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## Getting Muscles What They Need—Your Circulatory System

### Your Circulatory System and How It Works

#### How Do Oxygen and Nutrients Get to Your Muscle Cells?

Your muscle cells—and all the other cells in your body—could not stay alive without a constant flow of blood delivering oxygen and nutrients. This blood flow is also needed to carry away the waste your cells make.

But how does your blood get everywhere that it's needed? You may already know that your blood is carried in a system of tubes, or pipes, called **blood vessels**. But blood can't flow to all the parts of your body without some help. This is where your heart comes in. Your heart is a powerful “machine” for pumping blood throughout your body.

Your blood, blood vessels, and heart make up your **circulatory system**. Working together, this team delivers nutrients, oxygen, and other needed substances to the cells of your body and then carries away their waste.

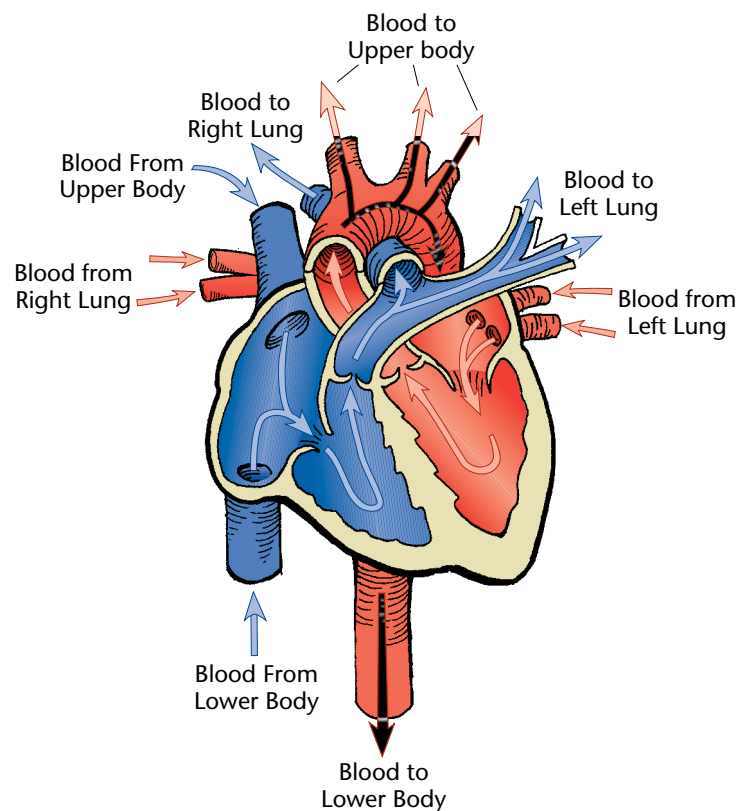
**Human Body Fact**

The human heart beats about 3 billion times in the average person's lifetime—about 100,000 times a day!

**The Heart**

Your heart itself is a muscle. It is powerful enough to pump blood to all the parts of your body, but it's only about the size of your fist.

Your heart expands (gets bigger) and contracts (gets smaller). When your heart expands, it fills with blood. When it contracts, it squeezes out the blood into your blood vessels.

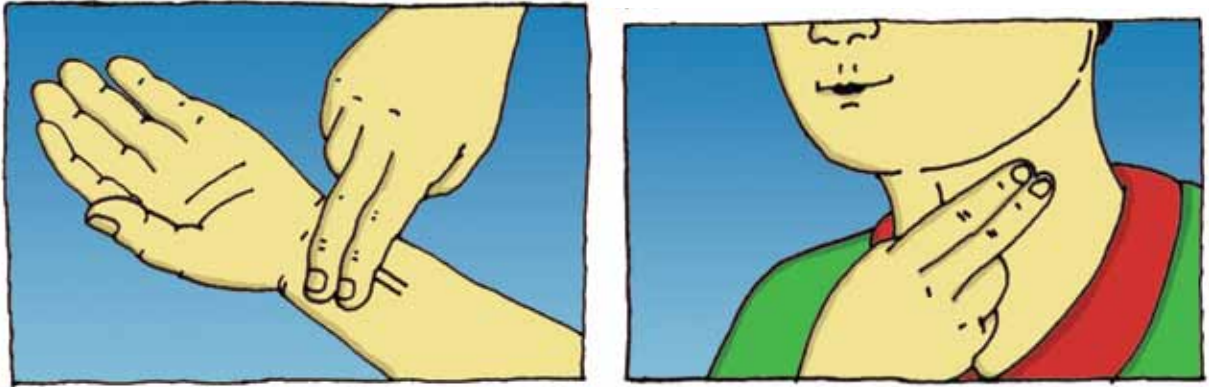


A look inside the heart. The arrows show how blood enters and leaves the heart with each beat.

Sometimes you can actually feel your heart beating through your chest. This might happen if you've been exercising very hard or you're scared or nervous. You can also feel your heart working by finding your pulse, as you did in class. When your

heart contracts, the blood inside it empties into blood vessels. As the blood vessels fill, they expand. The pulse you feel is the blood vessels that are close to your skin expanding and filling with blood.

To find your pulse, place two fingers inside your wrist just below the thumb, or on the side of your throat. (Don't use your thumb—it has its own pulse.)



The number of times your heart beats in one minute is called your **heart rate**. Your heart beats around 70 to 100 times a minute when you are not very active. When you exercise your heart rate goes up so that more oxygen and nutrients can get to your muscle cells. When your heart rate goes up, the extra waste your working muscles create can be removed more quickly, too.

## A Look at Other Animals

Animals' heart rates can be quite different from each other. An elephant's heart rate is much slower than a human's—only 20–30 beats per minute. A hummingbird's heart rate is much faster than ours—beating more than 1,000 times per minute when it's flying!

## Blood

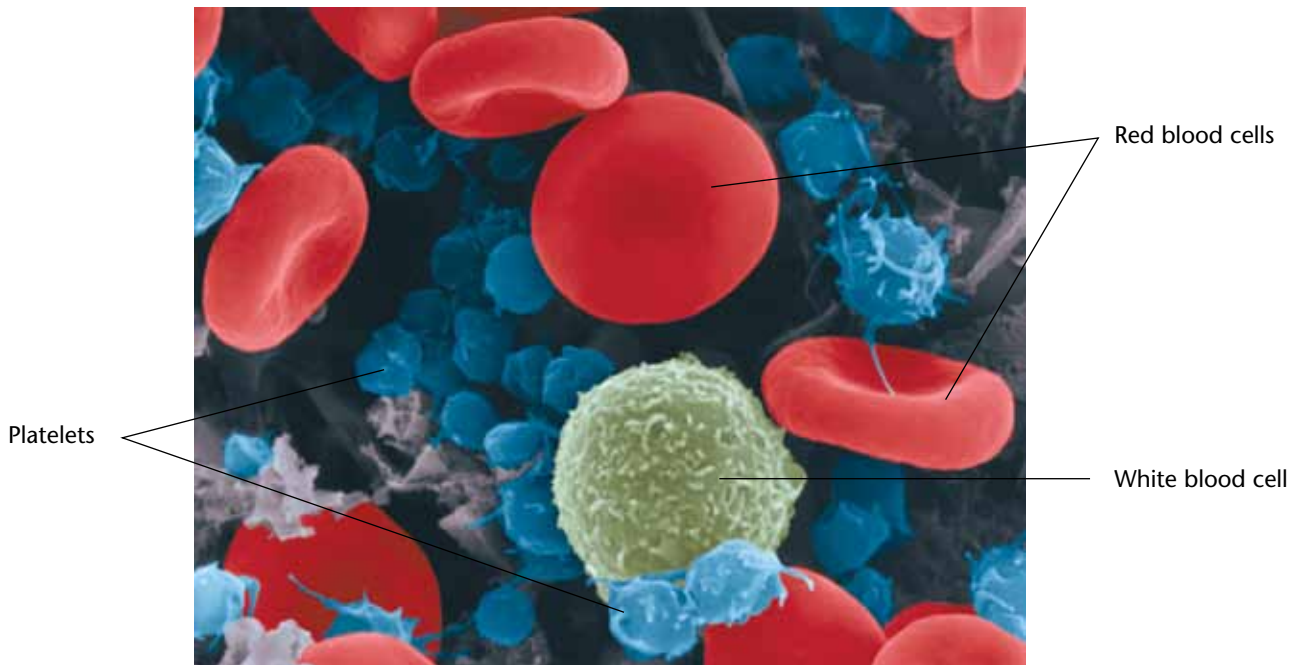
Your blood delivers the nutrients, minerals, and other substances that your body's cells need to function properly. If you looked at blood up close under a microscope, you would see a nutrient-rich liquid with blood cells floating in it—like a soup full of the healthy things your body's cells need.

### PLASMA

The liquid part of blood, called plasma, makes up about half of your blood. Its job is to carry blood cells, nutrients, and other substances throughout your body.

### BLOOD CELLS

Two types of blood cells—**red blood cells** and **white blood cells**—are carried in the plasma, along with tiny pieces of cells called **platelets**. All three are formed in the bone marrow, though each performs a different job.



A photograph of blood with red blood cells, a white blood cell, and some platelets. The platelets have been colored blue to make them easier to see.

There are more red blood cells than any other type of cell in your blood. Their job is to pick up oxygen from your lungs and carry it to your body's cells. Red blood cells give blood its red color.

White blood cells help protect your body from disease. There are many types of white blood cells. They all work together to keep germs and infections out of your body.

Platelets (PLAYT-luhts) are pieces of a special type of white blood cell. They form when these blood cells break apart. Platelets help scabs form on cuts.

### Human Body Facts

- Blood is thicker than water. In fact, with all the cells and other things in it, it's three times thicker than water!
- There are millions of red blood cells in one tiny drop of blood.
- Your blood has other things in it besides blood cells, including minerals and vitamins your cells need, and hormones. Hormones are chemicals which, among other things, control how you grow.

## How Do Platelets Stop Cuts from Bleeding?

Platelets repair your body if you get cut. When you cut yourself and blood pours out, platelets stick to the cut and to each other. For a very small cut, this may be enough to stop the bleeding.

For larger cuts, platelets release a chemical at the wound site that causes long strings or fibers to form. These fibers create a web. The web forms a clot, or plug, to stop the bleeding. After a while all the liquid is squeezed out and a hard scab forms.

## Blood Vessels

Just as the pipes for a large apartment building carry water to every kitchen and bathroom on every floor, a huge network of **blood vessels** carries blood to every part of your body.

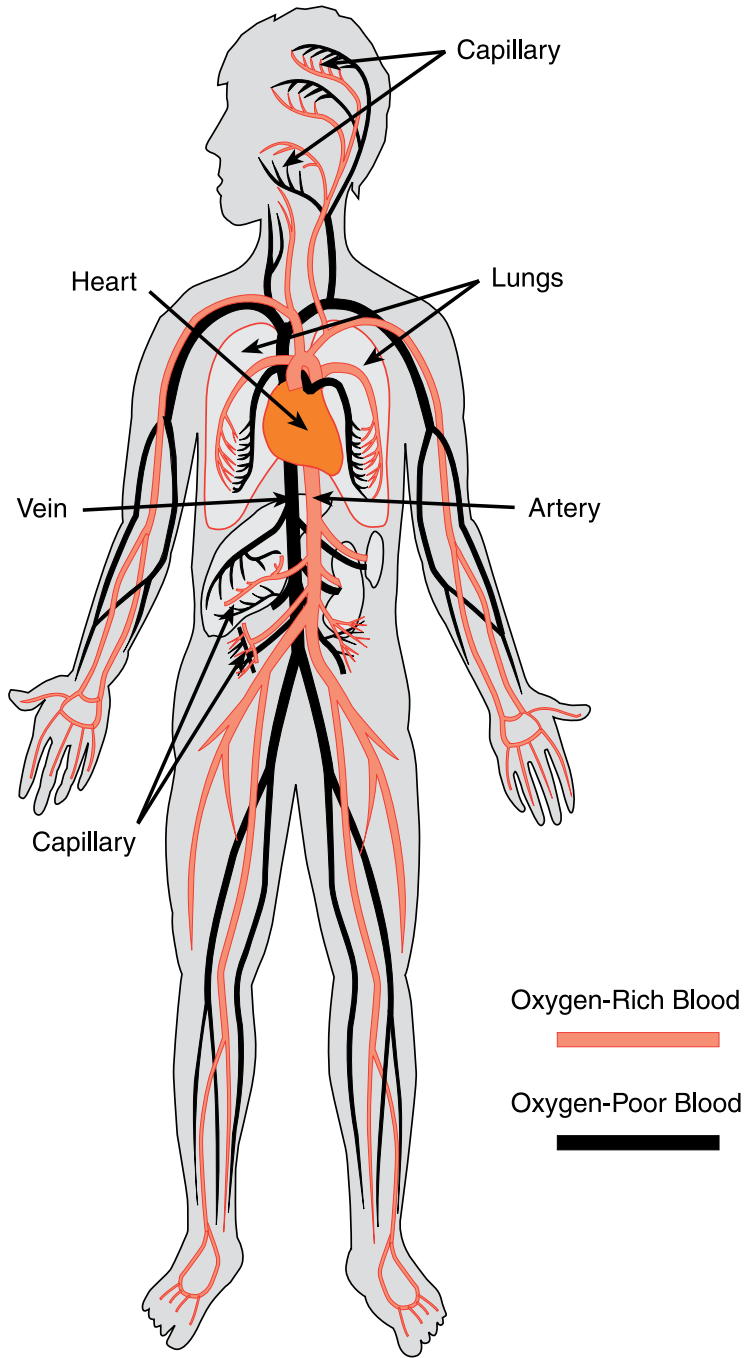
### Human Body Facts

- There are 60,000 miles of blood vessels in an adult's body.
- Blood cells travel around your body—from your heart and back to it—in less than one minute.
- In one day, your blood travels about 19,000 km (12,000 mi). That's four times the distance across the United States from coast to coast.

The diagram of the circulatory system on the next page shows the body's three major types of blood vessels:

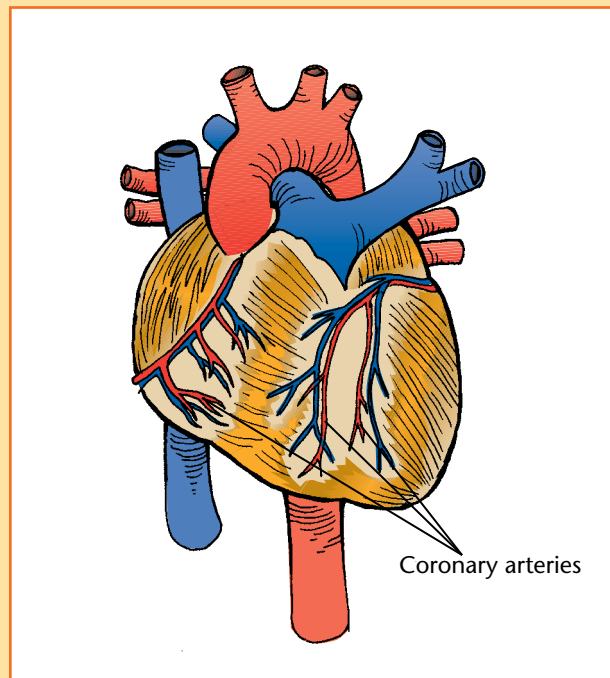
- **Arteries** (AHR-tuh-rees) carry blood from your heart to your cells. The arteries that connect to your heart are quite large. They branch out into smaller and smaller arteries to reach every part of your body that needs blood.
- **Capillaries** (KAP-uh-ler-ees) are the smallest, thinnest, and most numerous blood vessels. They branch off from the smallest arteries. Nutrients and oxygen in your blood pass from your capillaries directly to your cells. Waste moves from your cells into the capillaries. Capillaries then carry the blood into veins.
- **Veins** (VAYNs) are the blood vessels that carry blood from the capillaries back to your heart.

# The Circulatory System



## What Is a Heart Attack?

A heart attack happens when a part of the heart doesn't get enough oxygen-rich blood. If one or more of the arteries supplying the heart (the coronary arteries) gets clogged, a person can have a heart attack. Exercise and a good diet can lower the chances someone will have a heart attack. Smoking increases the risk of a heart attack. A heart attack happens suddenly. But it can be the result of years of bad habits. Eating healthy food, exercising, and not smoking throughout your life can help protect you from heart attacks when you're older!



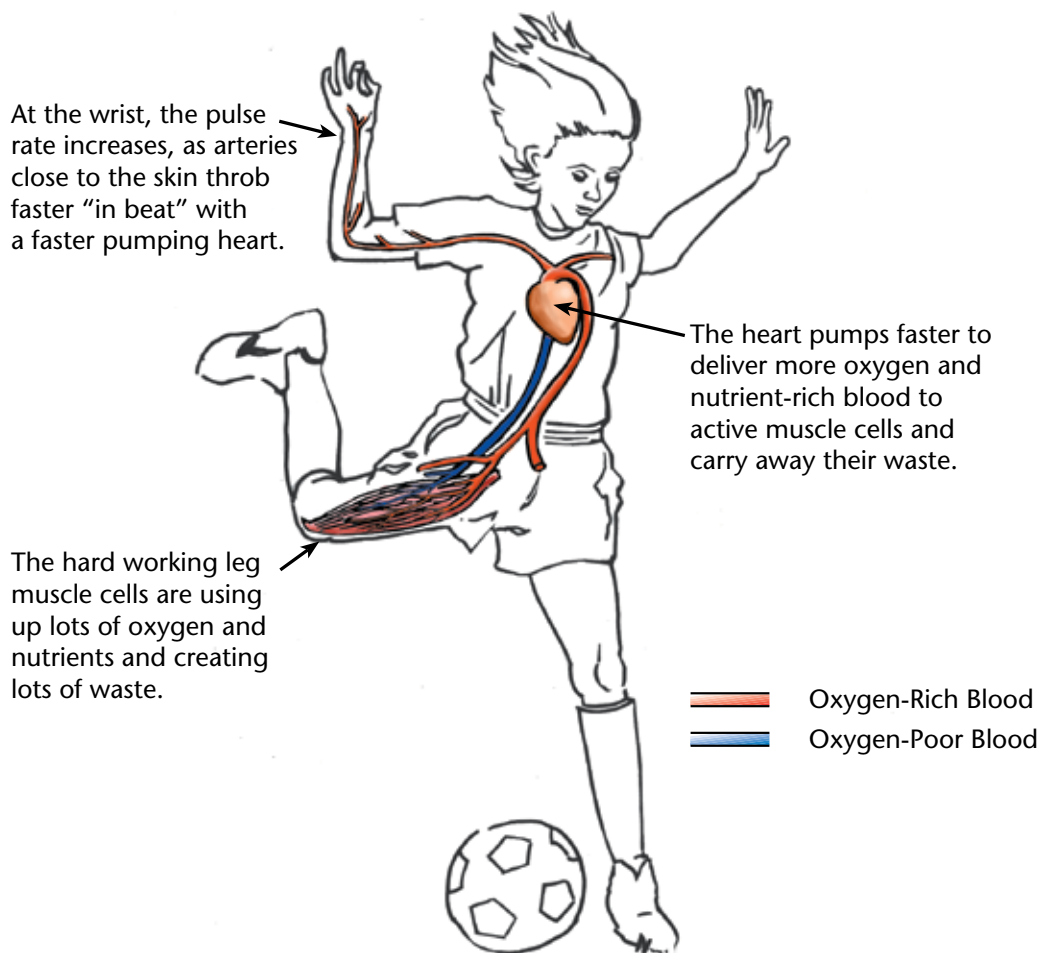


## How Your Circulatory System Works When You Exercise

### Why Does Your Heart Beat Faster When You Exercise?

Your body's cells—especially your muscle cells—need more energy when you exercise. To make more energy, they need more oxygen and nutrients. But just how do your cells get the extra oxygen and nutrients they need?

The answer is that your heart pumps faster so it can deliver more blood to your muscle cells.



With more blood flowing to them, your muscles get more oxygen and nutrients—so they can keep working (contracting). When your blood circulates faster, waste doesn't get the chance to build up in your muscles, either.

### **How Do Your Heart Muscles “Know” to Work Faster?**

When waste builds up in your blood (because your muscles are working hard), your brain sends messages to your heart muscles. These messages “tell” them to work harder and faster. (The messages are sent by your nervous system.)

### **Why Does Your Face Get So Red When You Exercise?**

As muscle cells make the energy they need, they also produce a lot of heat. This heats up your blood. The heated blood is carried to all the parts of your body, which warms you up.

Warmth is good, but too much heat could damage your body's cells. So your body has some ways to keep itself from getting too hot. Your face gets red when you exercise as your body works to cool itself down. Here's what happens:

- First, the blood vessels that supply your skin expand (get bigger) so more blood can flow through them.
- When the warmed blood moves into your skin, it makes your face, and other parts of your body, look red.
- The extra heat from the blood passes from your skin into the air around you, which is usually cooler. You cool down when the heat leaves your body.

Your red face shows that your body is getting rid of all that extra heat and keeping you—and your cells—healthy!



#### **Think About It!**

Your body also has built-in ways of keeping itself warm—since getting too cold can also damage cells. Can you think of things your body does to keep you warm when you're outdoors and it's cold?

## Your Body in Motion—An Owner’s Guide

### Heart-Healthy Habits

You can help keep your circulatory system healthy by doing the following things:

- Exercise at least three times a week. Your heart, like any muscle, gets stronger with regular exercise.
- Eat healthy food and limit the amount of “bad” fats you eat.
- Don’t smoke. Smoking is not just bad for your lungs. Smoking can also damage your heart and blood vessels, and make it harder for your heart to do its job.

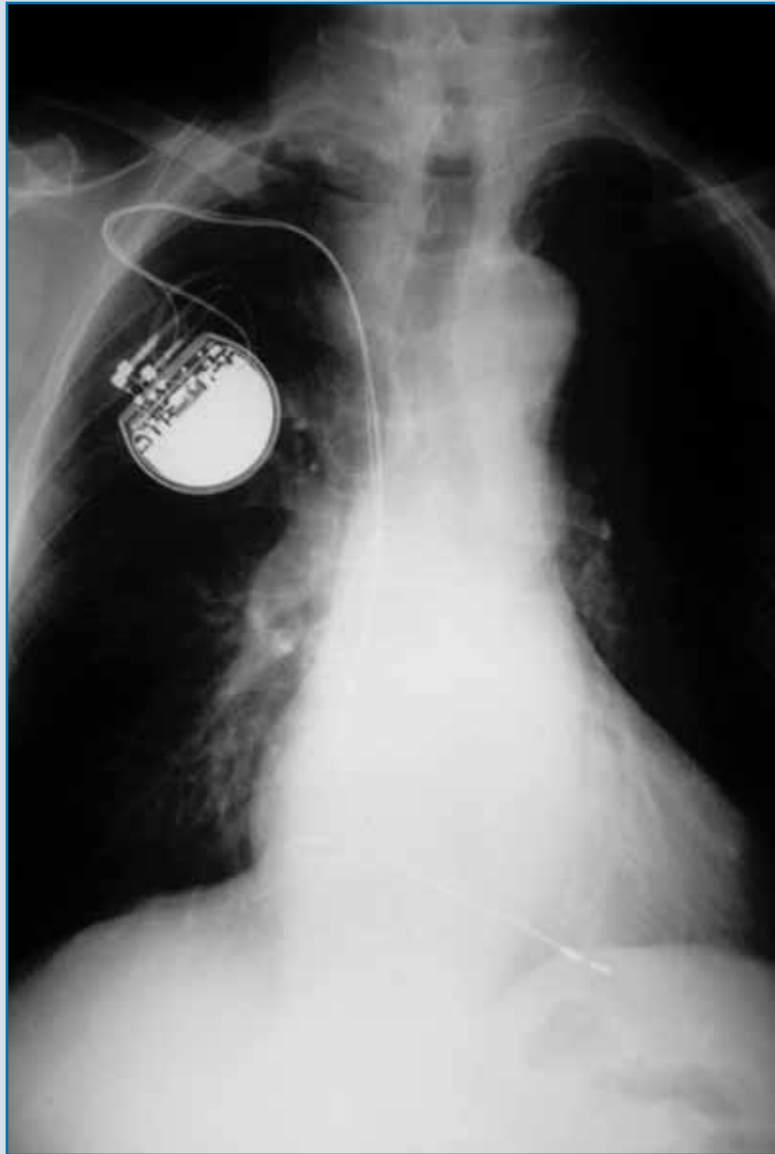
### Inventions—The Pacemaker

Some people have hearts that beat irregularly. Their hearts may beat too slowly or too fast, or may not beat at a steady rate. When this happens, their cells may not get enough oxygen, making them feel dizzy, tired, or out of breath.

Thanks to an amazing invention called the *pacemaker*, these people can do their everyday activities and even play sports. In fact, if someone in your class or on your soccer team had this problem, you probably would never even know about it.

A pacemaker is a small battery-powered machine that sets the pace for someone’s heart and keeps it beating at a steady rate.

Pacemakers are actually put inside people's bodies. A small wire leads from the pacemaker to the person's heart. Once a pacemaker is in place, it keeps the person's heart beating as regularly and tirelessly as anybody else's.



A pacemaker in a person's chest area. Notice the wires leading to the heart.