MCB 150

The Molecular and Cellular Basis of Life

Lecture 4: Continue Carbohydrates

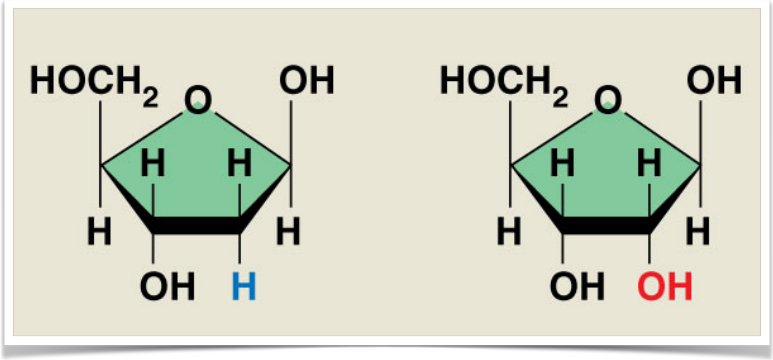
Today's Learning Catalytics Session ID is

18006122

Announcements

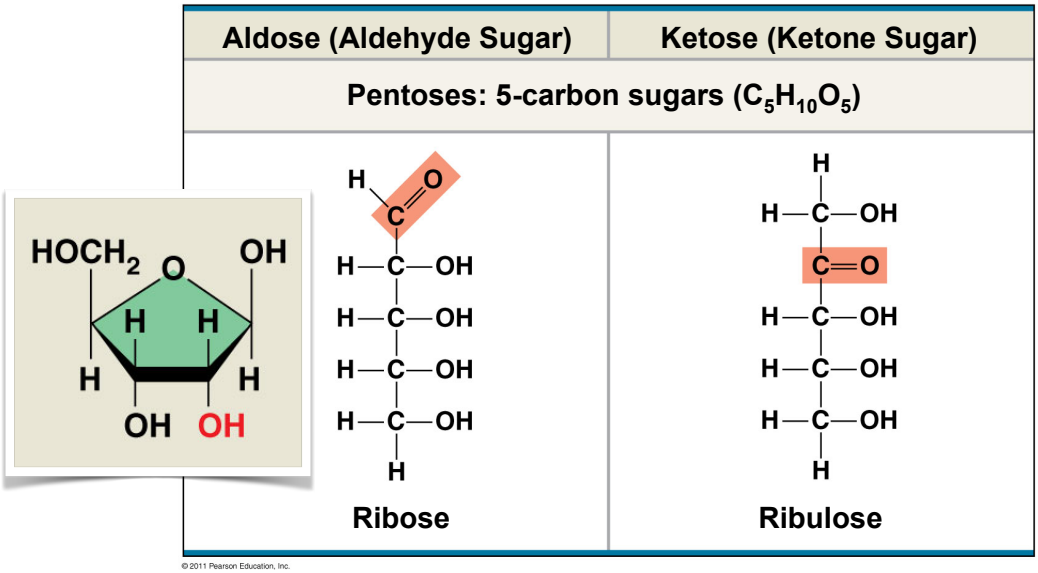
- Student Hours today *may* start a few minutes late
- Upcoming (lecture) assignments:
  - Lecture 4 post-lecture due 1:00 PM Thursday
  - Lecture 5 pre-lecture due 1:00 PM Friday
  - Lecture 5 post-lecture due 1:00 PM Monday
  - Lecture 6 pre-lecture due 1:00 PM Monday

Other monosaccharides have similar (but not identical) formulas, similar structures, and related functions:

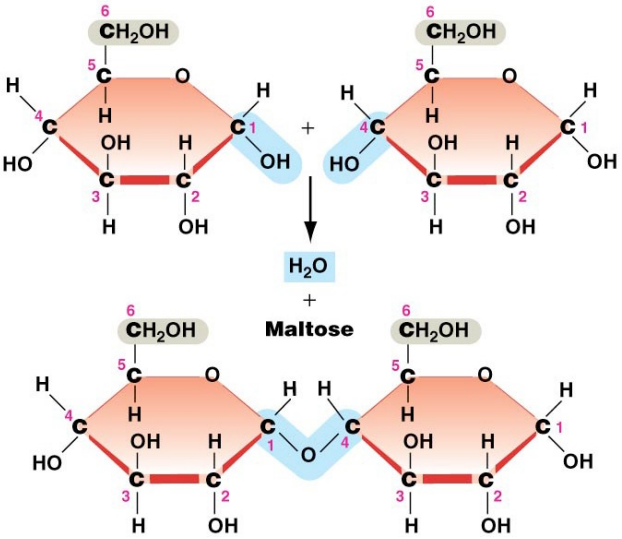


Deoxyribose Ribose

Monosaccharides are typically found with 3, 5, or 6 carbons



Two monosaccharides can be brought together to form a very simple polysaccharide called a **disaccharide** via a covalent bond called a *glycosidic linkage*.

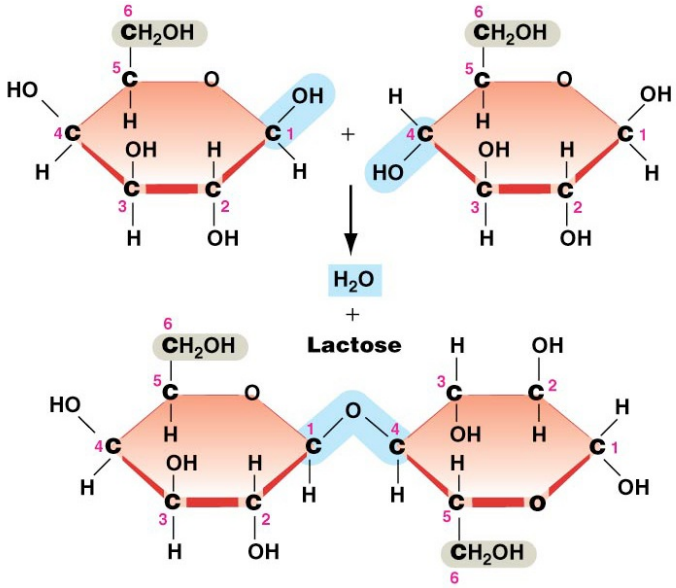


Note that the glucose molecule contributing its C_1 is an alpha glucose, making the resulting glycosidic linkage an α-1,4 glycosidic linkage.

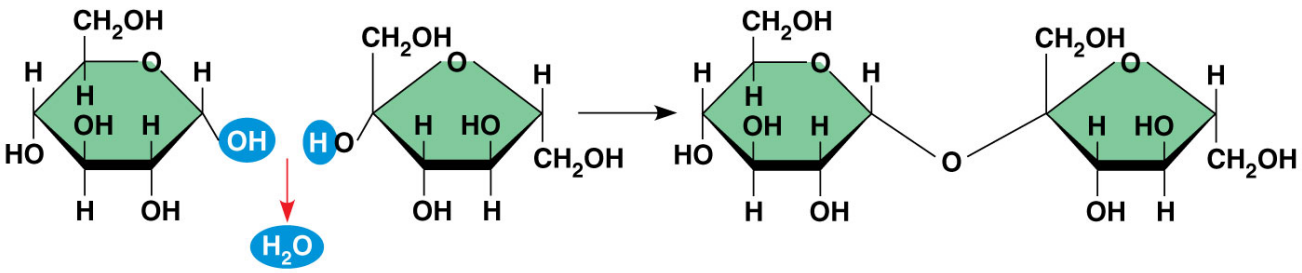
Cellobiose (not shown) is a disaccharide of beta glucose and another glucose connected via a β-1,4 glycosidic linkage.

In maltose and cellobiose, both monosaccharides are glucose, but not all disaccharides have to be the same monomers:

Lactose (milk sugar) is a disaccharide of glucose and galactose.

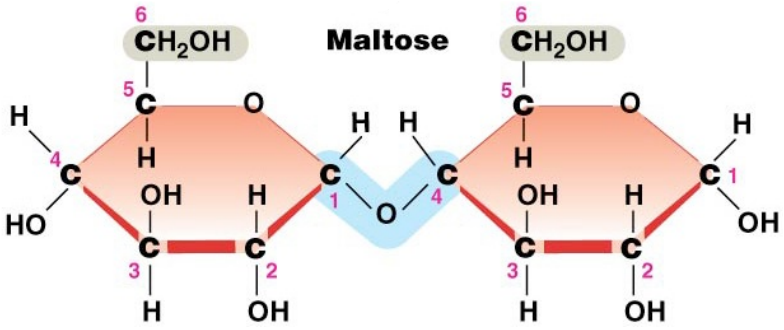


In maltose and cellobiose, both monosaccharides are glucose, but not all disaccharides have to be the same monomers:



Sucrose (table sugar) is a disaccharide of glucose and fructose.

The chemical formula for a disaccharide of hexose sugars is $C_{12}H_{22}O_{11}$



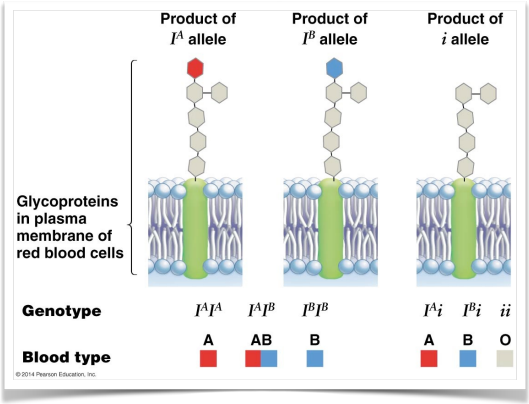
Why does this differ from the general formula of $C_n(H_2O)_n$?

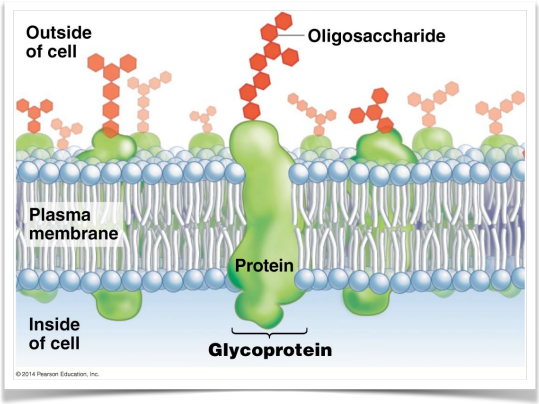
Some common terminology:

- One monomer is a **monosaccharide**.
- Two monomers are a **disaccharide**.
- Several monomers are called an **oligosaccharide** (oligo = several).
- Hundreds or thousands of monomers are a **polysaccharide** (poly = many).

Carbohydrates can be modified:

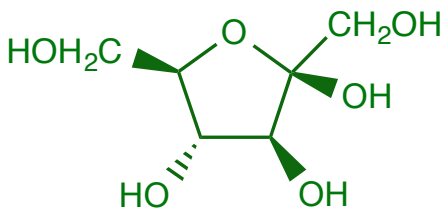
- Linkage of oligosaccharides to other macromolecules
  - When covalently linked to membrane proteins or lipids, carbohydrates act as identification and recognition molecules (chemical markers), as in blood typing.



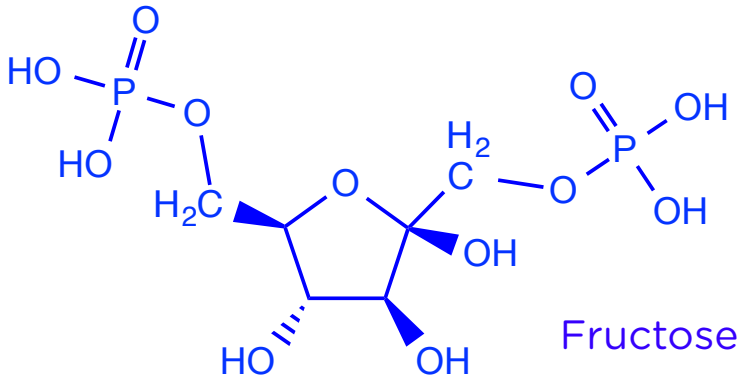


Carbohydrates can be modified:

- Addition of chemical groups:



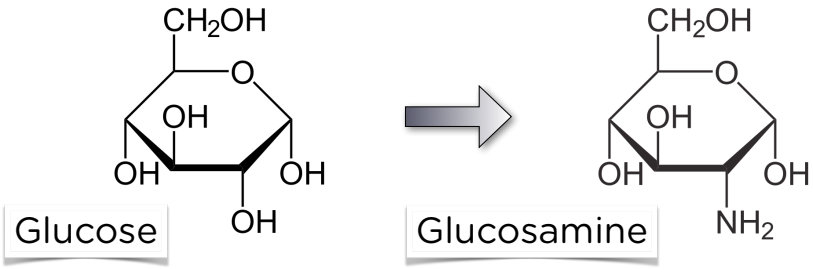
Fructose



Fructose-1,6-bisphosphate

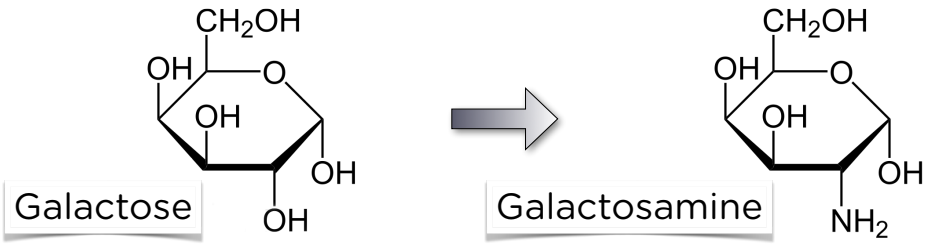
Carbohydrates can be modified:

- Addition of chemical groups:



Glucose

Glucosamine



Galactose

Galactosamine

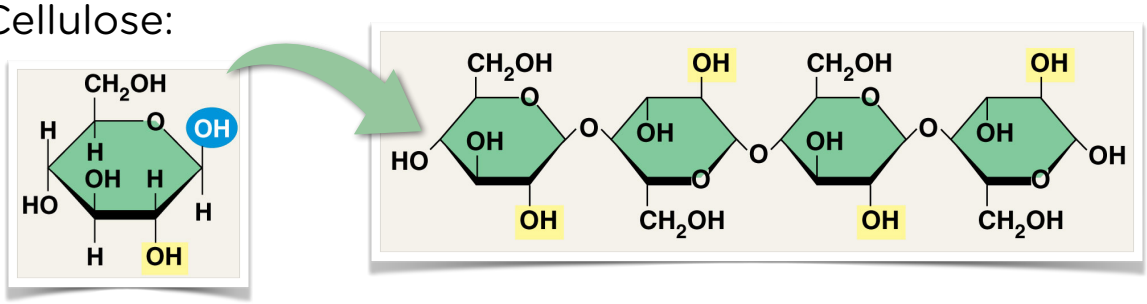
Polysaccharides serve as chemical sources of energy or structural compounds:

- Cellulose
- Starches
- Glycogen

Cellulose:

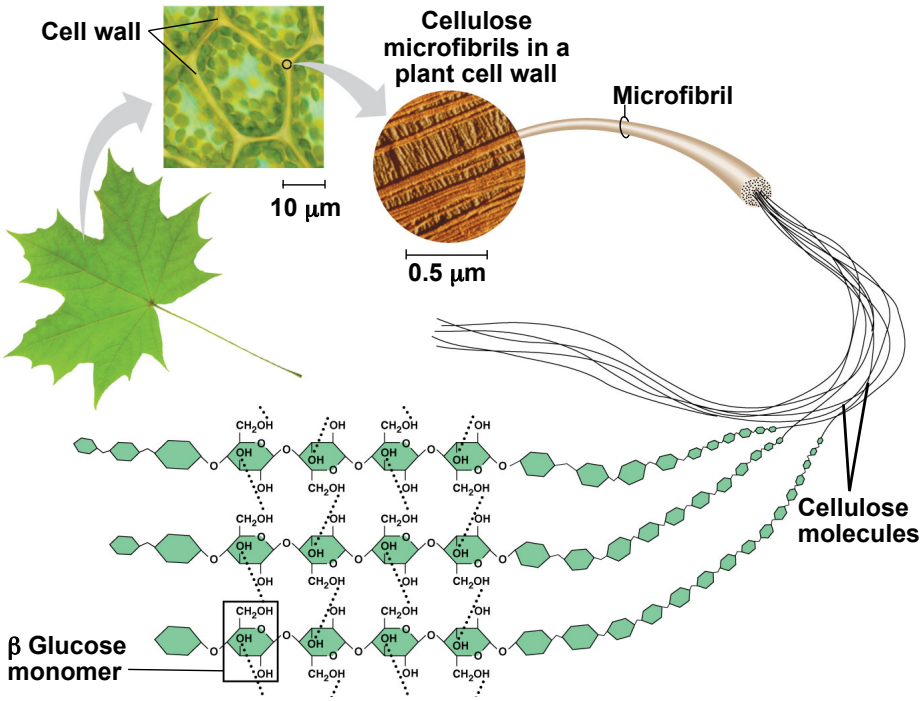
- The most abundant carbon-containing (i.e., organic) compound on Earth
- Found in plant cell walls
- Linear, unbranched polymer of glucose
  - monomers covalently linked by β-1,4 glycosidic linkages
  - linear polymers held together by hydrogen bonding with neighboring strands

Cellulose:



Polysaccharide	Chemical Structure	Three-dimensional Structure
Cellulose Used for structural support in cell walls of plants and many algae	β-Glucose, β-Glucose, β-1,4-glycosidic linkage, Hydrogen bond, β-1,4-glycosidic linkage	Parallel strands joined by hydrogen bonds

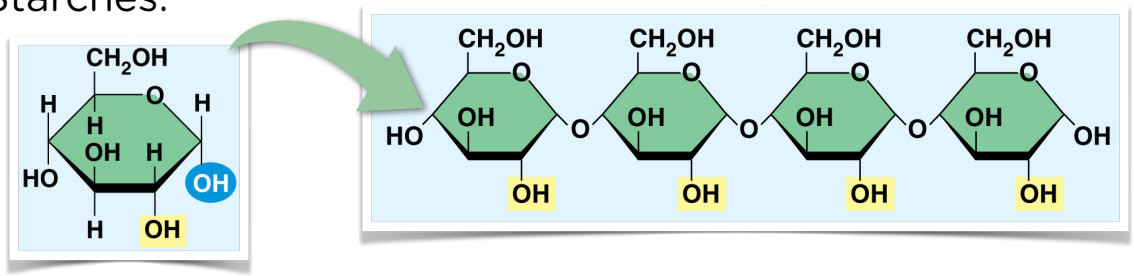
Cellulose:

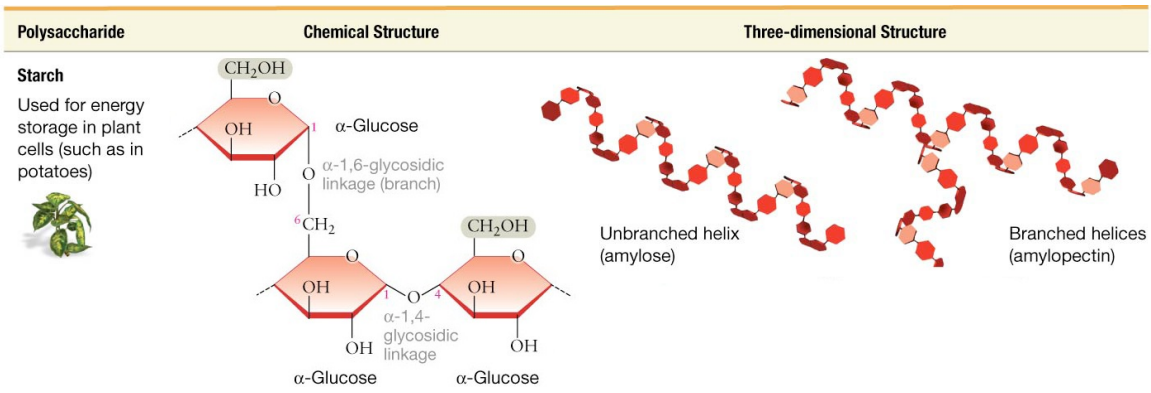


Starches:

- Found chiefly in seeds, fruits, tubers, roots and stems of plants; energy storage
- Helical, unbranched or loosely branched polymers of glucose
  - monomers within chains covalently linked by α-1,4 glycosidic linkages
  - chains branch by connecting with other chains by α-1,6 glycosidic linkages

Starches:





Glycogen:

- Found in muscle and liver cells of animals; energy storage
- Helical, highly branched polymers of glucose
  - monomers within chains covalently linked by α-1,4 glycosidic linkages
  - chains branch by connecting with other chains by α-1,6 glycosidic linkages

Glycogen: