

Highlights Gluconeogenesis

1. Gluconeogenesis is the pathway that is involved in the synthesis of glucose. It operates mostly in the liver and kidney. It uses 7 of the same enzymes as glycolysis by running the reactions in the opposite direction from glycolysis. The other three enzymes are replaced by four new enzymes in gluconeogenesis. The two of these are pyruvate carboxylase and phosphoenolpyruvate carboxykinase (PEPCK).
2. Pyruvate carboxylase is a biotin-containing enzyme that is found in the mitochondrion and it catalyzes the addition of a carboxyl group to pyruvate to make oxaloacetate. The reaction requires ATP
3. In the cytoplasm, PEPCK catalyzes the conversion of oxaloacetate to PEP and the reaction requires GTP. The next reactions for gluconeogenesis are the reversal of reactions of glycolysis up to PFK.
4. The PFK enzymatic reaction of glycolysis is replaced by the enzyme fructose-1,6bisphosphatase (F1,6BPase). It acts to remove a phosphate from F1,6BP, yielding F6P. This reaction is energetically favorable, since ATP is NOT regenerated (as it would be if the glycolysis reaction were reversed).
5. The hexokinase reaction of glycolysis is replaced by the enzyme glucose-6-phosphatase (G6Pase), which acts to remove a phosphate from G6P to yield free glucose. This reaction is energetically favorable, since ATP is NOT regenerated (as it would be if the glycolysis reaction were reversed).
6. Reciprocal regulation of glycolysis and gluconeogenesis is accomplished mainly by the molecule fructose-2,6-bisphosphate (F2,6BP). It acts to stimulate glycolysis by turning on PFK (your book calls it PFK-1) while at the same time acting to inhibit gluconeogenesis by turning off the corresponding enzyme, F1,6BPase. Thus, when F2,6BP is present, glycolysis is running and gluconeogenesis is inhibited. When F2,6BP is absent, gluconeogenesis is running and glycolysis is inhibited.
7. The Cori Cycle is a metabolic cycle in animal bodies that allows muscles to export lactate to the bloodstream. From there it goes to the liver, where gluconeogenesis acts to convert the lactate back to glucose. Glucose is dumped back into the blood where it arrives in the muscles and is used to continue the production of ATP in anaerobic glycolysis. Remember that under strenuous situations, oxygen is limiting, so lactate is produced initially in the muscles due to lack of oxygen. Oxygen is NOT limiting in the liver, however, so it can convert NADH back to NAD⁺ and also synthesize glucose.
8. Pyruvate kinase is the only enzyme of glycolysis that is regulated by both phosphorylation and allosteric means. Phosphorylation makes it less active, whereas dephosphorylation makes it more active. Allosterically, ATP and alanine inhibit it and F1,6BP activates it (by feedforward activation).

Exam 3 material ends here.

Highlights Pentose Phosphate Pathway

1. The pentose phosphate pathway is the cell's primary source of NADPH, ribose-5-phosphate (for nucleotide biosynthesis), and it is a way for cells to interchange sugars for use in pathways, such as glycolysis and gluconeogenesis.

