Radiation Lab

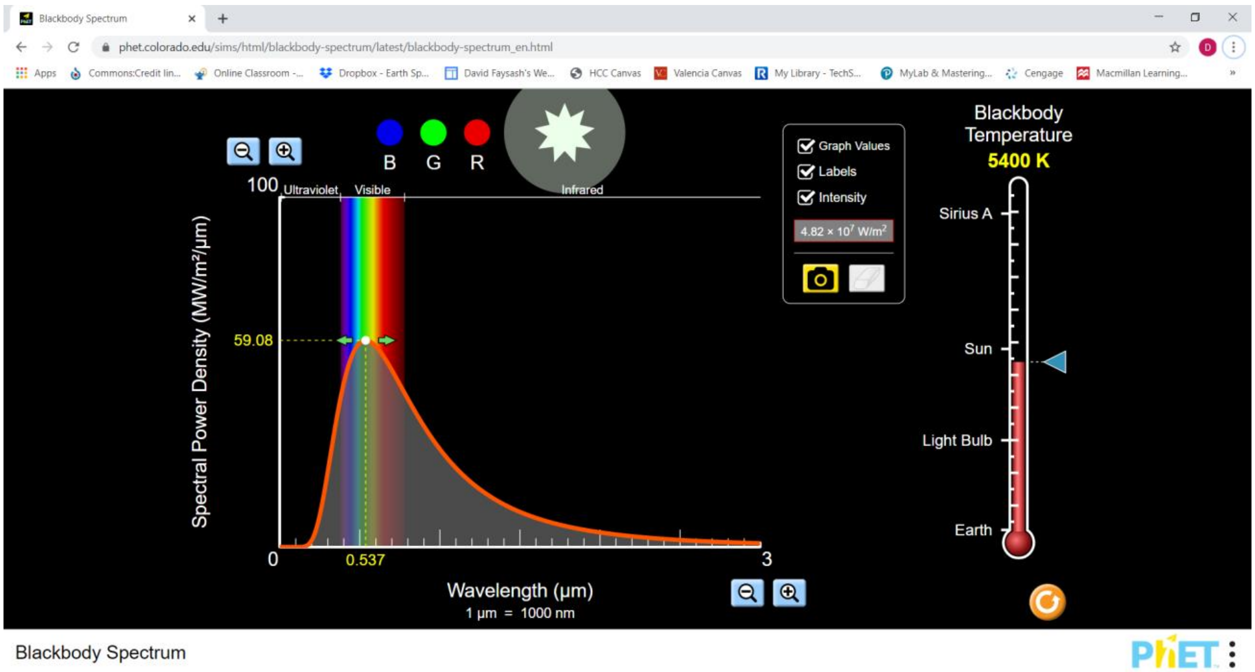
Background

In Chapter 4 Section 2 (Pages 122-124) you learned about two radiation laws. Wein's law gives the wavelength of peak radiation given off by an object at a given temperature. Stefan-Boltzmann's law gives total intensity of radiation given off by an object at a given temperature. These radiation laws are used by astronomers to determine the temperatures of objects in space. For example if they can determine the wavelength of peak intensity of radiation or the total intensity of radiation they can determine the temperature. For this lab we will explore how the change in the temperature of an object affects the type and amount of radiation given off by the object.

What to do

To begin go to this blackbody spectrum simulator (https://phet.colorado.edu/sims/html/blackbody-spectrum/latest/blackbody-spectrum_en.html)

Turn on the graph values, labels, and intensity. Adjust the temperature to 5450 K. Your simulator should look like this.



Let's explain the graph. The red graph line shows the spectral power density for each wavelength of electromagnetic radiation for the wavelengths between 0 and 3 µm for the given temperature (in this case 5400K). The red graph line is also known as the **blackbody curve.** Each point on the red graph line would give you the amount of radiation (MW/m^2) for each wavelength of radiation (µm). M stands for Mega, W stands for watts, and m2 is area in meters squared so the units are MegaWatts per square meter. The point on the graph is set for the wavelength of peak radiation. After you are done the lab you can move the point around and it will show you how much radiation is given. If you were to find the area under the red curve (i.e summing up all of individual radiations) you would get the total intensity of radiation which in this example is 4.82×10^7 Wm^2. This means for each square meter (an area 1 meter by 1 meter

For the first part of this lab you adjust the black body temperature to the values in the table below. For each temperature type in the wavelength of peak radiation, type of electromagnetic radiation, color of peak radiation, spectral power density, and total intensity.

Let's use the example in the picture. The **temperature** is set to 5400K

The **wavelength of peak radiation** is given on the wavelength axis. The value is 0.537 µm.

The **Type of Electromagnetic Radiation** (Ultraviolet, Visible, Infrared) for wavelength of peak radiation is given at the top of the graph. Since the peak of the curve is in the visible light section the type of electromagnetic radiation is visible light.

The **color of peak radiation** (if its in the visible spectrum) for this example of 5400K is green (green-yellow). You will only put a color if the peak is in the visible light section.

The **Spectral Power Density** for a temperature of 5400 K is 59.08 $MW/m^2/\ \mu m$. This is given on the y-axis of the graph.

The **Total Intensity** is given in the box that has the camera icon in it. The value for 5400K is 4.82×10^7 Wm^2.

Scroll down to the **data table**. Print out the student lab sheet on the next page. Use the simulator to fill in the information in the table (hand write the values). For each blackbody temperature in the graph adjust the temperature in the simulator and record the wavelength of peak radiation, type of electromagnetic radiation, color of peak radiation, spectral power density, and total intensity. Take a picture of the data table and upload it to question 1 of radiation lab.

For the **analysis questions** on page 3 I've provide them in this document but you will answer them in the radiation lab itself.

Data Table

Blackbody Temperature(K)	Wavelength of peak radiation (µm)	Type of Electromagnetic Radiation (Ultraviolet, Visible, Infrared) for wavelength of peak radiation	Color of peak radiation (if its in the visible spectrum)	Spectral Power Density (MW/m^2/ µm	Total Intensity (W/m^2)
Earth 550K					
Lightbulb 3050K					
3950K					
4550K					
4950					
Sun 5750K					
6550K *You should zoom the graph out w/the magnifying lens upper left corner					
7450 K					
8550 K					
9000 K					
Sirus A 9950K					

Analysis Questions

1. What do you notice about the wavelength of peak radiation as the temperature increases?

2. What do you notice about the type of electromagnetic radiation for the wavelength of peak radiation as the temperature increases?

3. What do you notice about the color of peak radiation when the peak radiation was in the visible spectrum as the temperature increases?

4. What do you notice about the spectral power density of the wavelength of the peak radiation as the temperature increases?

5. What do you notice about the total intensity of radiation as the temperature increases?

6. What do you notice about the size and shape of the black body curve as the temperature increases?