

## Calorie Cycle

**What to do:** Choose from different snacks, and compare how long it takes to burn off the calories of each while pedaling a hand cycle.

### What's the big idea?

A calorie is defined as unit of energy used to measure the energy in foods. One thousand calories equals a kilocalorie or a Calorie (the kind we use in food), which is the amount of heat energy required to raise the temperature of a kilogram of water one degree Celsius.

Many people will meet the daily calorie intake requirements, but oftentimes the calories come from non-nutritious foods, making them empty calories. “Good” nutritious calories include those from fruits, vegetables, low fat milk products, lean meats, grain breads, and cereal. “Bad” or empty calories include salty or sugar foods, fried foods, soda, and alcohol.

### So what?

Here is a list of calorie counts per gram of food:

- Carbohydrates (breads, grains, pasta, fruits, and vegetables) – 4 calories per gram
- Protein (meats, eggs, cheese, and milk) – 4 calories per gram
- Fat (milk, cream, butter, and bacon) – 9 calories per gram
- Alcohol – 7 calories per gram

One pound equals 3,500 calories. Therefore, if you want to lose one pound, you must eat 3,500 calories less in your energy intake. If you need to gain one pound, you need 3,500 extra calories. Riding a bike is a good way to burn extra calories. The outcome of this exercise depends on many factors, such as your weight, the time you spend biking, and the energy you put into it, but here are some general guidelines. If you weigh around 100 pounds and you ride a bike for 30 minutes at a moderate speed (12–14 mph), you will burn 191 calories. That means, for you to burn the 580 calories that are in a Big Mac, you need to ride a bike for 1 hour and 30 minutes, and to burn 500 calories of French fries, you will need to bike 1 hour and 20 min. To burn the 281 calories you'll intake while eating a slice of a medium pepperoni and sausage pizza, you'll need to bike for 45 min.

### Find out more:

Use the Fitness Calculator found at the link below to see how long it will take you to burn off calories of different snacks and find an exercise that burns calories in the shortest amount of time.

<http://www.bodybuilding.com/fun/calories.htm>

## Sports Injuries

**What to do:** Using an oversized Operation game, remove and repair body parts linked to the ten most common sports injuries.

### What's the big idea?

Here is a list of the top ten sports injuries:

1. **Tennis elbow** is an inflammation of the outside (lateral) side of the upper arm near the elbow that is very common in tennis players; however, people who do not play tennis may also get it due to repeated motions of the wrist or forearm. This is a painful injury that causes weakness in the wrist, making it difficult to do simple tasks such as opening a door or shaking hands with someone.
2. **Shin splints** are injuries to the front or inside of the shin. They belong to the group of "overuse injuries," which means that shin splints are caused by overly rigorous exercising or the increase of training too quickly. Shin splints occur most commonly in runners or aggressive walkers.
3. **Runner's knee** is a softening or wearing away and cracking of the cartilage under the kneecap, resulting in pain and inflammation. Most commonly found in runners, this injury can strike any athlete who does activities that require a lot of knee bending, such as walking, biking, and jumping.
4. A **broken bone**, or a bone fracture, is term that describes a crack in a bone. It is usually caused by high impact or trauma to the bone and can occur virtually in any sport. A bone fracture can result from falling, as well as traumatic, forceful, and unnatural movements. However, most injuries occur to ligaments (which connect bones together), tendons (which connect muscles to bones), and muscles. Only about 5 percent of sports injuries involve broken bones.
5. Any sport that subjects an athlete to repetitive elbow flexion-extension or wrist motion can cause an **injury to the forearm muscles**. Overuse injuries to the forearm and elbow are very common in throwing and racquet sports.
6. **Neck pain**. The neck muscles are constantly under tension to hold the head up. Therefore they are often prone to pain through gradual tightening of the muscles which can also result in tearing from sudden sharp movements.
7. **Wrist injuries** are more common in contact sports, racquet sports, and gymnastics. The injuries are associated with the following functions that the wrist performs: throwing, weight-bearing, twisting, and impact.
8. **Heart problems**. Physical activity can trigger hidden heart abnormalities and result in a sudden cardiac arrest. It is important to know your overall physical condition before starting to exercise. Still, there are many sports that are compatible with heart diseases. Swimming in the pool, light dancing, and golf are some of them. These activities mainly focus on building stamina, oxygen intake, strength training, and flexibility.
9. A **charley horse** is the common name for a muscle spasm in the leg. It can occur when a muscle is overused or injured. Athletes are vulnerable to muscle spasms if they haven't had enough fluids (they are dehydrated) or when they have low levels of minerals such as potassium or calcium.
10. A **groin pull** is an injury to the muscles of the inner thigh. The groin muscles are a group of muscles that pull the legs together and help with other movements of the hip joint. An

injury to groin muscles happens when the muscle is stretched too far. Groin pulls are often seen in athletes who participate in sports such as ice hockey and soccer.

### **So what?**

Although exercising is essential to keep you fit and healthy, virtually any sport involves a risk of injury. Here are some tips that will help reduce the chance of getting hurt:

- Most sports-related injuries occur to ligaments, tendons, and muscles. To protect them, always stretch before and after the game.
- Wear the gear required for the game (pads, helmets, eyewear, etc.).
- Take breaks in between games and practices. Give your muscles and heart time to rest and replenish the energy you're expending.
- Stop the activity if you feel pain in any part of your body.
- Drink plenty of water before, during, and after exercise to avoid heart injury.

### **Find out more:**

1. Sports Injury Clinic [link to: <http://www.sportsinjuryclinic.net/cybertherapist/front/lowerleg/shinsplints.htm>]
2. Caring Medical [link to: [http://www.caringmedical.com/sports\\_injury/wrist\\_injury.asp](http://www.caringmedical.com/sports_injury/wrist_injury.asp)]
3. Sports Injury Handbook [link to: <http://www.sportsinjuryhandbook.com/injuries/index.html>]
4. American Academy of Pediatrics [link to: <http://www.aap.org/advocacy/releases/aprsportsinjurytips.cfm>]
5. Sports and Recreation at Helium [link to: <http://www.helium.com/items/214583-sports-for-people-with-heart-problems>]

## Drugs in Sports

**What to do:** Learn about illegal sports drugs and the risks they involve.

### What's the big idea?

The pressure to break the record or win the game pushes many athletes into taking drugs that supposedly improve their performance. The most popular sports drugs include caffeine, anabolic steroids, and artificial growth hormone.

**Caffeine** can be found in many products like soda, tea, coffee, and several kinds of medications. It is known to stimulate the central nervous system, and many athletes believe that it can enhance their physical and mental performance. People believe that caffeine can improve an athlete's endurance in sports where long-term stamina is needed. These sports include cycling, running, and even soccer.

**Anabolic steroids** are synthesized derivatives of the male hormone testosterone. Testosterone has two types of effects on the body: anabolic and androgenic. Anabolic effects promote muscle building, while androgenic effects are responsible for male traits, such as facial hair and a deeper voice. Some athletes take steroids to increase their muscle mass and strength. Steroids are also believed to help athletes recover from a hard workout more quickly by reducing the amount of muscle damage that occurs during the session. Some athletes may like the aggressive feelings they get when they take the drugs.

**Artificial growth hormone** is made out of a growth hormone that naturally occurs in the human body. It was originally used to treat children that experienced growth problems. The hormone became a popular enhancement drug in sports when athletes started using it to increase muscle size. Because there is a correlation between muscle size and strength, competitors in events that require power are most likely to benefit. It also makes tired muscles recover quicker, allowing athletes to train harder and more often.

### So what?

Performance-enhancing drugs are illegal in most sports. Like many other drugs, caffeine, anabolic steroids, and artificial growth hormones are officially banned by the International Olympic Committee. The use of performance-enhancing drugs is unethical, because it goes against the idea of equal opportunity for all athletes and, most importantly, poses a serious threat to the athlete's health.

Coffee drinkers might experience side effects of caffeine such as sleep deprivation, nausea, cramping, anxiety, fatigue, headaches, and gastrointestinal instability. The abuse of caffeine in athletes may lead to muscle tightness, cramping, and dehydration. The biggest risk of taking steroids is damaging the liver. They are also known to cause heart disease, chest tumors, and bad acne. The abuse of artificial growth hormone may lead to disease of heart muscle, disproportional growth of the face and hands, and increase the risk of cancers due to the abnormal growth of cells.

**Find out more:**

- Caffeine and Sports Performance [link to: [http://www.vanderbilt.edu/AnS/psychology/health\\_psychology/caffeine\\_sports.htm](http://www.vanderbilt.edu/AnS/psychology/health_psychology/caffeine_sports.htm)]
- The Risks of Performance-Enhancing Drugs [link to: <http://www.mayoclinic.com/health/performance-enhancing-drugs/HQ01105>]
- BBC Sports [link to: [http://news.bbc.co.uk/sport2/hi/front\\_page/3101343.stm](http://news.bbc.co.uk/sport2/hi/front_page/3101343.stm)]

## MedTech iWall

**What to do:** Reveal the insides of the human body using X-ray, CT, and MRI scans with innovative touch-screen technology.

### What's the big idea?

**X-ray** (X-radiation) is a form of electromagnetic radiation. In a health care setting, machines send individual X-ray particles (photons) through the body. A computer or special film is used to record the images that are created. Structures that are dense (such as bone) will block most of the X-ray particles appear white. Metal and contrast media (a special dye used to highlight areas of the body) will also appear white. Structures containing air will be black, and muscle, fat, and fluid will appear as shades of gray.

A **computed tomography** (CT) scan is used to compose a detailed picture of structures inside of the body. During the test, the patient lies on the table attached to the doughnut-shaped CT scanner. The scanner sends the X-rays through the body area being studied. Each rotation of the scanner takes less than a second and provides a picture of a thin slice of the organ or area. A CT scan can be used to study all parts of the body, such as the chest, belly, pelvis, or an arm or leg. It can take pictures of body organs, such as the liver, pancreas, and kidneys. It also can study blood vessels, bones, and the spinal cord. Sometimes an iodine dye is used to make the organs easier to see. For instance, it may be put in the vein of the arm to study blood flow.

**Magnetic resonance imaging** (MRI) is a non-invasive medical test that helps physicians diagnose and treat medical conditions. MRIs use a powerful magnetic field, radio frequency pulses, and a computer to produce detailed pictures of organs, soft tissues, bone, and virtually all other internal body structures. The images can then be examined on a computer monitor and printed or copied to CD.

**Gamma cameras** are used in nuclear medicine and rely on small amounts of radioactive materials to diagnose or treat a variety of diseases, including many types of cancers and heart disease. Depending on the type of exam, the radiotracer is either injected into a vein, swallowed, or inhaled as a gas and eventually accumulates in the organ or area of the body being examined. It gives off energy in the form of gamma rays. This energy is detected by the gamma camera, a (positron emission tomography) PET scanner and/or probe. These devices work together with a computer to measure the amount of radiotracer absorbed by your body and produce special pictures offering details on both the structure and function of organs and tissues.

### Find out more:

- X-ray [link to: <http://www.nlm.nih.gov/medlineplus/ency/article/003337.htm>]
- Computed tomography [link to: <http://www.webmd.com/a-to-z-guides/computed-tomography-ct-scan-of-the-body>]
- Magnetic resonance imaging [link to: <http://www.radiologyinfo.org/en/info.cfm?pg=bodymr>]
- Gamma cameras [link to: <http://www.radiologyinfo.org/en/info.cfm?PG=pct>]

## ECG Staircase

**What to do:** Test your cardio fitness in a stair-stepping activity and see your heart's ECG.

### What's the big idea?

The electrocardiogram (ECG) is a diagnostic tool that measures and records the electrical activity of your heart in detail. This activity comes from the muscles in the heart. As you know, the heart is a double pump with four chambers, each separated by valves that only permit blood to flow in one direction. The right side of the heart pumps deoxygenated blood to the lungs, while the left side pumps oxygenated blood to the body. The heart operates automatically, but responds to 'information' received from other parts of the body by changing its output accordingly.

If, for example, hard-working muscles need more oxygen, the heart (and lungs) picks up the pace to supply the body's increased needs. That is why when you exercise, your heart rate goes up, as well as your breathing rate.

### So what?

Fitness of the heart, or cardiovascular fitness, describes a special form of muscular endurance. It is the efficiency of the heart, lungs, and vascular system to deliver oxygen to the working muscles, allowing you to exercise for a longer time. When you exercise regularly, you can increase your cardiovascular fitness as your heart becomes more efficient at pumping blood and oxygen to the body, and the body becomes more efficient at using that oxygen. These are simple exercises that will help you build a stronger heart: walking, jogging, jumping rope, bicycling (stationary or outdoor), cross-country skiing, skating, rowing, and low-impact aerobics or water aerobics.

### Find out more:

- Better Heart Channel [link to: [http://www.betterhealth.vic.gov.au/bhcv2/bhcarticles.nsf/pages/Heart\\_explained](http://www.betterhealth.vic.gov.au/bhcv2/bhcarticles.nsf/pages/Heart_explained)]

## Valve Challenge

**What to do:** Pump the blood through a simulated leg to see blood flow against the force of gravity.

### What's the big idea?

Blood vessels are hollow tubes that carry blood between the heart, different tissues, and organs of the body. There are three types of blood vessels: arteries, veins, and capillaries. These blood vessels have the ability to expand to allow more blood to flow through them. They can also contract to help control the flow of blood.

Most of our blood volume is carried in the veins (64 percent). The veins return blood from capillaries to the heart. In the legs, blood return occurs mainly through the deep veins. Within the veins, especially those of the legs, are valves. Venous valves are bicuspid (two) flap-like structures made of elastic tissue. The valves allow blood to flow toward the heart, but do not allow blood to flow backwards.

Once the blood has passed from the arteries through the capillaries, it is flowing at a slower rate because little pressure remains to move the blood along. Blood flow in the veins below the heart is helped back up to the heart by the muscle pump. To compensate for thin and floppy walls, many veins are located in the muscles. Movement of the leg squeezes the veins, which pushes the blood toward the heart. When the muscles contract, the blood within the veins is squeezed upward through the vein, and the valves open. When the muscle is at rest, the valves close, helping to prevent the backward flow of blood.

### So what?

When you walk and your leg muscles squeeze, the venous pump works well. But when you sit or stand, especially for a long time, the blood in your leg veins can pool, and the pressure in your veins can increase. Some are usually able to withstand short periods of increased pressures. However, if you are a susceptible individual, your veins can stretch if you repeatedly sit or stand for a long time. This stretching can sometimes weaken the walls of your veins and damage your vein valves. If this happens, the best way to get the blood moving up the veins again is exercise. When you exercise, your leg muscles alternately contract and relax, squeezing blood back toward the heart, so running, walking, cycling, skiing, skating, and dancing are considered ideal treatments.

### Find out more:

- JOBST [link to: <http://www.jobst-usa.com/en/leghealth/veinsandvalves/page.html>]
- Blood Vessels and Cardiovascular System [link to: <http://web.buddyproject.org/web019/web019/bvessels.html>]



## Joins Table

**What to do:** Discover how the joints of the human body work.

### What's the big idea?

Joints are the places in human body where two bones attach to each other. All of the joints of the human body are capable of movement, except for those in the skull. There are various kinds of movable joints.

In **ball-and-socket joints** the spherical head of one bone fits into the spherical cavity of another. Your shoulders and hips are ball-and-socket joints. In the shoulder joint, the upper arm bone fits into the socket of the shoulder blade. Because the socket is shallow and the joint loose, the shoulder is the body's most mobile joint. The hip joint is less mobile than the shoulder, but it is more stable. The ball of the thigh bone's head fits tightly into a deep socket in the pelvic bone. The grip is firm, and the ligament that binds the two bones is among the strongest in the human body.

**Hinge joints** are the simplest type of joint in the skeleton. They are the joints of elbows, knees, fingers, and toes. A hinge joint is formed by cylindrical bone sitting inside a curved bone. The hinge joint of the knee is the body's largest joint.

**Gliding joints** occur when two flat bone surfaces slide over one another. They permit a wide range of mostly sideways movements, as well as movements in one direction. Gliding joints are located in your ankles, wrists, and spine.

A **pivot joint** is a rotational joint that allows bones to spin around other bones. The neck and forearms have pivot joints.

### So what?

Each time you lean forward, pick up a cup of coffee, raise it to your lips, and put it back down, your bones, joints, muscles, and other tissues are all synchronized, working together to make this effort possible. The cartilage in the joints prevents the ends of the bones from being damaged by contact with each other. Cartilage itself can be harmed by infection, injury, disease, or simple wear and tear. This damage may lead to pain, inflammation and stiffness, a condition known as arthritis.

### Find out more:

- Inner body [link to: <http://www.innerbody.com/image/skel07.html>]
- Absolute Astronomy [link to: <http://www.absoluteastronomy.com/topics/Joint>]

## Healthy Heart

**What to do:** Compare your real-time heart rate with a selected animal's.

### What's the big idea?

Although the heart is one of the most important organs in the entire human body, it is really nothing more than a pump composed of muscles, which pumps blood throughout the body. It pumps the blood that carries vital materials that help our bodies function and removes the waste products that we do not need.

The heart is essentially a muscle a little larger than the size of a fist. Like other muscles in the human body, it contracts and expands. However, unlike skeletal muscles, its contraction is not voluntary. Each time the heart contracts, it does so with all its force. The pumping of the heart is called the cardiac cycle, which occurs about 72 times per minute on average. This means that each cycle lasts about eight-tenths of a second. During this cycle the entire heart actually rests for about four-tenths of a second. Roughly speaking, the human heart beats about 35 million times a year.

### So what?

Although all mammals have circulatory systems similar to humans, heart rates among species are very different. In general, the larger the animal, the slower its resting heart rate. Compare the numbers that were obtained in different studies of the following animals:

- The average heart rate of large whales is from 10 to 30 heart beats per minute.
- A resting horse has a heart rate of 38 to 40 beats per minute.
- A medium dog has a normal heart rate of 80 to 120 beats per minute.
- A cat's heart rate can range from 140 to 220 beats per minute.
- A medium-sized rabbit has a heart rate of 130 to 325 beats per minute.
- A hamster's heart rate ranges from 280 to 450 beats per minute.
- A typical house mouse may have a heart rate between 500 and 600 beats per minute at rest.

### Find out more:

- The Human Heart [link to: <http://www.worldinvisible.com/apologet/humbody/heart.htm>]

## Breathe Easy

**What to do:** Exhale a lung-full of air into a sensor, check out your lung capacity, then compare the results.

### **What's the big idea?**

Your lungs are complex organs that transport oxygen from the air into the bloodstream and release carbon dioxide back into the air. The air you breathe contains several gases, including oxygen, that your cells need to function. With each breath, the lungs add fresh oxygen to the blood, which then carries it to the cells. At the same time, they absorb waste carbon dioxide from the blood, which then leaves the lungs when you exhale.

Your lungs are made of elastic tissue that stretches and constricts as you breathe. When you inhale, the diaphragm and muscles between your ribs contract and expand the chest cavity. This expansion lowers the pressure in the chest cavity below the outside air pressure. Air then flows in through the airways (from high pressure to low pressure) and inflates the lungs. When you exhale, the diaphragm and the muscles relax and the chest cavity gets smaller. The decrease in volume of the cavity increases the pressure in the chest cavity above the outside air pressure. Air from the lungs (high pressure) then flows out of the airways to the outside air (low pressure). The cycle then repeats with each breath.

### **So what?**

- Your lungs do a vital job. Each day, you take about 23,000 breaths, which bring almost 10,000 quarts of air into your lungs.
- Lung function normally peaks in the late teens and early twenties. After the early twenties, lung function declines about 1 percent a year for the rest of a person's lifetime. Lung function decreases about 2 percent a year for people who smoke.
- It is impossible to increase the size of your lungs; however, you can increase the amount of air your lungs take in. Exercising in water, playing a wind instrument, running, or cycling are good ways to start.

### **Find out more:**

1. How Your Lungs Work [link to: <http://health.howstuffworks.com/lung1.htm>]
2. Mama's Health [link to: <http://www.mamashealth.com/organs/lungs.asp>]

### **Footwork**

**What to do:** Put your foot on a sheet of heat-sensitive crystals and discover which type of foot arch you have.

### **What's the big idea?**

A human foot has two important functions: bearing weight and propulsion (movement). To be able to perform these functions, the foot needs a high degree of stability. Also, the foot has to be flexible so it can adapt to uneven surfaces. The foot has three distinct arches, which are formed by the shapes of the bones, ligaments, and tendons. Two “longitudinal” arches (one on each side) run from front to back; one “transverse arch” runs across the mid-foot from the inside to the outside. The “medial longitudinal arch” is the most prominent foot arch, which is typically referred to as simply “the arch.” It runs from front to back along the inside of the foot. This arch absorbs the majority of the shock of impact while walking, jumping, or running.

### **So what?**

Based on the type of the arch, there are three types of feet: those with high arches, those who have a neutral foot type, and those who have flat feet. The type of foot you have affects the way you walk. Also, knowing your type of foot is useful when choosing running shoes. Most people have medium (neutral) arches, which means they can wear just about any type of shoes. Those with low arches need shoes with firmer support devices, and so do tall and heavy runners. High arch is the least common type of foot. High foot arches do not absorb shock as well, letting it travel up the leg. These individuals will need neutral-cushioned shoes with softer mid-soles.

### **Find out more:**

- Runner's World [<http://www.runnersworld.com/article/0,7120,s6-240-319-326-7152-0,00.html>]