Carbohydrates

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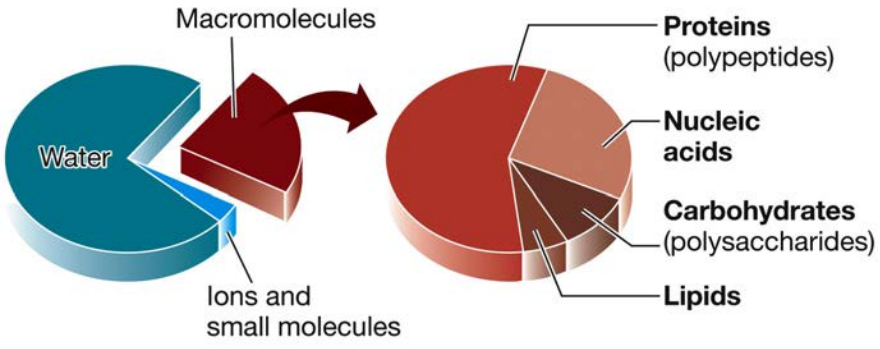


Carbohydrates

Definition

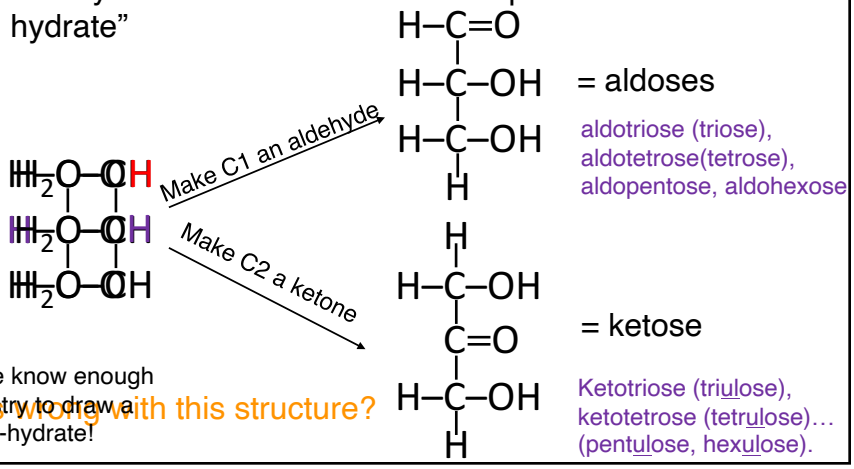
- Carbo-Hydrate: have formula $C_n(H_2O)_n$ (for $n \geq 3$)
- The precursor-macromolecule relationship is:
  - Monosaccharide–polysaccharide (or oligosaccharide)
- Carbohydrates are everywhere (ubiquitous) and versatile in function; fulfill a variety of functions.
  - Can be covalently linked with proteins and lipids; are intimately involved in nucleic acids

	ROLES	Monosacc.	Polysacc.
1.	Energy source/storage	glucose, fructose, etc.	Starch, glycogen
2.	Structure	glucose, glycerol	Cellulose, chitin, lipids
3.	Information	ribose (nucleotides)	Nucleic acids
4.	Recognition	many	Glycolipids & glycoproteins

Carbohydrates

Monosaccharides

- Basic nomenclature:
  - Use the suffix "-ose" — triose, tetrose, pentose, hexose
  - Aldehyde & ketone functions solve problem of a "carbo-hydrate"



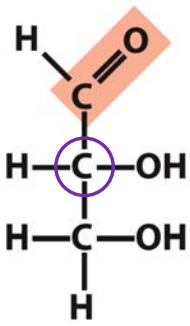
OK, we know enough chemistry to draw a carbon-hydrate!

What's wrong with this structure?

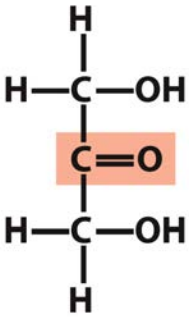
Carbohydrates

Monosaccharides

- An aldose is a carbohydrate with aldehyde functionality.
- A ketose is a carbohydrate with ketone functionality.



Glyceraldehyde, an aldotriose



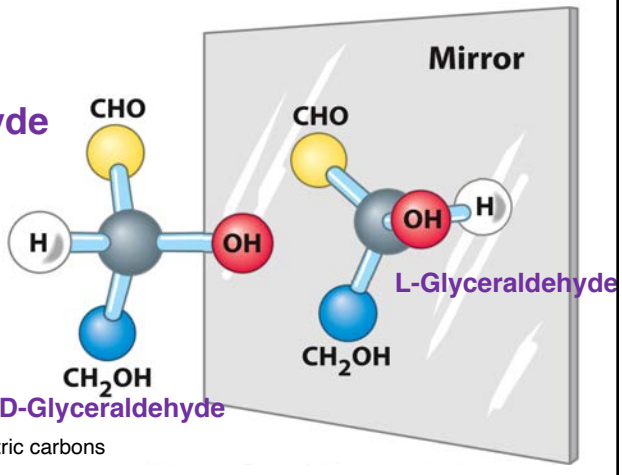
Dihydroxyacetone, a ketotriose

Are there any chiral carbons?

Carbohydrates

Monosaccharides

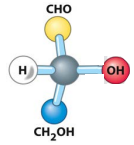
Glyceraldehyde

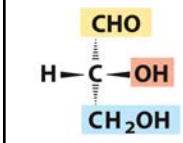


- Chemical Features:
  - Chirality
    - One or more asymmetric carbons
    - Linear and ring forms
  - Derivatives: the chemistry of carbohydrates
  - Polymerization
    - The Glycosidic Bond
    - Non-covalent bonds in macro-molecular structure

Carbohydrates

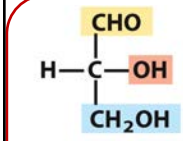
Monosaccharides





D-Glyceraldehyde

Perspective formulas



D-Glyceraldehyde

Fischer projection formulas

Fischer projections

- Vertical bonds are between carbons, with highest oxidation state at the top, AND project away from you.
- Horizontal bonds are pointing toward you.
- If hydroxyl is on the left; its **L**
- If hydroxyl is on the right; its **D**
- Here D=R & L=S

It turns out that the L form of glyceraldehyde is called L because it is "levorotary," meaning it will rotate plane-polarized light to the left, or counter-clockwise. D rotates "dextrorotary."

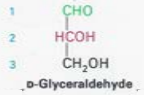
Carbohydrates

Nearly all sugars in biology are "D" (sort of like most amino acids are "L").

As you go to tetrose, pentose, etc., you are adding more chiral carbons.

A D- or L-sugar is defined by the chirality of the highest numbered carbon.

Another complete set of 15 L-aldoses exist, and are enantiomers of their D-aldose relatives shown here.



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