Investigating Stars Name:____ Block:____________

FYI: The Color of Stars **E1:R3**

1. Read FYI: *The Color of Stars*

   As you read use the spaces below to write down any information you find especially interesting. Also define the bold terms used in the text. If you run across any other words that you don't know the meaning of, write those down and ask your teacher to help you with them.

Word/Term	Definition
Wien's Law	**Wien's Law** describes a mathematical relationship between a star's ___________ and ___________________. • Hotter objects emit most of their radiation at ____________ wavelengths and therefore appear to be __________. • Cooler objects emit most of their radiation at ____________ wavelengths and therefore appear to be __________.
Stefan-Boltzmann Law	The **Stefan-Boltzmann Law** describes a mathematical relationship between a star's ________________ and the amount of __________ it emits.
Continuous Spectrum	A **Continuous Spectrum** is emitted by hot dense objects like stars and incandescent light bulbs. When a continuous spectrum is spread out, this results in the color spectrum we see in a _____________ .
Diffraction Grating	A **Diffraction Grating** is a device used to spread-out or "break apart" a star's spectrum.
Extra space for additional words or interesting information.	

1. How can a star's surface temperature be determined from a graph of its continuous spectrum?

2. How can the total energy output of a star be determined by examining a graph of its continuous spectrum?

FYI The Color of Stars

Stars emit all forms of electromagnetic radiation in varying amounts—amounts that are proportional to a star's surface temperature. When electromagnetic radiation from a star passes through a **diffraction grating**, a **continuous spectrum** is produced. For visible light emitted by white-hot objects such as light bulbs and stars, this results in the color spectrum we see in a rainbow. A similar "breaking apart" occurs as well for electromagnetic radiation we don't see, such as radio waves or x-rays.

When the light from a star is passed through a diffraction grating and produces a continuous spectrum, astronomers often graph this light with brightness on the vertical axis and wavelength on the horizontal axis. The result is a smooth curve with a peak at a certain wavelength. This peak occurs at the wavelength at which the most electromagnetic radiation is produced by the star. Since the radiation is caused by collisions among the moving particles within the star, the wavelength at which the peak occurs depends on the surface temperature of the star. The peak will be at shorter (bluer) wavelengths for hotter stars, and at longer (redder) wavelengths for cooler stars. The peak wavelength of cool stars lies in the infrared region of the spectrum; very hot stars peak at ultraviolet wavelengths.

The mathematical relationship between color and temperature of a star is called **Wien's Law**. Wien's Law tells us that objects of different temperatures emit spectra that peak at different wavelengths.

- Hotter objects emit most of their radiation at shorter wavelengths; hence they will appear to be bluer.
- Cooler objects emit most of their radiation at longer wavelengths; hence they will appear to be redder.

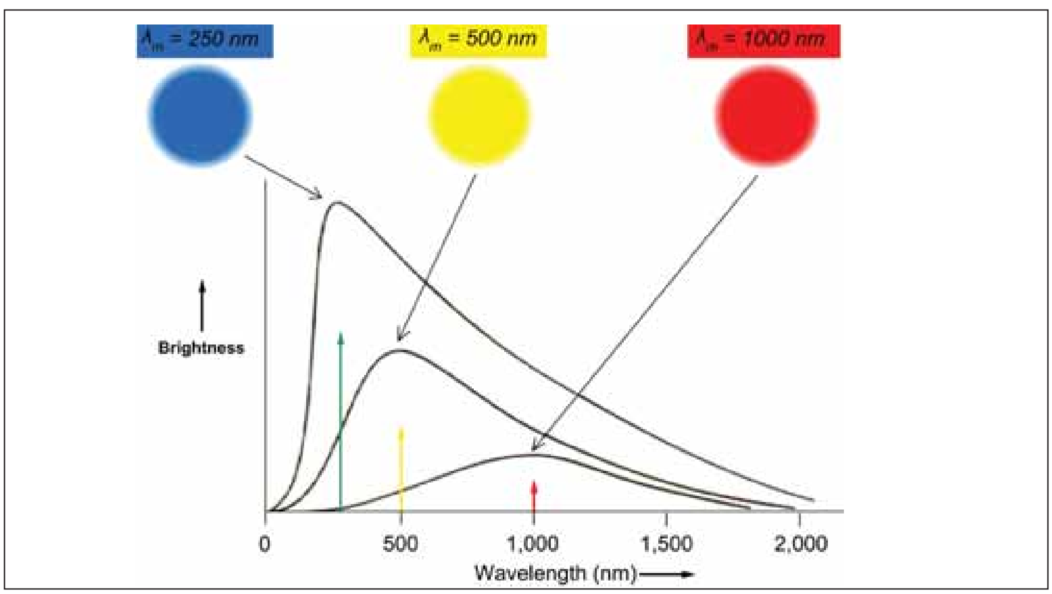

Figure 1-6: Graph of the continuous spectra of stars of different colors

The total area under the curve of a continuous spectrum is a measure of the total energy emitted by the star. Not only does the color of a star depend upon its surface temperature, the amount of total energy emitted by a star is also dependent upon temperature. A hotter star radiates more total energy and is more luminous than a cooler star. The **Stefan-Boltzmann Law** states that the energy a star emits is proportional to temperature raised to the fourth power. This means that temperature is a huge factor in the energy output of stars. The sun's surface temperature is about 5800 K. The Stefan-Boltzmann Law says that if a star has twice the surface temperature of the sun, it will emit not twice, not four times, not eight times, but 16 times more energy ($2^4 = 16$)! This is an important principle to keep in mind as your study of stars proceeds.

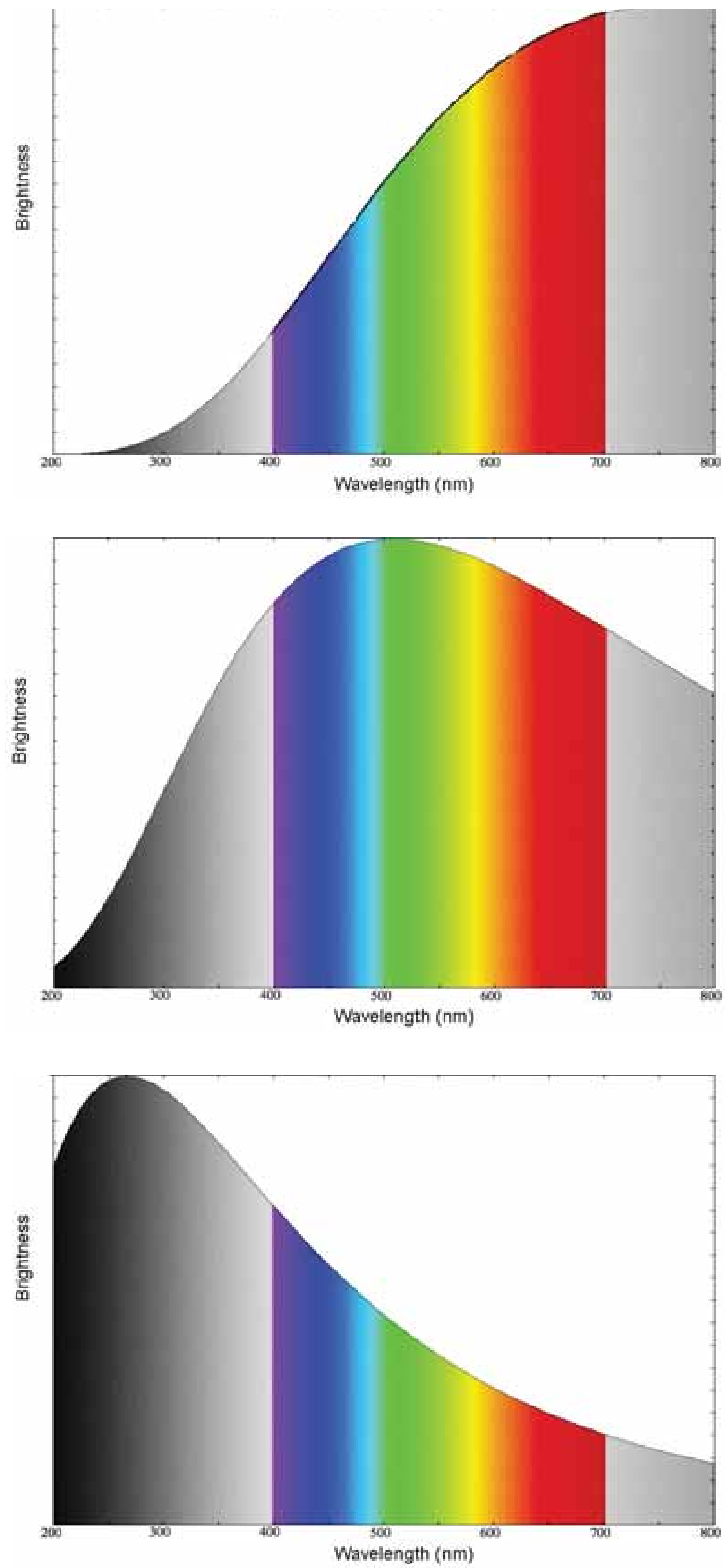

Figure 1-7: Blackbody diagrams for cool (top), moderate (middle), and hot (bottom) stars.