

## CELLULAR RESPIRATION

04 JUNE 2014

### Lesson Description

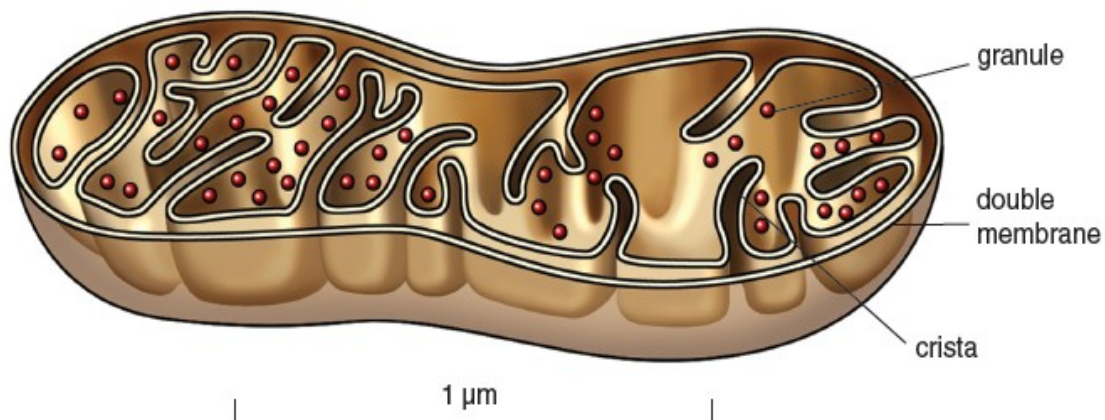
In this lesson, we:

- Define cellular respiration in terms of
  - Anaerobic respiration
  - Aerobic respiration
- Look at examples of anaerobic respiration in industry
- Describe a few experiments on cellular respiration.

### Summary

#### Cellular Respiration

- 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.



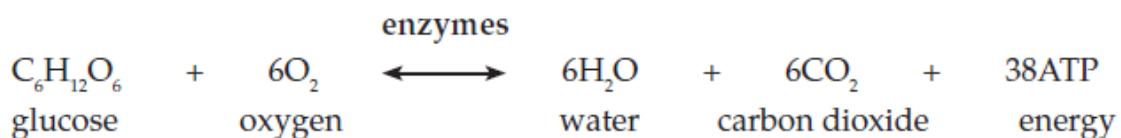
(Solutions for all Life Sciences, Macmillan, p183)

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.

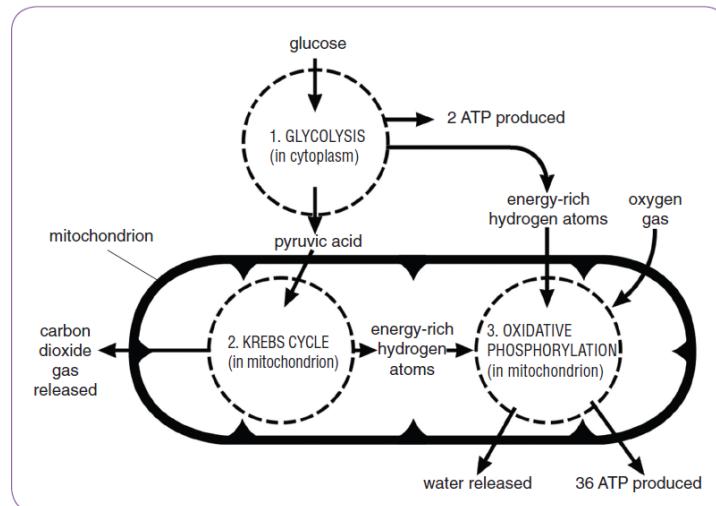


(Solutions for all Life Sciences, Macmillan, p184)

- There are three stages in aerobic respiration:

notes for...

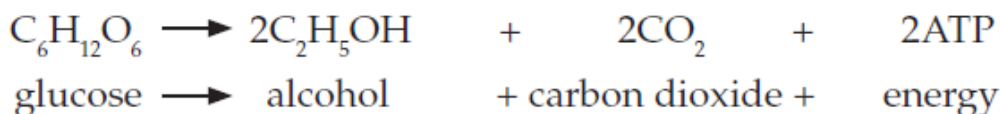
- **Glycolysis:** This occurs in the cytoplasm of the cell. Glucose is broken down into **pyruvic acid** and **energy-rich hydrogens are given off**.
  - The hydrogens move into the mitochondria to be used in oxidative phosphorylation.
  - **Two ATP molecules are produced during glycolysis.**
- The **Krebs 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, Macmillan, p185)

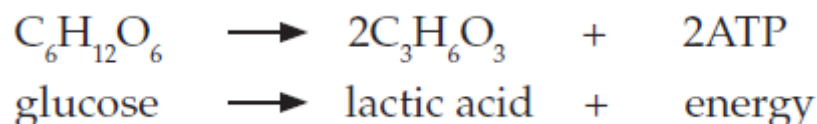
### Anaerobic Respiration

- 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.



(Solutions for all Life Sciences, Macmillan, p191)

### Alcoholic fermentation in primitive organisms



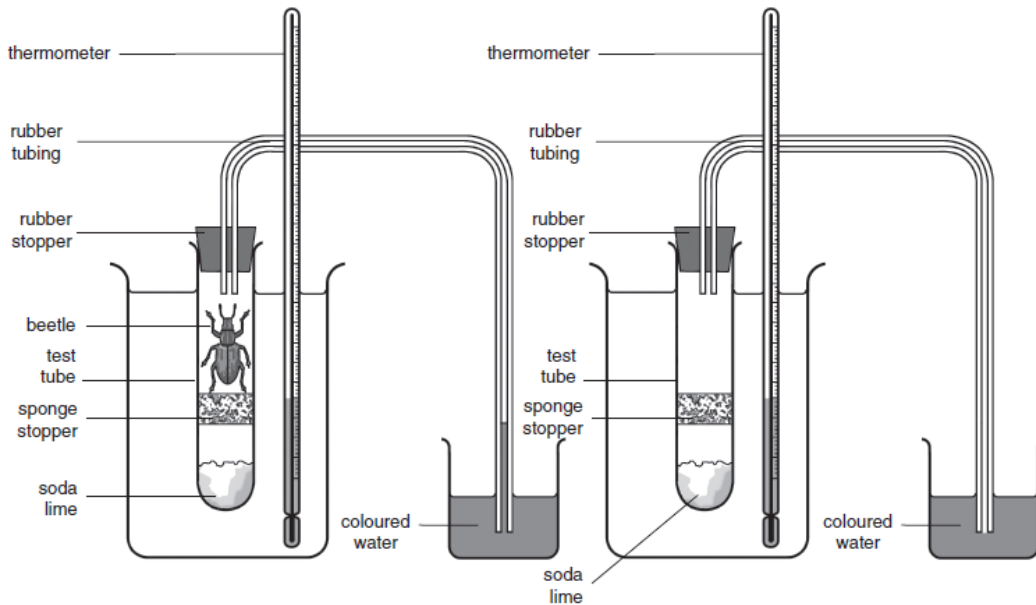
- Anaerobic respiration only occurs in humans when the oxygen supplied to muscles is used up and the muscles still require energy. This produces lactic acid and leads to the muscle fatigue during and stiffness after exercising.

**Anaerobic Respiration in Industry**

- Yeast is a fungus and the fermentation process occurring in the cell is used in the production of alcoholic beverages and bread.

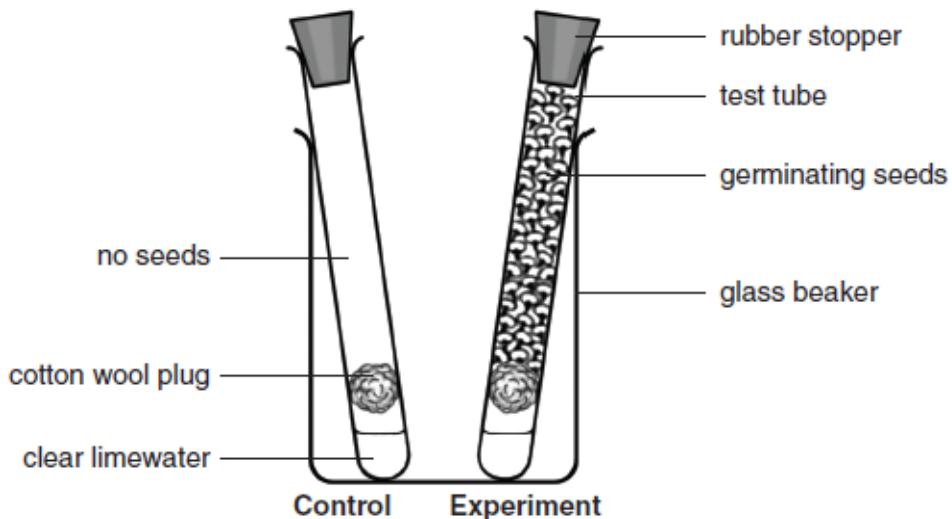
**Practicals**

- Prescribed practical for aerobic respiration



*(Solutions for all Life Sciences, 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, Macmillan, p187)*

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



## Test Yourself

### Question 1

Cellular respiration is the name given to a series of biochemical reactions that:

- A. makes glucose from carbon dioxide and water
- B. uses glucose to make ATP
- C. uses glucose to make oxygen
- D. uses ATP to make oxygen

### Question 2

The steps of respiration occur in different parts of the cell. Where in the cell does glycolysis occur?

- A. chloroplast
- B. mitochondria
- C. cytoplasm
- D. nucleus

### Question 3

Glycolysis produces a net gain of

- A. no ATP
- B. 1 ATP
- C. 2 ATP
- D. 5 ATP

### Question 4

When oxygen is present the pyruvic acid molecules enter the Krebs cycle. Where in eukaryotic cell does the Krebs cycle occur?

- A. mitochondria
- B. nucleus
- C. cytoplasm
- D. lysosome

### Question 5

During what stage of cellular respiration is the most ATP synthesised?

- A. glycolysis
- B. oxidation of pyruvate
- C. Krebs cycle
- D. fermentation

**Question 6**

Which of the following organisms carries out cellular respiration?

- A. a bacterium
- B. a dog
- C. a yeast
- D. all of the above

**Question 7**

The oxidation of glucose to two molecules each of pyruvate, ATP and NADH is called \_\_\_\_\_ and occurs in the \_\_\_\_\_.

- A. glycolysis, cytoplasm
- B. fermentation, cytoplasm
- C. Krebs cycle, matrix of the mitochondrion
- D. anaerobic respiration, cytoplasm

**Question 8**

In the presence of oxygen, all cells synthesize ATP via the process of glycolysis. Many cells also can metabolize pyruvate if oxygen is not present, via the process of:

- A. fermentation
- B. aerobic respiration
- C. oxidative phosphorylation
- D. photophosphorylation

**Improve your Skills****Question 1**

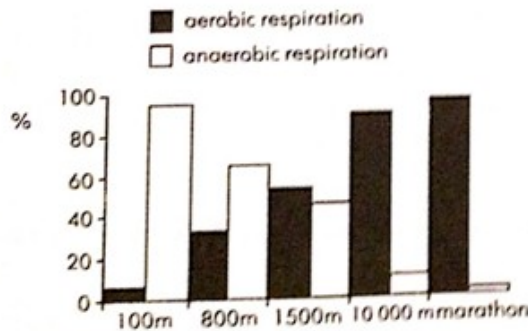
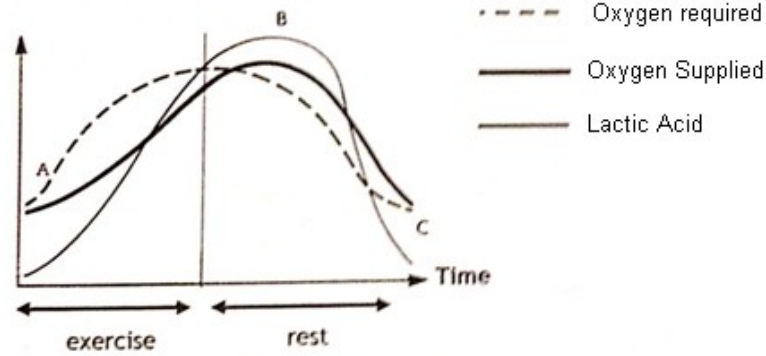
Study the graph showing what happens when we exercise vigorously.

- 1.1 Why does lactic acid build up between A and B? (3)
- 1.2 Why does the amount of oxygen taken in continue to increase once exercise has stopped? (3)
- 1.3 If you continue exercising you would probably end up with muscle cramps. Explain why this would happen. (3)



notes for...

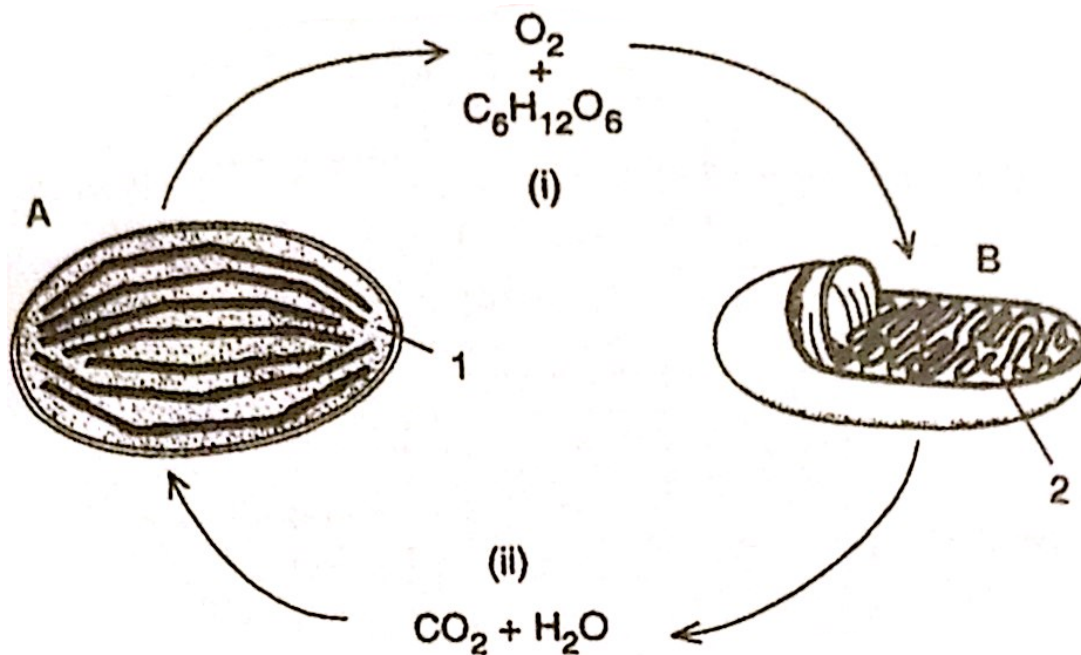
Amount of substance



- 1.4.1 Explain why a 1500m runner could not possibly run a race at the same pace as a 100m runner. (3)
- 1.4.2 If a marathon runner starts too quickly, they are unlikely to finish the race. Explain why this could happen. (3)
- 1.4.3 How might the result for the 800m athlete vary if he/she trained at a higher altitude for about a week just before the race? Explain (1)

**Question 2**

Study the diagram below and answer the questions set.



notes for...

- 2.1 Identify the cytoplasmic organelles A and B. (2)
- 2.2 Name the metabolic process with which each of organelles A and B are associated. (2)
- 2.3 Which one of the organelles (A or B) occurs only in plant cells? (1)
- 2.4 Identify parts 1 and 2. (2)
- 2.5 Complete each of the chemical equations numbered (i) and (ii). (6)
- 2.6 List TWO ways in which the process associated with organelle A is biologically important. (2)

### Question 3

*(Taken from Understanding Life Sciences Grade 11)*

Answer the following questions:

- 3.1 List THREE things that yeast requires in order for fermentation to occur. (3)
- 3.2 How do you know that the gas produced during fermentation is carbon dioxide? (2)
- 3.3 Explain why fermentation stops after a certain time in the making of bread. (2)
- 3.4 When making bread, why is the dough left in a warm place for a while before being put into the oven? (2)
- 3.5 Why would the dough not rise if it is placed straight into the hot oven after it has been mixed? (2)
- 3.6 Yoghurt contains living bacteria. Explain why the lid of a sealed container of yoghurt bulges upwards if left for a very long time in a warm place. (2)