Physical Science Study Guide Notes

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FORMULAS TO REMEMBER

What are you looking for?	Units	Formula
Density	g/cm^3	Density = Mass /Volume D=m/v
Volume of a Regular Solid	mm^3, cm^3, m^3	Volume = Height * Length * Width V=hlw
Speed	m/s	Speed = Distance/Time S=d/t
Acceleration	m/s^2	Acceleration = (Final velocity - initial velocity) / Time A = $(v_f - v_i) \ / \ t$
Momentum	Kg*m/s	Momentum = Mass * Velocity P = mv
Force	Newton (N)	(Net) Force = Mass * Acceleration F_{net}= m*a
Weight / Force of gravity	Newtons (N)	Weight= Mass * Acceleration due to gravity W=mg (g = 9.8 m/s^2)

Pressure	N/m^2	Pressure = Force /Area P=f/a
Work	Joule (J)	Work= Force * Distance W=fd
Power	Watt (W)	Power= Work / Time P = W/t
Ohm's Law	Amperes (A)	Current = Voltage/resistance I=V/R
Electric Power	Watts (W)	Electric Power = Voltage * Current P=VI
Electrical Energy	kWh	Electrical Energy= Power * time E=Pt
Wave Speed	m/s	Speed= Frequency * Wavelength C = $\nu\lambda$

NATURE OF MATTER

a. Distinguishing between atoms and molecules.

- Tiny moving particles made up of ***protons***, ***electrons***, and ***neutrons*** are called ***atoms***
    - Atoms are the smallest unit that matter can be broken down without releasing any electrically charged particles. They are also the smallest unit of matter that demonstrates the characteristic properties of an element.

- Two or more atoms joined together by a chemical bond create a ***molecule***.
    - Molecules are the "building blocks" of matter.

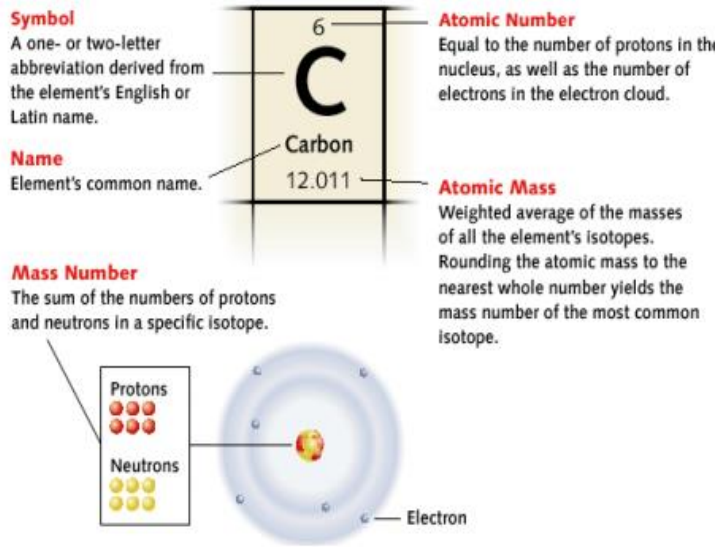


Image Credit: Holt Science Spectrum "Physical Science"

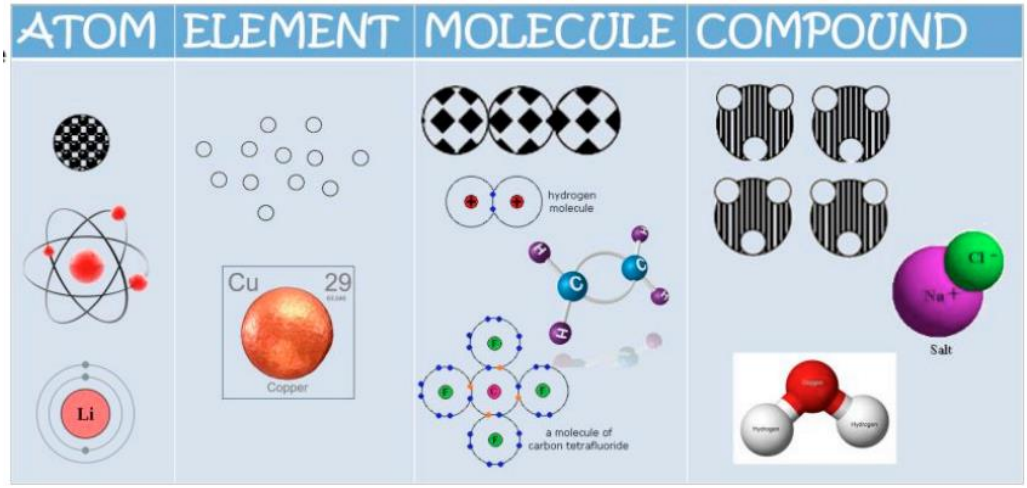
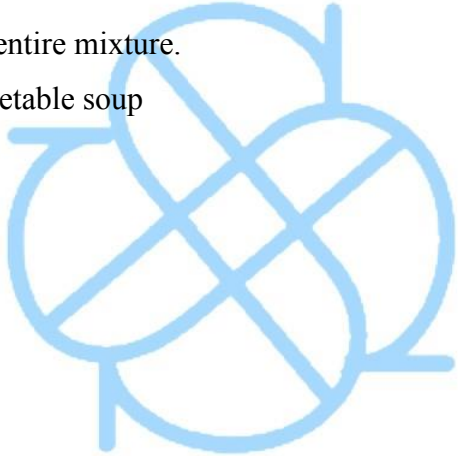


Image Credit: Physical science with Lieu (Science Teacher)

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

- A ***pure substance*** is a type of matter that has constant composition and properties throughout the sample. There are 2 types of pure substances:
    - ***Element***: substance that cannot be further broken down chemically.
    - ***Compound***: a molecule made up of at least 2 different, chemically-bonded elements.

- A ***mixture*** is made up of two or more substances that can be separated back to their original components (this is because they are physically combined but not chemically)
    - A homogenous mixture is a mixture where the composition is uniform throughout the mixture and evenly distributed throughout the mixture. Ex. Saltwater.
        - Often it is easy to confuse a homogeneous mixture with a pure substance because they are both uniform. The difference between the two is that the composition of a pure substance is always the same, whereas in homogeneous mixtures, the amount of salt in the saltwater, for example, can vary from one sample to another.
        - All solutions are homogeneous because of the dissolved material that is distributed evenly throughout the solution.
    - A heterogeneous mixture is a mixture in which the composition is not uniform throughout the entire mixture.
        - Ex. Vegetable soup



c. Describing the movement of particles in solids, liquids, gases, and plasma states.

- Atoms and particles behave differently depending on its phase.
- Particles move fastest in gases, then liquids, and slowest in solids.
- The particles in liquids and solids are very close together, and thus, liquids and solids are known as condensed phases.
    - There's the least amount of movement or space between particles in solids.

Gas	Liquid	Solid
- Assumes the shape and volume of its	- Takes the shape of the container	- Retains a fixed volume and shape

container - Particles can move past one another	- Particles can move/slide past one another	- Rigid-particles locked into place
- Compressible - Lots of free space between particles	- Limited compressibility - Little free space between particles	- Not easily compressible - Little free space between particles
- Flows easily - Particles can move past one another	- Flows easily - Particles can move/slide past one another	- Does not flow easily - Rigid- particles cannot move/slide past one another

Table: **[3]**

c. Describing the movement of particles in solids, liquids, gases, and plasma states. (continued)

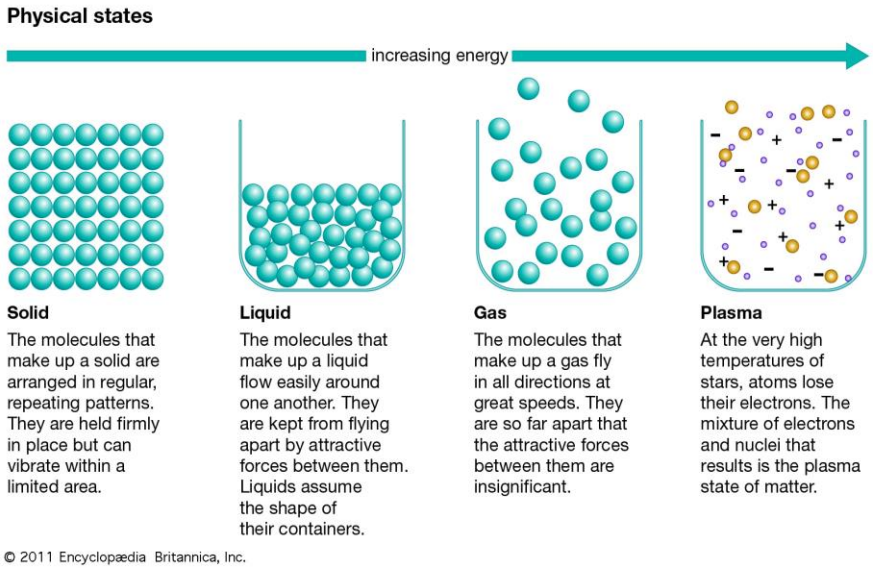


Image Credit: Britannica

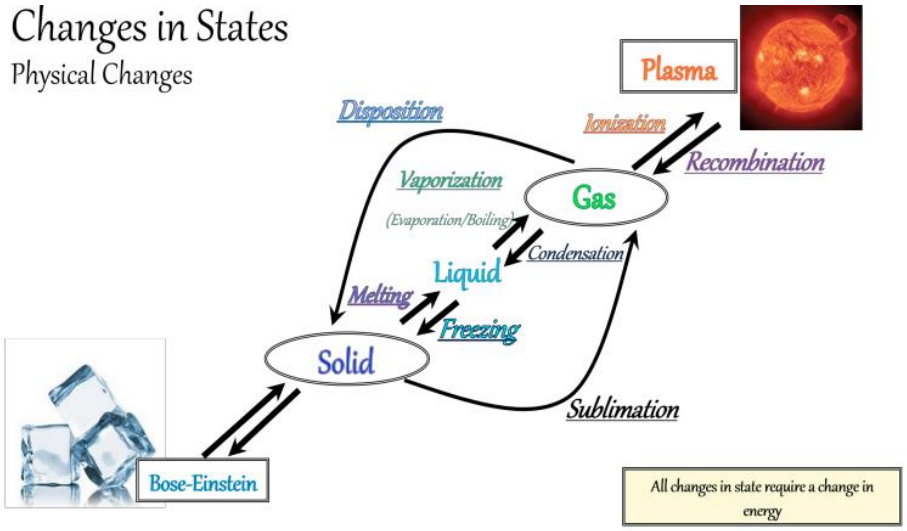


Image Credit: Physical Science with Lieu (Science Teacher)

d. Distinguishing between physical and chemical properties of matter as physical or chemical

- ***Physical properties*** are readily observable and will retain the same composition (nothing new is created).
    - Ex. Color, size, luster, odor, hardness, melting point, boiling points, conductivity (a measure of how well a material conducts electricity, in Siemens per meter), density (mass divided by volume), resistivity (measure of how well a material resists the current, or flow of charges; measured in Ohms/m ; total resistance measured in Ohms)
- ***Chemical properties*** are only observable during a chemical reaction and allows for change (something new is created).
    - Ex. Reactivity (describes how easily something reacts with something else), combustibility (likelihood to catch fire and burn), flammability

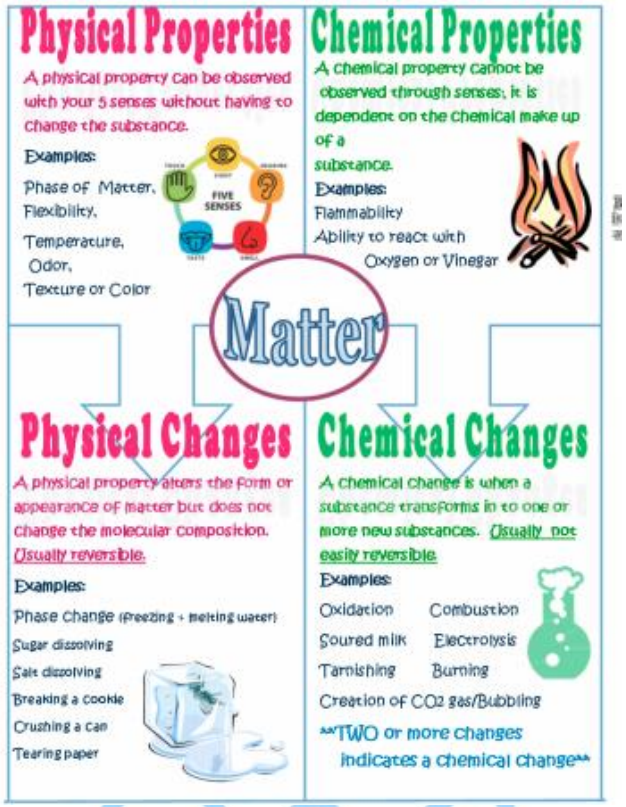


Image Credit: Physical Science with Lieu (Science Teacher)

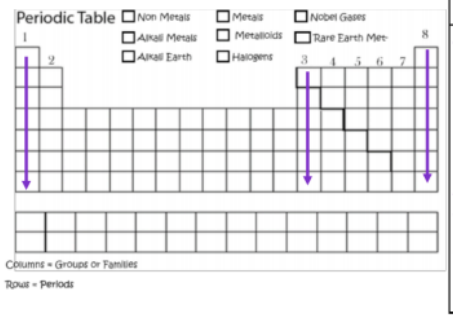
e. Distinguishing between changes in matter as physical or chemical.

- ***Physical change***: any change that doesn't cause a change in the identity of the matter.
    - Size, shape/form, or state can change, but NOT its identity.
    - Ex. Melting, freezing, condensing, evaporating, breaking, cutting, bending.
- ***Chemical change***: changes that cause a change in the identity of the matter, resulting in the formation of a new substance with different identities.
    - Substances before a chemical change are ***reactants***. After a chemical change, the new substances that are formed are called ***products***.
        - After a chemical change, the product cannot go back to its original reactants; the change is irreversible.
    - Signs of chemical changes: bubbling, color change, temperature change, and precipitation formation.
    - Ex. Burning, respiration, digestion, decomposition, photosynthesis, and rusting.

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

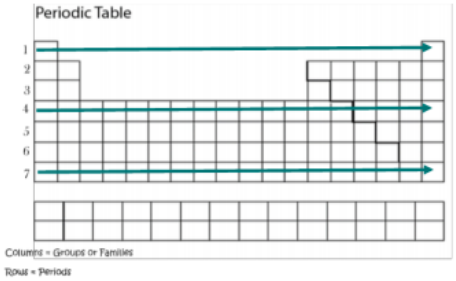
- Periodic Table is arranged by increasing atomic numbers (left to right, up to down).
- Each element on the Periodic Table consists of its atomic number, element name, atomic mass, and element's chemical symbol.
- Properties of an element can be predicted from its location on the periodic table.
    - Each horizontal row of the table is a period (7 periods), with each row representing the number of energy levels present in the atom.
    - The columns are known as groups (18 groups, and elements in the same group have similar characteristics/properties.
- Metals are located on the left, nonmetals on the right, and metalloids are in a zigzag line between metals and nonmetals.
- ***Atomic Number*** = # of protons the element has
- ***Atomic mass (weight)*** = # of protons + neutrons
- **Number of Neutrons** = Atomic mass (weight) - atomic #

THE COLUMNS ARE GROUPS OR FAMILIES



1	2	3	4	5	6	7	8
Alkali Metals	Alkaline Earth	III	Carbon	Nitrogen	Oxygen	Halogens	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

Image Credit: Made with Google Drawings and Table

FORMS AND TRANSFORMATIONS OF ENERGY

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

- The ***Law of Conservation of Energy*** states: energy cannot be created or destroyed, only transferred from one form to another
    - Ex. During photosynthesis, light energy from the sun is converted to chemical energy stored in glucose.

b. Explaining the relationship between potential and kinetic energy.

- ***Kinetic energy*** is the energy of motion, which depends on an object's mass and velocity.
    - Ex. someone walking, throwing a ball
- ***Potential Energy*** is stored energy due to an object's position or shape.
    - Ex. stretched rubber band, any object at rest
- **An increase in Kinetic energy results in a decrease of Potential energy, and an increase in Potential energy results in a decrease of Kinetic Energy.**

c. Comparing and contrasting the different forms of energy (heat, light, electricity, mechanical motion, and sound) and their characteristics.

- ***Heat energy:*** (thermal energy) the random motion of molecules between two objects with different temperatures. Ex. Steaming water or space heater
- ***Mechanical energy:*** sum of potential and kinetic energy.
- ***Light (radiant) energy:*** is electromagnetic energy that travels in transverse waves and doesn't need a medium.
    - Ex. Microwave
- ***Electrical energy:*** results from the movement of electrical charges.
    - Ex. Electricity or generator
- ***Sound energy:*** energy that results from the vibration of matter.
    - Ex. Guitar or a microphone

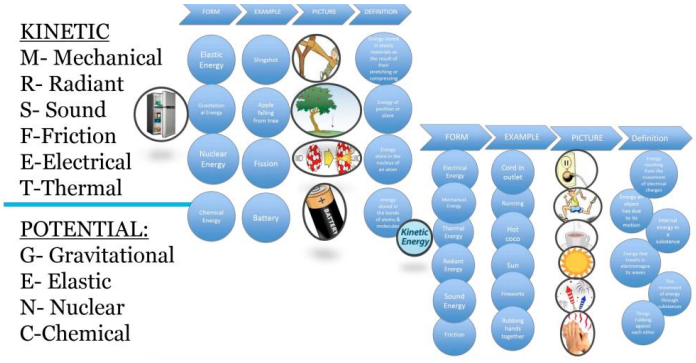


Image Credit: Activatelearning.org (Physical Science)

d. Describe the way heat can be transferred through matter.

- Within a liquid or gas, currents facilitate the transfer of heat (convection)
- When heat is transferred, thermal energy will always move from warmer to cooler objects.
    - The warmer object loses thermal energy and becomes cooler, while the cooler object gains thermal energy and becomes warmer until both reach the same temperature.
- Ways heat can be transferred: through convection, conduction, and radiation.
    - ***Conduction***: transfer of heat by direct contact. Conduction occurs mostly in solids.
        - Ex. Ice cube melting in your hand.
    - ***Radiation*** is heat that's transferred by electromagnetic waves.
        - Ex. the Sun, the warmth you feel sitting next to a fireplace.
    - ***Convection*** is heat transfer due to the movement of a liquid or gas, created by density differences made by temperature differences.
        - A current is created when the warmer and less dense material rises, forcing the cooler and more dense material to sink.
        - Ex. The flow of air, the flow of water currents, and from the air conditioner.

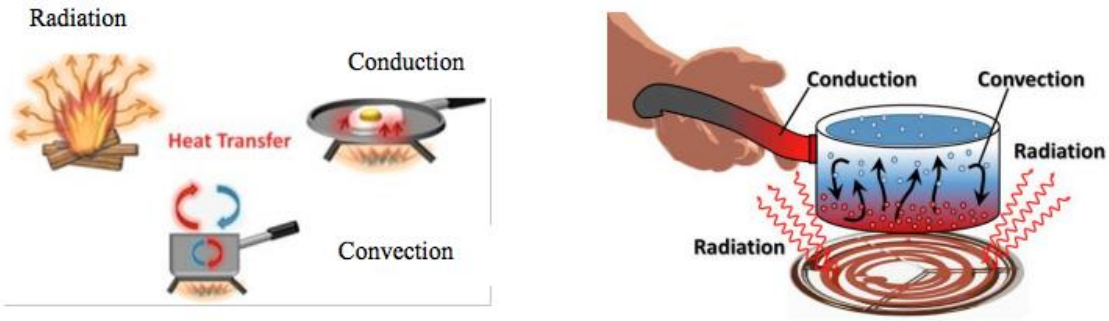


Image Credit: Mathsone on Conduction

WAVE NATURE OF SOUND AND ELECTROMAGNETIC RADIATION

a. Identifying the characteristics of electromagnetic and mechanical waves.

- A ***wave*** is any disturbance that transmits energy through matter or space.
- The ***medium*** is the substance that a wave travels through; can be a solid, liquid, or gas.
- ***Mechanical waves*** are waves that require a medium.
    - Ex. sound waves, ocean waves, and seismic waves.
- ***Electromagnetic waves*** don't require a medium.
- Waves are classified based on the direction the particles in the medium vibrate in comparison to the direction that the wave travels.
    1. ***Transverse waves***: waves in which the particles of the medium vibrate with an up and down motion, perpendicular to the direction that the wave is traveling.
        a. ***Crest:*** highest point of a transverse wave
        b. ***Trough:*** lowest point.
        c. Electromagnetic waves are considered transverse waves.

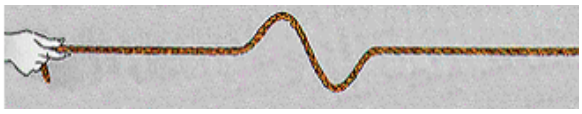


Image Credit: CyberPhysics

    2. ***Longitudinal waves***: waves in which the particles in the medium vibrate from one side to the other along the path the wave travels.

a. A ***compression*** is a longitudinal wave section where the particles come together. A ***rarefaction*** is a section of the wave where the particles are less crowded than normal.

b. Sound waves are longitudinal waves that travel by vibration of particles.

i. If there are no particles, there will be no sound, like in space

Image Credit: CyberPhysics

a. Identifying the characteristics of electromagnetic and mechanical waves. (continued)

- The ***amplitude*** of a wave is the distance between a wave's rest position (where particles of medium stay when there are no disturbances) and the crest.
  - Amplitude and energy are directly proportional
    - The larger the amplitude, the greater the energy

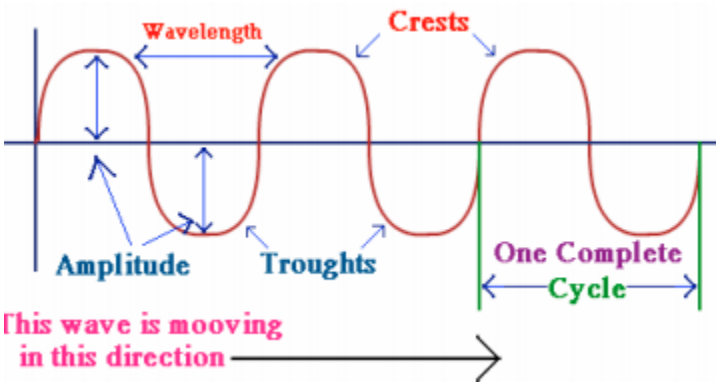


Image Credit: Physics from Tutorvista

- ***Wavelength:*** distance between two crests/compressions in a wave.
- ***Frequency:*** number of waves produced in a certain amount of time
  - Can be measured by counting either the number of crests or troughs that pass a point in a certain amount of time. Frequency is expressed in hertz (Hz).
  - Frequency and energy are directly proportional
    - Higher frequency means more energy

a. Identifying the characteristics of electromagnetic and mechanical waves. (continued)

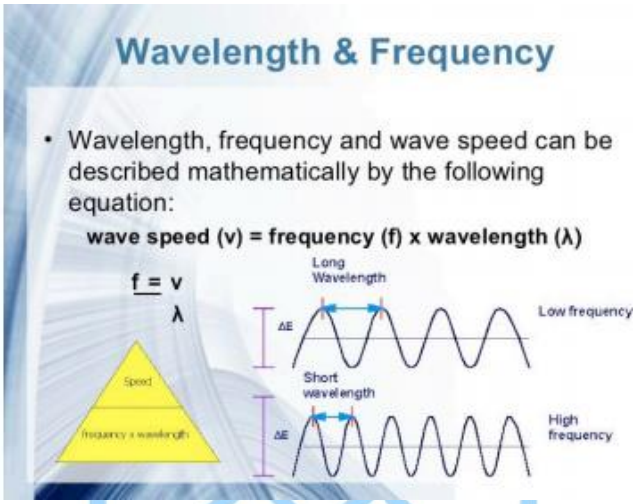


Image Credit: Activatelearning.org (Physical Science)

- ***Wave speed*** is the speed at which a wave travels and depends on the medium in which the wave is traveling.
    - Sound waves travel fastest in solids and slowest in gases - it requires a medium.
    - Can be calculated by multiplying the wavelength (represented with the Greek letter lambda) and the frequency of the wave.

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

- ***Reflection***: when a wave bounces back after striking a barrier.
    - You hear echoes when sound waves are reflected and see objects due to light waves being reflected.
- ***Refraction***: bending of a wave as it passes at an angle from one medium to another medium
    - Ex. 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 pass from the air to the water.
- ***Diffraction***: bending of waves around a barrier or an opening; depends on a wave's wavelength and size of the barrier/opening that the wave encounters.
    - Sound travels around corners because it has larger wavelengths than light, which is why we can hear sounds around corners, but we can't see around corners because light has a very small wavelength.
- ***Interference***: the result of overlapping.
    - Waves can meet, share space, and pass through each other.

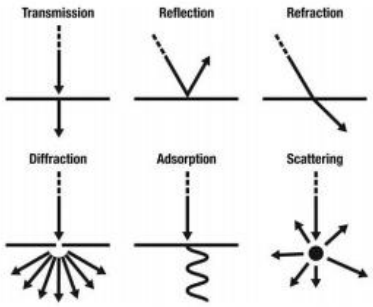


Image Credit: Clarks Science

c. Explaining how the human eye sees objects and hears sounds

- How we see:
    1. All the "invisible" colors of sunlight shine on the apple.
        a. ***Absorption***: light is taken in by an object
    2. The surface of a red apple absorbs all the colored light rays, except for red, which is reflected back to the human eye, allowing us to see the red color.
    3. The eye receives the reflected red light and then sends a message to the brain.

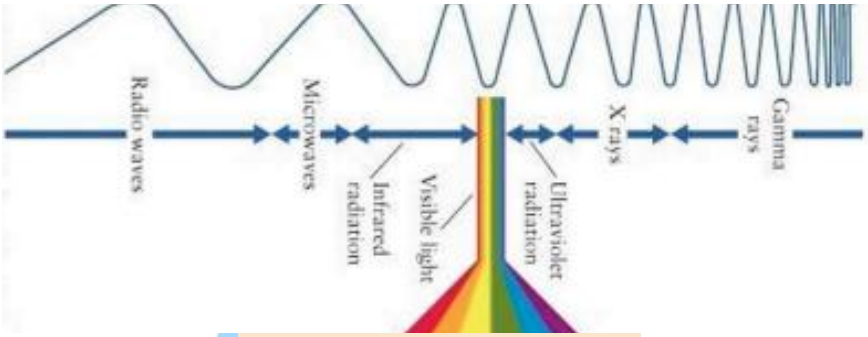


Image Credit: Nandon Solution

c. Explaining how the human eye sees objects and hears sounds (continued)

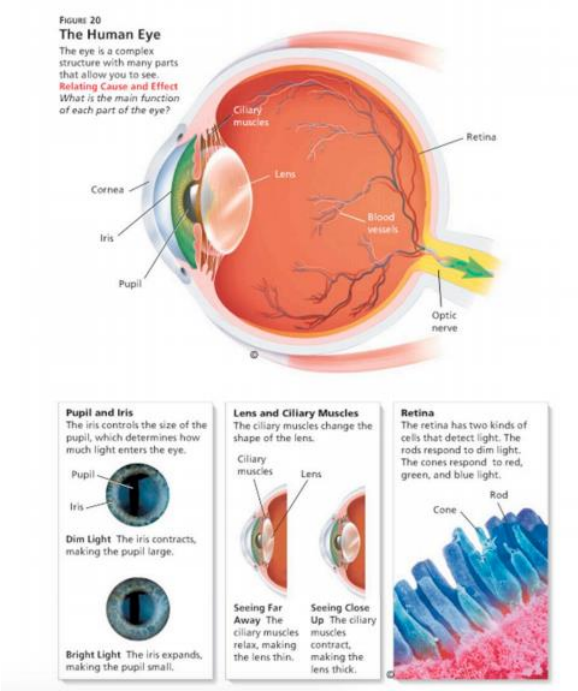


Image Credit: GoodRich Science

- **How we hear:**
    1. Sound is collected by the outer ear.
    2. The tympanic membrane (ear drum) vibrates and transfers sound to the inner ear.
        a. Malleus (hammer) → incus (anvil) → stapes (stirrup) → cochlea → auditory nerve.
    3. The auditory nerve sends a message to the brain.
    4. The brain interprets the information from the nerve, allowing you to hear sound.

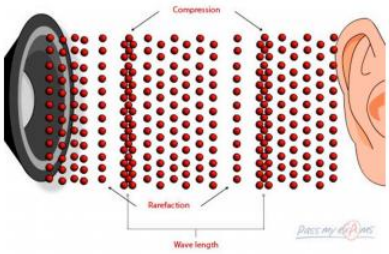


Image Credit: Avaca blog

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

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

e. Comparing the properties of sound to everyday experiences.

- ***Doppler Effect***: change in frequency detected when the sound is moving closer or further away from a person.
- ***Acoustics***: study of sound and ways to maximize the hearing of sound inside a room or building.
- ***Sonar:*** system that uses the reflection of underwater sound waves to detect different objects.
- ***Echolocation:*** the use of sound waves bouncing off of an object to find its location

f. Demonstrating the parts of the wave and how the parts are affected by changes in amplitude and pitch.

- Higher amplitude causes the sound to appear louder.
- Wavelength is inversely related to the frequency of a given waveform.
    - The longer the wavelength, the lower the frequency
- The ***pitch*** of a sound wave is directly proportional to frequency. A high-pitched sound has high frequency. A low-pitched sound has low frequency.

ELECTROMAGNETISM

a. Describing the properties of magnetism and it's materialism.

- At the end of each magnet is a magnetic pole, which are the points on a magnet that have opposite magnetic qualities.
- When you bring two magnets close together, the magnets each exert a magnetic force on the other. These magnetic forces result from spinning electric charges in the magnets.

- The force can either push the magnets apart or pull them together.
- The magnetic force is a universal force. It is always present when magnetic poles come near one another.

Figure 1 *More paper clips stick to the ends, or magnetic poles, of a magnet because the magnetic effects are strongest there.*

Image Credit: Holt Science Spectrum "Physical Science"

b. Explaining the Cause of Magnetism

- Electrons are negatively charged particles of atoms that create a magnetic field when moving around, causing the atom to have a north and south pole.
- More specifically, in materials such as iron, nickel, and cobalt, groups of atoms are in tiny areas called ***domains***.
    - North and south poles of the atoms in a domain line up, which creates a strong magnetic field. Domains are similar to tiny magnets of different sizes within an object. The arrangement of domains in an object decides whether the object is magnetic.

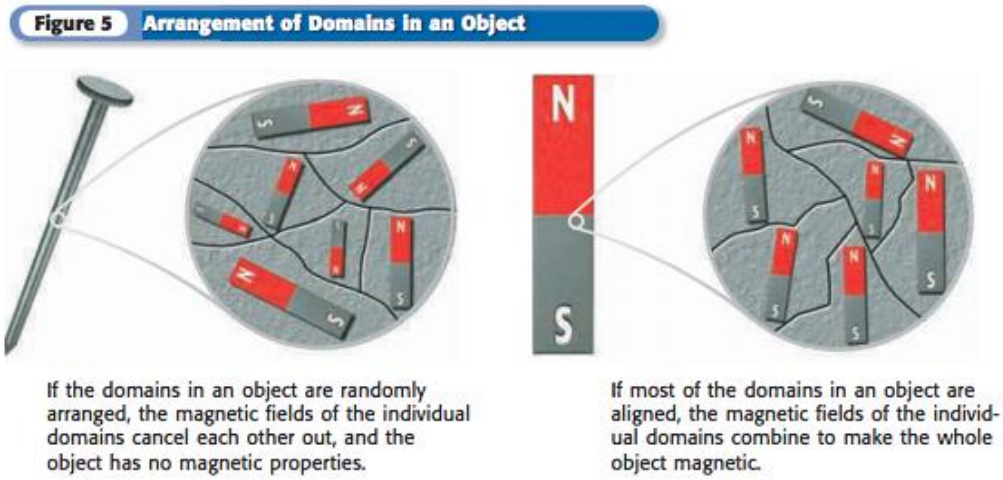


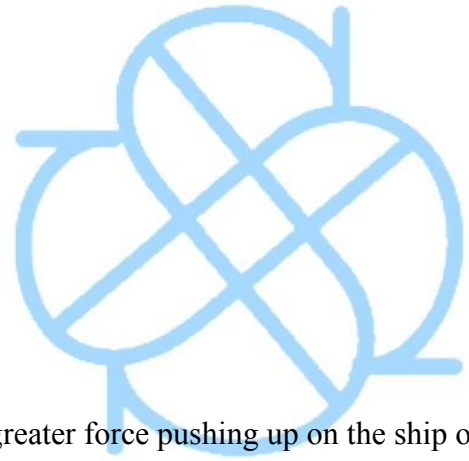
Image Credit: Holt Science Spectrum "Physical Science"

- ***Losing Alignment:*** the domains of a magnet most likely may not always stay lined up. When domains move, the magnet is demagnetized, or loses its magnetic properties. Dropping a magnet or hitting it too hard can move the domains. Putting the magnet in a strong magnetic field that is opposite to its own can also move domains. Increasing the temperature of a magnet can also demagnetize it. At higher temperatures, atoms in the mignet vibrate faster. As a result, the atoms in the domains no longer line up.

c. Describing the different kinds of Magnets

- Some magnets are made of iron, nickel, cobalt, or mixtures of those metals. Magnets made with these metals have strong magnetic properties, which are referred to as ***ferromagnets***.
- ***Electromagnets*** are magnets made by an electric current; they usually have an iron core.
- ***Temporary magnets*** are made from materials that are easy to magnetize, but they tend to lose their magnetization pretty easily.
    - Soft iron isn't mixed with any other materials and can be made into temporary magnets.
- ***Permanent magnets*** are harder to magnetize, but they tend to keep their magnetic properties longer than most temporary magnets do.

- Some permanent magnets are made with alinco, an alloy of aluminum, nickel, cobalt, and iron.



PROPERTIES OF FLUIDS

a. Learning how ships float.

- Ships float because a greater force pushing up on the ship opposes the weight -or force- of the ship pushing down, which is known as the buoyant force.
    - A **buoyant force** is an upward force that acts on an object in a fluid, opposing the downward force of gravity.
- All liquids and gases are fluids because they are free to flow.
- When the weight of a submerged object is greater than the buoyant force, the object will sink down.
- If the weight of a submerged object is equal to the buoyant force, the object will remain at any level, as the downward force of gravity is equal to the upward force of buoyancy.
- If the weight of the object is less than the buoyant force, the object will rise to the top and float on the surface.

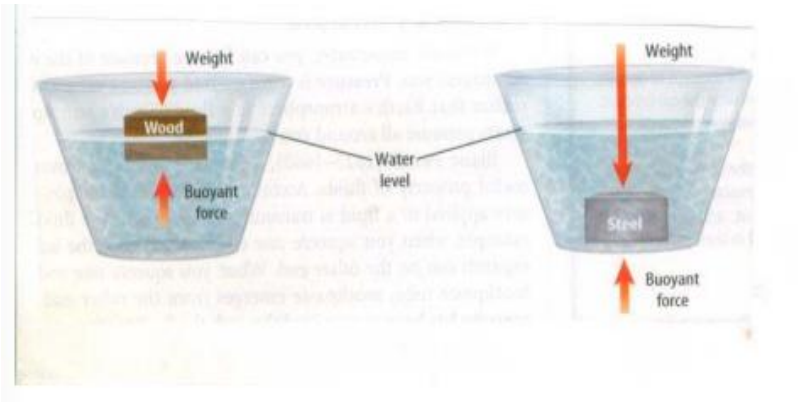


Image Credit: Holt Science Spectrum "Physical Science"

b. Learning different principles of fluids.

- ***Archimedes Principle***: named after Greek mathematician Archimedes, who found that the buoyant force on an object is equal to the weight of the fluid displaced by the object.
    - If you place a block of wood in water, it will push the water out of the way as it sinks, but only until the weight of the water displaced is equal to the block's weight. When the weight of the water displaced is equal to the block's weight, which means the buoyant force becomes equal to the weight of the block, it floats. However, if the weight of the water displaced is less than the weight of the block, the object sinks.

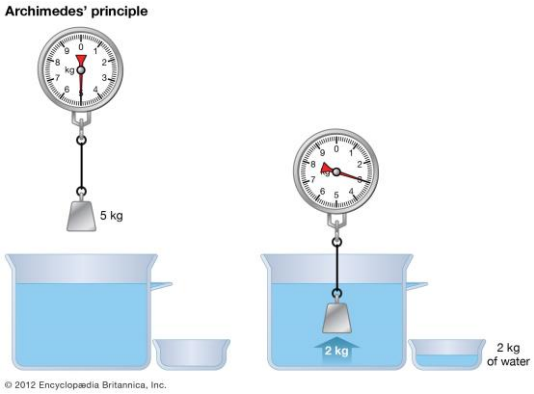


Image Credit: Britannica

b. Learning different principles of fluids. (continued)

- ***Pascal's Principle***: Pressure applied to a fluid is transmitted throughout the fluid in all directions.
- ***Atmospheric pressure*** is the weight of gas particles in the atmosphere (air), pulled down due to gravity.
    - High pressure always wants to fill in low pressure.
    - At higher altitudes, there are fewer particles of air in a given area; therefore, air pressure decreases, so the column of air does not apply as much pressure.
    - The air pressure outside of our bodies is blanched by the pressure inside our bodies; therefore, normal pressure does not crush us. This is called ***implosion***.
- The pressure a liquid expends varies with is depth.

- The deeper the liquid, the greater the pressure, since there are more liquid particles over you, and they are denser than that of air.
- The shallower the liquid, the less the pressure, and vice-versa
- ***Suction*** is a result of unequal air pressure.

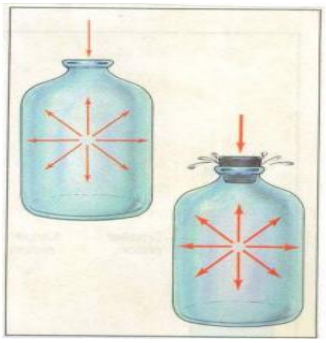
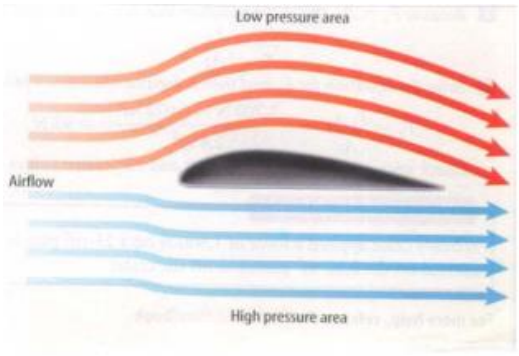


Image Credit: Holt Science Spectrum "Physical Science"

b. Learning different principles of fluids. (continued)

- ***Bernoulli's Principle***: when the velocity of a fluid increases, the pressure exerted by the fluid decreases.
    - The faster a fluid moves, the less pressure it exerts, the same goes the other way around
- Motion of a fluid creates unbalanced forces, in which a low pressure region is created on the top of a flying object and pressure below the object is greater; which produces an upward force.



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