

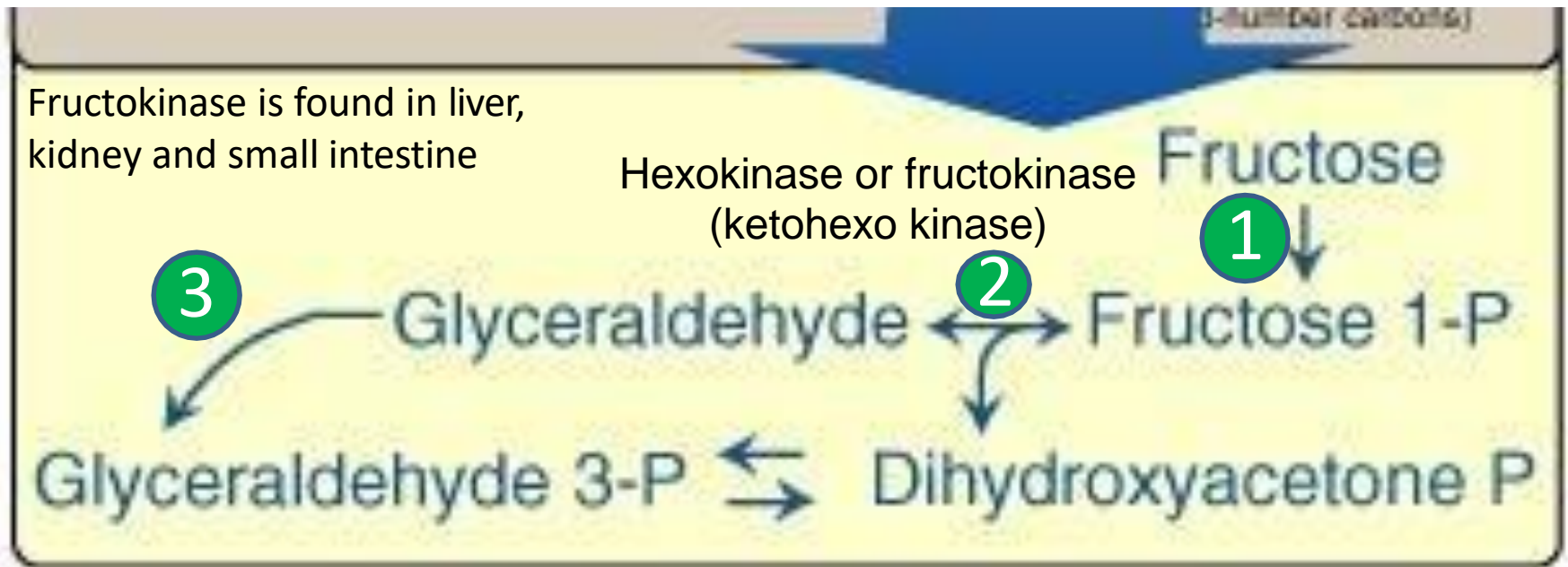


Metabolism of Monosaccharides and Disaccharides

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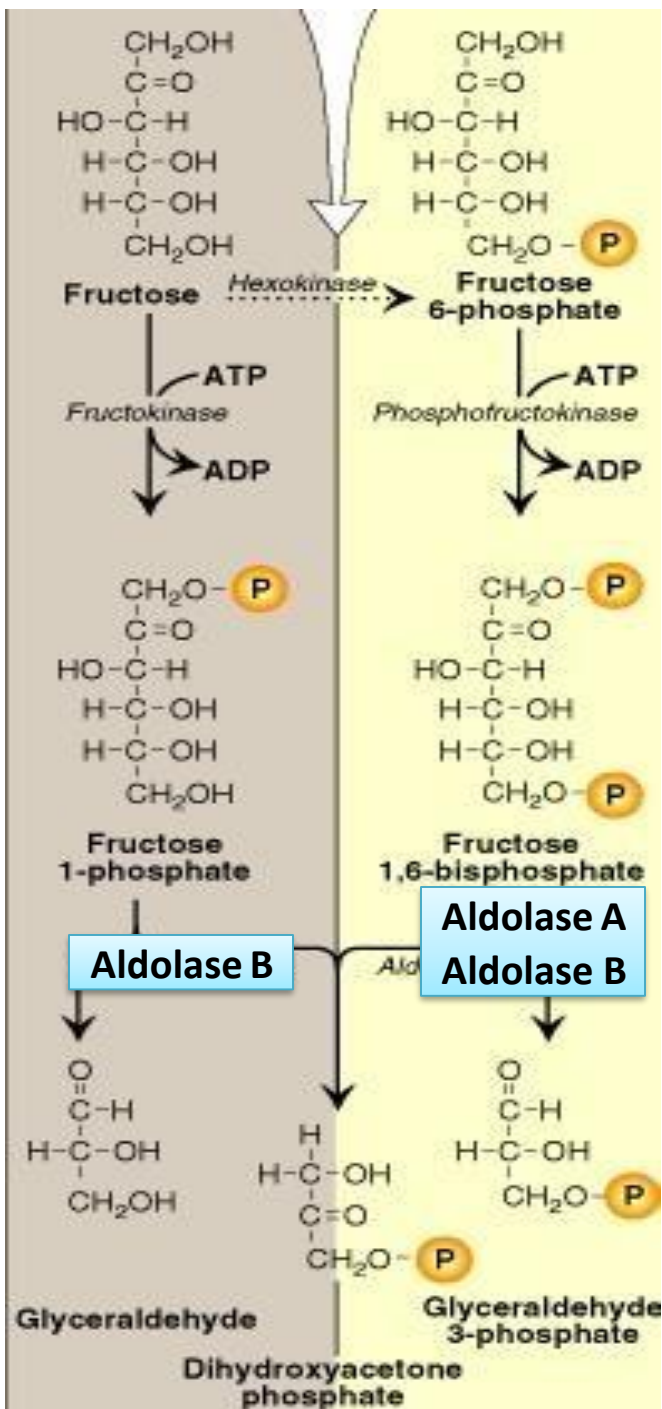
Fructose Metabolism

- 10% of the daily calorie intake
- Sources: sucrose, Fruits, honey, high-fructose corn syrup
- Entry into cells is not insulin dependent.
- Does NOT promote the secretion of insulin



Fructose Metabolism

Hexokinase affinity to fructose is low



- The rate of fructose metabolism is more rapid than that of glucose because the trioses formed from fructose 1-phosphate bypass *phosphor fructokinase-1-P* the major rate-limiting step in glycolysis

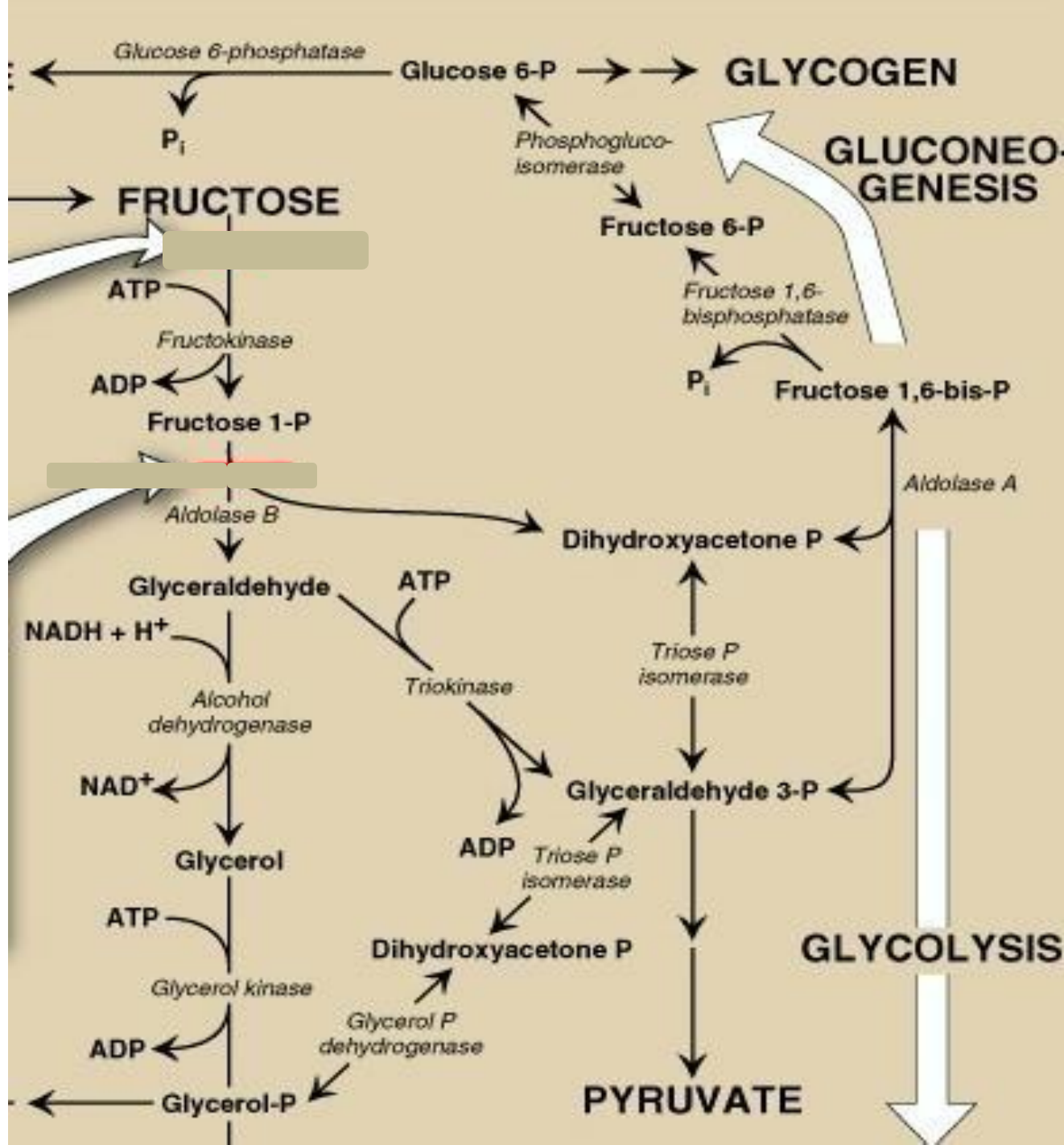
Human expresses three forms of aldolase

Aldolase B

- Liver, kidney, small intestine
 - Substrate
Fruc. 1 phosphosphate
Also
Fruc. 1,6 bisphosphate
- ↓ activity → fructose intolerance

Aldolase A

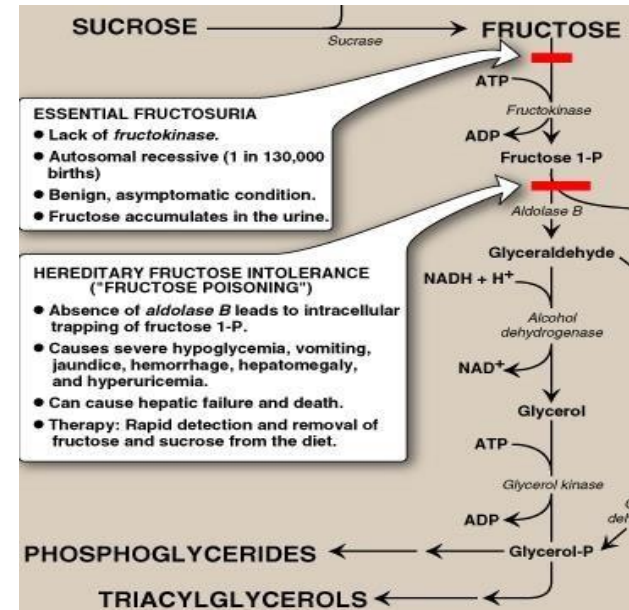
- In most tissues
- Substrate
Fruc. 1,6 bisphosphate
Not
Fruc. 1 phosphosphate



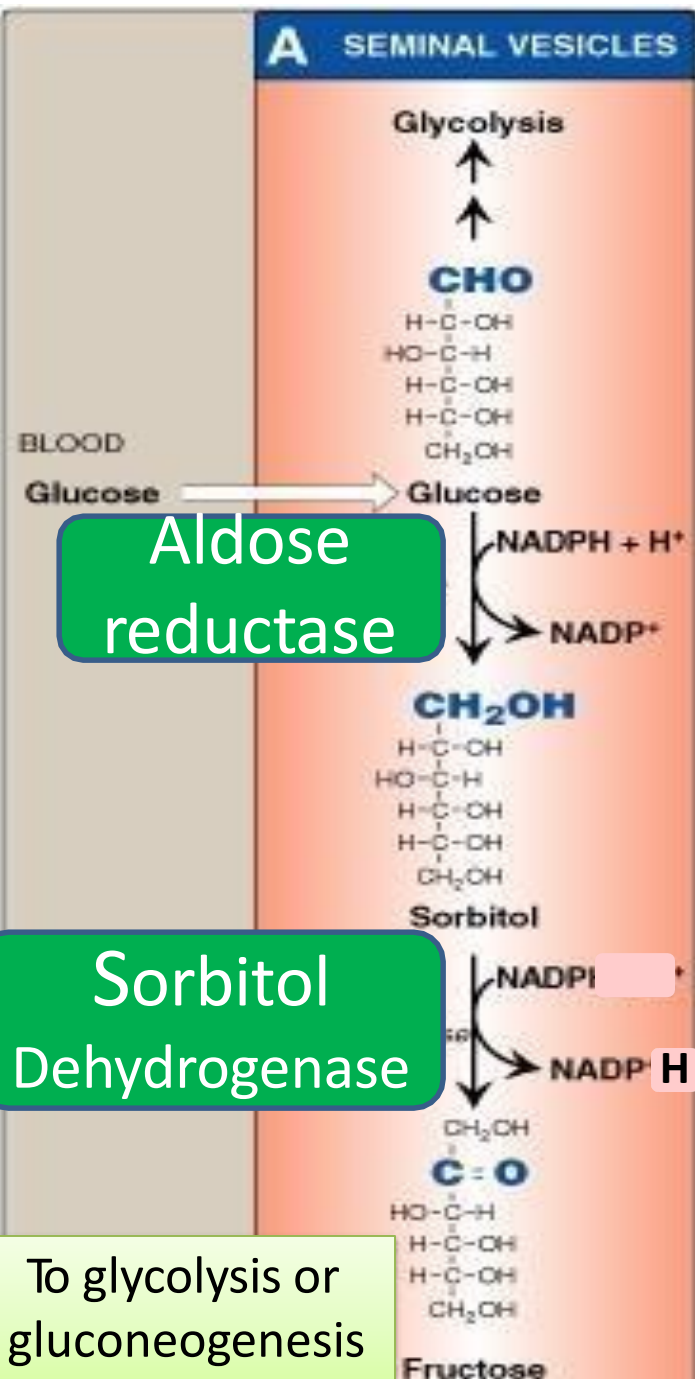
Fructose Metabolism and Interaction with other Pathways

Disorders of Fructose Metabolism

- Fructokinase Deficiency → essential fructosuria
 - Accumulation of fructose → fructosuria
 - Benign condition
- Aldolase Deficiency → hereditary fructose intolerance, (Fructose Poisoning)
 - Severe disturbance in liver and kidney metabolism
 - ↑↑↑ Fruc. 1-Phosph. → drop in P_i → drop in ATP → ↑↑ AMP → ↑ degradation of AMP
 - Hypoglycemia and lacticacidemia (lactic acidosis)
 - Hyperuricemia
 - Hepatic failure due to reduced hepatic ATP
 - Avoid fructose, sucrose and sorbitol



Conversion of glucose to fructose via sorbitol



Aldose Reductase:
Found in many tissues;
Lens, retina, schwan cells, liver,
kidney, ovaries, and seminal
vesicle

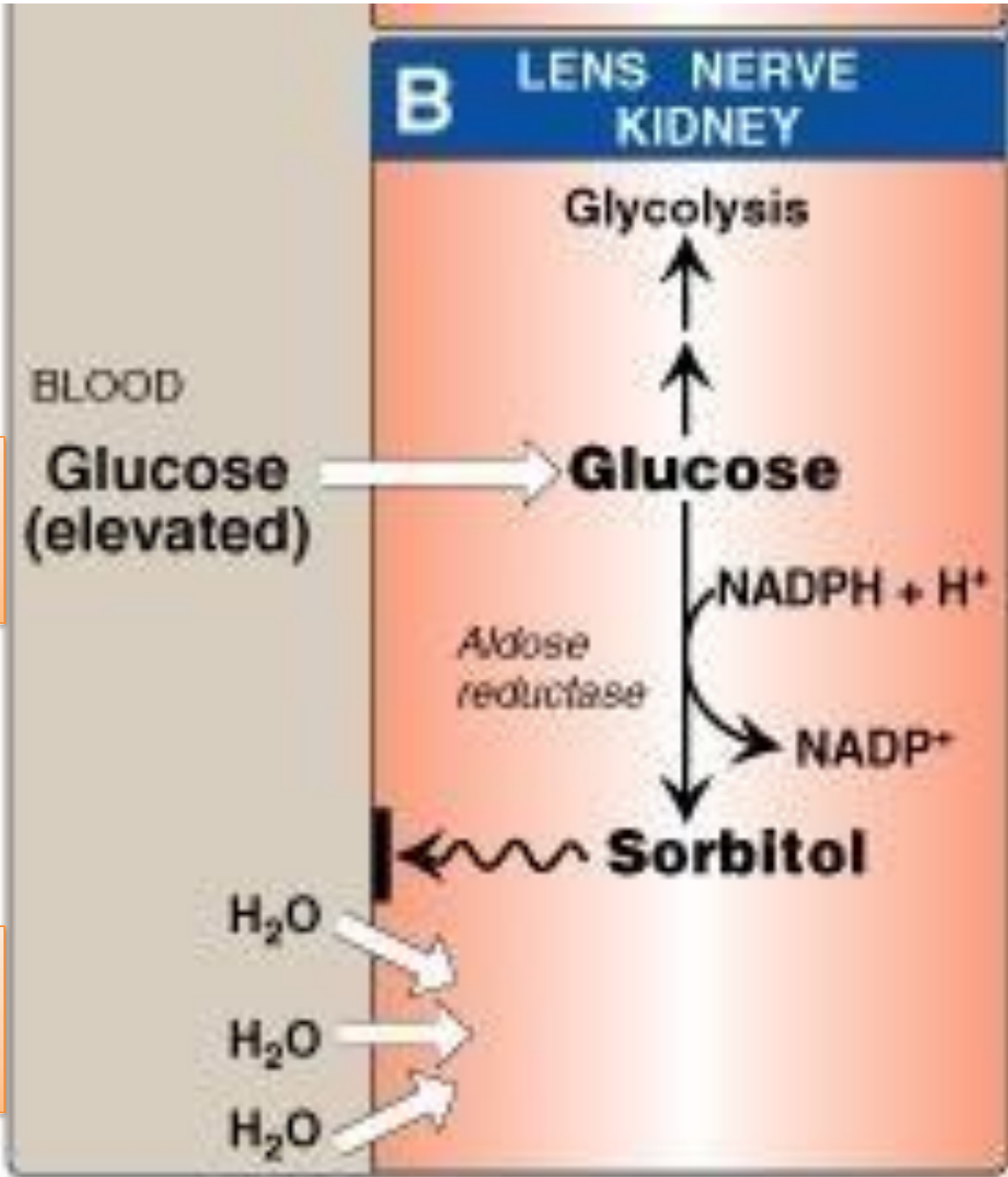
Sorbitol Dehydrogenase:
Liver, ovaries and seminal
vesicles

Fructose : the major energy
source for sperm cells

Conversion of glucose to sorbitol and Diabetic Complications

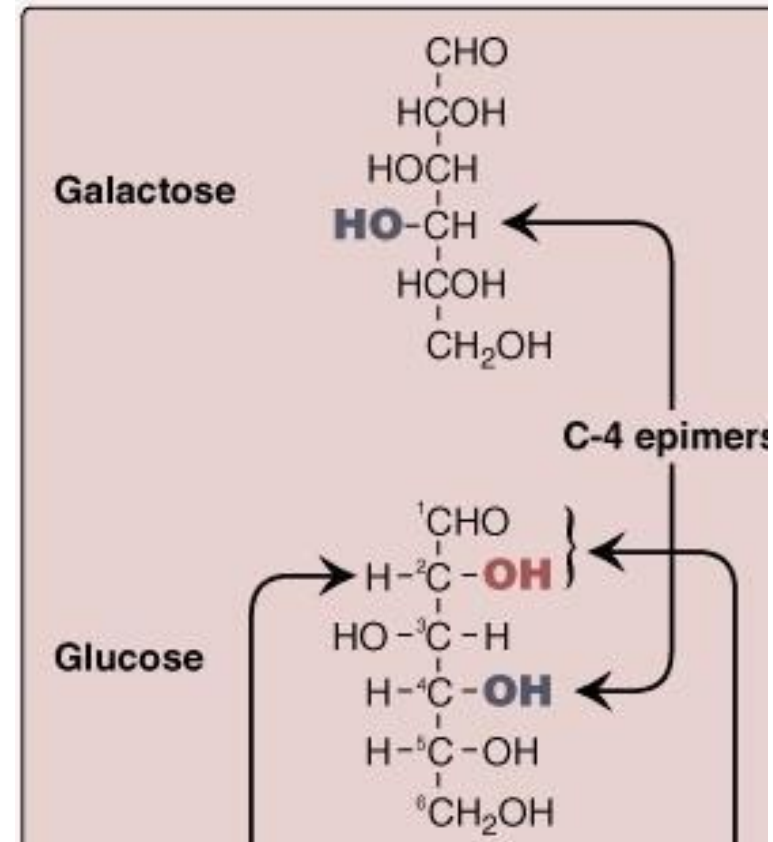
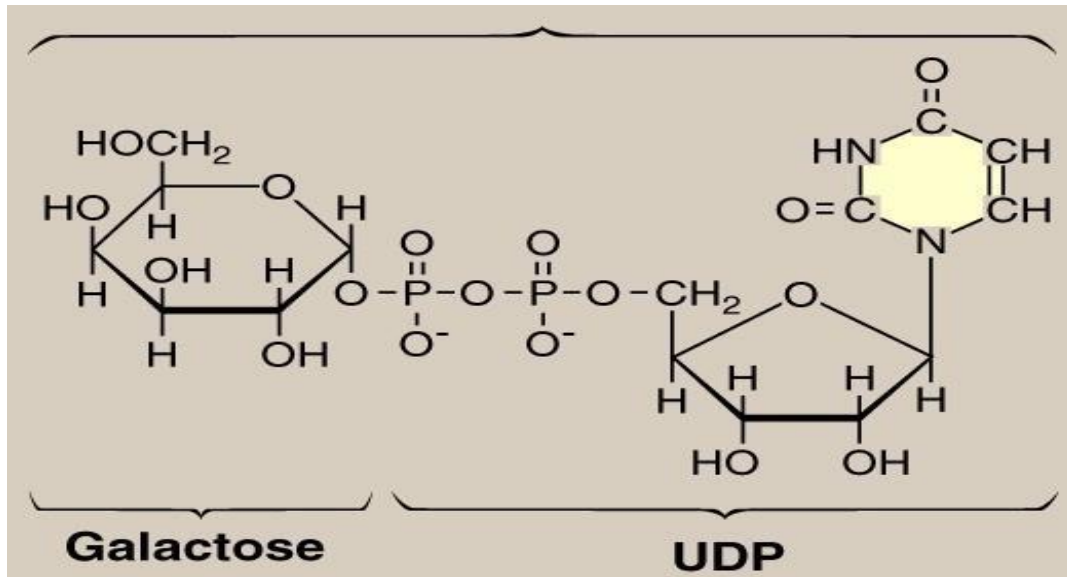
Glucose entry is insulin independent in these tissues

Water retention and cell swelling leading to diabetic complications

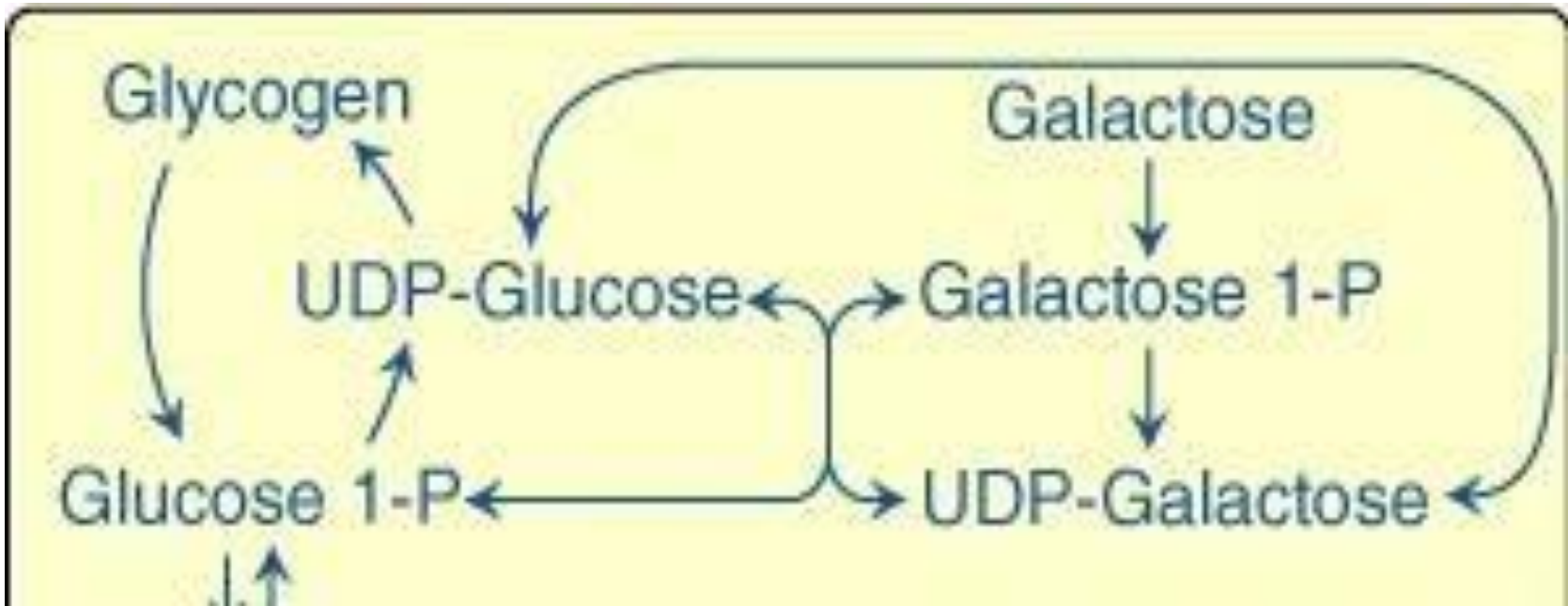


Galactose Metabolism

- Epimer of glucose
- Sources: component of lactose, lysosomal degradation glycolipids and glycoproteins
- Entry to cells is insulin independent
- UDP Galactose; an Intermediate in Galactose Metabolism



Galactose Metabolism



Galactokinase



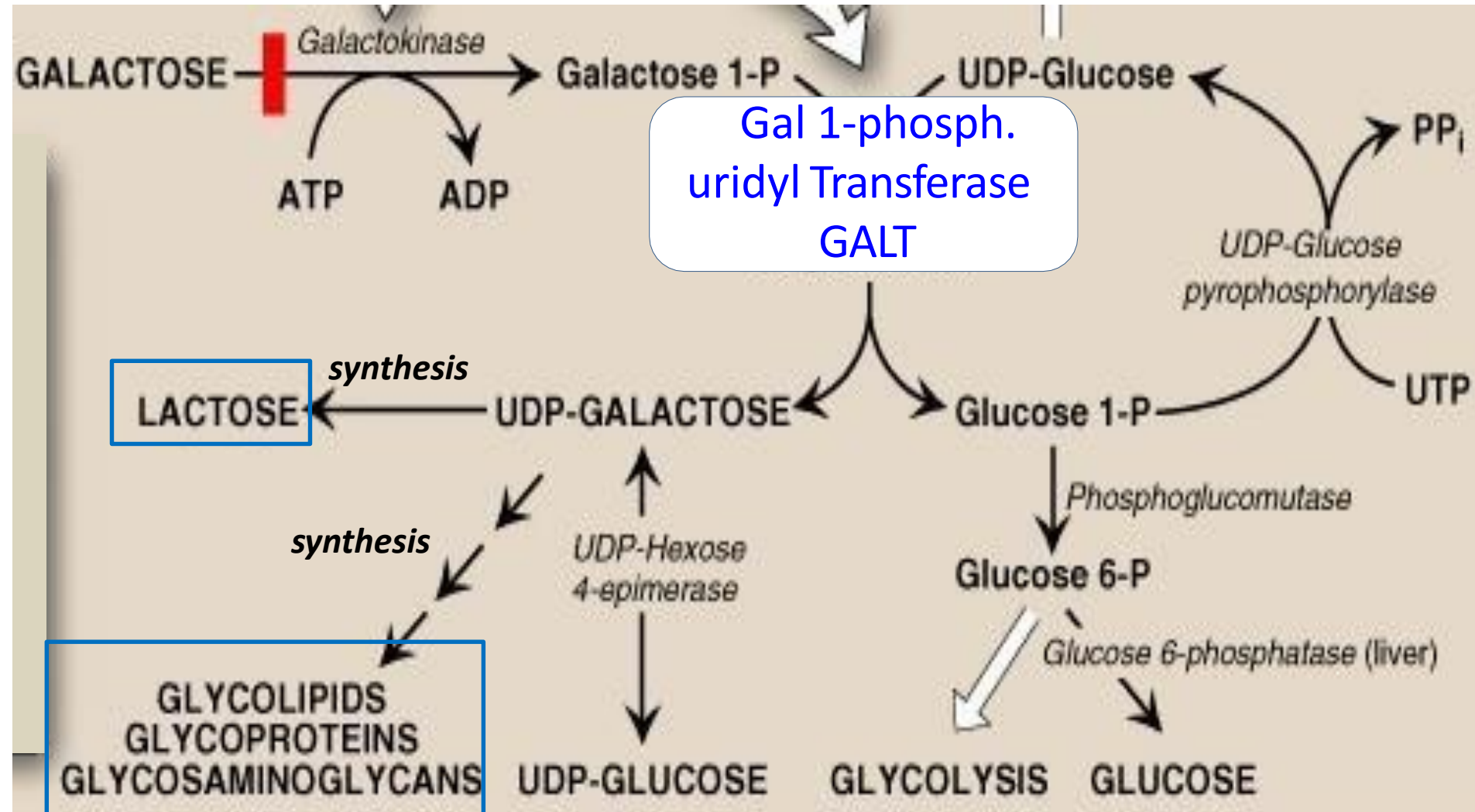
transferase



epimerase



Galactose metabolism and fates



Disorders of Galactose Metabolism

- Deficiency of GALT → classic Galactosemia
- Accumulation of Galactose 1-Phosphate and galactose
- Similar consequences to those in fructose intolerance

- Galactose→ Galactitol production
- Deficiency of Galactokinase

- Accumulation of Galactose→ Galactitol

Disorders of Galactose Metabolism

Sugar alcohol

GALACTOKINASE DEFICIENCY

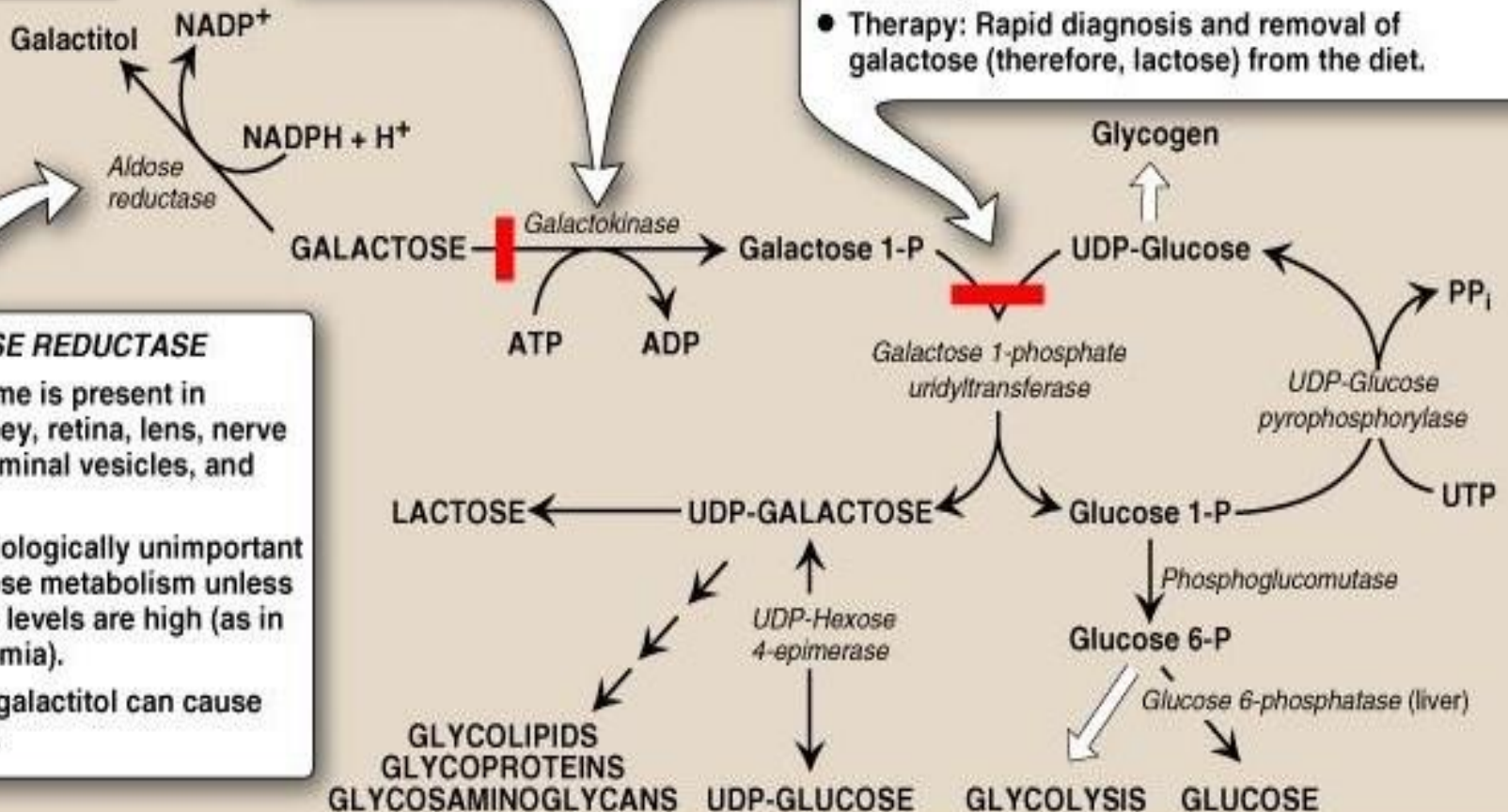
- This causes galactosemia and galactosuria.
- It causes galactitol accumulation if galactose is present in the diet.

CLASSIC GALACTOSEMIA

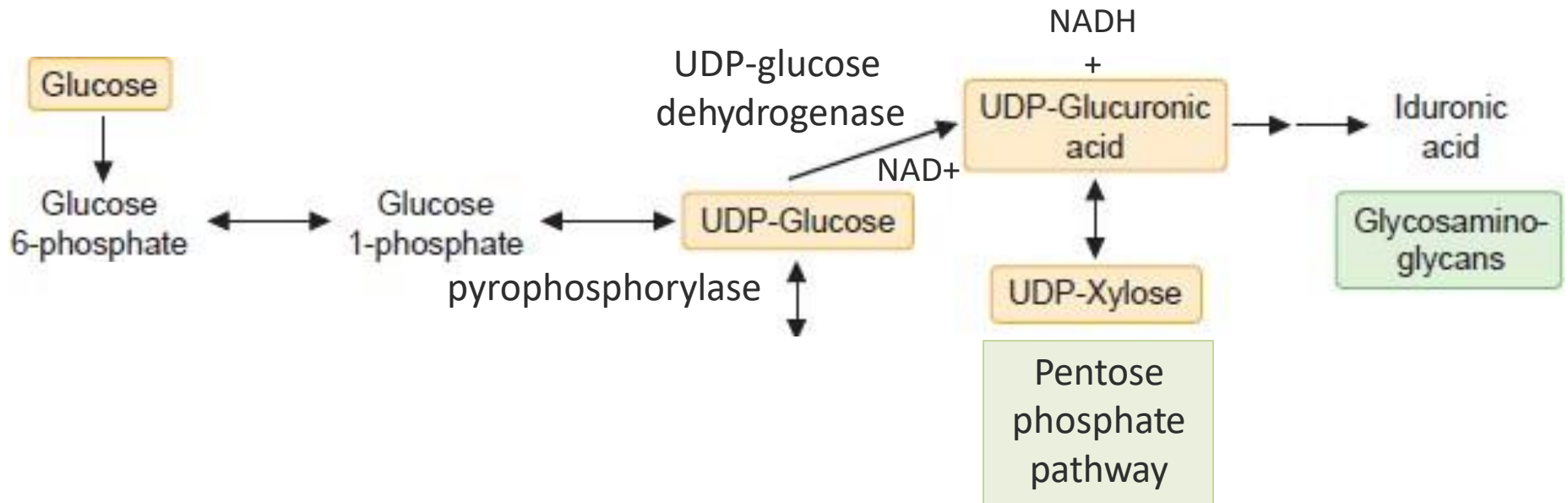
- *Uridyltransferase* deficiency.
- Autosomal recessive disorder (1 in 23,000 births).
- It causes galactosemia and galactosuria, vomiting, diarrhea, and jaundice.
- Accumulation of galactose 1-phosphate and galactitol in nerve, lens, liver, and kidney tissue causes liver damage, severe mental retardation, and cataracts.
- Antenatal diagnosis is possible by chorionic villus sampling.
- Therapy: Rapid diagnosis and removal of galactose (therefore, lactose) from the diet.

ALDOSE REDUCTASE

- The enzyme is present in liver, kidney, retina, lens, nerve tissue, seminal vesicles, and ovaries.
- It is physiologically unimportant in galactose metabolism unless galactose levels are high (as in galactosemia).
- Elevated galactitol can cause cataracts.



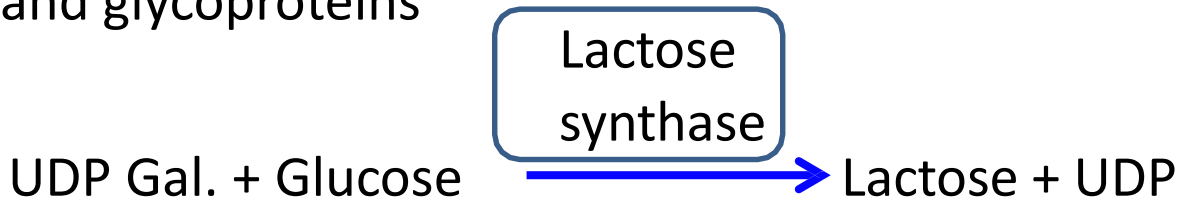
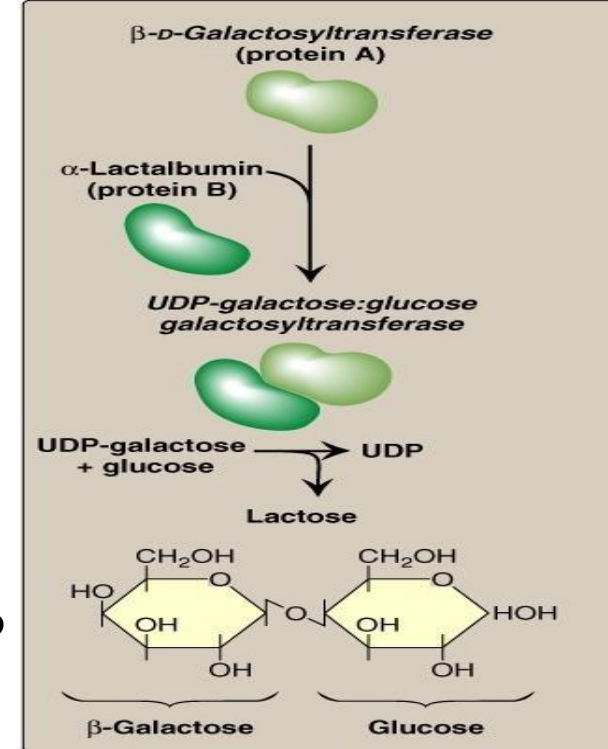
Metabolism of Glucuronic acid



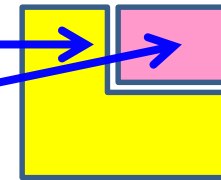
- Is a quantitatively minor route of glucose metabolism
- It provides biosynthetic precursors and interconverts some less common sugars to ones that can be metabolized.

Lactose (Galactosyl β (1 \rightarrow 4) glucose) Synthesis

- Produced by mammary glands
- Galactosyl β (1 \rightarrow 4) glucose is found in glycolipids and glycoproteins



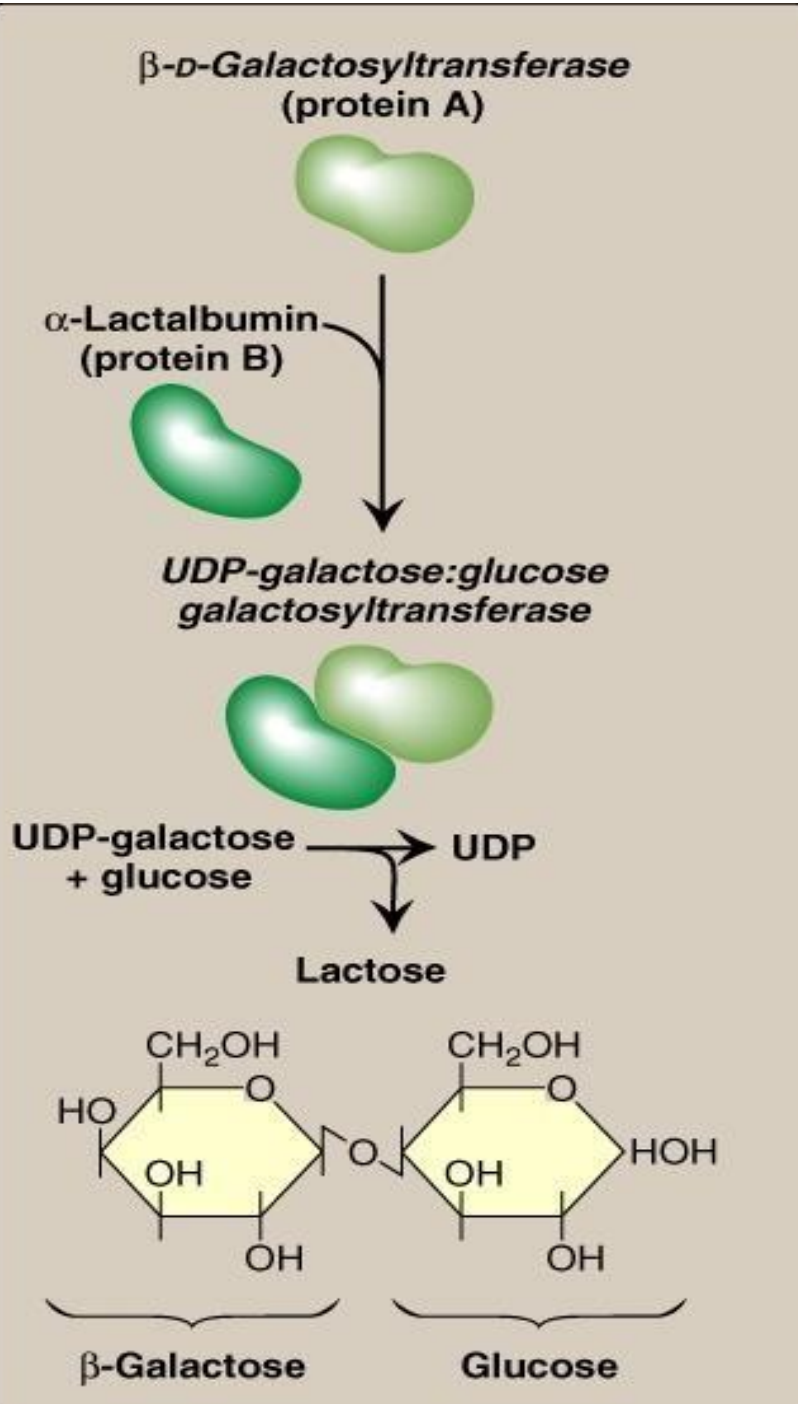
- Lactose Synthase: complex of 2 proteins
 - Galactosyl transferase (Protein A)
 - α -lactalbumin (Protein B)
- Only in mammary glands, its synthesis is stimulated by prolactin



Lactose synthesis in mammary glands

In glycolipids and N-linked glycoprotein synthesis





Lactose Synthesis in Mammary Glands