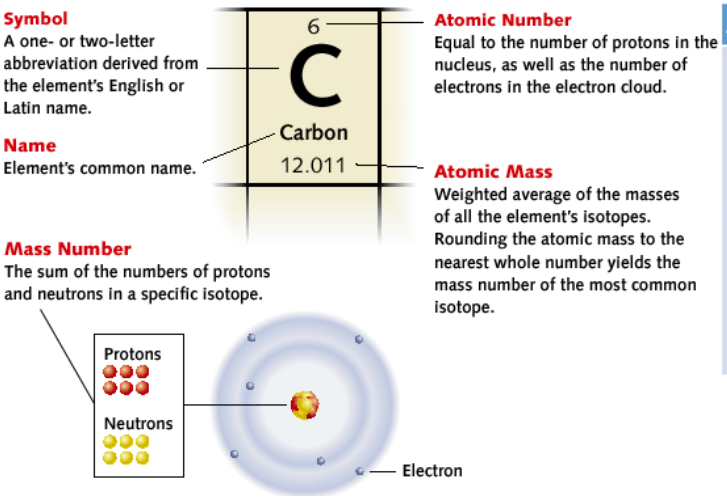
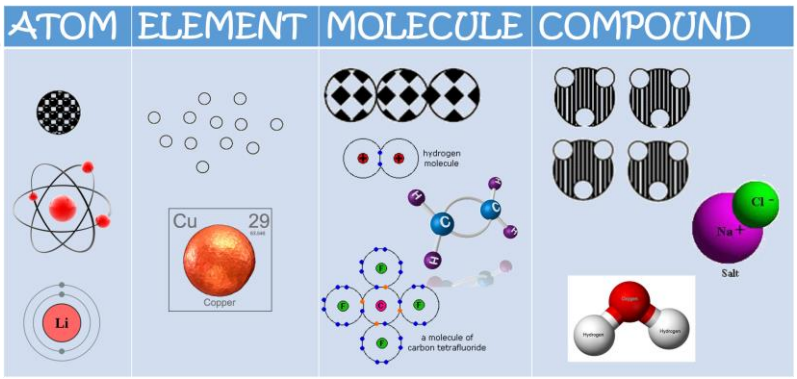
Physical Science Study Guide Notes

Standard S8P1 Students will examine the scientific view of the nature of matter

a. **Distinguish between atoms and molecules**.

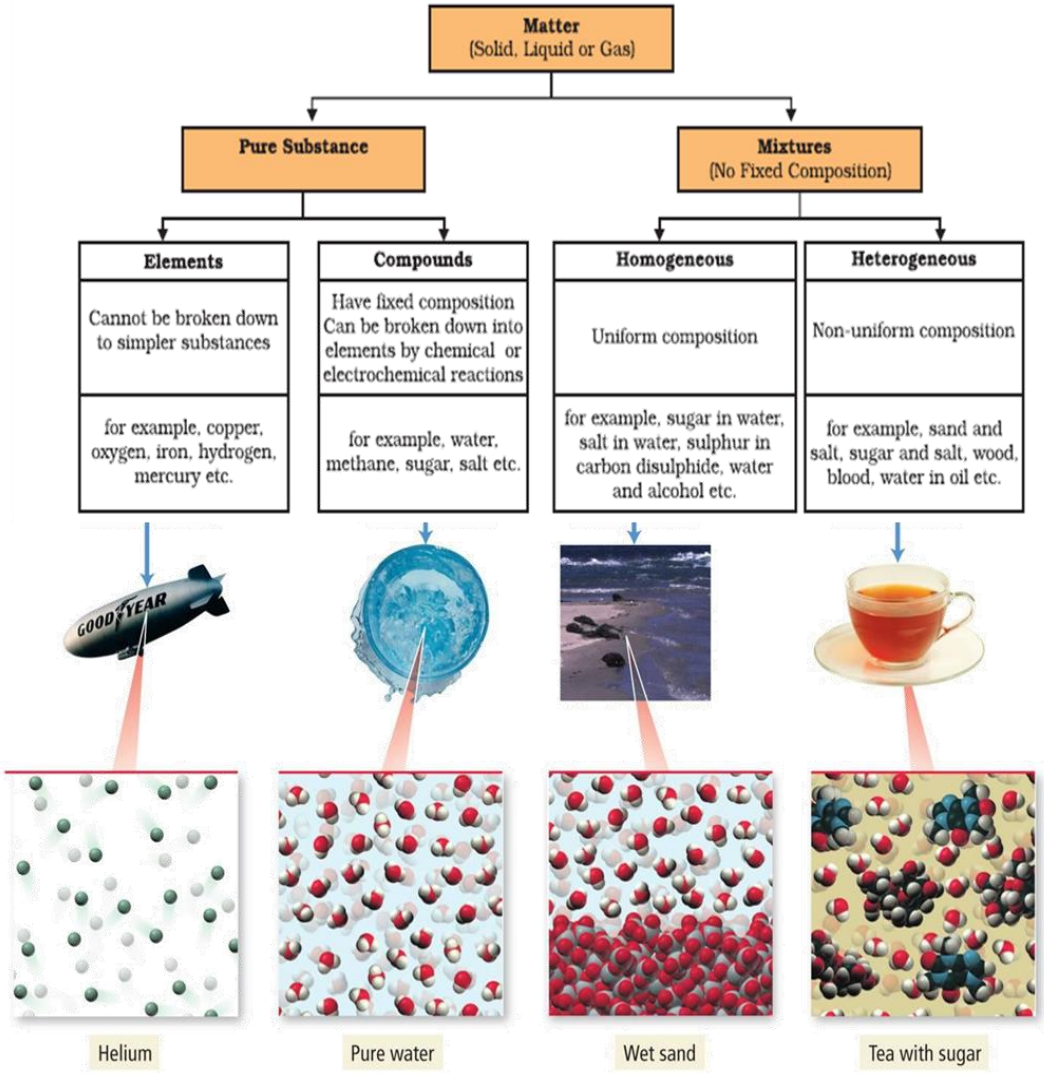
- Matter is made up of tiny moving particles called **atoms** and **molecules**.
- Two or more atoms can join together to form a **molecule**.
- Molecules are the "**building blocks**" of matter.
- Atoms are tiny particles composed of **protons, electrons, and neutrons**.





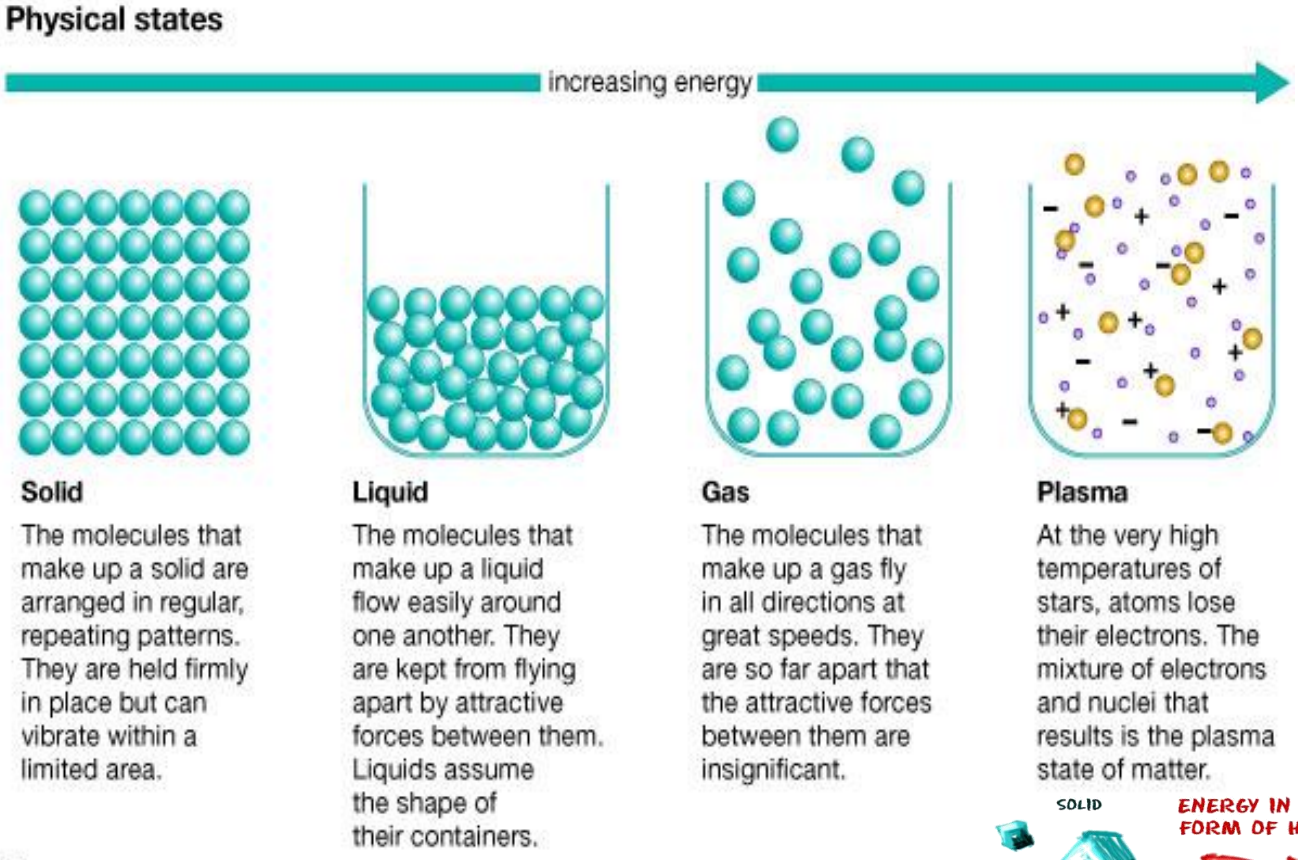
b. **Describe the difference between pure substances (elements and compounds) and mixtures**.

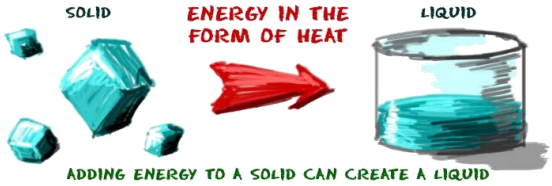
- An **element** is a substance that is made up entirely of the same type of atom.
- A **compound** is a molecule that contains at least two different elements that are *chemically bonded*.
- A **mixture** is made up of two or more substances that can be separated back to their original components (because they are *combined physically* but not chemically



c. <u>Describe the movement of particles in solids, liquids, gases, and plasmas states</u>

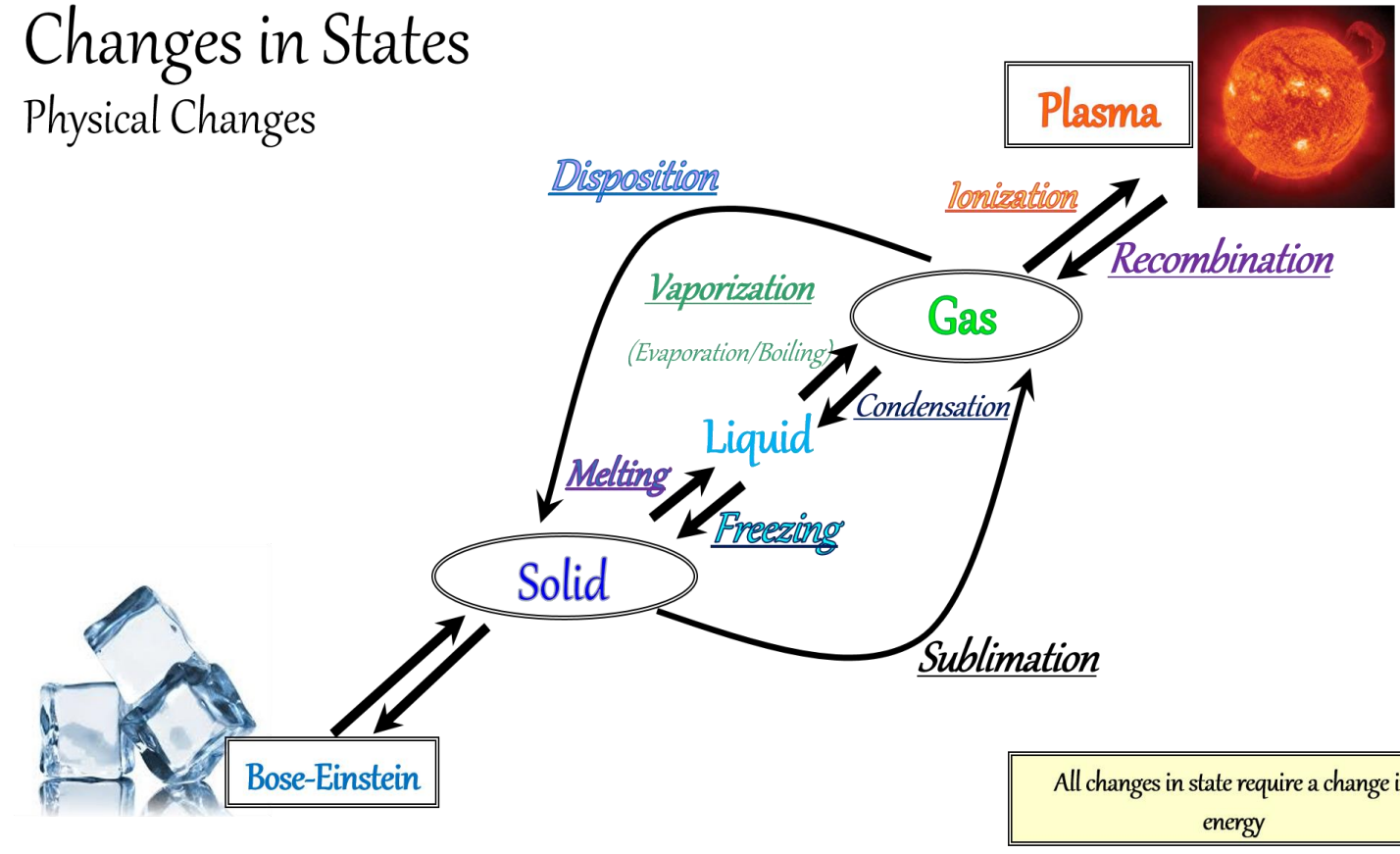
- **In gases, particles move faster than those in liquids or solids.**
- **In liquids, particles move faster than in solids.**
- **There is little movement or space between the particles in a solid substance**





Changes in States

Physical Changes



All changes in state require a change in energy

<u>d. Distinguish between physical and chemical properties of matter as physical (i.e., density, melting point, boiling point) or chemical (i.e., reactivity, combustibility).</u>

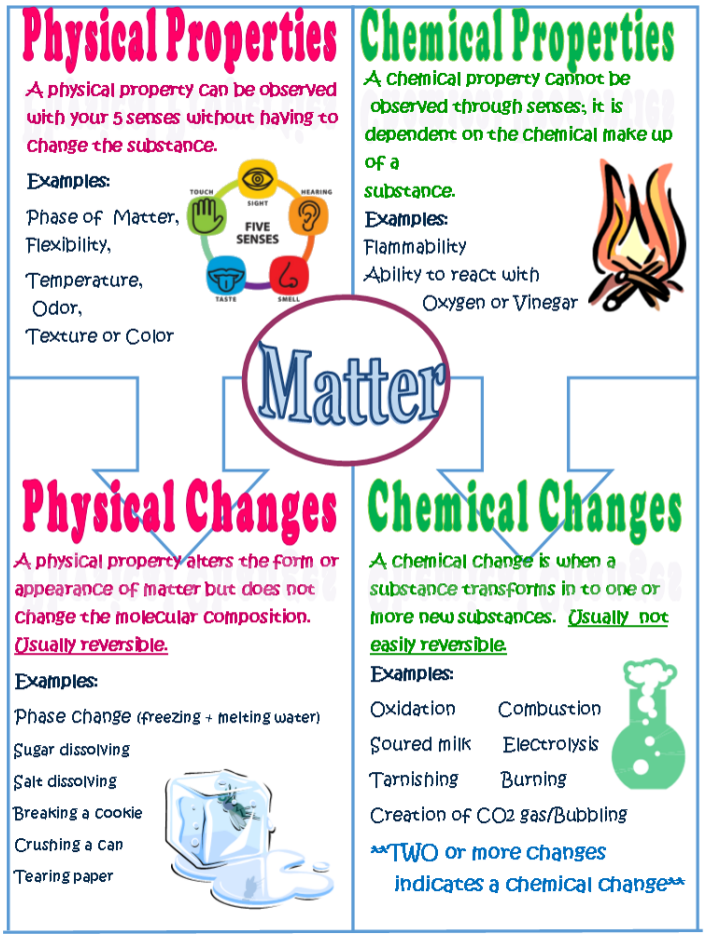
- **What do properties mean?** The properties of a substance are those characteristics that are used to identify or describe it.

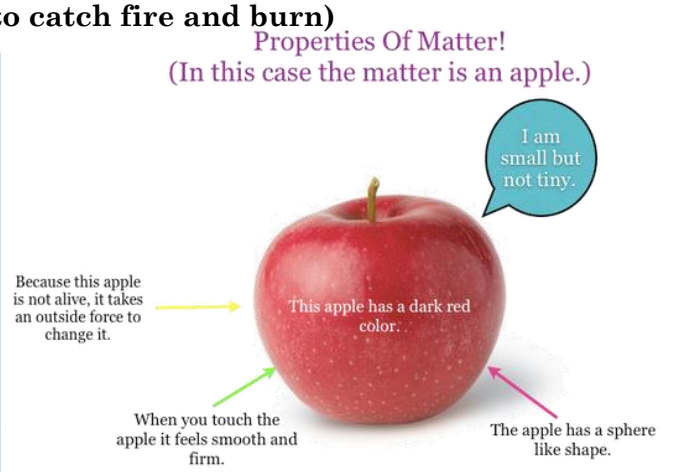
- **<u>Physical properties</u>** are **readily observable** and will retain the same composition **(nothing new is created).**

¬ Color, size, odor, luster, hardness, melting point, boiling points, conductivity, density (mass divided by volume**)**

Changes in state of matter **(¬melting, boiling, freezing, and condensing) do not create a new substance** and retain their original composition and is therefore a physical property

- **<u>Chemical properties</u> are only observable** during a chemical reaction and allows for change **(something new is created).** The property is the ability to change whereas the change is the action itself.
- **¬ *Reactivity* (describes how easily something reacts with something else), *combustibility* (a substance or material that is able or likely to catch fire and burn)**





Chemical Properties

- A **Chemical Property** indicates how a substance will react with another
- Chemical properties cannot be determined without changing the identity of the substance
- Examples:
  - Iron Rusting
  - Silver Tarnishing

<u>Distinguish between changes in matter as physical (i.e., physical change) or chemical (development of a gas, formation of precipitate, and change in color).</u>

- **<u>Physical change</u>- any change in size, shape, or form, or state where the identity of the matter stays the same**

Ex. Melting, freezing, condensing, evaporating, breaking, cutting, bending

- **<u>Chemical change</u>- occurs when one type of matter changes into a different type of matter with different properties.** Substances before a chemical change are "**reactants**." After a chemical change**, the new substances are formed;** they are called **"products."** After a chemical change**, the product cannot go back to its original reactants**

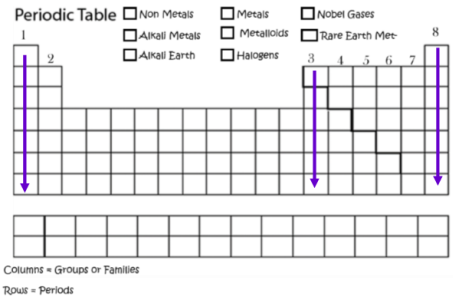
Many reactions involve heat. Some produce **a gas- bubbling.** Formation of **precipitate (to cause a solid to separate out from a solution) and changes in color** are also observable evidence.

Ex. Burning, digestion, respiration, photosynthesis, decomposition, and rusting.

f. Recognize that there are more than 100 elements and some have similar Properties as shown on the Periodic Table of Elements.

- They are arranged by **increasing atomic number (left to right, up to down).** The square has the **atomic number, atomic mass, element name, and element's chemical symbol.**
- **Properties of an element can be predicted from its location in the periodic table. Each horizontal row** of the table is **called a period (7 periods)** where each row represents the number of energy levels present in an atom of the element. **The columns are called groups (18 groups). Elements in each group have similar characteristics.**
- **Metals are located on the left, Nonmetals on the right, metalloids are in a zigzag line between metals and nonmetals**
- **Elements** located **on the left** of the Periodic Table are **most reactive metals, least reactive** in the **middle, nonmetals** on the **right**
- **Atomic# = #of protons or electrons /Atomic mass(weight)= #of protons + neutrons/ # of Neutrons= Atomic # - Atomic mass(weight)**

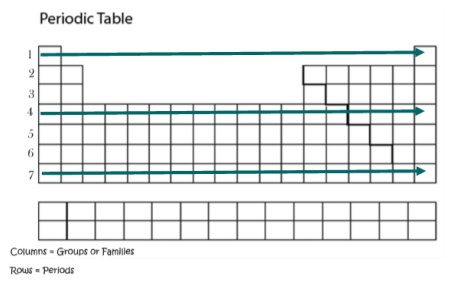
THE COLUMNS ARE GROUPS OR FAMILIES



1 Alkali Metals	2 Alkaline Earth	3 III	4 Carbon	5 Nitrogen	6 Oxygen	7 Halogens	8 Nobel Gases
Alkali Metals have one valence electron 1VE Highly Reactive Volatile with Water	Alkaline Earth Metals have 2 valence electrons 2VE Very Reactive	Group 3 has 3 valence electrons 3VE	Group 4 has 4 valence electrons 4VE	Group 5 has 5 valence electrons 5VE	Group 6 has 6 valence electrons 6VE	Halogens have 7 valence electrons 7VE	Nobel Gases or Group 8 or 0 are completely stable and need no electrons. Typically these elements do not bond with others.

Reactivity Decreases across the Periodic Table Groups
Density, Boiling, and Melting point increase across the Periodic Table Groups

THE ROWS ARE PERIODS



Period	Important Information
1	Shell 1 maximum electrons 2
2	Shell 2 maximum electrons 8
3	Shell 3 maximum electrons 18 (can be stable at 8)
4	Shell 4 maximum electrons 32
5	Shell 5
6	Shell 6
7	Shell 7

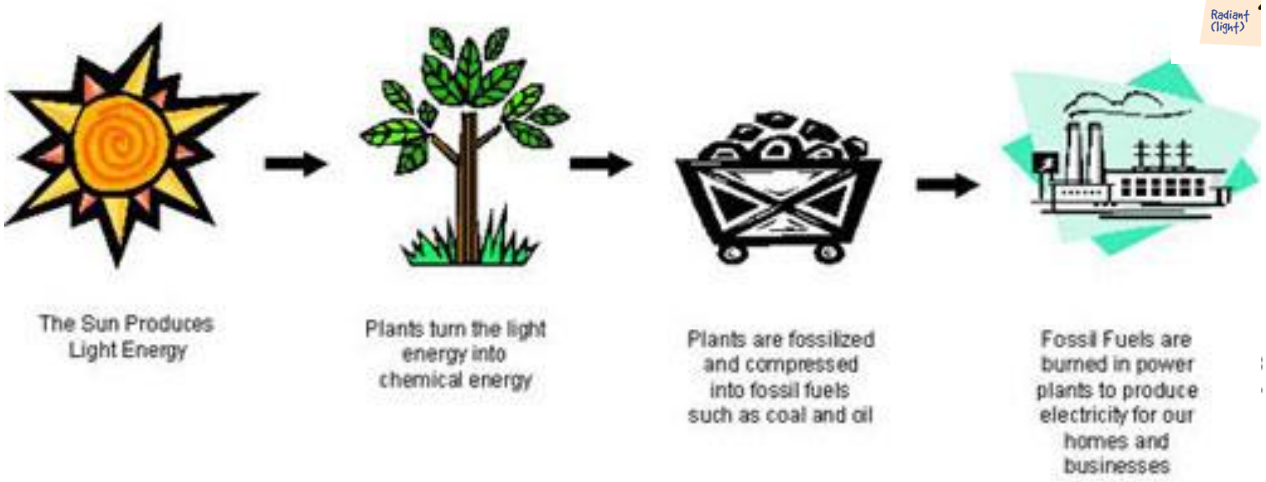
Standard-S8P2 -Students will be familiar with the forms and transformations of energy

a. Explain energy transformation in terms of the Law of Conservation of Energy.

- According to the **Law of Conservation of Energy, energy cannot be created or destroyed**. Energy always comes from somewhere and goes somewhere.
- **Energy can be changed from one form to another**.

Ex. Battery (stored chemical energy) converts to light¬ energy in a flashlight.

- We partake daily in energy transformations

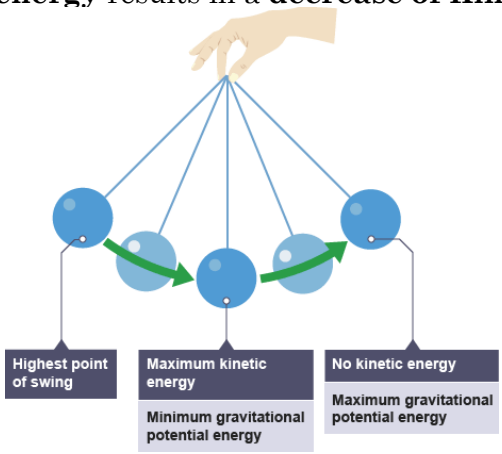


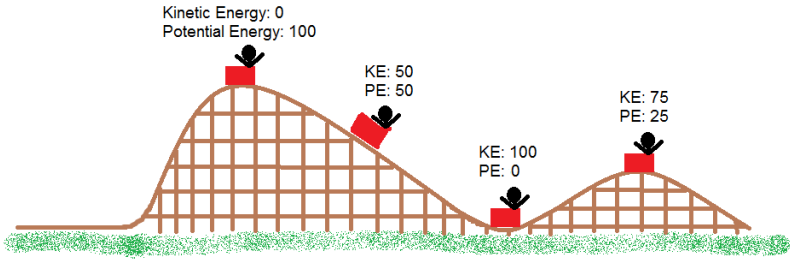
b. <u>Explain the relationship between potential and kinetic energy.</u>

- **Kinetic energy** is the energy of motion and is **<u>based on mass and velocity</u>** of an object. **(Ex.** A car speeding, Throwing a rock, or A flowing river.)
- **Potential energy** is stored energy that results **from an object's position or shape** and is based **<u>on height and weight</u>** of an object.

(Ex. A stretched rubber band, A parked car, or an uneaten plate of food.)

*An **increase in Kinetic energy** results in a **decrease of Potential energy**. An **increase in Potential energy** results in a **decrease of Kinetic Energy.**





c. <u>Compare and contrast the different forms of energy (heat, light, electricity, mechanical motion, and sound) and their characteristics.</u>

Energy appears in different forms.

Heat energy is in the wild or **random motion of molecules** (form of thermal) between two objects with different temperatures. (Ex. Steaming water or space heater)

Mechanical energy is in **moving bodies** and transfer of energy. (Mechanical energy = potential energy + kinetic energy)

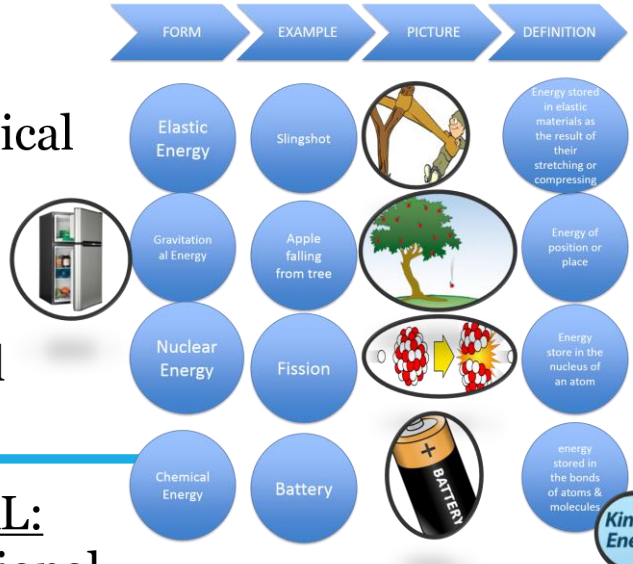
Light (radiant) energy is **electromagnetic energy that travels in transverse waves and that doesn't need a medium**. (Ex. Microwave)

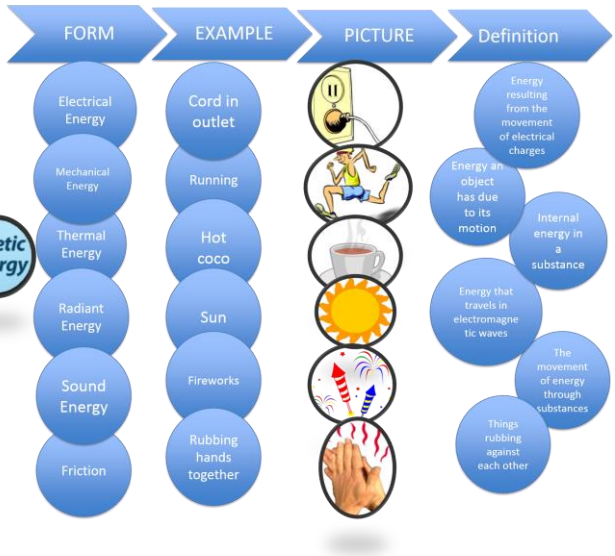
Electrical energy is the movement of electrical charges. (Ex. Electricity or generator)

Sound is the movement of energy through substances by vibrating matter in longitudinal waves.(ex. Guitar or a microphone)

<u>KINETIC</u>
M- Mechanical
R- Radiant
S- Sound
F-Friction
E-Electrical
T-Thermal

<u>POTENTIAL:</u>
G- Gravitational
E- Elastic
N- Nuclear
C-Chemical





d. Describe how heat can be transferred through matter by the collisions of atoms (conduction) or through space (radiation). In a liquid or gas, currents will facilitate the transfer of heat (convection).

- When heat is transferred, thermal energy (heat) always moves from warmer to cooler objects. The warmer object loses thermal energy (heat) and becomes cooler as the cooler object gains thermal energy (heat) and becomes warmer until both reach the same temperature.
- Heat can be transferred by ***conduction, convection, and radiation***
- **Conduction** is the transfer of heat by **direct contact**. Conduction occurs most easily in solids.

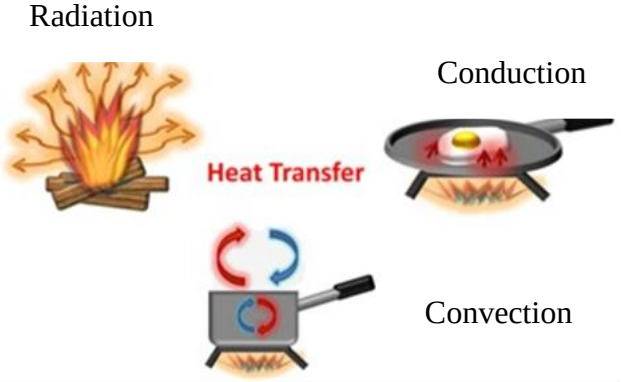
(**Ex**. Ice cube melting in your hand.)

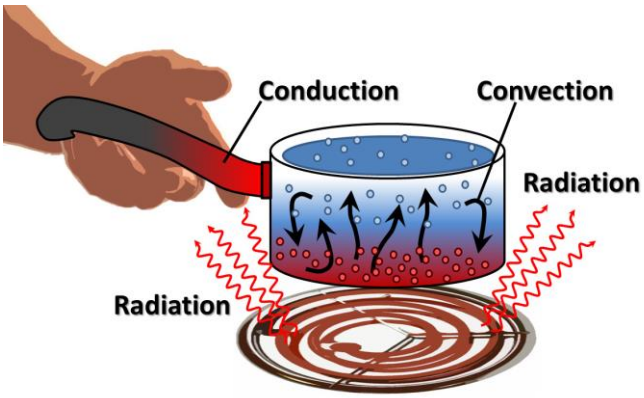
- **Radiation** is heat transfer that occurs when heat is transferred by **electromagnetic waves**. It can occur in empty space, as well as in solids, liquids, and gases.

(**Ex**. The Sun is a source of radiation; also, the warmth you feel sitting next to a fireplace.)

- **Convection** is heat transfer due to the movement of a liquid or gas. These movements or currents are created by density differences produced by temperature differences. A **current is created** when the **warmer/less dense material rises forcing the cooler/more dense material to sink.**

(**Ex**. The flow of water currents, the flow of air, and from the air conditioner.)





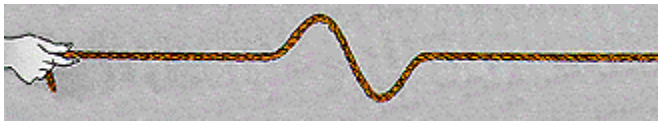
Standard S8P4- Students will explore the wave nature of sound and electromagnetic radiation.

a. Identify the characteristics of electromagnetic and mechanical waves.

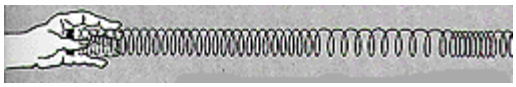
A transverse wave that does not require a medium is called **electromagnetic waves** (or E-M waves). ***Electromagnetic*** waves can travel through solids, liquids, and gases, but ***they travel fastest through empty space***.

Waves are classified based on the direction in which the particles of the medium vibrate compared with the direction in which the waves travel. There are three classifications of waves based on this criterion.

1. **Transverse waves** are waves in which the particles of the medium vibrate with an up and down motion. Particles in a transverse wave move perpendicular to the direction that the wave is traveling. The ***crest is the highest point*** of a transverse wave. The ***trough is the lowest point*** of a transverse wave. Although electromagnetic waves do not require a medium, they are considered transverse waves. (When studying seismic waves associated with earthquakes, these are the S-waves.)

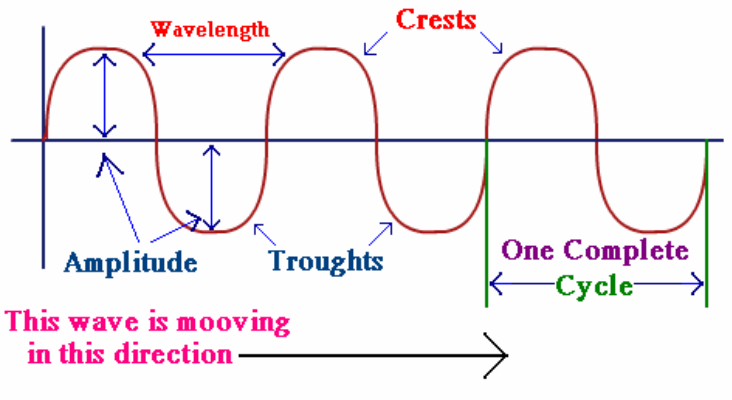


2. **Longitudinal waves** are waves in which the particles of the medium vibrate back and forth along the path that the wave travels. A **compression** is a section of longitudinal wave where the particles are ***crowded together***. A **rarefaction** is a section of the wave where particles are ***less crowded*** than normal. ***Sound waves are longitudinal waves***.

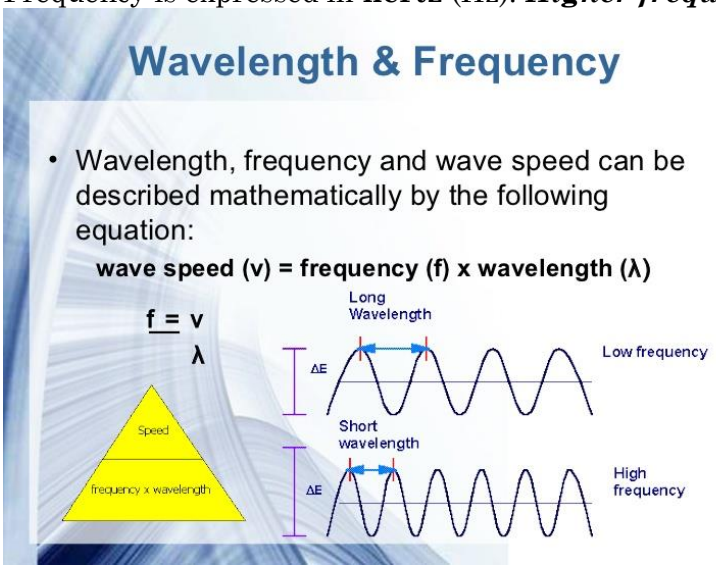


The **amplitude** of a wave is the ***maximum distance of the wave vibration from its rest*** position to the crest. The rest position of a wave is where the particles of a medium stay when there are no disturbances. The larger the amplitude, the greater is the energy of the wave.

Wavelength is the distance between two adjacent crests or compressions in a wave. Therefore ***wavelength is the distance from any point on a wave to the same point on the next wave.***



Frequency is ***the number of waves produced in a given amount of time***. Frequency can be measured by counting either the number of crests or the number of troughs that pass a point in a certain amount of time. Frequency is expressed in **hertz** (Hz). ***Higher frequency, just like higher amplitude, means more energy***.



Wave speed is ***the speed at which a wave travels***. The speed of a wave ***depends on the medium*** in which the wave is traveling. ***Sound waves travel fastest in solids***, next fastest in liquids, and slowest in gases. Wave speed can be calculated by multiplying the wavelength (represented with the Greek letter lambda) times the frequency of the wave.

b. Describe how the behavior of light waves is manipulated causing reflection, refraction, diffraction, and absorption.

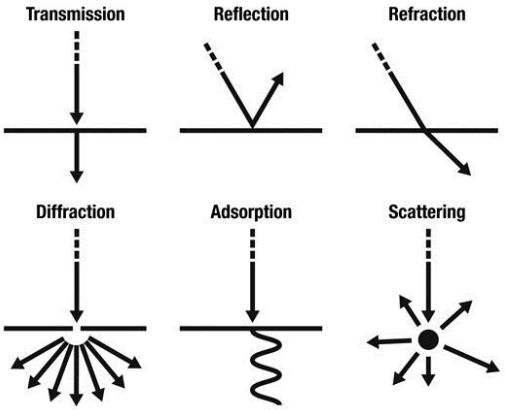
Waves that meet each other or an object in the environment may interact. There are several types of interactions that waves may have.

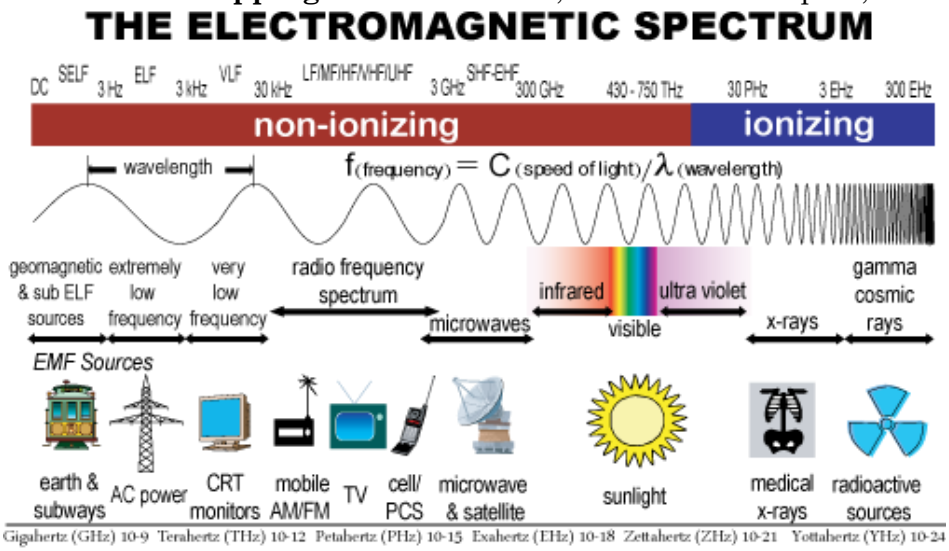
Reflection occurs ***when a wave bounces back after striking a barrier***. ***Reflected sound waves are called echoes***; reflected light waves allow us to see objects. Light travels at different speeds in different materials. This is why light refracts, or changes speed as it enters a new substance. Lenses operate on the principle of light refraction.

Refraction is t***he bending of a wave as it passes at an angle from one medium to another.*** One common example of refraction of light waves is the broken pencil effect that can be ***observed when a pencil is placed in a glass of water***. The pencil seems to be "broken" at the surface of the water as the light waves go from the air to the water.

Diffraction is the **bending of waves around a barrier or through an opening**. The amount of diffraction a wave experiences depends on two factors: the wavelength of the wave and the size of the barrier or opening the wave encounters. Sound travels around corners because it has relatively larger wavelengths than light. We can hear sounds around corners. We can't see around corners because light has a very small wavelength.

Interference is **the result of two or more waves overlapping**. Waves can meet, share the same space, and pass through each other.

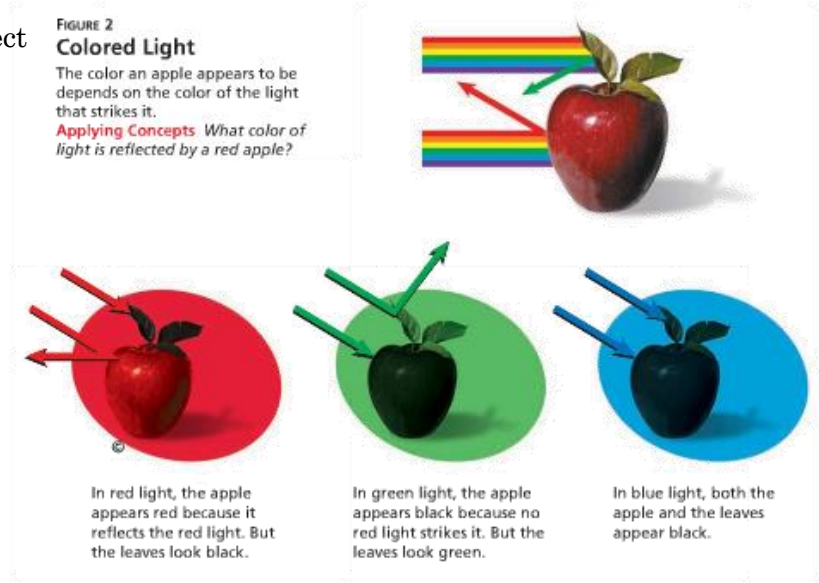




c. Explain how the human eye sees objects and colors in terms of wavelengths

1. All the" invisible" colors of sunlight shine on the apple.
2. The surface of a **red apple absorbs all the colored light rays, except for red**, and **reflects this color to the human eye.**
3. The eye receives the reflected red light and sends a message to the brain.

Absorption -light is taken in by an object

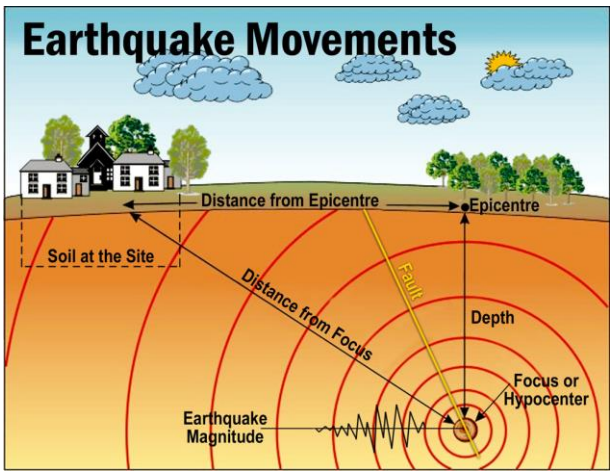


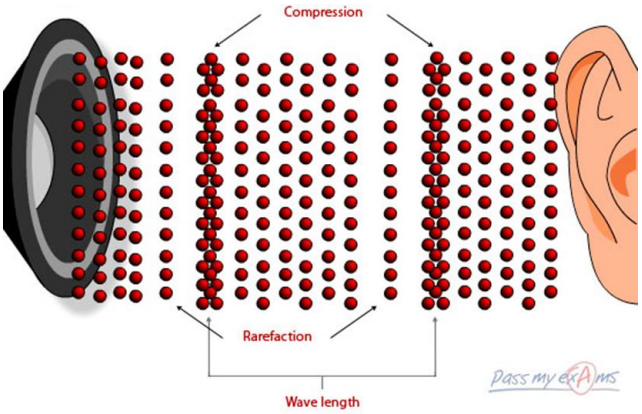
A **wave** is ***any disturbance that transmits energy through matter or space***.

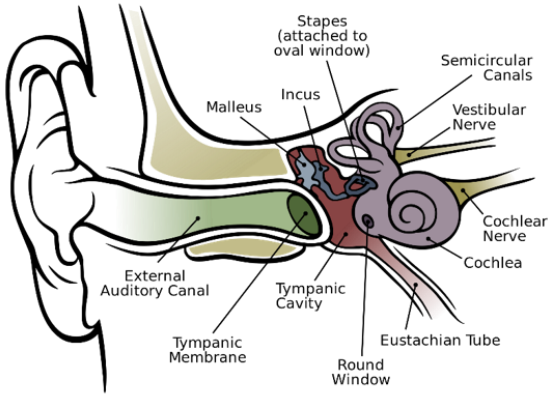
Sound is a type of energy that requires waves traveling through matter.
The ***material or substance through which a wave may travel*** is called the **medium**. The medium for a wave can be any of the common states of matter: solid, liquid, or gas. ***Sound waves require a medium***.

Sound waves travel by vibration of particles.
If there are no particles, there will be no sound. (Ex. In space)

Waves that require a medium are called **mechanical waves**.
(In addition to sound waves, ocean waves and seismic waves require a medium.
Therefore ***ocean waves and seismic waves are mechanical waves***.)



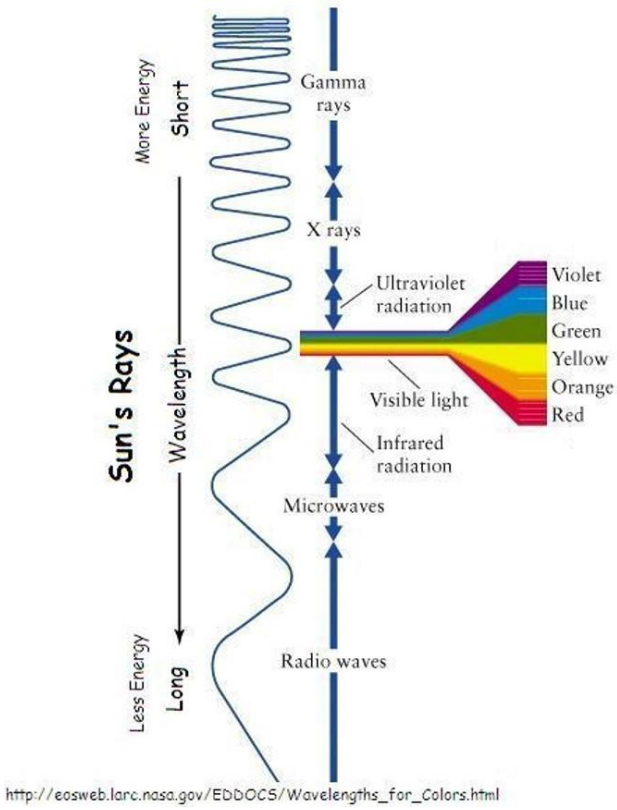


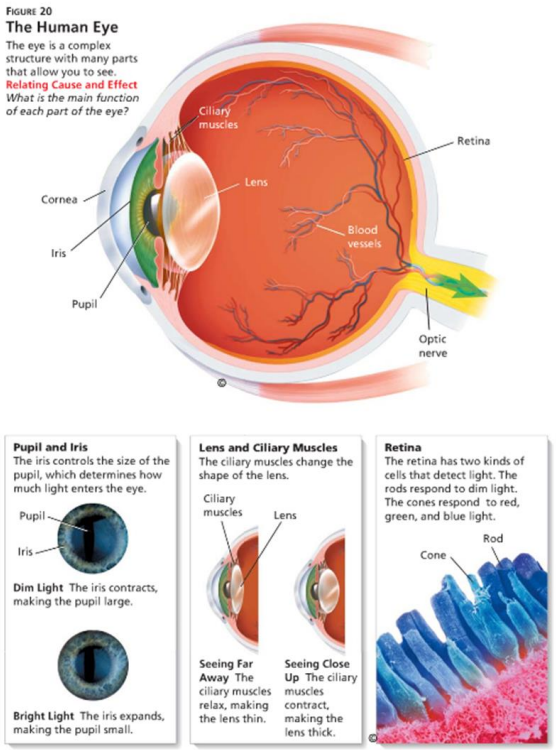


How we hear.

1. Sound is collected by the outer ear.
2. The tympanic membrane (ear drum) vibrates and transfers the sound to the inner ear.
3. The malleus (hammer) vibrates hitting the incus (anvil) which vibrates the stapes (stirrup) before vibrating the cochlea.
4. The cochlea vibrates and sends a message to the cochlear nerve (auditory nerve).
5. The auditory nerve transmits a message to the brain.
6. The brain interprets the information from the auditory nerve and you hear a particular sound.

Waves that do not require a medium *are* ***electromagnetic*** *waves like* ***light.***





e. Describe how the behavior of waves is affected by medium (such as air, water, solids).

Sound typically travels **faster in a solid than a liquid** and **faster in a liquid than a gas.**

The denser or more **concentrated the medium, the faster sound will travel.**

f. Relate the properties of sound to everyday experiences.

Doppler Effect is the change in frequency detected when the sound is moving closer or further away from the hearer

Acoustics is the study of sound and ways to maximize the hearing of sound inside a building or room.

Sonar is a system that uses the reflection of underwater sound waves to detect objects

Echolocation is the use of sound waves bouncing off of an object to find out its location

g. Diagram the parts of the wave and explain how the parts are affected by changes in amplitude and pitch.

The **greater** the intensity **(amplitude**) of sound the farther the sound will travel and the **louder the sound** will appear.

The ***pitch*** of a sound wave is directly related to ***frequency***. A **high-pitched** sound has a **high frequency** (a dog whistle). A **low-pitched** sound has a **low frequency** (a fog-horn).