7.6C: Connecting Lipids to Glucose Metabolism

Lipids can be both made and broken down through parts of the glucose catabolism pathways.

Learning Objectives

• Explain the connection of lipids to glucose metabolism

Key Points

• Many types of lipids exist, but cholesterol and triglycerides are the lipids that enter the pathways of glucose catabolism.

• Through the process of phosphorylation, glycerol can be converted to glycerol-3-phosphate during the glycolytic pathway.

• When fatty acids are broken down into acetyl groups through beta-oxidation, the acetyl groups are used by CoA to form acetyl-CoA, which enters the citric acid cycle to produce ATP.

• Beta-oxidation produces FADH$_2$ and NADH, which are used by the electron transport chain for ATP production.

Key Terms

• **beta-oxidation**: A process that takes place in the matrix of the mitochondria and catabolizes fatty acids by converting them to acetyl groups while producing NADH and FADH$_2$.

• **lipid**: A group of organic compounds including fats, oils, waxes, sterols, and triglycerides; characterized by being insoluble in water; account for most of the fat present in the human body.
Like sugars and amino acids, the catabolic pathways of lipids are also connected to the glucose catabolism pathways. The lipids that are connected to the glucose pathways are cholesterol and triglycerides.

Cholesterol

Cholesterol contributes to cell membrane flexibility and is a precursor to steroid hormones. The synthesis of cholesterol starts with acetyl groups, which are transferred from acetyl CoA, and proceeds in only one direction; the process cannot be reversed. Thus, synthesis of cholesterol requires an intermediate of glucose metabolism.

Triglycerides

Triglycerides, a form of long-term energy storage in animals, are made of glycerol and three fatty acids. Animals can make most of the fatty acids they need. Triglycerides can be both made and broken down through parts of the glucose catabolism pathways. Glycerol can be phosphorylated to glycerol-3-phosphate, which continues through glycolysis.

Fatty acids are catabolized in a process called beta-oxidation that takes place in the matrix of the mitochondria and converts their fatty acid chains into two carbon units of acetyl groups, while producing NADH and FADH$_2$. The acetyl groups are picked up by CoA to form acetyl CoA that proceeds into the citric acid cycle as it combines with oxaloacetate. The NADH and FADH$_2$ are then used by the electron transport chain.

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