

Energy Source for Contraction

All muscle contraction requires energy in the form of ATP. However, muscles store only very small amounts of ATP. In fact, just a few seconds of activity will completely deplete the ATP within a muscle fiber. Consequently, the constant synthesis of ATP is a necessity. Depending upon activity level, muscles obtain their energy supply in several ways.

At rest, muscles obtain most of their energy by metabolizing fatty acids. Because oxygen is plentiful, it uses the process of **aerobic respiration** to break down fatty acids for energy. (The term *aerobic* means "with oxygen.")

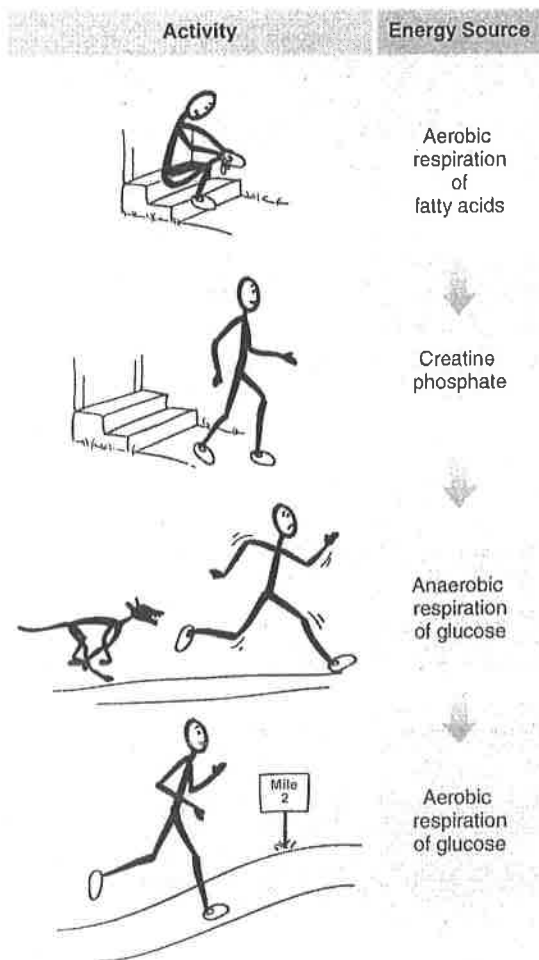
When beginning to exercise, the demand for oxygen suddenly increases. The heart and lungs work harder to meet this demand, but, in the short term, the supply of oxygen drops. When this happens, muscles quickly restock their waning supply of ATP by breaking down a compound called **creatine phosphate (CP)**, which is stored in muscle. This high-energy compound can furnish the muscle with fuel for about 20 seconds of high-energy activity or a minute of more moderate activity.

If exercise continues, the supply of CP is exhausted before the supply of oxygen has reached an acceptable level. At this point, muscles switch to **anaerobic** (meaning "without oxygen") **respiration** of glucose. Muscles receive much of their glucose through the bloodstream; however, some is stored within muscle in the form of glycogen. Anaerobic respiration can generate energy quickly; therefore, it's useful for intense bursts of activity. However, it also produces a byproduct called **lactic acid**, which, as it accumulates in muscle, leads to muscle fatigue.

After about 10 minutes of more moderate activity, the heart and lungs have had a chance to increase the supply of oxygen to the muscles. This allows muscles to shift back to aerobic respiration. Not only does aerobic respiration produce more ATP than anaerobic respiration, but byproducts are carbon dioxide and water, which aren't toxic to muscle like lactic acid is.

FAST FACT

Ultimately, the body obtains energy for the synthesis of ATP and CP from food, which is why athletes focus on diet as a key part of their training programs.



FAST FACT

When you "go for the burn" in strenuous exercise, that burn is a symptom of lactic acid accumulation from anaerobic respiration.

The Body AT WORK

Following strenuous exercise, some of the lactic acid produced during anaerobic respiration travels to the liver, where it is converted back into glucose. However, the conversion process consumes a lot of oxygen, which is why you continue to breathe heavily for several minutes following a hard workout. The extra oxygen that's needed to process lactic acid is called an oxygen debt.