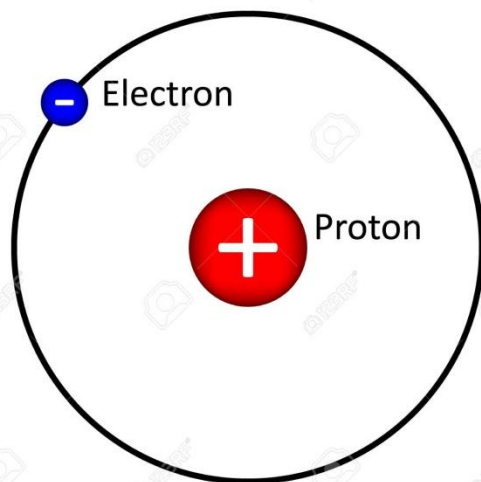


# **Molecules of life**

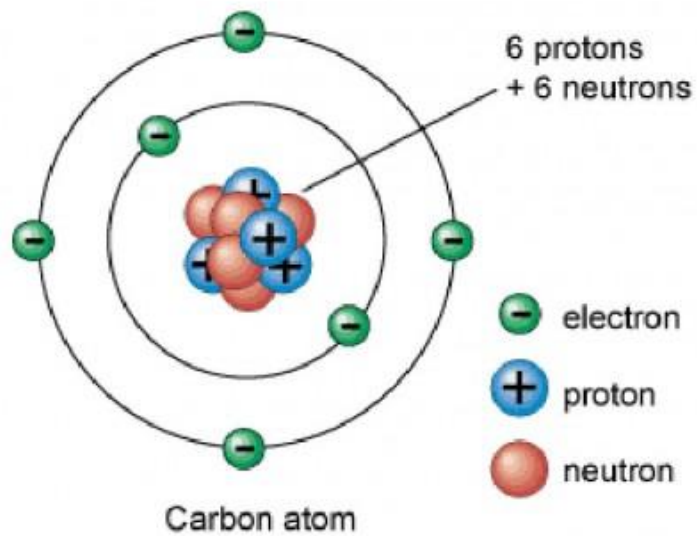
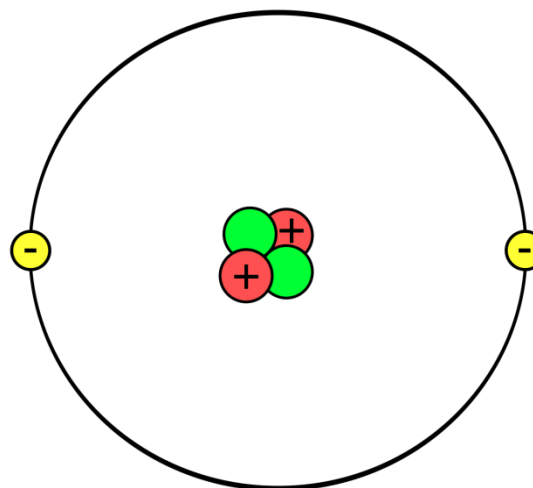
# Atoms

- 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

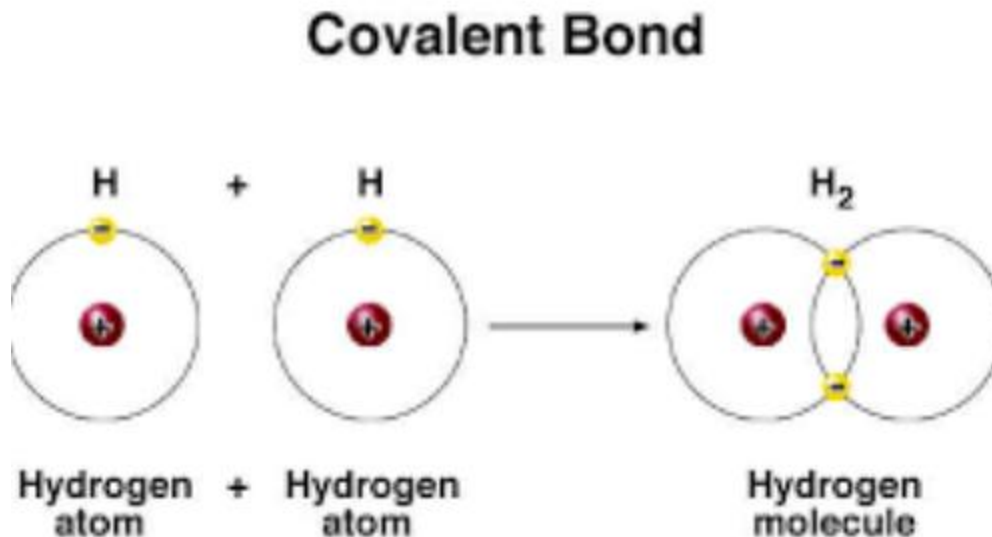


Helium atom



# Covalent bonds

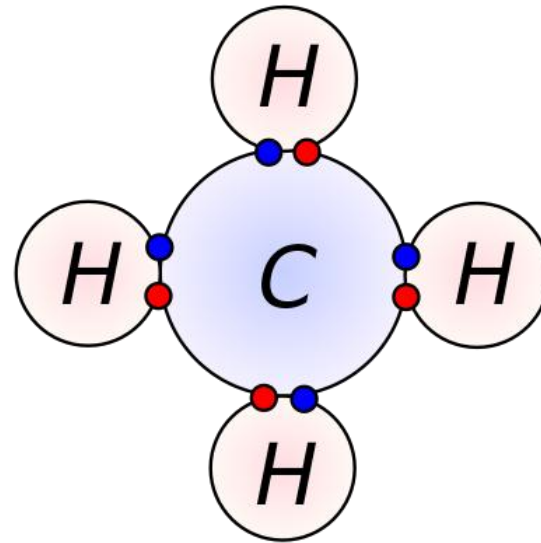
- Sometimes when atoms come close together they can share electrons with each other. This creates a connection between atoms called a **covalent bond**.



# 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

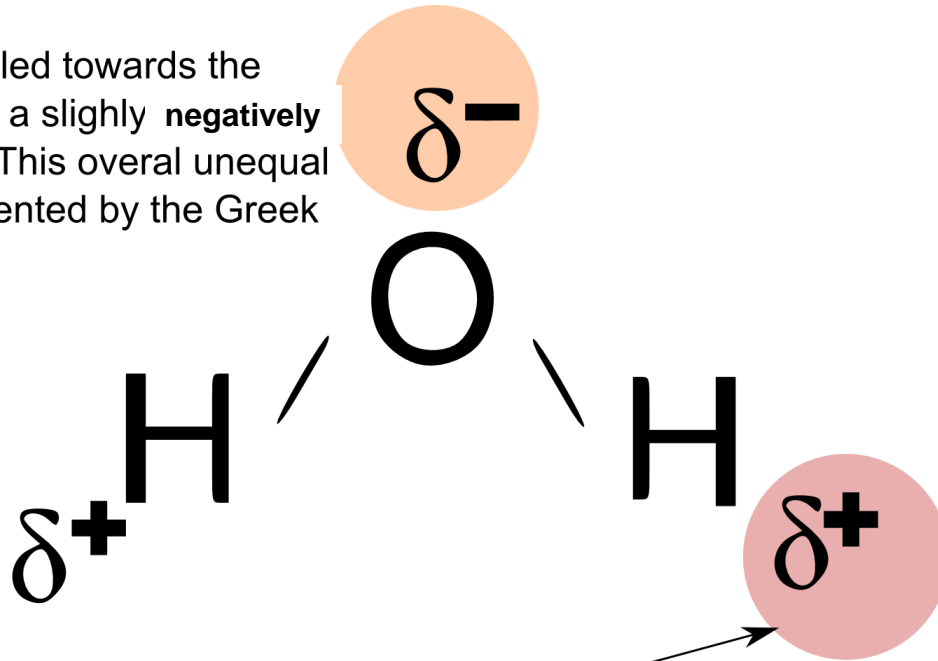
- A **non-covalent bond** is an interaction between atoms that does not involve the sharing of electron pairs. Non-covalent interactions can occur within a single molecule or between different molecules. Many interactions of biological molecules have non-covalent character.

# 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

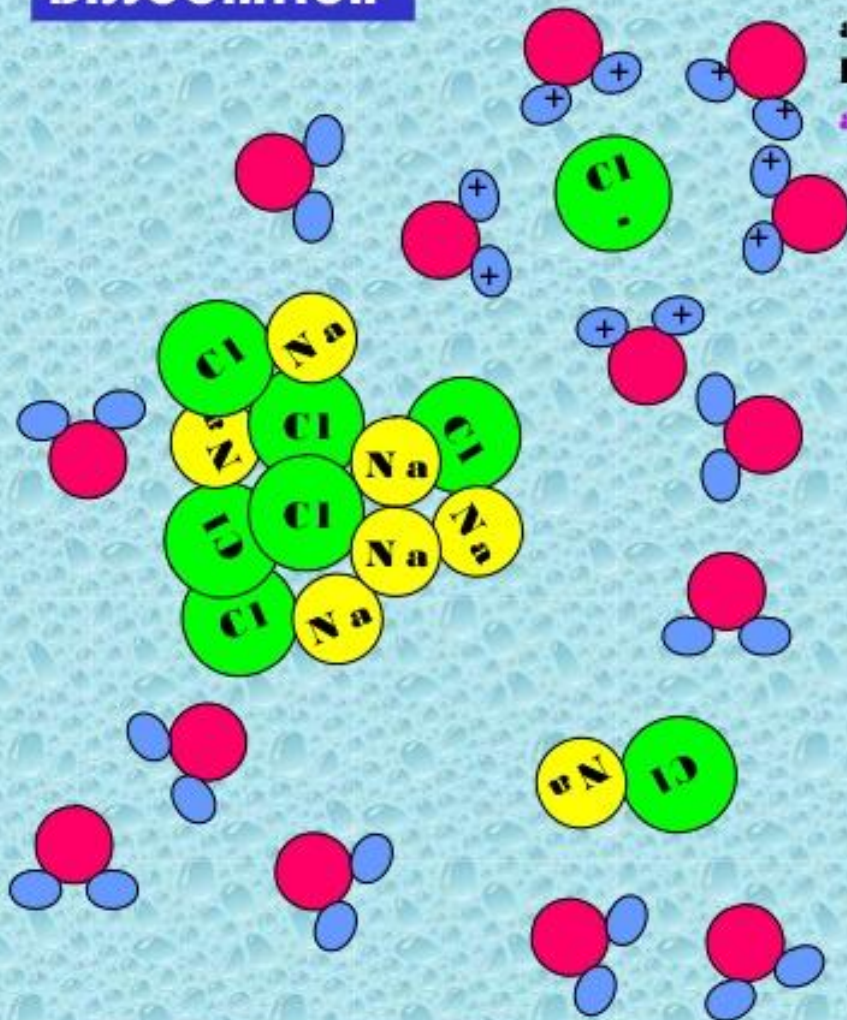


# Electrolytic Dissociation

- 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**.

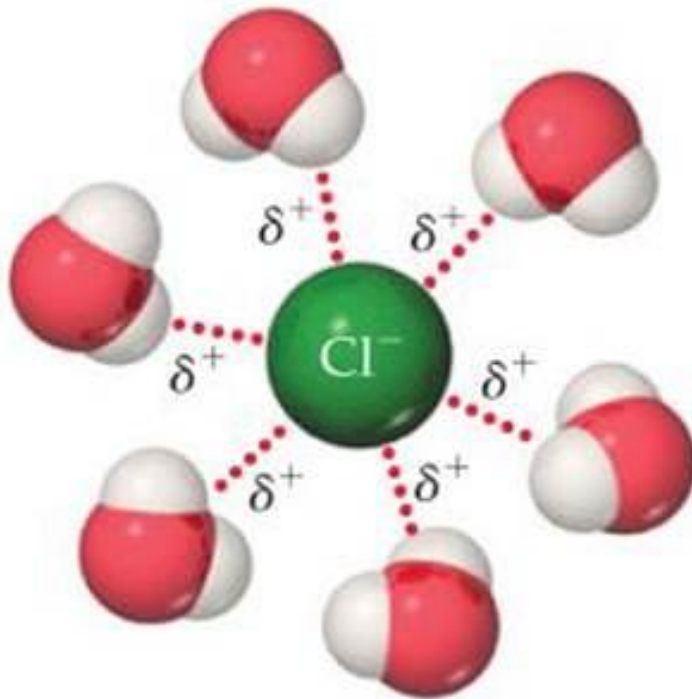


And the **cation**, will have the negative charge of the water dipole attracted.

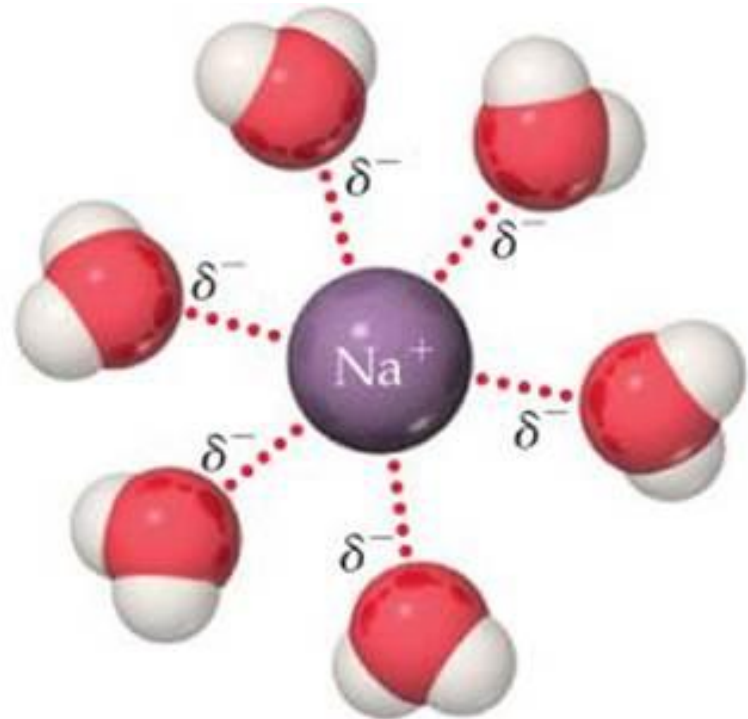
NEXT



# Ions in water



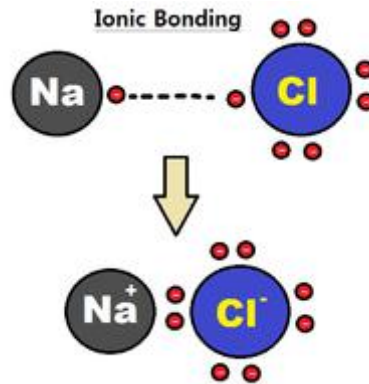
Positive ends of polar molecules  
are oriented toward negatively  
charged anion



Negative ends of polar molecules  
are oriented toward positively  
charged cation

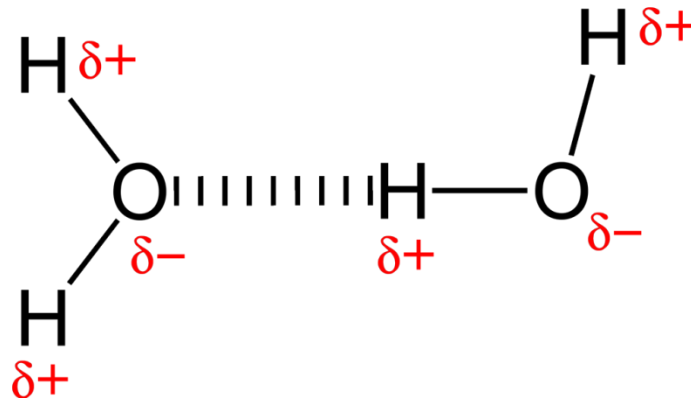
# Non-covalent bonds

**Ionic bonding** - the electrostatic attraction between oppositely charged ions.

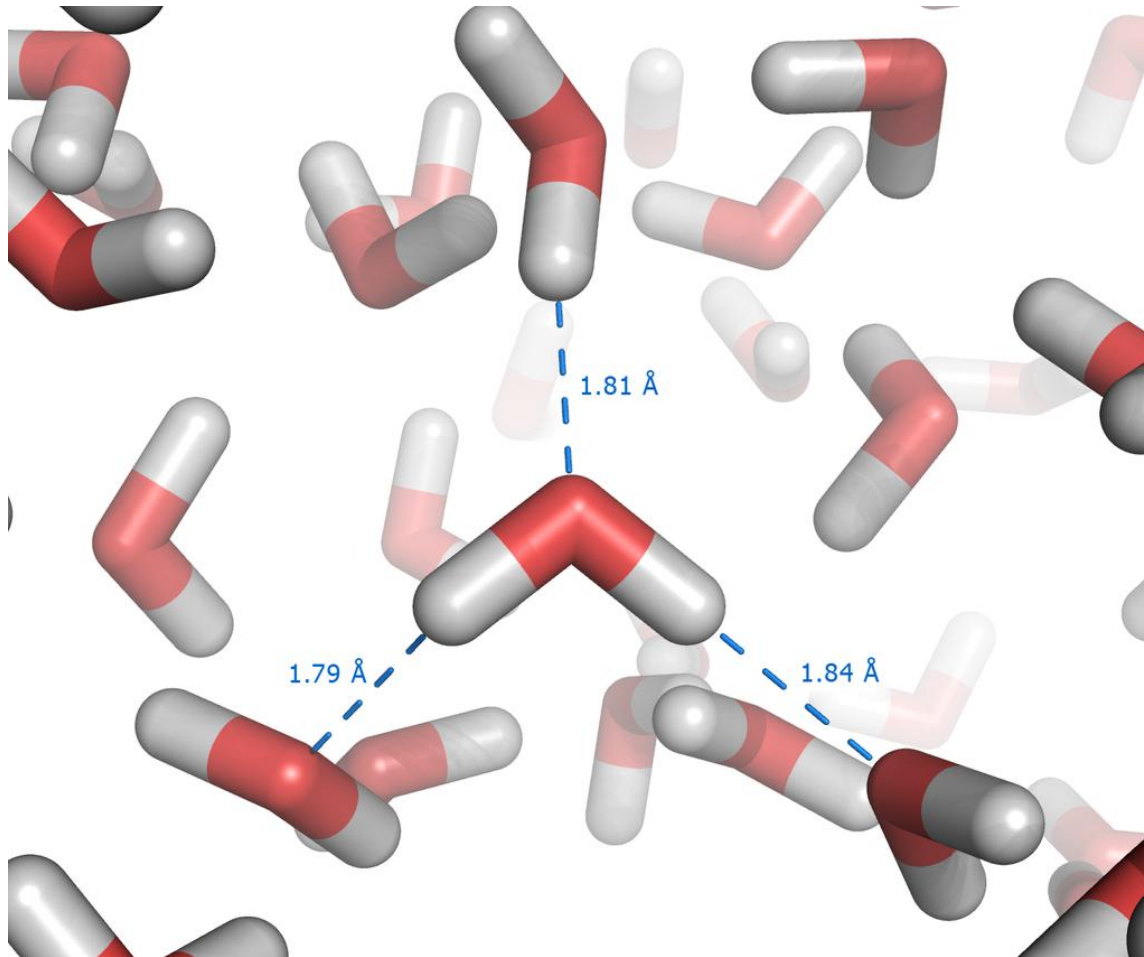


# Non-covalent bonds

**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) .

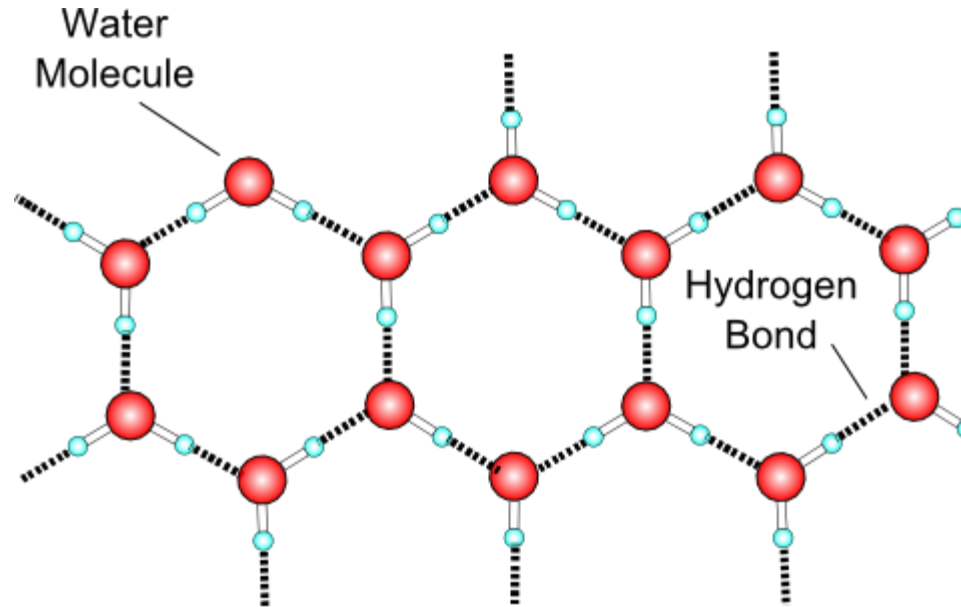


# Dynamic hydrogen bonds between molecules of liquid water





# 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.

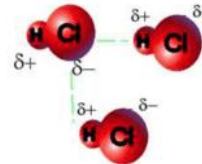
## Intermolecular Forces

- **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

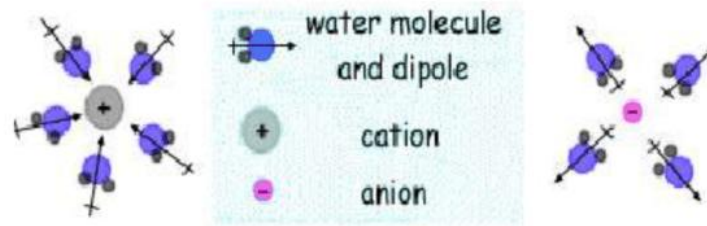
#### 1. Dipole-Dipole Force

- 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

