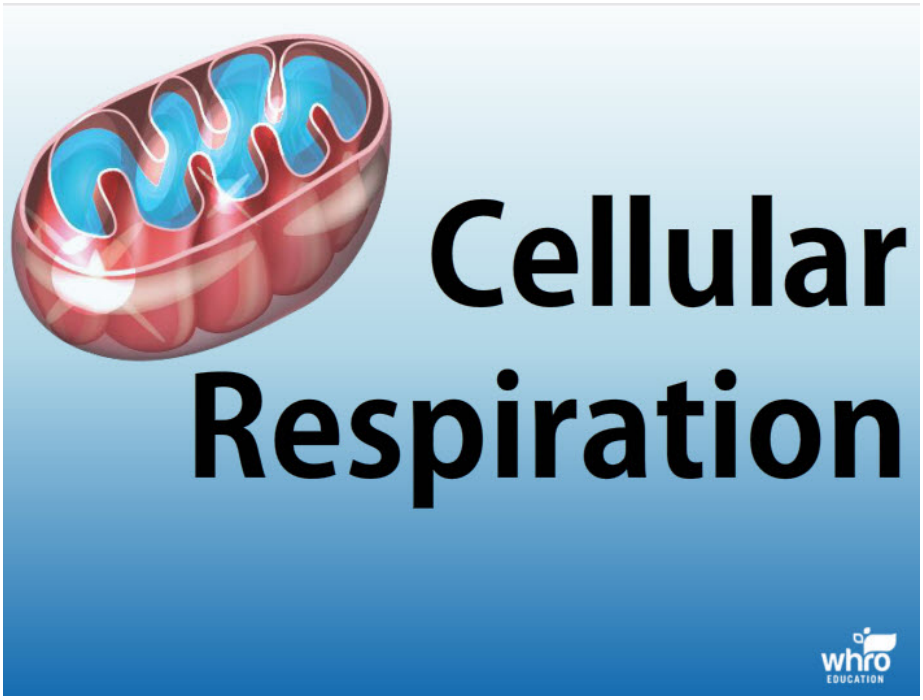
Module 3: Cell Biology - Structure and Function

Topic 5 Content: Cellular Respiration Notes

Introduction



Cellular Respiration

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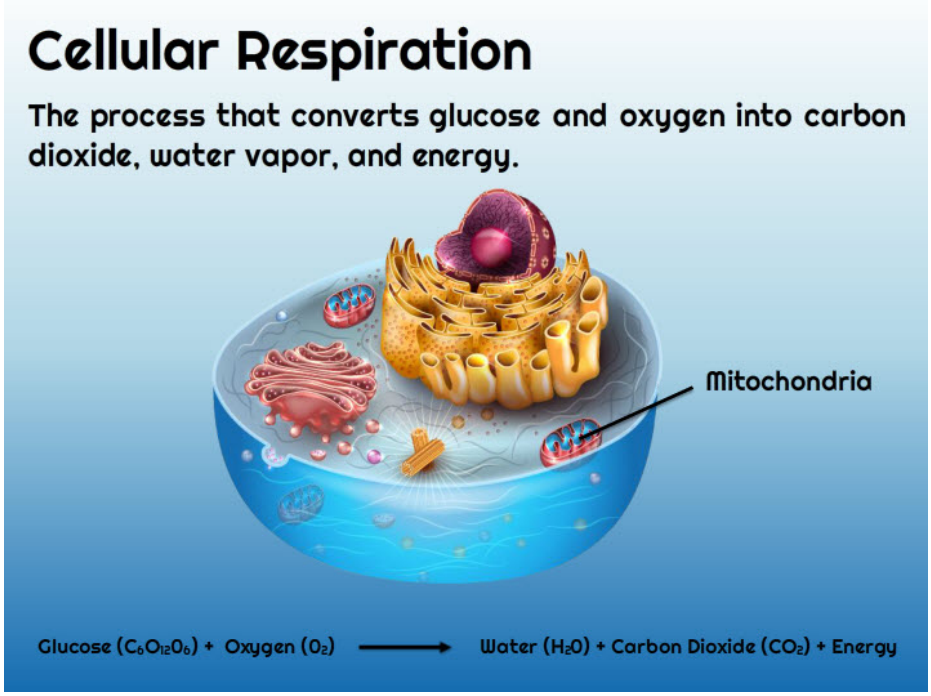
Cellular Respiration



Unlike autotrophic organisms, heterotrophic organisms must obtain energy by breaking down organic molecules, like glucose, to make ATP molecules. Cellular respiration is the aerobic process that occurs within the mitochondria of eukaryotic cells. Respiration uses glucose and oxygen to produce carbon dioxide, water, and energy. Click on the mitochondria to explore cellular respiration.

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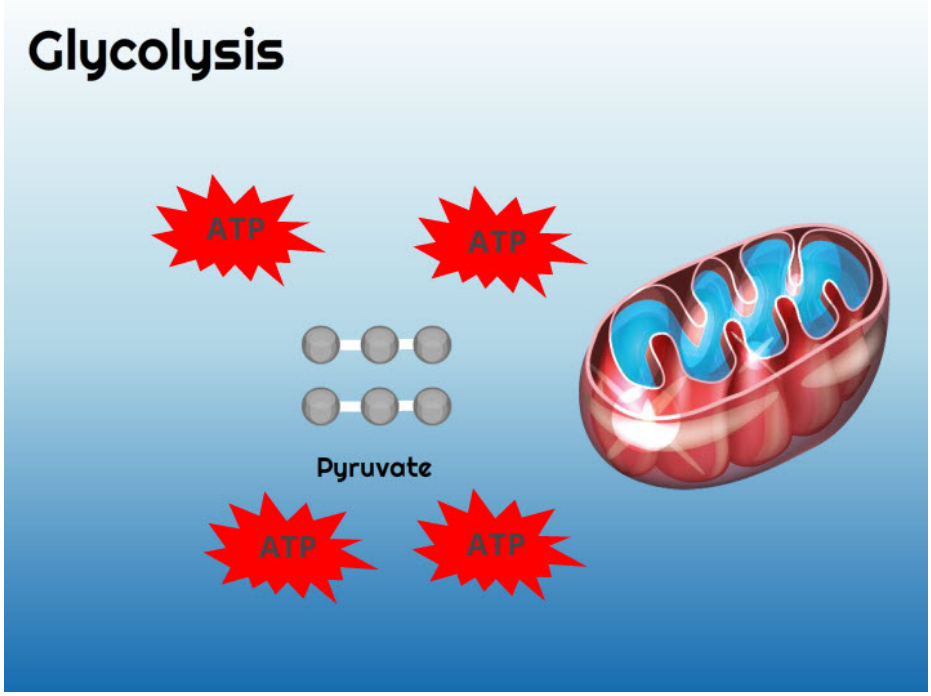
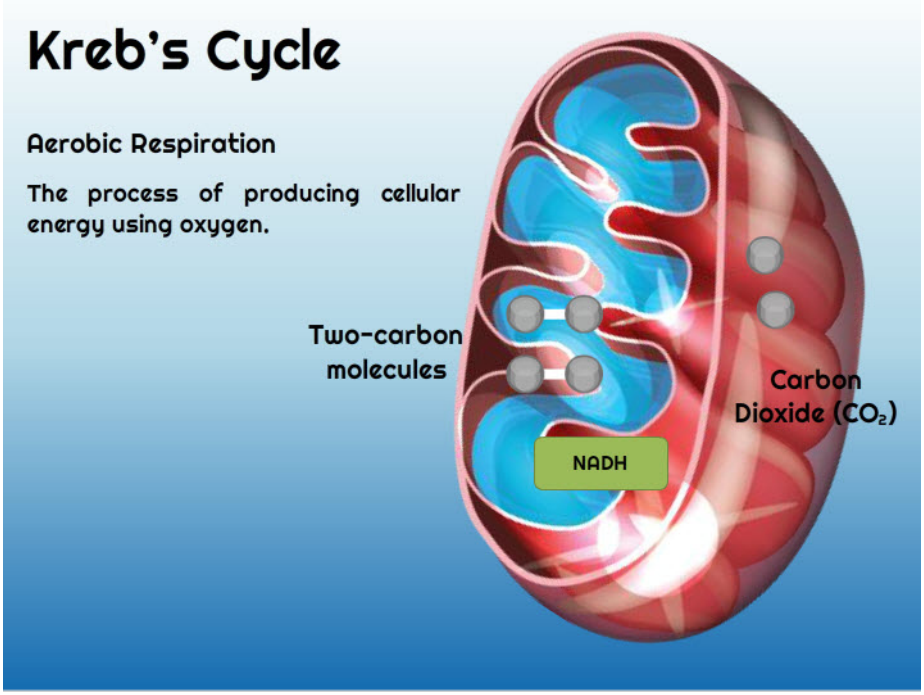
Glycolysis



The first stage of cellular respiration is glycolysis, an anaerobic process that actually occurs in the cytoplasm of the cell. To begin glycolysis, two molecules of ATP are required. The molecules of ATP provide the initial energy for the reaction. The net yield from the breakdown of one molecule of glucose is two ATP molecules and two pyruvate molecules. Most of the energy stored in glucose is contained in the pyruvate molecules. Click the mitochondria to continue learning about cellular respiration.

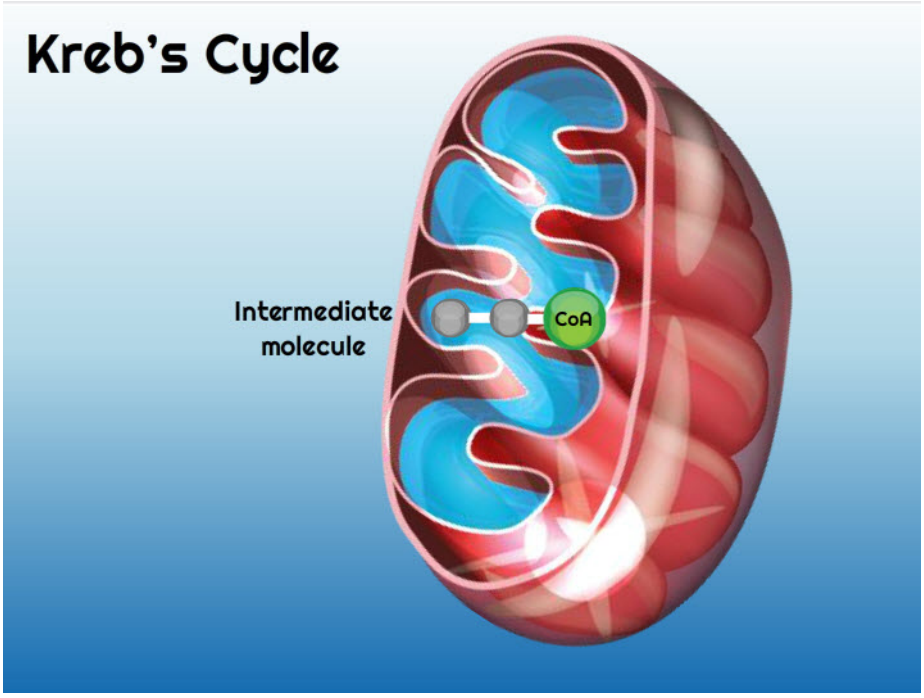
Krebs Cycle



Glycolysis continues when pyruvate molecules found in the cytoplasm are transported to the mitochondria. This only happens in the presence of oxygen and is referred to as aerobic respiration. The Krebs cycle, or citric acid cycle, is a series of reactions that occur after the pyruvate molecules enter the mitochondria and function to convert pyruvate to carbon dioxide.

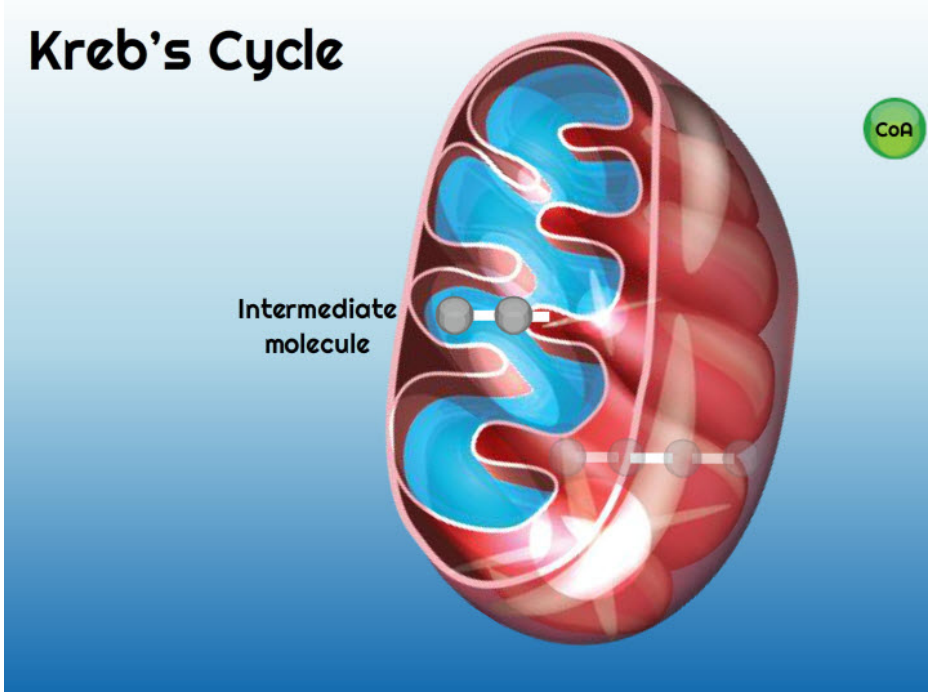
To begin the Krebs cycle, each pyruvate molecule is broken down into a two-carbon molecules. Carbon dioxide is released as waste, and NADH is produced for later use in the cycle. Click the two-carbon molecule to continue learning about the Krebs cycle.

Krebs Cycle



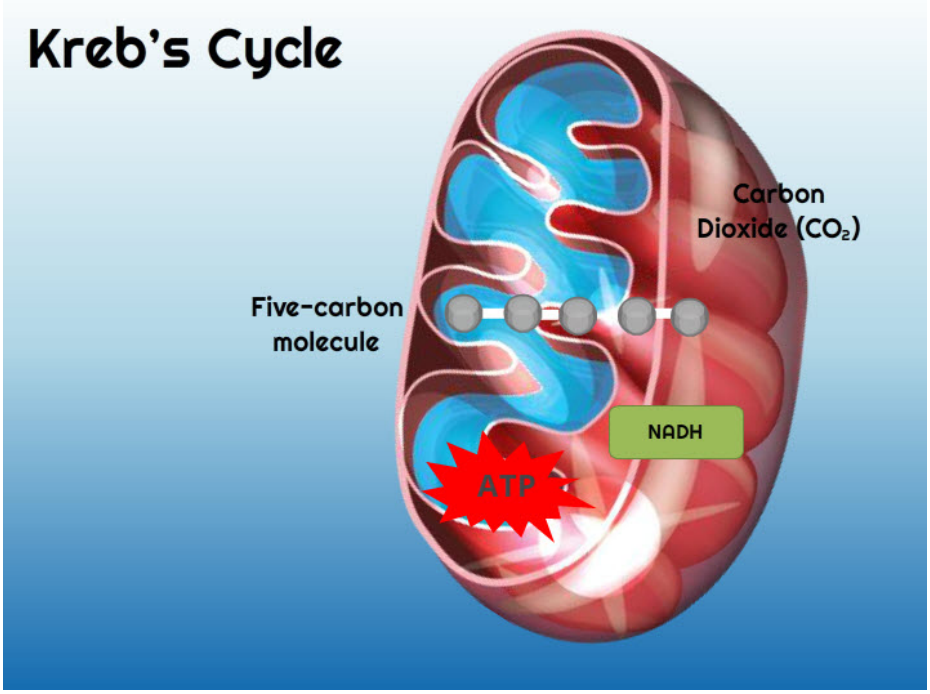
The Krebs cycle continues when Coenzyme A bonds with a two-carbon molecule and forms an intermediate molecule. Click the intermediate molecule to continue learning about the Krebs cycle.

Krebs Cycle



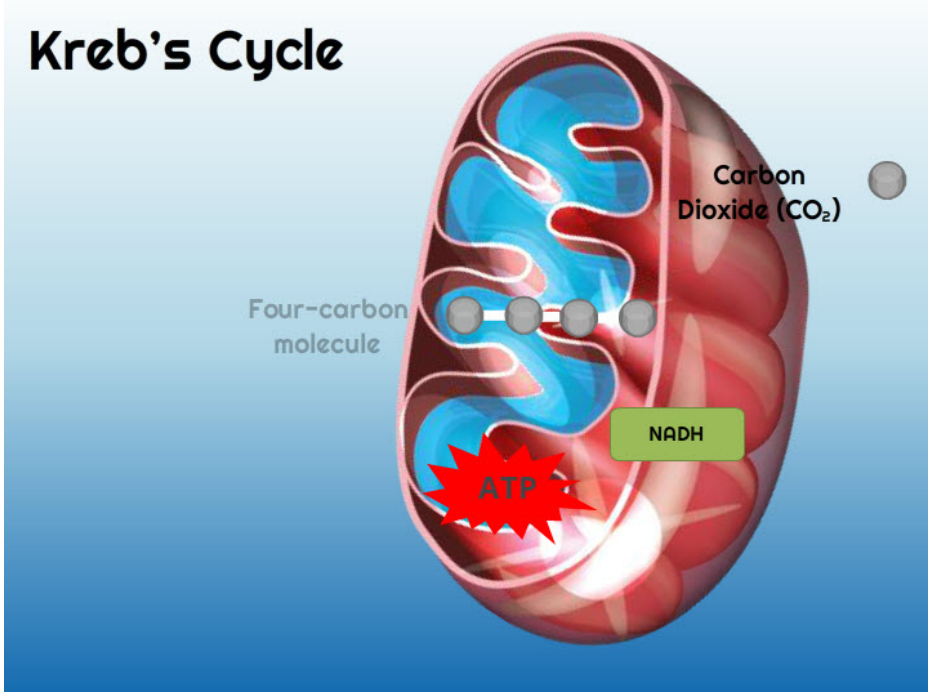
The intermediate molecule is added to a four-carbon molecule forming a six-carbon molecule. This six-carbon molecule is known as citric acid. During this part of the Krebs cycle, Coenzyme A is released. Click the citric acid molecule to continue learning about the Krebs cycle.

Krebs Cycle



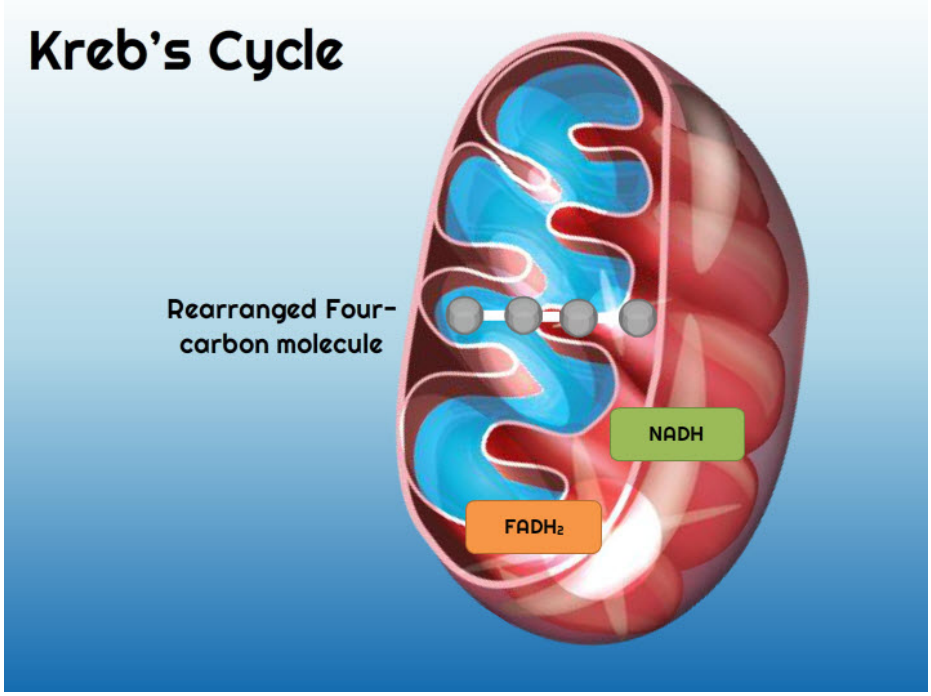
The Krebs cycle continues when citric acid is broken down and carbon dioxide is released as a waste product. NADH is produced and made available for later use in the cycle. Click the five-carbon molecule to continue exploring the Krebs cycle.

Krebs Cycle



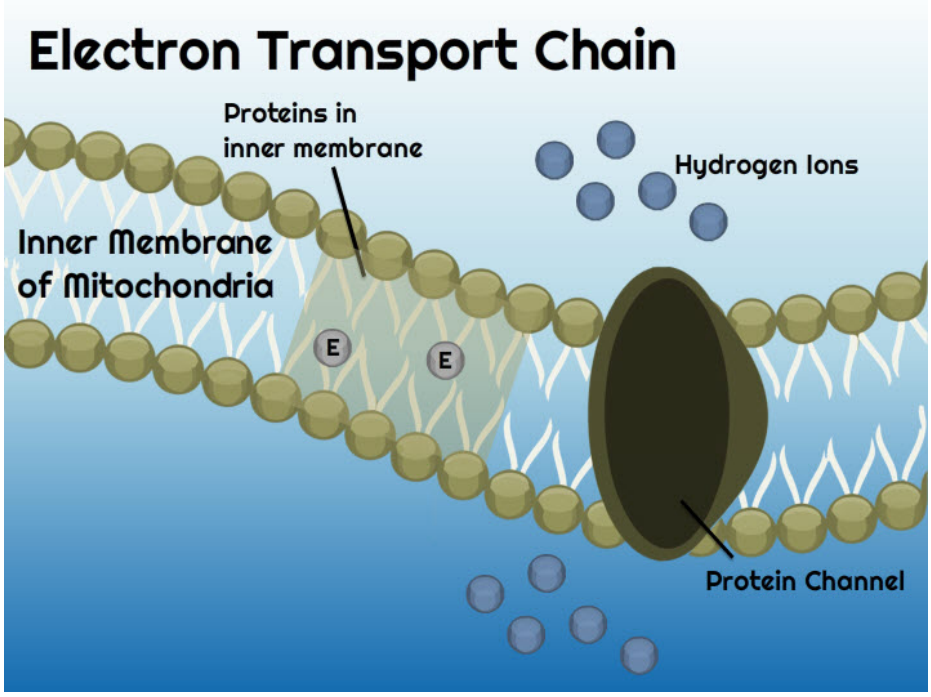
The five-carbon molecule is broken down and carbon dioxide is released as a waste product. NADH and ATP are made available for later use in the Krebs cycle. Click the four-carbon molecule to continue exploring the Krebs cycle.

Krebs Cycle



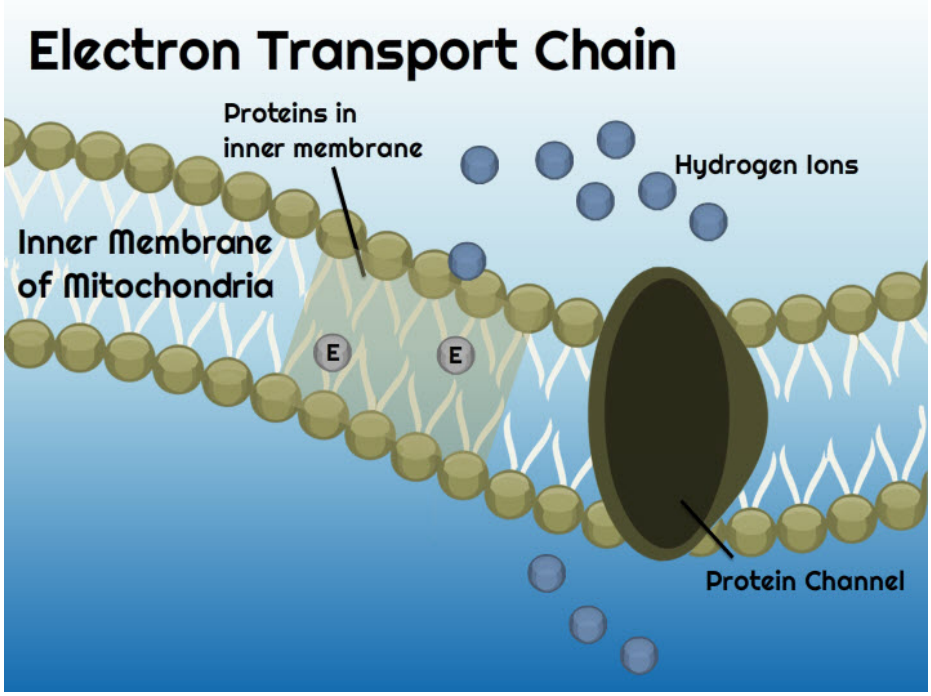
The final step of the Krebs cycle occurs when the four-carbon molecule is rearranged. The energy molecules NADH and $FADH_2$, are made available for later use. The cycle restarts and continues to produce carbon dioxide waste and energy carrying molecules. Click the mitochondria to learn about the electron transport chain.

Electron Transport Chain



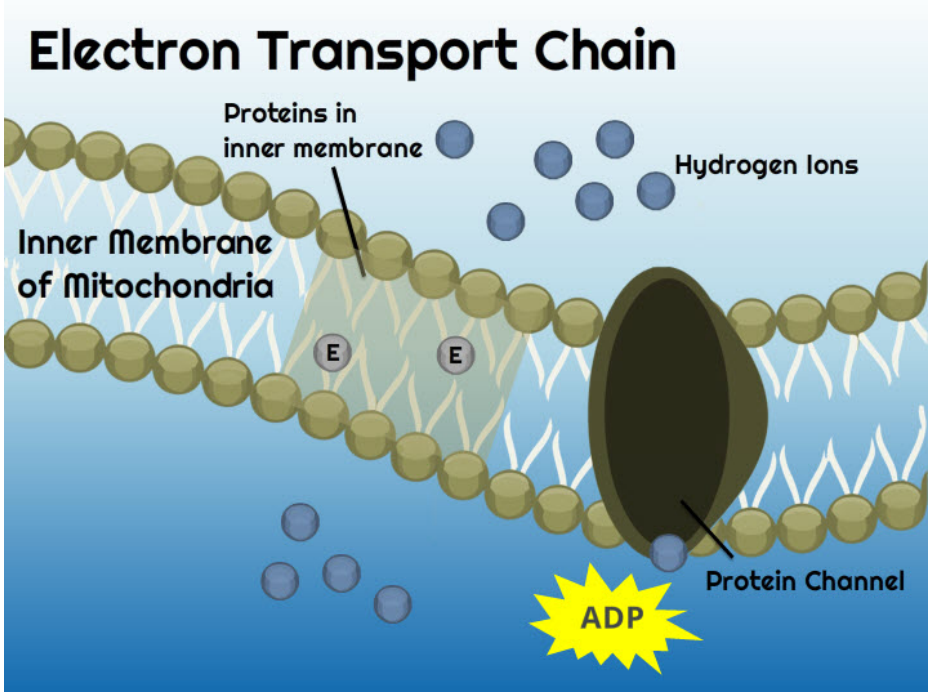
The second stage of cellular respiration is called the electron transport chain. This stage begins when electrons are removed from NADH and $FADH_2$. These electrons enter the proteins of the electron transport chain. Click the hydrogen ions to continue learning about the electron transport chain.

Electron Transport Chain



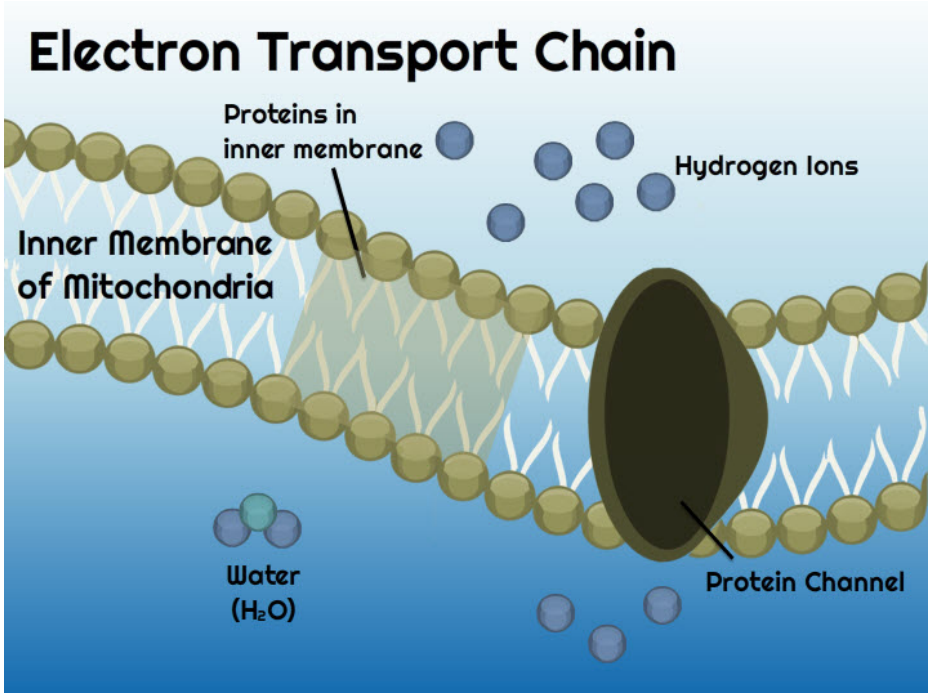
Once the electrons enter the proteins in the inner membrane, hydrogen ions are transported across the inner membrane. Click the protein channel to continue learning about the electron transport chain.

Electron Transport Chain



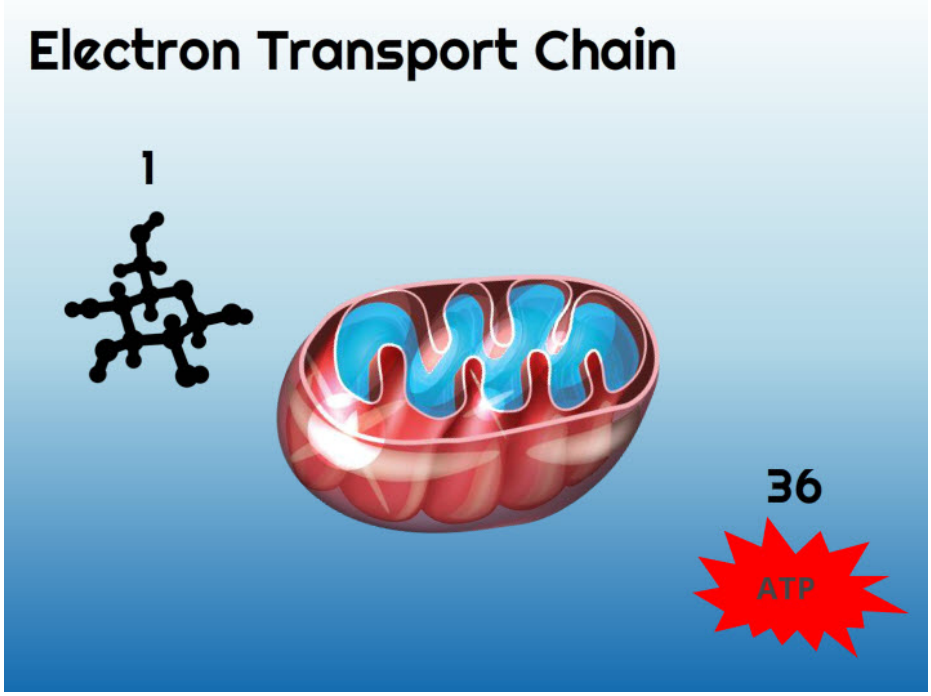
Hydrogen ions will diffuse through a protein channel and convert ADP into ATP. Click the hydrogen ions to continue learning about the electron transport chain.

Electron Transport Chain



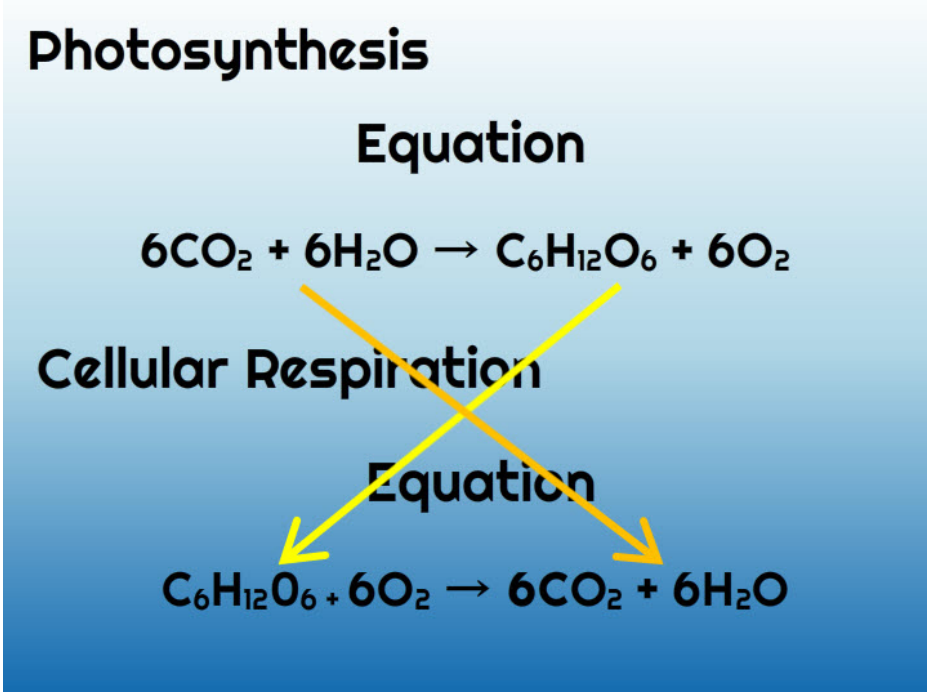
Water is formed when oxygen bonds with the hydrogen ions and electrons. The water is released as a waste product. Click the “zoom out” symbol to continue learning about the electron transport chain.

Electron Transport Chain



Overall, the electron transport chain produces 36 ATP molecules for each glucose molecule. Click the mitochondria to continue.

Cycle



The products of photosynthesis, glucose and oxygen, are the reactants that enter cellular respiration. The products of cellular respiration, carbon dioxide and water, are the reactants that enter photosynthesis. Together, photosynthesis and cellular respiration form a cycle in living systems. Click the cycle to continue.