Honors Biology Chapter 2 PPT Notes

**ELEMENTS, ATOMS, AND MOLECULES**

2.1 I can define the basic vocabulary needed to understand basic chemistry

* Chemicals are at the base level of biological hierarchy
* They are arranged into higher and higher levels of structural organization
  + Arrangement eventually leads to formation of living organisms

2.1 I can define the basic vocabulary needed to understand basic chemistry

* Living organisms are composed of **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**, which is anything that occupies space and has mass (weight)
  + Matter is composed of chemical elements
    - **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**—a substance that cannot be broken down to other substances
    - There are 92 elements in nature—only a few exist in a pure state
  + Life requires 25 essential elements; some are called **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

2.1 I can define the basic vocabulary needed to understand basic chemistry

* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**—a substance consisting of two or more different elements combined in a fixed ratio
  + There are many compounds that consist of only two elements
    - Table salt (sodium chloride or NaCl) is an example
    - Sodium is a metal, and chloride is a poisonous gas
    - However, when chemically combined, an edible compound emerges

2.4 I can describe the structure of an atom

* An **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** is the smallest unit of matter that still retains the properties of a element
  + Atoms are made of over a hundred subatomic particles, but only three are important for biological compounds
    - **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**—has a single positive electrical charge
    - **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**—has a single negative electrical charge
    - **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**—is electrically neutral

2.4 I can describe the structure of an atom

* Elements differ in their number of protons, neutrons, and electrons
  + Helium has two protons, two neutrons, and two electrons
  + Carbon has six protons, six neutrons, and six electrons

2.4 I can describe the structure of an atom

* Neutrons and protons are packed in the atom’s **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
  + The negative charge of electrons and the positive charge of protons keep electrons near the nucleus
  + The number of protons is the atom’s **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
    - Carbon with 6 protons has an atomic number of 6
    - The **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** is the sum of the protons and neutrons in the nucleus (carbon-12 is written 12C)

2.4 Atoms consist of protons, neutrons, and electrons

* Although all atoms of an element have the same atomic number, some differ in mass number
  + The variations are **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**, which have the same numbers of protons and electrons but different numbers of neutrons
    - One isotope of carbon has 8 neutrons instead of 6 (written 14C)
    - Unlike 12C, 14C is an unstable (radioactive) isotope that gives off energy

2.4 CONNECTION: Radioactive isotopes can help or harm us

* Living cells cannot distinguish between isotopes of the same element
  + Therefore, when radioactive compounds are used in metabolic processes, they act as tracers
  + Radioactivity can be detected by instruments
* With instruments, the fate of radioactive tracers can be monitored in living organisms

2.6 I can explain how the electron configuration of an atom influences its chemical behavior

* Only electrons are involved in chemical activity
* Electrons occur in energy levels called **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Information about the distribution of electrons is found in the *periodic table of the elements*

2.6 Electron arrangement determines the chemical properties of an atom

* Electron arrangement is in shells (levels/orbitals)
  + The number of electrons in the outermost shell (valence electrons) determines the chemical properties of the atom

The first shell is full with two electrons, whereas the second and third will hold up to eight electrons

2.6 Electron arrangement determines the chemical properties of an atom

* Atoms want to fill their outer electron shells
  + To accomplish this, the atom can share, donate, or receive electrons (which results in **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**)

2.6 Electron arrangement determines the chemical properties of an atom

* An **\_\_\_\_\_\_\_\_\_\_\_\_** is an atom or molecule with an electrical charge resulting from gain or loss of electrons
  + When an electron is lost, a positive charge results; when one is gained, a negative charge results
* Two ions with opposite charges attract each other
  + When the attraction holds the ions together, it is called an **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

2.8 Covalent bonds join atoms into molecules through electron sharing

* A **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** results when atoms share outer-shell electrons
  + A **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** is formed when atoms are held together by covalent bonds

2.9 Unequal electron sharing creates polar molecules

* In molecules of only one element, the pull toward each atom is equal, because each atom has the same electronegativity
  + The bonds formed are called **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

2.9 Unequal electron sharing creates polar molecules

* Water has atoms with different electronegativities
  + Oxygen attracts the shared electrons more strongly than hydrogen
  + So, the shared electrons spend more time near oxygen
  + The result is a **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

2.9 Unequal electron sharing creates polar molecules

* In H2O the oxygen atom has a slight negative charge and the hydrogens have a slight positive charge
  + Molecules with this unequal distribution of charges are called **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

2.10 Hydrogen bonds are weak bonds important in the chemistry of life

* Some chemical bonds are weaker than covalent bonds
* Water molecules are electrically attracted to oppositely charged regions on neighboring molecules
  + Because the positively charged region is always a hydrogen atom, the bond is called a **\_\_\_\_\_\_\_\_\_\_\_\_\_**

**WATER’S LIFE-SUPPORTING PROPERTIES**

2.11 I can describe the special properties of water

* Hydrogen bonding causes molecules to stick together, a property called **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
  + Cohesion is much stronger for water than other liquids
  + This is useful in plants that depend upon cohesion to help transport water and nutrients up the plant

2.11 I can describe the special properties of water – HYDROGEN BONDS

* Cohesion is related to **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**—a measure of how difficult it is to break the surface of a liquid
  + Hydrogen bonds are responsible for surface tension

2.11 I can describe the special properties of water – HYDROGEN BONDS

* Because of hydrogen bonding, water has a greater ability to resist temperature change than other liquids
  + **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** is the energy associated with movement of atoms and molecules in matter
  + **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** measures the intensity of heat
* Heat must be absorbed to break hydrogen bonds; heat is released when hydrogen bonds form

2.11 I can describe the special properties of water – HYDROGEN BONDS

* Water can exist as a gas, liquid, and solid
* Water is less dense as a solid, a property due to hydrogen bonding
* When water freezes, each molecule forms a stable hydrogen bond with four neighbors
  + A three-dimensional crystal results
  + There is space between the water molecules
* Ice is less dense than water, so it floats

2.14 I can define a solute, solvent, and a solution

* A **solution** is a liquid consisting of a uniform mixture of two or more substances
  + The dissolving agent is the **solvent**
  + The substance that is dissolved is the **solute**

2.14 I can define a solute, solvent, and a solution

* Water is a versatile solvent that is fundamental to life processes
  + Its versatility results from its polarity
  + Table salt is an example of a solute that will go into solution in water
    - Sodium and chloride ions and water are attracted to each other because of their charges

2.15 I can explain how acids and bases are represented on the pH scale

* A few water molecules can break apart into ions
  + Some are hydrogen ions (H+)
  + Some are hydroxide ions (OH–)
    - Both are extremely reactive
    - A balance between the two is critical for chemical processes to occur in a living organism

2.15 I can explain hoe acids and bases are represented on the pH scale

* Chemicals other than water can contribute H+ to a solution
  + They are called **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
  + An example is hydrochloric acid (HCl)
    - This is the acid in your stomach that aids in digestion
* An acidic solution has a higher concentration of H+ than OH–

2.15 I can explain how acids and bases are represented on the pH scale

* Some chemicals accept hydrogen ions and remove them from solution
  + These chemicals are called **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
  + For example, sodium hydroxide (NaOH) provides OH– that combines with H+ to produce H2O (water)
  + This reduces the H+ concentration

2.15 I can explain hoe acids and bases are represented on the pH scale

* A **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** (pH = potential of hydrogen) is used to describe whether a solution is acidic or basic
  + pH ranges from 0 (most acidic) to 14 (most basic)
  + A solution that is neither acidic or basic is neutral   
    (pH = 7)

**CHEMICAL REACTIONS**

2.18 I can explain the significance of chemical reactions. (reactants and products)

* You learned that the structure of atoms and molecules determines the way they behave
  + Remember that atoms combine to form molecules
  + Hydrogen and oxygen can react to form water

2H2 + O2  2H2O

2.18 I can explain the significance of chemical reactions. (reactants and products)

* The formation of water from hydrogen and oxygen is an example of a **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
* The **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** (H2 and O2) are converted to H2O, the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
  + Organisms do not make water, but they do carry out a large number of chemical reactions that rearrange matter
  + Photosynthesis is an example where plants drive a sequence of chemical reactions that produce glucose