

Carbohydrate

Presented by

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Carbohydrates

Carbohydrates are broadly defined as polyhydroxy aldehydes or ketones and their derivatives or as substances that yields one of these compounds

- Composed of carbon, hydrogen, and oxygen
- Functional groups present include hydroxyl groups
- -ose indicates sugar



Carbohydrates contained in foods such as pasta and bread provide energy for the body.

Carbohydrates are the most abundant of all the organic compounds in nature.

- In plants, energy from the Sun is used to convert carbon dioxide and water into the carbohydrate glucose.
- Many of the glucose molecules are made into long-chain polymers of starch that store energy.
- About 65% of the foods in our diet consist of carbohydrates.
- Each day we utilize carbohydrates in foods such as bread, pasta, potatoes, and rice.
- Other carbohydrates called disaccharides include sucrose (table sugar) and lactose in milk.
- During digestion and cellular metabolism, carbohydrates are converted into glucose,
- which is oxidized further in our cells to provide our bodies with energy and to provide the cells with carbon atoms for building molecules of protein, lipids, and nucleic acids.
- In plants, a polymer of glucose called cellulose builds the structural framework. Cellulose has other important uses, too.
- The wood in our furniture, the pages in your notebook, and the cotton in our clothing are made of cellulose.

Classification of Carbohydrates


- Carbohydrates are classified according to the number of subunits that make them up

3 Types of Carbohydrates

- Monosaccharides
- Oligosaccharides

- Polysaccharides

Disaccharides
Trisaccharides
Tetrasaccharides



Monosaccharides are simple sugars, or the compounds which possess a free aldehyde (CHO) or ketone (C=O) group and two or more hydroxyl (OH) groups. They are the simplest sugars and cannot be hydrolysed further into smaller units.

Monosaccharides contain a single carbon chain and are classified on the basis of number of carbon atoms they possess, and as aldoses or ketoses depending upon their groups.

Monosaccharides

Classification by Carbon Atoms

Sugar	Structure formula	Aldoses	Ketoses
1. Triose	$C_3H_6O_3$	Glyceraldehydes	Dehydroxy acetone
2. Tetroses	$C_4H_8O_4$	Erythrose, Threose	Erthrulose
3. Pentoses	$C_5H_{10}O_5$	Xylose Ribose Arabinose	Ribulose
4. Hexoses	$C_6H_{12}O_6$	Glucose Galactose Mannose	Fructose

Oligosaccharides

These are *compound sugars* that yield 2 to 10 molecules of the same or different monosaccharides on hydrolysis. Accordingly, an oligosaccharide yielding 2 molecules of monosaccharide on hydrolysis is designated as a disaccharide, and the one yielding 3 molecules of monosaccharide as a trisaccharide and so on.

Disaccharides – Sucrose, Lactose, Maltose, Cellobiose, Trehalose, Gentiobiose, Melibiose

Trisaccharides – Rhamnose, Gentianose, Raffinose (= Melitose), Rabinose, Melezitose

Tetrasaccharides – Stachyose, Scorodose

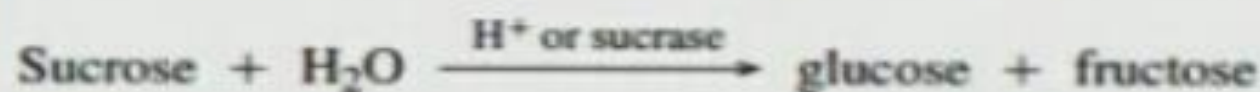
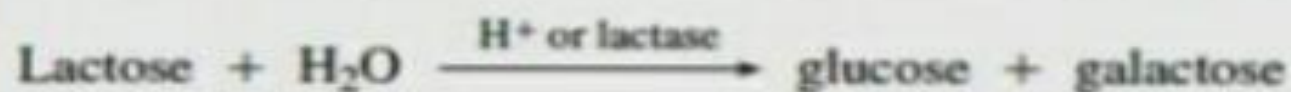
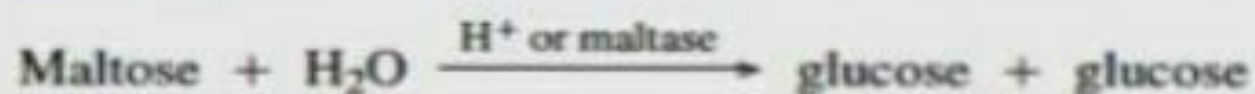
Pentasaccharide – Verbascose

The molecular composition of the 3 legume oligosaccharides (viz., raffinose, stachyose and verbascose) is shown below :

α -Galactose (1-6) α -Glucose (1-2) β -Fructose Raffinose

α -Galactose (1-6) α -Galactose (1-6) α -Glucose (1-2) β -Fructose Stachyose

α -Galactose (1-6) α -Galactose (1-6) α -Galactose (1-6) α -Glucose (1-2) β -Fructose Verbascose



Polysaccharides

Containing 10 or more monosaccharide units attached together

- Examples

1. Starch- digestible
2. Glycogen- digestible
3. Fiber- indigestible

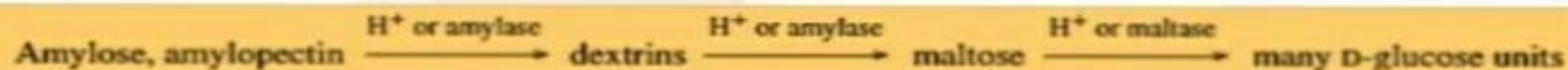
Long chains of glucose units form these polysaccharides

- Cellulose gives structure to plants, fiber to our diet
- Glycogen is an energy storage sugar produced by animals
- Liver cells synthesize glycogen after a meal to maintain blood glucose levels

A great majority of carbohydrates of nature occur as polysaccharides

Chemically, the polysaccharides may be distinguished into **homopolysaccharides**, which yield, on hydrolysis, a single monosaccharide and **heteropolysaccharides**, which produce a mixture of monosaccharides on hydrolysis. Based on their functional aspect, the polysaccharides may be grouped under two heads :

- (a) **Nutrient (or digestible) polysaccharides.** These act as metabolic reserve of monosaccharides in plants and animals, *e.g.*, starch, glycogen and inulin.
- (b) **Structural (or indigestible) polysaccharides.** These serve as rigid mechanical structures in plants and animals, *e.g.*, cellulose, pectin and chitin and also hyaluronic acid and chondroitin.



Types of Polysaccharides

1. Starch

- The major digestible polysaccharide in our diet.
- The storage form of carbohydrate in plants.
- Sources: Wheat, rice, corn, rye, barley, potatoes, tubers, yams, etc.
- Two types of plant starch:
 1. Amylose
 2. Amylopectin

Types of Polysaccharides

2. **Cellulose** - form cell walls in plant cells
- also called fiber or ruffage
 - indigestible by humans

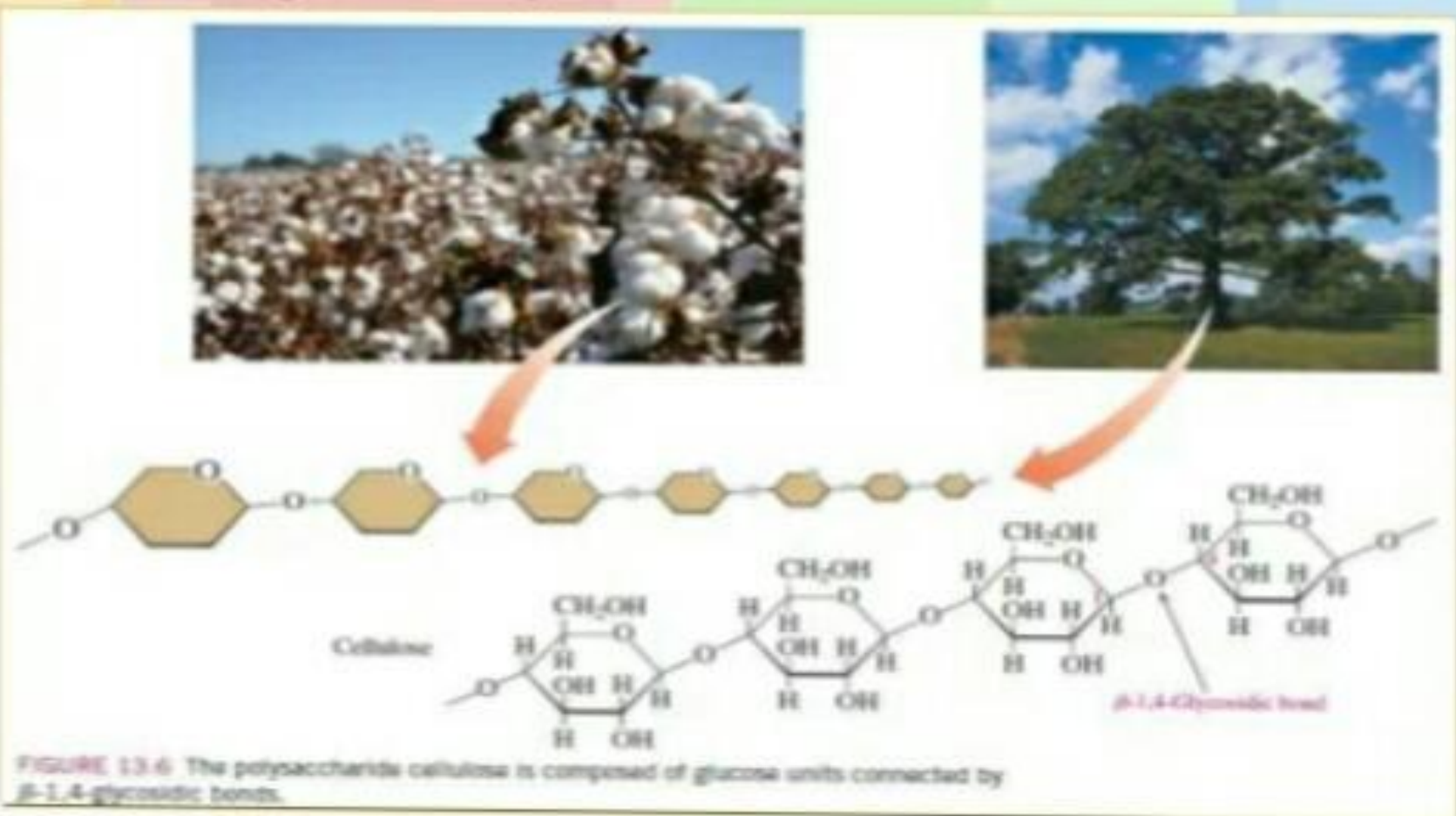
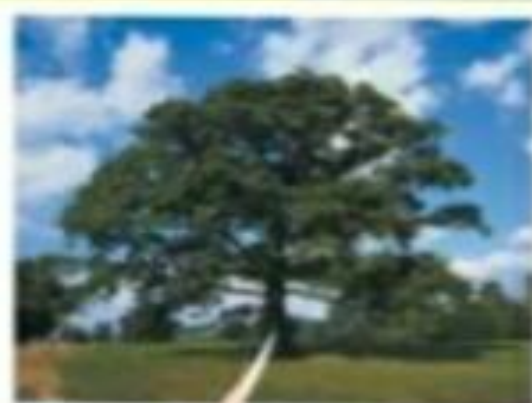
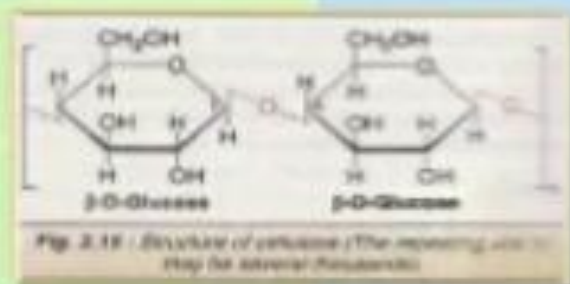


FIGURE 13.6 The polysaccharide cellulose is composed of glucose units connected by β -1,4-glycosidic bonds.



Types of Polysaccharides

3. Glycogen

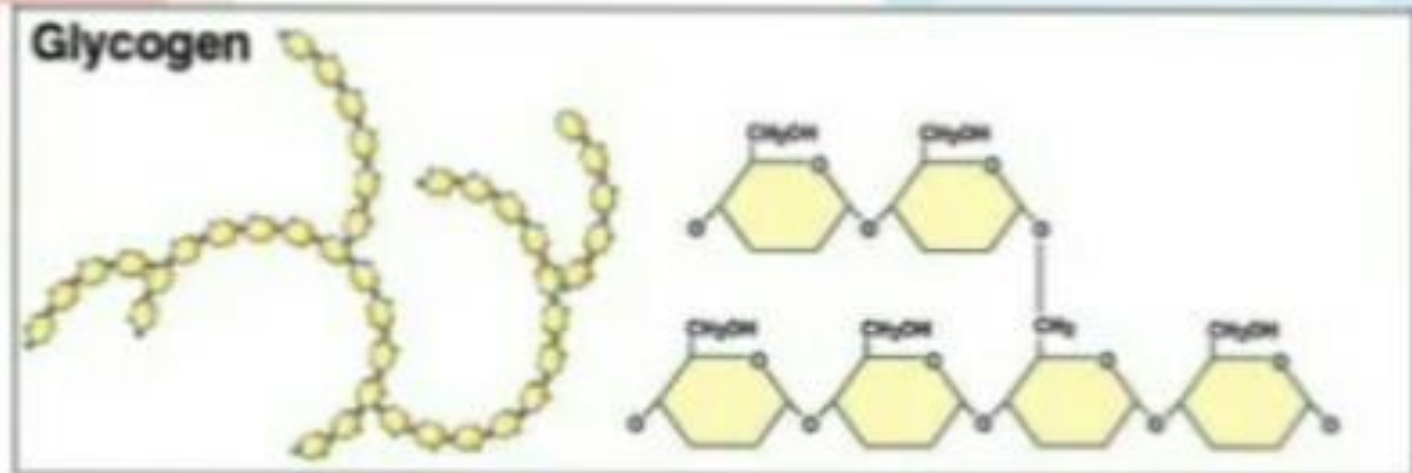
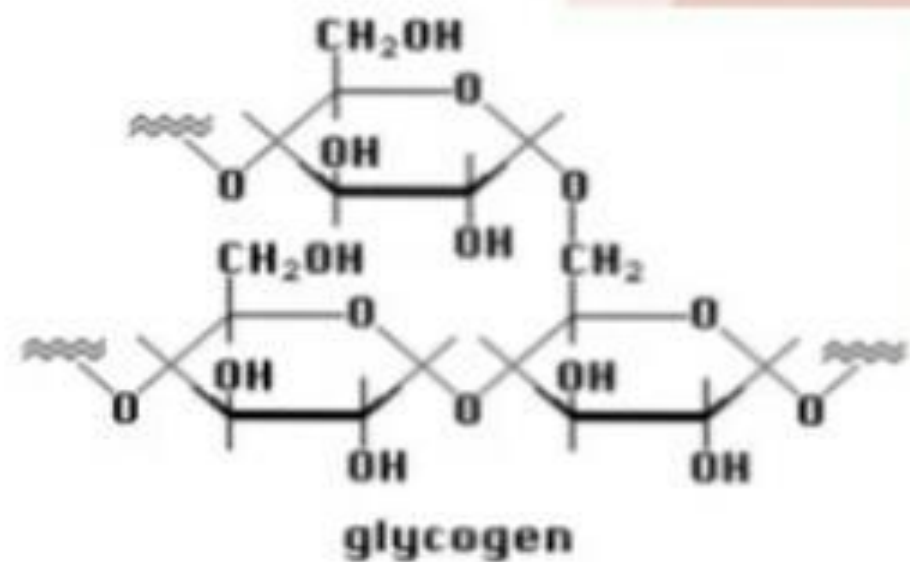
The storage form of glucose in the body.

Stored in the liver and muscles.

Found in tiny amounts in meat sources.

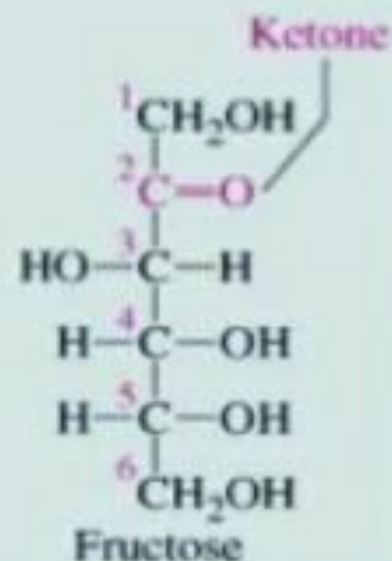
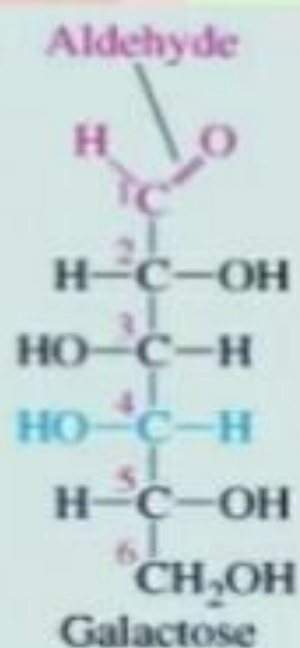
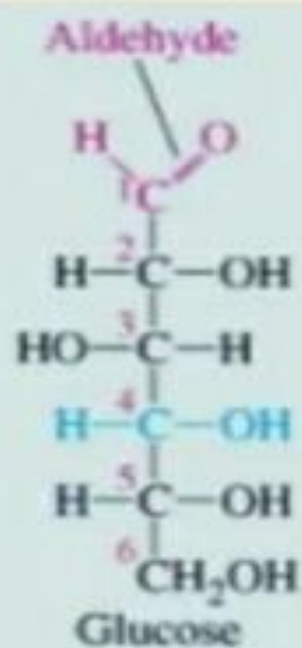
Not found in plants.

Not a significant food source of carbohydrate.



Function of Carbohydrates in Cells

- ✓ Major source of energy for the cell
- ✓ Major structural component of plant cell
- ✓ Immediate energy in the form of GLUCOSE
- ✓ Reserve or stored energy in the form of GLYCOGEN





Thank You!