THE ENERGY SUPPORT IN AEROBIC AND ANAEROBIC ACTIVITY

Introduction

Energy is defined as the ability or the capacity to do work. Energy lights our cities, powers our vehicles, and runs machinery in factories. It warms and cools our homes, cooks our food, plays our music, and gives us pictures on television.

We use energy to do work and make all movements. When we eat, our bodies transform the food into energy to do work. When we run or walk or do some work, we 'burn' energy in our bodies. Cars, planes, trolleys, boats, and machinery also transform energy into work. So, work means moving or lifting something, warming or lighting something. There are many sources of energy that help to run the various machines invented by man.

Therefore, all parts of the body i.e. muscles, brain, heart, and liver need energy to work and this energy comes from the food we eat. Our bodies digest the food we eat by mixing it with fluids i.e. acids and enzymes in the stomach. When the stomach digests food, the carbohydrate i.e. sugars and starch in the food breaks down into another type of sugar, called glucose. The stomach and small intestines absorb the glucose and then release it into the bloodstream. Once in the bloodstream, glucose can be used immediately for energy or stored in our bodies, to be used later. However, our bodies need insulin in order to use or store glucose for energy. Without insulin, glucose stays in the bloodstream, keeping blood sugar levels high.

Those who are involved in sports like athletes, coaches and those who work with athletes – understand the importance of fuelling the body to maximize energy and performance. It also helps to understand how the body converts energy so that healthy strategies can be used to improve athletic performance.

The first law of thermodynamics states that energy cannot be created, but must be transferred or converted from one form to another. Like an automobile only runs on gasoline, the human body runs on only one kind of energy: chemical

energy. More specifically, the body can use only one specific form of chemical energy, or fuel, to do biological work i.e. adenosine tri-phosphate (ATP).

So, how does the human body make ATP, the only fuel it can convert to energy? Our bodies have three different chemical systems that convert energy. Most of us know that we use proteins, carbohydrates and fats for energy. Calories are measurement of a unit of heat or food energy. For example, we can achieve four calories per gram of proteins and carbohydrates, and nine calories per gram from fats.

Thus, Energy is required for all kinds of bodily processes including growth and development, repair, the transport of various substances between cells and of course, muscle contraction.

AEROBIC EXERCISE

Aerobic refers to how the body uses oxygen to sufficiently meet energy demands during exercise. Aerobic exercise is any physical activity that makes the sweat, causes to breathe harder, and gets the heart beating faster than at rest. It strengthens the heart and lungs and trains the cardiovascular system to manage and deliver oxygen more quickly and efficiently throughout the body. Cardiovascular system is made up of heart and blood vessels e.g., arteries, veins, and capillaries that transports blood throughout the body. Aerobic exercise uses the large muscle groups, it is rhythmic in nature, and can be maintained continuously for at least 10 minutes.

Benefits of Aerobic Exercise

In addition to strengthening the heart and cardiovascular system, participation in regular aerobic exercise has many health benefits. They are:

1. Improvement in the circulation and helps the body to use oxygen better
2. Increases energy
3. Increases endurance, which means we can work out longer without getting tired
4. Helps to reduce the risk of developing heart disease
5. Helps to reduce the risk of developing diabetes
6. Helps to reduce body fat
7. Helps to reach and maintain a healthy weight
8. Helps to reduce stress, tension, anxiety, and depression
9. Improves sleep

Examples of Aerobic Exercise

Physical activity such as walking, jogging, indoor cycling, or aerobic dancing are all examples of aerobic exercise that strengthen the heart and lungs, hence improving our body's utilization of oxygen. For general health, aim for a 30-minute workout (or three times 10-minute workouts per day) three to five days a week at moderate intensity. Moderate intensity refers to an activity that will increase the breathing and get the heart beating fast. One should be able to talk with ease during moderate intensity workouts; though trying to sing would be more challenging.

For weight loss, gradually work up to 45 minutes or longer at moderate to vigorous intensity five to six days a week, allowing for at least one day of rest a week. Vigorous intensity refers to an activity that will have the heart beating quite a bit more than moderate intensity workouts, and breathing will be harder so saying more than a few words will be difficult.

Walking is a great moderate intensity aerobic exercise. The beauty of walking is that it is easy to do with minimal costs. All we need is a good pair of walking shoes, comfortable clothing, and places to walk: for example hiking trails, around the neighbourhood, and on rainy days we can take our walk indoors and use a treadmill.

Aerobic Metabolism

Aerobic metabolism is a necessary component to support the metabolic function of the heart. Oxygen is necessary, and if even a small part of the heart is oxygen-deprived for too long, a myocardial infarction i.e. heart attack will occur. Coronary circulation branches from the aorta soon after it leaves the heart, and supplies the heart with the nutrients and oxygen needed to sustain aerobic metabolism. Cardiac muscle cells contain larger amounts of mitochondria than other cells in the body, enabling higher ATP production.

The heart derives energy from aerobic metabolism via many different types of nutrients. Sixty percent of the energy to power the heart is derived from fat, 35% from carbohydrates, and 5% from amino acids and ketone bodies from proteins. These proportions vary widely with available dietary nutrients. Malnutrition will not result in the death of heart tissue in the way that oxygen deficiency will, because the body has glucose reserves that sustain the vital organs of the body and the ability to recycle and use lactate aerobically.

ANAEROBIC EXERCISE

Anaerobic means without oxygen. Anaerobic exercise consists of brief intense bursts of physical activity, such as weightlifting and sprints, where oxygen demand surpasses oxygen supply.

Anaerobic exercise is fuelled by energy stored in the muscles through a process called glycolysis. Glycolysis is a method by which glycogen is broken down into glucose, also known as 'sugar' and is converted into energy. Glycolysis occurs in muscle cells during anaerobic exercise without the use of oxygen in order to produce energy quickly, thus producing lactic acid, which causes the muscles to fatigue. Lactic acid is a by-product of glycolysis and forms when our body breaks down glucose for energy when oxygen is low. Participation in regular anaerobic exercise will help our body tolerate and eliminate lactic acid more efficiently.

Benefits of Anaerobic Exercise

In addition to helping our body handle lactic acid effectively, anaerobic exercise has great benefits for our overall health. They are:

1. It builds and maintains lean muscle mass.
2. It protects our joints. Increased muscle strength and muscle mass helps protect our joints, which can protect from injury.
3. It boosts metabolism. Anaerobic exercise helps boost metabolism because it helps build and maintain lean muscle. Lean muscle mass is metabolically active, so the more lean muscle mass we have, the more calories we will burn.
4. It increases bone strength and density. Anaerobic activity will increase the strength and density of our bones more than any other type of exercise, therefore decreasing our risk of osteoporosis.
5. It improves our energy. Our body relies on glycogen stored in our muscles as energy. Regular anaerobic exercise increases our body's ability to store glycogen, giving our more energy during intense physical activity.
6. It increases sports performance. Regular anaerobic exercise increases strength, speed and power, which will ultimately help to improve our sport performance.

Examples of Anaerobic Exercise

Examples of anaerobic exercise include heavy weight training, sprinting i.e. running or cycling and jumping. Basically any exercise that consists of short exertion, high-intensity movement is an anaerobic exercise. Heavy weight

training is an excellent way to build strength and muscle mass. We should only be able to complete three to six repetitions with the weight chosen until reaching muscle fatigue, or the inability to do one more repetition.

Anaerobic Metabolism

While aerobic respiration supports normal heart activity, anaerobic respiration may provide additional energy during brief periods of oxygen deprivation. Lactate, created from lactic acid fermentation, accounts for the anaerobic component of cardiac metabolism. At normal metabolic rates, about 1% of energy is derived from lactate, and about 10% under moderately hypoxic (low oxygen) conditions. Under more severe hypoxic conditions, not enough energy can be liberated by lactate production to sustain ventricular contraction, and heart failure will occur. Lactate can be recycled by the heart and provides additional support during nutrient deprivation.

The Energy Systems

There are three separate energy systems through which ATP can be produced. A number of factors determine which of these energy systems is chosen, such as exercise intensity for example.

- The ATP-PCr System
- The Glycolytic System
- The Oxidative System

The ATP-PCr System

ATP and creatine phosphate (also called phosphocreatine or PCr in short) make up the ATP-PCr system. PCr is broken down releasing a phosphate and energy, which is then used to rebuild ATP. The enzyme that controls the breakdown of PCr is also called creatine kinase.

The Glycolytic System

Glycolysis literally means the breakdown of glucose and consists of a series of enzymatic reactions. The carbohydrates we eat supply the body with glucose, which can be stored as glycogen in the muscles or liver for later use.

The end product of glycolysis is pyruvic acid. Pyruvic acid can then be either funnelled through a process called the Krebs cycle or converted into lactic acid. Traditionally, if the final product is lactic acid, the process is labelled as

anaerobic-glycolysis and if the final product remained as pyruvate, the process is labelled as aerobic-glycolysis.

The Oxidative System

The oxidative system consist of four processes to produce ATP:

- Slow glycolysis
- Krebs cycle
- Electron transport chain
- Beta oxidation

Slow glycolysis

In slow glycolysis, the pyruvate is shuttled to our mitochondria and we enter the citric acid cycle, or the oxidative system. In the oxidative system the re-synthesis of ATP happens at a much slower rate, but we can maximize the number of ATPs produced, yielding us with the highest amount of energy.

Krebs cycle

The Krebs cycle is a complex series of chemical reactions that continues the oxidization of glucose that was started during glycolysis. Acetyl coenzyme A enters the Krebs cycle and is broken down in to carbon dioxide and hydrogen allowing two more ATPs to be formed.

Electron transport chain

Hydrogen is carried to the electron transport chain, another series of chemical reactions, and here it combines with oxygen to form water thus preventing acidification.

Beta oxidation

Lipolysis is the term used to describe the breakdown of fat into the more basic units of glycerol and free fatty acids. These free fatty acids can entered the Krebs cycle only when the process of beta oxidation takes place with a series of reaction to further reduce free fatty acids to acetyl coenzyme A and hydrogen.

Conclusion

Energy is said to be the ability or the capacity to do work. We use energy to do work and make all movements. When we eat food, our bodies transform the food into energy to do work. When we run or walk or do some work, we ‘burn’ energy in our bodies. Thus, Energy is required for all kinds of bodily processes including growth and development, repair, the transport of various substances between cells and of course, muscle contraction.