

Swimming is one of the earliest forms of documented exercise. It is a fantastic aerobic workout that quickly builds cardiorespiratory fitness. In addition, swimming is low impact and can be continued for a lifetime. Swimming also increases flexibility and builds muscle mass.

Basic Anatomy and Physiology

To gain a better understanding of how the swimming benefits the body, it is important to have a basic understanding of how our muscles function. The human body contains over 600 skeletal muscles. They are known as voluntary muscles and are attached to bones and move the skeleton. These are the muscles we are most familiar with, such as the triceps, biceps, quadriceps, and pectorals.

Muscle Types

There are two other types of muscles in the human body: smooth muscle and cardiac muscle. Smooth muscles are involuntary; we cannot directly control these muscles. They are found in most blood vessels and in most internal organs.

Cardiac muscle is found only in the heart and is also an involuntary muscle. Cardiac muscle is also known as the myocardium. The thickness of the myocardium will depend on how much stress is placed on the wall of the heart. Aerobic exercise will place stress on the heart, specifically the left ventricle. The cardiac muscle, like skeletal muscle, will increase in size and grow stronger and more efficient.

Structure and Function of Skeletal Muscle

We often think of every muscle as a single unit, but a muscle actually contains many layers. The base of the muscle is fibers known as fasciculi. Each fasciculus is surrounded by protective layers that serve to hold the muscle together. The muscle fibers are also known as a single muscle cell. Each muscle cell produces large amounts of energy or adenosine triphosphate (ATP) that you need to contract muscles.

Slow and Fast Twitch Muscle Fibers

Now that we know the basic structure of skeletal muscles, we must look closer at how a muscle functions during exercise. Skeletal muscle contains two major types of muscle fibers, slow twitch (ST) and fast twitch (FT), which are differentiated by their speed of action.

Generally, ST muscles have a greater capacity for aerobic endurance. These are the muscle fibers utilized in recovery and endurance rides. In aerobic exercise, energy is produced from the oxidation of carbohydrates and fats. ST fibers are used for activities requiring low intensity endurance or any long sustained effort.

One primary benefit of endurance training is an increase in the number and size of mitochondria, the “energy factories” in our cells. Energy production and fat oxidation occur in the mitochondria. Therefore, the more mitochondria you develop, the more efficiently your body will burn fat.

FT fibers have poor aerobic endurance and are recruited during activities requiring short bursts of energy such as sprints.

Swimming incorporates the use of all major muscle groups:

Arms: forearm extensors and flexors, biceps brachia, triceps

Shoulders: deltoids, rotator cuff

Back: trapizius, rhomboids, latissimis dorsi

Abdominal Muscles

Leg: quadriceps, hamstring, hip flexors, calf muscles

The Three Energy Pathways

ATP-Creatine Phosphate Pathway

This energy pathway is anaerobic (without oxygen) and can only sustain your muscles’ energy requirements for up to 15 seconds during an all-out sprint. Thus, muscles will rely in the next two pathways for additional production of ATP.

The Glycolysis Pathway (Lactic Acid)

This pathway can also generate ATP anaerobically. Glycolysis is the way the body breaks down glucose for energy. An inadequate amount of oxygen in glycolysis produces lactic acid. The Creatine Phosphate and glycolysis pathway contribute to energy during the first two or three minutes of high intensity exercise.

The Aerobic/Oxidative Pathway

The oxidative pathway can utilize glucose, fat, and amino acids (protein) for energy (ATP) production but is reliant on a steady supply of oxygen. The more efficient your breathing, the greater the amount of oxygen is delivered to working muscles to produce consistent energy for long-term activities. Fat and glucose are the preferred sources of fuel for this pathway. The body spares protein use as source of energy, so that protein can be used for repairing and rebuilding the body, one of the body’s most vital functions.

The Four Swimming Strokes

Freestyle (aka crawl): This is the most popular stroke and the easiest for beginners to learn. It is a simple flutter kick and windmill arm motion, like the backstroke, only on your belly. The most difficult part is coordinating the breathing since your face is in the water most of the time.

The leg kick:

It's a flutter kick where the legs kick in an alternating order. Bend the knees slightly. Relax the feet and ankles.

The arm stroke:

Move the arms in an alternating windmill motion. Pull each arm through the water with equal strength and arm reach to ensure that you swim straight. Pull arms underwater in an "S" pattern.

The breathing:

Raise one arm to begin the stroke. As the shoulder rises, turn the head to catch a breath. Turn the head only enough to leave the water to breathe. Do not lift the head because it will slow you down. Take as many breaths as necessary and then exhale through the nose and mouth when the head returns to the water. Repeat the head turn to the other side in coordination with the beginning of the opposite arm stroke.

Backstroke: This stroke is the inverted form of freestyle, or crawl. It is important to keep your body in line with this stroke, otherwise you will sink. Keep your chin high, and your hips up.

The leg kick:

It's a flutter kick where the legs kick in an alternating order. Bend the knees slightly. Relax the feet and ankles.

The arm stroke:

Move the arms in an alternating, windmill pattern as they rotate and pass your face. Cup the hands, and the thumb leaves the water first. Move the hands in an "S" pattern when they are pushing the water.

The breathing:

Keep your head back and eyes toward the ceiling. You can find your own breathing pattern with the backstroke because the breathing is less coordinated

with the arms and kick than other strokes since your head should always be out of the water.

Breaststroke: breaststroke involves exquisite timing, and in fact, you can be disqualified from competition if you miss even one stroke. The stroke involves form that causes your body to bob up and down as you glide forward through the water. This is a difficult stroke and not one to choose if you're just learning how to swim. The basics are that your arms pull, you breathe, you kick (arms alternate with the kick), and you glide. Here are details. You must touch the wall simultaneously with both hands.

The leg kick:

Bring the ankles to the glutes. Point the toes out. Snap the legs together to push the water and propel you forward (frog kick).

The arm stroke:

Start with the arms overhead. Pull on the water, and bring arms toward the chest. Do not pull the arms past the rib cage. Return arms to starting position.

The breathing:

Breathe every time you stroke with your arms.

Butterfly: this is a difficult stroke and not recommended for beginners because it requires perfect timing and a good deal of strength. During the stroke, the legs move together in a dolphin kick (imagine a mermaid), the arms move together to push the water downward and backward, and the torso undulates like an earthworm as the body moves forward through the water. Like breaststroke, you must touch the wall simultaneously with both hands.

The leg kick:

Bend the knees slightly, and keep them together. The chest begins the motion, and the hips and knees follow. There should be two kicks for every arm stroke.

The arm stroke:

Move the arms together, and pull through the water. The underwater stroke resembles an old keyhole on a door. (Face the palms outward, and press down and outward.) Swing the arms forward above the water in a sweeping motion to complete the stroke.

The breathing:

Breathe at the end of the arm stroke.

Nutritional aspects of Physical Fitness

Fad diets are rampant in our country today, and promise fast results and rapid weight loss. Most of these diets require limiting or restricting certain food groups, causing depletion in vitamins and minerals our bodies need to function properly. The truth is, there are no miracle foods to improve physical fitness or exercise performance. However, a healthy and well balanced diet can help quicken recovery time after a hard workout and improve overall health. The macronutrients our bodies use for fuel are carbohydrate, protein, and fat. Each of these fulfills a different role in the body.

Carbohydrates

Carbohydrates have received a bad reputation over the past decade; however, carbohydrates and fat are the preferred fuel for muscles during exercise and carry 4 calories per gram. Carbohydrates are separated into two categories: simple and complex. Simple carbohydrates are broken down quickly in the body and include white potatoes, white bread, cookies, cakes, etc. Complex carbohydrates include whole grain cereals, breads, and fiber found in fruits and vegetables. To maintain a healthy weight, it is recommended that more complex carbohydrates be consumed in the diet than simple carbohydrates. They aid in keeping blood sugar levels stable and promote a healthy digestive system.

Fats

Fat is an excellent storage form of energy, and carry 9 calories per gram. Excess fat is stored under the skin and around internal organs, and therefore should only make up 30% of total caloric intake. Fat provides cushioning for joints, and stores the vitamins A,D,E, and K. Although all fats carry the same caloric density, all fats are not created equal. Monounsaturated fats such as olive oil and oils found in nuts and seeds promote heart health and won't clog arteries. While saturated fats such as animal meat and animal products (butter, dairy, etc) are not heart healthy and promote plaque formation in the arteries. Recently, trans fats have come into the spot light. These manmade fats may elevate total cholesterol levels and decrease good cholesterol levels. Cholesterol is a form of fat and protein in the body called lipoproteins. The "bad cholesterol" is low-density lipoprotein and should be kept under 130mg/dl. The "good cholesterol" is high density lipoprotein and should be kept higher than 40 mg/dl. Maintaining proper cholesterol levels is important to overall heart health.

Proteins

The primary role of dietary protein is to build and repair damaged body tissue. Proteins also form hormones, antibodies, and enzymes in the body which regulate metabolism and provide protection and immunity. The body does a great job at sparing the protein we eat for completing these purposes. However, in cases of low carbohydrate intake, the body can convert proteins to glucose and used for fuel. Protein intake should consist of 15-20% of total caloric intake. It is important to choose lean sources of protein, as animal and animal products contain saturated fat. Skinless white meat of poultry, fish, and lean beef provide excellent sources of protein. In addition, beans can provide protein while adding fiber to the diet. It is recommended that legumes (dried beans of any variety) be incorporated into the diet at least once a week.