**How does the *temperature* of a ‘Blackbody effect the *maximum wavelength* of light it gives off?**

Website for virtual Blackbody Simulation Lab:

<http://phet.colorado.edu/sims/blackbody-spectrum/blackbody-spectrum_en.html>

Background: A “blackbody” is an object that does not reflect light, it only gives off (emits) light! Of course in order for any object to emit light it must get hot and glow. In this lab you are going to observe the distribution of light (**EM Radiation**) given off by hot objects and determine if there is an empirical relationship between an object’s temperature and the **EM Radiation** emitted.

**Part I Characteristics of the blackbody spectrum emitted from an incandescent light bulb.**

Set the temperature of the blackbody to 3000 K. This is approximately the temperature of the tungsten filament in an incandescent light bulb which is a good black body. Adjust the axis zoom tools to observe a large peak; 3.16 on the vertical axis and 3 on the horizontal axis. Understand the labels of each axis! On the vertical axis is **intensity;** the amount (or strength) of light given off. On the horizontal axis is the **wavelength** of all EM Radiationemitted; including the visible light given off.

1. Based on the graph, describe the **intensity and distribution of EM Radiation** (Electromagnetic output) produced by the glowing tungsten of an incandescent light bulb?

2. Explain how the graph of a light bulb’s EM Radiation shows that X-rays are not produced?

3. In the spectrum made by the incandescent light bulb, what is the maximum wavelength produced and how would you classify it?

Wavelength \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Type: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. Given your answer to #3, is an incandescent light bulb **efficient** at producing visible light? Explain and suggest alternatives that could lower your electric bill and save your household money.

Click Save. (The curve will turn yellow)

**Part II Comparing spectra of different objects.**

Set the temperature to 615 K, this is comparable to the temperature in a very hot oven. Notice that the RED line shows the EM Radiation emitted (give off) by an oven. The line appears flat at the current settings on the graph, so adjust the settings to be able to see the wavelength distribution Zoom the y axis in to read 0.001 and zoom the x-axis out to 24.

1. How is the shape of curve produced by an oven **similar** to the line produced by the light bulb?

2. How is the curve produced by the oven **different** from the curve produced by the light bulb?

3. What is the maximum wavelength produced by an oven produced and how would you classify it?

Wavelength \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Type: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. If the light goes out in your kitchen, could you see in the dark by light from hot oven? Explain.

**Set the temperature to 5800K. This is approximately the surface temperature of the sun.** You’ll need to zoom in on the horizontal axis to 1.5 and zoom out on the vertical axis to 100.

5. **Compare** the maximum wavelength produced (the wavelength of the peak or top of the curve) made by the light bulb to the most intense wavelength produced by the sun.

6. Describe the **intensity and distribution EM radiation** emitted (given off) by the sun and propose a relationship the maximum wavelength produced and the temperature of the glowing object.

7. Is there evidence of the sun producing harmful ultraviolet radiation? Explain.

**Part III The relationship between maximum wavelength and temperature.**

Now you will **record data and graph** the relationship between maximum wavelength and temperature. **For the following temperatures determine the maximum wavelength emitted.** Use the ruler tool to line-up the peak (top) of the curve to get an accurate reading from the x-axis. **Be sure to adjust and record your wavelength in nm!**

|  |  |  |
| --- | --- | --- |
| Temperature (K) | Peak Wavelength **(nm)** | 1/Wavelength **(nm-1)** |
| 600 K |  |  |
| 1200 K |  |  |
| 2500 K |  |  |
| 3500 K |  |  |
| 4500 K |  |  |
| 5500 K |  |  |

**Part IV Analysis of graphs and the slope of ‘Best Fit’ line:**

1. Make a plot of **Temperature (K) vs. Wavelength (nm**). What is this kind of relationship called?

2. Confirm this relationship by graphing **Temperature (K) vs. 1/Wavelength (nm)** and calculating the slope of a best fit line. State a mathematical relationship between T and Peak Wavelength.

3. **Write** Wien’s Displacement Law, **compare** Wien’s constant to your slope and find your **% error**.