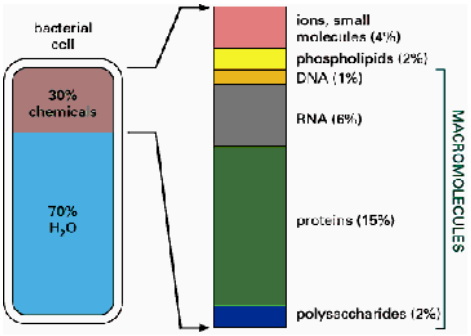
❖ Polymer Principles (p. 62 – 64)

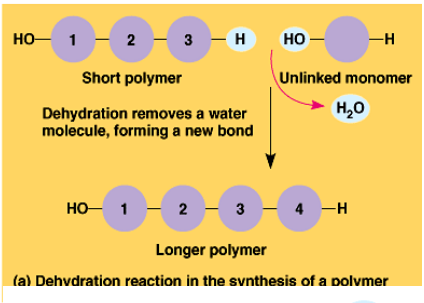
- **Monomers** – simple units (usually only a few) that can be linked in various chainlike sequences to form many more complex molecules (like letters:words or notes:songs)
- **Polymers** – large molecule made of similar repeating subunits (the words or songs)

Benefit: the ability to make many large molecules that are based on only a few parts, just in unique sequence. (26 letters – 250,000 words in English)

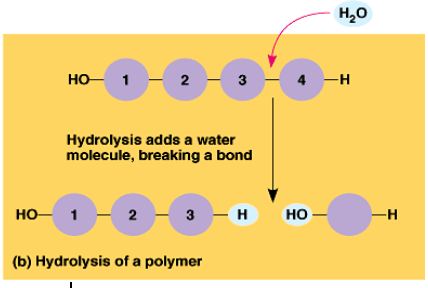


- 4 main biological macromolecules are polymers
  - **Carbohydrates** - Sugars, starch, …
  - **Lipids** – fat, oil
  - **Proteins** – Keratin, lactase
  - **Nucleic Acids** – DNA, RNA

❖ Synthesis



- **Dehydration Synthesis** (Condensation reaction)
  - Removal of water (OH from one molecule and H from the other) Monomers join w/ covalent bond to fill valence shell of exposed C.
- **Hydrolysis**
  - Exact opposite reaction of Dehydration Synth. (add water OH to one C, H to the other. Monomers separate.



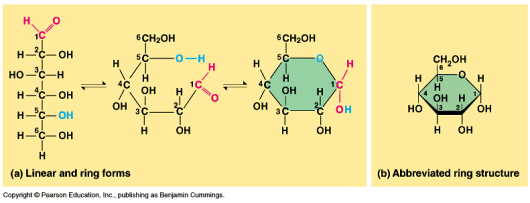
❖ Carbohydrates (p. 64 – 68)

- Function in living things:
  - 1. Contain energy stored in C-C bonds. Originally E from Sunlight
  - 2. Building materials – not as common
- Nomenclature
  - **Saccharide** = sugar
  - **Mono** = 1 **Di** = 2 **Oligo** = some **Poly** = many
- Formula is some multiple of (CH2O) with some slight variations
- Mono: $C_6H_{12}O_6$ **Di:** $C_{12}H_{22}O_{11}$ (remember lost H_20)
- Mono & Disaccharides usually end in "ose"

❖ Monosaccharides

- Glucose, fructose, and galactose have the chemical formula $C_6H_{12}O_6$
- All three form rings when in water

- **Biological Monosaccharides →**
  - Serve as monomers for all other carbs.
  - In water, all fold into rings (except Glyceraldehyde)

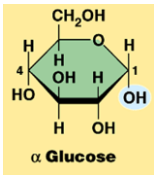


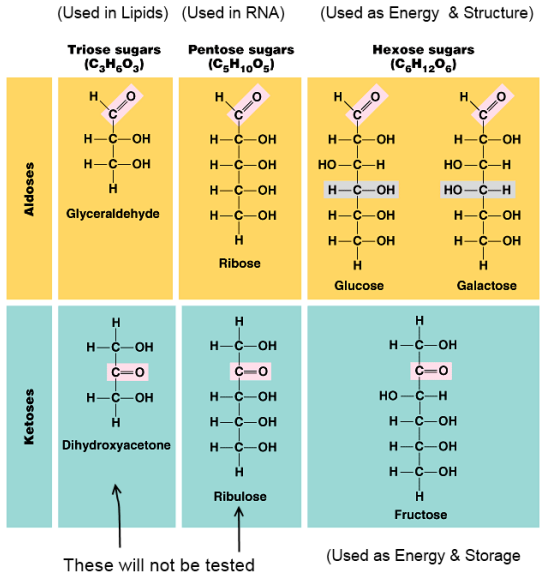
  - Carbon # - Look at the numbering of the Carbon in ring on right. (Find O and CH_2OH. C1 is adjacent clockwise. C6 is on CH_2OH)

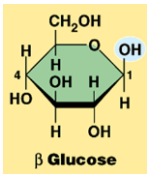
Two Isomers

α (alpha): OH on C1 is opposite CH_2OH

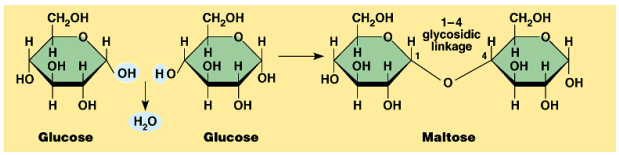
β (Beta): OH on C1 is same as CH_2OH







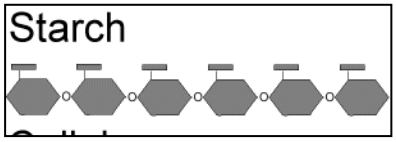
- **Disaccharides**
  - Product of Dehydration synth between two mono.
    - Glucose + Glucose = **Maltose** (Grains)
    - Glucose + Fructose = **Sucrose** (Table S)
    - Glucose + Galactose = **Lactose** (Milk)



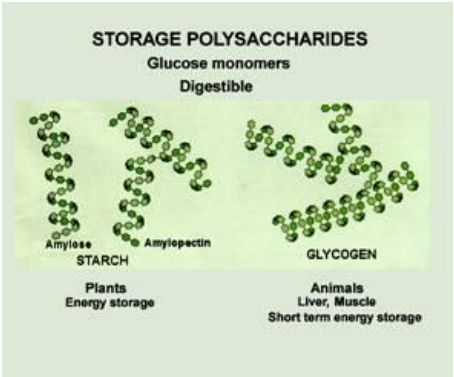
(a) Dehydration synthesis of maltose

  - Bond between C1 (where OH was) on one molecule and the O (where H was) on C4. Called "**1-4 Glycosidic Linkage**"

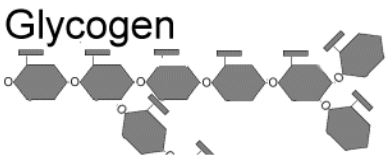
- Polysaccharides
  - Monomers are still monosacch.
  - Usually very large. (Starch – 200 subunits)



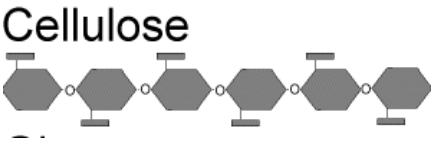
  - Storage Polysaccharides: **Starch** (plants) , **Glycogen** (animals)
    - Starch (**Amylose, Amylopectin**)
      - Function: Energy Storage in Plants
      - Structure: Repeating α Glucose (1-4 linkage) – all facing same way. Most 16 – 20 Gluc. long
      - Bond angle creates helical molecule (L-L-L-L) – poor H bonding to neighbors – less rigid.
      - Varities –
        - Amylose – unbranched,
        - Amylopectin – branched (2-4 Linkage on branch pt)



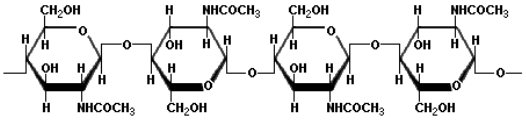
- Glycogen
  - Function: Short Term E storage in animals
  - Structure: Same as Amylopectin but longer chains and more branches. Dozens of branches each about 16 glu. long



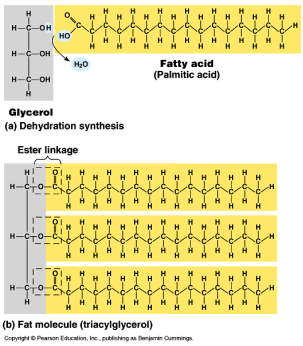
- Structural Polysaccharides
  - Cellulose
    - Function: Structural material in all plant walls. (Wood, Paper, Crunch)
    - Structure: Made from: β Glucose in 1-4 Linkage.
    - Alternating bond angles cancel each other, forming a straight molecule (L-R-L-R). Shape allows them to H bond with neighbors forming "cables" made from numerous strands.
    - Not digestible by animals. Ideas why?



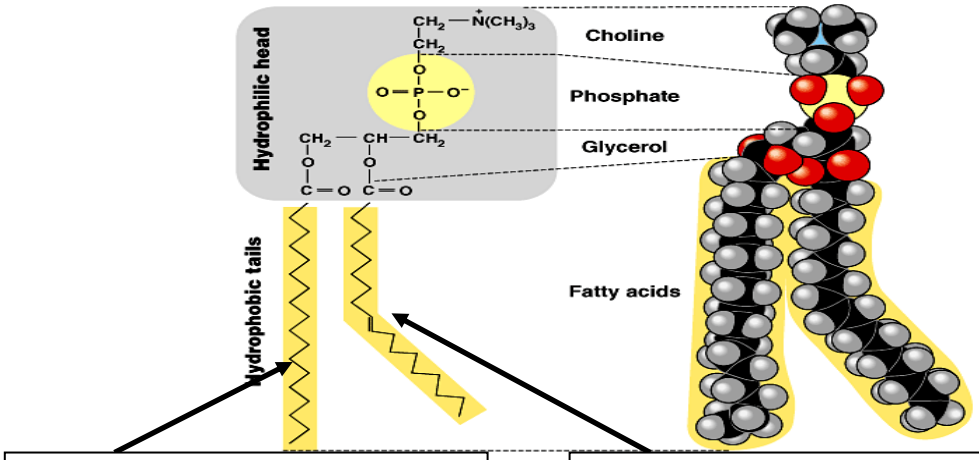
  - Chitin
    - Function: Skeleton of Arthropods (Insects, Crabs, Shrimp)
    - Structure: Same as Cellulose except a Nitrogen replaces the OH on C2.
    - Leathery except when Calcium Carbonate (chalk) bonds to chain - Rigid



- **Lipids**
  - Function: Cellular membranes in all organisms. Energy storage in most.
  - Structure: A different kind of macromolecule – not a polymer.
    - Fatty Acid – Long hydrocarbon (14 – 20 C) with a Hydroxyl at one end. Very Nonpolar.
    - Glycerol – 3C alcohol. Slightly Polar.
- **Dehydration Synthesis**
  - Bonds 1 FA to each of the three C of the Glycerol. Because the FA had a Hydroxyl at one end, you end up with a different bond – Ester Linkage



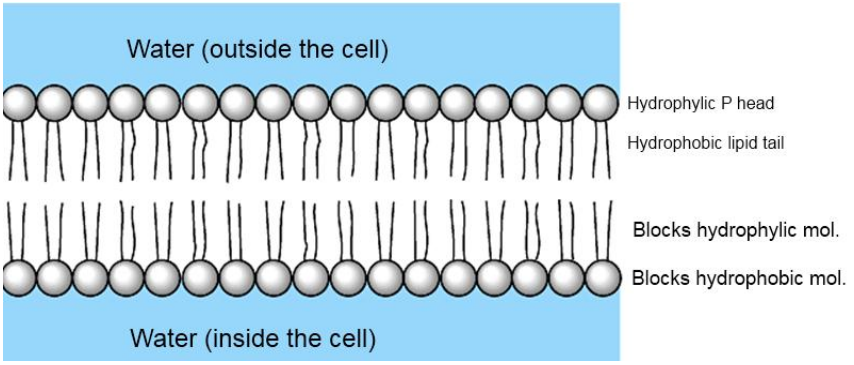
Two major types of fats



Saturated fats, but not much
All C-C-C- with two H per C
Very Nonpolar

Unsaturated fats 1 or more -C=C- with 1 H removed from each.
Slightly less nonpolar, but not much

- **Other biologically important lipids**
  - **Phospholipids** (See molecule above)
    - **Hydrophobic tail**(nonpolar): Two 16 C lipids (1 saturated, 1 unsaturated)
    - **Hydrophilic head** (polar): typical glycerol + Phosphate group (highly polar) and a nitrogen based Choline.
    - These form (almost) all of the cellular membranes found in all species



More types of lipid molecules

- Steroids
- Hormones
- Waxes
- Cholesterol