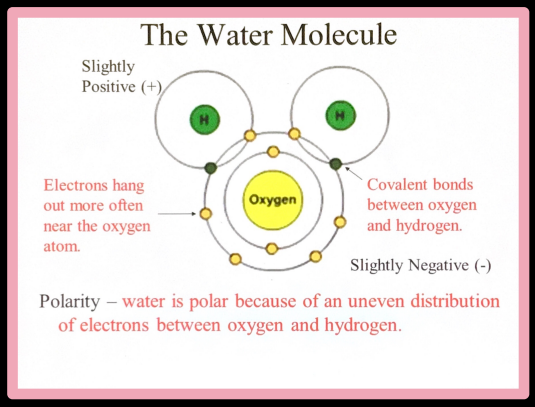
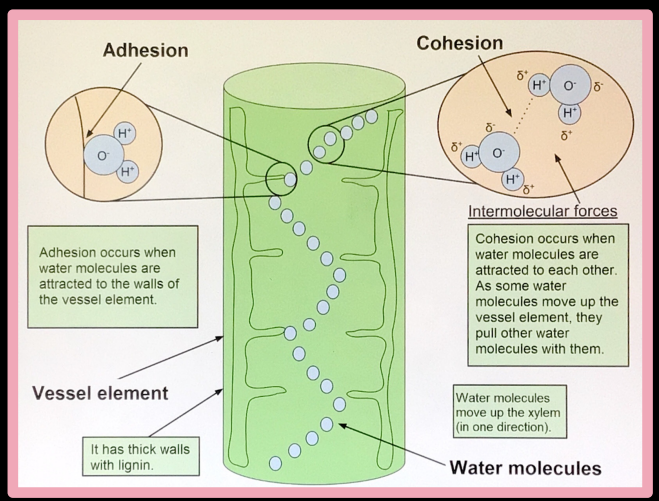
Basic chem & water notes:

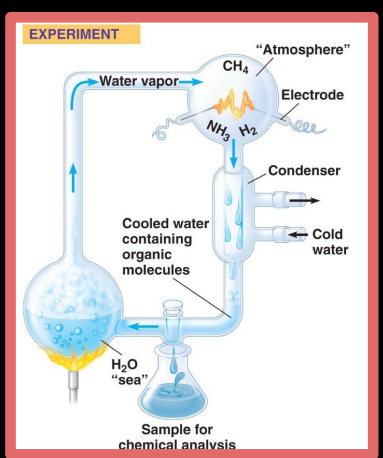
- common elements are H, C, N, O, P, Na, Mg, S, K, & Ca
- Bonds
  - ↳ weak bonds
    - hydrogen bonds
    - hydrophobic/phillic interactions
    - ionic bonds
    - van Derwaals
  - ↳ strong bonds
    - covalent bonds
  - ↳ differences
    - non-polar bonds - electrons are shared equally
    - polar bonds - electrons are shared unequally
  - ↳ polar molecule just means it has polar bonds
- Properties of water
  - ↳ cohesion
    - when water molecules are attracted to each other
    - occurs between the oxygen of one molecule & the hydrogen of another
  - ↳ adhesion
    - the attraction between a water molecule & another molecule
  - ↳ surface tension
    - the ability of bonds (hydrogen) to hold objects on the surface of water
    - ex) paperclips, cork
  - ↳ capillary action
    - ↳ use of adhesion for water molecules to travel across different surfaces
  - ↳ good solvent
    - dissolves polar substances well
  - ↳ lower density as a solid
    - allows for nutrient turnover
    - entire lake would freeze over without this property
  - ↳ high heat of vaporization
    - allows sweat to absorb more heat before evaporating promoting homeostasis

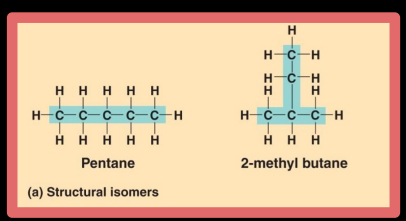


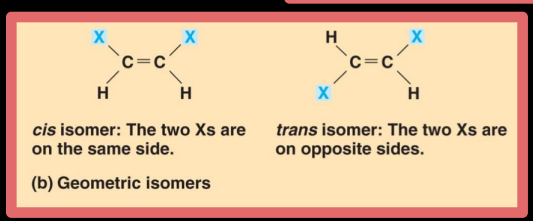


Carbon Notes:

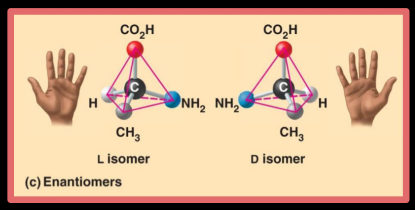
- ↳ major part of many organic elements
- ↳ carbon is very versitile due to it's ability to create 4 bonds
- ↳ miller-urey experiment simulated primative earth creating molecules of life →
- ↳ can create isomers
  - structural isomers are when 2 structures have a slight difference in covalent bonds leading to a whole different molecule with vastly different functions
  - geometric isomers occur when two molecules vary in space around a carbon double bonds
    - cis: same side of double bond
    - trans: opposite side of double bond







- enantiomer which is two molecules that are mirror images of each other
  - seems unimportant but can have a huge impact
  - often arranged around asymmetric carbon



↳ Functional groups
- substitute other atoms or groups around the carbon
- leads to the difference of molecules like ethane (C_2H_6) & ethanol (C_2H_5OH)
- these groups contribute in many chemical reactions

Types:

key
phosphate
hydrogen
sulfur
oxygen
carbon
nitrogen

Hydroxl: -OH
↳ found in alcohols
↳ polar
↳ can help dissolve organic compounds in water

Carbonyl: -C(=O)-
↳ differs ketones & aldehydes due to placement
- for ketones it is within the carbon skeleton
- for aldehydes it is at the end of the carbon skeleton

↳ The two are structural isomers
↳ both found in sugar leading to aldoses & ketoses

Carboxyl: -C(=O)OH
↳ in organic acids or carboxylic acids
↳ has acidic properties because the covalent bond between the oxygen & hydrogen is super polar
↳ can also lose a hydrogen resulting in an ion
↳ found in ionized forms of cells

Amino: -NH_2
↳ acts as a base because it can take in a H^+
↳ amino acids are when there is both an amino group & a carboxyl group

nonionized

ionized

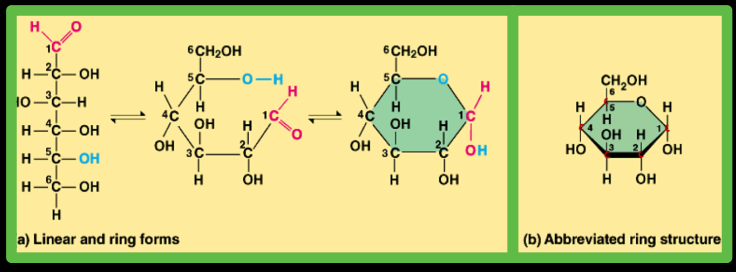
Phosphate: -O-P(=O)(-O⁻)-O⁻
↳ contributes to the negative charge of a molecule
↳ part of ATP
- when reacting with water it can release energy

↳ provides the backbone for phospholipids

Sulfhydryl: -SH
↳ two of these groups can react resulting in a covalent bond
↳ this is the structure determining hair type

Methyl: -CH_3
↳ addition of the methyl group in DNA can greatly affect genetics
↳ arrangement in sex hormones affects male & female hormones

Carbohydrates:
↳ functions: fast energy, raw materials, energy storage, structural materials (plants)
↳ monomer (building blocks) that are monosaccharides
↳ sugars:
- end in -ose
- classified by the number of carbon
  ↳ ex) glucose has 6, ribose has 5
- aldehyde: C=O at the end of the chain
  ↳ ex) anything like ribose, glucose
- ketone: C=O in the middle (on the second part: H-C(OH)H-C(=O)-C(OH)H- etc.)
  ↳ ex) ribulose, fructose
- Ring structure in water with 5 & 6 sugars
  ↳ bond is between the 1 carbon & the hydroxyl group from the 5th carbon
  ↳ O-H & C=O → O-C-OH
  ↳ carbons are numbered based off the O
- Isomers:



- types:
  - ↳ monosaccharides
    - simple 1 monomer sugar (ex: glucose)
  - ↳ disaccharides
    - 2 monomer sugar (sucrose)
  - ↳ polysaccharides
    - large polymers with a large number of monomers (starch, glycogen)
    - polymer of sugars
      - costs little energy to build
      - easily reversible so commonly seen as a form of energy storage
    - functions
      - energy storage starch (plants) & glycogen (animals)
      - structure chitin (animals/fungi) & cellulose (plants)
    - Linear vs branched
      - linear: starch, slow release energy storage
      - branched: fast release energy storage as the bonds are easier to digest, glycogen
    - diversity
      - ↳ molecular structure determines function
      - ↳ α glucose has the OH below the 1st carbon vs the β glucose has the OH above the 1st carbon
      - ↑ isomers of glucose
      - ↳ creates things like starch & cellulose

α monomers w/ '$_O$' bonds	↑ cellulose is β glucose monomers
easy to digest	hard to digest
all bonds are below	alternates bonds
humans have the enzymes to digest it	only fungi & cows, etc. can break down the cellulose "fiber"
	↳ fiber is good for the gut as we don't break it down so it all passes through

      - ↳ Cellulose
        - most abundant organic compound
        - since most carnivores can't digest cellulose they have to use meat to get digestible energy
        - many herbivores have bacteria to help digest it
        - the term ruminants is for animals that eat this with a rumen & coprophage for animals who consume fecal matter
- Building sugars
  - ↳ dehydration synthesis
    - removal of water
    - the OH off the C^1 & the H off the C^4: products H_2O & disaccharide
    - the bond is a glycosidic linkage between the two sugars

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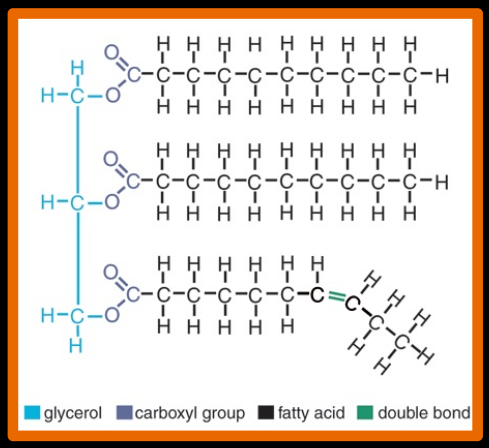
Lipids:

↳ long term energy storage

↳ structure

- long hydrocarbon chains (H-C)
- not a polymer (has tinier sections but not any repeating ones)
- glycerol & fatty acid (long HC chain plus a carboxyl)
  - ↳ the H from the glycerol & the OH from the carboxyl undergoes dehydration synthesis leading to an ester linkage
  - ↳ can result in a triacylglycerol which'll have one glycerol & 3 fatty tails & 3 H_2O molecules



↳ function

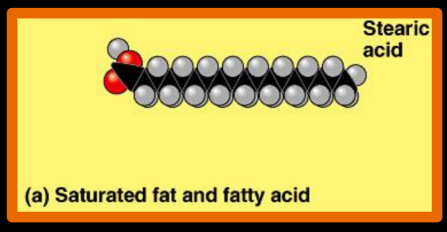
- btw it is non-polar & hydrophobic
- energy storage

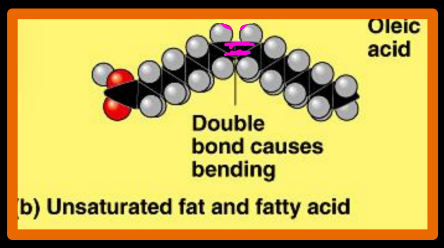
- very concentrated
  - 2 x the energy of carbohydrates
- cushions organs
- insulates the body

↳ Family: fats, phospholipids, & steroids

↳ saturated vs unsaturated fats
- saturated is all C-H bonds
- straight
- most fats in animals
- solid at room temperature causing it to cause issues in the artery

↳ unsaturated
- C=C bonds are present causing bends
- plant & fish fats
- found in vegetable oil
- liquid at room temperature as the bends prevent stacking





↳ Phospholipids
- Structure
  - glycerol & 2 fatty acids & PO_4
  - the tails are hydrophobic but the heads are hydrophillic
  - allows it to form the phospholipid bilayer in the cell membrane

↳ Steroids
- Structure
  - 4 fused C-rings & other functional groups
  - different functional groups lead to different steroid types
- ex) cholesterol, sex hormones
- cholestrol
  - parts of the animal cell membrane
  - precursor of all other steroids
  - high levels may be harmful to the heart

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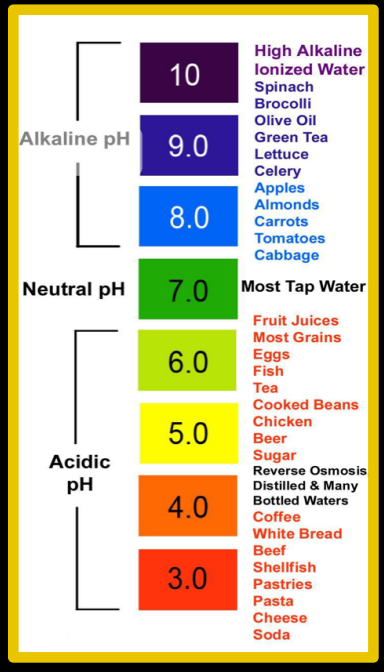
pH & Buffer:

↳ water can ionize
- H^+ splits from H_2O leaving a basic OH^-
- 1 → 7 → 14
- nuetral is 7, acidic is 3, & basic 10
- the higher the H^+ concentration the lower the pH

↳ affects
- it can alter the shape of molecules by denaturing them
- pH can be controlled by buffers
  - reservoir of H^+
    - ↳ weak acids & conjugate bases can be used to balance the pH

↳ Homeostasis
- human blood range 7.3-7.4

↳ zwitter ions
- neutral molecule
- positive & negative charge w/in molecule



Proteins:

↳ function: enzymes, structure, carries & transport, cell communication, defense, movement, & storage

↳ Structure
- monomer - amino acid

- polymer = poly peptide
  - can be folded & bonded together

↳ amino acids

- structure: central carbon, amino group, carboxyl group, & variable R-group (20 different types)
- non-polar r-groups that have c & h bonds, also hydrophobic
- polar due to polar bonds & hydrophillic
- ones with SH can create disulfide bridges between the sulfur (really strong)

↳ peptide bonds

- covalent bond post-dehydration synthesis in proteins
- the HO & H create a water to become a C & N bond
- n-terminus = NH_2 end or C-terminus = COOH, can only grow on n-terminus side

↳ primary structure

- amino acid seqvence
- slight change can make all the difference