

Name: \_\_\_\_\_

Date: \_\_\_\_\_

## Electromagnetic Spectrum Reading Passage

# ELECTROMAGNETIC SPECTRUM

Different types of electromagnetic waves make up the **electromagnetic spectrum**. The electromagnetic spectrum is continuous. It is a range of electromagnetic waves with different wavelengths and frequencies. Different types of electromagnetic waves oscillate at different rates. The rate determines the frequency and wavelength of each type of EM wave. The faster the wave oscillates, the higher the frequency. As the frequency of an EM wave increases, the wavelength of an EM wave decreases. As the frequency of an EM wave increases, the energy carried by EM wave increases.

There are eight major types of electromagnetic waves, summarized in the table below.

Type	Wavelength	Frequency	Uses
Long Radio Waves	> 1,000 meters	$< 3.0 \times 10^5$ Hz	Aeronautical & marine navigation, Morse Code
Radio Waves	1 m to 1,000 m	$3.0 \times 10^5$ Hz to $3.0 \times 10^9$ Hz	Radio & TV broadcasting, radar, naturally made by lightning & stars
Microwaves	1 mm to 1 m	$3 \times 10^9$ Hz to $3 \times 10^{12}$ Hz	WiFi, cellphones, GPS, air traffic control, weather forecasting, cooking
Infrared (IR)	700 nm to 1 mm	$3.0 \times 10^{12}$ Hz to $4.3 \times 10^{15}$ Hz	Associated with thermal energy
Visible Light	700 nm (red) to 380 nm (violet)	$4.3 \times 10^{15}$ Hz to $7.9 \times 10^{15}$ Hz	Made of seven colors: red, orange, yellow, green, blue, indigo, violet
Ultraviolet Light (UV)	380 nm to 10 nm	$7.9 \times 10^{15}$ Hz to $3.0 \times 10^{16}$ Hz	Promotes vitamin D production in skin, overexposure damages skin & eyes
X-Rays	10 nm to .01 nm	$3.0 \times 10^{16}$ Hz to $3.0 \times 10^{18}$ Hz	Medical imaging, airport security, overexposure can damage cells
Gamma Rays	< .01nm	$> 3.0 \times 10^{18}$ Hz	Produced during radioactive decay, can cause radiation poisoning

Name: \_\_\_\_\_

Date: \_\_\_\_\_

■ Electromagnetic Spectrum Answer Sheet

**Questions**

1. What is the electromagnetic spectrum?

---

---

---

---

2. List the eight major types of electromagnetic waves from lowest to highest frequency.

---

---

---

---

3. How does the wavelength and energy of an electromagnetic wave change as frequency increases?

---

---

---

---

4. What type of electromagnetic energy is most important to our technology today? Justify your answer.

---

---

---

---

5. Why type of electromagnetic waves is most dangerous to humans? Justify your answer.

---

---

---

---

Name: \_\_\_\_\_

Date: \_\_\_\_\_

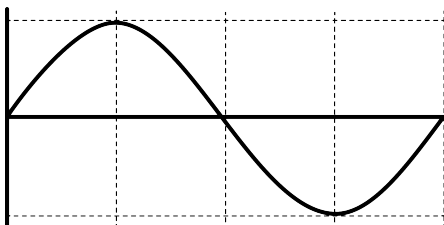
■ Wave Equation Reading Passage

# WAVE EQUATION

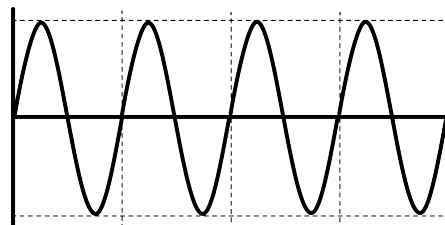
The wave equation is a formula: velocity ( $v$ ) = wavelength ( $\lambda$ )  $\times$  frequency ( $f$ ). Velocity is the speed of a wave and measured in meters per second (m/s). Wavelength is the length of one complete wave cycle and measured in meters (m). Frequency is the number of wave cycles that a wave completes in one second and measured in Hertz (Hz). The speed of light is  $3.00 \times 10^8$  m/s and thus, all electromagnetic waves travel at  $3.00 \times 10^8$  m/s in a vacuum or dry air. Therefore, this equation is used for all types of electromagnetic waves.

We use the wave equation to determine the frequency or wavelength of an EM wave since the speed of light is constant. If you know the frequency of an electromagnetic wave, you can determine its wavelength. If you know the wavelength of an electromagnetic wave, you can determine its frequency. Furthermore, you can determine the speed of an unknown wave if you know the wave's frequency and wavelength.

The wave equation confirms the relationship between a wave's velocity, wavelength and frequency. Since the speed of light is constant, wavelength and frequency are inversely related. In other words, when the wavelength of an EM wave increases, frequency of an EM wave decreases (and vice versa). This makes sense because a wave that oscillates more frequently completes more wave cycles per second. To complete more wave cycles, the length of the wave must be shorter.



*Long wavelength, low frequency*



*Short wavelength, high frequency*

Name: \_\_\_\_\_

Date: \_\_\_\_\_

■ Wave Equation Answer Sheet

**Questions**

1. What is the wave equation?

---

---

---

---

2. How do we use the wave equation to study electromagnetic waves?

---

---

---

---

3. According to the wave equation, what is the relationship between the frequency and wavelength of an EM wave?

---

---

---

---

4. A electromagnetic has a frequency of  $3.0 \times 10^7$  Hz. What is its wavelength? What type of wave is it?

5. A electromagnetic has a wavelength of 1 millimeter. What is its frequency? What type of wave is it?