



False-colored SEM of a blood vessel (cross section).
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Overview of the Cardiovascular System

Center for
Educational Outreach
Baylor College of Medicine



Overview of the Cardiovascular System

Image Reference

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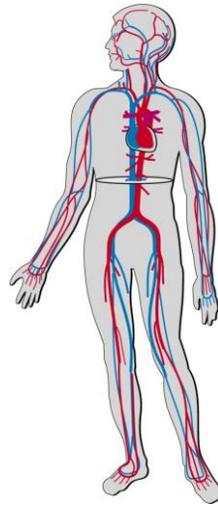
Key Words

cardiovascular system, human, circulation

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Major Components of the System

- The cardiovascular or circulatory system is made up of the heart, a network of blood vessels, and blood.
- Blood is moved along this transport network to service every cell in the body.
- Blood picks up oxygen and unloads carbon dioxide, transports nutrients and hormones, works as part of the immune system, and transports waste.



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Major Components of the System

The cardiovascular system (also known as the circulatory system) consists of the heart, a network of blood vessels, and blood. The pumping action of the heart transports blood throughout the body via this closed network of blood vessels.

One component of blood, the red blood cells (erythrocytes), picks up oxygen and unloads carbon dioxide (a waste product) in the lungs. The blood provides oxygen to each body cell and carries away carbon dioxide for removal by the lungs.

References

1. Circulation Station. National Library of Medicine, NIH.
<http://www.nlm.nih.gov/changingthefaceofmedicine/activities/circulatory.html>
2. Raven, P.H. (2005). *Biology, 7th Edition*. New York, NY: McGraw-Hill.

Image Reference

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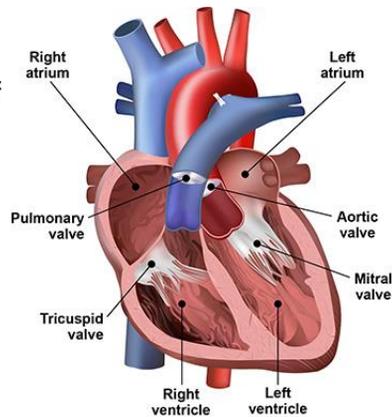
Key Words

cardiovascular system, human, circulation, blood vessels, blood, heart

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Heart

- Powerful pump that provides both systemic (body) and pulmonary (lung) circulation of blood.
- Consists of four chambers: two upper atria and two lower ventricles.
- Composed of cardiac muscle.
- Heartbeat (contraction) originates from a “pacemaker” located in the right atrium.



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Heart

The heart consists of four separate chambers; two smaller upper atria and two larger lower ventricles. The right atrium receives oxygen-depleted blood from the body and delivers it to the right ventricle, which pumps blood to the lungs to remove carbon dioxide and pick up oxygen. The left atrium receives this oxygenated blood and delivers it to the left ventricle, which pumps it to the rest of the body.

Both atria fill with blood and contract simultaneously, emptying their blood into the ventricles. Similarly, both ventricles contract at the same time, pushing blood into pulmonary vessels (to the lungs) and systemic vessels (to the body). One-way valves between the atria and ventricles, and between the ventricles and blood vessels, prevent blood from back up. The “pacemaker” (sinoatrial node) in the wall of the right atrium originates the heartbeat.

Reference:

Raven, P.H. (2005). *Biology, 7th Edition*. New York, NY: McGraw-Hill.

Image Reference

Illustration © Peter Junaldy. Licensed for use.

Key Words:

cardiovascular system, human, circulation, heart, atrium, ventricle, heartbeat, sinoatrial node

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Vessels: Arteries

- Arteries transport blood away from the heart.
- Arteries contain elastic fibers in their thick muscular walls.
- The main artery supplying blood to the body (aorta) branches into smaller and smaller vessels.
- The smallest arteries are called arterioles.

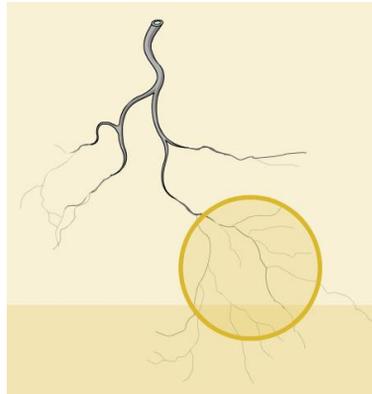


Illustration courtesy of the U.S. National Library of Medicine, NIH.

Vessles: Arteries

Blood leaves the heart through the arteries, which transport oxygen and nutrients to the body. Large arteries branch into smaller and smaller arteries as they travel throughout the body. The smallest arteries are called arterioles.

The walls of arteries are thicker than those in other blood vessels. They contain elastic fibers and smooth muscle that allow them to recoil each time they receive a volume of blood pumped by the heart. This creates what we refer to as a pulse.

Reference

Raven, P.H. (2005). *Biology, 7th Edition*. New York, NY: McGraw-Hill.

Image Reference

Circulation Station. Courtesy of the U.S. National Library of Medicine, NIH.
<http://www.nlm.nih.gov/changingthefaceofmedicine/activities/circulatory.html>

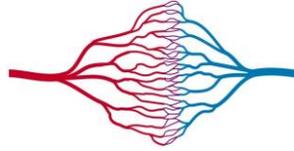
Key Words

cardiovascular system, human, circulation, blood vessels, blood, artery, aorta, heart

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Vessels: Capillaries

- Small arteries (arterioles) feed into the capillaries, very narrow vessels that contact individual cells directly.



- Capillary walls are very thin, allowing for easy exchange between cells and capillaries.
- Capillaries distribute oxygen and nutrients from the blood to the body cells.
- Capillaries also pick up carbon dioxide and waste products from the cells for removal from the body.



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Vessels: Capillaries

Arterioles become capillaries, which are only a single cell layer thick, allowing for easy exchange between capillaries and individual cells. Capillaries deliver oxygen and nutrients via red blood cells and carry carbon dioxide and other waste away.

Reference

Raven, P.H. (2005). *Biology, 7th Edition*. New York, NY: McGraw-Hill.

Image Reference

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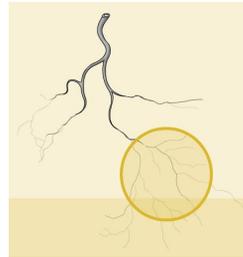
Key Words

cardiovascular system, human, circulation, blood vessels, blood, capillary, oxygen, carbon dioxide

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Vessels: Veins

- Blood flows from the capillaries to the small venules, then to larger veins, and ultimately, back to the heart.
- Blood is moved through the veins and back to the heart by:
 - Skeletal muscle activity near the veins, which squeezes the blood along.
 - One-way venous valves that keep blood from flowing backwards in response to gravity.



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Vessels: Veins

As blood begins its journey back to the heart, capillaries empty into very small venules, which lead to larger and larger veins. Eventually, blood arrives back at the heart through through very large vessels. Because veins have only a thin layer of smooth muscle, other mechanisms are needed to help propel blood to the heart. Skeletal muscles surrounding the veins contract during body movement and help move blood by squeezing the veins, which is called the venous pump. One-way valves in veins keep blood moving in the right direction and allow it to flow against gravity.

Reference

Raven, P.H. (2005). *Biology, 7th Edition*. New York, NY: McGraw-Hill.

Image References

Circulation Station. Courtesy of the U.S. National Library of Medicine, NIH.
<http://www.nlm.nih.gov/changingthefaceofmedicine/activities/circulatory.html>

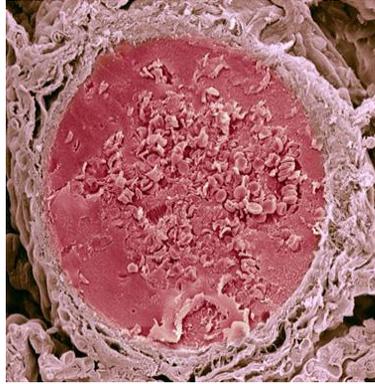
Key Words

cardiovascular system, human, circulation, blood vessel, blood, vein, venous pump, heartbeat

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Blood

- Blood is comprised of fluid plasma and three cell types produced by bone marrow. The first cell type is erythrocytes, or red blood cells.
- In the lungs, red blood cells are loaded with oxygen and unload carbon dioxide carried from body cells.
- Carbon dioxide is breathed out through the lungs.



SEM of a small blood vessel in alveoli within the lungs.



SEM © David Gregory and Debbie Marshall/Wellcome Images CC-BY-SA 4.0.

Blood

Plasma—the fluid portion of blood—is about 90% water. It contains blood cells, metabolites, platelets, hormones, waste products, ions, electrolytes and proteins.

Mature erythrocytes (red blood cells) have no nuclei. They contain a molecule, called hemoglobin, which facilitates oxygen transport. Erythrocytes pick up oxygen in the lungs and deliver it to body cells. While in the lungs, red blood cells rid themselves of carbon dioxide, which is disposed as we exhale. In humans, erythrocytes account for 45% of the total blood volume.

Reference

Raven, P.H. (2005). *Biology, 7th Edition*. New York, NY: McGraw-Hill.

Image References

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BY-NC-ND 4.0. <http://wellcomeimages.org/>

Key Words

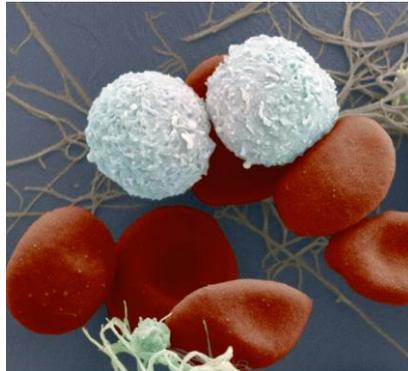
cardiovascular system, human, circulation, blood vessels, blood, erythrocyte, red blood cell, plasma

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Blood, cont.

The second two primary components of blood are:

- leukocytes (white blood cells), and
- platelets (pieces of a larger cell, megakaryocyte).



SEM of red blood cells, two white blood cells and a platelet (colored green).

Blood, cont.

Leukocytes (white blood cells) are larger than erythrocytes and have nuclei throughout their life. They provide defense against foreign invaders of the body and are a major part of our immune system.

Platelets are fragments of a larger cell in the bone marrow, the megakaryocyte. They function in blood clotting, accumulating at an injury site to form a plug by sticking to each other and surrounding tissues.

Reference

Raven, P.H. (2005). *Biology, 7th Edition*. New York, NY: McGraw-Hill.

Image References

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Key Words

cardiovascular system, human, circulation, blood vessels, blood, leukocyte, white blood cell, platelet

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Functions of the System

- Transportation:
 - Carbon dioxide and oxygen
 - Nutrients and enzymes
 - Waste products
 - Hormones
- Regulation:
 - Blood pH
 - Body temperature
 - Water balance
- Protection:
 - Blood clotting
 - Immune system for defense



Functions of the System

All substances essential for cellular metabolism are transported by the cardiovascular system. Erythrocytes transport oxygen to tissue cells and remove carbon dioxide. The digestive system breaks down food into nutrient molecules that are absorbed through the intestinal wall into the blood vessels. Blood then carries these nutrients to all of the body cells. Enzymes necessary for body metabolism are released by the liver and carried by blood vessels to areas where they are needed. Metabolic waste created by the cells is filtered through capillaries of the kidneys and excreted in urine. The blood also carries hormones from the endocrine glands to distant target organs.

The cardiovascular system helps to maintain the blood's pH level to allow necessary functions to proceed optimally.

In addition, the cardiovascular system regulates small changes in body temperature via blood vessels located just under the epidermis. When the ambient temperature is cold, superficial blood vessels constrict (close down) to divert warm blood to deeper vessels and prevent body heat loss. When the ambient temperature is warm, superficial vessels dilate (open up) so the

warmth of the blood can be dissipated by radiation.

Excess water retained by the body is filtered through capillaries of the kidneys and excreted as urine. If the body is dehydrated, this filtering is restricted to keep the body hydrated.

Blood's clotting mechanism protects against blood loss when vessels are damaged.

Leukocytes (white blood cells) provide protection against many disease-causing agents.

References

1. Circulation Station. National Library of Medicine, NIH.
<http://www.nlm.nih.gov/changingthefaceofmedicine/activities/circulatory.html>
2. Raven, P.H. (2005). *Biology, 7th Edition*. New York, NY: McGraw-Hill.

Key Words

cardiovascular system, human, circulation, blood vessel, blood, oxygen, carbon dioxide, nutrient, waste, hormone, regulation, protection, blood clot

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