1.3: Electronegativity and types of Chemical Bonds

Electronegativity

The electronegativity of an atom is a measure of its affinity for electrons. The atoms of the various elements differ in their affinity for electrons.

This image distorts the conventional periodic table of the elements so that the greater the electronegativity of an atom, the higher its position in the table. Although fluorine (F) is the most electronegative element, it is the electronegativity of runner-up oxygen (O) that is exploited by life. The shuttling of electrons between carbon (C) and oxygen (O) atoms powers life.

1. Moving electrons against the gradient (O to C) — as occurs in photosynthesis — requires energy (and stores it).
2. Moving electrons down the gradient (C to O) — as occurs in cellular respiration — releases energy.
The relative electronegativity of two interacting atoms also plays a major part in determining what kind of chemical bond forms between them.

**Chemical Bonds**

Three main types of chemical bonds: Ionic Bond, Covalent Bond, Polar Covalent Bond.

**Ionic Bond**

Example of an ionic bond is: Sodium (Na) and Chlorine (Cl) = Ionic Bond. There is a large difference in electronegativity between Na and Cl atoms, so

- the chlorine atom takes an electron from the sodium atom
- converting the atoms into ions (Na\(^+\)) and (Cl\(^-\))
- These are held together by their opposite electrical charge forming ionic bonds
- Each sodium ion is held by 6 chloride ions while each chloride ion is, in turn, held by 6 sodium ions
- Result: a crystal lattice (not molecules) of common table salt (NaCl)

**Covalent Bond**

Example of a covalent bond is: Carbon (C) and Hydrogen (H) = Covalent Bond. There is only a small difference in electronegativity between the C and H atoms, so

- the two atoms share the electrons
- Result: a covalent bond (depicted as C:H or C-H)
- The atoms are held together by their mutual affinity for their shared electrons
- An array of atoms held together by covalent bonds forms a true molecule

**Polar Covalent Bond**

Example of a polar covalent bond is: Hydrogen (H) and Oxygen (O) = Polar Covalent Bond. There is a moderate difference in electronegativity, causing the oxygen atom to pull the electron of the hydrogen atom closer to itself. This results in a polar covalent bond. Oxygen does this with 2 hydrogen atoms to form a molecule of water

Molecules, like water, with polar covalent bonds are themselves polar; that is, have partial electrical charges across the molecule and may be attracted to each other (as occurs with water molecules). These species are good solvents for polar and/or hydrophilic compounds may form hydrogen bonds.

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