

# Krebs Cycle

---

Douglas Wilkin, Ph.D.  
Jean Brainard, Ph.D.

**Say Thanks to the Authors**

Click <http://www.ck12.org/saythanks>

*(No sign in required)*

To access a customizable version of this book, as well as other interactive content, visit [www.ck12.org](http://www.ck12.org)

CK-12 Foundation is a non-profit organization with a mission to reduce the cost of textbook materials for the K-12 market both in the U.S. and worldwide. Using an open-content, web-based collaborative model termed the **FlexBook®**, CK-12 intends to pioneer the generation and distribution of high-quality educational content that will serve both as core text as well as provide an adaptive environment for learning, powered through the **FlexBook Platform®**.

Copyright © 2014 CK-12 Foundation, [www.ck12.org](http://www.ck12.org)

The names “CK-12” and “CK12” and associated logos and the terms “**FlexBook®**” and “**FlexBook Platform®**” (collectively “CK-12 Marks”) are trademarks and service marks of CK-12 Foundation and are protected by federal, state, and international laws.

Any form of reproduction of this book in any format or medium, in whole or in sections must include the referral attribution link <http://www.ck12.org/saythanks> (placed in a visible location) in addition to the following terms.

Except as otherwise noted, all CK-12 Content (including CK-12 Curriculum Material) is made available to Users in accordance with the Creative Commons Attribution-Non-Commercial 3.0 Unported (CC BY-NC 3.0) License (<http://creativecommons.org/licenses/by-nc/3.0/>), as amended and updated by Creative Commons from time to time (the “CC License”), which is incorporated herein by this reference.

Complete terms can be found at <http://www.ck12.org/terms>.

Printed: November 26, 2014

**flexbook**  
next generation textbooks



## AUTHORS

Douglas Wilkin, Ph.D.

Jean Brainard, Ph.D.

# CHAPTER 1

## Krebs Cycle

- Summarize the Krebs cycle
- Identify the products of the Krebs cycle.



### What type of acid do these fruits contain?

Citric acid. Citric acid is also the first product formed in the Krebs cycle, and therefore this acid occurs in the metabolism of virtually all living things.

### Cellular Respiration Stage II: The Krebs Cycle

Recall that glycolysis, stage I of cellular respiration, produces two molecules of pyruvate. These molecules enter the matrix of a mitochondrion, where they start the **Krebs cycle**. The reactions that occur next are shown in **Figure 1.1**. You can watch an animated version at this link: <http://www.youtube.com/watch?v=p-k0biO1DT8>.

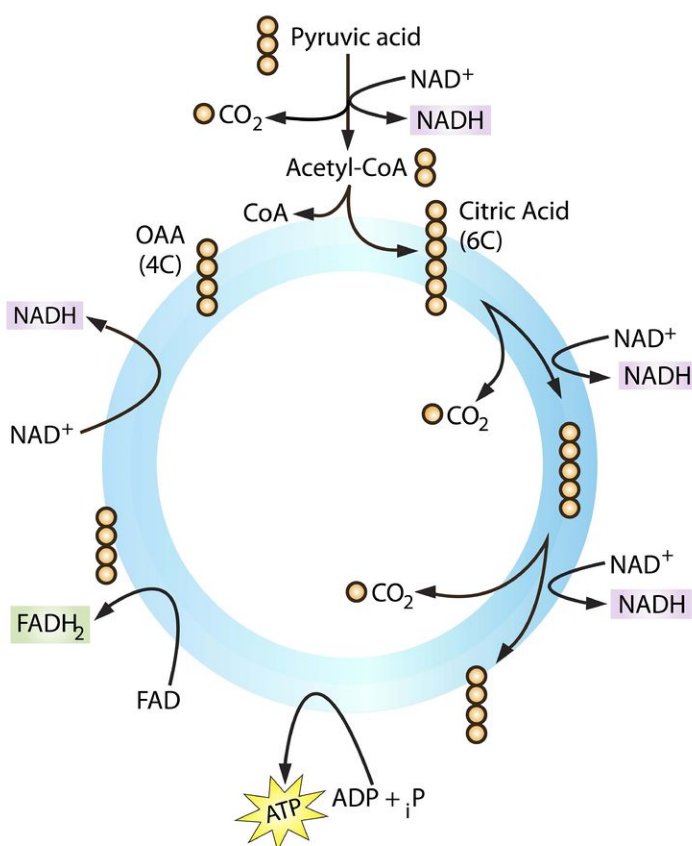
Before the Krebs cycle begins, pyruvic acid, which has three carbon atoms, is split apart and combined with an enzyme known as CoA, which stands for coenzyme A. The product of this reaction is a two-carbon molecule called acetyl-CoA. The third carbon from pyruvic acid combines with oxygen to form carbon dioxide, which is released as a waste product. High-energy electrons are also released and captured in NADH.

### Steps of the Krebs Cycle

The Krebs cycle itself actually begins when acetyl-CoA combines with a four-carbon molecule called OAA (oxaloacetate) (see **Figure 1.1**). This produces citric acid, which has six carbon atoms. This is why the Krebs cycle is also called the **citric acid cycle**.

After citric acid forms, it goes through a series of reactions that release energy. The energy is captured in molecules of NADH, ATP, and  $\text{FADH}_2$ , another energy-carrying compound. Carbon dioxide is also released as a waste product of these reactions.

## Krebs Cycle (Citric Acid Cycle)



**FIGURE 1.1**

The Krebs cycle starts with pyruvic acid from glycolysis. Each small circle in the diagram represents one carbon atom. For example, citric acid is a six carbon molecule, and OAA (oxaloacetate) is a four carbon molecule. Follow what happens to the carbon atoms as the cycle proceeds. In one turn through the cycle, how many molecules are produced of ATP? How many molecules of NADH and FADH<sub>2</sub> are produced?

The final step of the Krebs cycle regenerates OAA, the molecule that began the Krebs cycle. This molecule is needed for the next turn through the cycle. Two turns are needed because glycolysis produces two pyruvic acid molecules when it splits glucose. Watch the OSU band present the Krebs cycle: <http://www.youtube.com/watch?v=FgXnH087Jik> .

### Results of the Krebs Cycle

After the second turn through the Krebs cycle, the original glucose molecule has been broken down completely. All six of its carbon atoms have combined with oxygen to form carbon dioxide. The energy from its chemical bonds has been stored in a total of 16 energy-carrier molecules. These molecules are:

- 4 ATP (including 2 from glycolysis)
- 10 NADH (including 2 from glycolysis)
- 2 FADH<sub>2</sub>

### Summary

- The Krebs cycle is the second stage of cellular respiration.

- During the Krebs cycle, energy stored in pyruvate is transferred to NADH and FADH<sub>2</sub>, and some ATP is produced.

---

## References

1. Hana Zavadska. Steps of the Krebs Cycle. CC BY-NC 3.0