amount of energy in the universe remains the same. When we use energy, we do not "use it up"; we convert one form of energy into other forms. Usually the conversion of energy produces some heat, which is considered the lowest form of energy, since it dissipates into the surroundings and is difficult to capture and use again. Energy is categorized in many ways: the forms it takes and what it does, the changes it makes, the effects we can see, feel or measure.

When energy hits objects it can be reflected or absorbed. The absorbed radiant energy can be converted into heat (thermal energy). Dark colored objects tend to absorb radiant energy. Shiny or light colored objects tend to reflect radiant energy. Radiant energy can be by the sun or by an artificial source.

Solar Energy

Solar energy is energy from the sun (radiant energy). The sun is a giant ball of hydrogen and helium gas. The enormous heat and pressure in the interior of the sun cause the nuclei of the two hydrogen atoms to fuse, producing one helium atom in a process called fusion. During fusion, nuclear energy is converted into thermal (heat) energy and radiant energy. The radiant energy is emitted from the sun in all directions and some of it reaches Earth.

Radiant energy is energy that travels in electromagnetic waves or rays. Radiant energy includes visible light, x-rays, infrared rays, microwaves, gamma rays, and others. These rays have different amounts of energy depending upon their wavelength. The shorter the wavelength, the more energy they contain.

Materials:

- 5 thermometers for each group (You can also do this as a class and only need 5 thermometers and 1 piece of each color of paper.)
- 1 piece of black paper (15 x 15 cm) for each group.
- 1 piece of yellow paper (15 x 15 cm) for each group.
- 1 piece of white paper (15 x 15 cm) for each group.
- 1 piece of bright blue paper (15 x 15 cm) for each group.
- 1 piece of bright red paper (15 x 15 cm) for each group.
- Tape
- Bright light or sunny day
- Timers (optional)

Procedure:

THIS ACTIVITY NEEDS TO BE DONE ON A SUNNY DAY!!

1. Introduce the students to the concept of radiant energy. If the students already know a little about energy then remind them of what radiant energy is. Tell them that today they are going to explore one way of changing radiant energy into thermal energy.
2. Explain the procedure to the students. Divide the students into groups.
3. Each group should have 5 thermometers and 5 pieces of different colored paper.
4. Each group creates and records a hypothesis (What they think will happen.) after reading the procedures.
5. Fold each paper in half and tape the sides and one end together to make pouches.
6. Record the temperature of each thermometer and then slip one into each pouch.
7. Place the pouches in the sun or under a bright light (about 0.5 meter away).
8. Create a data table. Record the beginning temperature of each thermometer onto the data table. Have columns for temperature taken at 5, 10, 15, and 20 minutes. (If pressed for time you can cut it down to temperatures taken at 5 and 10 minutes.)
9. After the students have completed taking the temperature have them draw conclusions from their data collected and answer the questions posed on the lab sheet. Was their hypothesis correct or incorrect?
10. To wrap up, discuss the results with the students. Did the results differ from group to group? What conclusions did they come up with?

11. You can also have the students graph their data and see if the conclusions change from the conclusions that they made when just looking at the data table.

Below in the additional content area are two sample lab sheets that you could use.

Assessment:

Assessments will be made by observing the students and how well they work together and follow the directions.
Assessments will also be made by reviewing the data tables and conclusions of the students after the lab was completed.

Additional Content:

EXPLORING RADIANT ENERGY

Objective: To explore how the energy in light is changed into measurable thermal energy.

MATERIALS:

- 5 thermometers
- 1 piece of black paper (15 x 15 cm)
- 1 piece of yellow paper (15 x 15 cm)
- 1 piece of white paper (15 x 15 cm)
- 1 piece of bright blue paper (15 x 15 cm)
- 1 piece of bright red paper (15 x 15 cm)
- Tape
- Bright light or sunny day

HYPOTHESIS: Read the procedure. Record your hypothesis. (What you think will happen.)

PROCEDURE:

1. Fold the pieces of paper in half and tape the sides and one end together to make pouches.
2. Record the temperature of each thermometer on the chart below.
3. Put one thermometer face up into each pouch. Place the pouches in the sun or under a bright light (about 0.5 meter away) as your teacher directs.

DATA: Record the temperature of each thermometer after 5, 10, 15 and 20 minutes. Remember to record the temperature in Celsius.

CONCLUSIONS: Which color paper absorbed the most radiant energy and turned it into thermal energy?
Which color paper reflected the most radiant energy?
Do your results support what you have learned about radiant energy?

Color Of Paper	Temperature Beginning	Temperature 5 minutes	Temperature 10 minutes	Temperature 15 minutes	Temperature 20 minutes	Total Change in Temperature
WHITE						
BLACK						
RED						
YELLOW						
BLUE						

EXPLORING RADIANT ENERGY

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- 1 piece of black paper (15 x 15 cm)
- 1 piece of yellow paper (15 x 15 cm)
- 1 piece of white paper (15 x 15 cm)
- 1 piece of bright blue paper (15 x 15 cm)
- 1 piece of bright red paper (15 x 15 cm)
- Tape
- Bright light or sunny day

HYPOTHESIS: Read the procedure. Record your hypothesis. (What you think will happen.)

PROCEDURE:

1. Fold the pieces of paper in half and tape the sides and one end together to make pouches.
2. Create a data table and record the temperature of each thermometer.
3. Put one thermometer face up into each pouch. Place the pouches in the sun or under a bright light (about 0.5 meter away) as your teacher directs.

DATA: Record the temperature of each thermometer after 5, 10, 15 and 20 minutes. Remember to record the temperature in Celsius. After recording all the temperatures, calculate the total amount of change in the temperature.

CONCLUSIONS: Which color paper absorbed the most radiant energy and turned it into thermal energy?
Which color paper reflected the most radiant energy?
Do your results support what you have learned about radiant energy?

References:

Adapted from The NEED Project's Energyworks http://www.need.org/
Adapted by Jill Williams as part of the INL Educational Science writing team.