The Process of Pumping Blood Throughout the Human Body
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What is the Circulatory System?
The circulatory system, otherwise known as the cardiovascular system, is a vital organ system for all macroorganisms and is responsible for supplying an organism’s tissues with oxygen and other key nutrients. All vertebrates, along with cephalopods (e.g. octopi) and annelids (e.g. earthworms) have closed circulatory systems. A closed circulatory system refers to a network of vessels that funnel blood to and away from the heart in order to oxygenate all the cells in the body.

Humans are vertebrates and therefore have a closed circulatory system with a highly developed four-chambered heart. The heart is controlled by electrical impulses that are produced by the sinoatrial node, which controls the atria and the atrioventricular node, which controls the ventricles. The heart is separated into the right atrium, right ventricle, left atrium and left ventricle. Arteries carry blood away from the heart to arterioles followed by capillaries. Blood is sent back towards the heart through venules and finally through veins before emptying into the heart. This document focuses on the process of transporting blood throughout the body and the steps taken along the way for our body to replenish oxygen levels and expel built up waste.

The Steps of Blood Circulation
(Refer to Figure 1. for steps 1-11)

Step 1. Deoxygenated blood collects in the right ventricle of the heart reaching about 120 mL. An electrical impulse is sent from the atrioventricular node to the base of the heart and causes the heart muscle to contract, pumping the blood through the pulmonary semilunar valve.

Step 2. The blood enters the pulmonary artery en route to the lungs to be oxygenated.

Figure 1. The Human Circulatory System:
The arrows represent the flow of blood. Red represents oxygenated blood and blue represents deoxygenated blood.¹

¹ Figure 1 from http://www.rudyard.org/wp-content/uploads/2014/06/human-circulatory-system-function.png
**Step 3.** Once the blood enters the lungs it is sent through capillaries that line the alveoli (refer to Figure 2.). Alveoli are the small gas exchanging sacs of the lungs. Deoxygenated blood enters, expelling CO₂ and absorbing O₂.

**Step 4.** The newly oxygenated blood travels through the pulmonary veins and back to the heart where the blood is emptied into the left atrium. The left atrium funnels blood through the left AV valve, or bicuspid valve as it is also called, into the left ventricle.

**Step 5.** The left ventricle begins to fill with blood and eventually the atrium contracts to completely fill the ventricle. The pressure within the ventricle is now much greater than the pressure within the atrium and the blood tries to flow backwards. To stop the reverse flow of blood the bicuspid valve slams shut and the blood smacks against the newly closed valve. The sudden stop creates a sound; it is commonly known as the “lub” sound. The heart has two distinct sounds that are marked as the “lub-dub” sounds and are the main noises heard when listening to a person’s heart beat. The pressure built up in the left ventricle causes it to be expelled out of the left ventricle through the aortic valve.

**Step 6.** The pressure in the aorta is now higher than that of the left ventricle, which creates the same situation seen earlier in the left ventricle. The blood tries to move to the lower pressure area, the left ventricle, and is stopped by the aortic valve. The sudden stop creates the last sound of the heart, the “dub” sound. The blood is then forced through the aorta to the upper and lower extremities of the body. The aorta is the largest artery in the human body and supplies the entire body, except for the lungs, with oxygen rich blood. Blood flows out of the aorta at about 30 cm/sec. This high-speed blood flow slows as the blood moves through smaller and smaller vessels. The aorta becomes smaller arteries that then branch into arterioles and eventually become capillaries.

**Step 7 and 8.** The smallest units of blood vessels in the body are the capillaries. Capillaries have a single layer of cells that make up the lining of these very small tubes. The thin walls of the capillaries allow for easy transport of compounds between the blood and the cells of our tissues. Oxygen, water and key compounds for proper cellular function are released from the blood. Waste products produced by the cells, including carbon dioxide and nitrogenous wastes, are absorbed by the blood to be expelled from the body (depicted in Figure 3.)

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2 Figure 2 from [http://rrapid.leeds.ac.uk/ebook/assets/images/illustrations/alveolus-with-corpuscles.jpg](http://rrapid.leeds.ac.uk/ebook/assets/images/illustrations/alveolus-with-corpuscles.jpg)
Step 9 and 10. The blood leaving the capillaries is now deoxygenated. The blood travels through venules to the veins of the body and eventually reaches the anterior and posterior vena cava. The anterior vena cava receives all the blood from the upper extremities and the posterior vena cava receives the blood from the lower portion of the body, but it all ends up getting funneled into the right atrium of the heart.

Step 11. The blood enters the right atrium and begins to collect. The right AV valve, also called the tricuspid valve, is open while the blood is collecting and allows blood to fill the right ventricle. An electrical impulse is sent from the sinoatrial node through the right atrium to the atrioventricular node, causing the right atrium to contract and fill the right ventricle. Ending the process of blood flow throughout the body.

Summary of Circulatory Blood Flow

Blood begins in the right ventricle and is pumped to the lungs through the pulmonary artery. The blood is oxygenated in the lungs and sent through the pulmonary vein into the left atrium of the heart. The left atrium passes blood into the left ventricle and the heart contracts sending blood through the aorta to all the tissues of the body. Once in the capillaries of the tissues the blood releases key compounds and absorbs waste. The blood then flows through veins to the vena cava and form there the blood is emptied into the right atrium of the heart. The blood completes the cycle by being emptied into the right ventricle of the heart.

3 Figure 3 from http://miracleofthebloodandheart.imanisiteler.com/4_clip_image006_0000.jpg