

Matter, Energy, Environment

Name: _____

Part 4 Lesson 1 Energy Waves

A wave: In physics – A wave is the _____ up and down or back and forth.

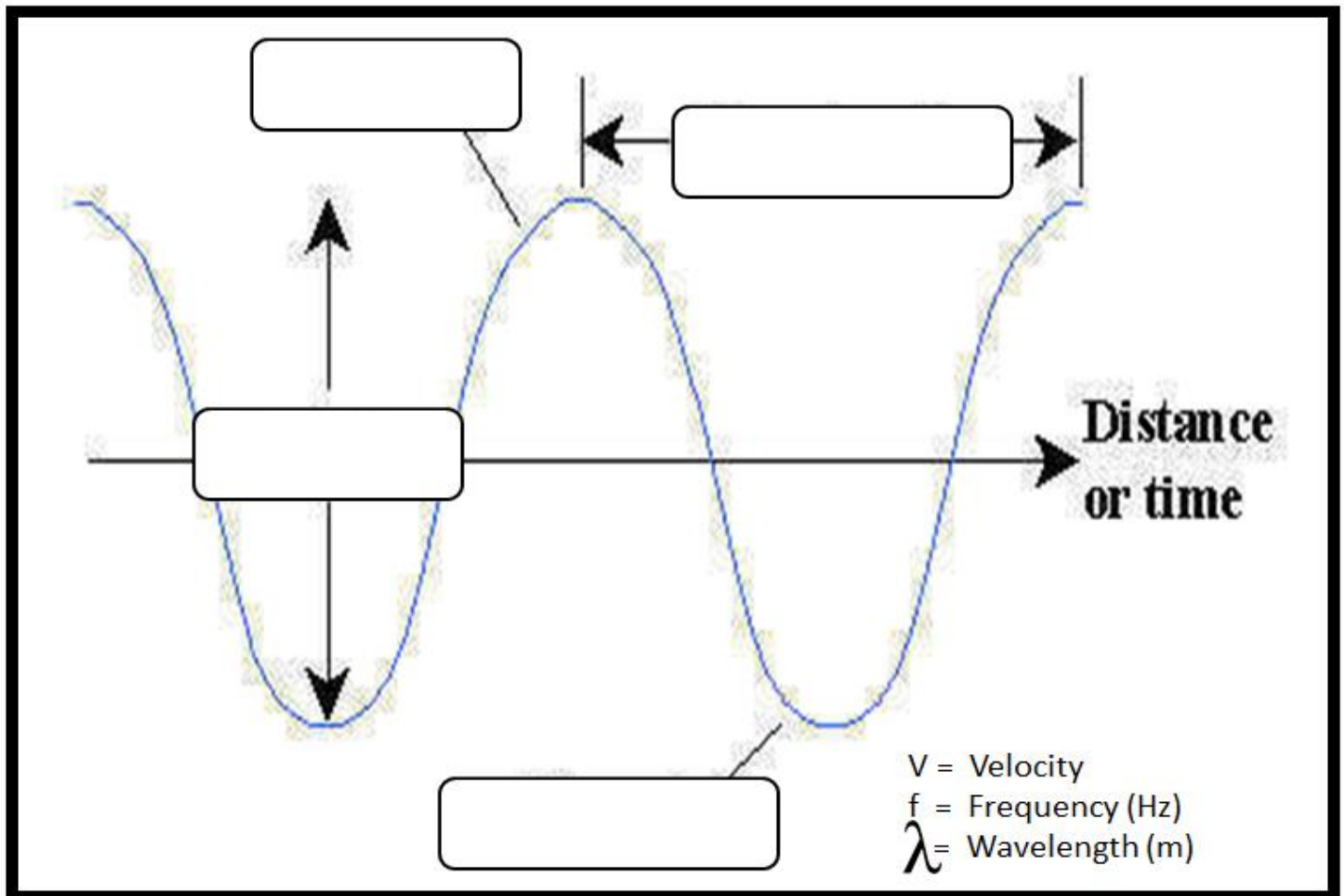
The three types of waves:

Mechanical Wave: Moves through a _____. Solid, Liquid, Gas

Electromagnetic Waves: _____ require a medium to move through.

Matter Waves: Electrons and Particles.

Please label the parts of the wave below.



Part 4 Lesson 2 Types of Waves

Mechanical Waves are waves which propagate through a _____.

They can be _____ and _____

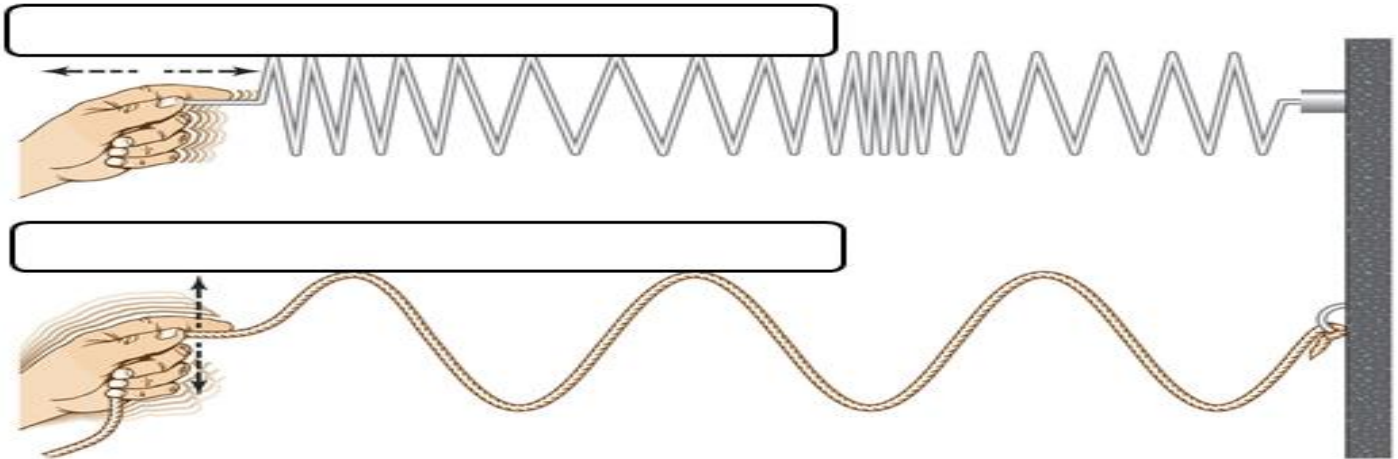
Longitudinal wave: A wave that is propagated in the _____ direction as the displacement of the transmitting medium

Primary Wave, (P-Wave) Arrives first / Fast

Transverse Waves: The particle displacement is _____ to the direction of wave propagation

Secondary Wave (S-Wave) Slower but powerful.

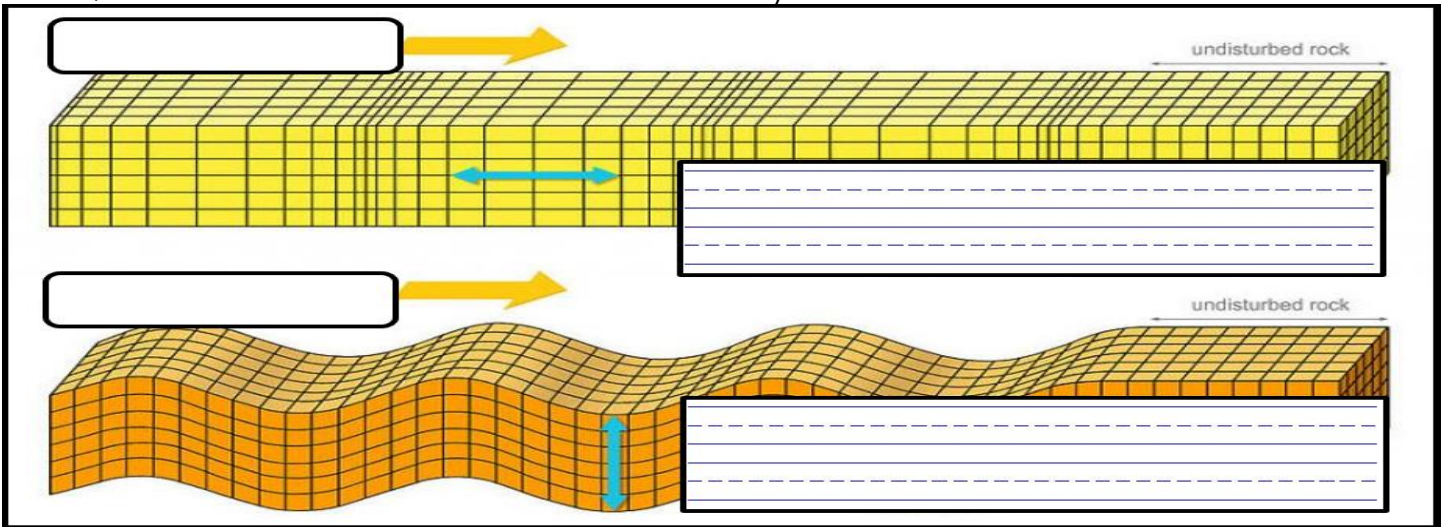
Which is a longitudinal wave? And which is a transverse wave?



Waves

The diagram is set on a background of blue horizontal lines. At the top, the word "Waves" is written in a large, yellow, 3D-style font. A large black bracket underneath "Waves" branches into two paths. The left path leads to a diagram of a longitudinal wave. It shows a hand on the left moving back and forth horizontally, labeled "HAND MOTION". The wave consists of regions of high particle density labeled "COMPRESSION" and regions of low particle density labeled "RAREFACTION". The right path leads to a diagram of a transverse wave. It shows a wave moving horizontally with the electric field (red) and magnetic field (blue) oscillating vertically. Labels "Electric field" and "Magnetic field" are present. Below these diagrams, there are two smaller, faint diagrams of waves, one longitudinal and one transverse, with arrows pointing down to them.

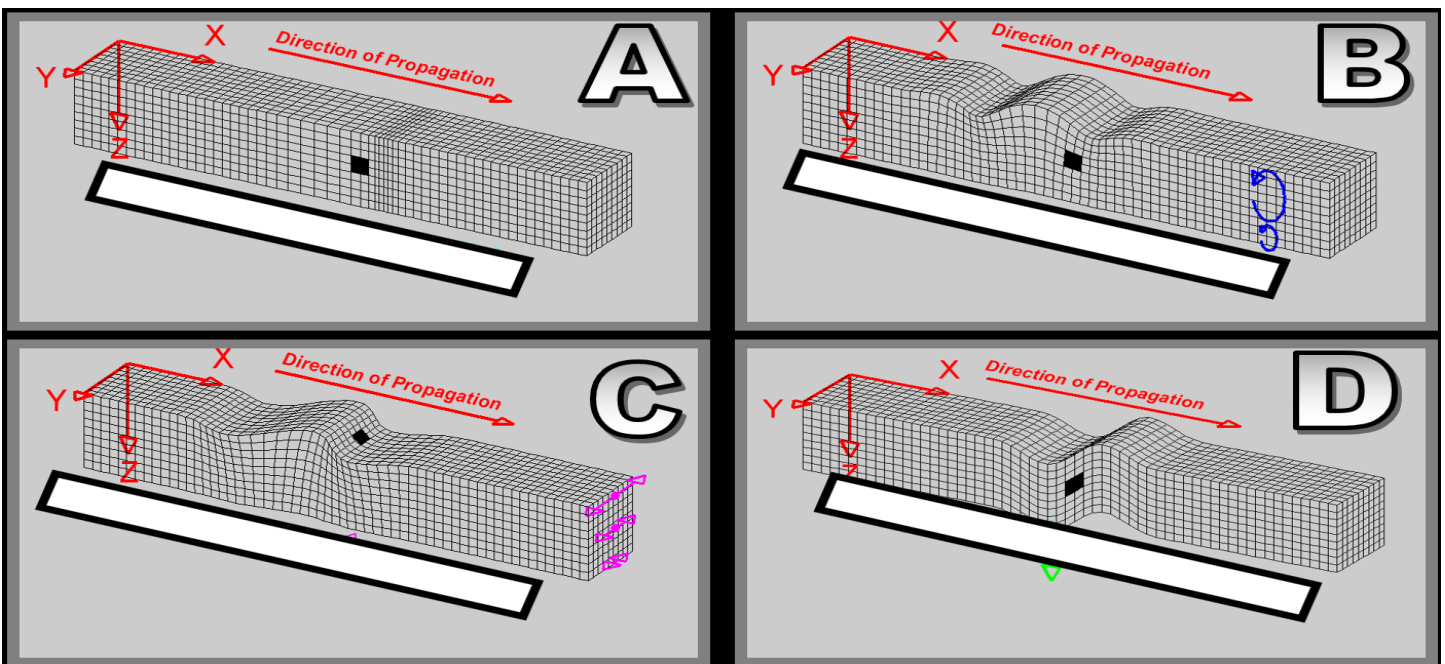
Mechanical waves can be longitudinal or transverse. Which one below is a longitudinal P Wave, and which is a transverse S-Wave? Add any additional info on the lines.



Which one of the waves above causes the most damage in an earthquake?
 _____? Which one will arrive first _____?

Name each wave below. Word Bank: Primary Wave, Secondary Wave, Rayleigh Wave, Love Wave

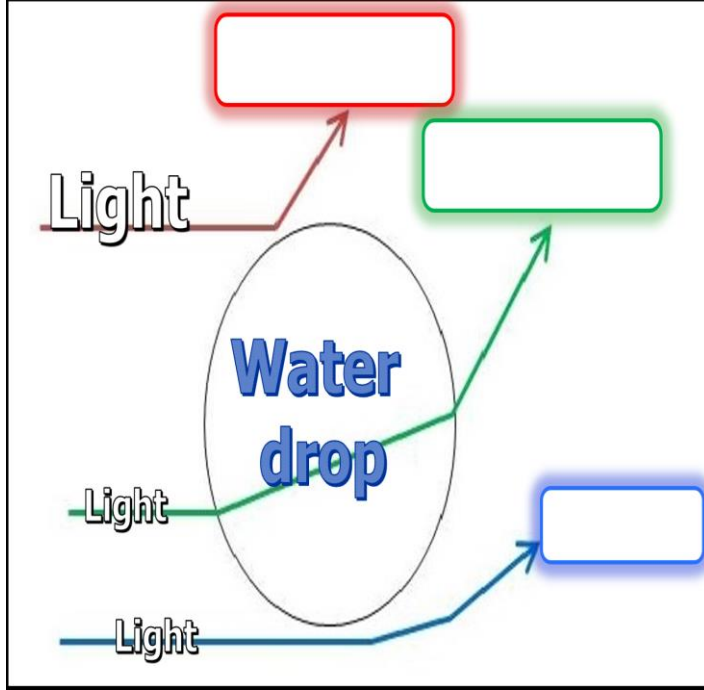
Which two are body waves?	Which two are surface waves?	Which ones are transverse?	Which one is longitudinal only?
Which two cause the most destruction?	Which is the fastest wave?	Is the S-Wave or P-wave more powerful?	How are you doing?



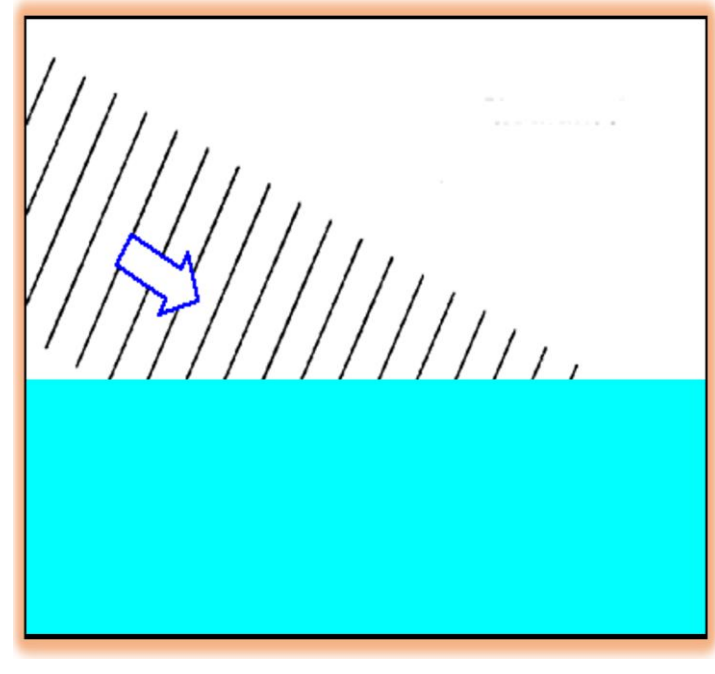
Part 4 Lesson 3 Light

Light is a _____ and a _____ and goes out in a straight line unless it bumps something.

Word Bank: Diffraction, Refraction, Reflection



Refract this light as it hits the water in the diagram below.

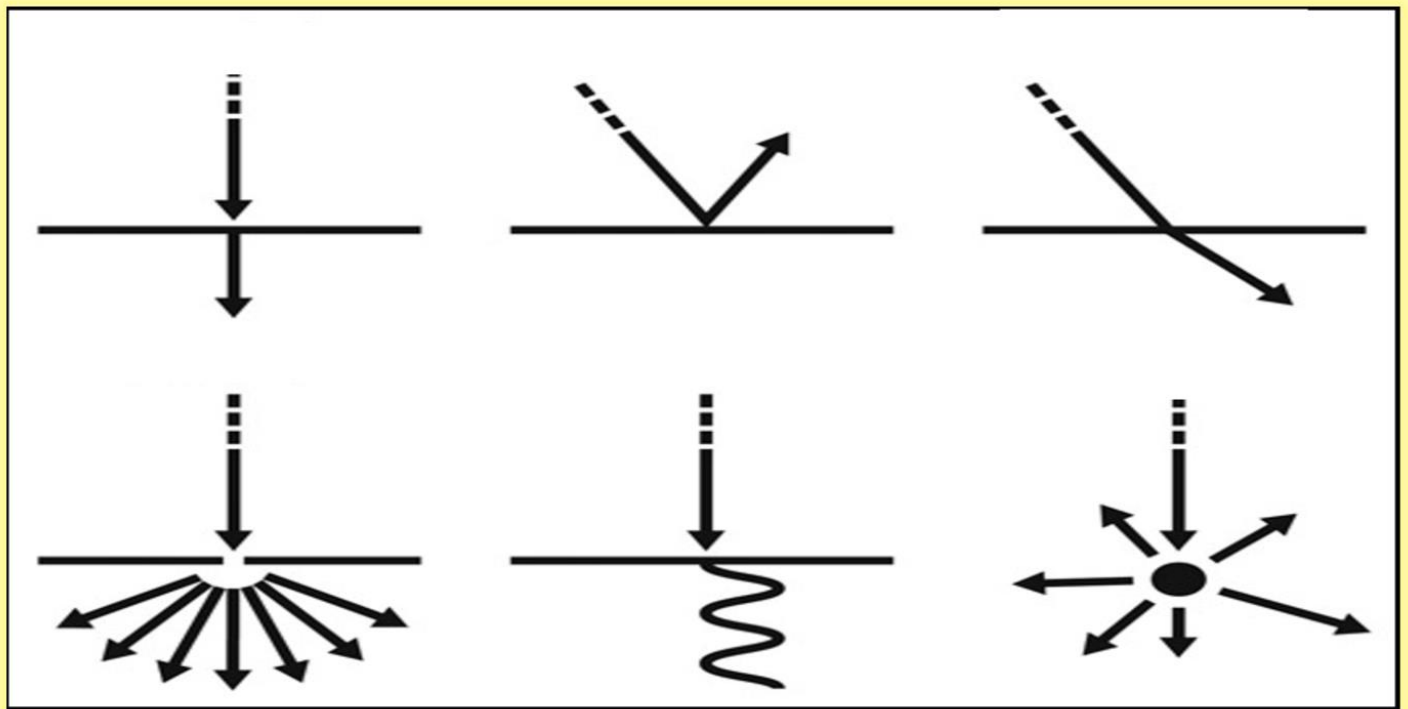


Refraction: The _____ of a wave when it enters a medium where its speed is changed.

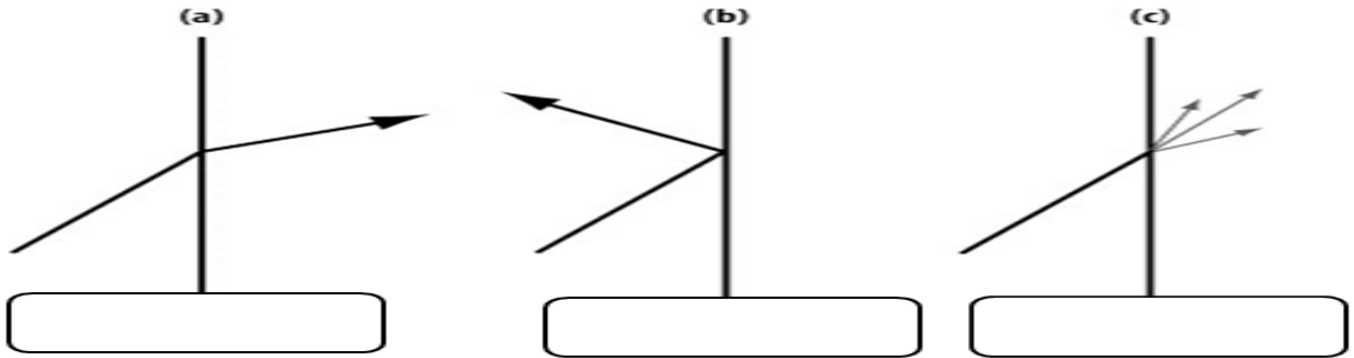
Diffraction: _____ of waves.

Scattering: _____ off of something

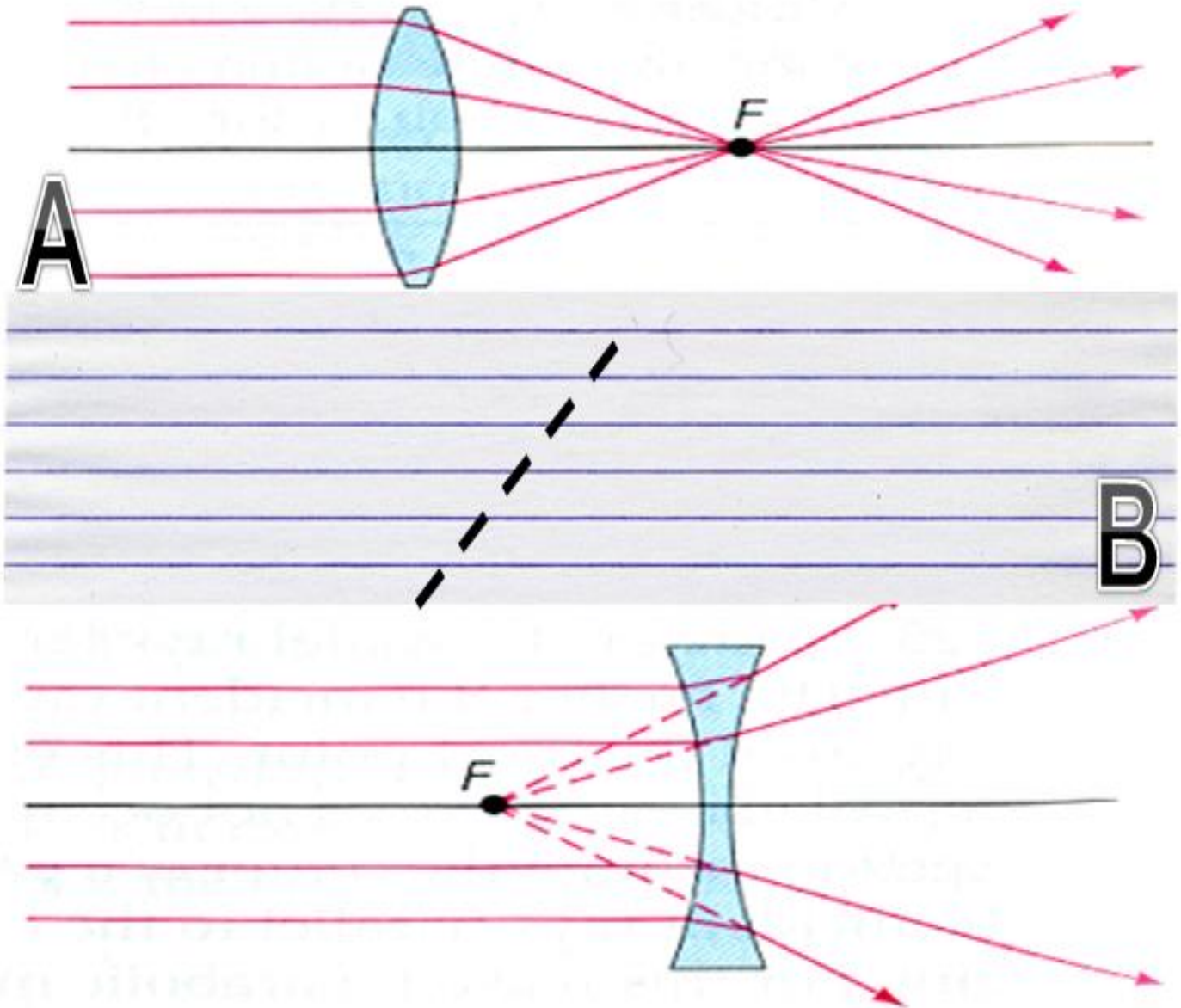
Word Bank: Scattering, Diffraction, Refraction, Absorption, Transmission, Reflection



Which is Diffraction, Refraction, and Reflection?



Provide some information about the lenses below. What are they doing to light?

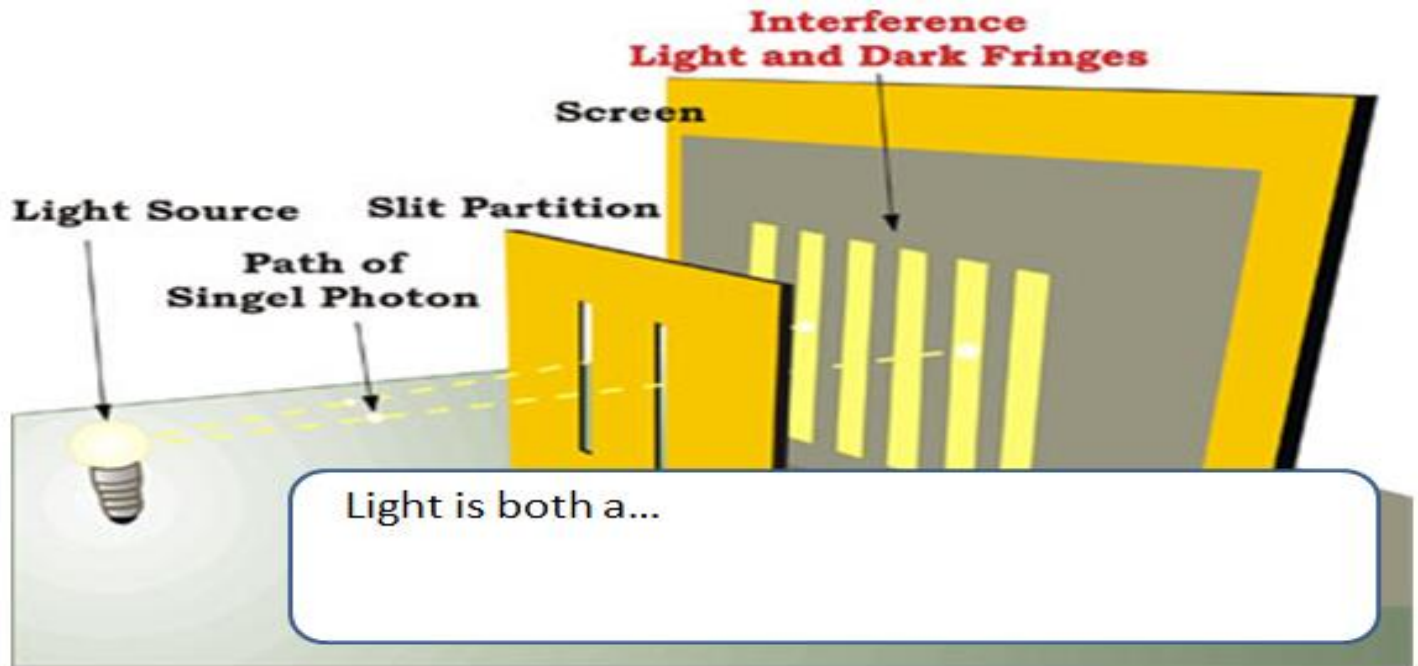


Wave particle duality: The exhibition of both _____ and _____ like properties by a single entity.

Particle: Any of the basic units of _____ and _____.
Ex. atom, proton, electron, or photon

Video Link! Slit experiment and particle and wave duality. (Optional) Explain below.

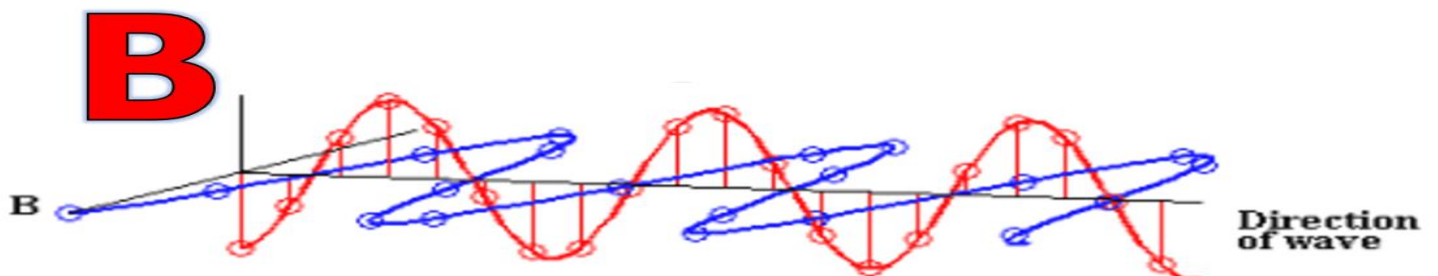
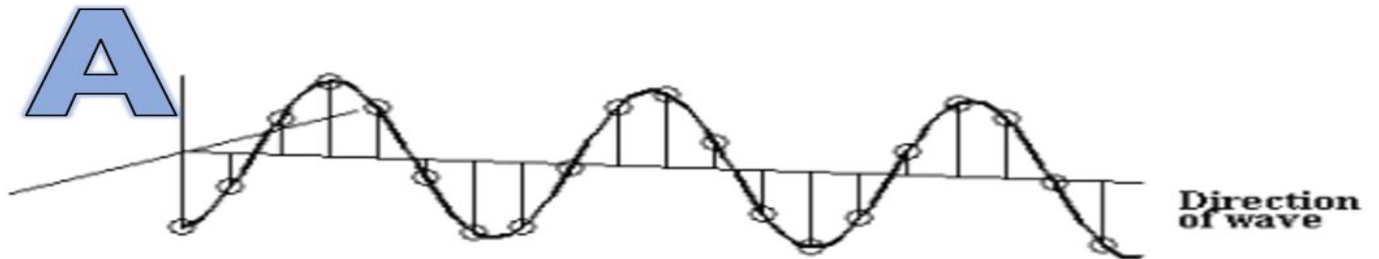
- <https://www.youtube.com/watch?v=luv6hY6zsd0>



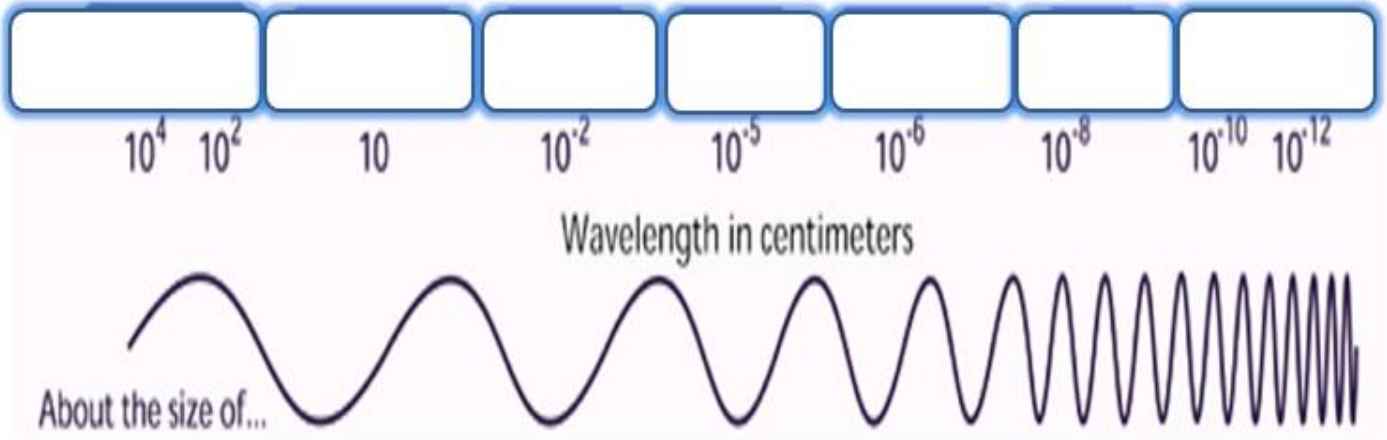
Part 4 Lesson 4 EM Spectrum Radio, Infrared, Visible Light, Microwave

The Electromagnetic Spectrum: The entire frequency range of electromagnetic _____.

Which is a mechanical wave? And which is an EM / Electromagnetic Wave?

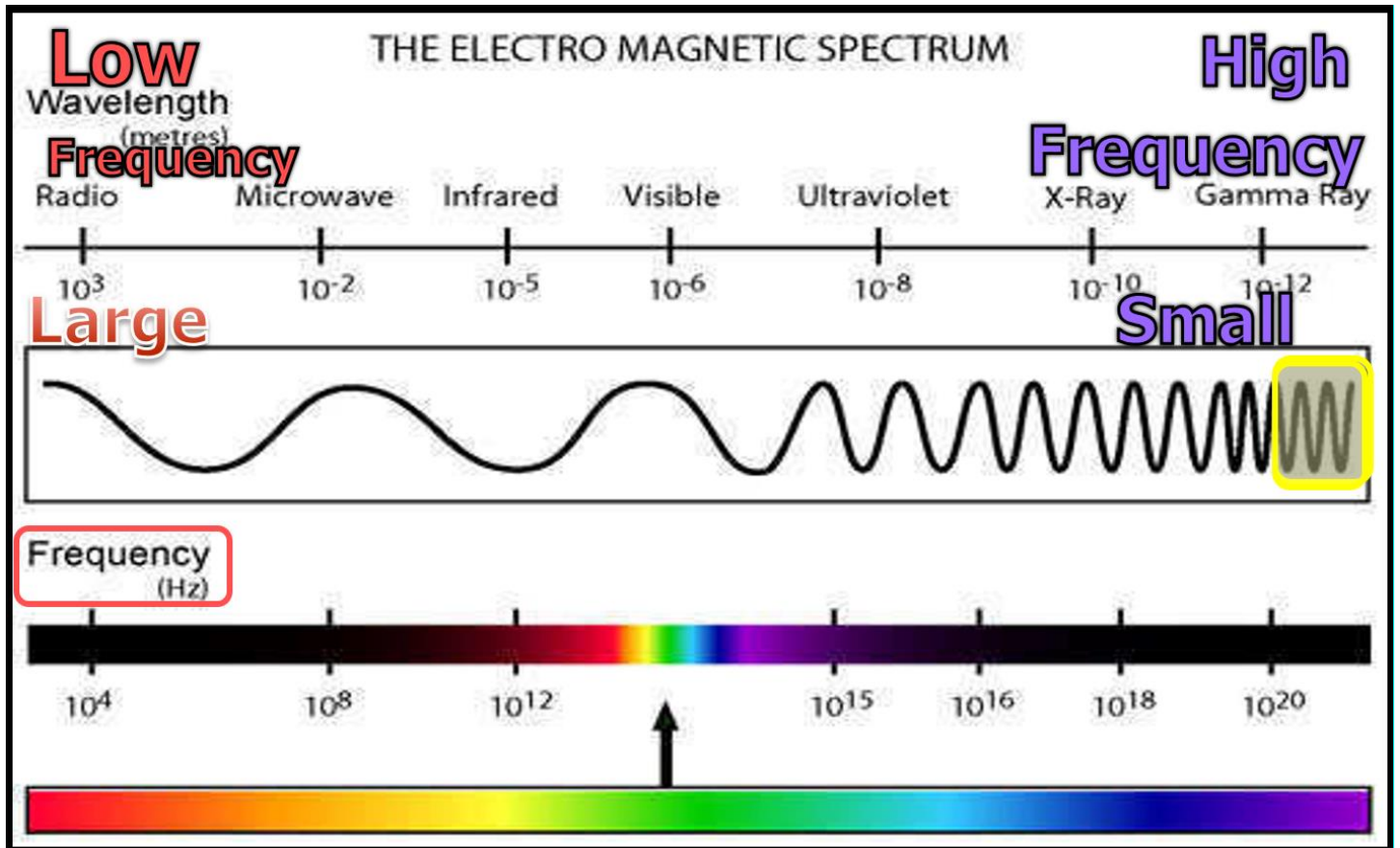


Please name the wave in the Electromagnetic Spectrum according to its size/wavelength.



Provide a picture of something that is about the same size as the wave if possible as well as additional information about each EM Wave.

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Waves carry energy! The amount of energy they carry is related to their frequency and their amplitude. The higher the frequency, the more energy, and the higher the amplitude, the more energy.



Visible Light

X-Rays

Microwaves



Gamma Rays

Ultraviolet

Infrared

Radio Waves



Part 4 Lesson 5 Visible Light, UV, X-Rays

Record Note to each EM wave on the Previous Page.

Waves of the electromagnetic spectrum travel at the speed of _____. 186,000 miles per second or 300,000 kilometers per second in a _____.

Visible light measured in _____.

All others are measured in _____.

What is Radio Direction and Ranging? _____

Part 4 Lesson 6 Gamma Rays and Wrap Up

Gamma ray: Highest energy, _____ wavelength.

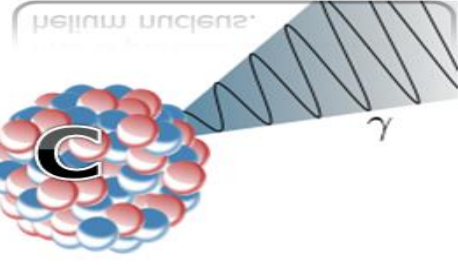
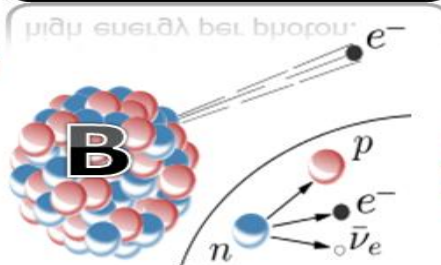
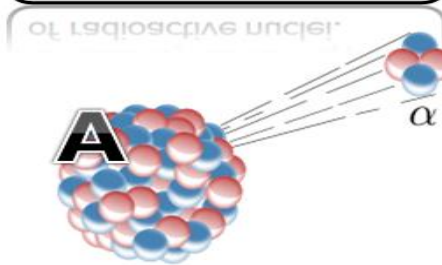
Emitted during radioactive decay of a fission product.

- Match the radioactive decay to the picture.

Beta particles are high-energy, high-speed electrons or positrons emitted by certain types of radioactive nuclei.

Gamma Ray: Electromagnetic radiation of extremely high frequency and therefore high energy per photon.

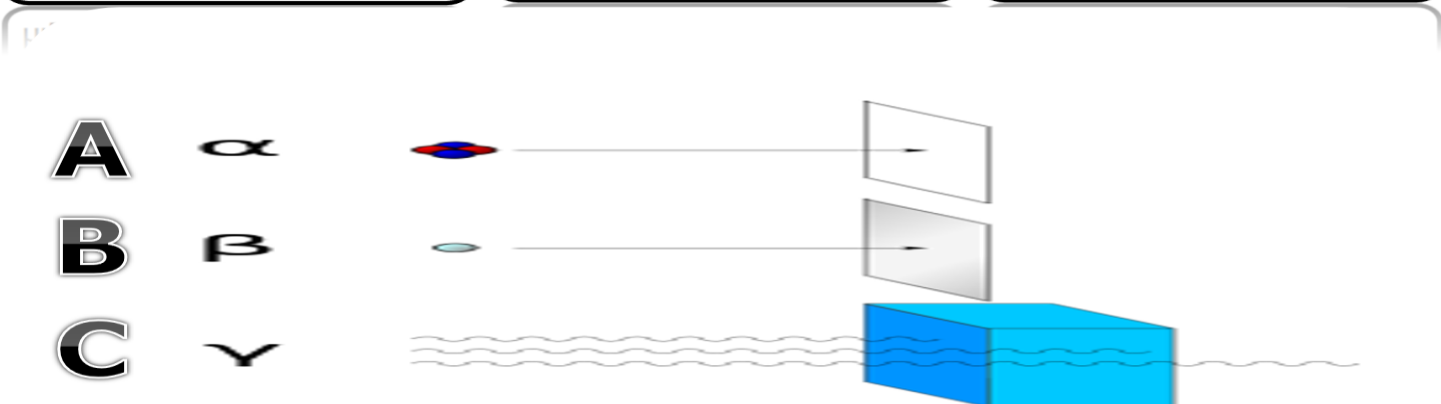
Alpha particles consist of two protons and two neutrons bound together into a particle identical to a helium nucleus.



Gamma Ray: Electromagnetic radiation of extremely high frequency and therefore high energy per photon.

Alpha particles consist of two protons and two neutrons bound together into a particle identical to a helium nucleus.

Beta particles are high-energy, high-speed electrons or positrons emitted by certain types of radioactive nuclei.



The radioactive _____ of a given radioisotope decays at a predictable rate and can be used as a clock.

This makes several types of radioactive dating feasible.

Decay is not affected by outside conditions like wind, water, temperature.

What is a Laser?



Quiz Wiz 1-10 Name the wave of the electromagnetic Spectrum.

1)	2)	3)
4)	5)	6)
7)	8)	9)
10)	*11)	

Unit Notes

A series of horizontal blue lines for writing notes, with a vertical red margin line on the left side.

Across

2. _____ light. The visible spectrum is the portion of the electromagnetic spectrum that is visible to the human eye.
3. The number of waves that pass a fixed point in unit time;
5. Light Amplification by Stimulated Emission of Radiation.
7. Wave particle duality: The exhibition of both _____ and particle like properties by a single entity.
9. Waves of the electromagnetic spectrum travel at the speed of _____. 186,000 miles per second or 300,000 kilometers per second in a vacuum.
10. _____ Ray: Highest energy, shortest wavelength. Emitted during radioactive decay of a fission product.
11. _____ lenses are thicker at the middle. Rays of light that pass through the lens are brought closer together (they converge).
12. The highest part of a wave or the line along the top of a wave
13. _____ (UV): Has shorter wavelengths than visible light. More powerful than visible light.
14. A wave that is not capable of transmitting its energy through a vacuum. These waves require a medium in order to transport their energy from one location to another. A sound wave is an example
15. What is Radio Direction and Ranging?
16. In Physics, this is the is the movement up and down or back and forth.
17. Wave particle duality: The exhibition of both wavelike and _____like properties by a single entity.
20. _-__They have smaller wavelengths and therefore higher energy than ultraviolet waves.
22. Longest wave in the spectrum. (Low frequency)
23. The lowest part of the wave between crests
24. This... Abbreviated-Sound Navigation and Ranging, is helpful for exploring and mapping the ocean because sound waves travel farther in the water than do radar and light waves.
25. The distance between successive crests of a wave, especially points in a sound wave or electromagnetic wave.

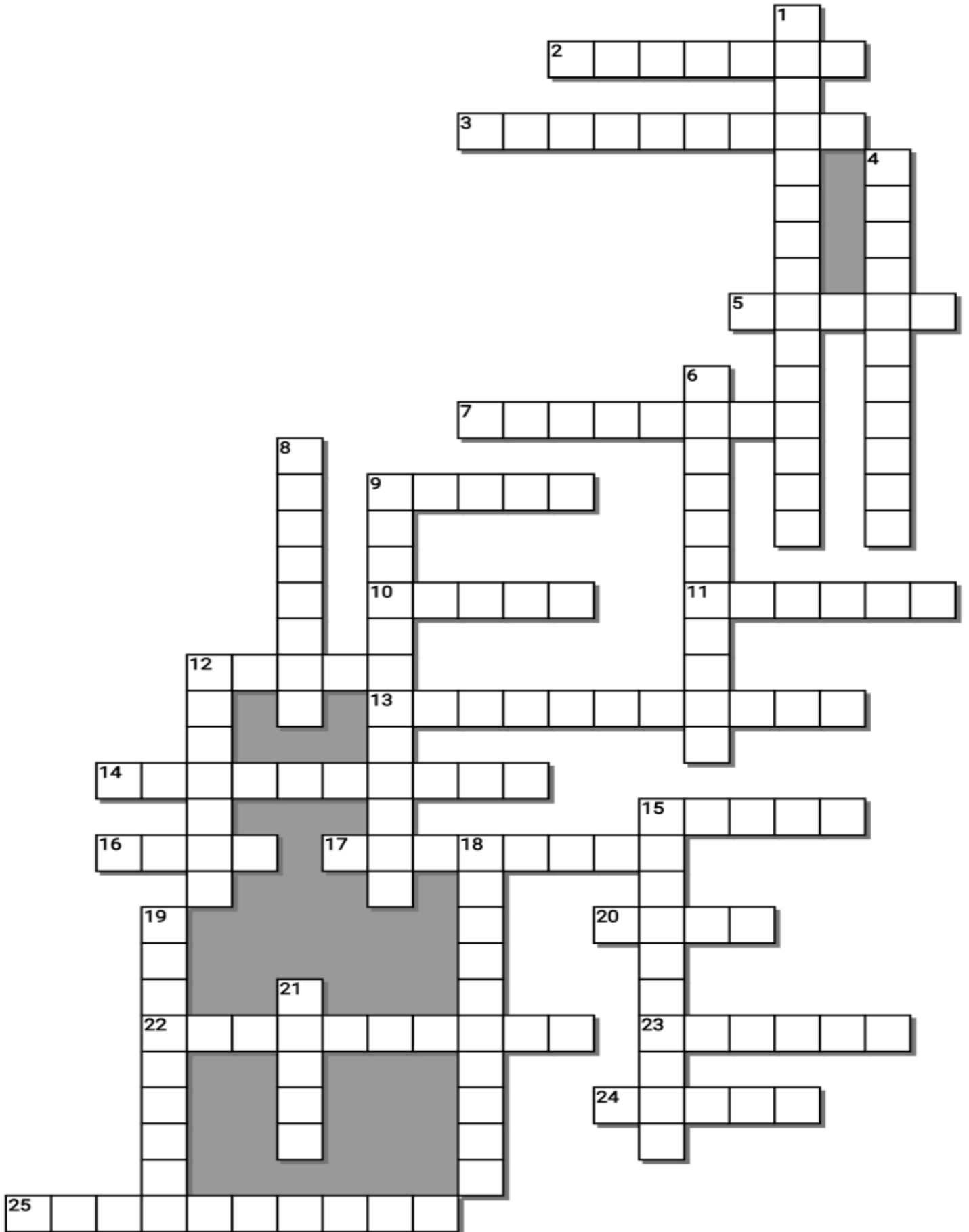
Down

1. _____ Waves: one of the waves that are propagated by simultaneous periodic variations of electric and magnetic field intensity and that include radio waves, infrared, visible light, ultraviolet, X-rays, and gamma rays
4. _____ of an object relates to the amount of radiation released.
6. Bending of a Wave
8. _____ Radiation: Wavelengths between microwaves and visible light. (heat)
9. These waves are waves in which the displacement of the medium is in the same (or opposite) direction of the wave propagation
12. A _____ lens is a lens that possesses at least one surface that curves inwards. It is a diverging lens, meaning that it spreads out light rays that have been refracted through it
15. The bending of a wave when it enters a medium where its speed is changed.
18. A _____ wave is a wave whose oscillations are perpendicular to the direction of the wave's advance.
19. Waves with wavelengths ranging from 1 m down to 1 mm.
21. This is a particle and a wave. It is a particle and a wave and goes out in a straight line unless it bumps something

-----teacher can remove this word bank to make more challenging-----

Possible Answers

CONVEX, CREST, DIFFRACTION, ELECTROMAGNETIC, FREQUENCY, GAMMA , INFRARED, LASER, LIGHT, LONGITUDINAL, MECHANICAL, MICROWAVE, RADAR, RADIO WAVES, REFRACTION, SONAR, TEMPERATURE , TROUGH, ULTRAVIOLET, VISIBLE, WAVE, WAVELENGTH, X-RAY, CONCAVE, LIGHT, PARTICLE , TRANSVERSE , WAVELIKE



Part 4 Review Game

Name: _____
 Score ____ / 100

1-20 = 5 pts **Part 4 Lesson 7**
 *20-*25 * = Bonus + 1 pt,
 (Secretly write owl in correct space +1 pt)
 Final Question = 5 pt wager

WAVY GRAVY	NITE LITE	IT's ALL ABOUT EM	BALANCE BEAM	RIDE THE WAVE Bonus round 1 pt each
1)	6)	11)	16)	*21)
2)	7)	12)	17)	*22)
3)	8)	13)	18)	*23)
4)	9)	14)	19)	*24)
5)	10)	15)	20)	*25)

Final Question Wager ____/5 Answer _____

Matter, Energy, Environment

Name: _____

Part 4 Lesson 1 Energy Waves

A wave: In physics – A wave is the **movement** up and down or back and forth.

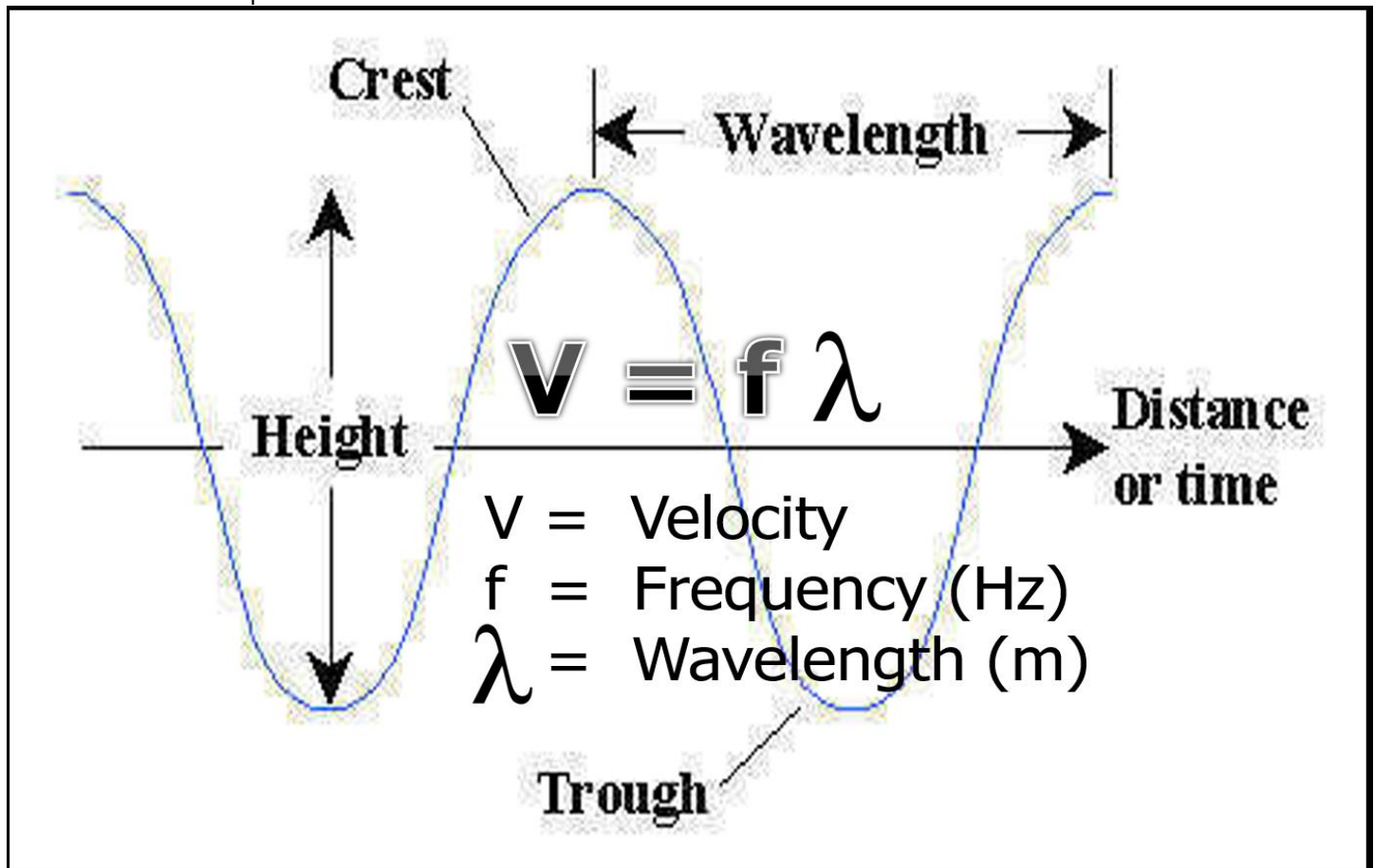
The three types of waves:

Mechanical Wave: Moves through a **medium**. Solid, Liquid, Gas

Electromagnetic Waves: **Do not** require a medium to move through.

Matter Waves: Electrons and Particles.

Please label the parts of the wave below.



Part 4 Lesson 2 Types of Waves

Mechanical Waves are waves which propagate through a **medium**.

They can be **mechanical** and **transverse**

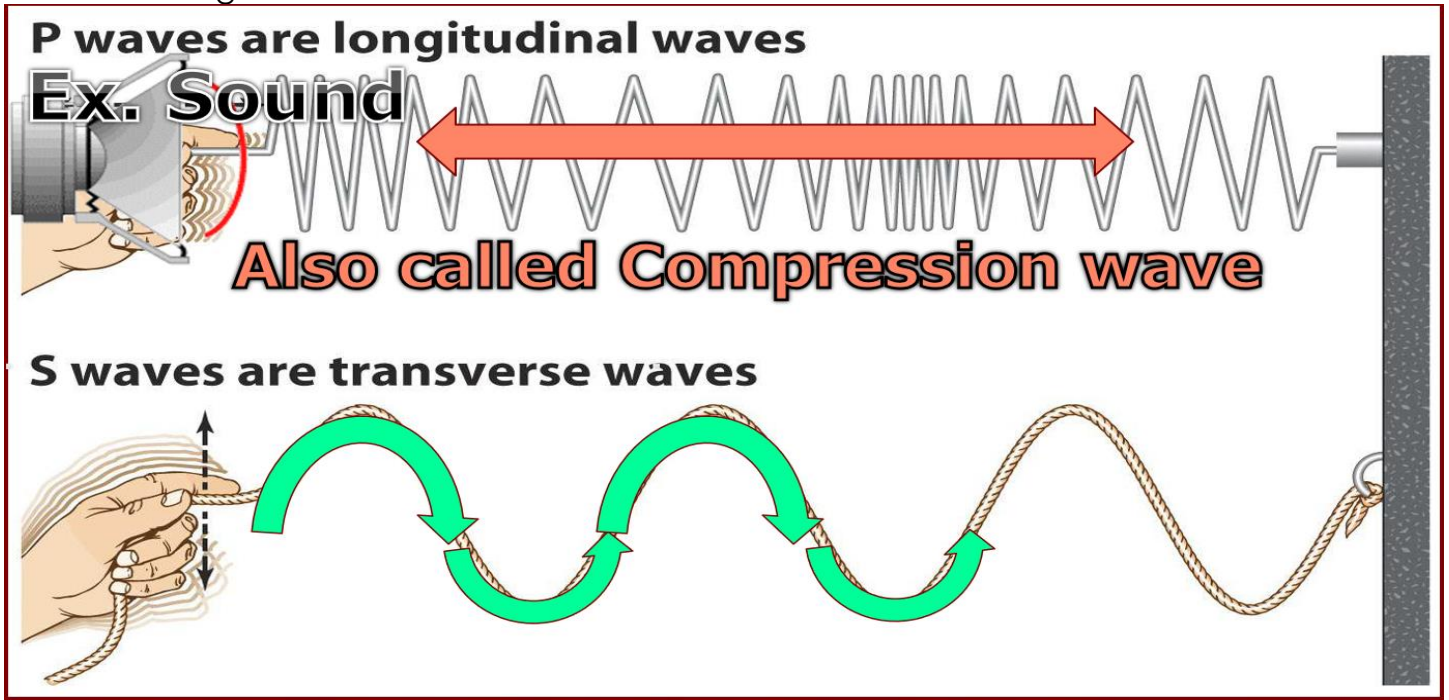
Longitudinal wave: A wave that is propagated in the **same** direction as the displacement of the transmitting medium

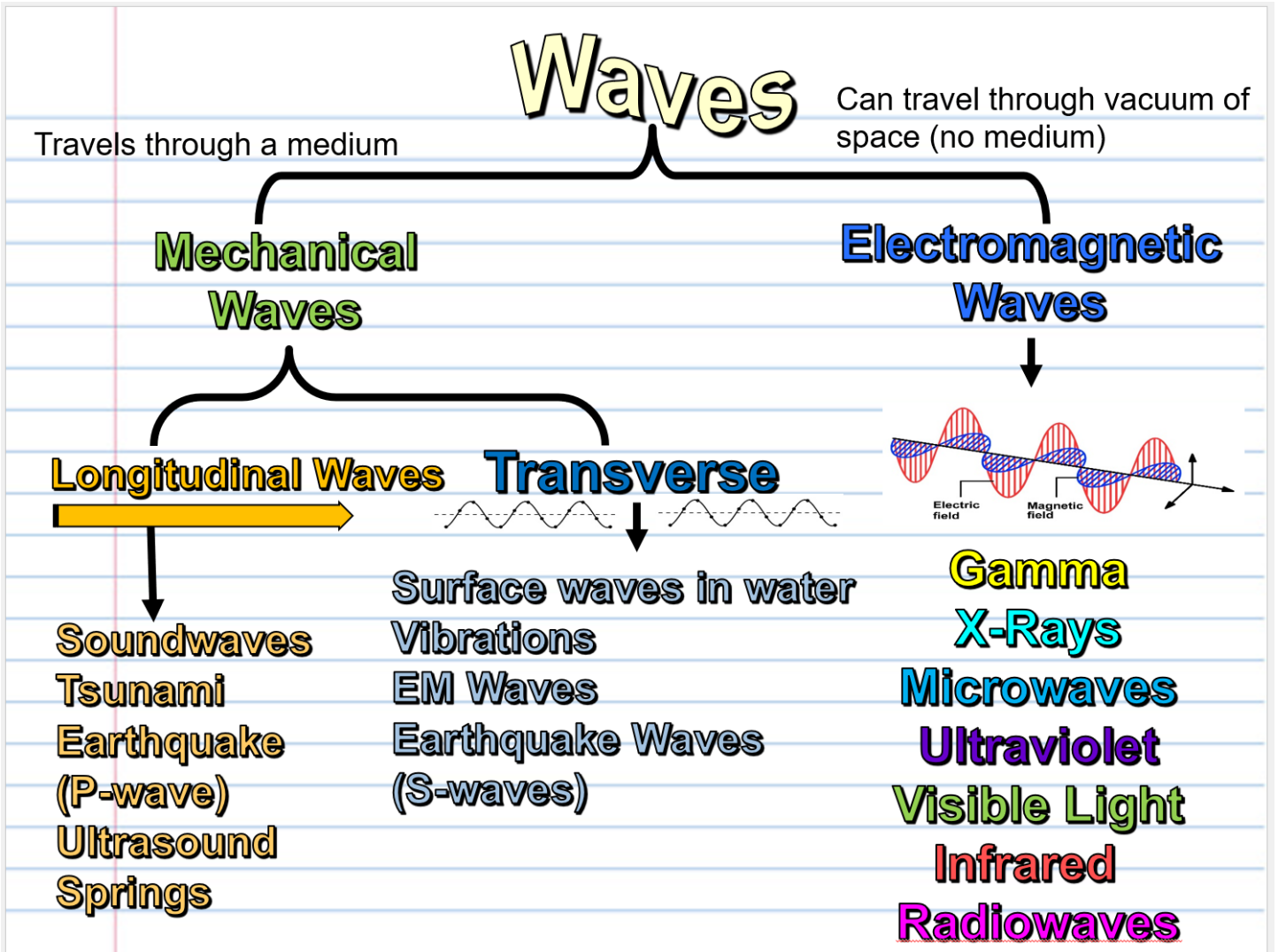
Primary Wave, (P-Wave) Arrives first / Fast

Transverse Waves: The particle displacement is **perpendicular** to the direction of wave propagation

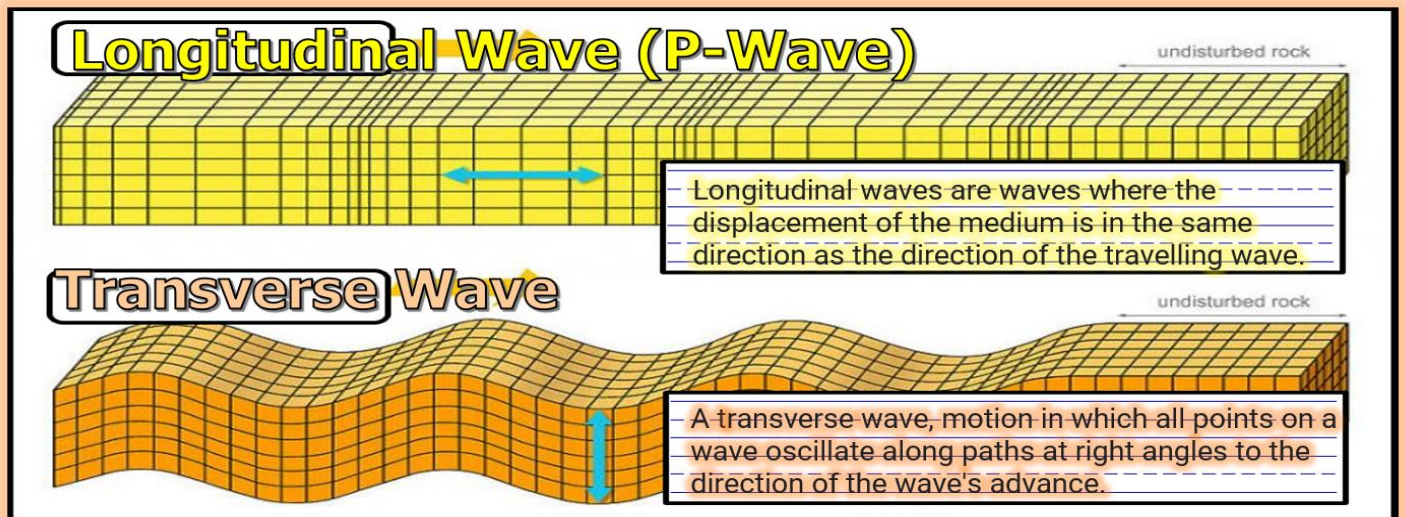
Secondary Wave (S-Wave) Slower but powerful.

Which is a longitudinal wave? And which is a transverse wave?





Mechanical waves can be longitudinal or transverse. Which one below is a longitudinal P Wave, and which is a transverse S-Wave? Add any additional info on the lines.

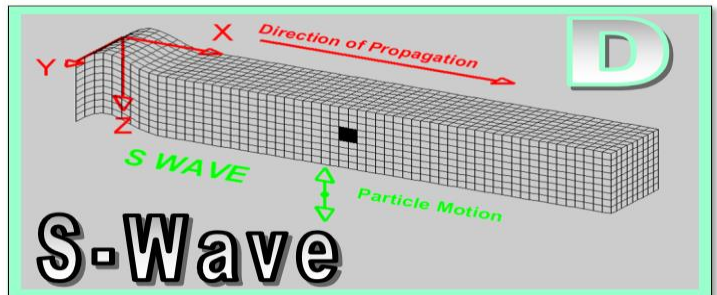
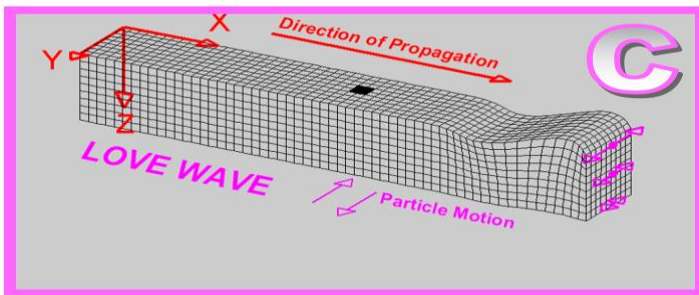
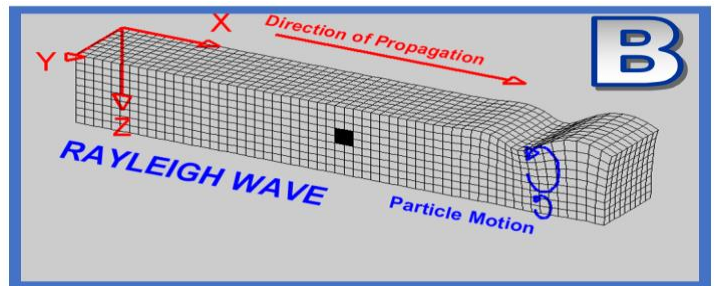
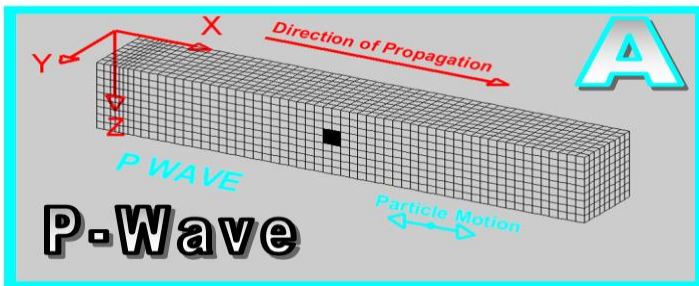


Which one of the waves above causes the most damage in an earthquake? Transverse will cause the most damage. Which one will arrive first Longitudinal / Primary wave.

Name each wave below. Word Bank: Primary Wave, Secondary Wave, Rayleigh Wave, Love Wave

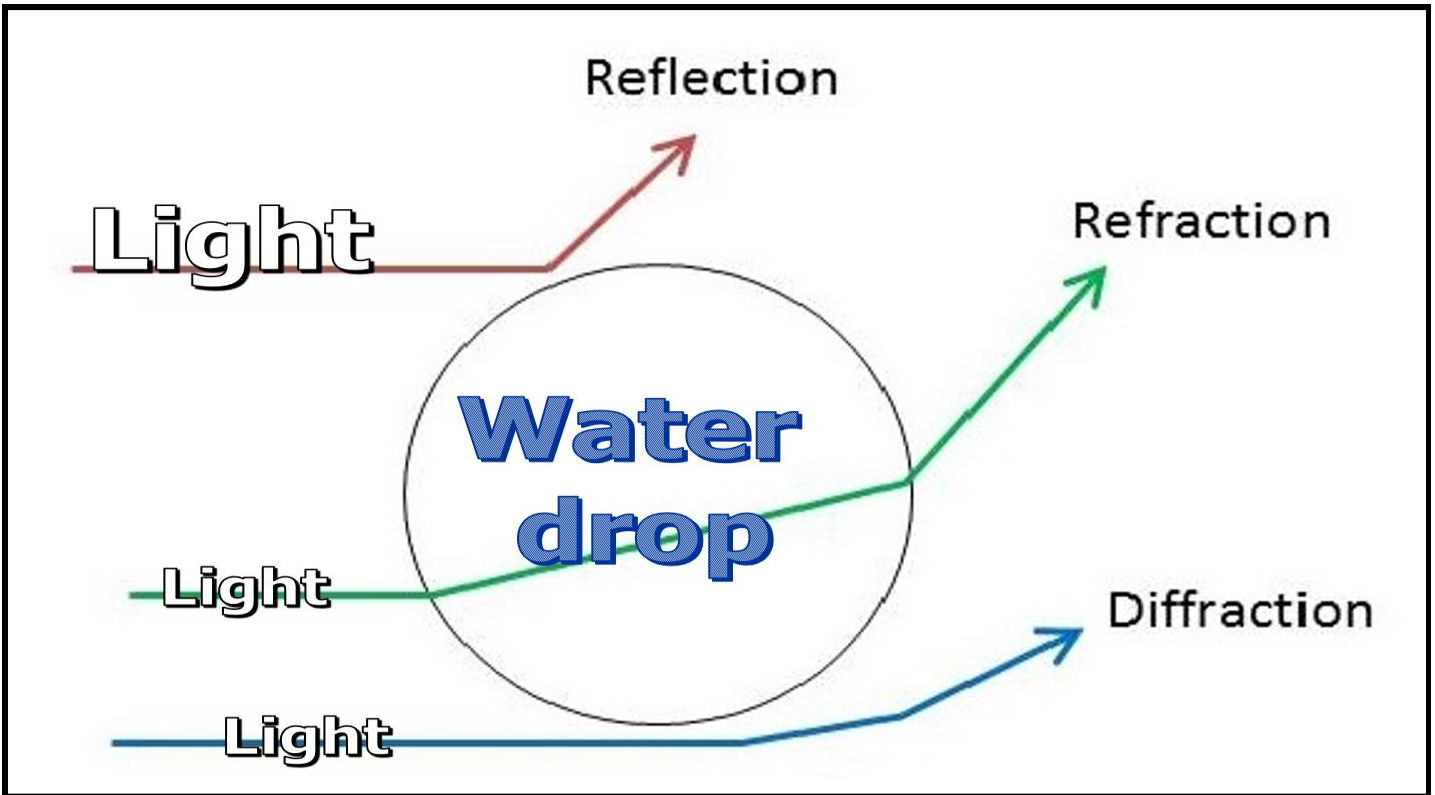
Name each wave below. Word Bank: Primary Wave, Secondary Wave, Rayleigh Wave, Love Wave

Which two are body waves? S and P Waves (A and D)	Which two are surface waves? Love and Rayleigh Waves (B and C)	Which ones are transverse? B, C, D all but primary waves	Which one is longitudinal only? Primary Wave
Which two cause the most destruction? Surface Waves Love and Rayleigh (B and C)	Which is the fastest wave? Primary Wave	Is the S-Wave or P-wave more powerful? S-wave	How are you doing? Teachers need to get more rest periods 😊



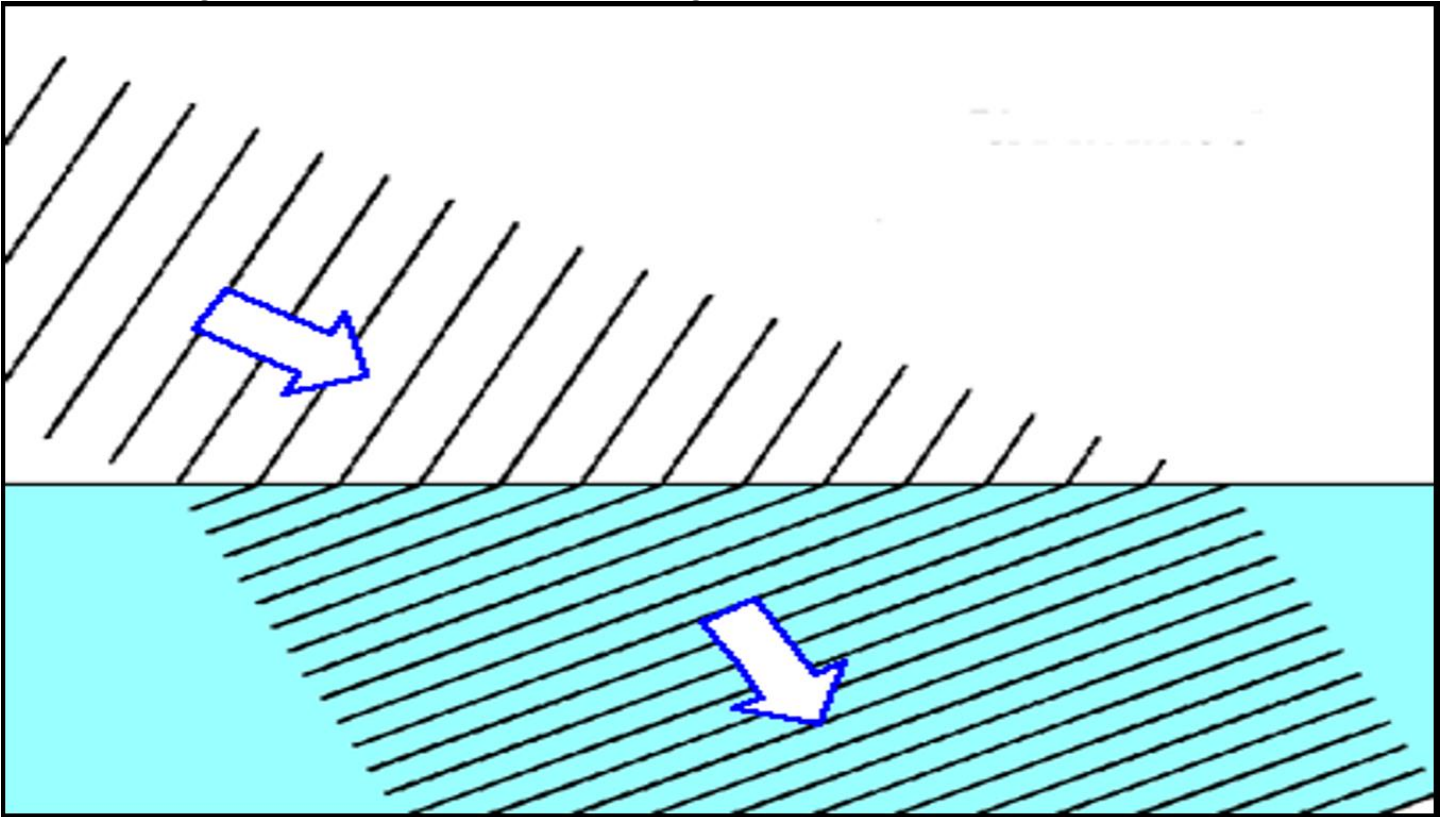
Part 4 Lesson 3 Light

Light is a **particle** and a **wave** and goes out in a straight line unless it bumps something.



Refraction: The **bending** of a wave when it enters a medium where its speed is changed.

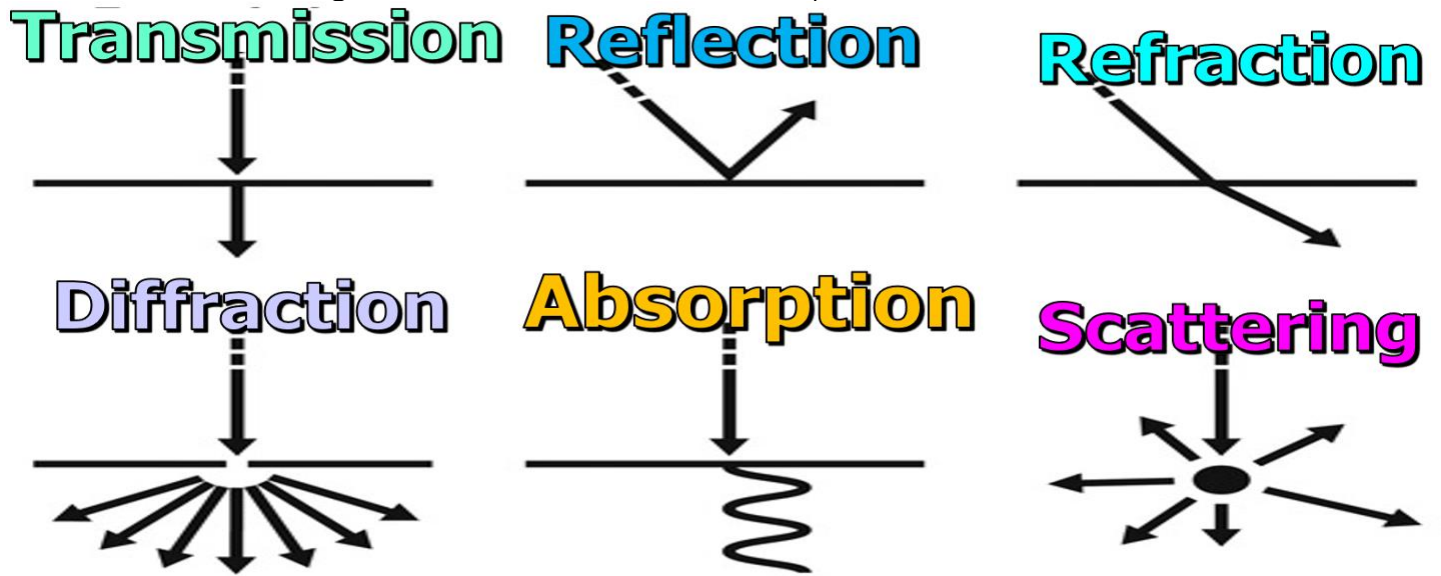
Refract this light as it hits the water in the diagram below.



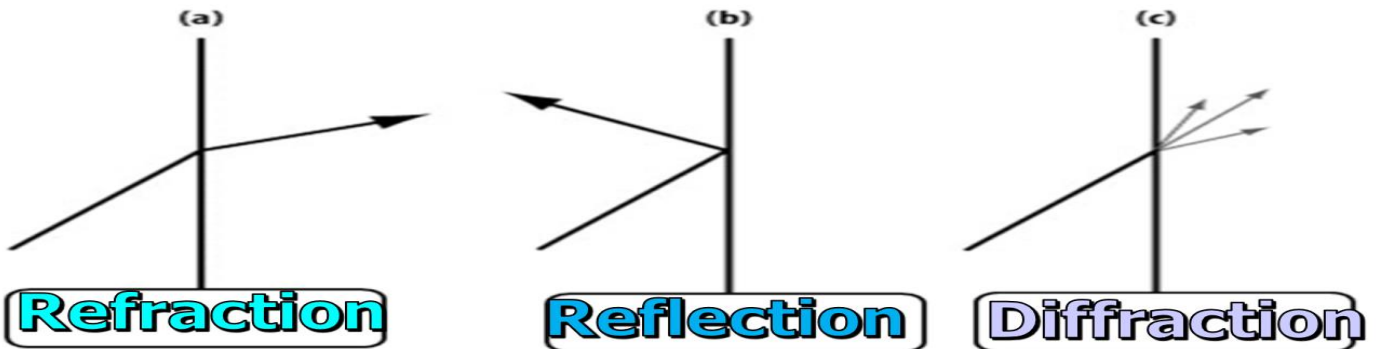
Diffraction: **Bending** of waves.

Scattering: **Bouncing** off of something

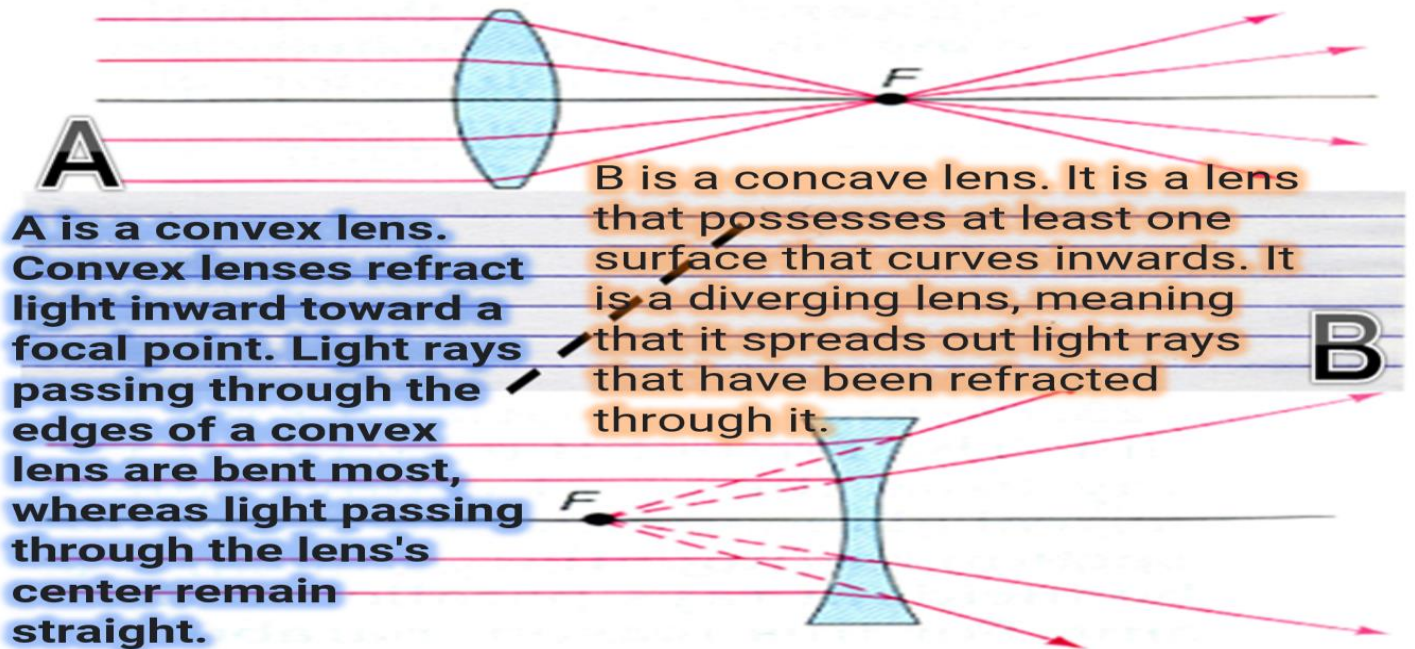
Word Bank: Scattering, Diffraction, Refraction, Absorption, Transmission, Reflection



Which is Diffraction, Refraction, and Reflection?



Provide some information about the lenses below. What are they doing to light?
Provide some information about the lenses below. What are they doing to light?



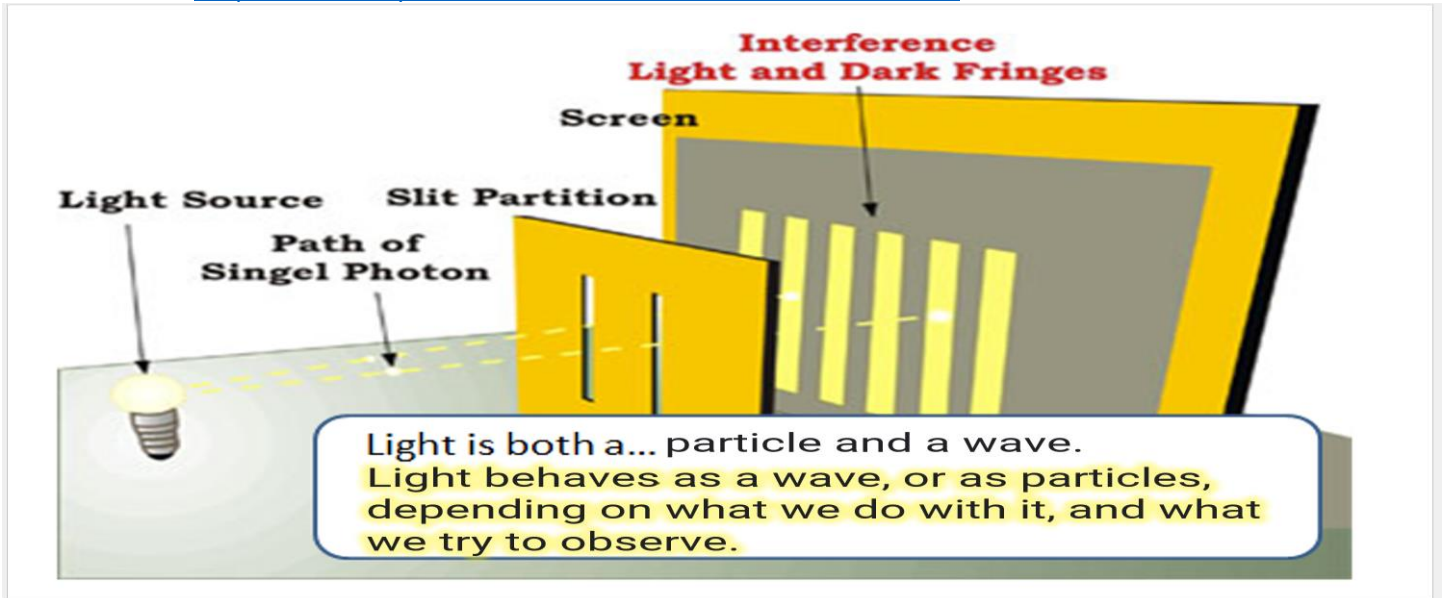
Wave particle duality: The exhibition of both a **particle** and **wave** like properties by a single entity.

Particle: Any of the basic units of **matter** and **energy**.

Ex. atom, proton, electron, or photon

Video Link! Slit experiment and particle and wave duality. (Optional) Explain below.

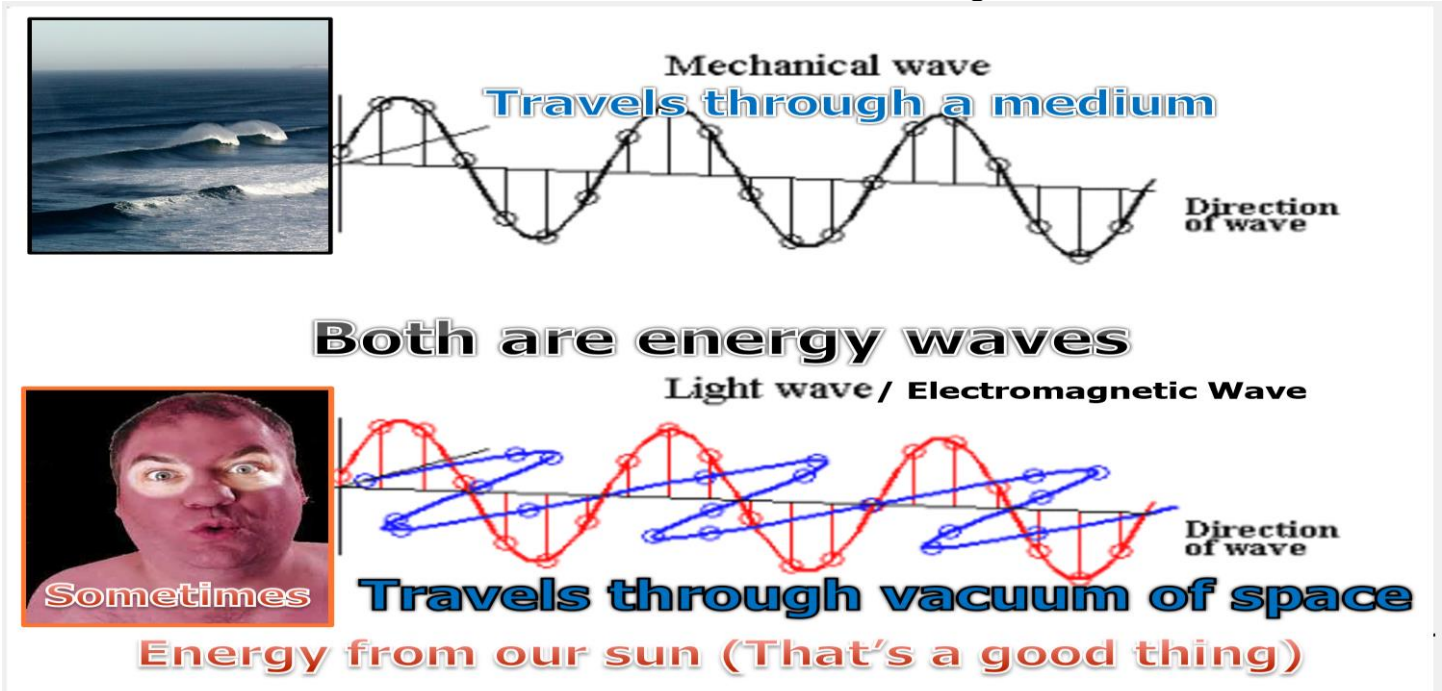
– <https://www.youtube.com/watch?v=luv6hY6zsd0>



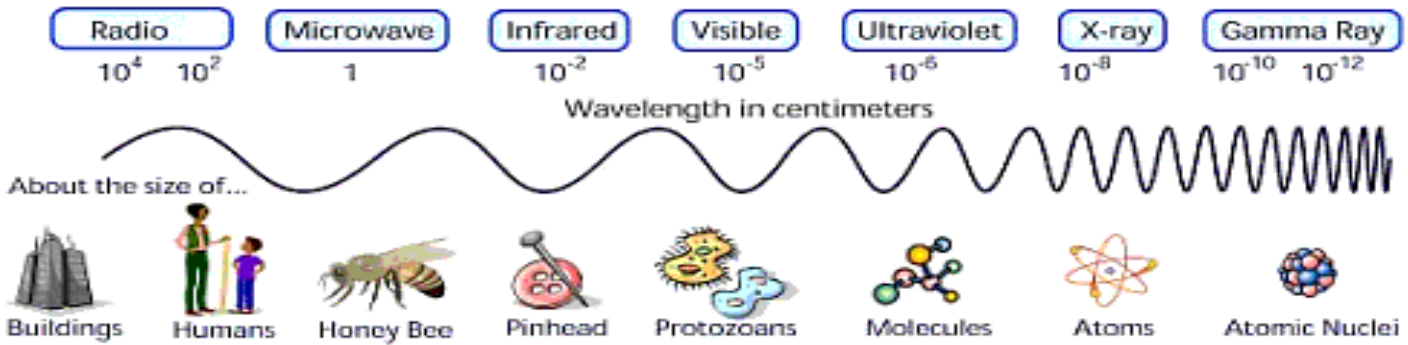
Part 4 Lesson 4 EM Spectrum Radio, Infrared, Visible Light, Microwave

The Electromagnetic Spectrum: The entire frequency range of electromagnetic **waves**.

Which is a mechanical wave? And which is an EM / Electromagnetic Wave?



Please name the wave in the Electromagnetic Spectrum according to its size/wavelength.



Provide a picture of something that is about the same size as the wave if possible as well as additional information about each EM Wave.

Please describe some uses of waves in the electromagnetic spectrum

UVC, UVB, UVA

X-rays are high-frequency, and thus high-energy, electromagnetic radiation. They have wavelengths ranging from 0.01 to 10 nanometres, and thus frequencies from 3×10^{19} to 3×10^{16} Hz. They are found to reside between ultraviolet radiation and gamma rays on the electromagnetic spectrum. Used in medical devices and they are also used by astronomers - many objects in the universe emit X-rays, which we can detect using suitable radio telescopes.

What wavelengths are visible light? The visible wavelengths cover a range from approximately 0.4 to 0.7 μm .

Microwave is a form of electromagnetic radiation with wavelengths ranging from about one meter to one millimeter. uses of microwaves include heating devices, communication devices, and radar.

Visible Light
 The longest visible wavelength is red and the shortest is violet. We see colors in this wavelength.

Gamma Rays
 A gamma ray, also known as gamma radiation, is a penetrating form of electromagnetic radiation arising from the radioactive decay of atomic nuclei. It consists of the shortest wavelength electromagnetic waves, typically shorter than those of X-rays. Gamma rays are used in medicine (radiotherapy), industry (sterilization and disinfection) and the nuclear industry. Examples of gamma rays are found in radioactive decay of naturally-occurring radionuclide, lightning (terrestrial gamma-ray flashes), and nuclear explosions. Gamma rays are also found in black holes, supernova remnants, and gamma-ray bursts.

Ultraviolet
 Ultraviolet is a form of electromagnetic radiation with wavelength from 10 nm to 400 nm, shorter than that of visible light, but longer than X-rays. UV radiation is present in sunlight. UV radiation is widely used in industrial processes and in medical and dental practices.

Infrared
 Infrared is electromagnetic radiation with wavelengths longer than those of visible light. It is therefore invisible to the human eye. Has wavelengths from around 1 millimeter to the nominal red edge of the visible spectrum, around 700 nanometers.

Radio waves
 Radio wave, wave from the portion of the EM Spectrum at lower frequencies than microwaves. The wavelengths of radio waves range from thousands of meters to 30 cm

Record Note to each EM wave on the Previous Page.

Waves of the electromagnetic spectrum travel at the speed of **light**. 186,000 miles per second or 300,000 kilometers per second in a **vacuum**.

Visible light measured in **lumens**.

All others are measured in **radiation**.

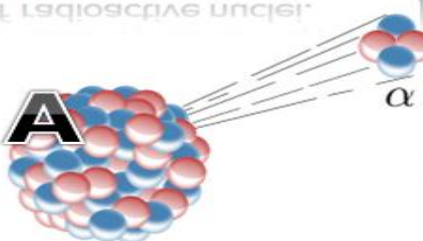
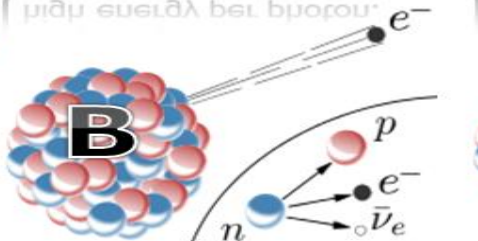
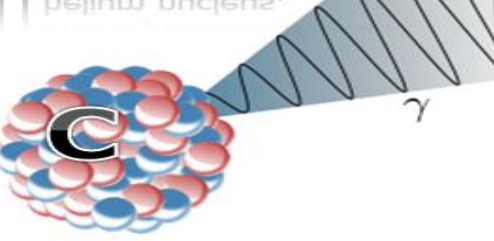
What is Radio Direction and Ranging? **RADAR**




Part 4 Lesson 6 Gamma Rays and Wrap Up




Gamma ray: Highest energy, **shortest** wavelength.

Emitted during radioactive decay of a fission product.

- Match the radioactive decay to the picture.

<p>Beta particles are high-energy, high-speed electrons or positrons emitted by certain types of radioactive nuclei.</p>	<p>Gamma Ray: Electromagnetic radiation of extremely high frequency and therefore high energy per photon.</p>	<p>Alpha particles consist of two protons and two neutrons bound together into a particle identical to a helium nucleus.</p>
		

<p>Gamma Ray: Electromagnetic radiation of extremely high frequency and therefore high energy per photon.</p>	<p>Alpha particles consist of two protons and two neutrons bound together into a particle identical to a helium nucleus.</p>	<p>Beta particles are high-energy, high-speed electrons or positrons emitted by certain types of radioactive nuclei.</p>
		

A	α		Alpha
B	β		Beta
C	γ		Gamma

The radioactive **half-life** of a given radioisotope decays at a predictable rate and can be used as a clock.

This makes several types of radioactive dating feasible.
Decay is not affected by outside conditions like wind, water, temperature.

Laser - Light Amplification by Stimulated Emission of Radiation.
Lasers cross over many parts of the EM

What is a Laser?



Quiz Wiz 1-10 Name the wave of the electromagnetic Spectrum.

1) RADIOWAVES	2) INFRARED	3) MICROWAVES, RADIOWAVES
4) UV Ultraviolet	5) VISIBLE LIGHT	6) X-Rays
7) GAMMA RAYS	8) X-RAYS	9) INFRARED
10) MICROWAVES	*11) SUPER WHY	

Across

2. _____ light. The visible spectrum is the portion of the electromagnetic spectrum that is visible to the human eye.
3. The number of waves that pass a fixed point in unit time;
5. Light Amplification by Stimulated Emission of Radiation.
7. Wave particle duality: The exhibition of both _____ and particle like properties by a single entity.
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11. _____ lenses are thicker at the middle. Rays of light that pass through the lens are brought closer together (they converge).
12. The highest part of a wave or the line along the top of a wave
13. _____ (UV): Has shorter wavelengths than visible light. More powerful than visible light.
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23. The lowest part of the wave between crests
24. This... Abbreviated-Sound Navigation and Ranging, is helpful for exploring and mapping the ocean because sound waves travel farther in the water than do radar and light waves.
25. The distance between successive crests of a wave, especially points in a sound wave or electromagnetic wave.

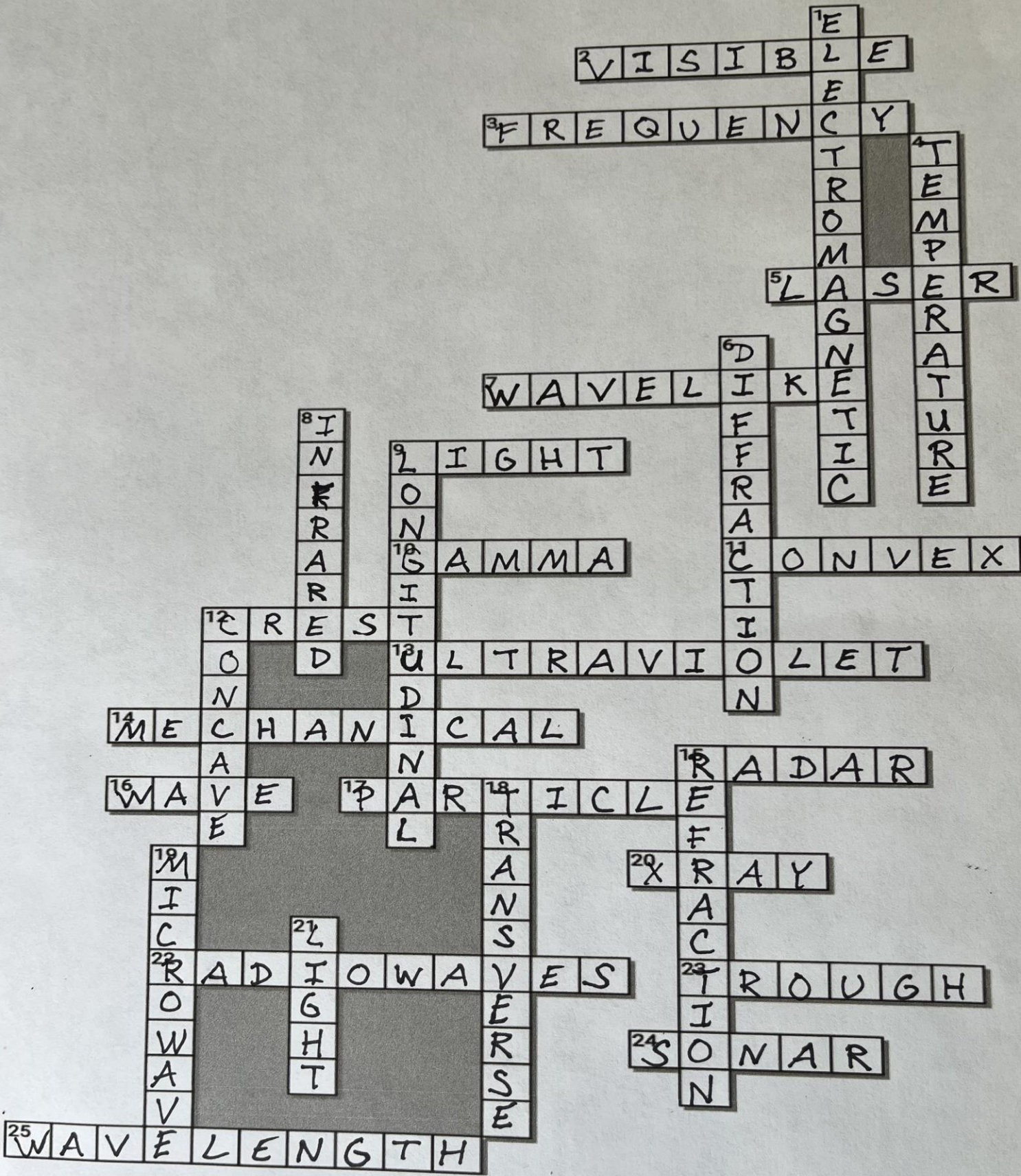
Down

1. _____ Waves: one of the waves that are propagated by simultaneous periodic variations of electric and magnetic field intensity and that include radio waves, infrared, visible light, ultraviolet, X-rays, and gamma rays
4. _____ of an object relates to the amount of radiation released.
6. Bending of a Wave
8. _____ Radiation: Wavelengths between microwaves and visible light. (heat)
9. These waves are waves in which the displacement of the medium is in the same (or opposite) direction of the wave propagation
12. A _____ lens is a lens that possesses at least one surface that curves inwards. It is a diverging lens, meaning that it spreads out light rays that have been refracted through it
15. The bending of a wave when it enters a medium where its speed is changed.
18. A _____ wave is a wave whose oscillations are perpendicular to the direction of the wave's advance.
19. Waves with wavelengths ranging from 1 m down to 1 mm.
21. This is a particle and a wave. It is a particle and a wave and goes out in a straight line unless it bumps something

-----teacher can remove this word bank to make more challenging-----

Possible Answers

CONVEX, CREST, DIFFRACTION, ELECTROMAGNETIC, FREQUENCY, GAMMA , INFRARED, LASER, LIGHT, LONGITUDINAL, MECHANICAL, MICROWAVE, RADAR, RADIO WAVES, REFRACTION, SONAR, TEMPERATURE , TROUGH, ULTRAVIOLET, VISIBLE, WAVE, WAVELENGTH, X-RAY, CONCAVE, LIGHT, PARTICLE , TRANSVERSE , WAVELIKE



Part 4 Review Game

1-20 = 5 pts **Part 4 Lesson 7**

*20-*25 * = Bonus + 1 pt,

(Secretly write owl in correct space +1 pt)

Final Question = 5 pt wager

Name: _____

Score ____ / 100

WAVY GRAVY	NITE LITE	IT's ALL ABOUT EM	BALANCE BEAM	RIDE THE WAVE Bonus round 1 pt each
1) A=Mechanical Wave B= Electro- magnetic Wave	6) Longitudinal Wave	11) A=Mechanical Wave B=Electromagnetic Wave	16) Infrared	*21) Lilo and Stitich
2) A=Crest B=Wavelength C=Height D=Trough	7) Transverse Wave	12) Speed of Light	17) ROYGBiV Red, Orange, Yellow, Green, Indigo, Violet	*22) Surf's Up
3) Frequency of the wavelength	8) Particle and a Wave A= Beta B=Gamma C=Alpha	13) Non-ionizing Ionizing	18) UV Rays, Ultraviolet, UVB	*23) Point Break
4) Gamma Ray is The shortest	9) A=Diffraction B=Refraction	14) Violet has the shorter wavelength	19) Radiation	*24) Rug RATS
5) Mechanical Wave	10) Concave Convex	15) A bsorbed R eflected S cattered -Diffraction, Refraction T ransmitted	20) Microwaves	*25) BAY WATCH

Final Question Wager ____ /5 Answer

The Herschel Experiment

