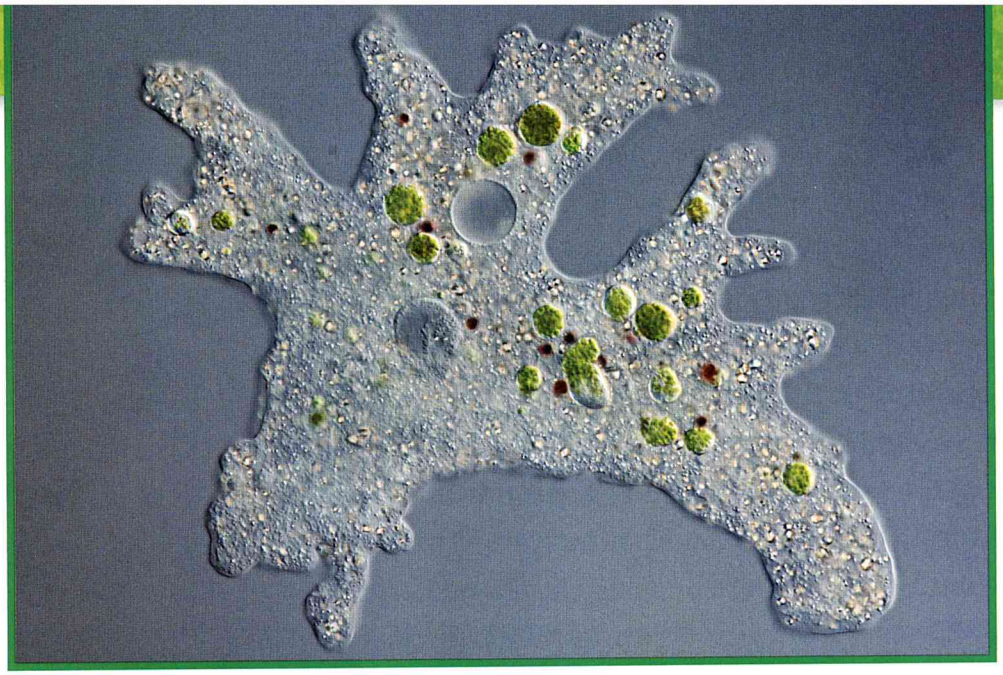


A living amoeba

The Human Circulatory System

The basic unit of life is the cell. All organisms are made of living cells. The simplest organisms, such as the amoeba, are just one cell.

All living cells have something in common. They all have a membrane on the outside. All cells are filled with a liquid called **cytoplasm**, which is mostly water. And all cells need four resources in order to stay alive. They are water, food, gases, and waste disposal.

How Do Cells Get Resources?

Single-celled organisms live in water. The food and gases they need to survive are in the water. The environment brings water, food, and gases to the cells all the time. The cell releases waste products into the water. The environment provides all the resources that single-celled organisms need.

A human is a multicellular organism. A human is made of trillions of cells. Humans don't live in water, and most of the cells are deep inside the body.

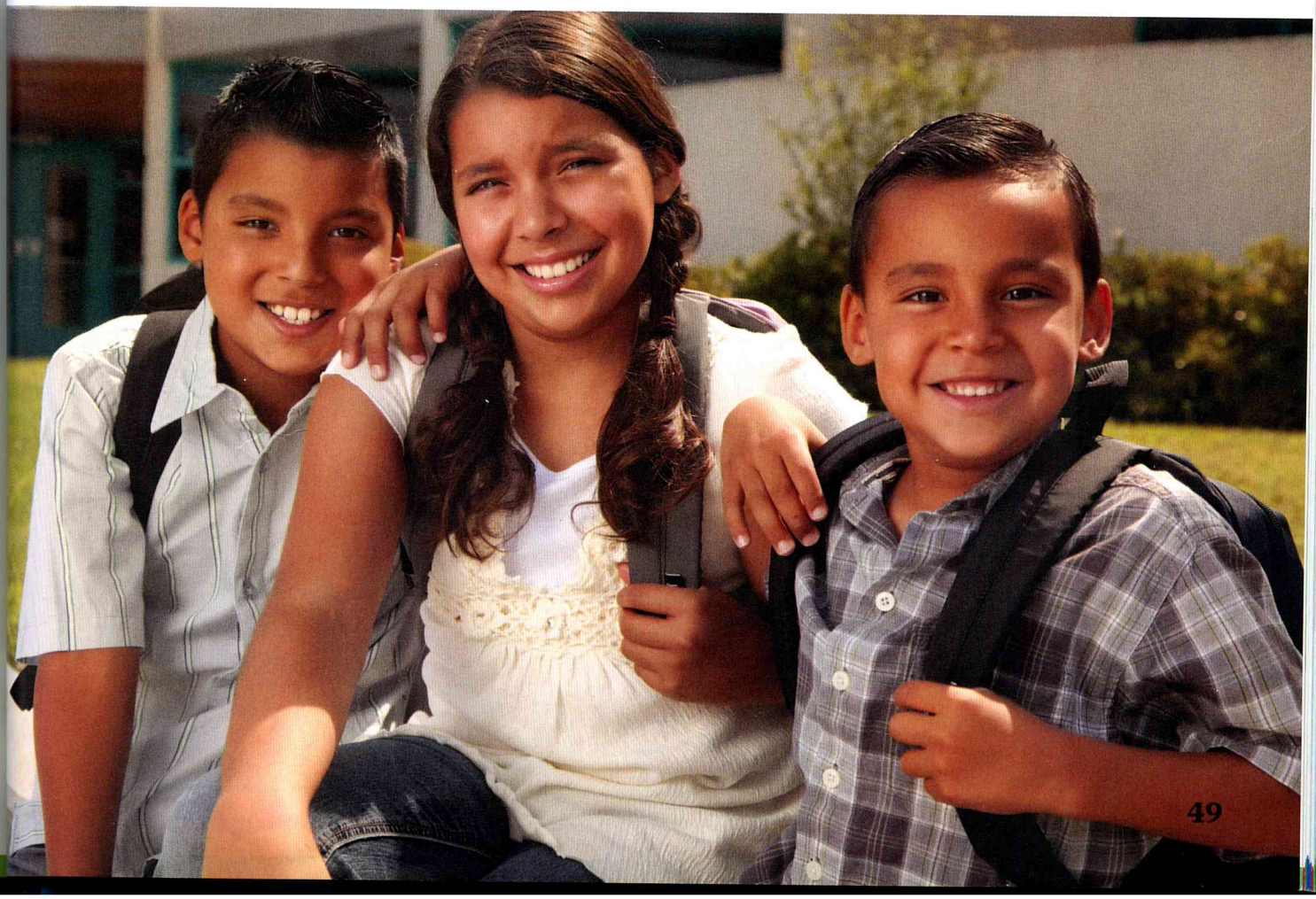
Muscles are made of millions of cells. Every cell in a human muscle is alive. That means every cell is getting the resources it needs to survive. How do these muscle cells get the water, food, gases, and waste removal they need to survive?

Multicellular organisms have specialized structures to transport resources to cells. In humans, blood, which is mostly water, is pumped through blood vessels to all the cells. The blood carries food and gases to the cells, and carries away wastes.

The human body is made of many different kinds of cells. There are nerve cells, muscle cells, bone cells, liver cells, lung cells, skin cells, and so on. A group of cells of the same kind, working together to perform a function, is called a tissue. Muscle tissue contracts to produce movement. Bone tissue gives our bodies structure. Nerve tissue sends electric messages. Each tissue is made of its own kinds of cells. But the cells in all tissues need the same basic resources.

Cells break down sugar to get energy. Cells need oxygen to do the job. One of the by-products of the sugar breakdown is the waste gas carbon dioxide (CO_2). If cells don't get oxygen, they will die. If cells don't get rid of the carbon dioxide, they will die.

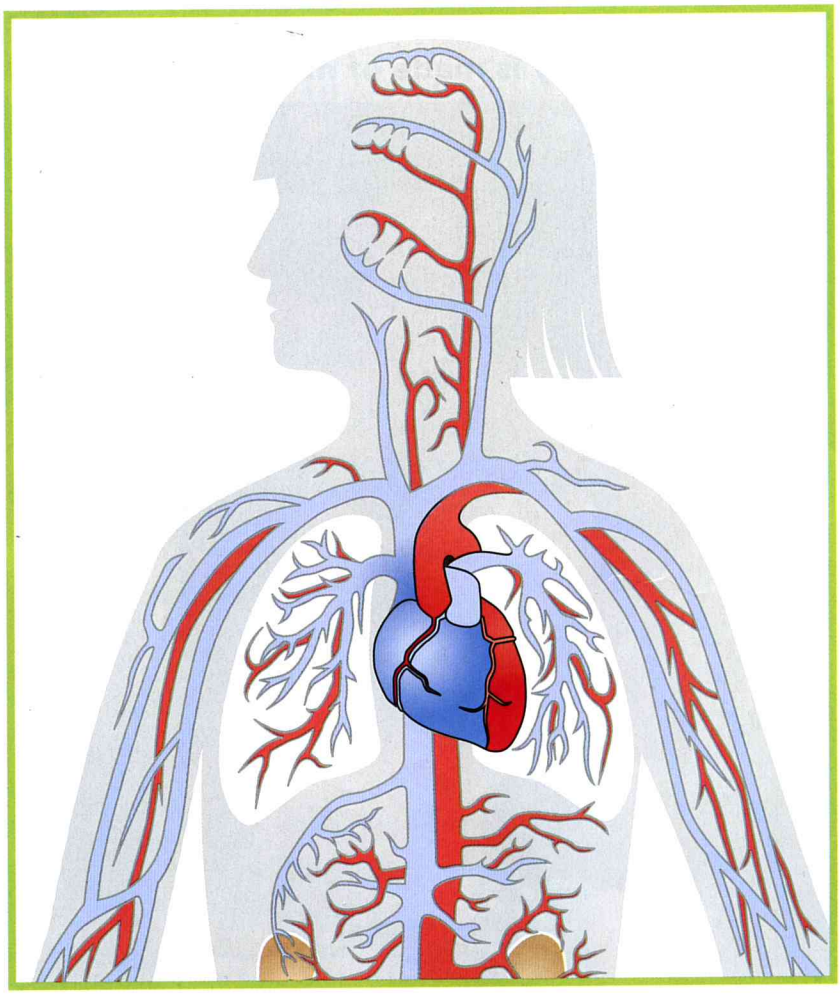
The human body is made of many different kinds of cells.



Resource Delivery

Blood flows through blood vessels to every cell in the body. The blood is kept flowing with a pump called the heart. The human heart is a four-chambered organ made of powerful muscles. The muscles contract to pump the blood about once every second. You can feel the beat of your pumping heart when you put your hand on your chest. The heart muscle works all the time. It pumps day and night, year after year. Every year your heart beats more than 30 million times!

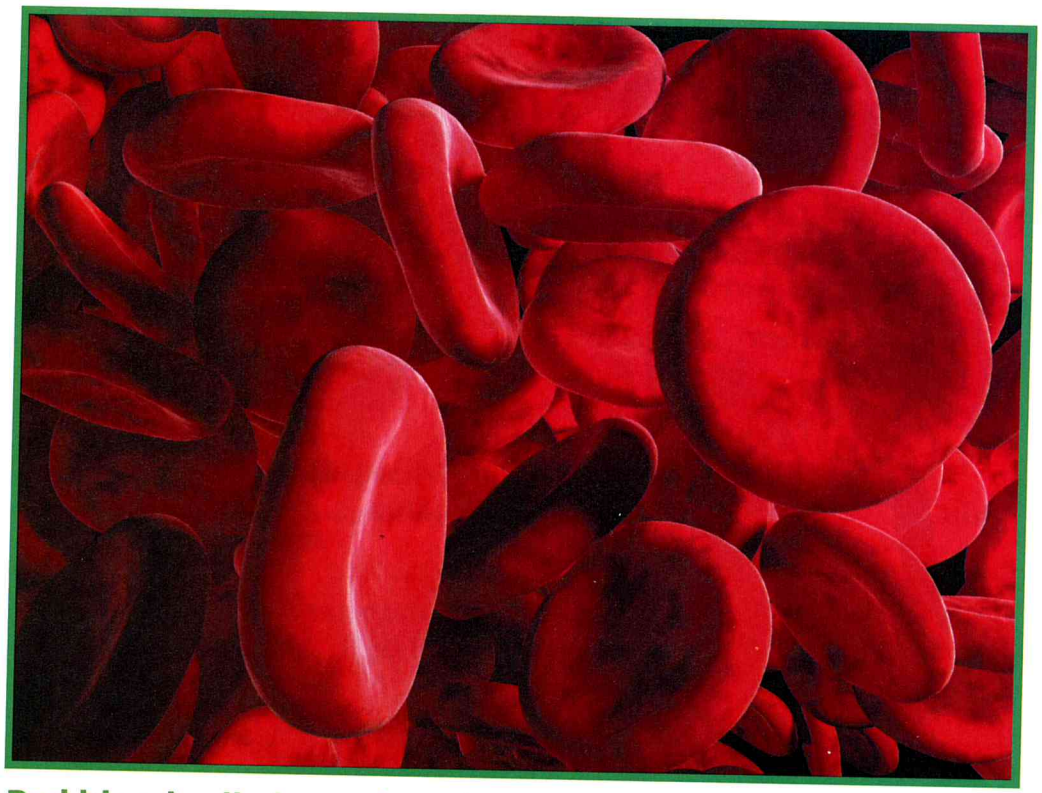
Blood flows away from the heart in blood vessels called arteries. Blood flows back to the heart in vessels called veins. The smallest blood vessels, the ones that serve the cells, are called capillaries. The system of blood vessels and the heart is called the **circulatory system**. It circulates blood to every cell in your body.



The human circulatory system

The two most important resources transported to cells are oxygen (a gas) and sugar (food). The most important waste product removed from cells is carbon dioxide (a gas). Oxygen comes from the air we breathe, and sugar comes from the food we eat. In order to get fresh oxygen, dispose of carbon dioxide, and get new sugar for cells, the circulatory system has to connect with the **lungs** and intestines.

To learn how the circulatory system works, let's take an imaginary trip through it. Red blood cells carry oxygen to the cells and carbon dioxide away from the cells. You have about 25 trillion red blood cells in your body. They live only about 4 months, so they are being replaced at the amazing rate of about 3 million per second.

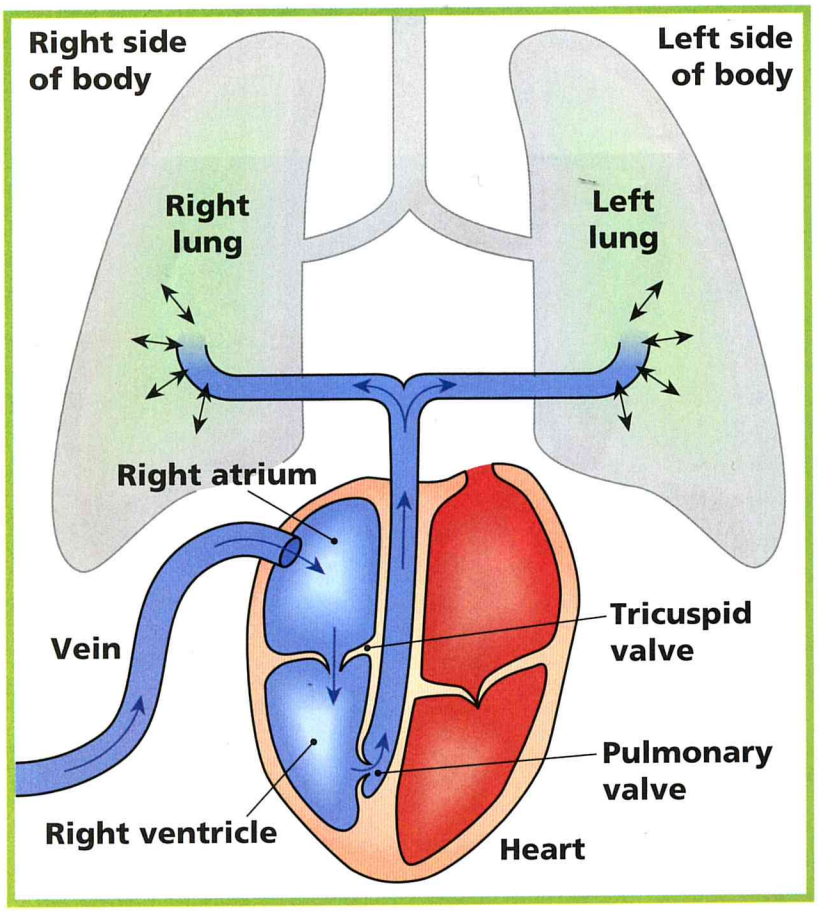


Red blood cells (scanning electron microscope view, about 4,000X)

The Right Side of the Heart

It takes about a minute for a red blood cell to travel once through the circulatory system. Blood returning from the body cells goes to the right side of the heart. The returning red blood cells are carrying carbon dioxide waste. The returning blood enters the upper chamber on the right side of the heart, called the **right atrium**. When the heart beats, the right atrium squeezes blood down into the **right ventricle**.

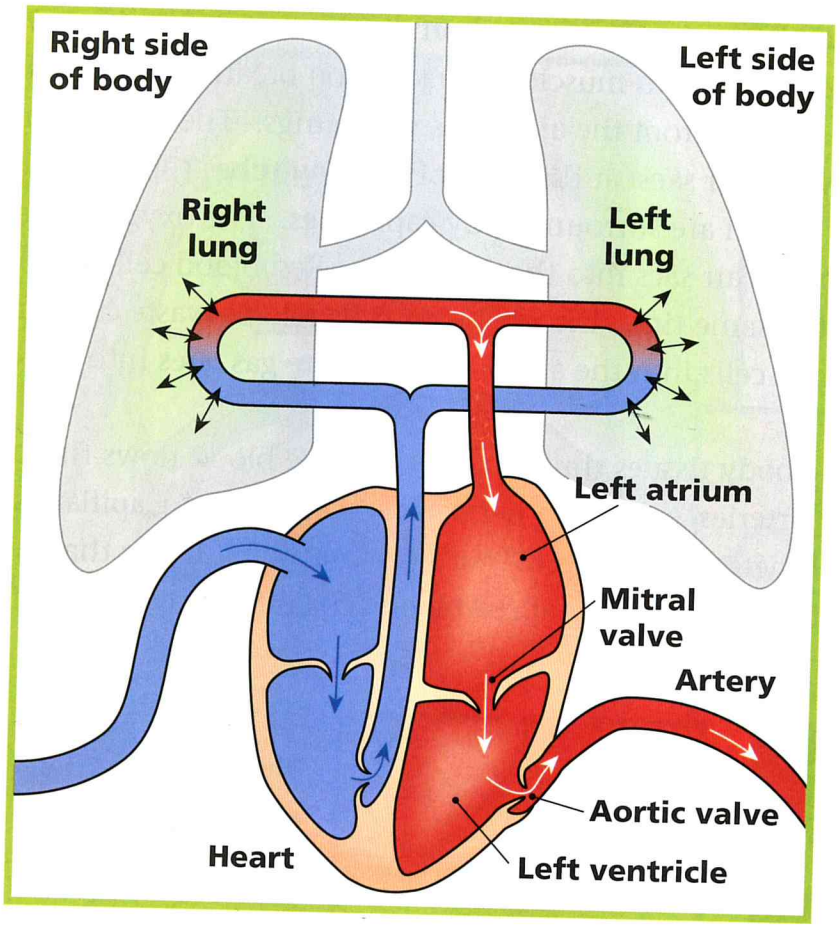
The next time the heart beats, it pushes blood out of the right ventricle to the lungs. The blood flows through tiny capillaries that are touching the air sacs in the lungs. The red blood cells release carbon dioxide. The carbon dioxide enters the air in the lungs and is exhaled. Then the red blood cells take oxygen from the air you breathe in.



A diagram showing how the right side of the heart works

The Left Side of the Heart

The oxygen-rich red blood cells go back to the left side of the heart. Blood from the lungs flows into the **left atrium**. The next time the heart beats, it squeezes blood into the powerful **left ventricle**. When the left ventricle contracts, it pumps blood through arteries to the body. The red blood cells transport oxygen and pick up waste carbon dioxide. Then the cycle starts over again.



A diagram showing how the left side of the heart works

Thinking about the Human Circulatory System

1. What is the heart and what is its role in the circulatory system?
2. What are heart valves and what do they do?
3. Where are the heart valves?
4. What is the main function of the left side of the human heart?
5. What is the main function of the right side of the human heart?