Teacher Materials

Student Materials

Build your own star!

In the lower right corner (light blue panel) there are 2 sliders, which can be used to adjust the radius and the temperature of the star you build. The radius and the temperature of your star are the only inputs for this simulation. You can also type directly into the 2 boxes that display numbers below the sliders. This is important if you want to enter a number that is outside the range of the sliders.

In the lower left corner (pink panel) values are displayed for the star you have created. Values are displayed here for the peak wavelength of emission, the energy output in Solar Units (SUs), the estimated mass in SUs (only good for main sequence stars),and the estimated lifespan of your star.

The black body spectrum is displayed in the middle panel on the right side (beige panel). The surface area of the star is taken into account, and the Y axis of the graph is in SUs, 1 SU being the height of the peak from our sun.

The upper left panel (light purple) displays the star, with the color as it would appear. The middle panel on the left (medium blue) displays both the peak wavelength and the star appearance.

The panel in the upper right corner is the real heart and soul of this simulation. This is a Hertsprung Russell diagram, also known as an HR diagram. This is a log-log plot. Luminosity is on the Y axis, and goes from .0001 to 100,000 SUs. The X axis is reversed, and goes from 2500 Kelvins on the right to 40,000 Kelvins on the left side.

The yellow squares are plots of individual main sequence stars. While stars do exist that are not on the main sequence, these will not be stable stars in the prime of life. Stars above and to the right of the main sequence stars are red giants, and nearing the end of their lives as stars. Stars below and to the left of the main sequence are white dwarves, and are even closer the end of their lives then the red giants.

The stars you create should be main sequence stars, and you will find it necessary to adjust the temperature and radius of your star, with one eye on the estimated mass display, to create realistic and stable main sequence stars of a given mass. Your star will appear as a red dot on the HR diagram. Please go to the activities page, create main sequence stars, and fill in the required data.

Create main sequence stars of the masses given, and fill in the missing data:

Mass (SUs)	Radius (SUs)	Temperature (K)	Luminosity (SUs)	Lifespan (years)
.25				
.5				
1				
2				
3				
4				
5				
10				
15				
18				

Teacher Appendix

Your students should get results that are similar to, but not identical, to the following numbers.

Mass (SUs)	Radius (SUs)	Temperature (K)	Luminosity (SUs)	Lifespan (years)
.25	.24	2900	.004	700 Billion
.5	.54	3960	.065	82 Billion
1	1	5780	1.007	9.95 Billion
2	1.88	8285	15.019	1.24 Billion
3	2.5	10,643	72.325	371 Million
4	2.94	13,000	223	156 Million
5	3.17	15,572	533	80 Million
10	4.16	26,714	7949	10 Million
15	6	33,030	38645	296,121
18	7.2	36,020	78,703	171,337

The wavelength of maximum emission is calculated using Wein's Law.

The luminosity, or total energy output, is given by the Stefan-Boltzmann Law.

The surface area of the star is calculated, and the ratio between the surface area of your star and the sun is used to convert the black body diagram from arbitrary units per meter into solar units.

The mass is estimated using the relationship that says mass to the 3.9th power equals luminosity (for main sequence stars only).

The expected lifetime of the star is calculated using a fairly common relationship that says that the life expectancy of a star is proportional to 1 over mass to the 3rd power.

The peak wavelength color becomes black when the wavelength is above 700nm or below 400nm because light outside the 400nm-700nm is not visible to humans.

As the temperature is increased the black body curve becomes more pointy. A star that is hotter than the sun may have a peak value 100 times that of the sun, while the luminosity is only 50 times more. This is reasonable because the peak value is being compared to the sun's peak value, where as the luminosity is related to the area under the curve. As the temperature increases and the black body curve gets more pointy, the differences in peak values become larger when compared to the differences in luminosity.

Students can be given red giants and white dwarves to plot. These will be off of the main sequence. The students should be able to identify them by their position on the HR diagram.

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