

The Molecular and Biochemical Basis of an Organism

Chemical Basis of Life

Why chemistry in a Biology class?

- ❑ Body functions depend on cellular functions
- ❑ Cellular functions result from chemical changes
- ❑ Biochemistry helps to explain physiological processes, and develop new drugs and methods for treating diseases

Matter – anything that takes up space and has weight; composed of elements

Elements – composed of chemically identical atoms

- There are 26 elements in the human body
- There are 11 “major elements,” four of which (carbon, oxygen, hydrogen, and nitrogen) make up 96% of the human body
- There are 15 “trace elements” that make up less than 2% of body weight

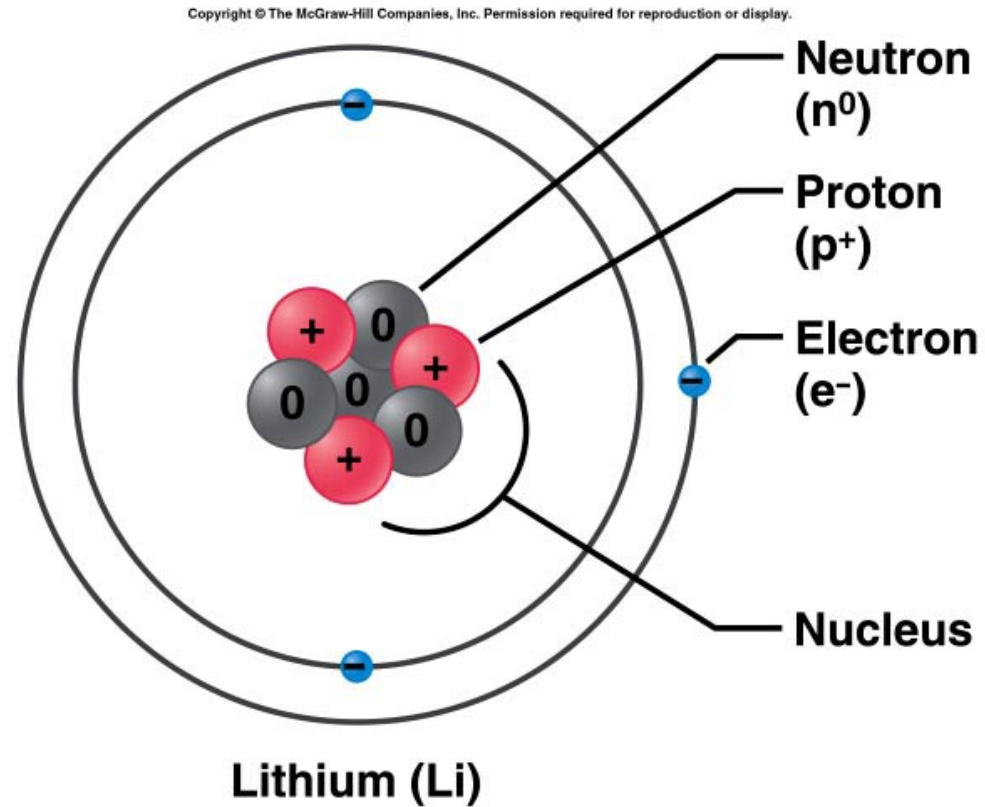
Atomic Structure

Atoms – smallest particle of an element composed of subatomic particles:

- **proton** – carries a single positive charge
- **neutron** – carries no electrical charge
- **electron** – carries a single negative charge

Nucleus

- central part of atom
- composed of protons and neutrons
- electrons move around the nucleus



Molecules and Compounds

Molecule – particle formed when two or more atoms
chemically combine

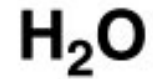
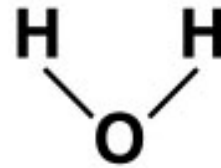
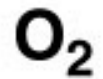
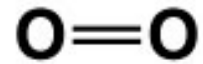
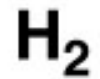
Compound – particle formed when two or more
molecules of different elements chemically combine

Molecular formulas – depict the elements present
and the number of each atom present in the molecule



Structural Formula

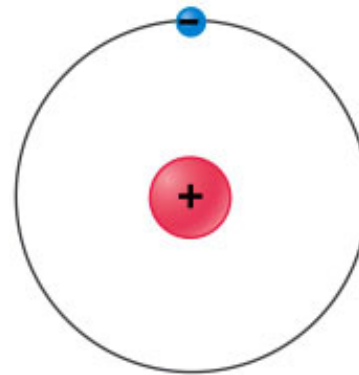
Structural formulas show how atoms bond and are arranged in various molecules



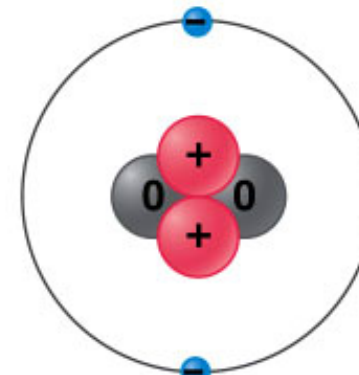
Bonding of Atoms

- bonds form when atoms combine with other atoms
- electrons of an atom occupy regions of space called **electron shells** which circle the nucleus
- each shell can hold a limited number of electrons
- for atoms with atomic numbers of 18 or less, the following rules apply:
 - the first shell can hold up to 2 electrons
 - the second shell can hold up to 8 electrons
 - the third shell can hold up to 10 electrons

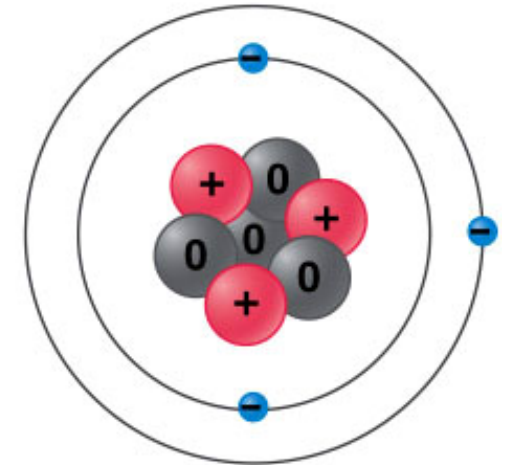
- lower shells are filled first
- If the outermost shell is full, the atom is stable



Hydrogen (H)



Helium (He)



Lithium (Li)

Ions

Ion

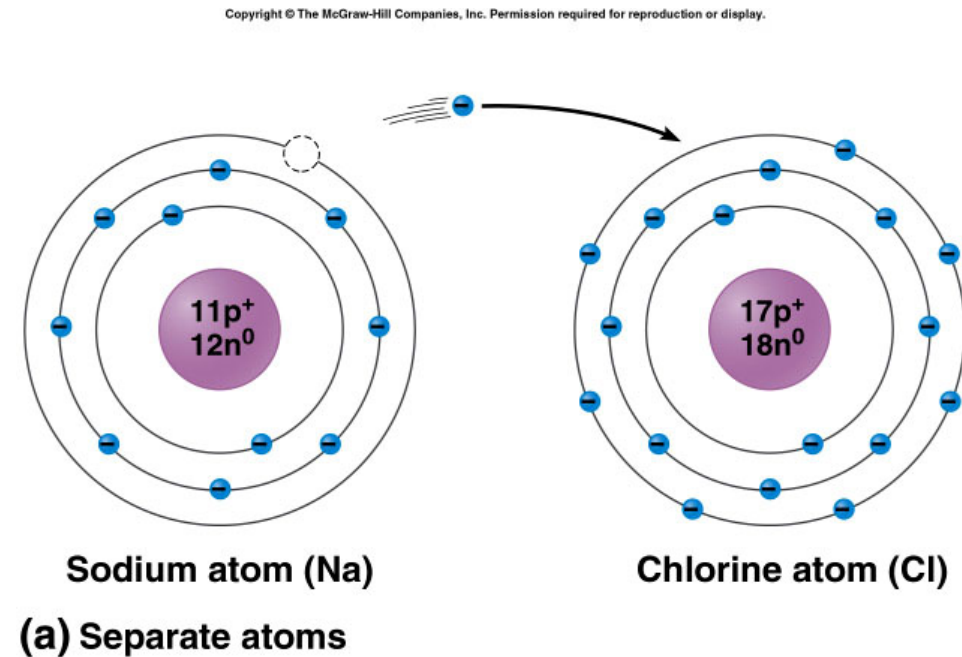
- an atom that gains or loses electrons to become stable
- an electrically charged atom

Cation

- a positively charged ion
- formed when an atom loses electrons

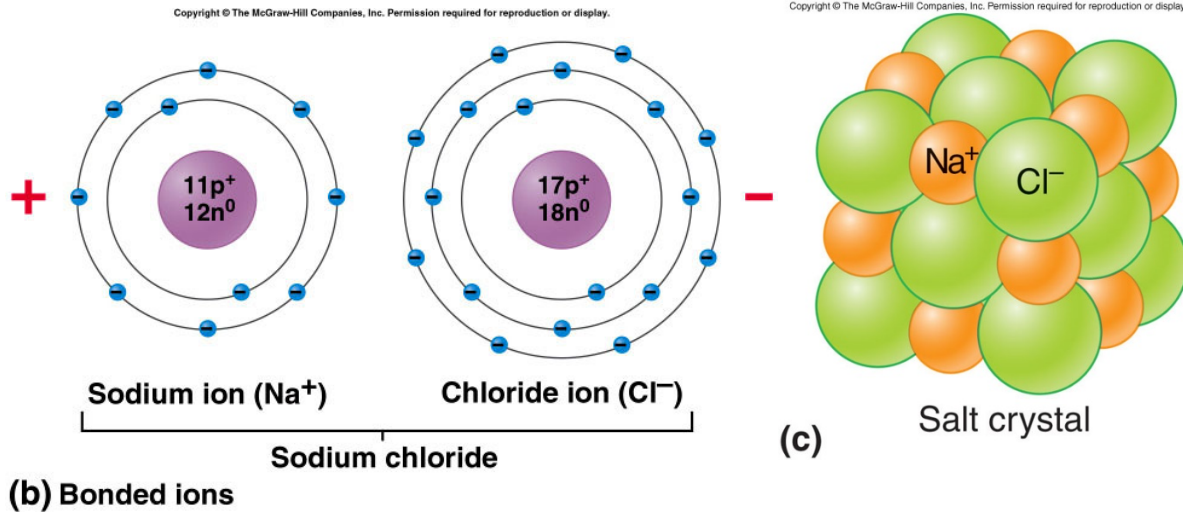
Anion

- a negatively charged ion
- formed when an atom gains electrons



Ionic Bond

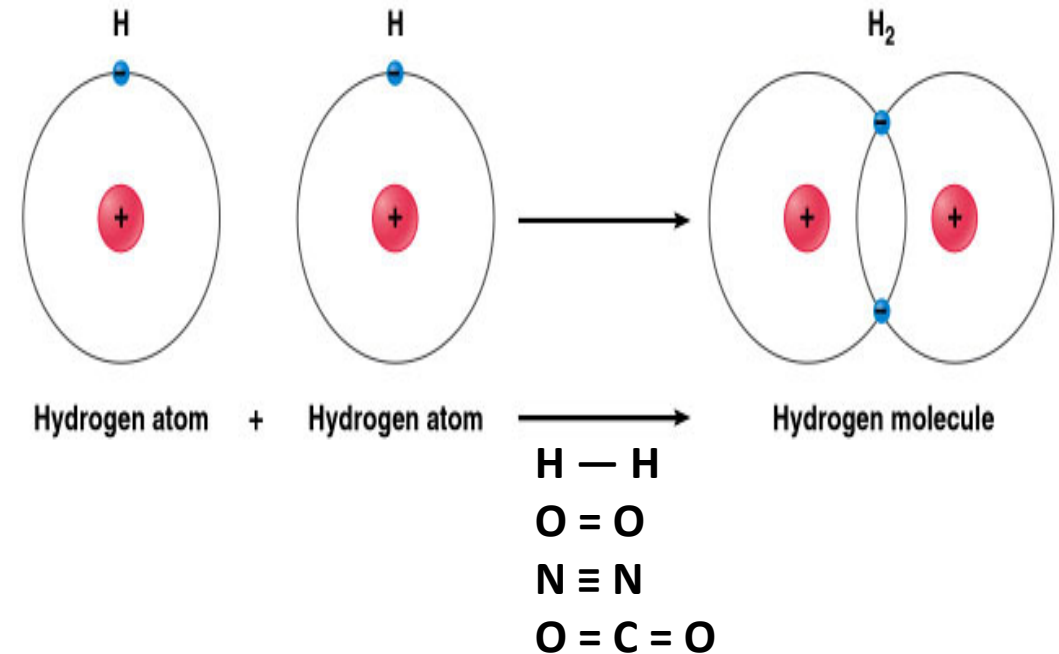
- an attraction between a cation and an anion
- formed when electrons are transferred from one atom to another atom



Covalent Bond

Formed when atoms share electrons

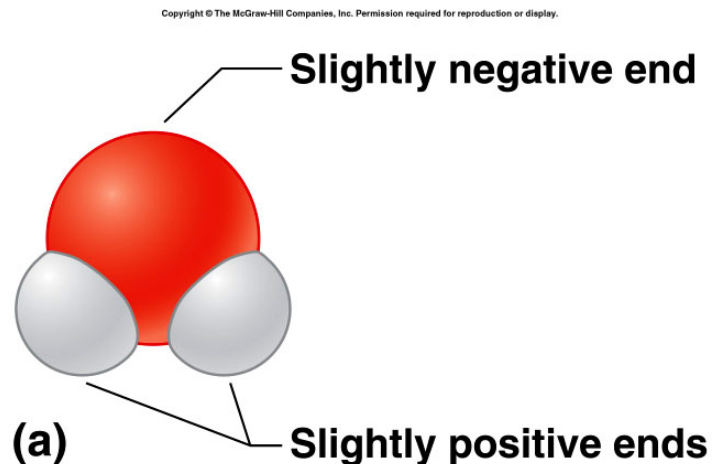
- Hydrogen atoms form single bonds
- Oxygen atoms form two bonds
- Nitrogen atoms form three bonds
- Carbon atoms form four bonds



Polar Molecules

Molecule with a slightly negative end and a slightly positive end

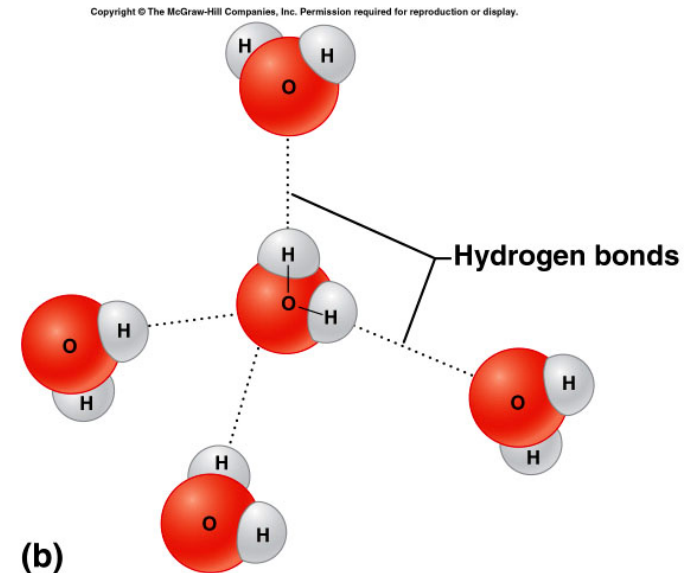
- Results when electrons are not shared equally in covalent bonds
- Water is an important polar molecule



Hydrogen Bonds

A weak attraction between the positive end of one polar molecule and the negative end of another polar molecule

- formed between water molecules
- important for protein and nucleic acid structure

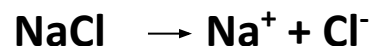


Chemical Reactions

Chemical reactions occur when chemical bonds form or break among atoms, ions, or molecules

Reactants are the starting materials of the reaction- the atoms, ions, or molecules

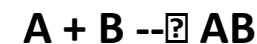
Products are substances formed at the end of the chemical reaction



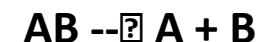
Reactant Products

Types of Chemical Reactions

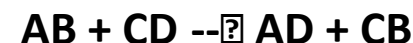
Synthesis Reaction – more complex chemical structure is formed



Decomposition Reaction – chemical bonds are broken to form a simpler chemical structure



Exchange Reaction – chemical bonds are broken and new bonds are formed



Reversible Reaction – the products can change back to the reactants



Organic Versus Inorganic

Organic molecules

contain C and H

- **usually larger than inorganic molecules**
- **dissolve in water and organic liquids**
- **carbohydrates, proteins, lipids, and nucleic acids**

Inorganic molecules

generally do not contain C

- **usually smaller than organic molecules**
- **usually dissociate in water, forming ions**
- **water, oxygen, carbon dioxide, and inorganic salts**

Thank you

