

PE2 UNIT GUIDE

*Content Title: Energy Systems***Key points**

- Explanation of the energy systems
- How intensity, duration and individual levels of fitness affect the use of the energy systems

Overview of the Energy Systems

- Adenosine tri-phosphate (ATP) is the only energy source for all bodily functions and activities (movements).
- When ATP is used for energy production it must be replenished.
- The body can replenish (recreate) ATP aerobically or anaerobically.
- There is one Aerobic Energy System which requires oxygen to replenish ATP and two Anaerobic Energy Systems that can recreate ATP to produce energy without the need of oxygen.

These are the 3 Energy Systems:

- ATP-PC System or Alactic System – ATP and creatine phosphate (CP) are present in very small amounts in the muscle cells. The system can supply energy very quickly because oxygen is not needed for the process. No lactic acid is produced in the process (Alactic).
- Anaerobic Glycolysis or Lactic Acid System uses carbohydrates (glucose) stored in the muscles as Glycogen. Because no oxygen is required to re-synthesise ATP, energy is produced quickly. Also because no oxygen is used in the process lactic acid is produced as an end product.
- Aerobic System – This system uses carbohydrates (glucose/glycogen) and fats to replenish ATP. Because oxygen is required for the process, energy production takes a little longer but can continue for a much longer duration. Because of the presence of oxygen, no lactic acid is produced.

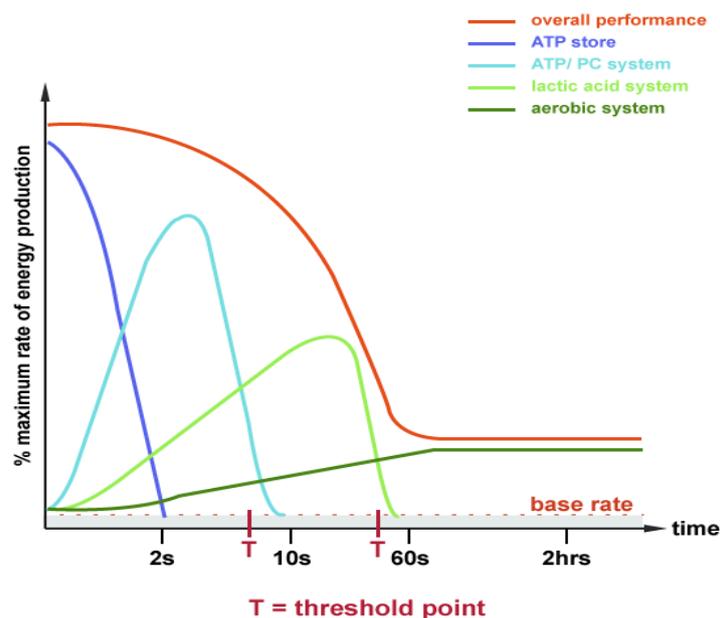
Practical Application/Explanation

The energy systems are all working at the same time (see Energy Continuum). However, the predominant Energy System used to re-supply ATP depends on 3 things:

- **INTENSITY** of exercise (how hard you are working). The more intense the exercise the greater amount of (Anaerobic Energy) – creatine phosphate and muscle glycogen will be used. Low to medium intensity exercise will use predominantly the aerobic system.
- **DURATION** of exercise. (How long you are exercising) e.g. if the exercise is high intensity and lasts over 2 minutes, then both CP and Muscle Glycogen will become depleted and need repaying. Intensity of exercise will drop as the aerobic system becomes more dominant.
- **FITNESS LEVEL** of the performer. Individual levels of both aerobic and anaerobic fitness will impact on the predominant energy system being used. A higher level of **aerobic fitness** will mean it will take a performer longer to reach the **Anaerobic Threshold** (the point at which the performer gets more energy from the anaerobic systems rather than aerobic). This is beneficial because when a performer begins to work anaerobically, there is only a limited supply of energy available (PC and muscle glycogen - up to 2 minutes max). If the exercise continues to increase, then the performer will run out of anaerobic energy and return to using aerobic, whereby performance will then drop. This can be seen at the last few stages of the multi stage fitness test where the performer struggles to stay in time with the 'beeps' and eventually has to stop.

The greater the **anaerobic fitness** the longer the performer can work in the anaerobic zone. In reality, most people have anaerobic stores that last just over a minute. A trained performer can last up to 2 minutes, and also be able to 'tolerate' greater amounts of lactic acid in their muscles.

- In practice, all these factors work together to determine which are the predominant energy systems being used during the activity.
- The predominant energy system being used at **rest** is the aerobic system.



Quick revision

- The energy systems work together to replenish ATP.
- The 3 energy systems are the ATP-PC, Anaerobic Glycolysis and Aerobic.
- The energy systems all work together at the same time to keep replenishing ATP. At no point will only one energy system be used, but there is often a predominant system.
- The predominant energy system used during exercise will depend on the intensity and duration of the activity and the individual's levels of fitness.
- ATP-PC system is predominantly used during maximum intensity activities lasting no longer than 10 seconds.
- Anaerobic Glycolysis system is predominantly used for high intensity activities lasting approximately 1 minute.
- Aerobic system is predominantly used during medium to low intensity activity.
- The predominant energy system being used at **rest** is the aerobic system.

Example 1: In netball the ATP-PC system would be the predominant energy system used when a Centre sprints at maximum intensity or 100% to get into space to receive the ball.

The candidate has therefore demonstrated with the example that there is a direct link between the ATP-PC system and maximum or 100% intensity.

Example 2: The Anaerobic Glycolysis or lactic acid system would be predominantly used in netball when a centre works at a **high intensity** for **duration** of up to 40 seconds. This could occur if a team fails to score, resulting in a prolonged period of play. Also, during this time most of the CP stores would have been depleted, therefore the body would rely on the anaerobic glycolysis system for energy.

The candidate has demonstrated with the example that the anaerobic glycolysis system is high intensity and is used over longer periods of anaerobic exercise. The answer also shows further knowledge through the link between the depletion of CP as the predominant energy source and the increase in muscle glycogen as the predominant source.

Example 3: The Aerobic System would be predominantly used by a centre in netball in **medium to low intensity** phases of play when the ball is out of play or when returning for a centre pass when a goal has been scored. An increased level of aerobic fitness would mean that the centre would take longer to reach anaerobic threshold and therefore would maintain anaerobic energy stores for longer. This means that a higher intensity can be maintained throughout the duration of the game.

The candidate has used an appropriate example to make the link between low to medium intensity exercise and the aerobic system. There is also understanding of how aerobic fitness levels influence the predominant energy system used.

Top Tips:

Candidates must be able to provide practical sporting examples of when each of the energy system is being predominantly used. Good knowledge and understanding is demonstrated with the candidate being able to highlight the link between intensity and duration of exercise as well as the individual's level of fitness to the predominant energy system being used.



Exam Style Questions

1. *The continued replenishment of Adenosine Triphosphate (ATP) is essential in maintaining sporting performance.*

Use a chosen sporting activity to explain when each energy system would be used to replenish ATP.

[3]

