GLYCOGENSIS PATHWAY

- **Path definition**

The process by which units of glucose are added to stored glycogen.

- **The site in the body**: the liver and muscles
  The concentration of storage glycogen in muscles is 0.5-1% and in liver is 2-8%, it is used in muscles as a source of energy while in liver, glycogen synthesis and degradation are regulated to maintain blood-glucose levels .
- **The site in the cell**: the cytoplasm

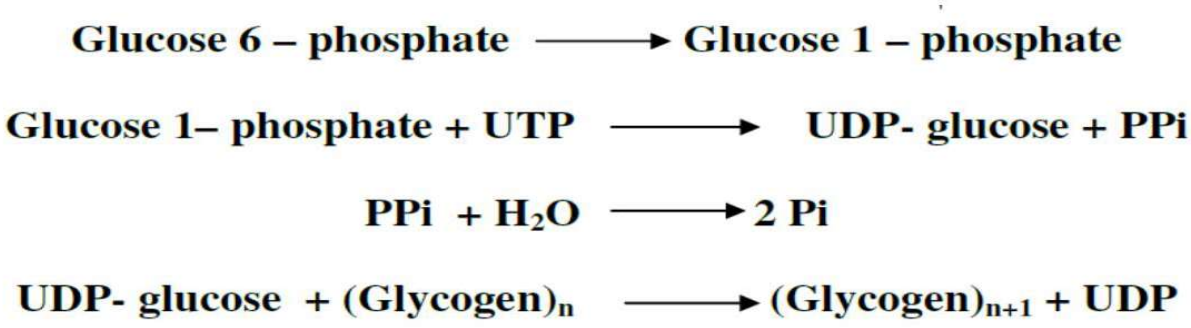
- **The general equation:**

$$(\text{Glycogen})_n + \text{Glucose} + 2\,\text{ATP} + H_2O \longrightarrow (\text{Glycogen})_{n+1} + 2\,\text{ADP} + 3\,\text{Pi}$$

- **Importance of pathway:**

formation of glycogen by adding units of glucose to glycogen as it is storeed and then use it at time of need. It is happened during rest periods ,food satisfication and excess of glucose for maintaining normal blood-glucose levels and as a source of energy .

General eq. for glycogenesis pathway



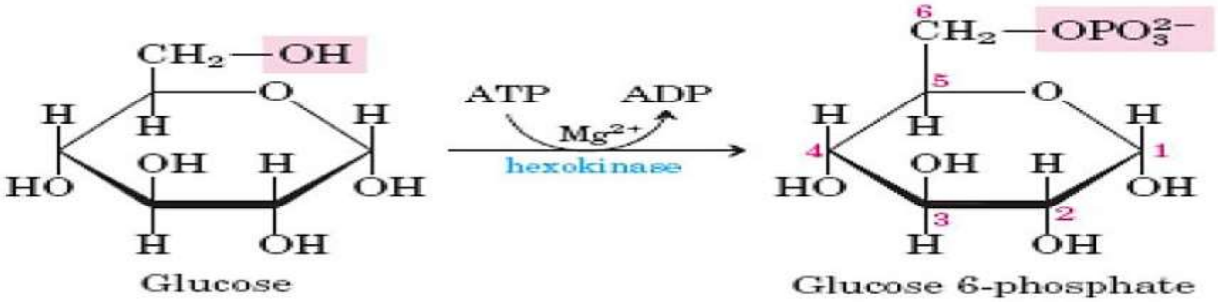
Steps of Glycogenesis pathway:

- Glucose phosphorylation
- Glu 6 P to Glu 1 P conversion
- UDP Glucose – synthesis of the carrier molecule
- Elongation of glycogen chain
- Branching in glycogen

Detail steps of Glycogenesis pathway:

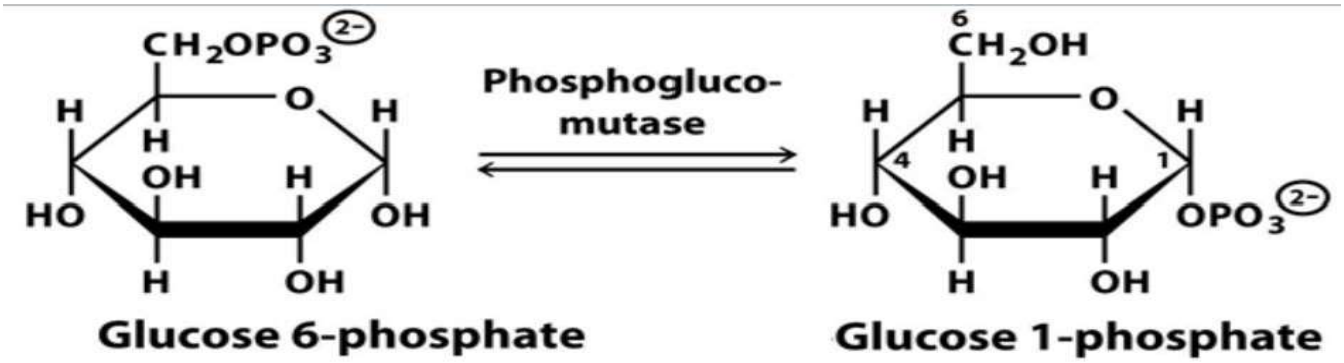
- **Step1: phosphorylation of glucose :**

conversion of glucose to glucose 6-phosphate (phosphorylated).This reaction catalyzed by hexokinases (**glucokinase**) :



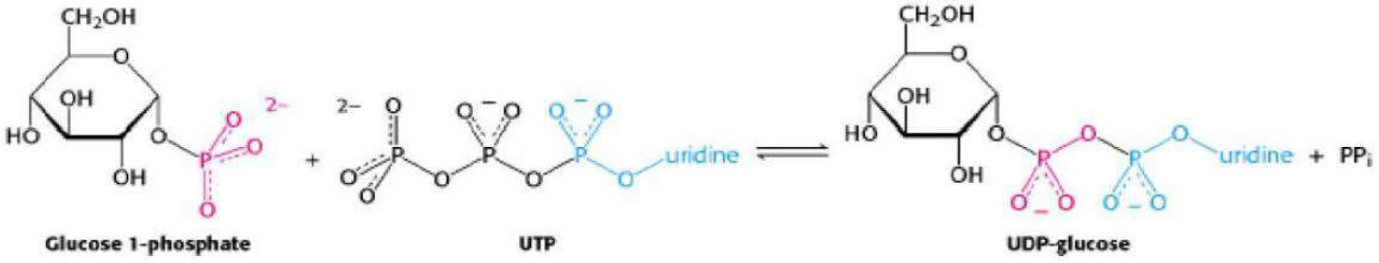
- **step2: Gonversion of glucose 6-phosphate to glucose 1-phosphate.**

isomerization of glucose 6-phosphate in to glucose 1- phosphate by **phosphoglucomutase** (catalyzes the transfer of the phosphate group from carbon 6 to carbon 1 on the glucose molecule)



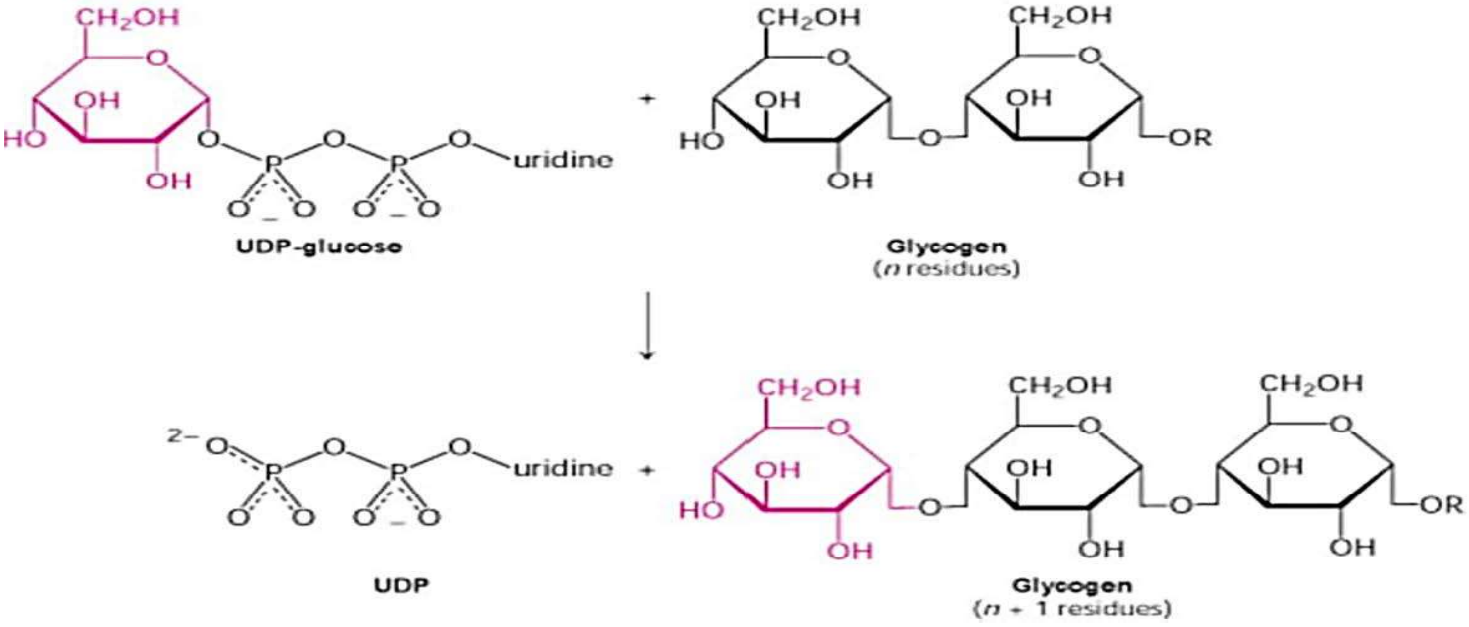
- **Step 3 :Conversion of glucose-1-phosphate to uridine di phosphate glucose :**

Glucose-1-phosphate with the high energy nucleotide uridine triphosphate (UTP) to give uridine diphosphate glucose (UDPG) and pyrophosphate (PPi). The reaction is catalyzed by**glucose-uridinediphosphate pyrophosphorylase** (note : UDPG is The raw material for building glycogen) .



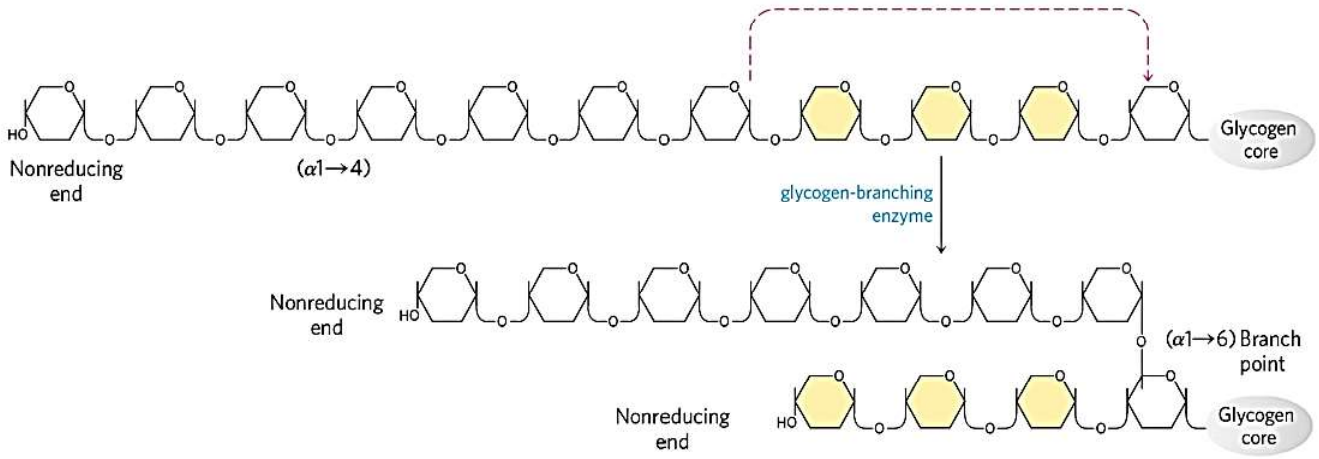
- **Step 4: Glucose addition to the polymer of glycogen (glycogen elongation):**

At this step, glucose unit is added to the non-reducing terminal residues of glycogen to form α-(1, 4) glycosidic bonds. This reaction is catalyzed by **glycogen synthase** (the key regulatory enzyme in glycogen synthesis).



- **Step 5: Branch formation in Glycogen chain:**

six or seven of glucose units in glycogen chain are transferred to the other chain and then forming α-(1, 6) glycosidic bond at a branching point in glycogen chain, This reaction is catalyzed by **glycogen-branching enzyme**



- **Step 6: regenerated of UTP from UDP**:

End step in this pathway, UTP is regenerated from UDP to reuse in glycogen syntheses

Energy Requirements for Glycogen Synthesis:

Addition of glucose to glycogen is required to (**2ATP**) energy. One required for the phosphorylation of glucose by **hexokinases (glucokinase)**, while other is needed for conversion of UDP to UTP .

Regulation of Glycogenesis pathway:

- when glucose level is high glycogen synthesis activated (glycogenesis)but when glucose level is low activated (glycogenolysis) and inhibit (glycogenesis)
- Glycogen synthesis is regulated by phosphorylation and de phosphorylation, phosphorylation activate glycogen phosphorylase but inhibit Glycogen synthase as a glycogenolysis activated while glycogenesis inhibit.
- Insulin stimulates the synthesis of glycogen due to facilities inter of glucose to cell and conversion of it to glucose 6-phosphate and addition to glycogen as a glucose 1- phosphate.