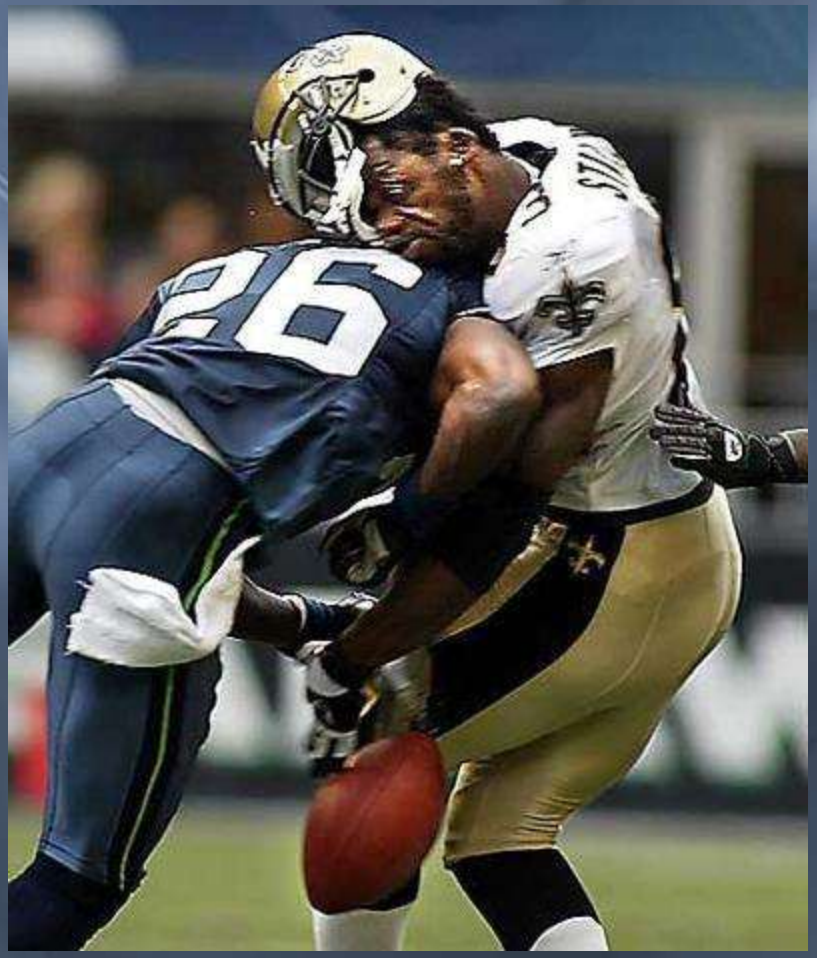
Waves of Energy

Energy -

The ability to do work or make something move.

Work -

The transfer of energy.



There are 9 forms of energy

1. Mechanical or kinetic energy (moving energy)

2. Electrical energy

3. Light energy

Laser

4. Sound energy

5. Thermal energy (heat energy)

Friction

6. Chemical energy

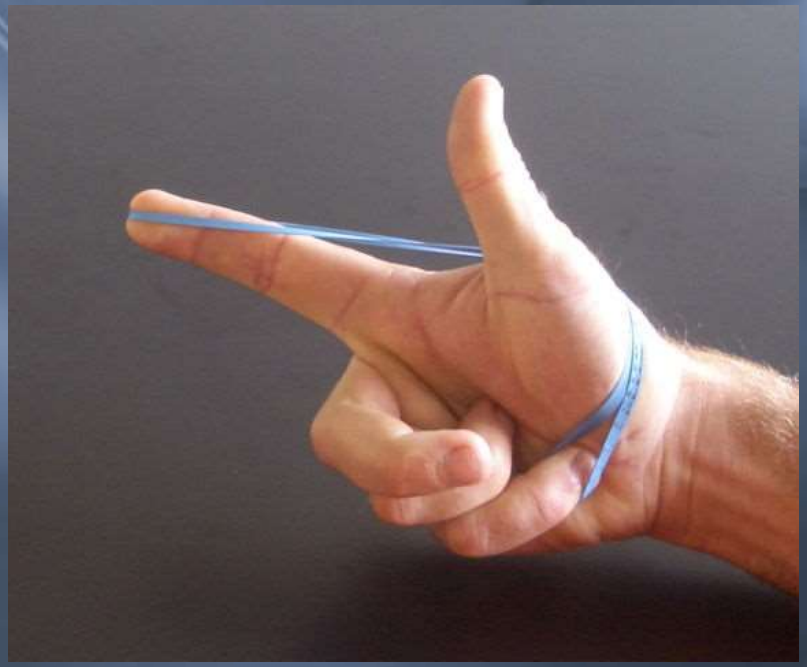
Food

Gasoline

Car Bomb

7. Gravitational energy (energy from height)

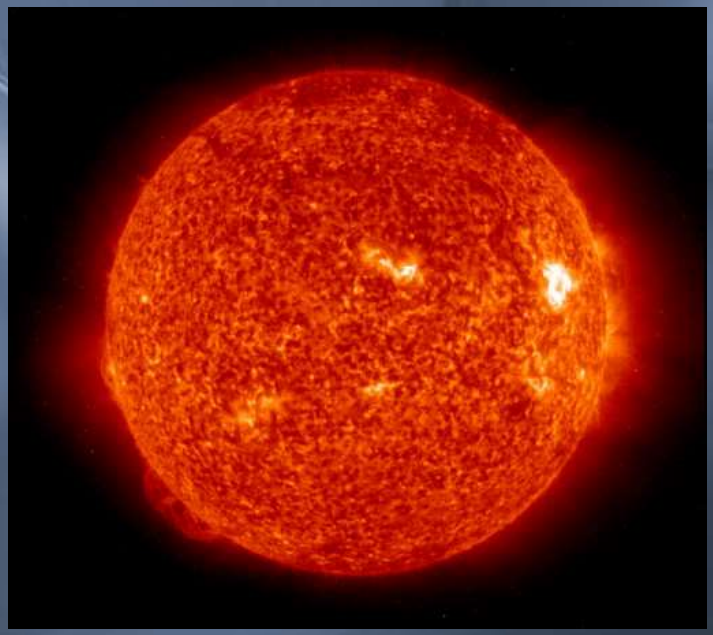
8. Elastic energy (energy from stretching)



Slingshot ride

9. Nuclear energy

Fission



Fusion

Fusion

Law of Conservation of Energy -

The total amount of energy cannot change. Energy cannot be created or destroyed.

Energy can be changed from one form to another. For instance, You can change sound into light and then change light back into sound again. No energy is destroyed, however.

Closed system -

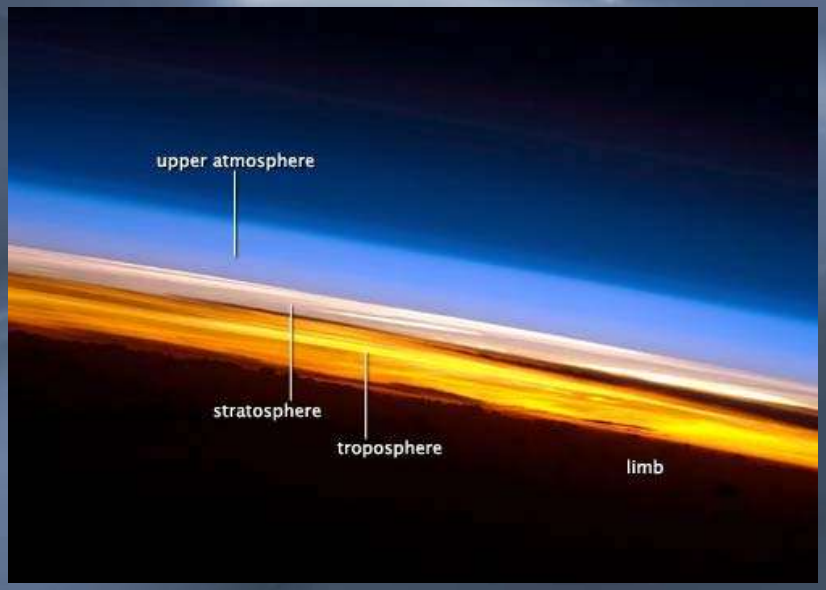
A system where no energy or matter can get in or out. For matter, the earth itself is a closed system.

Open system -

A system where energy and matter can get in and out. Most of the systems on earth are open.

Examples of open systems -

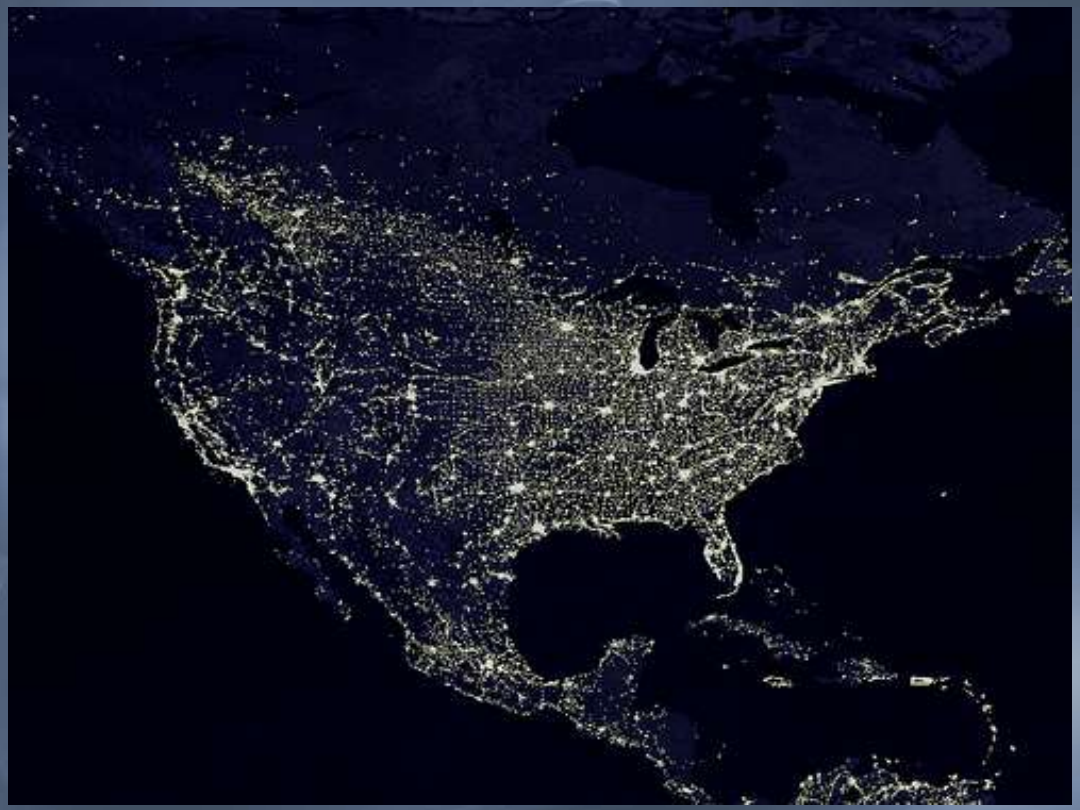
1. The atmosphere



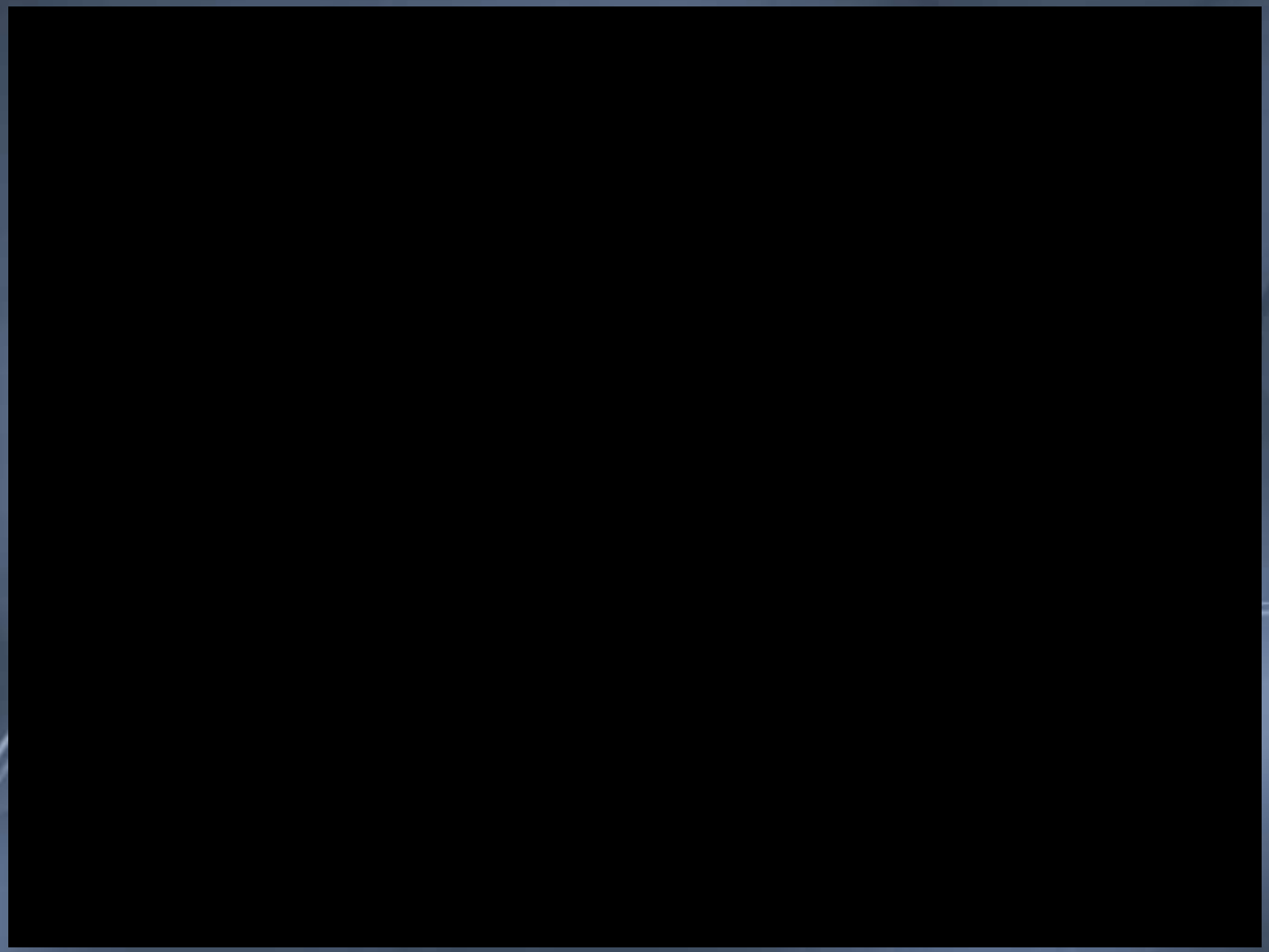
What matter comes into the atmosphere?

Meteorites from space and things like airplanes from earth, etc.

What energy comes into the atmosphere?



Thermal and light energy from the sun and the earth, etc.



What matter leaves the atmosphere?

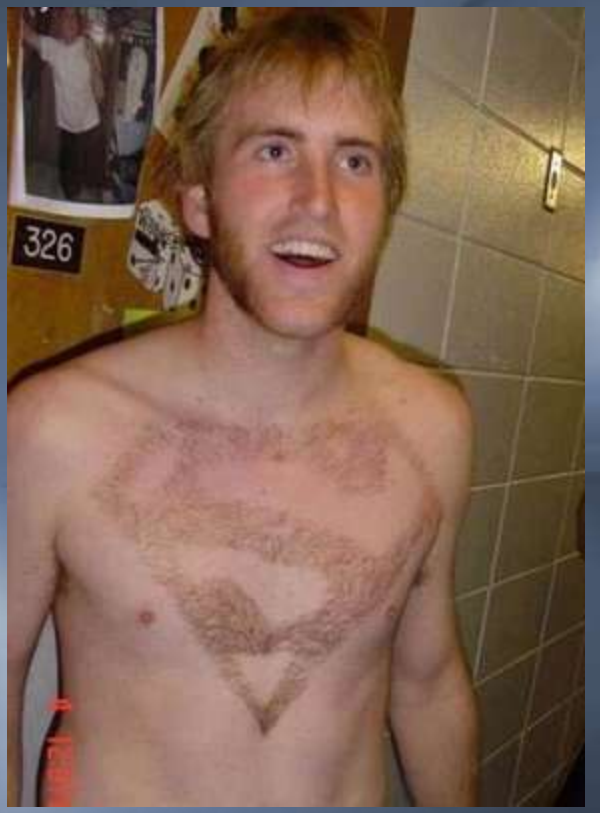
Rain and snow from the atmosphere comes back to earth, etc.

What energy leaves the atmosphere?

Electrical energy, sound energy, mechanical energy, etc.

Examples of open systems -

3. The human body



What matter goes into the human body?

Food, water, oxygen, etc.

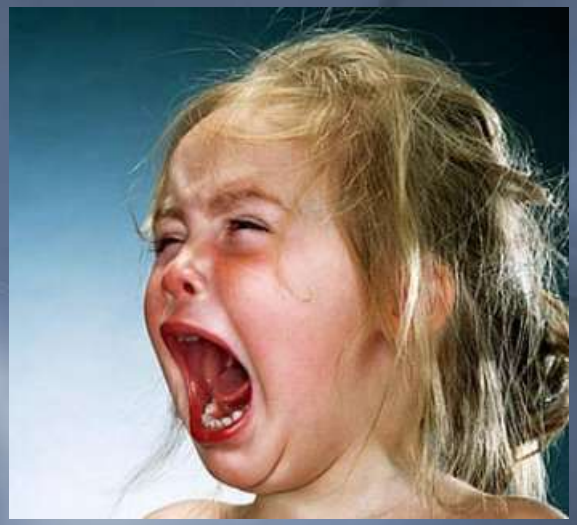
What energy goes into the human body?

Chemical energy in food, sound energy, etc.

What matter leaves the human body?

Solid and liquid wastes, carbon dioxide, etc.

What energy leaves the human body?



Thermal, sound, mechanical, etc.

All of the 9 forms of energy are either kinetic or potential

Kinetic energy -

The energy of motion. This is energy being used.

Potential energy -

Stored energy. This is energy not being used.


DURACELL
DURALOCK


BUNGY
MACAU TOWER
BUNGY

You can calculate potential energy from gravity with the following formula:

$$PE = \frac{\text{mass} \times 9.8 \times \text{height}}{}$$

(The mass has to be in kg, the height has to be in m.)

This means there are two things that can affect potential energy from gravity:

Height and mass

For example, if you want to make more potential energy while sledding what can you do?

Make a heavier sled or higher hill.

Unit of energy -

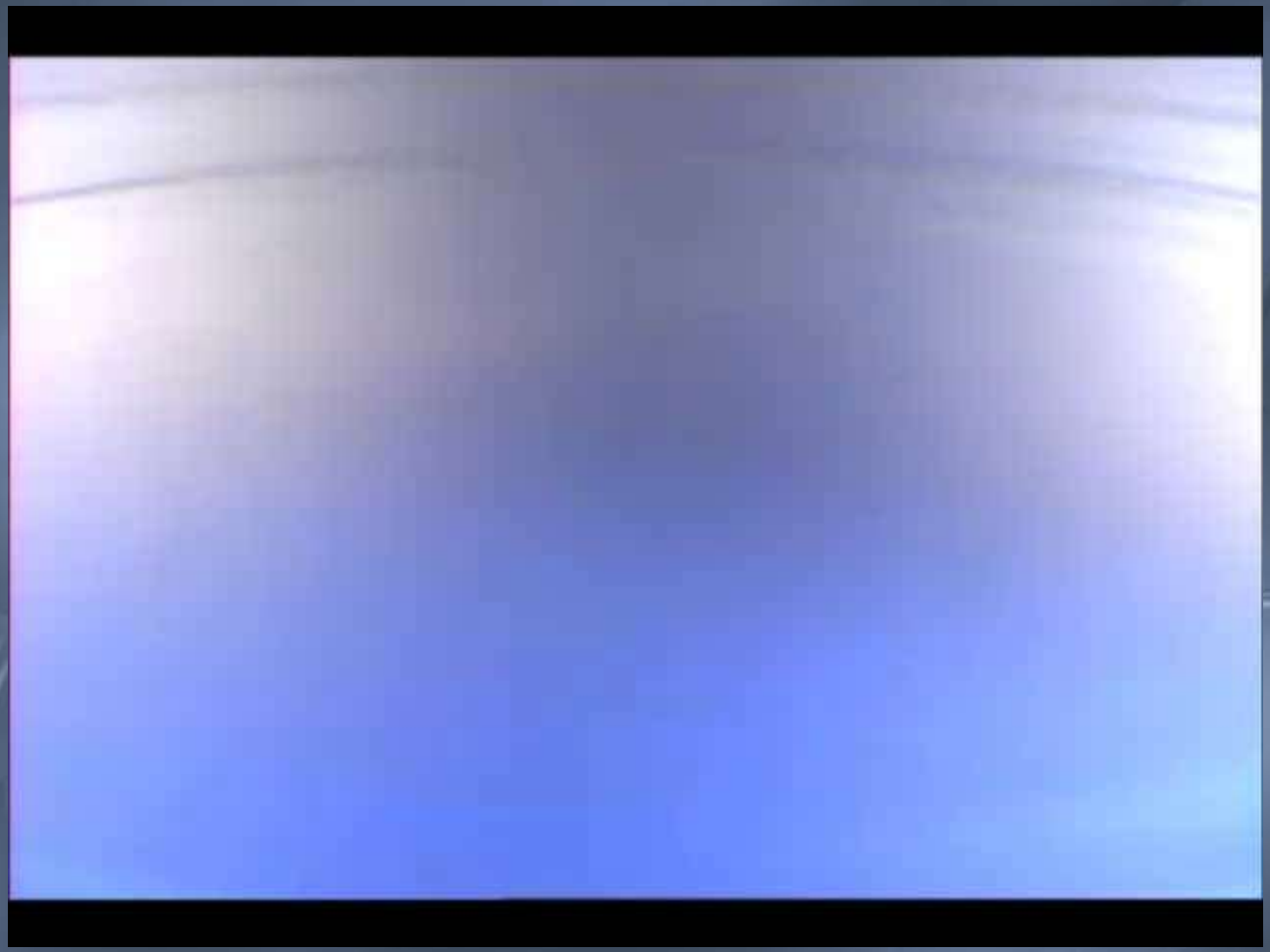
Joule (J).

(It's really a kgm^2/s^2 so thank God all you have to know is J.)

Waves

Wave -

A disturbance that transfers energy from one place to another.



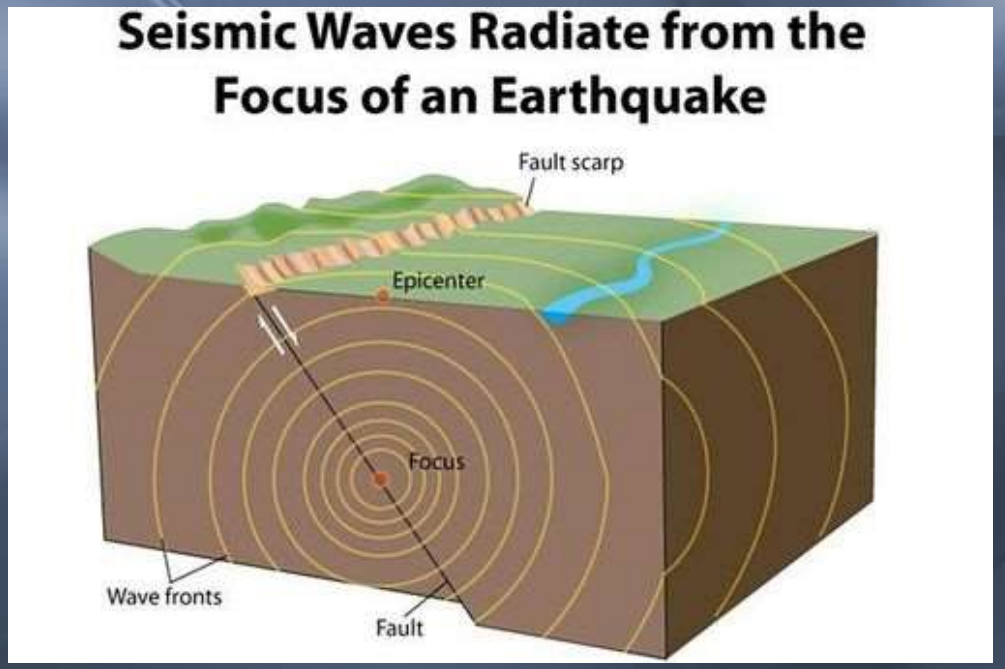
There are two main types of waves, mechanical and electromagnetic.

1. Mechanical waves -

A wave that requires a material to travel through.

Examples of mechanical waves -

Sound, seismic and ocean waves



Plucking a guitar string

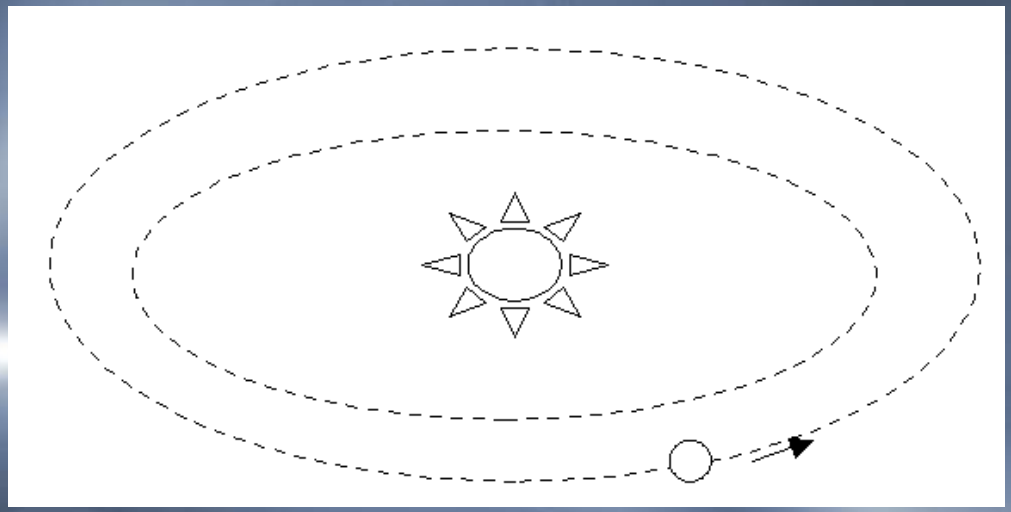
2. Electromagnetic waves -

A wave that does not require a material to travel through.

Examples of electromagnetic waves -

Visible light, radio waves, microwaves.

Our Earth receives light from the sun, but not sound. Identify both light and sound as either mechanical or electromagnetic waves, and explain why light can travel through space while sound cannot.

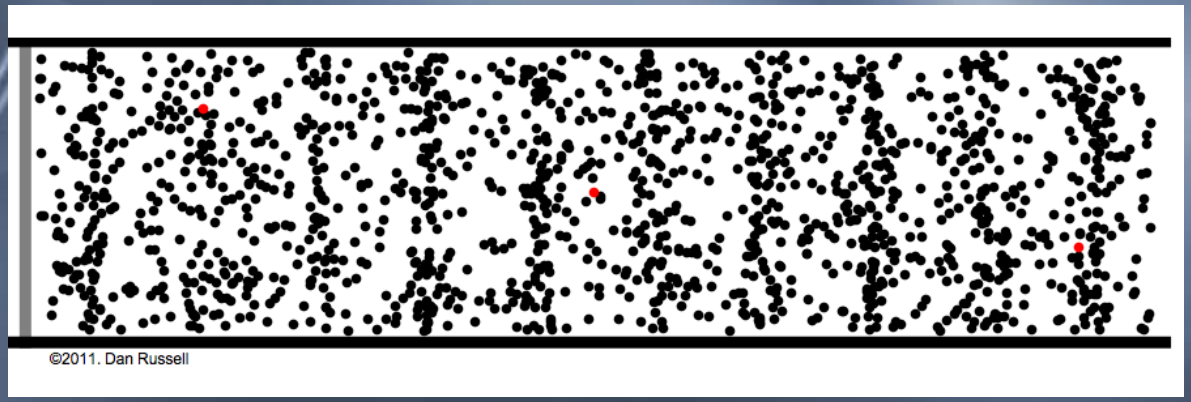


Light is electromagnetic, sound is mechanical. We see light because electromagnetic waves do not need a material to travel through. We don't hear sound because mechanical waves need a material to travel through, and there is nothing in space. It is a vacuum.

Waves can be one of two types: longitudinal or transverse.

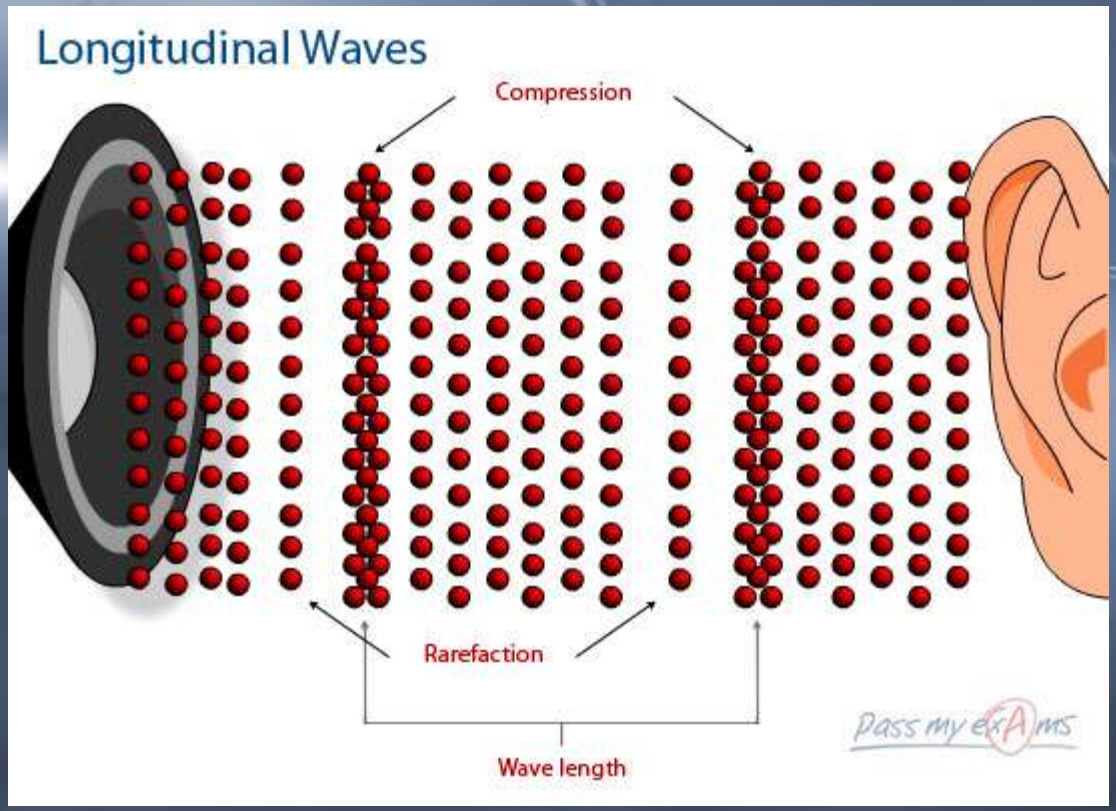
1. Longitudinal waves -

Waves that move in the same direction as the disturbance. They are sometimes called compression waves.



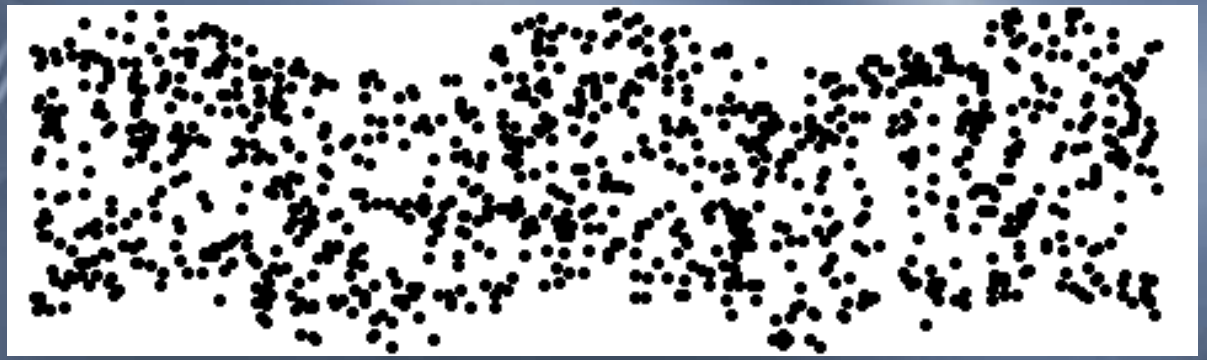
Ex. of a longitudinal wave -

Sound (mechanical).



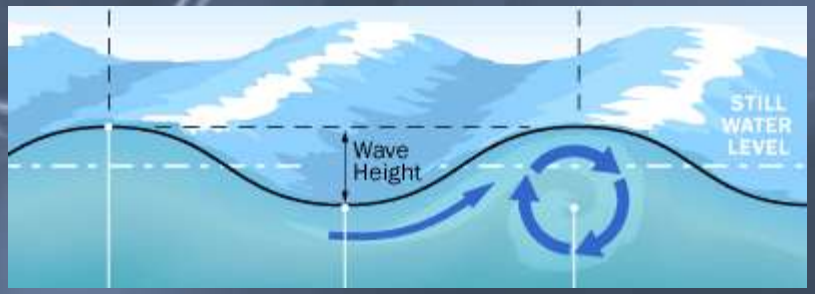
2. Transverse waves -

Waves that move in the opposite way as the disturbance.



Ex. of a transverse wave -

Water waves and jump rope waves (mechanical). Light waves (electromagnetic).



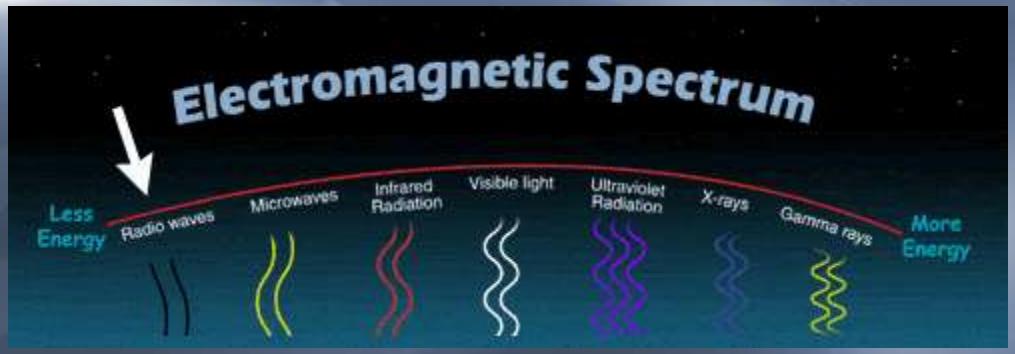
There are four ways you can describe a wave. They are speed, wavelength, amplitude and frequency.

1. Wave speed -

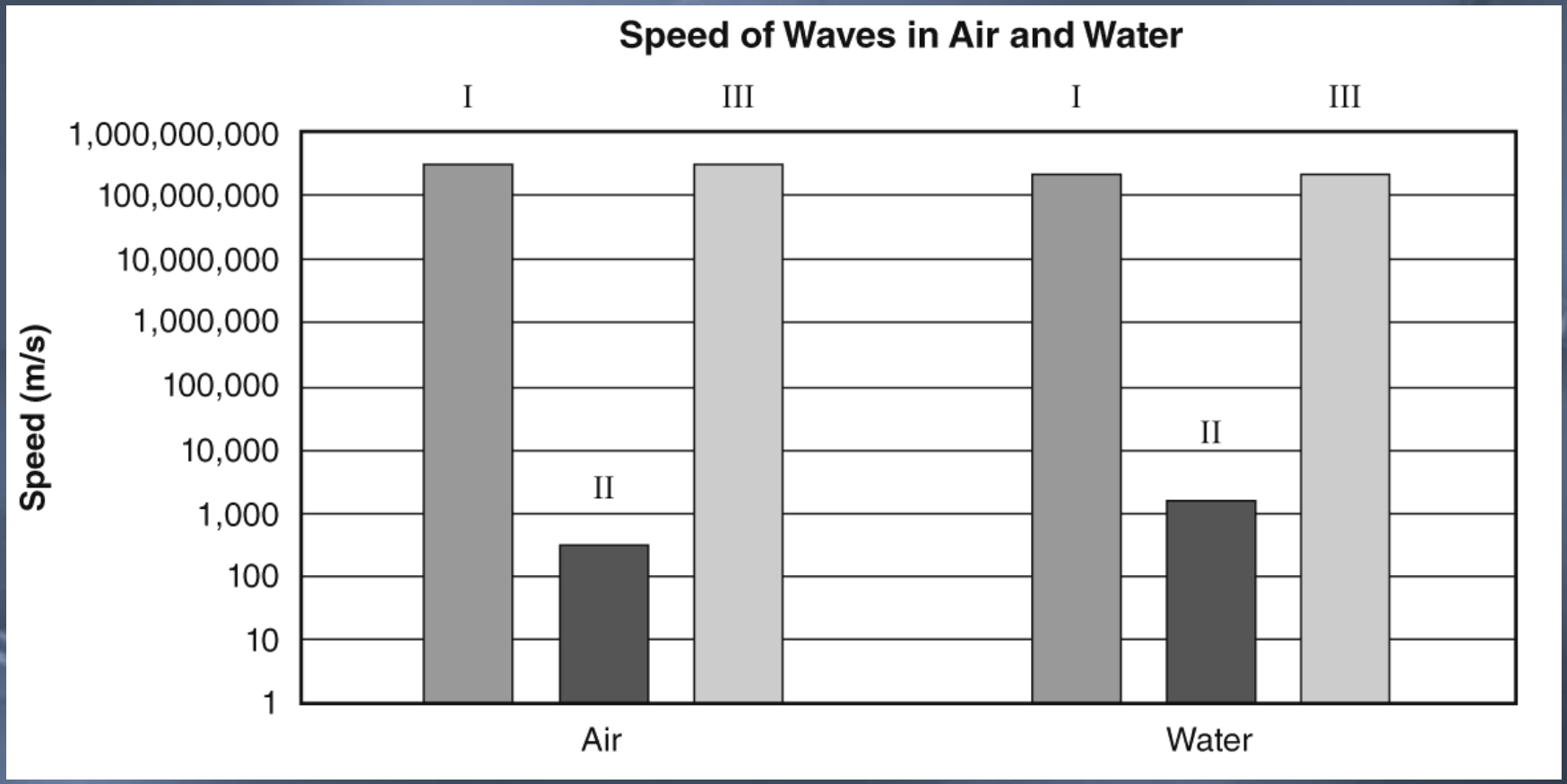
How fast the wave is moving.

Mechanical waves get faster if they are traveling through a solid.

Electromagnetic waves all travel at about the same speed, no matter which material they go through.

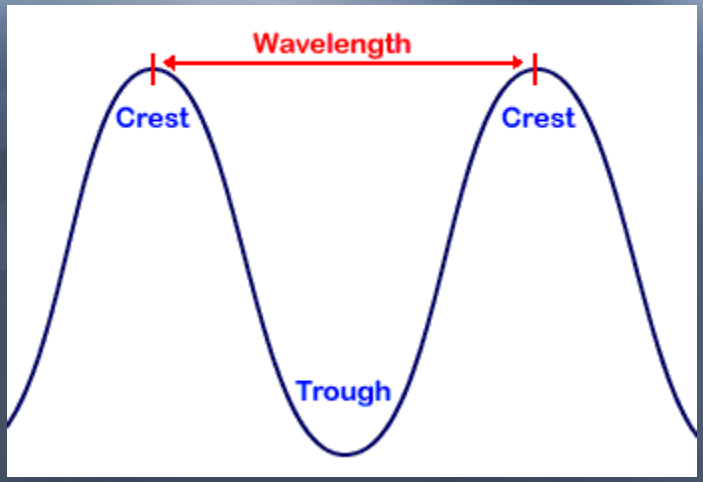


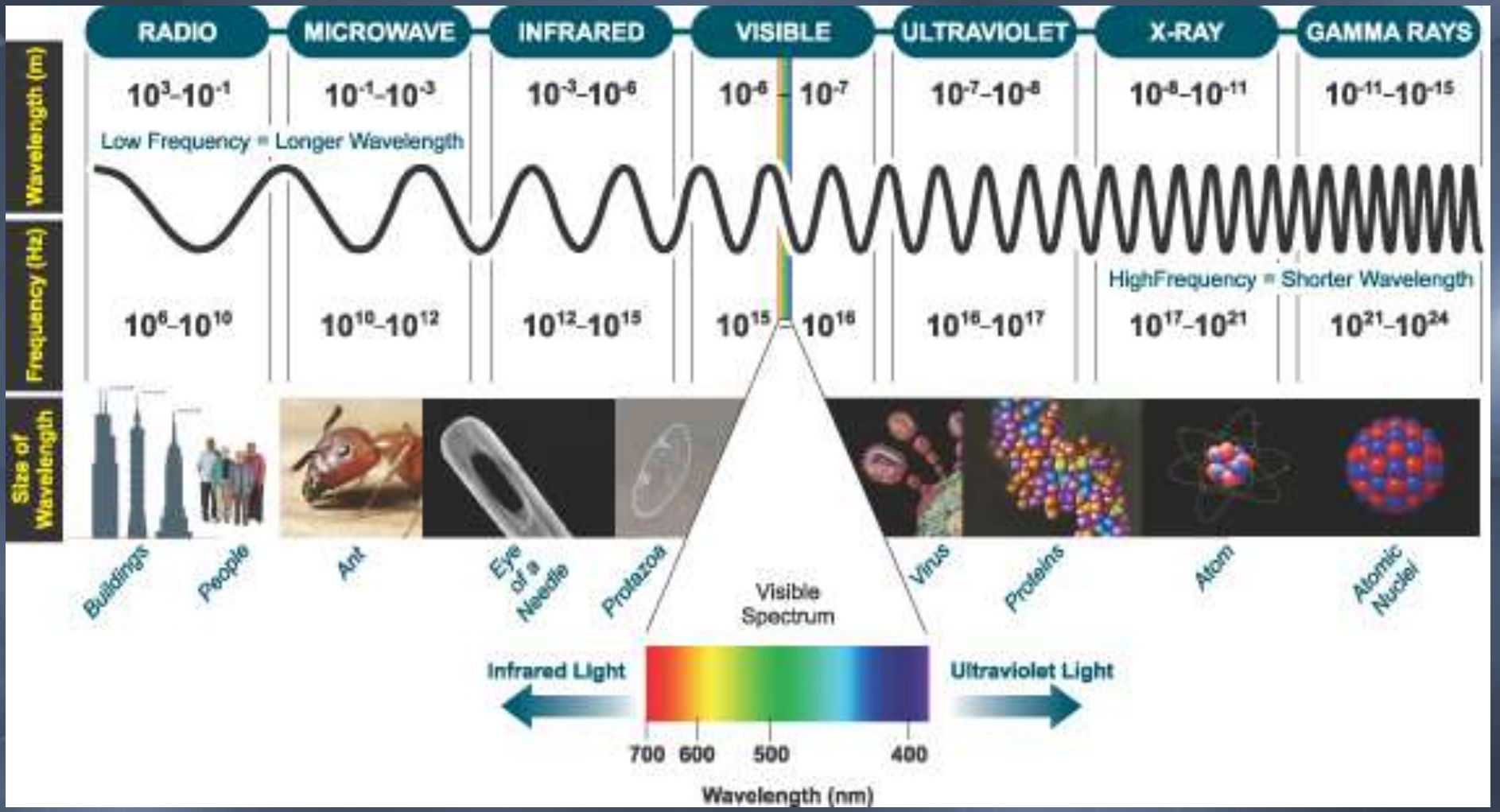
Which of the following are electromagnetic waves?



2. Wave wavelength -

The distance between two points on a wave.




RADIO
MICROWAVE
INFRARED
VISIBLE
ULTRAVIOLET
X-RAY
GAMMA RAYS
Wavelength (m)
10^{3}–10^{-1}
10^{-1}–10^{-3}
10^{-3}–10^{-6}
10^{-6} – 10^{-7}
10^{-7}–10^{-8}
10^{-8}–10^{-11}
10^{-11}–10^{-15}
Low Frequency = Longer Wavelength
Frequency (Hz)
HighFrequency = Shorter Wavelength
10^{6}–10^{10}
10^{10}–10^{12}
10^{12}–10^{15}
10^{15} – 10^{16}
10^{16}–10^{17}
10^{17}–10^{21}
10^{21}–10^{24}
Size of Wavelength
Buildings
People
Ant
Eye of a Needle
Protozoa
Virus
Proteins
Atom
Atomic Nuclei
Visible Spectrum
Infrared Light
Ultraviolet Light
700
600
500
400
Wavelength (nm)

3. Wave amplitude -

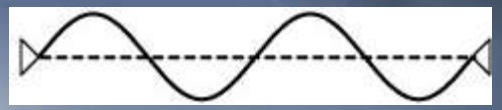
The amount of energy the wave has. The higher the amplitude, the louder the sound.

Because a bomb has such a large amplitude, it creates a lot of energy.

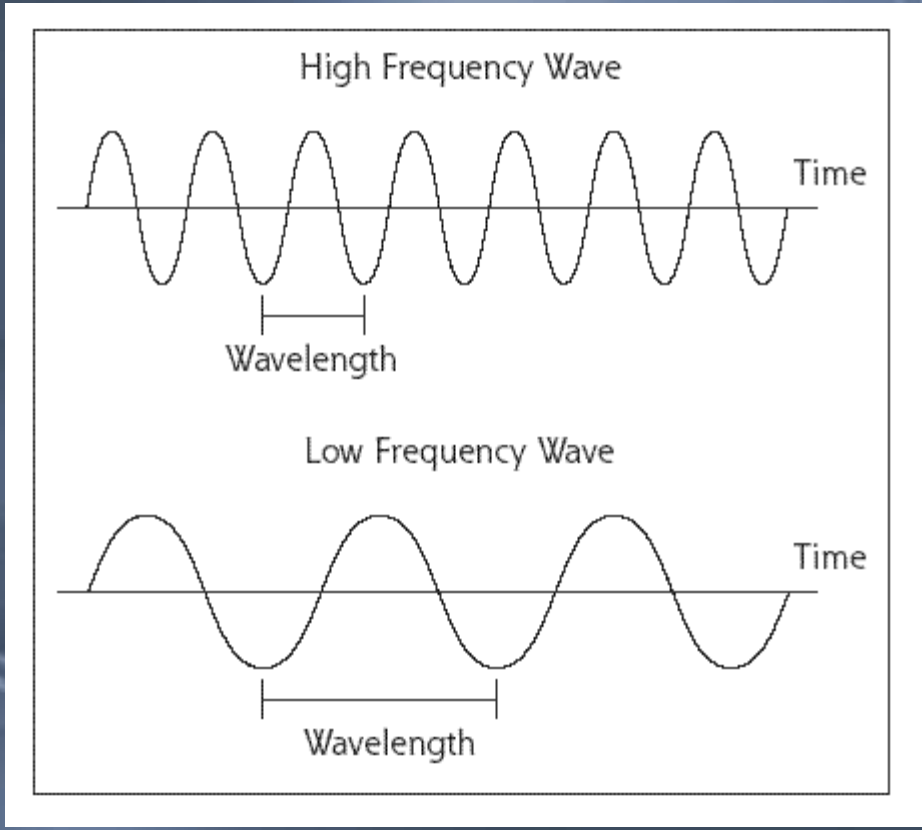
4. Wave frequency -

The number of waves in a certain amount of time. The higher the frequency, the higher the pitch of the sound.

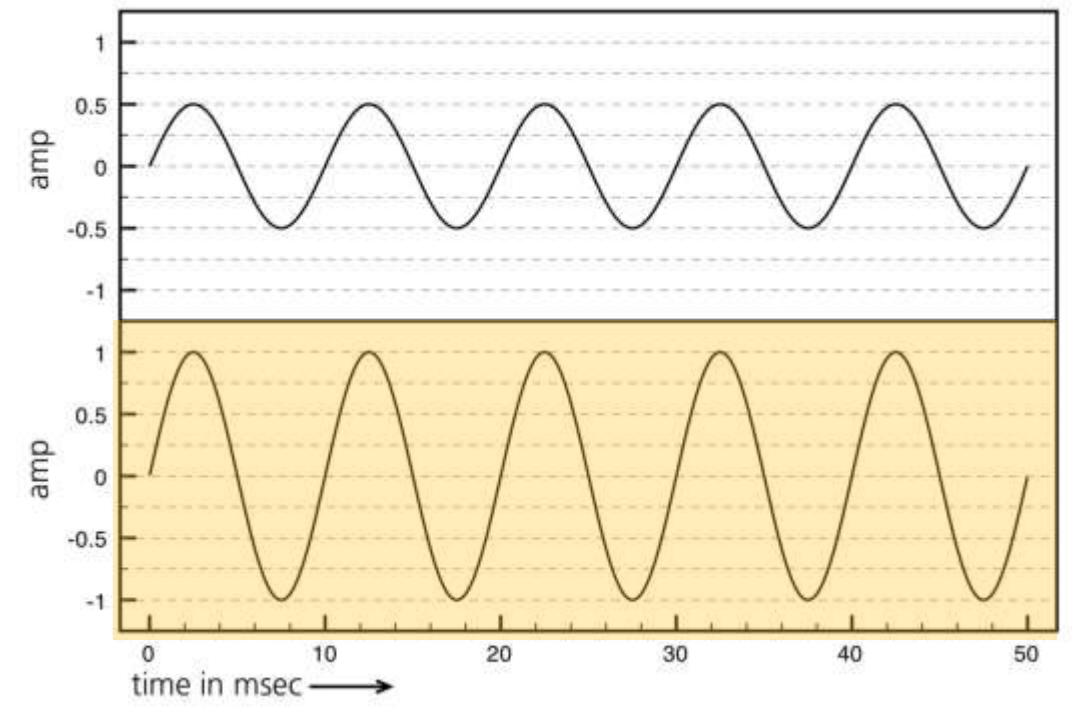
The higher the frequency, the more waves you have. For sound, this makes a higher pitch. So, which would have the highest pitch?



A piccolo is very short and a tuba is very long. Which frequency represents the low pitched tuba and which represents the high pitched piccolo?



Which wave would have the highest pitch and why? Which would have the lowest pitch and why?



Neither, because they both have the same frequency.

Thermal Energy

Thermal energy (heat) can travel three ways: conduction, convection and radiation.

1. Conduction -

The transfer of heat from one substance to another by touching.

Example of conduction -

Touching a hot stove, lava hitting water, ice melting in your hand.

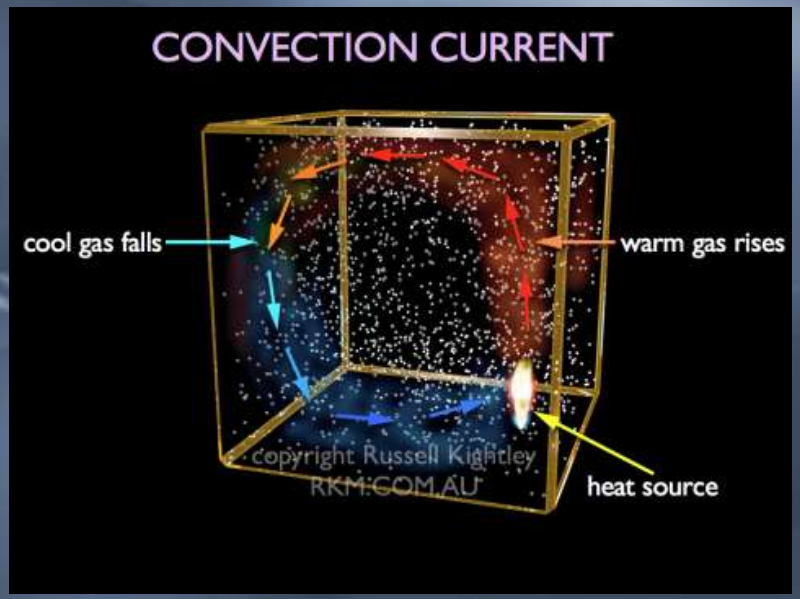
Lava heating the ocean through conduction.

2. Convection -

The transfer of heat within a liquid or gas.

Example of convection -

Air currents and ocean currents. Holding something over a fire

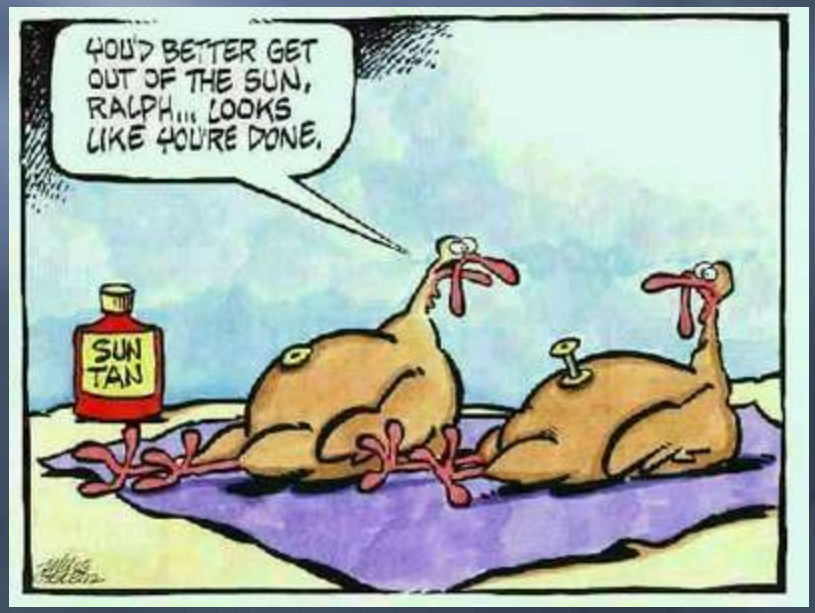


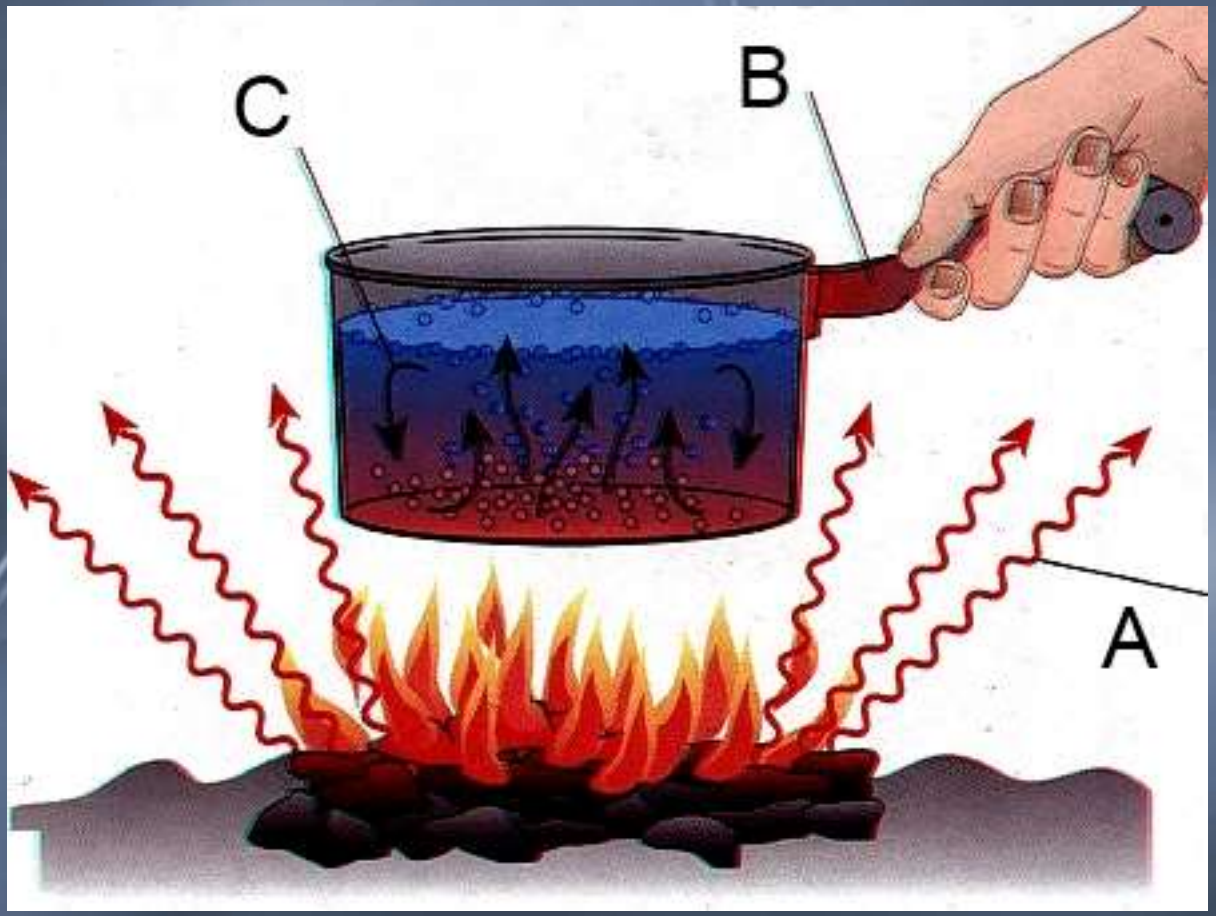
3. Radiation -

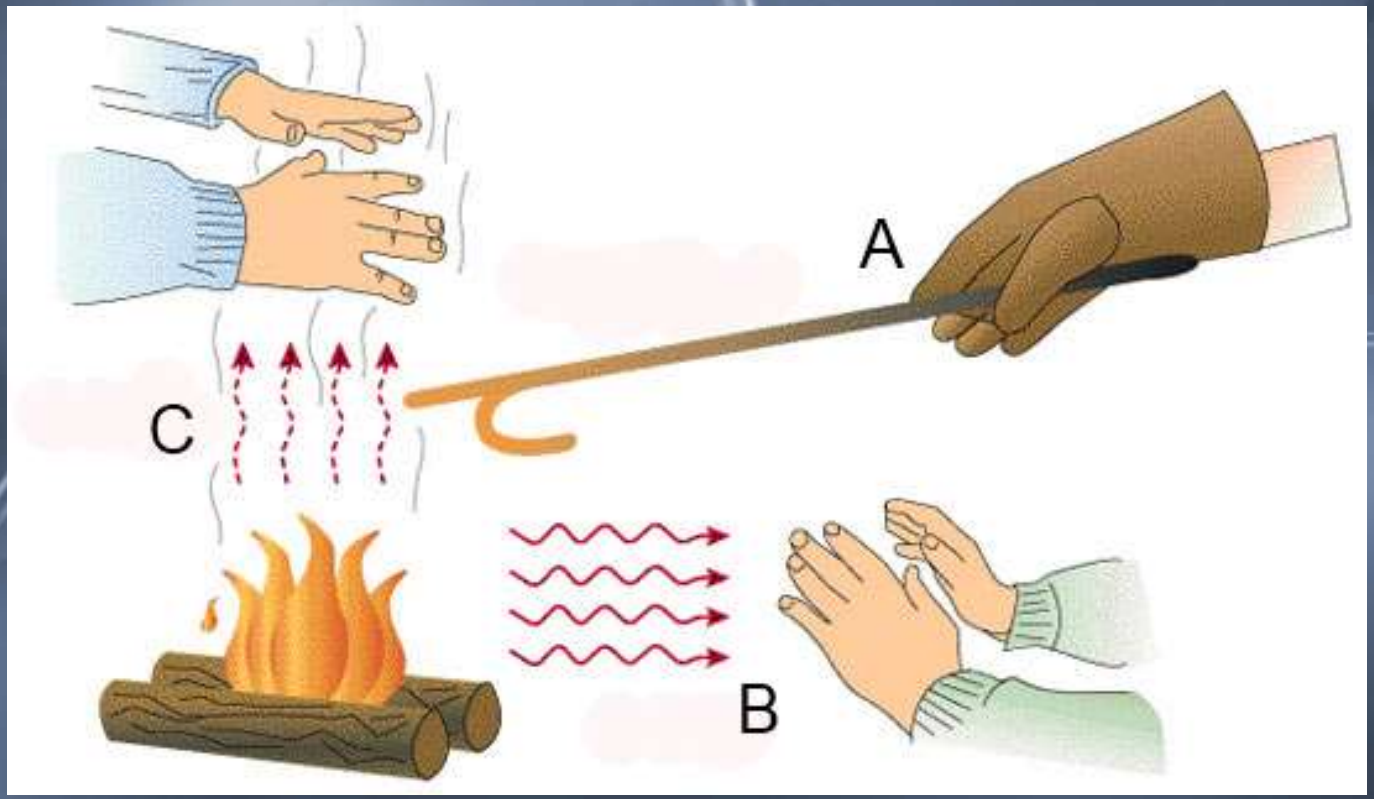
The transfer of heat as a wave without going through anything else.

Example of radiation -

The sun warming the earth, microwaves, sitting by the fire.




C
B
A


A
C
B

A

B

C

Three ways to cook a marshmallow

Conduction

Convection

Radiation