

## Part I: Spectral Curves

White light is made up of all colors of light. We can see the individual colors when white light is passed through a prism or when we look at a rainbow. Light can come in an array of types or forms, which we call a *spectrum*. A *spectral curve* (like the one shown below) is a graph that displays the amount of energy given off by an object each second versus the different wavelengths (or colors) of light. For a specific color of light on the horizontal axis, the height of the curve will indicate how much energy is being given off at that particular wavelength. Figure 1 shows the spectral curve for an object emitting more red and orange light than indigo and violet. Notice that the red end of the curve is higher than the violet end so the object will appear slightly reddish in color.

- 1) Which color of light has the greatest energy output in Figure 1?
- 2) Imagine that the blue light and orange light from the source were blocked. What color(s) would now be present in the spectrum of light observed?
- 3) Which of the following is the most accurate spectral curve for the spectrum described in Question 2?

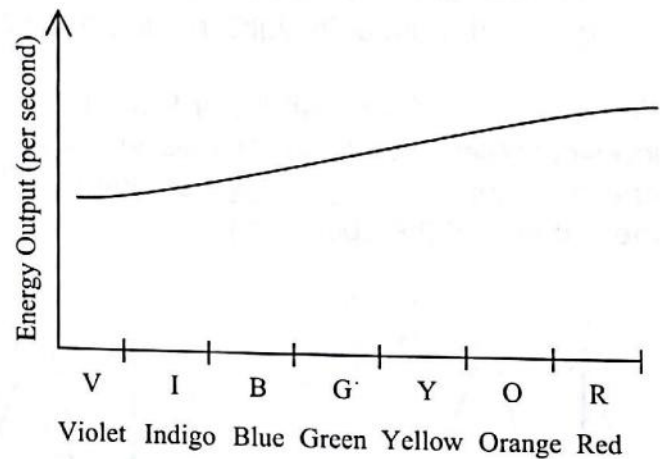
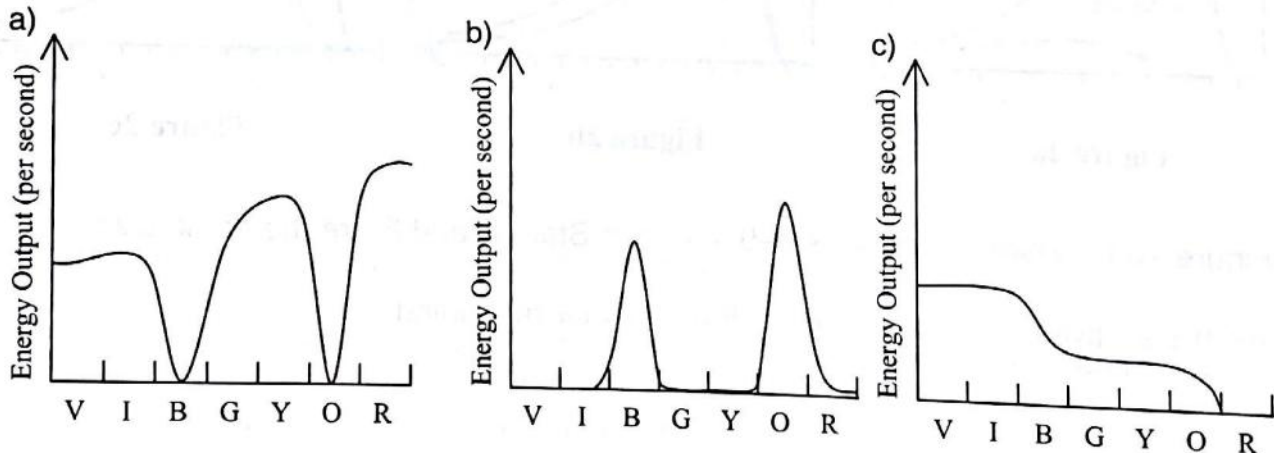


Figure 1



- 4) What colors of light are present in 3b above?
- 5) What colors are present in 3c above? Would this object appear reddish or bluish?

## Part II: Blackbody Curves

Different colors of light are manifestations of the same phenomenon but have different wavelengths. For example, red light has a wavelength between 650 nm and 750 nm, whereas violet light has a shorter wavelength between 350 nm and 450 nm. Stars also give off light at wavelengths outside the visible part of the spectrum as seen in Figures 2a, 2b, and 2c.

The two most important features of a star's spectral curve (also known as a blackbody curve) are:

- its maximum height or peak—where the energy output is greatest; and
- the corresponding wavelength at which this peak occurs—which indicates the star's temperature. If the peak occurs at a long wavelength the star is cooler than a star that gives off most of its light (peaks) at a short wavelength.

For example, if Star E and Star F are the same size and temperature, they will have identical blackbody curves. However, if Star F is the same size as Star E, but is cooler, its energy output is less at all wavelengths and the peak occurs at a longer wavelength (toward the red end of the spectrum).

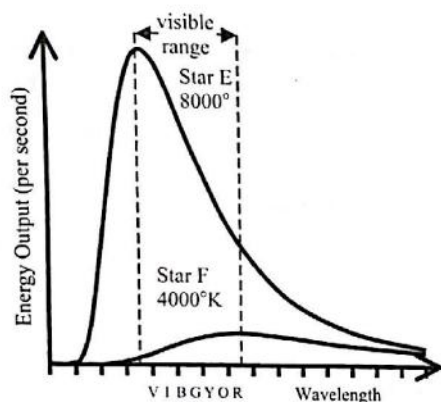


Figure 2a

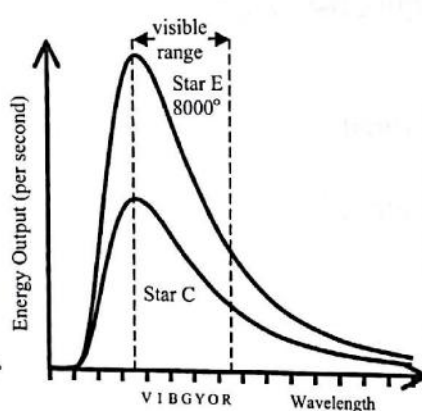


Figure 2b

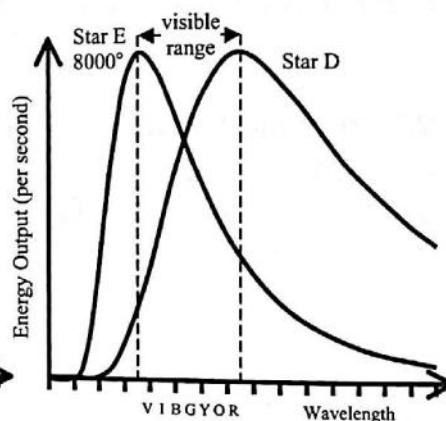


Figure 2c

Use Figure 2a to answer Questions 6–9. Assume Stars E and F are the same size.

- 6) Which star gives off more red light? Explain your reasoning.
- 7) Which star gives off more blue light? Explain your reasoning.
- 8) Which star looks redder? Explain your reasoning.

- 9) Two students are discussing their answers to Question 8.

**Student 1:** *Star E looks redder because it is giving off more red light than Star F.*

**Student 2:** *I disagree, you're ignoring how much blue light Star E gives off. Star E gives off more blue light than red light so it looks bluish. Star F gives off more red than blue so it looks reddish. That's why Star F looks redder than Star E.*

Do you agree or disagree with either or both of the students? Explain your reasoning.

- 10) Using the blackbody curves shown in Figure 2b, circle the characteristics shown in the table below that best correspond with Stars E and C.

Peaks at a longer wavelength	Star E	Star C	Same	
Lower surface temperature	Star E	Star C	Same	
Looks red	Star E	Star C	Both	Neither
Looks blue	Star E	Star C	Both	Neither
Greater energy output	Star E	Star C		

- 11) How must Star C be different from Star E to account for their difference in energy output?

- 12) Two students are discussing their answers to Question 11.

**Student 1:** *The peaks are at the same place so they must be at the same temperature. If Star C were as big as Star E, it would have the same output. Since the output is lower, Star C must be smaller.*

**Student 2:** *No. If its output is lower, it must be cooler. Since the temperature of the two stars are the same, they must be the same size.*

Do you agree or disagree with either or both of the students? Explain your reasoning.

Consider the blackbody curves for Stars E and D shown in Figure 2c when answering Questions 13–15.

13) For each star, describe its color as either reddish or bluish.

Star E:

Star D:

14) Which star has the greater surface temperature? Explain your reasoning.

15) Which star is larger? Explain your reasoning. (Hint: Consider how the energy output and temperatures for the two stars compare.)