Lecture 2 –*Carbohydrates*

Sources of CHOs

- Wholegrains –major dietary intake
- Vegetables, legumes ad fruit contain dietary fibre
- Milk products provide lactose –essential for infants

Glycogen is a storage carbohydrate, providing about half of the bodies use (other half mostly from fats).

Simple Carbohydrates

Monosaccharides-

-are single ring sugars (approx. 118 naturally occurring)

Majority are 6-membered ring structures

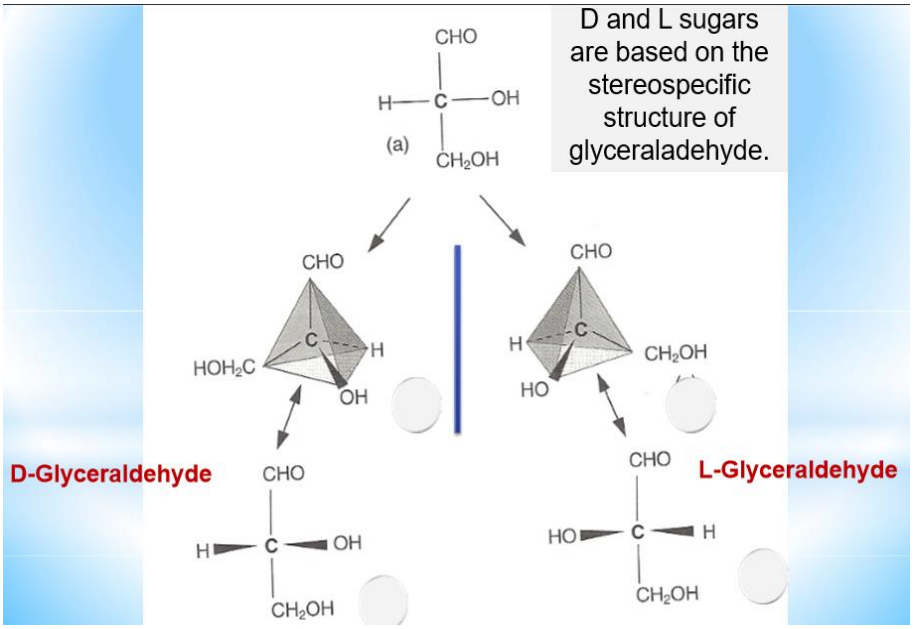
Glucose: an essential energy source

Fructose: the sweetest sugar and naturally occurring honey and fruit

Mannose: occurs in small amounts in some fruits

Galactose: rarely in the form as a single ring (usually bonded)

D and L Sugar Configuration

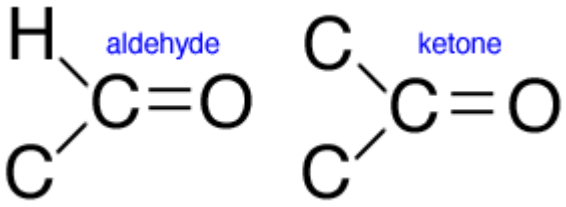


Stereoisomers (non-superimposable mirror images).

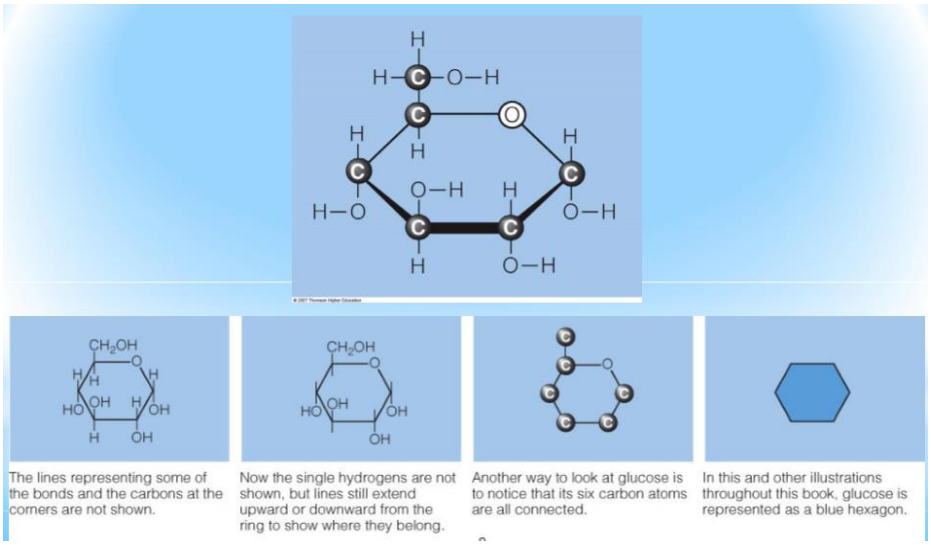
Majority of food products are in the form of **D**-glyceraldehyde.

L-Glyceraldehyde contains OH group attached on the left side of the anomeric/chiral carbon atom.

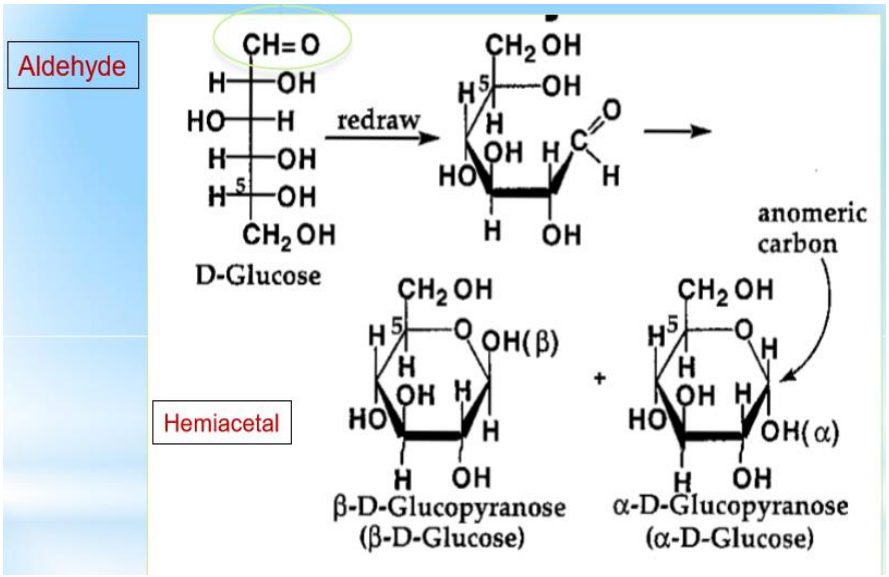
- Aldo sugars contain an aldehyde group
- Keto sugars contain a ketone group



Haworth Projections



Glucose –Fischer Projection



Glucose is a **hexose** and a **D-Glyceraldehyde**

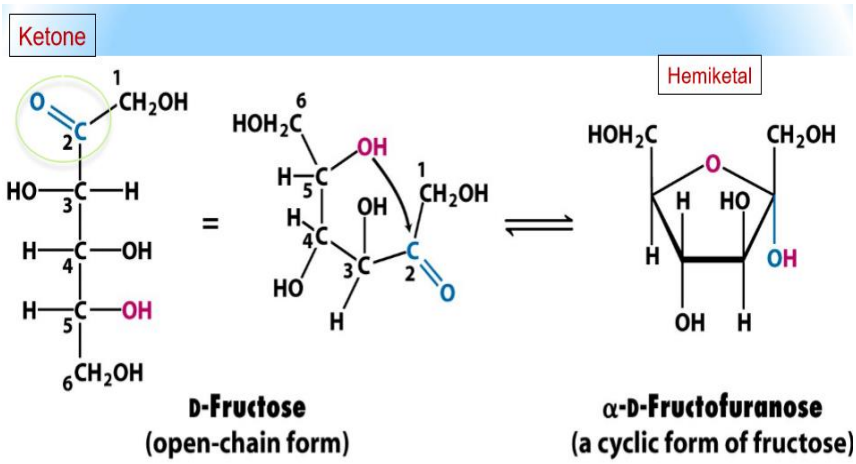
6 ring structure (**Pyranose**)

Hemiacetal not very stable (contains reducing anomeric carbon)

Beta: OH group on anomeric C point upwards cis with CH2OH group

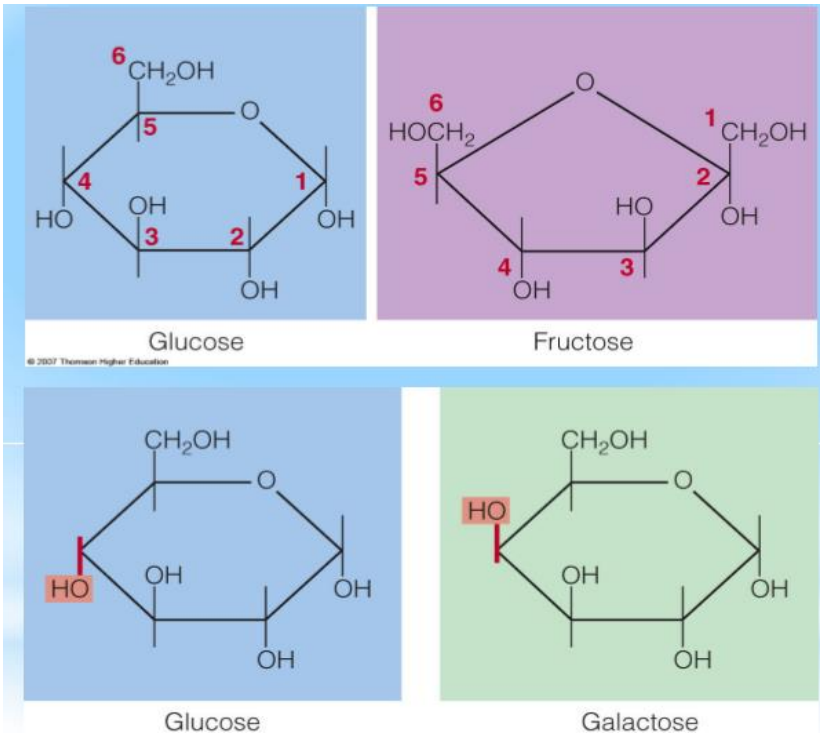
Alpha: OH group pointed axially downwards; *trans* to CH2OH

Fructose –Fischer Projection



Fructose is a hexose (6 C) and a D-Ketosugar; contains a ketone group

5 membered ring structure = Furanose



Disaccharides –pairs of monosaccharides

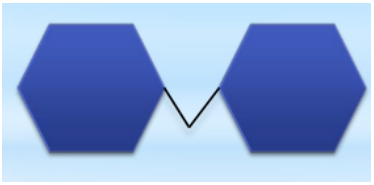
- One in the pair is always glucose
- Condensation reaction links together (H2O released)
- Hydrolysis splits (H2O used up)

Maltose: 2 glucose units; produced during germination of seeds

Malt sugar

Disaccharide derived from starch: in the intestine, starch digested by pancreatic amylase. Further digestion by maltase to form maltose (2 glucose molecules joined).

D-glucose and D-glucose linked by an alpha-(1, 4)-glycosidic bond.



Lactose: galactose and glucose; milk products.

Milk sugar

Digested by lactase

D-galactose and D-glucose joined by a beta-(1, 4)-glycosidic bond

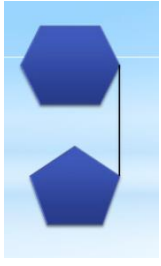
Sucrose: fructose and glucose; from sugar cane

Table sugar

Digested by sucrose

Bound via the anomeric carbons, hence, a non-reducing sugar.

Alpha D-glucose joined with beta D-fructose via an alpha-(1, 2)-glycosidic bond



Complex Carbohydrates

- Few (oligosaccharides) or many (polysaccharides) glucose units linked together in a straight or branched chain

Glycogen:

-storage form of glucose in the body

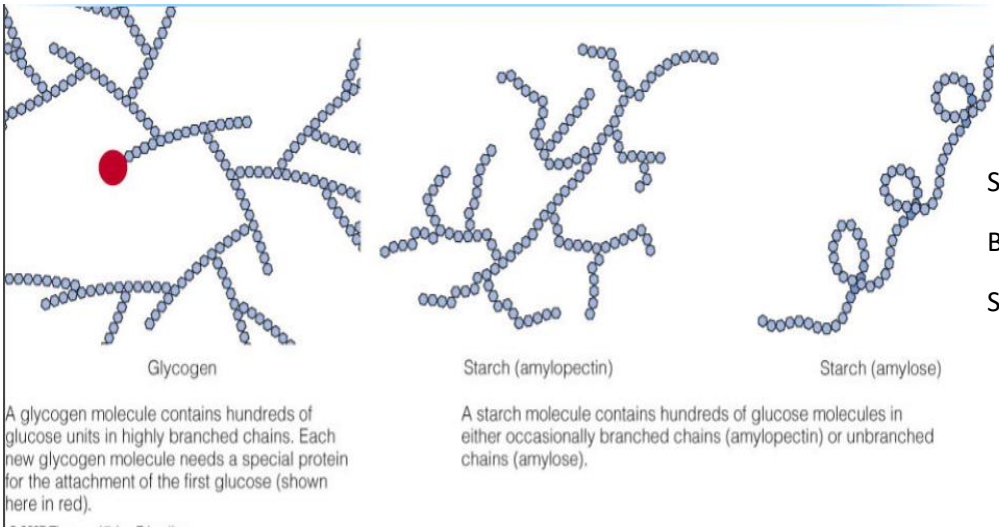
-can provide a rapid release of glucose for energy

Starch:

-storage form of glucose in plants

-Found in grains, tubers and legumes

-Major source of energy for the body



A glycogen molecule contains hundreds of glucose units in highly branched chains. Each new glycogen molecule needs a special protein for the attachment of the first glucose (shown here in red).

A starch molecule contains hundreds of glucose molecules in either occasionally branched chains (amylopectin) or unbranched chains (amylose).

Starch-

Branched and straight structure = amylopectin

Spiral structure = amylose

Definitions

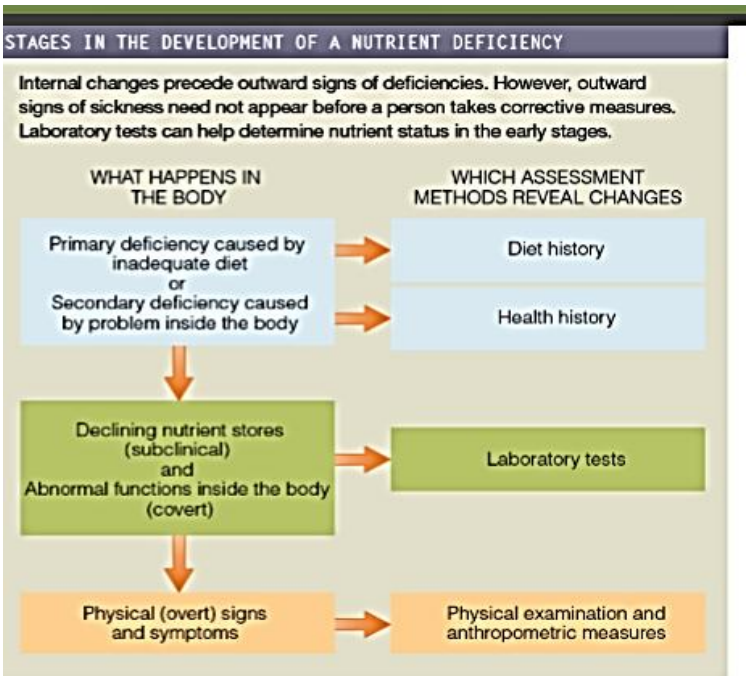
- **Estimated Average Requirement (EAR**): A daily nutrient level estimated to meet the requirements of half the healthy individuals.

- **Recommended Dietary Intake (RDI)**: The average daily dietary intake level sufficient to meet the nutrient requirements of nearly all healthy individuals in a particular life stage, gender group and population.

- **Adequate Intake (AI):** Used when an RDI cannot be determined. The average daily intake level based on observed or experimentally determined approximates of nutrient intake by a group that are assumed to be adequate.

- **Upper Level of Intake (UL)**: The highest average daily nutrient intake level likely to pose no adverse health effects to almost all individuals in the general population. As intake increases above the UL the risk of adverse effects increase.

  - Amount of the nutrient concertation is too much for the body to use –remaining is passed out of the body as waste.
  - RDI determined by plotting a distribution, use = mean + 2 x sd.
  - The RDI and AI are approximates only and in general there is a broad range around them that is generally sufficient and safe for most people
  - Intake of <u>water soluble</u> vitamins can be averaged over <u>several days</u> whilst intake of <u>fat soluble vitamins</u> can be averaged over <u>weeks.</u>
  - Under-nutrition = protein energy malnutrition (PEM)
  - Nutritional assessment
    - Diet history
    - Health status
    - SES
    - Physical exam.
    - Lab test



<u>Types of Risk factors</u>

- **Modifiable risk factors**: contributing to deaths - smoking, diet, physical inactivity, alcohol, overweight etc.
- **Non modifiable risk factors** - genetics, age, sex
- **Measurable risk factors (biomarkers)** - Blood pressure, plasma lipids, BMI, insulin resistance etc.

Lecture 3 –*Digestion, Absorption and Transport*

- Cells require a constant supply of nutrients