Chemistry

I. Atoms: the smallest particles that retain the properties of an element.
   a. Element: substance that cannot be degraded by ordinary means into a substance having different properties
   b. Two main parts of an atom
      i. Nucleus
         1. Center of the atom where almost all the mass is located
      ii. Electron cloud
         1. Area surrounding the nucleus where the electrons are located
         2. The Shell Model is a convenient way to think of the distribution of electrons in the electron cloud
            a. A series of “shells” surround the nucleus
            b. Each shell can fit a certain number of electrons
               i. The first shell fits two electrons
               ii. The second and third shells can hold eight electrons each.
               iii. Atoms are most stable (meaning they don’t gain or lose electrons) when they are filled
      c. Atoms are made of smaller subatomic particles
         i. Protons
            1. Positively charged particles located in the nucleus
            2. Protons have mass
         ii. Electrons
            1. Negatively charged particles located in the electron cloud
            2. Electrons have so little mass that they are not considered when determining the mass of an atom
            3. The magnitude of the charge on an electron is equivalent to the magnitude of the charge on a proton.
         iii. Neutrons
            1. Neutrally charged (no charge) particles located in the nucleus
            2. The mass of a neutron is equal to that of a proton
   d. Atoms are ordered on the periodic table by their atomic number
      i. Periodic table: where the elements are located…hehehe
         1. In the periodic table, elements are denoted by an atomic symbol
            a. H: Hydrogen
            b. O: Oxygen
            c. K: Potassium
            d. Na: Sodium
         ii. Atomic number
            1. Equal to the number of protons
            2. It is used to define an element
a. If two atoms have different atomic numbers, they are different elements.

iii. Atomic mass
   1. The mass of an atom
   2. Equal to the number of protons and neutrons in the nucleus
      a. Electrons have so little mass that they are not considered when determining the mass of an atom

II. Molecules: a unit of matter in which chemical bonds hold together two or more atoms of the same or different elements
   a. Examples
      i. Nitrogen gas: N₂
         1. The subscripts in front of an atomic symbol denote the number of atoms of that type.

b. Molecules are created through chemical bonds
   i. Chemical bond is a union between the electron clouds of two atoms

c. The molecules of compounds consists of two or more different elements in proportions that never vary.
   i. Example
      1. Water: H₂O

III. Chemical Bonds
   a. Ionic bonds
      i. Ion: An atom that has either lost or gained one or more electrons is said to be ionized and is now an ion.
         1. Losing an electron results in a net positive charge because there are now more protons in the atom than electrons.
         2. Gaining an electron results in a net negative charge because there are now more electrons in the atom than protons.
      ii. Ions with opposite charges attract and form bonds known as ionic bonds.
         1. Example: Sodium Chloride (NaCl)
            a. Na loses one electron to Cl
            b. Na becomes Na⁺ and Cl becomes Cl⁻
            c. Together they form NaCl

b. Covalent Bonds
   i. When two atoms do not have completely full outer shells, they may share electrons so that each has a full outer shell.
      1. Example: Hydrogen (H₂)
   ii. Single covalent bonds are written as H-H
   iii. Double covalent bonds are written as O=O
   iv. Triple covalent bonds are written as N≡N
   v. Polar Covalent Bonds
      1. Sometimes one of the atoms will pull more strongly on the bond than the other atom, this causes the more attractive
atoms to have a slightly negative charge. These atoms are known as **electronegative**.

1. **Ex: Oxygen**

2. The less attractive atoms to have a slightly positive charge, and are known as **electropositive**
   1. **Ex: Hydrogen**

3. Therefore, one end of the **molecule** is slightly positive and the other is slightly negative, but overall the molecule has no net charge.

**vi. Nonpolar Covalent Bonds**

1. Participating atoms exert equal pull and therefore no charges exist on the molecule.

**c. Hydrogen Bonds**

i. Not **Chemical Bonds**, but instead weak attractive forces between molecules.

ii. Because **polar** bonds have charges on either end, they will tend to be attracted to each other.

iii. When a hydrogen is bonded to an electronegative atom, like oxygen, it becomes **electropositive**.

iv. This causes it to be attracted to **electronegative** parts of the same or other molecules.

**IV. Water**

a. **Water** is a polar molecule.

b. It therefore forms **hydrogen bonds**.

i. **Polar** molecules, such as sugars, are **hydrophilic** (water-loving) molecules form hydrogen bonds with water.

ii. **Nonpolar** molecules, such as fats, are **hydrophobic** (water-fearing) molecules do not form hydrogen bonds with water.

iii. Because of the hydrogen bonds and water’s structure, it forms a very cohesive lattice.

   1. Therefore

      a. Water is very stable to changes in temperature, making a great insulator and an ideal medium in which biological processes occur.
      b. Water has strong cohesive forces which allow water to flow and therefore be used in biological systems

iv. Water is also a good solvent

   1. Ions and polar molecules easily dissolve in it.
      a. **Solute**: that which is dissolved
      b. **Solvent**: That which does the dissolving