

http://www.mhhe.com/physsci/astronomy/applets/Blackbody/applet_files/BlackBody.html

There is a link from our class web page – Blackbody Radiation Applet #1

A. Wien's law gives the wavelength where the blackbody peaks as a function of temperature.

$$\lambda_{\max} = \frac{2.9 \times 10^6}{T} \text{ nm-K}$$

Play with the Applet to find out how high the temperature has to be for the peak of the curve to fall outside the visible spectrum. Use Wien's law to determine at what exact wavelength the peak occurs?

B. If the peak of the curve falls outside the visible range, what determines the color of a star? White light has an approximately equal mix of colors. White dwarfs are high temperature stars ($T > 30,000$ K). Use the Applet to figure out how they got their name. Explain.

C. The luminosity relation for blackbodies says that if two stars have the same radius but different temperatures, the hotter (bluer) star is a whole lot brighter than the cooler (redder) star. Just in case you forgot here is the luminosity relation,

$$L = 4\pi R^2 \sigma T^4$$

You can also see this by using the applet to plot two blackbody curves of different temperature. The applet uses the first plot you created to set the scale of y-axis (which is the radiation's intensity). When you plot the second curve you can then see how its intensity compares to the first. Try plotting a high temperature blackbody curve and then, using the "new graph" button, try plotting one with a slightly lower temperature. Does the second curve peak below the first one? What does that tell you?

D. Now try plotting a third curve that has a slightly higher temperature. Does the peak of this curve rise so far that it is off the plot? What is this telling you?

E. Physically, why do you think the intensity in a blackbody is so dependent on temperature?

1. Use Wein's law to estimate the temperature of the Red Supergiant star Betelgeuse. Obviously Betelgeuse appears red but its blackbody curve actually peaks in the infrared with a wavelength of 855 nanometers.
2. Now use the applet to create a blackbody curve with the temperature you found above. How well do they match? What is the color of the star in the applet?
3. Now lets flip the problem on its head. The star Rigel has a temperature of 11,000 K. Use Wien's law to find the peak wavelength of the star. What color does this correspond to?
4. Here is an exercise comparing the energy output of two stars with the same temperature but different sizes. The temperature of both stars is 4000 K. Use Wien's law and the Applet to find the peak wavelength.

Now imagine one star is a giant and has a radius that is 80 times bigger than the Sun. The other star is smaller and has a radius that is .8 times that of the sun. Can you use the Luminosity relation for blackbodies to compare how much more luminous the big star is compared to the small one? (Note, you are only being asked to make a comparison so you should be able to do this problem without actually using the value of the Stefan-Boltzmann constant or calculating the $4\pi r^2$ in the problem).

Look at the other two Blackbody Applets. Do they help you understand any of concepts about Blackbodies? Is anything clearer when you try them out?

Play the Blackbody Game at least several times. Record how many guesses it took for you to be correct for each trial. Make sure you erase the decimal in the temperature.

#1 _____ #2 _____ #3 _____