

| <u>Wave Your<br/>Hands in the<br/>Air</u> | <u>What Doesn't<br/>Kill You Makes<br/>You Stronger</u> | <u>What's the<br/>Frequency,<br/>Kenneth?</u> | <u>Hit Me!</u> | <u>Radiation<br/>May Induce<br/>Vomiting...</u> |
|---|---|---|----------------|---|
| <u>1pt</u>                                | <u>1 pt</u>   | <u>1 pt</u>                                   | <u>1pt</u>     | <u>1 pt</u>                                     |
| <u>2 pt</u>                               | <u>2 pt</u>   | <u>2pt</u>                                    | <u>2pt</u>     | <u>2 pt</u>                                     |
| <u>3 pt</u>                               | <u>3 pt</u>   | <u>3 pt</u>                                   | <u>3 pt</u>    | <u>3 pt</u>                                     |
| <u>4 pt</u>                               | <u>4 pt</u>   | <u>4pt</u>                                    | <u>4 pt</u>    | <u>4pt</u>                                      |
| <u>5pt</u>                                | <u>5 pt</u>   | <u>5 pt</u>                                   | <u>5 pt</u>    | <u>5 pt</u>                                     |

Name a *Similarity* and a  
*Difference* among the  
wavelengths longer than Visible  
Light.

**Learning Goal: Identify similarities/differences among EM waves;  
similarities/difference between EM & Mechanical Waves**

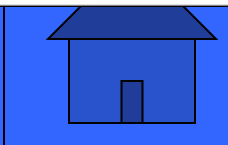
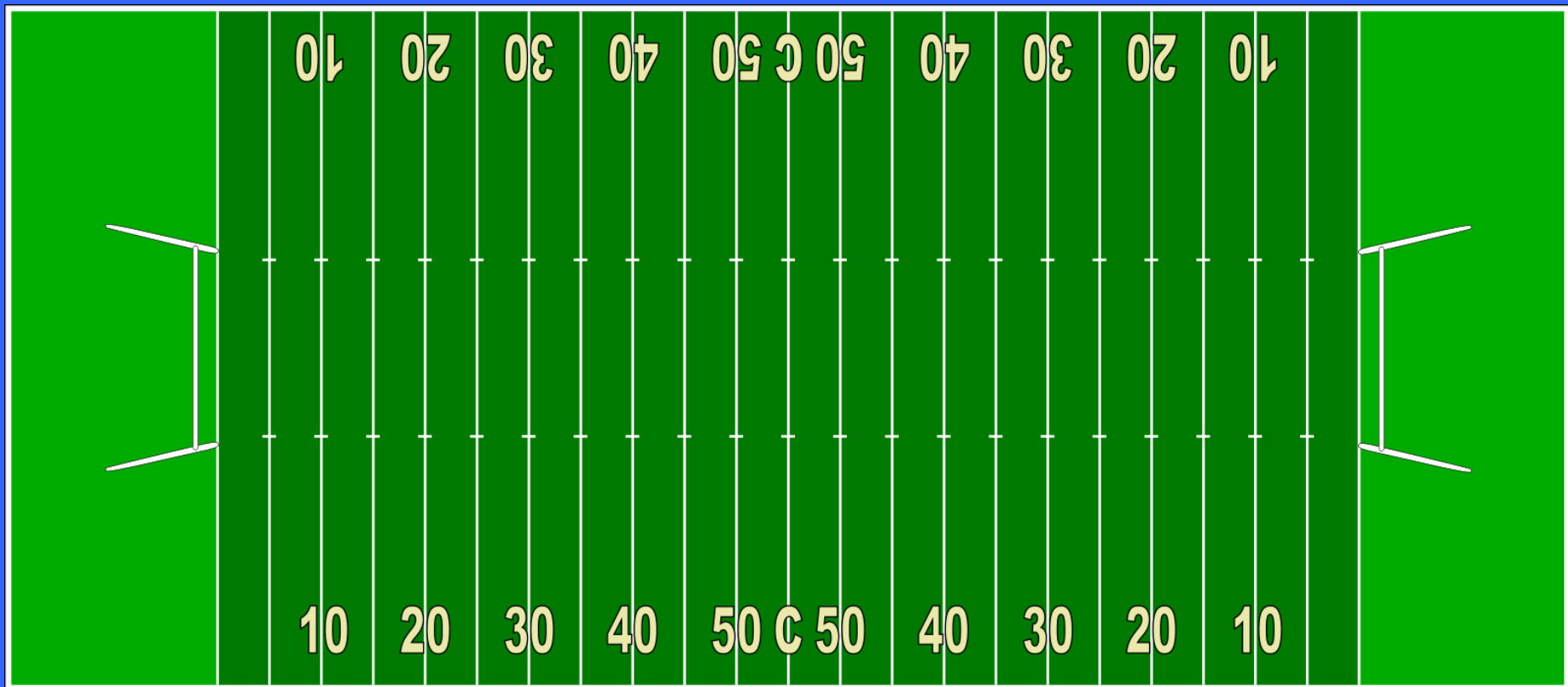
- Similarities
  - Speed of light in vacuum
  - Longer W/L than Visible Light
  - Used for communication
  - Used for astronomy
- Differences
  - Wavelength
  - Frequency
  - Energy

**Learning Goal: Identify similarities/differences among EM waves;  
similarities/difference between EM & Mechanical Waves**

Identify the EM Wave with the Longest Wavelength and name something of comparable size

# Radio Waves

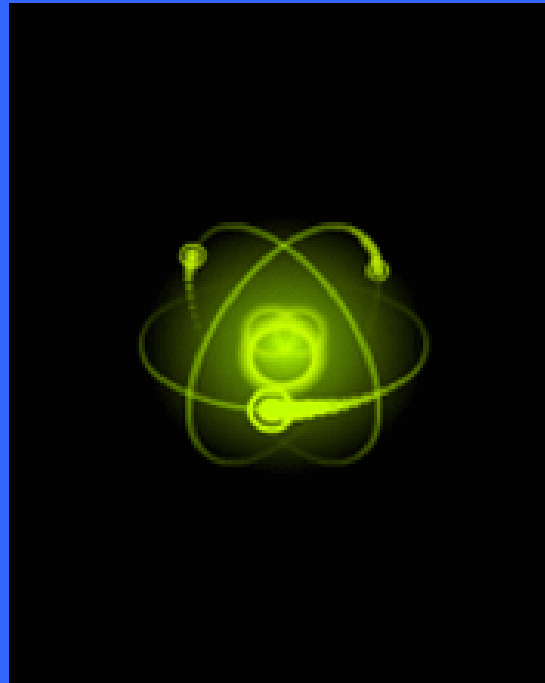
Human Height to Football field  
to Earth's diameter



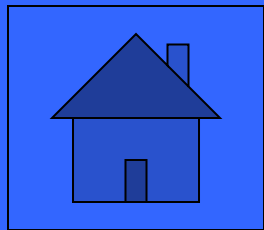
Identify the EM Wave with the Shortest Wavelength and name something of comparable size

# Gamma Rays

## Nucleus of an Atom

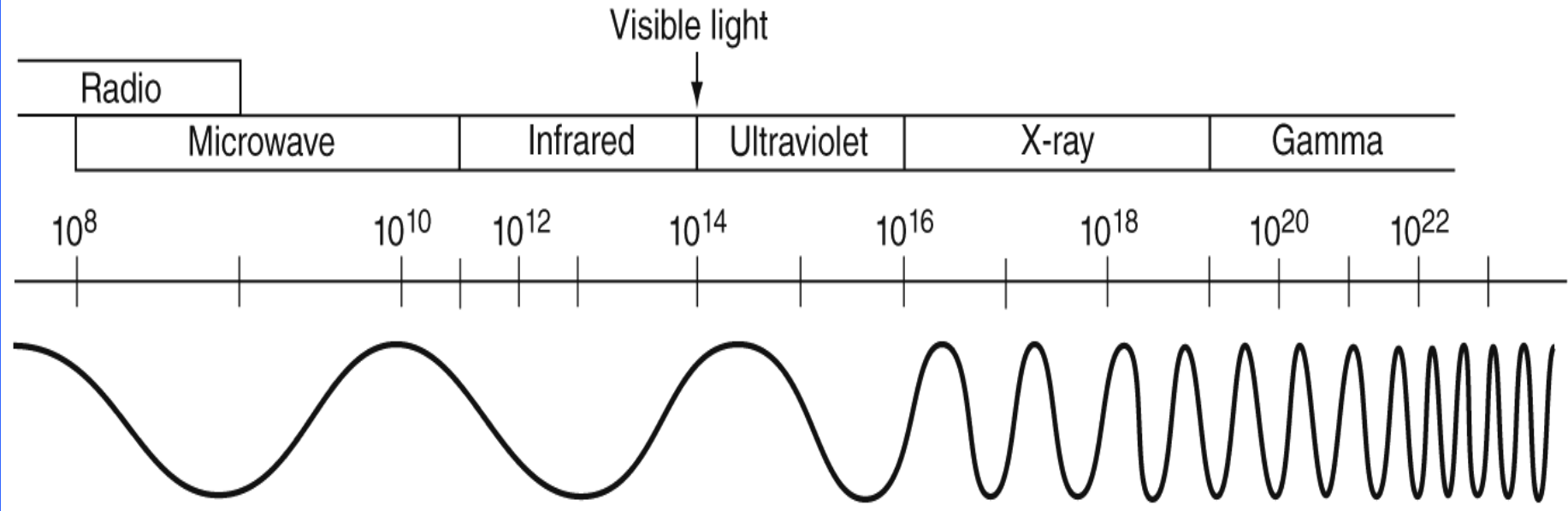


**Learning Goal: Identify similarities/differences among EM waves;  
similarities/difference between EM & Mechanical Waves**



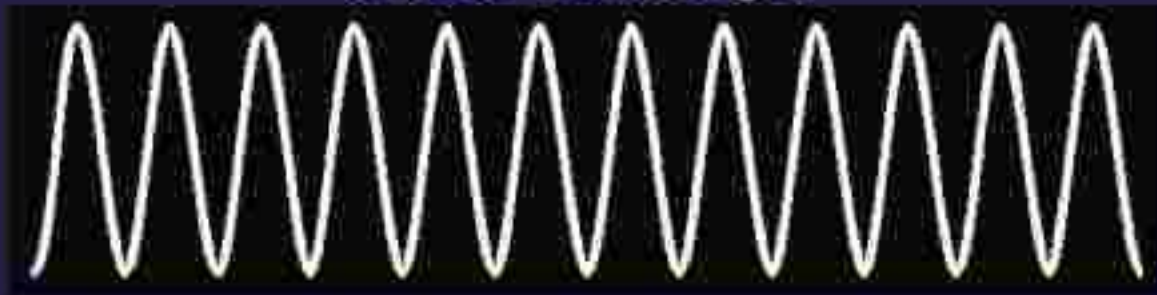
The diagram below represents the electromagnetic spectrum.  
What is the relationship between Wavelength and Frequency?

**The Electromagnetic Spectrum**  
Frequency in hertz (1 hertz = 1 wavelength/second)





**HIGHER FREQUENCY**  
shorter wavelength

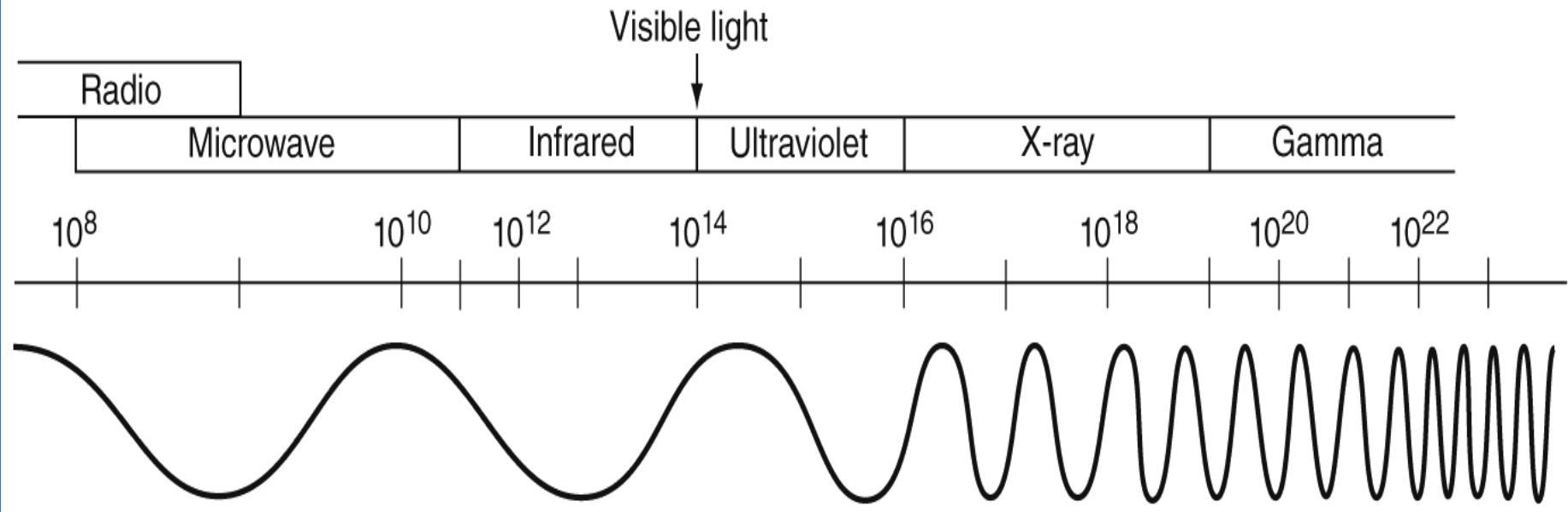


**LOWER FREQUENCY**  
longer wavelength



The diagram below represents the electromagnetic spectrum.  
What is the relationship between  
Frequency and Energy?

**The Electromagnetic Spectrum**  
Frequency in hertz (1 hertz = 1 wavelength/second)



## Higher Energy

**HIGHER FREQUENCY**  
shorter wavelength



**LOWER FREQUENCY**  
longer wavelength

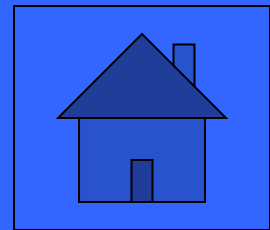
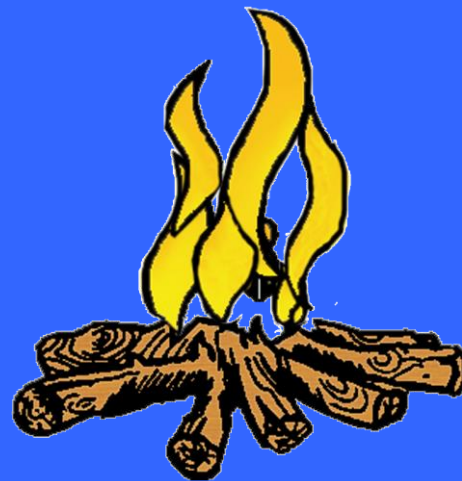


## Lower Energy



Name a hazard of wavelengths  
*longer* than visible light and  
ways to protect yourself from it.

- Long wavelength waves (Radio, Micro, I/R) can heat the water in your body if you're overexposed.
- Prevent this by
  - Staying away from Radio transmission towers
  - Don't crawl into microwave ovens
    - Metal grid on door keeps microwaves inside
  - Don't play with fire!



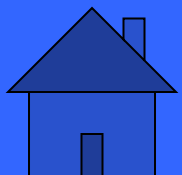
1. Name a hazard of visible light waves and ways to protect yourself from it.
2. Name uses of visible light.

# Hazards and Uses of Visible Light

- Hazard: Too much can blind you.
- Prevention: Don't stare at the sun!
- Uses
  - Seeing
  - Communication
  - Astronomy

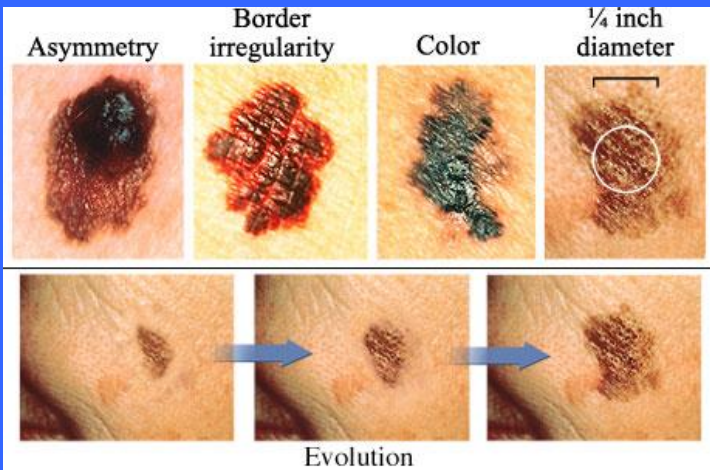


**Learning Goal: Identify similarities/differences among EM waves; similarities/difference between EM & Mechanical Waves**



Name hazards of the three  
wavelengths *shorter* than Visible  
Light and ways to protect  
yourself from them.



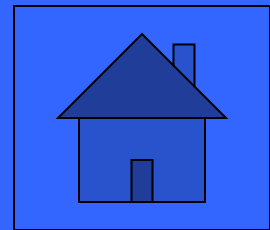


# Cancer, Cell Damage, DNA Damage

UV: Sunscreen, Avoid Overexposure,  
Ozone Layer

X-Ray: Lead Screens

Gamma Ray: Thick Lead/Concrete

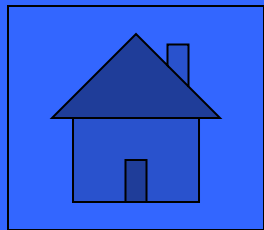


Name Uses of wavelengths  
*longer* than Visible Light.

# Uses of Radio, Micro, I/R

- Radio, Microwave, I/R: Communications  
Broadcasting, Astronomy
- Microwave & I/R: Heating Food
- I/R: Heating, Remote Controls, Fiber-optic  
communications

**Learning Goal: Identify similarities/differences among EM waves;  
similarities/difference between EM & Mechanical Waves**

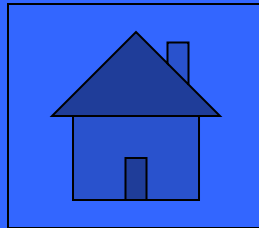


Name at least two uses for  
wavelengths *shorter* than visible  
light.

# Uses of U/V, X-ray, Gamma ray

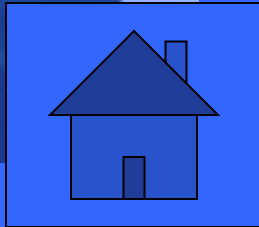
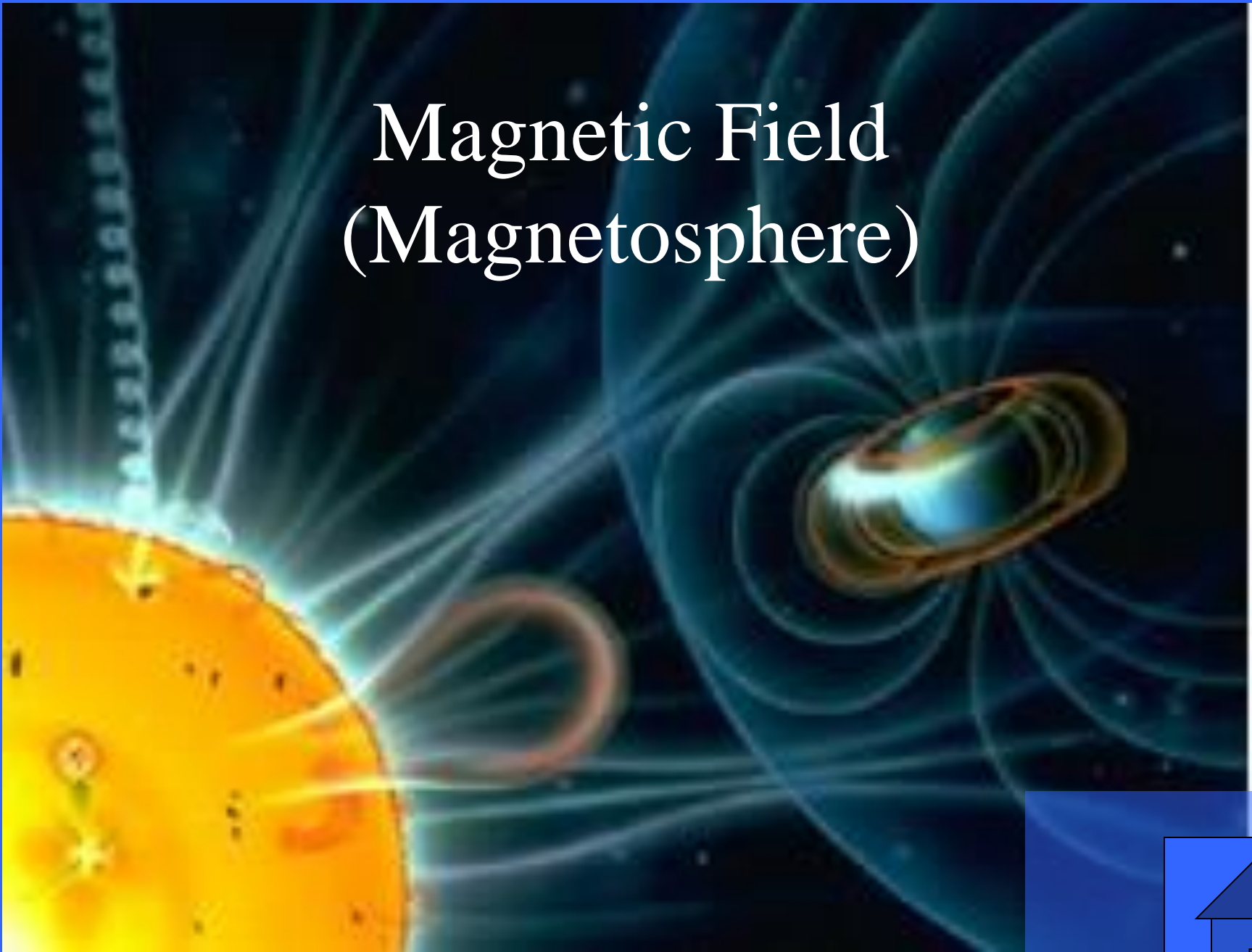
- All: Astronomy, Studying Health of Earth
- U/V: Sterilizing, Suntanning
- X-ray: Medical X-rays, Forecasting CME
- Gamma: Medical (chemotherapy), Scientific Research

**Learning Goal: Identify similarities/differences among EM waves;  
similarities/difference between EM & Mechanical Waves**



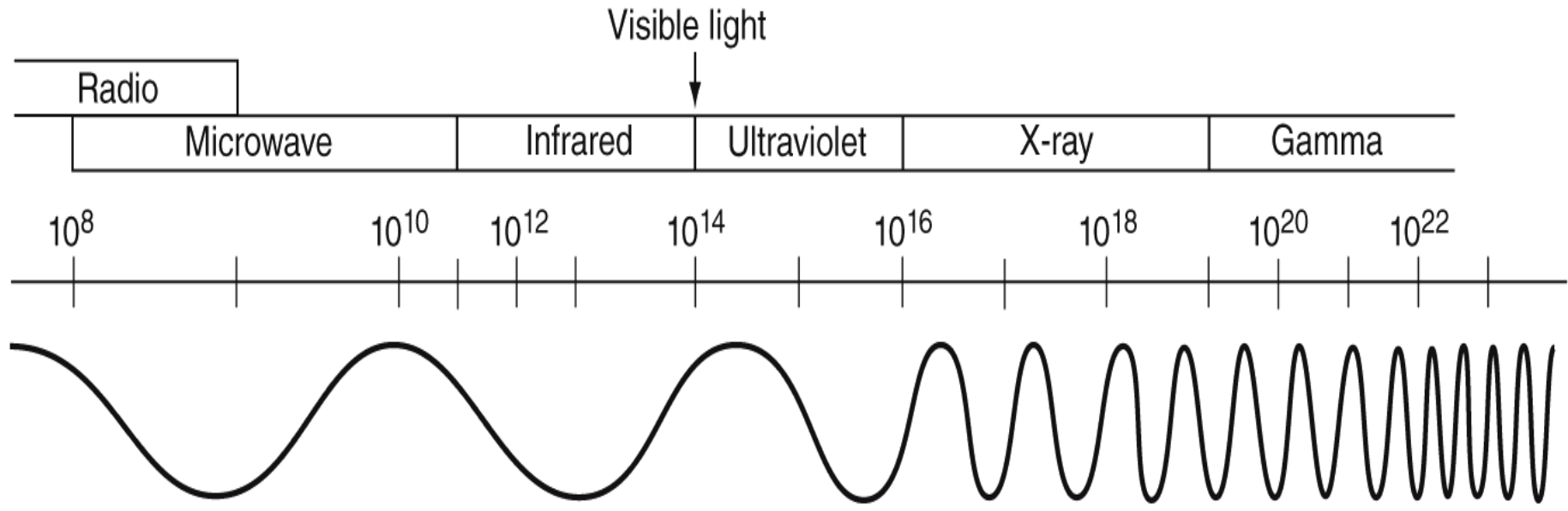
What deflects almost all of the deadly, high-energy EM radiation from the sun, enabling life to exist on Earth?

# Magnetic Field (Magnetosphere)



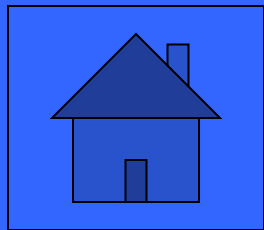
Name a use common to all wavelengths of the EM spectrum.

**The Electromagnetic Spectrum**  
Frequency in hertz (1 hertz = 1 wavelength/second)



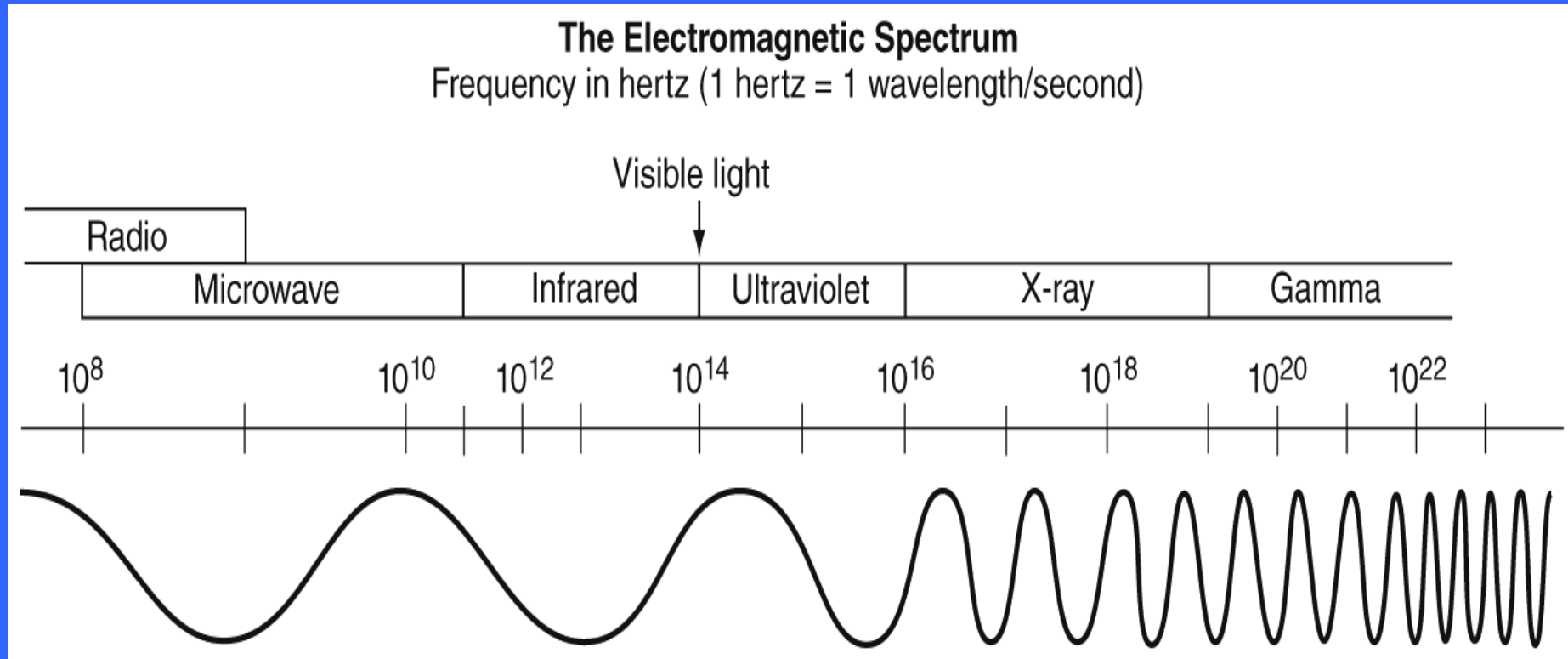


- Astronomy (studying stars, planets, sun)
- Earth Study from space-based satellites



The diagram below represents the electromagnetic spectrum.

What is the relationship between Wavelength, Frequency and Energy?



## Higher Energy

**HIGHER FREQUENCY**  
shorter wavelength



**LOWER FREQUENCY**  
longer wavelength



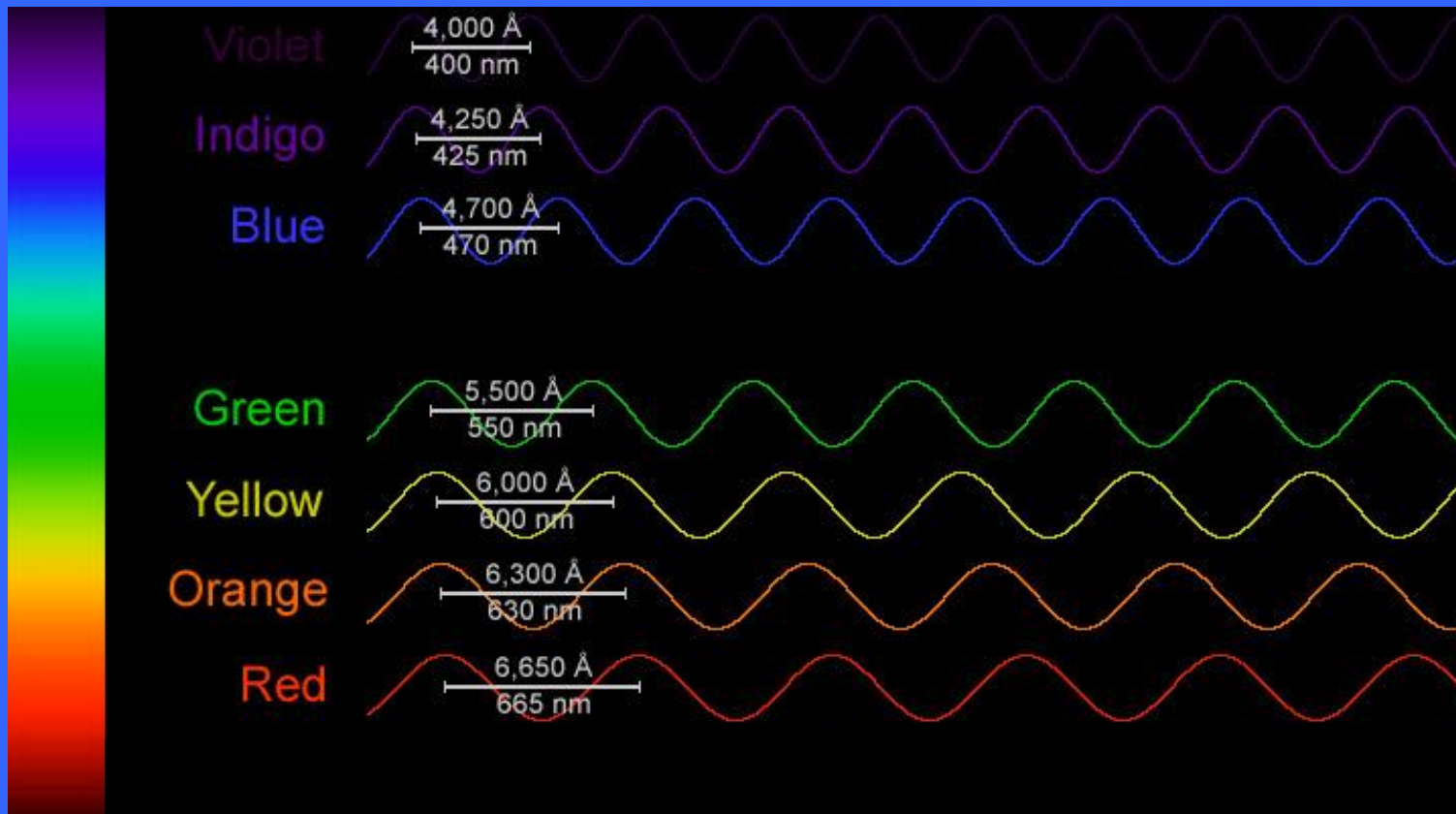
## Lower Energy



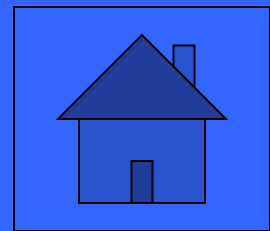
Our eyes detect light that lies only within a small region of the electromagnetic spectrum. This region is called visible light. Which of these statements describes the visible spectrum of light as seen by the human eye?

- A. The lowest frequency appears red, and the highest frequency appears violet.
- B. The lowest frequency appears green, and the highest frequency appears red.
- C. The lowest frequency appears blue, and the highest frequency appears orange.
- D. The lowest frequency appears yellow, and the highest frequency appears green.

A. The lowest frequency appears red, and the highest frequency appears violet.

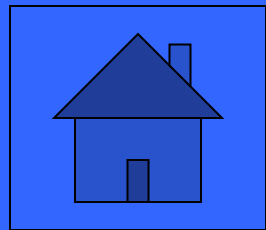


**Learning Goal: Identify similarities/differences among EM waves; similarities/difference between EM & Mechanical Waves**



What do radio waves transfer  
between a cell phone and a cell  
phone tower?

# Electromagnetic Energy (No, NOT Sound!!!)

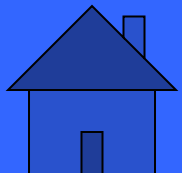


How fast does light move in the vacuum of empty and what happens to its speed when it moves from a vacuum through a medium?



Speed of light in vacuum:  
300,000 km/s

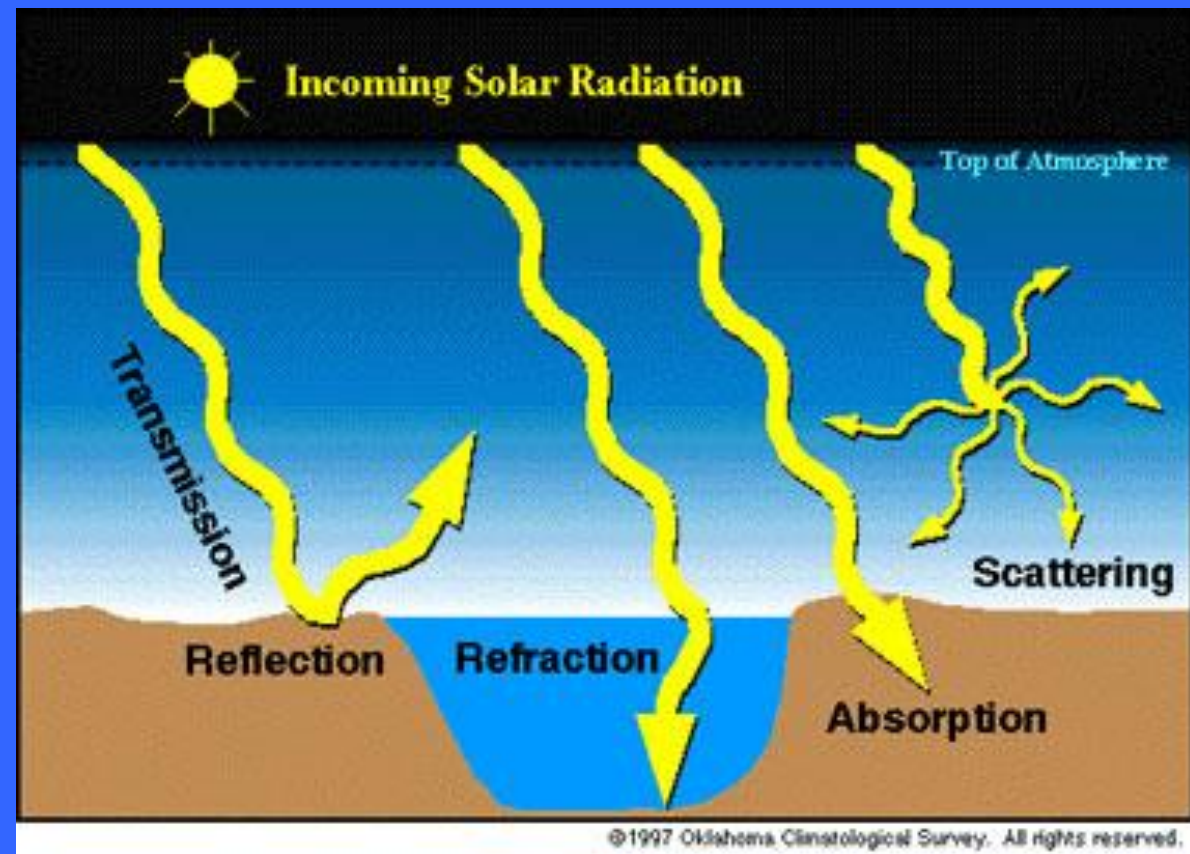
It slows down when it goes  
through a medium.



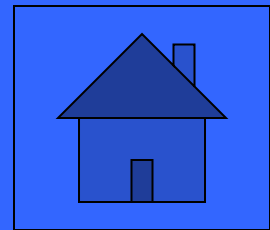
When light meets a medium,  
what three things can happen to it  
(other than slowing down)?



- Reflection
- Refraction
- Absorption



**Learning Goal: Identify similarities/differences among EM waves; similarities/difference between EM & Mechanical Waves**

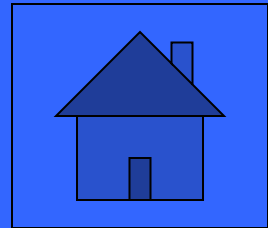


Media that allow light to pass through (transmit) are either what or what? Give an example of each.

# Transparent or Translucent

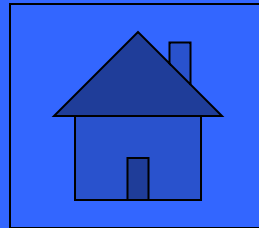


**Learning Goal: Identify similarities/differences among EM waves;  
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Name, define, and give an example of the term that describes what happens to light when it's transmitted through a medium.

# Refraction: bending of light passing through a medium







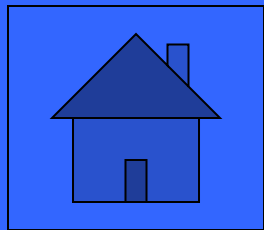
Why are bananas yellow?



- Bananas *reflect* yellow light and *absorb* red, orange, green, blue, indigo, and violet.



**Learning Goal: Identify similarities/differences among EM waves;  
similarities/difference between EM & Mechanical Waves**



What does *Vomit* mean?

What colors are *Vomit*?

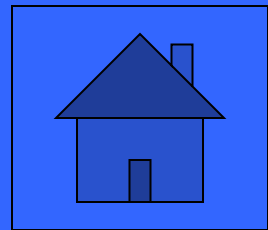
AND name a hazard and use.

# Visible light ROY G. BIV

- Blindness
- Seeing
- Communication



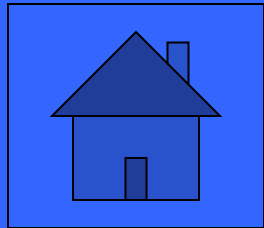
**Learning Goal: Identify similarities/differences among EM waves;  
similarities/difference between EM & Mechanical Waves**



Name 3 *similarities* and 3  
*differences* among ALL the  
wavelengths of the  
Electromagnetic Spectrum

- Similarities
  - EM waves
  - Properties of W/L, Frequency
  - Speed in vacuum/empty space
  - Useful
  - Hazardous
- Differences
  - W/L, Frequency, Energy
  - Speeds in media
  - Higher energy waves are more hazardous
  - Visibility

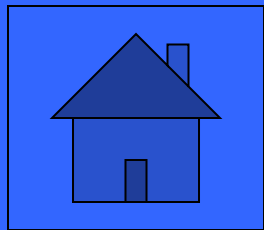
**Learning Goal: Identify similarities/differences among EM waves;  
similarities/difference between EM & Mechanical Waves**



When moving from a gas to a liquid, Light waves do this and Sound waves do this.

- **Light slows down, Sound speeds up**

**Learning Goal: Identify similarities/differences among EM waves;  
similarities/difference between EM & Mechanical Waves**



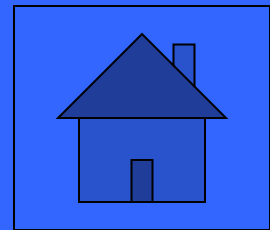
*Sound* waves need this to exist;  
*EM* waves do not.



# Medium



**Learning Goal: Identify similarities/differences among EM waves; similarities/difference between EM & Mechanical Waves**

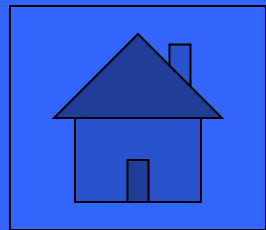


Name two Similarities and  
two Differences between  
Sound Waves and  
Electromagnetic Waves...

Learning Goal: Identify  
similarities/differences among EM  
waves: similarities/difference

- Similar
  - Both transfer energy
  - Both have wavelength, frequency, amplitude
- Differences
  - Sound waves need medium, EM doesn't
  - Sound waves move **FASTER** as medium gets denser, EM waves slow down
  - Sound waves are **ALWAYS** slower than EM

**Learning Goal: Identify similarities/differences among EM waves;  
similarities/difference between EM & Mechanical Waves**



# NGSSS Benchmarks

- **SC.7.P.10.3** Recognize that light waves, sound waves, and other waves move at different speeds in different materials. (L)
- **SC.7.P.10.2** Observe and explain that light can be reflected, refracted, and/or absorbed. (H)
- **SC.8.E.5.11** Identify and compare characteristics of the electromagnetic spectrum such as wavelength, frequency, use, and hazards and recognize its application to an understanding of planetary images and satellite photographs. (H)
- **SC.7.P.10.1** Illustrate that the sun's energy arrives as radiation with a wide range of wavelengths, including infrared, visible, and ultraviolet, and that white light is made up of a spectrum of many different colors. (L)
- **SC.6.E.7.9** Describe how the composition and structure of the atmosphere protects life and insulates the planet. (M)