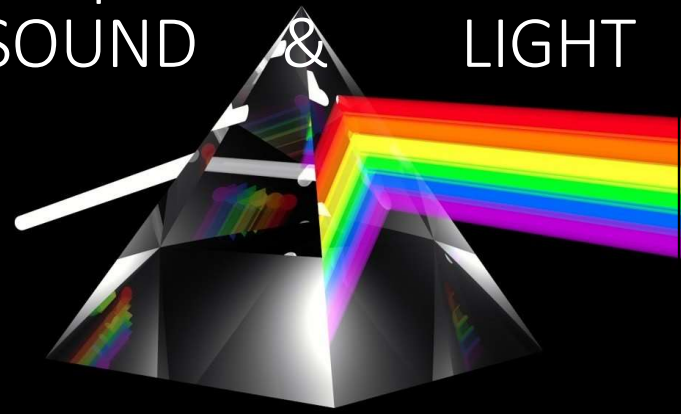
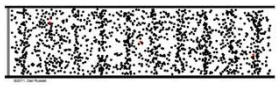
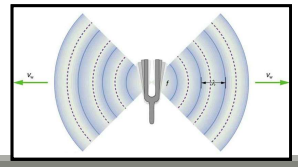
Chapter 16
SOUND & LIGHT



Properties of Sound

- Sounds waves
  - Type of mechanical energy
  - They are longitudinal waves
  - Moves in directions away from the source.
  - Speed of sound depends on the medium

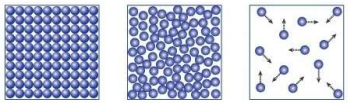




Properties of Sound

Density

- The density of the medium affects the speed at which sound travels through the medium.



	Speed of Sound (m/s)	Density (kg/m^3)
Air	325	1.316
Water	1600	1000
Coal	2133	1300
Shale	4800	2800

- Mediums that are denser allow sound to travel faster because the particles are close together.
- Temperature also affects the speed of sounds
  - Hot temperature allow sounds to move faster than cold temperatures.

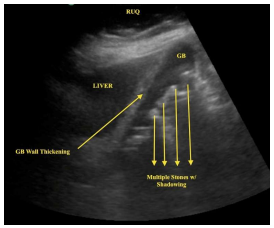
Properties of Sound

- Travel faster in **solids** and **liquid** than **gases**

Medium	Speed of sound (m/s)	Medium	Speed of sound (m/s)
Gases		**Liquids at 25 °C**	
Air (0 °C)	331	Water	1,490
Air (25 °C)	346	Sea water	1,530
Air (100 °C)	386	**Solids**	
Helium (0 °C)	972	Copper	3,813
Hydrogen (0 °C)	1,290	Iron	5,000
Oxygen (0 °C)	317	Rubber	54

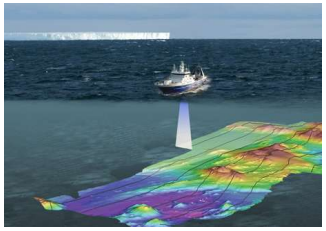
Ultrasound and Sonar

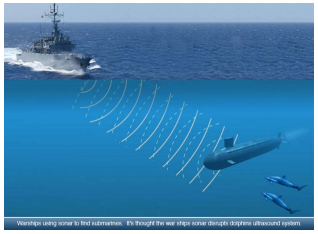
- Like all waves, sound waves **reflect**
- The reflection of sound waves can be used to determine distance and to create maps and images
  - Sonogram made by different boundary surfaces by a computer. **Ultrasound** is used to create sonogram (1,000,000,000 Hz and 15,000,000 Hz). Not damaging to human cells



Ultrasound and Sonar

- *Sonar* is a system that uses reflected sound waves to determine the distance to and location of objects

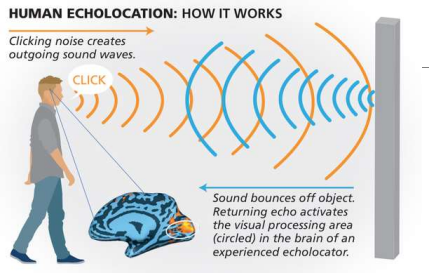


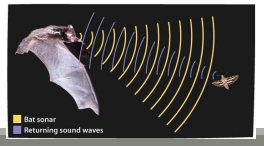


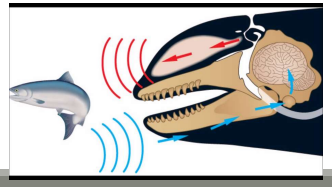
What wave behavior is being used to do this?

Video

Ecolocation







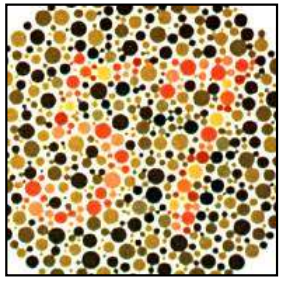
Light

Color Blindness

- one or more sets of cones does not function properly

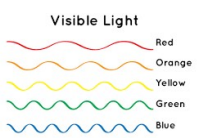
The retina contains…

- **Rods** - dim light, black & white
- **Cones** - color
  - red - absorb red & yellow
  - green - absorb yellow & green
  - blue - absorb blue & violet

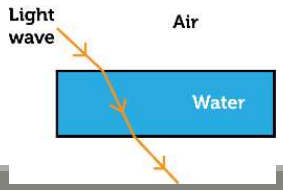


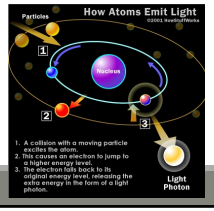
Test for red-green color blindness.

Light



- Type of electromagnetic energy
- Light behaves like a photon of energy
- Light can also behave as a transverse wave
- Travels without a medium(Vacuum), but can move through a medium.





Light

Nothing travels faster than the speed of light.

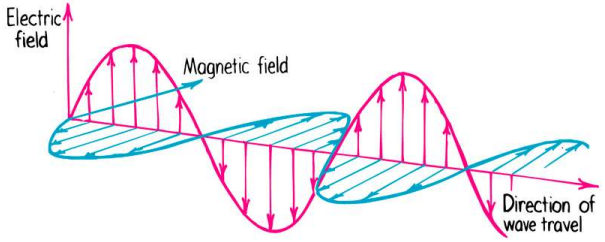
The speed of light depends on the medium

- Travels the fastest in a vacuum:
  - c =3 x 10^8 m/s.
- Light is the fastest signal in the electromagnetic spectrum.
- Slows down as density of materials(medium) increase

Medium	Speed of light ($\times 10^8$ m/s)
Vacuum	2.997925
Air	2.997047
Ice	2.29
Water	2.25
Quartz	2.05
Glass	1.97
Diamond	1.24

Light

The electromagnetic wave is part electric and magnetic fields.

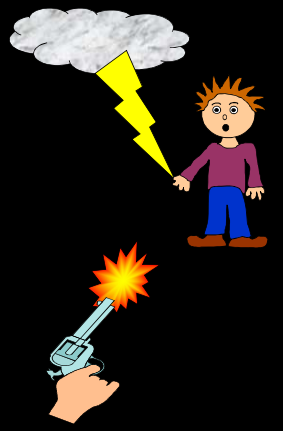


Light travels much faster than sound.

1) Thunder and lightning start at the same time, but we will see the lightning first.

2) When a starting pistol is fired we see the smoke first and then hear the bang.

Why?

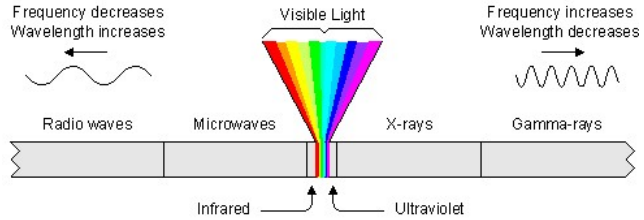


Electromagnetic Spectrum

- EM Spectrum- the range of wavelengths or frequencies over which electromagnetic radiation extends.
- Classified by their wavelength

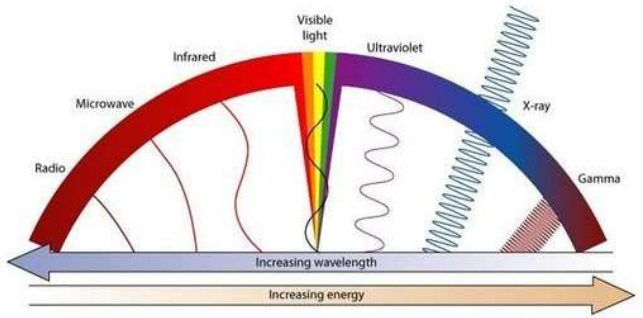
As wavelength increases, frequency **decreases**, it contains **less** energy.

As wavelength decreases, frequency **Increases**, it contains **more** energy

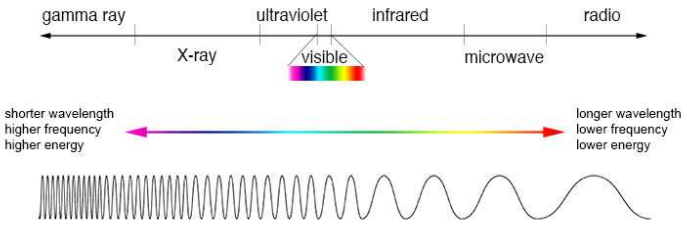


EM clip

Electromagnetic Spectrum



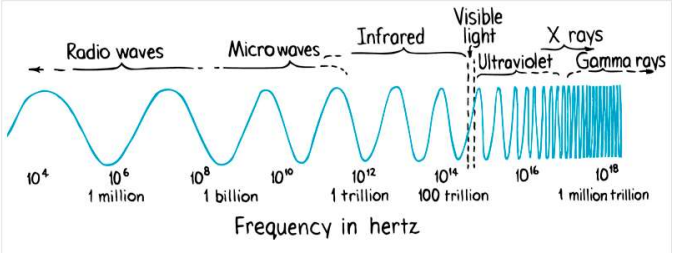
Electromagnetic Spectrum



Which change do you notice in this EMS diagram compared to the diagram in the previous EMS diagram?

Electromagnetic Spectrum

Electromagnetic waves are classified by their wavelength into a spectrum.

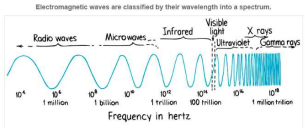


Does an X-ray have more energy than an infrared wave?

Does a microwave have less energy than a radiowave?

Electromagnetic Spectrum

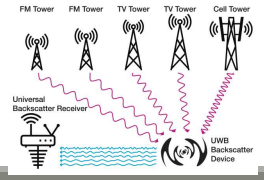
- **Radio waves** are used in communication and radar
  - Lowest frequency(energy)
  - Ex: FM, AM, and TV signals



Which radio station has the shortest wavelength?

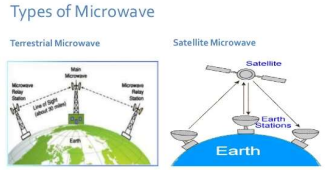
Atlanta Radio Stations
WRFG 79.3 MHz
WZGC 82.9 MHz
WVEE 101.3 MHz
WYAY 105.7 MHz

Why?

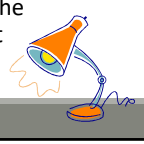


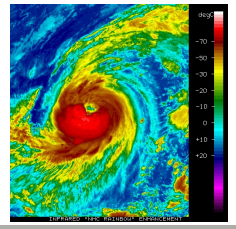
Electromagnetic Spectrum

- **Microwaves** used in cooking and communication
  - Telecommunication over a long distance. (Space to Earth)



- **Infrared light** can be felt as warmth
  - Sun or a heat lamp warm you.
  - Weather satellites read (temperature changes) for the tracking of cloud movement

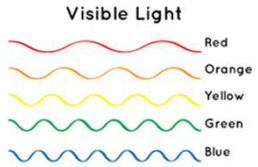




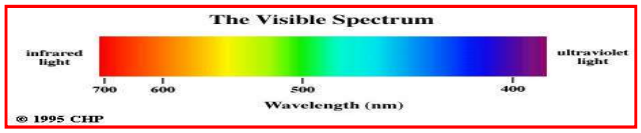
Visible Spectrum – Light we can see

- Roy G. Biv – Acronym for remembering the colors of visible light
  - Largest to Smallest Wavelength.

R- Red
O- Orange
Y- Yellow
G- Green
B- Blue
I- Indigo
V-Violet

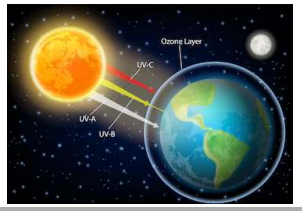


How are the visible light spectrums above and below different?



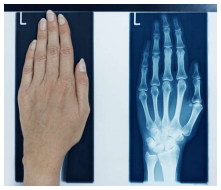
Electromagnetic Spectrum

- **Ultraviolet light** has higher energy and shorter wavelengths than visible light.
  - Sunlight contains ultraviolet light (UV rays) (9%)
  - UV rays can pass through thin layers of clouds, causing sunburn.



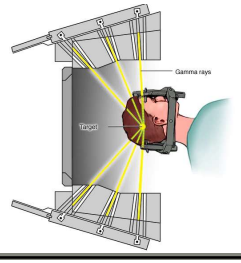
Electromagnetic Spectrum

- **X rays** has the 2nd highest energy and shorter wavelength.
  - Helpful in medical procedures due to being able to pass through our bodies and create images.
  - Harmful in that they can increase cancer rates.



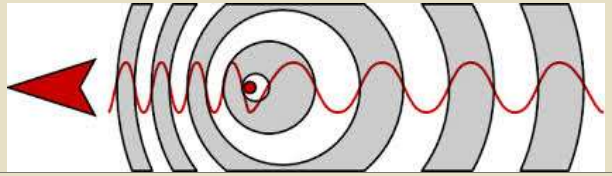
Electromagnetic Spectrum

- **Gamma rays** have the highest energy and the shortest wavelengths.
- Helpful during medical procedures and treatment of cancer.
- Extremely harmful in that they can also increase cancer rates and destroy good health cells.



Doppler Effect

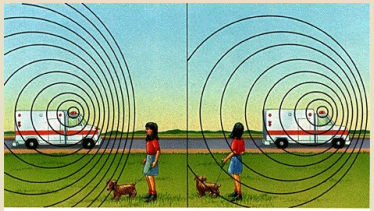
- Doppler effect-an observed change in the frequency of a wave when the source or observer is moving
- Occurs in sound and light waves
- As frequency change, there is a change in pitch (Sound Waves).
- As frequency changes, there is a change is brightness (light waves)



Video Clip

Doppler Effect

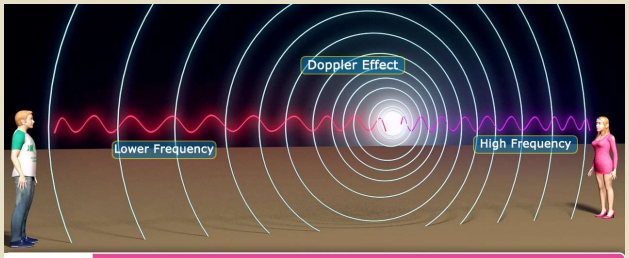
- Frequency changes when the source of waves is moving.
  - Ex. Siren moving toward you sounds different than a siren moving away from you



What happens to the amount of energy as the ambulance moves farther from the girl?

What happens to wavelengths as the ambulance moves farther from the girl?

Doppler Effect in Light

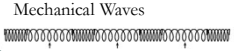


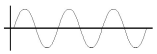
DOPPLER EFFECT IN LIGHT WAVES

Compare the wavelengths between the guy and the girl..

Comparing and Contrast Waves

Sound Waves	Both	Light Waves
• Longitudinal Wave	• Waves that transfer energy	• Transverse Wave
• Can only travel through a medium	• Can travel through matter	• Can travel through a medium or a vacuum
• Speed of 343 m/s	• Reflection and Refraction	• Speed around 300,000,000 m/s
• Can't see them		• Can see some of them
• Speeds up when they go from liquids to solids		• Slows down when passing liquid to solid
• Mechanical Waves		• Electromagnetic Waves





Electromagnetic Spectrum

Directions: For each blank space indicate if its HIGH or LOW.

Long Wavelength=__Low__ Frequency=__Low__ Energy

Short Wavelength=__High__ Frequency=__High__ Energy

Directions: Fill in if these items are *indirectly* or *directly* proportional.

Wavelength +Frequency =__Indirectly__ Proportional

Wavelength + Energy=__Indirectly__ Proportional

Energy + Frequency=__Directly__ Proportional

C.E.R

Table A		
	Velocity (m/s)	Density (kg/m³)
Substance A	289	1.6
Substance B	1,456	957.0
Substance C	3,245	3,204.0
Substance D	5,342	6,243.0

Table B		
	Velocity (m/s)	Density (kg/m³)
Substance A	346,000,000	1.6
Substance B	228,000,000	957.0
Substance C	177,000,000	3,204.0
Substance D	95,000,000	6,243.0

Use the data table above and what you have learned to construct an explanation for the question below. Use the graphic organizer below to help you organize your thoughts.

Question: How can you predict which table is showing the speed of light and which one is showing the speed of sound through different media?

Claim: Often you can use part of the question to formulate your claim. In an extended response, this will be your topic or thesis sentence.)

Evidence: (This is data gathered from text or graphics that help you answer the question provided in the task. Choose a quote or other evidence that directly supports your claim. If you use a quote, then be sure to credit the quote properly.)

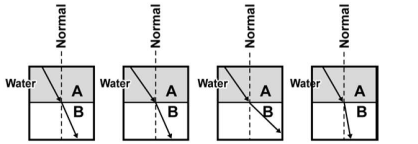
Reasoning: This is the most important part of your answer. It provides your reader with the explanation for our claim, and it explains how your evidence supports your claim. This is also where you should draw on key ideas and concepts from discipline to tie your evidence to your claim.)

The evidence shows:

Why does a light ray bend?

Medium	Index of Refraction (n)
Helium	1.00004
Water	1.33
Emerald	1.58
Cubic Zirconia	2.17

The diagrams below show light traveling from water (A) into another material (B). Using the chart above, label material B for each diagram as helium, water, emerald, or cubic zirconia.



Water Emerald Helium Cubic Zirconia