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Ms.Prabu - 3rd period 9/8/2014

Chapter 2 Outline

Section 2.1:

What are atoms?

a. Element - a substance that cannot be separated into other substances and cannot be converted into another substance by regular chemical reactions.

b. Atoms - The smallest unit of elements. All atoms retain the chemical properties of each element.

c. Atoms are composed of subatomic particles:  
 Neutron(n) 1 atomic mass unit 0 charge  
 Proton(p^+) 1 atomic mass unit +1 charge  
 Electron(e^-) 0.00055 atomic mass unit -1 charge

An atom is uncharged/neutral if it contains equal numbers of protons and electrons because the protons and electrons cancel themselves out.

The mass number of an atom is the total number (and mass) of protons and neutrons in the nucleus. Protons and neutrons cluster together in the center of an atom, called the atomic nucleus. Electrons revolve around the nucleus in a three dimensional space.

d. Elements in the periodic table are identified by their atomic number (number of protons).

e. Isotopes are atoms of the same element. Some isotopes are unstable and radioactive, so their nuclei spontaneously break apart/decay, emitting subatomic particles that carry large amounts of energy. Can damage cells.

f. Nuclei (non-radioactive) provide stability by resisting outside disturbances such as heat, electricity, and light. Electrons are dynamic and can capture and release energy.

g. Electrons occupy 3d regions called electron shells around the nucleus. Each shell has a specific energy associated with it. More distance between nucleus and shell means higher electron energy in that shell and less stability.

h. When an atom is excited by energy such as heat/light this energy can cause an electron to jump from a lower-energy electron shell to a higher energy shell. After some time, the electron falls back to its original cell, releasing extra energy, often as light (But as what else?)

i. Each electron shell can hold a certain amount of electrons. The closest shell to the nuclei can only hold two, more distant shells hold eight. The shells closest are always filled first. Elements with larger numbers of protons in their nuclei require more electrons to balance those protons, so their electrons will occupy shells at increasing distance.

Section 2.2

How do atoms interact to form molecules?

a. Most matter is composed of different elements linked together to form molecules.

b. Atoms form molecules to fill vacancies in their outer electron shells. Electrons nearest the atomic nucleus are the most stable and have a lower probability to interact with other atoms with full electron shells.  
For most elements, the # of electrons needed to balance the # of protons will fill one or more inner shells, but not the entire outer shell. Atoms usually behave in accordance with the following two rules:

1. An atom will not react with other atoms when its furthest electron shell is completely full. Such atoms ( like helium) are very stable and described as inert.

2. An atom will react with other atoms if its furthest shell is not entirely full (hydrogen). An atom like this is reactive

3 major bonds, iconic bonds, covalent, and hydrogen.

c. Ionic bonds: Atoms generally have equal numbers of protons and electrons.

An atom with an almost empty furthest electron shell tend to become more stable by losing electrons and completely emptying its shell (if less electrons than protons, atom = positively charged). An atom with an almost full furthest shell tends to get more electrons (if more electrons than protons, atom = negatively charged). These are called ions.  
Ions of opposite charged attract and form ionic bonds. An example would be sodium chloride. Water can break ionic bonds and most biological molecules must function in water and formed with covalent bonds

d. Covalent Bonds: Atoms with partially filled outer electron shells can become stable by sharing electrons, filling outer shells and forming covalent bonds. Most biological molecules are joined by covalent bonds.

e. Covalent bonds may produce nonpolar or polar molecules:  
 1.Non polar covalent bonds occur when electrons that are shared equally result in no charge in any part of the molecule.

2. Polar covalent bonds occur when unequally shared electrons (caused by atoms attracting electrons more strongly) results in charged poles. In H2O, an electron is shared between each H atom and the central atom oxygen atom, The oxygen atoms exerts a stronger attraction, so the shared electrons spend more time near the oxygen atom. The oxygen pole becomes more negative and the hydrogen more positive.  
  
 Some atoms/molecules with unfilled outer shells are so reactive that they can tear molecules apart. These are called free radicals. They are produced in large numbers in the body by reactions that make energy available.

f. Hydrogen bond - the attraction between a slightly positive hydrogen and a slightly negative oxygen/nitrogen. This occurs in water where the molecules form hydrogen bonds with one another, giving a loosely linked network.

2.3:

Why is water so important to life?

a. Hydrogen bonds cause cohesion - the tendency for molecules of a single type to stick together. Cohesion of water plays a crucial part in land plants. Leaves allow water to evaporate, pulling other water molecules under it up. Hydrogen bonds are stronger than the weight of water, so the chain of water does not break.  
Cohesion among water also produces surface tension - the tendency for a water surface to resist being broken.

b. A solvent is a substance that dissolves some other substance ( a solvent completely surrounds and spreads the molecules of another substance). Water dissolves many molecules important for life.  
Sodium chloride (NA+ and CL-) are attracted to the negative oxygen poles and the positive hydrogen poles respectively, surrounding and separating sodium chloride entirely.  
Ions and polar molecules tend to be attracted to water and are called hydrophillic - water loving in Greek.  
Gases are small enough to fit in between the spaces of water molecules.  
Larger molecules with nonpolar covalent bonds such as fats and oils do not dissolve in oil and are called hydrophobic.  
Water molecules stick together and exclude oil molecules, forcing oil to clump together - described as hydrophobic interaction.

c.Water has a very high specific heat At any temperature above absolute 0, atoms are always moving. Breaking hydrogen bonds require a lot of energy. This allows organisms to function in warmer environments.  
This is used in perspiration. Water has an extremely high heat of vaporization - the amount of heat needed to cause of a substance to evaporate. Water absorbs energy to evaporate, cooling the skin.

d. Ice is an unusual solid because it becomes less dense as a solid. When frozen, molecules line up in a hexgonal shape, forcing water molecules further apart. This allows ice to float to the top and provide an insulating layer to the organisms below.

e. At anytime, water molecules will have split into hydroxide ions(OH-) and hydrogen ions (H+). Pure water contains equal concentrations. When ion forming substances are added to water, the concentrations imbalance. More positively charged ions result in higher acidity(lower pH) and more negatively charged ions result in higher base levels (higher pH). 7 pH is neutral.  
A buffer is a type of molecule that tends to maintain a solution at a constant pH by accepting or releasing H+ in response to small changes in H+ concentration.