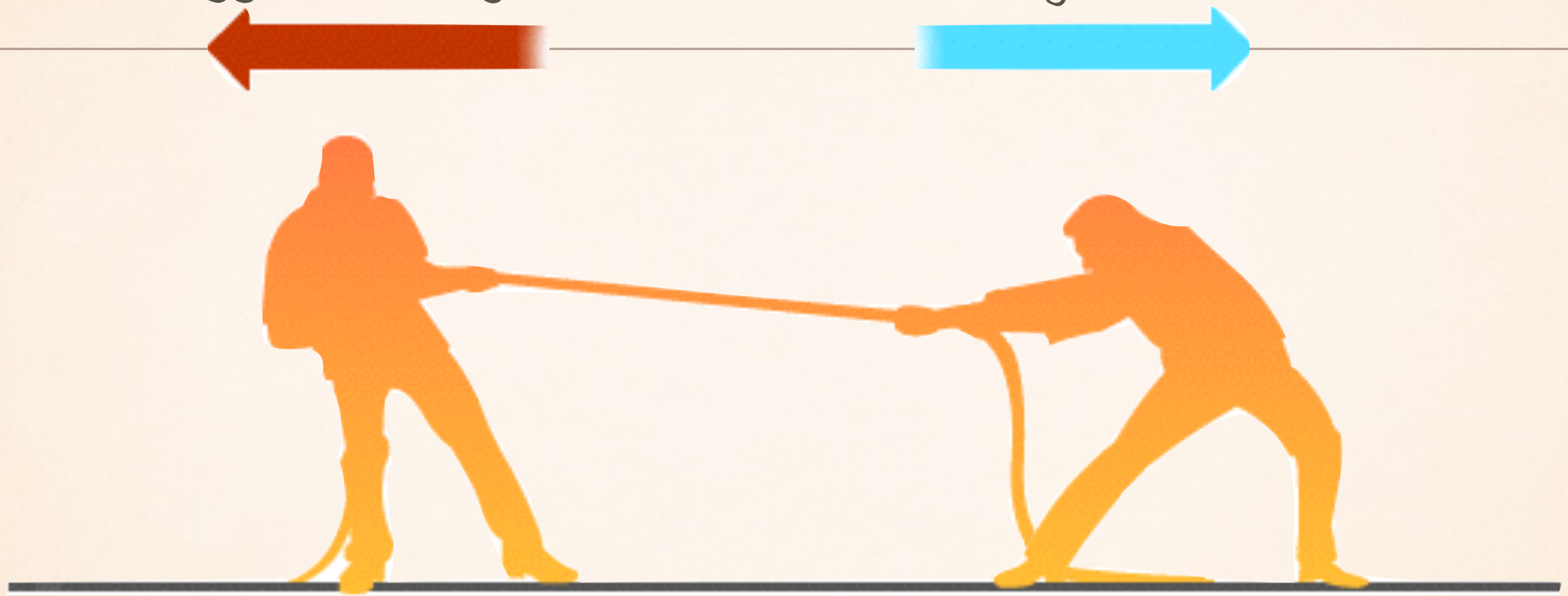
Physics
The Study of Energy, Motion, and Forces

The ability to do work.

ENERGY

ENERGY

- **Energy** - the ability to do work - measured in joules (J)



- **Work**- work happens when an object is moved a distance measured in joules (J)

- Bigger objects take more work to move. The farther an object is moved, the more work is done.

Amina Olhaye

POWER

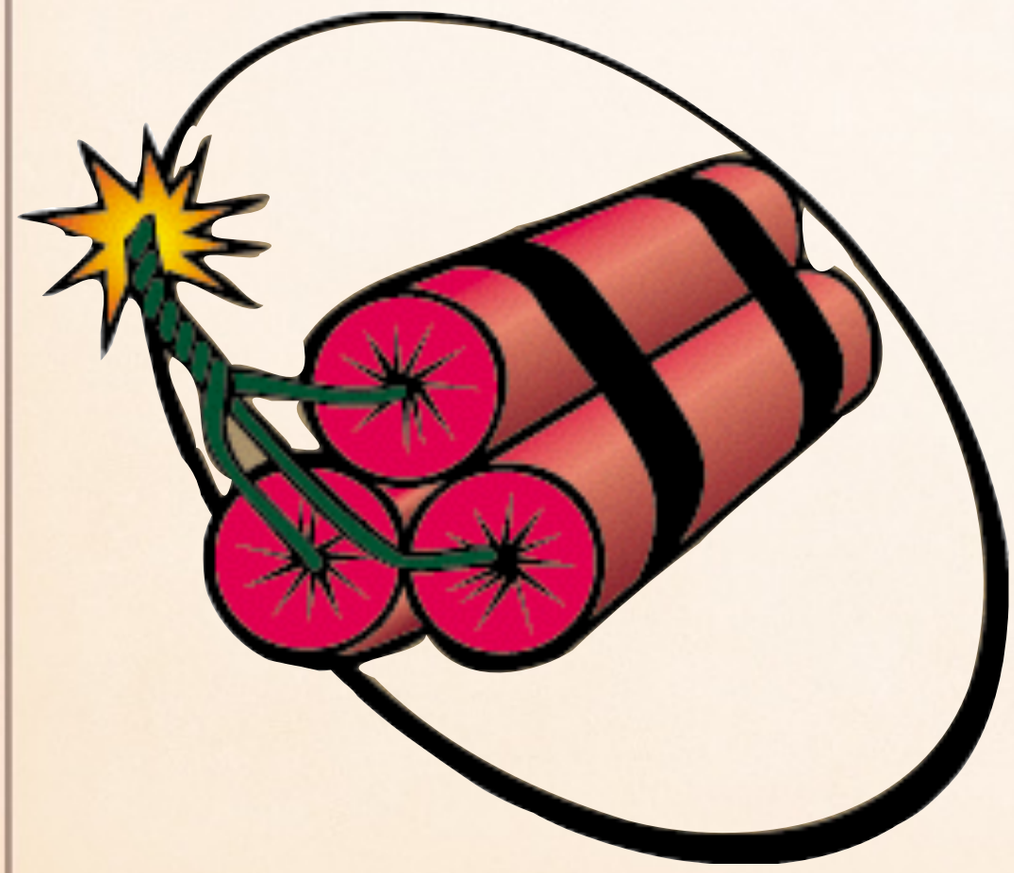
- **Power**- how fast the work is done.

- Measured in watts

Amina Olhaye

CHEMICAL ENERGY

Chemical Energy- Energy stored in chemicals released by a chemical reactions.



Amina Olhaye

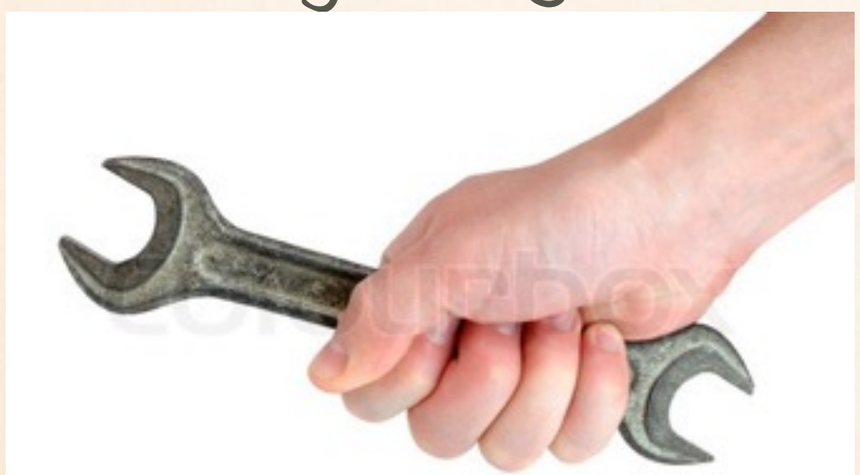
HEAT ENERGY

- **Heat Energy**- the energy that makes the atoms moves faster.

Amina Olhaye

MECHANICAL ENERGY

- **Mechanical Energy**- energy from the movement of one object by another object.



POTENTIAL ENERGY

- **Potential Energy**- stored energy that will turn into movement.

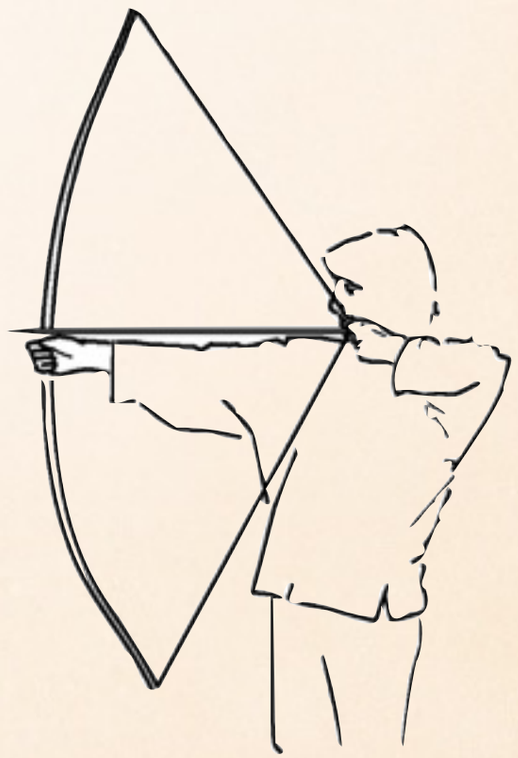
2 Types of Potential Energy

Gravitational Potential - objects that have the potential to fall

Elastic Potential - when something is stretched back but not yet moving

Gravitational Potential
waiting to fall

Elastic Potential
Pulling back the string of an archer bow.



KINETIC ENERGY

- **Kinetic Energy** - Energy from moving objects

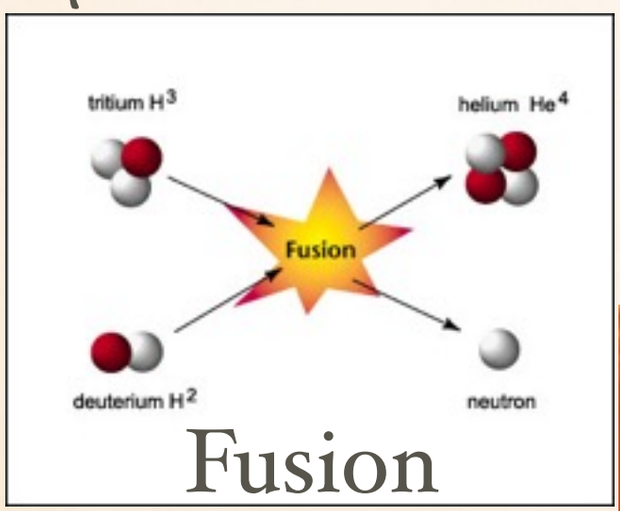
  More mass = More Kinetic Energy

  More velocity (speed) = More Kinetic Energy

Julie Irving

NUCLEAR ENERGY

- **Nuclear Energy** - energy from the nucleus of atoms being split (fission) or combined (fusion)

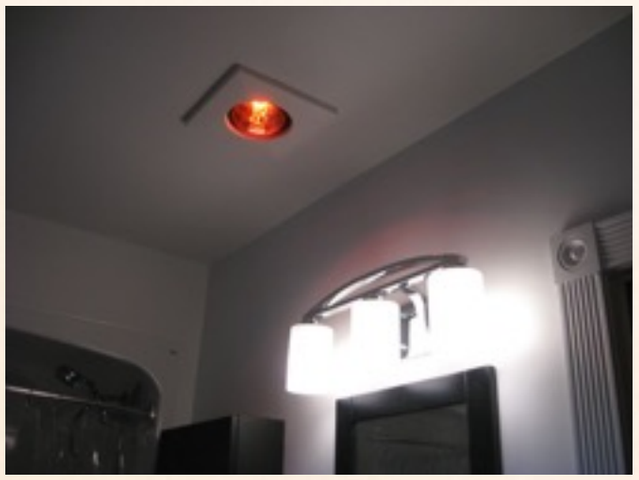


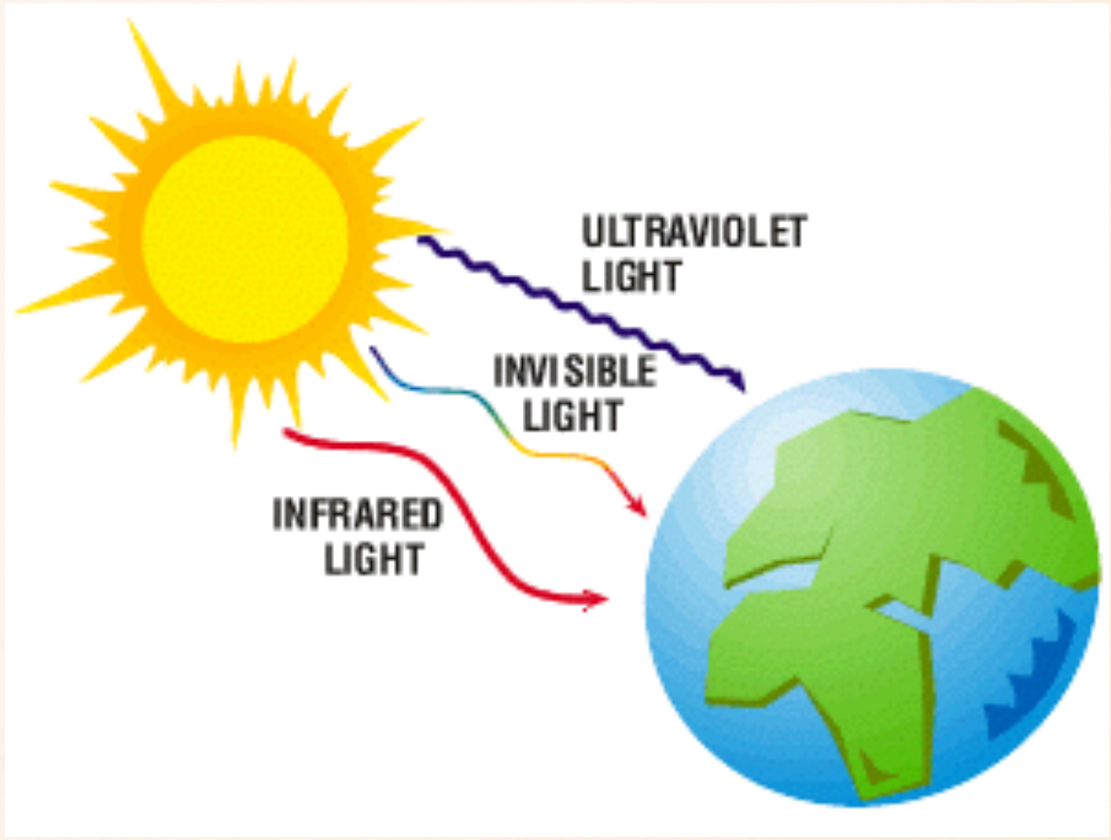
Fusion

RADIANT ENERGY

- **Radiant Energy** -

Energy in rays that are given off from a light or heat source.

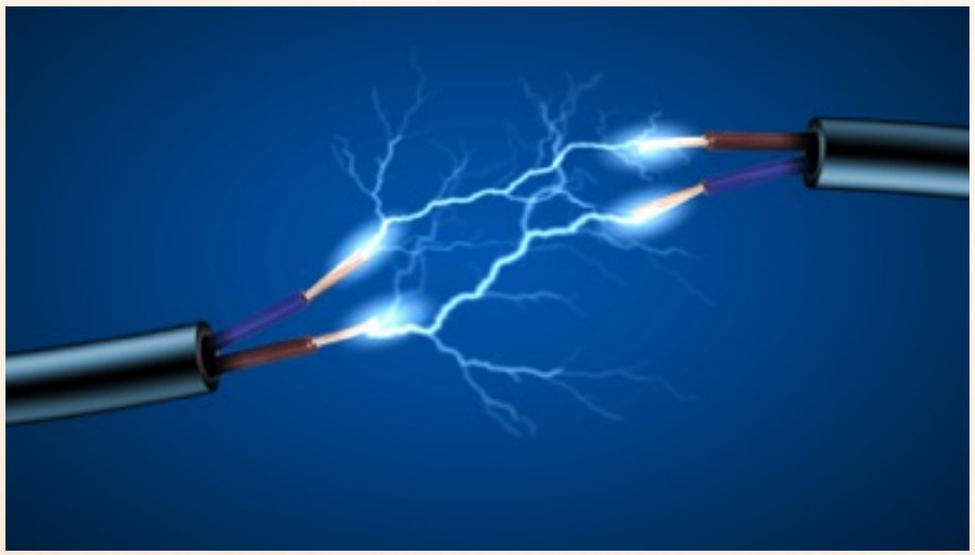


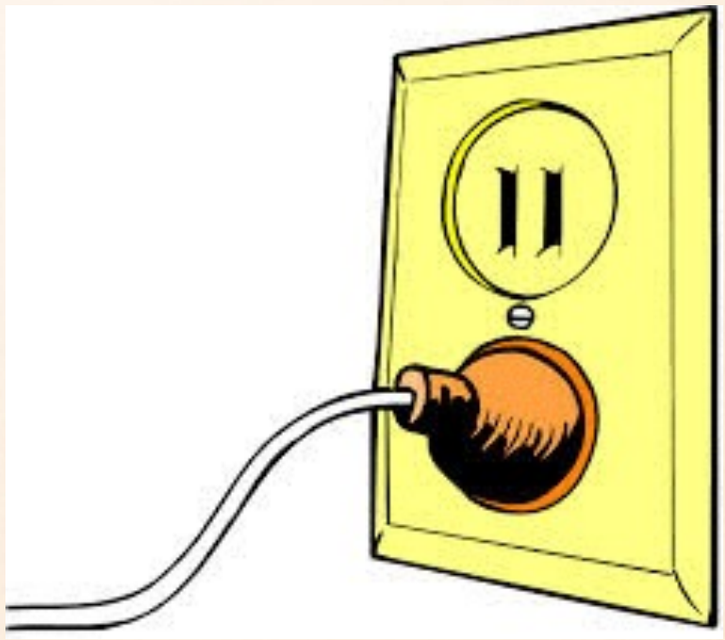


ELECTRIC ENERGY

- **Electric Energy** - energy from electrons flowing through a wire conductor

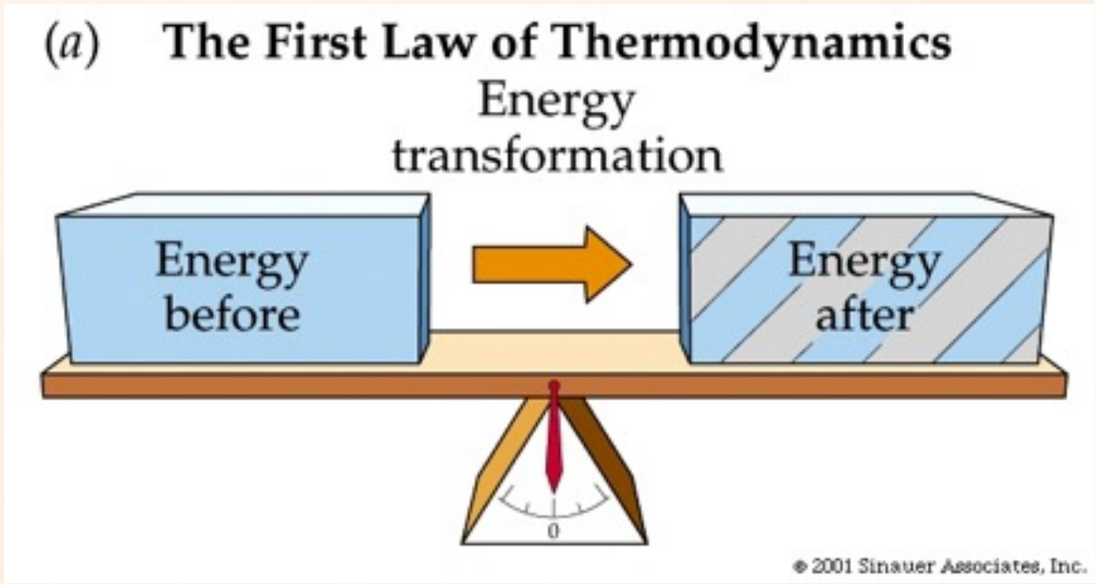
Made by generators, batteries, and solar cells





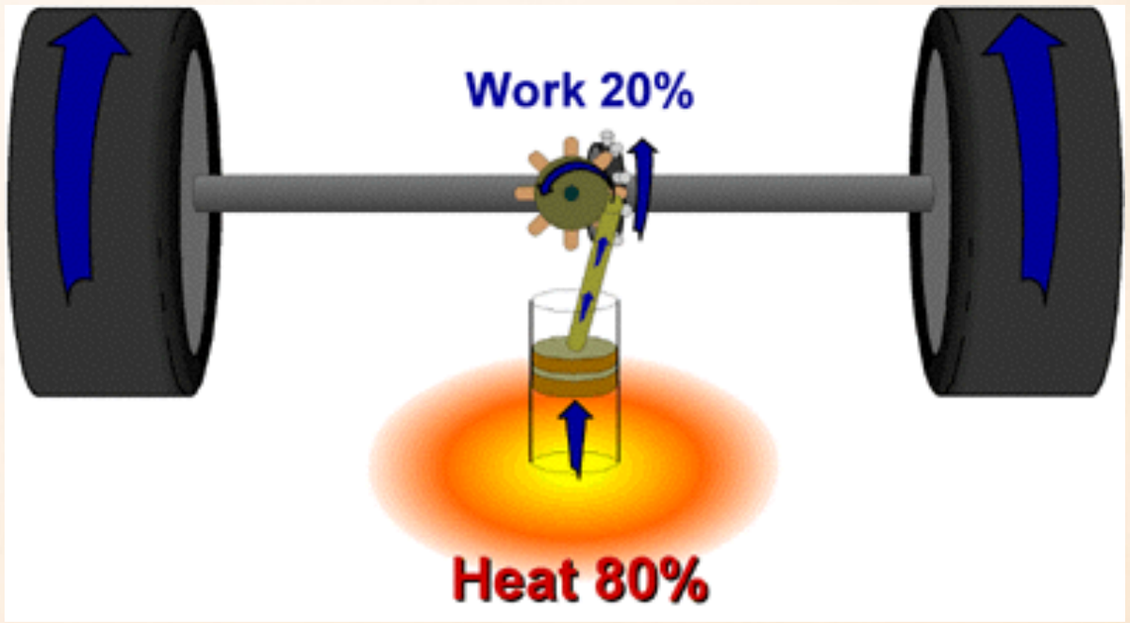
LAWS OF THERMODYNAMICS

- **1st Law of Thermodynamics**- (called the law of Conservation of energy) the total amount of energy in a closed system is constant. Energy is always changing forms.



LAWS OF THERMODYNAMICS

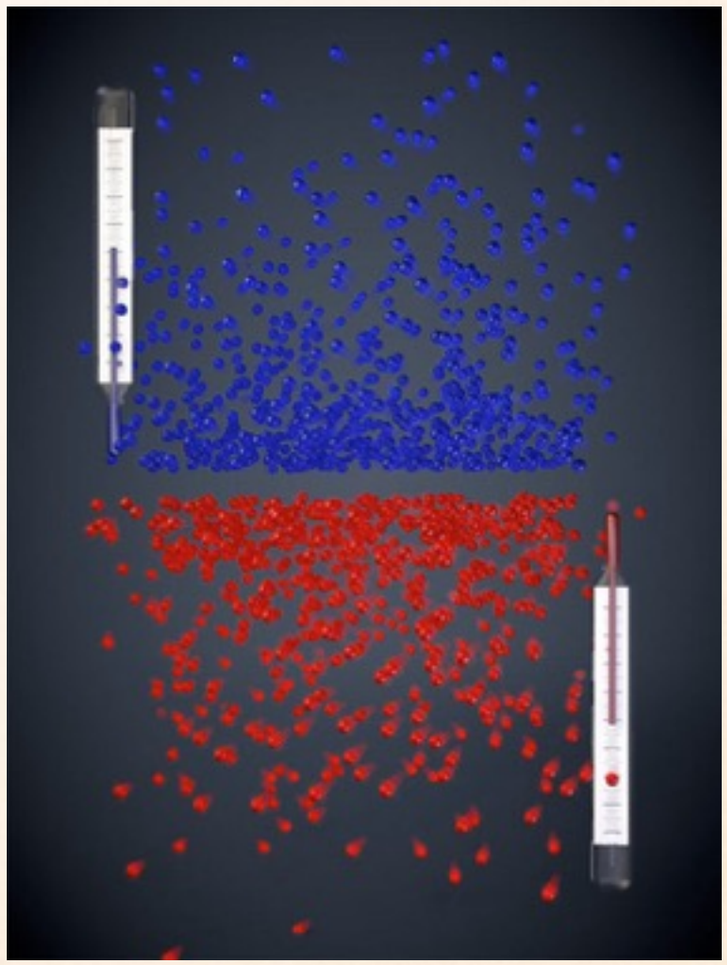
- **2nd Law of Thermodynamics** - Entropy (disorder) is always increasing. (Energy is always getting more spread out)



LAWS OF THERMODYNAMICS

3rd Law of Thermodynamics -

All molecular movement stops at a temperature we call absolute zero -273c°



HEAT SLIDE SHOW

What is heat?

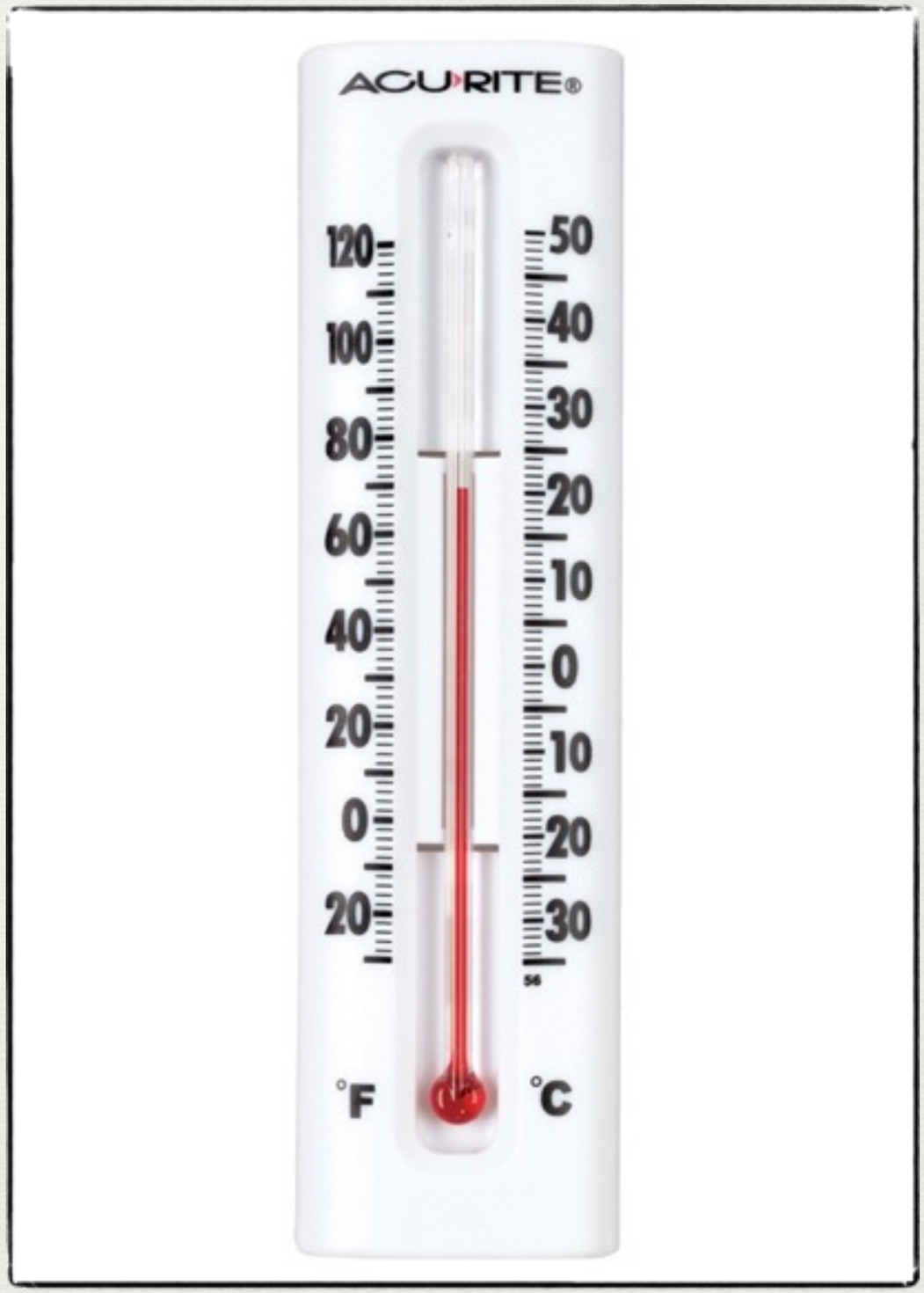
Heat - the total kinetic energy from the speed of all of e atoms/molecules moving in a substance - measured in calories (old term was B.T.U.s)

Heat makes atoms move faster

Heat measurements

Temperature - the average kinetic energy from the speed of all of the atoms/molecules moving in a substance - measured in degrees

Thermometer – a device used to measure the temperature of substances



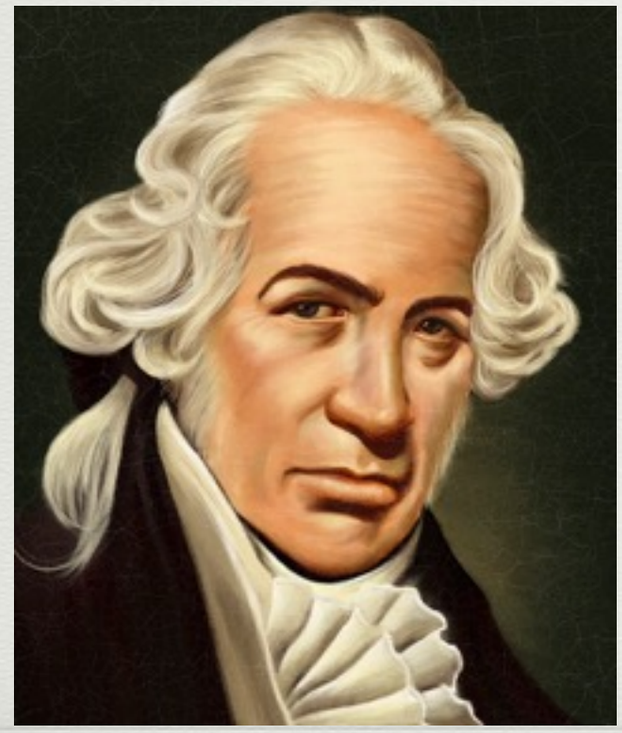
Types of Thermometers

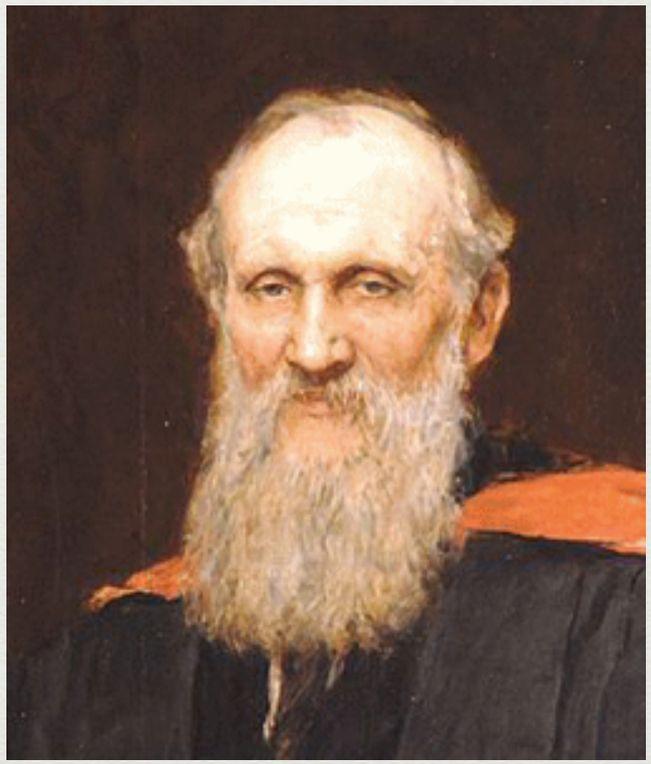
- Liquid expansion
- Metal expansion
- Electrical conduction
- Density

3 Temperature Scales

	Water Boils	Water Freezes	Absolute Zero
Fahrenheit – 1706 –Gabriel Fahrenheit	212º	32º	-460º
Celsius – 1742 – Anders Celsius	100º	0º	-273º
Kelvin – 1907 – Lord Kelvin	373º	273º	0º

Absolute Zero – the lowest possible temperature, all atoms/molecules stop moving



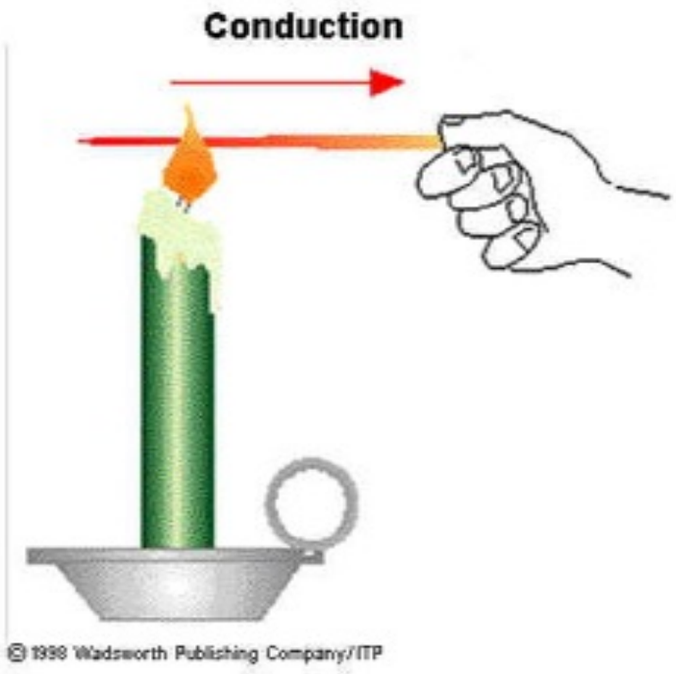


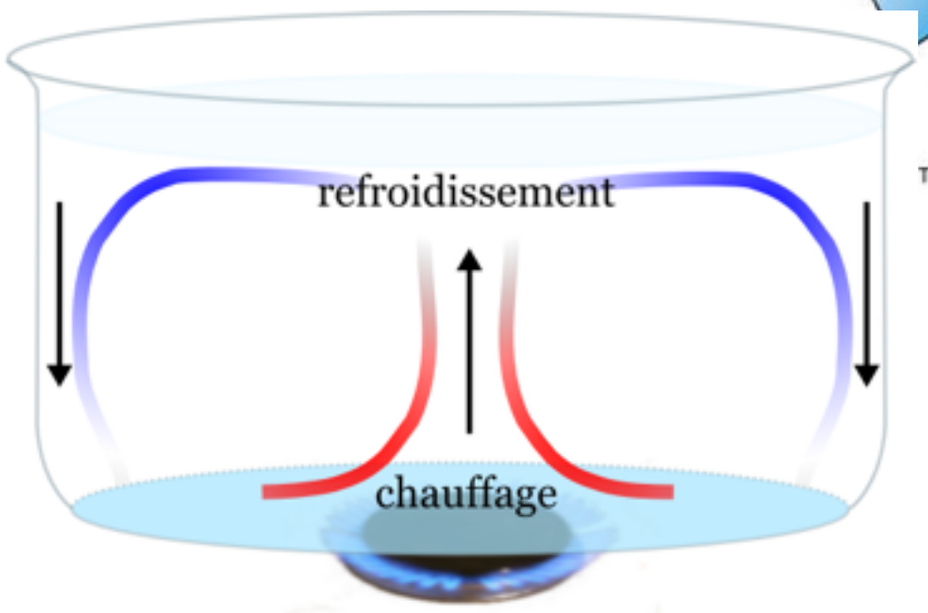
Heat Movement

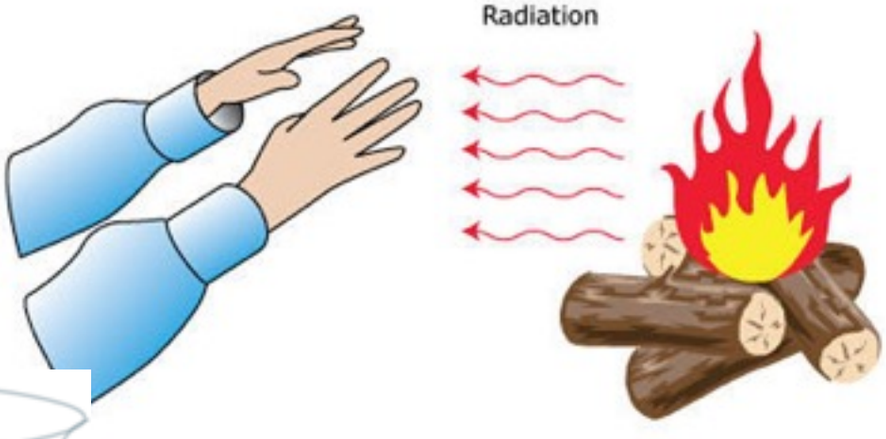
Conduction – transfer of heat by direct contact

Convection – transfer of heat by the movement and mixing hot particles of gas or liquid

Radiation – transfer of heat through space by infrared heat rays







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Specific Heat – the amount of heat needed to raise the temperature of 1 gram of a substance 1 degree Celsius.
- measured in Joules per gram x Cº (J/gCº)

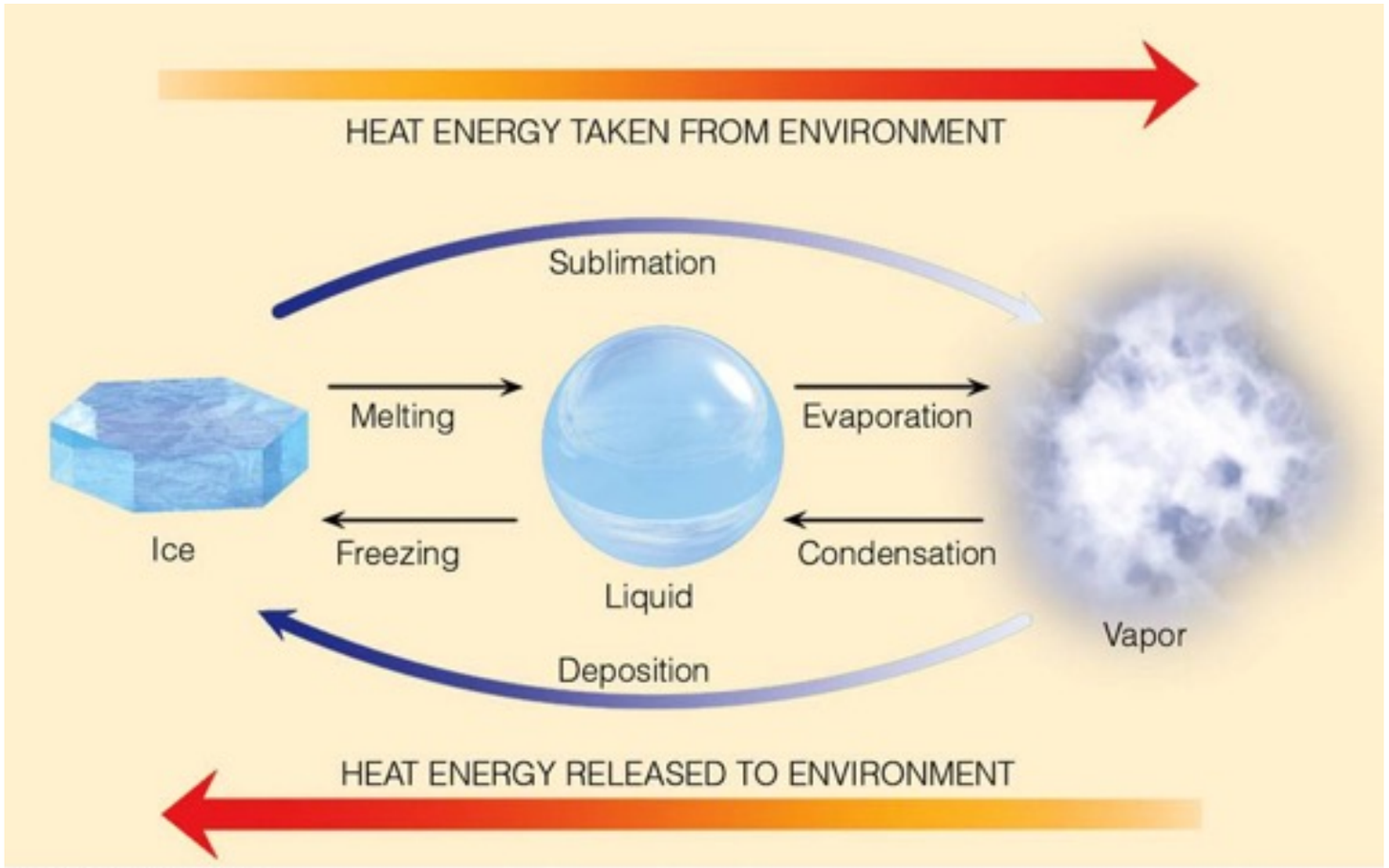
Conductor - a material that allows heat to pass through easily
Insulator - a material that blocks heat from going through it

Materials that conduct heat will have a low specific heat number and the ones that block heat out will have a higher number.

Lead .16	Air 1.04	Ice 2.10	Water 4.18
Tin .22	Glass .84	Mercury .14	Wood 1.80
Steel .88	Iron .45	Copper .38	Aluminum .90

Heat of Vaporization – the heat needed to boil 1 gram of liquid into a gas at the same temperature

Heat of Fusion – the heat needed to melt 1 gram of a solid into a liquid at the same temperature



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Electricity

Electricity

Electrons flowing through a wire

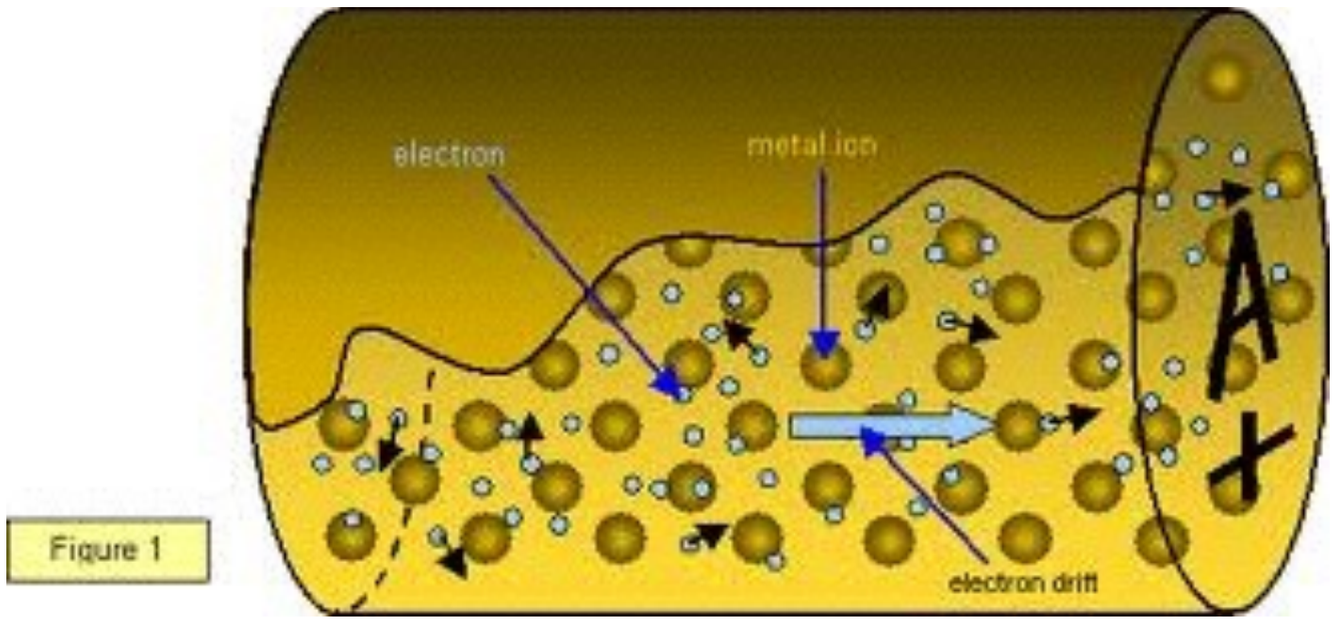


Figure 1

Insulator

A material that blocks the flow of electrons

Most insulators are made of non-metals: glass, fiberglass, and rubber.

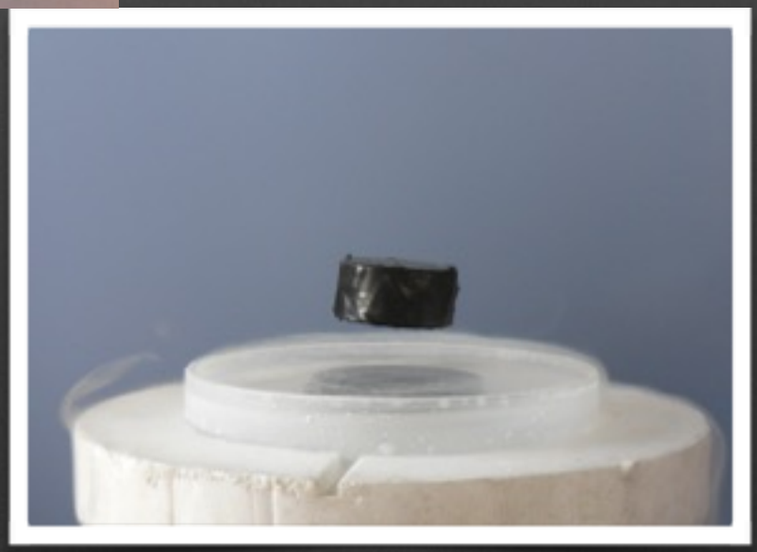
Conductor

A material that allows electricity to flow easily. Most conductors are

Super Conductor

A material that allows electrons to flow with NO RESISTANCE

At this time Superconductors only work when an material is near absolute zero (-460F)



Lucas P.

Voltage

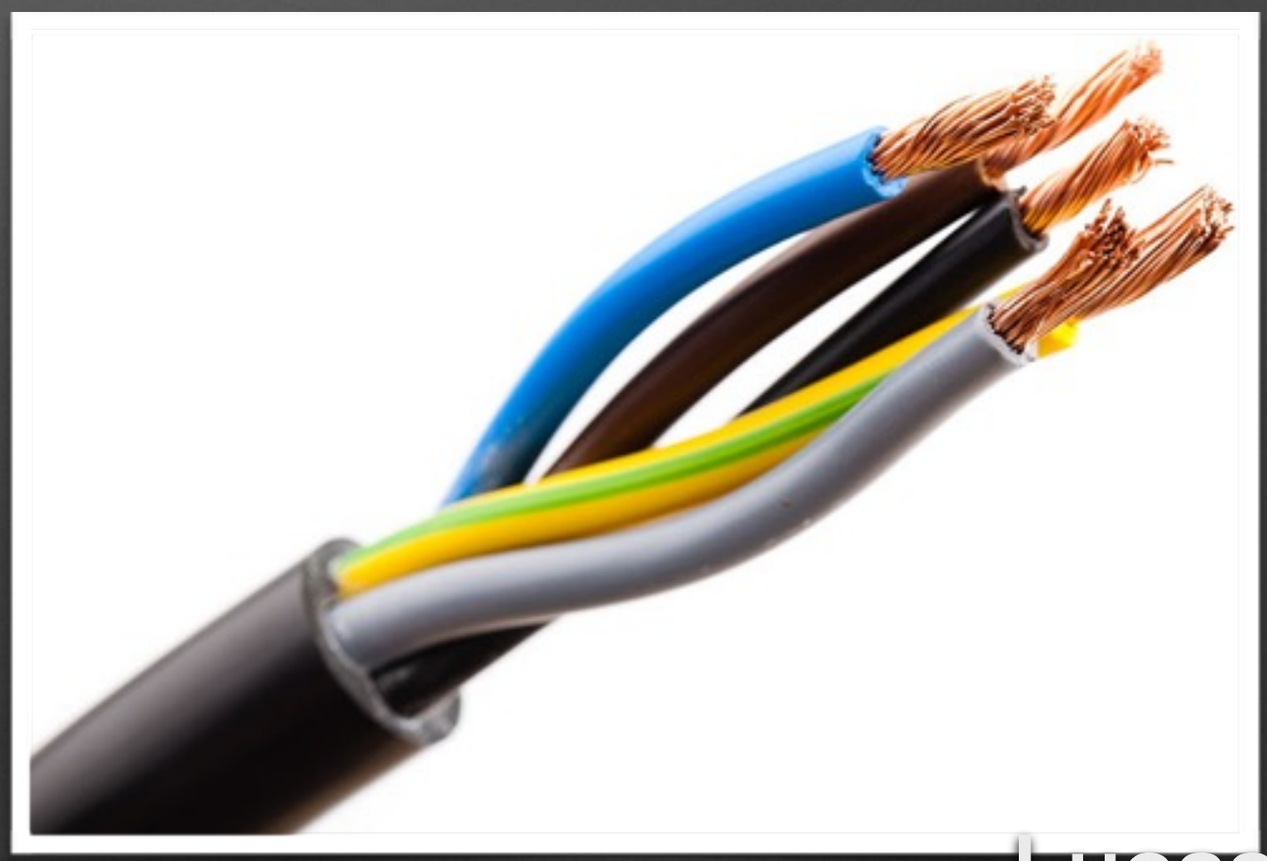
The push on the electrons flowing through the wire.
Measured in volts.
Low voltage is like a faucet dripping. High voltage is like faucet on full.

AJ Smaha

Amperage (Current)

How many electrons pass through one point in one second

Measure in Amps (A), 1Amp=6.25*10^18 electrons per second.



Lucas P.

Resistance

Resistance (R) – electrical friction –
how hard it is for electrons to flow in a wire
Measured in – Ohms ( )

Resistance Depends on 4 Things –

1. Composition of the wire
2. Thickness of the wires
3. Length of the wire
4. Temperature of the wire

AJ Smaha

Current

Alternating Current (AC)

Electrons go two directions - in AND out of wires
(power from generators).

Direct Current (DC)

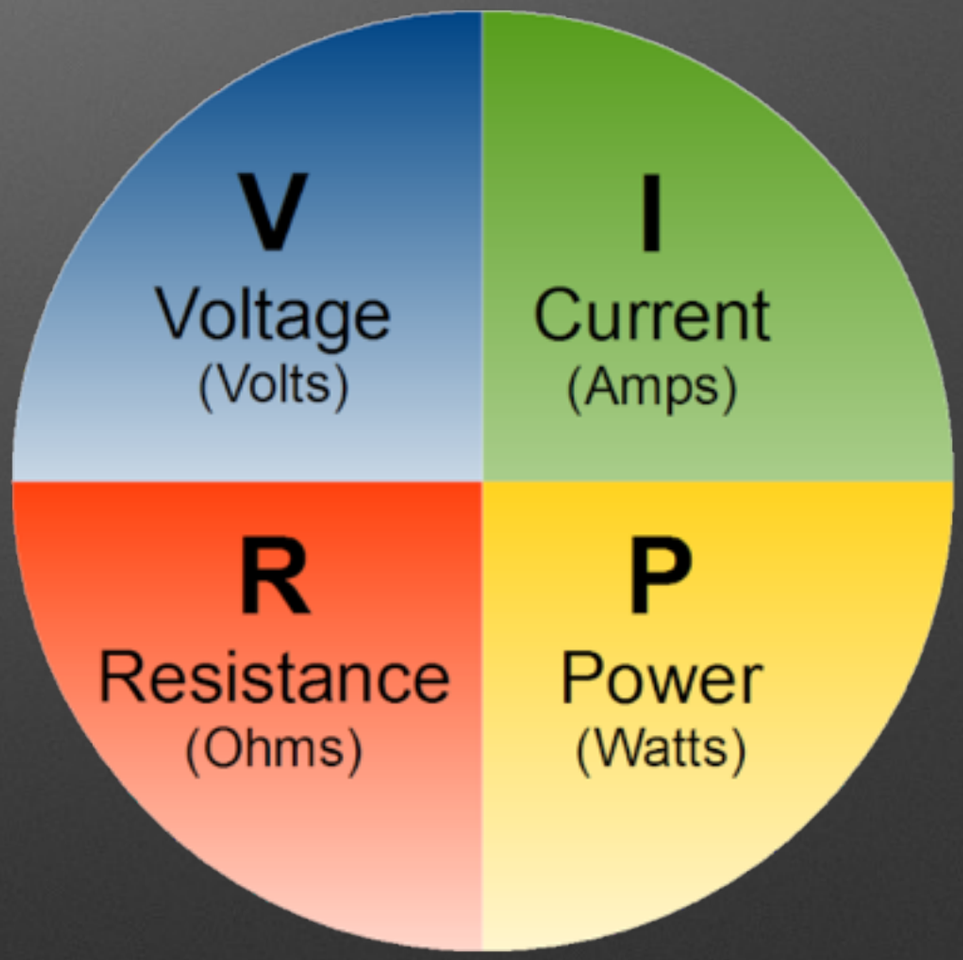
Electrons flow one direction in wires
(power from batteries).

Lucas P.

Ohms law

Voltage= Amperage*Resistance

Used to find the voltage in things when you know the amperage and the resistance.



Lucas P.

Power Law

A functional relationship between two quantities, where one quantity varies as a power of another.

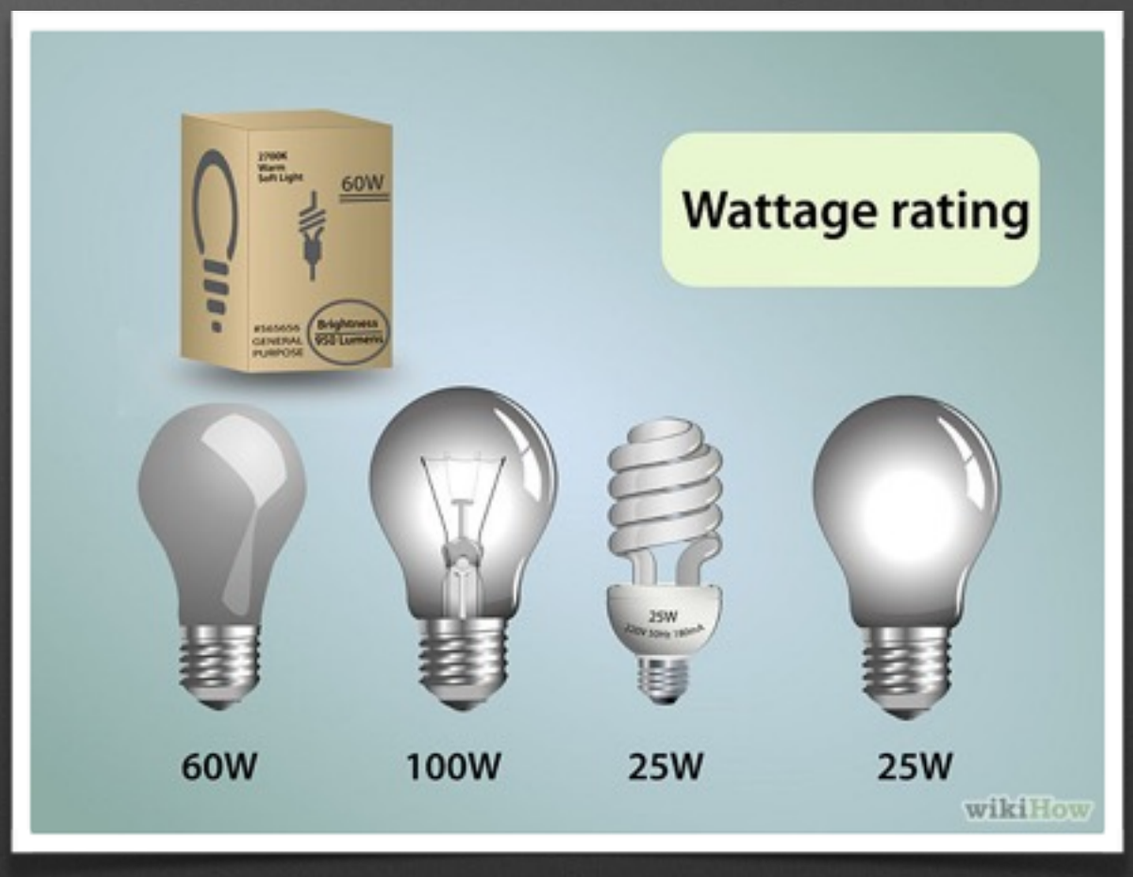
$$P = V \times I$$

AJ Smaha

Power

How fast electricity does its work

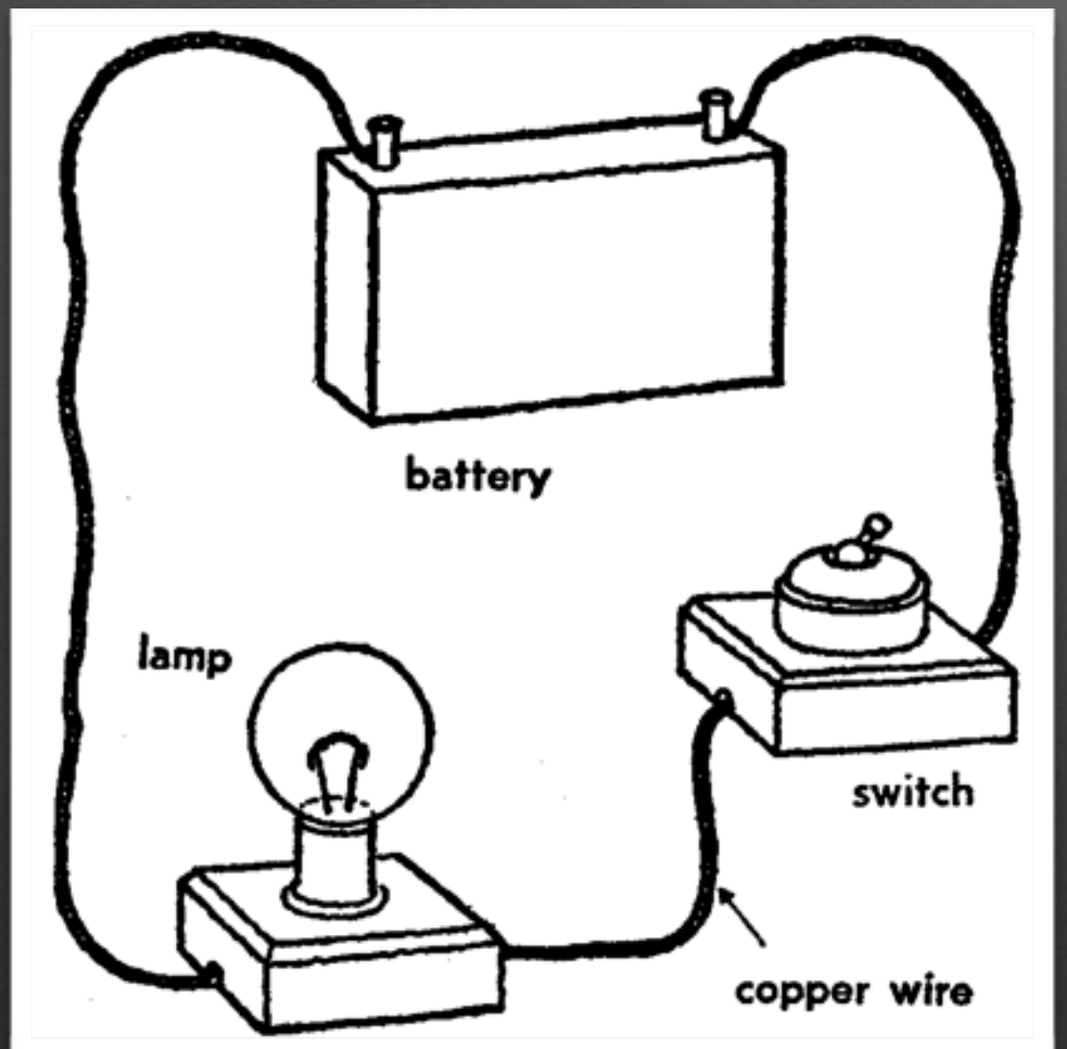
Power (P), is measured in watts (w).

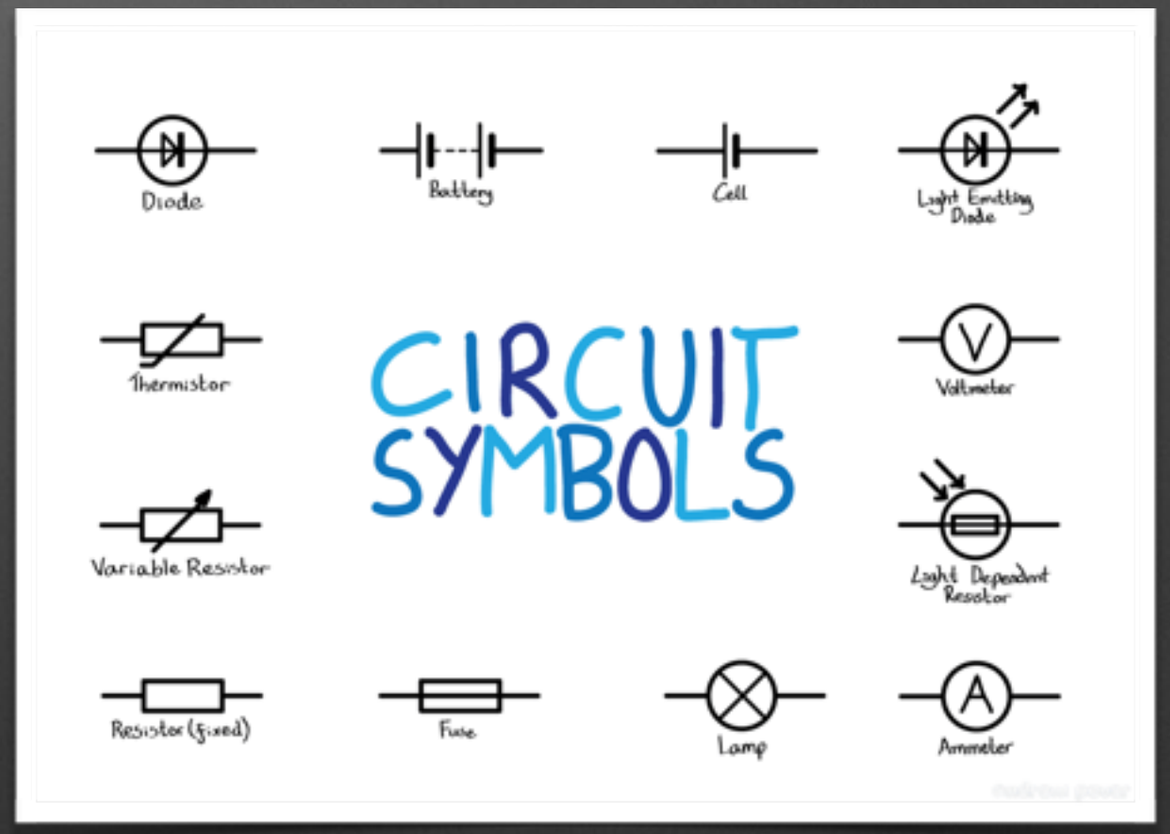


Lucas P.

Circuit

A complete loop for the electricity to flow through

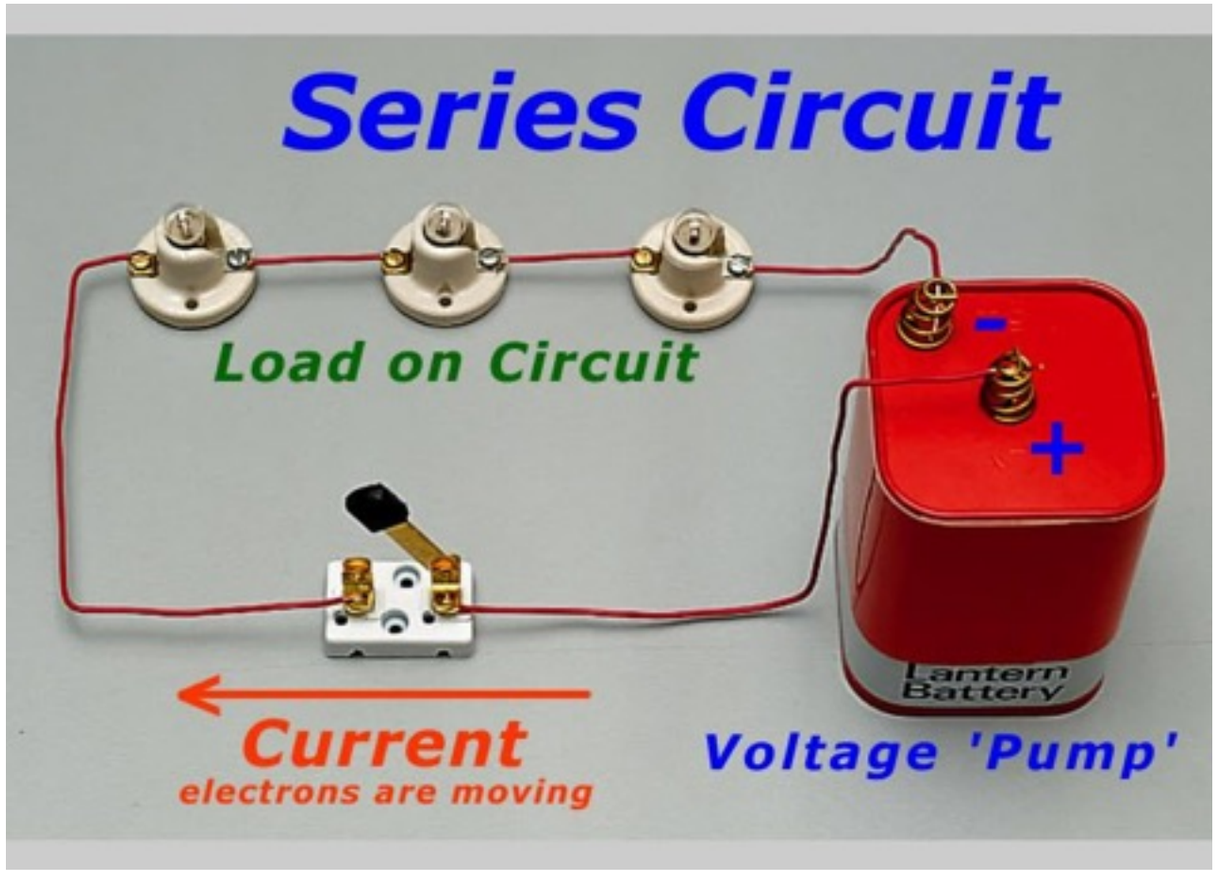




Lucas P.

Series Circuit

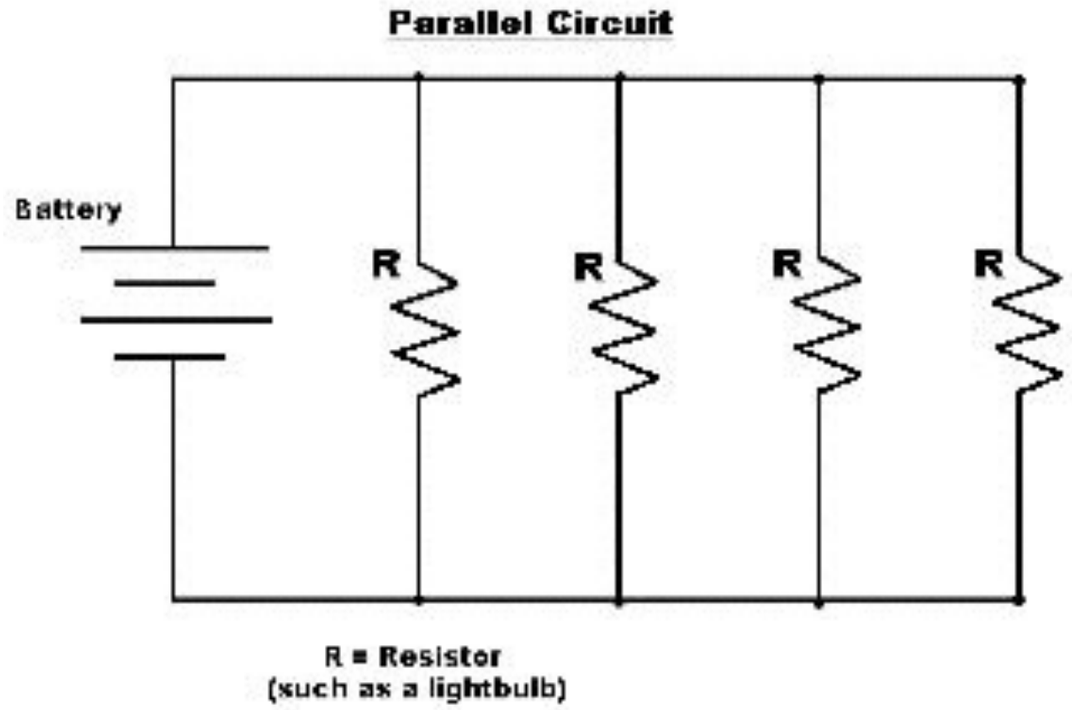
Since there's one wire on each end (+ and -), if one part goes out, they all go out, like Christmas lights.



AJ Smaha

Parallel Circuit

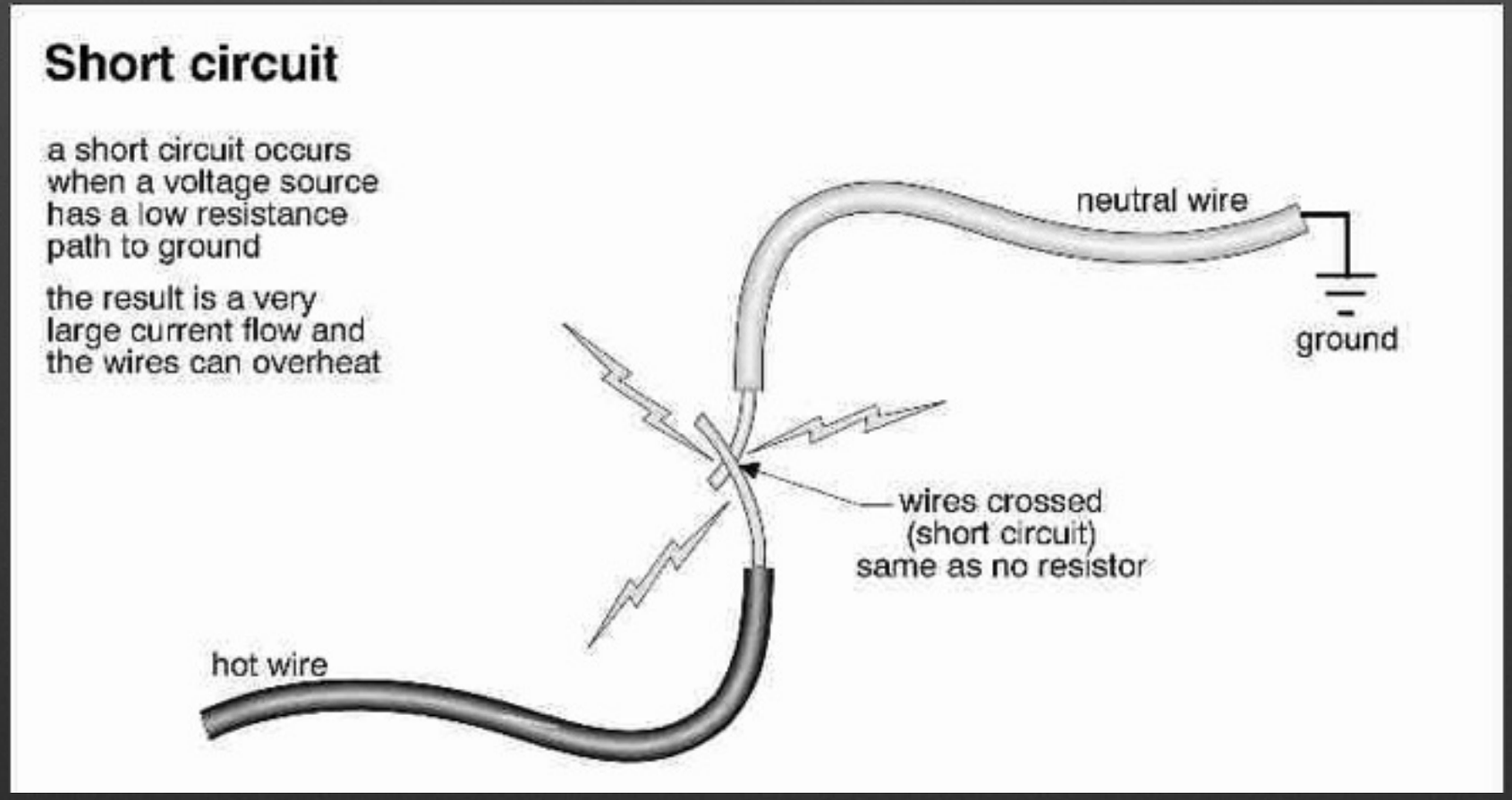
A closed electrical circuit in which the current is divided into two or more paths and then returns via a common path to complete the circuit.



AJ Smaha

Short Circuit

To wires touch that should not touch, with no device between, the resistance drops, a huge current increase happens producing much heat, damages the wires, and can start fires



Lucas P.

Circuit Breakers of Fuses

Act like a switch, shutting off the short circuit before it heats up

Circuit Breakers

Fuses

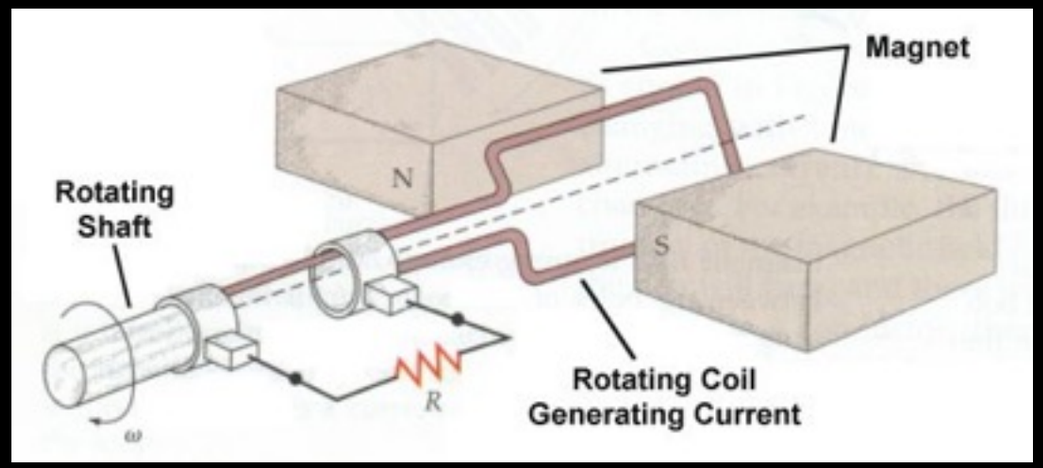
Lucas P.

5 Ways to Make Electricity

Cell-Battery

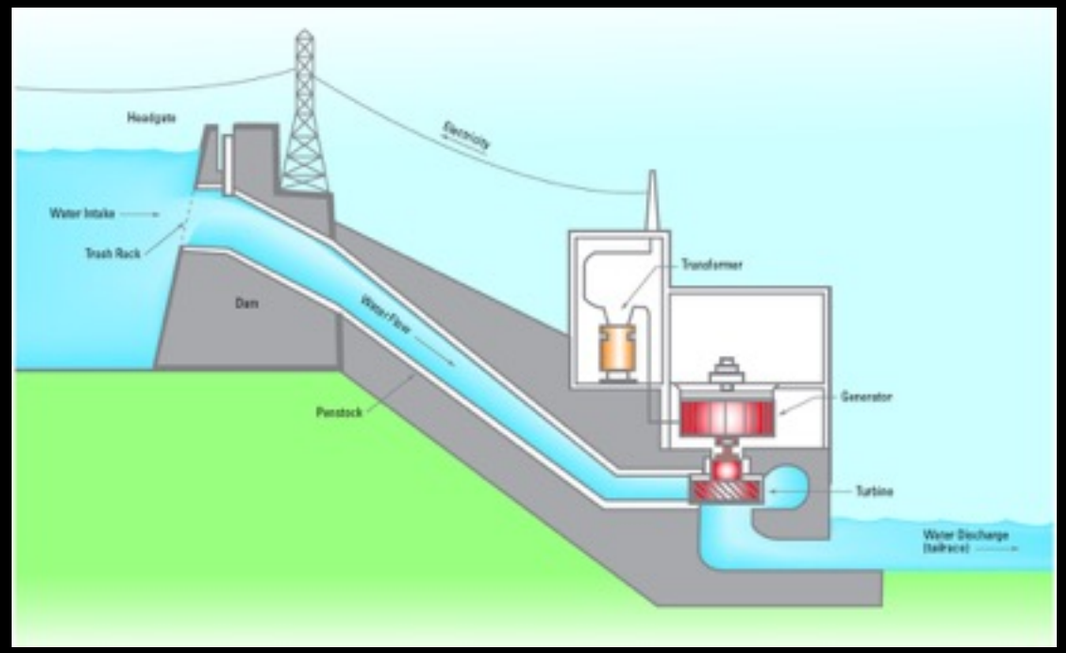
A Cell converts chemical energy into electricity.
A battery is a group of cells hooked in a series.

Generator-
Electro Magnetic Induction



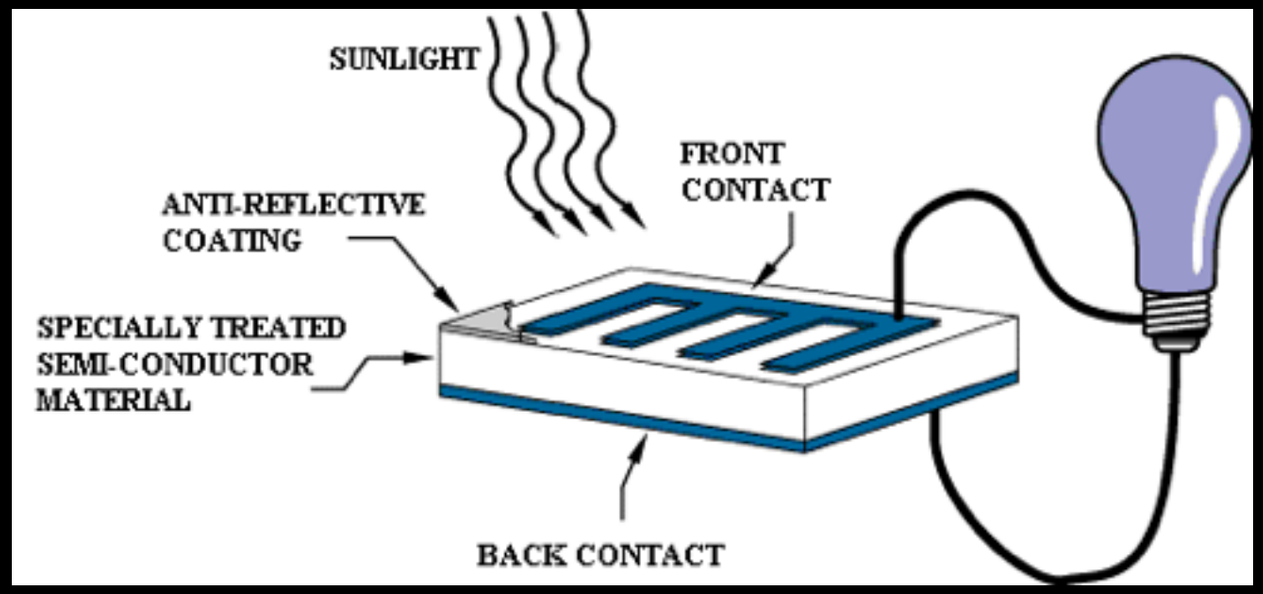
Magnets make electrons flow through wires.

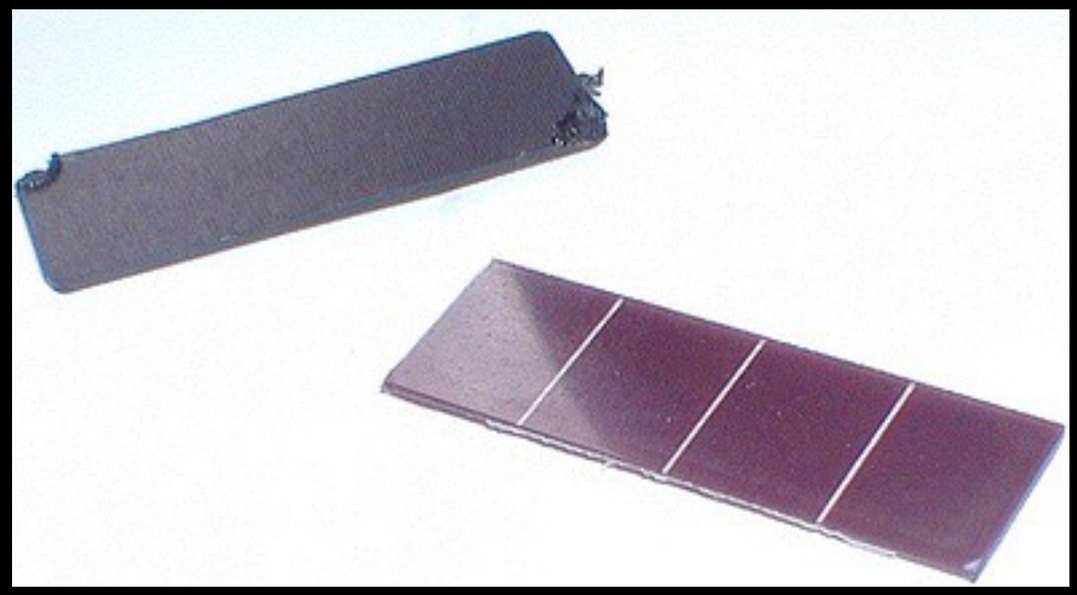
http://youtu.be/HLNugJwBRow



Solar Cell
Photovoltaic Cell

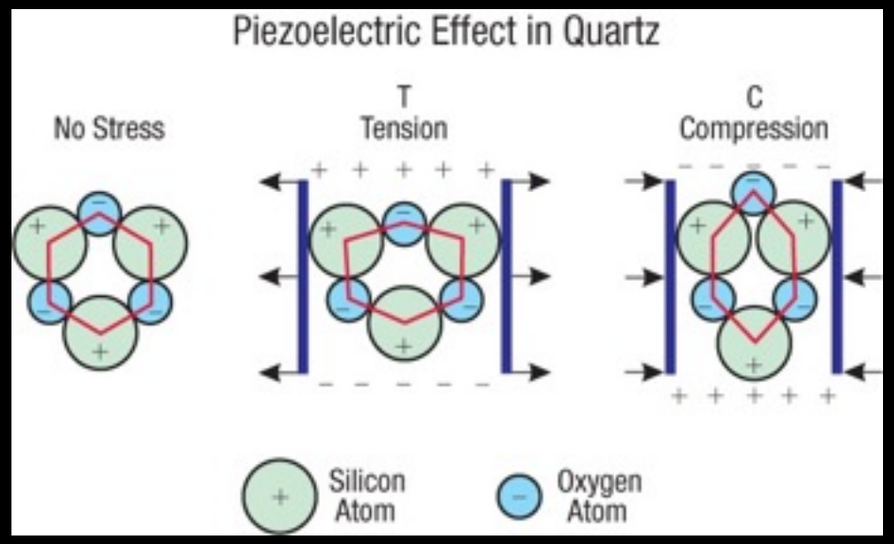
Light striking special silicon materials free electrons.





Piezoelectric Crystals

Crystals are squeezed to create a tiny current, sometimes called "pressure electricity". used in piezoelectric grill igniters



Also, a tiny computer can zap a crystal to make it expand. Used in Quartz clocks and watches

NICK.E

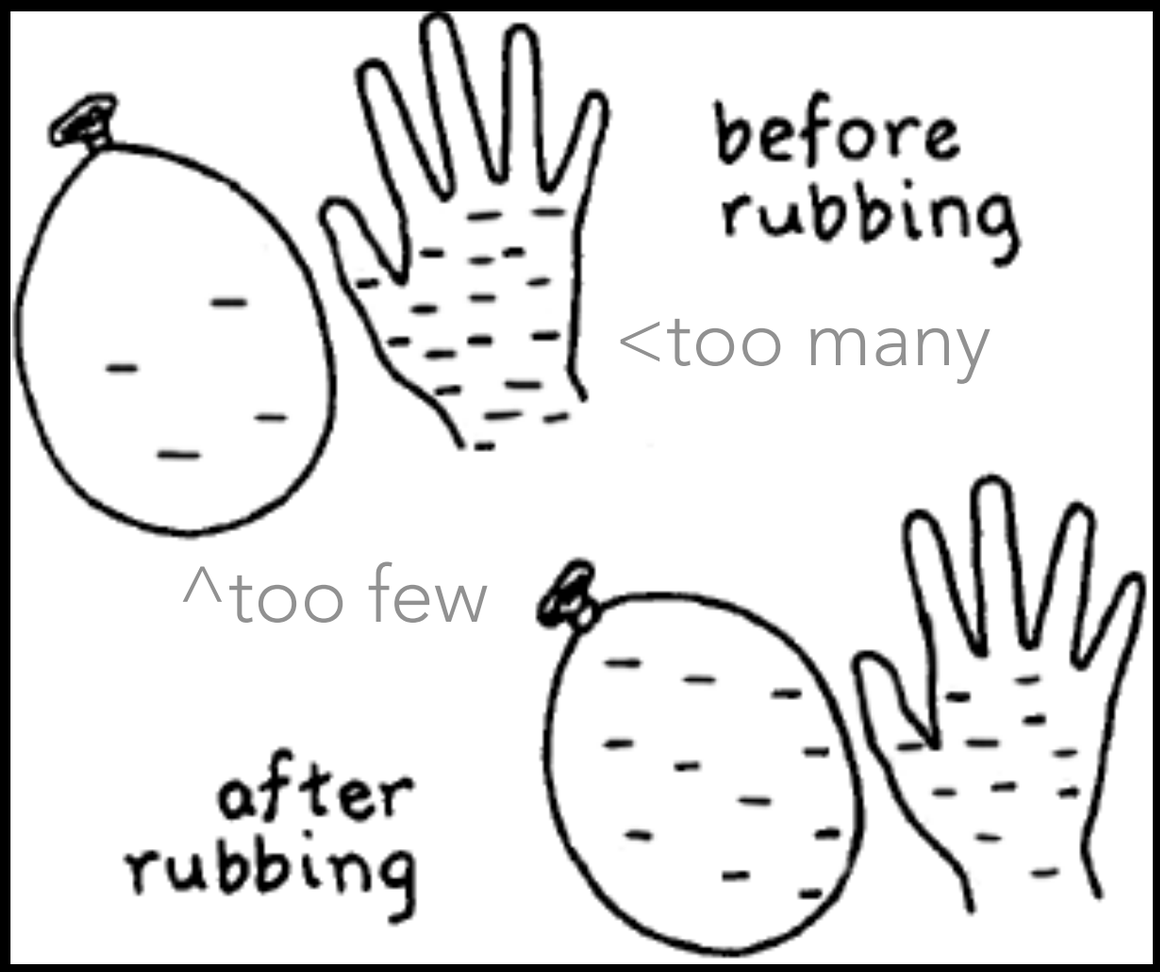
Thermocouple

Wires made of two different metals are connected and heated, making a small flow of electrons
Used in gas stove pilot lights and fire detection sensors.

STATIC ELECTRICITY

STATIC ELECTRICITY

- Static Electricity — electrons on the surface of objects that can jump from where there are too many to where there are too few.

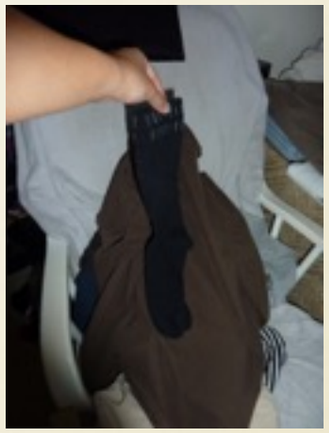


Examples of Static Electricity:

Lightning

Shocks when you walk across a rug

Dried Clothes Sticking Together

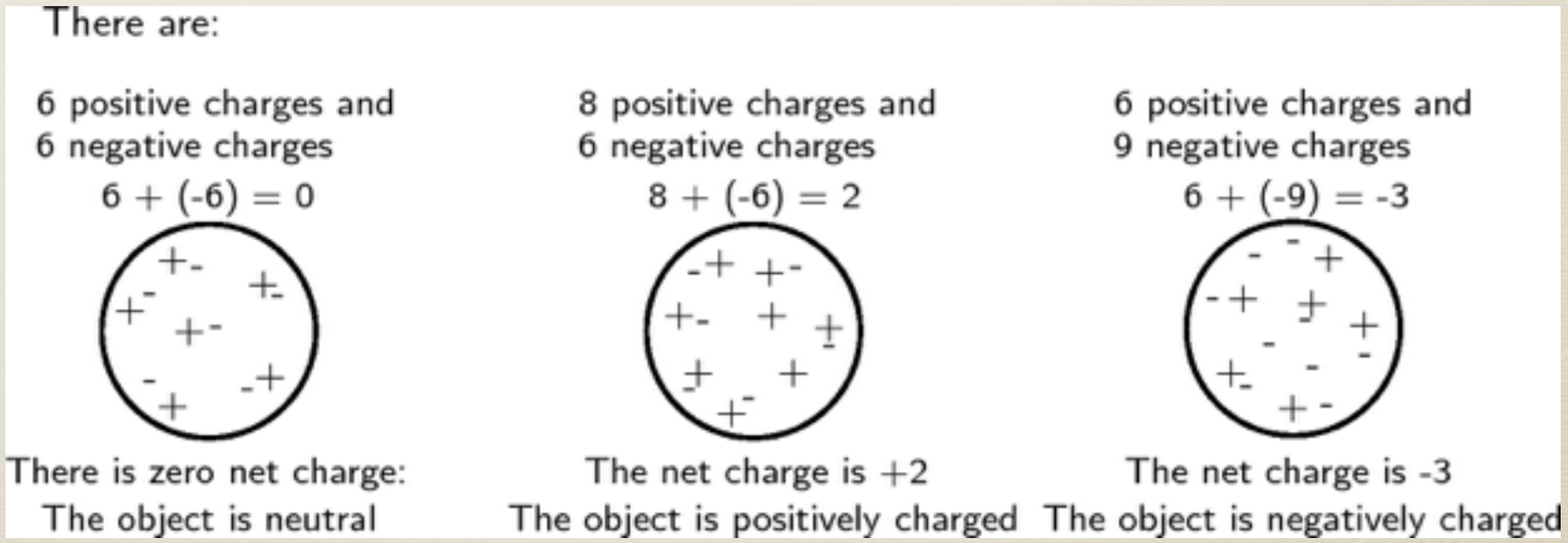


Balloon sticking to a ceiling

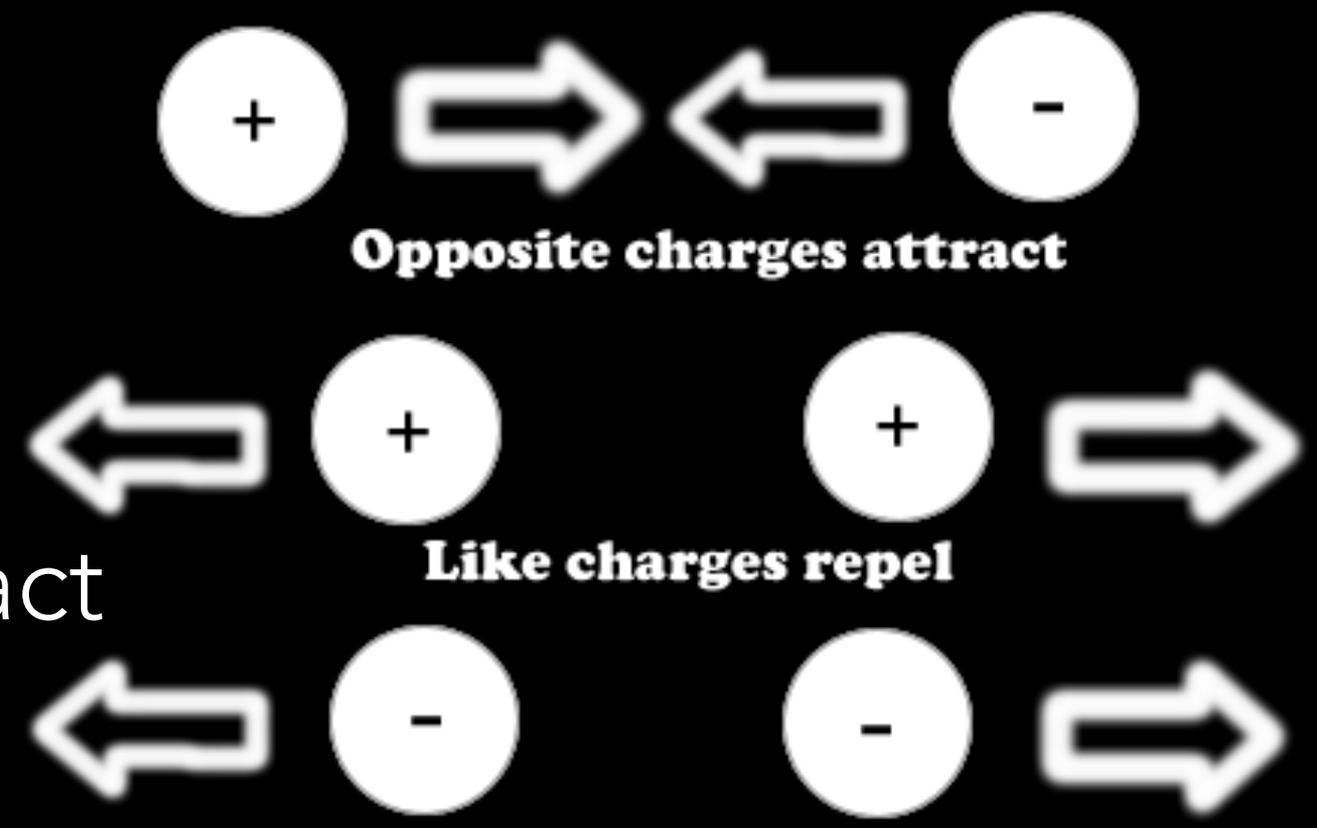
Hair attracting to objects

All objects are either:

* Positive - missing electrons on the surface
* Negative - extra electrons on the surface
* Neutral - the correct number of electron or surface



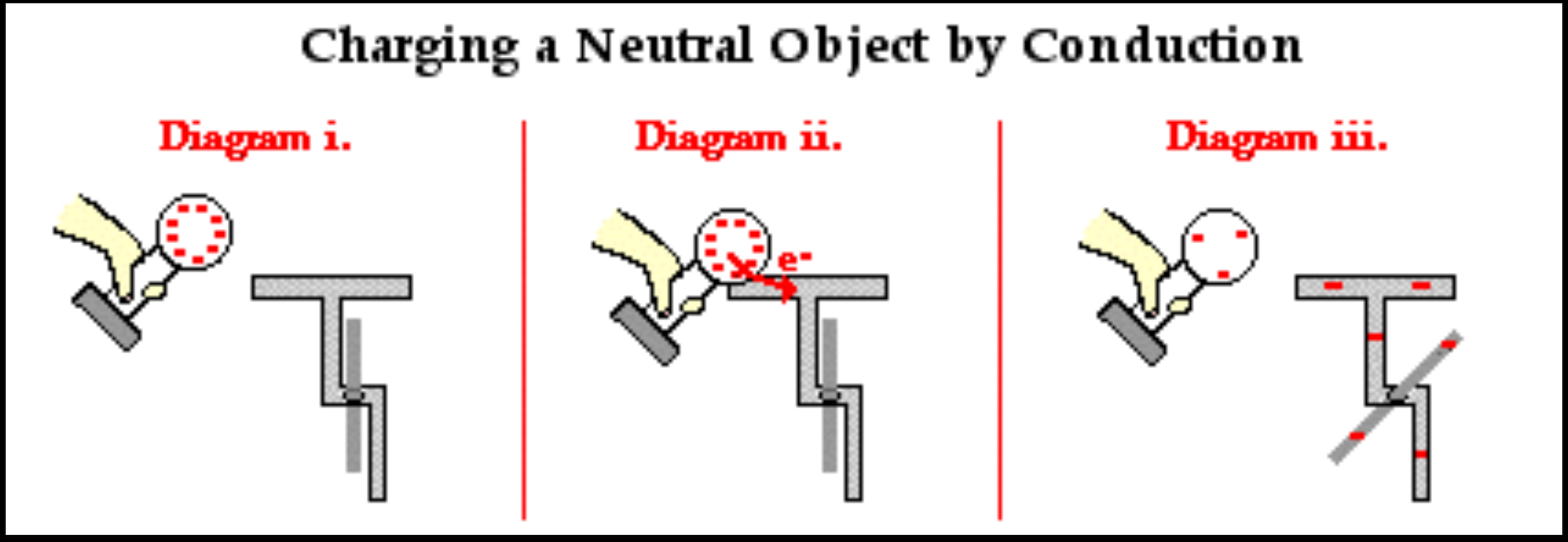
CHARGE FACTS



- Opposite charges attract
- Same charges repel
- Charged objects attract neutral objects
- The more electrons on an object, the larger the charge force will be
- The closer the object gets, the stronger the force gets

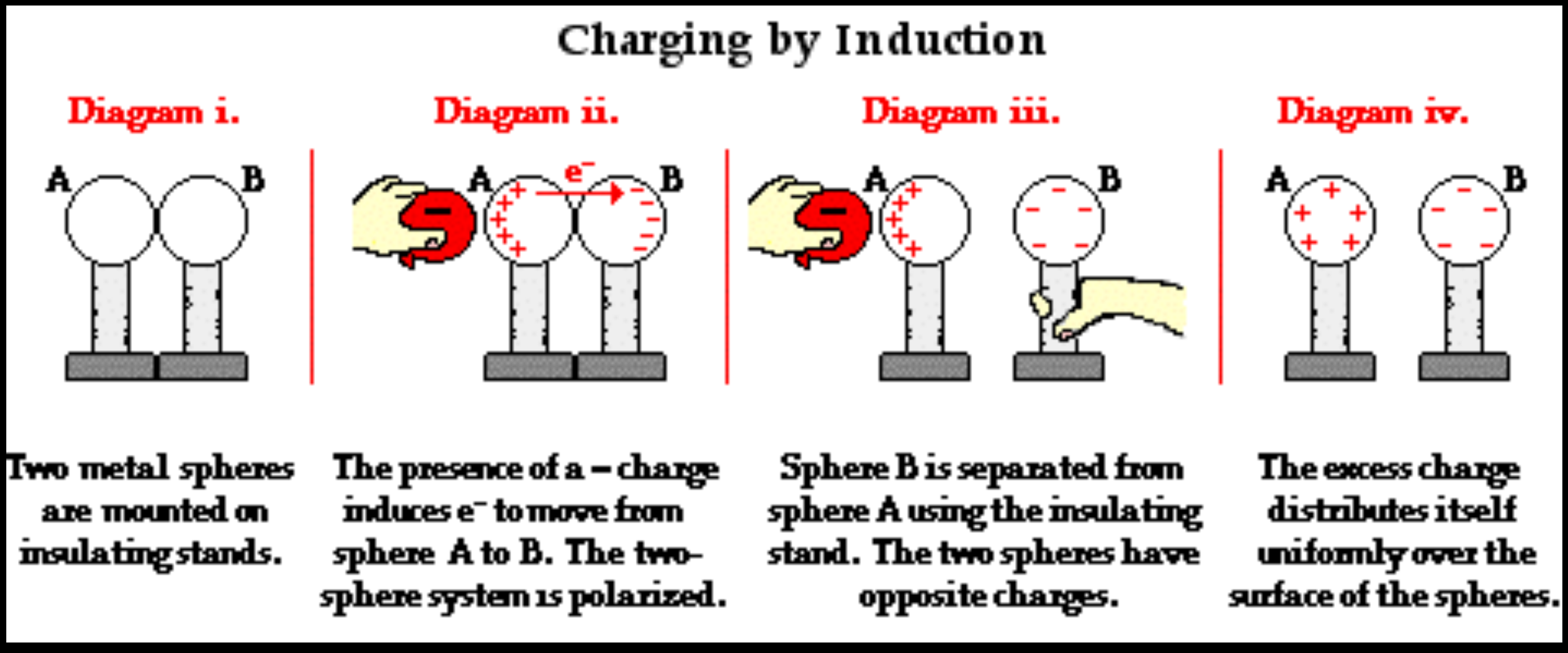
WAYS TO CHARGE AN OBJECT

- CONTACT — a charged object touches another object, and then will give that same charge to the other object



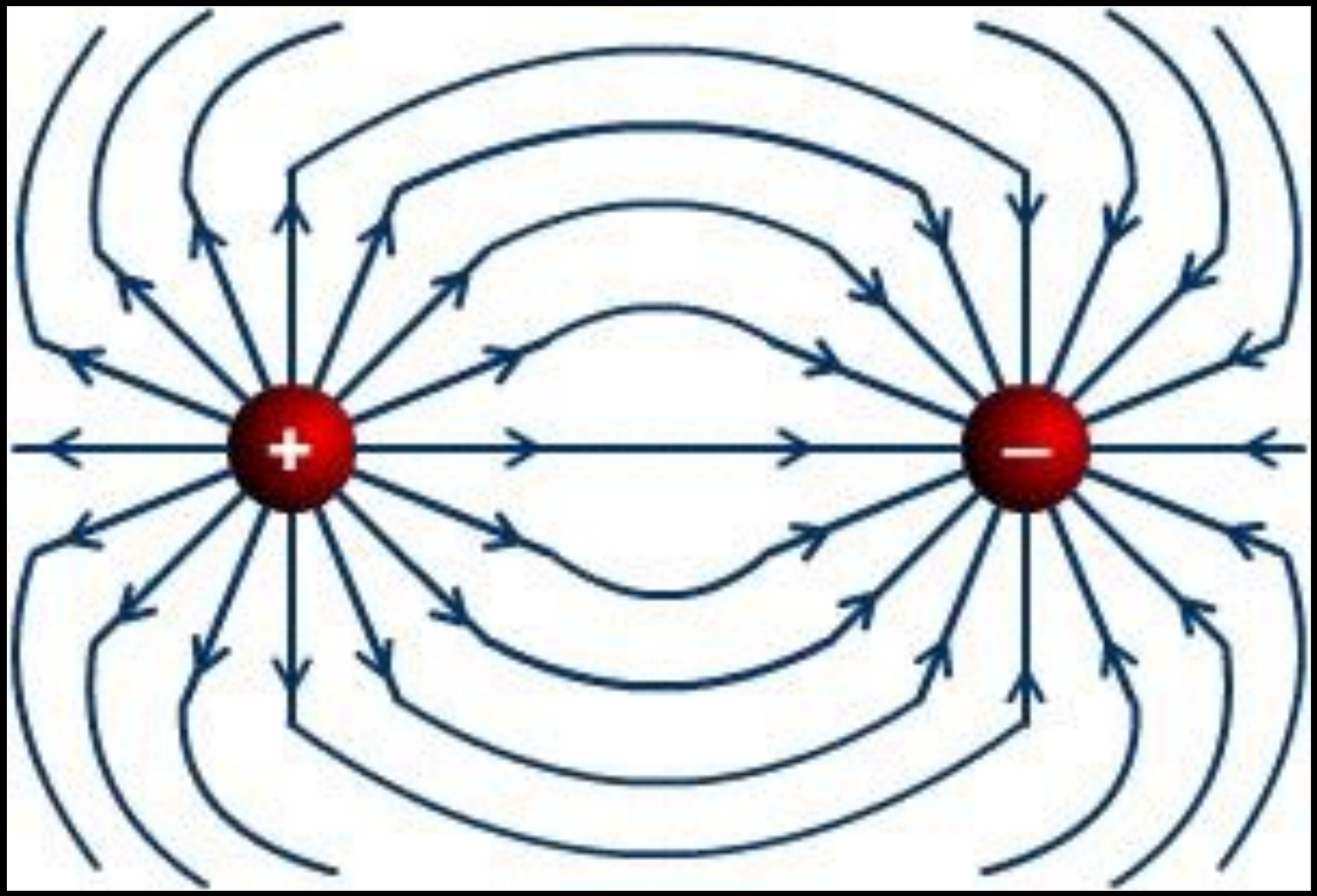
WAYS TO CHARGE AN OBJECT

- INDUCTION — a charged object gets close to a neutral object and attracts the opposite charge to the side closest to it and drives the same charge to the side farthest away from it



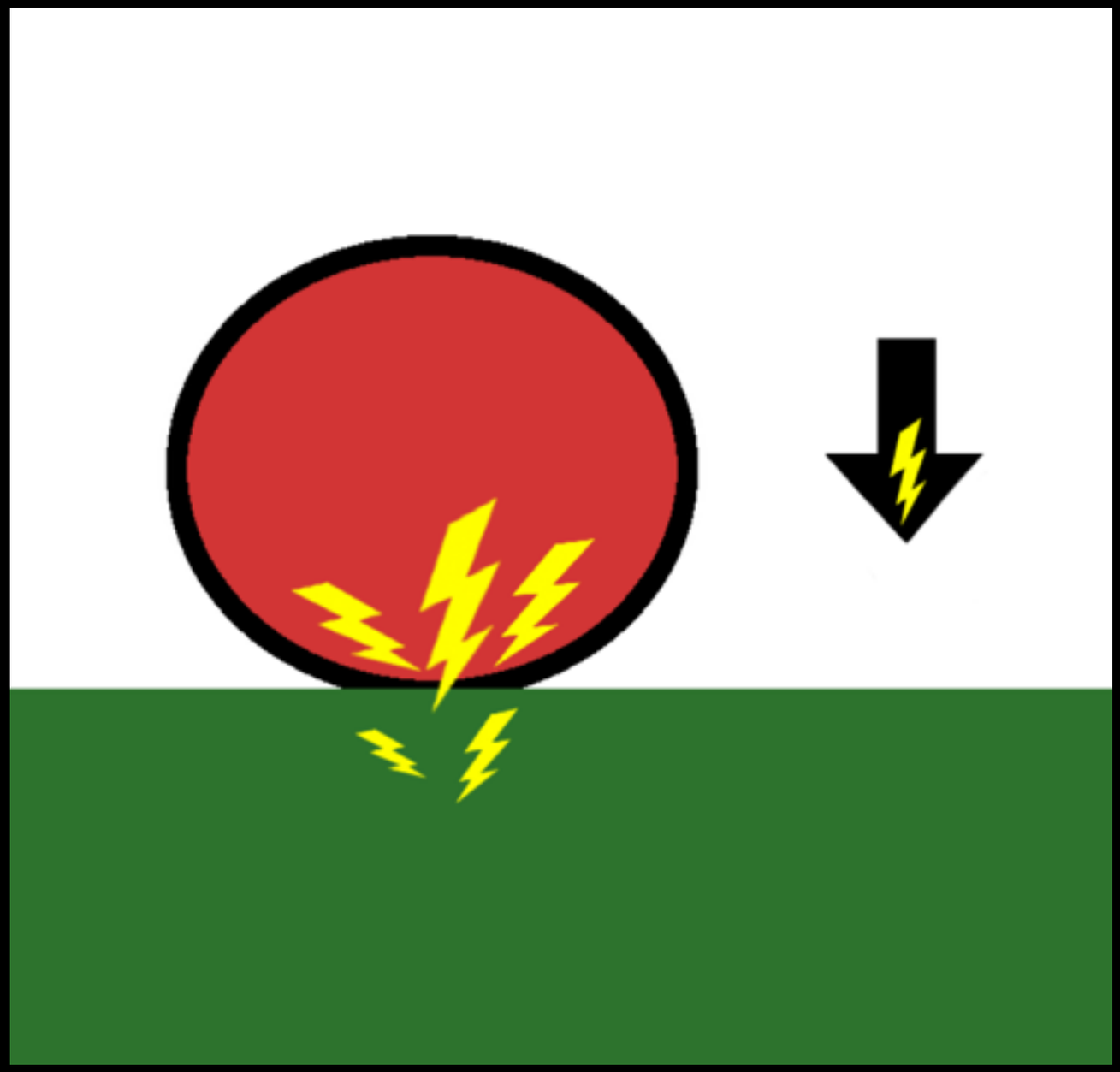
3 WAYS TO NEUTRALIZE AN OBJECT

1. Give it the equal and opposite charge



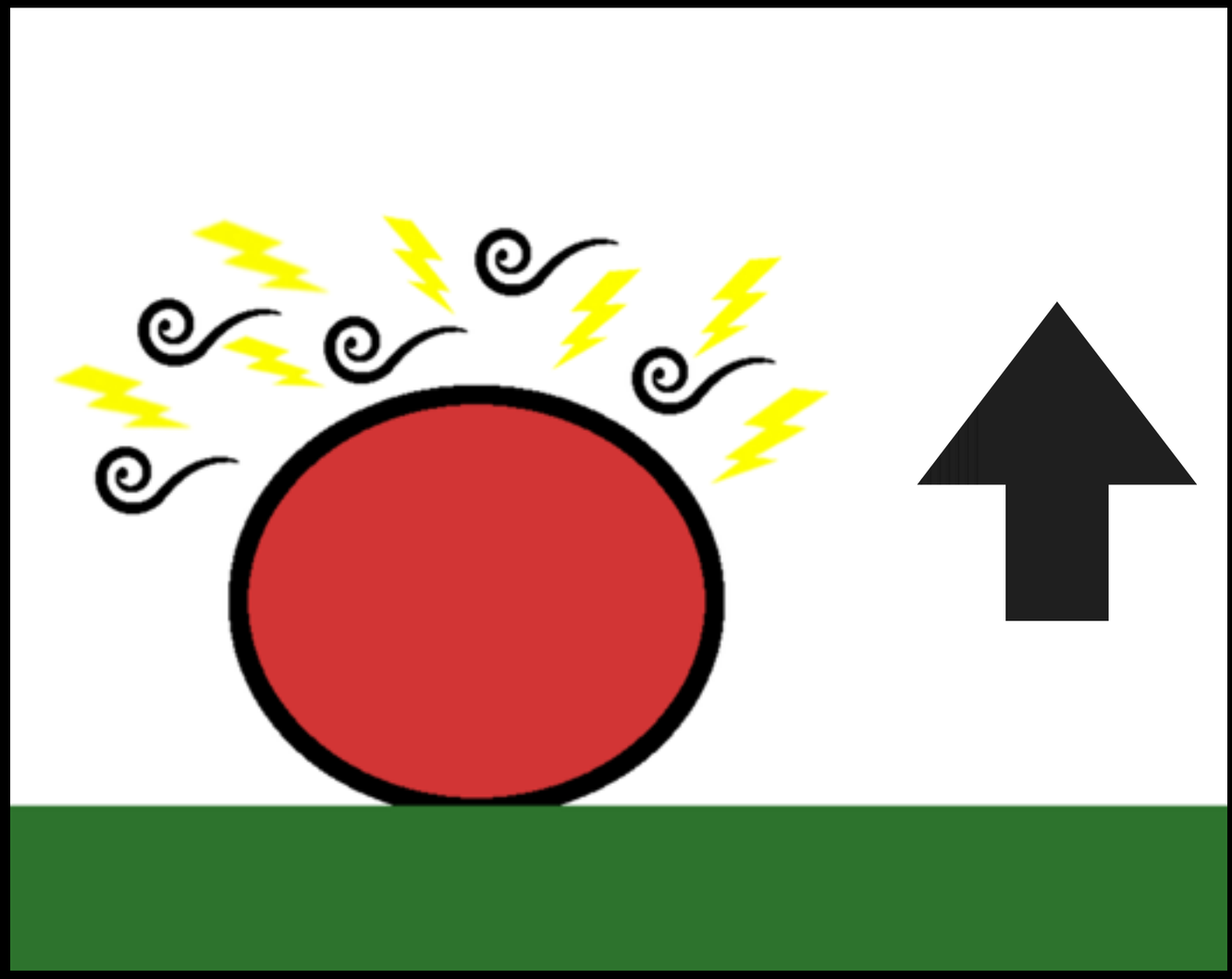
3 WAYS TO NEUTRALIZE AN OBJECT

2. Grounding- connecting the object to the earth. The ground takes or gives all of



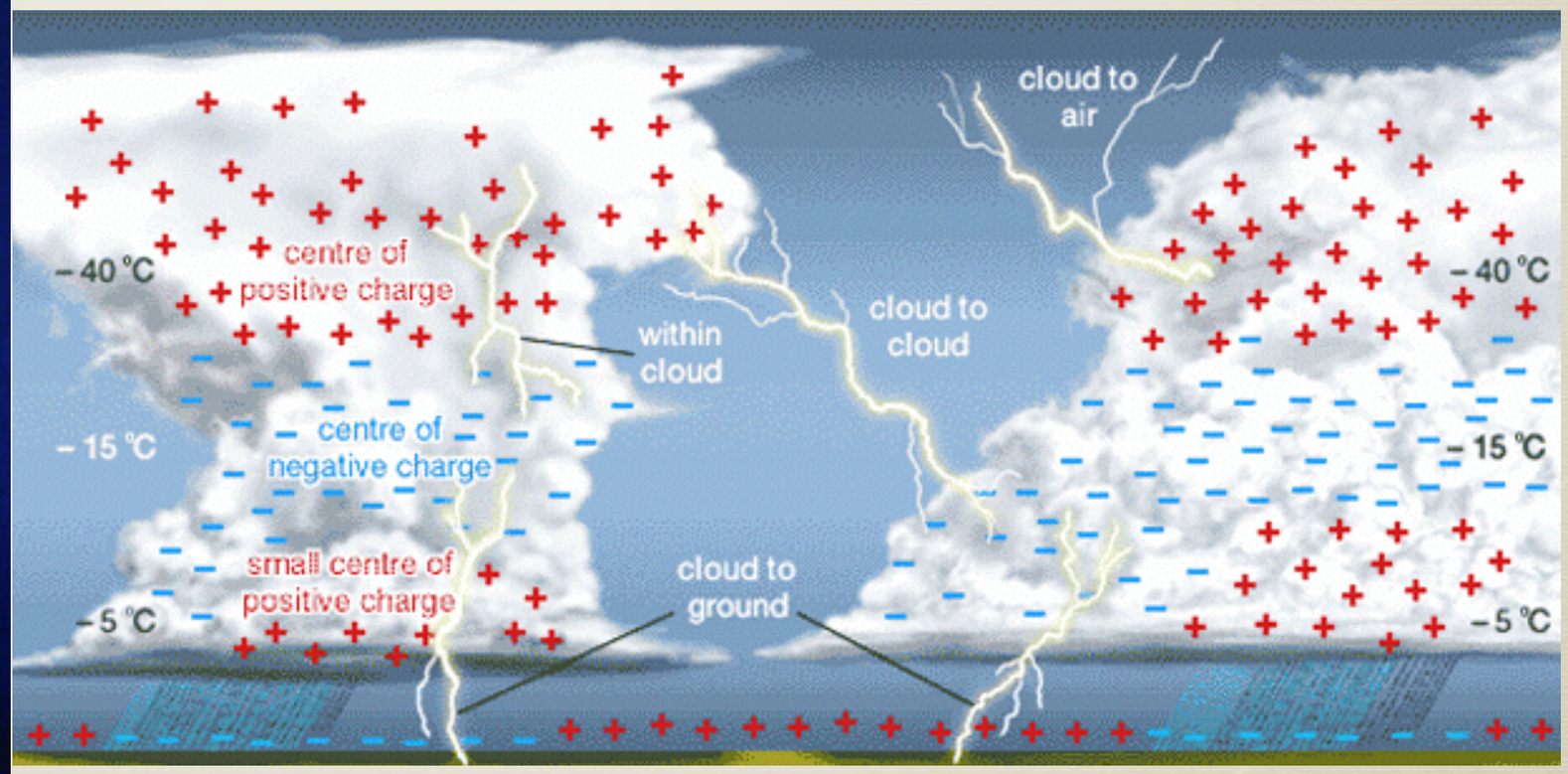
3 WAYS TO NEUTRALIZE AN OBJECT

3. Leave the object alone and it will slowly lose the charge to passing air.



How lightning forms

1. Air atoms move for miles, gaining or losing billions of electrons.
2. When strong enough charges are given, the electrons jump from the negative area with too many electrons to a positive or neutral area.
3. When the electrons jump, they ionize the air, making a flash of heat and light. The super heated air expands and makes a cracking sound we call thunder.



How lightning forms http://youtu.be/jM8h60S1GsM

Cloud to cloud lightning

Cloud to ground lighting

Ground to
cloud lightning
http://youtu.be/6NZ7BollR04

Lightning safety

1. Light travels faster than sound. If you see lightning, every 5 seconds it takes to hear the thunder equals a mile. If you hear thunder, you are in the danger zone!
2. Never be in the highest point in an area. Get out of the water, don't hide under a tall tree or picnic shelter. Stay away from fences, wires, etc.
3. Inside a car is safe! ;)
4. If indoors, stay away from pipes and wired devices.
5. Lower is better! If caught in the open, find a low area and crouch down. Don't lie flat
6. If in a group, stay apart. Don't take shelter all together!

Myth busters

Music

TWO MEN + TWO TESLA COILS = ELECTRICITY BATTLE

http://youtu.be/fPoomwdNZeY

http://youtu.be/VhWQ-r1LYXY

http://youtu.be/yfRBxpsJb

Videos

How lighting forms — http://youtu.be/jM8h60S1GsM

Myth busters — http://youtu.be/7qgM1A3pgkQ

Music — http://youtu.be/fPoomwdNZeY

Ground to cloud lightning — http://youtu.be/6NZ7BollRo4

http://m.youtube.com/watch?v=ltK5c60nBHQ

http://m.youtube.com/watch?v=fPoomwdNZeY

Motion

Motion

The change in position of an object caused by forces pushing or pulling on the object.

http://m.youtube.com/watch?v=3nbjhpcZ9_g

5 Forces

- Most things can push or pull an object when they touch the object, but five forces can work without touching an object.

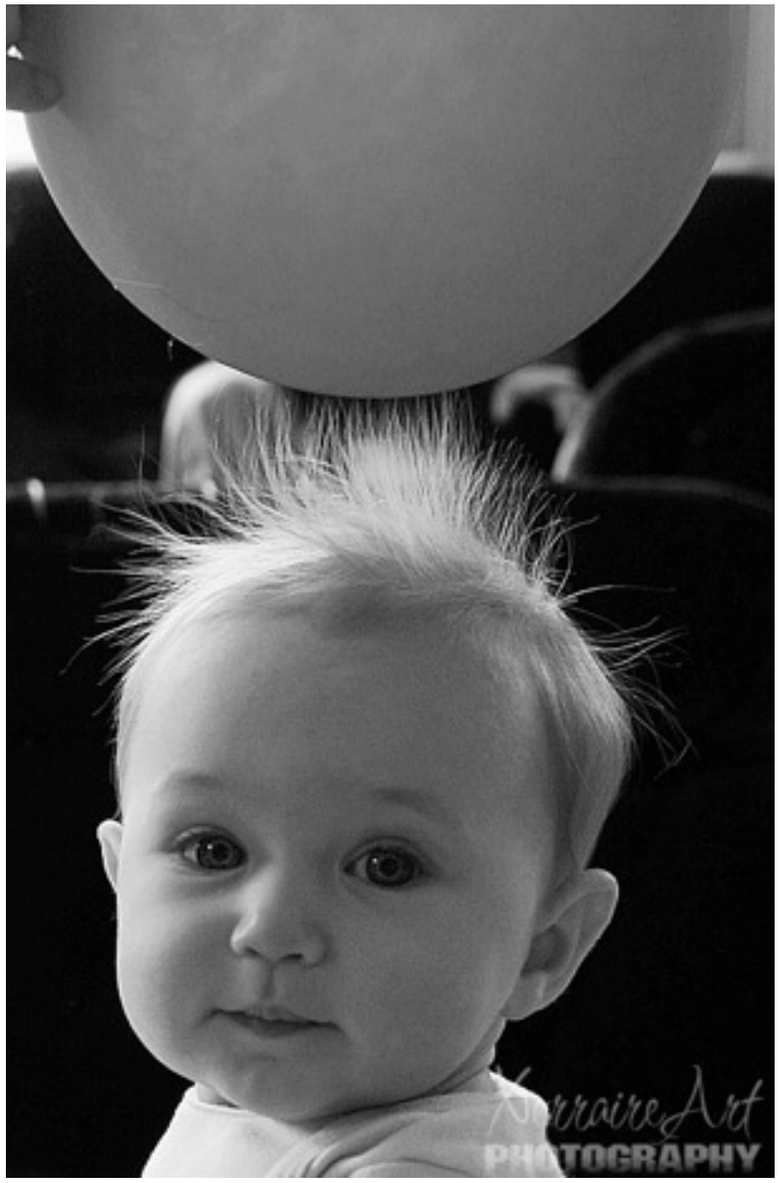
- **Gravitational Force**- a force that pulls objects together, bigger objects have more gravitational force.

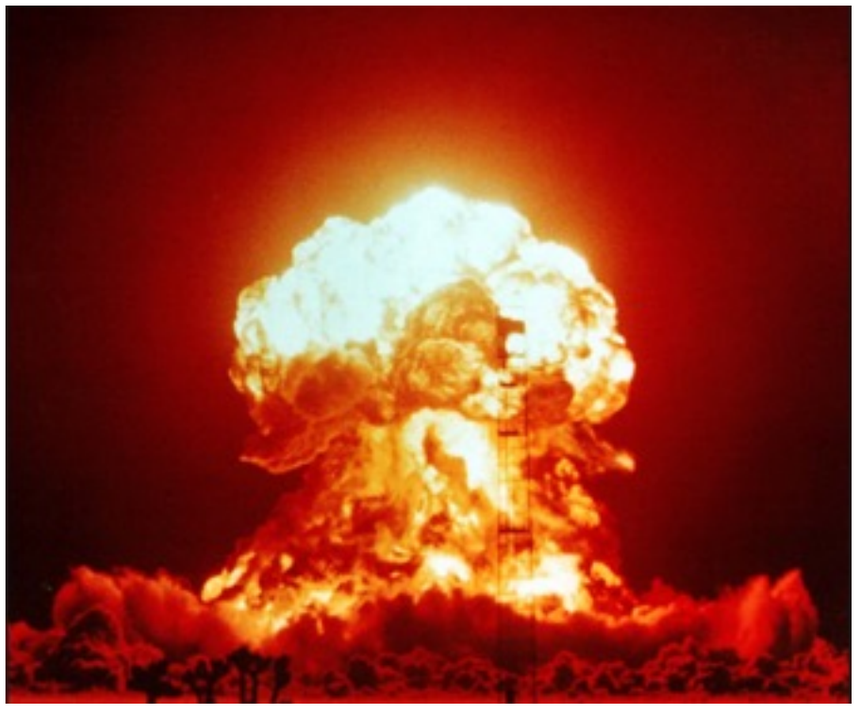
- **Static Electrical Force**-electrons on the outside of an object attract or repel other objects.

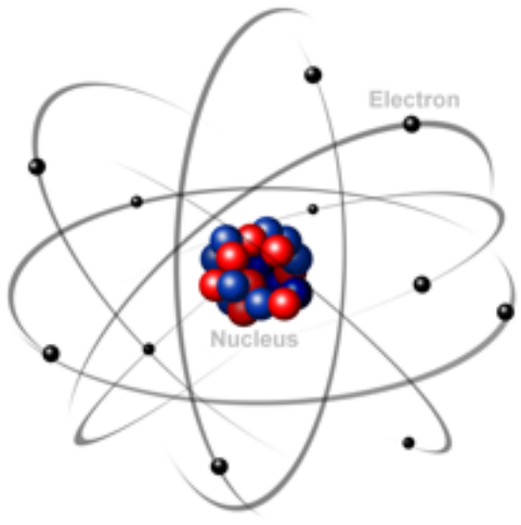
- **Magnetic Force**-the force of attraction between iron and nickel objects.

- **2 Nuclear Forces**-unknown forces that hold the nucleus of an atom together.

http://m.youtube.com/watch?v=4z8g8OSOMzY


PHOTOGRAPHY




Electron
Nucleus

Force (F)

- A push or pull that makes an object start moving, stop moving, or change it's motion.

Force=mass x acceleration (F=mXa)

Measured in Newtons (N)

(1 Newton = (1Kg X meter) / second)

http://youtu.be/-lORpn68yxI

Kinetic Energy

- **Kinetic Energy (KE)** – the energy a moving object has, based on it's mass and it's velocity (KE=1⁄2 x m x V2)

- The more mass, the more Kinetic Energy it will have when it moves.

- The faster an object moves, the more Kinetic Energy it will have.

Friction

- A force that slows down a moving object that is touching other matter or another object.

Velocity (V)

- The speed of an objects motion.

  Velocity=distance/time (V=d/t)
  Measured in m/s, miles/hr etc.

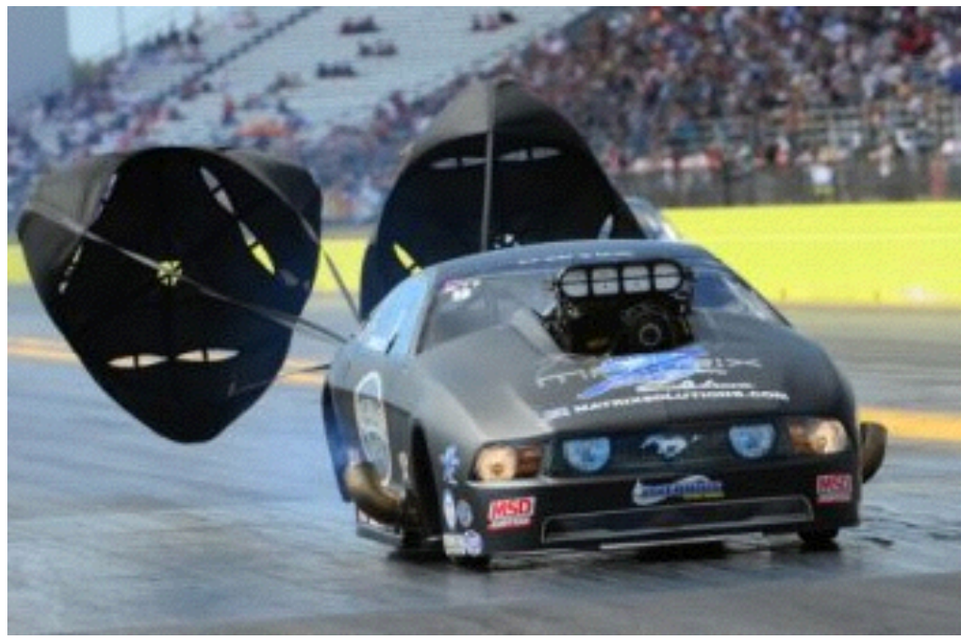
Acceleration

- Acceleration (a) - when the velocity of an object changes.
  Acceleration = Final Velocity - Original Velocity / Time
  a=Vf-Vo/t

- Measured in meters/second/second (meters per second squared)

- Speeding Up = Positive Acceleration

- Slowing Down = Negative Acceleration



Newton's 1st Law

"The Law of Inertia"

- An object will remain at rest or move in a straight line at a steady speed, unless acted upon by an outside force.

Inertia-an object wants to stay still if it's still and keep moving if it's moving

Momentum(p)-a moving objects inertia-the object wants to keep moving as it is

Momentum=mass X velocity (p=m X V)

http://www.youtube.com/watch?v=Jbg-daPUT_I

http://m.youtube.com/watch?v=Mi9BMx8C9LI

Newton's 2nd Law

"The Law of Equilibrium"

- When an unbalanced force acts on an object, the object will be accelerated.

- Force = mass x acceleration (F = m x a)

http://m.youtube.com/watch?v=UDDfJh6CkS8

Newton's 3rd Law

“The Law of Action and Reaction"

- Every action has an equal but opposite reaction.

http://m.youtube.com/watch?v=TERA-GY2K1o

Simple Machines

Simple Machines

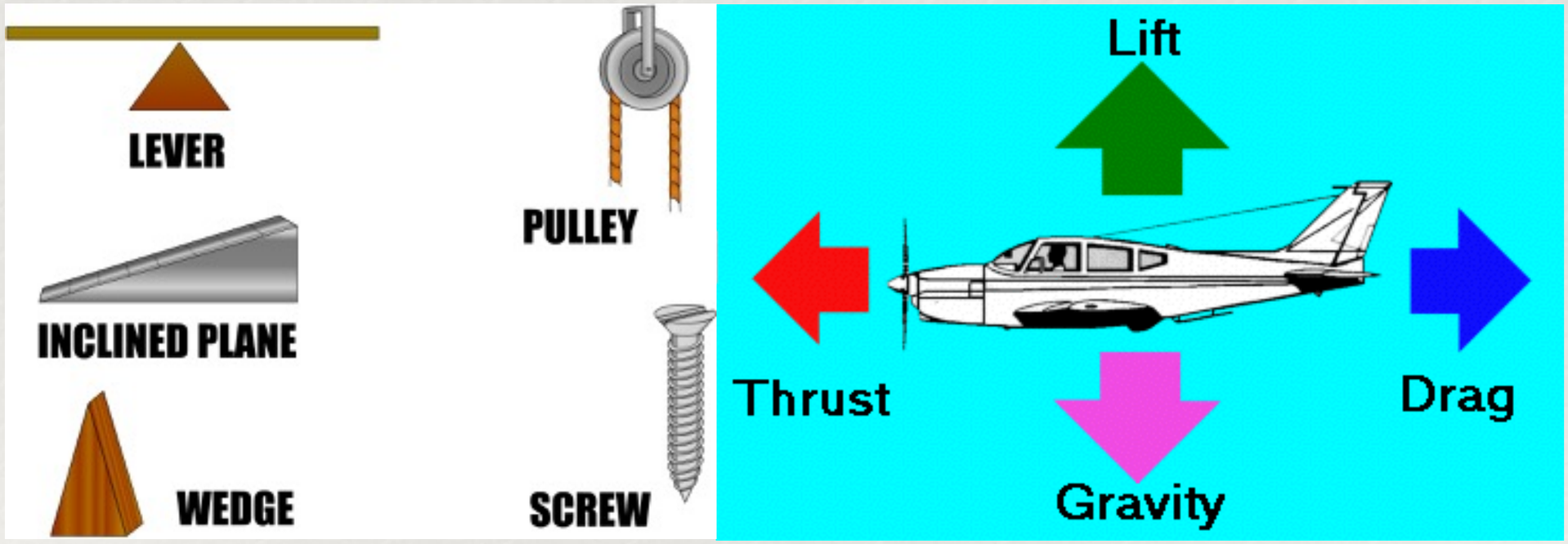
give us an advantage by changing the size or direction of forces used to do work

Force

a push or pull that changes the motion of an object. Starts,

Work

work is done whenever an object gets



Effort force

the force applied to the machine by the user

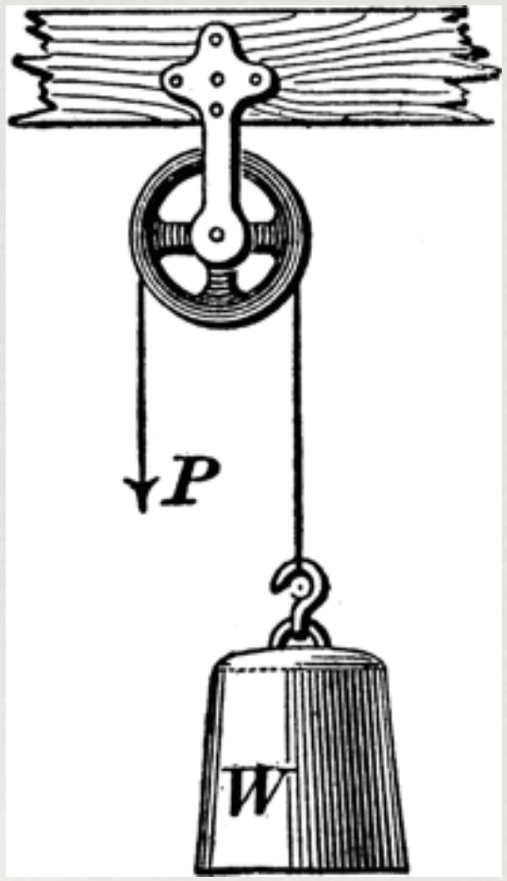
Resisting force

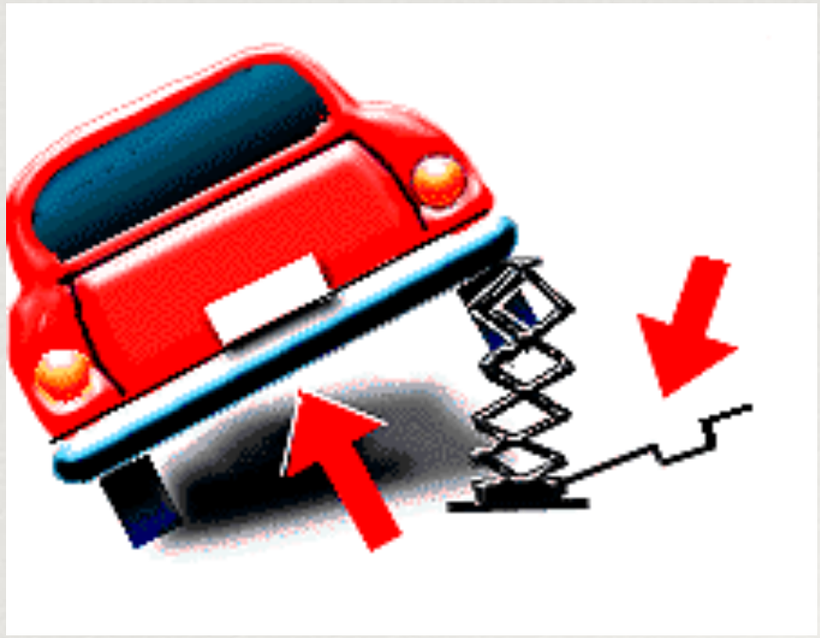
the force needed to move the object

Mechanical Advantage

the number of times the machine multiplies the users effort force

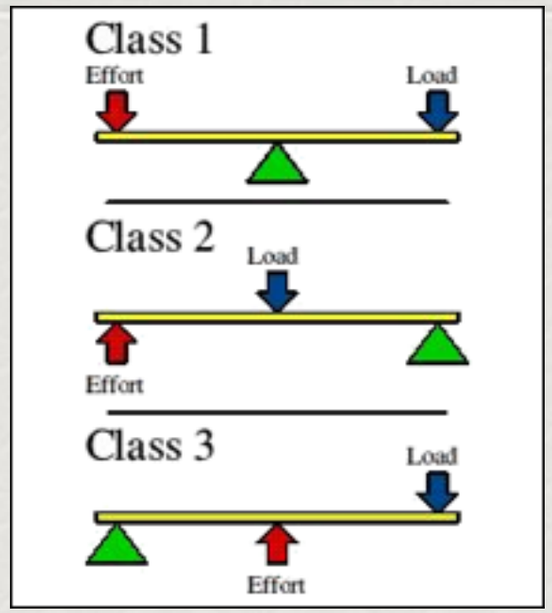
Mechanical advantage = Resistance Force / Effort Force





Levers

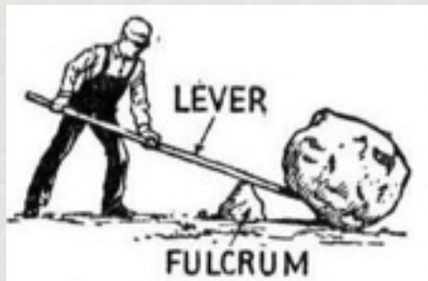
a bar supported in one place by a fulcrum that multiplies or changes the direction of the users effort force



1st Class Lever

multiplies the effort and changes the direction

scissors, seesaw



2nd Class Lever

multiplies the effort

wheelbarrow, paper cutter

3rd Class Lever

multiplies the distance the effort moves the lever

broom, hoe, pencil

Pulley

– a device that allows the user to pull down on a rope or chain to lift an object

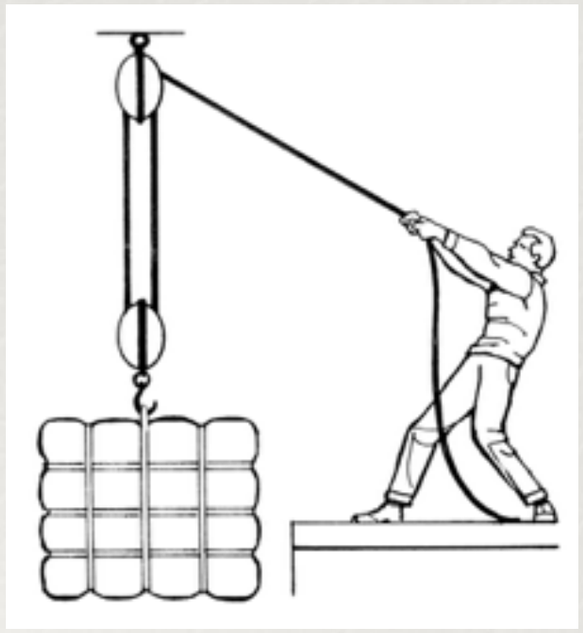
Examples: pulleys, block and tackle, hoist, chain-fall

Fixed Pulley Only changes the direction of the effort

Moveable Pulley or Block and Tackle

Changes the direction and multiplies the effort

The number of ropes equals the mechanical advantage



Wheels & axels or gears

Wheels & Axels or Gears:
one circle turning another to gain speed or power.

Large turning Small
Advantage :speed

http://YouTu.be/oauDyIu_swM

Patuel

Wheels & axels or gears

Wheels & axels or gears: one circle turning another to gain power.

Small turning Large Advantage :power

http://YouTu.be/oauDyIu_swM

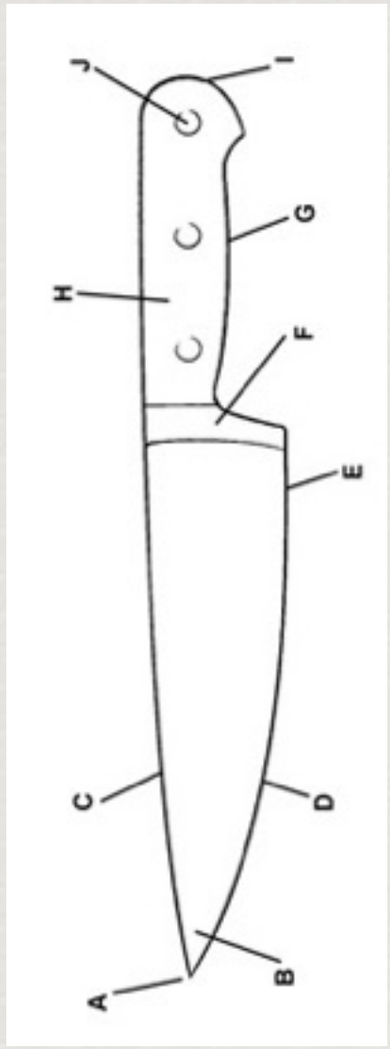
Patuel

Inclined planes

- *Inclined Planed or Ramp: the ramp does not move but is used to lift objects easier by rolling them up little at a time.*

Patuel

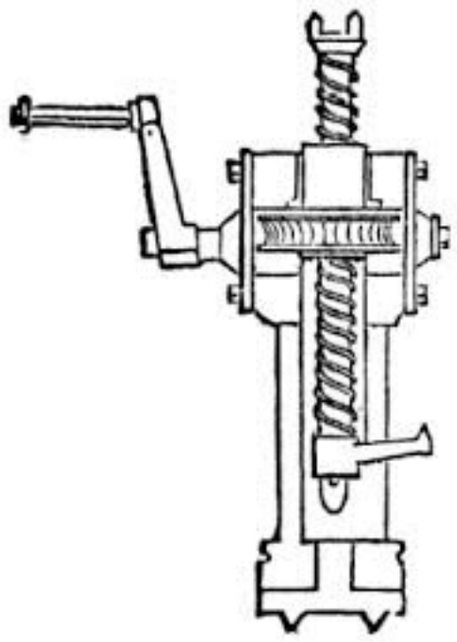
Wedge – a triangular shape that moves under or into an object, causing it to lift or split apart. Longer, thin wedges give more power, but work slowly. Examples: splitting wedge, axe, knives, and sports.

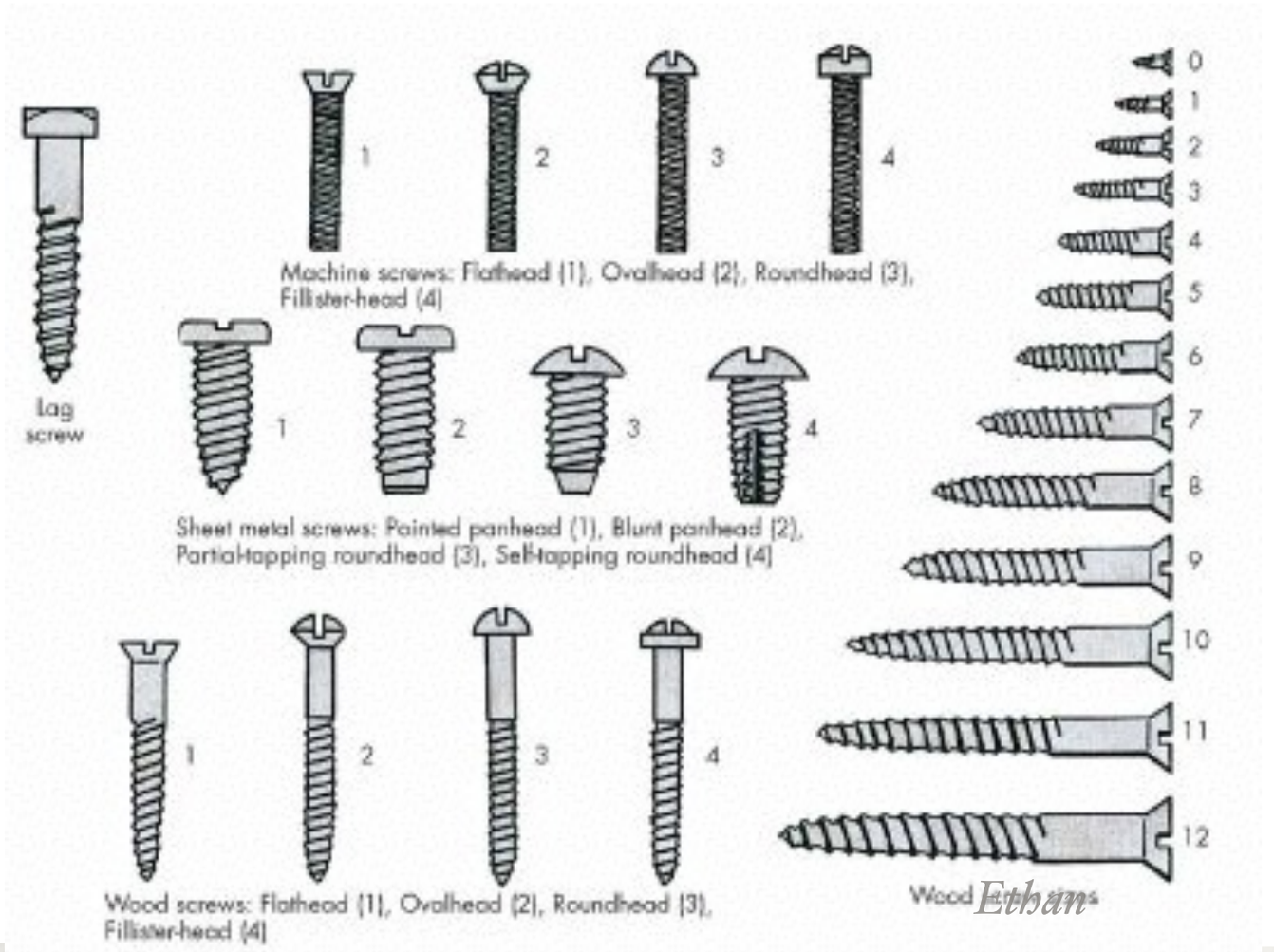


Ethan

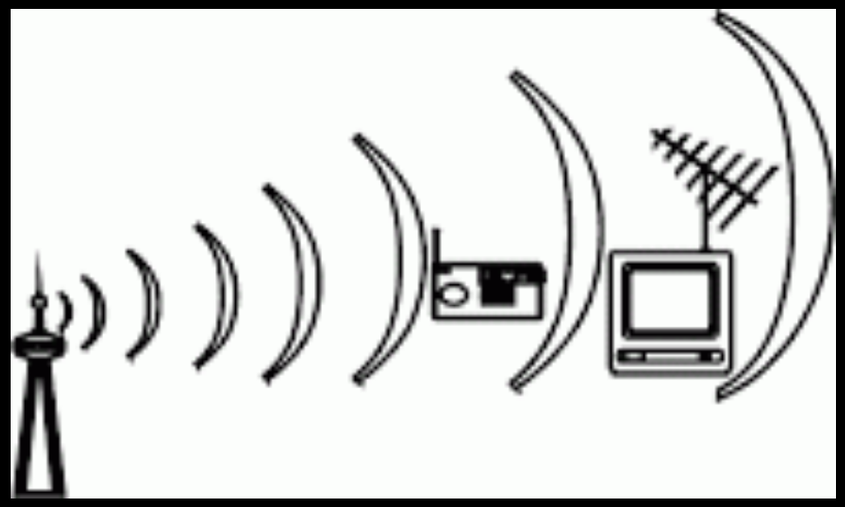
Screw – a rod with a spiral ridge called threads cut into it. Changes turning motion into pulling or pushing itself into or against an object.
Examples: jacks, screws, bolts

Pitch is the distance between the threads.
Closer pitch gives more power, but moves slow.





Waves and Sound



Wave

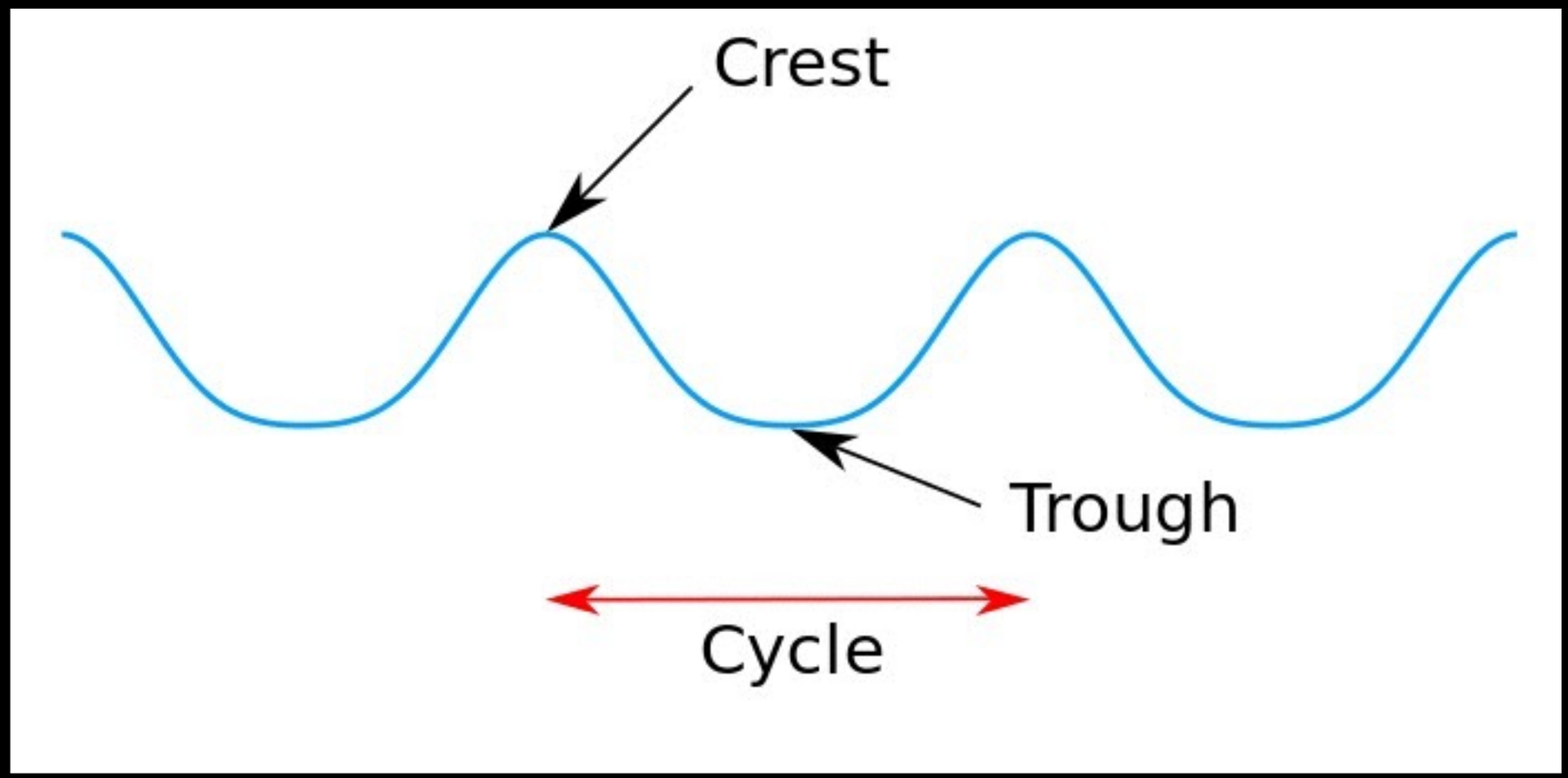
- How energy moves from one place to another.

Medium

- The matter a wave moves through.

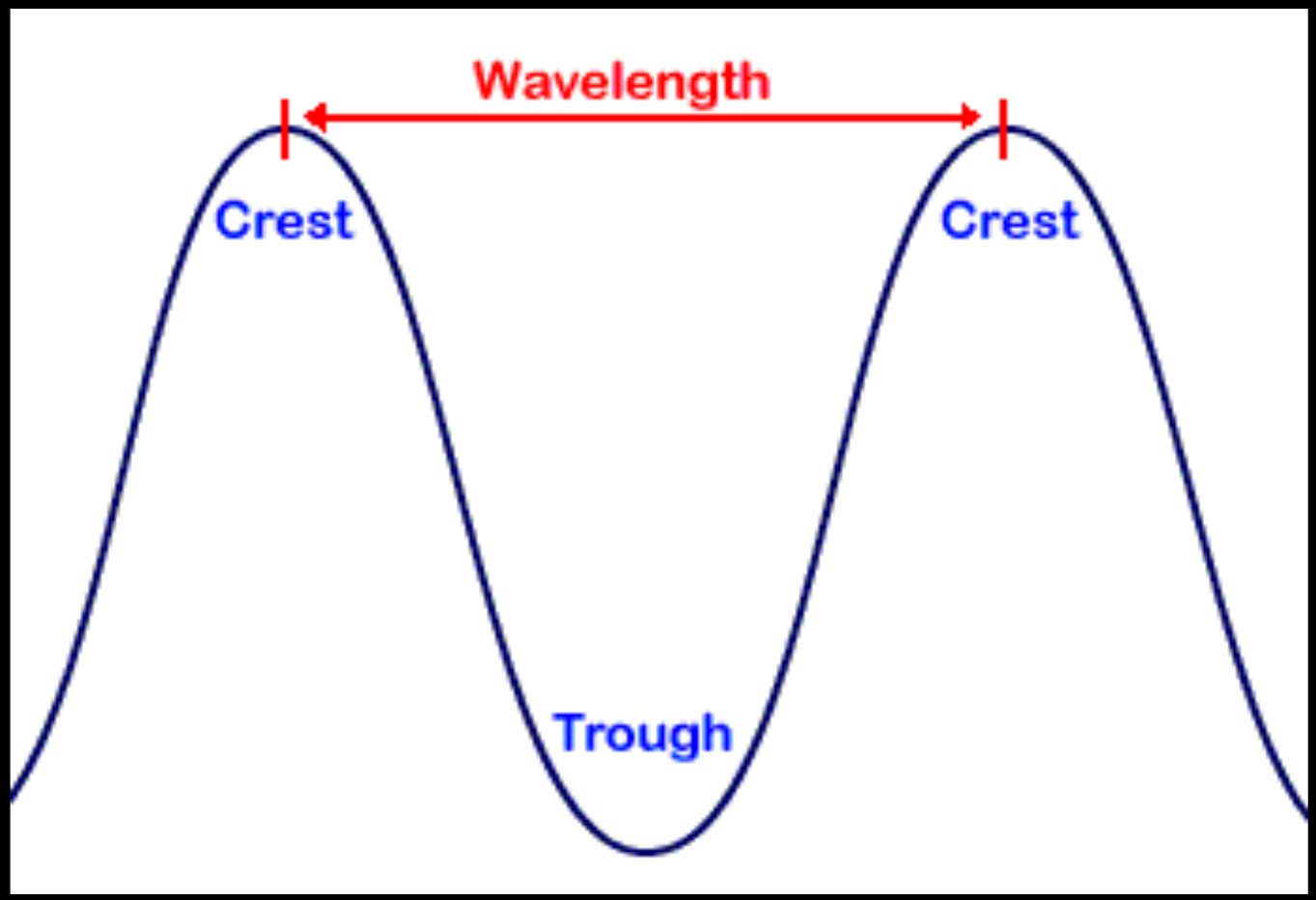
Crest

- The top or peak of a wave.



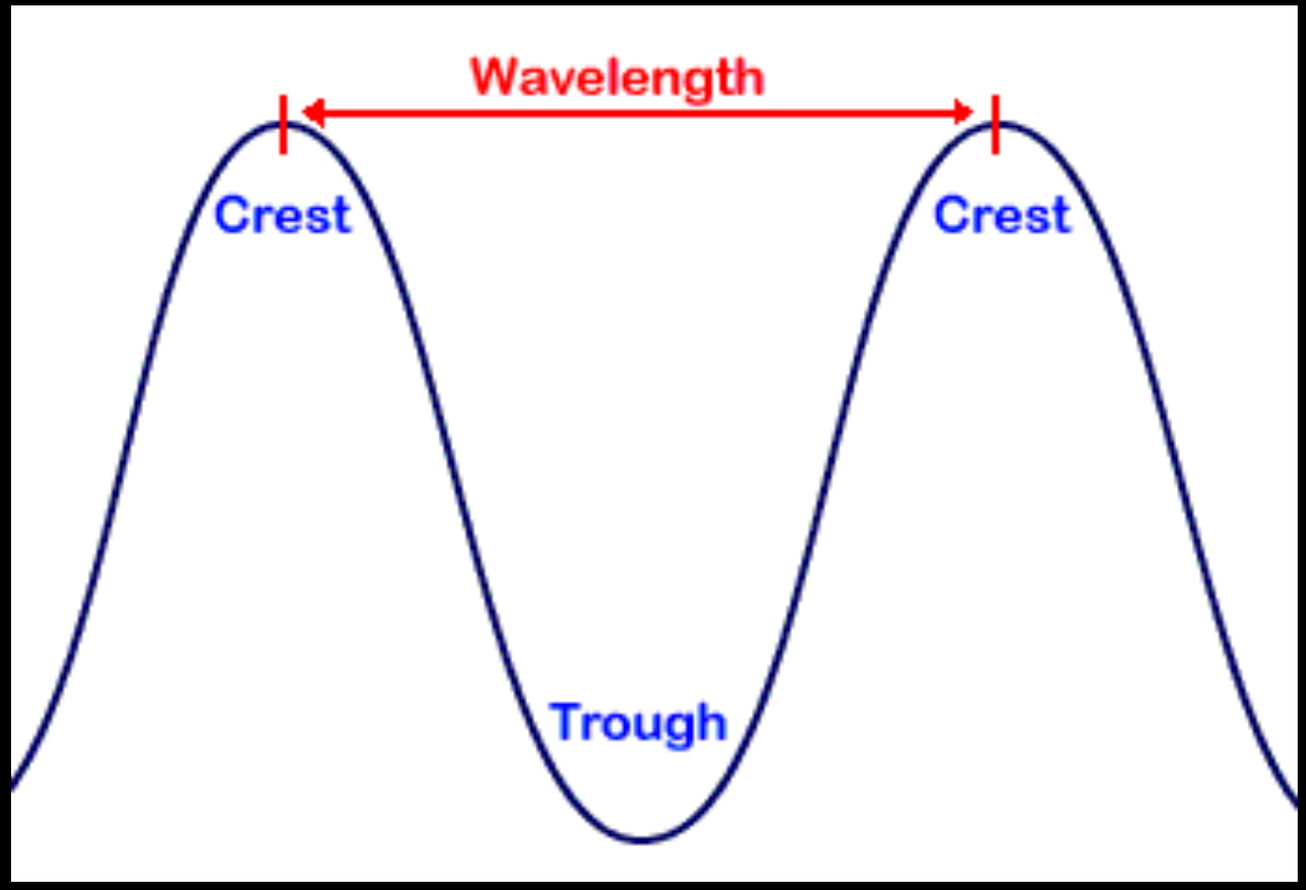
Trough

- The bottom or low point of a wave.



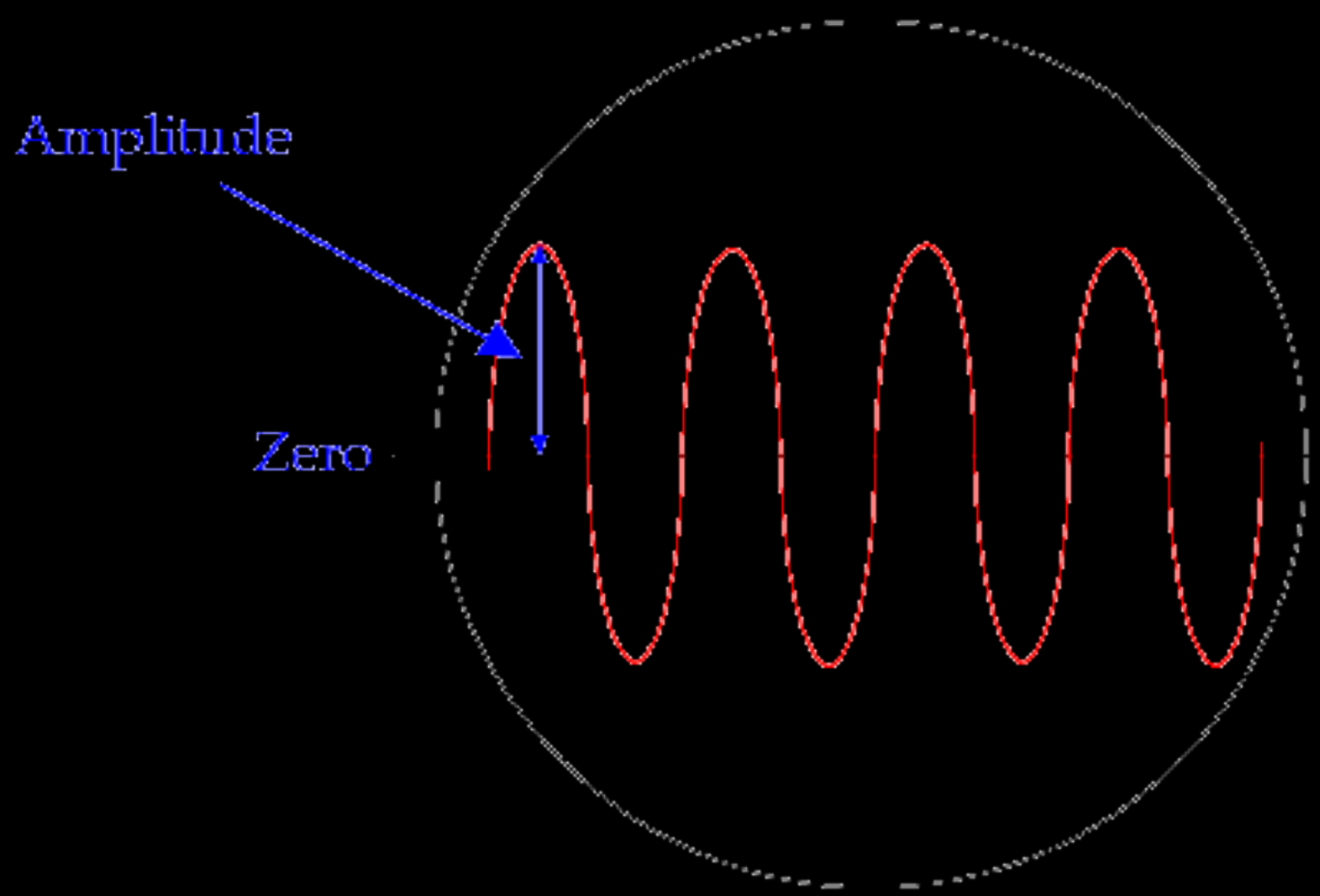
Wavelength

- The distance between two consecutive crest (or troughs) of a wave- measured in meters.



Amplitude

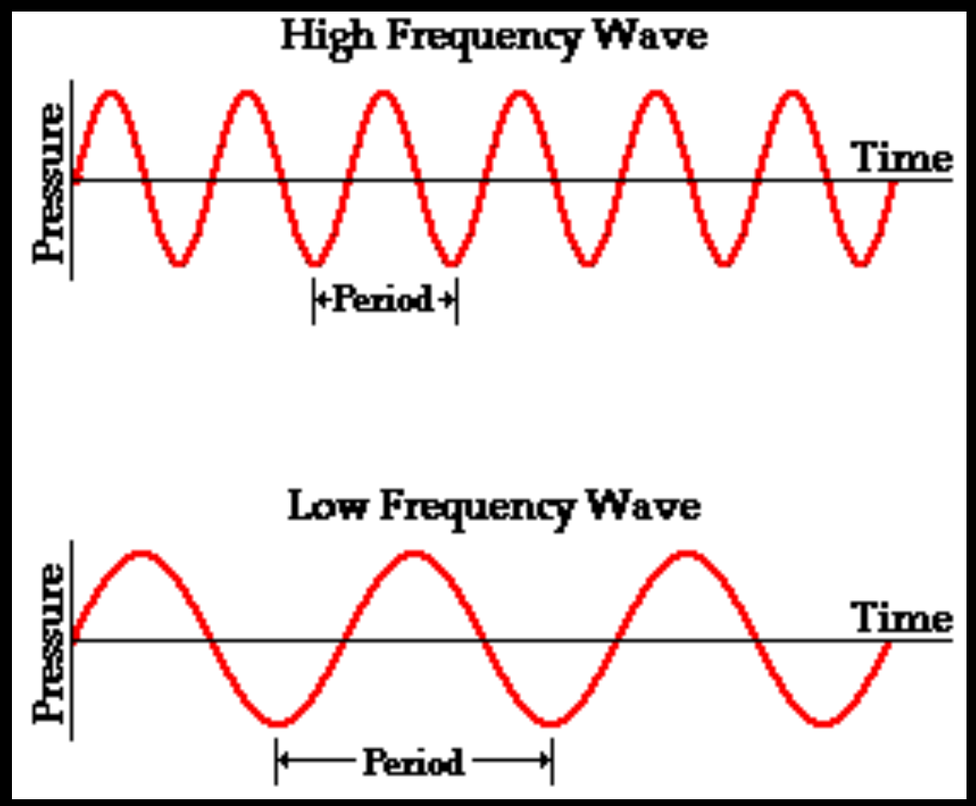
- The height of a wave, from the rest point to the crest- measured in meters.



Frequency (F)

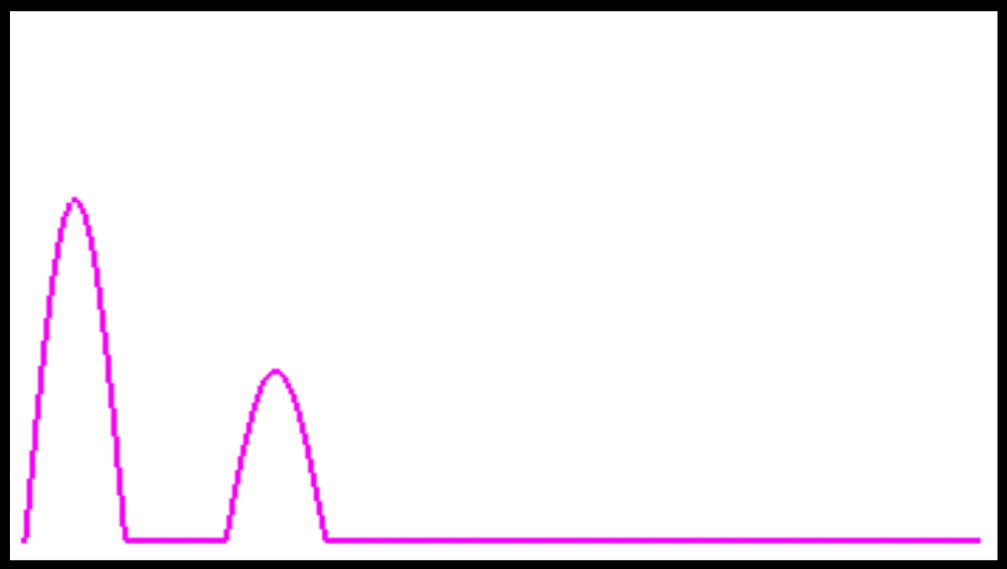
- The number of waves that pass a point each second- measured in hertz (hz)

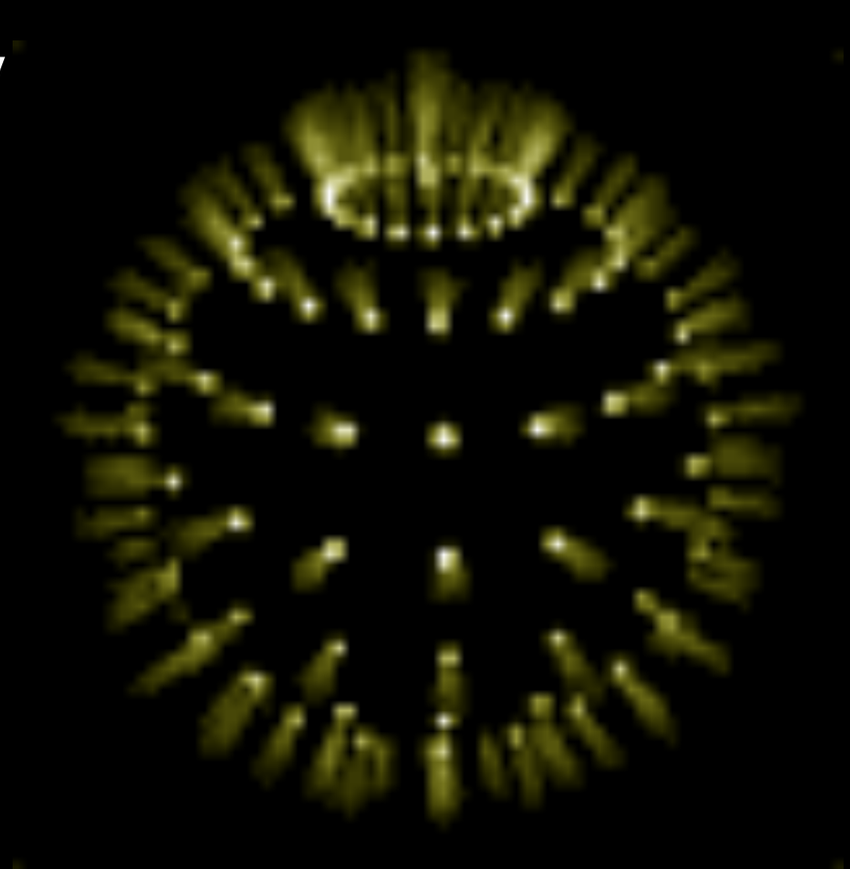
- 1 wave per second= 1 hertz



Velocity (V)

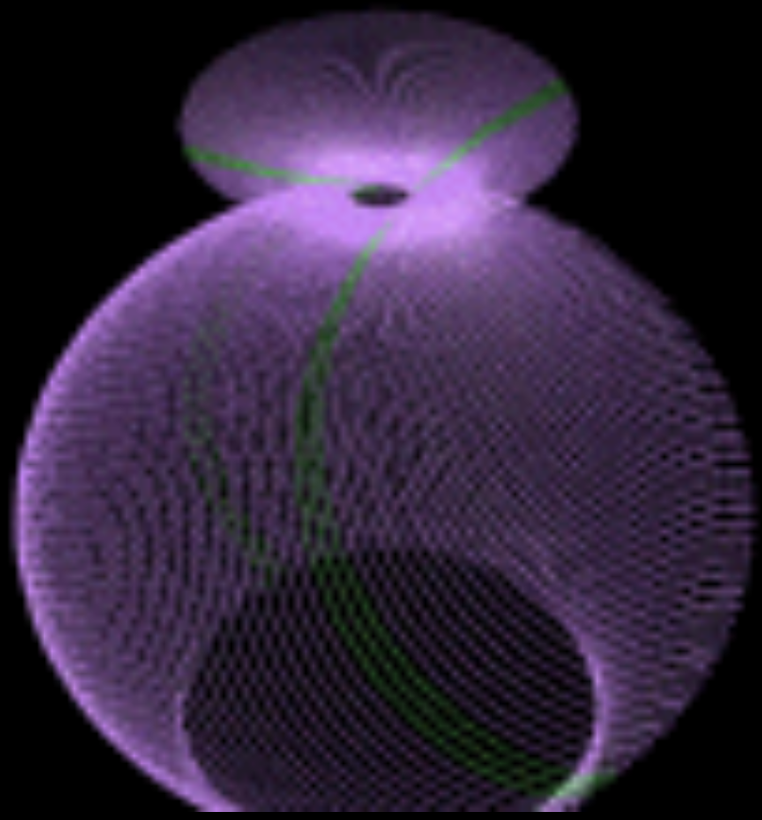
- The speed of a wave- measured in meters per second.
- V = wavelength x frequency

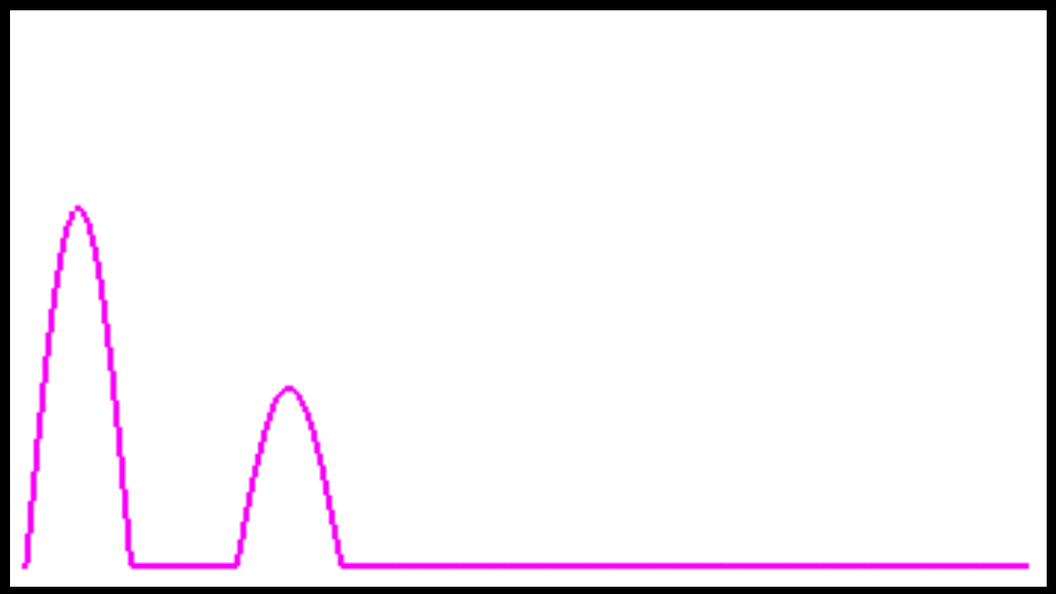




Propagation

- A word for the way waves move or spread out.



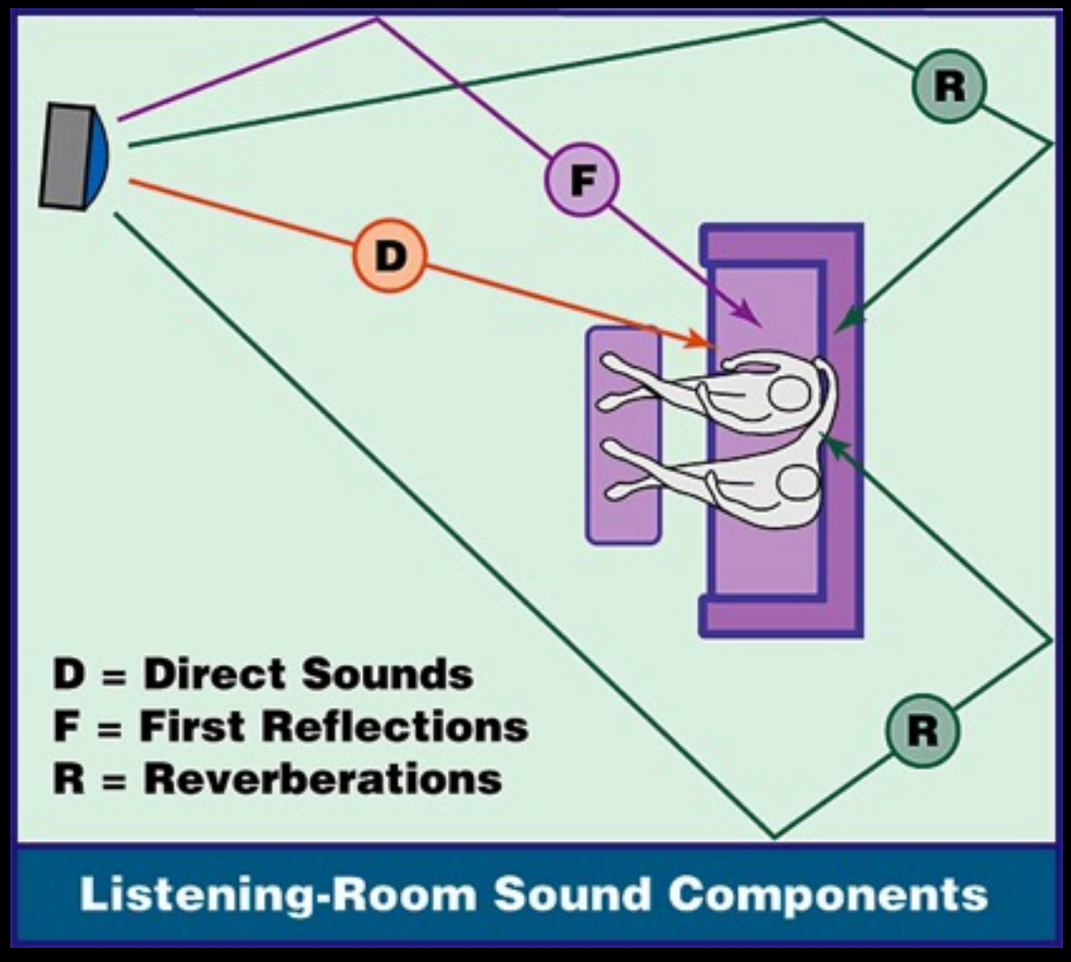


6 Wave Behaviors.

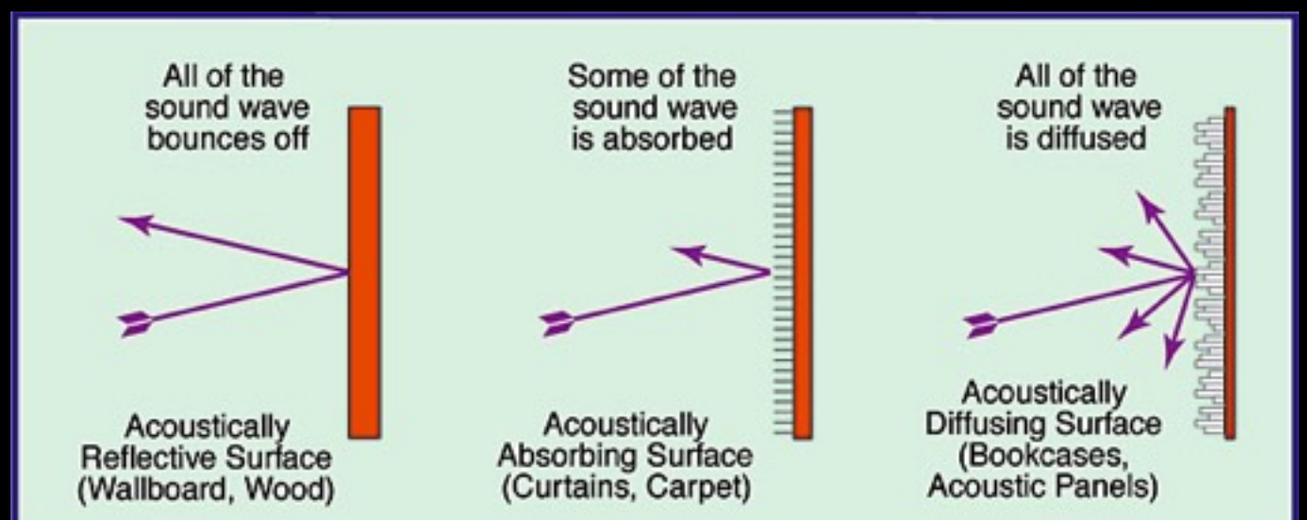
Diana Isabel Burgos-Amaya

Reflection

- Waves bouncing off a barrier
- The waves get inverted (reversed) after they reflect



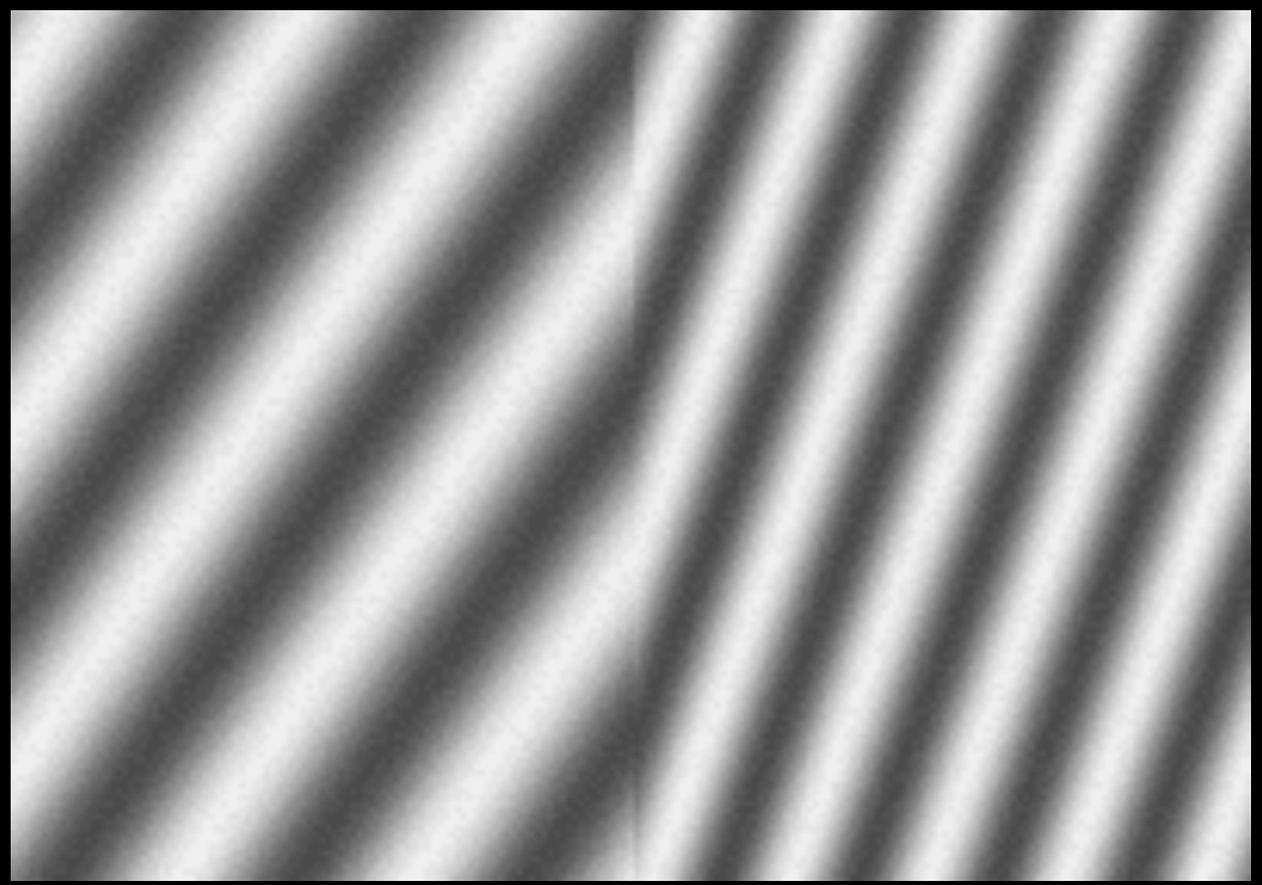
Listening-Room Sound Components



Acoustic Surfaces

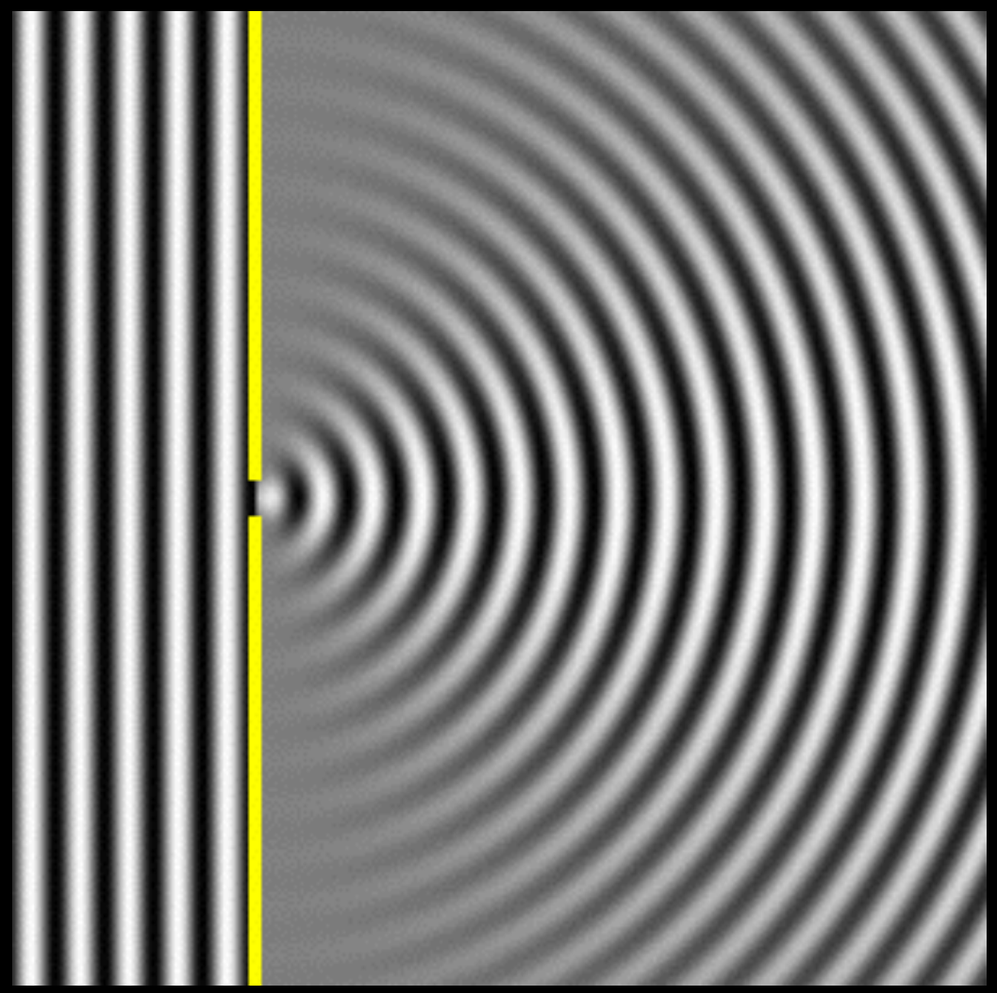
Refraction

- Waves turn or bend because their speed changes
- Waves change speed when they go into a new medium.



Diffraction

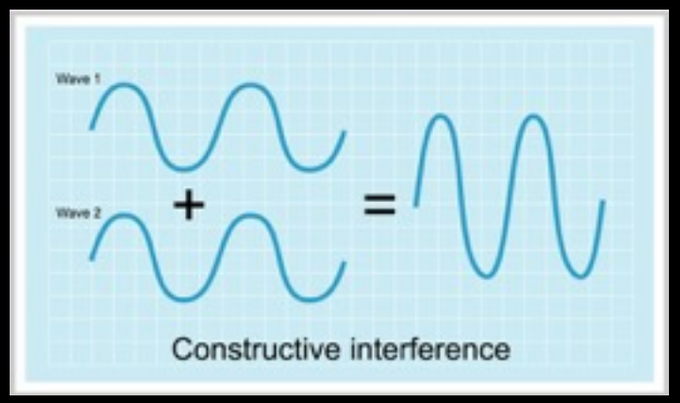
- Waves hit an object, rub along a edge, then continue
- When waves diffract they lose some amplitude.

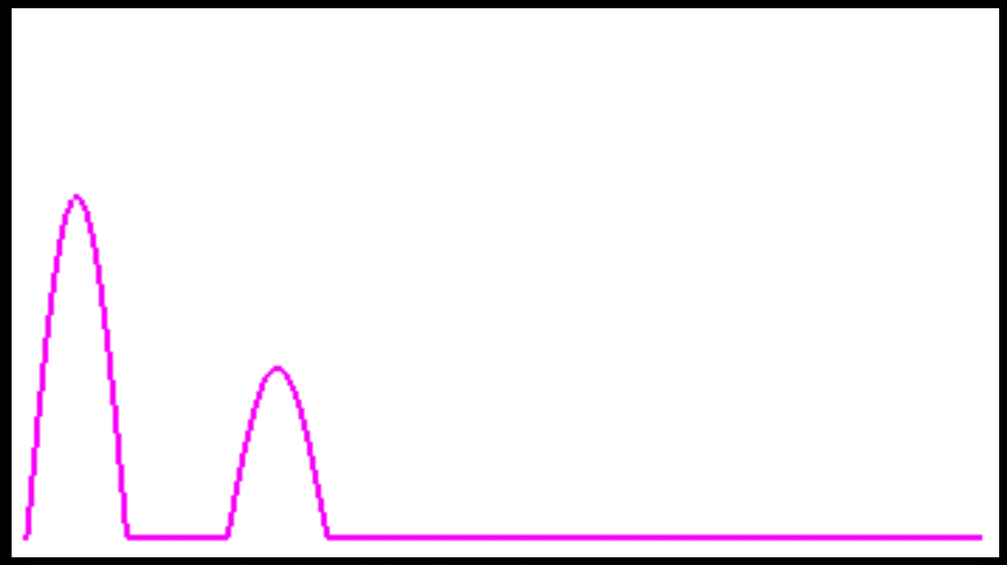


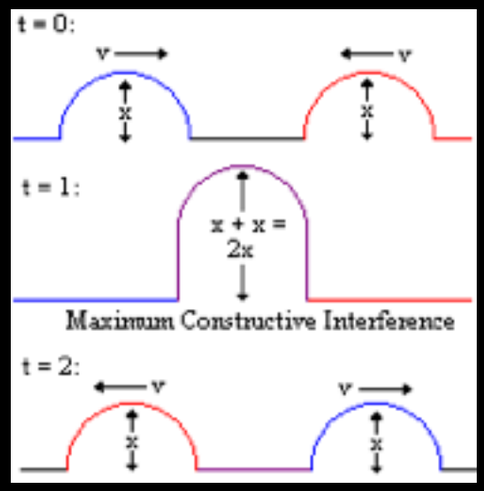
Diana Isabel Burgos-Amaya

Constructive Interference

- Two wave crest approach, collide, combine then separate- the giant wave is called an Anti-node"

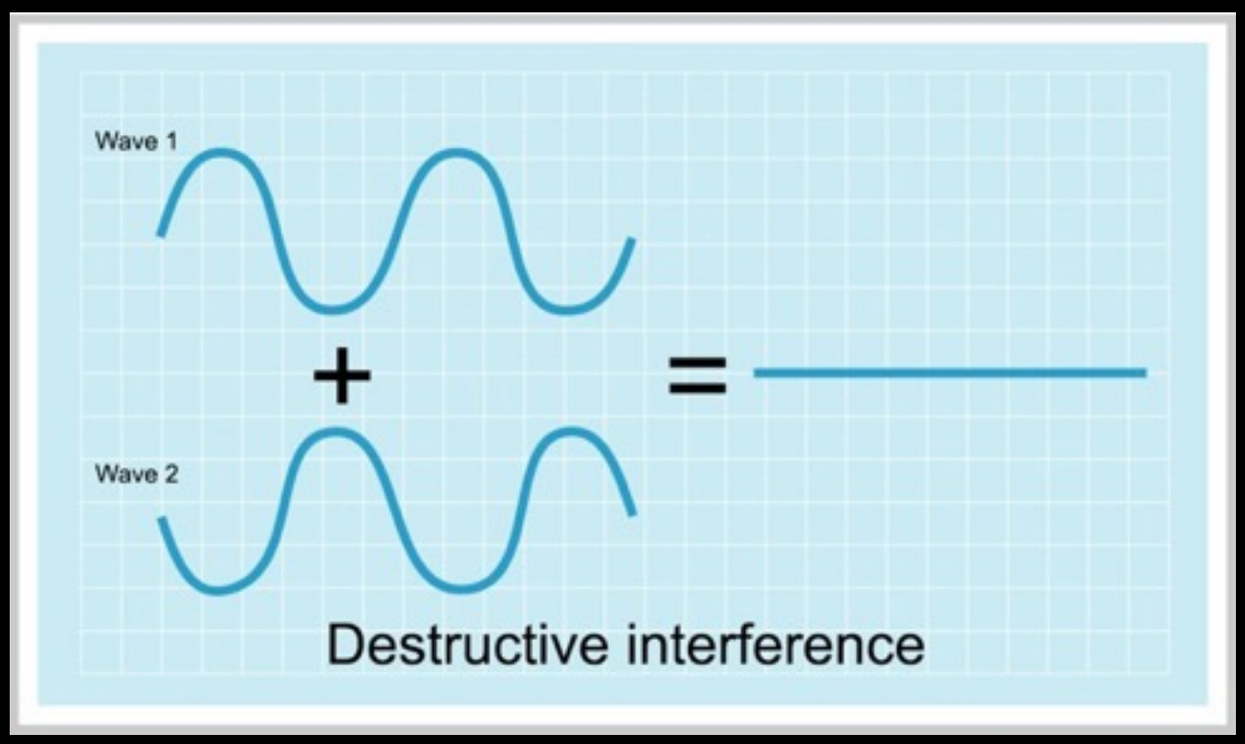


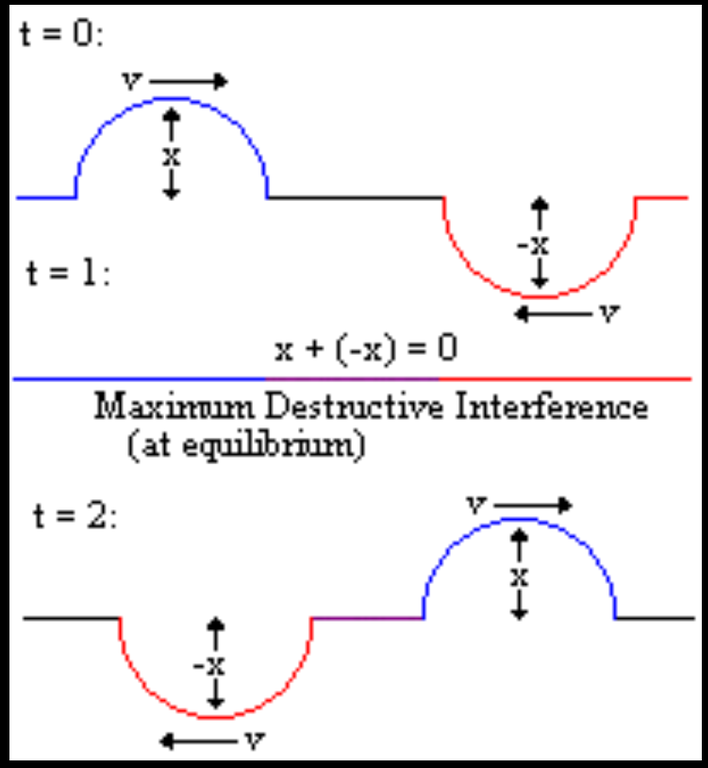




Destructive interference

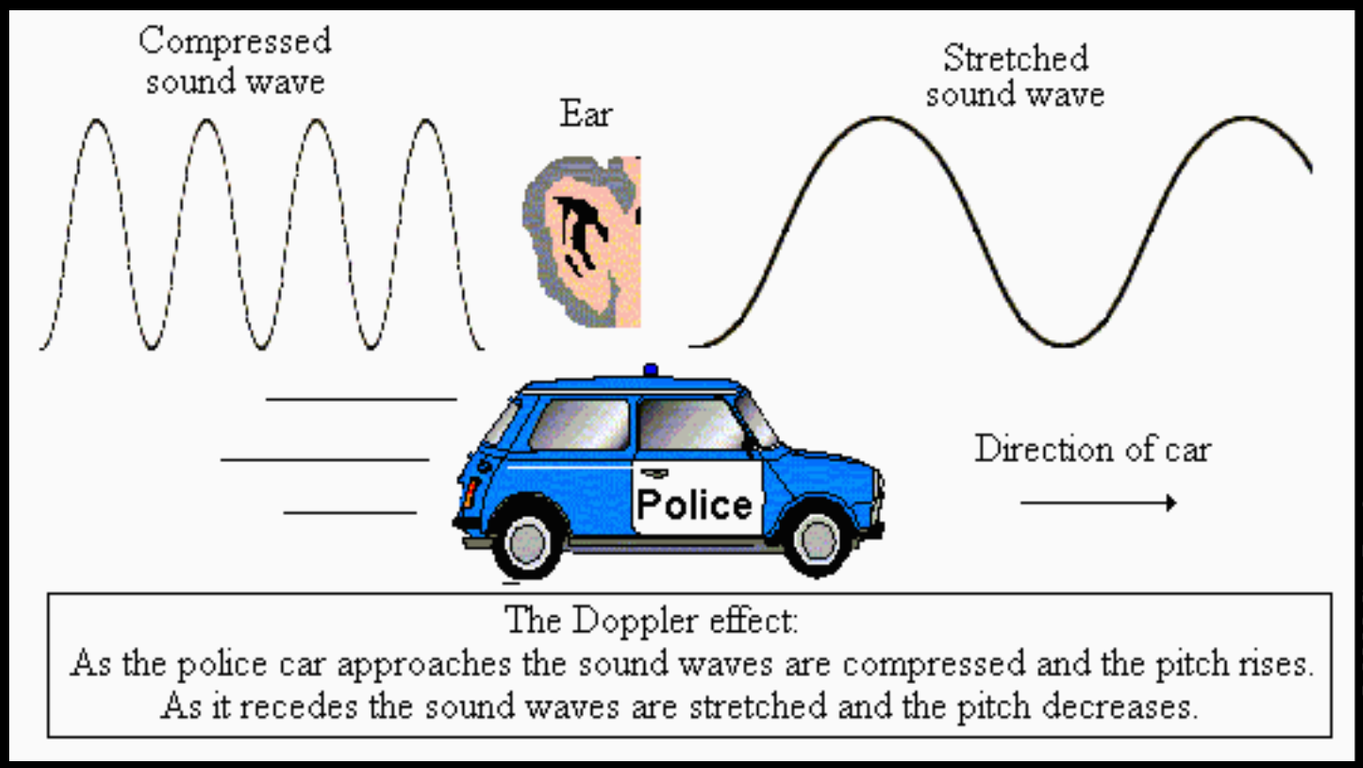
- A wave crest and a wave trough approach, collide and cancel each other out then separate- the flat spot is called a "Node"





The Doppler effect.

- The apparent change in the frequency of a wave, caused by the motion of the wave maker or the wave observer.



Doppler Effect videos.

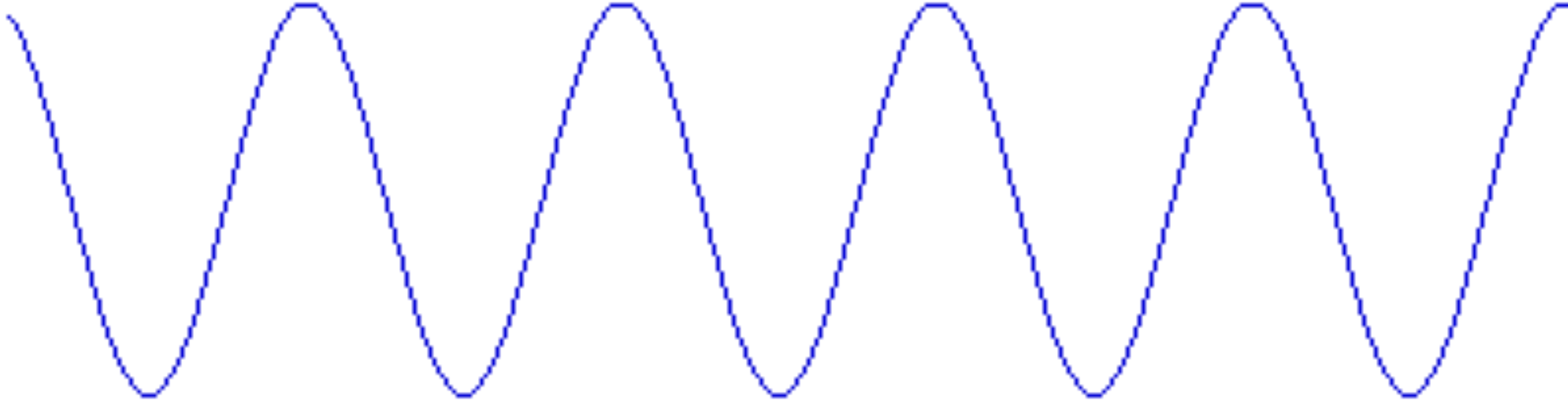
- http://m.youtube.com/watch?v=5eEFBiI6IOo (horn train)
- http://m.youtube.com/watch?v=yq-QP_95U-0 (Indonesia train)

Sound

Waves or vibrations that the human ear can detect.

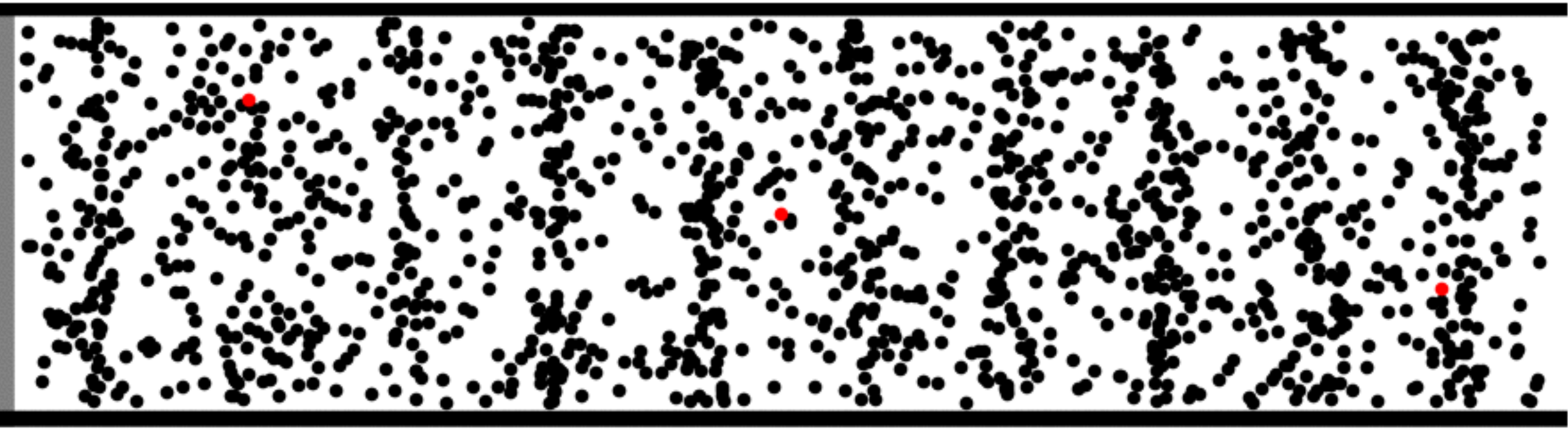
Transverse Waves

Waves that move up and down as the move ahead



Longitudinal (Compression) Waves

Waves that move forward and back as the waves move ahead



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Speed of Sound in Air

770 miles per hour (343 meters per second) is the fastest speed of sound in the air.

This jet is breaking the sound barrier.

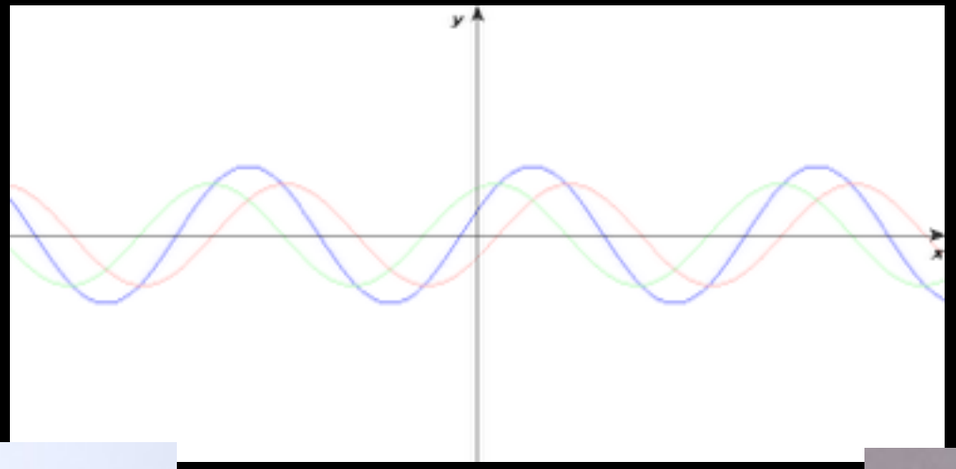
http://m.youtube.com/watch?v=gWGLAAYdbbc

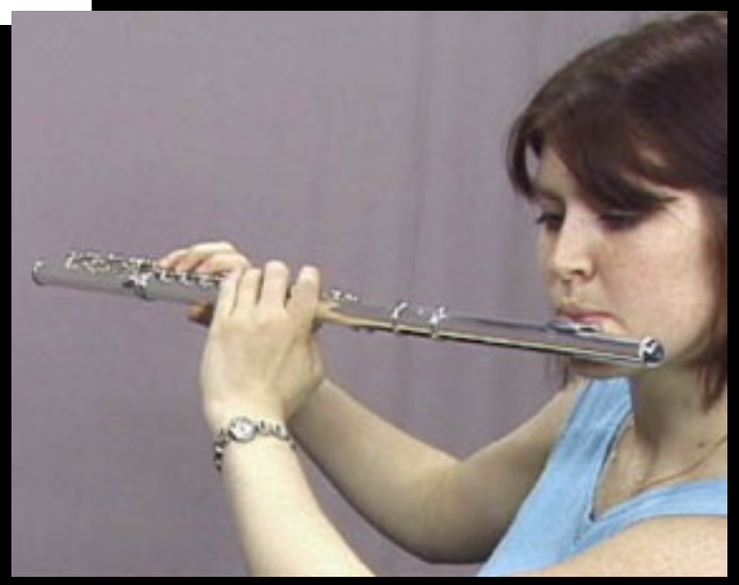
Fastest Jet in the World

The fastest jet in the world can go 3,529.6 km per hour

Pitch

The highness or lowness of a sound
Pitch depends on the frequency of the sound waves
Pitch is measured in hertz (hz)
Human hearing range for pitch is from 20 to 20,000 hertz





Intensity

The loudness or volume of a sound

Intensity depends on the amplitude of the sound waves

Intensity is measured in decibels (db)

Human hearing range for intensity is from 0 to 120 decibels - over 120 db causes pain and ringing

http://m.youtube.com/watch?v=_fB8DzjBtz8

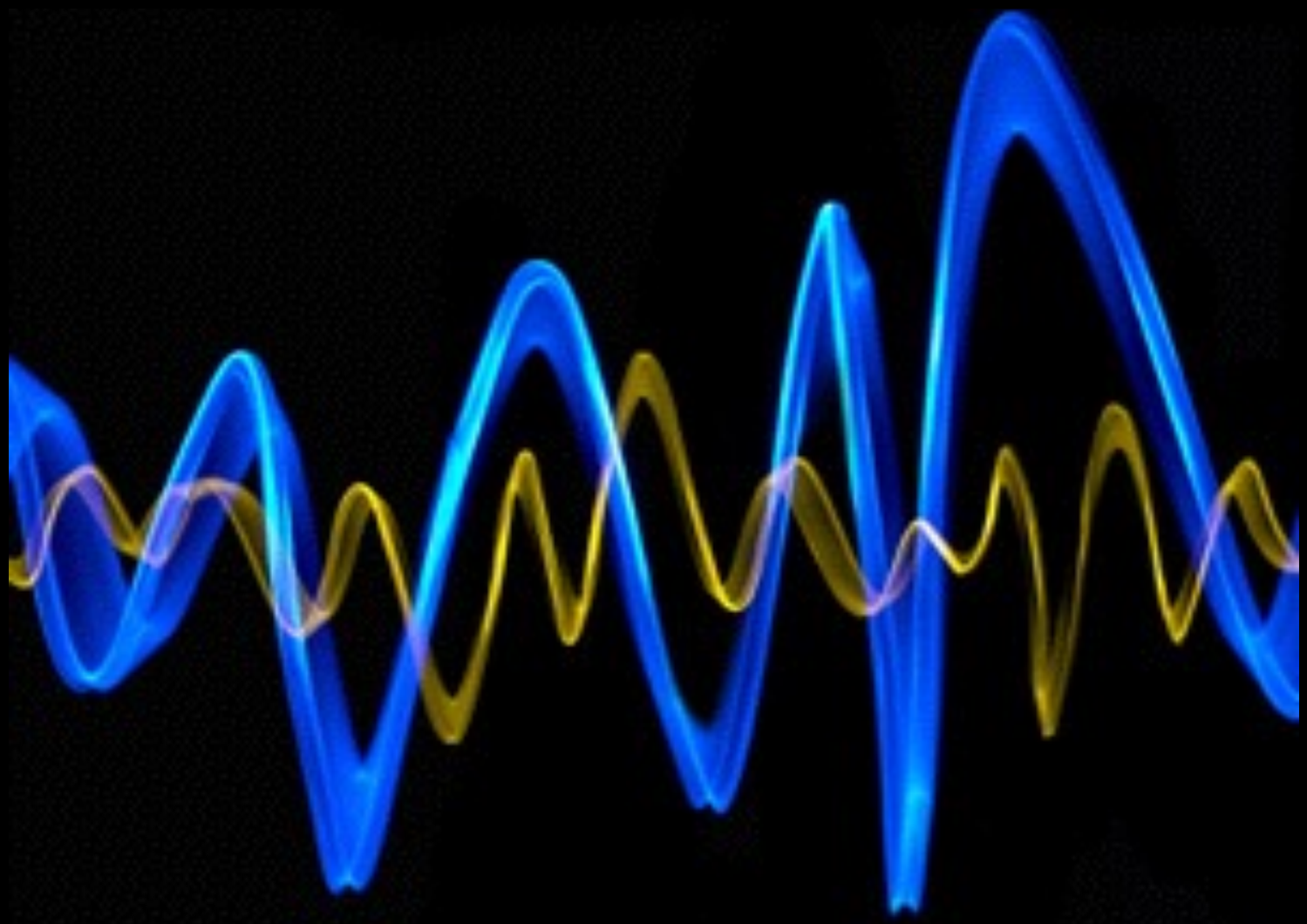
Dog Whistles

kHz - Kilohertz (1,000 Hertz)

Dogs can hear up to 45 kHz, while cats can hear up to 64 kHz, humans can only hear up to 20 kHz. The highest frequency for dog whistles are 54 kHz.

Acoustics

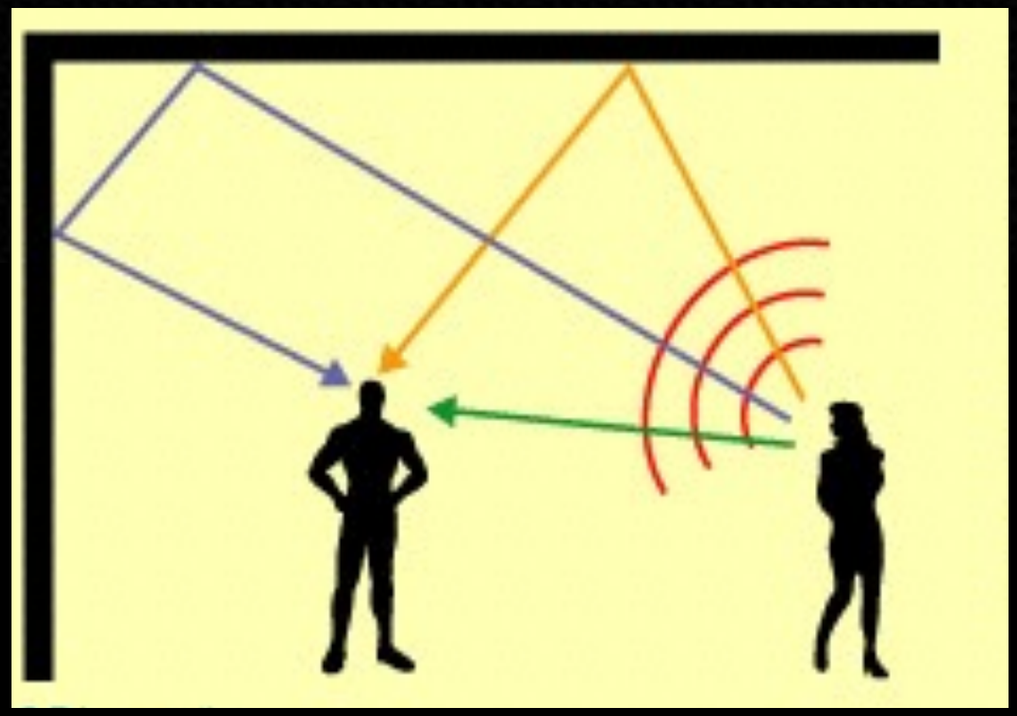
The study of sound



Quietest Room in the World

http://m.youtube.com/watch?v=mXVGIb3bzHI

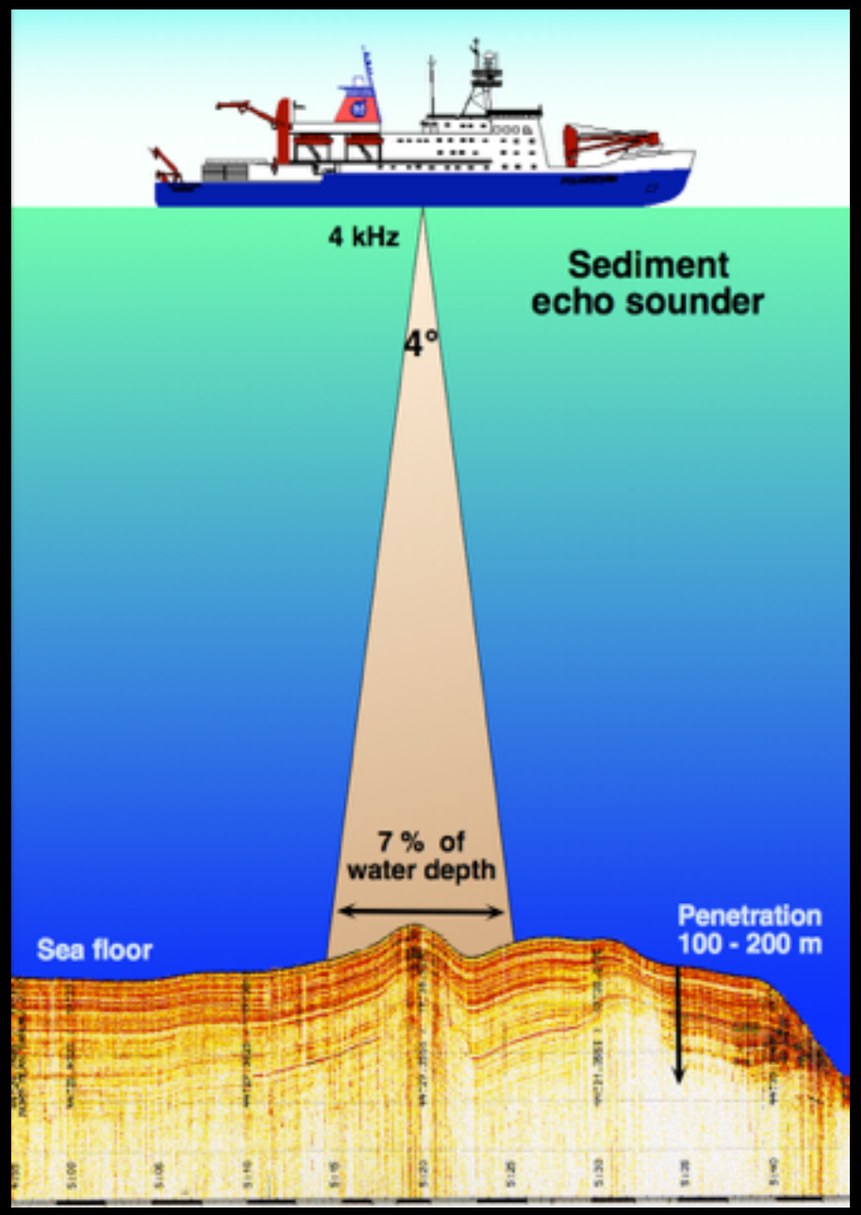
Reverberation

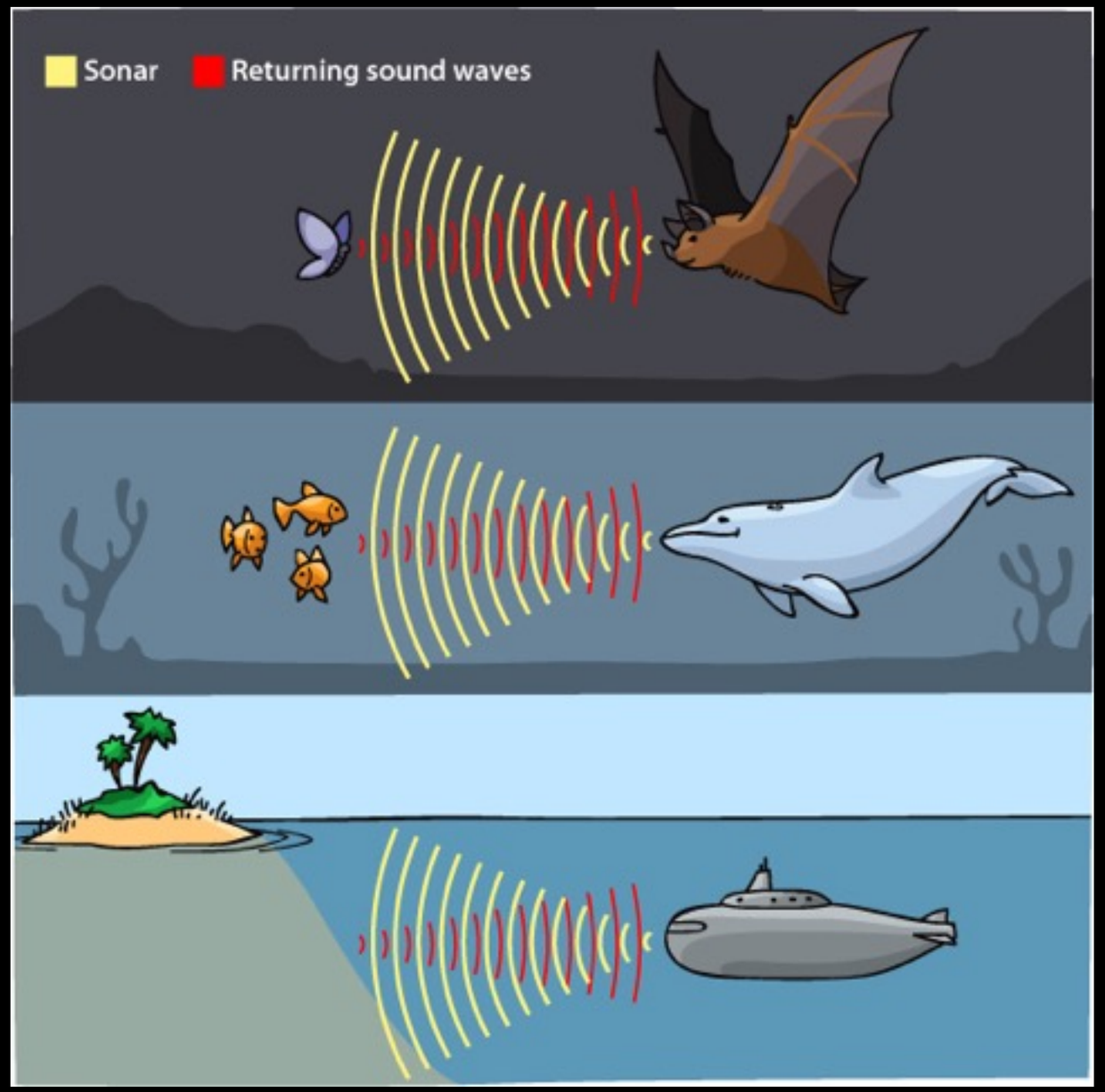


Multiple reflections of a sound wave - less than 1/10 of a second apart

Echo

The reflection of a sound greater than 1/10 of a second part - e can hear the echo





Other Uses for Sound Waves

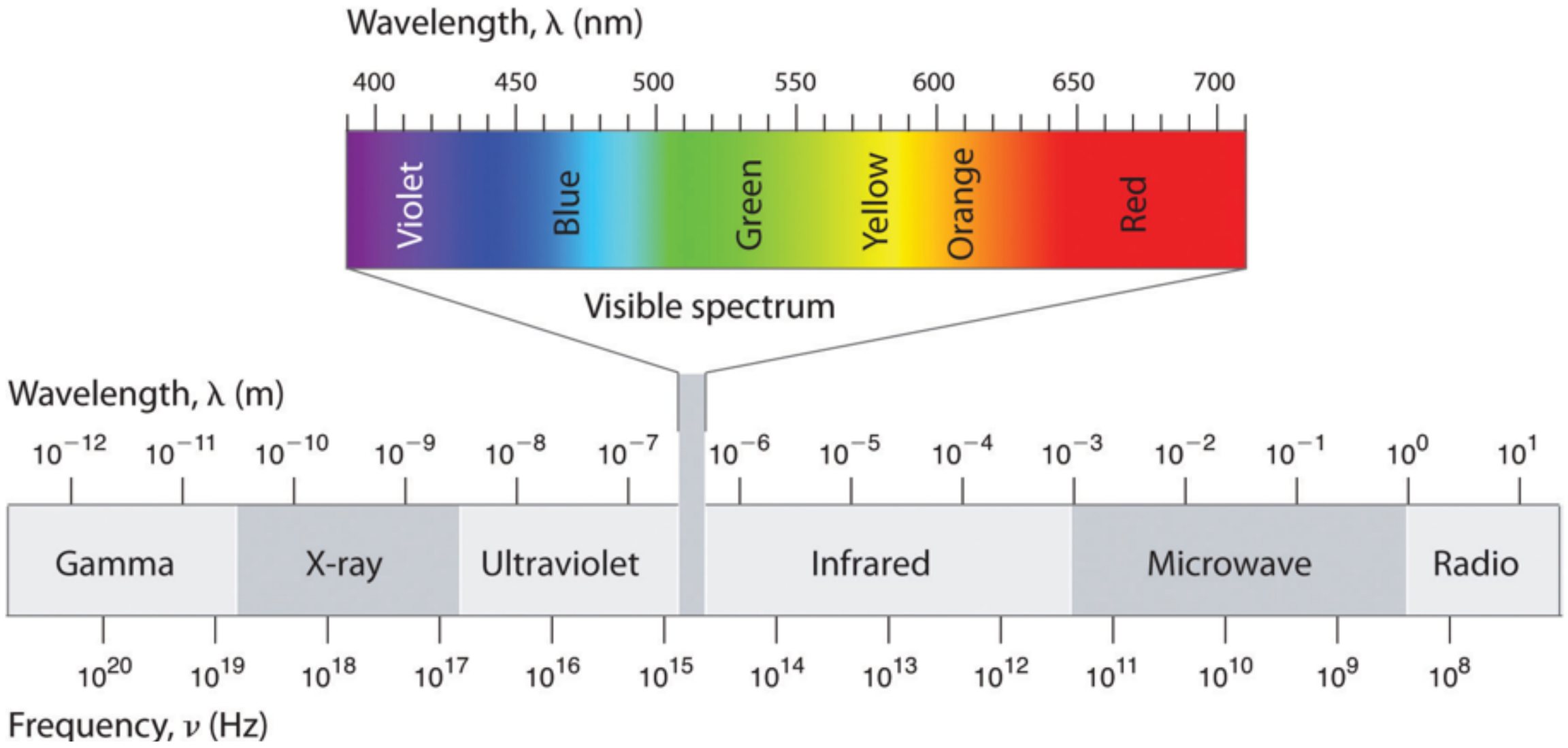
Sonar, Ultra-Sounds, Ultrasonic Cleaners, Ultra-Sonic Humidifiers

Light

Electromagnetic Wave Spectrum

<u>Electromagnetic Wave Spectrum (Family)</u> – waves that are produced and affected by electricity and magnetism

Short Wavelength (10 meters) Long Wavelength (10 meters)
High Frequency (10 hz) Low Frequency (10 hz)



LIGHT

Light – electromagnetic waves that human eyes can sense – light is emitted and absorbed like a particle, but travels like waves

Photon – a particle or packet of light energy

Speed of Light in a vacuum – 186, 000 miles per second (300,000 Kilometers per second)

Jacob Libby

Ways To Create Light

Incandescence – a material gets so hot that electrons move and it glows
example - typical light bulbs

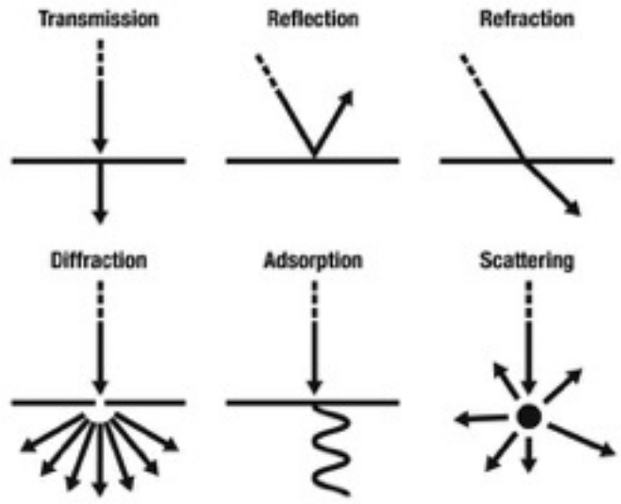
Fluorescent – a material that glows when it is hit by strong rays, forcing electrons to move
example - Fluorescent and CFL bulbs

Passing Electricity Through a Gas – the gas atoms are struck by electricity
example - Neon Signs

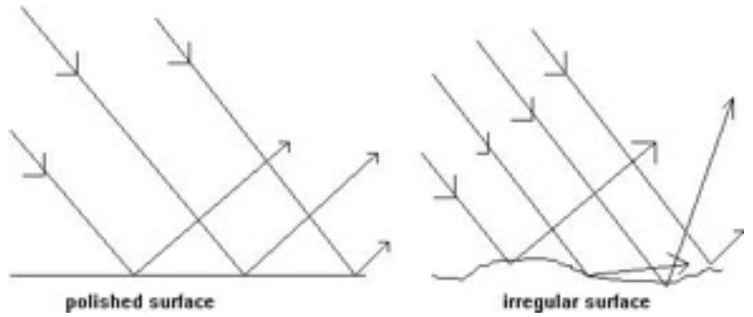
Chemical Reactions – the reaction forces electrons closer to the nucleus.
example - Glowsticks

What happens when light hits something?

1. Transmission – passes through a material
   A. Passes straight through
   B. Refracted – the light turns or is bent as it goes through
   C. Diffused – the light is scattered or broken up by the material

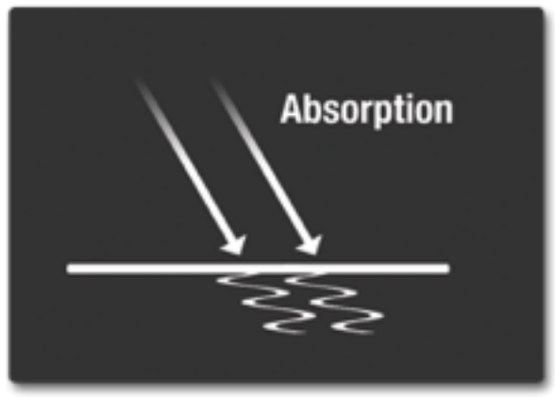


2. Reflection – the light bounces off – If it bounces off smoothly we see an image called a reflection or it is if it bounces off scattered it is called diffraction and it allows us to see the surface of the object.



Reflection Diffused

3. Absorption – the light get stuck in the material



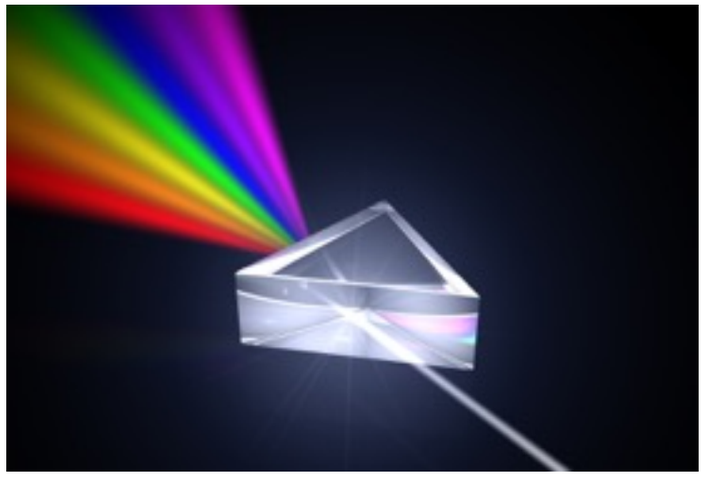
3 Types of Materials https://engagor.com/wp-content/uploads/2014/01/transparent-piggy-bank.jpg

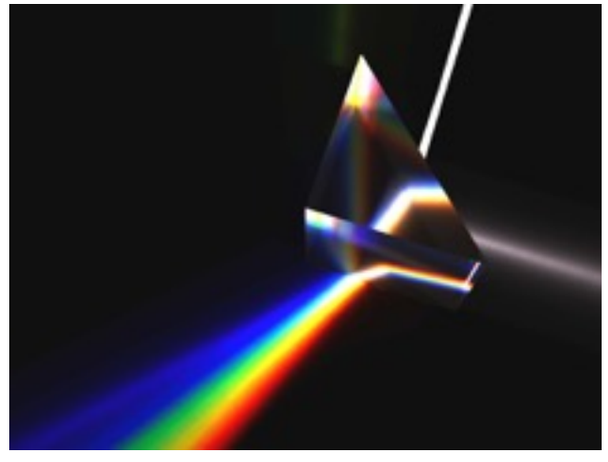
Transparent – lets light pass through so we can see images through it

Translucent – light passes, but we cannot see images through it

Opaque – no light passes through it at all

Colors of Light





http://m.youtube.com/watch?v=9eEyTw4wylk

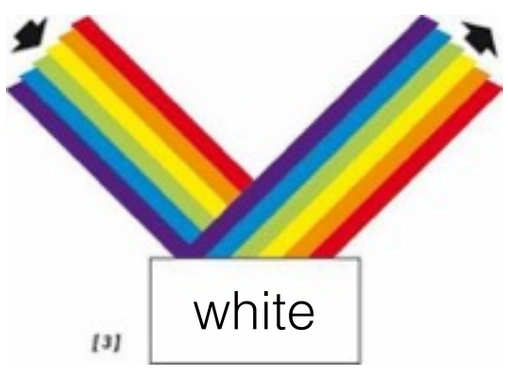
White Light is made of all 7 Colors of the Rainbow– called the Visible Light Spectrum

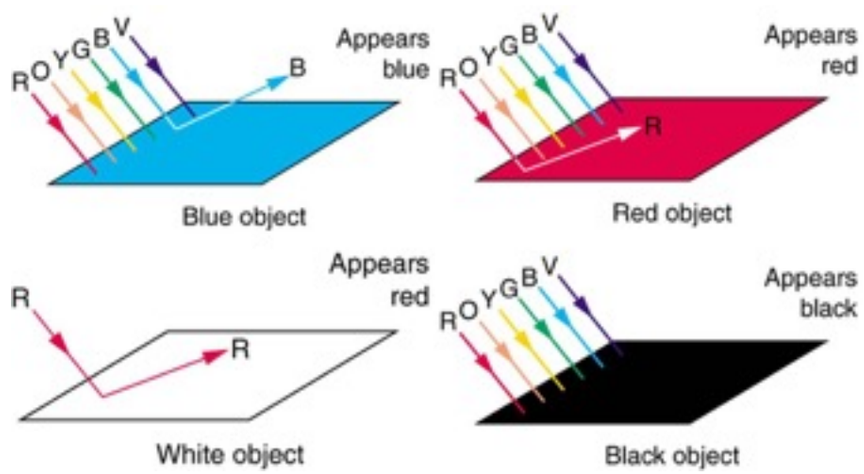
Short Wavelength –(.0000004 meters) **Long Wavelength – (.0000007 met)**

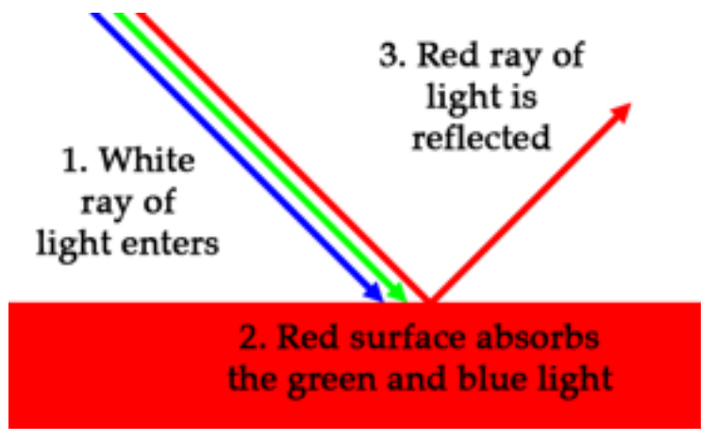
V I B G Y O R

High Frequency – (800,000,000,000,000 hz) **Low Frequency –(400,000,000,000,000 hz)**

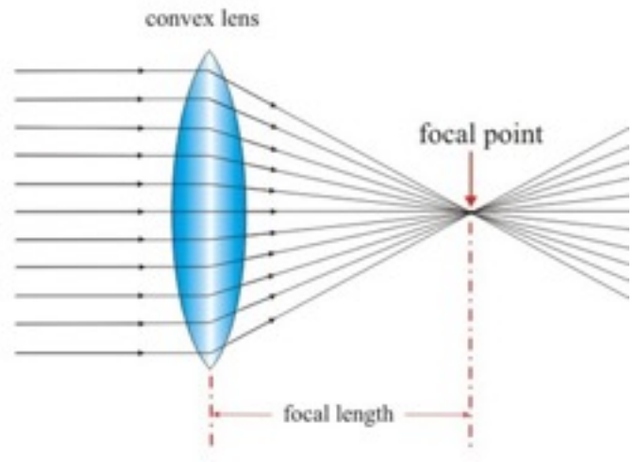
When we see white – all colors are bouncing off and hit our eyes
When we see black – no colors are bouncing off – all are getting absorbed - none hit our eyes
When we see one color – only that particular color is bouncing off and hits our eyes

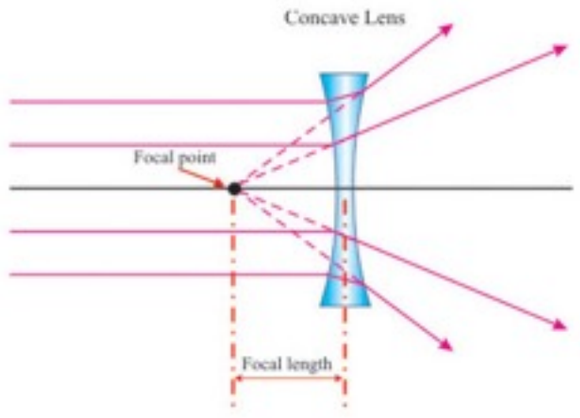






Devices that Change Light





<u>3 Devices that Change Light</u>

1. Lens – a transparent material shaped to refract(bend) light

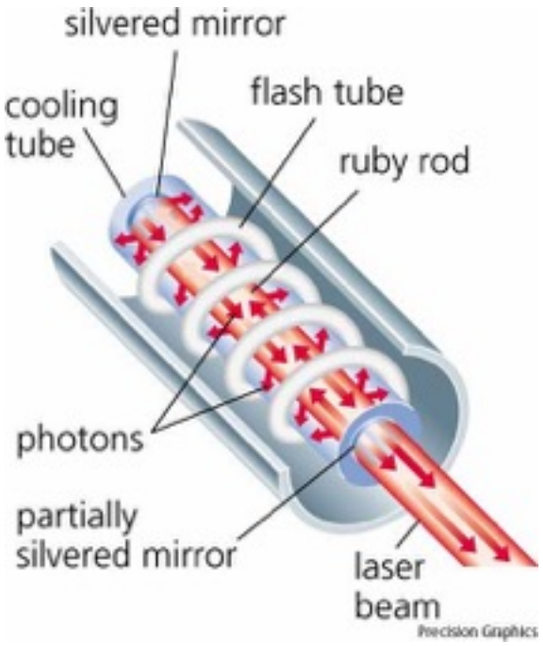
Convex Lens – curved out, thicker in the middle– bends light inward

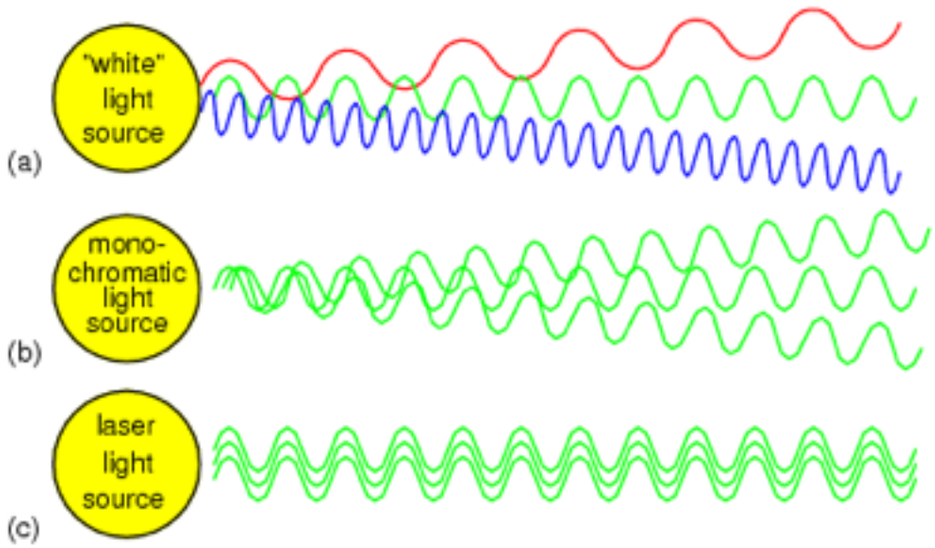
Concave Lens – curved in , thinner the middle – bends light outward

2. **Mirror – a smooth material the reflects light so an image can be seen**

3. **LASER – L -light A - amplification (by) S - stimulated E - emission (of) R - radiation**

Laser





<u>3 things that make LASER light special</u>

Monochromatic- only one color of light comes out

Coherent – all of the light waves crests and troughs are lined up, in step

Travels in a Plane Wave Front - the light waves travel in straight, parallel lines. They don't spread .