

CELLULAR RESPIRATION

29 MAY 2013

Lesson Description

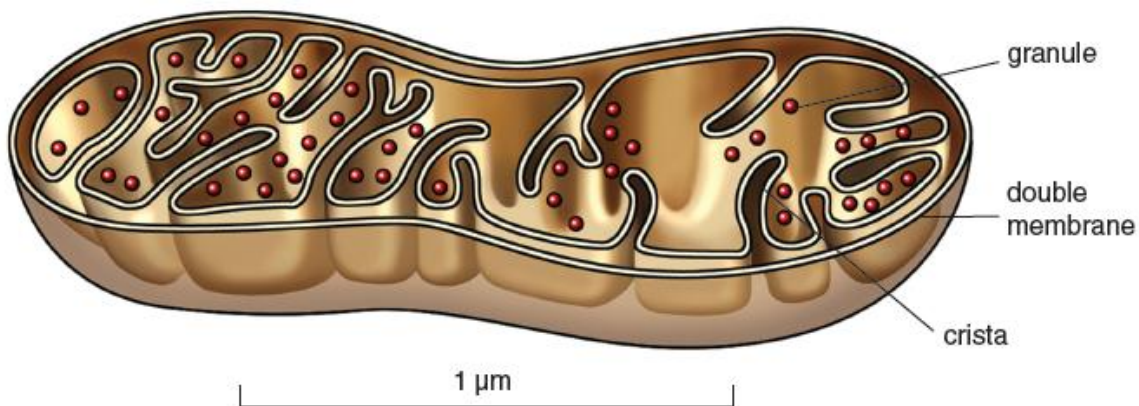
In this lesson, we:

- Define cellular respiration
- Define aerobic respiration
 - The role of glycolysis in aerobic respiration
 - The role of the Krebs's cycle and
 - Oxidative phosphorylation in aerobic respiration
- Define anaerobic respiration
 - Alcoholic fermentation
 - Lactic acid fermentation in muscles
- Look at the role of anaerobic respiration in industry
- Review investigations into aerobic and anaerobic experiments

Key Concepts

Define Cellular Respiration

- Cellular respiration is defined as a series of metabolic processes that take place within a cell in which biochemical energy is harvested from organic substance (e.g. glucose) and stored as energy carriers (ATP) for use in energy-requiring activities of the cell (http://www.biology-online.org/dictionary/Cell_respiration).
- Simply put chemical energy is transferred to ATP and the ATP molecules provide energy to all the processes of the cells.
- The transformation of energy occurs in the mitochondrion in the cells. The mitochondrion is specially adapted for this.



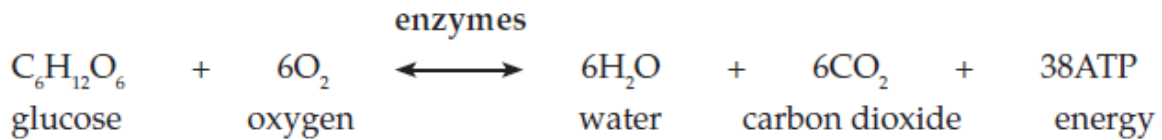
(Solutions for All, Life Sciences, Grade 11, Macmillan, p183)

Recap from Grade 10

- A mitochondrion has two membranes – an inner and an outer membrane. Between the membranes is a space. The inner membrane is folded and these folds are called cristae and the space in the centre of the inner membrane is called the matrix.
- The cristae increase the surface area of the inner membrane and so increase ATP production.

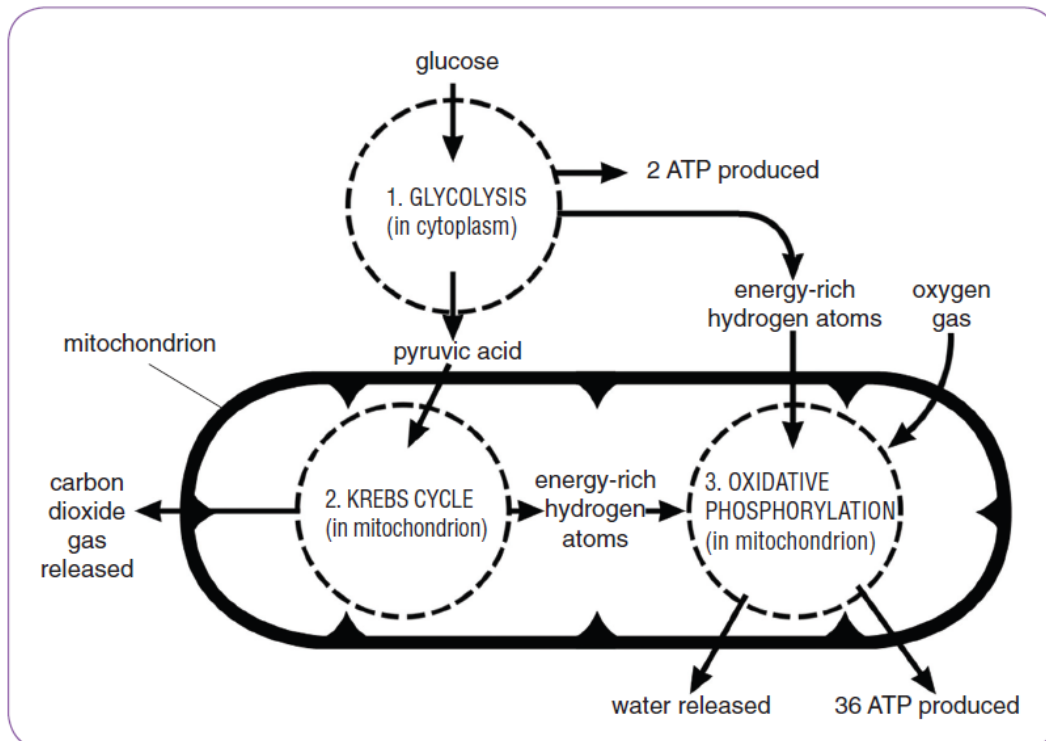
Aerobic Respiration

- Aerobic respiration occurs when glucose is broken down in the presence of oxygen. A lot of energy (many ATP molecules) is produced
- Aerobic respiration is summarised in the equation below.



(Solutions for All, Life Sciences, Grade 11, Macmillan, p184)

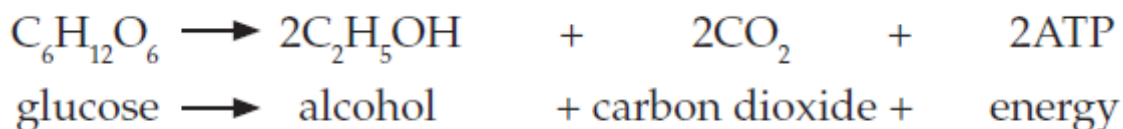
- There are three stages in aerobic respiration, namely glycolysis, the Krebs cycle and oxidative phosphorylation.
- **Glycolysis:** This occurs in the cytoplasm of the cell. Glucose is broken down into **pyruvic acid** and energy-rich hydrogens are given off.
- The hydrogens move into the mitochondria to be used in oxidative phosphorylation.
- Two ATP molecules are produced during glycolysis.
- The **Krebs cycle** breaks down the pyruvic acid completely into energy-rich hydrogens and carbon dioxide. The hydrogens will be used in **oxidative phosphorylation** and the carbon dioxide will be breathed out.
- **Oxidative phosphorylation:** takes the energy from the energy-rich hydrogens to make ATP. The energy depleted hydrogens combine with oxygen to make water. This is either breathed out as water vapour or excreted via the kidneys.



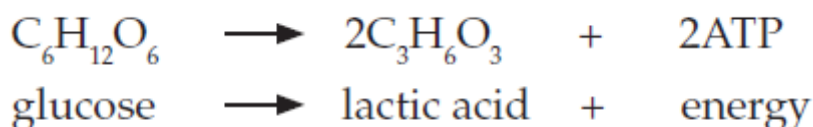
(Solutions for All, Life Sciences, Grade 11, Macmillan, p185)

Anaerobic Respiration

- Anaerobic respiration occurs when glucose is broken down and there is no oxygen present. Very little energy is produced.
- There are two types of anaerobic respiration – the respiration that occurs in organisms that are not human is called alcoholic fermentation. Anaerobic respiration in the human body is called lactic acid fermentation.



Alcoholic fermentation in primitive organisms
(Solutions for All, Life Sciences, Grade 11, Macmillan, p191)



Lactic acid fermentation in humans
(Solutions for All, Life Sciences, Grade 11, Macmillan, p191)

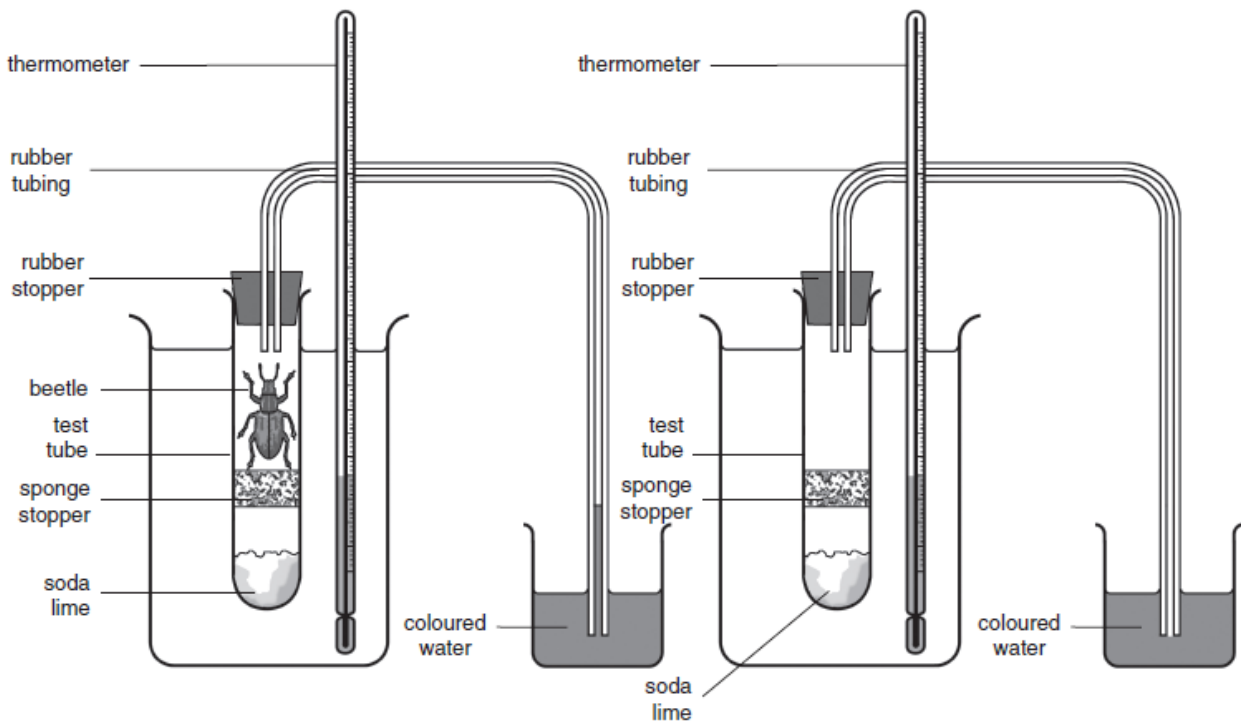
- Anaerobic respiration only occurs in humans when the oxygen supplied to muscles is used up and the muscles still require energy. This produces lactic acid and leads to the muscle fatigue during and stiffness after exercising.

Anaerobic Respiration in Industry

- Yeast is used widely in Biotechnology. It is used in the fermentation of alcohols and the production of bread.

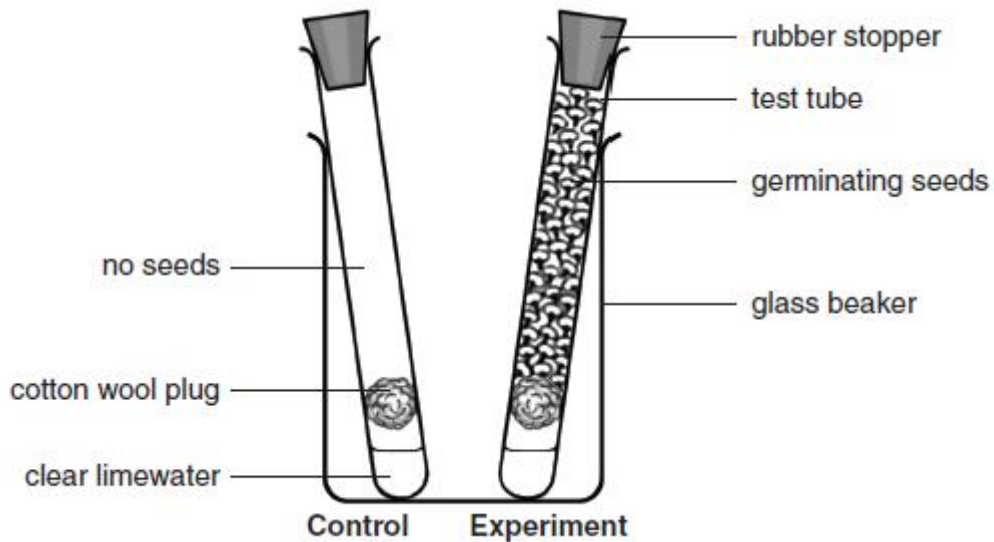
Practicals

- Prescribed practical for aerobic respiration



(Solutions for All, Life Sciences, Grade 11, Macmillan, p186)

- The above apparatus is set up to determine whether oxygen is used in aerobic respiration or not in animals, insects etc.



(Solutions for All, Life Sciences, Grade 11, Macmillan, p187)

- The above apparatus is set up to determine whether oxygen is used in aerobic respiration or not in plants.

Questions

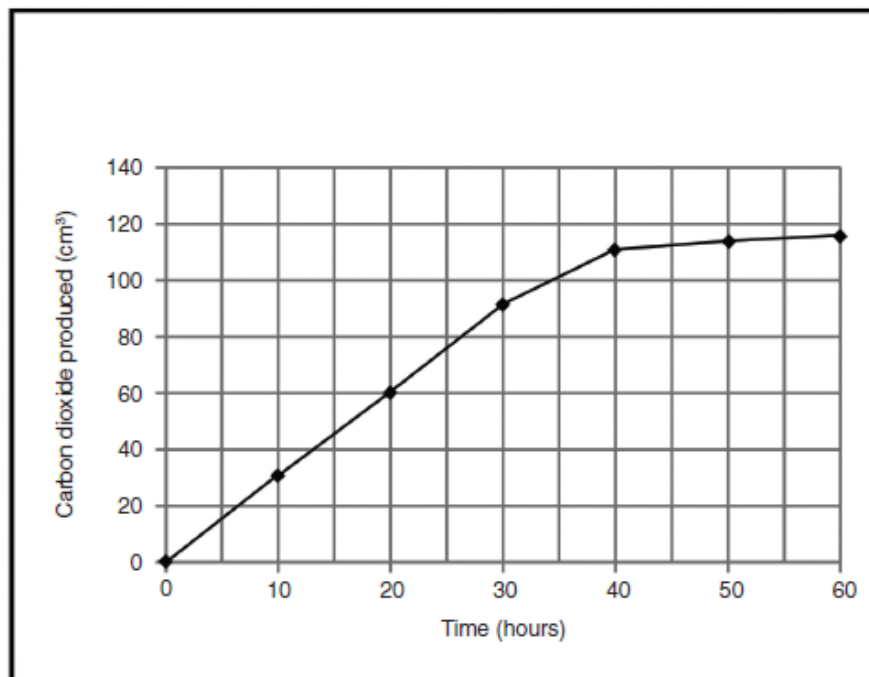
Question 1

Give the correct biological term for each of the following descriptions:

- the general energy carrier in cells
- animals that maintain a constant body temperature despite the outside temperature
- the first stage of aerobic respiration, which occurs in the cytoplasm
- the second stage of aerobic respiration, which occurs in the mitochondria
- type of anaerobic respiration that occurs in animals
- the third and last stage of aerobic respiration, which occurs in the mitochondria

Question 2

A learner performed an investigation to measure the rate of carbon dioxide produced by a culture of micro-organisms in the presence of oxygen. Readings were taken at regular intervals over a period of 60 hours. The results are shown below. Study the graph and answer the questions that follow.



Graph showing the rate of carbon dioxide production in a culture of micro-organisms

- Identify the process the learner investigated. (1)
- State the volume of carbon dioxide that was produced 35 hours after the start of the investigation. (2)
- What is the relationship between time and the amount of carbon dioxide produced as seen from the shape of the graph? (1)
- Name one product other than carbon dioxide that is produced from the physiological process in organisms. (1)

Question 3

(Adapted from Solutions for All, Life Sciences, Grade 11, Macmillan, p197 - 200)

In industrial brewing processes, yeast is added to a sugary solution and left at 25 °C. The sugars are converted to glucose and then this undergoes fermentation.

- a.) What are the products of fermentation? (2)
- b.) List FOUR ways that the above-mentioned process is economically important. (4)
- c.) (i) This type of biochemical process also occurs in animals. What product is produced in animal tissue? (1)
(ii) What effect does this product have on the muscles? Explain what the body does to ease the symptoms. (3)