

Name: \_\_\_\_\_ Date: \_\_\_\_\_

## Student Exploration: Heat Absorption

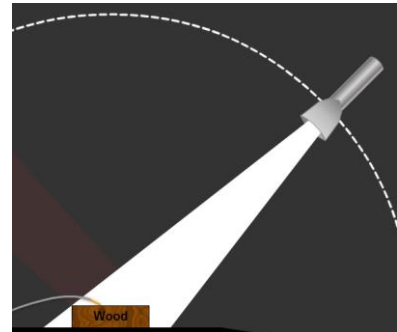
**Vocabulary:** absorb, greenhouse, radiation, reflect, thermal energy

**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?  
\_\_\_\_\_  
\_\_\_\_\_

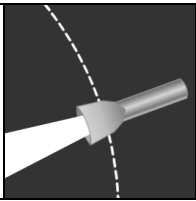
### Gizmo Warm-up

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.

<b>Activity A:</b> <b>Angle of light</b>	<u>Get the Gizmo ready:</u> <ul style="list-style-type: none"> <li>• Click <b>Reset</b> (↺).</li> <li>• Check that <b>Light color</b> is still set to <b>White</b>.</li> <li>• If necessary, drag the <b>Wood</b> under the light.</li> </ul>	
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**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?  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

<b>Activity B:</b> <b>Colored materials</b>	<u>Get the Gizmo ready:</u> <ul style="list-style-type: none"> <li>Click <b>Reset</b>.</li> <li>Drag the flashlight so that the <b>Light angle</b> is 75°.</li> </ul>	Black brick	White brick
		Green brick	Blue brick

**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?

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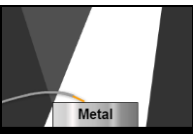


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<b>Activity C:</b> <b>Comparing materials</b>	<u>Get the Gizmo ready:</u> <ul style="list-style-type: none"> <li>Click <b>Reset</b>.</li> <li>Change the <b>Light color</b> to <b>white</b>.</li> </ul>	
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**Question: Which materials are easiest to heat up?**

1. Predict: 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. Experiment: Using white light, heat up each of the following substances for 3 hours.

	<b>Metal</b>	<b>Wood</b>	<b>Water</b>	<b>Black brick</b>	<b>White brick</b>
Final temperature (no glass cover)					

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

\_\_\_\_\_

4. Experiment: 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.

	<b>Metal</b>	<b>Wood</b>	<b>Water</b>	<b>Black brick</b>	<b>White brick</b>
Final temperature (under glass)					

5. Analyze: What effect did the glass cover have? \_\_\_\_\_

\_\_\_\_\_

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

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