In Experiment C you will investigate how the amount of carbon dioxide in your breath changes after exercising. You will also investigate whether the type of exercise changes the amount of carbon dioxide in your breath.

Most sports events use both types of energy system but in differing proportions. Sports and physical activities are of different durations.

In Experiment A you will investigate how much power your muscles generate during a stepping exercise.

There are two energy systems in the body:

- **Long-term energy system** uses aerobic respiration.
- **Short-term energy system** uses anaerobic respiration. The lactic acid produced during anaerobic respiration can be recycled and be used as a fuel for aerobic respiration.

**Energy systems and respiration**

For muscles to generate power they must use adenosine triphosphate (ATP) to contract. Muscle cells contain a very small amount of ATP but this can only fuel a very short burst of powered contraction (see graph on the reverse – alactic anaerobic respiration). For a sustained effort, more ATP has to be produced via respiration. Anaerobic respiration is used during the first 1–2 minutes of exercise to meet the increased need for ATP.

ATP is a small soluble molecule found in all types of cells. It releases energy in small manageable amounts that will not damage cells. It is produced during respiration and is therefore the energy currency of the cell.

**The universal energy currency**

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Most sports events use both types of energy system but in differing proportions. Sports and physical activities are of different durations.

My name is Dr Valerie Gladwell and I am a senior lecturer in Sport and Exercise Science at the University of Essex. My research involves exploring how the cardiovascular system responds following exercise. I am also passionate about the role physical activity can have on health.

Websites

[www.getinthezone.org.uk](http://www.getinthezone.org.uk)
My name is Jay Younger. I am 17 years old. My event is the 400 m sprint. In my first year in athletics (Under 17 level), I became The Scottish Schools Champion and rounded the season off by winning the AAA championships with a personal best. I was also part of the Under 20 Scottish 4×400 m team that broke the Scottish record and I was grateful to be given the award of Young Scottish Athlete of the Year. This year I won the Scottish Championship and have gathered more experience about how to run the 400 m race more effectively. Here are some statistics about me.

- **Height**: 186 cm
- **Sitting height**: 37 cm
- **Mass**: 86 kg
- **Resting blood pressure**: 153/80 mm hg
- **Resting heart rate**: 55 bpm
- **Peak flow**: 700 l per minute
- **Recovery rate after step test**: 120 bpm (1 minute), 104 bpm (2 minutes), 80 bpm (3 minutes)
- **Heart rate after full squats**: 64 bpm (1 minute), 86 bpm (2 minutes)

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**Training**

Training fine-tunes the balance of an athlete’s anaerobic and aerobic energy systems as well as increasing stamina and endurance. All sportsperson need to do strength (resistance) training, such as squats, to increase the strength of leg muscles; press-ups and weightlifting to strengthen arm muscles; as well as aerobic (cardiovascular endurance) training, such as skipping or running, which enables athletes’ bodies to both use oxygen and deal with lactate more efficiently. All types of athlete train to improve their aerobic capacity or VO2max. Reducing the intensity of exercise but increasing its duration improves the efficiency of the aerobic system.

Many athletes and coaches have devised complicated training plans to encompass all parts of fitness including endurance, speed, strength and power. The type of training sportsperson do will depend upon the event they are training for: sprinters need to focus on power and strength but need a good aerobic base; for long-duration endurance athletes the main training is stamina and endurance so their bodies are able to provide their energy aerobically and can deal with the lactate more efficiently. They also incorporate strength training to help to improve their performance. Many sports however, are not one or the other and require high levels of fitness mixed with speed and strength (for example, rugby).

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**a. Which energy system do you think i) sprinters and ii) long-distance cyclists use predominantly?**

- **i) Sprinters**: Predominantly lactic anaerobic respiration
- **ii) Long-distance cyclists**: Predominantly aerobic respiration

**b. Suggest what kind of training each type of sportsperson from question a) would do.**

- **Sprinters**: Focus on power and strength training
- **Long-distance cyclists**: Focus on aerobic endurance training

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**c. How would knowing blood oxygen level, pulse rate, and blood pressure help inform training programmes for athletes?**

Knowing these parameters helps in monitoring an athlete’s fitness level and adapt training accordingly. It also helps in identifying any potential health issues.

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**d. How could you investigate the effect of exercise on blood oxygen level, pulse rate, and blood pressure?**

- Measure blood oxygen level, pulse rate, and blood pressure before and after exercise.
- Record any changes and determine if they are significant.

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**Footnotes:**