

## Module 16: Glycogen Metabolism

### Glucose in the Body

- When blood glucose concentration is high, muscle and liver form glycogen
- Glycogen stores the glucose as a backup -- stored in the liver and muscles
  - Muscles for work
  - Liver for when blood glucose dips
- Glycogen synthesized in the liver and muscles
  - Synthesized through **G6P** which can have multiple fates
- When blood glucose decreases
  - Muscles: break down glycogen for internal use
  - Liver: regulate blood glucose concentration

### Glycogen Structure

- Characterized by  $\alpha$ -(1 $\rightarrow$ 4) glycosidic bonds which form chains that have  $\alpha$ -(1 $\rightarrow$ 6) linked branches every 8-14 residues
- Stored in large amounts in liver and smaller amounts within the muscle
- Glucose units stretch from one end to the other
- **Reducing end**
  - Anomeric carbon can perform reduction reaction
  - These are linked through alpha (1 $\rightarrow$ 4) linked
- Anomeric carbon in linkage is non-reducing



### Glycogen Synthesis Enzymes

1. **UDP-glucose pyrophosphorylase**
2. **Glycogen synthase**
3. **Glycogen branching enzyme**

### Phosphoglucosylase

- Glucose enters by GLUT
  - Converted to G6P by hexokinase or glucokinase
  - Enters glycolysis if glucose levels are high
  - Large surplus of glucose, then there are sufficient glucose molecules to meet glycolysis requirements and surplus glucose is prepared for storage in glycogen
- **G6P is converted to G1P by phosphoglucosylase**
- Step 1: Phosphorylation of the substrate at C1-OH
- Step 2: phosphorylation of the enzyme by the phosphoryl group at C6 of the substrate

### UDP-glucose Pyrophosphorylase

- **UDP-glucose pyrophosphorylase** catalyzes the reaction to convert G1P into UDP-Glucose (UDPG)
- Overall reaction without hydrolysis of PP has  $\Delta G > 0$
- Reaction
  - G1 nucleophilic attack on alpha phosphate of UDP
  - Beta and gamma phosphate leave as pyrophosphate

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**RM Cervero**



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