

Introduction to Nutrients

- Living organisms are made up of many non-living chemicals such as: carbohydrates, proteins, lipids, nucleic acids, vitamins and minerals.
- These **macromolecules** are mainly made up of carbon, oxygen and hydrogen, and sometimes with nitrogen.
- These elements are used and recycled constantly from the surrounding environment, and are altered inside your cells. At one time or another, the molecules in your body could have been used by the person next to you.
 - **Example:** The Mitochondria will use the oxygen you breathe to break the bonds in sugar which will produce usable energy, carbon dioxide and water.

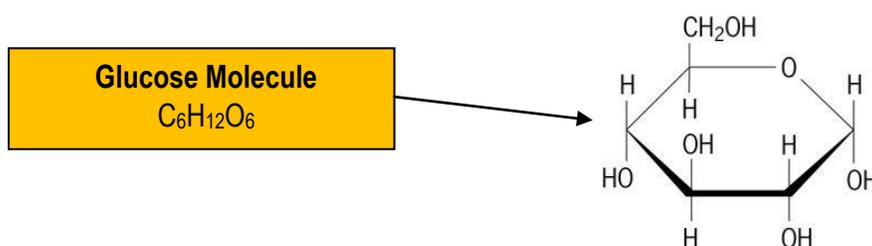
Carbohydrates

- Carbohydrates are the most abundant class of organic compounds and most important source of energy found in living organisms.
- Carbo – “Carbon” hydrate – “water”
- They are a group of organic compounds that consists primarily of carbon, oxygen and hydrogen
- General formula is $(\text{CH}_2\text{O})_n$
- They originate as products of photosynthesis from green plants.
- As part of your diet, the carbohydrate is important for your body as a source of energy and as building materials for cells.
- Carbohydrates are found in foods like: breads, potatoes, beans, fruits, and peas.
- There are three main categories of carbohydrates:

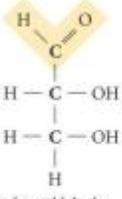
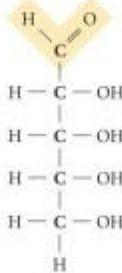
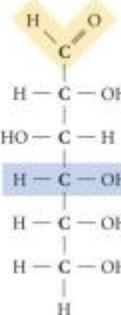
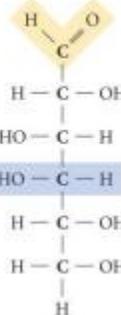
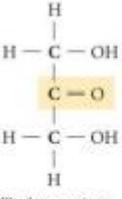
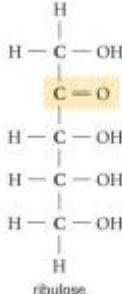
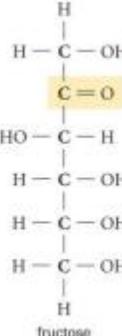


a. Monosaccharides: (Simple Carbohydrates)

- Mono – “one” saccharide – “sugar”
- These carbs are a single sugar molecule.
- Plants produce Glucose ($\text{C}_6\text{H}_{12}\text{O}_6$) in photosynthesis and it is considered to be the simplest sugar. Other examples are fructose and deoxyribose.
- Simple carbohydrates are absorbed into your blood much faster, and while they provide some really quick energy, many foods with them may have lots of fat and lack important vitamins that your body needs.
- Fruits like apples, bananas, grapes, and raisins contain simple sugars. Other sources of simple sugars are candy, pop, and chocolates.



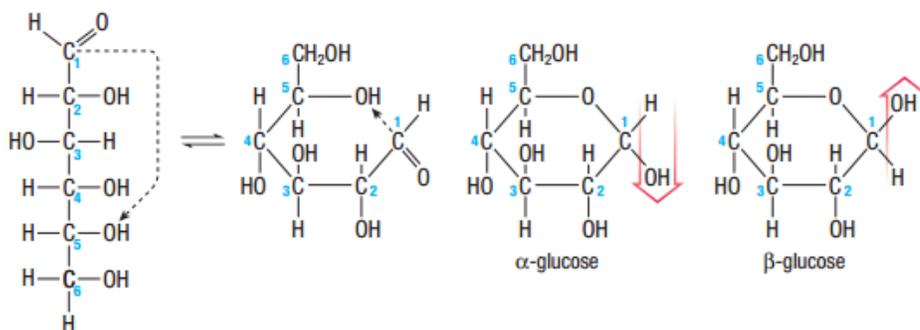
Monosaccharides that contain three (3) carbons (triose), five (5) carbons (pentose), and six (6) carbons (hexose) are the most common in living organisms.

	Triose sugars (3-carbon)	Pentose sugars (5-carbon)	Hexose sugars (6-carbon)	
Aldoses	 <p>glyceraldehyde</p>	 <p>ribose</p>	 <p>glucose</p>	 <p>galactose</p>
Ketoses	 <p>dihydroxyacetone</p>	 <p>ribulose</p>	 <p>fructose</p>	

Glucose is a **linear molecule**, but **in the presence of water it forms a ringed molecule** as functional groups (hydroxyl and carbonyl) from the molecule interact. When glucose forms a ring there are two possible arrangements created when the -OH group attached to the carbon at position 1:

α - glucose β- glucose

Isomer – is a molecule that has the same composition as another, but a different arrangement of atoms.



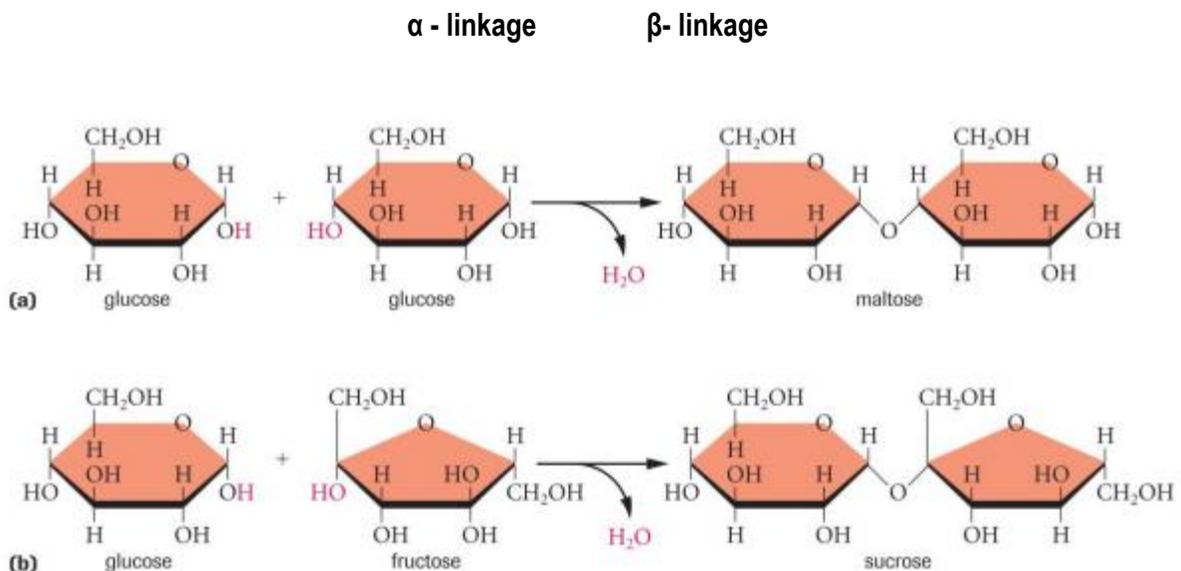
The different arrangement of the hydroxyl (-OH) group on glucose can give chemicals different properties. Ex: humans can easily digest starches composed of **α - glucose**. However, cellulose, assembled from **β- glucose**, is completely indigestible for humans.

b. **Disaccharides: (Simple Carbohydrates)**

- Di – “two” saccharide – “sugar”
- These molecules contain two simple sugar molecules attached **covalent** bond.
- All Disaccharides are formed by a process called **Dehydration synthesis**
- Some common disaccharides:
 - Maltose: 2 α - glucose molecules
 - Lactose: β - glucose and galactose molecules (milk sugar)
 - Sucrose: α - glucose and fructose molecules

Glycosidic bond - is a bond between two monosaccharides

A linkage is determined by the orientation of the –OH group, to the carbon position 1 (1 – carbon).

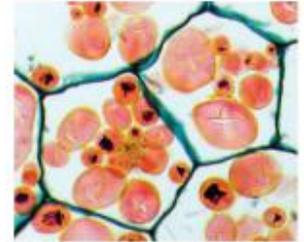
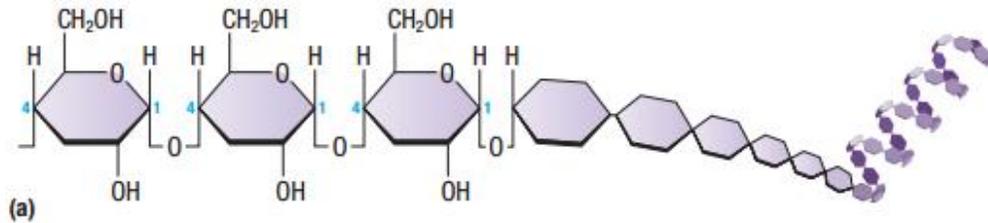


c. **Polysaccharides: (Complex Carbohydrates)**

- Poly – “many” saccharide – “sugar”
- These carbs are made up of many sugar molecules are assembled by covalent linkage of smaller subunits into large branching chains.
- Some complex carbohydrates are important for:
 - Energy storage in cells
 - structural support

Starch (Amylose)

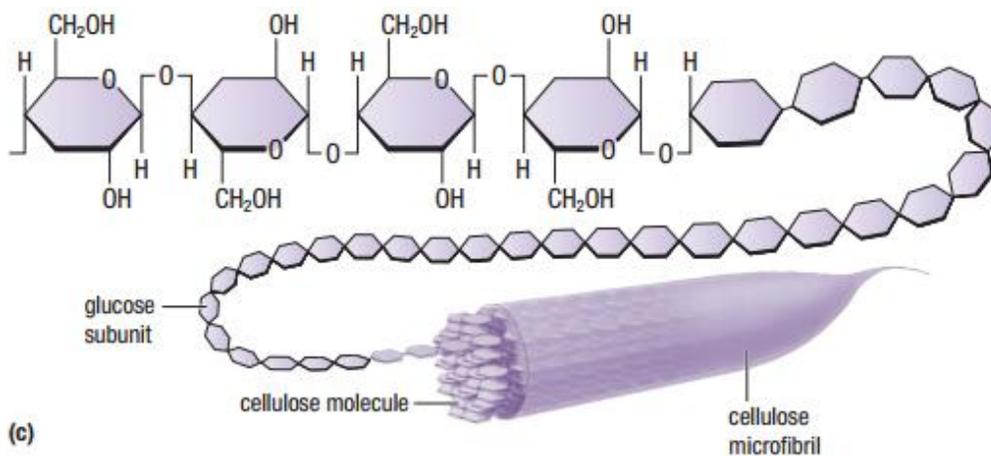
- a large carbohydrate molecule used by plants to **store energy**.
- Starches can have between 2000-6000 glucose molecules.
- Starches are found in wheat, potatoes, and rice.



Amylose grains (stained with a purple dye) in plant root tissue

Cellulose

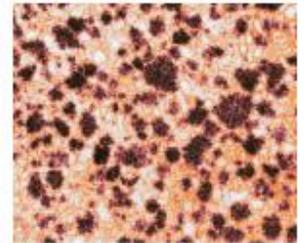
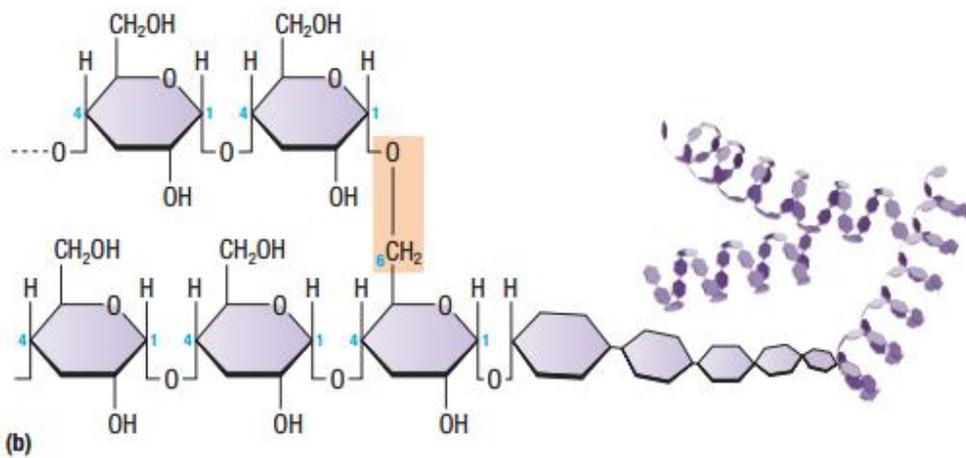
- main component of the plant cell wall assembled from hundreds or thousands of glucose molecules.
- Long and straight chains with a large number of -OH groups which enable cellulose to assemble side by side and form hundreds of hydrogen bonds. These numerous bonds are what give cellulose fibers great strength.
- Has more of **structural role** of plant cells rather than energy storage.
- Cellulose is more commonly known as “**FIBRE**”



Cellulose microfibrils in plant cell wall

Glycogen

- A large carbohydrate molecule use by animals to store energy
- All unused, excess sugar transported by the blood are linked together to for a glycogen molecule for later use.
- When glucose level begin to drop in the blood, glycogen can then breakdown, by way of **Hydrolysis**, into individual glucose units



Glycogen particles (stained with a magenta dye) in liver cell

- Complex carbohydrates take longer to be digested, so your body needs more time to release these carbs into your blood as glucose.
- These are better when you are exercising because they will give you energy that is long lasting.
- They are also healthier than simple carbs because they usually come with lots of vitamins and minerals your body needs.
- Commonly found in foods like:
 - bread,
 - noodles,
 - rice,
 - grains,
 - vegetables (corn, potatoes, sweet potatoes, tomatoes, carrots, cucumbers, lettuce, and peppers).