Ross Cook

ATP Synthesis

The human body is reliant on adenosine triphosphate (ATP) to produce energy. Unfortunately, the body only stores very small amounts of ATP, enough to power strenuous exercise for just a few seconds.

In order to overcome this problem the body must constantly resynthesise ATP. The body uses 3 pathways called metabolic pathways to resynthesise the ATP. Which pathway used depends on the type of exercise that is occurring.

ATP – PCr System

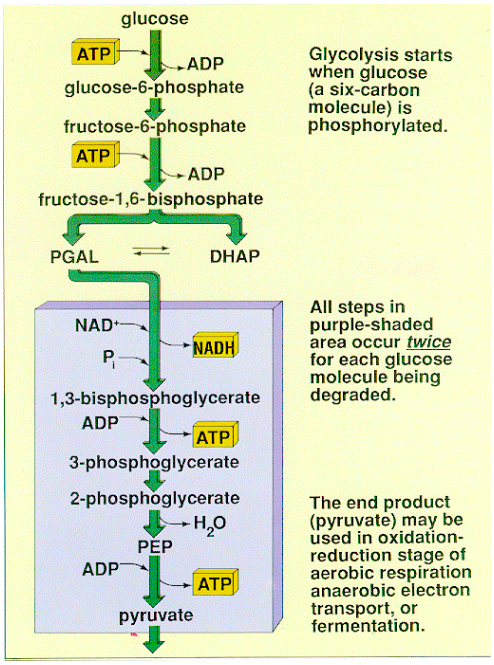
There is only a small quantity of ATP stored in your muscles. When this runs out a reservoir of a similar high energy compound called **PCr** (phosphocreatine) is used. Combined, ATP and PCr will give about 5 to 8 seconds worth of energy in very strenuous activity which isn't very much.

If activity continues after the stores of ATP and PCr have run out, the lactic acid system begins to predominate.

Lactic Acid System (anaerobic glycolysis)

Carbohydrate stored in the body is broken down and used to form ATP in a process known as anaerobic glycolysis.

The chemical reactions that take place during the lactic acid system, occur without the presence of oxygen. So it's labelled an anaerobic process. A by-product of anaerobic exercise is lactic acid.



This system will power an athlete for around 45 seconds. The lactic acids accumulating in your muscles will either put a halt to your progress or the exercise intensity declines and you can continue. Now the aerobic system starts to predominate.

The Aerobic System

As exercise duration extends over 2 minutes the lactic acid system is relied on less and less. The body gradually shifts towards an aerobic pathway to replenish those initial ATP stores. The longer exercise continues the more reliance is placed on the aerobic system.

The body can breakdown fat or carbohydrate to create ATP within the aerobic system. Carbohydrate is the first substrate the body uses. The switch to fat as a source of fuel depends on several factors such as exercise intensity, training status and diet.

As the intensity of exercise is much lighter and the demand for energy declines, the body has time to use oxygen in the chemical reactions. Hence it is labelled aerobic exercise.

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Energy Systems In Sport

Applying energy systems to some some sports can get quite complicated. It's easiest to look at straight forward running events first...

100m Sprint

Top athletes run this event regularly under 10 seconds. The ATP-PCr system powers a sprinter for most of the race.
If you watch a slow motion reply of a 100m sprinter you will notice they don't breathe. With pursed lips their face is a picture of concentration. All of their energy production is from anaerobic processes that occur without oxygen.

800m Run

Just as with the 100m, an athlete is powered by the ATP-PCr energy system for the first few seconds. Because the athlete is not running 'all out' the stores of ATP and PCr will last a few seconds longer.
The lactic acid system predominates for the rest of the race but the aerobic system does make a contribution. With energy systems the emphasis is on what predominates. No activity, whether it's a gentle stroll or an all out sprint, uses just one energy system exclusively... they all contribute to some extent.

Half Marathon

Without doubt the aerobic system makes the greatest contibution to this event. The other two energy systems will predominate during the first minute or so of the race and in a sprint finish.
What determines whether the athlete is 'burning' carbohydrate or fat during the run?
Well, as the aerobic system begins to predominate, carbohydrate (in the form of glucose and glycogen) will make the greatest contribution to energy production. If exercise intensity is relitively low, fat will be relied on more and more as the duration increases. Again the body doesn't suddenly switch from one substrate to another, the cross over is a gradual shift.
If exercise intensity is relatively high the body will continue to rely predominantly on carbohydrate.