

Subject code:	Bio1	Fundamentals of Biology
Learning Guide Code:	3.0	Transport and Circulation of Materials
Lesson Code:	3.4	Pathways of Blood in the Body
Time Limit:		30 minutes (1 session)



MATERIALS

To complete this module, you need the following:

1. pen and paper
2. phone/tablet/laptop
3. stable internet connection



TARGET (1 min)

At the end of this module, you should be able to trace various pathways of the blood in the cardiovascular system which includes the systemic, pulmonary and cardiac circulation.



HOOK (2 mins)

We will be discussing circulation in this chapter and the processes that comprise the whole mechanism by which nutrients are transported throughout the body. But another molecule that is transported throughout the body is oxygen, which is important in the production of energy in cells. Watch the video below and learn more about the extraordinary journey of oxygen as it travels from the atmosphere down to every cell in our being! *Note: You are not required to access the link.*



WATCH!
https://www.youtube.com/watch?v=GVU_zANtroE

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IGNITE (18 mins)

The heart contracts and relaxes rhythmically in a cycle called the **cardiac cycle**. When the heart contracts, it is able to pump blood, while relaxation allows the heart to be filled with blood. These alternating actions allow the blood to move in and out of the heart as shown Figure 1.

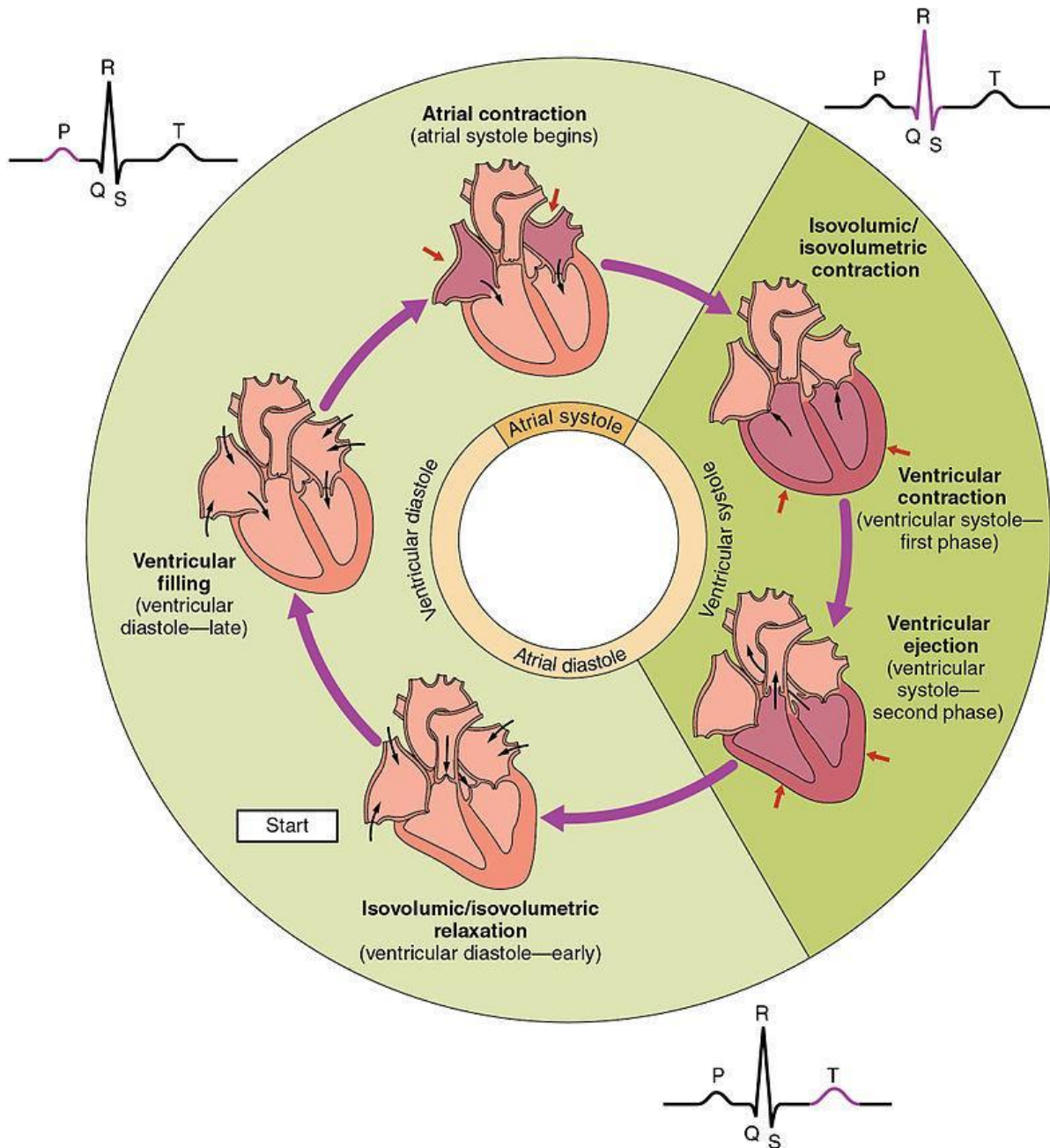


Figure 1. The Cardiac Cycle

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Examine the image above and correlate the action of the heart to the waves shown in an electrocardiogram.

The circulatory system runs in two paths: the **systemic** and the **pulmonary** circuit. The pulmonary circulation is responsible for supplying the blood with oxygen while the systemic circulation allows oxygenated blood to be supplied around the body and deoxygenated blood back to the heart to be supplied with oxygen by the pulmonary circuit. These two create a continuous flow of blood around the body. Before we start with the process of circulation, familiarize yourself with the different parts of the heart and the blood vessels immediately attached to it as shown in Figure 2.

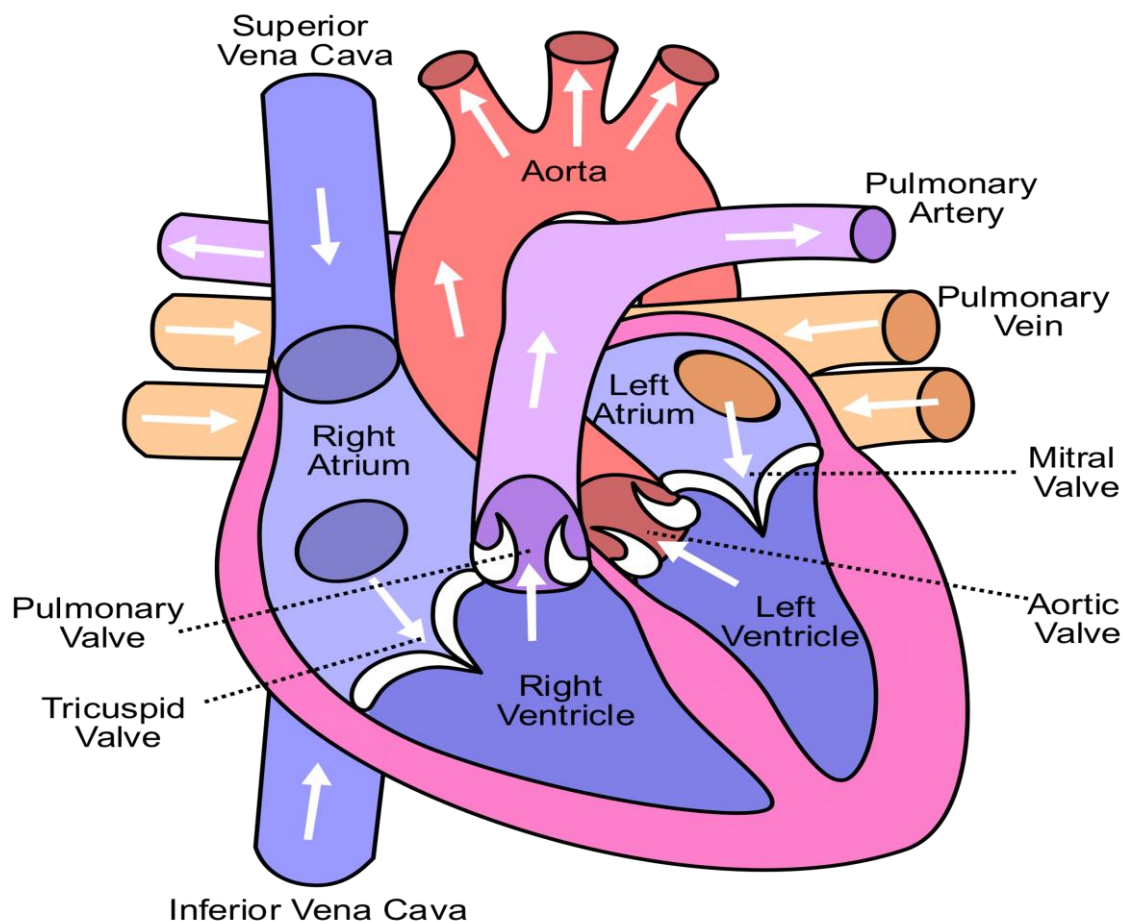


Figure 2. The Flow of Blood Inside the Heart.

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Pulmonary Circulation

This circulation involves the **movement of blood from the heart to the lungs and back to the heart again**. Deoxygenated blood leaves the systemic circuit when it enters the right atrium of the heart through the two large veins namely the superior and inferior vena cava. From the right atrium, the blood flows to the right ventricle as the tricuspid valve opens during ventricular relaxation (or diastole). The right ventricle then pumps the blood through the pulmonary valve, into the pulmonary artery. This artery split into two branches—the left and right pulmonary arteries traveling to each of the lungs.

The blood then traverses the capillary beds of the **lung's alveoli** where exchange of gas occurs. Gas exchange would occur because of the gradient pressure across the air sacs of the lungs and the capillaries around the alveoli.

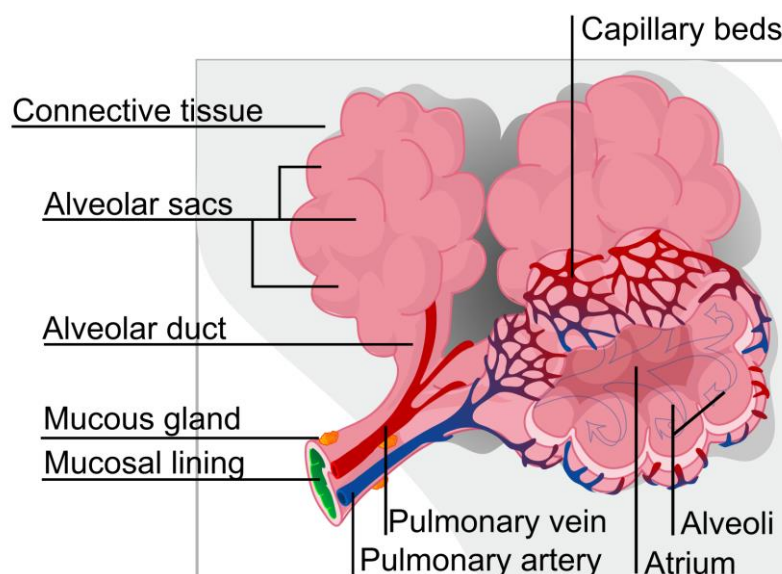


Figure 3. The Structure of an alveolus and the capillaries around it.

([https://med.libretexts.org/Bookshelves/Anatomy_and_Physiology/Book%3A_Anatomy_and_Physiology_\(Boundless\)/17%3A_Cardiovascular_System%3A_The_Heart/](https://med.libretexts.org/Bookshelves/Anatomy_and_Physiology/Book%3A_Anatomy_and_Physiology_(Boundless)/17%3A_Cardiovascular_System%3A_The_Heart/) licensed by CC-BY-NC-SA 3.0)

The oxygen-rich blood then leaves the lungs and travels through the pulmonary vein which leads back to the heart, ready for systemic circulation.

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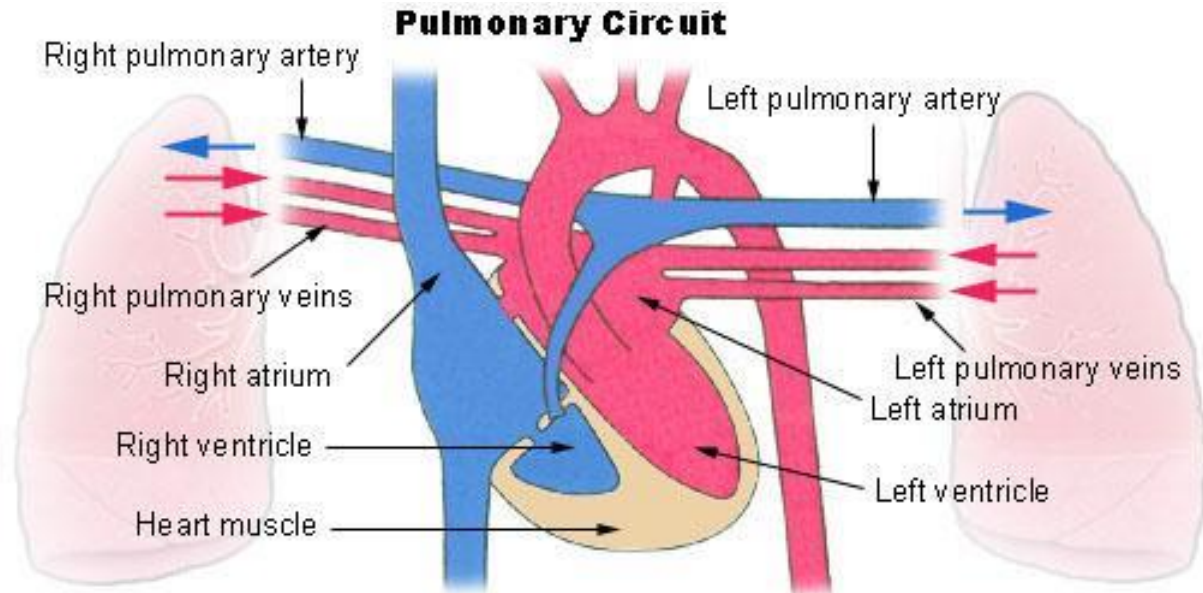


Figure 4. The Pulmonary Circulation.

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Systemic Circulation

Systemic circulation involves the movement of blood from the heart to the body thus providing the necessary nutrient and oxygen to the tissues of the body and consequently bringing back oxygen-depleted blood back to the heart.

Oxygen-rich blood from the lungs enters the left atrium from the pulmonary veins. The blood is then pumped through the mitral valve as it is deposited in the left ventricle. Ventricular contraction causes the blood to be pumped out through the aortic valve and into the aorta, the largest artery in the body. The aorta branches into the major arteries allowing the flow of blood to different organs in the body-- the ascending aorta, the aortic arch and the descending aorta. The arterial system is shown below in Figure 5.

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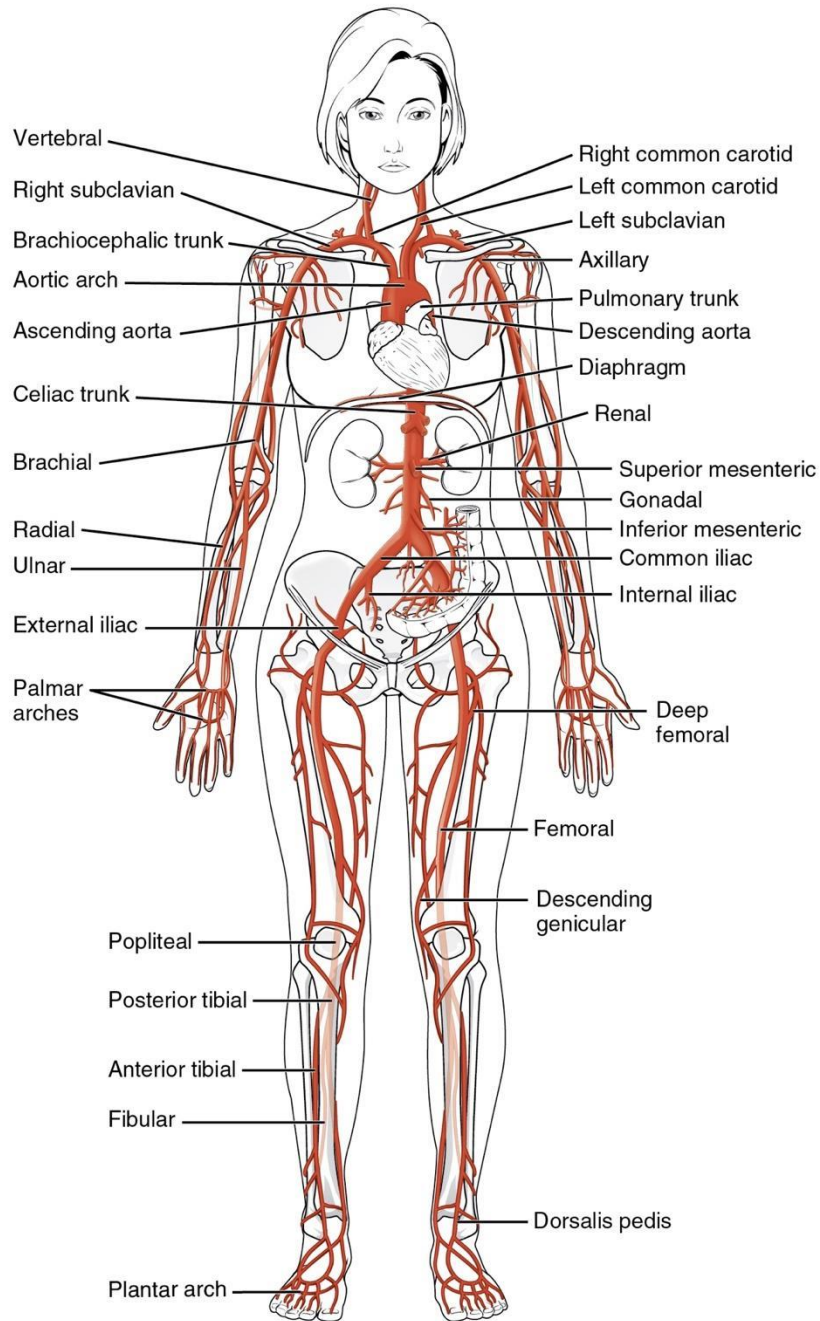


Figure 5. The Major Arteries of the Human Body.

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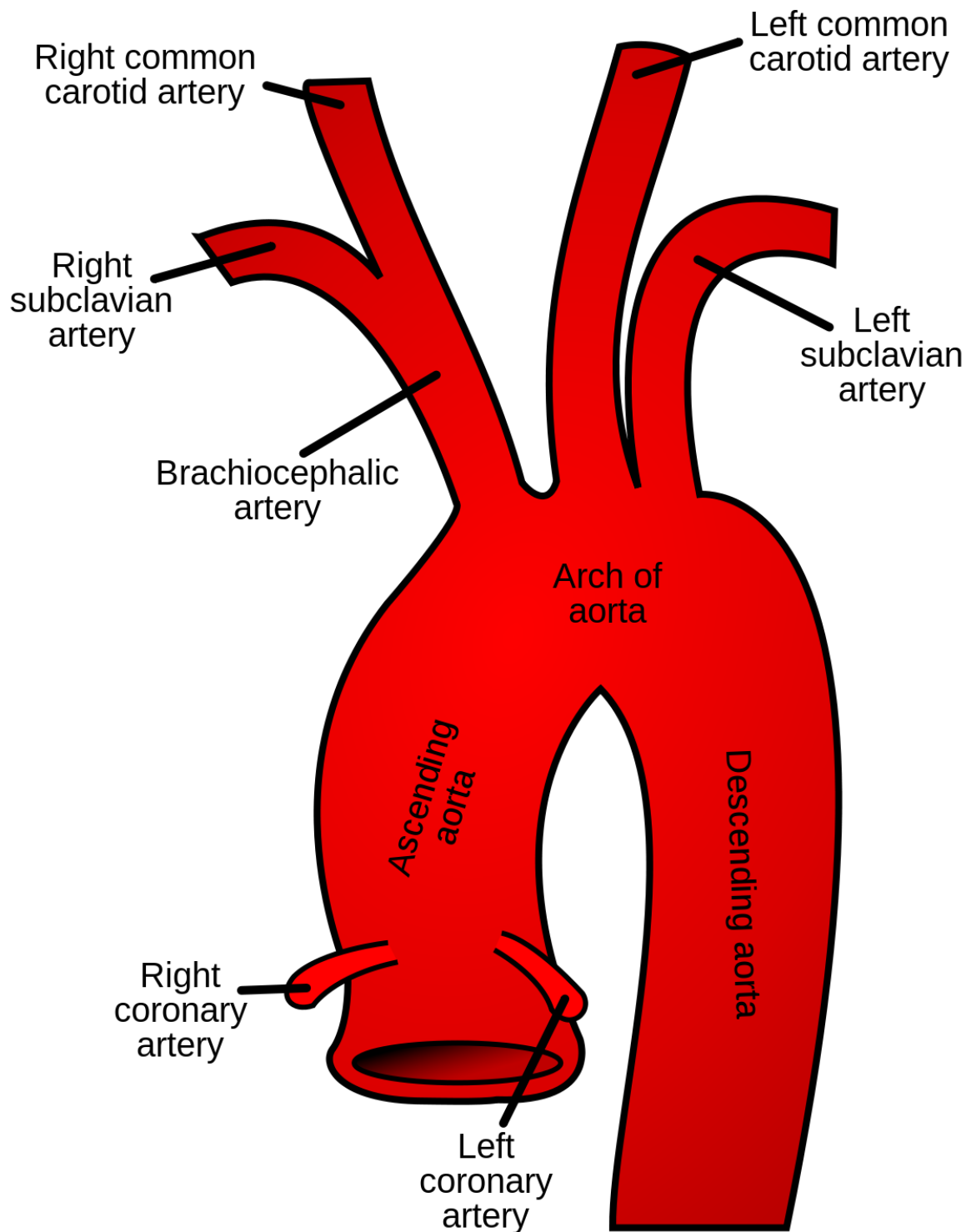


Figure 7. The Parts of the Aorta.

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The **ascending aorta** is the part of the aorta directly connected to the heart, pointing superiorly to the head. It has two branches, the left and right coronary artery responsible for the transport of blood to the muscle of the heart.

The **arch of the aorta** is the part where the aorta changes its direction. It branches to form the **brachiocephalic artery** which is further subdivided into the right common carotid artery and the right subclavian artery. The other branches of this arch include the **left common carotid artery** and the **left subclavian artery**. All of these arteries provide blood to the arms and the head. Shown below are the different branches rooted from the aortic arch.

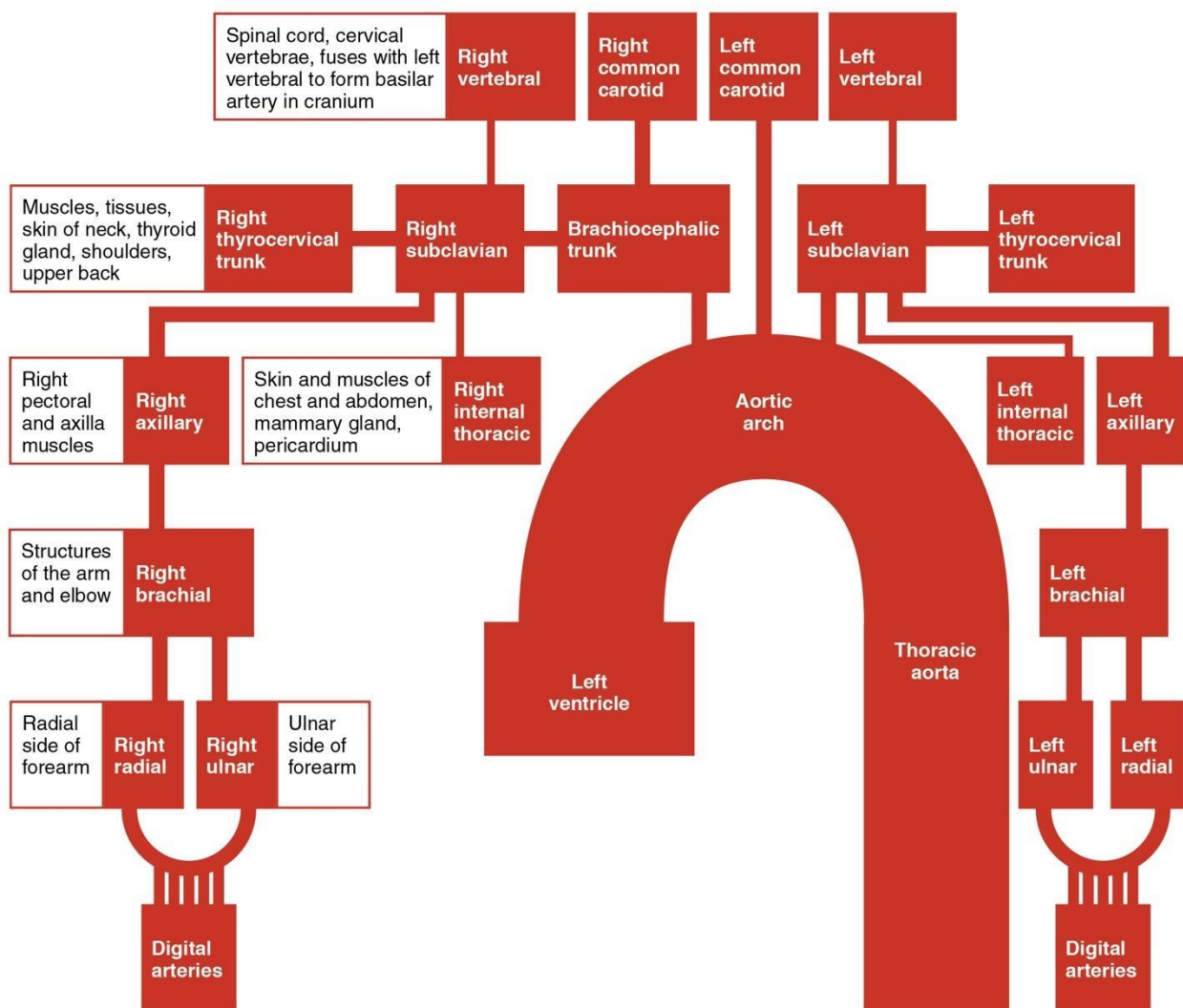


Figure 8. The Branches of the Aortic Arch.

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The **descending aorta** runs from the end of the aortic arch down to the abdomen. It is divided into two parts, the **thoracic and the abdominal aorta**. The **thoracic aorta** starts after the aortic arch, running down to the diaphragm, the muscle separating the chest from the abdomen. This artery branches to supply oxygenated blood to the organs within the thorax. The **abdominal aorta** supplies the blood to the abdominal cavity. It branches terminally forming the common iliac arteries responsible for supplying blood to the pelvic area and the lower limbs. Figure 9 shows the branches of the descending aorta. It also illustrates the paired and unpaired branches. **Paired arteries** occur in sets of two, with one branch providing blood to organs or tissues on the right side of the body and the other providing blood to the left side. **Unpaired arteries** on the other hand exist as a single artery.

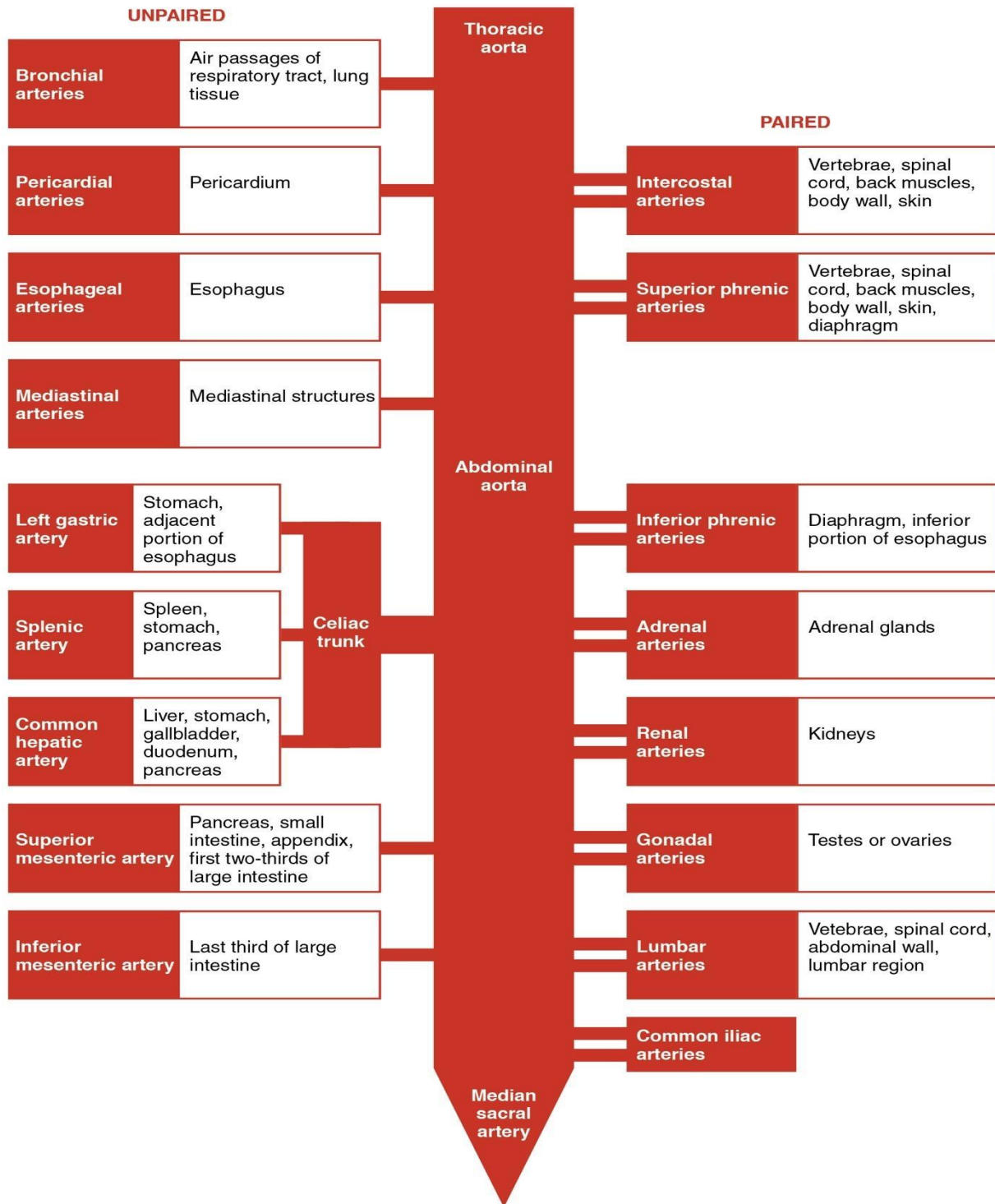


Figure 9. The Branches of the Descending Aorta.

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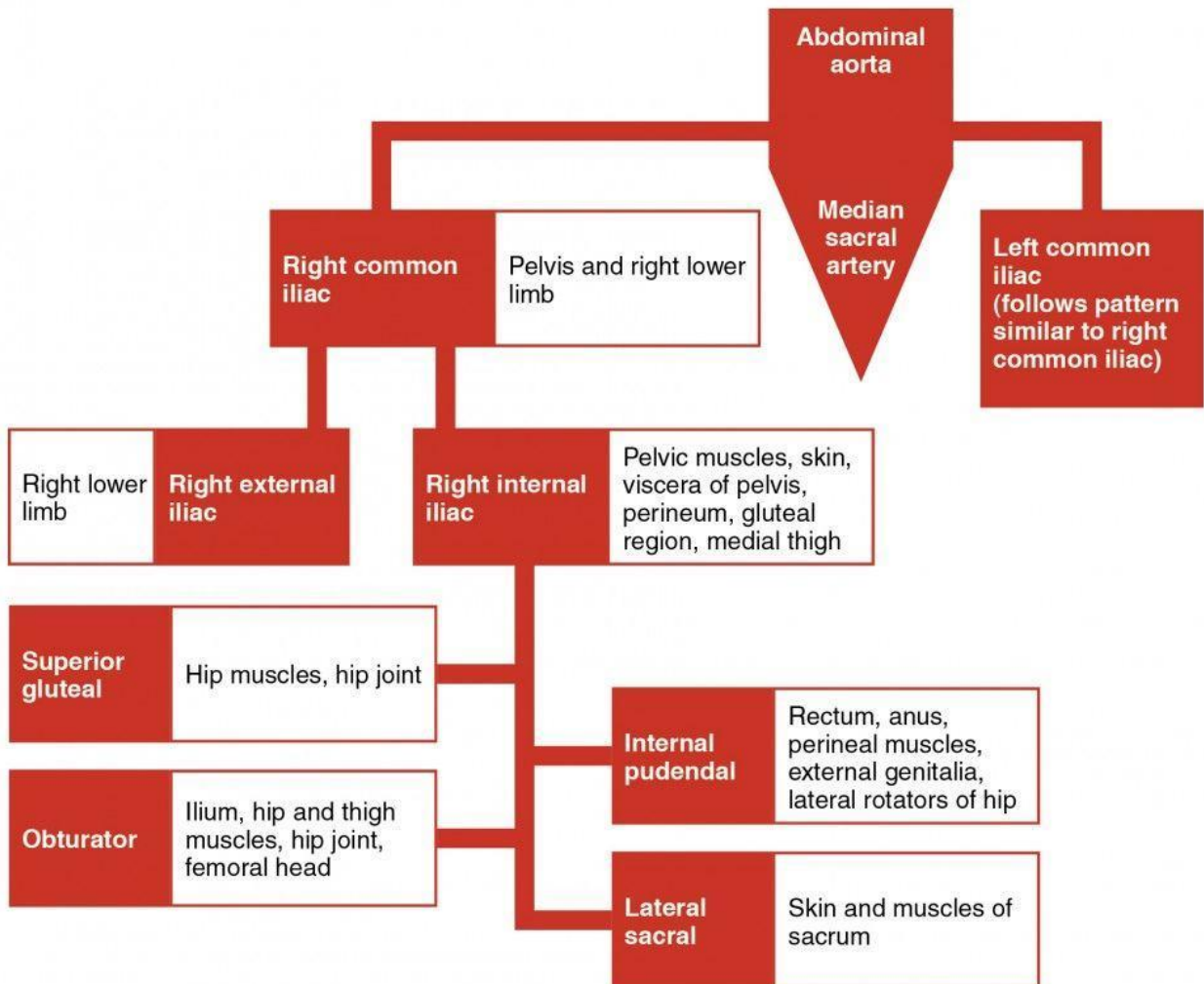


Figure 10. Branches of arteries inferior to the abdominal aorta.
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The blood will now be devoid of oxygen after the exchange of materials happens in the capillaries. The blood then travels back to the systemic venous system, flowing either to the superior vena cava or the inferior vena cava before being drained at the right atrium. Drawing an imaginary line at the level of the diaphragm, blood from above it will drain into the superior vena cava while those beneath the diaphragm would let blood flow through the inferior vena cava. Shown below is the route of the blood from the different parts of the body back to the heart.

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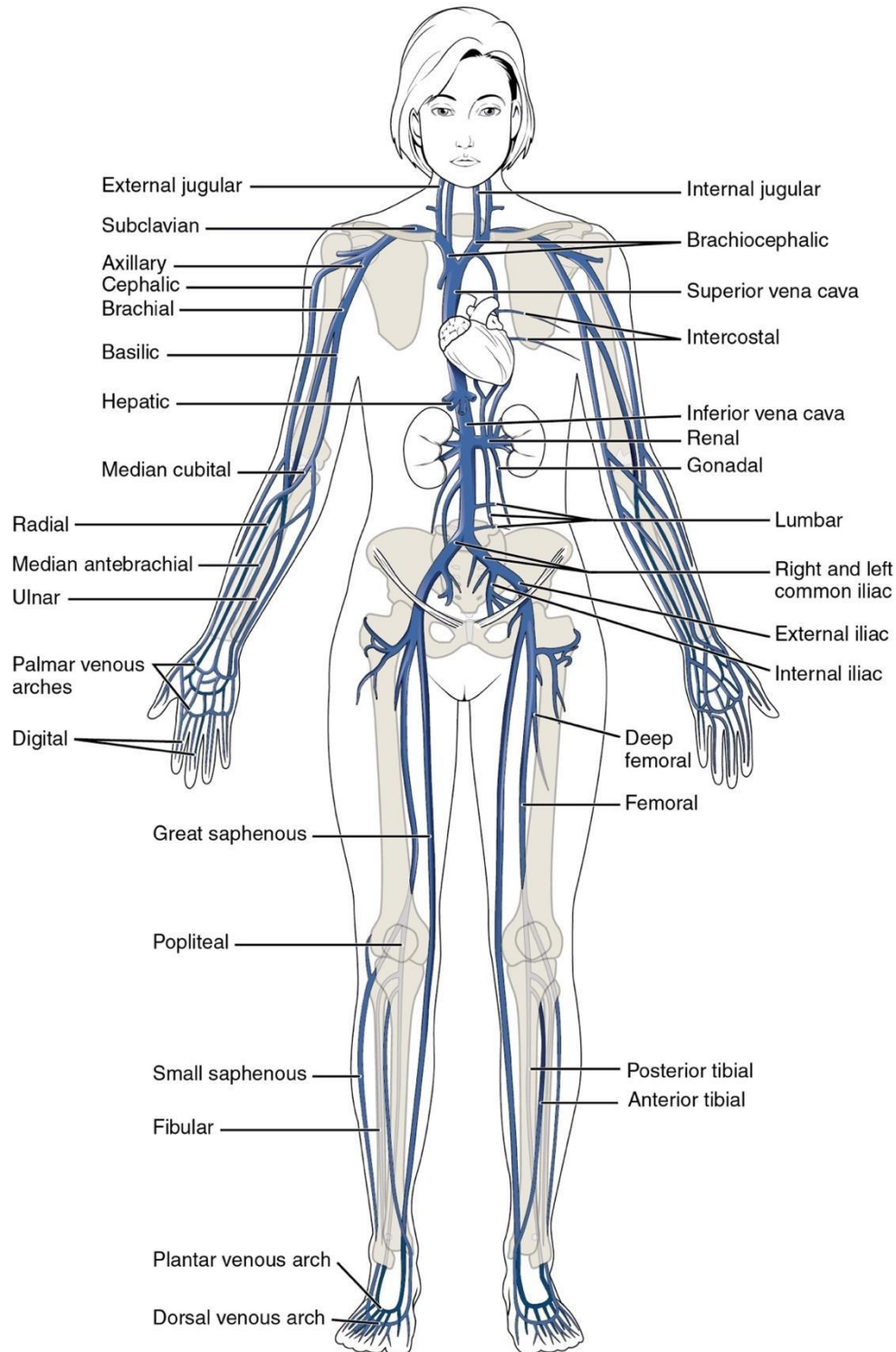


Figure 11. The Major Veins of the Human Body.

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The **inferior vena cava** drains all the blood from parts inferior to the diaphragm. It parallels the abdominal aorta where it could receive blood from abdominal veins as shown

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below. Inferior to these abdominal veins are the common iliac veins where the blood from the internal and external iliac veins are drained into. What is the difference between the internal and the external iliac veins?

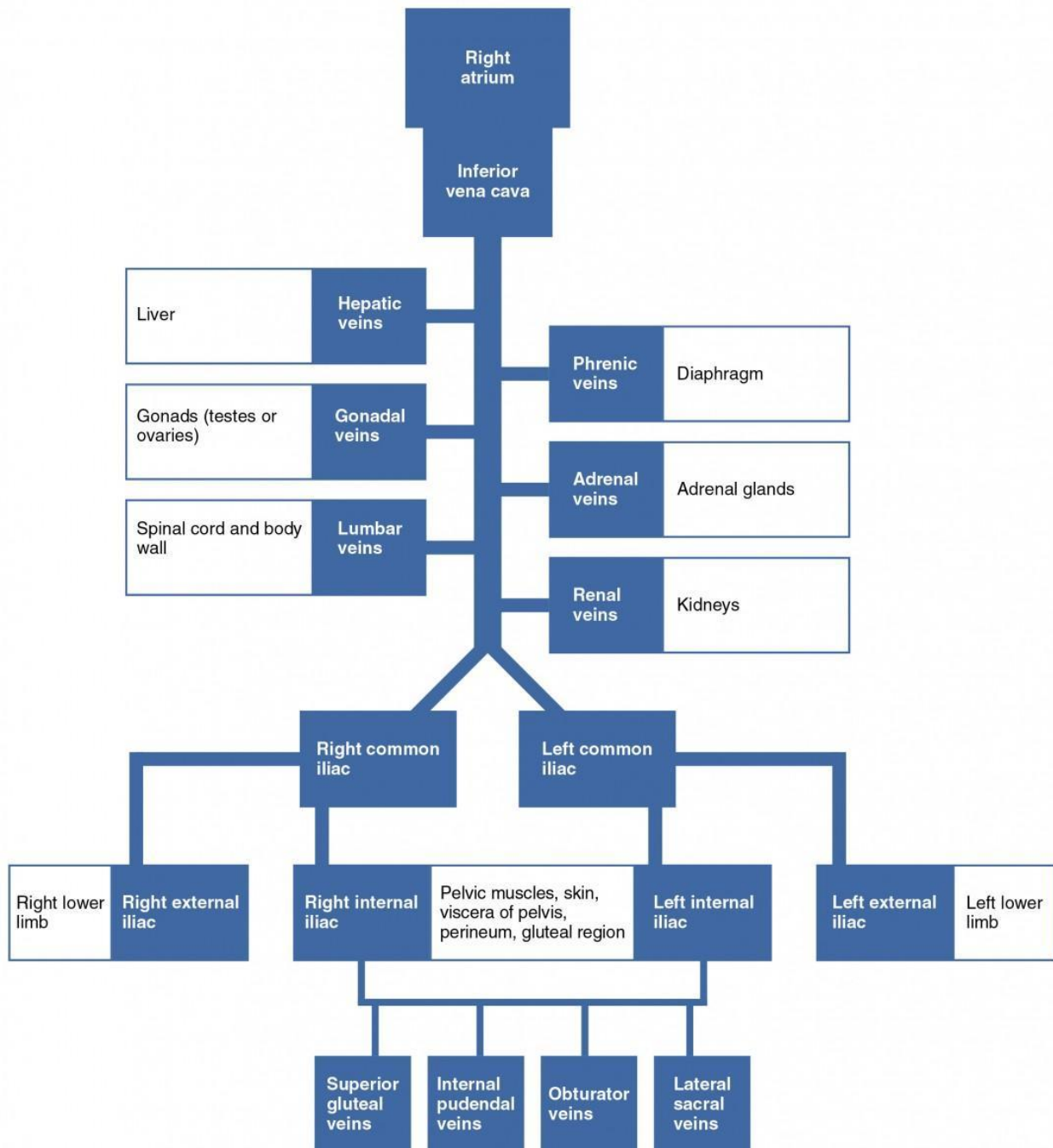


Figure 12. Branches of Veins the Drain Blood to the Inferior Vena Cava.
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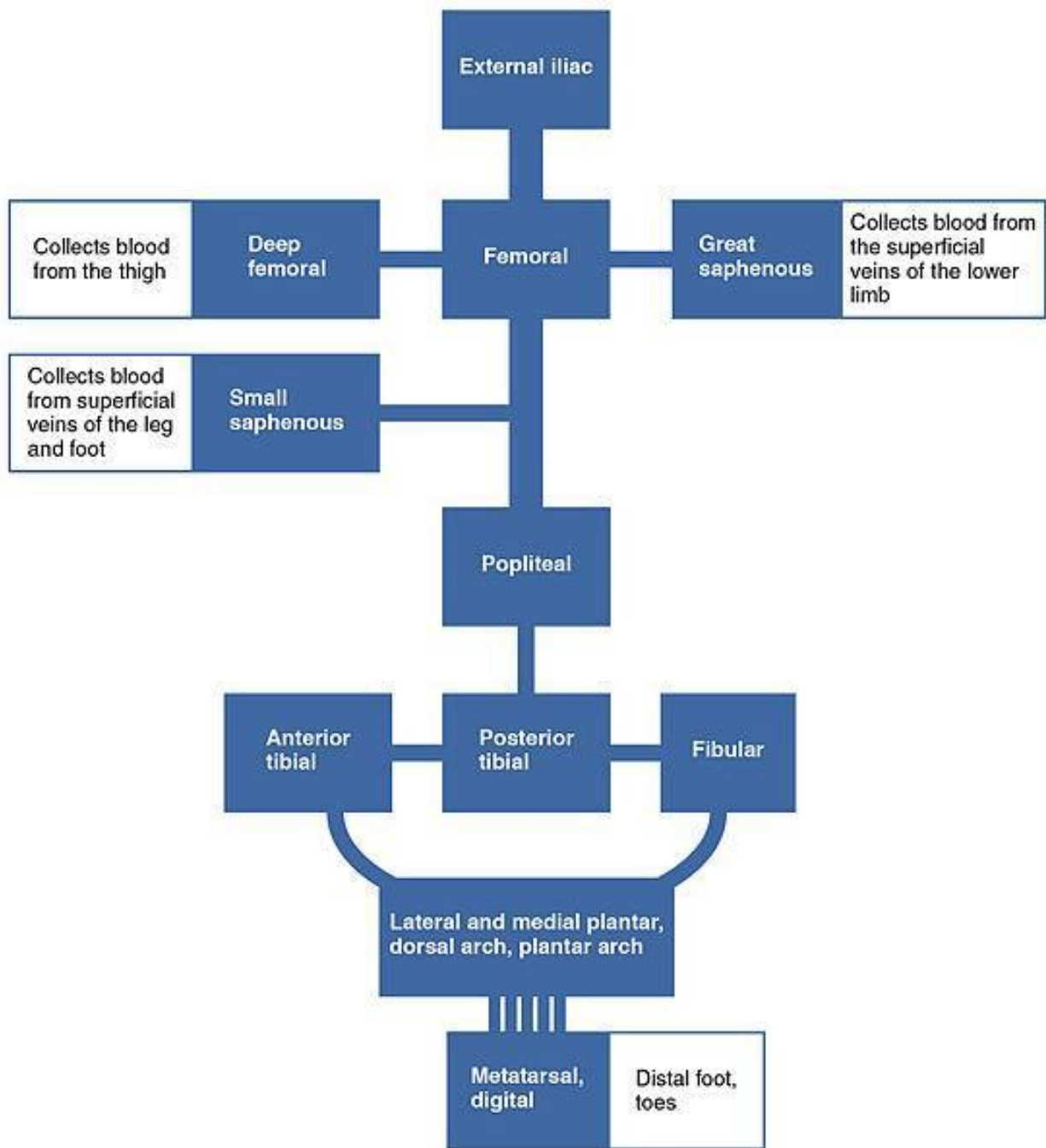


Figure 13. Branches of Veins the Drain Blood to the Exterior Iliac.
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The **superior vena cava** drains the blood from parts above the diaphragm. On both left and right sides, the brachiocephalic veins are formed from the fusion of the subclavian veins and the jugular veins where blood from the head, neck and limbs are drained from. The

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internal thoracic veins also flow into the brachiocephalic vein as it drains blood from the anterior surface of the chest.

How does the blood from the rest of the thoracic area flow back to the heart?

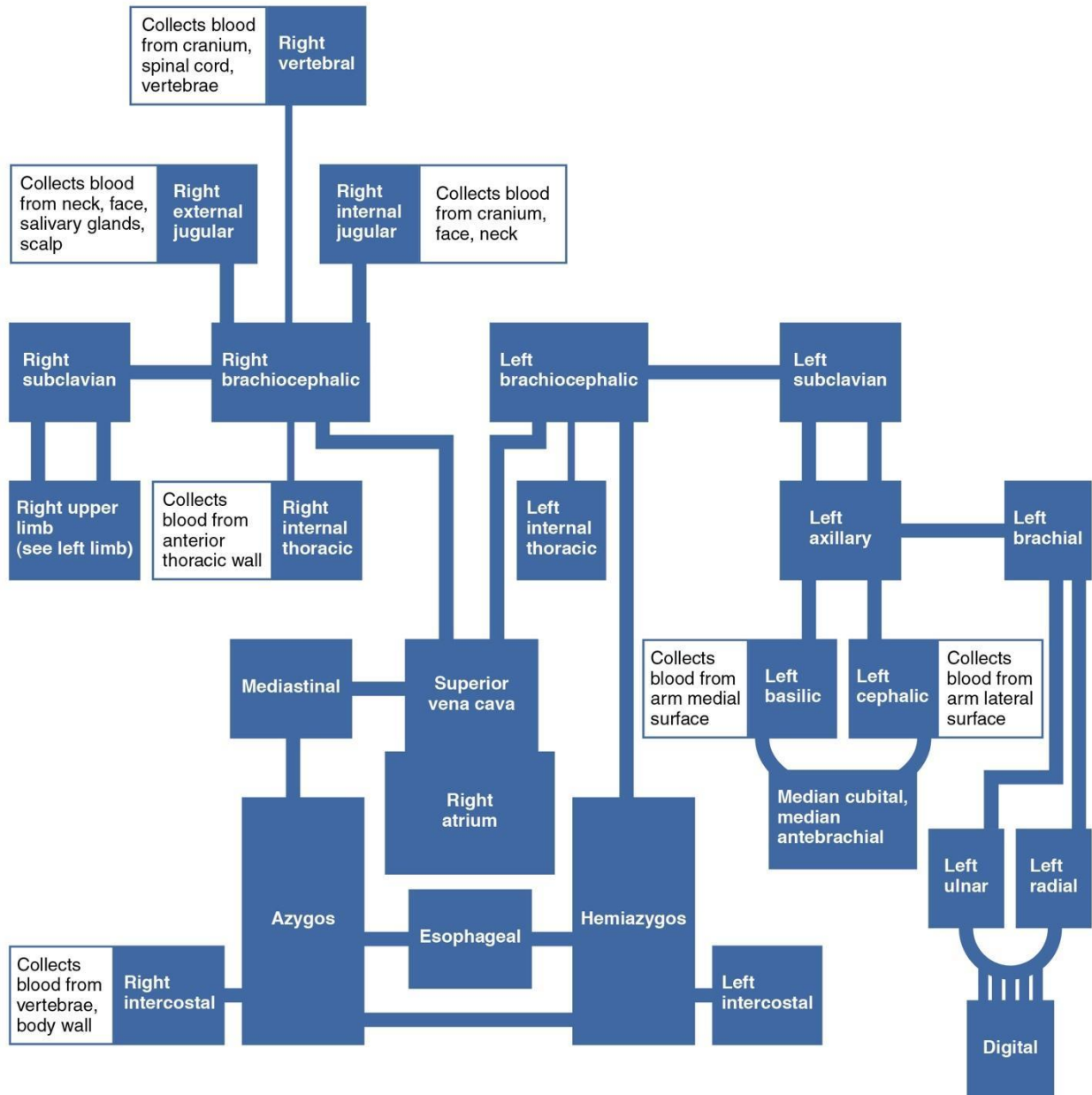


Figure 14. Branches of Veins the Drain Blood to the Superior Vena Cava.
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NAVIGATE (7 mins)

Draw the diagrams asked in each of the following items. Label them correctly and supply the needed descriptions and explanations. This is a non-graded activity.

1. **Coronary circulation** is responsible for the circulation of blood in the blood vessel of the myocardium or the heart muscle. But how does this circulation happen? Draw the circulation of blood in the heart muscle in the space provided below. Supply an explanation of the process.

2. **Coronary Heart Disease** is a condition that develops when the coronary arteries become too narrow for blood to normally pass through. In the space provided below, explain the possible causes of the disease. Present the signs and symptoms of this condition and provide some ways to prevent this from happening.

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KNOT (1 min)

In this chapter, we learned how the human circulatory works particularly those of the different paths of blood as it traverses every part of our body. Recall that deoxygenated blood is pumped by the right ventricle into the pulmonary arteries leading to the lungs. Gas exchange happens in the alveoli and the oxygen-rich blood is then transported by the pulmonary veins back to the left atrium. The left ventricle then pumps the oxygen-rich blood out of the aorta, to the different arteries throughout the body. After transporting oxygen to the tissues of the body, it must go back to the heart via the venous system. The blood is then drained from the different veins to the inferior and superior vena cava before leading to the right atrium.

References/Sources:

Overview of the Circulatory System (2019) Retrieved from: [https://bio.libretexts.org/Bookshelves/Introductory and General Biology/Book%3A General Biology \(OpenStax\)/7%3A Animal Structure and Function/40%3A The Circulatory System/40.1%3A A Overview of the Circulatory System](https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_General_Biology_(OpenStax)/7%3A_Animal_Structure_and_Function/40%3A_The_Circulatory_System/40.1%3A_A_Overview_of_the_Circulatory_System).

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