Macromolecules

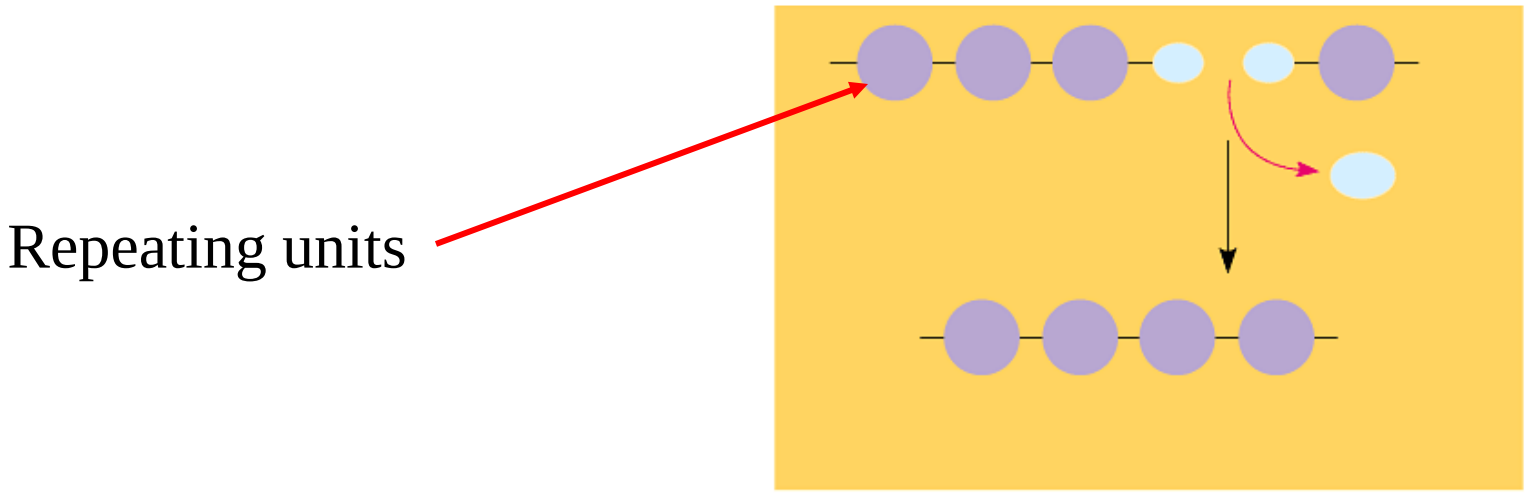
Chapter 5

Macromolecules - General

- Small organic molecules joined to form large molecules
- 4 classes:
  -
  -
  -
  -

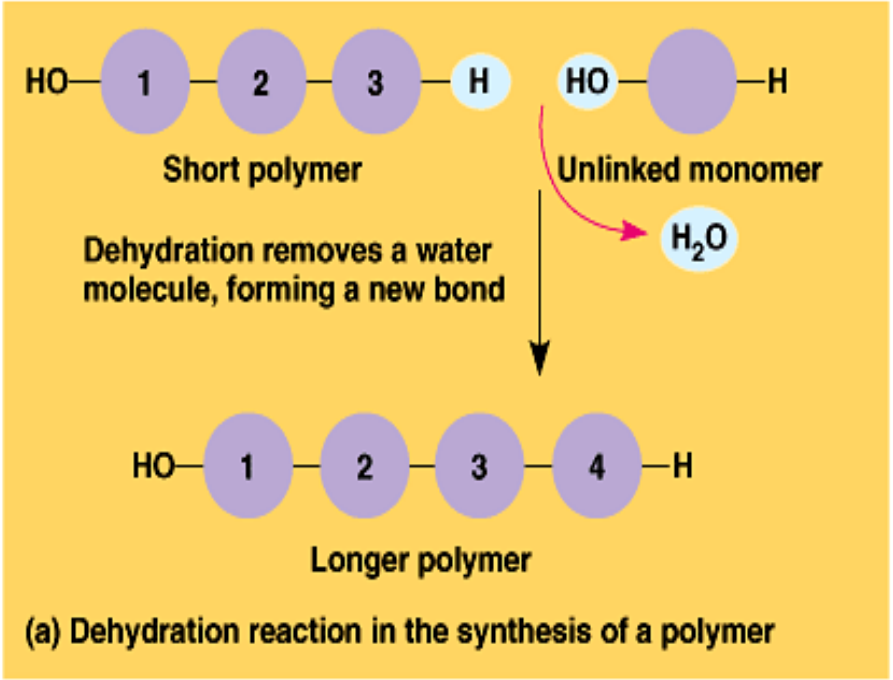
Polymers

- Carbohydrates, proteins and nucleic acids are _____
- **Polymers**: long molecule built by linking repeating units _____
  - Each unit of polymer = _____

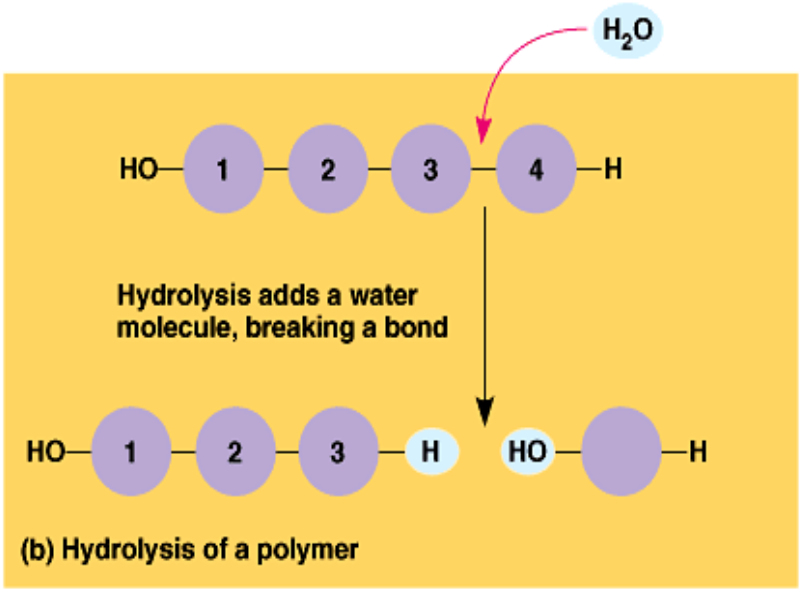


Synthesis of Polymers

- Condensation reaction:
  - Dehydration synthesis – _____
  - Monomers joined by removal of water
    - One contributes –_____
    - One contributes –_____
    - Together → H_2O
  - Process requires _____& _____



Breakdown of Polymers



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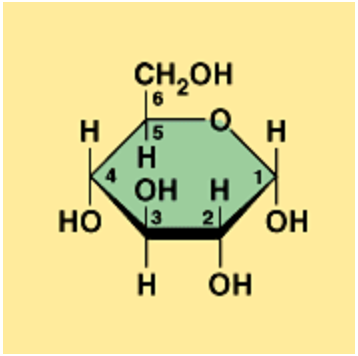
- Hydrolysis Reaction:
  - Hydro = water
  - Lysis = to _____
  - Reverse of condensation reaction
  - Uses water to _____ polymer
  - H2O splits into –H & -OH
  - -H & -OH bond to where covalent bond was before

Carbohydrates

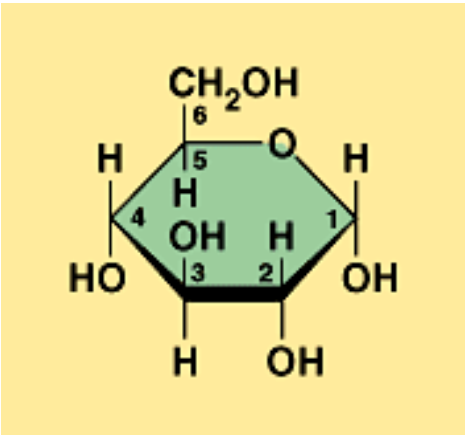


- Types
  - Monosaccharides – _____ sugars (1 monomer)
    - Ex: glucose
  - Disaccharides – double sugars; two monosaccharides joined through dehydration reaction.
    - Ex: _____
  - Polysaccharides – polymers composed of _____ sugar building blocks (monosaccharides)
    - Ex: starch

Functions:

- _____ – Cell respiration
- Energy Storage (not as long as lipids)
- Raw Materials
- _____ Materials
- Ex: sugars (sucrose) and starches

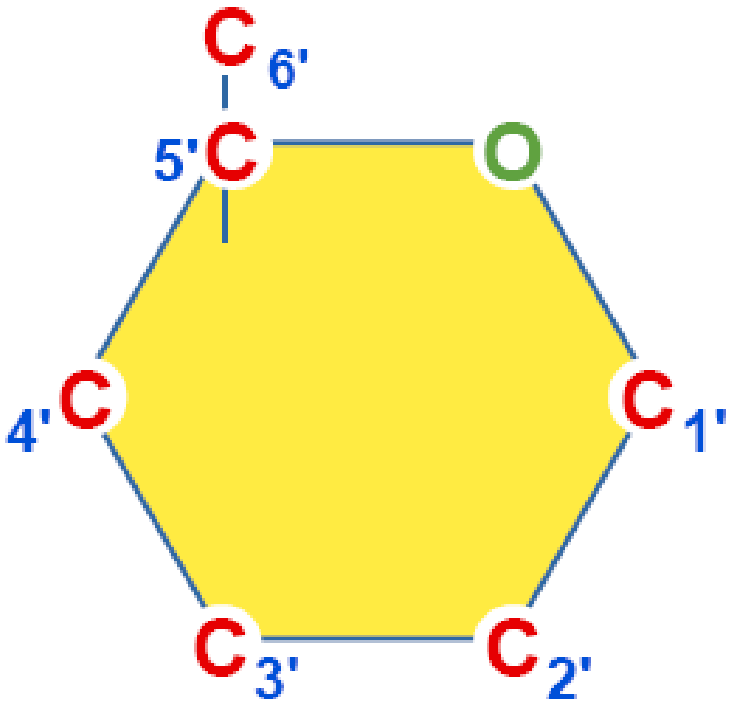
Structure:



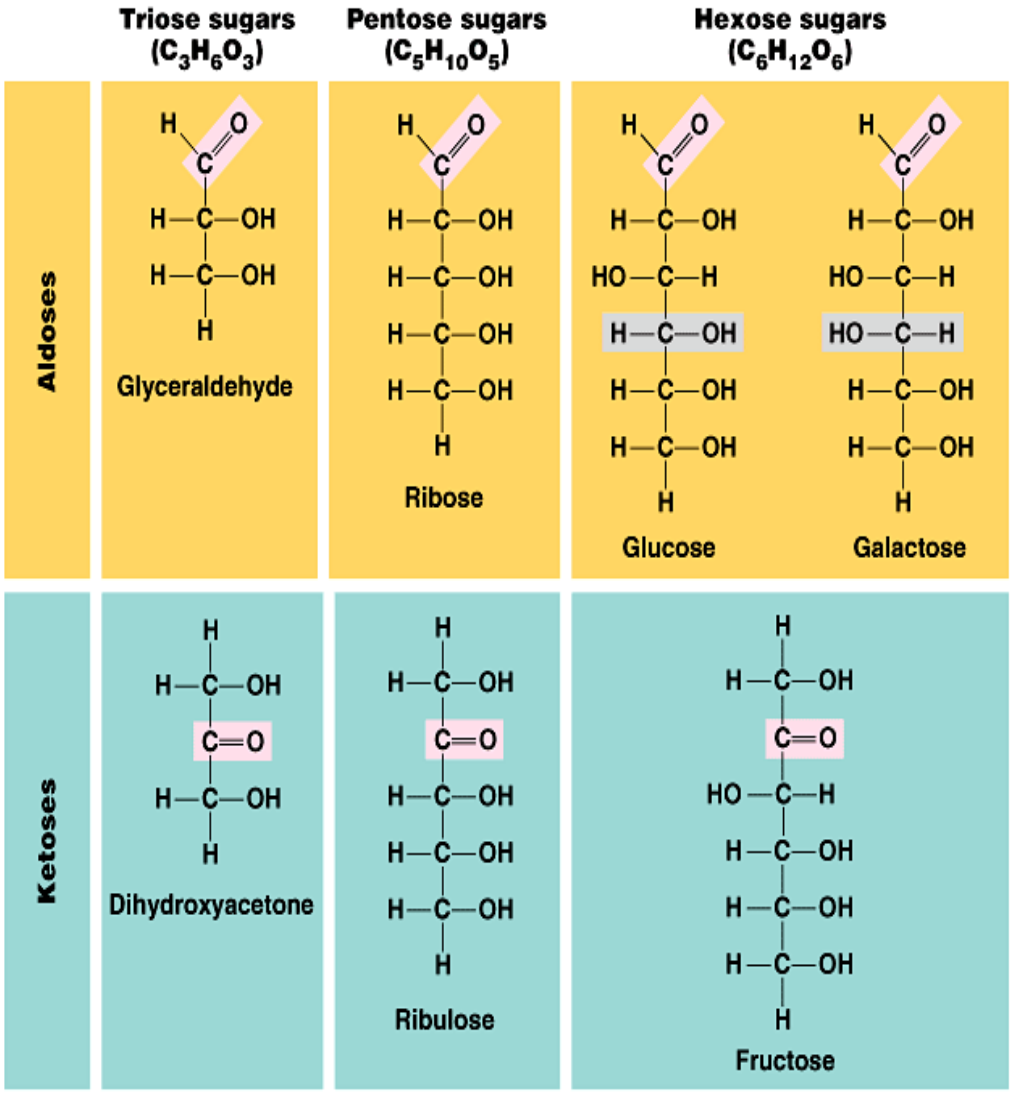
- Composed of _____
- $(CH_2O)_x$; when x = 6 → $C_6H_{12}O_6$

- 5C & 6C sugars form rings in aqueous solutions
  - Carbons are numbered

Numbered Carbons



Functional Groups



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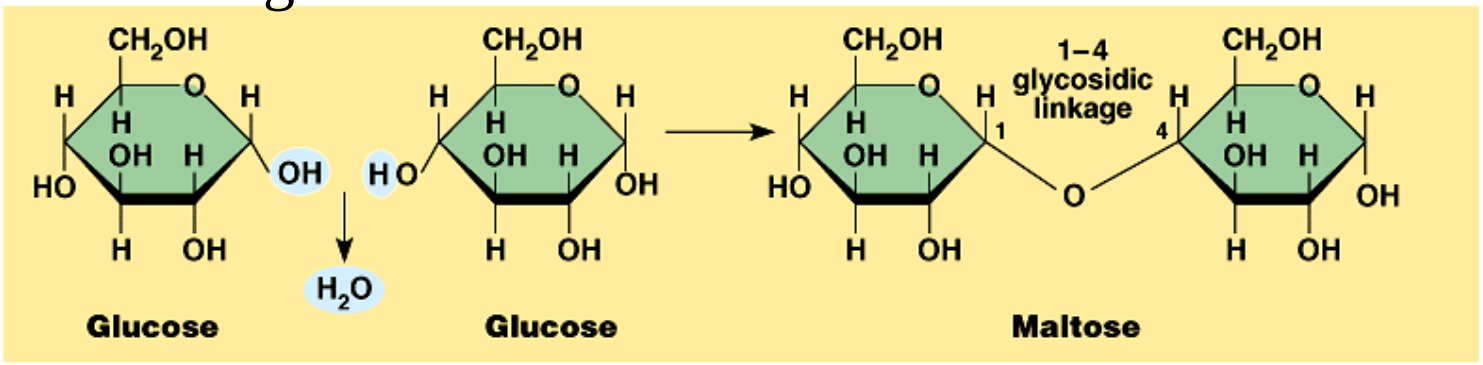
- Sugars have multiple _____ groups (-OH)
- <u>Aldose sugars</u>:
  - Carbonyl group (>C=O) is on the _____of the molecule
- <u>Ketose sugars</u>:
  - Carbonyl group (>C=O) is located in the _____ of the molecule

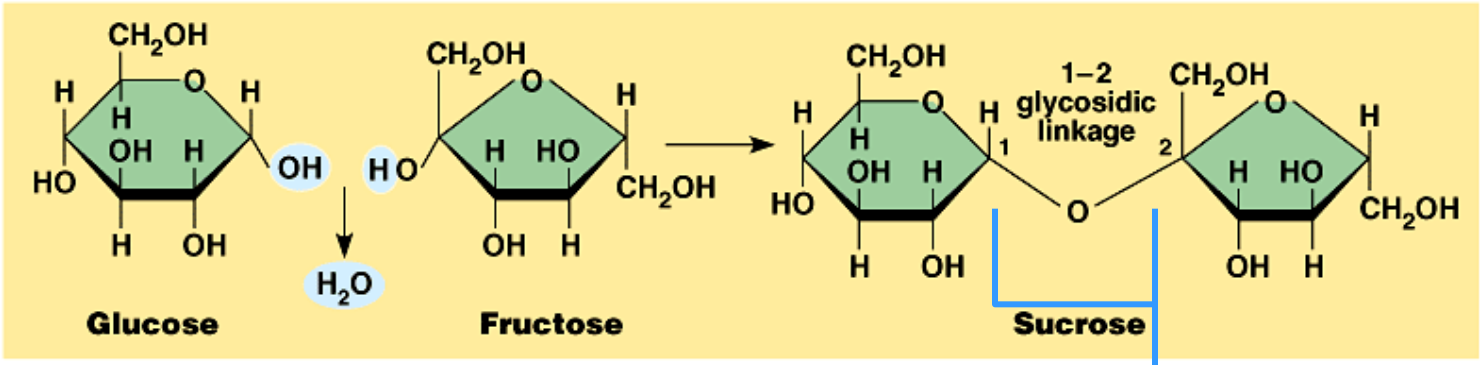
Building Sugars

- Dehydration synthesis
- Sucrose = table sugar

Disaccharide



(a) Dehydration synthesis of maltose



(b) Dehydration synthesis of sucrose

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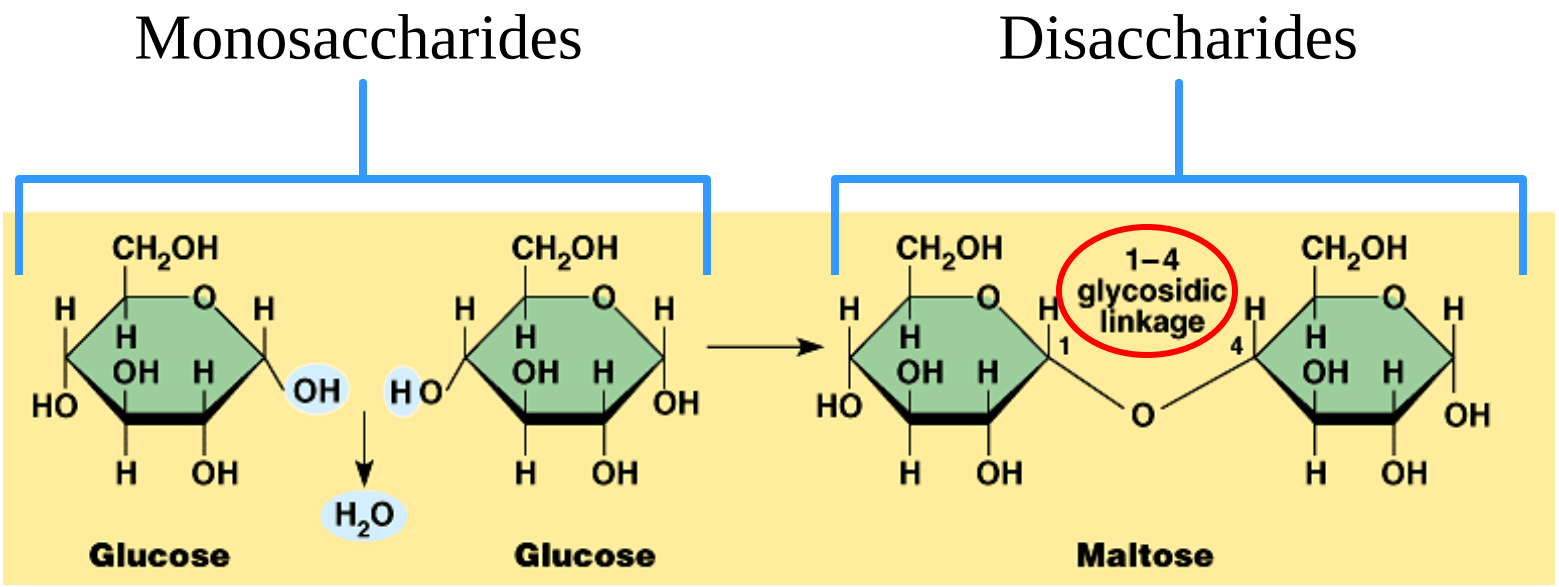
Glycosidic linkage

Structural Isomers

Building Sugars

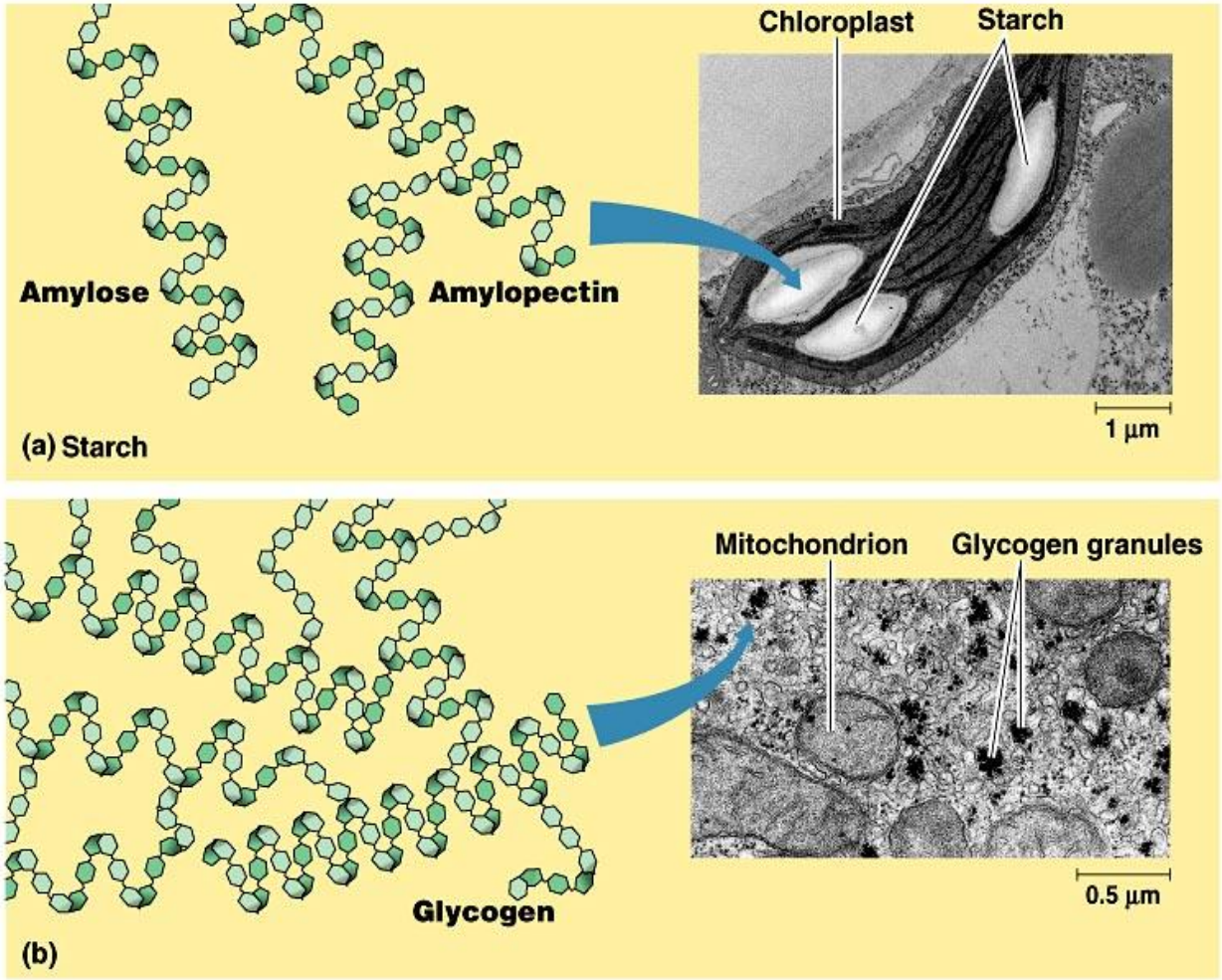
- Dehydration Synthesis -



Polysaccharides

- Polymers of a few 100 → few 1000 monosaccharides
- Functions:
  - Energy Storage
    - _____ (plants)
    - _____ (animals)
  - Structural
    - _____ (plants)
    - _____ (arthropods & fungi)

Branched vs. Linear Polysaccharides



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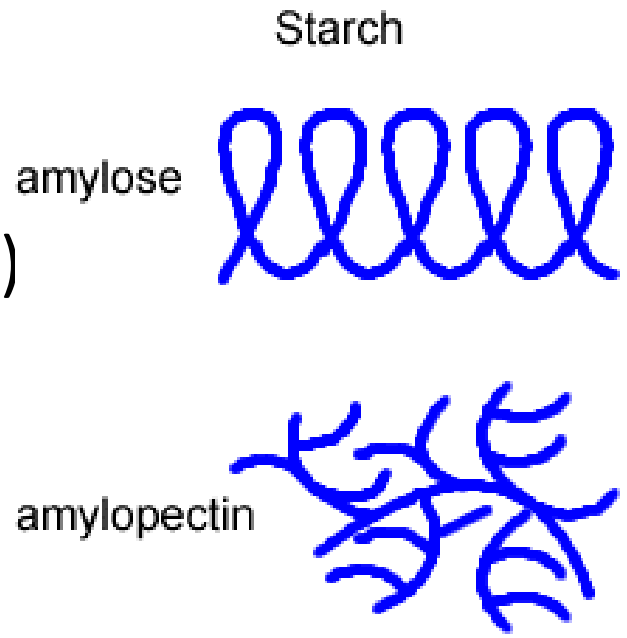
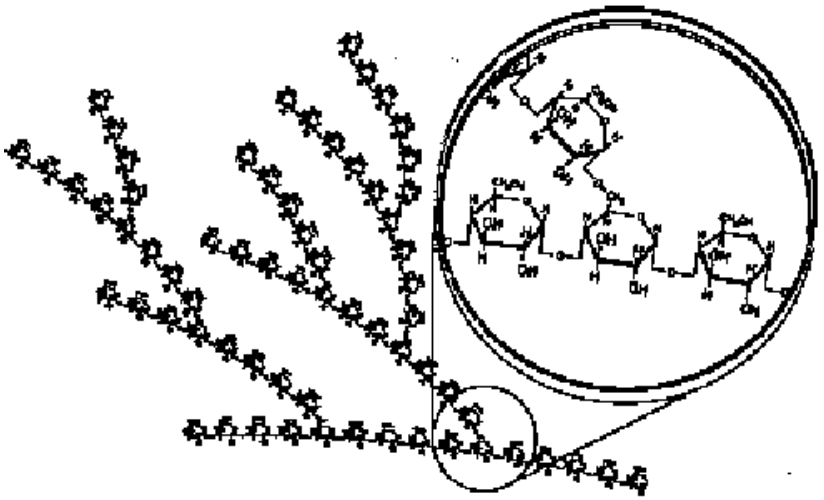
Branched vs. Linear Polysaccharides

- Starch
  - Stored as granules within _____(chloroplasts)
  - Amylose – unbranched
  - Amylopectin – branched
  - All glucose in _____ (α) configuration (-OH group is below the plane on 1C)



Branched vs. Linear Polysaccharides

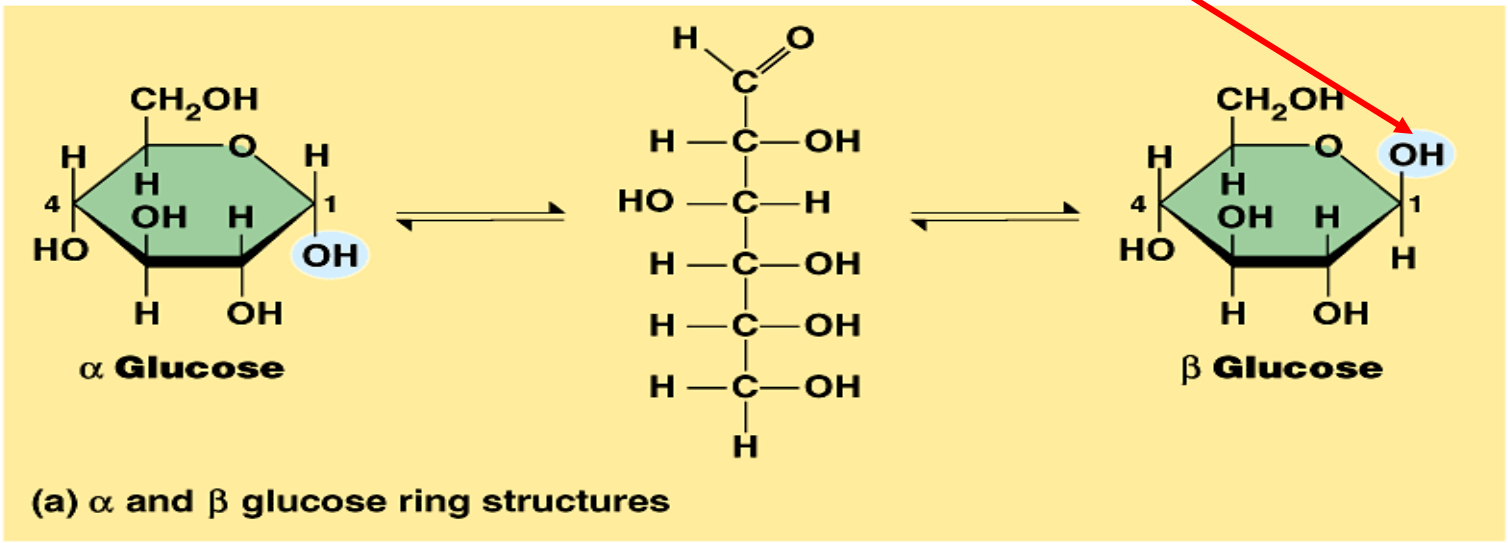


- Glycogen
  - Branched – creates several ends for quick release of glucose available for energy
  - Stored in muscle and liver cells

- Both starch and glycogen are broken down for _____through hydrolysis.

Structural Polysaccharides

- Cellulose
  - Component of _____ in plants
  - Most abundant sugar on Earth
  - Polymer of glucose
  - All glucose monomers are in the _____(β) configuration (-OH is located above the ring plane on the 1C)



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Cellulose

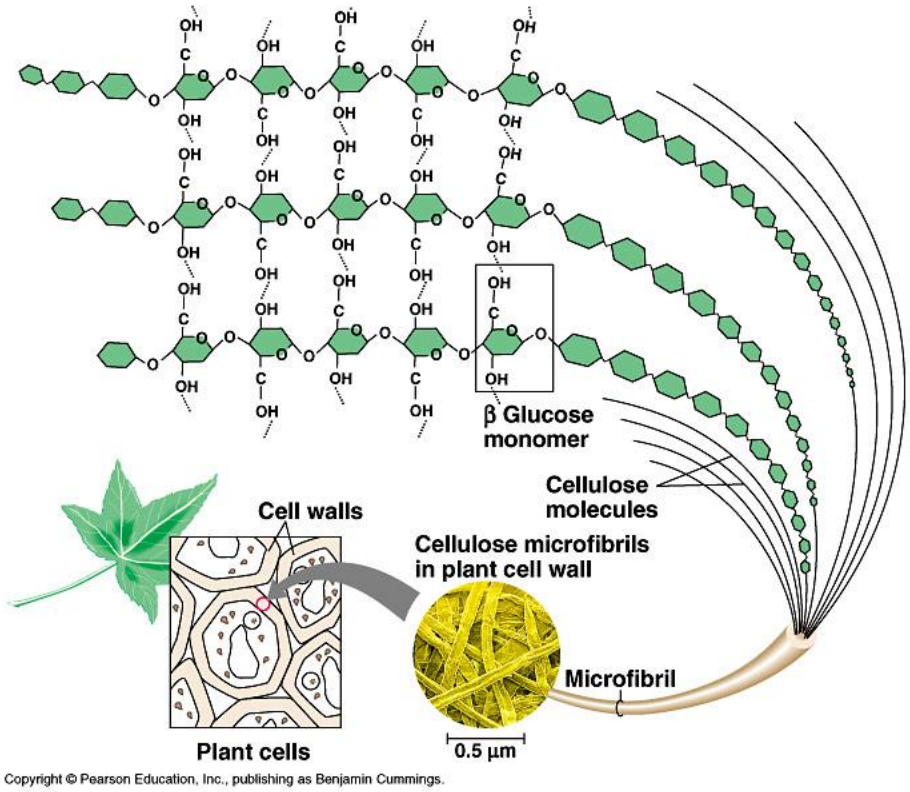
- Very difficult to digest
- Few organisms have

  _____

  that can digest cellulose
  - Humans do not
  - “insoluble fiber”
  - Cows have

    _____

    that are able to break down cellulose



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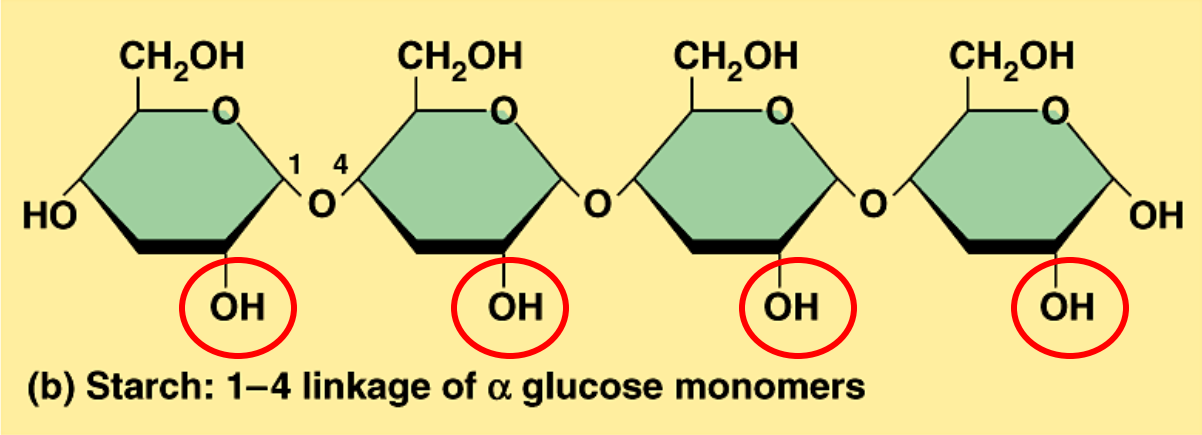
Starch vs. Cellulose Digestion

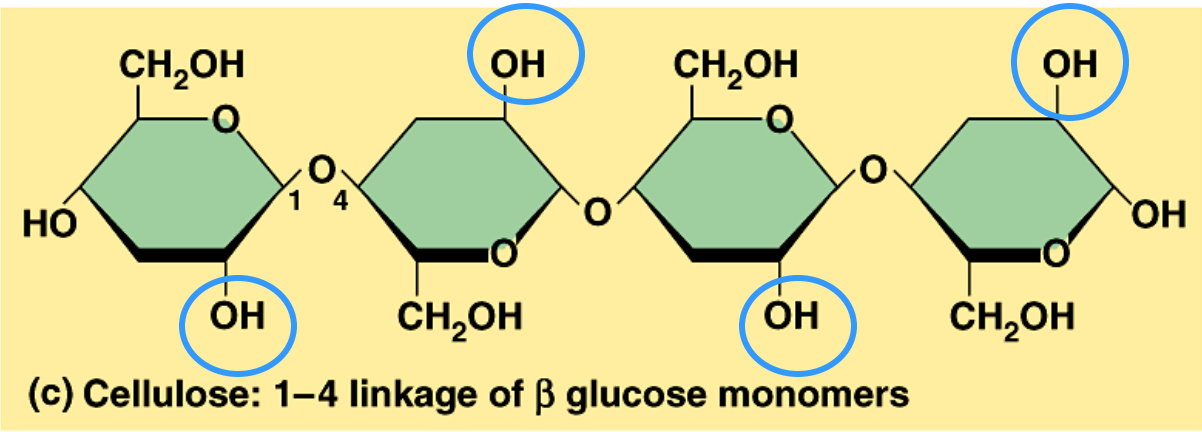
_____

_____

in same plane: easier to digest – molecule is branched.

Every other glucose monomer is upside down; molecule is straight.





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Chitin

- Makes up cell walls in _____ and _____in arthropods (insects, lobster, crab) – even makes up surgical thread
- Tough, _____, indigestible – similar to cellulose
- Hydroxyl group on the second carbon is replaced with NHCOCH3 group