Biomolecules — Carbohydrates: Structure and Functions

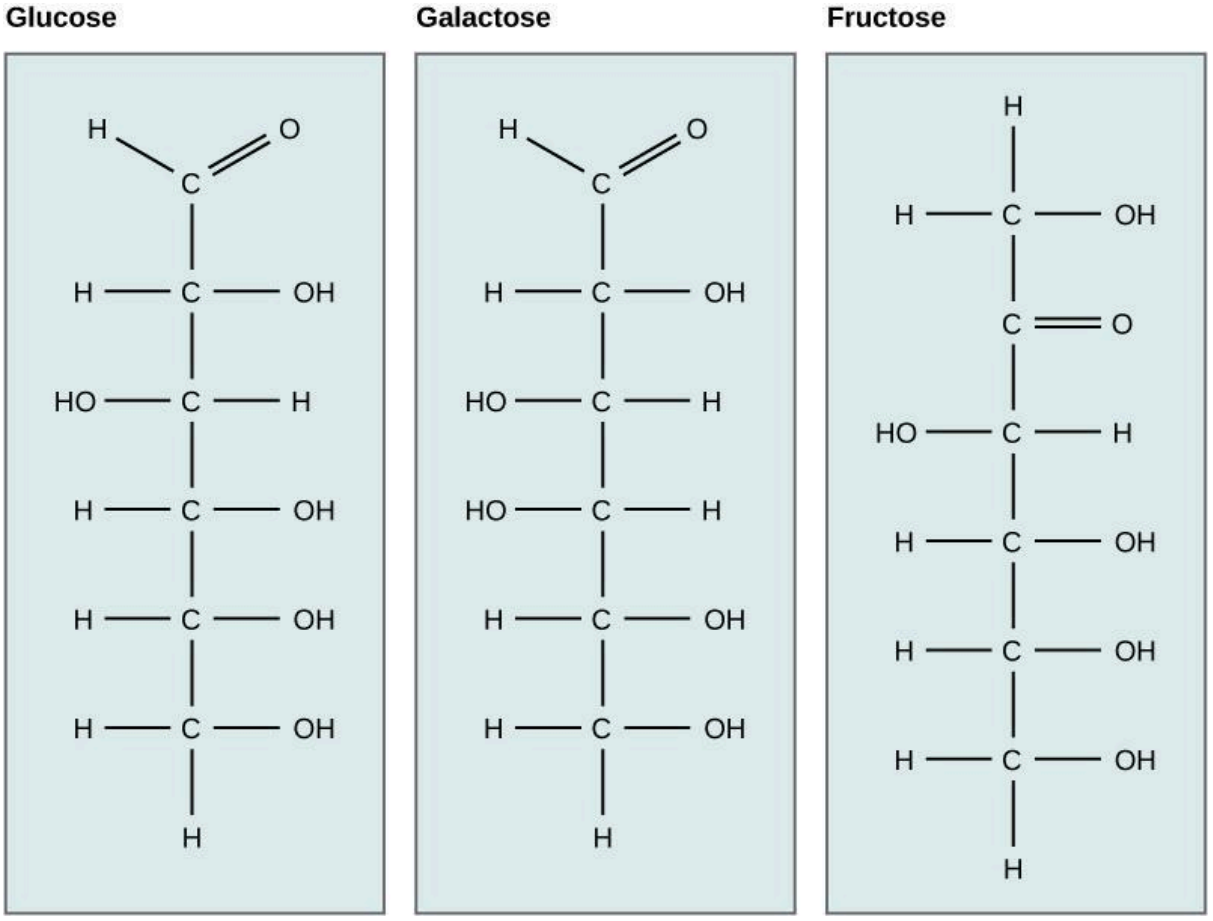
NEET UG Biology | Chemical Constituents of Living Cells

1. Definition

Carbohydrates are organic compounds made primarily of carbon, hydrogen and oxygen. They include sugars, starch, glycogen and cellulose. They serve as energy sources, energy reserves and structural components of cells.

Many carbohydrates have the approximate formula $(CH_2O)_n$, although this is not true of all carbohydrates.

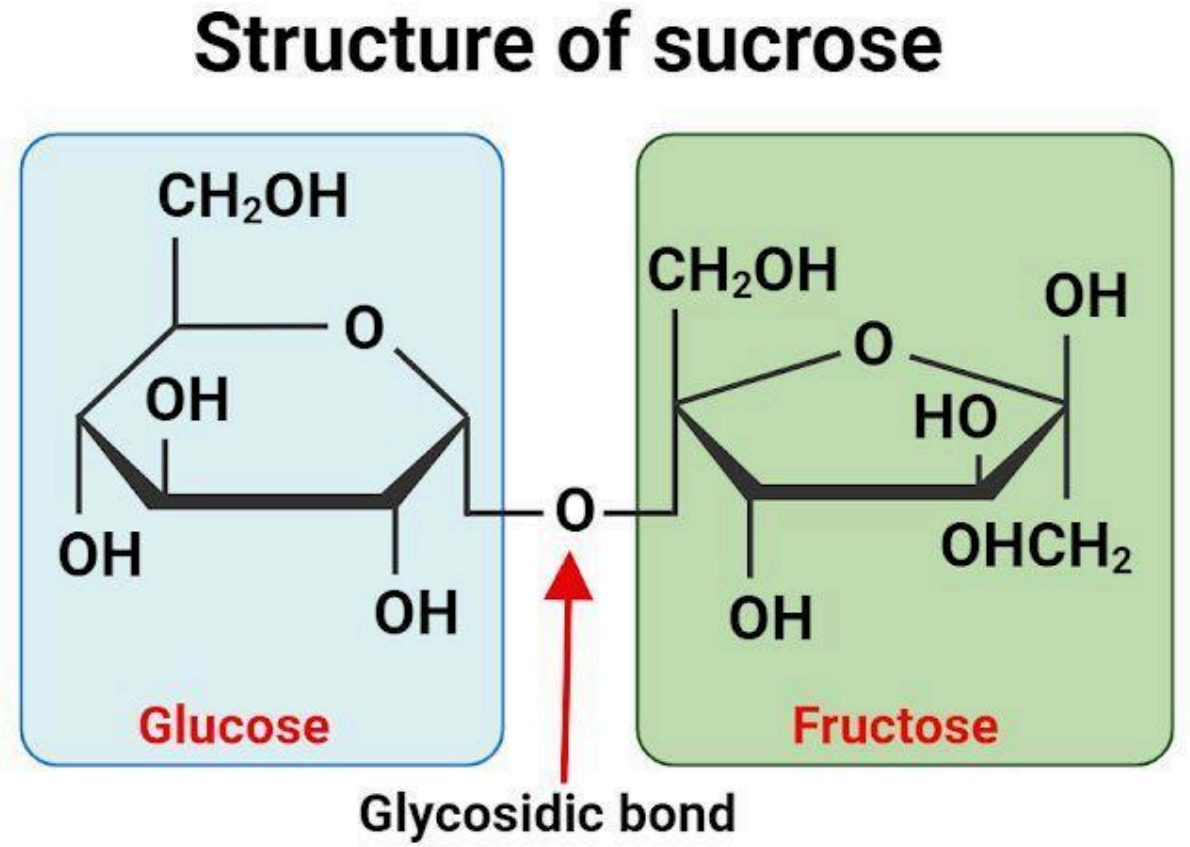
2. Classification of carbohydrates



A. Monosaccharides

The simplest carbohydrates; they cannot be hydrolysed into smaller carbohydrate units.

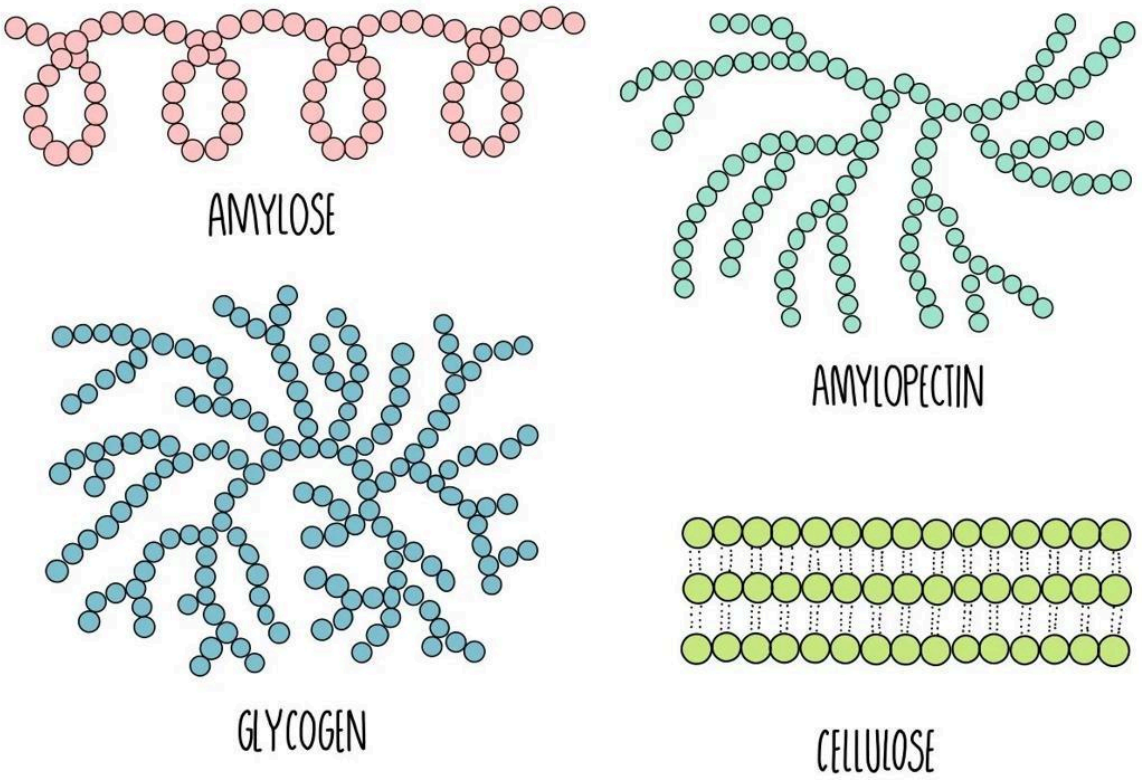
Examples: glucose, fructose, galactose and ribose.



B. Oligosaccharides

Contain a small number of monosaccharide units. Disaccharides are the most important examples for NEET.

Examples: sucrose, maltose and lactose.



C. Polysaccharides

Long chains of many monosaccharide units. They function in storage or structural support.

Examples: starch, glycogen, cellulose and chitin.

3. Monosaccharides — important examples

Monosaccharides are classified by the number of carbon atoms and by their functional group.

Monosaccharide	Carbon atoms	Type / importance
Ribose	5	Pentose; present in RNA

Deoxyribose	5	Pentose; present in DNA
Glucose	6	Aldohexose; major cellular fuel
Fructose	6	Ketohexose; found in fruits
Galactose	6	Component of lactose

- Aldoses contain an aldehyde group in their open-chain form, e.g. glucose.
- Ketoses contain a ketone group in their open-chain form, e.g. fructose.

In aqueous solution, glucose and fructose exist predominantly in cyclic forms.

4. Disaccharides

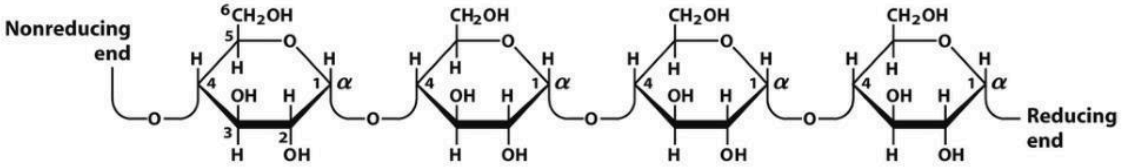
Disaccharides consist of two monosaccharides joined by a glycosidic bond, usually formed by a condensation reaction.

Disaccharide	Components	Common source
Sucrose	Glucose + fructose	Sugar cane, sugar beet
Maltose	Glucose + glucose	Starch digestion
Lactose	Glucose + galactose	Milk

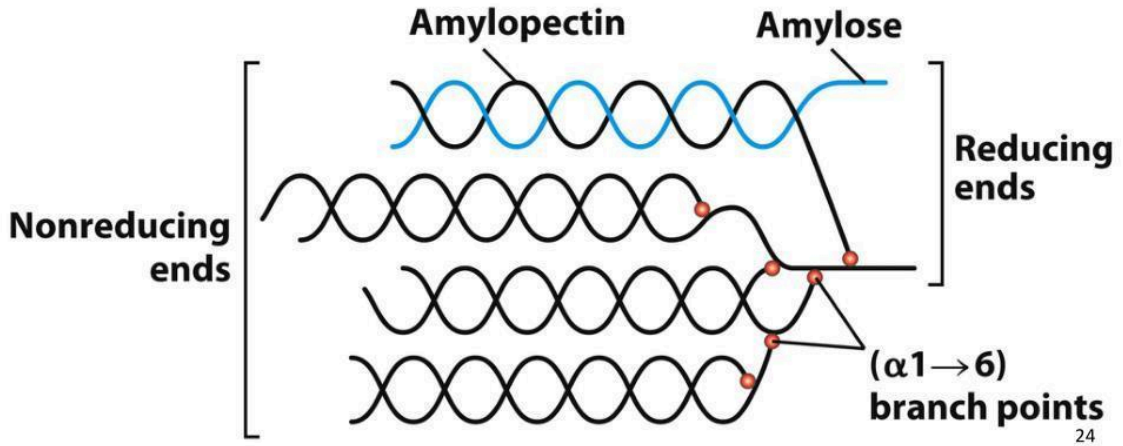
NEET point: Sucrose is a non-reducing sugar, whereas maltose and lactose are reducing sugars.

5. Polysaccharides — structure and functions

2. Storage Polysaccharides- Starch



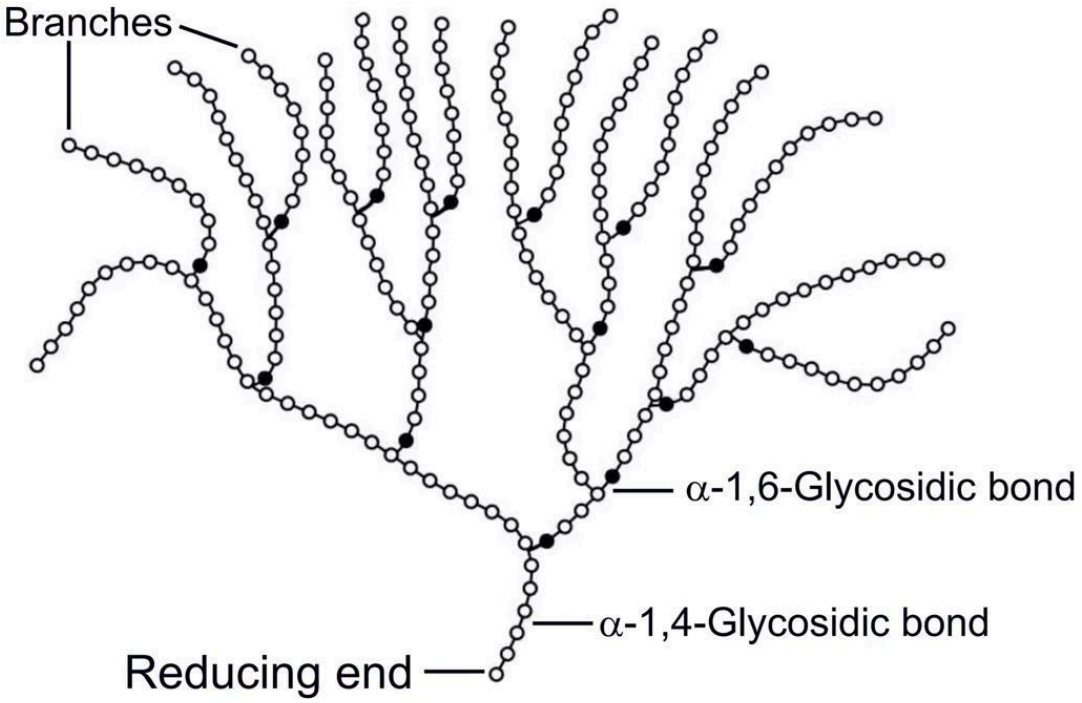
Amylose



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Starch

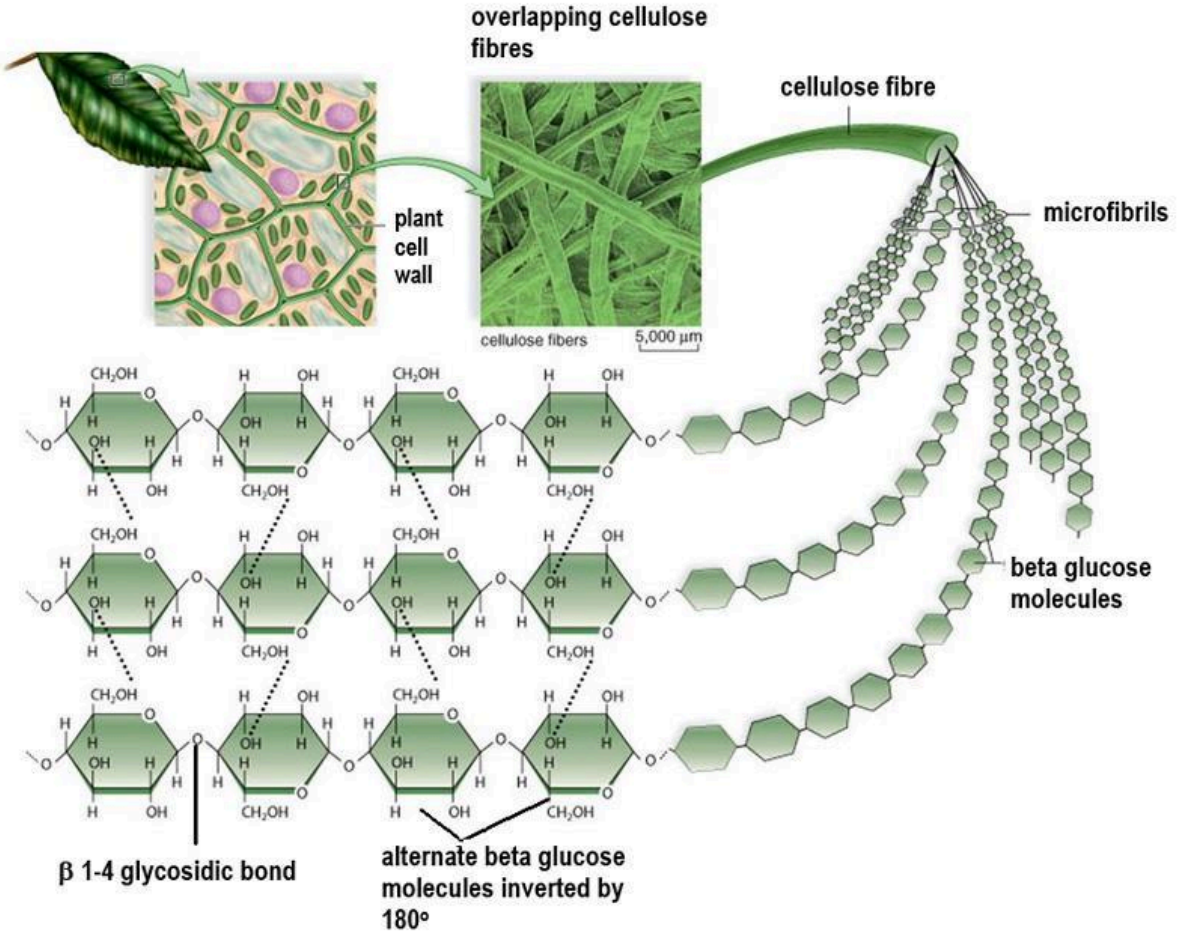
- Main storage carbohydrate in plants.
- Composed of α-glucose.
- Contains amylose (mostly unbranched) and amylopectin (branched).



Glycogen

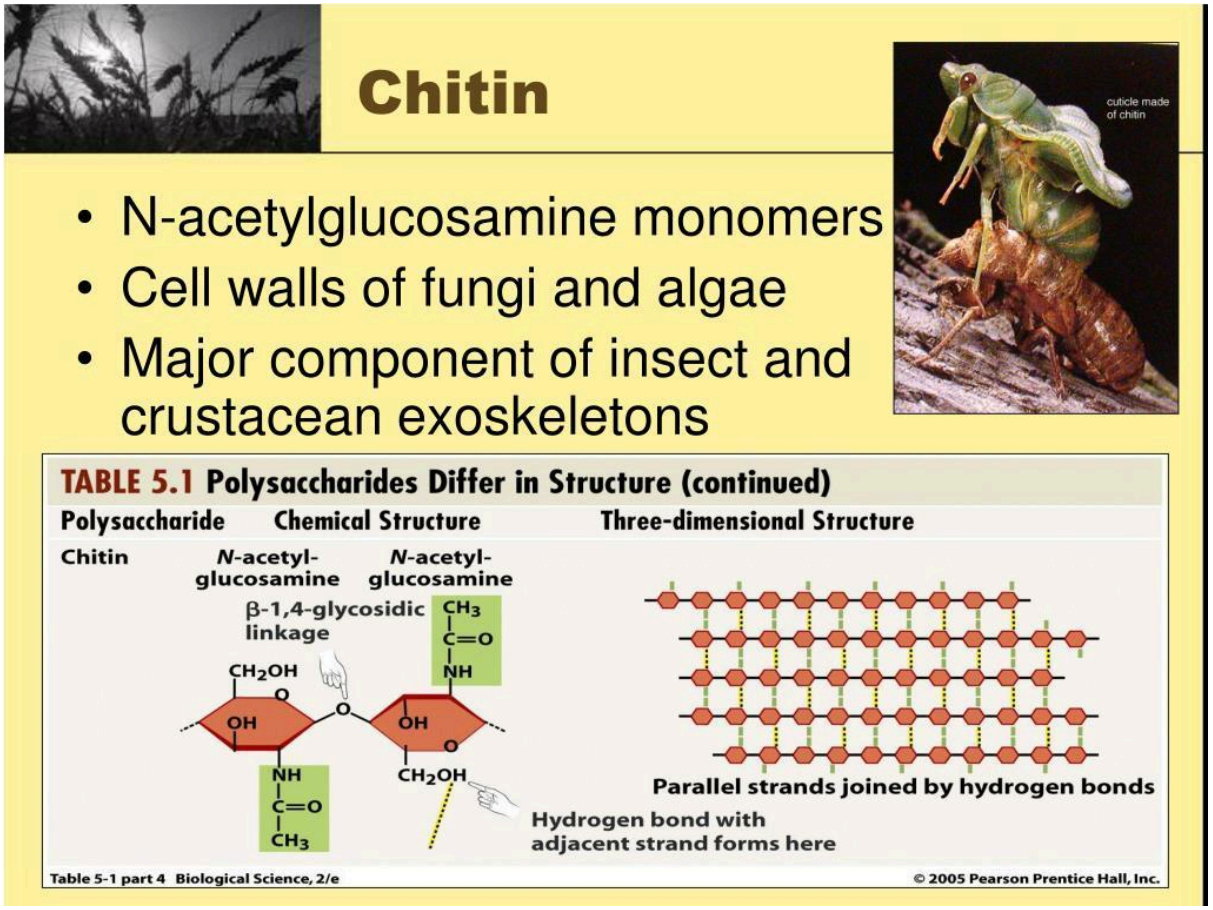
Glycogen

- Main storage carbohydrate in animals and fungi.
- Highly branched polymer of α-glucose.
- Stored especially in liver and skeletal muscle in humans.



Cellulose

- Structural component of plant cell walls.
- Made of β-glucose units joined by β(1→4) glycosidic bonds.
- Humans lack cellulase, so cellulose acts as dietary fibre.



Chitin

- Structural polysaccharide in arthropod exoskeletons and fungal cell walls.
- Composed of N-acetylglucosamine units.

6. Functions of carbohydrates

1. Energy source: Glucose is used in cellular respiration to produce ATP.
2. Energy storage: Starch in plants and glycogen in animals store glucose in polymeric form.
3. Structural support: Cellulose forms plant cell walls; chitin provides structural strength in fungi and arthropods.
4. Components of nucleic acids: Ribose occurs in RNA, while deoxyribose occurs in DNA.
5. Cell recognition: Carbohydrate chains on glycoproteins and glycolipids contribute to cell recognition and signalling.
6. Dietary fibre: Cellulose and other non-digestible carbohydrates support normal bowel function.

7. High-yield NEET comparison

Feature	Starch	Glycogen	Cellulose
Main role	Energy storage	Energy storage	Structural support
Found mainly in	Plants	Animals and fungi	Plant cell walls
Monomer	α-glucose	α-glucose	β-glucose
Branching	Amylose unbranched; amylopectin branched	Highly branched	Straight chains
Digested by humans?	Yes	Yes	Not by human enzymes

8. NEET practice MCQs

1. The main storage carbohydrate in animals is:

Cellulose
Starch
Glycogen
Chitin

2. Which sugar is a component of RNA?

Deoxyribose
Ribose
Fructose
Galactose

3. Cellulose is composed of repeating units of:

α-glucose
β-glucose
Fructose
Galactose

4. Which of the following is a non-reducing sugar?

Glucose
Maltose
Lactose
Sucrose

5. The principal structural carbohydrate of plant cell walls is:

Glycogen
Starch
Cellulose
Sucrose
Check answers

Quick revision: Glucose = energy; starch = plant storage; glycogen = animal storage; cellulose = plant cell wall; ribose = RNA; deoxyribose = DNA.