612-1265 (15-065) Radiation Can Set Teacher Pages

Benchmarks and Standards

This investigation provides support for the *Benchmarks for Science Literacy* and *National Science Education Standards* shown in the table below.

<table>
<tr><th colspan="3">Benchmarks for Science Literacy</th><th colspan="3">National Science Education Standard</th></tr>
<tr><td>Physical Setting</td><td>4E.3</td><td>Heat can be transferred through materials across space by radiation.</td><td rowspan="2">Science as Inquiry</td><td colspan="2">Design and conduct a scientific investigation.</td></tr>
<tr><td>Mathematical World</td><td>9C.4</td><td>The graphic display of numbers may help to show patterns such as trends, varying rates of change, gaps or clusters.</td><td colspan="2">Use appropriate tools and techniques to gather, analyze, and interpret data.</td></tr>
<tr><td>Habits of Mind</td><td>12D.1</td><td>Organize information in simple tables and graphs and identify relationships they reveal.</td><td>Physical Science</td><td rowspan="2">Transfer of Energy</td><td>Energy is a property of many substances and is associated with heat, light etc.</td></tr>
<tr><td colspan="3"></td><td colspan="2"></td><td>Energy is transferred in many ways.</td></tr>
</table>

Before they begin:

Have students read the Background section of their labs highlighting important terms and concepts. Review classroom safety procedures.

After the Investigation:

As students answer questions on their Journal Pages, encourage students to use the data collected during their experiments and their graphs to help answer the questions.

Answers to Think It Over:

1. Student responses should indicate that the black container absorbed the most energy **and** cite reasonable evidence supporting that answer such as temperature increased more in the black container than the silver one.

2. Student responses should indicate that the black container absorbed energy fastest **and** support their answer citing evidence from their observations, graphs and/or data tables.

3. Student responses should indicate that the black container lost the most energy **and** cite reasonable evidence as support.

4. Student responses should indicate that the black container lost energy faster **and** support their answer citing evident from their observations, graphs, and/or data tables.

5. The color of the containers was the variable in this experiment.

Assessment:

Collect and grade student graphs and Journal Pages. For ESL or Special Education students, have students draw or describe what happened in their experiments.

Warranty and Parts:

We replace all missing or defective parts free of charge. For additional parts, use part numbers above. We accept Mastercard, Visa, checks, school P.O.'s. All products guaranteed free from defect for 90 days after sale, defined as 90 days after date of invoice. This guarantee does not include accident, misuse, or normal wear and tear.

P/N 24-5065

Exploring Radiation and Absorption

Objectives

- To observe how surface color affects rate of energy absorption by an object.
- To observe how surface color affects rate of energy radiation from an object.

Materials

- Black container with one-hole lid
- Silver container with one-hole lid
- Two (2) thermometers, not included
- Lamp with reflector, not included
- Ring stand, not included

Background

Energy is the ability to do work. Almost all energy on Earth's surface can be traced back to the sun. The sun radiates or gives off energy in the form of invisible electromagnetic waves. How much energy an electromagnetic wave has, depends on the nature of the wave itself.

Long waves have relative small amounts of energy. *Radio waves* are long waves that pass through your body every day without causing harm. Microwaves are shorter than radio waves and have more energy.

Infrared waves are essentially heat energy waves. Night vision goggles detect infrared waves. A person wearing night-vision goggles sees the hat given off by an animal or object. Different temperature regions represent different infrared waves and are seen as different colors.

Visible light waves are shorter and have more energy than infrared waves. You see visible light as white light. A light bulb also radiates energy in infrared and visible waves, as heat and light.

Ultraviolet waves are shorter and have more energy than visible light waves. Energy from these waves is strong enough to cause damage to skin cells and has been lined to skin cancer.

X-rays are short, high-energy electromagnetic waves. These energy waves are strong enough to go through the skin and into the interior of the body. Because of the potential for damage, exposure to X-rays such as those at a dentist's office is tightly controlled.

The sun's highest energy waves are given off as *gamma rays*. Luckily, Earth's atmosphere blocks out more of the sun's damaging rays. Those that do get through the atmosphere to Earth's surface power many of Earth's nonliving systems such as weather as well as life itself.

If you have ever seen a picture of Earth's surface taken from an airplane, you'll remember that many types of features - water, ice, rocks, sand, soil and plants - cover its surface. Do all of these objects absorb incoming solar radiation equally? Once heated by the sun, do they all give off heat energy equally: Do the investigation to find out.

Procedure

1. Carefully place a thermometer into each container through the hole in the lid.

2. Place the black and silver containers next to each other, 3 to 4 inches apart.

3. Attach the lamp to the ring stand or other support so that the light points directly at the sides of both containers.

4. Read the temperatures of each container and record these measurements at the start (Time 0 on your Journal Page).

5. Turn on the lamp. Read and record container temperatures each minutes for Minutes 1 through 5.

6. Turn off lamp. Read and record container temperatures each minutes for Minutes 6 through 10,.

7. Label and scale the axes on your graph. Graph your data. Include a key.

8. Complete the questions on your Journal Page.

More Information

To learn more about electromagnetic ways - and to have a little fun with them - check out the following websites:

http://amazing-space.stsci.edu/resources/explorations/light/ems-frames.html

http://www.klbschool.org.uk/interactive/science/em_spectrum.html

http://www.physics.ucsb.edu/~jatila/xmm/TheElectromagneticSpectrum_revisions.html

http://www.colorado.edu/physics/2000/wray/index.html

http://www.colorado.edu/physics/2000/waves_particles/index.html

Name _____ Date _____

Class _____

Exploring Radiation and Absorption

Journal Page

Lamp on

Time (min.)	Temperature Silver (°C)	Temperature Silver (°C)
0		
1		
2		
3		
4		
5		

Lamp off

Time (min.)	Temperature Silver (°C)	Temperature Silver (°C)
6		
7		
8		
9		
10		

Think It Over

1. Which container **absorbed the most** energy? How do you know?

2. After the light was turned on, which container **absorbed energy faster?** Use evidence from your investigation to explain your answer.

3 Which container **lost the most energy** after the light was turned off? How do you know?

4. After the light was turned off, which container radiated or **lost energy faster?** Use evidence from your investigation to explain your answer.

5. What was the variable in this experiment?

Challenge

1. In this investigation, you measured how surface color affected air temperature inside a container. Would you expect the same results if the containers were filled with water? Explain your answer.

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2. Design an experiment to test your prediction.

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3. Perform your experiment.

4. Conclusion : _____
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