Cardiovascular Anatomy and Physiology

A PowerPoint presentation (no narration) can be accessed by clicking here. Viewers without PowerPoint software can view the information in pdf format by clicking here.

The term "cardiovascular" refers to the heart ("cardio") and the blood vessels ("vascular") within the body. The heart is a muscular organ that pumps blood to the body's tissues. The blood travels through a network of blood vessels on its way to the body's tissues, and also travels through other blood vessels on its way back to the heart. For a better understanding of cardiovascular disease, you should have a working knowledge of basic cardiovascular anatomy and physiology, including the heart and the basic blood vessels.

Arteries
These blood vessels bring blood away from the heart to the rest of the body. Most often, arteries contain oxygen-rich blood pumped from the heart to the body's tissues needing that blood. The exception would be in the pulmonary (lungs) system, where arteries leading away from the heart are delivering oxygen-poor blood to the lungs. At the lungs the blood is refreshed with oxygen, where it is then delivered to the heart and pumped to throughout the body.

Below see a simple image of an artery sliced in half. You can see the walls of the vessel are quite thick and muscular. Arteries must be strong to move blood away from the heart and through the rest of the body.

The above image originates from the University of Minnesota's (UM's) Image Library. Per UM, the image is free to be used for educational purposes.

The below websites provide additional optional (O) resources to view:

- **What is an Artery?** Read artery information at About.com
- **Arteries Tutorial** (GetBodySmart.com)
- **Arteries** (Loyola University's Stritch School of Medicine; click on the region of the body, which will then show you an illustration of arteries in that region. Click on the numbers next to the arteries if you want to see the arterial names)
- **Artery photo**: A SENSITIVE photo of "real" heart arteries, taken by "Anatomist90," via Wikimedia Commons

As arteries move away from the heart toward the rest of the body, they branch into smaller vessels called arterioles. These arterioles will continue to branch off, becoming smaller and smaller. They will eventually become capillaries.

Capillaries
Capillaries are a tremendous network of tiny blood vessels connecting the arterial system (arteries) to the venous system (veins). As arteries lead away from the heart, they become smaller arterioles, then divide into
even smaller vessels called capillaries. The capillaries deliver oxygenated blood and nutrients to the body's tissues. Capillaries are also responsible for taking de-oxygenated blood with carbon dioxide out of the body's tissues and begin merging into larger vessels, the venules, which will eventually lead into veins. Below are links with information about capillaries; at least one link is required, but viewing more than one is recommended for understanding:

- **Capillaries**: the BBC provides an illustration showing how these blood vessels are connected. (R)
- Great Pacific Media produced a video describing capillary function (O, via YouTube--first 2.5 minutes)
- What is a Capillary Read artery information at About.com (O)
- Khan Academy features a video describing three types of capillaries (O, via YouTube, nine minutes)

Below you will see an image of a capillary. Notice the vessel is only one or more cells thick, a requirement in order for oxygen and carbon dioxide to be exchanged easily between the blood and the body's tissues.

![Capillary Image](https://example.com/capillary.png)

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**Veins**

Veins are vessels that bring blood away from the body's tissues to the heart. Capillaries are responsible for delivering oxygen-rich blood to the body's tissues and also accept the oxygen-poor blood in return. After accepting the oxygen-poor blood from the body's tissues the capillaries will begin to merge, becoming larger blood vessels called venules. The venules will also merge, becoming larger blood vessels called veins. Although most veins contain blood that is low in oxygen and high in carbon dioxide, there are some exceptions. In the pulmonary (lungs) system, veins deliver oxygen-rich blood from the lungs to the heart.

Below you will see an image of a vein. Notice the vessel contains valves. This is because by the time blood reaches the veins the pressure moving that blood is quite low. The valves are in place to minimize the back-up of blood in the body's tissue.

![Vein Image](https://example.com/vein.png)

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The below websites are optional for an image and additional information about veins (O):

- **Vein photo**: This is a SENSITIVE photo of a "real" vein, the subclavian vein, located at Dr. David Frankhauser's website
Heart
The heart muscle, when contracting, delivers oxygen-rich blood originating from the lungs to the rest of the body while it simultaneously delivers oxygen-low blood from the body to the lungs. The body needs oxygen-rich blood to move, to think, and to perform other basic tasks. When the body takes in the oxygen from the new blood delivery, it returns waste products to the circulation for removal. Below you will see an image of the heart. The arrows show the directions of blood flow moving both away from and to the heart.

The heart has two types of compartments, atria (singular: atrium) and ventricles. The atria are the upper chambers in the heart, ventricles are the lower chambers. Visit the National Library of Medicine to view the four heart's chambers (R). In the picture you may notice the left and right sides seem incorrectly labeled. The heart's left and right sides, however, are identified from the perspective of being inside the body rather than looking at the heart from outside the body.

The heart's left and right sides are divided in half by a structure called the septum. The heart can be thought of as two separate pumps, as the septum divides the left and right sides, and each side of the heart contracts at about the same time. Please see the image at right to view how one half of the heart pumps oxygenated blood (red) while the other pumps deoxygenated blood (blue).

Oxygenated blood from the heart's left side is pumped out to the body via the aorta while the right side pumps deoxygenated blood via the pulmonary artery to the lungs. Since both pumps operate at the same time, when the heart contracts, blood moves from the ventricles to both the body and the lungs--so, the heart is simultaneously pumping "fresh" blood to the body while returning "old" blood to the lungs for waste elimination. When the heart relaxes, deoxygenated blood is moved from the body to the heart via the vena cava.
while oxygenated blood moves from the lungs to the heart via the **pulmonary vein**. The atria fill up with blood. The process is then repeated.

To familiarize yourself with the blood flow, visit at least one of the below websites (R):

- [Cengage.com](http://cengage.com) provides a step-by-step animation and narration describing blood circulation (click on "start animation")
- PBS' NOVA On-Line "Cut to the Heart" site, offers a [map of the heart](http://www.pbs.org/wgbh/nova/), which breaks down blood flow through the heart into six steps
- KScience has its own [animation](http://www.kscience.com) of how blood flows through the heart.
- Sumanasinc.com shows [blood flow](http://www.sumanasinc.com) in an illustrated, narrated slide presentation. Each slide progressed by clicking on the appropriate number below the illustration. Audio begins when the "play" button is clicked.
- A blood flow [media](http://www.media.com) presentation is provided by the American Heart Association and the American Stroke Association
- Khan Academy provides an 8-minute [video](http://www.khanacademy.com) tutorial on blood flow through the heart
- YouTube features an animation on the [circulatory system](http://www.youtube.com)
- For images of the atria, ventricles, aorta, pulmonary artery, vena cava and pulmonary vein, visit the Texas Heart Institute, [non-Flash version](http://www.txinstitute.org) or [Flash version](http://www.txinstitute.org) from the "Project Heart" kids-based web version: the heart structures are identified by hovering the mouse over the various parts of the heart