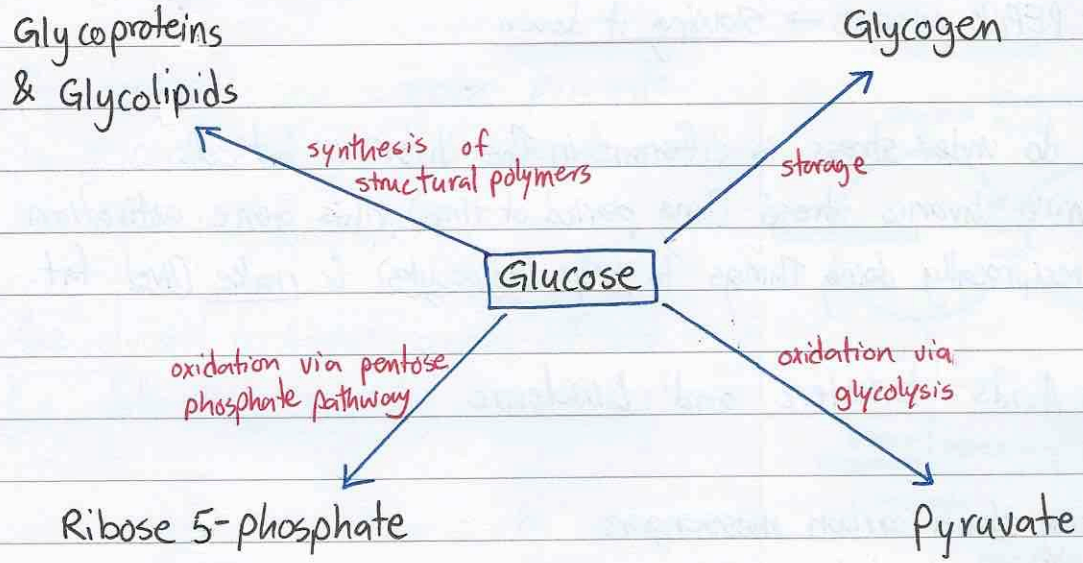
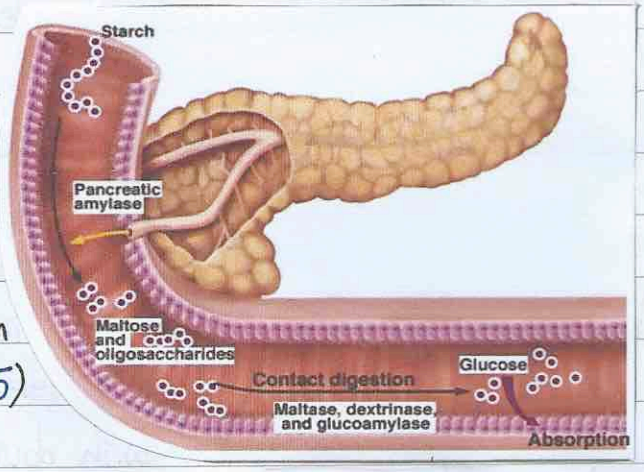
Week 7 - Carbohydrate Metabolism I



Carbohydrate Digestion in Small Intestine

- mastican (chewing up food) is to increase surface area

- salivary amylase is released in the mouth & is the begining of carbohydrate metabolism



are inactivated once it reaches the stomach (since it's acidic → if pH is less than 4.5)

- 50% of dietary starch is digested before it reaches the small intestine
- the pancreas however will produce amylase later on to continue digestion of sugars

Starch → Maltose & oligosaccharides → Glucose
(polysaccharide) (disaccharide) (monosaccharide)

- the brush border enzymes act upon: oligosaccharides, maltose, sucrose, lactose & fructose

- lactose digestion is not an issue before the age 4 (depends on genetic background)
  - ↳ if after age 4 they can't digest lactose → they lack lactase

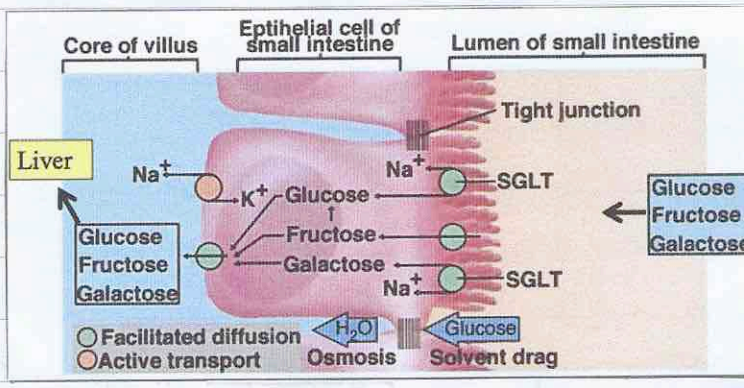
Maltose: 2 units of glucose joind in α1-4 bond

Sucrose: 1 unit of glucose + 1 unit of fructose

lactose: 1 unit of glucose + 1 unit of galactose

- after digestion in the gut, the sugar directly in the blood stream

Carbohydrate Absorption



- are glucose transporters
  - a glucose coming in requires Na^+ for assistance
    - ↳ -Sodium-glucose transporter proteins (SGTP) in the membrane help absorption of both glucose & galactose

- Fructose is absorbed by facilitated diffusion → then converted to glucose inside the cell

- are integral membrane protens that speed up the absorption process
  - many sugars can get in to cells → but to slow for the metabolic demand of the cell
- the sugars need to be exported out of the cell by another transported (assuming the epithelial cell did n't use the glucose for itself)

- the extra Na^+ that came in as a symporter with the sugars is managed through the sodium-potassium pump
  - ↳ an antiporter that pumps out Na^+ & in K^+ (trying to maintain osmolarity of the cell)

- after released in the blood stream → liver to be managed

Glucose Transporters

Name	Tissue location	K_m	Comments
GLUT1	All mammalian tissues	1 mM	Basal glucose uptake
GLUT2	Liver and pancreatic β cells	15–20 mM	In the pancreas, plays a role in regulation of insulin In the liver, removes excess glucose from the blood
GLUT3	All mammalian tissues	1 mM	Basal glucose uptake
GLUT4	Muscle and fat cells	5 mM	Amount in muscle plasma membrane increases with endurance training
GLUT5	Small intestine	—	Primarily a fructose transporter

- these different types of glucose transporters have different roles, and are often tissue specific

- GLUT1 is used across all tissues
  - the Km refers to how much glucose the transporter can take up
    - ↳ is higher in erythrocytes (RBCs) but low in the liver
      - ↳ have no mitochondria so they need glucose to maintain their activity via glycolysis (they live ~150 days)

- GLUT 2 is used in the liver & pancreatic β-cells
- has a much greater activity (Km is much higher)
- It's trying to maintain blood sugar levels (refer to table)
  - ↳ to either produce Insulin or glucagon

- the GLUT 2 is high in hepatocytes (liver cells) and they're not saturated (can slow them down)

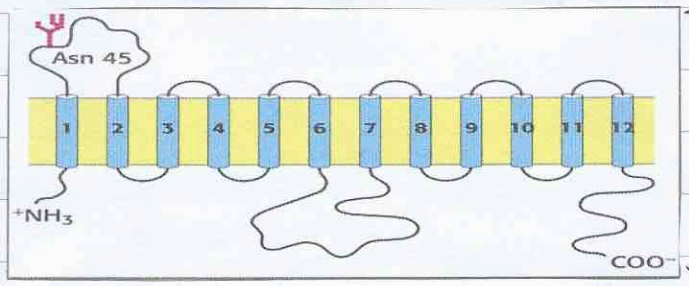
because any excess of glucose will be converted into fat

  - this particular transporter is important because it also releases glucos to circulation → enables regulation of blood sugar (particularly responding to Insulin levels)

- GLUT 3 is pretty much the same as GLUT 1
- but particularly used in brain & nerve tissue when glucose demand is high

- GLUT 4 is seen on muscle & fat cells
- slightly higher uptake of glucose (Km of 5mM)
- used for maintenance of activity of muscle & fat cells
- In vesicles, Insulin stimulates movement of vesicles

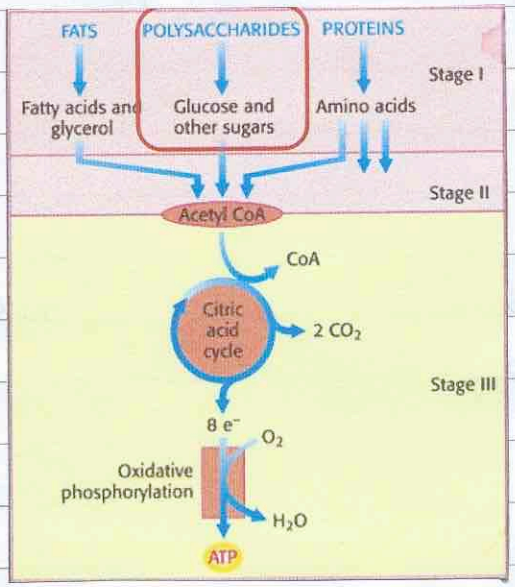
- GLUT 5 is used in the small intestine (page 99)
- mainly a fructose transporter



- shows the glucose transporter going through the membrane
- goes through a dozen times

mainly seen on the testis, kidney and sperm

Energy Production



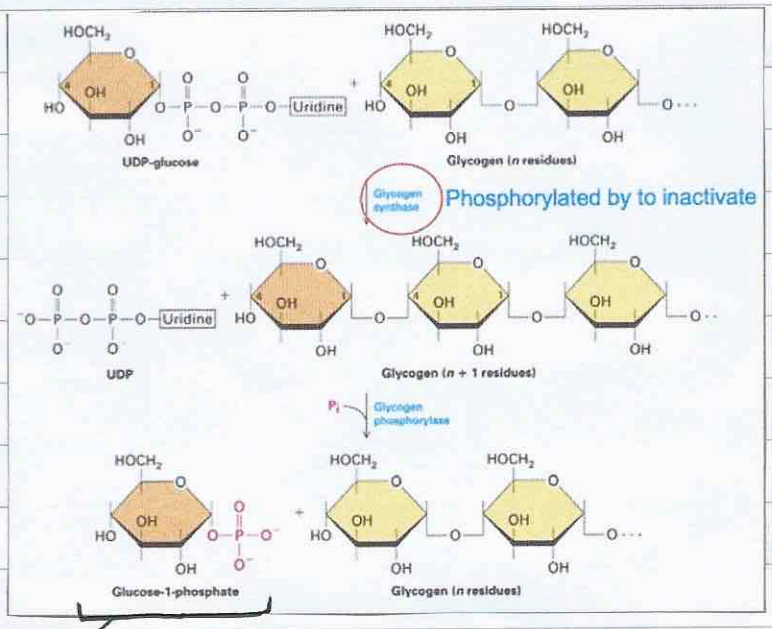
- sugars get converted to Acetyl-CoA

- that enters CAC & ETC in stage III to produce ATP and other by products

Synthesis & Degradation of Glycogen (Glucose polymer)

- muscle do store some sugar, as glycogen, for a short period

- intracellular [glucose] > 0.4 M in mammalian cells would rupture the cell due to increased osmotic pressure (water entering the cell)



- a series of sugars are put together via glycogen synthase
  - to form a polymer of the sugars
  - the sugars can either be used or stored
- they can be reactivated by attaching a P_i to it via glycogen phosphorylase

active sugar → it's still trapped in the cell, until the phosphate is removed