

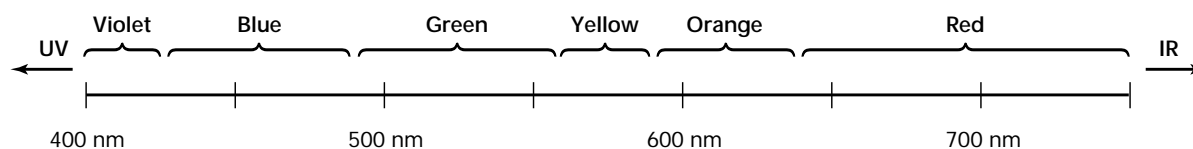
Color at Light Speed

Analyze the wavelength and frequency of the colors in light.

Visible light consists of a range of different colors that combine to form white light. This range is called the **color spectrum**. Each color in the color spectrum has a unique wavelength and frequency. Our eyes see light of different wavelengths as different colors. The frequency (f) and wavelength (λ) of visible light can be used to determine the speed of light (v) by the following equation:

$$\begin{aligned} \text{speed of light} &= \text{frequency} \times \text{wavelength} \\ v &= f \times \lambda \end{aligned}$$

The frequency of waves is measured in waves per second, or hertz (Hz). The wavelength can be measured as the distance between two wave crests. The diagram below shows the spectrum of visible light with the corresponding wavelengths for each color. As you can see, the wavelengths of visible light fall in the range of 400 nanometers (nm) to 750 nm. One nanometer is equal to 0.000000001 m.



1. Calculate the speed of light for the following. Show your work.

- a. a shade of yellow light with a wavelength of 5.8×10^{-7} m and a frequency of 5.17×10^{14} Hz

- b. a shade of red light with a wavelength of 6.98×10^{-7} m and a frequency of 4.3×10^{14} Hz

- c. a shade of violet light with a wavelength of 4×10^{-6} m and a frequency of 7.5×10^{13} Hz

- d. What can you conclude about the speed of light of different colors?

Color at Light Speed, continued

2. a. If the speed of light is constant (meaning it does not change), does the wavelength increase or decrease with an increase in frequency?

b. What happens to the wavelength as the frequency decreases?

3. Convert the following metric measurements:

a. An orange light with a wavelength of 620 nm is _____ m long.

b. A blue light with a wavelength of _____ nm is 0.000445 mm long.

c. A _____ light with a wavelength of _____ nm is 0.00041 cm long.

d. A _____ light with a wavelength of 550 nm is _____ m long.

4. The relationship between the energy of a light wave and its frequency is given in the following equation:

$$E = h \times f$$

In this equation, f is the frequency and h is a constant.

a. Which of the colors from question 1 has the most energy?

b. Which color has the least energy?

c. What is the relationship between the frequency of a light wave and its energy?

d. What is the relationship between the wavelength of a light wave and its energy?



STUDENT SELF-ASSESSMENT REVISITED

Go back and read your assessment on page vi. Then fill in the chart below.

Math skill	Good	OK	Needs improvement
Addition			
Subtraction			
Multiplication			
Division			
Positive and negative numbers			
Fractions			
Ratios and proportions			
Decimals			
Percentages			
Powers of 10			
Scientific notation			
SI measurement and conversion			
Dimensional analysis			
Geometry			

Describe three instances in which you have needed to use math in your science class.

Which of your math skills have improved the most? Which need more improvement?
