Aerobic and anaerobic exercise
What you will learn about in this topic:

1. Aerobic respiration
2. Anaerobic respiration
3. The function and role of blood
4. The recovery process
Learning objectives

By the end of this presentation you should be able to:

- **Understand** the differences between aerobic and anaerobic respiration
- **Describe** what oxygen debt is
- **Explain** the role of the blood in the transport of substances around the body
Aerobic respiration

During **aerobic respiration** your heart and lungs work to supply the muscles with oxygen.

The aerobic system is used in moderate to hard continuous activities.
The formula for aerobic respiration is:

$$\text{glucose} + \text{oxygen} = \text{Energy} + \text{CO}_2 + \text{H}_2\text{O}$$

To help you remember:

Extra air = aerobic respiration
As long as enough oxygen is supplied to the muscles you can use the aerobic system.
Anaerobic respiration

During **anaerobic respiration** the muscles are NOT supplied with oxygen.

\[
\text{glucose} + \text{NO oxygen} \rightarrow \text{lactic acid} + \text{energy}
\]

To help you remember:

**No air = anaerobic respiration**
Athletic field events are good examples of anaerobic exercise. These activities use one all-out burst of maximum effort to complete the event; the time it takes to complete the attempt is very short.
The demand for oxygen is so great that the cardiovascular system does not have time to supply the demand.

When an athlete stops after a sprint, they continue to breathe more heavily for a while to take in ‘extra’ oxygen.

This is in order to break down the accumulated lactic acid, which makes your muscles feel tired.
The shortage of oxygen is called **oxygen debt**, and the body is paying back the oxygen built up during the sprint.
Working together

Both the aerobic and anaerobic respiration systems work together.

For the first part of an activity the body tends to work in an anaerobic way until the body has had a chance to process and use the oxygen it is breathing in.

The aerobic system then takes over for activities lasting longer than a minute.
Task

With a partner, make a list of the positive and negative effects of aerobic and anaerobic training on performance.

For each effect add a detailed sporting example.
Short-term effects on exercise

- Tidal volume increases
- Blood flow reduced to areas not in use
- Fatigue in muscles
- Oxygen debt
- Gaseous exchange in alveoli
- Aerobic respiration
3.1.1c The demands of performance: the difference between aerobic and anaerobic exercise

- Stroke volume increases as the heart sends out more blood per beat
- Heart beat increases
- Air exhaled to stop build up of carbon dioxide
- Release of energy
- Adrenaline released
- Waste water released from the body as sweat on surface of the skin
Long-term effects on exercise

Endurance training makes the exchange of gases in the alveoli more efficient.

The muscles are able to work at a moderate to hard level for longer without tiring, which increases the vital capacity of the lungs.
Interval training over short distances at fast speeds results in an oxygen debt.

By continuing this form of training new capillaries are formed, heart muscles are strengthened and the delivery of oxygen is improved, helping to stop the build up of lactic acid.

The overall effect is called an **oxygen debt tolerance**.
Task 2

1. Create a table to show the long-term and short-term effects of exercise on the respiratory system.

2. Use the two headings ‘Long-term effects of exercise’ and ‘Short-term effects of exercise’ and write a list of what happens to the body under each heading.
The function and role of blood

**Red blood cells** (erythrocytes) are small but the body contains millions of them.

The main job of the red blood cell is to carry oxygen around the body and to transport carbon dioxide, a waste product, to the lungs.
In adults, red blood cells are produced in the bone marrow of long bones.

During exercise the blood increases in thickness as water is removed as waste.
Red blood cells contain a substance called haemoglobin. Oxygen chemically attaches itself to it to make oxyhaemoglobin.

This is how oxygen is transported to the working muscles and carbon dioxide is taken to the lungs, transported in a solution of plasma.
White blood cells (leukocytes) protect the body by fighting infection at its source, repairing damaged tissue after an injury and destroying bacteria.
3.1.1c The demands of performance: the difference between aerobic and anaerobic exercise
When a cut or graze occurs, the white blood cells gather to stop bacteria entering the body. When a scab forms it is made up of dead leukocytes.
There are fewer white than red blood cells in the body.

Between 60 and 70 per cent of white blood cells are produced in the bone marrow of long bones while the remaining 20 to 30 per cent is made in the lymph tissue of the body.
The recovery process

**Recovery** allows the muscles to become stronger, increases muscle proteins and helps to improve the lactic acid threshold.
Recovery phases are important. They:

- must be planned
- repair damaged tissue (including muscle)
- should improve level of fitness.
There are many differences which affect the time taken to recover from physical activity:

- The time and intensity of the exercise
- Physical differences such as size and weight
- Age
- Gender
- Fitness level
Exam question

1. Explain the difference between aerobic and anaerobic respiration.

2. What sports does aerobic respiration help most effectively? Give two examples.
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2. Anaerobic respiration
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• **Describe** what oxygen debt is

• **Explain** the role of the blood in the transport of substances around the body