Physical Science Unit 4 Crash Course

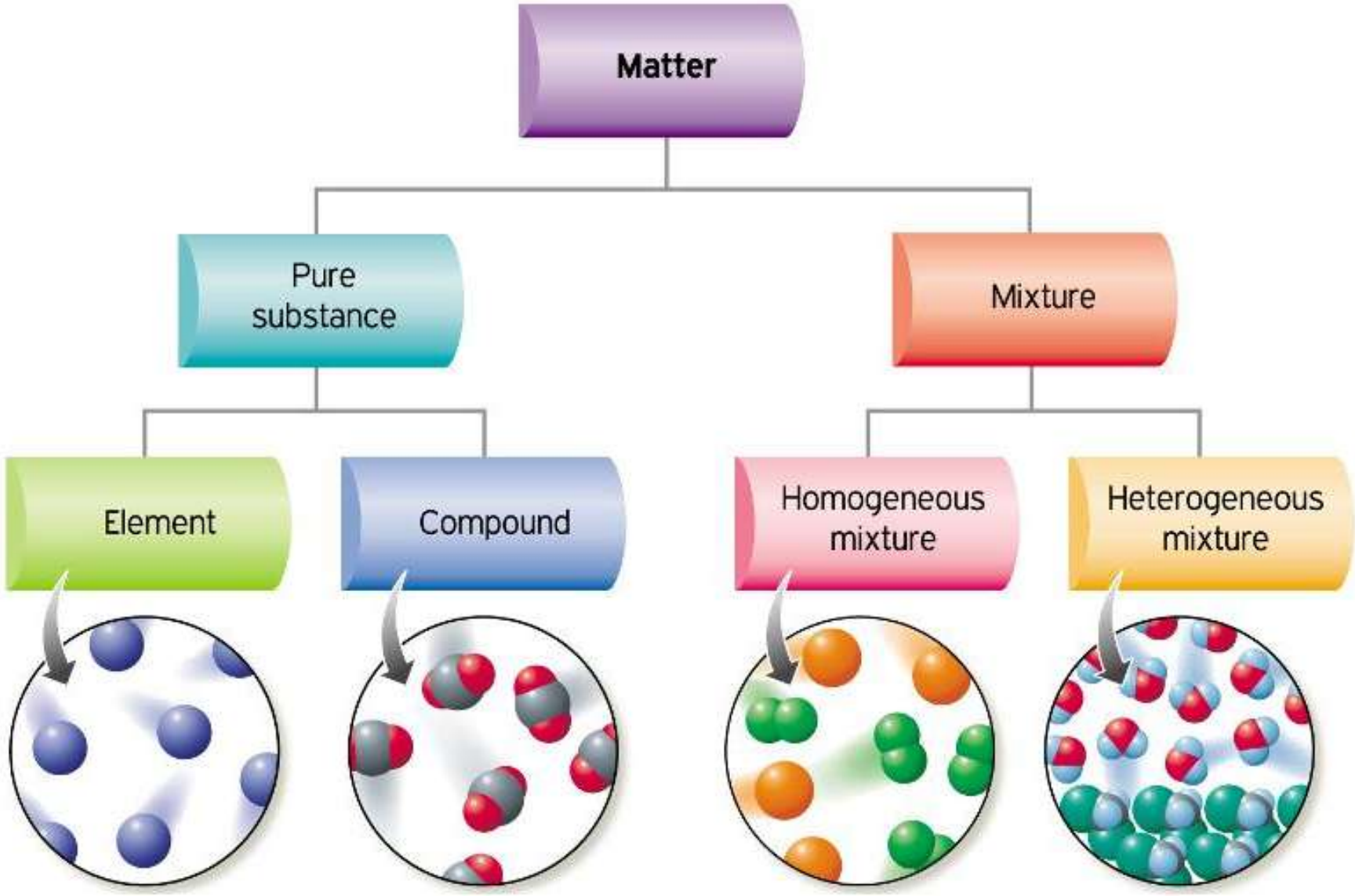
Chapter 2, 3, and 4

(Properties of Matter, States of Matter, and Atomic Structure)

Chapter 2 - Matter

- An element is a substance that cannot be broken down into simpler substances.
- An atom is the smallest particle of an element.
- Each element symbol is either one or two letters.
- The first letter is always capitalized. If there is a second letter, it is lowercase.
- A compound always contains two or more elements joined in a fixed proportion.
- The properties of a mixture can vary because the composition of a mixture is not fixed.

Chapter 2 - Matter



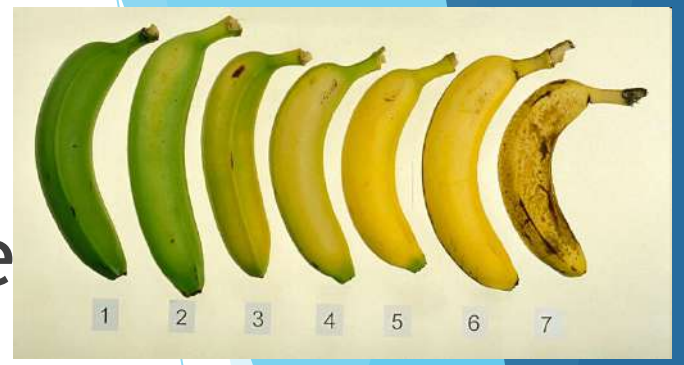
Chapter 2 - Matter

- Based on the size of its largest particles, a mixture can be classified as a solution, a suspension, or a colloid.
- Properties of solutions: small particles, do not settle, cannot be filtered, allow light to pass through, and have small particles.
- Properties of colloids: medium particles, do not settle, cannot be filtered, scatter light, and have medium-sized particles.
- Properties of suspensions: large particles, settle over time, can be filtered, scatter light, and have large particles.

Chapter 2 - Matter

- A physical property is any characteristic of a material that can be observed or measured without changing the composition of the substances in the material.
- Viscosity, conductivity, malleability, hardness, melting point, boiling point, and density are examples of physical properties.
- Filtration and distillation are two common separation methods.
- Filtration is a process that separates materials based on the size of their particles.
- Distillation is a process that separates the substances in a solution based on their boiling points.
- A physical change occurs when some of the properties of a material change, but the substances in the material remain the same. Physical changes can be reversible or irreversible.

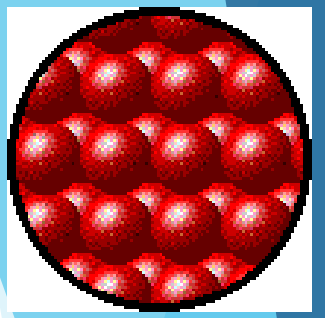
Chapter 2 - Matter

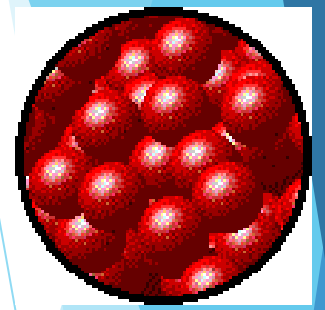


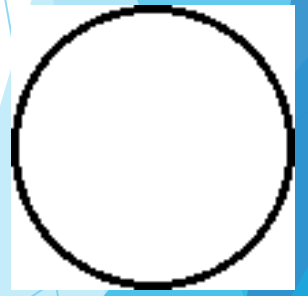
- A chemical property is any ability to produce a change in the composition of matter.
- Flammability and reactivity are two examples of chemical properties.
- A chemical change occurs when a substance reacts and forms one or more new substances.
- Three common types of evidence for a chemical change are a change in color, the production of a gas, and the formation of a precipitate.
- Any solid that forms and separates from a liquid mixture is called a precipitate.

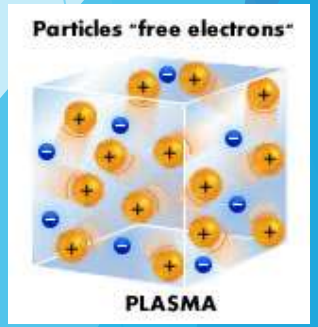
Chapter 3 – States of Matter

- Solid is a state of matter in which materials have a definite shape and definite volume.
- Liquid is a state of matter in which a material has a definite volume but an indefinite shape.
- Gas is the state of matter in which a material has an indefinite shape and an indefinite volume.
- Plasma is a state of matter composed of positive ions and electrons.



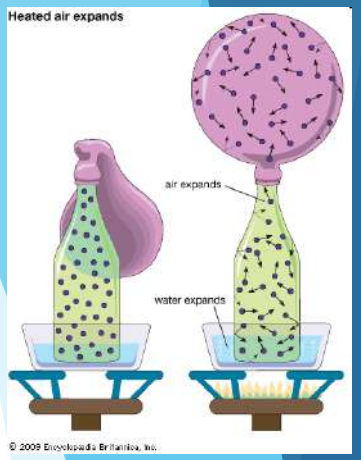


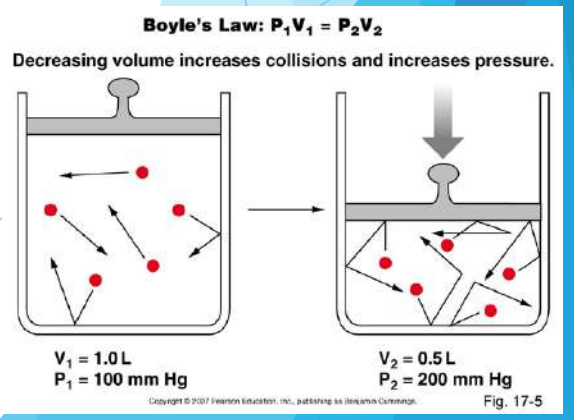




Chapter 3 – States of Matter

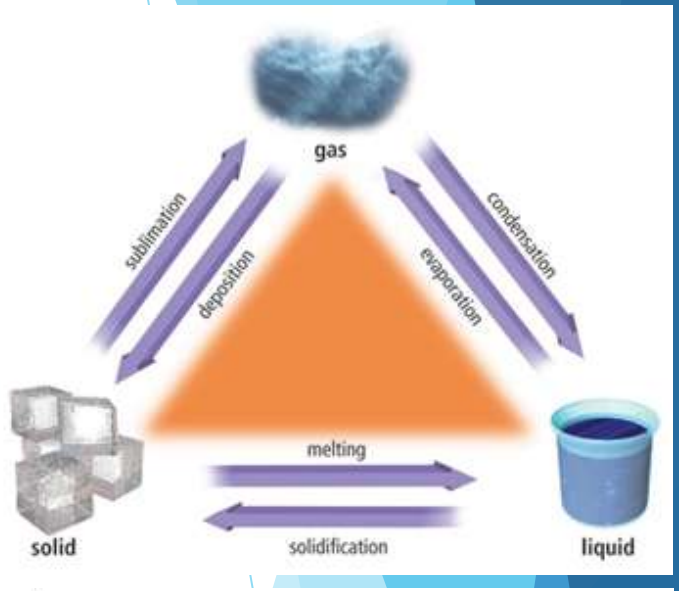
- Collisions between particles of a gas and the walls of the container cause the pressure in a closed container of gas.
- Factors that affect the pressure of an enclosed gas are its temperature, its volume, and the number of its particles.
- Charles' law states that the volume of a gas is directly proportional to its temperature in Kelvin if the pressure and the number of particles of the gas are constant.
- Boyle's law states that the volume of a gas is inversely proportional to its pressure if the temperature and the number of particles are constant.

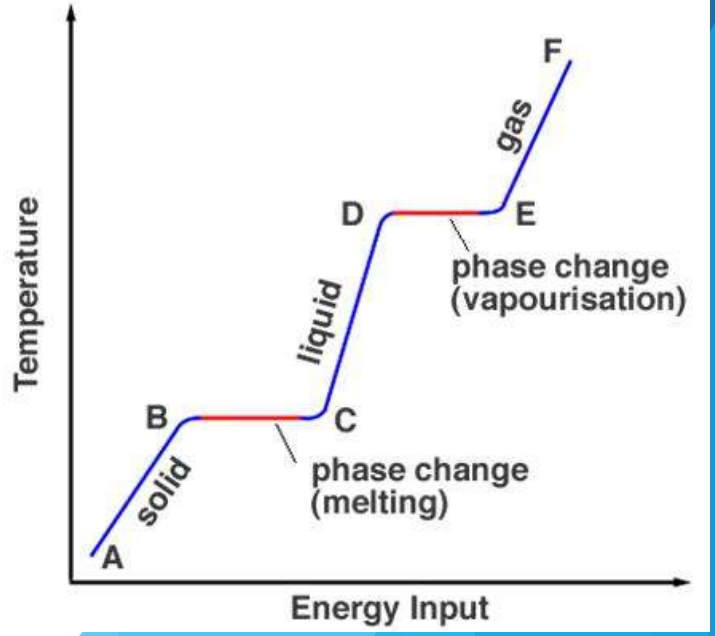




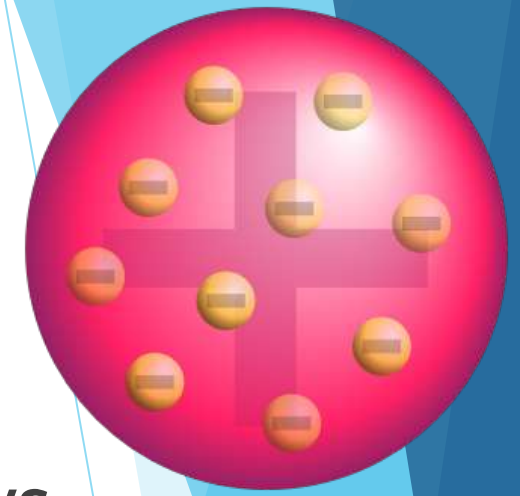
Chapter 3 – States of Matter

- Melting, freezing, vaporization, condensation, sublimation, and deposition are six common phase changes.
- The temperature of a substance does not change during a phase change.
- During an endothermic change, the system absorbs energy.
- During an exothermic change, the system releases energy to the surroundings.

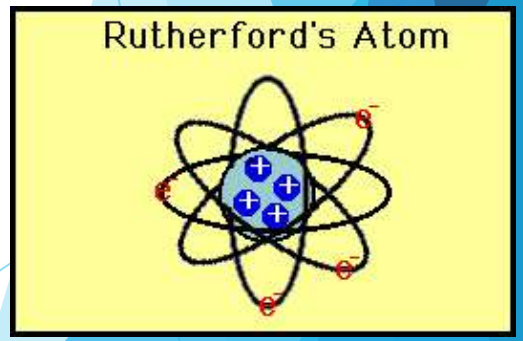




Chapter 4 – Atomic Structure



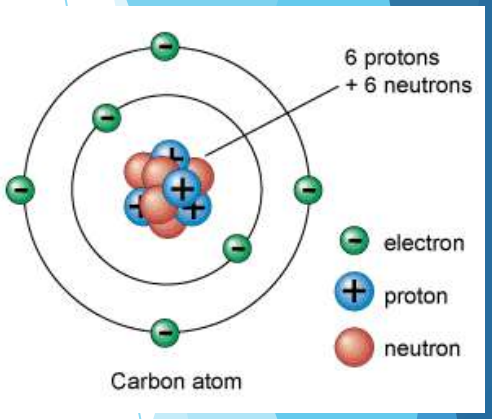
- Thomson concluded that the particles in the cathode ray have a negative charge, and he called them electrons.
- Since atoms are neutral, Thomson's model shows a positively charged area with electrons scattered throughout. This model is known as the plum pudding model.
- Rutherford shot alpha particles at a gold foil.
- This led Rutherford to the conclusion that there was a dense positive charge in the center of the atom and that most of the atom is empty space.



Chapter 4 – Atomic Structure

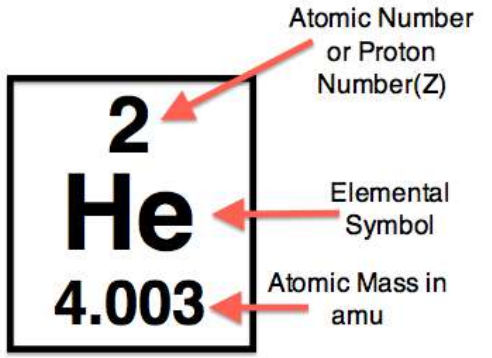
- Protons, electrons, and neutrons are subatomic particles.

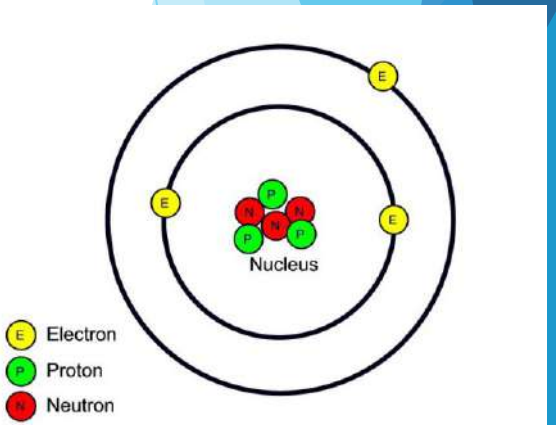
Subatomic Particle	Charge	Relative Mass	Location
proton	+1	1	nucleus
neutron	0	1	nucleus
electron	-1	1/1840	electron cloud



Chapter 4 – Atomic Structure

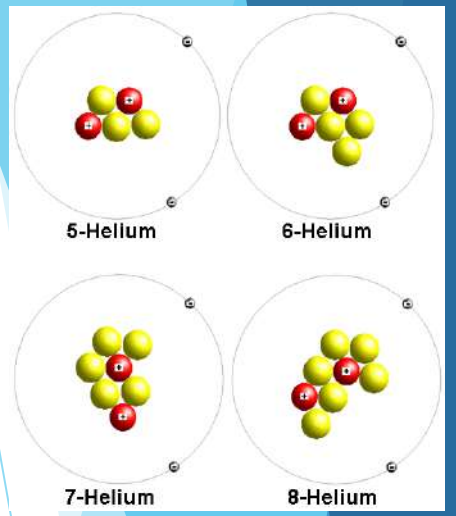
- The atomic number of an element equals the number of protons in an atom of that element.
- Atoms of different elements have different numbers of protons.
- So the atomic number of an element also equals the number of electrons in an atom.
- The mass number of an atom is the sum of the protons and neutrons in the nucleus of that atom.



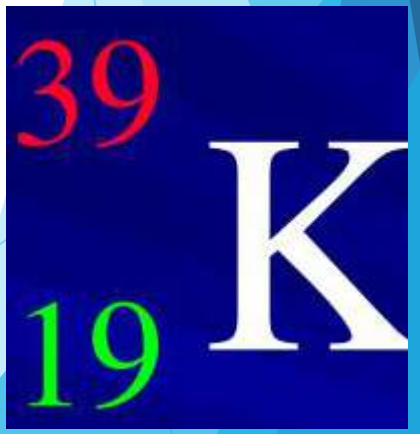


Number of neutrons = mass # – atomic #

Chapter 4 – Atomic Structure



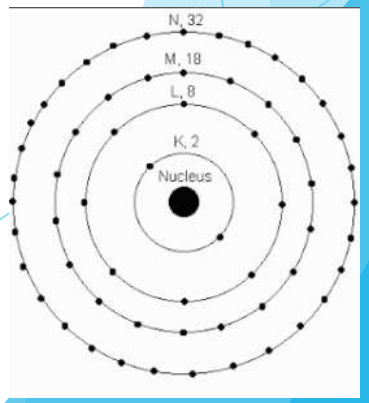
- Isotopes are atoms of the same element that have different numbers of neutrons and different mass numbers.
- Isotopes are referred to in the following way: carbon – 12, carbon – 13, and carbon – 14 where the numbers are the mass numbers.
- Some isotopes are written in the shorthand shown to the right where the top number is the mass number and the bottom number is the atomic number.



Chapter 4 – Atomic Structure

- In Bohr's model, the electrons move with constant speed in fixed orbitals around the nucleus.
- The possible energies that electrons in an atom can have are called energy levels.
- If an atom gains or loses energy, the energy level of an electron can change.
- Each energy level can hold a maximum number of electrons.

Energy Level	Max Number of Electrons
1	2
2	8
3	18
4	32



Chapter 4 – Atomic Structure

- When all the electrons in an atom have the lowest energy possible, the atom is said to be in its ground state.
- If one or more electrons have jumped to higher energy levels, the atom is said to be in its excited state.
- The movement of electrons between energy levels explains the light you see when fireworks explode. Light is a form of energy.