GLUCOSE

BY KRISTOPHER REMBERT M. MARIANO

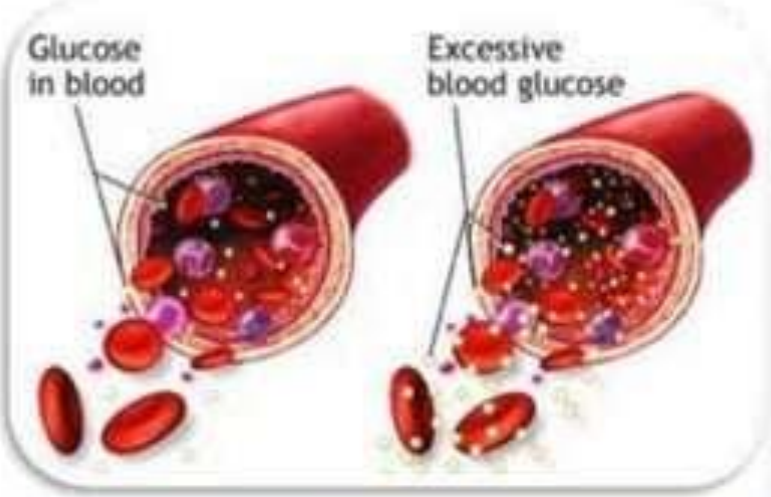
DEFINITION:

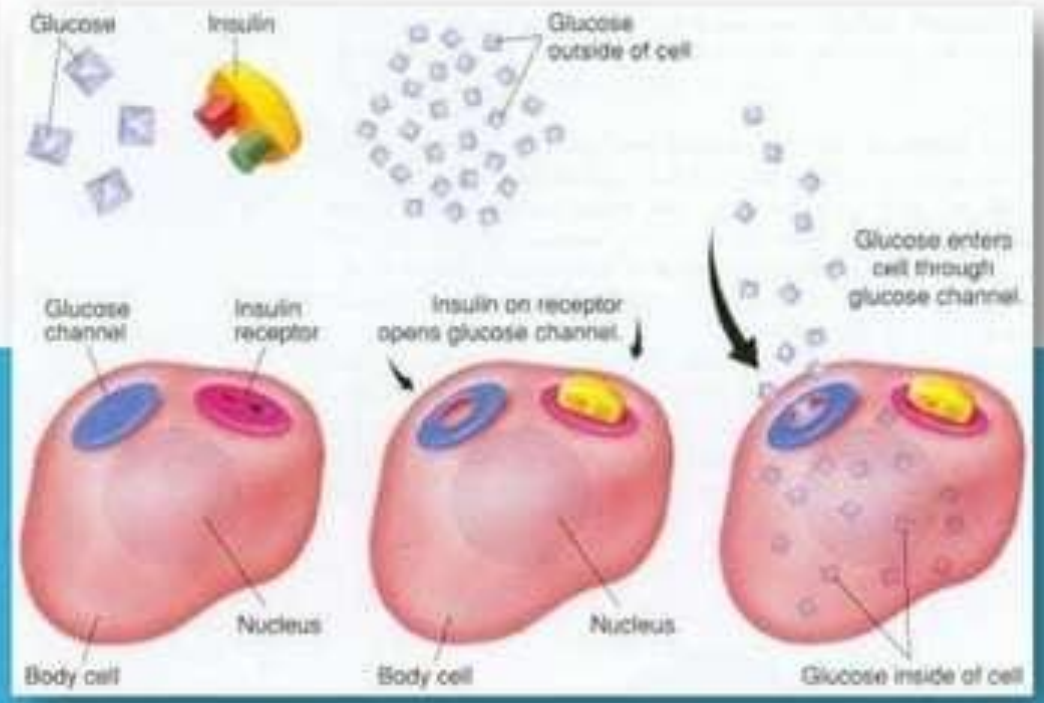
- monosaccharide (1 of 3 dietary monosaccharide)
- main type of sugar in the blood (GLUCOSE = DEXTROSE)
- major source of energy for the body's cells (Glycolysis)
- comes from the foods we eat or the body can make it from other substances (Gluconeogenesis)

DEFINITION:

- carried to the cells through the bloodstream.

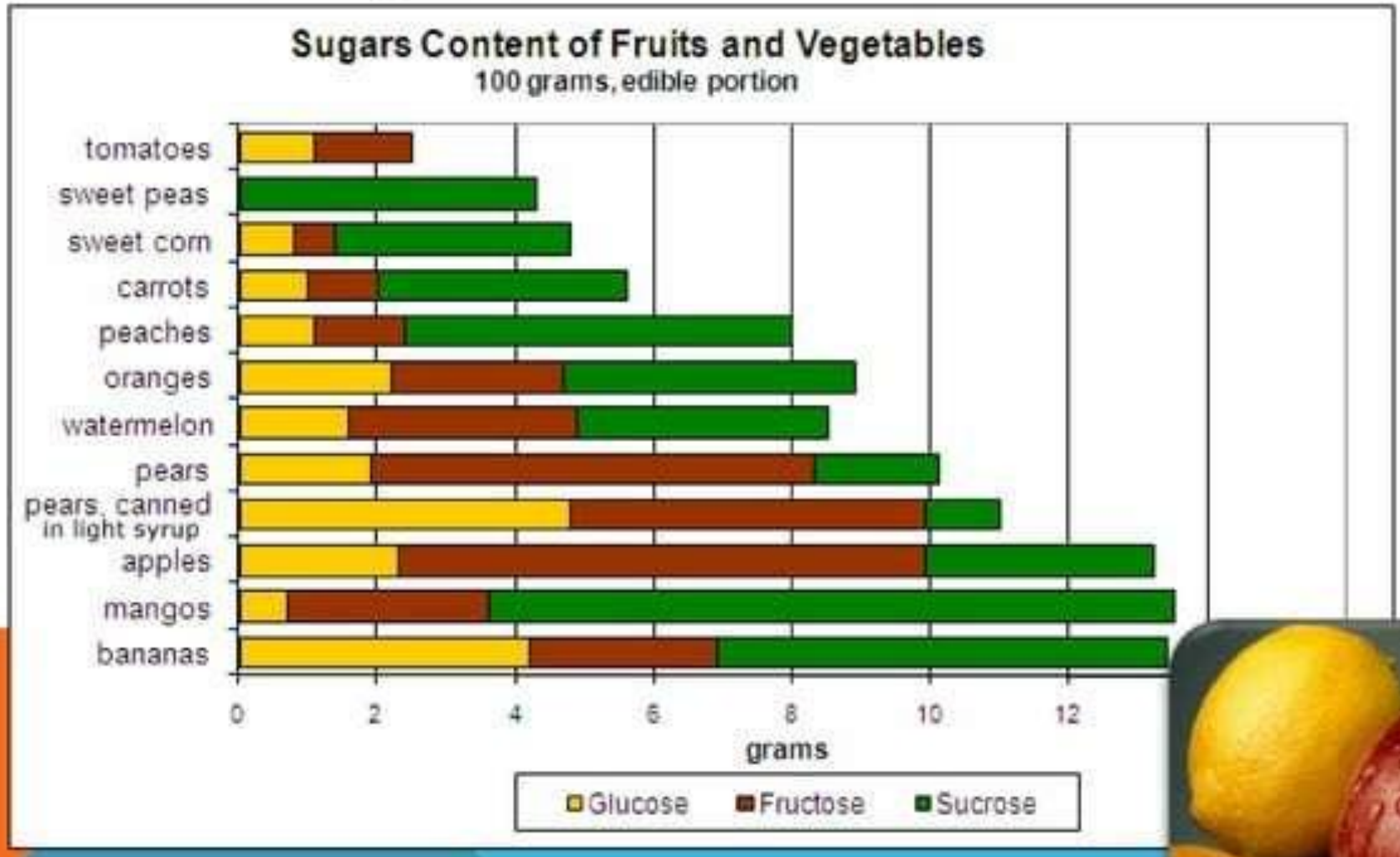
- Several hormones, including insulin, control glucose levels in the blood





COMPOSITION IN FOOD:

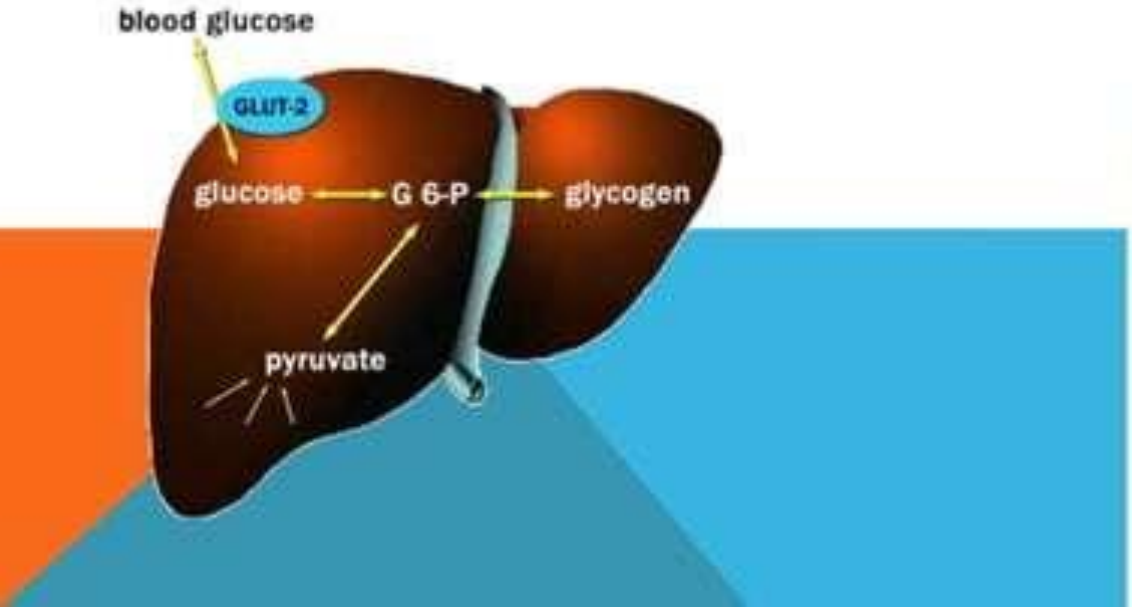
- **Fruit and Vegetables**

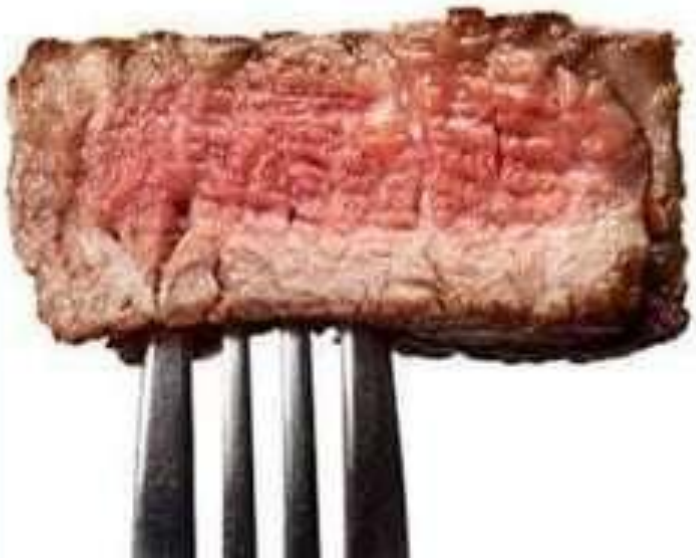


COMPOSITION IN FOOD:

- **Meat Products**

- ❑ are good sources of glucose (Group Health Research Institute)
- ❑ meat is a protein
- ❑ human body can convert some proteins into glucose (proteins like peanut butter, fish and cheese can be converted into glucose)
- ❑ proteins have little effect on blood sugar levels (glucose from the protein is stored in the liver)





COMPOSITION IN FOOD:

- **Fats**

- Butter is a fat-based food
- contains a small amount of glucose.
- the body converts 10 % of the fats consumed into glucose (Group Health Research Institute)
- fats consumption results to a gradual increase in blood sugar (the body convert fats into glucose at a slow rate
- other fats that are converted into glucose are avocados, salad dressing and olive oil.

COMPOSITION IN FOOD:

- **Grains**

❑ starches or complex carbohydrates:

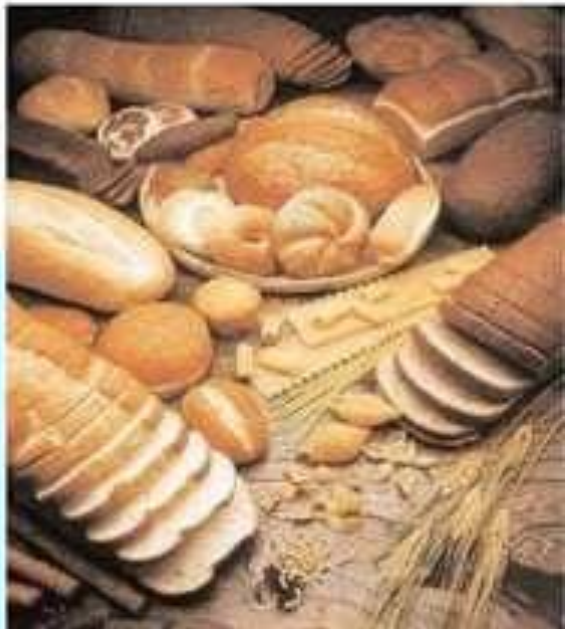
rice, wheat, barley and oats

- naturally contain glucose (American Diabetes Association).

❑ commercially processed grain products:

breads, pastas, instant oatmeal, cereals, pastries and desserts

- contain large amounts of glucose (addition of sweeteners as white sugar, brown sugar, and corn syrup)



FUNCTIONS:

- Preference for Glucose in bodily functions:

❑ lower tendency to react non-specifically with amino groups of proteins

❑ results to low rate of Glycation (protein or lipid covalently bonds with a sugar)

- Glycolipids
- Glycoproteins
- reduces or destroys function of many enzymes

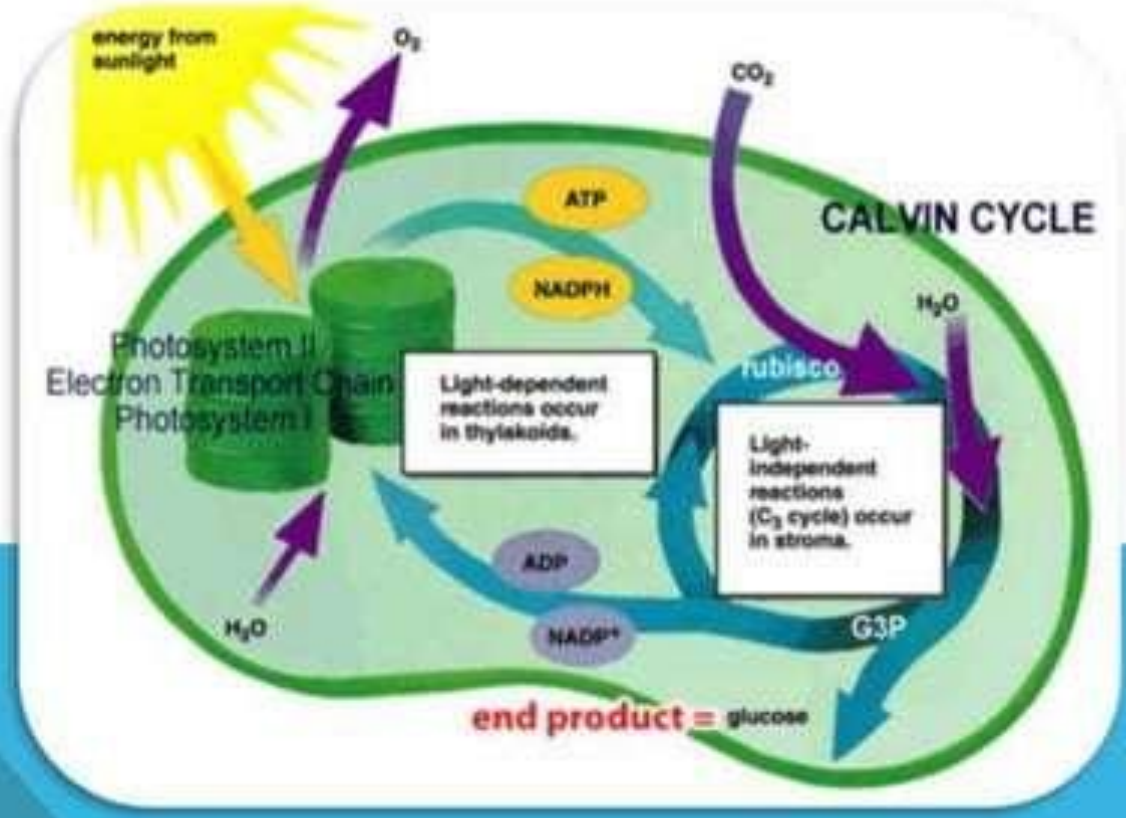
* Long term complications of diabetes (blindness, renal failure, etc.) are due to Glycation

FUNCTIONS:

- cells use it as the primary source of energy and a metabolic intermediate (from bacteria to humans)
  - ❑ aerobic respiration (with O_2, in mitochondrion)
    - glycolysis (with or without O_2, glucose to pyruvate, in cytoplasm)
    - citric acid/Kreb's cycle (with O_2, Acetyl CoA broken down to CO_2 and H_2O producing ATP)
  - ❑ anaerobic respiration (without O_2, in cytoplasm)
  - ❑ fermentation (without O_2, pyruvate to lactic acid, in cytoplasm)

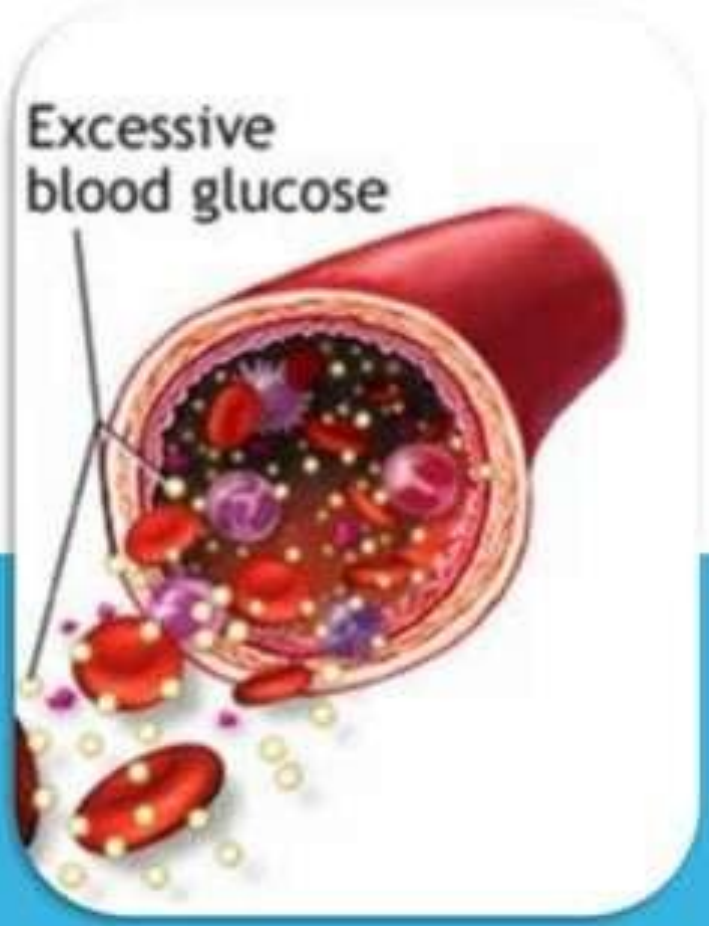
FUNCTIONS:

- main products of photosynthesis and fuels for cellular respiration (plants)
- ❑ Light-independet or Calvin cyle



FUNCTIONS:

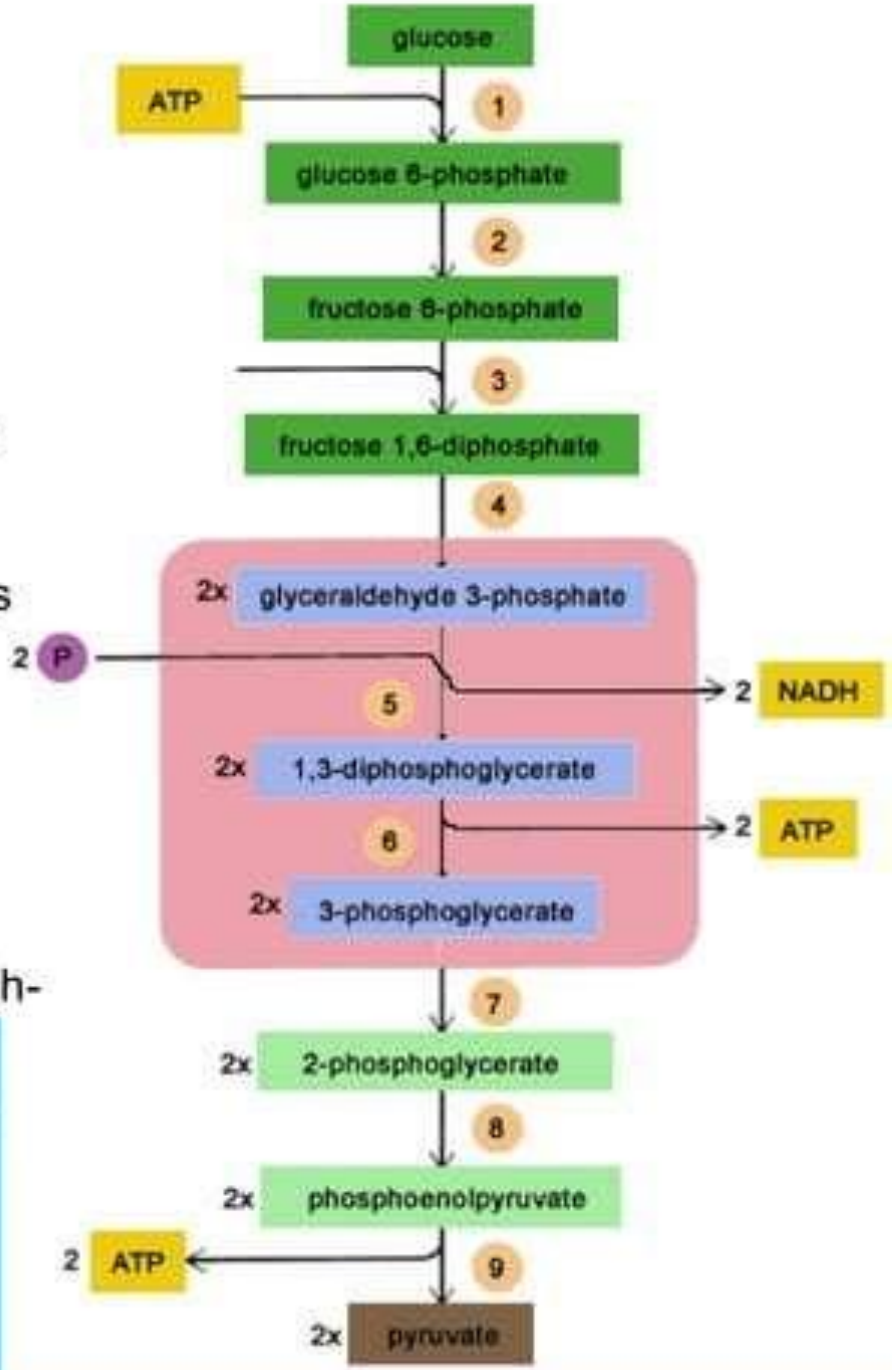
- Analyte in blood tests
  - ❑ eating or fasting affects results
  - ❑ high level of glucose may be due to prediabetes or diabetes mellitus



FUNCTIONS:

- Glucose in Glycolysis

1. Phosphorylation of Glucose by ATP
2. Conversion to 5-carbon ring isomer
3. Phosphorylation 5-carbon ring isomer by ATP
4. Processing into two molecules by enzyme
5. Oxidation of the two molecules, losing protons and gaining phosphate groups; two NAD^+ to NADH
6. Phosphorylation of ADP yields two new molecules and two ATP
7. Moving of phosphate group to 2nd carbon
8. Dehydration of the two molecules into two high-energy molecules
9. Phosphorylation of two ADPs by high-energy molecules producing two more ATP and two pyruvate



FUNCTIONS:

- As a precursor for synthesis of several important substances:

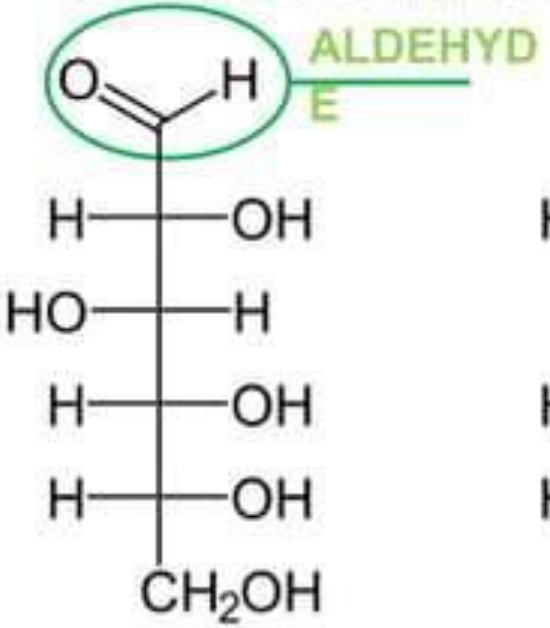
- ❑ monomer
- ❑ energy storage: starch and glycogen
- ❑ structure: cellulose and chitin
- ❑ oligosaccharides of glucose (fructose, galactose)
- ❑ Glycosylation: glycoprotein and glycolipid
- ❑ broken down to synthesize other molecules (lipids, amino acids, ascorbic acid)

FUNCTIONS:

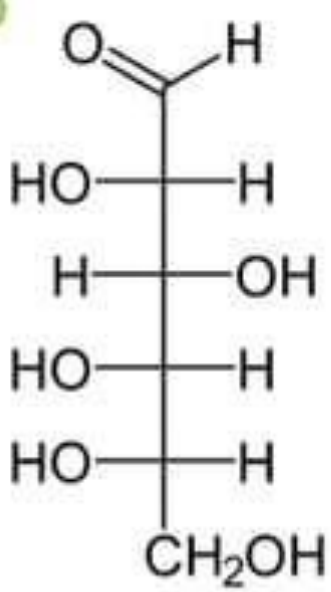
- Industrial use
- ❑ Vitamin C or ascorbic acid
- ❑ Citric acid
- ❑ Gluconic acid
- ❑ Bio-ethanol
- ❑ Polylactic acid
- ❑ sorbitol

STRUCTURE

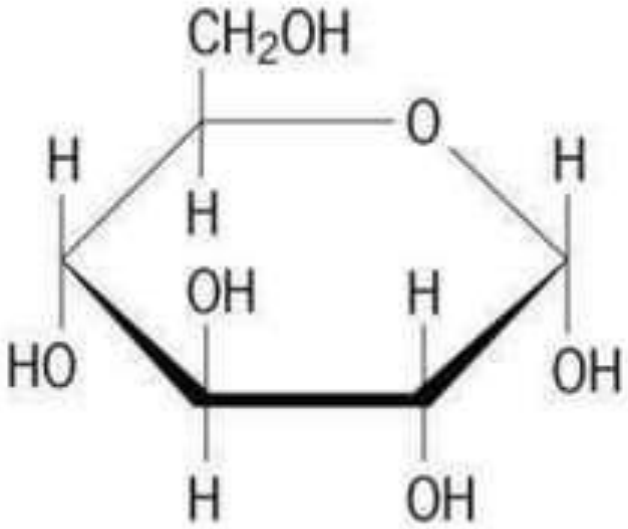
- Glucose isomers, all of $C_6H_{12}O_6$

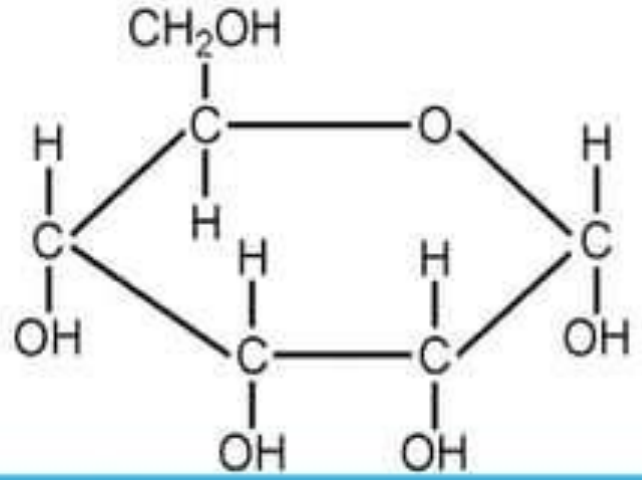


D-Glucose



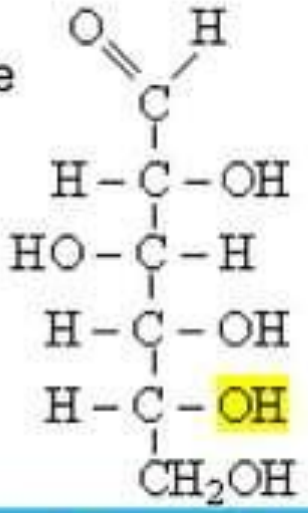
L-Glucose



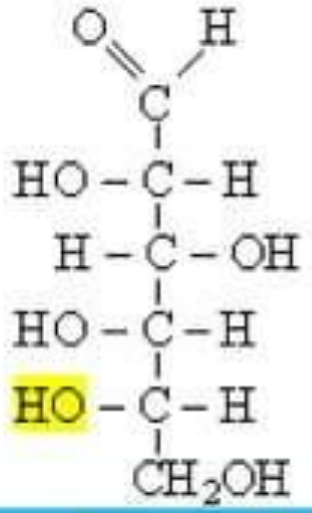


NOMENCLATURE:

- Hexoses – 6 carbon + "-ose"
- Aldoses – aldehyde group at one end
- Stereoisomers - Dextrotation(D) and Levorotation(L) Conformations
- More than one chiral center, D and L conformation refers to asymmetric carbon farthest from the aldehyde group
- D - conformation most abundant in nature
- D and L are mirror images



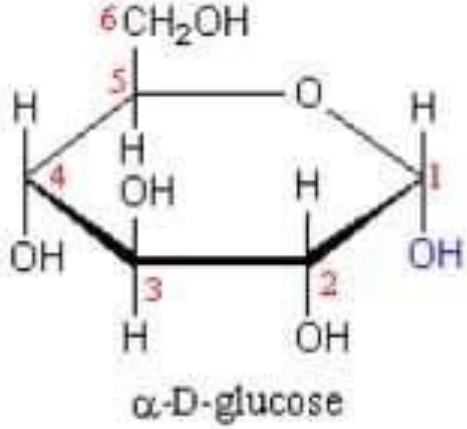
D-glucose



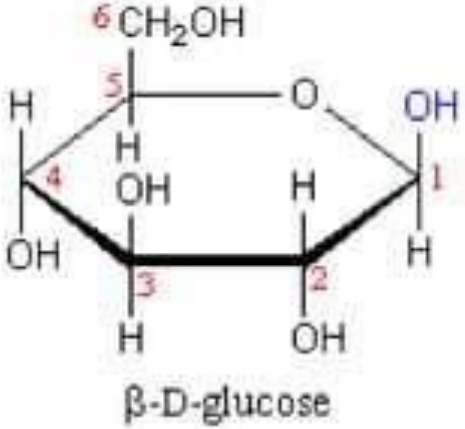
L-glucose

NOMENCLATURE:

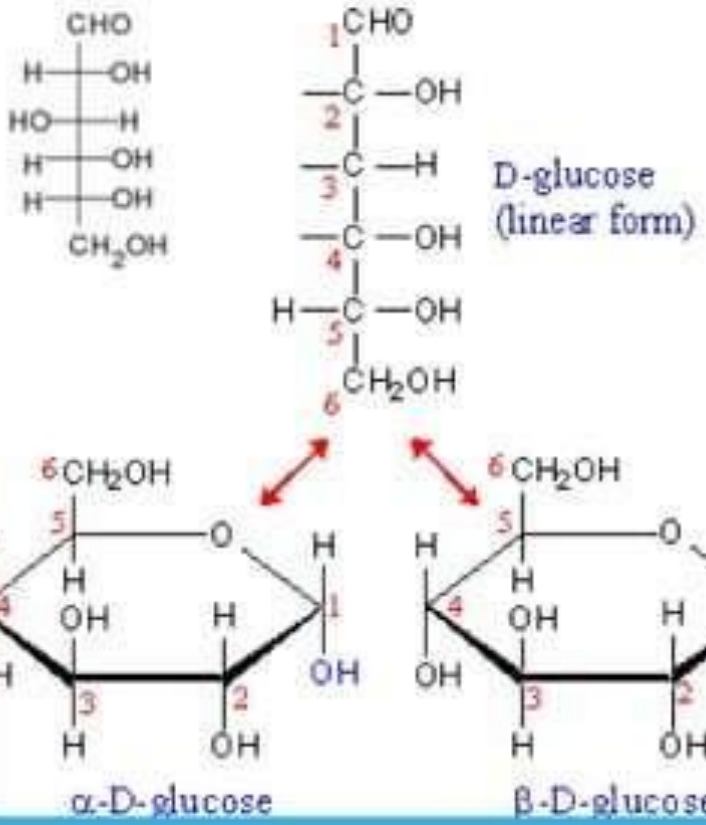
- Hexoses can cyclize, as the aldehyde or ketone group reacts with a –OH on one of the distal carbons.
- Cyclization of glucose produces a new asymmetric center at C1, with the two stereoisomers called anomers, a (below ring) & b (above ring)



α-D-glucose

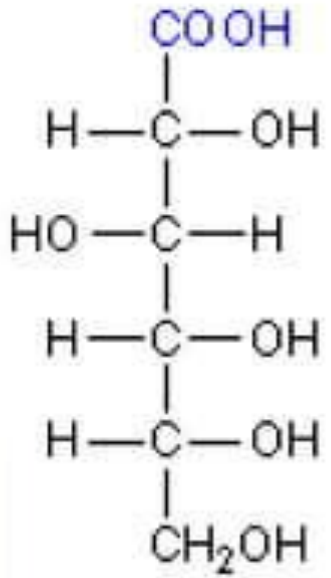


β-D-glucose

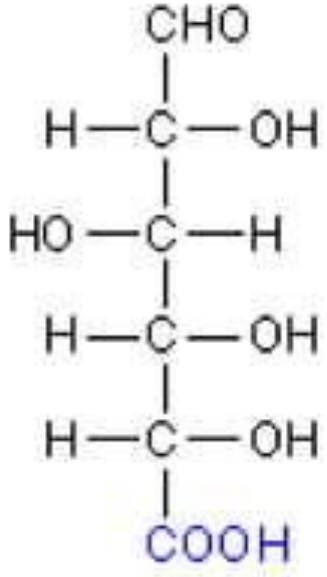


NOMENCLATURE:

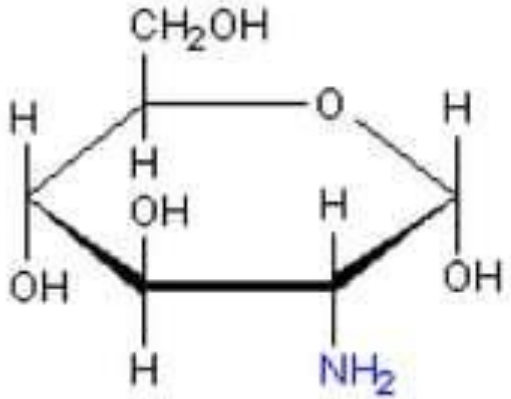
- Sugar acids – aldehyde or hydroxyl is oxidized to carboxylic acid
  ex. gluconic acid and glucuronic acid
- Amino sugar – amine group takes the place of one hydroxyl
  ex. glucosamine



D-gluconic acid



D-glucuronic acid



α-D-glucosamine

PHYSICAL PROPERTIES:

- Appearance – colorless solution, white powder
- crystallised from water solutions: α-glucopyranose, β-glucopyranose, and β-glucopyranose hydrate
- Solubility – easily soluble in water (91 g/100 mL) , acetic acid, blood, and other solvents
- Optical activity – dextrorotatory, rotates polarized light clockwise
- Molar mass - 180.16 g/mol
- Melting point - α-D-glucose: 146 °C ; β-D-glucose: 150 °C

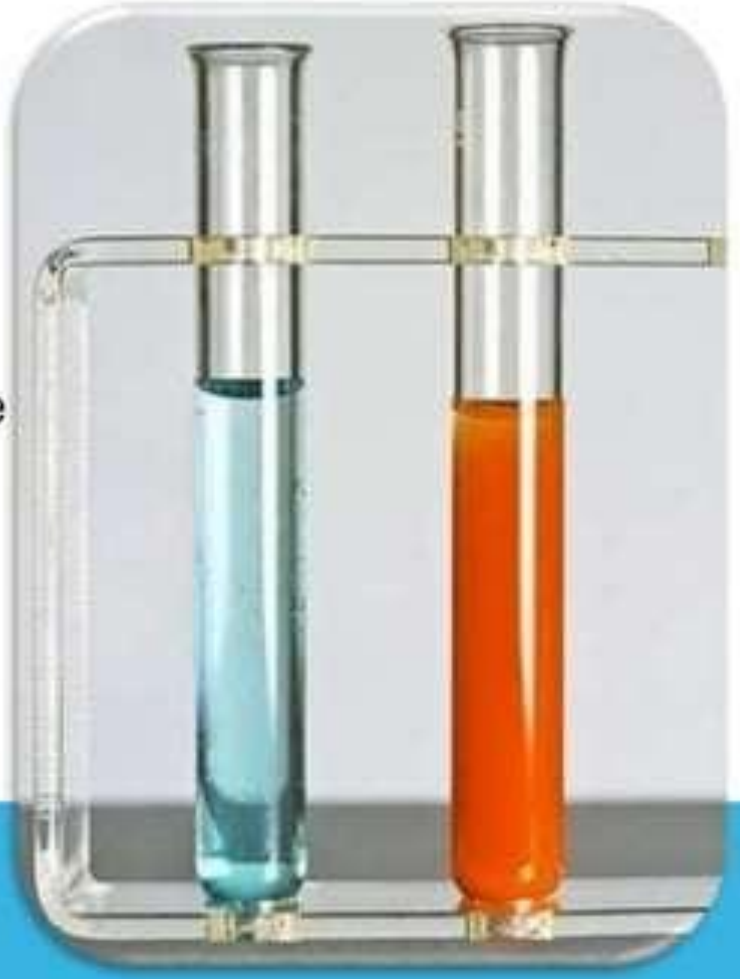
CHEMICAL PROPERTIES:

- oxidized to yield energy(ATP) and water and CO_2
- broken to produce lipids and amino acids
- violent reaction with Sodium peroxide and Potassium nitrate
- simple sugar – easily broken down by the body
- chemical stability - ring form
- regulated by insulin in the blood
- glycosylation – glucose added to lipids or proteins
- phosphorylated to reduce diffusion in cells
- glycogenolysis - breakdown on glycogen into glucose
- gluconeogenesis – non-carbohydrate into glucose

SPECIFIC TEST

Benedict's Test

- test for reducing sugars
- turns solution with glucose, red/orange



THAT'S ALL. THANK YOU!