

U1 Learning Aim E – Energy Systems

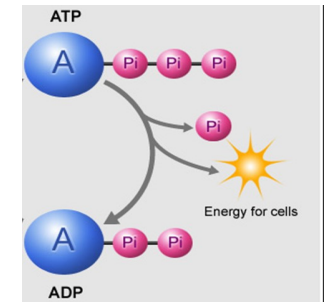
ATP is the energy currency molecule of the human body, without it we cannot contract our muscles and therefore movement cannot occur. ATP = Adenosine Tri-phosphate. ATPase (enzyme) breaks off a Phosphate molecule (exothermic reaction) which releases energy that our muscles use to contract. This results in ADP and a separate Phosphate. The body has approximately 3 seconds of ATP before more must be resynthesized.

3 systems for resynthesizing ATP: ATP-PC system

Lactic Acid system

Aerobic system

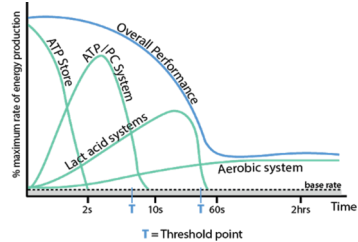
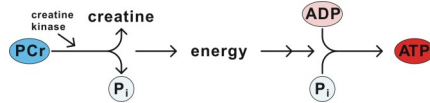
The system the body uses depends on the intensity and duration of the exercise. The body used chemical energy from carbohydrates, fats (occasionally proteins) to power the Lactic acid and Aerobic systems.



ATP-CP System (Anaerobic)

Also known as: Alactic & Phosphocreatine systems

- ⇒ Does not rely on oxygen
- ⇒ Phosphocreatine is broken down by Creatine Kinase – this reaction releases energy and a Phosphate to resynthesize ATP from ADP and PC
- ⇒ Approximately 3-10 seconds of high intensity energy
- ⇒ Big advantage is the immediate supply of energy
- ⇒ Reactions take place in the Muscle Sarcoplasm
- ⇒ Recovery time = 30 seconds – 4 mins
- ⇒ Used of short and explosive actions e.g. shot put or sprinting up a basketball court
- ⇒ This system can be enhanced using Creatine supplements



Energy systems do not work in isolation. They work together to supply the body with the energy it needs depending on the intensity and duration. This means the systems work together and often more than one at a time, e.g. in an 800m race the Lactic acid system and Aerobic system work together to supply ATP during the middle and end of the race to supply ATP whilst helping to reduce the impact of lactic acid.

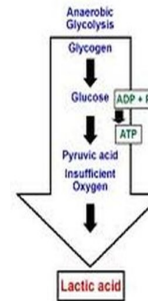
In Games sports e.g. Football the body is constantly switching its predominant system depending on the demands of the sport e.g. ATP-PC system for headers, Lactic acid system for prolonged sprints and Aerobic system for walking and jogging.

Diabetes: Body unable to maintain correct blood glucose (sugar level) due to the body not producing enough insulin which allows the glucose to enter the cells. Hypoglycemic attack is when the blood glucose level is severely low—treatment is carbohydrates

Lactic Acid system (Anaerobic)

Also known as: Lactate or Glycolytic system

- ⇒ Used when ATP-PC system has been used up
- ⇒ ATP resynthesized by partially breaking down glucose through Anaerobic Glycolysis
- ⇒ Glucose is stored as Glycogen in the muscles and Liver
- ⇒ Supplies energy for high intensity exercise for 6-90 seconds depending on intensity
- ⇒ A by-product of this system is Pyruvic acid (Pyruvate) that is converted into Lactic acid because there is insufficient oxygen
- ⇒ Lactic acid fatigues and prevents correct muscle contraction
- ⇒ This system takes 20mins to 2 hours to recover
- ⇒ A 400m runner would use this system after the first 10 seconds to run the race to a high intensity



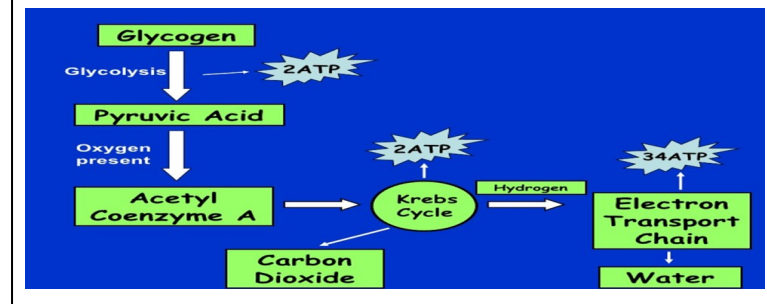
Adaptations to the systems

- * Increased number and size of Mitochondria
- * Increased ability to store glycogen
- * Increased use of fat as an energy store (due to increased oxygen supply and use of oxygen)
- * Increased Creatine stores (benefits ATP-PC system)
- * Increased tolerance to Lactic acid due to better oxygen supply—respiratory and cardiovascular (increased capillary network)
- * Increased aerobic and anaerobic enzyme activity

Aerobic system

Includes 3 stages: Aerobic glycolysis, Krebs Cycle and Electron Transport Chain

- ⇒ This system is slow to start producing ATP and is therefore used after the other two systems and is only used in activities that are low-medium intensity
- ⇒ Glucose stored as Glycogen is again broken down in the process of Glycolysis to produce ATP (2) but the Pyruvic acid is then taken into the Krebs cycle by the enzyme Acetyl Co A and converted into Citric acid
- ⇒ In the Mitochondria the Krebs cycle occurs which produces a further 2 ATP and more importantly produces Hydrogen molecules: FADH and NADH which 'power's the next process
- ⇒ These molecules enter the Electron Transport Chain which produces a further 34 ATP molecules which Water and CO₂ as waste products
- ⇒ Total of 38 ATP molecules per Glucose or 129 ATP per fat molecule
- ⇒ Supplies energy for hours depending on intensity
- ⇒ Recovery is hours to days depending on intensity and duration



Children's Lactate system—not fully developed until aged 20. Therefore have reduced Anaerobic capacity due to reduced muscle mass and lower muscle glycogen stores. Recommended that they work on their cardiovascular system to help remove lactic acid