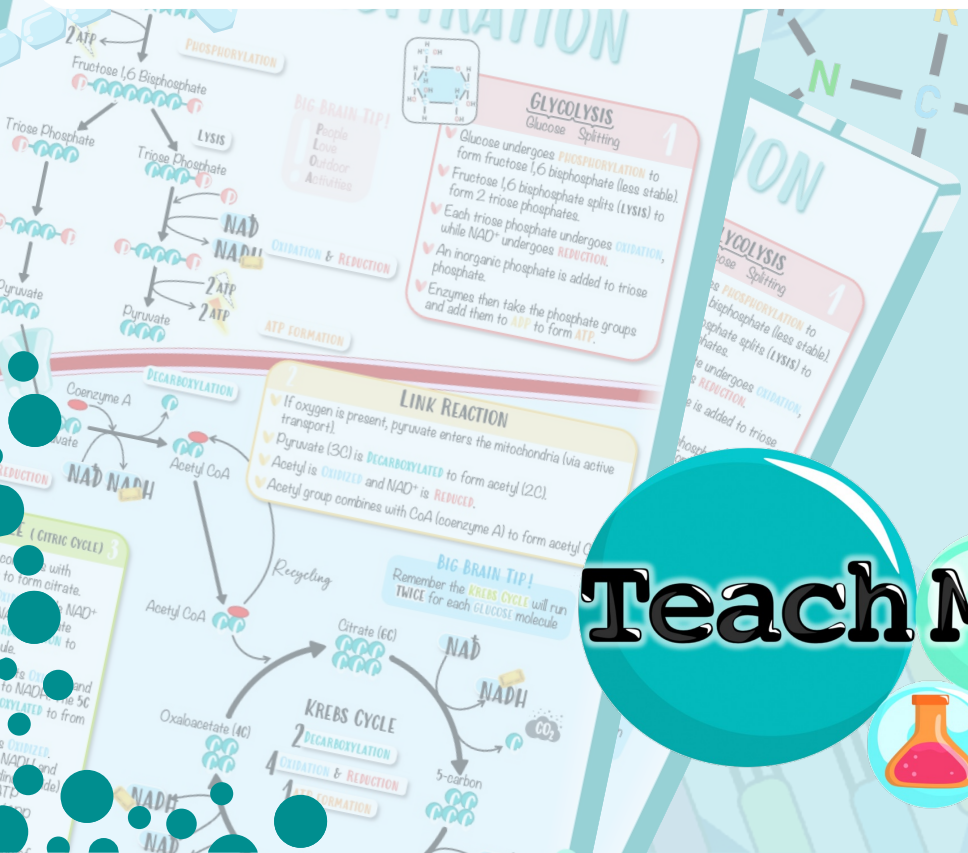
TeachMe

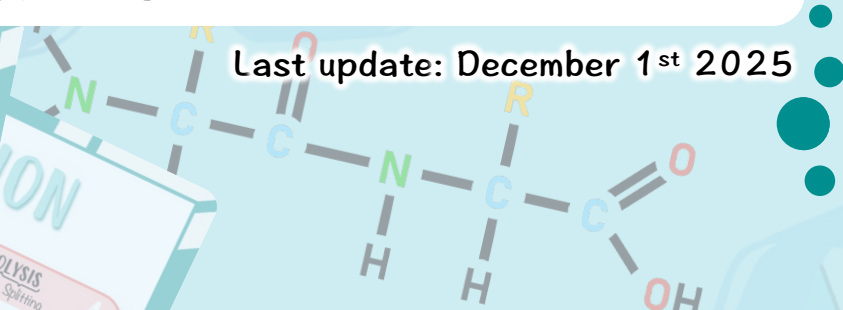
STUDY NOTES

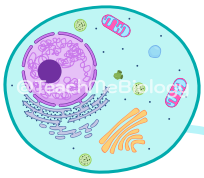
CHAPTER 2 - BIOLOGICAL MOLECULES

WATER

Last update: December 1st 2025







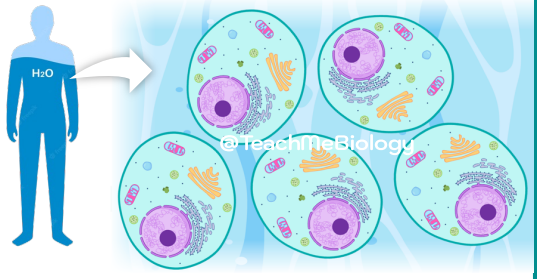
WATER

- Carbohydrates
- Lipids
- Protein
- Nucleic Acids (Chapter 6)
- Water

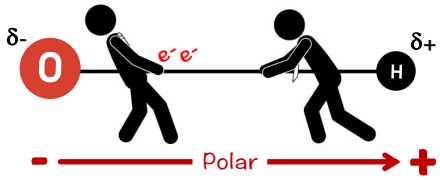
Macromolecules

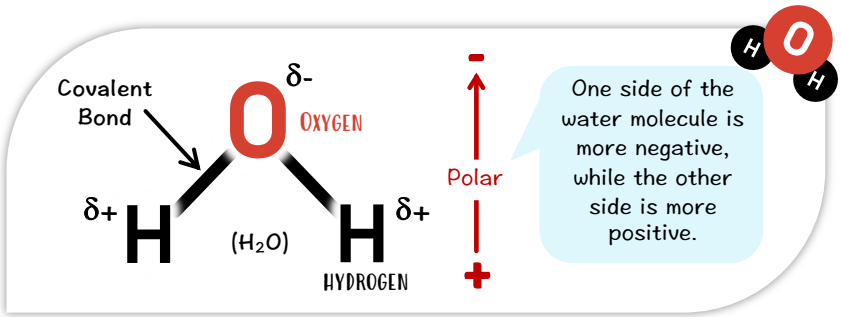
Water is found everywhere! It fills our cells and organelles, surrounds them as extracellular fluid, and makes up most of our blood and bodily fluids — all while serving as a vital habitat for countless organisms.

In fact, about **70%** of the human body is made of water!



Water is **POLAR** because oxygen pulls the electrons harder than hydrogen — like a tug-of-war where oxygen is winning, giving it a partial negative charge.

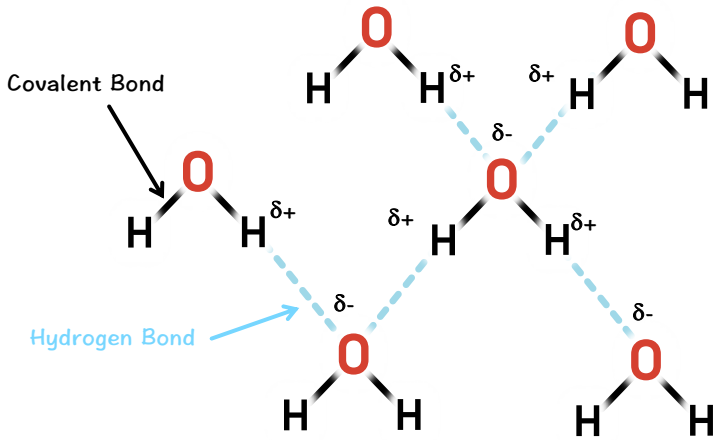


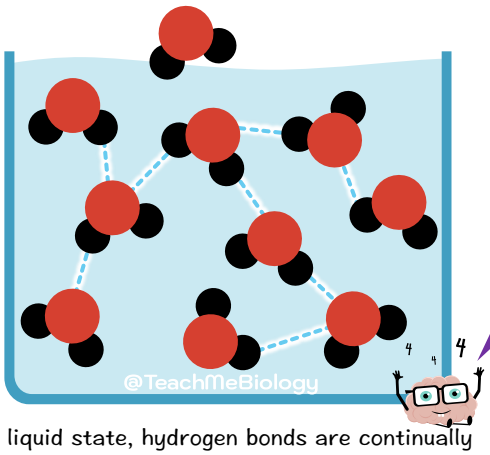


BIG BRAIN TIP!
Hydrogen bonds are hyding Weaker than covalent bonds

The positive end of one molecule is attracted to the negative end of another (opposites attract). These attractions are called **HYDROGEN BONDS**.

This causes water molecules to stick together — giving water its special properties.





1 Water molecule can form a total of 4 hydrogen bonds.

In liquid state, hydrogen bonds are continually breaking, reforming and moving around.

Although each hydrogen bond is weak, the large number of them between water molecules gives water several unique properties that are essential to life. These include:

- **COHESION & ADHESION** (page 2)
- **UNIVERSAL SOLVENT** (page 2)
- **HIGH LATENT HEAT OF VAPORIZATION** (page 3)
- **HIGH SPECIFIC HEAT CAPACITY** (page 3)

Cohesion & Adhesion

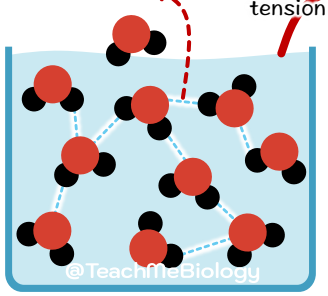
Cohesion

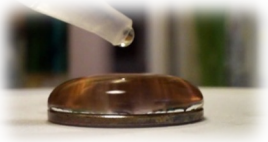
When molecules of the same type are attracted to each other.

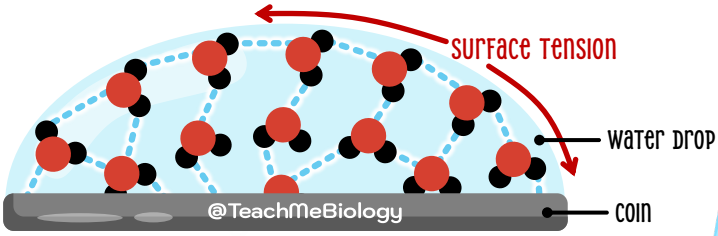
water – water

Bonding between water molecules

Surface tension



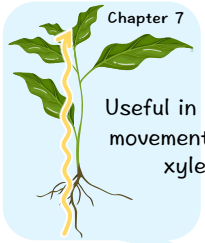




Adhesion

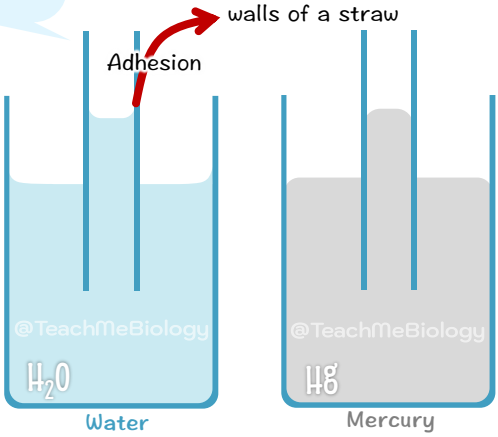
When unlike molecules are attracted to each other.

water – other substance



Useful in capillary action - movement of water up the xylem in plants.

Water climbs up the walls of a straw



Mercury does not have any adhesion properties.

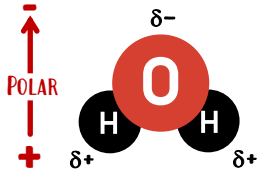
Universal Solvent

Liquid in which substances can be dissolved.

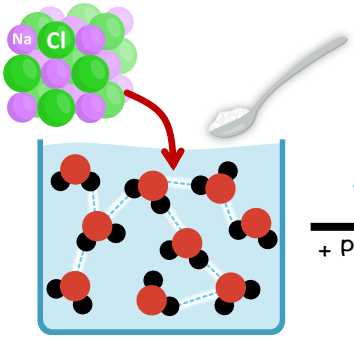
Water is known as the *universal solvent* because it can dissolve more substances than any other liquid. This ability comes from its **polarity**.

"Similar Molecules Mingle"

"Polar dissolves polar"



(NaCl – salt)

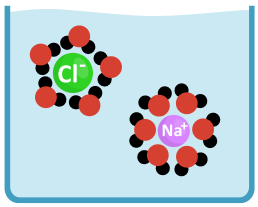


Hydrophilic

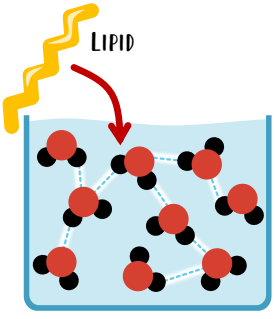
Water Loving

+ Polar Substance

Sugars
Some AA & Proteins
NaCl
Glycerol



Great solvent for polar molecules.

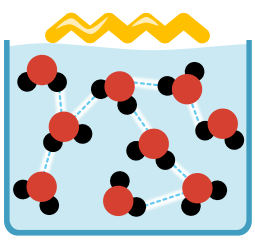


Hydrophobic

Water Fear

+ Non-Polar Substance

Lipids (TG*'s, Phospholipids)
Some AA & Proteins
CO_2, O_2



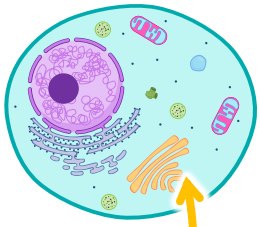
Poor solvent for non-polar molecules.

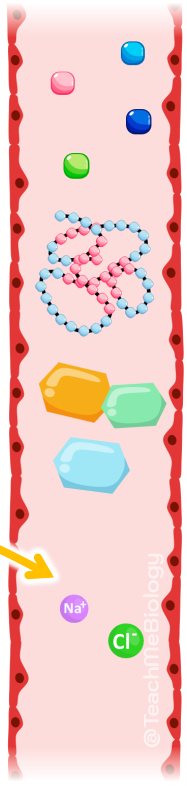
*TG – Triglyceride

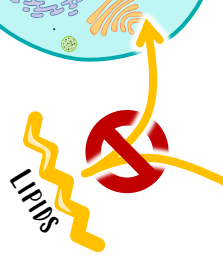
Real Life Implications:

(1) Good transport medium
→Bloodstream (animals)
→Xylem & Phloem (plants)

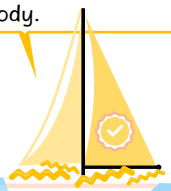
(2) Chemical reactions

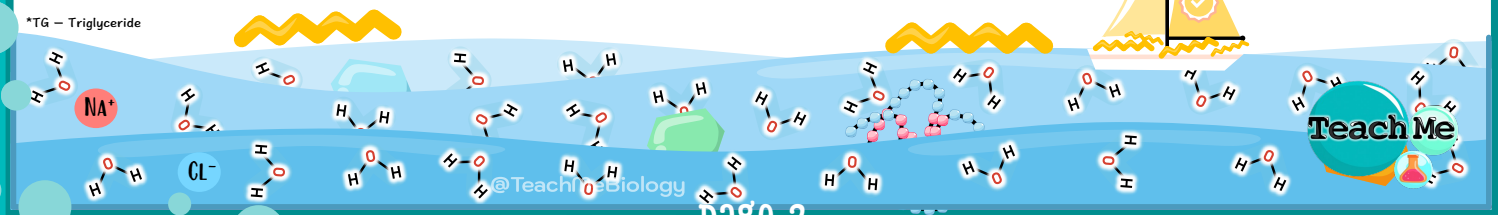






Lipids instead require different means of transport to move across the body.





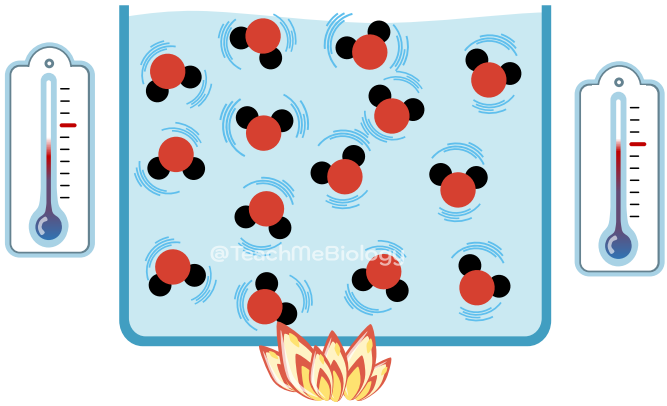
High Specific Heat Capacity

The amount of heat energy required to raise the temperature of 1kg (or g) of water by 1°C.

Temperature is average kinetic energy (how fast molecules move).

Water has a HIGH specific heat capacity – It requires a lot of energy to raise its temperature.

In liquid state, hydrogen bonds are continually breaking and reforming as water molecules move around.

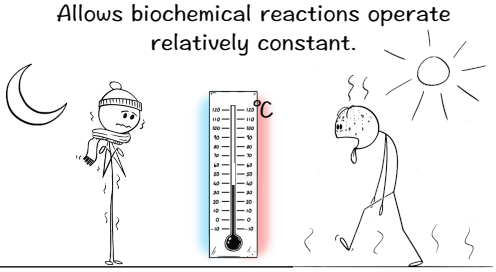


Biological Implications:

(1) **Constant body temperature despite air temperature outside**

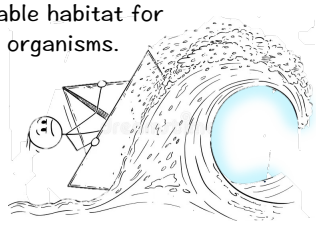
Body is mostly water-filled cells.

Allows biochemical reactions operate relatively constant.



(2) **Environmental water (lakes/oceans) has constant temperatures.**

Provides stable habitat for aquatic organisms.

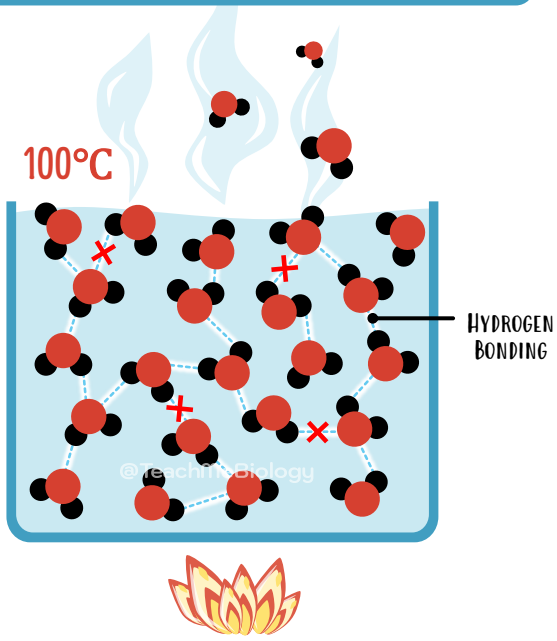


High Latent Heat of Vaporization

The amount of the heat energy required to vaporize (evaporate) a liquid.

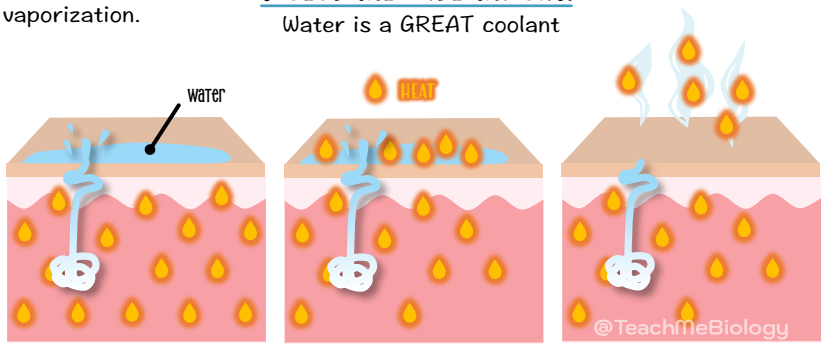
Water has a HIGH latent heat of vaporization.

Water has a HIGH latent heat of vaporization – a lot of energy is transferred to water to convert it into vapor (gas).



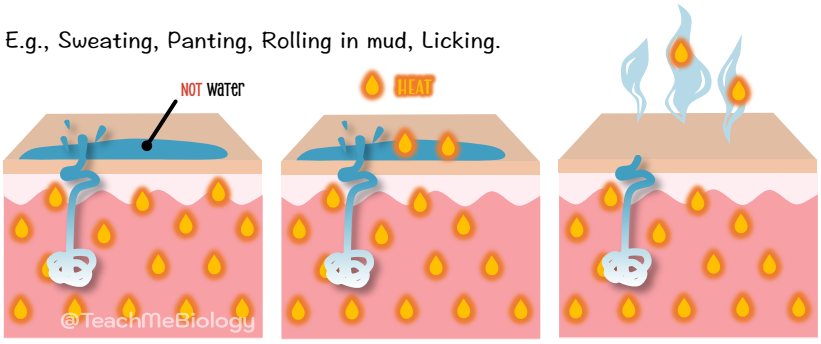
Biological Implications:

Water is a GREAT coolant



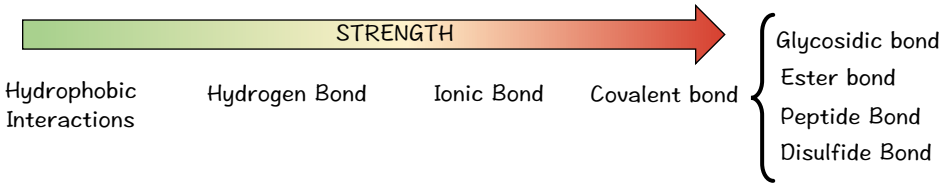
Lots of heat is transferred to water to vaporize it. This process therefor results in a significant cooling effect of body.

E.g., Sweating, Panting, Rolling in mud, Licking.



Summary

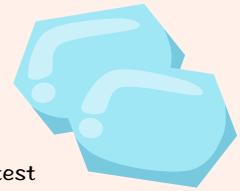
Within chapter 2, you have learned about many different types of bonding. Here is a summary of their relative strengths:



Carbohydrates

[C, H, O]

Monomer: Monosaccharides
Polymer: Polysaccharides
Role: Energy storage
Bonds: Glycosidic bond
Tests: Benedicts test, Iodine test

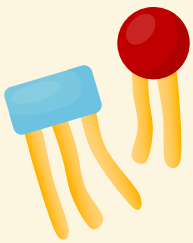


Alpha & Beta glucose
Condensation/Hydrolysis

Lipids

[C, H, O, (P)]

Simple: Fatty Acids, Glycerol
Complex: Phospholipid, Triglyceride
Role: Energy storage (& more)
Bonds: Ester bond
Tests: Lipid Emulsion test



Glycerol, Fatty Acids
Condensation/Hydrolysis

Protein

[C, H, O, N, (S)]

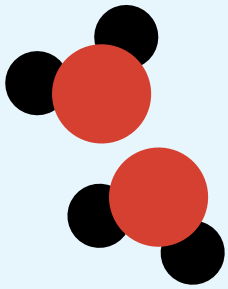
Monomer: Amino Acid
Polymer: Polypeptide
Role: Functional & structural
Bonds: Peptide, disulfide, ionic, hydrogen, hydrophobic int.
Tests: Biuret rest

Amino Acid
Condensation/Hydrolysis

Water

[O,H]

Monomer: Does not apply
Polymer: Does not apply
Role: Solvent, Coolant, etc…
Bonds: Hydrogen bond
Tests: Does not apply



Water & Interactions
Condensation/Hydrolysis

notes