

The Human Body

Circulation and Respiration

Every time your heart beats, blood pumps through a network of blood vessels, from the heart to all the parts of your body. Every time you breathe in, air fills your lungs. Oxygen in that air travels from your lungs into your bloodstream, ready to feed the cells in your body.

The heart and the blood vessels are parts of your body's circulatory system. The lungs and windpipe are parts of your respiratory system. These two systems work together to keep you alive.

The Heart

The heart is a powerful muscle. It works every second of every day, from the moment you are born until the day you die. Most of the time, you don't even know it is working, but if you sprint up some stairs, you can feel it working harder.

Your heart is about the size of your fist. It is divided into four chambers. The top two chambers are called the **atria**s; the bottom two, the **ventricles**. Valves in between the ventricles and atria open and close to allow the blood to flow through the heart.

Blood needing oxygen comes into the heart through the right atrium. It squeezes through a valve and into the right ventricle. From there, it flows out to the lungs for a new supply of oxygen. From the lungs, it flows back into the left atrium of the heart, squeezes through a valve into the left ventricle, and then is pumped out of the heart through the **aorta**, the biggest blood vessel of all. The aorta divides and branches out to take the blood to all the different parts of the body.

The Blood Vessels

The heart pumps blood through your body in hollow stretchy tubes called **blood vessels**. The blood vessels that carry the oxygen-rich blood away from your heart are called **arteries**. The blood vessels that carry blood back to your heart for more oxygen are called **veins**.

Smaller blood vessels, called capillaries, branch off from arteries and veins. The tiny capillaries bring blood in contact with the cells in the body. Capillary walls are so thin that nutrients, oxygen, and waste products pass back and forth through them easily. Capillaries connect arteries and veins. They are the endpoint of arteries, through which oxygen and nutrients are delivered, and the starting point of veins, which pick up and carry waste materials away.

Blood Pressure and Heart Rate

Each time the heart pumps, the stretchy blood vessels swell and shrink as the blood courses through them. The pushing force, caused by the pumping heart, that moves blood through the body is called **blood pressure**. Blood pressure is one of the things that nurses and doctors check to make sure that your circulatory system is working properly.

Your pulse, or heart rate, indicates how often your heart squeezes to pump blood through your body. To measure your heart rate, press your fingertips on the pulse point in your wrist. Use a watch with a second hand and count the number of pulses in 30 seconds. The average human heart rate is about 90 pulses a minute so you will probably count about forty-five in half a minute. When you exercise, your

cells use lots of oxygen and soon need more. That's why exercise makes you breathe harder and makes your heart pump faster.

What is blood and why do we need it?

Blood never stops moving through your body. It delivers nutrients from food and oxygen to the cells in organs, muscles, bones, and nerves. It picks up waste materials from the cells in your body and carries that waste to organs that can process it. Cells give off a gas called carbon dioxide, which blood carries back to the lungs. When you breathe out, you release carbon dioxide.

If you look at blood under a microscope, you can see tiny objects of several different shapes, all floating in a thin, clear liquid. The liquid part of blood is called the **plasma**. The most common shapes you would see floating in the plasma are the **red blood cells**. There are over 25 trillion (25,000,000,000,000) red blood cells in one person's body. Red blood cells contain a substance called **hemoglobin**. It's the hemoglobin that does the work of carrying oxygen and carbon dioxide.

Looking through the microscope, you would also see **white blood cells**. White blood cells are like a special forces team that travels in the blood, ready to fight disease on a moment's notice. When an infection develops, white blood cells attack.

If you have ever had a cut, then you've seen **platelets** in action. Platelets are tiny solids in the blood. Their job is to help stop bleeding. Platelets make blood **coagulate**, or get thicker, so a scab develops, protecting the wound while it heals.

Your red blood cells work really hard so they only last for about four months before they die and are replaced by new ones. Red blood cells die at a rate of 8 million a second! That means a lot of dead red blood cells are floating in your blood right now.

Understanding and Preserving Your Heart

For a long time, people did not know that the heart pumps blood in a circuit through the body. One of the men who helped us understand this was an English doctor named **William Harvey**.

Harvey suggested that the heart was at the center of a blood-circulating system. For a while no one believed him. A few years later, though, the newly invented microscope was used to investigate his claim. Through the microscope, doctors watched blood flowing in the tail of a live fish and realized Harvey had been right.

Today we know much more about the circulatory system and how to keep it healthy. We understand that exercising makes your heart muscle grow stronger, and can help you live longer.

Eating smart is another key to a healthy heart. If you eat more fat than your body can use, it may build up on the inside of blood vessels like crud in an old sink pipe. Then less blood flows through and less oxygen gets to the fingers and toes, brain and heart. When the heart does not receive enough oxygen, heart muscle cells die. The result is called a **heart attack**.

The Lungs

You breathe in and out more than 20,000 times a day. Each time, you replenish the oxygen in your body's systems and release carbon dioxide that your body can not use. Your lungs and your respiratory system work together with your heart and circulatory system to keep you healthy and keep your cells alive.

Inside your chest, on either side of your heart are two inflatable sacs called **lungs**. They are like warm, wet sponges inside. They expand and contract as your breathing fills them with air, then pushes the air out again.

As you take a breath, air flows through your nose or your mouth and travels down the windpipe, or **trachea**. It moves past the voice box and into tubes inside your lungs called **bronchi**. Bronchi branch into smaller and smaller tubes. At the very ends of the tiniest bronchi are air sacs called **alveoli**. These alveoli contain tiny capillaries where the respiratory and the circulatory systems meet. Hemoglobin in red blood cells absorbs the oxygen from the breath you took and carries it to all the cells in your body.

The process happens in reverse, too. As blood circulates through your body, it picks up carbon dioxide, which is of no use to your body. When the red blood cells carrying the carbon dioxide reach the capillaries in the alveoli, they unload the waste products into the lungs. Then you breathe out and get rid of the unneeded gas.

Breathing in and out happens because of the diaphragm, which is a stretchy sheet of muscle underneath your lungs. When the diaphragm arches down, it opens up space in your lungs and air rushes in to fill them. When the diaphragm arches up, it pushes the lungs together and forces air out of them, through the windpipe.

What about Smoking?

Smoking cigarettes is one of the worst things you can do to your lungs and heart. Every pack of cigarettes carries a warning, like this:

Surgeon General's Warning:

Smoking causes lung cancer, heart

Disease, emphysema, and may

Complicate pregnancy.

When a person inhales cigarette smoke, 4,000 different chemicals invade the lungs. Some of these chemicals are poisons that cause lung cancer. Cigarette smoke also contains sticky, black tar. When the nooks and crannies of a smoker's lungs become clogged with tar, the alveoli can become so stiff with goo that they cannot expand and pass oxygen to the blood. With less of their lungs working, smokers cannot exercise without running out of breath. Their hearts pump harder and harder, but less oxygen reaches their cells.