

IMPORTANT BONDS IN BIOLOGICAL MOLECULES

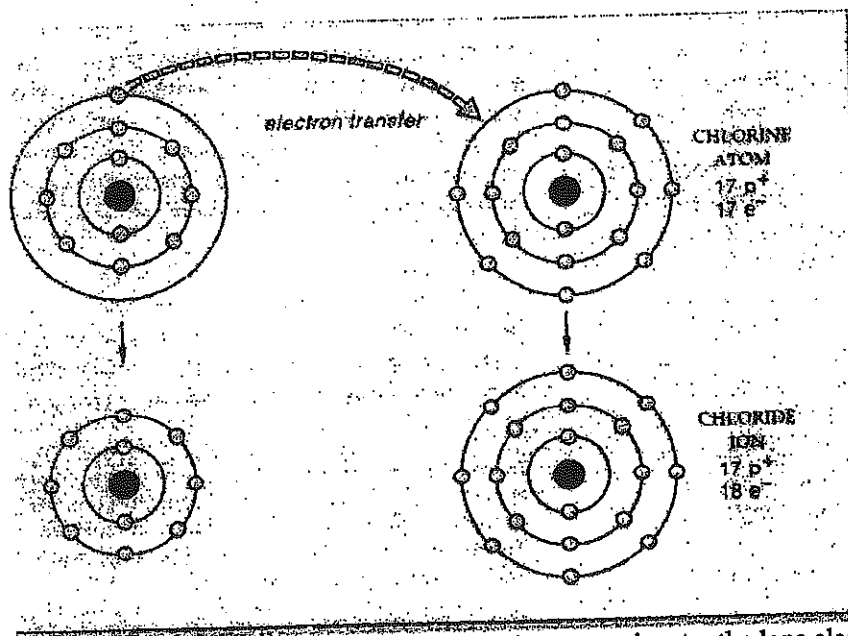
Eat your peas! Drink your milk! Probably for longer than you care to remember, somebody has been telling you to eat foods that are rich in carbohydrates, proteins, and other "biological molecules." Only living organisms put together and use these molecules, which consist of a few kinds of atoms held together by only a few kinds of bonds.

Foremost among the molecular interactions are the ionic, covalent, and hydrogen bonds.

Ion Formation and Ionic Bonding

- An atom has just as many electrons as protons, so it carries no net charge.
- However, that balance can change for atoms with a vacancy—an unfilled orbital in their outermost shell.
- For example, a chlorine atom can acquire an extra electron and thus fill the vacancy.
- Similarly, the lone electron in a sodium atom's outermost shell can be knocked out of an orbital or pulled completely away from it.

SODIUM AND THE FORMATION OF AN ION

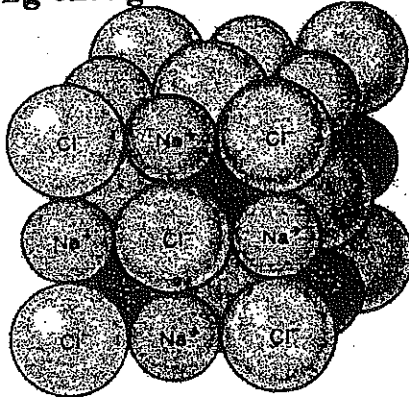


Ionization by way of an electron transfer. In this case, a sodium atom donates the lone electron in its outermost shell to a chlorine atom, which has an unfilled orbital in its outermost shell. A sodium ion (Na^+) and a chloride ion (Cl^-) are the outcome of this interaction.

Any atom that has either gained or lost one or more electrons is an ion. The balance between its protons and its electrons has shifted, so the atom is now ionized; it has become positively or negatively charged.

In living cells, neighboring atoms commonly accept or donate electrons among one another. When one atom loses an electron and one gains, both become ionized.

They may remain together as a result of the mutual attraction of opposite charges. **An association of two ions that have opposing charges is known as an ionic bond.**

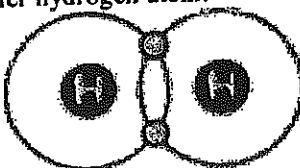


In each crystal of table salt, or NaCl, many sodium and chloride ions remain together because of the mutual attraction of their opposite charges. Their interaction is an example of ionic bonding.

NOTES TAKEN IN CLASS:

Covalent Bonding

- Suppose two atoms, each with an unpaired electron in its outermost shell, meet up.
- Each exerts an attractive force on the other's unpaired electron but not enough to yank it away.
- Each atom becomes more stable by sharing its unpaired electron with the other.
- **A sharing of a pair of electrons is a covalent bond.**
- For example, a hydrogen atom can partially fill the electron vacancy in its outermost shell when it is covalently bonded to another hydrogen atom.



- In structural formulas a single line that is drawn between two atoms represents a single covalent bond. Molecular hydrogen has such a bond: H-H.
- In a double covalent bond, two atoms share two pairs of electrons. This is the case with molecular oxygen, or $O=O$.
- In a triple covalent bond, two atoms share three pairs of electrons. This is true of molecular nitrogen, which may be written as $N\equiv N$.
- These three examples happen to be gaseous molecules. Each time you breathe in some air, you draw a great number of H_2 , O_2 , and N_2 molecules into your nose.

NOTES TAKEN IN CLASS:

Covalent bonds are nonpolar or polar.

- In a *nonpolar* covalent bond, participating atoms exert the same pull on the electrons and share them equally.
- Molecular hydrogen is a simple example of this. Its two H atoms, each with one proton, attract the shared electrons equally.
- In a *polar* covalent bond, atoms of different elements (which have different numbers of protons) do not exert the same pull on shared electrons.
- The more attractive atom ends up with a slight negative charge; the atom is "electronegative." Its effect is balanced out by the other atom, which ends up with a slight positive charge.
- In other words, taken together, the atoms interacting in a polar covalent bond have no *net* charge-but the charge is distributed unevenly between the bond's two ends.
- Consider the water molecule, which has two polar covalent bonds: H-O-H. In this molecule, electrons are less attracted to the hydrogens than to the oxygen, which has more protons. A water molecule carries no *net* charge.

NOTES TAKEN IN CLASS:

SO REMEMBER...

1. In an ionic bond, two ions of opposite charge attract each other and stay together. Ions form when atoms gain or lose electrons and so acquire a net positive or negative charge.
2. In a covalent bond, atoms share a pair of electrons. If the atoms share the electrons equally, the bond is nonpolar.
3. If the sharing is not equal, the bond itself is polar-slightly positive at one end, slightly negative at the other.