

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

## Student Exploration: Radiation

**Vocabulary:** filament, infrared, Kelvin scale, radiation

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

1. The Sun is millions of kilometers away. How can heat from the Sun get here? \_\_\_\_\_  
\_\_\_\_\_
2. If you look inside an electric stove or toaster oven, how can you tell whether it's turned on?  
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### Gizmo Warm-up

In the *Radiation* Gizmo™, you can focus the light of a super-powerful flashlight upon a kernel of popcorn and see what happens. The lens, which focuses the light, can be moved to the left or right.

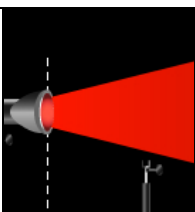


1. The **Temperature** slider controls the heat of the metal **filament** inside the light. Scientists use the **Kelvin scale** to measure the temperature of very hot objects. It is like the Celsius scale except 0 K (absolute zero) is the coldest anything can ever be.

Slowly move the **Temperature** slider all the way to the right. What happens? \_\_\_\_\_  
\_\_\_\_\_

The light energy emitted by the flashlight is called **radiation**.

2. Slide the lens so the distance to the flashlight is 40 cm. Press **Play** (▶). What happens?  
\_\_\_\_\_
3. Do you think the kernel will pop if you place cardboard in front of the flashlight? \_\_\_\_\_
4. Click **Reset** (↶). At the top of the Gizmo, next to **Obstacle**, select **Cardboard**. Press **Play**. What happens? \_\_\_\_\_

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| <p><b>Activity A:</b><br/><b>What does the popping?</b></p> | <p><u>Get the Gizmo ready:</u></p> <ul style="list-style-type: none"> <li>• Click <b>Reset</b>.</li> <li>• Set <b>Temperature</b> to 1500 K.</li> <li>• Slide the lens so it is 50 cm from the light.</li> <li>• For Obstacle, select <b>None</b>.</li> </ul> |  |
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**Question: How does heat get from the flashlight's metal filament to the kernel?**

1. Observe: Press **Play**. How long does it take the kernel to pop? \_\_\_\_\_

2. Form hypothesis: Inside the light bulb is a very hot piece of metal, called the filament. It gives off light because it is so hot. In addition, the glass bulb gets hot and heats the air.


How do you think heat gets from the filament to the kernel? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

3. Predict: Click **Reset** and select **Cardboard**. This blocks all light and some of the hot air. Based on your hypothesis, how will this affect popping time? Explain. \_\_\_\_\_

\_\_\_\_\_

4. Test: Click **Play** or **Fast forward** (  ). Was your prediction correct? \_\_\_\_\_

5. Predict: Click **Reset** and select **Red glass**. This lets most of the light through but still blocks some air. What do you think will happen? Explain. \_\_\_\_\_

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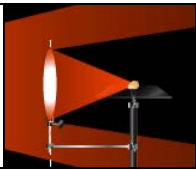
6. Test: Click **Play** or **Fast forward**. What did you find? \_\_\_\_\_

7. Draw conclusions: When the popcorn kernel popped, was it because it was heated by light (radiation) or hot air from the flashlight? Explain how you know this.

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| <b>Activity B:</b><br><b>Out of sight</b> | <u>Get the Gizmo ready:</u> <ul style="list-style-type: none"> <li>• Click <b>Reset</b>.</li> <li>• Slide the lens so it is 60 cm from the light.</li> <li>• Set the <b>Temperature</b> to 2000 K.</li> </ul> |  |
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**Goal: Understand that light is both visible and invisible.**

1. Observe: Select **Blue glass**. How does this affect the light that gets to the corn? \_\_\_\_\_  
\_\_\_\_\_
2. Conjecture: Will the corn pop when you start the simulation? Explain. \_\_\_\_\_  
\_\_\_\_\_
3. Experiment: Click **Fast forward**. What happens? \_\_\_\_\_
4. Draw conclusions: The filament radiates both visible light (orange in this case) and invisible light (**infrared light**). Did the blue glass block infrared light? Explain how you can tell.  
\_\_\_\_\_  
\_\_\_\_\_
5. Run Gizmo: Click **Reset**. Remove the glass. Click **Play**. When does the corn pop? \_\_\_\_\_
6. Analyze: Compare the popping times with and without the blue glass. Is most of the radiation given off by the filament red or infrared? Explain. \_\_\_\_\_  
\_\_\_\_\_
7. Test: Click **Reset**. Select **Cardboard** and then click **Fast forward**. Does the cardboard block infrared light? Explain. \_\_\_\_\_  
\_\_\_\_\_
8. Extend: Do you think the blue glass or the cardboard gets hotter in this experiment? Why?  
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\_\_\_\_\_

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| <b>Activity C:</b><br><b>Blended light</b> | <u>Get the Gizmo ready:</u> <ul style="list-style-type: none"><li>• Click <b>Reset</b>.</li><li>• Set the <b>Temperature</b> to 1300 K.</li></ul> |  |
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**Question: How does temperature affect the kinds of visible light produced?**

1. Observe: Colored glass allows some light through and absorbs (or reflects) the rest.

A. Select **Green glass**. Does green glass let red light through? \_\_\_\_\_

B. Select **Red glass**. Does red glass let red light through? \_\_\_\_\_

2. Analyze: Select **Blue glass**. Slowly increase the **Temperature** to 3600 K. What happens?

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3. Draw conclusions: The radiation given off by the flashlight filament is a mixture of colors.

Does it give off more blue light at 3600 K or 1300 K? Explain. \_\_\_\_\_

\_\_\_\_\_

4. Observe: Set the **Temperature** to 2500 K. Observe the light through the different glasses.

A. The orange light radiated at 2500 K is a blend of which colors? Explain. \_\_\_\_\_

\_\_\_\_\_

B. Is there more red light or green light? How do you know? \_\_\_\_\_

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5. Compare: Select **Red glass**. Slowly slide the **Temperature** slider to 1000 K. Does the orange light at 2500 K have more or less red light in it than the red light at 1000 K? Explain.

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6. Challenge: Purple glass lets red and blue light through but not green. What would you see as you increased the temperature from 1000 K to 3600 K using purple glass?

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