

Topic: Respiration: Aerobic & Anaerobic
B.Sc. Botany (Sub.) II
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Respiration

All organisms respire in order to release energy to fuel their living processes. The respiration can be aerobic, which uses glucose and oxygen, or anaerobic which uses only glucose. Respiration must happen all of the time so that the organism can survive.

Respiration releases energy - it is an exothermic process. The energy is stored in molecules of ATP. ATP can be broken down in other processes in cells to release the stored energy.

During the process of photosynthesis, light energy is converted to chemical energy and stored in bonds of complex organic molecules. The major portion of stored energy in plants is found in the form of carbohydrates, such as starch and glucose

Photosynthesis is the process by which plants, and some bacteria, synthesise food molecules - which they then use, in addition to other things, for respiration. The process of photosynthesis requires energy - it is endothermic.

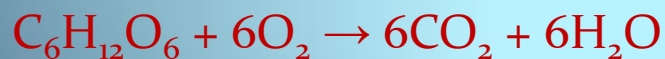
The chemical reactions to build complex carbohydrates, proteins and lipids from the products of photosynthesis in plants, and the products of digestion in animals, require energy.

Movement in animals, ATP is needed to make muscles contract, while in plants, it is needed for transport of substances in the phloem.

Aerobic respiration

Respiration using oxygen to break down food molecules is called aerobic respiration. 'Aero' means air, which contains oxygen, leading to the name aerobic respiration. Glucose is the molecule normally used for respiration it is the main respiratory substrate. Glucose is oxidised to release its energy, which is then stored in ATP molecules.

The equation for aerobic respiration is:



Respiration is a series of chemical reactions, but this equation summarises the overall process. Aerobic respiration breaks down glucose and combines the broken down products with oxygen, making water and carbon dioxide. The carbon dioxide is a waste product of aerobic respiration because cells do not need it.

The first stages of respiration occur in the cytoplasm of plant and animal cells, but most of the stages of respiration that release energy happen in the mitochondria. Microorganisms do not have mitochondria - they carry out respiration only in the cytoplasm.

Anaerobic respiration

Most of the organisms cannot respire without oxygen but some organisms and tissues can continue to respire if the oxygen runs out. In conditions of low or no oxygen the process of anaerobic respiration occurs. The 'an' in 'anaerobic' means without.

During anaerobic respiration, the oxidation of glucose is incomplete, not all of the energy can be released from the glucose molecule as it is only partially broken down. The

reaction therefore releases much less energy than aerobic respiration around only a nineteenth of the energy released during aerobic respiration. This means that fewer molecules of ATP can be made.

Glucose in human muscle cells is converted to lactic acid during anaerobic respiration. The lactic acid is a waste product.

Some plants, microorganisms and fungi such as yeast can respire anaerobically - it's preferable to release less energy and make less ATP but remain alive.

Glucose in yeast cells is converted to carbon dioxide and ethanol, which refer to as 'alcohol':



This reaction is also called fermentation.

The main difference between aerobic and anaerobic respiration are given below-

Aerobic respiration

- It is common in all higher plants.
- It occurs inside the living cells.
- It is a permanent process and goes on throughout the life of plants.
- Energy released in a larger amount in the form of ATP (38 ATP).
- Not toxic to plants.
- Occurs in the presence of O_2 .
- End products are CO_2 and H_2O .

Anaerobic respiration

- It is uncommon in higher plants but common in certain microorganisms.
- It occurs inside the living cells. Living cells are not essential in some fermentation.
- It occurs for a temporary phase under anaerobic conditions in higher plants.
- Energy released in a lesser amount in the form of 2 molecules of ATP. Heat is generated in fermentation.
- Toxic to higher plants.
- Occurs in the absence of O_2 .
- End products are ethanol and CO_2 .