BIOL10008: ELITE [H1] STUDY RESOURCE

2023	Semester 1	BIOL10008	Introductory Biology: Life's Machinery	1	95	H1	First Class Honours	12.500

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Topic 2

Biological Macromolecules

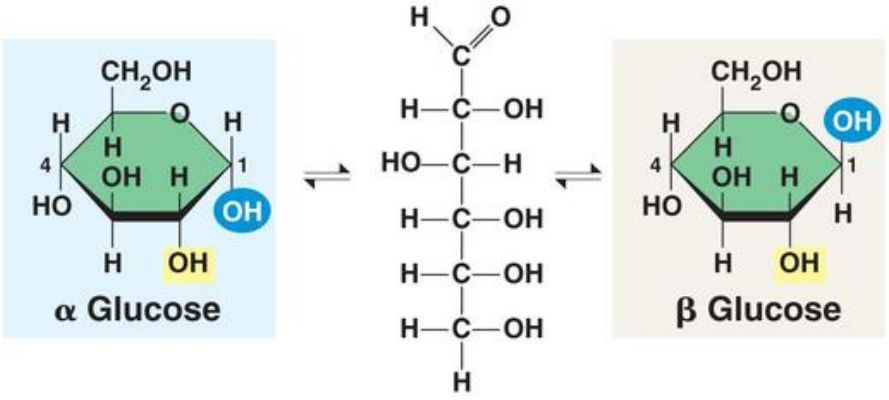
- **Carbohydrates**, **proteins**, **lipids** and **nucleic acids** are the main classes of macromolecule They are polymers (long chains consisting of repeating 'monomer' units)
- Macromolecules are usually produced by the body through **condensation reactions** where a covalent bond forms and a H_2O molecule is released
    - These reactions are also known as **dehydration reactions**

Carbohydrates

- Carbohydrates follow a general empirical formula of **$(CH_2O)_n$** for most simple sugars
- The presence of multiple **hydroxyl (-OH)** groups makes carbohydrates polar and generally soluble in water when the molecules are small
- Classification of carbohydrates depends on the total number of saccharide units within the molecule

Monosaccharides

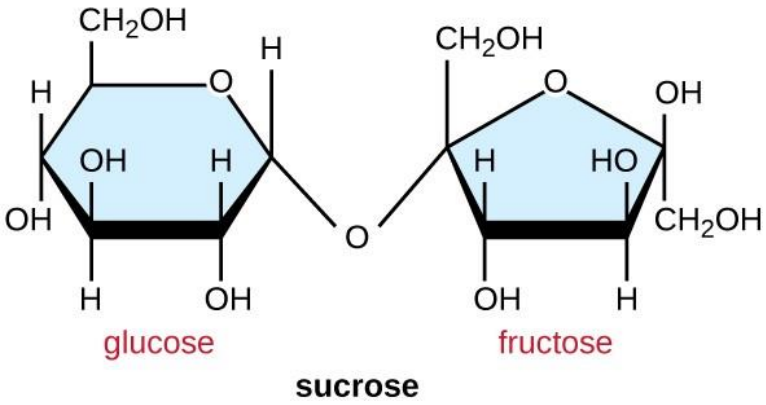
- Monosaccharides are single sugar units and represent the basic monomers for all carbohydrate polymers
- **Glucose** is a critical monosaccharide that acts as the primary fuel for cellular respiration and a building block for larger carbs
- In aqueous environments, most monosaccharides exist in ring forms
    - The ring can take an **α** or **β** configuration
    - This specific orientation dictates how polymers eventually form and how they behave



Disaccharides

- Disaccharides consist of two monosaccharides joined by a covalent linkage
- A **glycosidic bond** forms during a condensation reaction, creating an ether-like (C–O–C) bridge between sugars

- The specific properties of a disaccharide depend on which monomers are linked and whether the bond is an α or β linkage



sucrose

- **Polysaccharides**
  - Polysaccharides are long carbohydrate polymers linked by glycosidic bonds
  - Function is determined by monomer type, linkage type (α vs β), the length of the chain, and whether the chain is linear or branched
  - Polysaccharides are categorised by their use for either energy storage or structural support
    - Storage molecules use compact, digestible linkages
    - Structural molecules utilize strong, resistant linkages
- **Starch**
  - Starch is the primary energy-storage polysaccharide in plants and is composed entirely of glucose
  - The molecule is built using **α-glycosidic linkages**, resulting in shapes that are easily recognized by digestive enzymes
  - Enzymes like amylase efficiently hydrolyze these α-linkages to release glucose for respiration
  - Starch can be branched, which increases the number of available chain ends for enzymatic breakdown
    - Increased branching allows for faster glucose release
  - In food contexts, starch acts as a thickener or emulsifier because it swells and changes the viscosity of mixtures
- **Cellulose**
  - Cellulose is the most abundant polymer on Earth and serves as a primary structural component in plants
  - Unlike starch, cellulose is composed of **β-glucose** monomers held together by **β-1,4 glycosidic linkages**
  - The β-1,4 linkages force the molecule into straight, linear chains rather than coils