Glucose Metabolism: Pathways of Glucose

Foundation block..

➢ Table of contents:

Color index: red=important note
orange=further explanation

Metabolic Pathway

- Pathway: Series of chemical reactions that have one goal.
- Reaction: Substrate+Substrate Product.

Definition

Pathway for glucose happens in almost every cell, starting by oxidation of glucose and ending with pyruvate (or lactate).

Regulatory mechanisms

- Rapid (Short Term):

Allosteric , Covalent modification

- Slow (Long Term):

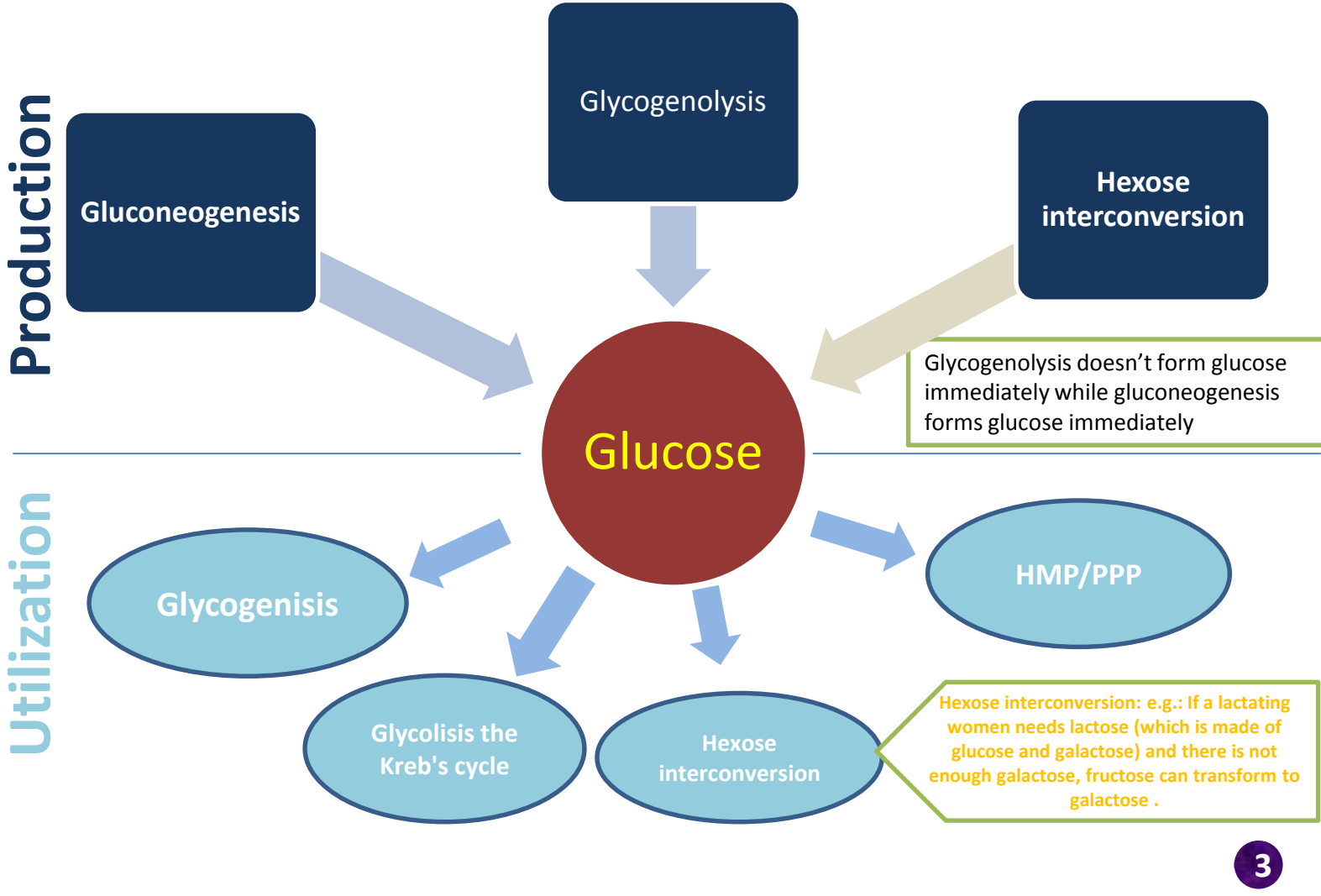
induction/repression

Site

- Cellular(Tissue): All tissues or specific tissues (e.g. liver)
- Sub Cellular: Inside the cell (e.g. Mitochondrial or Cytoplasmic) or both.

Reactions:

Few are rate-limiting (They are found only in irreversible pathways).


Production
Gluconeogenesis
Glycogenolysis
Hexose interconversion
Glucose
Glycogenolysis doesn't form glucose immediately while gluconeogenesis forms glucose immediately
Utilization
Glycogenisis
HMP/PPP
Glycolisis the Kreb's cycle
Hexose interconversion
Hexose interconversion: e.g.: If a lactating women needs lactose (which is made of glucose and galactose) and there is not enough galactose, fructose can transform to galactose .

Metabolic Pathways of Glucose

Catabolic cycles

- ✓ Glycolysis (amphibolic – 9 catabolic steps and 1 anabolic) – **Mainly catabolic-**
- ✓ Krebs cycle -**Mainly catabolic -**
- ✓ Glycogenolysis
- ✓ HMP

Anabolic cycles

- ✓ Gluconeogenesis
- ✓ Glycogenesis

-Lysis: Break down
-Genesis: synthesis
-Any cell that has cytosol can undergo glycogenesis or glycogenolysis but mainly in liver and skeletal muscles.

❖ *Glycogenesis:*
Synthesis of glycogen from glucose
Mainly liver and muscle,Cytosol

❖ Glycogenolysis:
Degradation of glycogen into glucose
Mainly liver and muscle, Cytosol

Hexose Monophosphate Pathway (HMP) or Pentose Phosphate Pathway (PPP)

1. **Important source for NADPH:**

   Which is used in reductive synthesis (When the cell needs oxygen)

2. **Source for metabolically active ribose:**

   Production of nucleotides:

   - For nucleic acids
   - For co-enzymes

Glucose Transport

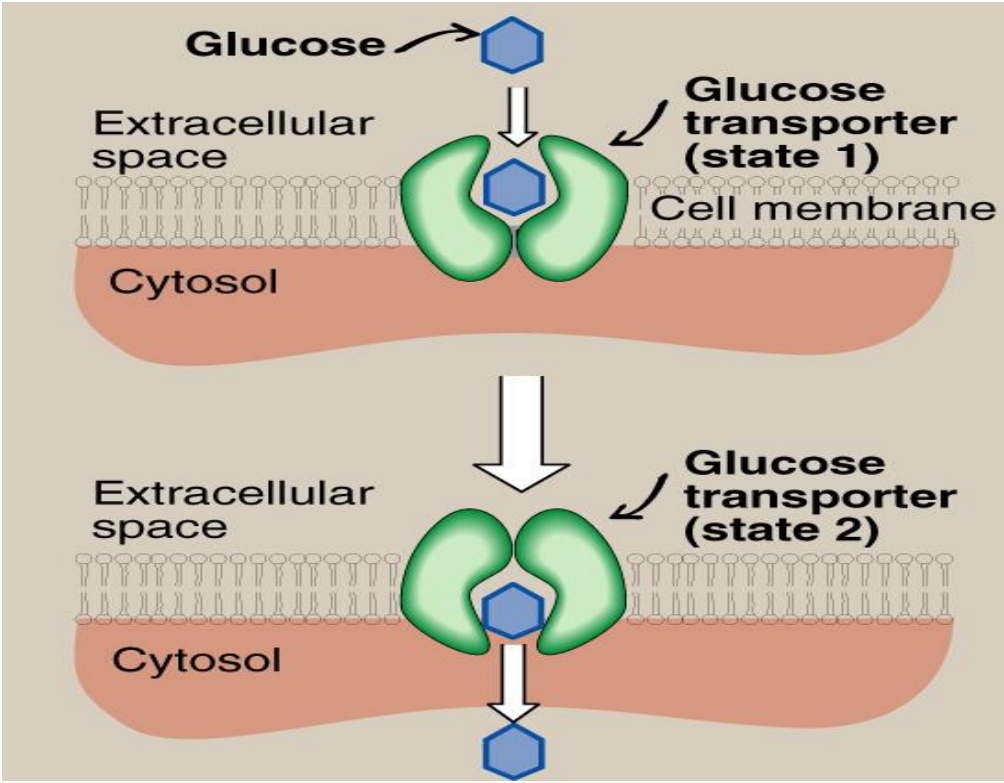
➢ Na+-Monosaccharide Co-transporter:

- ✓ Against concentration gradient.
- ✓ Energy dependent.
- ✓ Carrier-mediated.
- ✓ Coupled to Na+ transport.
- ✓ Small intestine, renal tubules.

➢ Na+-Independent Facilitated Diffusion:

- ✓ With concentration gradient.
- ✓ Energy Independent.
- ✓ Glucose Transporters (GLUT 1-14).
- ✓ Facilitated Diffusion.

Glucose Transport: Facilitated Diffusion



GIF

Glucose Transporters (GLUT)

- ✓ Tissue specific expression pattern.
- ✓ All Glut are found in cell membrane except Glut 7 which is found in Endoplasmic Reticulum membrane(of the liver).
- ✓ All Glut are found all the time except Glut 4 which is found only when needed (when insulin binds to its receptor) if Glut 4 is not needed it stays in blood vesicles.

Tissue-specific expression pattern

Glut - 1	RBCs and brain
Glut - 2	Liver, kidney & pancreas
Glut - 3	Neurons
Glut - 4	Adipose tissue & skeletal muscle
Glut - 5	Small intestine &testes
Glut - 7	Liver (ER-membrane)

Functions of GLUT

Glut - 1, 3 & 4	Glucose uptake from blood to tissue
Glut - 2	Blood & cells (either direction from tissue to blood or from blood to tissue)
Glut - 5	Fructose transport (Fructose is one of the nutrients for spermatozoa)

1. Which of these is NOT **Utilization** In metabolic pathway of glucose:

a. Glycogenesis.
b. HMP/PPP.
c. Glycolysis.
d. Gluconeogenesis .

2. Na+-Monosaccharide Co-transporter is:

a. Facilitated Diffusion.
b. Energy Independent.
c. Against concentration gradient.
d. With concentration gradient.

3. Example for **Anabolic cycles:**

a. HMP.
b. Gluconeogenesis .
c. Glycolysis.
d. Krebs.

4. Glut – 3 Function is:

a. Fructose Transport.
b. Blood & cells.
c. Neurons.
d. Glucose uptake from blood.

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