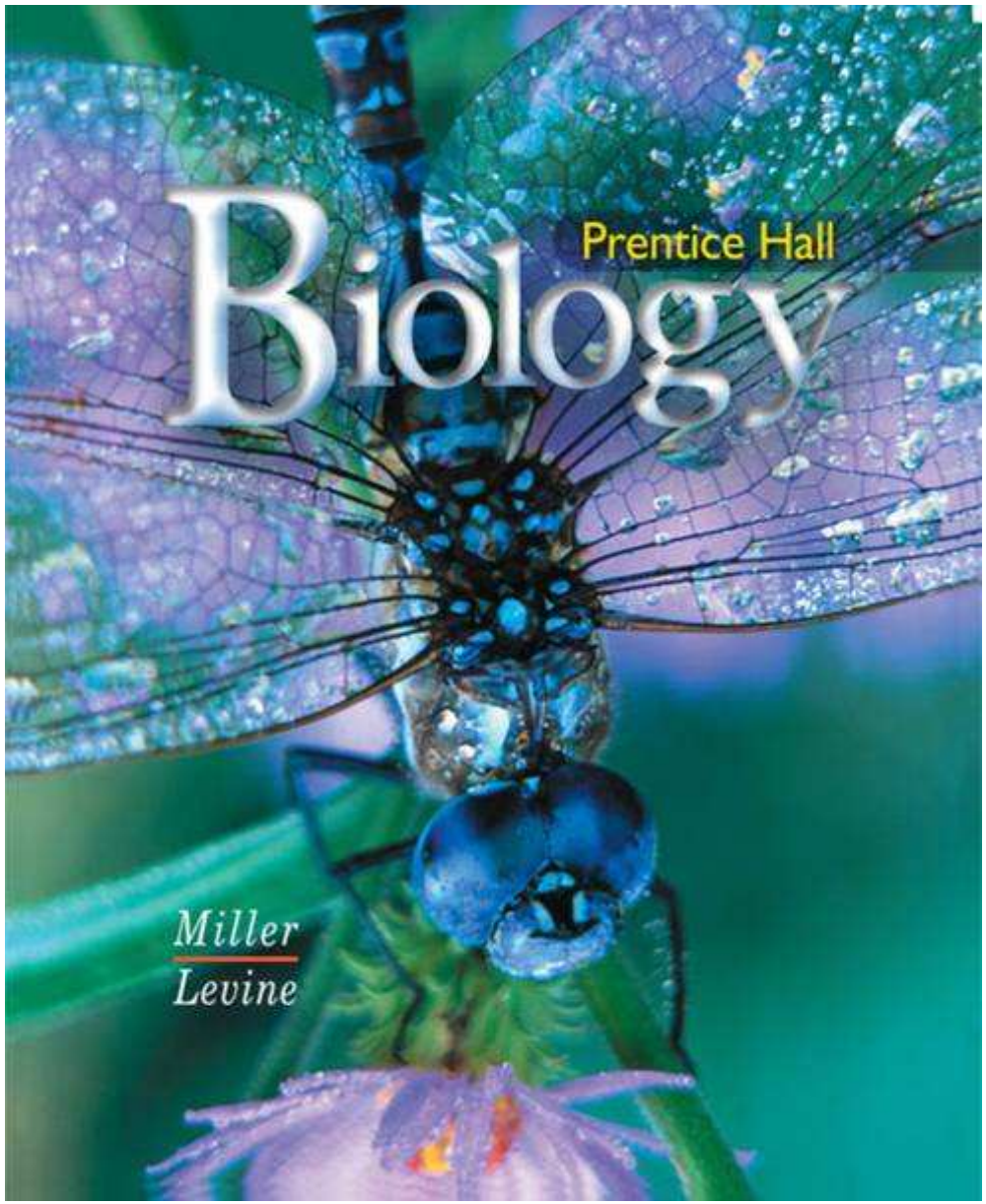

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EQ What is glycolysis? What are the results from the Krebs Cycle and Electron Transport ?

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movie
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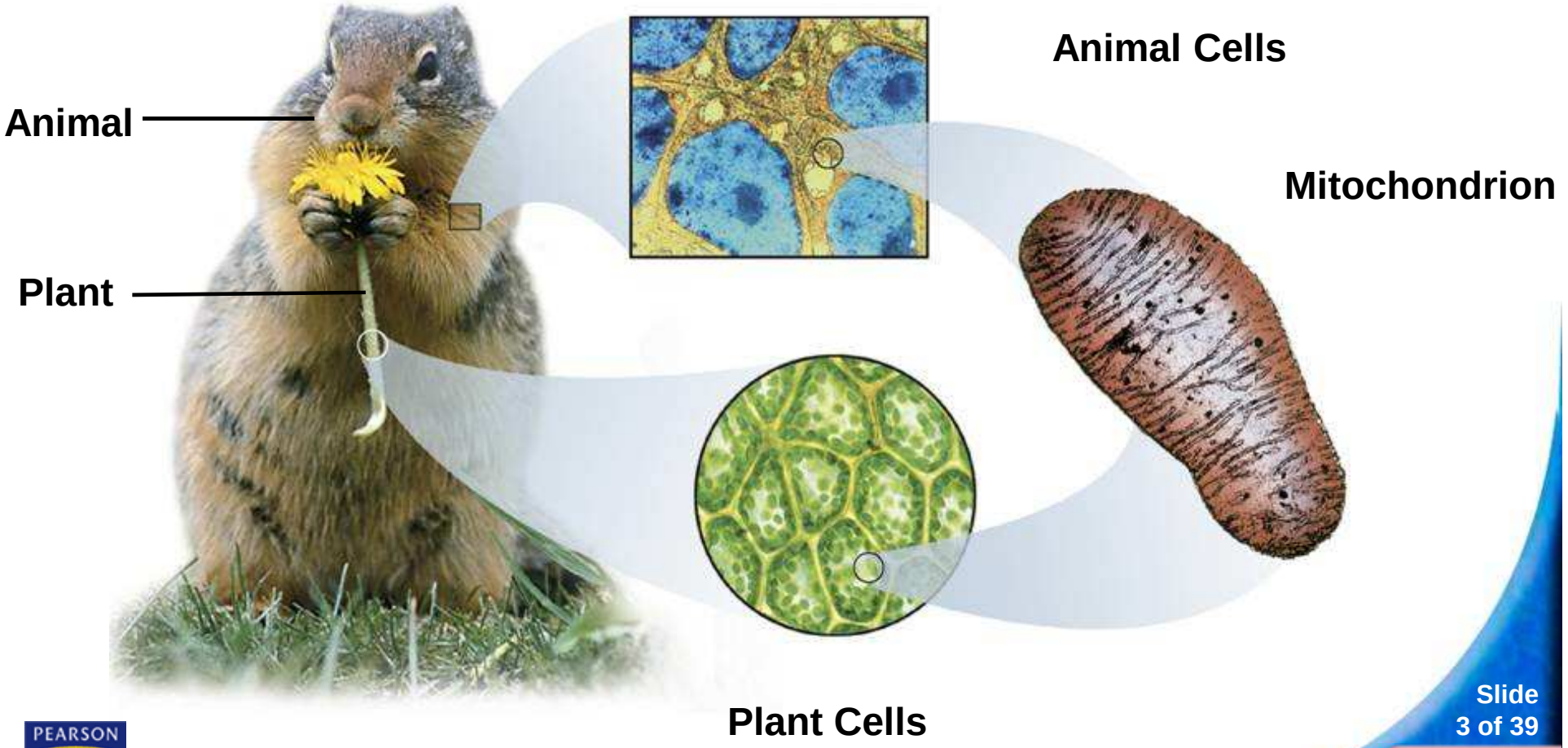
Food serves as a source of raw materials for the cells in the body and as a source of energy.



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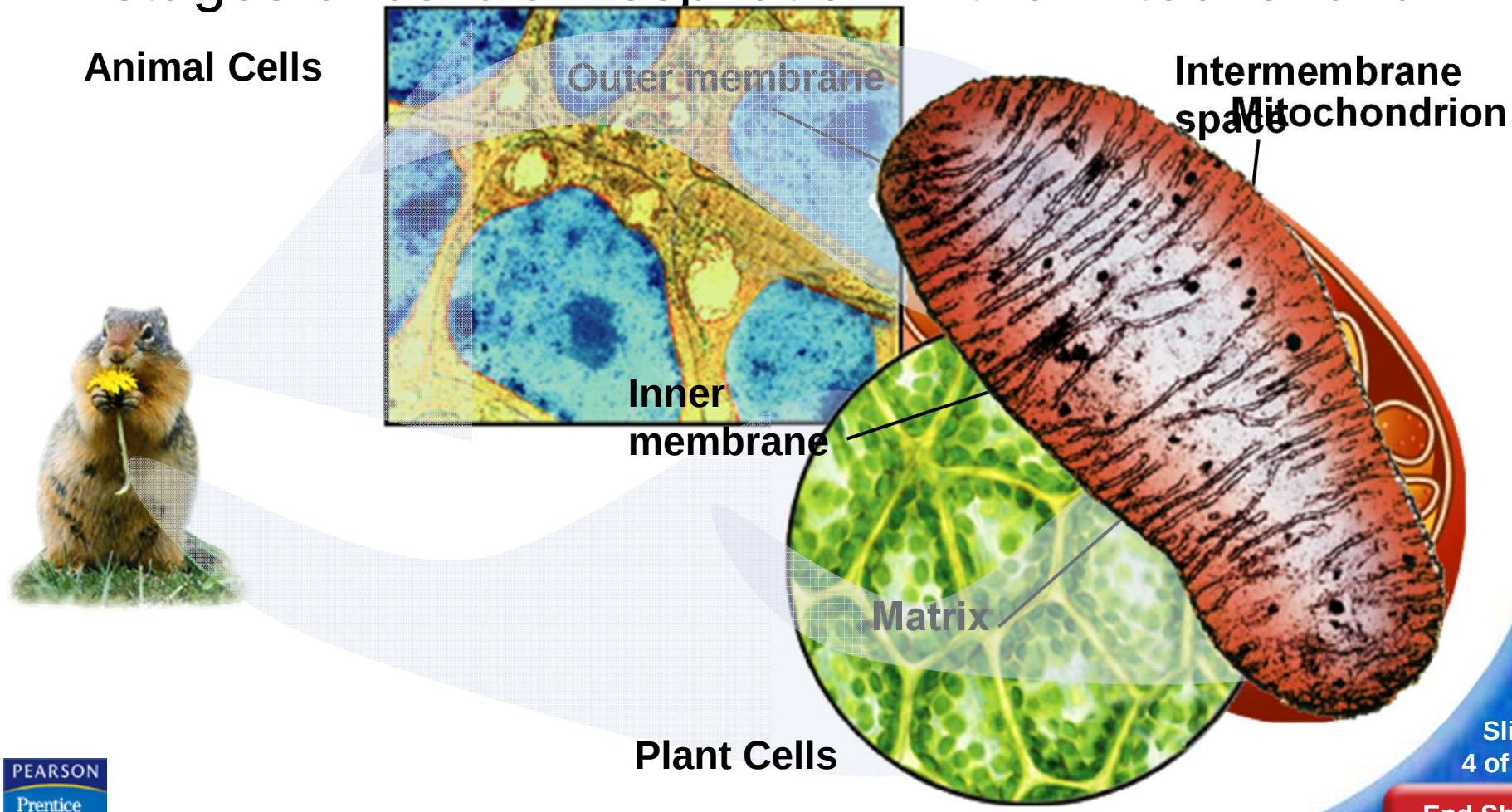
Both plant and animal cells carry out the final stages of cellular respiration in the mitochondria.



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Chemical Energy and Food

One gram of the sugar glucose ($C_6H_{12}O_6$), when burned in the presence of oxygen, releases 3811 calories of heat energy.

A **calorie** is the amount of energy needed to raise the temperature of 1 gram of water 1 degree Celsius.

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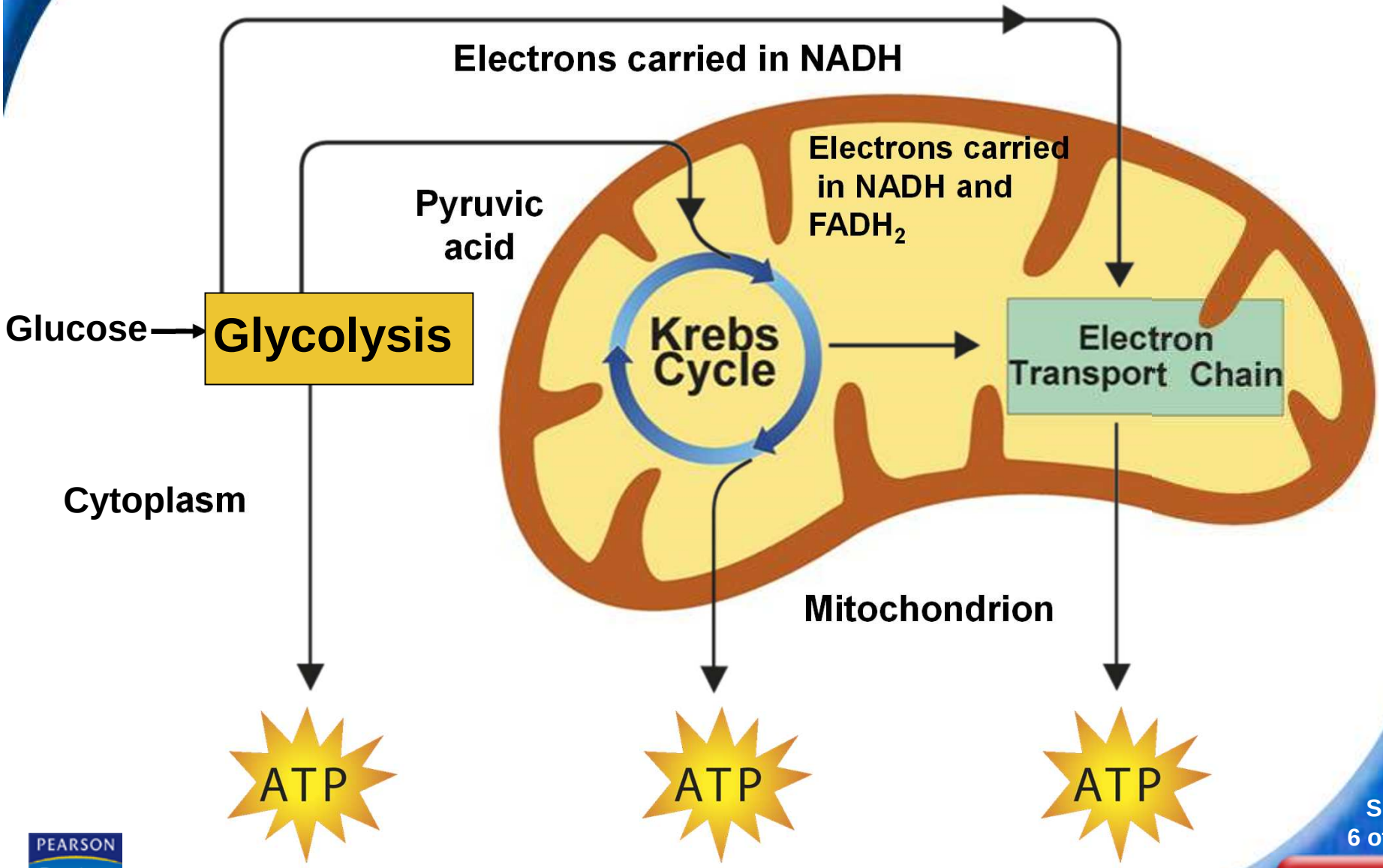

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Cellular respiration is the process that releases energy by breaking down glucose and other food molecules in the presence of oxygen.

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The equation for cellular respiration is:

$6O_2 + C_6H_{12}O_6 \rightarrow 6CO_2 + 6H_2O + Energy$

oxygen + glucose → carbon dioxide + water + Energy

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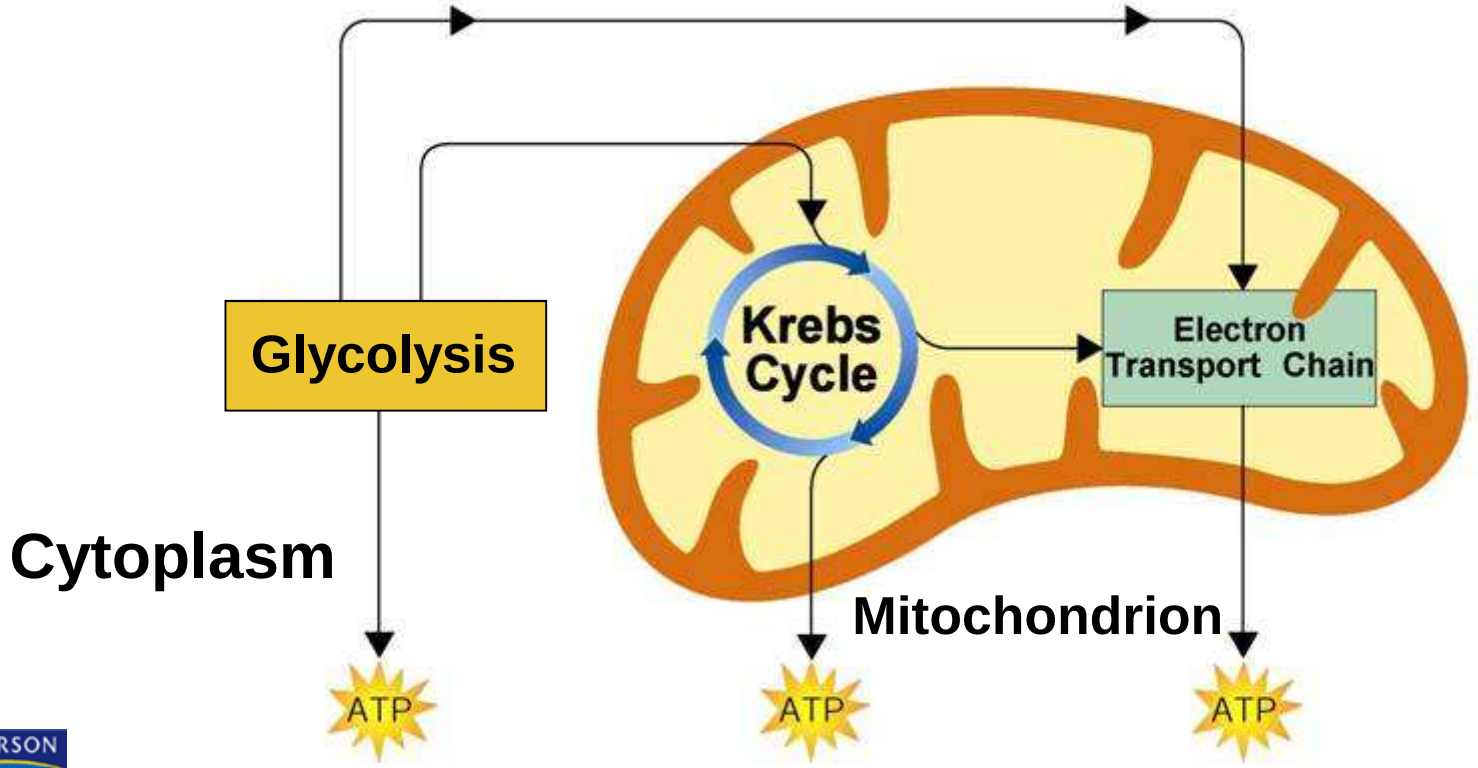
Glycolysis takes place in the cytoplasm. The Krebs cycle and electron transport take place in the mitochondria.



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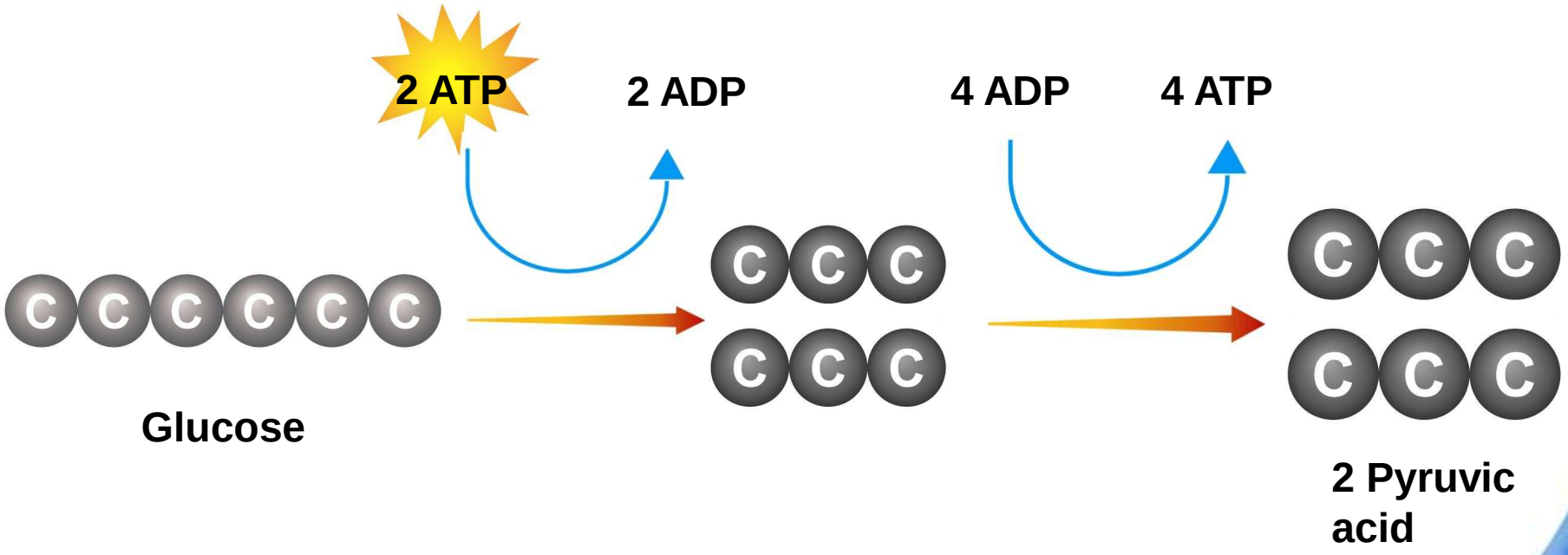
ATP Production

At the beginning of glycolysis, the cell uses up 2 molecules of ATP to start the reaction.



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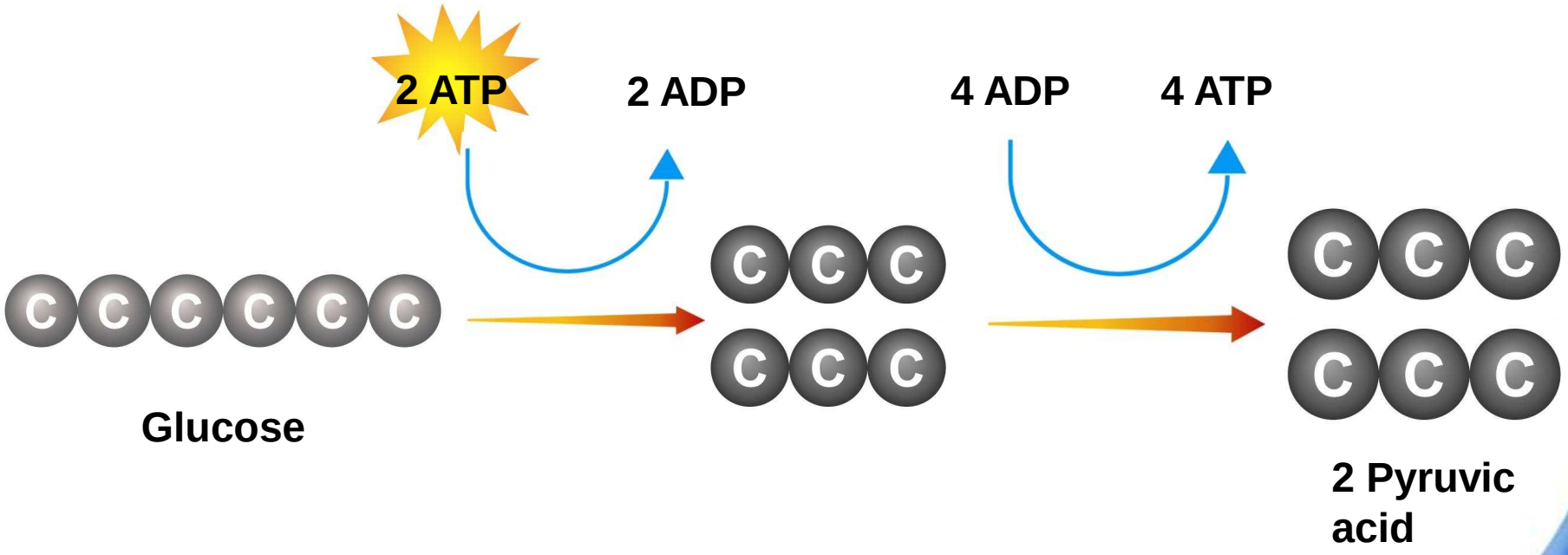
When glycolysis is complete, 4 ATP molecules have been produced.



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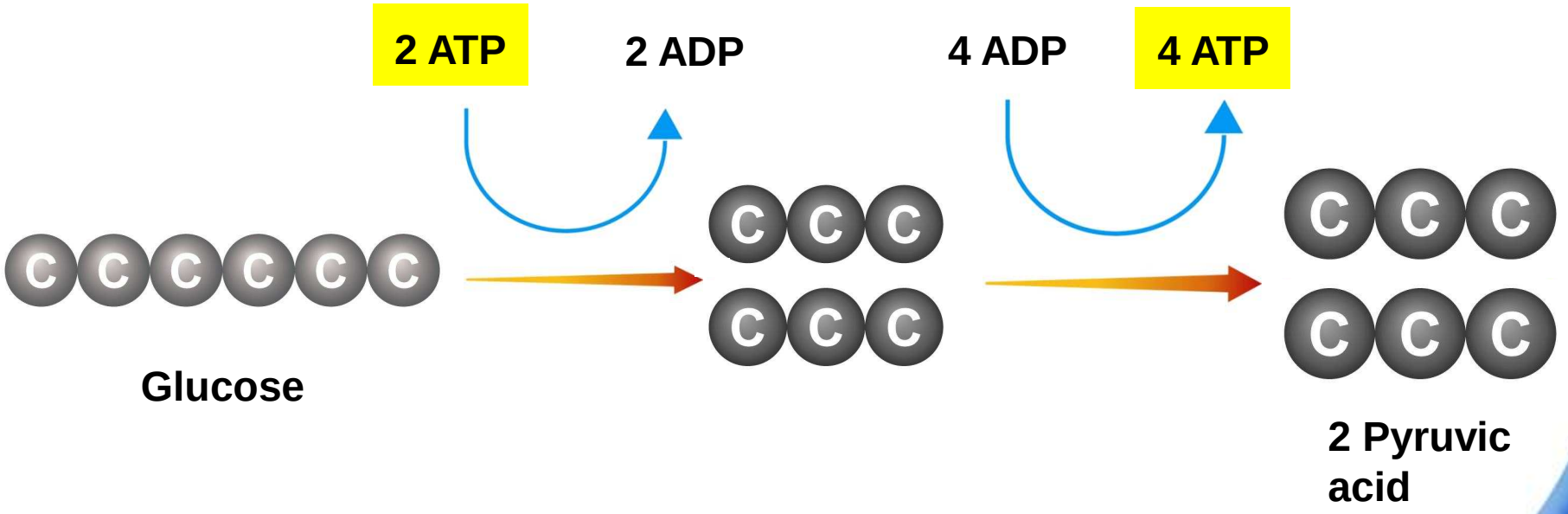
This gives the cell a net gain of 2 ATP molecules.



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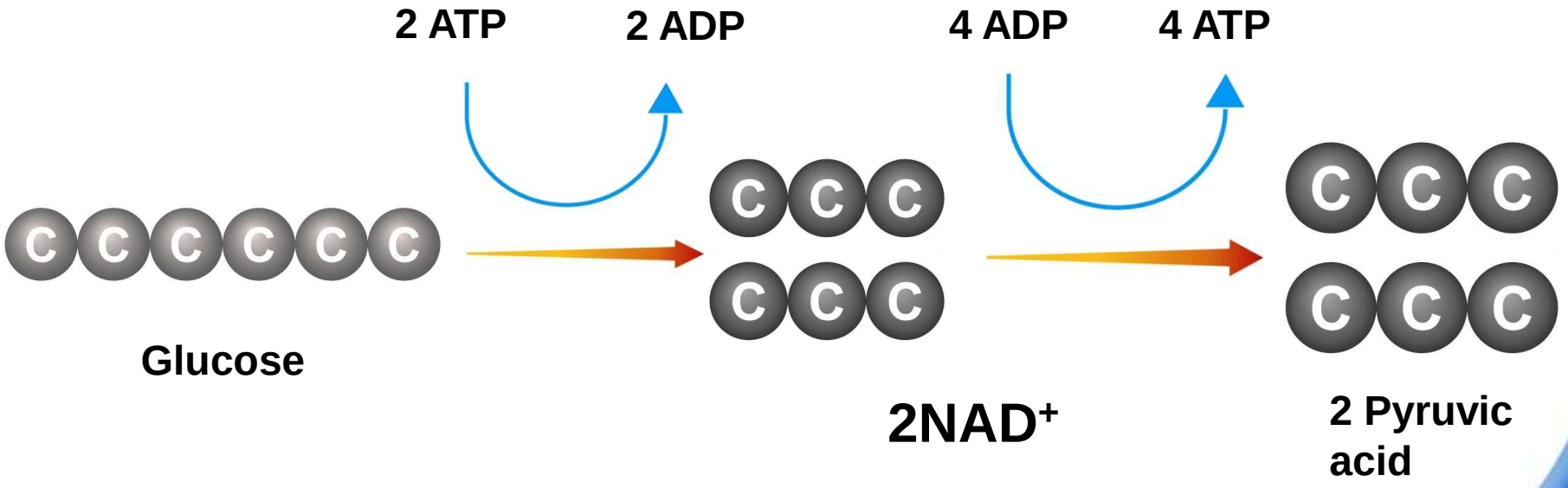
NADH Production

One reaction of glycolysis removes 4 high-energy electrons, passing them to an electron carrier called **NAD^+**.



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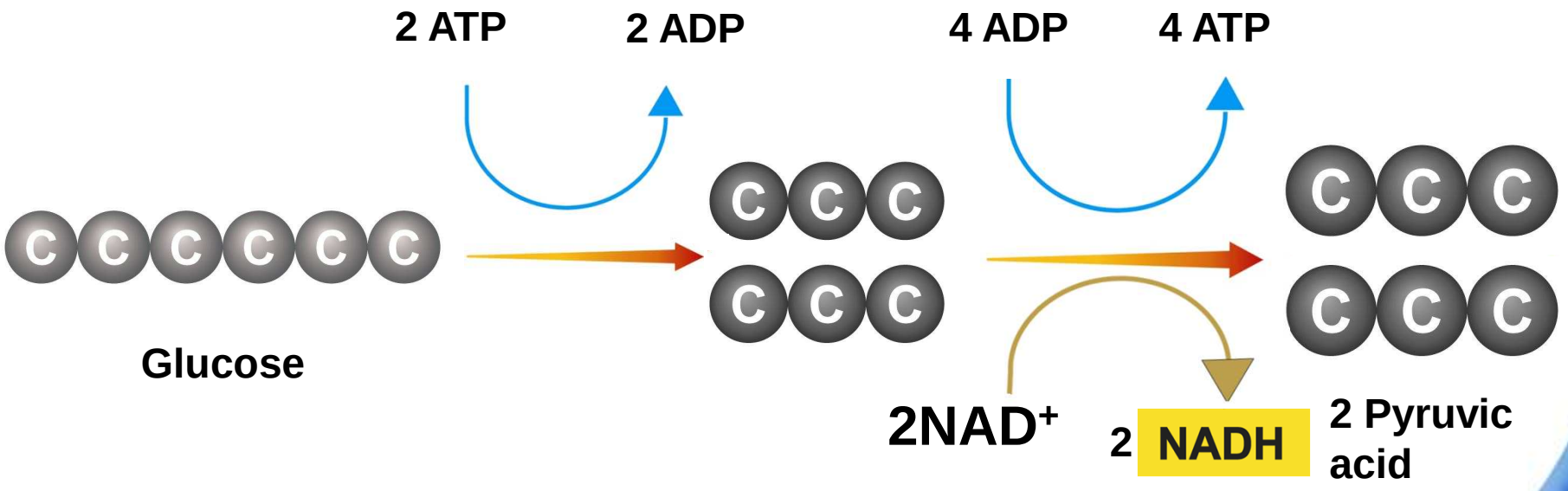
Each NAD^+ accepts a pair of high-energy electrons and becomes an NADH molecule.



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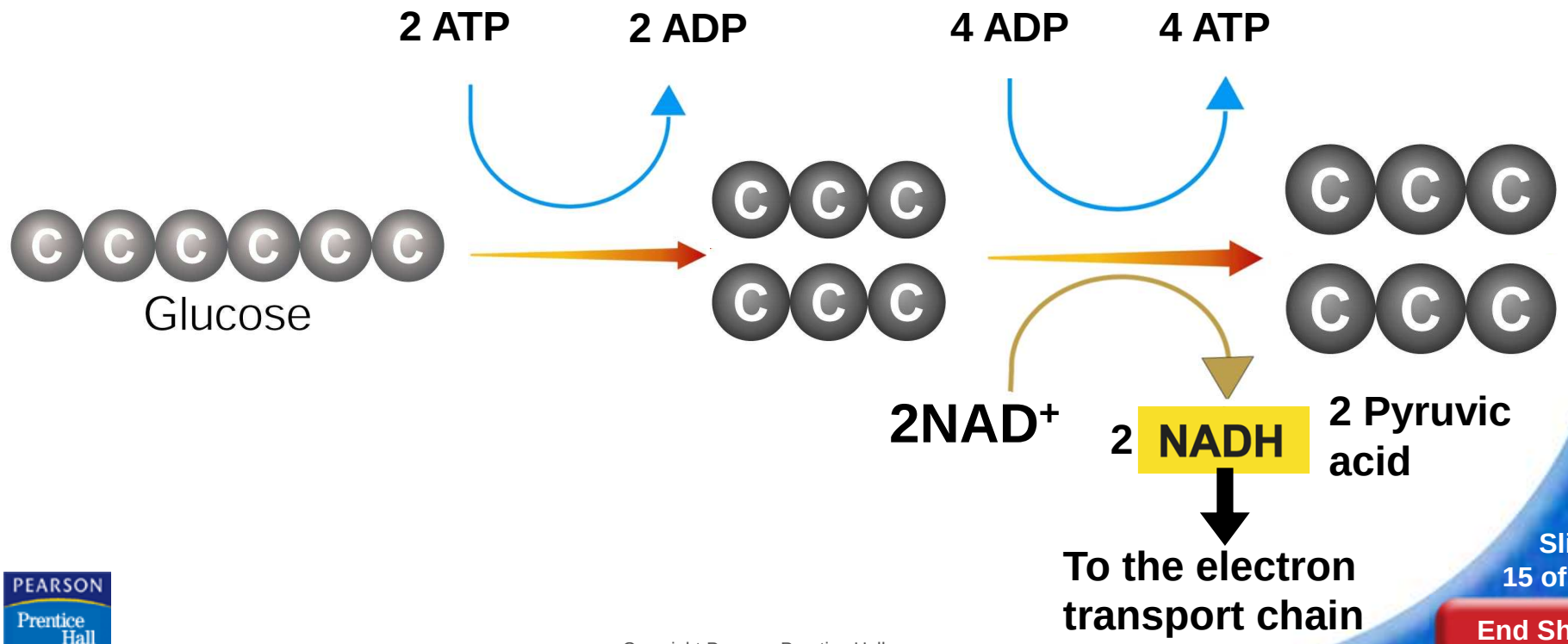
The NADH molecule holds the electrons until they can be transferred to other molecules.



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The Advantages of Glycolysis

The process of glycolysis is so fast that cells can produce thousands of ATP molecules in a few milliseconds.

Glycolysis does not require oxygen.

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Fermentation

When oxygen is not present, glycolysis is followed by a different pathway. The combined process of this pathway and glycolysis is called fermentation.

Fermentation releases energy from food molecules by producing ATP in the absence of oxygen.

There are two main types of fermentation, alcoholic fermentation and lactic acid fermentation.

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Oxygen is required for the final steps of cellular respiration.

Because the pathways of cellular respiration require oxygen, they are **aerobic**.

During the Krebs cycle, pyruvic acid is broken down into carbon dioxide in a series of energy-extracting reactions.

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The energy tally from 1 molecule of pyruvic acid is

- 4 NADH
- 1 $FADH_2$
- 1 ATP

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The Totals

Glycolysis produces just 2 ATP molecules per molecule of glucose.

The complete breakdown of glucose through cellular respiration, including glycolysis, results in the production of 36 molecules of ATP.

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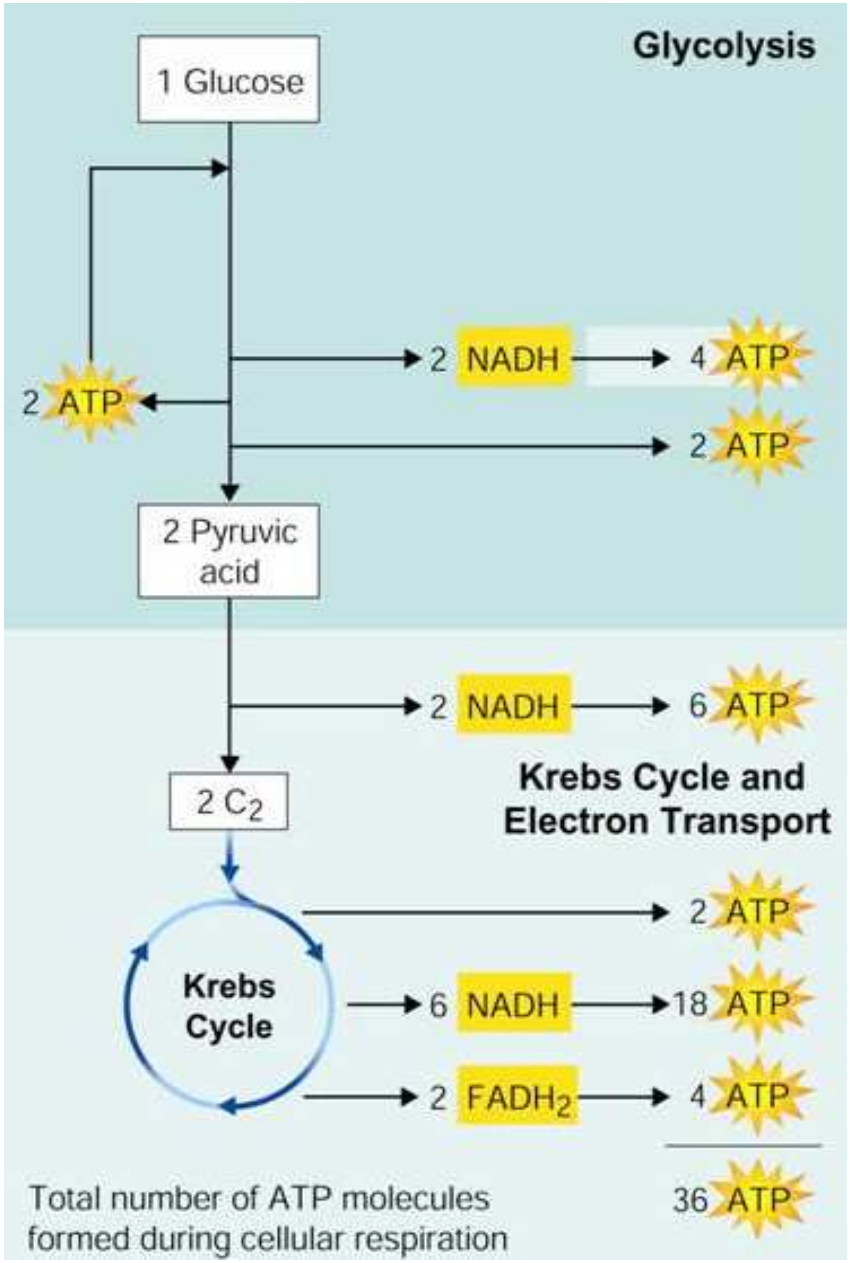
9-1 Chemical Pathways ➡ The Totals



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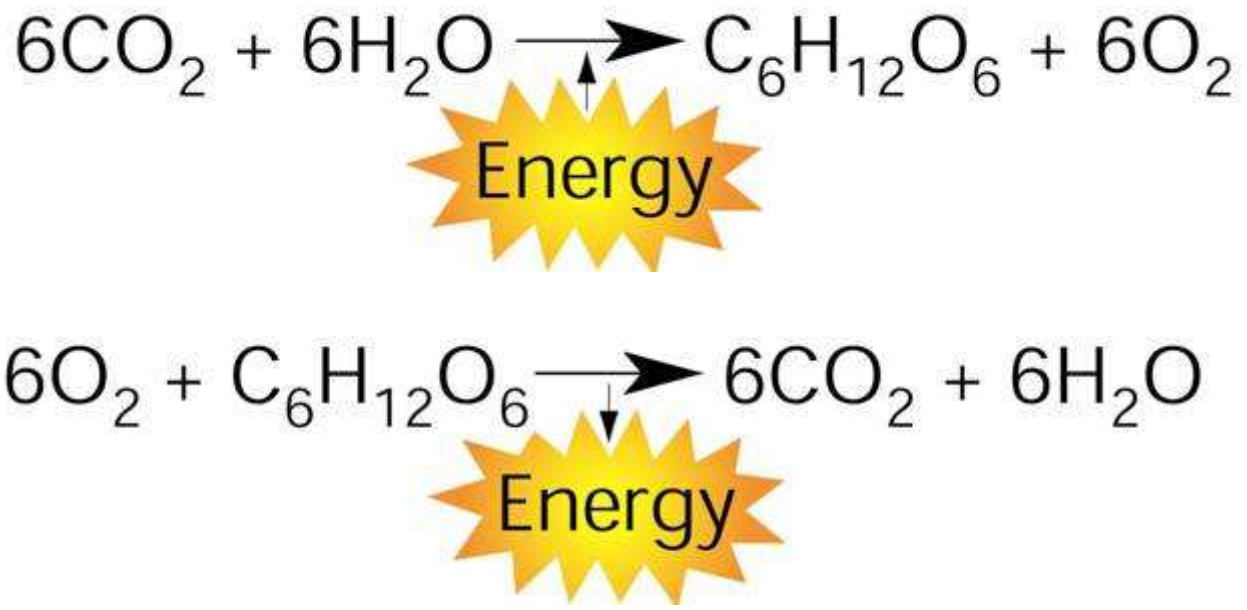
Comparing Photosynthesis and Cellular Respiration

The energy flows in photosynthesis and cellular respiration take place in opposite directions.



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On a global level, photosynthesis and cellular respiration are also opposites.

- Photosynthesis removes carbon dioxide from the atmosphere and cellular respiration puts it back.
- Photosynthesis releases oxygen into the atmosphere and cellular respiration uses that oxygen to release energy from food.

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Left Side Activity

- Write down the equations for photosynthesis and cellular respiration. Write down as many similarities and differences between them.

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