

Lecture 5

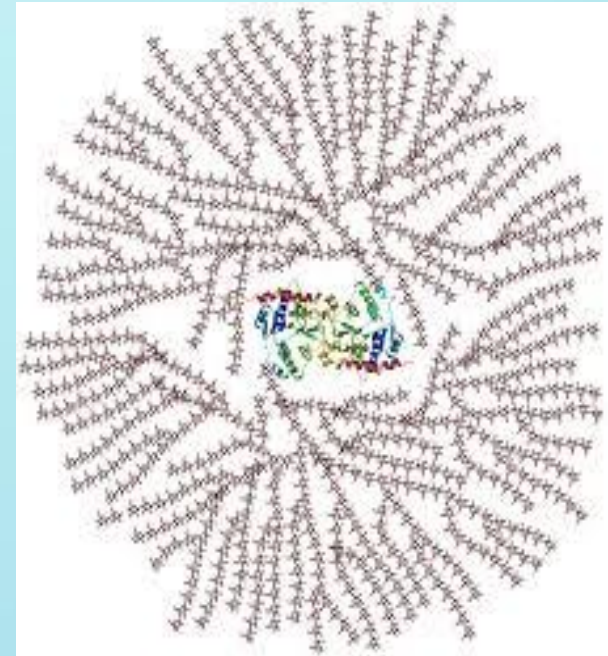
Carbohydrate metabolism

Muthanna University–Veterinary Medicine College-
Physiology And Chemistry Department

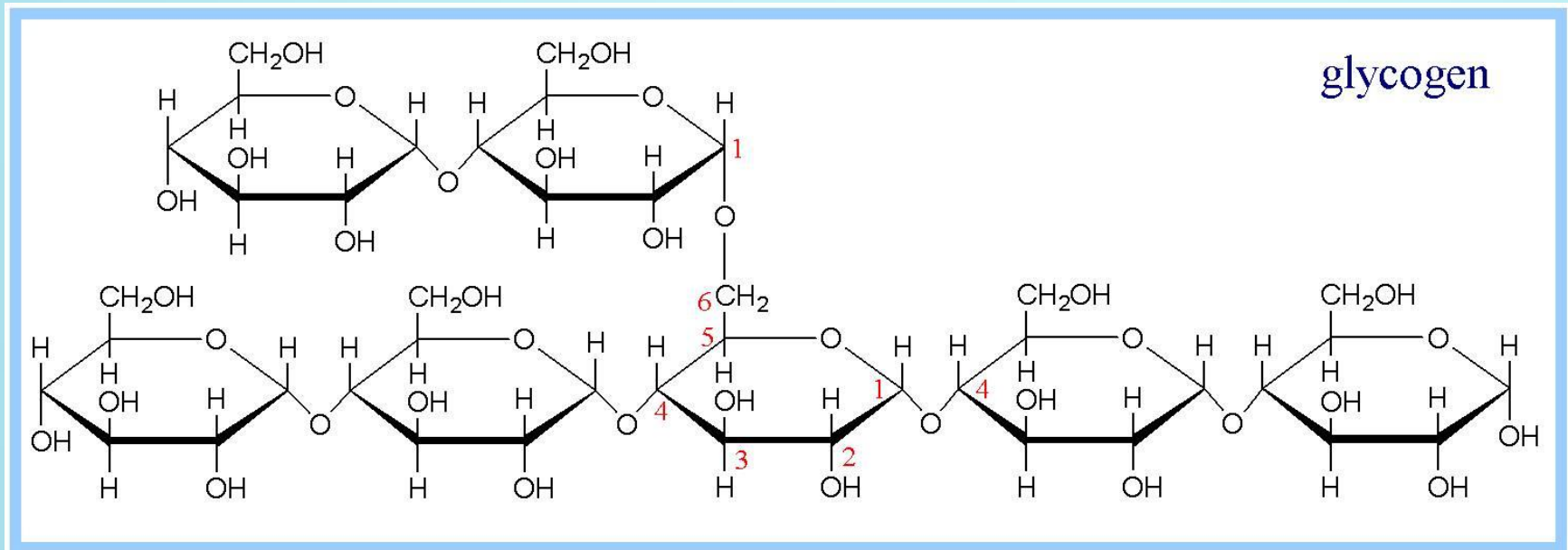
**Senior Lecturer
Hayder H. Abed**

What is Glucogen

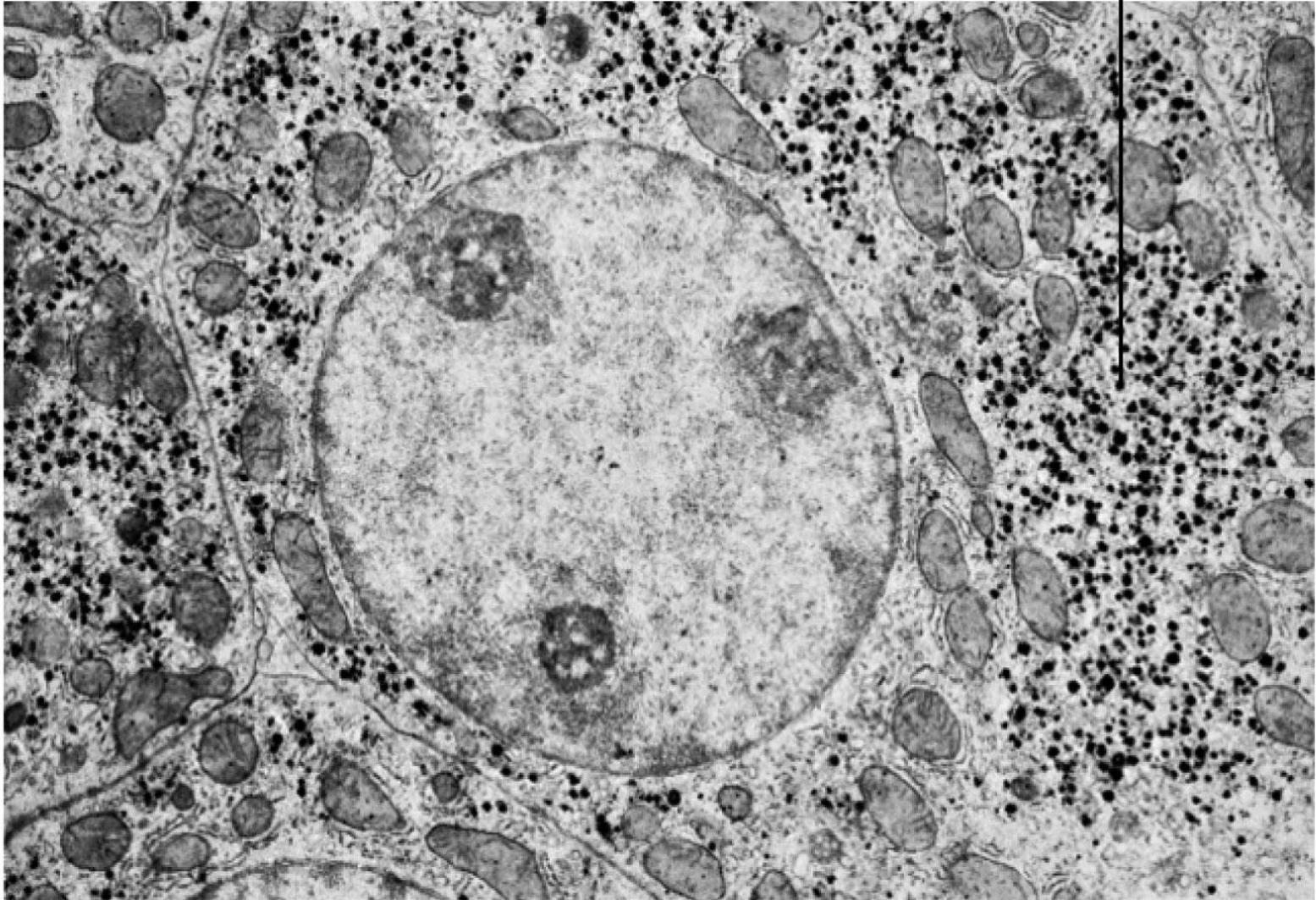
- ▶ Glycogen is a polysaccharide molecule stored in animal cells along with water and used as a source of energy. When broken down in the body, it is transformed into glucose, an important source of energy for animals.



Glucogen structure



Glycogen granules



Glycogen Function

- ▶ In liver – The synthesis and breakdown of glycogen is regulated to maintain blood glucose levels.
- ▶ In muscle – The synthesis and breakdown of glycogen is regulated to meet the energy requirements of the muscle cell.



Hayder H. ABED

BLISTERS

SHINSPLINTS

CHAFING

SIDE STITCH

BONKING

DEHYDRATION

HITTING THE
RED ZONE

LEG CRAMPS

HITTING THE WALL

LEG LOCK

OUCH! You're out of energy.

SCIENCE: You've depleted your liver's supply of glycogen and it can't maintain blood glucose.

CURE: Begin long runs with full glycogen stores and down carbs when runs top 75 minutes.
Aim for 30 to 60 grams per hour.



Want more info on nutrition? [Click here!](#)

Back to **WHERE IT HURTS**

Glycogenesis

Glycogenesis

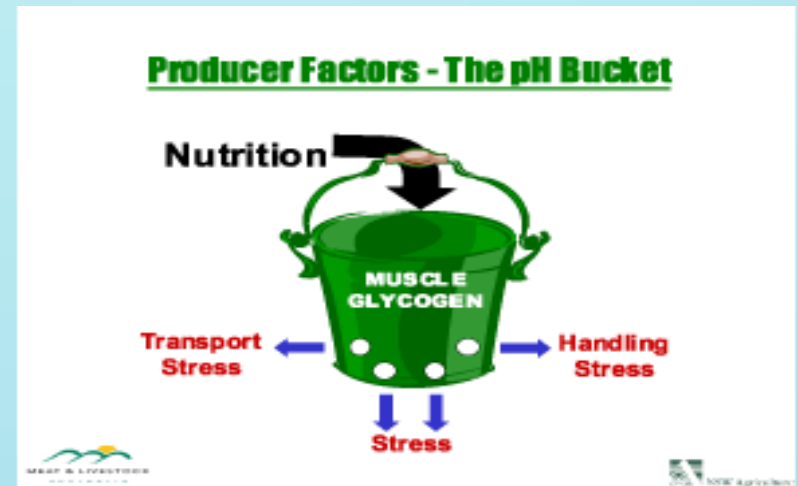
- ▶ Glycogenesis is the process of glycogen synthesis , in which glucose molecules are added to chains of glycogen for storage .
- ▶ Glycogen synthesis takes place in virtually all animal tissues but is especially prominent in the liver and skeletal muscles

Glycogenesis

- ▶ In a wide range of organisms, excess glucose is converted to polymeric forms for storage glycogen in vertebrates and many micro organisms , starch in plants.
- ▶ In vertebrates, glycogen is found primarily in the liver and skeletal muscle; it may represent up to 10% of the weight of liver and 1% to 2%of the weight of muscle.

Glycogenesis

- ▶ The glycogen in muscle provide a quick source of energy for either aerobic or anaerobic metabolism.
- ▶ Liver glycogen serves as a reservoir of glucose for other tissues when dietary glucose is not available.



Glycogenesis

- ▶ Glycogen is a highly branched glucose polymer used for carbohydrate storage in animals
- ▶ Glycogen stores are used to keep the blood sugar level steady between meals
- ▶ **Glycogenesis** is the synthesis of glycogen from glucose-6-phosphate
- ▶ it occurs when high levels of glucose-6-phosphate are formed in the first reaction of glycolysis
- ▶ it does not operate when glycogen stores are full, which means that additional glucose is converted to body fat

Diagram of Glycogenesis

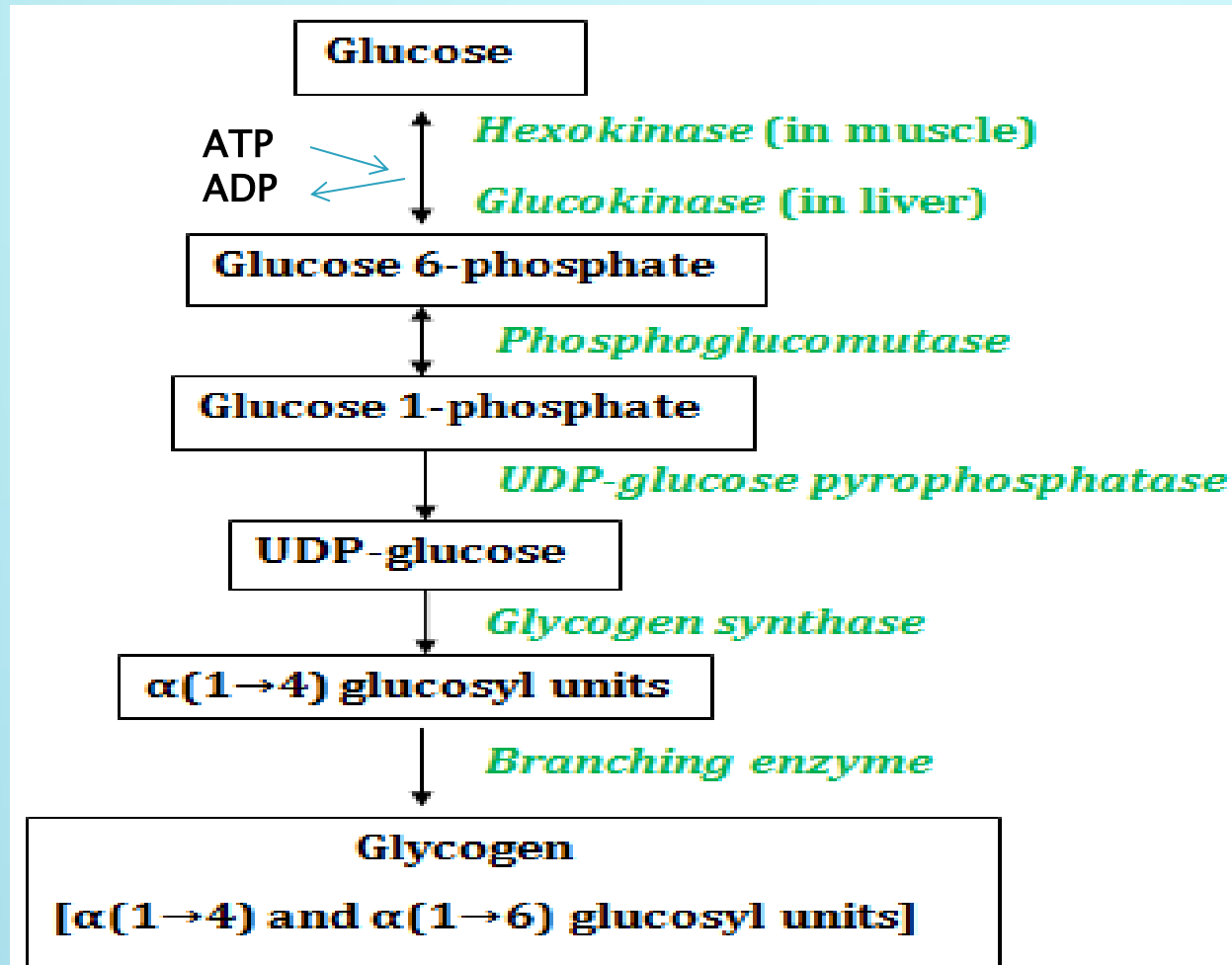
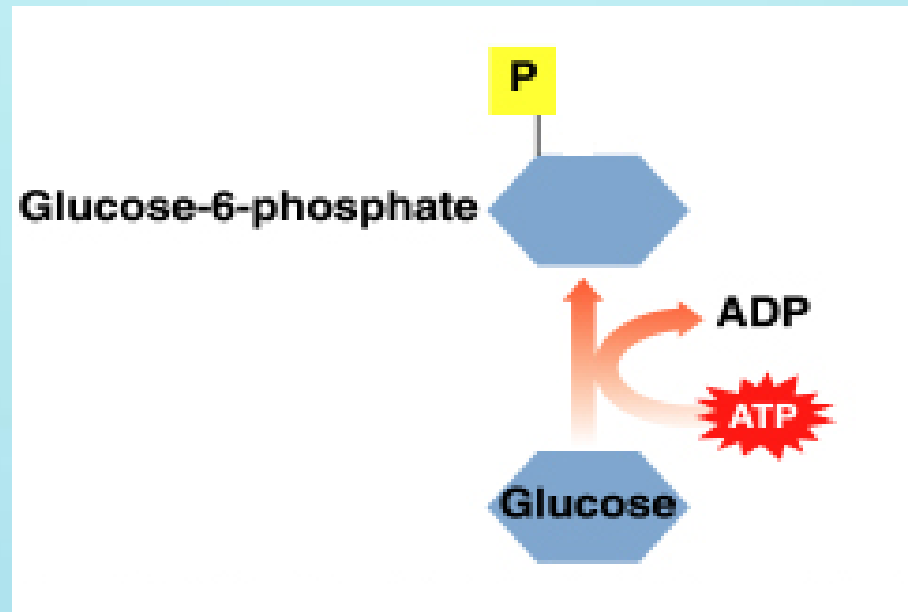
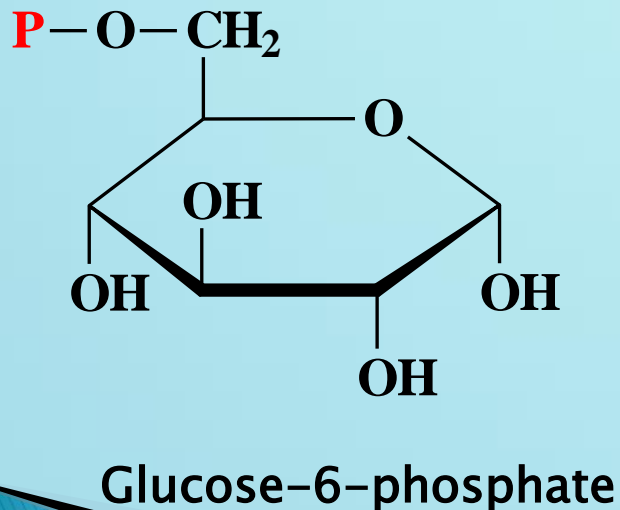


Diagram: Steps of glycogenesis

Steps in glycogenesis

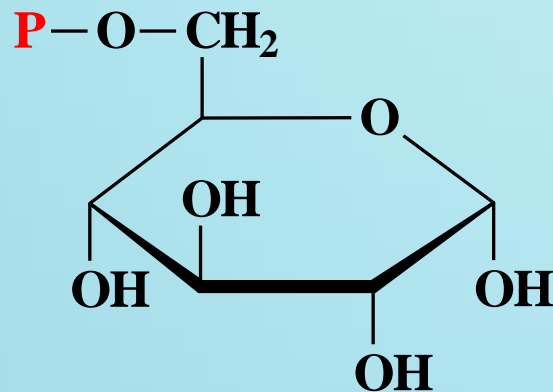
Formation of Glucose-6-Phosphate

- ▶ Glucose is converted into glucose-6-phosphate by the action of glucokinase or hexokinase

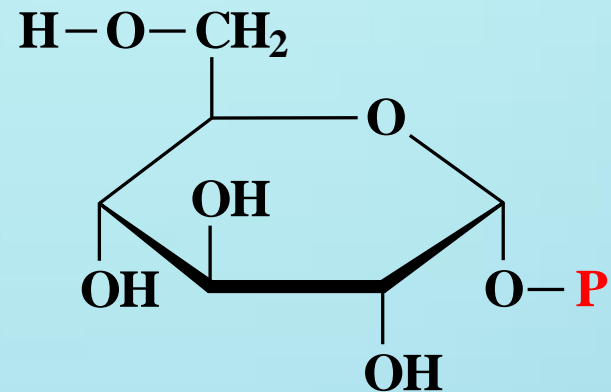
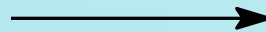


Formation of Glucose-1-Phosphate

- ▶ Glucose-6-phosphate is converted into glucose 1-phosphate by the action Phosphoglucomutase.



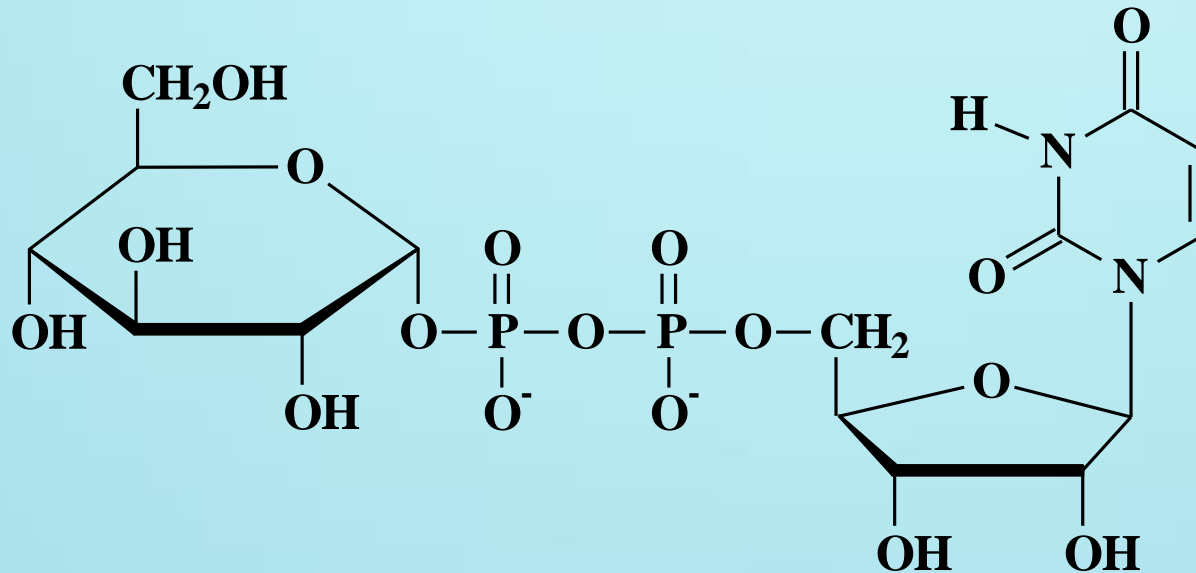
Glucose-6-phosphate



Glucose-1-phosphate

Formation of UTP-Glucose

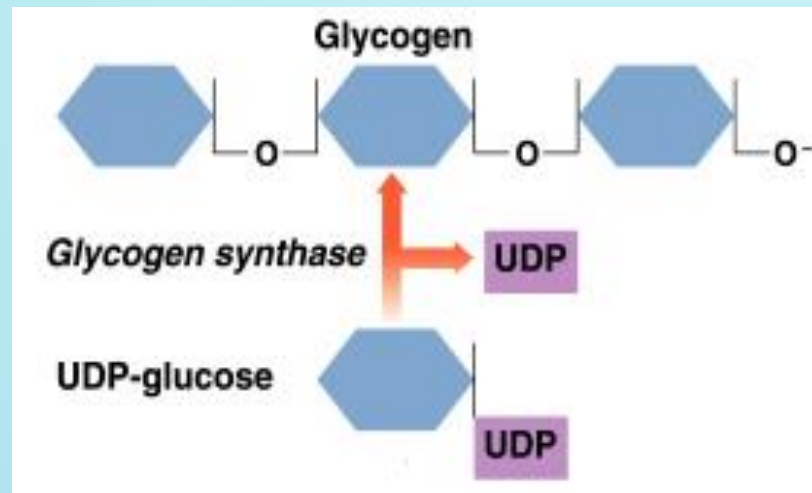
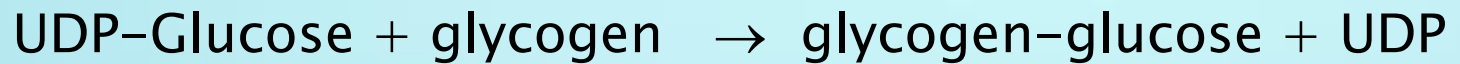
- ▶ UTP activates glucose-1-phosphate to form UDP-glucose and pyrophosphate (PP_i)



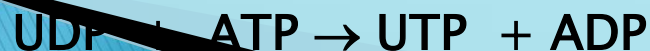
UDP-glucose

Glycogen Formation

- ▶ The glucose in UDP-glucose adds to glycogen



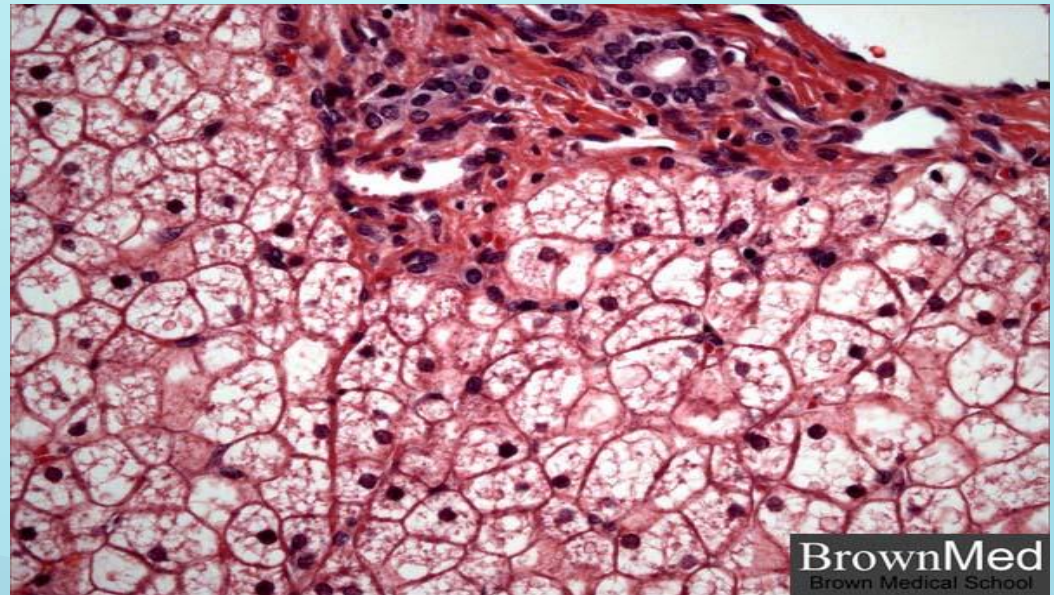
- ▶ The UDP reacts with ATP to regenerate UTP.



Glycogenolysis

Glycogenolysis

- ▶ Glycogenolysis is a catabolic process; the breakdown of glycogen to glucose units.
- ▶ Glycogen is principally stored in the cytosol granules of :-
 - Liver
 - Muscle



Glycogenolysis

- ▶ **Glycogenolysis** is the breakdown of glycogen to glucose
- ▶ The glucose is phosphorylated as it is cleaved from the glycogen to form glucose-1-phosphate
- ▶ Glucose-1-phosphate can be converted to glucose-6-phosphate, which can enter glycolysis
- ▶ Phosphorylated glucose can't be absorbed into cells
in the liver and kidneys, glucose-6-phosphate can be hydrolyzed to glucose

Glycogenolysis

- ▶ Glycogenolysis is activated by glucagon in the liver and epinephrine in muscles these are produced when blood glucose levels are low
- ▶ Glycogenolysis is inhibited by insulin
- ▶ insulin is produced when blood glucose levels are high

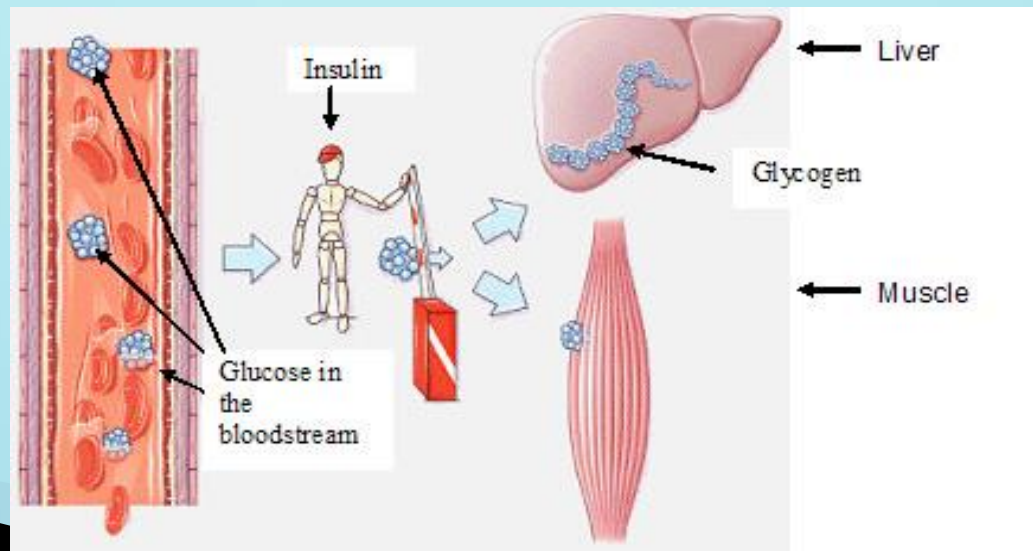


Diagram of Glycogenolysis

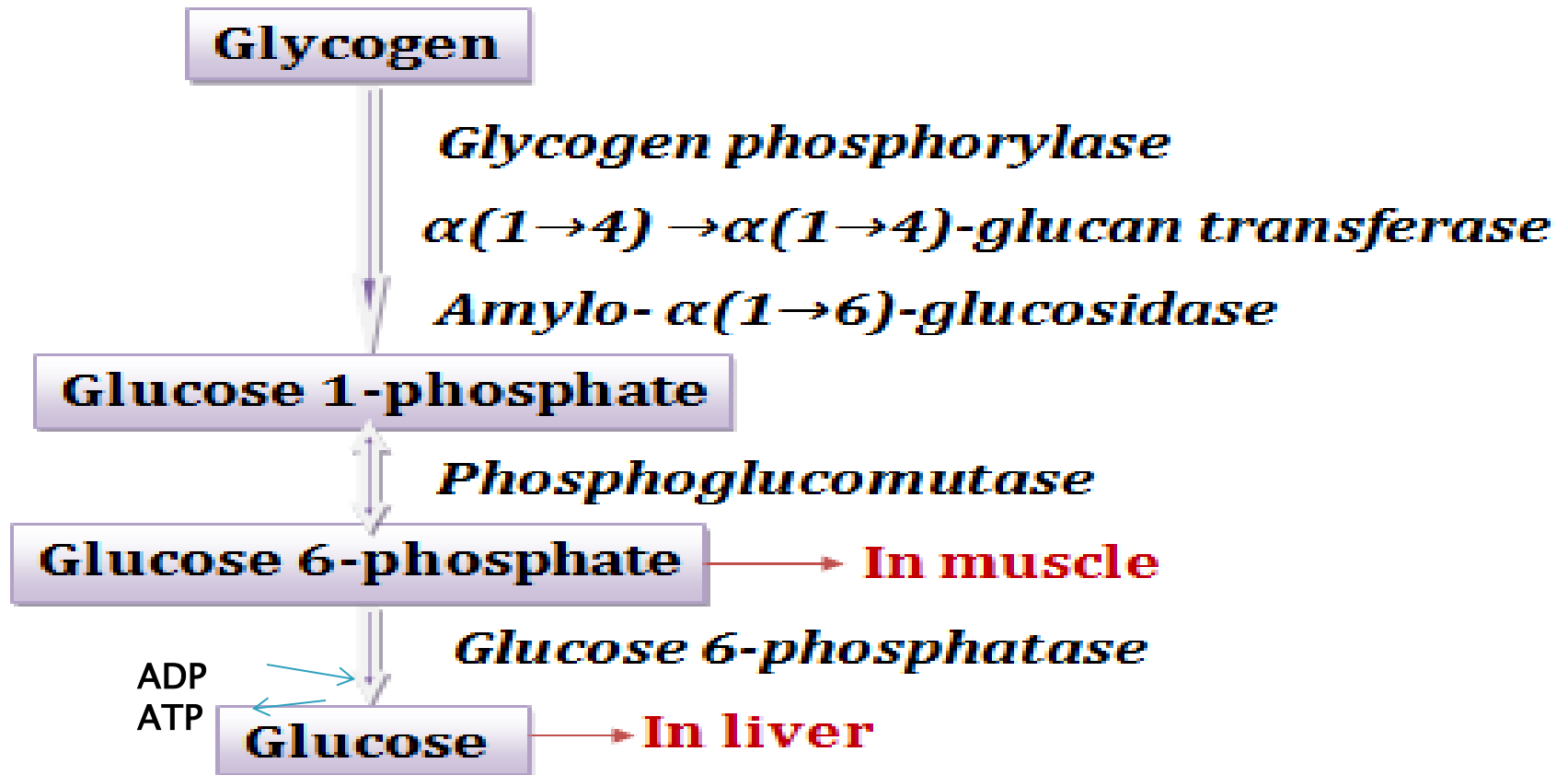
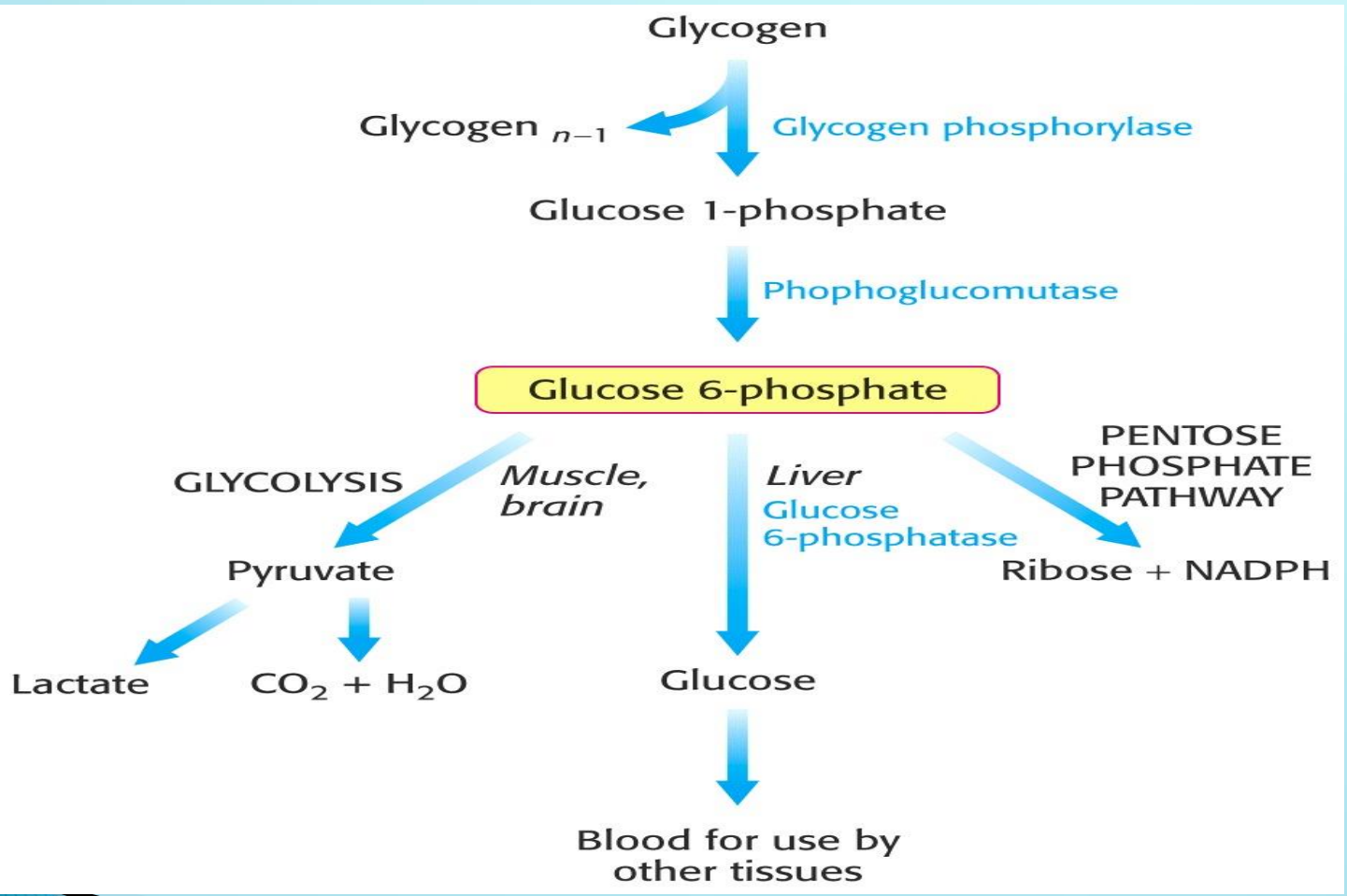
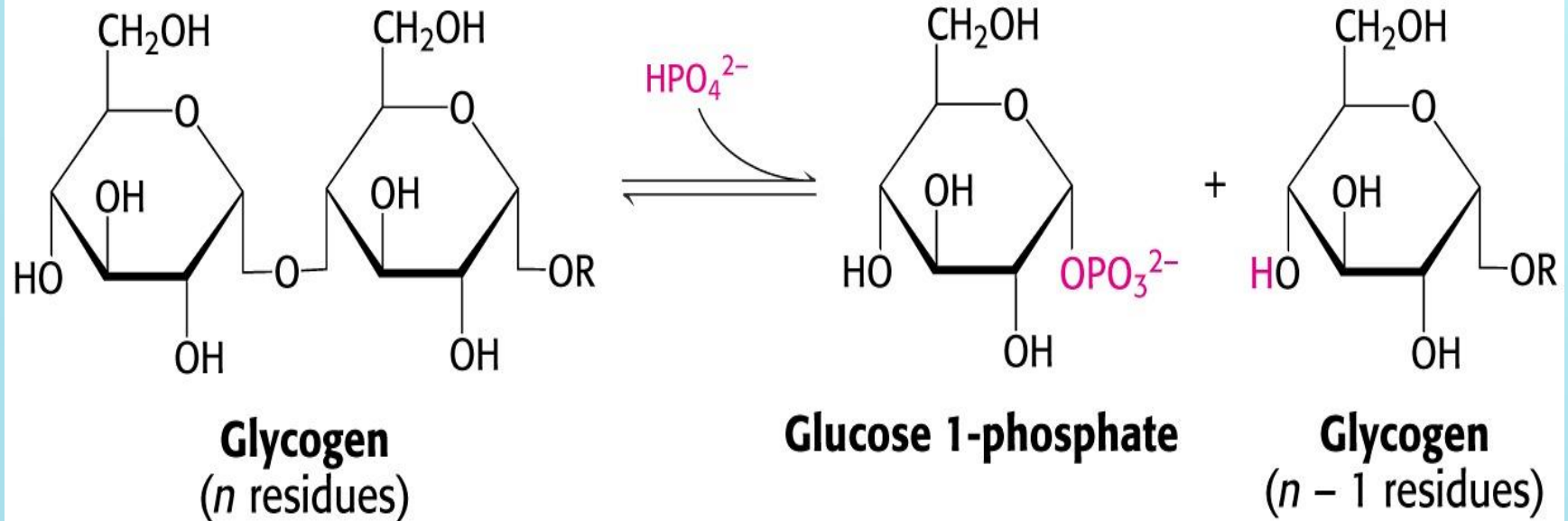


Diagram: Steps of glycogenolysis

Steps of Glycogenolysis



Glycogen phosphorylase catalyzes the breakdown of glycogen



Remember!

- ▶ Liver contains glucose 6-phosphatase.
- ▶ Muscle does not have this enzyme.

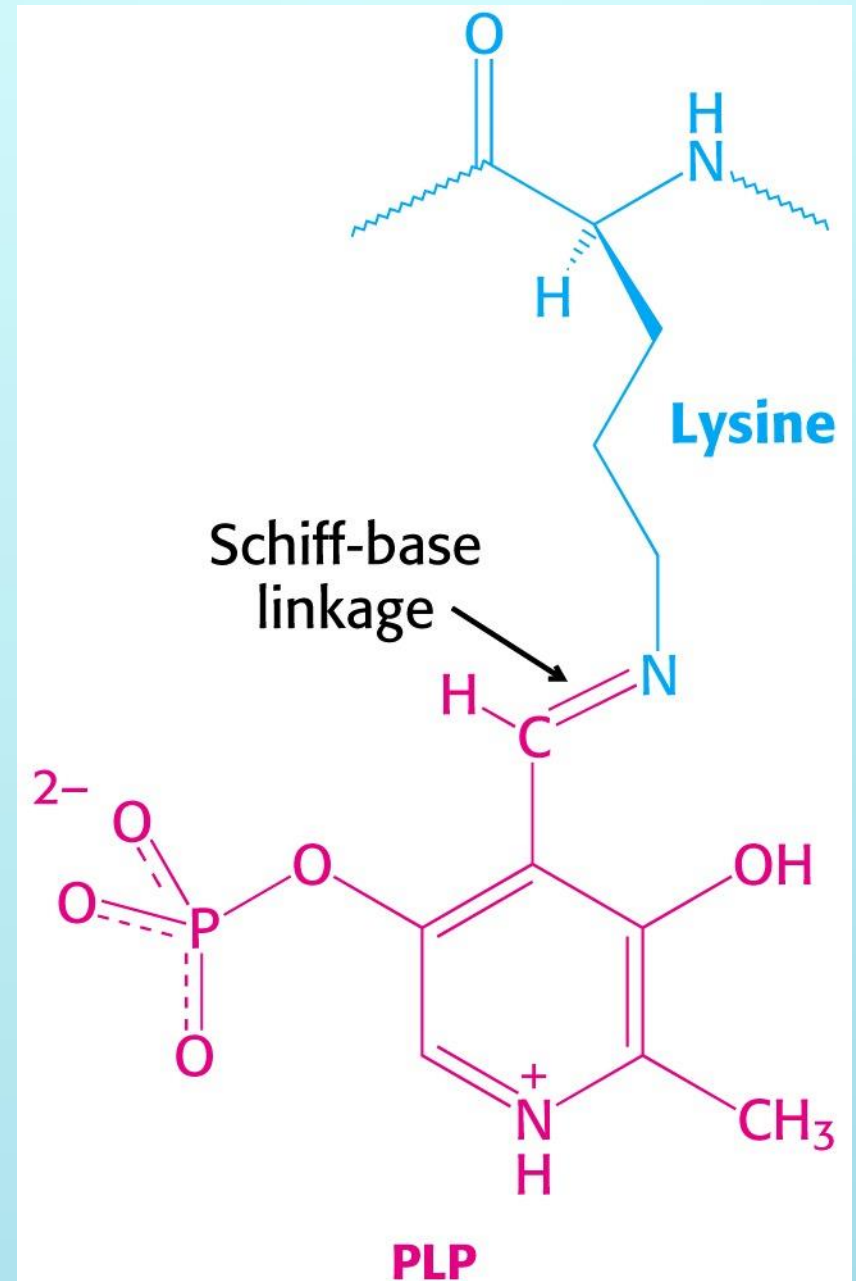
WHY?

The liver releases glucose to the blood to be taken up by brain and active muscle. The liver regulates blood glucose levels.

The muscle retains glucose 6-phosphate to be use for energy. Phosphorylated glucose is not transported out of muscle cells.

Glycogen phosphorylase uses pyridoxal phosphate (PLP) a derivative of pyridixine (vitamine B₆) as a coenzyme.

B₆ is required for the mobilization of glucose from glycogen. It is also required for other biochemical reactions such as transamination.



Thank you