

The Electromagnetic Spectrum 2

In a previous pod, we learned to describe the seven types of electromagnetic waves using the quantities of *frequency* and *energy*. In this section, we will learn to discuss waves using the energy of photons and to merge the six colors into the broader electromagnetic spectrum.

Part 1: Photons and Photon Energy

All light comes in tiny pieces called **photons**. The color *red* is made from photons of red light, the color *blue* is made from photons of blue light, etc.

Each photon has **four** quantities that make it work how it does: wavelength, frequency, energy, and speed.

1. Wavelength and frequency are inversely proportional.
When wavelength is longer, frequency is lower.
When wavelength is shorter, frequency is higher.

2. Frequency and energy are directly proportional.
When frequency is higher, energy is higher
When frequency is lower, energy is lower

(This means that wavelength and energy are inversely proportional.)

3. All photons have the *same speed* (3.0×10^8 m/s), regardless of what color they are:

Red	Longest wavelength	Lowest frequency	Lowest Photon Energy	THE SAME SPEED
Orange				
Yellow				
Green				
Blue				
Violet	Shortest wavelength	Highest frequency	Highest Photon Energy	

1. True or false? All light waves have the same speed.

2. True or false? All light waves have the same photon energy.

3. Light waves come in tiny pieces called _____.

4. When wavelength is longer, the photon energy is _____.

5. When wavelength is shorter, the photon energy is _____.

6. Compare red waves and green waves:

A red wave has a _____ wavelength, a _____ frequency, a _____ photon energy than a green wave, but the _____ speed.

7. Compare blue waves and yellow waves:

A blue wave has a _____ wavelength, a _____ frequency, a _____ photon energy than a yellow wave, but the _____ speed.

8. Compare orange waves and red waves:

An orange wave has a _____ wavelength, a _____ frequency, a _____ photon energy than a red wave, but the _____ speed.

9. Using the terms *wavelength*, *frequency*, *photon energy*, and *speed*, compare red waves and violet waves.

10. Using the terms *wavelength*, *frequency*, *photon energy*, and *speed*, compare blue waves and green waves.

11. Using the terms *wavelength*, *frequency*, *photon energy*, and *speed*, compare orange waves and yellow waves.

There are seven types of electromagnetic waves:

Radio waves, microwaves, infrared waves, visible light waves, ultraviolet waves, X-Ray waves, and gamma ray waves.

All electromagnetic waves come in tiny pieces called *photons*. Every photon has a specific *wavelength*, *frequency*, and *energy* that make it act the way it does.

Radio waves have the longest wavelength and the lowest frequency and energy.

Gamma ray waves have the shortest wavelength and the highest frequency and energy.

All photons have the same speed: 3.0×10^8 m/s.

Radio Waves	Longest wavelength	Lowest frequency	Lowest Photon Energy	THE SAME SPEED
Microwaves				
Infrared Waves				
Visible Light Waves				
Ultraviolet Waves				
X-Ray Waves				
Gamma Ray Waves	Shortest wavelength	Highest frequency	Highest Photon Energy	

12. Using the terms *wavelength*, *frequency*, *photon energy*, and *speed*, compare microwaves waves and ultraviolet waves.

13. Using the terms *wavelength*, *frequency*, *photon energy*, and *speed*, compare radio waves and infrared waves.

14. Using the terms *wavelength*, *frequency*, *photon energy*, and *speed*, compare ultraviolet waves and infrared waves.

Part 2: The Full Spectrum

However, this is not the full story.

The *visible light waves* can be broken into six colors:

Red, Orange Yellow, Green, Blue, and Violet.

Of the six colors, red has the longest wavelength and the lowest frequency, and violet has the shortest wavelength and the highest frequency.

However, *red* still has a higher frequency than infrared, and violet still has a lower frequency than ultraviolet

Radio Waves	Longest wavelength	Lowest frequency	Lowest Photon Energy	THE SAME SPEED
Microwaves				
Infrared Waves				
Red Light Wave				
Orange Light Wave				
Yellow Light Wave				
Green Light Wave				
Blue Light Wave				
Violet Light Wave				
Ultraviolet Waves				
X-Ray Waves				
Gamma Ray Waves	Shortest wavelength	Highest frequency	Highest Photon energy	

Altogether, these 12 waves called **The Electromagnetic Spectrum**.

The electromagnetic spectrum consists of six visible waves and six invisible waves.

All of the waves are made of photons of a certain wavelength, frequency, and energy. All photons have the same speed. But only *six* of the photons are visible, and some are invisible.

15. Copy the 12 types of electromagnetic waves, including the six invisible types and the six colors, from longest wavelength to shortest wavelength.
(I know its repetitive, but copying does help you remember!)

16. In the list you made above, *circle* the six **visible colors** and *underline* the six **invisible waves**.

17. True or false? We can see every electromagnetic wave.

18. True or false? We can see none of the electromagnetic waves.

19. True or false? We can see only some of the electromagnetic waves.

20. Using the terms *wavelength*, *frequency*, *photon energy*, and *speed*, compare green light waves and microwaves.

21. Using the terms *wavelength*, *frequency*, *photon energy*, and *speed*, compare blue light waves and gamma rays.

22. Using the terms *wavelength*, *frequency*, *photon energy*, and *speed*, compare red light waves and infrared waves.

23. Using the terms *wavelength*, *frequency*, *photon energy*, and *speed*, compare violet light waves and ultraviolet waves.

Bonus fact:

Infrared waves have a frequency just below red, and the word *infrared* literally means *below red*.

Ultraviolet waves have a frequency just above violet, and the word *ultraviolet* literally means *above violet*.