How does oxygen get into the blood?

The main function of the circulatory system is to pump blood carrying oxygen around the body. But how does that oxygen get into the blood in the first place? You may already know that this occurs in the lungs. So the blood must also be pumped to the lungs, and this happens separately from the circulation to the rest of the body.

**Pulmonary and Systemic Circulations**

The double circulatory system of blood flow refers to the separate systems of pulmonary circulation and systemic circulation in amphibians, birds, and mammals (including humans). The adult human heart consists of two separated pumps: the right side, which pumps deoxygenated blood into the pulmonary circulation, and the left side, which pumps oxygenated blood into the systemic circulation. Blood in one circuit has to go through the heart to enter the other circuit, as shown in Figure 1.1.

**Pulmonary Circulation**

The *pulmonary circulation* is the portion of the cardiovascular system that carries oxygen-poor (deoxygenated) blood from the heart to the lungs and returns oxygenated blood back to the heart. As shown in Figure 1.2, deoxygenated blood from the body leaves the right ventricle through the pulmonary arteries, which carry the blood to each lung. The pulmonary arteries are the only arteries that carry deoxygenated blood. In the lungs, red blood cells release carbon dioxide and pick up oxygen during respiration. The oxygenated blood then leaves the lungs
through the pulmonary veins, which return it to the left side of the heart and complete the pulmonary cycle. The oxygenated blood is then distributed to the body through the systemic circulation before returning again to the pulmonary circulation.

The pulmonary circulation was first discovered by a Syrian physician, Ibn al-Nafis, in 1242. However, credit for the first description of blood circulation is given to an English medical doctor, William Harvey, who described in detail the pulmonary and systemic circulation systems in 1616.
Systemic Circulation

The **systemic circulation** is the portion of the cardiovascular system that carries oxygenated blood from the heart to the body and returns deoxygenated blood back to the heart. Oxygenated blood from the lungs leaves the left ventricle through the aorta. From here it is distributed to the body’s organs and tissues, which absorb the oxygen through a complex network of arteries, arterioles, and capillaries. The deoxygenated blood is then collected by venules and flows into veins before reaching the inferior and superior venae cavae, which return it to the right heart, completing the systemic cycle (see **Figure 1.3**). The blood is then re-oxygenated through the pulmonary circulation before returning again to the systemic circulation.

Just like every other organ in the body, the heart needs its own blood supply, which it gets through the **coronary circulation**. Although blood fills the chambers of the heart, the heart muscle tissue is so thick that it needs blood vessels to deliver oxygen and nutrients deep within it. The vessels that deliver oxygen-rich blood to the heart muscle are called coronary arteries; they branch directly from the aorta, just above the heart, as shown in **Figure 1.4**. The vessels that remove the deoxygenated blood from the heart muscle are known as cardiac veins.
Portal Venous System

A portal venous system occurs when a capillary bed drains into another capillary bed through veins. They are relatively uncommon, as the majority of capillary beds drain into the heart, not into another capillary bed. Portal venous systems are considered venous because the blood vessels that join the two capillary beds are either veins or venules.

An example of a portal venous system is the blood vessel network between the digestive tract and the liver. The hepatic portal system is responsible for directing blood from parts of the gastrointestinal tract to the liver. Nutrients that have been absorbed into the blood from the small intestine are taken to the liver for processing before being sent to the heart. The term "portal venous system" often refers to the hepatic portal system.
Summary

- The pulmonary circulation is the portion that brings blood to the lungs and back.
- The systemic circulation is the portion that brings oxygenated blood to the rest of the body.
- The heart gets its own supply of blood through the coronary circulation. Coronary arteries deliver oxygenated blood from the aorta to the heart. Cardiac veins remove deoxygenated blood from the heart.
- Portal venous systems involve a system where capillary beds are connected to other capillary beds through veins.

Review

1. What does the double circulatory system refer to?
2. What is the difference between pulmonary circulation and systemic circulation?
3. Why does the heart need its own blood supply if it is filled with blood?
4. Give an example of a portal venous system in the human body.

References

2. Mariana Ruiz Villarreal (LadyofHats) for CK-12 Foundation. CK-12 . CC BY-NC 3.0
3. Mariana Ruiz Villarreal (LadyofHats) for CK-12 Foundation. CK-12 Foundation . CC-BY-NC 3.0