Chapter 22  Carbohydrates

碳水化合物
22.1 Introduction
Carbohydrates

Carbohydrates are everywhere in nature. They occur in every living organism and are essential to life.

The word carbohydrate derives historically from the fact that glucose, has the molecular formula \( C_6H_{12}O_6 \) and was originally thought to be a “hydrate of carbon”, \( C_6(H_2O)_6 \).

Simple carbohydrates are also known as sugars or saccharides, and the ending of the names of most of sugars is –ose.
22.1A Classification of Carbohydrates

Carbohydrates are usually defined as polyhydroxy aldehydes and ketones or substances that hydrolyze to yield polyhydroxy aldehydes and ketones.

- **Carbohydrates**
  - **Monosaccharides** (The simplest carbohydrates)
  - **Oligosaccharides** (2-10 Monosaccharides)
  - **Polysaccharides** (>10 Monosaccharides)
22.1B Photosynthesis and Carbohydrates

Metabolism

- Carbohydrates are synthesized in green plants by photosynthesis.
- Carbohydrates act as the chemical intermediaries by which solar energy is stored and used to support life.

\[ \text{Light} \rightarrow \text{Photosynthesis} \]

\[ \text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2 \]

Starch, Cellulose
22.2 Monosaccharides

单糖
22.2A Classification of Monosaccharides

- The number of carbon atoms present in the molecule.
- Whether they contain an aldehyde or keto group.

Monosaccharides

- Aldoses
  - Aldopentoses (戊醛糖)
  - Aldohexoses (己醛糖)
- Ketoses
  - Ketopentoses (戊酮糖)
  - Ketohexoses (己酮糖)
22.2B D and L Designations of Monosaccharides

D-Glyceraldehyde

D-Ribose

D-Glucose

D-Fructose
**D,L Sugars**

- **L-Glyceraldehyde**
  - Formula: CHO\(\text{HO} \text{HO} \text{HO} \text{H} \text{CH}_2\text{OH}\)

- **L-Glucose**
  - Formula: CHO\(\text{HO} \text{HO} \text{HO} \text{H} \text{CH}_2\text{OH}\)

- **D-Glucose**
  - Formula: CHO\(\text{H} \text{OH} \text{HO} \text{HO} \text{H} \text{CH}_2\text{OH}\)

- **S-(−)-Glyceraldehyde**
  - Formula: CHO\(\text{HO} \text{HO} \text{HO} \text{H} \text{CH}_2\text{OH}\)
The carbonyl carbon is always placed either at the top or near the top when showing the Fischer projection of a carbohydrate.
Configurations of Aldoses

D-Glyceraldehyde

D-甘油醛

D-Erythrose

D-赤藓糖

D-Threose

D-苏阿糖
Configurations of Aldopentoses

D-Ribose
D-Arabinose
D-Xylose
D-Lyxose
Configurations of Aldohexoses

D-Allose

D-Altrose

D-Glucose

D-Mannose

D-Gulose

D-Idose

D-Galactose

D-Talose