

# CHEMISTRY OF life

AP Bio

## Key terms

monomer - small building block

polymer - many monomers joined

dehydration synthesis - builds polymers by removing water

hydrolysis - breaks polymers by adding water

denaturation - enzyme / protein loses shape → no function

polar - uneven charge distribution  
(like water!)

hydrogen bond - weak bond between polar molecules

# 1. Elements of Life

Main elements in living things:

C - carbon

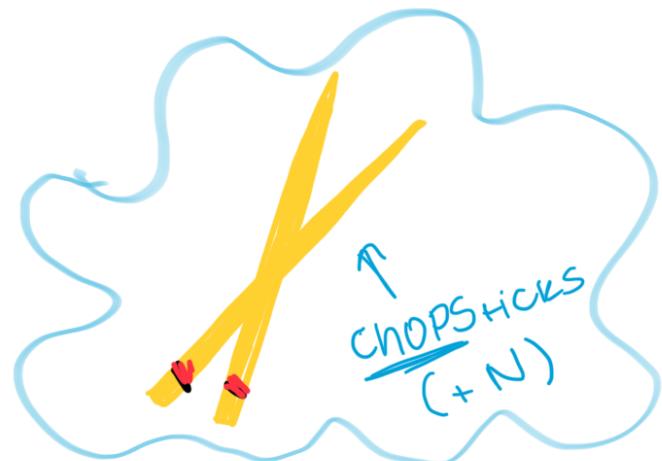
H - hydrogen

O - oxygen

P - phosphorus

S - sulfur

N - nitrogen



★ These elements are used to build biological molecules such as:

→ carbohydrates

- main use: quick energy
- atoms: C H O



→ proteins

- Main use: build + repair body tissues
- atoms: C H O N



→ lipids

- main use: long term energy + insulation
- atoms: C H O



→ nucleic acids

- main use: store genetic info (DNA, RNA)
- atoms: C H O P N



# 2. Properties of Water

Water polarity & hydrogen bonding

- Water =  $H_2O \rightarrow$  2 hydrogen, 1 oxygen
- oxygen "pulls" electrons more  
↳ becomes slightly negative
- hydrogens become slightly positive
- 2 positive ends  $\rightarrow$  polar (charged ends)
- polar water molecules STICK together using hydrogen bonds
- hydrogen bonds = weak attraction between +H and -O
- gives water special properties!

## Water's Special properties: (must memorize)

- **cohesion:** water sticks to itself  
  - $\rightarrow$  attracted to each other due to hydrogen bonding
  - $\rightarrow$  ex: water droplets forming on a surface
- **adhesion:** water sticks to other things  
  - $\rightarrow$  water molecules are attracted to other materials due to polar charges, allowing water to move up plants or stick to surfaces
  - $\rightarrow$  ex: water climbing up plant stems
- **high specific heat:** water resists temp change  
  - $\rightarrow$  high capacity to absorb and release heat w/o changing temp quickly



(thanks to hydrogen bonds absorbing  
before temp rises) 

- ex: ocean staying cool in summer
- **evaporative cooling**: sweat cools you down
  - when water evaporates, it takes heat away from your body. Heat breaks the hydrogen bonds, cooling you down as water turns into  vapor
  - ex: sweat reducing body heat
- **ice floats**: ice is less dense than liquid
  - water molecules in ice are arranged in a way that makes them less dense than water. This is due to the fact that hydrogen bonds push molecules further apart in ice, making it float.
  - ex: ice cubes floating in a drink

### 3. Macromolecules

#### Overview

All macromolecules are built by **DEHYDRATION SYNTHESIS**

- water molecule is removed
- one molecule loses a hydrogen atom (H) and the other loses a hydroxyl group (OH)
- removal of water allows the 2 molecules to form a covalent bond, linking them into a bigger molecule

**How?** The removal of water makes space for the molecules to bond and form a bigger structure, like a chain

All macromolecules are broken by **HYDROLYSIS**

- water is added
- water molecule splits into H and OH, which are added to the two parts of the large molecule
- This breaks the covalent bonds between molecules

**How?** Adding water breaks the bond between the two smaller molecules by providing the necessary components (H & OH) to split them apart.

# Macromolecules:

## CARBOHYDRATES

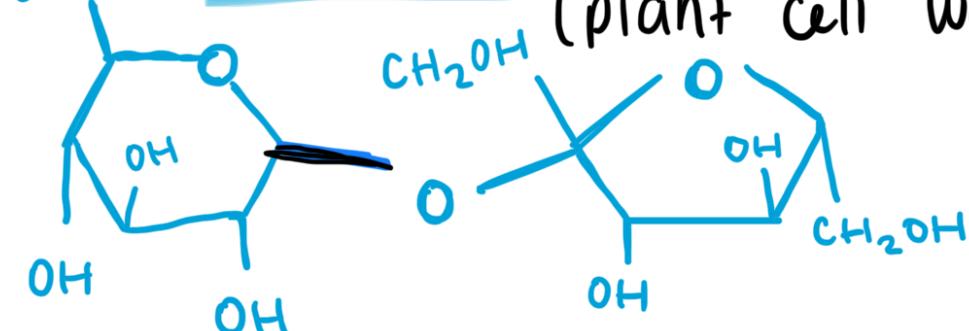
- monomer of carbohydrate:

monosaccharide (e.g. glucose)

- polymer of carbohydrate:

polysaccharide (e.g. starch, cellulose)

- function: quick energy, structure  
(plant cell walls)



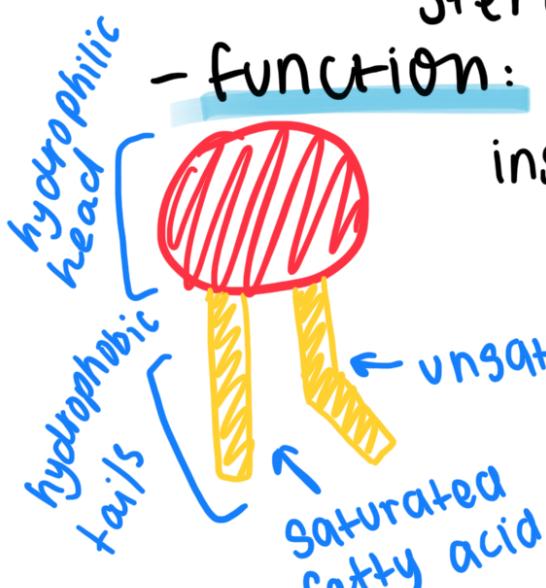
## LIPIDS

- not true polymers

- made of: glycerol + fatty acids

- types: fats, oils, phospholipids, steroids

- function: long-term energy, insulation, membranes



Saturated fats:

carbon atoms fully bonded to hydrogen atoms, no double bonds b/w carbons. solid

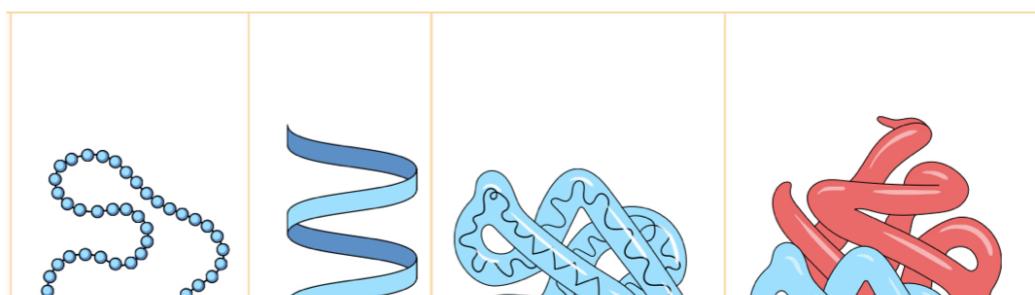
at room temp (e.g. butter, lard).  
Can raise bad cholesterol in body.

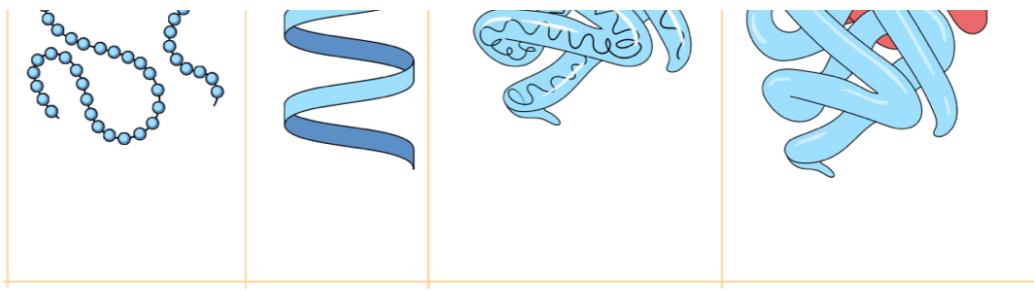
### UNSATURATED FATS:

Carbon bonds contain one or more double bonds, causing bends in the chain. Liquid at room temp (e.g. olive oil, avocado). Generally better for heart health, can lower bad cholesterol.

## PROTEINS

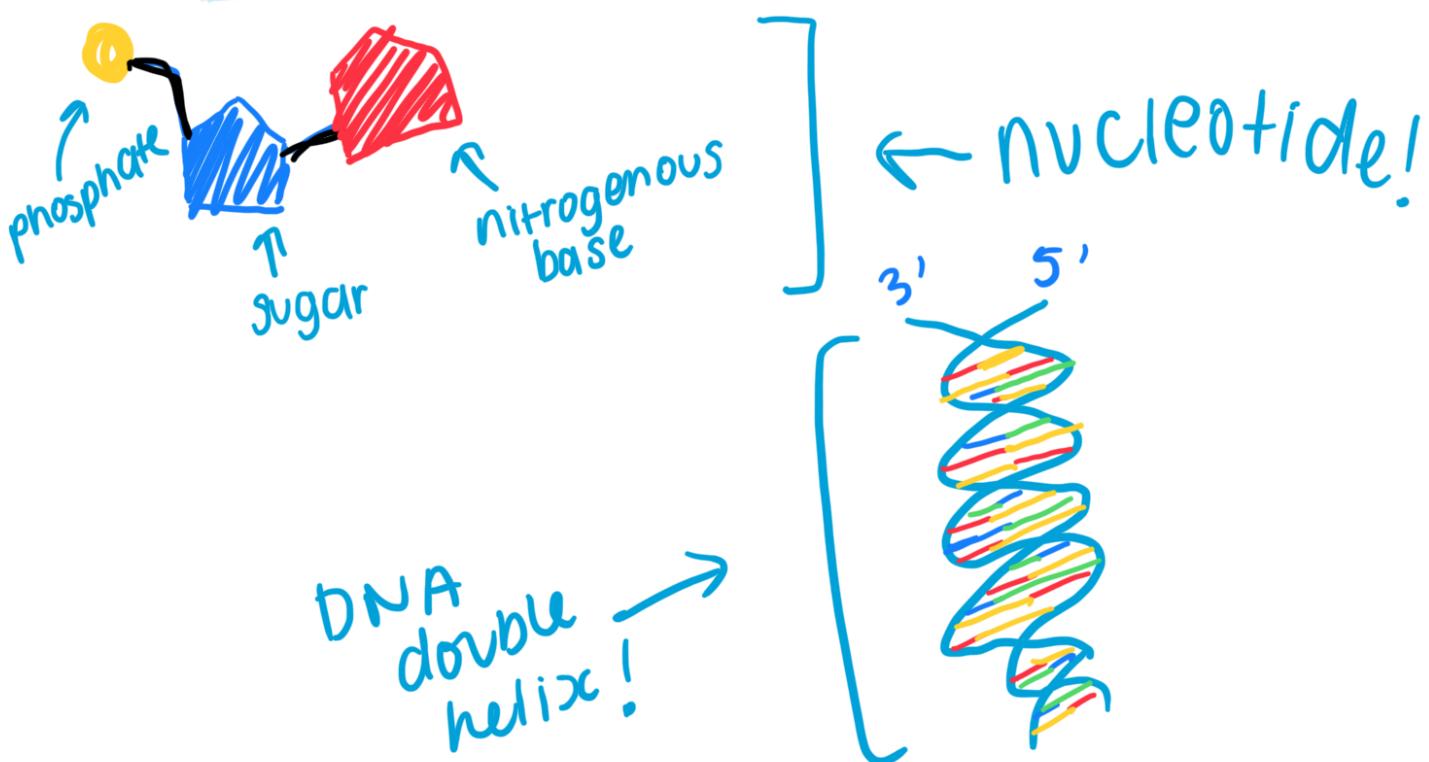
- monomer: amino acid
- polymer: polypeptide
- function: enzymes, structure, transport, hormones
- structure levels
  - primary: chain of amino acids
  - secondary: coil (alpha-helix) or sheet (beta-pleated) from H-bonds
  - tertiary: 3D folded shape from side chain interactions
  - quaternary: multiple chains combined





## NUCLEIC ACIDS

- **monomer**: nucleotide
- **Polymer**: DNA | RNA
- **function**: genetic info storage & transfer



## 4. Enzymes and Reactions

**Enzymes**: proteins that speed up chemical reactions in the body

- **Lower activation energy**: Enzymes make it easier for reactions to start

by lowering the energy needed

- Substrate: The molecule an enzyme works on. It fits into the enzyme's active site like a key in a lock
- Affected by pH, temperature, concentration: if these change too much, the enzyme may not work well
- Denature: If conditions are too extreme, the enzyme loses its shape, so the substrate no longer fits → stops working

## Reactions:

- Enzymes speed up dehydration by helping molecules come together and remove water to form bonds
- Enzymes speed up hydrolysis by helping add water to break bonds b/w molecules
- Enzymes help link monomers into polymers
- Enzymes help split polymers into monomers