

# Cellular Respiration: Making Energy

## Cellular Respiration: Using energy that is stored in the cell

Cells store and use energy in a way that is similar to the way you deposit and withdraw money from a savings account. When you eat a meal, you add to your body's energy savings account. When your cells need energy, they make a withdrawal and break down the glucose in food to release energy. The process by which cells "withdraw" energy from glucose is called respiration. During respiration, cells break down simple food molecules such as glucose and release the energy they contain. Because living things need a continuous supply of energy, the cells of all living things carry out respiration continuously. The term respiration is also used to mean breathing, that is, moving air in and out of your lungs. To avoid confusion, the respiration process that occurs inside cells is called cellular respiration. The two kinds of respiration are related. Breathing brings oxygen into your lungs and oxygen is necessary for cellular respiration to occur in cells.

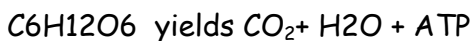
The overall process of respiration can be summarized in a simple chemical equation. There are two basic types of cellular respiration: aerobic and anaerobic. Aerobic respiration occurs in the presence of oxygen in the mitochondria of a cell. With aerobic respiration, a lot of energy is released in the form of a molecule called ATP. This is the main source of energy plants and animals use to perform live processes such a movement, growth and reproduction. Anaerobic respiration occurs when no oxygen is available in the cytoplasm of a cell. Anaerobic respiration does not release as much ATP as aerobic respiration.

There is another special type of anaerobic respiration called fermentation. Fermentation does not release much ATP and does not use oxygen. Some single-celled organisms like yeast use this process to break down simple sugars as they create energy for life processes. Fermentation produces alcohol as a product rather than water.

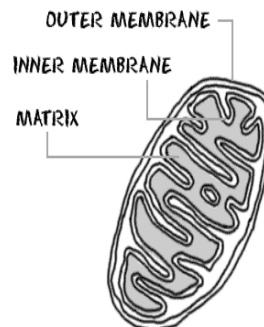
Aerobic Cellular Respiration Equation:



Anaerobic Cellular Respiration Equation:



Fermentation Equation:



1. How is respiration different from cellular respiration?

Respiration or breathing, uses the lungs to bring air into your body. Cellular respiration uses oxygen from the air you bring into your lungs to break down food for cells to have energy.

2. What is cellular respiration?

Cellular respiration is the process that cells use to break down glucose into energy so cells can perform life process such as growth and reproduction.

3. What are the 2 types of cellular respiration?

Two types of cellular respiration are aerobic and anaerobic respiration. Aerobic uses oxygen and anaerobic does not.

4. What is the difference between the 2 types of anaerobic cellular respiration?

Anaerobic respiration in yeast and other single celled organisms is called fermentation.

Fermentation creates alcohol as one of its byproducts. The anaerobic respiration that occurs in multicellular organisms like humans is called lactic acid fermentation.

5. Where do each of the 2 types of cellular respiration occur?

Aerobic respiration occurs in the mitochondrion of a cell. Anaerobic respiration occurs in the cytoplasm of a cell.

6. What are the reactants for each of the 2 types of cellular respiration?

The reactants for aerobic respiration are glucose and oxygen. The reactant for anaerobic respiration is glucose.

7. What are the products of each of the 2 types of cellular respiration?

The products for products for aerobic respiration are carbon dioxide, water and ATP. The products for anaerobic respiration are carbon dioxide, ATP, and either lactic acid or alcohol (see #4 above).

### More about Fermentation

As we already stated, fermentation is a type of anaerobic respiration that occurs in single celled organisms. Sometimes cells in multicellular organisms also undergo a similar type of fermentation when no oxygen is available. For example, when your muscles are overworked from running or some other activity, lactic acid is released rather than water or alcohol. The result is a burning or soreness of the muscles that are involved because the lactic acid irritates them.

8. What kind of respiration occurs in yeast and other unicellular organisms?

Anaerobic respiration known as fermentation.

9. How are the products of fermentation in unicellular vs. multicellular organisms different?

Unicellular organisms produce carbon dioxide, alcohol and ATP.

Multicellular organisms produce carbon dioxide, lactic acid and ATP.

10. Why do plants need oxygen?

Plants need oxygen to perform cellular respiration on the glucose they make.

11. Why do animals need oxygen?

Animals need oxygen to perform cellular respiration on the glucose they obtain by eating other organisms such as plants or animals. This occurs after the food is digested and reaches the individual cells in the organism.

12. How do plants get the glucose they use to make energy?

Plants get their glucose through the process of photosynthesis.

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13. How do animals get the glucose they use to make energy?

Animals get the glucose they need by eating organisms like plants and animals.

14. What type of energy does the plant use to convert  $CO_2$  and  $H_2O$  into sugar?

Plants use radiant energy from the Sun to convert carbon dioxide and water into glucose.

15. In what form is the energy released by cellular respiration stored?

Energy released from cellular respiration is stored in ATP molecules.

Complete the following table to summarize the difference between the types of cellular respiration:

| Type   | Reactants                | Products                            | Where in Cell |
|--|--------------------------|-------------------------------------|---------------|
| Aerobic Cellular Respiration                     | Glucose and oxygen       | Carbon dioxide, water and ATP       | mitochondrion |
| Anaerobic Cellular Respiration<br>(Lactic acid)  | Glucose                  | Carbon dioxide, lactic acid and ATP | cytoplasm     |
| Anaerobic Cellular Respiration<br>(Fermentation) | Glucose                  | Carbon dioxide, alcohol and ATP     | cytoplasm     |
| Photosynthesis                                   | Carbon dioxide and water | Glucose and oxygen                  | chloroplast   |

**Reflection Question:** Describe the flow of energy in a simple food chain from grass to a rabbit to a fox, using the processes of photosynthesis and cellular respiration. Include details about each of the processes including reactants, products and any other information you have learned.

Grass captures energy from the Sun, storing it in its leaves, in the chloroplasts of mesophyll cells.

Through photosynthesis, water and carbon dioxide is taken in and glucose is created and stored in the plant (transported by the phloem to all parts of the grass). Oxygen is also released by the plant. A rabbit eats the grass and digests it. The digested grass cells provide glucose to the rabbit. When the rabbit breathes, it brings oxygen into its body, which is used by cellular respiration to break down the glucose and ATP is formed in the rabbit's cells. The rabbit exhales carbon dioxide. The rabbit now has stored chemical energy (ATP) which can be used as needed. The rabbit will use the energy to grow and reproduce. Foxes eat the rabbits, which provide their stored energy to the foxes to be broken down by cellular respiration in the same way.