Investigating Stars Name:____Block:____________

What Determines the Color and Temperature of Stars? **E1:A3**

The gases in the outer layers of a star emit photons of light as a result of the collisions and interactions of electrons. The average speed of these particles determines the temperature of a star, and the temperature in turn determines the color of a star. In this activity, you will consider the relationship between color and temperature in stars.

1. Read FYI: *The Color of Stars*. Complete the reading guide and questions after reading. When everyone has completed this, go on to #2.

2. Use a red filter and then a blue filter to look at an image of the Cygnus star field projected onto a screen in your classroom.

   What differences do you notice between the two views?

3. Select three stars of different colors, and for each, find the graph in FYI: *The Color of Stars* that would most resemble your prediction of what the brightness vs. wavelength should be for that star.

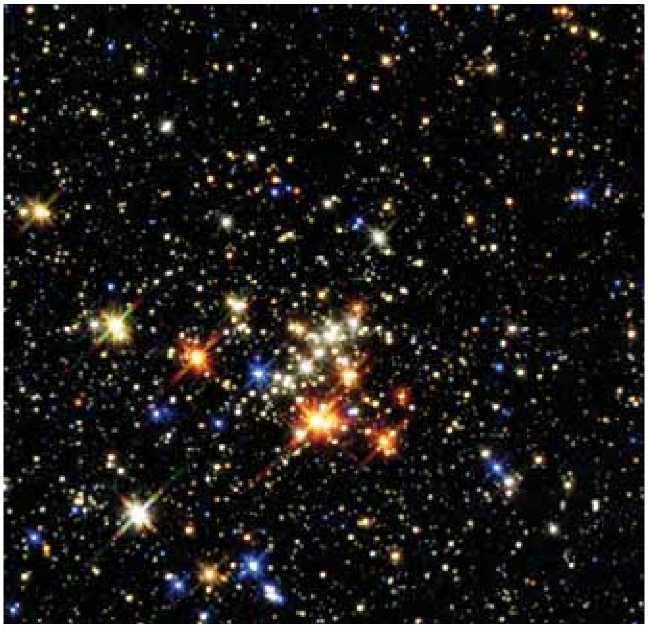

Figure 1-5: Image of stars. The stars in the night sky may appear mostly white, but seen through a telescope they can be quite colorful. The color of a star is proportional to its temperature. Hot stars emit shorter wavelengths of light that are higher in energy, so they appear bluer than red stars, which are cooler.

4. Now explore a simulation of how the temperature of an object changes the light that it emits. As a small group or class, navigate to the Blackbody Spectrum Simulation at https://phet.colorado.edu/en/simulation/legacy/blackbody-spectrum

Background: A "blackbody" is a term used to describe the light given by an ideal object that emits and absorbs light perfectly. Of course in order for such an object to emit light it must get hot. In this simulation you are going to observe the nature of light given off by hot objects and determine if there is an empirical relationship between an object's temperature and the light emitted.

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Part I Characteristics of the blackbody spectrum of 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. Use the zoom tools so that you can observe a large peak (3.16 on the vertical axis and 3 on the horizontal axis would be good. Be clear about the information on each axis. Intensity is the amount of light given off and the wavelength of light is given on the horizontal axis.

1. Based on the graph, does the light bulb produce visible light? How can you tell?

2. Does the light bulb produce X-rays? How can you tell?

3. In the spectrum made by the light bulb, which wavelength is most intense and how would you classify it?

Wavelength __________________________ Type:________________________

4. Given your answer to #3 is an incandescent light bulb very good for its intended use? Explain and suggest alternatives.

5. Based on the shape of the graph would you expect the light bulb to emit radio waves? Would the amount be significant? Explain.

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 is the radiation emitted by the oven. The line should appear flat, but it isn't. Zoom the y axis in to read .001 and zoom the x-axis out.

1. How is the curve produced by the 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. If the power goes out in your kitchen, could you see in the dark using light from hot oven? Explain.

Set the temperature to 5600K. This is approximately the surface temperature of the sun. You'll need to zoom in on the horizontal axis and zoom out on the vertical axis.

4. Compared the most intense wavelength produced by the light bulb to the most intense produced by the sun.

5. Explain the relationship you see between the radiation emitted by the sun and the visible spectrum.

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

Part III The relationship between peak wavelength and temperature.

Now you will explore the relationship between peak wavelength and temperature. For the following temperatures determine the peak wavelength using the ruler tool to help you line-up the peak with the x-axis. Be careful to make sure your wavelength is in nm!

Temperature (K)	Peak Wavelength (nm!)
600 K	
1200 K	
2500 K	
3500 K	
4500 K	
5500 K	

Analysis

1. What relationship do you notice between temperature and the peak wavelength emitted?