

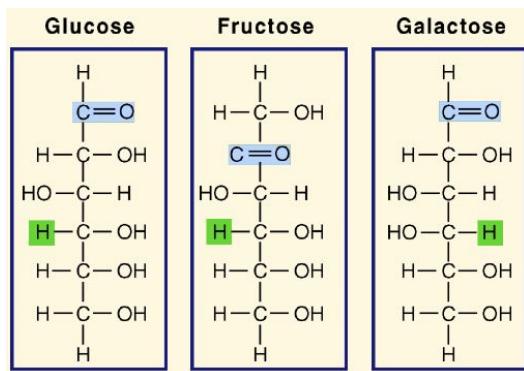
Biochemistry

"I will praise you for I am fearfully and wonderfully made; marvelous are Your works"
Psalm 139:14

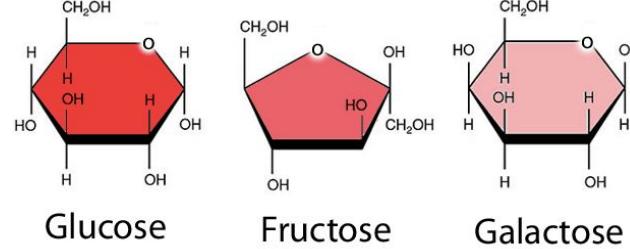
- living cell contains four primary types of organic compounds: carbohydrates, lipids, proteins, nucleic acids
- biochemistry: study of the chemistry of living things

Carbohydrates

- compounds that provide most energy for living things
- composed only of C, H, O
- sugars: small carbs containing about ten rings of atoms; indicated by suffix -ose
 - 1. monosaccharides (one ring)/simple sugars
 - glucose ($C_6H_{12}O_6$) produced by green plants in photosynthesis:
 $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$
 - fructose (isomer of glucose)



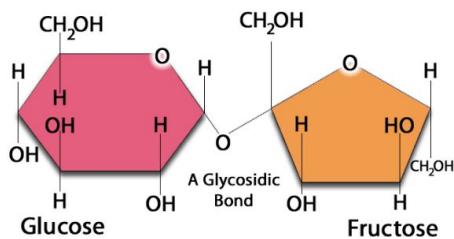
Monosaccharides



2. disaccharide: two linked monosaccharides

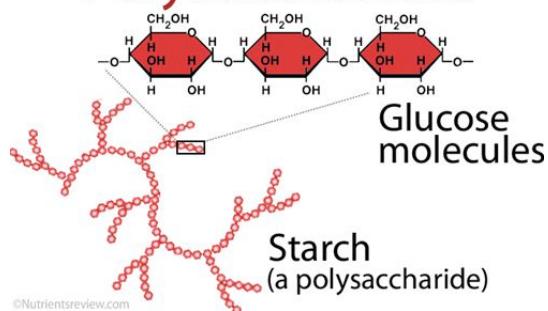
sucrose ($C_{12}H_{22}O_{11}$) = glucose+fructose

Sucrose



- 3. polysaccharide: sugar polymers made of large numbers of linked monosaccharides

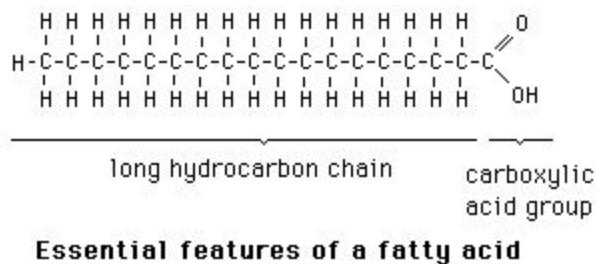
Polysaccharides



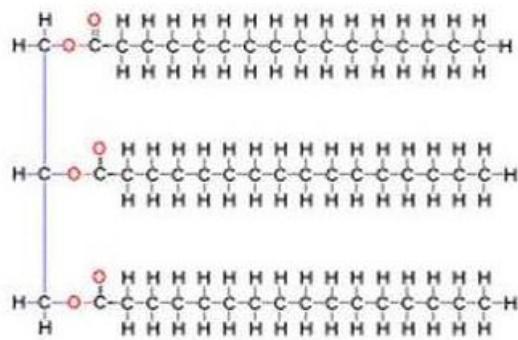
- Simple sugars (candy) broken down quickly v. complex sugars/carbohydrates which provide more energy
- starches (plants) and glycogen (animals, people) are forms of food storage
- cellulose: polysaccharide found in plants; not digestible in humans; also known as fiber which helps intestinal functions

Lipids

- insoluble in water; used to store energy , build cell parts, transfer chemical messages between cells
- fatty acids: rod of C and H attached to “handle” of carboxylic acid (-COOH)

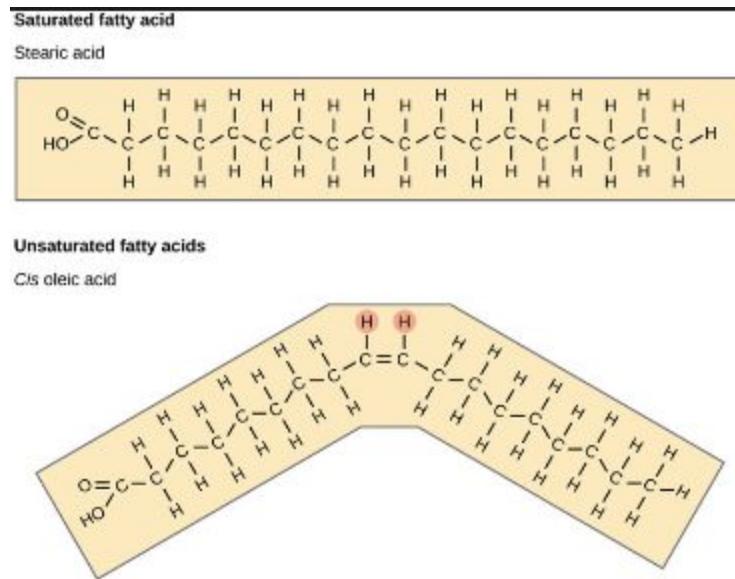


- combined into larger molecules called fats [p.183]
fats consist of three fatty acid rods with handles attached to single molecule of glycerol ($C_3H_8O_3$)



Simple (Pure) fat

- oil: fat at room temperature
- saturated fats: solid at room temperature; C atoms connected to as many H atoms as they can accommodate; molecule contains no bonds
- unsaturated fats: liquid at room temp; double bonds between C atoms result in fewer H atoms
 - monounsaturated - one pair of H atoms missing (replaced by one double bond)
 - Polyunsaturated - two or more H atom pairs missing

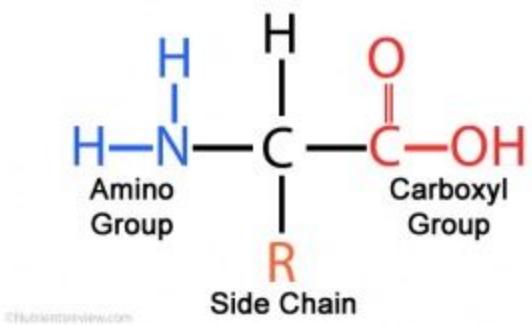


- unsaturated fats better so majority of fat intake should come from unsaturated fats; sources - fish oils, vegetable oils, olive oil, peanut butter, nuts
- hydrogenation: adding H to some double bonds in vegetable oil to make it more solid at room temperature (spreadable v. pourable)
- cholesterol: used by body to make bile, vitamin D, cell membranes, hormones
 - LDL (low-density lipoprotein) bad, HDL (high-density lipoproteins) good

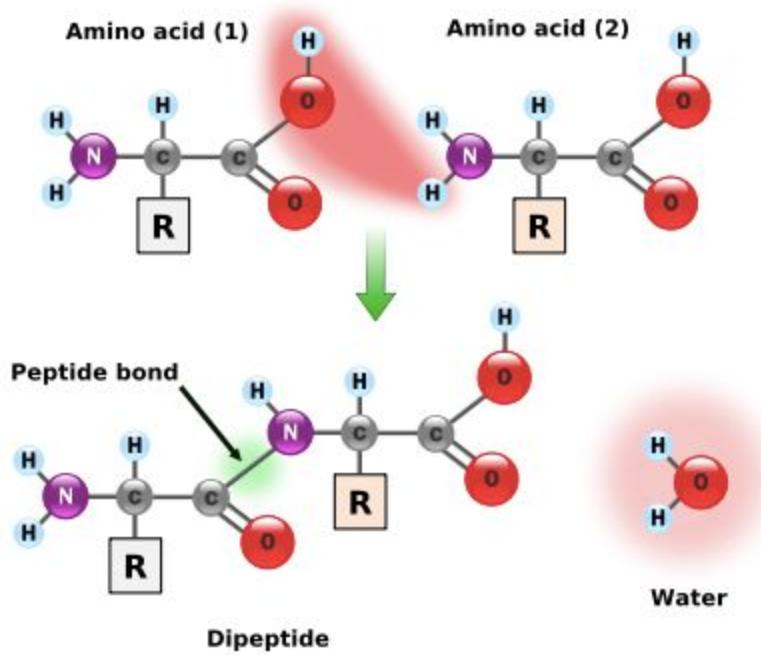
Proteins

- build and maintain living cells
- amino acids: smaller compounds that compose proteins; 20 different amino acids combine in various ways to produce different proteins
- [p. 186]
all amino acids contain a central C to which a -H, -NH₂ and -COOH are attached; biological amino acids differ in the fourth group (side chain)

Amino Acid Structure



- essential amino acids: amino acids that cannot be synthesized by the body and must be obtained directly from food
- most animal sources of protein provide all essential amino acids; eggs, poultry, fish, red meat, milk, cheese
- peptide bonds: bonds that link amino acids which connect the $-\text{NH}_2$ group of one amino acid to the $-\text{COOH}$ of another; also forms H_2O in the process

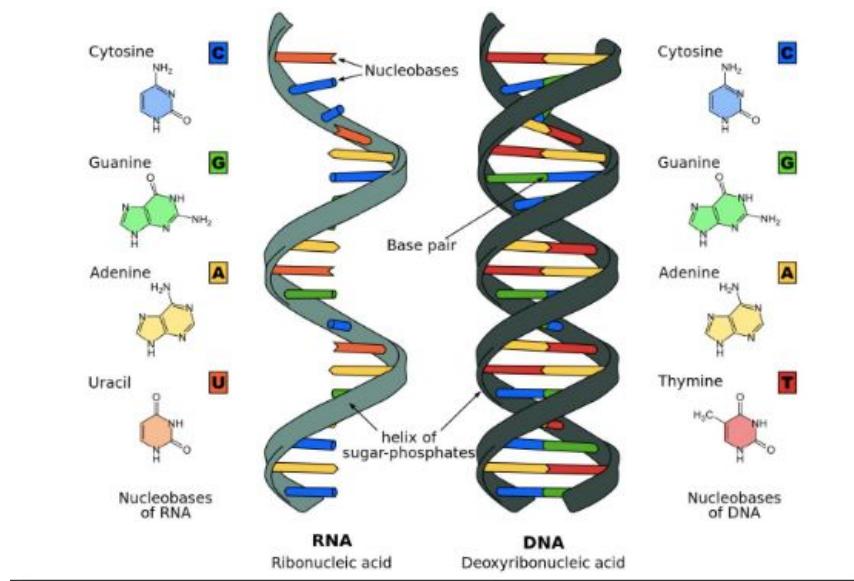


- fibrous proteins remain straight (hair, fingernails, gelatin)
globular proteins fold up and coil upon themselves with intricate 3D shapes
- enzymes: special globular proteins that initiate or regulate chemical reactions within a cell; like biochemical catalysts; indicated by suffix -ase
Ex: lactase helps break down lactose in milk / lactose intolerance

Nucleic Acids

- contain information that guides the construction of all proteins in the cell
- DNA (deoxyribonucleic acid):
 1. found in every cell of every living organism
 2. contains "blueprint" for every protein in the body and determines which proteins are produced --> determining form and function of every cell

- 3. directs construction of new cells
 - 4. directs how new cells are put together during the growth of an organism or repair of damaged tissue
 - 5. controls heredity/genetic traits
 - [p.189]
 - double backbone structure composed of alternating deoxyribose sugar (5C) and phosphate (PO_4) groups
 - nitrogen-containing bases stretch across backbone like ladder rungs; two bases interlock and form “base pair”
 - twisted into spiral shape called double-helix
 - 46 DNA molecules in each human cell
 - Bases: guanine (G), cytosine (C), adenine (A), thymine (T)
- Order in which bases connected along the backbone contains the information that a cell uses to build proteins; three bases code for each amino acid



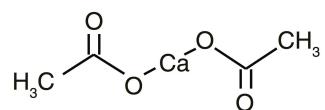
Metabolism

- Process by which the body produces and uses energy for food
- Involves cellular respiration - conversion of glucose to usable energy in body
 $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow \text{CO}_2 + 6\text{H}_2\text{O} + \text{energy}$
- Energy used for manufacturing proteins, storing fats, driving chemical processes

Activity

- Breakdown of wheat flour $\text{C}_6\text{H}_{10}\text{O}_5$
- Breakdown of sucrose $\text{C}_{12}\text{H}_{22}\text{O}_{11}$
- Egg composition:

Shell - calcium phosphate $\text{Ca}(\text{H}_2\text{PO}_4)_2$	White - albumin protein $\text{C}_{720}\text{H}_{1134}\text{N}_{218}\text{S}_{50241}$ (long chain of amino acids)
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Yolk - lipids

- Combustion (combining with O₂) of any hydrocarbon yields CO₂ + H₂O

