Name: _____   Date: _____

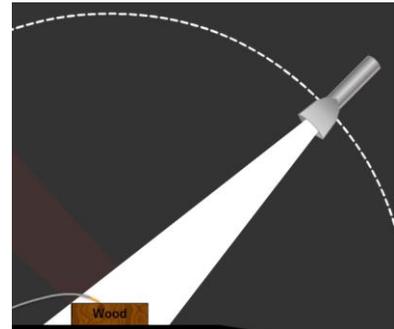# Student Exploration: Heat Absorption

Vocabulary: absorb, greenhouse, radiation, reflect, thermal energy

Prior Knowledge Questions (Do these BEFORE using the Gizmo.)

1. Is it usually hotter outside when the Sun is low in the sky, such as early in the morning, or

   when the Sun is high in the sky, around noon? _____

2. If you want to stay cool on a hot, sunny day, should you wear black or white? Why?

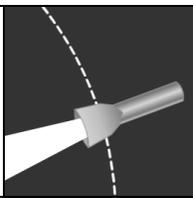   _____

   _____

Gizmo Warm-up
In the *Heat Absorption* Gizmo, a powerful flashlight can shine on a variety of materials. Make sure that the **Light color** is set to **White**.

1. Drag the **Wood** under the beam of light. What do you

   notice? _____

   _____

2. What is the color of the light that is **reflected** off the wooden block? _____

3. Click **Play** (▶) to start the clock.

    A. What happens to the temperature of the wood? _____

    B. The light that is not reflected away is **absorbed** by the wood. What does the

       absorbed light energy do to the wood? _____

       _____

    Energy that is transmitted through space by light waves is called **radiation**. The wood gets
    hotter because it gains **thermal energy** from the light waves.

	Get the Gizmo ready:
Activity A: **Angle of light**	• Click **Reset** (↺). • Check that **Light color** is still set to **White**. • If necessary, drag the **Wood** under the light.

Question: How does the angle of light affect heating?

1. Observe: Drag the flashlight to several different angles. When is the light beam most

   concentrated on the piece of wood? _____

2. Form hypothesis: How will the angle of light affect how much the piece of wood is heated?

   _____

   _____

3. Predict: Which angle will result in the hottest piece of wood? _____

4. Experiment: For each angle listed below, record the final temperature of the wood after 3
   hours of heating with the flashlight.

	20° angle	40° angle	60° angle	80° angle	90° angle
Final temperature					

5. Draw conclusions: Why did increasing the angle of the beam of light cause the wood to heat

   up more? _____

   _____

   _____

6. Apply: St. Louis, Missouri, is located near the middle of the United States. On June 21, the
   noon Sun rays hit St. Louis at an angle of 75°. On December 21, the noon Sun rays hit at an
   angle of 28°. How will this affect the temperature in St. Louis on these dates?

   _____

   _____

   _____

Activity B: **Colored materials**	Get the Gizmo ready: • Click **Reset**. • Drag the flashlight so that the **Light angle** is 75°.	

Question: How do colored materials absorb and reflect light?

1. Observe: Drag the **red brick** under the flashlight beam. Try three different **Light colors**: **red**, **blue**, and **green**.

    A. What color(s) reflect off a red brick? _____

    B. What colors of light are absorbed by the brick? _____

2. Predict: Predict what color(s) of light will heat the red brick the most and the least.

    Most heating: _____   Least heating: _____

3. Collect data: Heat the **red**, **green**, and **blue bricks** under each color of light. Record results.

	Red light	**Blue light**	**Green light**
Red brick final temperature			
Green brick final temperature			
Blue brick final temperature			

4. Analyze: Based on your data, what light colors were absorbed and reflected by each brick?

    Red brick reflects _____ light, absorbs _____ and _____ light.

    Green brick reflects _____ light, absorbs _____ and _____ light.

    Blue brick reflects _____ light, absorbs _____ and _____ light.

5. Extend your thinking: White light is a combination of red, green, and blue light. Why is it cooler to wear a white shirt on a sunny day than a black shirt?

    _____

    _____

    _____

Activity C:	Get the Gizmo ready:	
Comparing materials	• Click **Reset**. • Change the **Light color** to **white**.	

Question: Which materials are easiest to heat up?

1. <u>Predict</u>: In this activity you will compare how **metal**, **wood**, **water**, and **brick** heat up.

   A. Which substance do you think will heat up the most? _____

   B. Which substances will heat up the least? _____

2. <u>Experiment</u>: Using white light, heat up each of the following substances for 3 hours.

	Metal	**Wood**	**Water**	**Black brick**	**White brick**
Final temperature (no glass cover)					

3. <u>Analyze</u>: Based on the results, which substances do you think reflected the most light?

   _____

4. <u>Experiment</u>: A **greenhouse** is a building with a glass roof and walls. Light can get in, but the heated air inside cannot escape.

   Click **Add glass cover** to simulate conditions in a greenhouse, and heat up each substance. Record your results below.

	Metal	**Wood**	**Water**	**Black brick**	**White brick**
Final temperature (under glass)					

5. <u>Analyze</u>: What effect did the glass cover have? _____

   _____

6. <u>Extend your thinking</u>: Why is it dangerous to leave an infant or pet in a car on a sunny day with the windows rolled up?

   _____

   _____