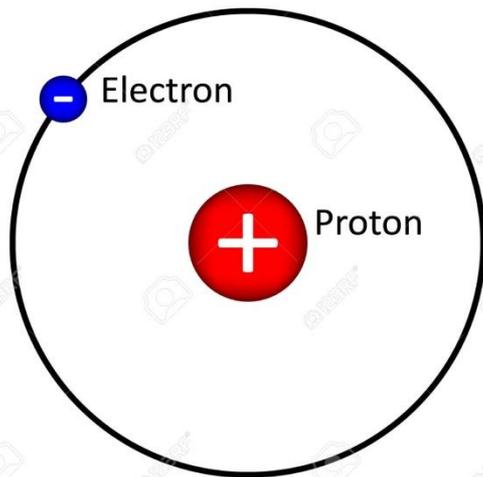


Molecules of life

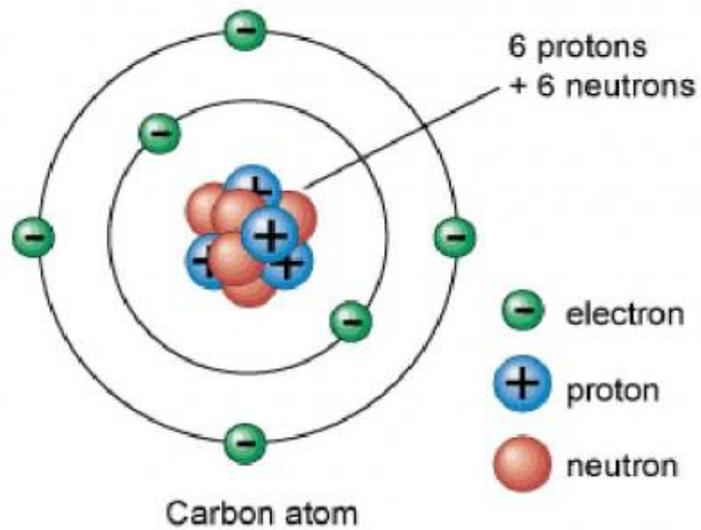
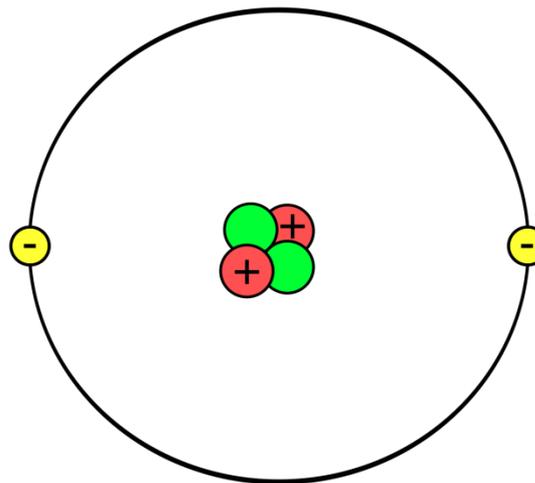
Atoms

- Physical matter consists of atoms that can associate with each other and form molecules
- Every atom is composed of a nucleus and one or more electrons bound to the nucleus. Nucleus has positive electrostatic charge, electrons have negative electrostatic charge.
- Interactions between nucleus and electrons are governed by laws of quantum mechanics

Hydrogen atom

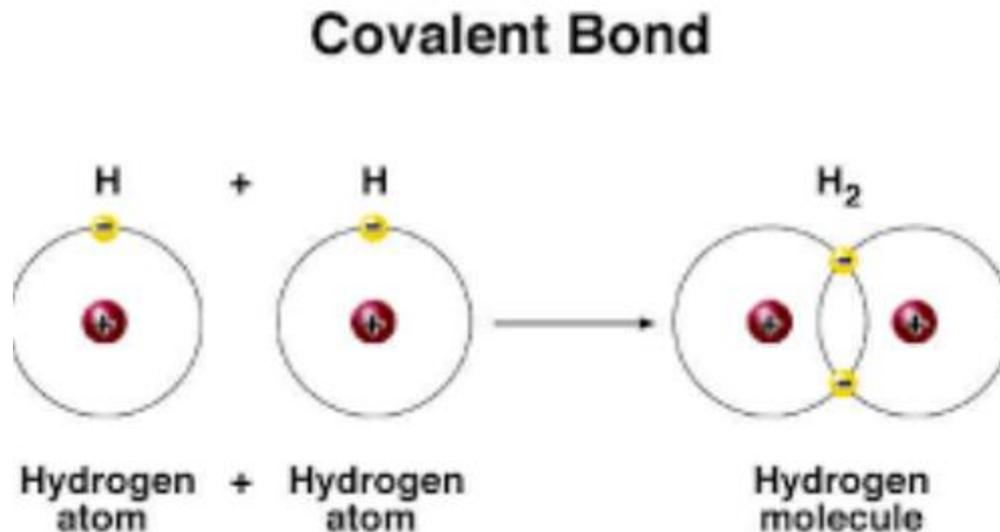


Helium atom



Covalent bonds

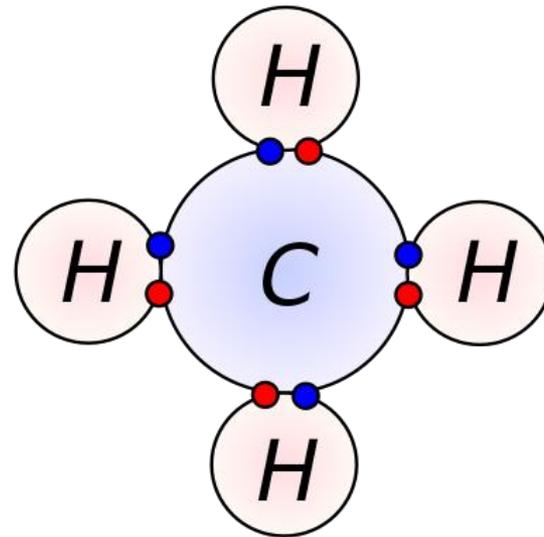
- Sometimes when atoms come close together they can share electrons with each other. This creates a connection between atoms called a **covalent bond** .



Molecules

- A group of two or more atoms connected by covalent bonds constitute a **molecule**.

Example :
a molecule of methane



- Electron from hydrogen
- Electron from carbon

Non-covalent bonds

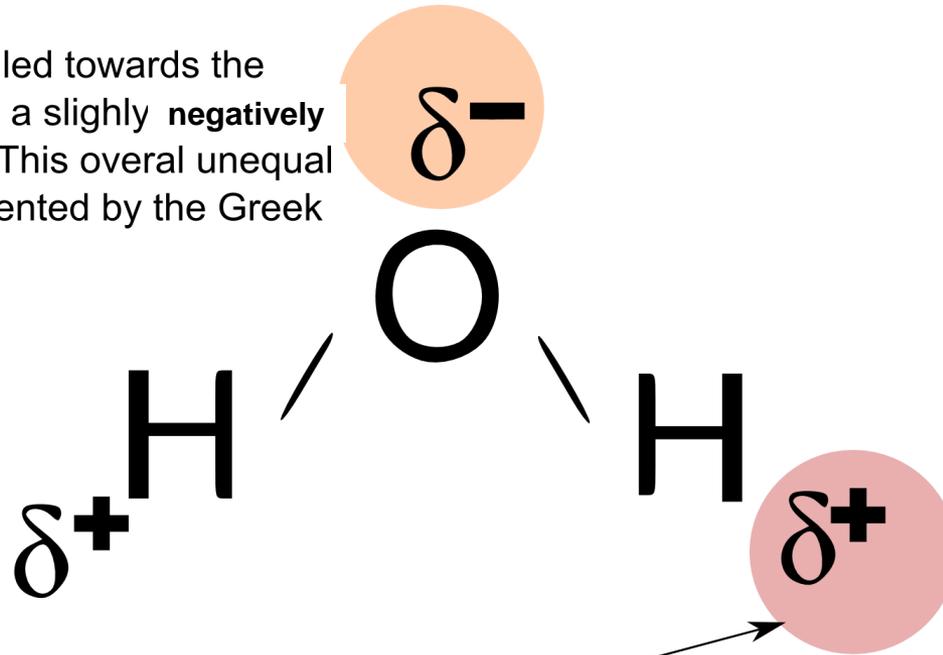
- A **non-covalent bond** is an interaction between atoms that does not involve the sharing of electron pairs. Non-covalent interactions can occur within a single molecule or between different molecules. Many interactions of biological molecules have non-covalent character.

Water

- Water is of major importance to all living things; in some organisms, up to 90% of their body weight comes from water.
- Water is an active matrix of life for cell and molecular biology
- Up to 60% of the human adult body is water.

Water molecule

electrons are pulled towards the oxygen, creating a slightly **negatively** charged region. This overall unequal charge is represented by the Greek delta, for dipole

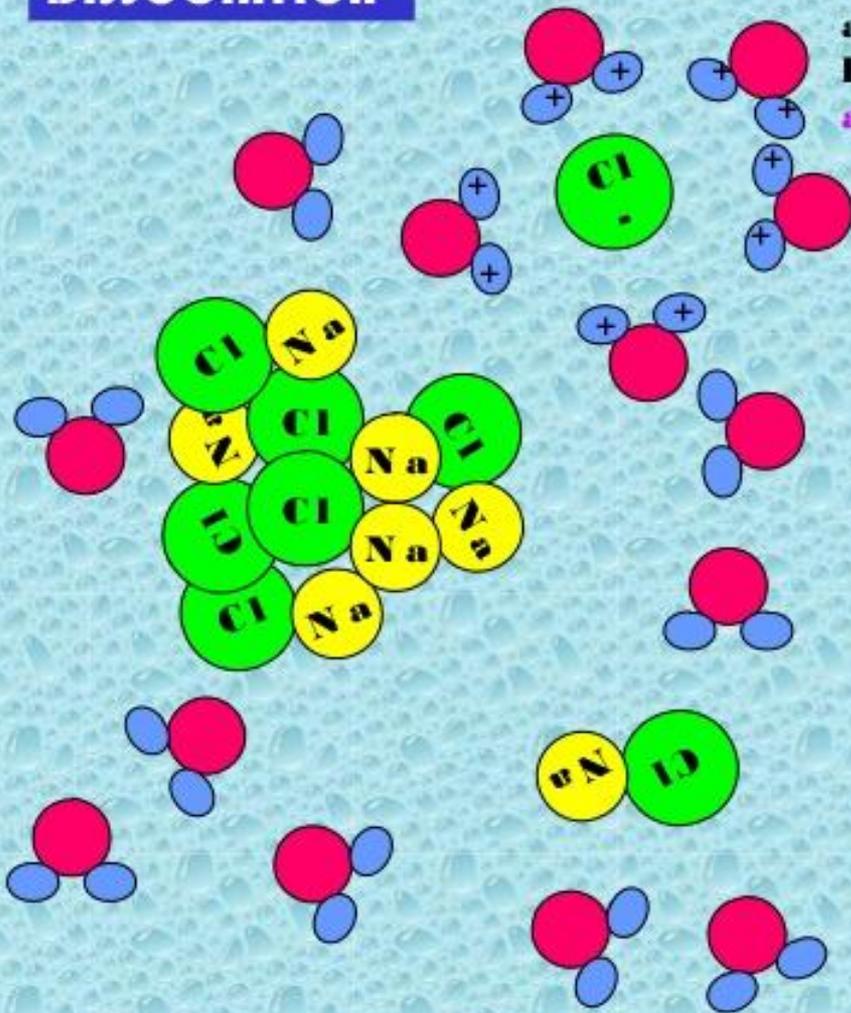


electrons are pulled away from the hydrogen towards the oxygen, creating a slightly positively charged region

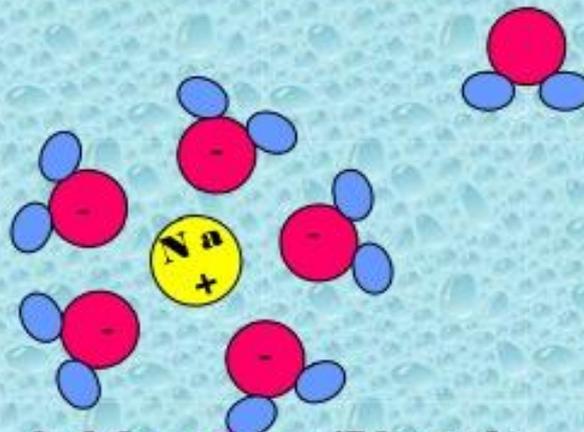
Electrolytic Dissociation

- Many substances will undergo an event called *dissociation* when dissolved in water.
- In electrolytic, or ionic, dissociation, the addition of a water causes molecules or crystals of the substance to break up into *ions* (electrically charged particles).
- The salt can be recovered by evaporation of the solvent.
- Positively charged ions are called *cations*, negatively charged – *anions*.

DISSOCIATION



As you observe, the negative ions, are surrounded by water with the hydrogen oriented toward the **anion**.

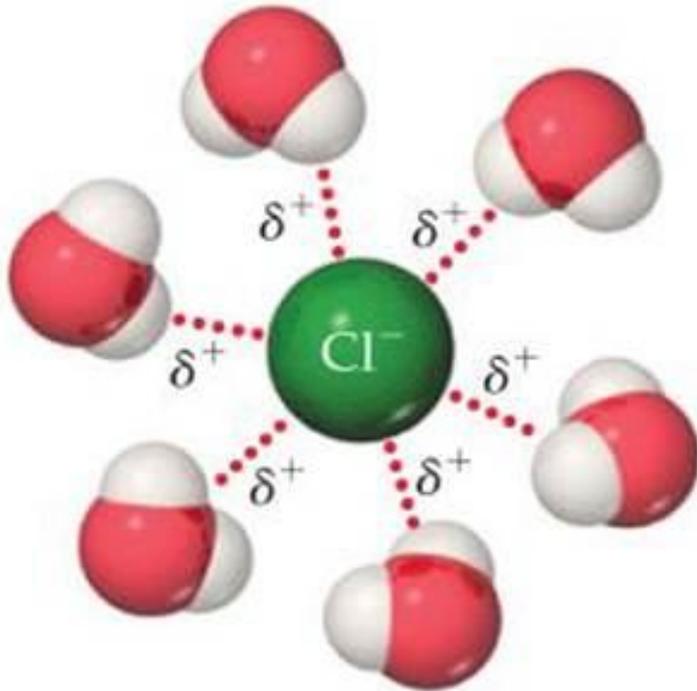


And the **cation**, will have the negative charge of the water dipole attracted.

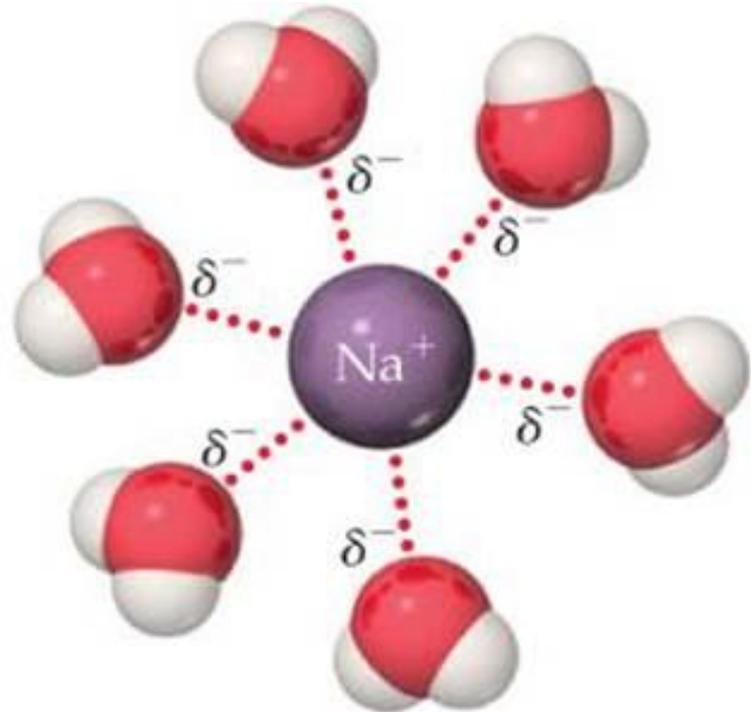
NEXT



Ions in water



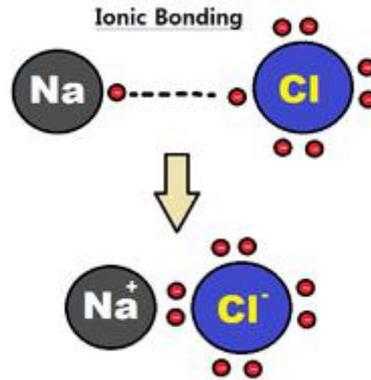
Positive ends of polar molecules are oriented toward negatively charged anion



Negative ends of polar molecules are oriented toward positively charged cation

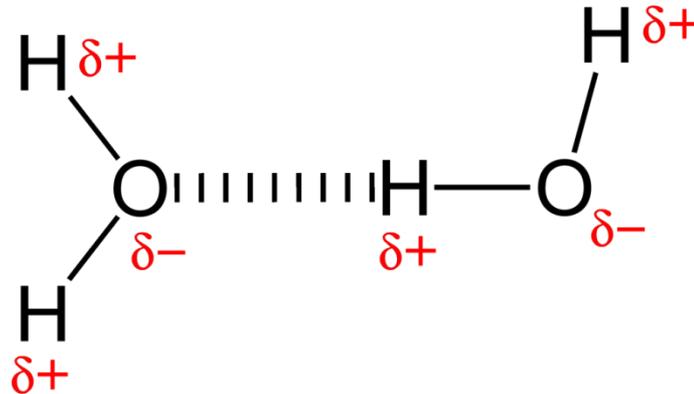
Non-covalent bonds

Ionic bonding - the electrostatic attraction between oppositely charged ions.

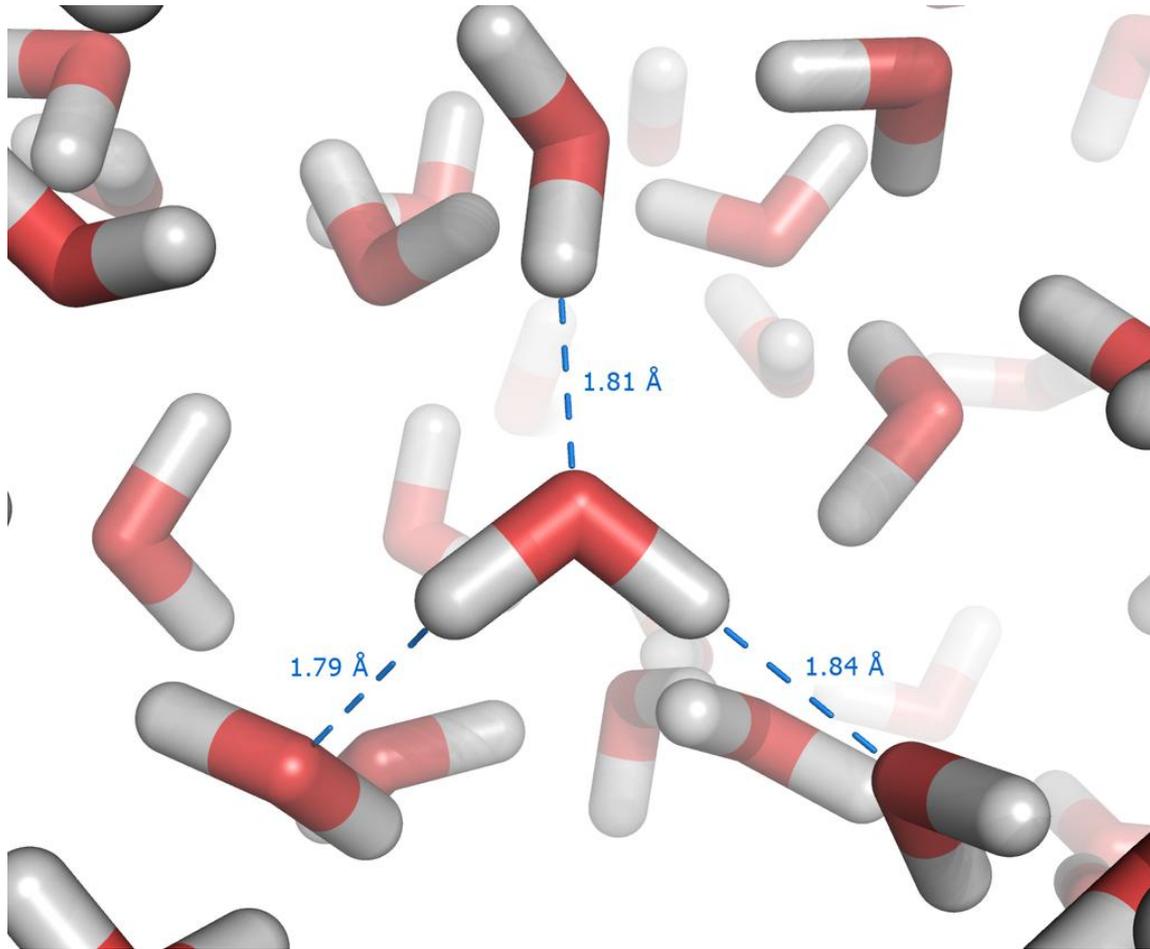


Non-covalent bonds

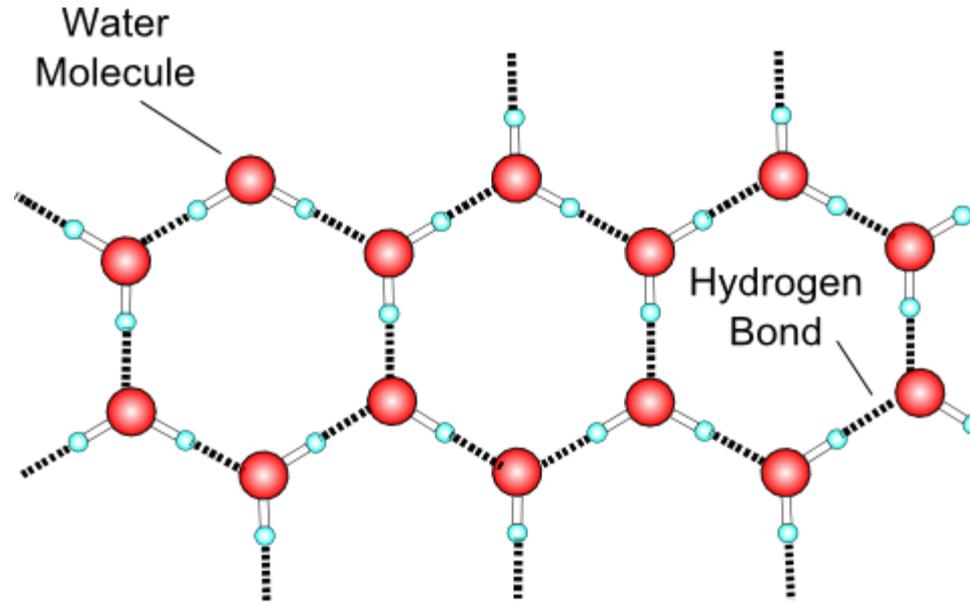
Hydrogen bond - electrostatic attraction between two polar groups. It involves hydrogen (H) atom covalently bound to a highly electronegative atom such as nitrogen (N), oxygen (O), or fluorine (F) .



Dynamic hydrogen bonds between molecules of liquid water



Ice



When temperature of water is decreased more water molecules stick together with hydrogen bonds. At 0°C they form a regular pattern, as shown here.

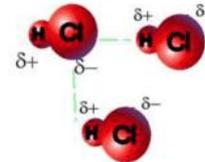
Intermolecular Forces

- **Intramolecular force** - forces that act within a molecule (ie. Ionic, covalent and metallic bonding).
- **Intermolecular force** - forces that act between stable molecules. Differences in physical properties are the direct result of intermolecular forces.

Types of Intermolecular forces

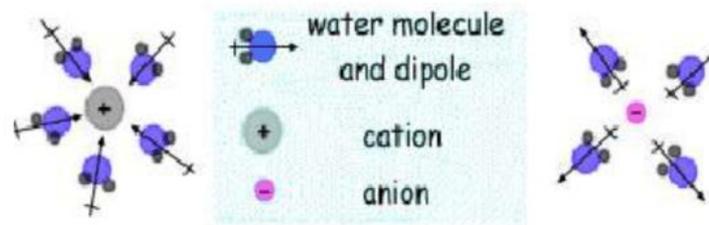
1. Dipole-Dipole Force

- Attractions between opposite charges in polar molecules



2. Ion-Dipole Force

- Force of attraction between an ion and a polar molecule
- Ie. NaCl dissolves in water because of these forces



3. Hydrogen Bonding

- A strong type of dipole-dipole attraction that occurs in one of these types of bonds:
 - H-O
 - H-N
 - H-F

