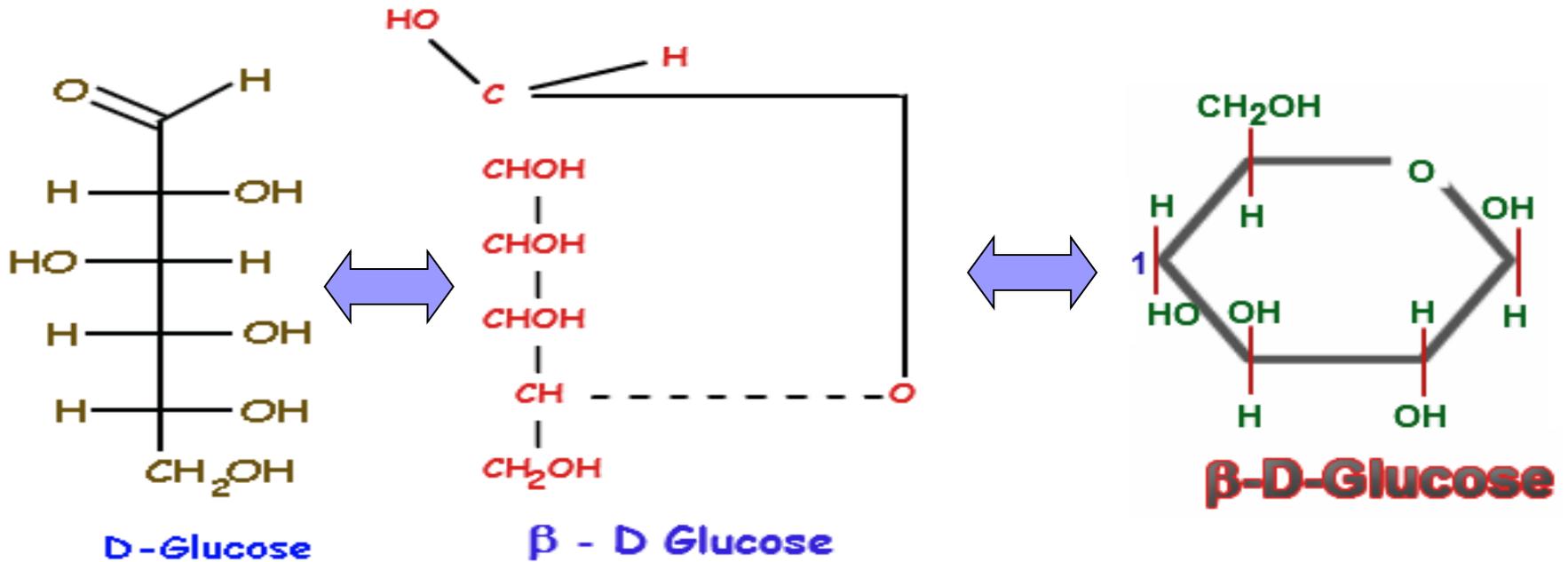


A close-up photograph of a white bowl filled with uncooked, yellow penne pasta. The pasta pieces are short, cylindrical, and have a hollow center. A dark, semi-transparent horizontal banner is overlaid across the middle of the image, containing the word "CARBOHYDRATES" in large, bold, white, sans-serif capital letters. In the top-left corner of the overall image, there is a decorative graphic consisting of a grid of squares in shades of blue and white.

# CARBOHYDRATES

# Structure of Glucose



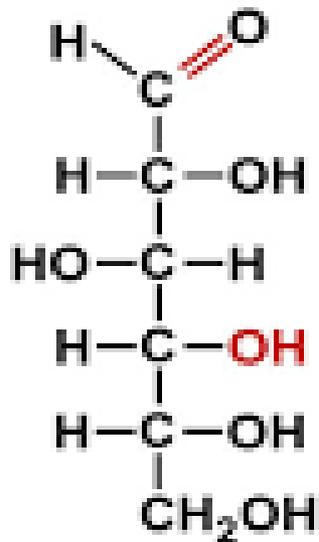
Open chain form

Hemiacetal form

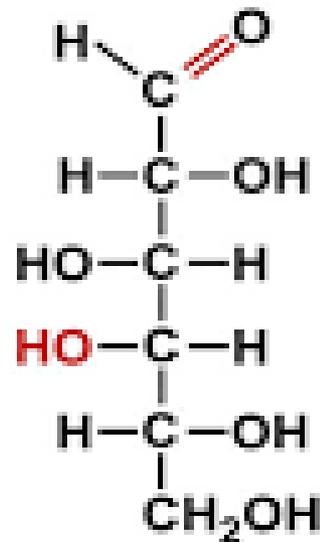
Pyranose ring structure  
(6 membered ring)

# Classification based on the number of subunits

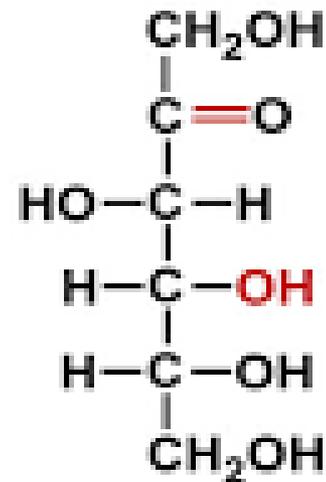
## Carbohydrate Isomers



*Glucose*



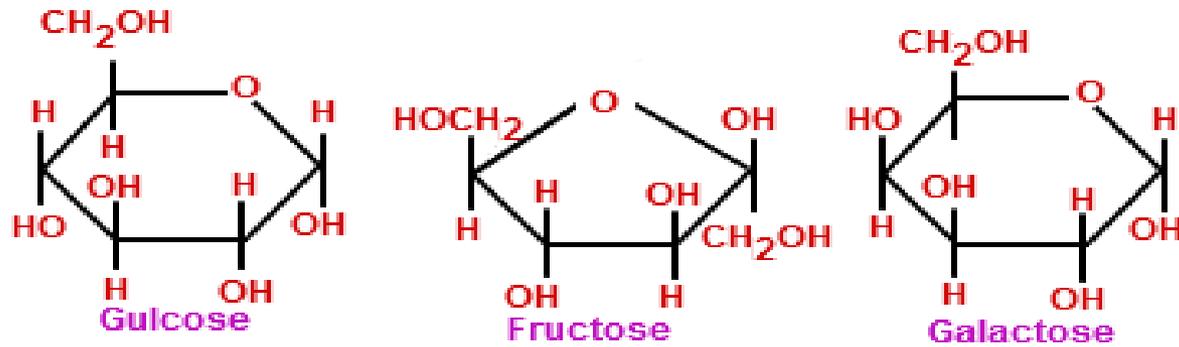
*Galactose*



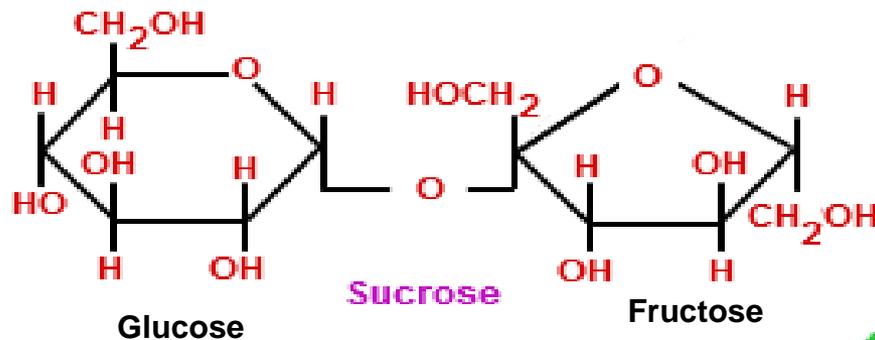
*Fructose*

## Monosaccharides

# Classification based on the number of subunits



Monosaccharides



Sucrose

Glucose

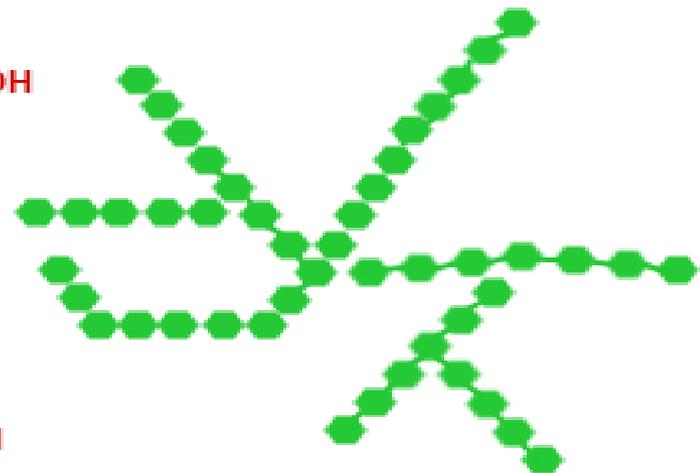
Fructose

Galactose

Lactose

Glucose

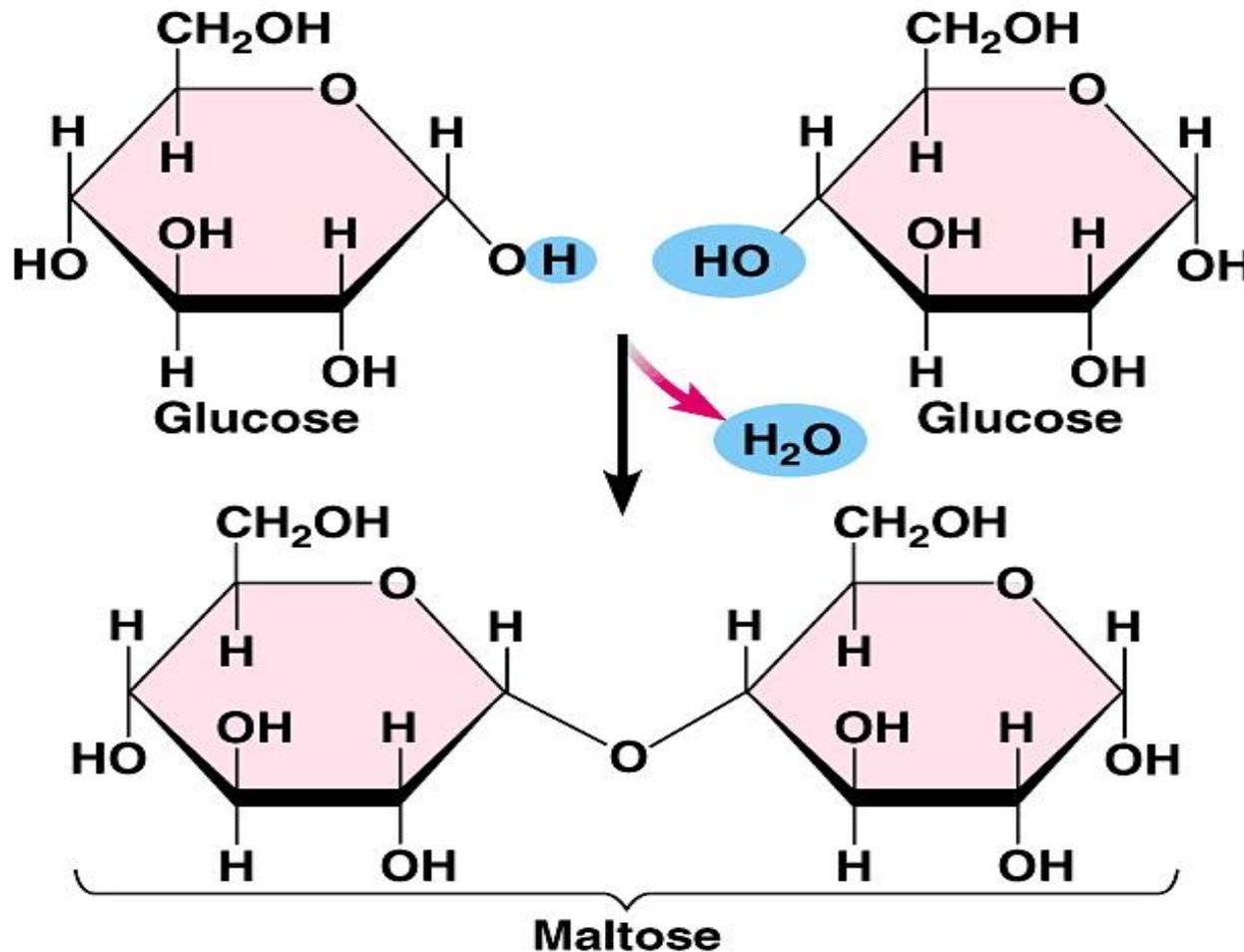
Disaccharides



Glycogen

polysaccharide

# Formation of disaccharide by dehydration synthesis

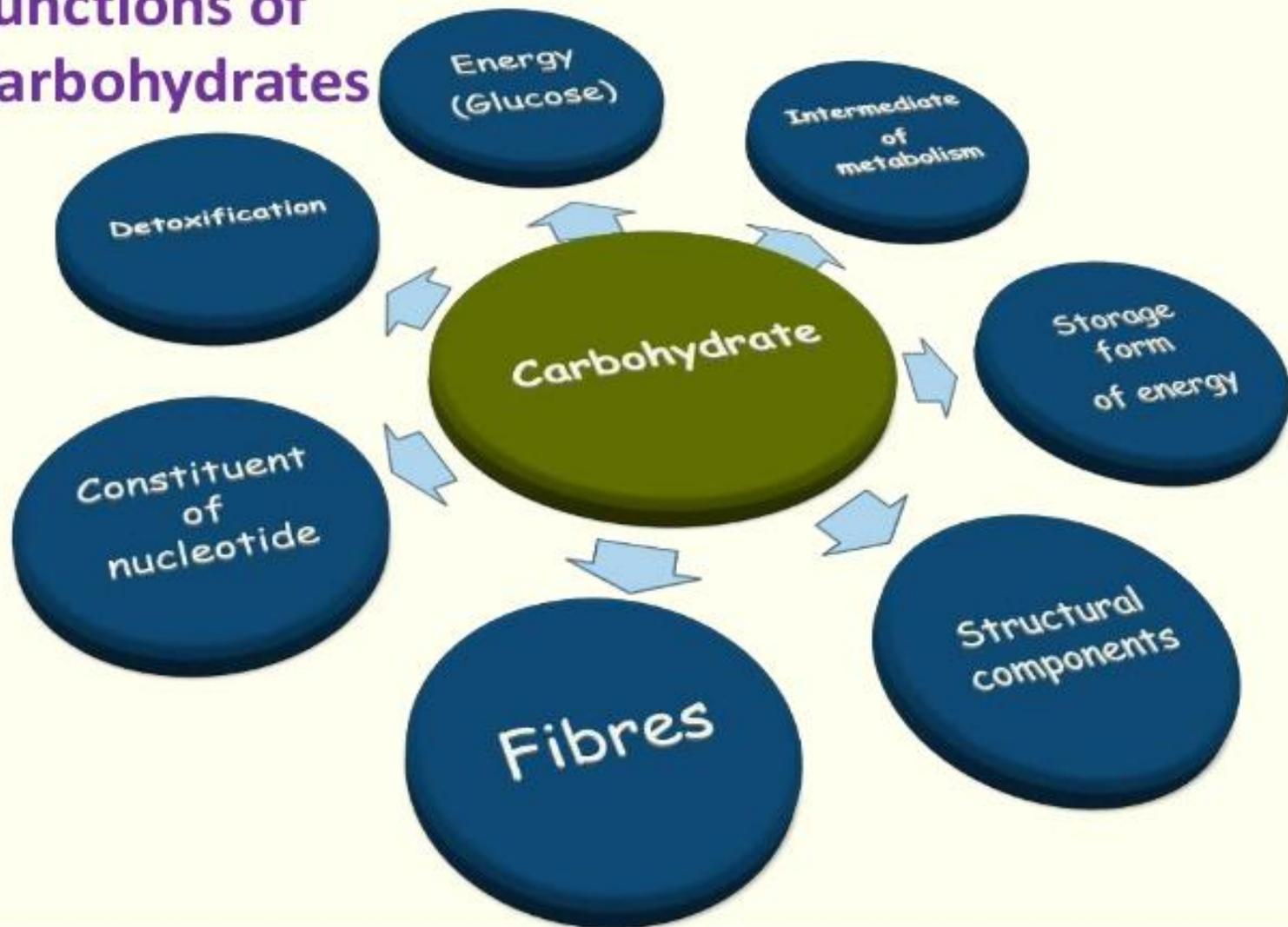


## Examples of Polysaccharides

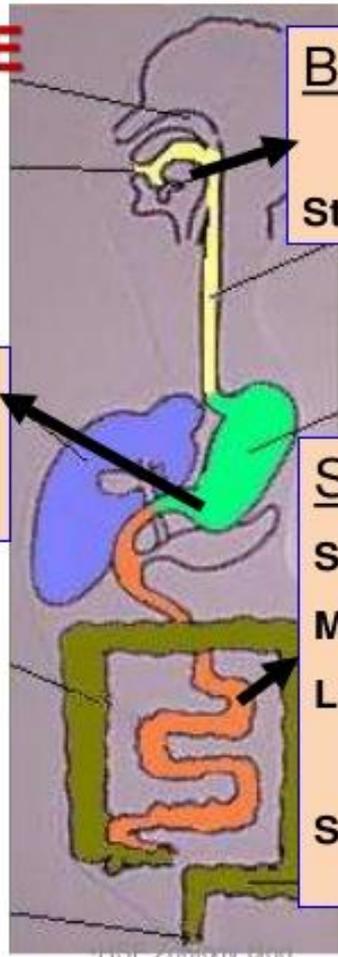
Name of the Polysaccharide	Composition	Occurrence	Functions
<b>Starch</b>	<b>Polymer of glucose containing a straight chain of glucose molecules (amylose) and a branched chain of glucose molecules (amylopectin)</b>	<b>In several plant species as main storage carbohydrate</b>	<b>storage of reserve food</b>
<b>Glycogen</b>	<b>Polymer of glucose</b>	<b>Animals (equivalent of starch)</b>	<b>Storage of reserve food</b>
Insulin	Polymer of fructose	In roots and tubers (like Dahlia)	Storage of reserve food
<b>Cellulose</b>	<b>Polymer of glucose</b>	<b>Plant cell wall</b>	<b>Cell wall matrix</b>
Pectin	Polymer of galactose and its derivatives	Plant cell wall	Cell wall matrix

Name of the Polysaccharide	Composition	Occurrence	Functions
Murein	Polysaccharide cross linked with amino acids	Cell wall of prokaryotic cells	Structural protection
<b>Hyaluronic acid</b>	<b>Polymer of sugar acids</b>	<b>Connective tissue matrix, Outer coat of mammalian eggs</b>	<b>Ground substance, protection</b>
Chondroitin sulphate	Polymer of sugar acids	Connective tissue matrix	Ground substance
Heparin	Closely related to chondroitin	Connective tissue cells	Anticoagulant
Gums and mucilages	Polymers of sugars and sugar acids	Gums - bark or trees. Mucilages - flower	Retain water in dry seasons
Chitin	Polymer of glucose	Bodywall of arthropods. In some fungi also	Exoskeleton Impermeable to water

# Functions of Carbohydrates



# CARBOHYDRATE DIGESTION



Buccal cavity  
Salivary amylase  
Starch → Maltose

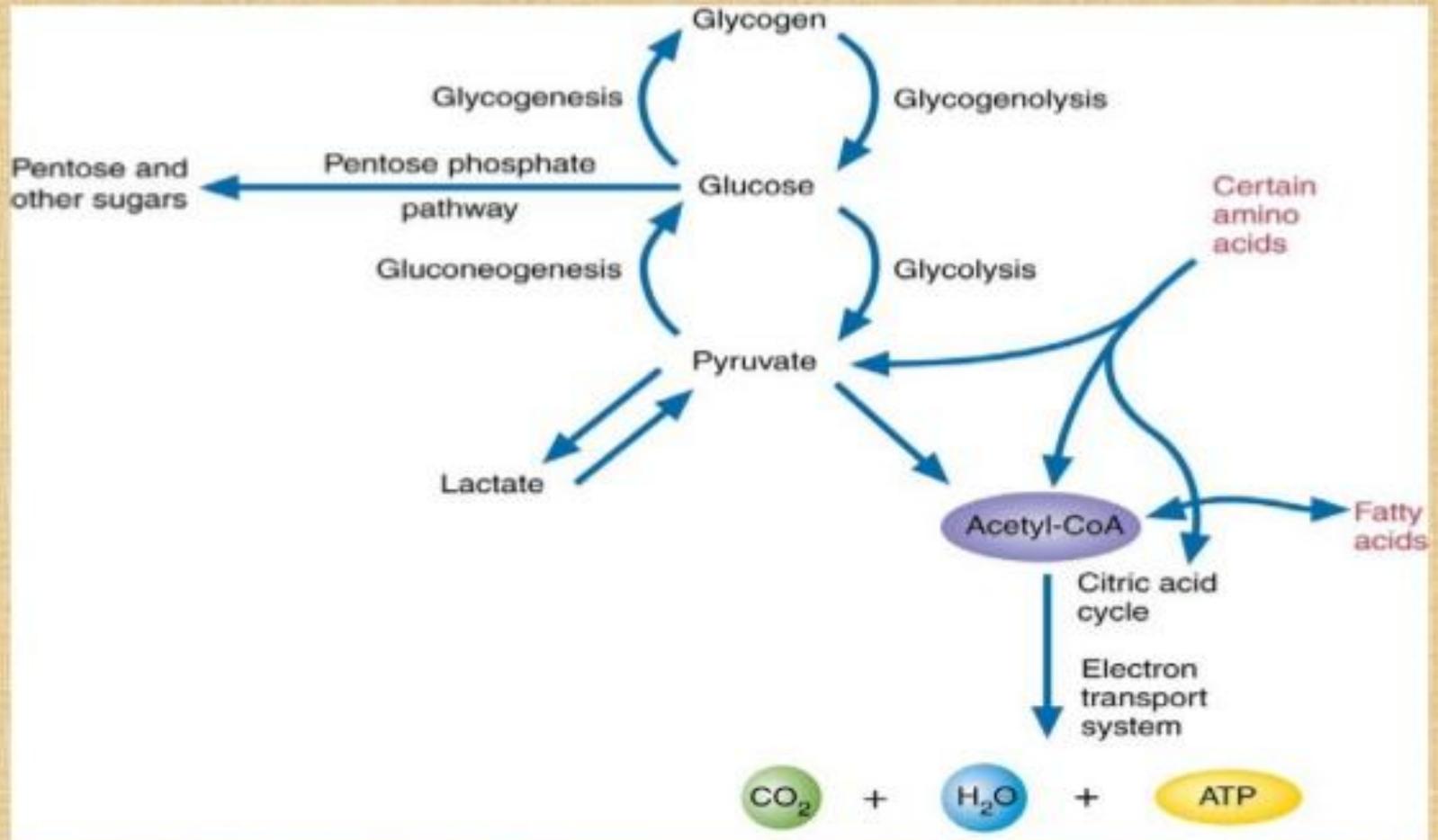
Stomach  
No carbohydrate digestion

Small Intestine  
Starch  $\xrightarrow{\text{P. amylase}}$  Maltose  
Maltose  $\xrightarrow{\text{Maltase}}$  2 Glucose  
Lactose  $\xrightarrow{\text{Lactase}}$  Glucose + Galactose  
Sucrose  $\xrightarrow{\text{Sucrase}}$  Glucose + Fructose

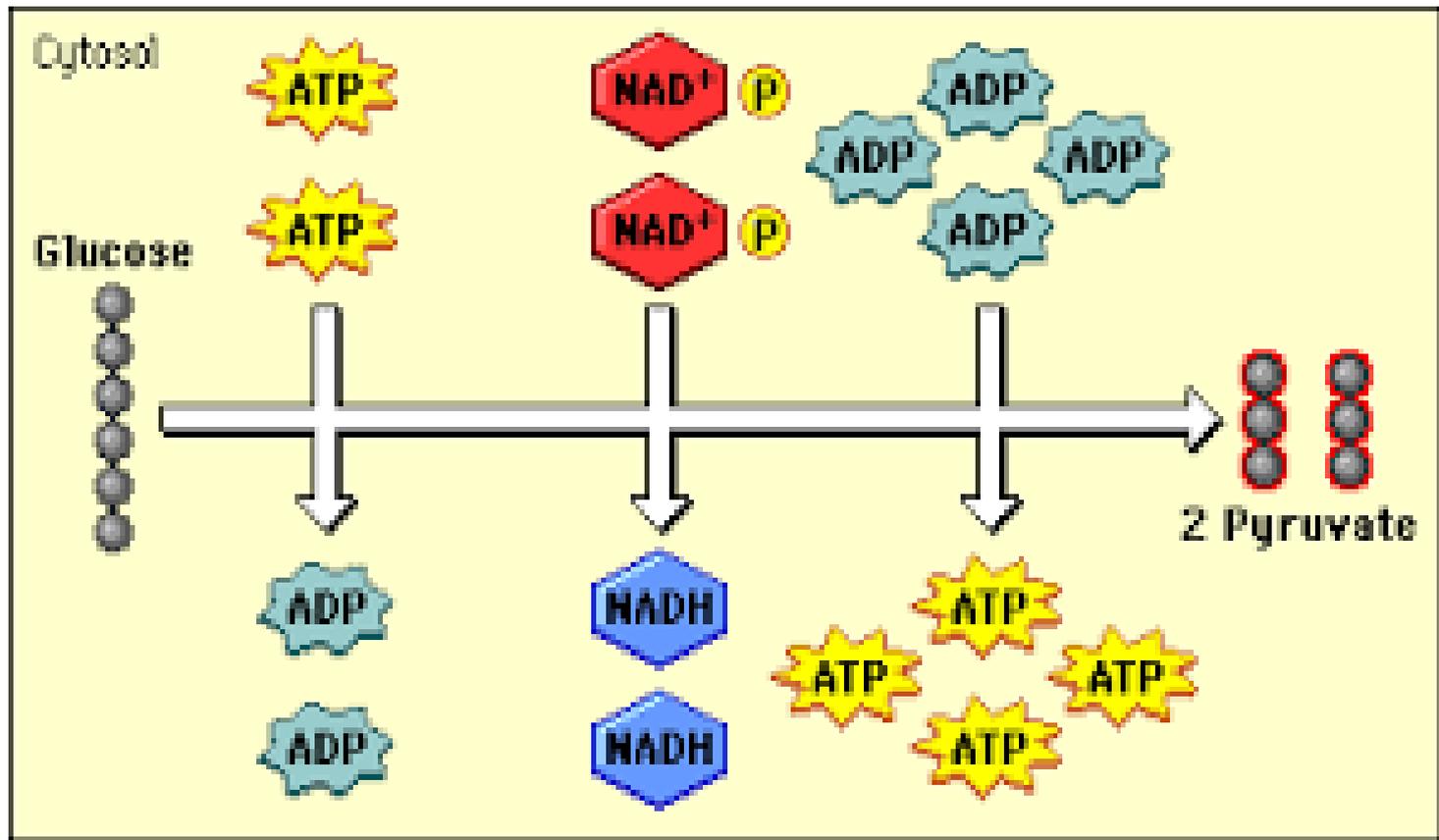
## How much fiber do you need?

	<b>Age 50 or younger</b>	<b>Age 51 or older</b>
<b>Men</b>	<b>38 grams</b>	<b>30 grams</b>
<b>Women</b>	<b>25 grams</b>	<b>21 grams</b>

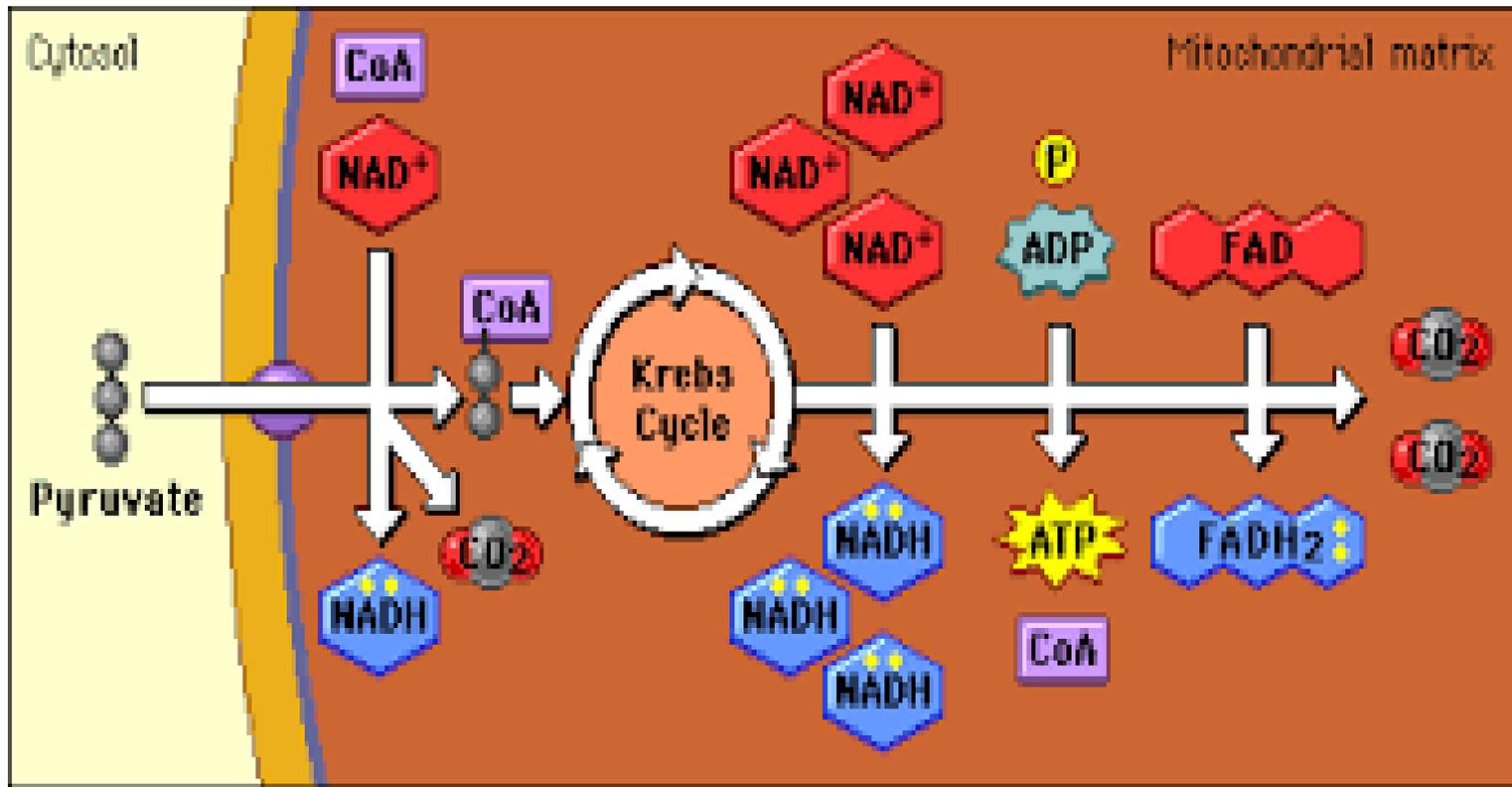
# MAJOR PATHWAYS OF CARBOHYDRATE METABOLISM



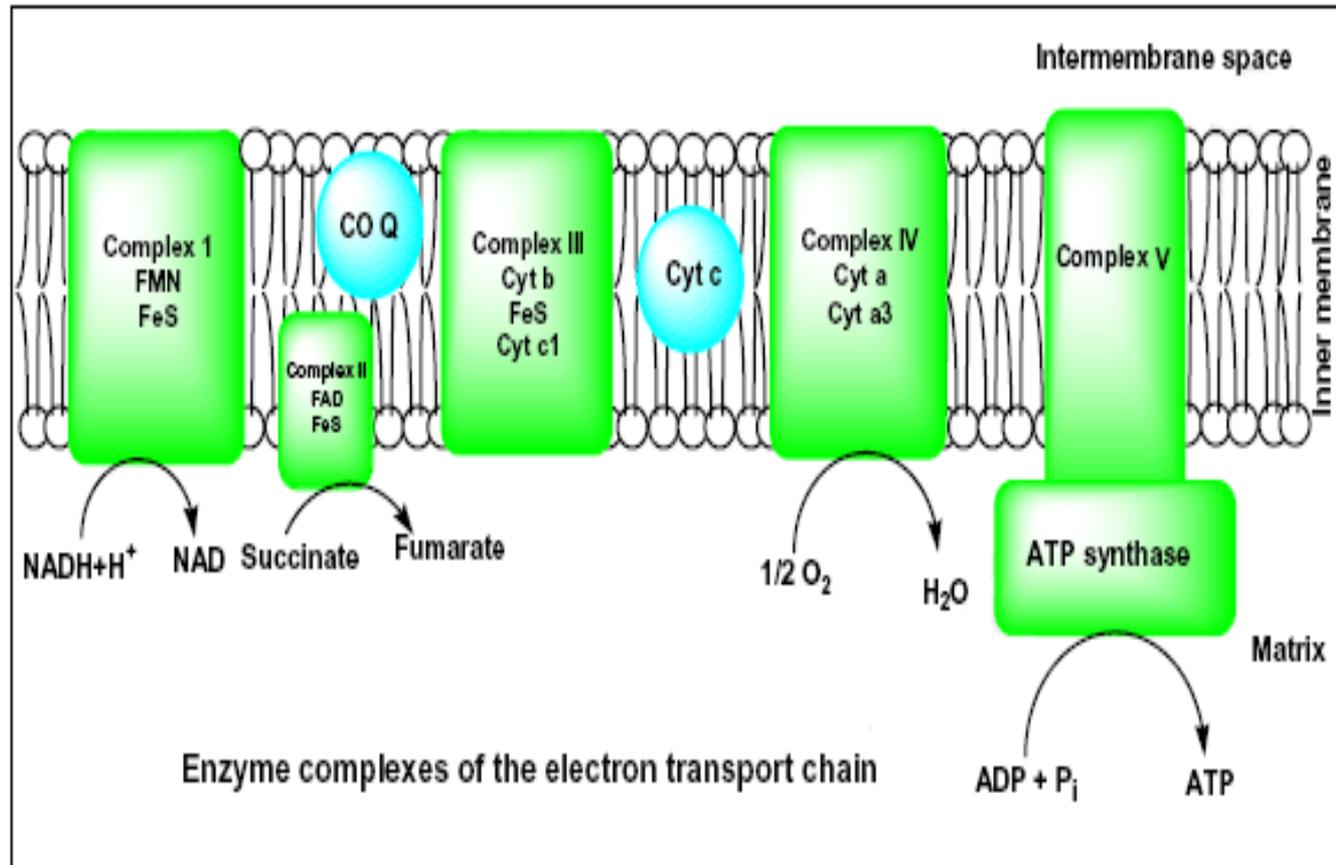
# 1. Glycolysis



## 2. Kreb's cycle/ TCA Cycle/ Citric Acid Cycle



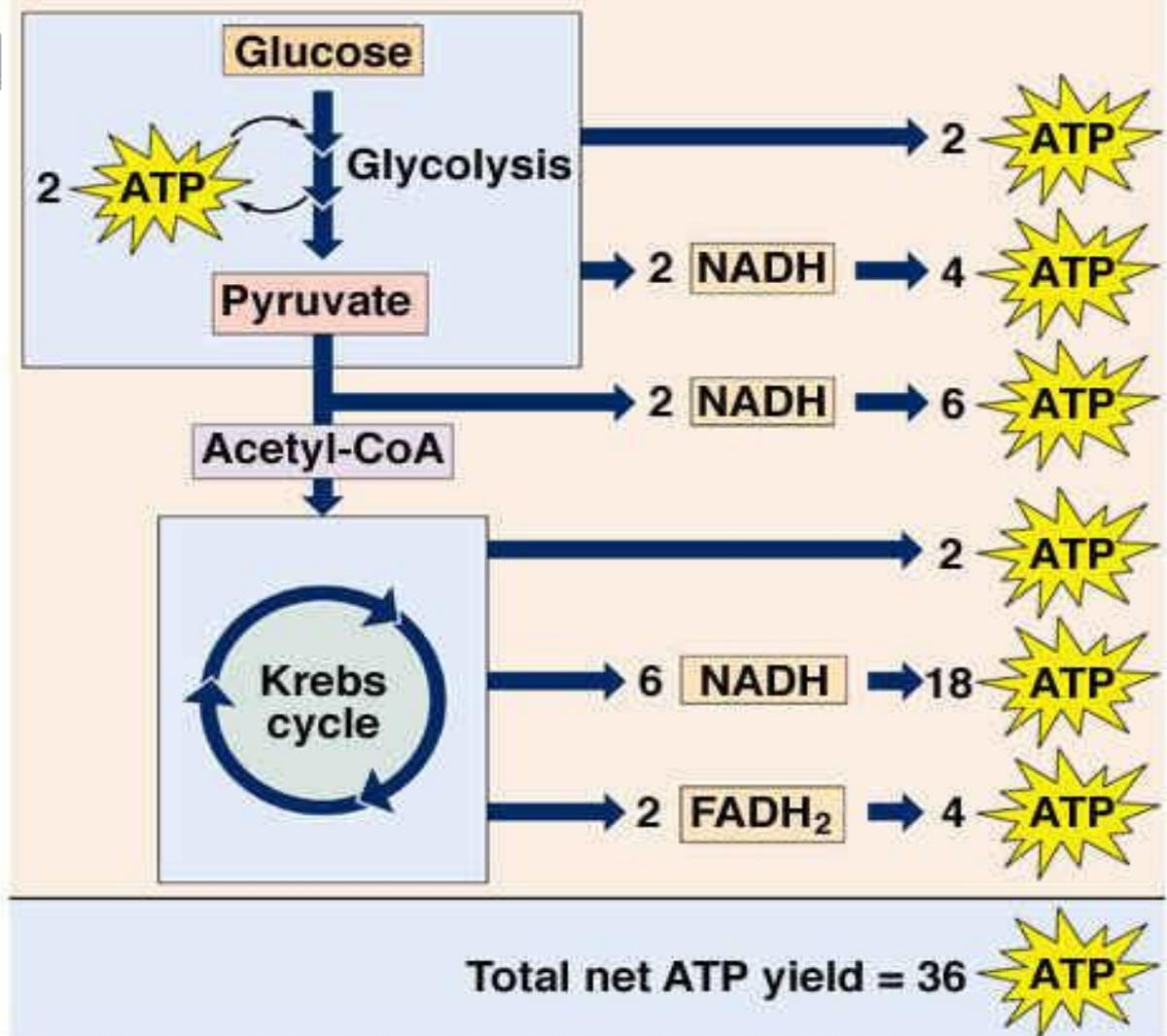
### 3. Electron Transport Chain (ETC)



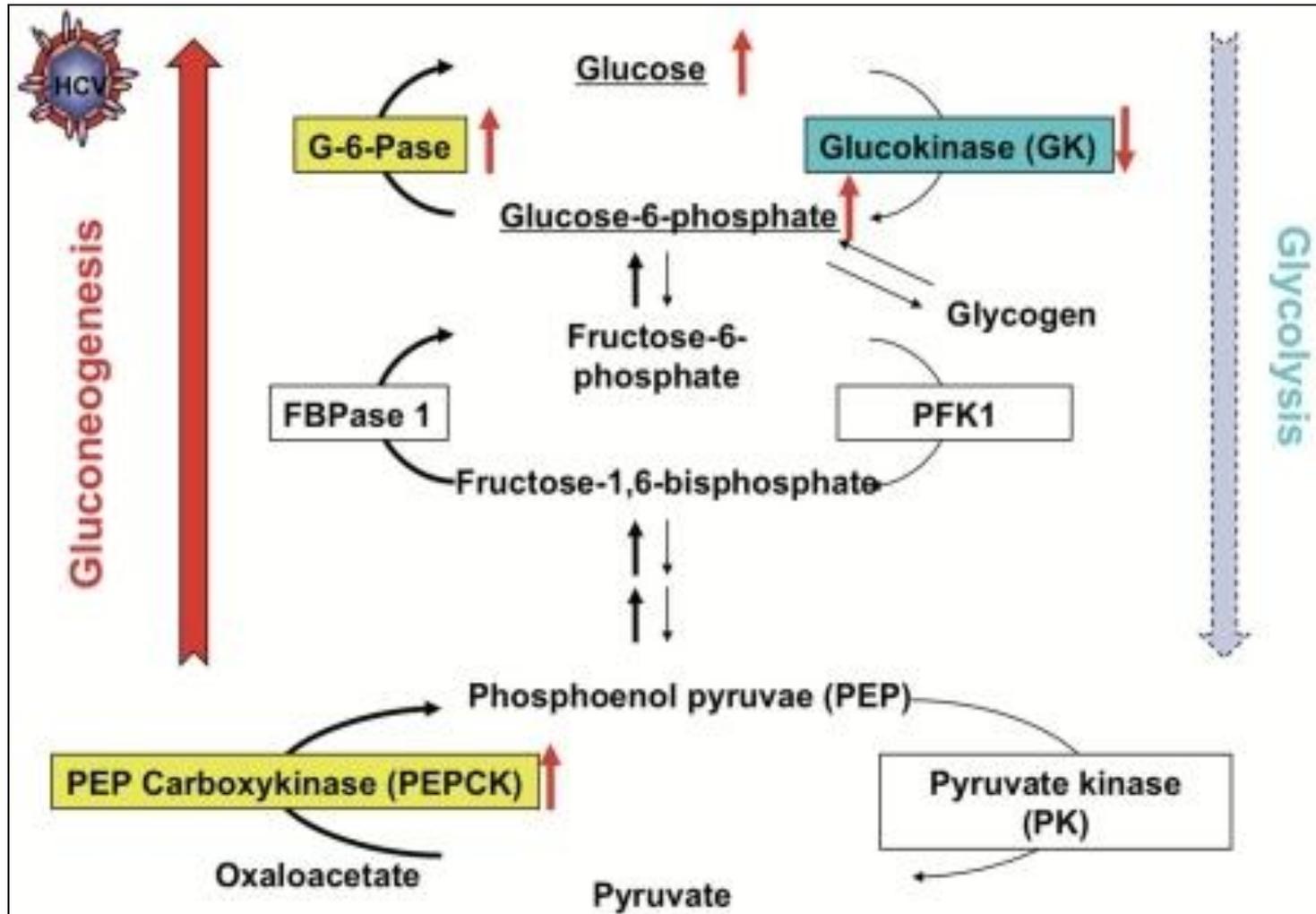
# ATP Yield in Aerobic Respiration:

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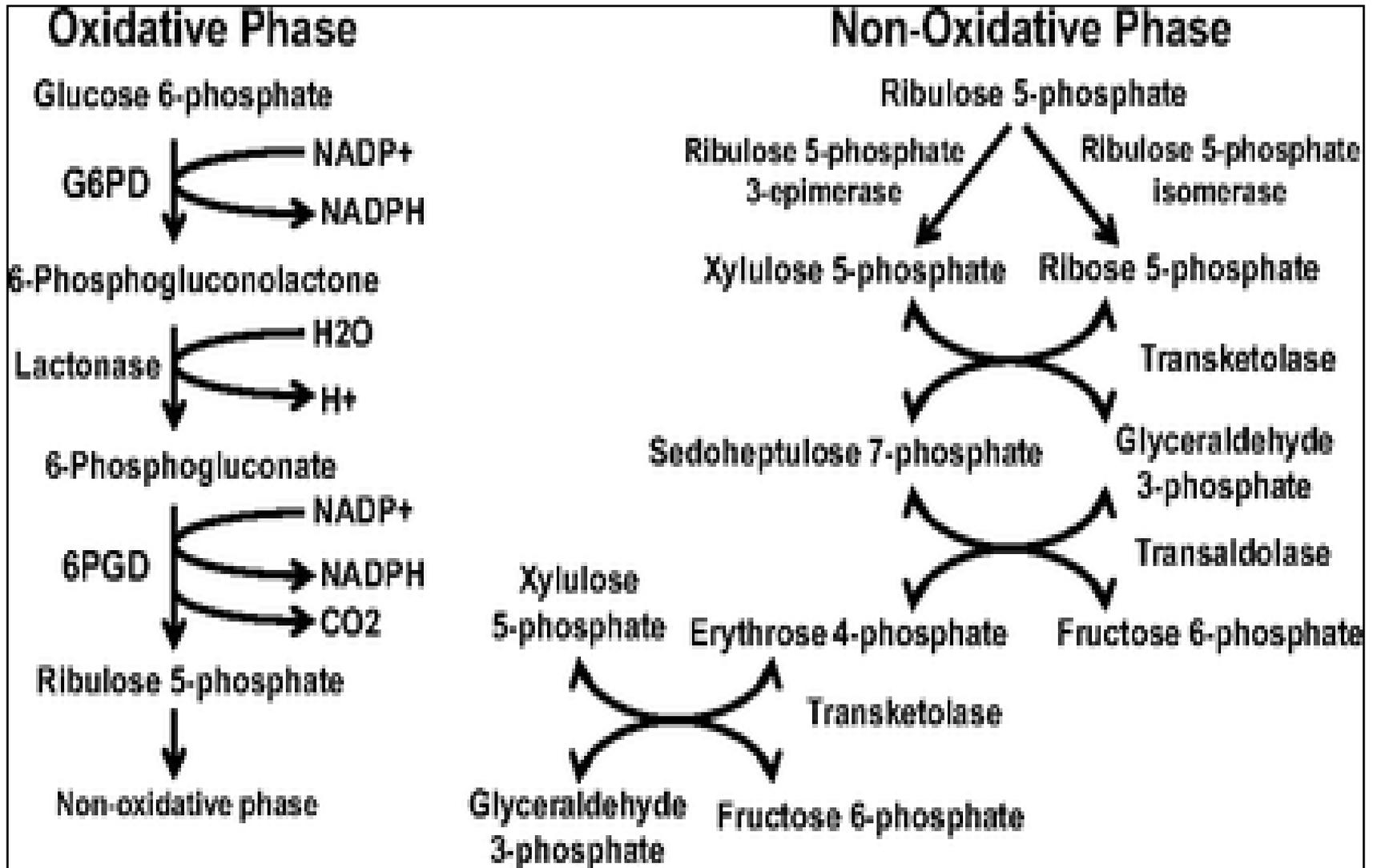
## ATP Theoretical Yield



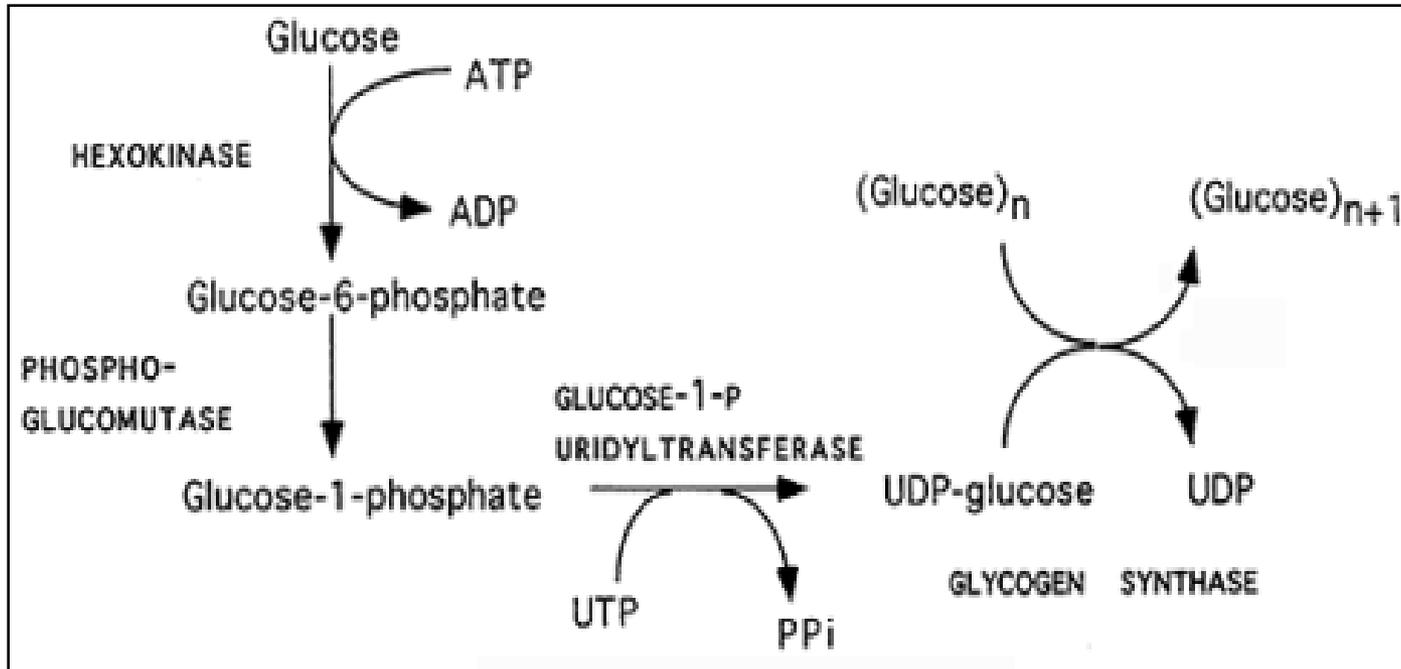
## 4. Gluconeogenesis



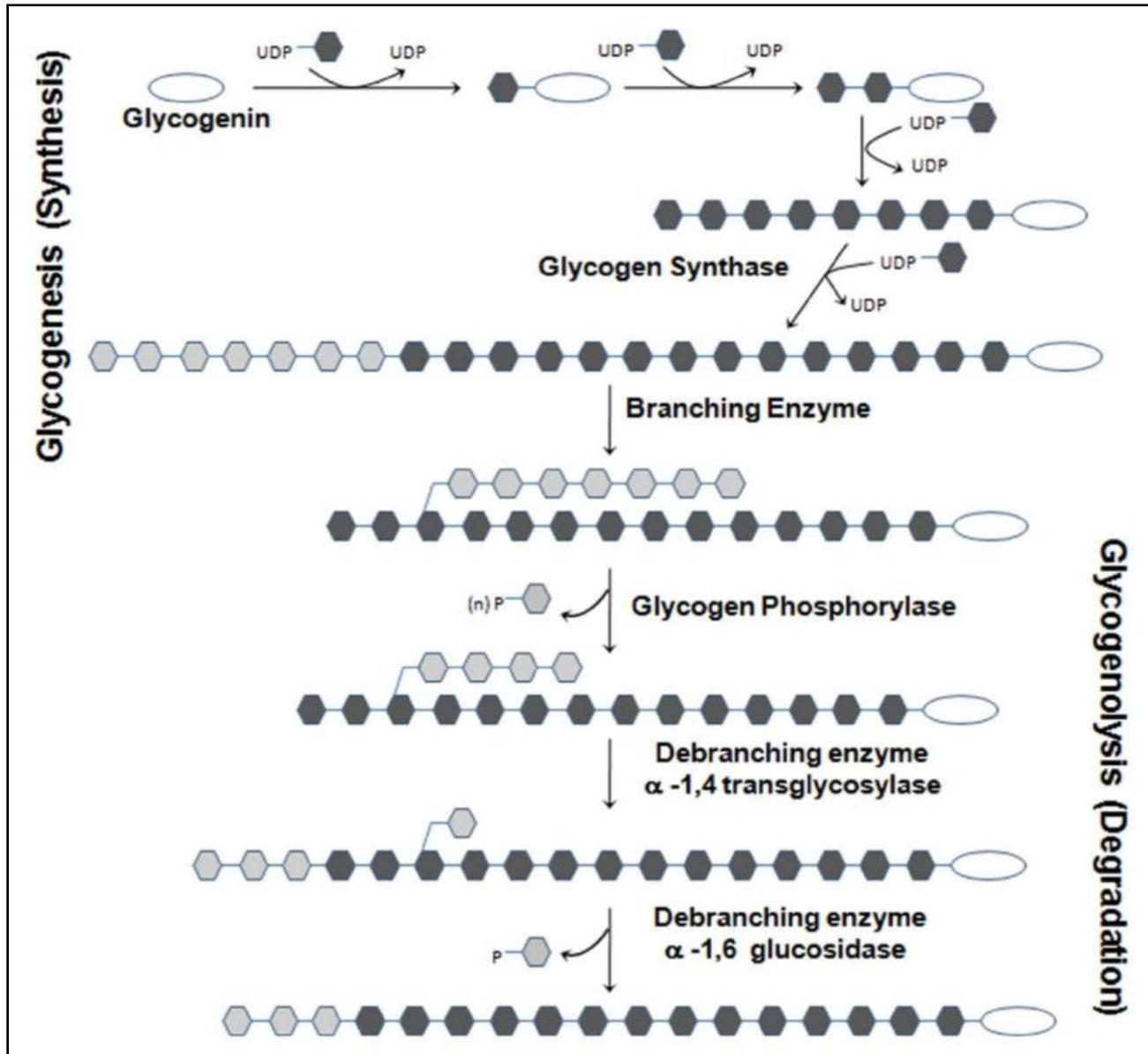
# 5. Pentose Phosphate Pathway



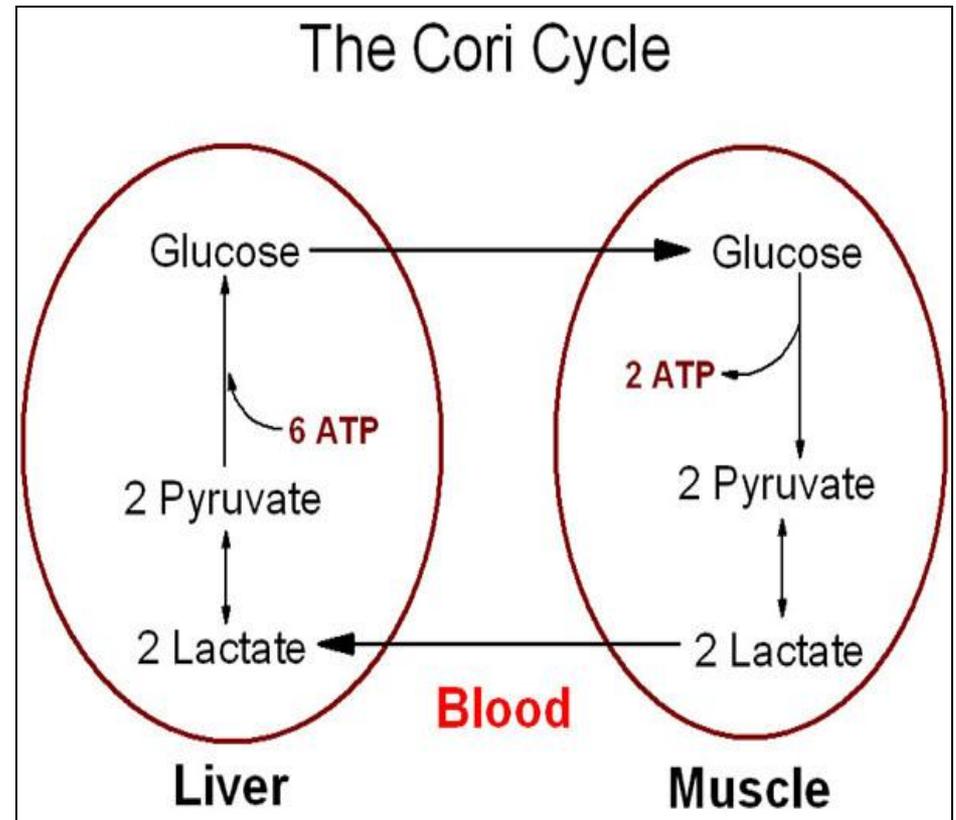
## 6. Glycogenesis & Glycogenolysis



# 6. Glycogenesis & Glycogenolysis



**Cori cycle:** A metabolic pathway in which lactate produced by anaerobic glycolysis in the muscles moves to the liver and is converted to glucose, which then returns to the muscles and is metabolized



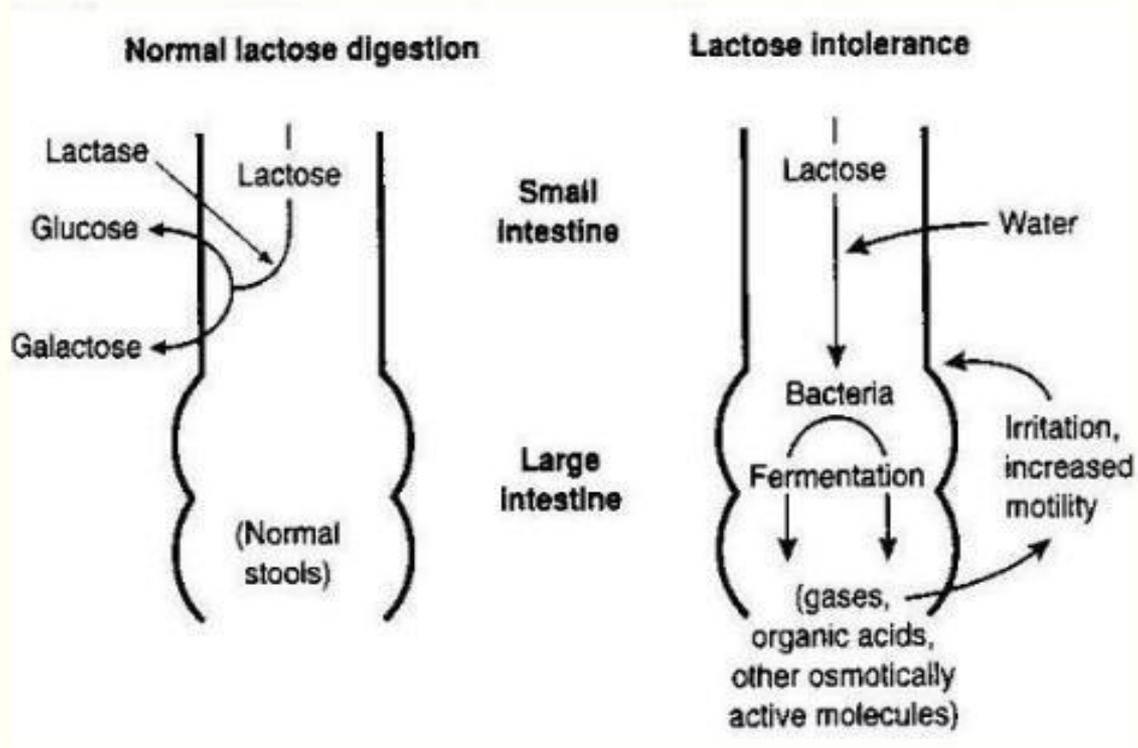


# Disorders of Carbohydrate Metabolism

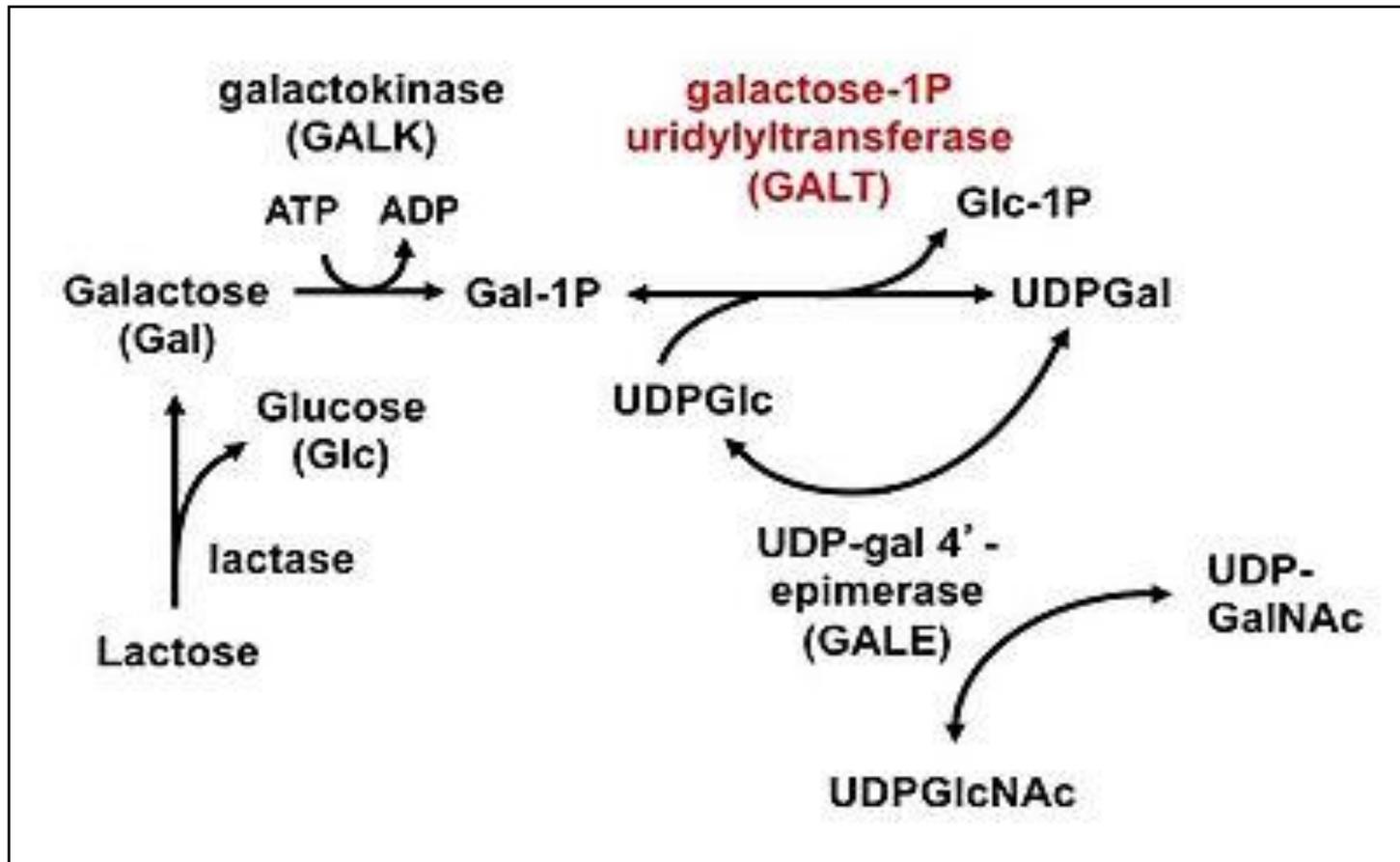
- Lactose Intolerance
- Galactosemia
- Fructose Intolerance
- Glycogen Storage Disease
- Diabetes Mellitus
- Hypoglycemia

# Lactose Intolerance

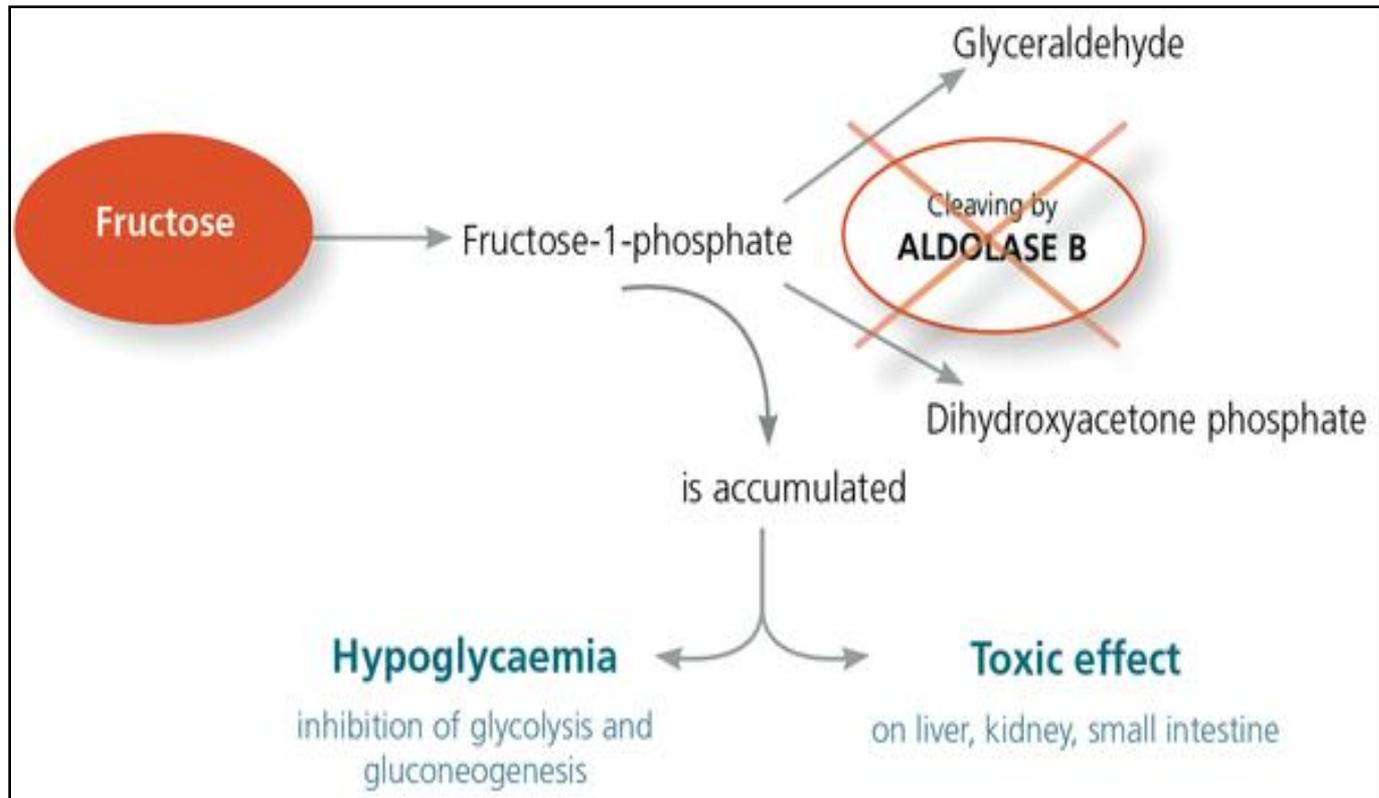
Deficiency of the enzyme lactase



# Galactosemia



# Fructose Intolerance

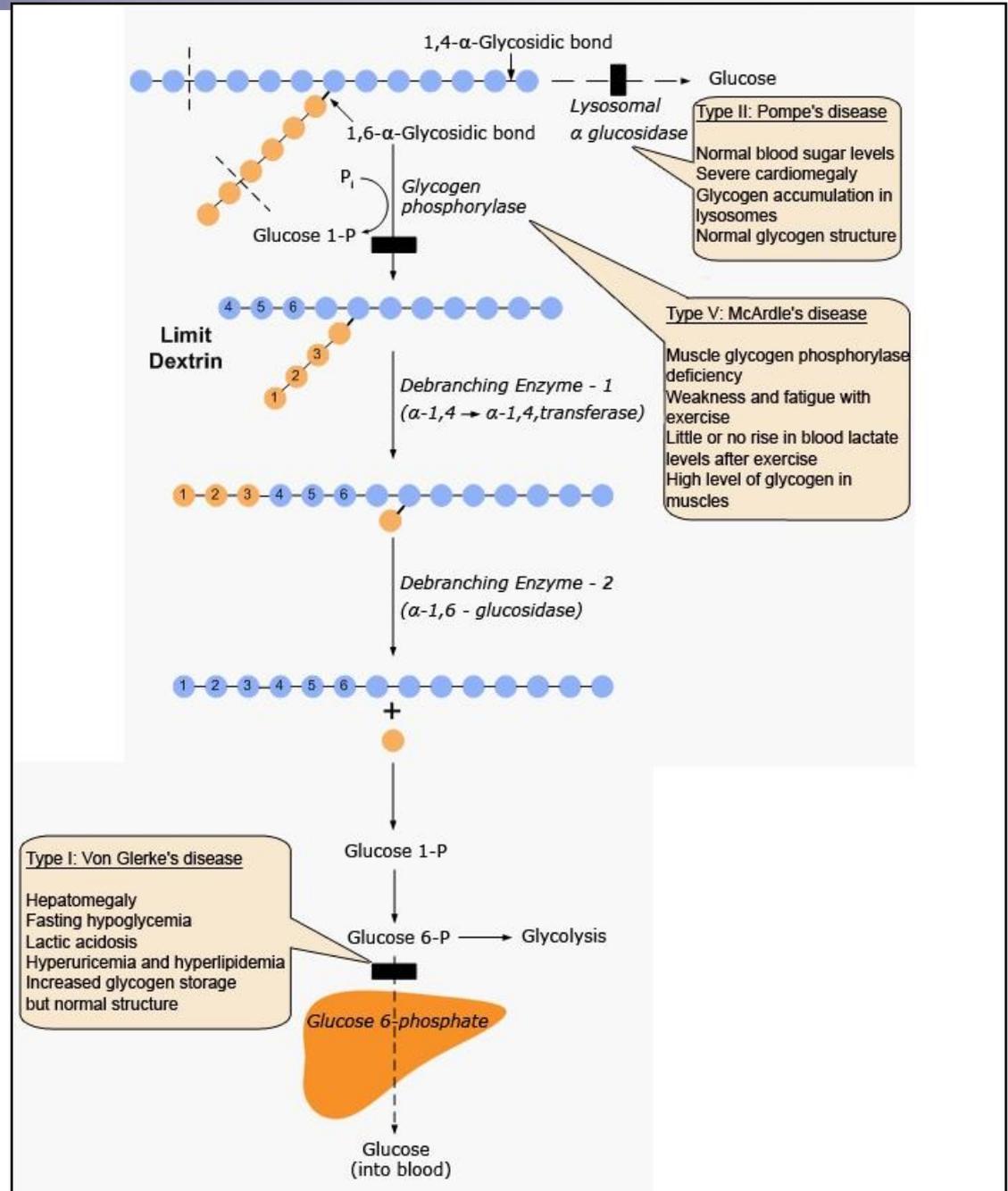


# Glycogen Storage Disease (GSD)

- Also known as **Glycogenosis** or **Dextrinosis**
- Is the result of defects in the processing of **glycogen** breakdown or synthesis within muscles, liver, and other cell types.
- GSD has two classes of cause: genetic and acquired.

TYPE	ENZYME DEFECT	CLINICAL FEATURES
<b>Type I (Von Gierke's disease)</b>	Glucose-6-phosphatase deficiency.	Hypoglycemia, enlarged liver and kidneys, gastro-intestinal symptoms, Nose bleed, short stature, gout
<b>Type II (Pompe's disease)</b>	Acid maltase deficiency	Diminished muscle tone, heart failure, enlarged tongue
<b>Type III (Cori's disease,Forbe disease)</b>	Debranching enzyme deficiency	Hypoglycemia, enlarged liver, cirrhosis, muscle weakness, cardiac involvement
<b>Type IV (Andersen's disease)</b>	Branching enzyme deficiency	Enlarged liver & spleen, cirrhosis, diminished muscle tone, possible nervous system involvement
<b>Type V (McArdle's disease)</b>	Muscle phosphorylase deficiency	Muscle weakness, fatigue and muscle cramps

# Glycogen Storage Disease (GSD)



# DIABETES MELLITUS

IS A SYSTEMATIC ILLNESS THAT INTERFERES WITH THE BODY'S ABILITY TO PROCESS CARBOHYDRATES AND SUGAR INTO FUEL.



## TYPE 1: DIABETES



It is due to the body's malfunction to produce insulin in the body, and requires the person to inject insulin.

## TYPE 2: DIABETES

It is due to insulin resistance, a condition in which cells fail to use insulin properly, sometimes combined with an absolute insulin deficiency.

### INSULIN RESISTANCE



Inadequate Insulin Production

## TYPE 3: DIABETES

Gestational diabetes occurs when pregnant women without a previous diagnosis of diabetes develop a high blood glucose level.



© National Health Portal (NHP)

## Effects:

- Hyperglycemia
- Glycosuria
- Polyuria
- Polydipsia
- Polyphagia
- Ketonuria
- Coma

# HYPOGLYCEMIA

(LOW BLOOD GLUCOSE LEVEL)

**Causes:** Too little food or skip a meal;  
too much Insulin or Diabetes Pills;  
more active than usual

**Onset:** Often Sudden; may pass out if untreated

## SYMPTOMS

 <b>SWEATING</b>	 <b>DIZZY</b>	 <b>ANXIOUS</b>	 <b>HUNGRY</b>
 <b>BLURRY VISION</b>	 <b>WEAKNESS OR FATIGUE</b>	 <b>HEADACHE</b>	 <b>IRRITABLE</b>

**WHAT CAN YOU DO?**

 <b>CHECK</b>	<b>TREAT</b>	 <b>CHECK</b>	 <b>CHECK</b>
--	--------------	--	--

**Check:** your blood glucose right away. If you can't Check; treat anyway

**Treat:** By eating 3 to 4 glucose tablets or 3 to 5 hard candies; you can chew quickly (such as peppermints) or by drinking 4 ounces of Fruit Juice; or 1/2 can of regular soda pop

Check your blood glucose level again after 15 minutes. If it still low, treat again. If symptoms don't Stop, call your health care provider.

- Plasma glucose <60mg/dl
- Decreased insulin & increased glucagon secretion
- May occur due to **Insulinoma** ( $\beta$  cell tumor of pancreas)

# Regulation of blood sugar by Insulin & Glucagon

