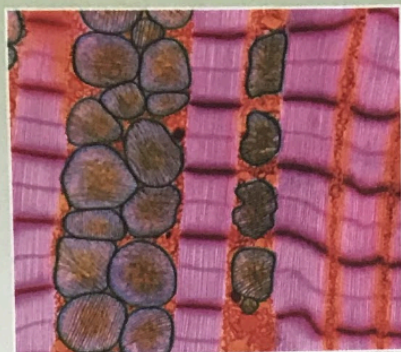




This picture shows a slice of heart muscle through a microscope. The heart is mostly made of muscle.

The heart

Your heart is an amazingly hard-working muscle. It's only about the size of your fist, but it's strong enough to keep pumping blood around your whole body 24 hours a day, never stopping for a rest. Most of the time, you forget it's even there.

Where is it?

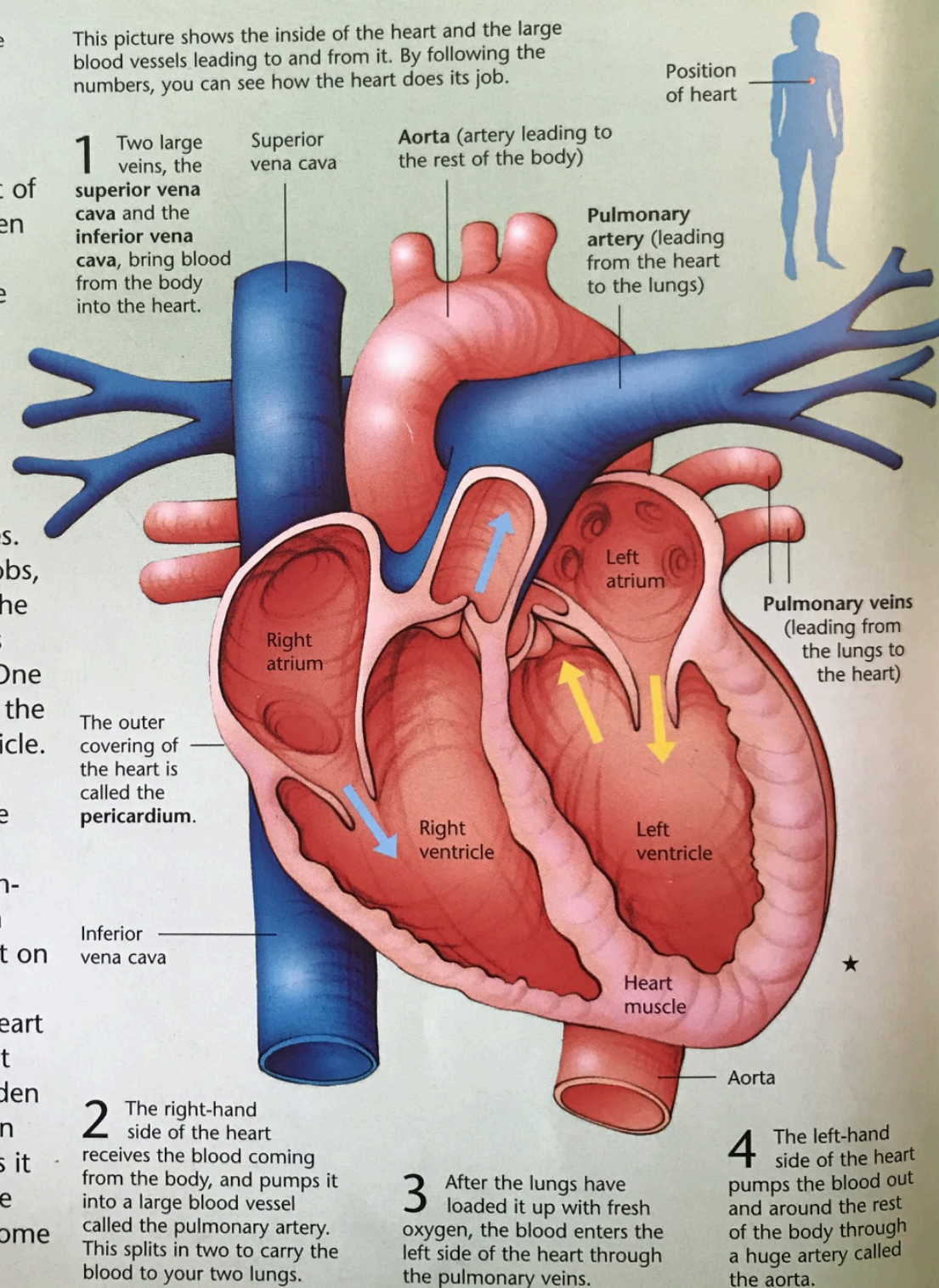
Your heart is in the front of your chest. It sits between the lungs, and in most people it's slightly to the left side of the body. It's covered with a skin called the pericardium.

Heart halves

The heart has two halves. They do two different jobs, although they work in the same way. Each half has two hollow chambers. One is called the atrium and the other is called the ventricle.

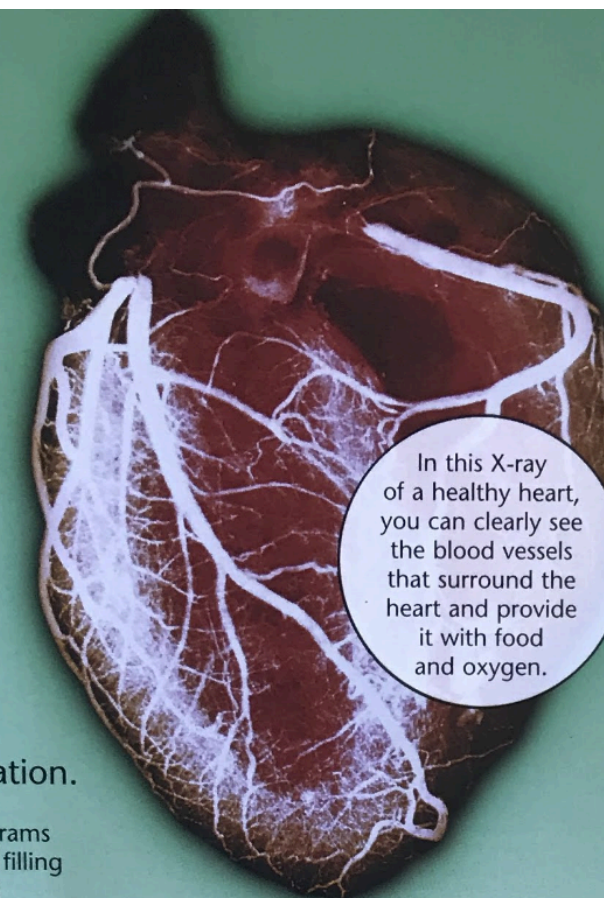
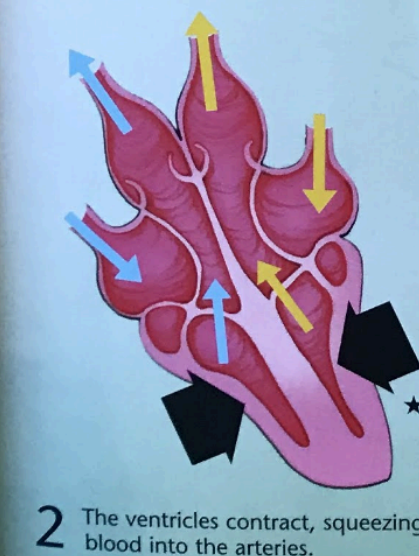
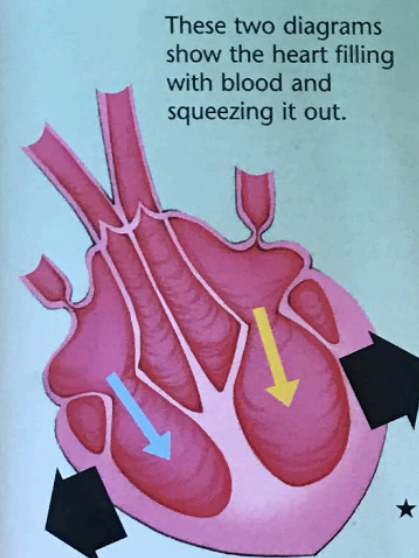
The atrium and ventricle on the left side of your heart fill up with oxygen-rich blood coming from your lungs, and pump it on around your body. The right half of your heart does the opposite job. It fills with used blood, laden down with waste carbon dioxide gas, and pumps it back to your lungs to be cleaned up and given some more oxygen.

This picture shows the inside of the heart and the large blood vessels leading to and from it. By following the numbers, you can see how the heart does its job.



Powerful pump

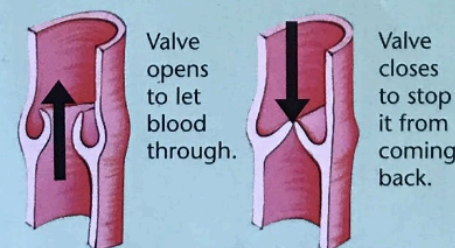
But how does the heart actually do its pumping? As the heart is a muscle, it works by contracting (getting smaller) and relaxing. Each time a chamber in the heart relaxes, it opens and fills up with a new supply of blood. Each time it contracts, the blood is squeezed out and towards its destination.



In this X-ray of a healthy heart, you can clearly see the blood vessels that surround the heart and provide it with food and oxygen.

Flapping valves

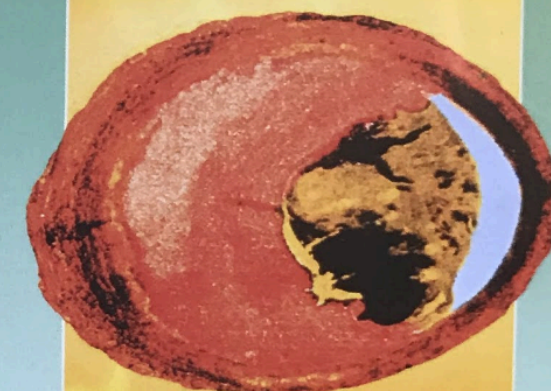
Your heart has four valves to make sure that when the heart muscle squeezes, the blood goes the right way instead of going back where it came from. Each valve is made of a set of flaps which only open in one direction. If blood tries to move in the other direction, they flap shut.



This flapping makes a "lub-dup" sound – your heartbeat. The "lub" is made by the two big valves in the middle of the heart. The sharper "dup" is made by the two smaller valves at the top of the heart.

GOING WRONG: Heart attack

The heart has blood vessels all around it. They deliver the food and oxygen the heart needs in order to work. A heart attack happens if one of these blood vessels is blocked by a blood clot (a hard lump of blood). If the blockage is big, your heart runs out of fuel and stops working.



This is a cross section of a heart artery containing a build-up of fat. This makes a heart attack more likely, as a blood clot could easily block the artery.

INTERNET LINK

For links to websites where you can see a heart pumping, hear heart sounds and find amazing heart facts, go to www.usborne-quicklinks.com

Emotions

Lots of people feel as if emotions come from the heart, even though they are really in the brain. This is because feelings like fear and excitement make your heart beat faster and make you breathe more quickly, in case you need extra oxygen to help you act quickly or run away.

Circulation

Circulation means going around and around – and that's what blood does inside your body. You have a network of thousands of kilometres of blood vessels reaching to every part of your body, so that your blood can carry oxygen and food to every single cell.

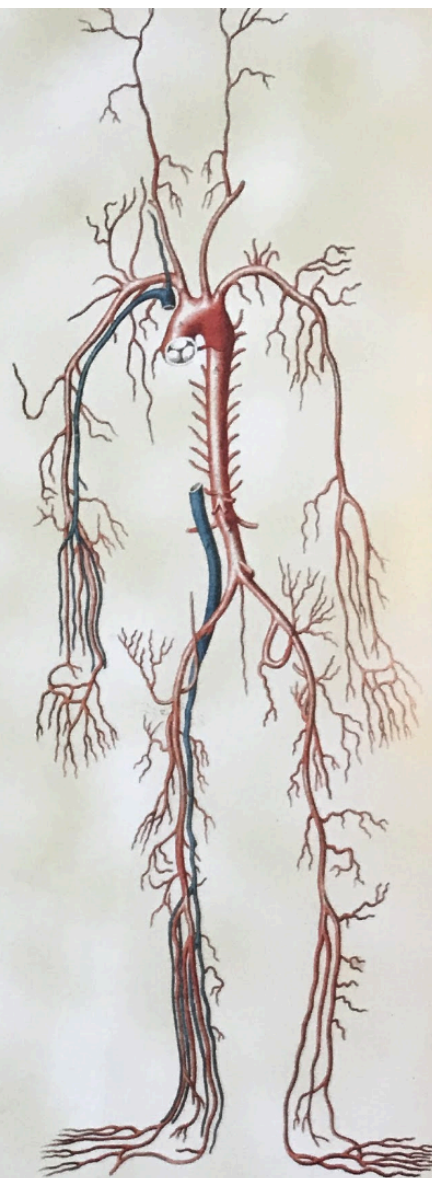
Delivery system

As well as taking food and oxygen to your cells, blood carries all kinds of other things around your body. It visits your kidneys to drop off waste chemicals. It carries hormones, which give different parts of your body instructions, such as “grow some hair”. And if you take a drug, such as a painkiller, your blood will carry it to the right place. Whatever it's carrying, each blood cell only takes around 20 seconds to make its deliveries and travel back to the heart.

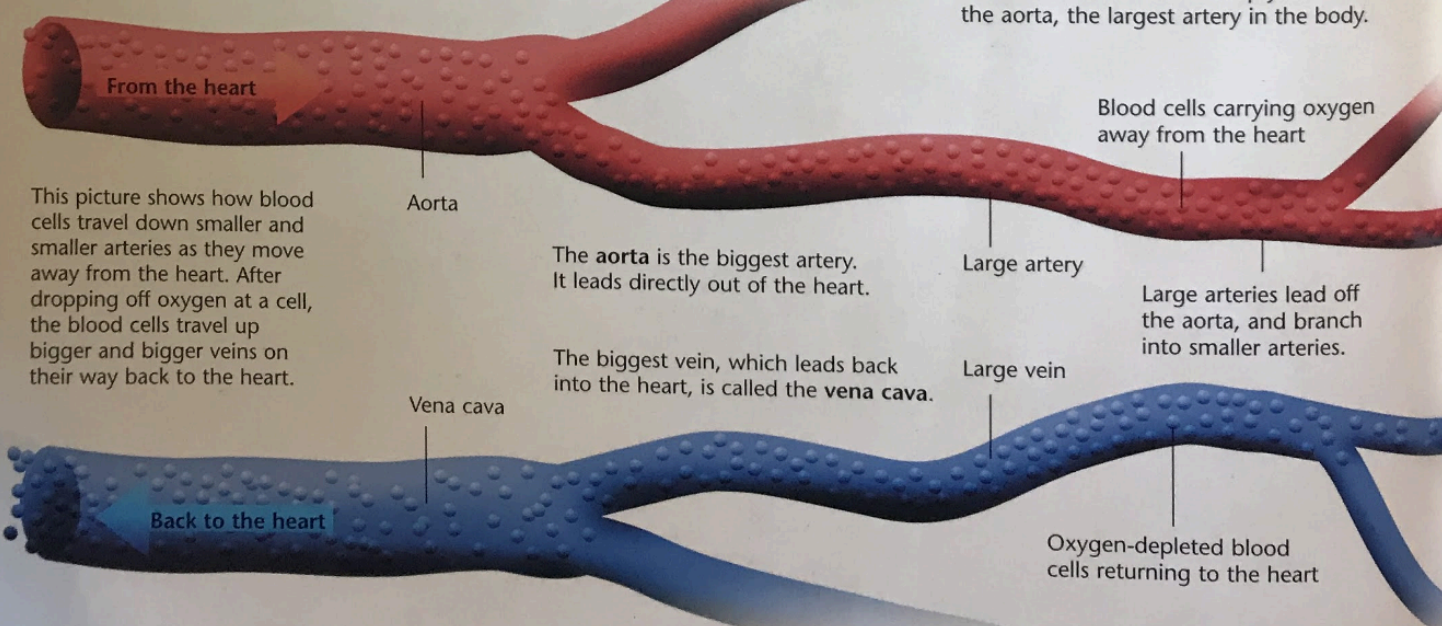
Blood vessels

Blood vessels are the tubes that blood travels along. There are two main types: arteries and veins. Arteries carry blood away from your heart to its destination somewhere in your body. Veins carry blood back to the heart.

In pictures, arteries are usually red and veins are blue. This is because the oxygen-rich blood in arteries is redder. The blood in your veins has had its oxygen used up, and this gives it a darker, purplish colour.



This drawing, dating from 1837, shows some of the body's main arteries and a few of the veins. Near the top you can see the aorta, the largest artery in the body.



BODY SCIENCE: Feeling a pulse

Every time your heart beats, or contracts, arteries all over your body swell slightly as blood surges through them. You can feel this surge, or pulse, at several points in your body, such as your wrist.



A friend can feel your pulse by pressing his or her fingers on your wrist, just below your thumb.

INTERNET LINK

For a link to a website where you can watch a movie about the circulation of the blood, go to www.usborne-quicklinks.com

The handover

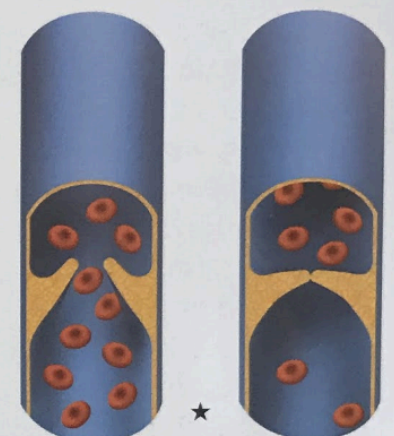
After leaving your heart, your blood ends up in a network of tiny blood vessels called capillaries, which lie between your cells. The blood travels along the capillaries, releasing oxygen, food and other chemicals, which float out of the capillary walls and into the cells. Waste chemicals from the cells float the other way, out of the cells and back into the blood.



This microscope photo shows blood cells inside a capillary. The capillary is only one or two blood cells wide.

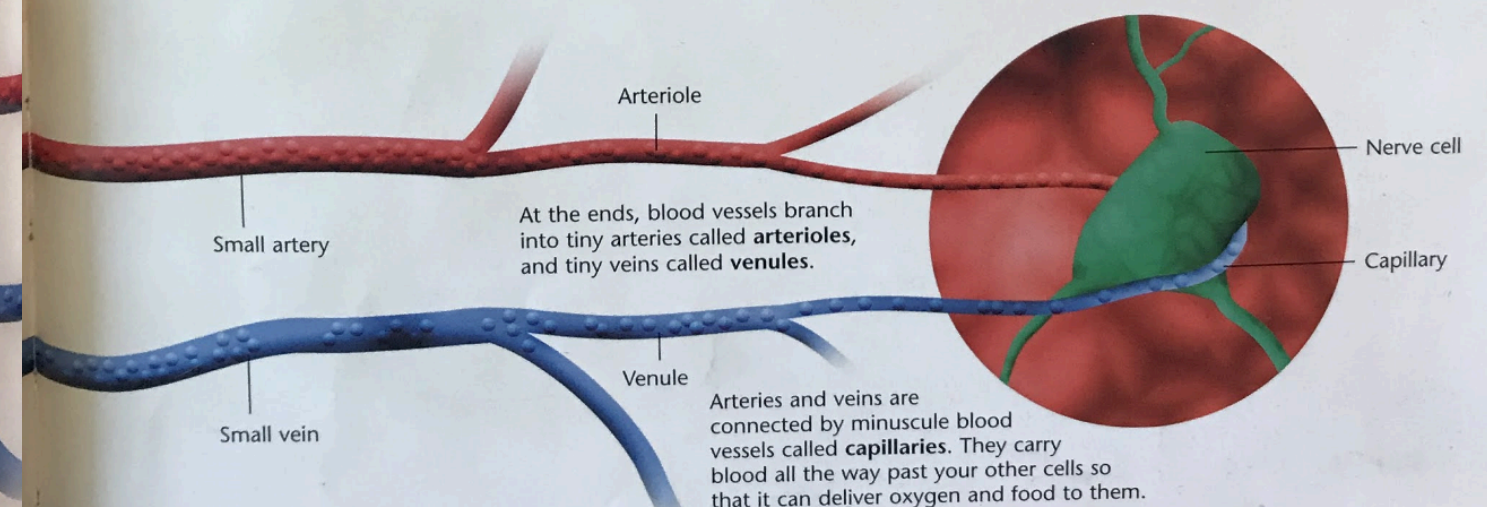
Up the hill

On its way back to the heart, your blood can have a tough job fighting the force of gravity. Even though your heart is still pumping it onwards, blood starts to slow down as it makes its way up the veins in your legs and arms. To help it along, veins have valves in them, similar to the valves in your heart. With each heartbeat, the valves open to let blood through, then close to stop it from slipping back down.



Vein valve opens to let blood move uphill on its way back to your heart.

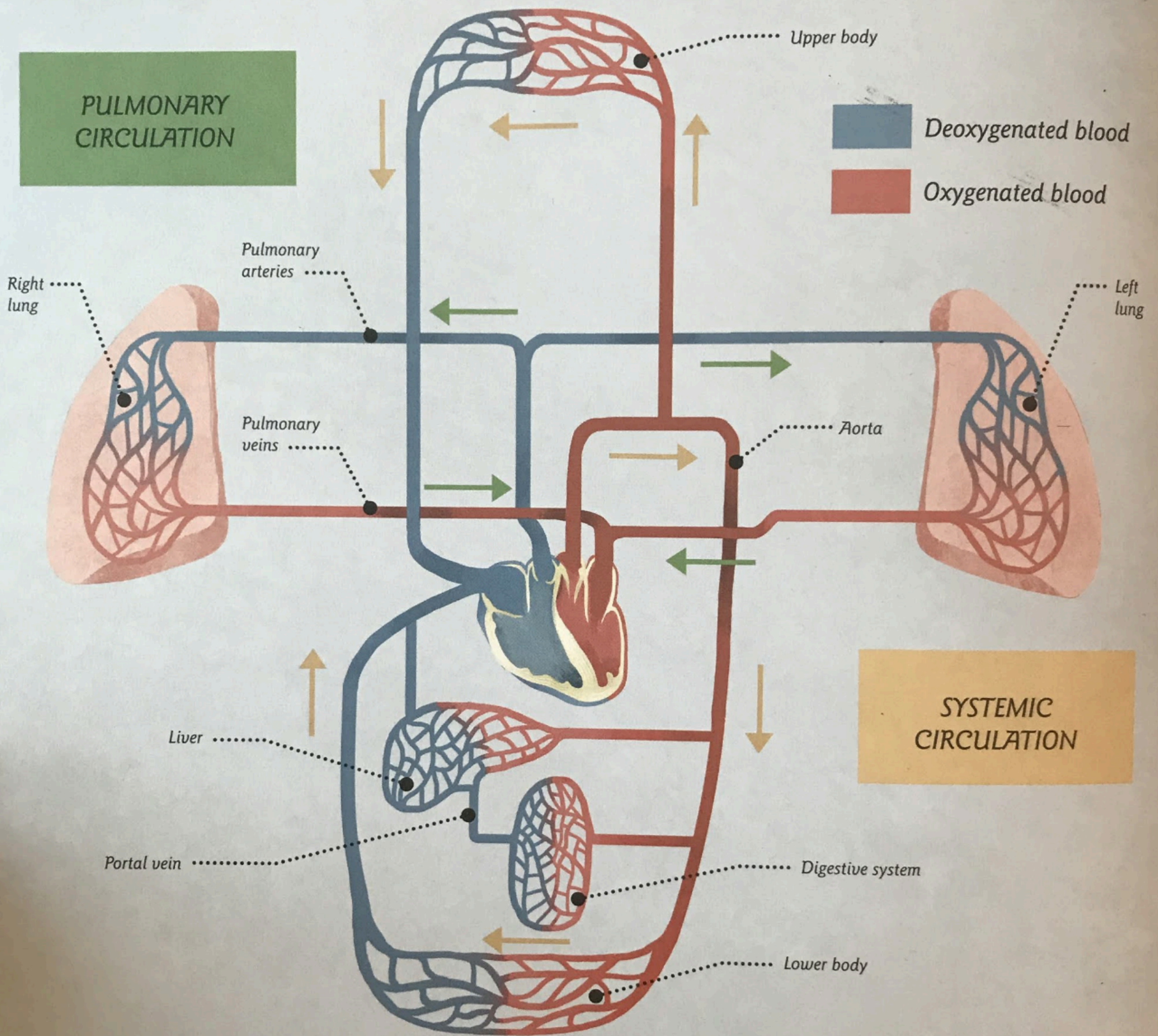
Vein valve closes to stop blood from being pulled back down by gravity.



SIX

Circulatory system

Your body's circulatory system keeps blood, oxygen and nutrients flowing.



The two halves of your circulatory system

Your circulatory system uses two different paths of blood circulation:

The **pulmonary circuit** takes blood from your heart to your lungs where oxygen is added before the blood is sent back to your heart.

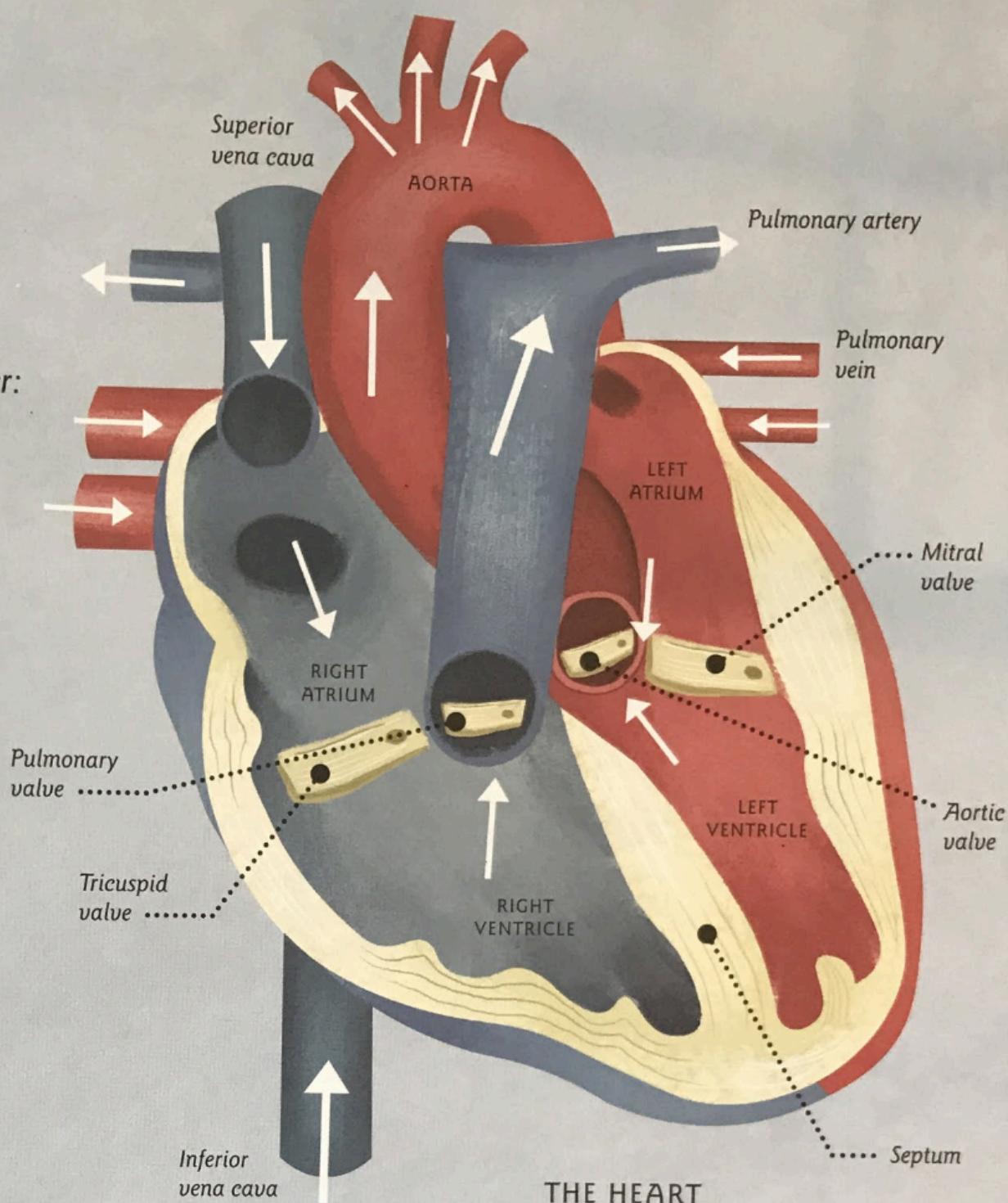
The **systemic circuit** takes oxygenated blood away from your heart and delivers it all around your body before returning it to your heart with its oxygen removed.

What is the heart and what is its job?

Your heart is a muscle the size of an apple that sits just to the left of the middle of your chest. Its job is to pump blood around your body. Blood supplies your body with oxygen and nutrients as well as getting rid of waste.

Your heart is like two pumps working together:

- The right side of your heart takes blood from your body and pumps it to your lungs where it picks up the oxygen that it needs.
- Then the left side of your heart takes the oxygenated blood from the lungs and pumps it to the rest of the body that needs the oxygen.
- Each side of your heart has an atrium (at the top) and a ventricle (at the bottom). When your heart beats, blood gets pushed from the atria into the ventricles on each side of the heart.
- There's a wall of muscle called the septum in between these two sides, which stops the two kinds of blood from mixing together.
- There are also four valves (which work like doors) in the heart. They have flaps that stop blood from flowing in the wrong direction.

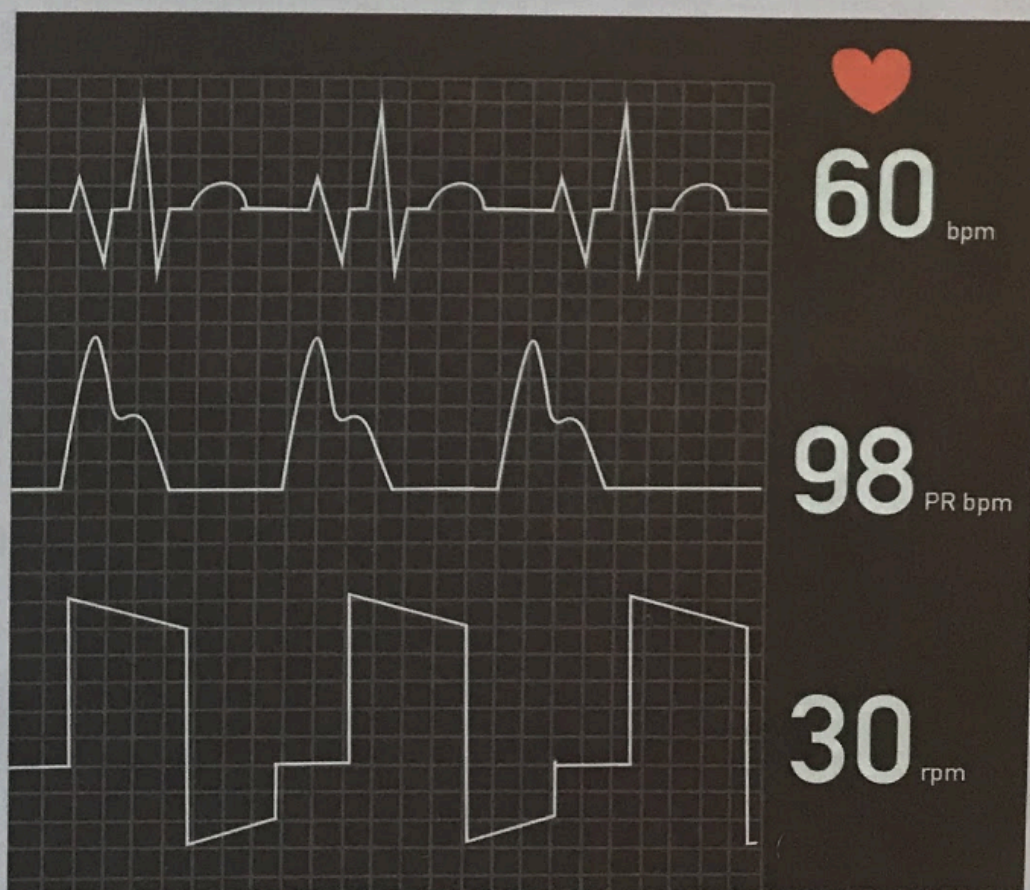


What makes my heart beat?

A clump of cells in the upper right-hand side of your heart (the right atrium), called the sinoatrial (or SA) node, fires electricity at a regular rate. This makes the walls of the atrium tighten and push blood into the ventricles and out to the rest of the body. This movement makes the heart beat.

Your heart rate

A normal heart rate is between 60 and 100 beats per minute, but sometimes very fit people like athletes have heart rates as low as 40 beats per minute. This is because their hearts get bigger and stronger and can pump more blood per heartbeat, so having fewer beats isn't a problem. But a low heart rate in non-athletes can be a sign of heart disease. A quick heart rate (over 100 beats per minute) can be a sign of exercise, stress or illness (your body raises your heart rate when it's trying to fight off sickness).



Engine room

At the centre of your circulatory system is your heart, a fist-sized powerful pump that beats every second. With every beat, your heart pushes about a cupful of blood around your body and refills in time for the next beat. Made from a special kind of muscle, your heart never gets tired.

INSIDE THE HEART

Your heart lies in the middle of your chest, sandwiched between your two lungs and protected by the ribcage. It has two sides, each with a smaller, upper space, the atrium, and a lower, larger one, the ventricle. The right side of your heart pumps blood to your lungs, while the left side receives blood from your lungs and pumps it to every part of your body.



SWAPPING HEARTS

Before the 1960s, heart transplants were thought impossible because of the high risk of death. But in 1967, history was made when a pioneering South African surgeon, Christiaan Barnard (centre), carried out the world's first successful heart transplant. He removed the damaged heart from his patient and replaced it with a healthy heart from a donor. Today, heart transplants are performed all the time.

Right side

Left side

▲ **VALVES** These open and close during each heartbeat to make sure that blood always flows in the right direction and never backwards.

Right atrium

Valve

Right ventricle

► **HEARTSTRINGS** These thin cords anchor the valve between each atrium and ventricle. When the heart beats, the heartstrings stop the valve turning inside out.

The inferior vena cava, your body's biggest vein, carries oxygen-poor blood from the lower body.

Blood races through this large artery, called the aorta, on its journey around your body.

The pulmonary artery is the only artery in your body that carries oxygen-poor blood.

WOW!

Each day, enough power is produced in the heart to drive a car 32 km (20 miles).

Blood from your lungs enters through these pulmonary veins.

Left atrium

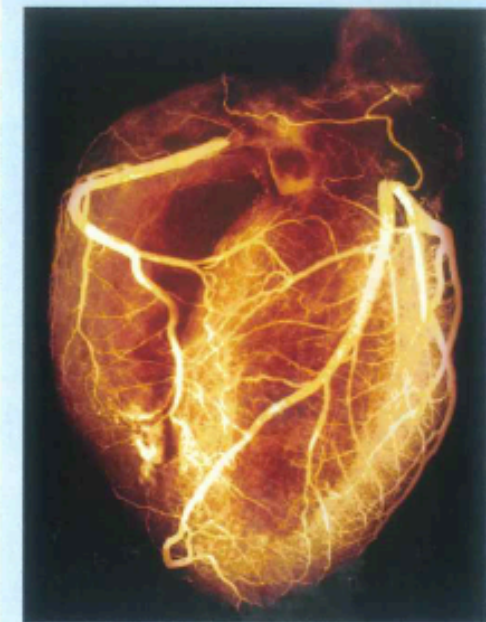
The left ventricle has a thicker muscular wall because it has to pump blood further than the right ventricle.

A wall of muscle divides the heart into right and left halves.

This tough double membrane surrounds and protects the heart.

LOOK CLOSER: BLOOD SUPPLY

Hard-working cardiac muscle cells demand constant supplies of food and oxygen to give them the energy needed to keep the heart beating. However, these cannot be supplied by the blood gushing through the heart. Instead, the heart has its own special network of blood vessels to supply its needs.



▲ **ANGIOGRAM** This special type of X-ray shows the main blood vessels, called coronary arteries, that supply the heart's muscular wall with blood.

◀ **CARDIAC MUSCLE** The thick walls of the heart are made with cardiac muscle cells (green). These are packed with mitochondria (red), which supply the heart's muscle cells with the energy they need to keep on beating.

FAST FACTS

- The first heart beat happens during the fourth week of pregnancy, when the baby is no bigger than the size of your fingernail.
- The heart is the first organ to receive oxygen-rich blood.
- On average, an adult heart beats about 70 times a minute, when at rest.