Glycogen Metabolism

By the end of the chapter you should be able to:

1. Recognize the structure of glycogen and its role in metabolism

2. Know the difference between phosphorolytic cleavage and hydrolytic cleavage and know the reaction mechanism for glycogen phosphorylase

3. Outline the steps in glycogenolysis and glycogenesis.

4. Understand the actions of the debranching enzyme.

5. Relate the role of glucose 6-phosphatase in the release of glucose by the liver.

6. Explain the glycogen phosphorylase mechanism. Include intermediate states.

7. Explain the roles of UDP-glucose and inorganic pyrophosphatase in the synthesis of glycogen.

8. Explain the difference between phosphorylase a and phosphorylase b.

9. Know the differences between the muscle and liver phosphorylase isozymes.

10. Describe the major compositional features of phosphorylase kinase and its activation by protein kinase A.

11. Relate the importance of calmodulin to glycogen metabolism.

12. Understand the effects of epinephrine and glucagon on glycogen metabolism.

13. Explain the roles of protein phosphatases and kinases in the regulation of glycogenolysis and glycogenesis.

14. Know the role of Insulin on glycogen synthase regulation.

15. Give examples of glycogen storage diseases and their effects.

16. Understand the means that glycolysis and gluconeogenesis are regulated in relationship to glycogen metabolism

A Take Home Example: A young 15 year old woman, experiencing health problems (increased fatigue, extreme hunger, excessive thirst, blurred vision and weight loss). A fasting blood glucose test shows an abnormally high blood glucose level. What is the diagnosis for this young person? What is the underlying cause of this problem? What gene(s) are involved? What is the consequence of this disease as it relates to metabolism and blood clearance in liver and muscle? ***Your answer should include but not be limited to discussing the concerted actions of the liver and the muscle as well as hormone(s). What pathways are involved? Include mechanism of action. Do not forget to support your answer with reasoning and detail.***

Which of the following glucose transporters is high capacity, low affinity?
a) Glut 1, b) Glut 2, c) Glut 3, d) Glut 4, e) Glut 6

Which of the following tissues contains the highest concentration of glycogen by cell **and** which contains the highest total mass of glycogen
I) brain II) muscle III) lung

IV) liver V) kidney

a) I and II b) II and IV
b) IV and V c) IV and I
e) IV and II

A loss of muscle phosphorylase kinase will result in:

a) skeletal muscle glycogen with a very low degree of branching
b) skeletal muscle glycogen with a high degree of branching
c) a deficiency of skeletal muscle glycogen
d) an abnormally high level of skeletal muscle glycogen

Addition of an ionophore which permits high concentrations of calcium to enter the cell leads to a decrease in cellular glycogen. Why?

Why is it important that the glycogen phosphorylase reaction uses phosphate rather than water in a similar reaction?