Intermolecular Forces

SBI4U

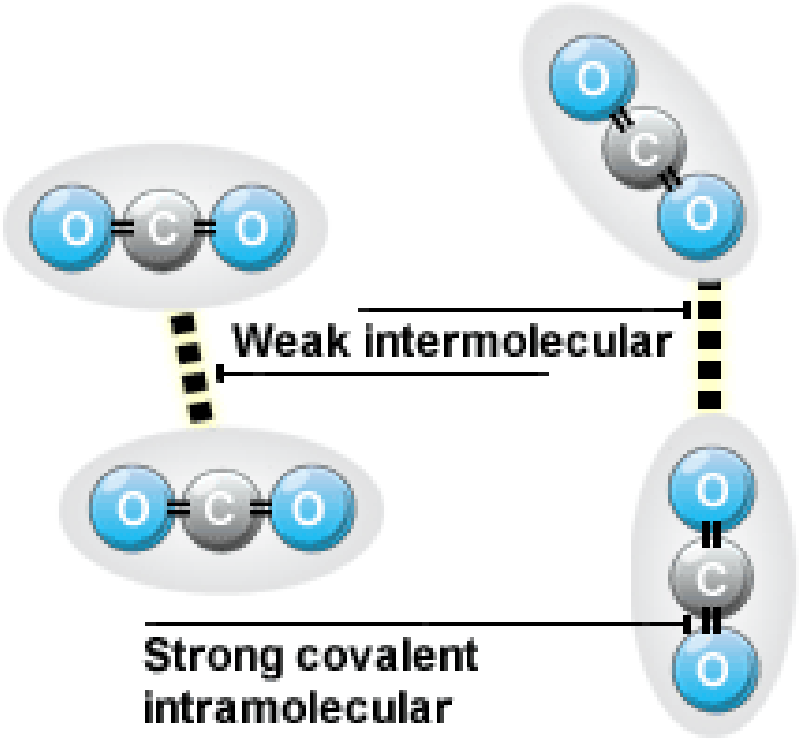
Types of Forces

INTRAMOLECULAR FORCES:

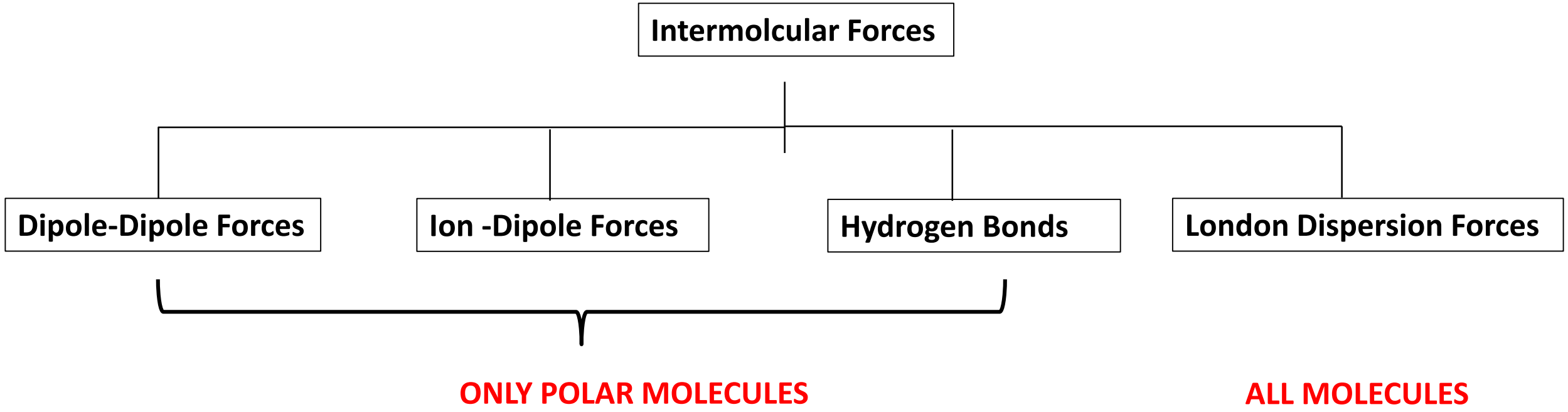
- the attractive force between atoms **within** a molecule
- the attractive force between ions within an ionic crystal
- very strong forces
- include ionic and covalent bonds

INTERMOLECULAR FORCES:

- The attractive forces between molecules
- weaker than intramolecular forces



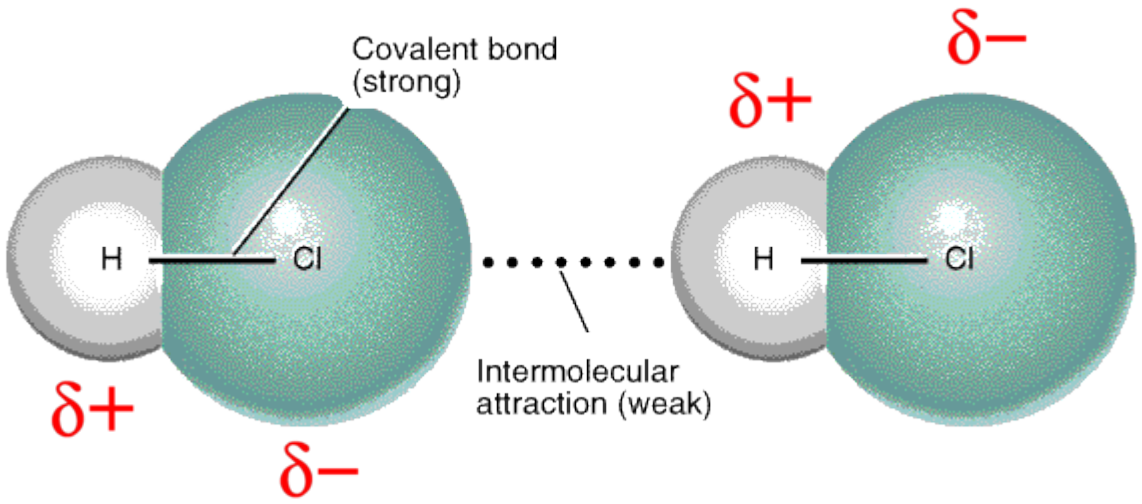
Intermolecular Forces (IMF)



Dipole – Dipole Forces

Attractive forces between polar molecules that have a **permanent dipole**. Dipole – Dipole forces are the ***strongest intermolecular force***, but weaker than a covalent bond.

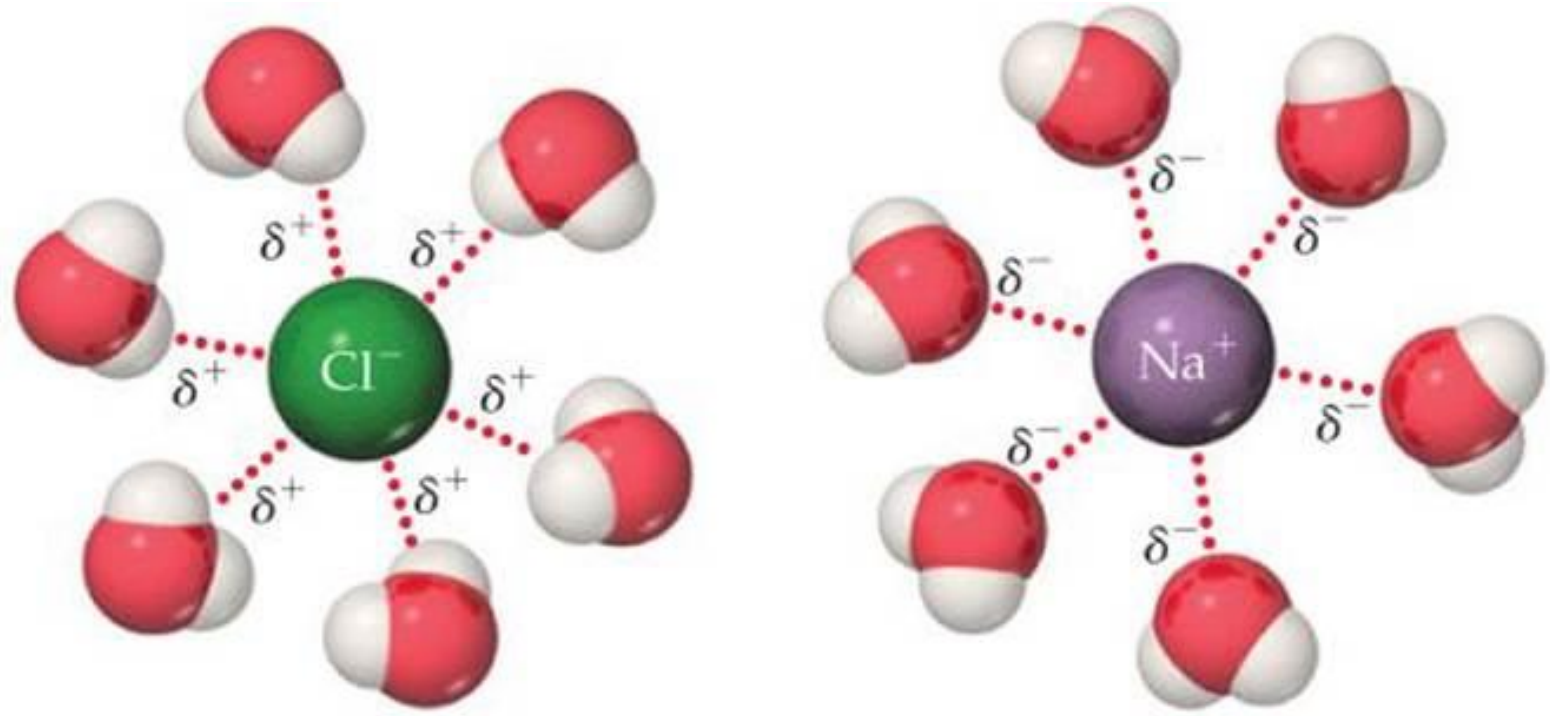
The positive dipole of one molecule is attracted to the negative dipole of another.



Ion – Dipole Forces

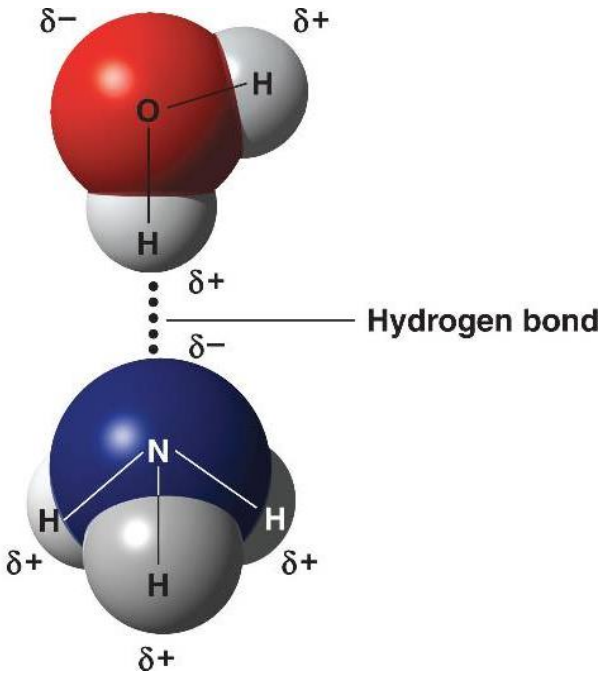
An Ion-dipole bond is an attractive force between an **ion (anion or cation)** and a molecule with a **permanent dipole**.

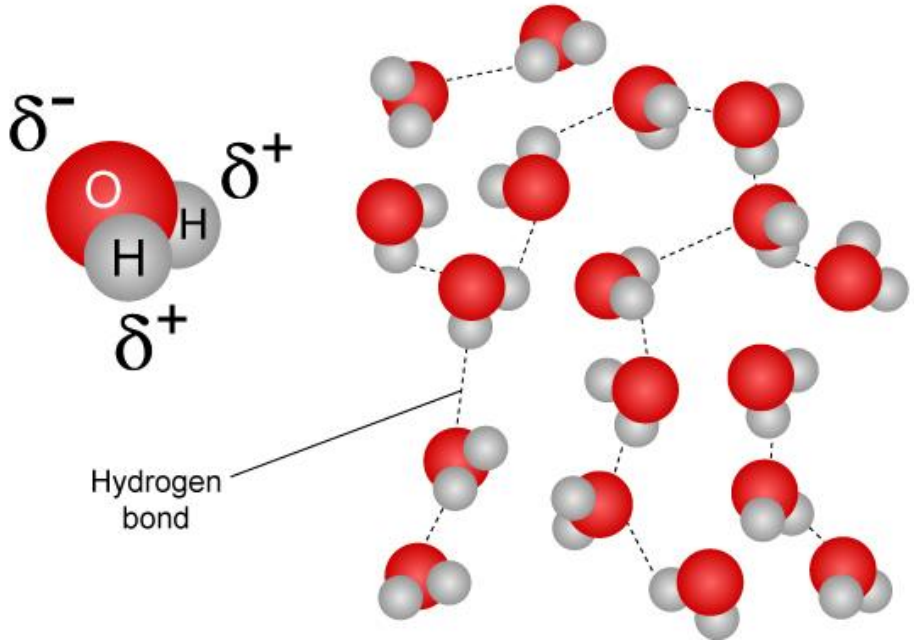
Ion-dipole forces are the strongest IMF due to the strong charge of an ion relative to a dipole.



Hydrogen Bonds

A hydrogen bond is typical formed betweenthe ***lone pair of an electronegative atom*** and the ***hydrogen*** that is bound to either an oxygen, nitrogen or fluoride atom.

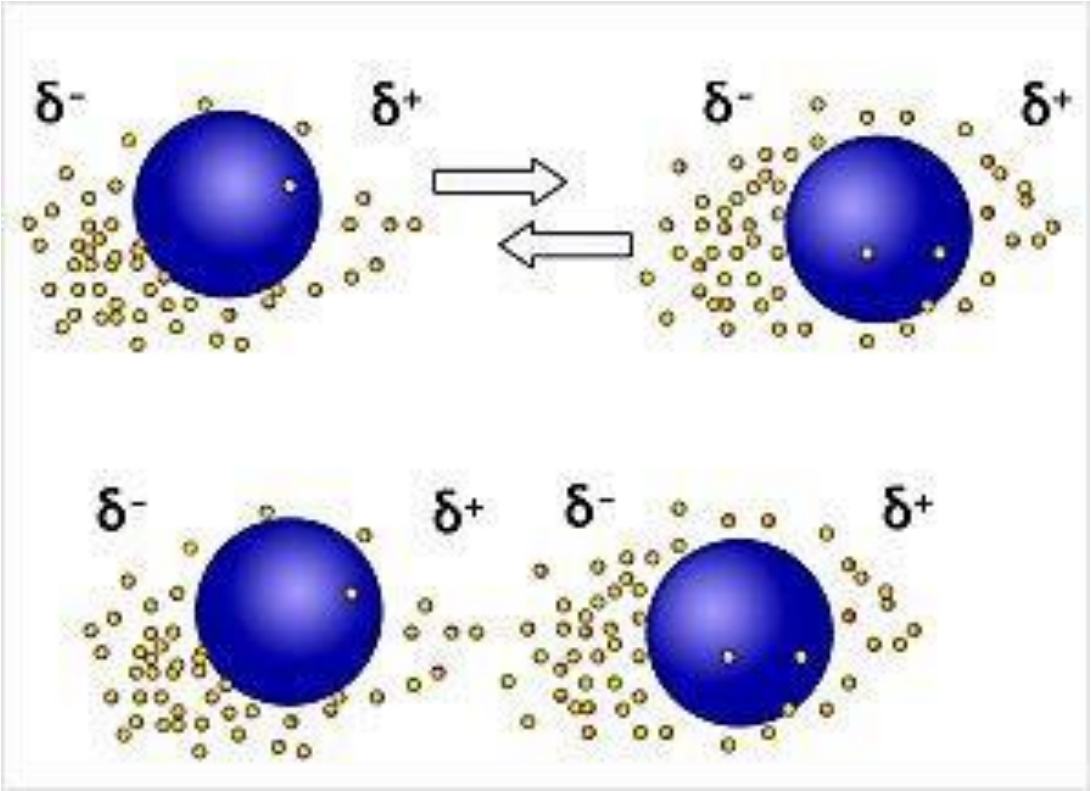




London Dispersion Forces

Van der Waals forces occur between nonpolar molecules with **temporary dipoles**. Due to the electrons that are constantly in motion, **hot spots** are created within the molecules.

The molecules must be close together in order for these forces to occur.



Relative Forces of IMFs

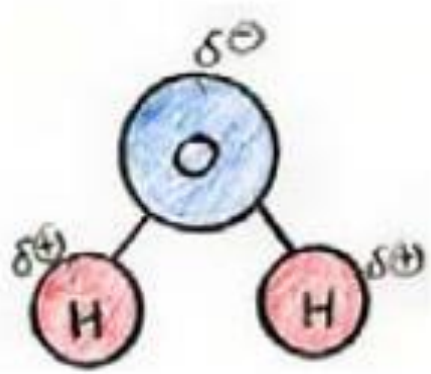
TYPE OF FORCE	RELATIVE STRENGTH	EXHIBITED BY
Ion-Ion	very strong	Ionic Compounds
Ion - Dipole	strong	An ion and a molecule with a permanent dipole
Hydrogen bond	moderate	Molecules with an O-H, N-H, or H-F bond
Dipole – Dipole	weak	Molecules with a permanent dipole
London Dispersion	very weak	All molecules

Water

- Water is required for all life on Earth.
- Cells are 70 – 95 % water.
- Extracellular fluid is also water-based
- Aqueous medium contains dissolved proteins, nutrients and ions essential for functioning.

What's so special about water?

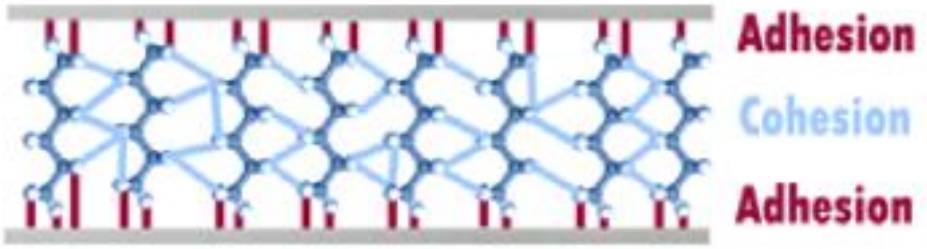
- ✓ polar – due to bent shape
- ✓ water molecules will from hydrogen bonds between one another



Properties of Water

1. Water Clings.

- Cohesion
- Adhesion



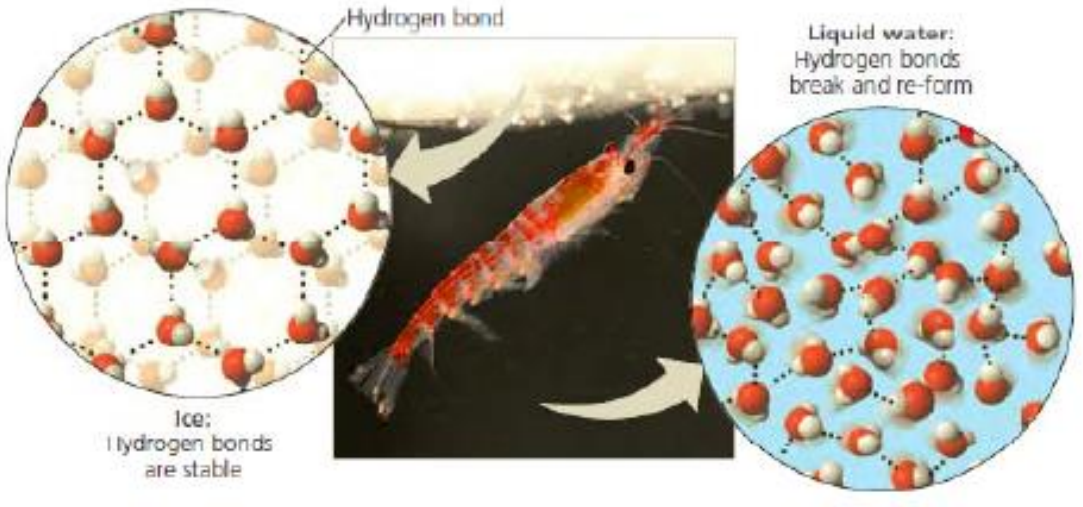
2. Water absorbs lots of heat

- High specific heat capacity and hear of vaporization.
- Moderates air/land temperature
- Allows animals to thermo-regulate via evaporative cooling.

Properties of Water

3. Solid water is less dense than liquid water.

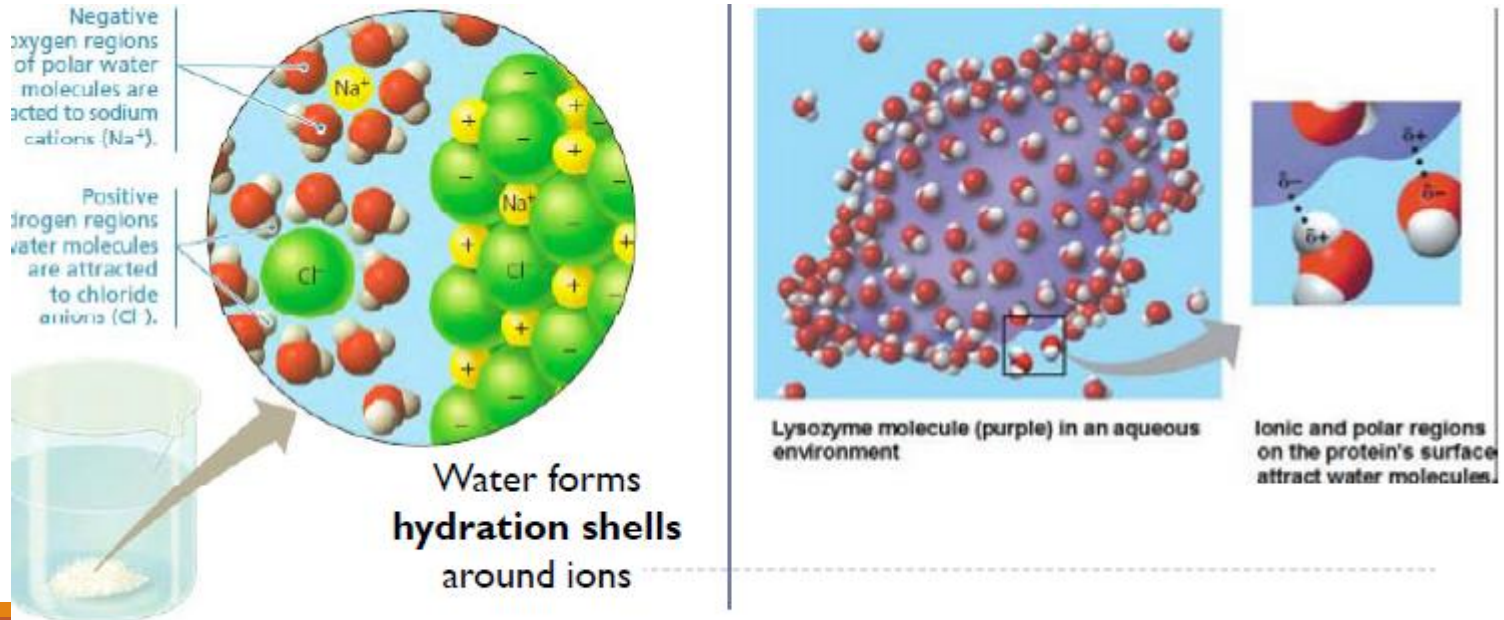
- Highest density at 4^{o}C
- Ice floats on liquid water
- Prevents bodies of water from freezing solid



Properties of Water

4. Water is a versatile solvent.

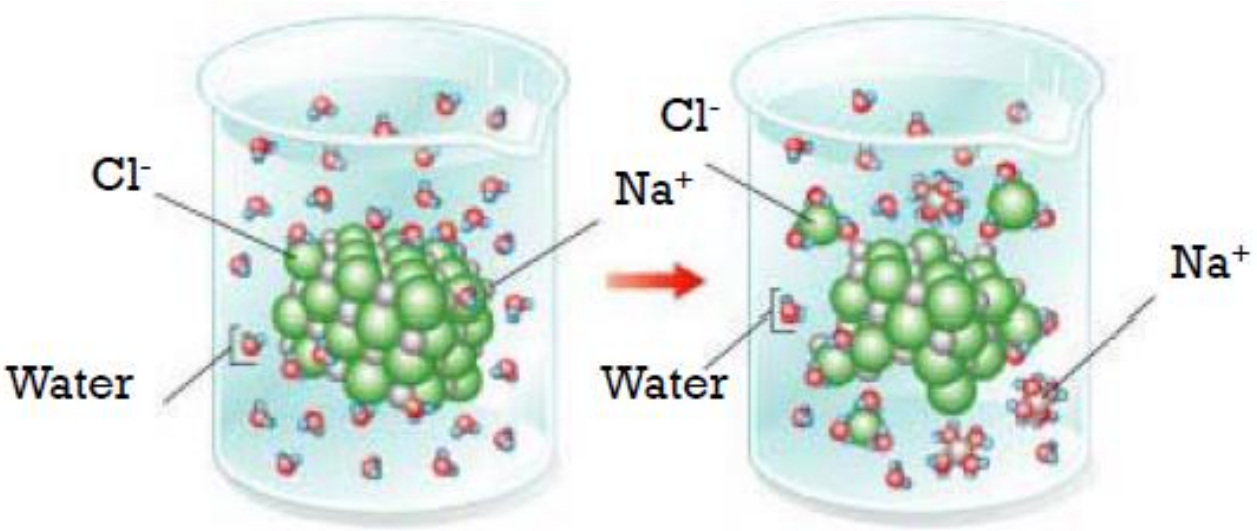
- Charged ends have a high affinity for charged ions and polar covalent substances.
- Allows many solutes to be dissolved and transported within the body.



Solubility of Substances in Water

Water is a great solvent due to its polarity.

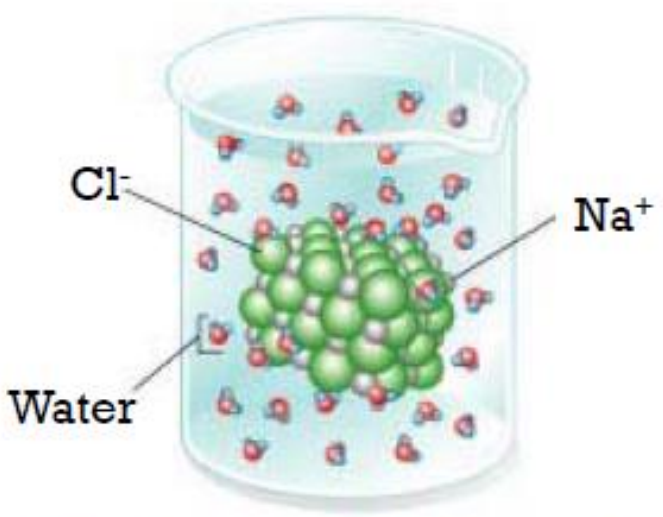
What is happening is this example?



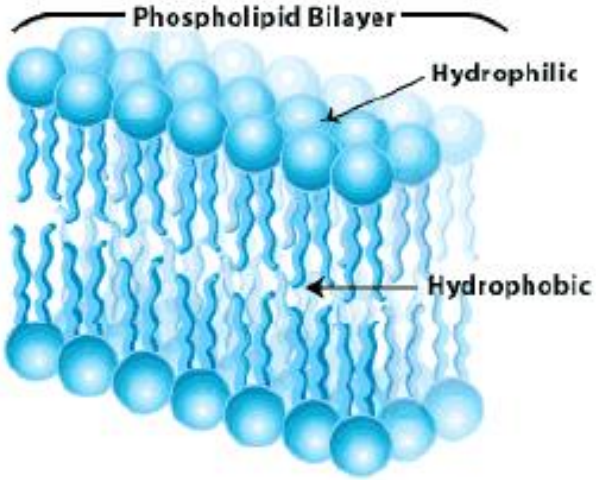
*Water is great at dissolving both **ionic (+,-) compounds and polar** (partial positively, partial negatively charged molecules) molecules.*

Solubility of Substances in Water

Hydrophilic Properties:



E.g., Anions (chloride ions) in salt attracted to + poles of water

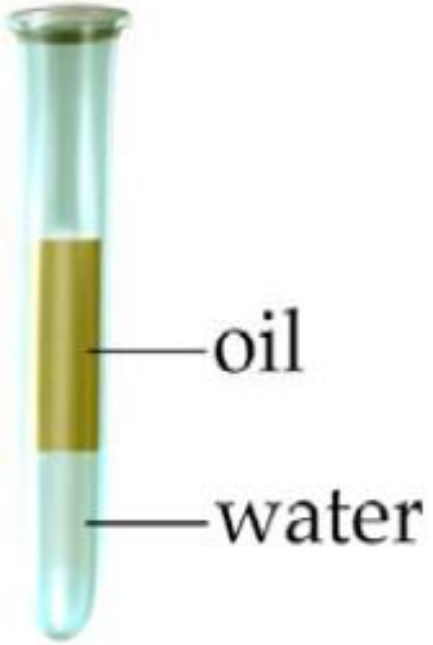


Solubility of Substances in Water

Hydrophobic Properties:

E.g Non-polar compounds are insoluble in water.

Oil – non-polar compound of carbon and hydrogen.



Soap:

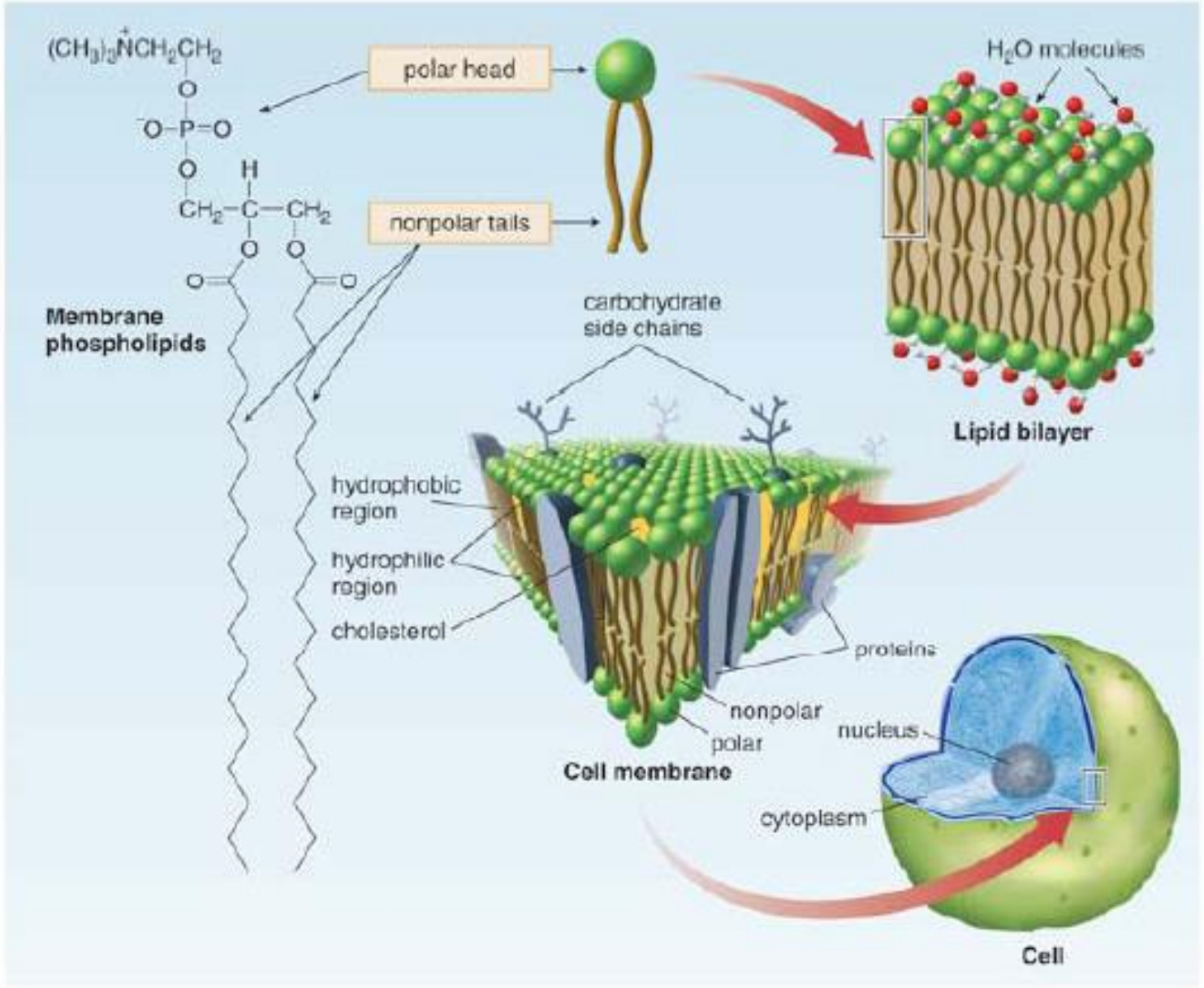
Soap molecules have two distinct parts—a hydrophilic portion composed of ions called the polar head, and a hydrophobic carbon chain of nonpolar C—C and C—H bonds, called the nonpolar tail.

Figure 3.7 Dissolving soap in water

When soap is dissolved in H_2O, the molecules form micelles with the nonpolar tails in the interior and the polar heads on the surface. The polar heads are solvated by ion–dipole interactions with H_2O molecules.

Retrieved from: http://www.uiowa.edu/~c004121/notes/ch03_2.pdf

Figure 3.8 The cell membrane



Phospholipids contain an ionic or polar head, and two long nonpolar hydrocarbon tails. In an aqueous environment, phospholipids form a lipid bilayer, with the polar heads oriented toward the aqueous exterior and the nonpolar tails forming a hydrophobic interior. Cell membranes are composed largely of this lipid bilayer.

Homework

- Complete the IMFs Worksheet