

Chemistry of Life Notes Guide:

Concept: Matter consists of Chemical elements in pure form and in combinations called compounds.

Matter is composed of Elements

_____ is anything that takes up space and has mass. Matter is made up of elements.

*Matter can exist as a solid, liquid, or gas.

An _____ is the basic unit of matter. It cannot be broken down further to a different substance with different properties. 92 naturally occurring.

The smallest complete unit of an element and therefore matter is called the _____.

_____ = the atomic number

Neutrons = the atomic number minus the number of protons

Electrons* weigh 1/1800 as much as a proton or neutron.

Everything is made of matter. Matter is made of atoms. Atoms of the various elements differ in number of subatomic particles.

Elements of Life:

Life requires about 25 chemical elements. Four elements make up 96% of living matter.

Carbon, hydrogen, _____, and nitrogen make up 96% of living matter. Most of the remaining 4% consists of calcium, phosphorus, potassium, and sulfur.

Trace elements are those required by an organism in minute quantities. Examples: Iron and Iodine

Compounds vs Molecules:

A compound is a substance consisting of _____ or more elements in a fixed ratio. A compound has characteristics different from those of its elements.

Molecules are formed when two or more elements are _____ together.

Concept: An element's properties depend on the structure of its atoms

Properties of the Atom:

An _____ is the smallest unit of matter that still retains the properties of an element.

Neutrons (no electrical charge)

Protons (positive charge)

Electrons (negative charge)

All atoms of an element have the same number of protons but may differ in number of neutrons.

Isotopes are two atoms of an element that differ in number of neutrons. Radioactive isotopes decay spontaneously, giving off particles and energy.

An element's **mass number** is the sum of protons plus neutrons in the nucleus.

Atomic mass, the atom's total mass, can be approximated by the mass number.

Concept: The formation and function of molecules depend on chemical bonding between atoms.

Energy transfer to make bonds:

_____ is the capacity to cause change.

Potential energy is the energy that matter has because of its location or structure. The electrons of an atom differ in their amounts of potential energy. An electron's state of potential energy is called its energy level, or electron shell.

Bonding properties

Effect of **Electrons** determine chemical behavior of an atom. It depends on the number of electrons in an atom's outermost shell (_____ **Shell**).

Periodic Table: Elements in the same _____ have the same number of _____.

Elements in the same columns have the same valence (meaning the same number of _____ in their outermost shell).

Chemical Reactivity:

Atoms tend to 1) complete a partially filled valence shell or 2) empty a partially filled valence shell. This tendency drives chemical reactions and creates _____.

Types of Bonds

Weak Bonds: Hydrogen Bonds (attraction between + and -)

Ionic Bonds (attraction between a + charged element and an – charged element)

Strong Bonds: _____ Bonds

Covalent Bonds: A covalent bond is the sharing of a pair of valence electrons by two atoms. In a covalent bond, the shared electrons count as part of each atom's valence shell.

---Nonpolar covalent bonds share electrons equally. Example $O=O$, $H-H$

---Polar covalent bonds have an unequal sharing of electrons between atoms. This creates a molecule which has an area which is more positive or negative than the other parts. Example: Water H_2O .

Draw how covalent bonds share electrons:

Multiple Covalent Bonds:

2 atoms can share >1 pair of electrons
double bonds: 2 pairs of electrons
triple bonds: 3 pairs of electrons
Very _____ bonds

Nonpolar covalent bonds

- Pair of electrons shared _____ by 2 atoms
 - ◆ example: hydrocarbons = C_xH_x
 - methane (CH_4)

Polar covalent bonds:

- Pair of electrons shared _____ equally by 2 atoms
 - ◆ example: water = H_2O
 - oxygen has stronger “attraction” for the electrons than hydrogen
 - oxygen has higher electronegativity
 - water is a polar molecule
 - ◆ + vs – poles
 - ◆ leads to many interesting properties of water...

Ionic Bonds: Two atoms attract valence electrons so unequally that the more electronegative atom _____ the electron away from the less electronegative atom.

Draw how ionic bonds work:

Hydrogen Bonds: The polarity of water creates molecular attractions

- ◆ _____ between positive H in one H_2O molecule to negative O in another H_2O
- ◆ also can occur wherever an -OH exists in a larger molecule
- Weak bond

These weak bonds form between partial positively charged hydrogen atoms of one molecule and the strongly electronegative oxygen or nitrogen of another molecule.

Draw how hydrogen bonds work:

Van Der Waal interactions are very weak connections which result from an asymmetrical distribution of electrons within a molecule.

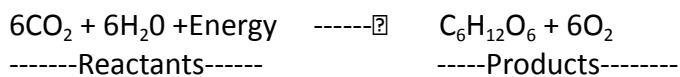
Concept: Chemical reactions make and break chemical bonds

Chemical reactions are the making and breaking of chemical bonds.

In order for a chemical reaction to take place, the reacting molecules (or atoms) must first collide and then have sufficient energy (_____ energy) to trigger the formation of new bonds.

Ions such as Na that take on a positive charge are called _____, and are composed of more protons than electrons. Ions with a negative charge are called _____, and are composed of more electrons than protons.

The starting molecules of a chemical reaction are called _____.
The final molecules of a chemical reaction are called _____.



The number of molecules is represented by the prefix or coefficient. 6CO_2 . There are 6 molecules of CO_2 . There may be 6 Carbon atoms and 12 Oxygen atoms. There are only 6 Molecules. (Molecules are atoms held together with chemical bonds).

Chemical Reactions Cont:

Endergonic Reaction: A reaction that requires input of energy to occur. $\text{A} + \text{B} + \text{energy} \rightarrow \text{C}$

Exergonic Reaction: A reaction that gives off energy as a product. $\text{A} + \text{B} \rightarrow \text{Energy} + \text{C}$

Although many reactions can occur spontaneously, the presence of a catalyst accelerates the rate of the reaction because it lowers the activation energy required for the reaction to take place.

A _____ accelerates the rate of the reaction but does not undergo a chemical change itself. Since the catalyst is not changed by the reaction, it can be used over and over again.

Chemical reactions that occur in biological systems are referred to as metabolism. These include the breakdown of substances (catabolism), the formation of new products synthesis or _____), or the transferring of every form one substance to another.