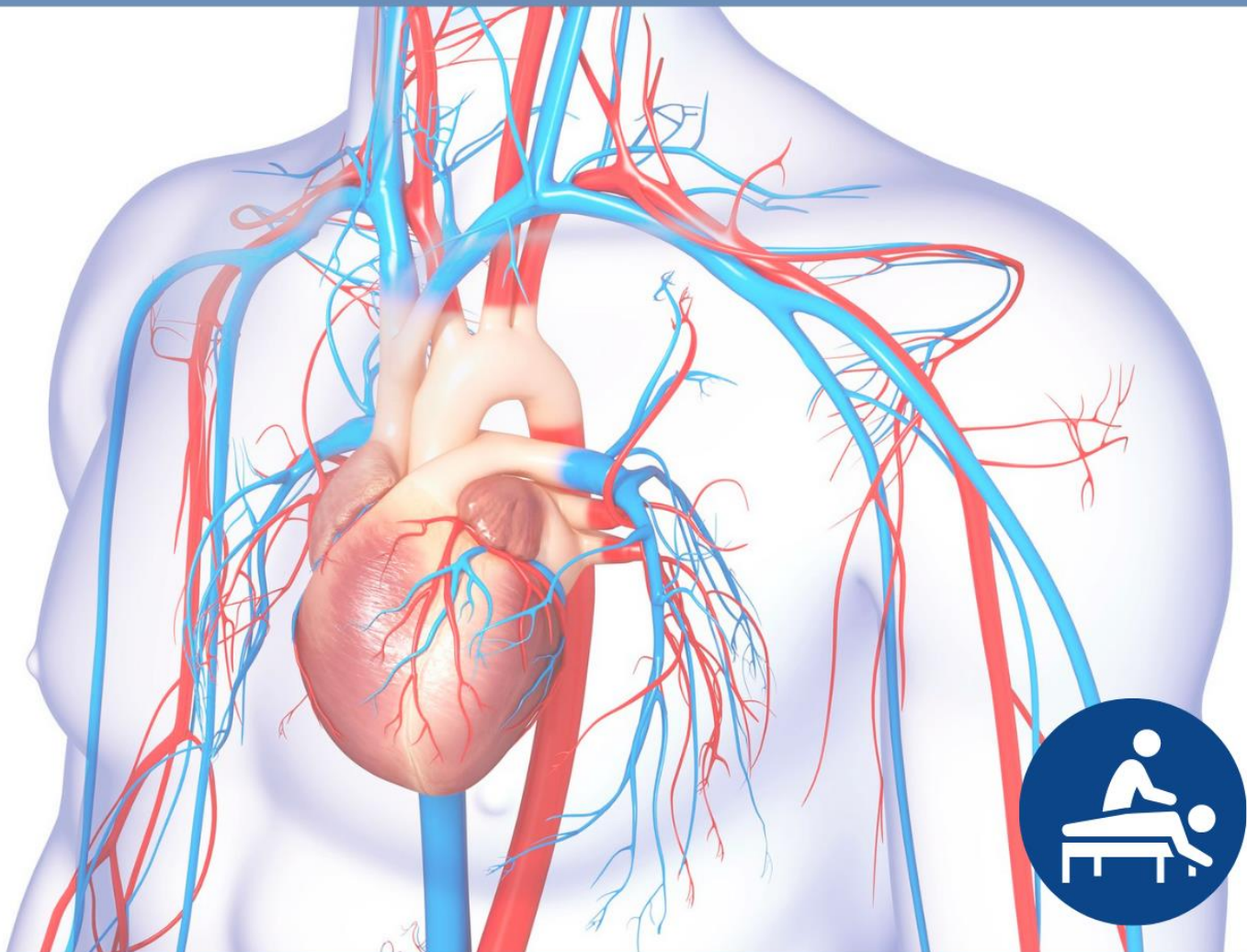




# ANATOMY & PHYSIOLOGY

## LESSON 5: CARDIOVASCULAR SYSTEM

### Student Workbook



**Brighton School of Massage**

## Section 1: Overview of the Cardiovascular System

This section gives a brief look at the components of the system.

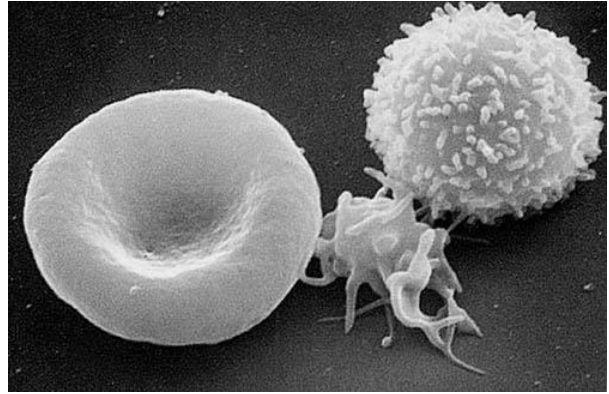
### Components of the Cardiovascular System

#### Organs

- Heart
- Blood Vessels:
  - Arteries
  - Veins
  - Capillaries

#### Tissue

- Blood (a connective tissue)



*From left to right: red blood cell, platelet, white blood cell.*

*Can you find three interesting facts about the cardiovascular system? Write them here:*

---

---

---

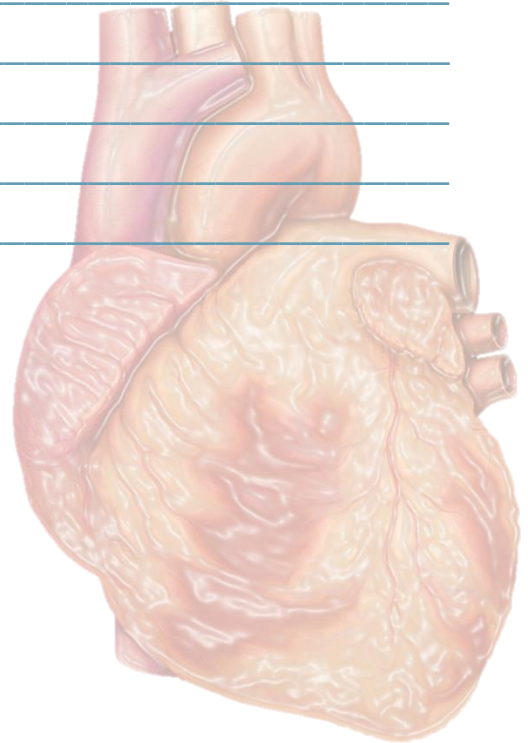
---

---

---

---

---

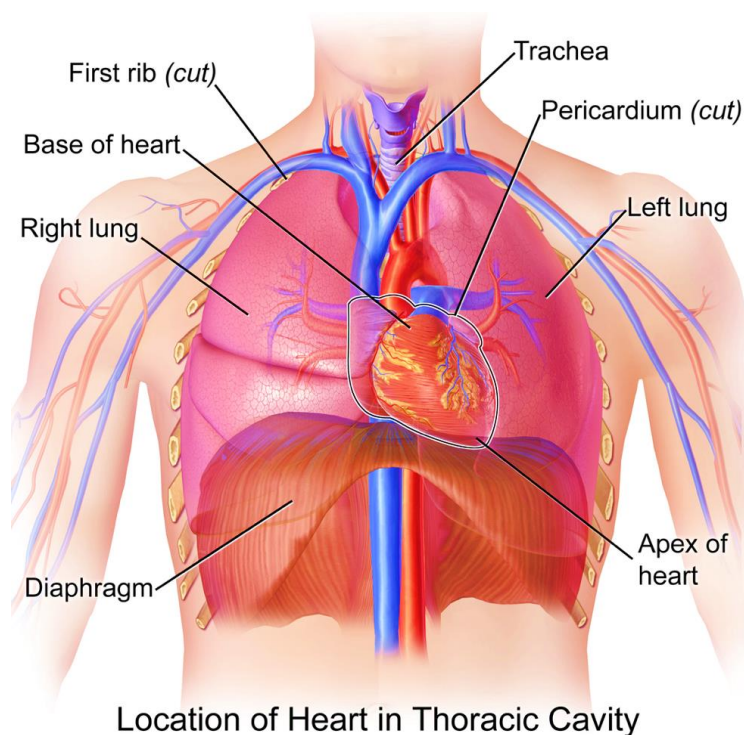


## Section 2: Anatomy of the Heart

This section focuses on the anatomy of the main organ of the system: the heart.

### Location of the Heart

- Between the lungs in the thoracic cavity
- Within the inferior mediastinum, the middle cavity of the thorax
- Base (superior end) points towards the right shoulder
- Apex (inferior end) points toward the left hip and rests on the diaphragm

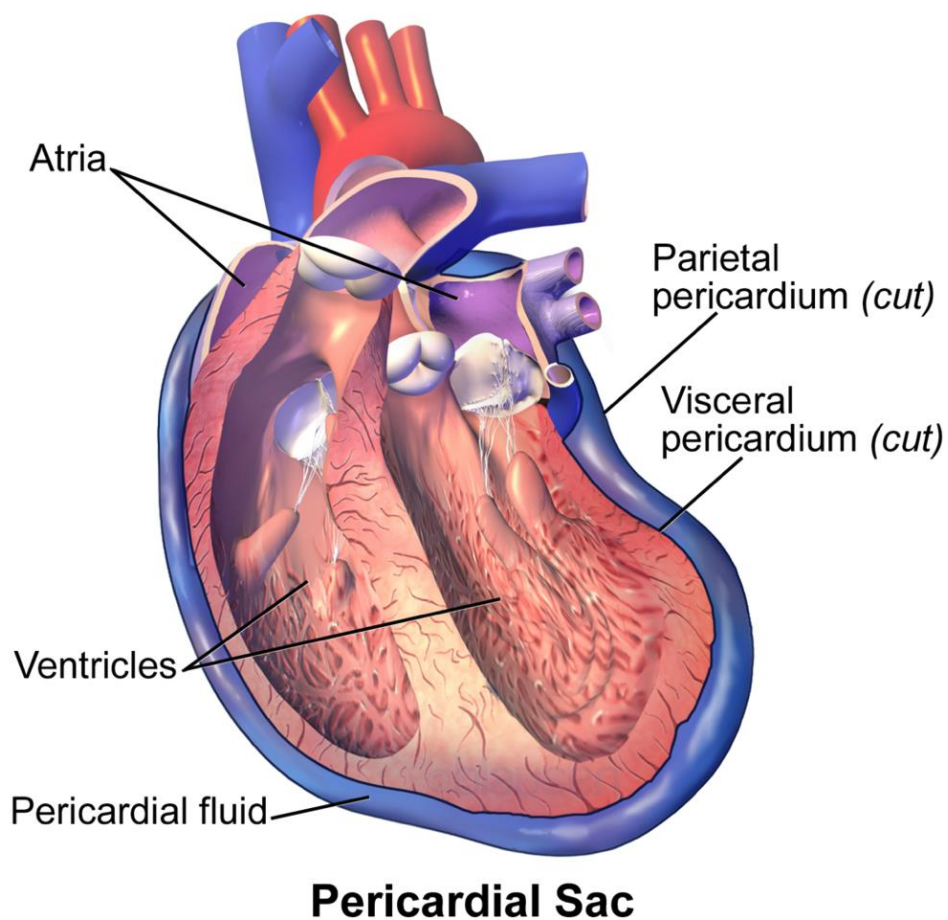


*Write 3 characteristics of the heart:*

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

## Pericardium

- The heart is surrounded by a serous membrane called the pericardium or pericardial sac
- Secretes serous fluid to reduce friction
- Visceral pericardium – covers exterior surface of heart, also called the epicardium
- Parietal pericardium – lines mediastinum, and is reinforced by a fibrous layer that protects and anchors the heart
- Serous membranes have two layers with serous fluid in between the layers



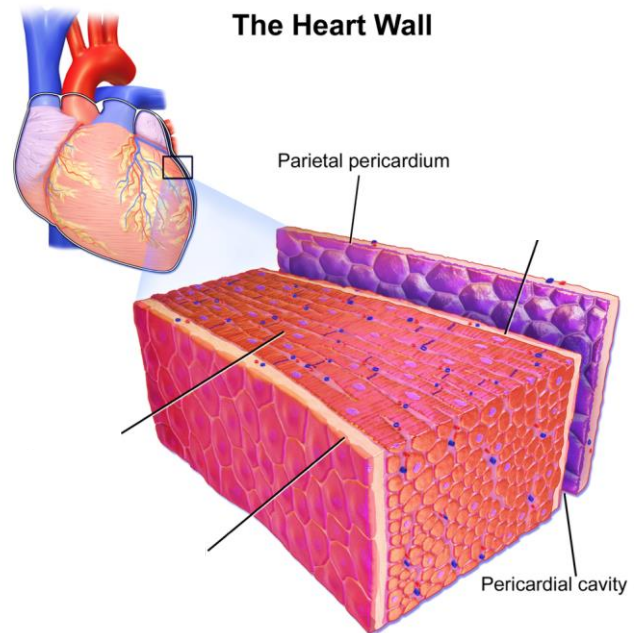


## Heart Walls

The heart wall is composed of 3 layers:

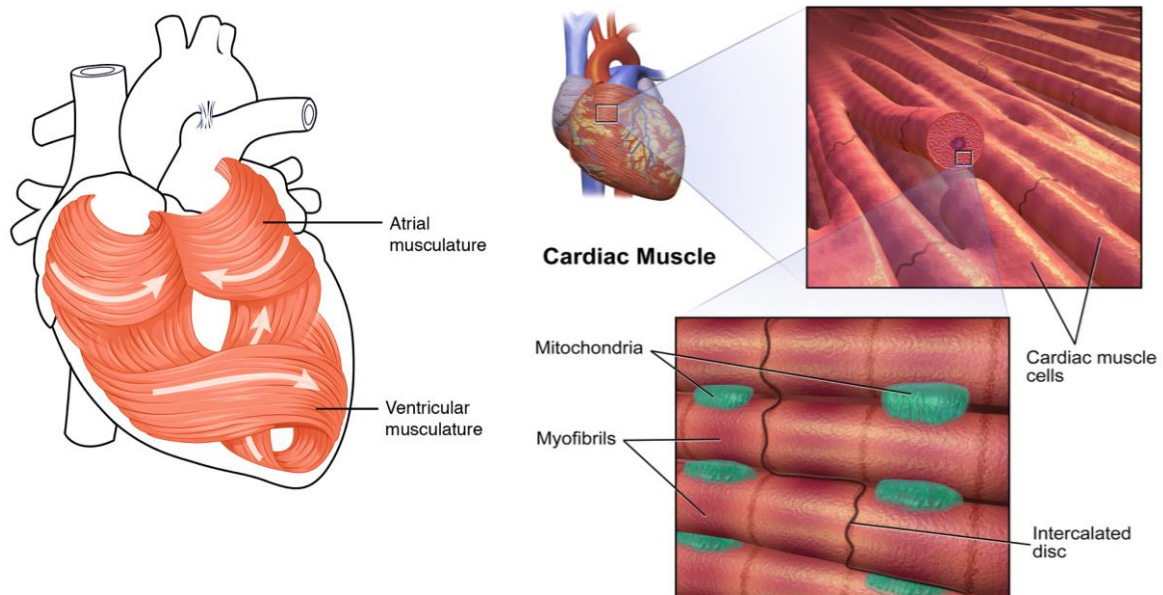
1. **Epicardium** or visceral pericardium
2. **Myocardium** – thick muscular layer
3. **Endocardium** – lines heart chambers

*Label the 3 layers on the diagram:*



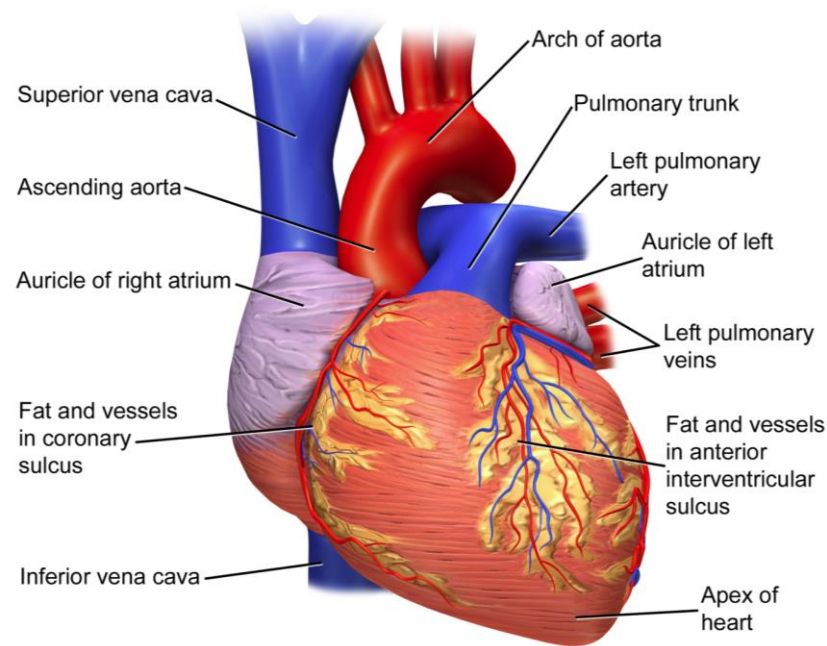
## Myocardium

- Thick bundles of **cardiac muscle** that are twisted into ring-like arrangements
- This is the layer of the heart wall that actually contracts

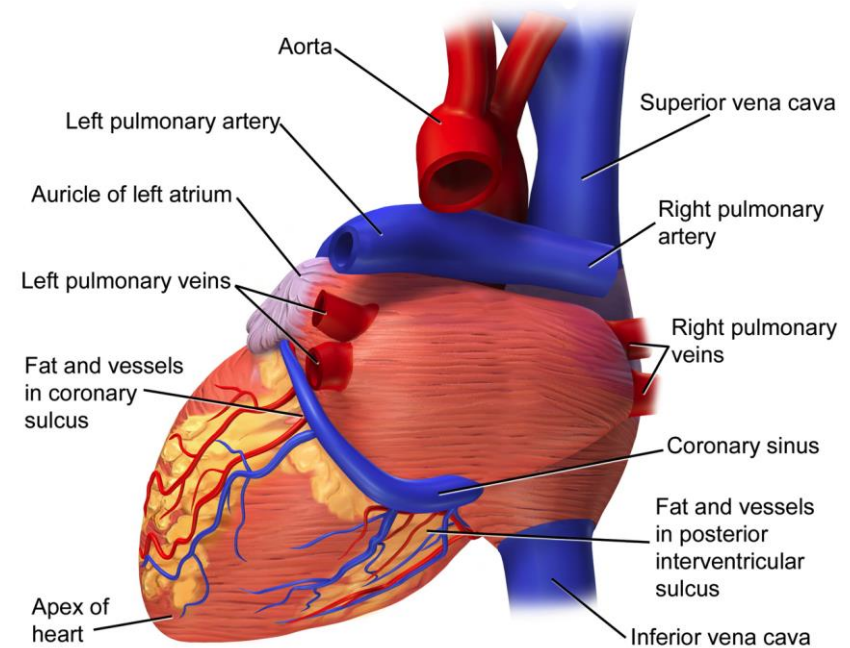


## Superficial Heart Anatomy

### Anterior View

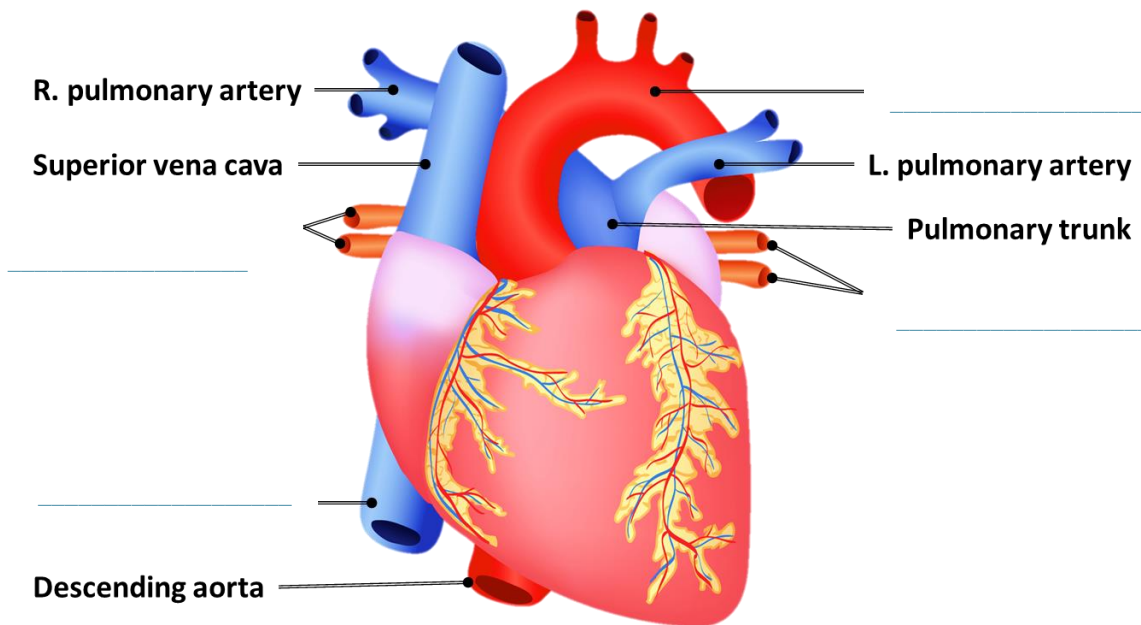


### Posterior View



## Large Vessels of the Heart

Fill the gaps in this diagram:



Summarise the analogy of the motorways below:

---

---

---

---

---

---

---

---

---

---

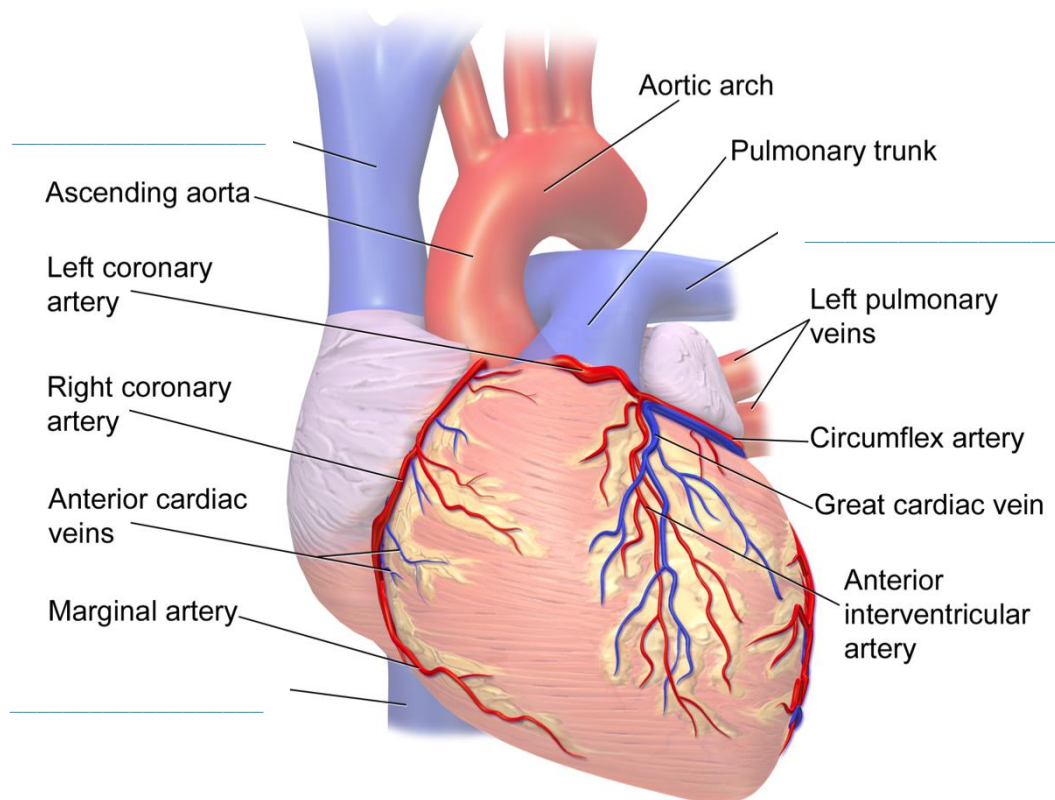
### REMEMBER:

Arteries carry blood \_\_\_\_\_ the heart & veins carry blood \_\_\_\_\_ the heart.

## Coronary Circulation

- Blood supply to the myocardium itself is provided by coronary arteries
- The main (right and left) coronary arteries branch from the aorta
- The myocardium is drained by cardiac veins that empty into a vessel on the back side of the heart and eventually into the right atrium

Fill the gaps in this diagram:

[illegible]

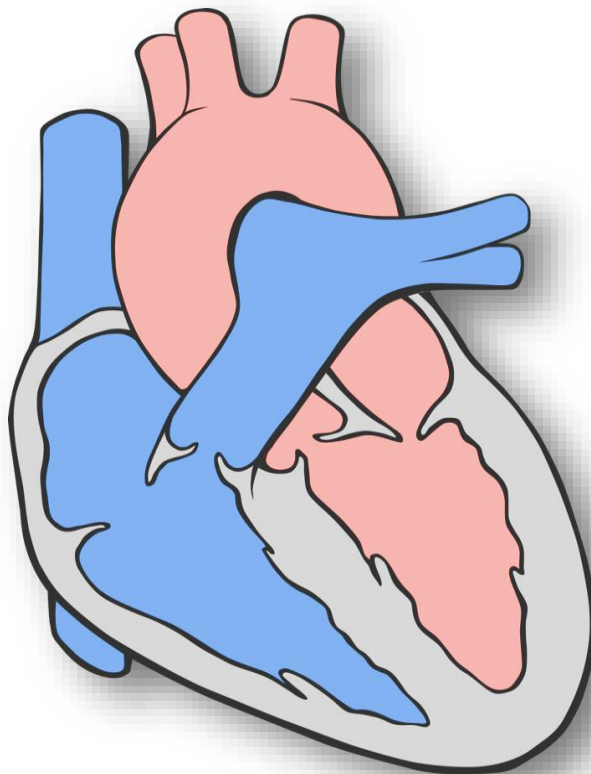


## Heart Anatomy

Complete this table. (Note, this section covers a few slides on the learning resources).

| Structure                 | Location and function |
|---------------------------|-----------------------|
| Right atrium              |                       |
| Left atrium               |                       |
| Right ventricle           |                       |
| Left ventricle            |                       |
| Interventricular septum   |                       |
| Interatrial septum        |                       |
| Aortic semilunar valve    |                       |
| Pulmonary semilunar valve |                       |
| Tricuspid valve           |                       |
| Bicuspid valve            |                       |

Label the diagram with the components in the above table.



Note the thicker myocardium surrounding the left ventricle.

*Why is this muscular wall thicker than the right ventricle?*

---



---



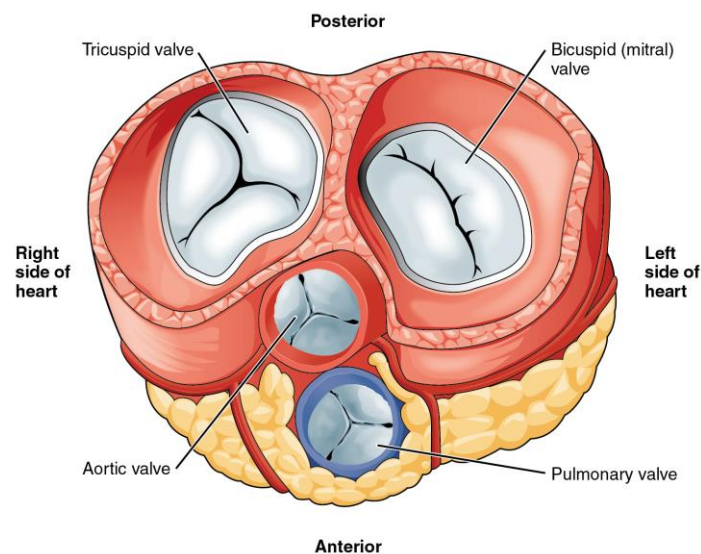
---



---

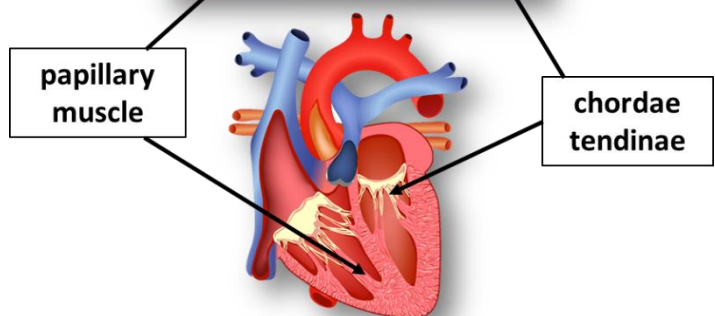
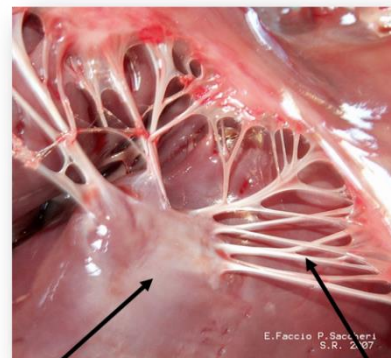
### Heart Valves

The function of heart valves is to prevent the backflow of blood.

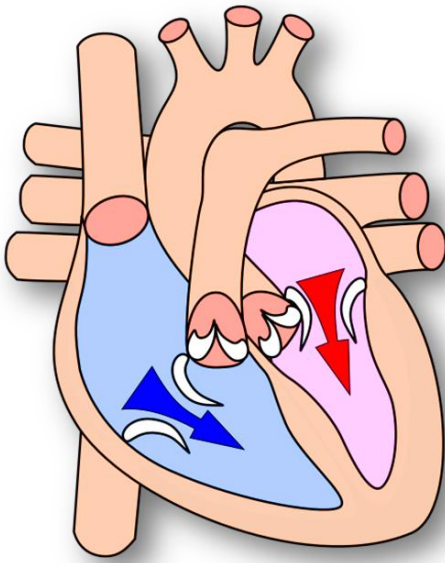


### Chordae Tendinae

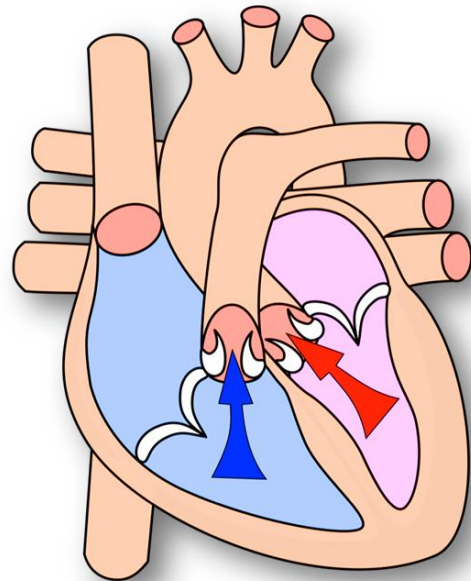
- Tendinous chords that anchor the flaps of AV valves to the heart walls
- Prevent flaps from blowing up into the atria when ventricles are contracting
- Attached to papillary muscles of heart wall



## Operation of Heart Valves



- AV valves are open as atria contract & ventricles fill
- Semilunar valves are closed



- AV valves close when ventricles contract
- Semilunar valves are open

When atria are filling with blood, the pressure of blood on the AV valves forces them open and blood flows into the ventricles, then atria contract to force additional blood into the relaxed ventricles.

Semilunar valves are closed at this time to prevent blood in the large vessels exiting the heart from flowing back into the ventricles.

When ventricles contract, the AV valves close to prevent blood from being pushed back up into the atria and, instead, flow into the pulmonary arteries (from the RV) and aorta (from the LV).

---

---

---

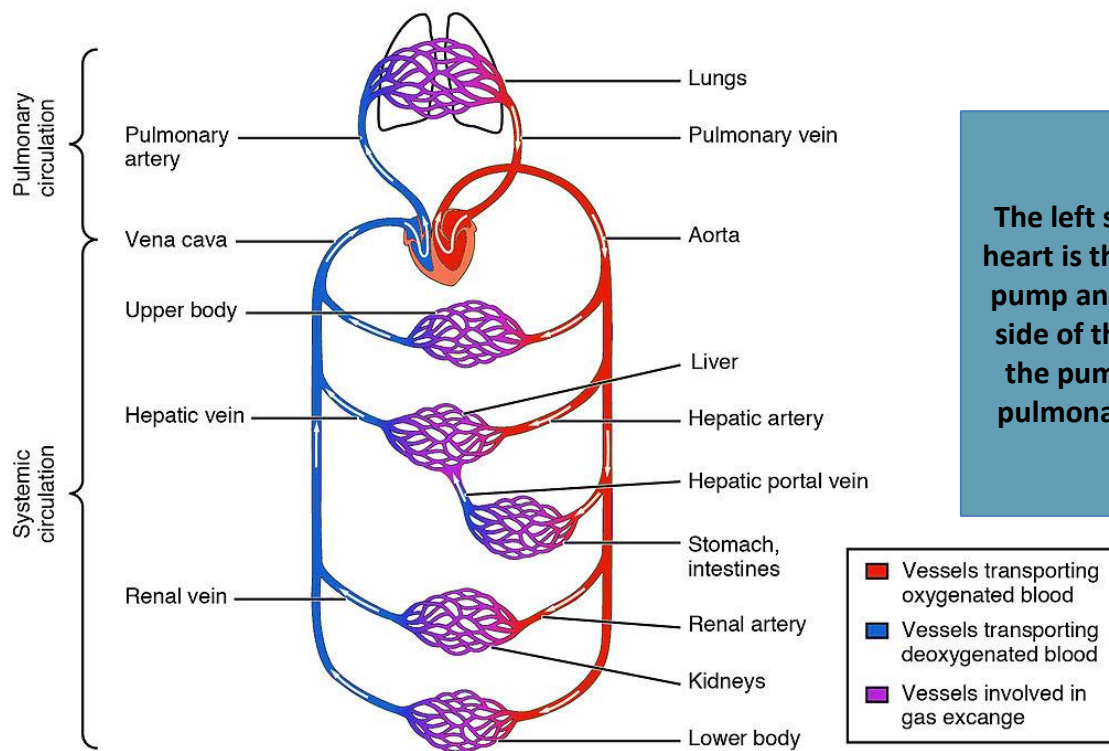
---

---

---

---

## The Heart is a Double Pump



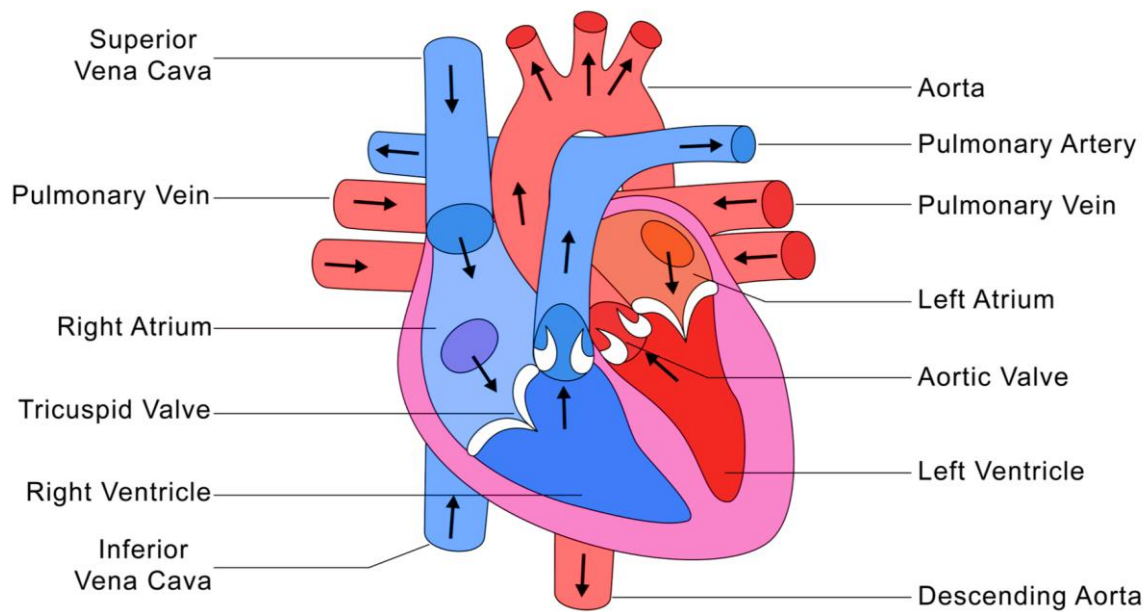
**The left side of the heart is the systemic pump and the right side of the heart is the pump for the pulmonary circuit.**

- **Systemic circulation** is the circuit of blood flow from the left side of the heart to the body tissues and back to the right side of the heart
- **Pulmonary circulation** is the circuit from the right side of the heart to the lungs and back to the left side of the heart

This image shows a single sheet of white paper with horizontal blue ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



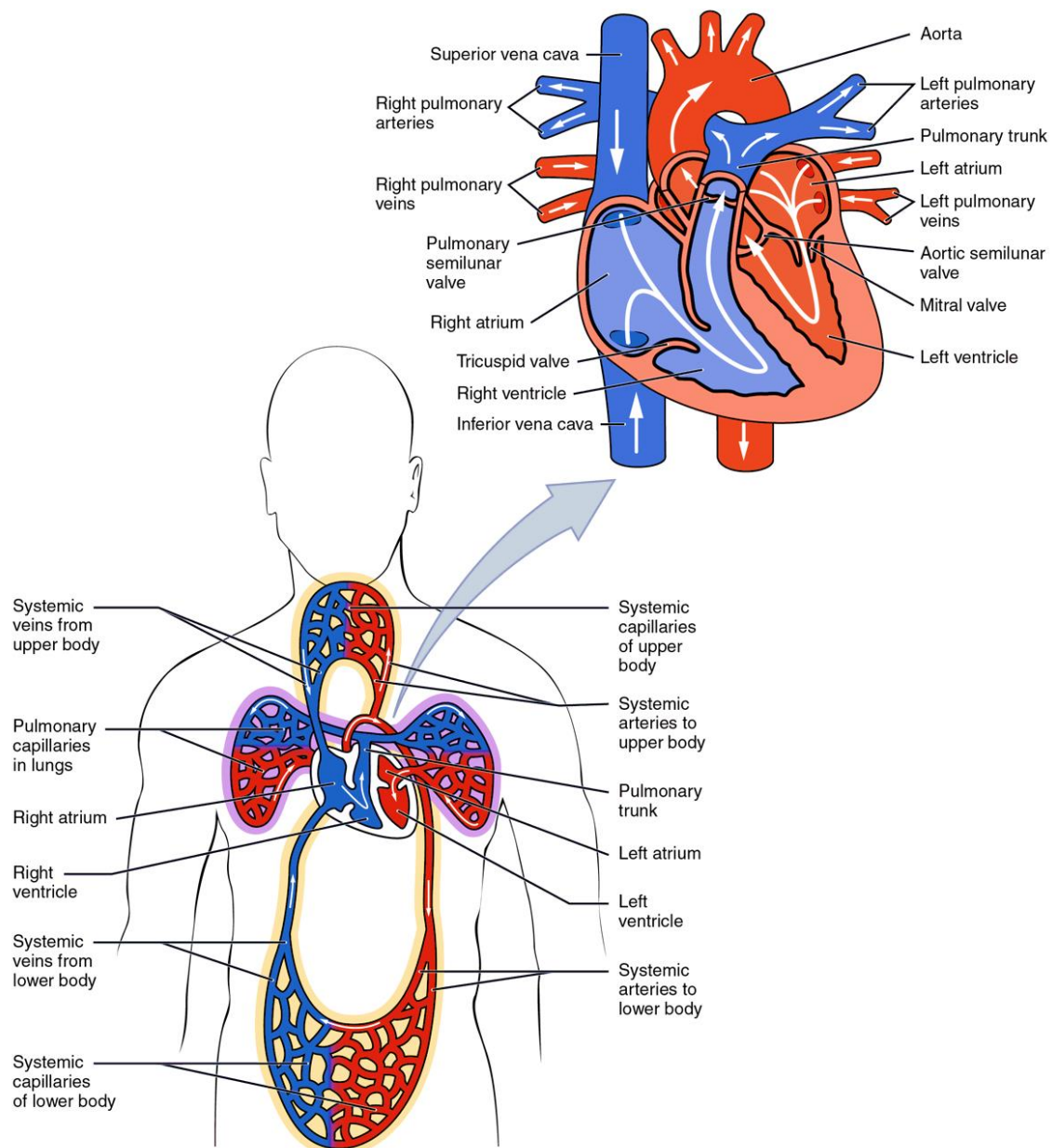
## Flow of Blood Through the Heart



*Describe the sequence as you trace the flow of blood into, through and out the heart.*

This image shows a single sheet of white paper with horizontal blue ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

## Summary of Circulation



Which chamber receives deoxygenated blood from the body? \_\_\_\_\_

Which chamber pushes blood to the lungs? \_\_\_\_\_

Which chamber pushed oxygenated blood to the body? \_\_\_\_\_

Name the vessel that carries blood to the lungs. \_\_\_\_\_

Name the vessels that return blood to the heart from the lungs. \_\_\_\_\_

Name the vessel that carries blood from the left ventricle to all parts of the body. \_\_\_\_\_

Which side of the heart acts as the pump for the pulmonary circuit? \_\_\_\_\_

Which side of the heart acts as the pump for the system circuit? \_\_\_\_\_

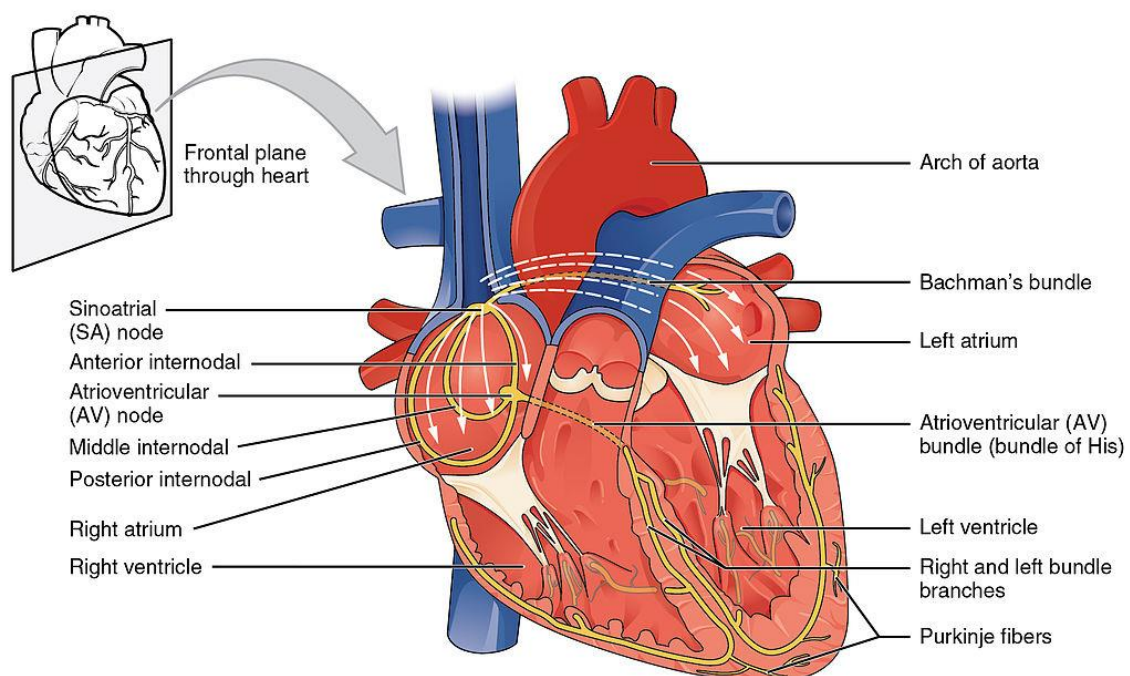
## Section 3: Physiology of the Heart

This section looks at the physiology of the heart.

### The Heart Beat

- As the heart beats, the entire volume of blood,  $\approx 5\text{-}6\text{ L}$ , makes about 1,000 trips through the body and back to the heart each day
- Heart activity is regulated by the nervous system and the intrinsic conduction system

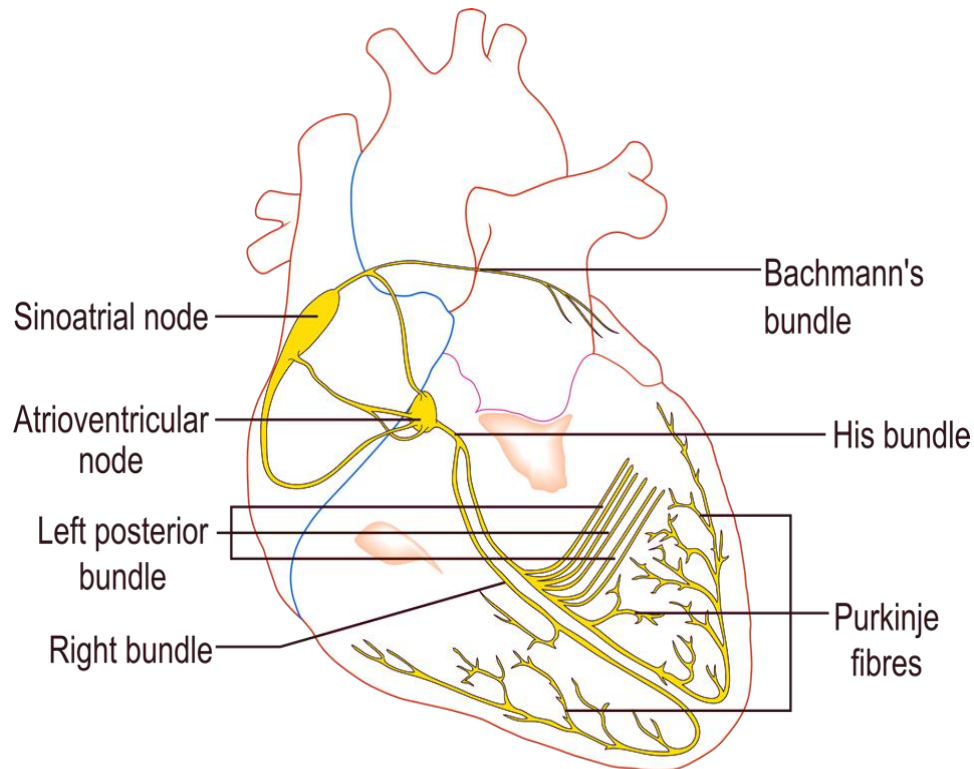
### Intrinsic Conduction System



- This system maintains an average heartbeat of 75 beats per minute.
- Depolarization begins at the SA node, travels across the atria to the AV node and then moves to the AV bundle (Bundle of His), the right and left bundle branches in the interventricular septum and then to the Purkinje fibers in the ventricle walls.

## Sinoatrial Node

- Starts each heartbeat
- Also called the SA node and the pacemaker
- Composed of specialized tissue
- Impulse travels from SA node across atria to atrioventricular or AV node



**SA node → AV node → Bundle of His → R/L bundle branches → Purkinje fibers**

**Interesting fact:** The SA node is composed of a type of tissue found nowhere else in the body; it is a composite of muscle and nervous tissue.

---

---

---

---

---

---

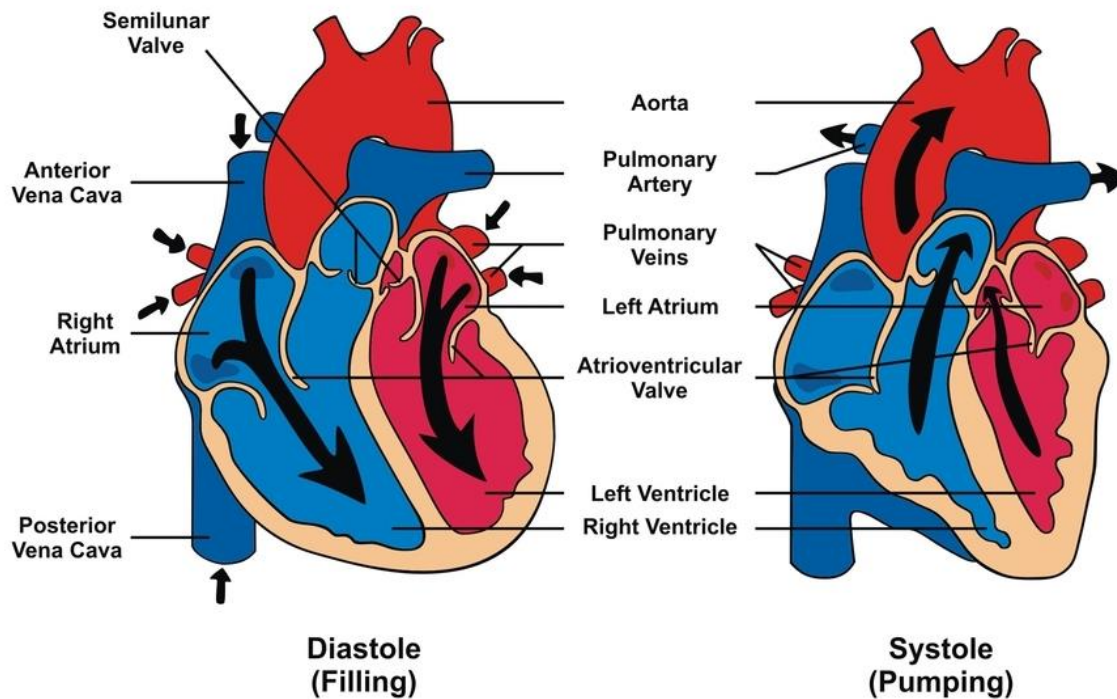
---

---



## Cardiac Cycle

- The cardiac cycle includes the events in one heartbeat
- At 75 beats/minute, the cardiac cycle lasts about 0.8 seconds
- Includes contraction and relaxation of both atria and ventricles



### Diastole (means relaxation)

- ventricles are relaxed and passively filling with blood from the atria
- the atria will contract at the end of diastole to force remaining blood into ventricles
- AV valves are open; semilunar valves are closed to prevent blood in the aorta and pulmonary trunk from falling back into the ventricles

### Systole (means contraction)

- Ventricles contract to force blood out through the aorta (left side) and pulmonary trunk (right side)
- AV valves are closed; semilunar valves are open

### Fill the gaps:

**Tachycardia:** rapid heart rate is over \_\_\_\_ bpm

**Average** heart rate is \_\_\_\_ bpm

**Bradycardia:** slow heart rate is under \_\_\_\_ bpm

What does **bpm** stand for? \_\_\_\_\_

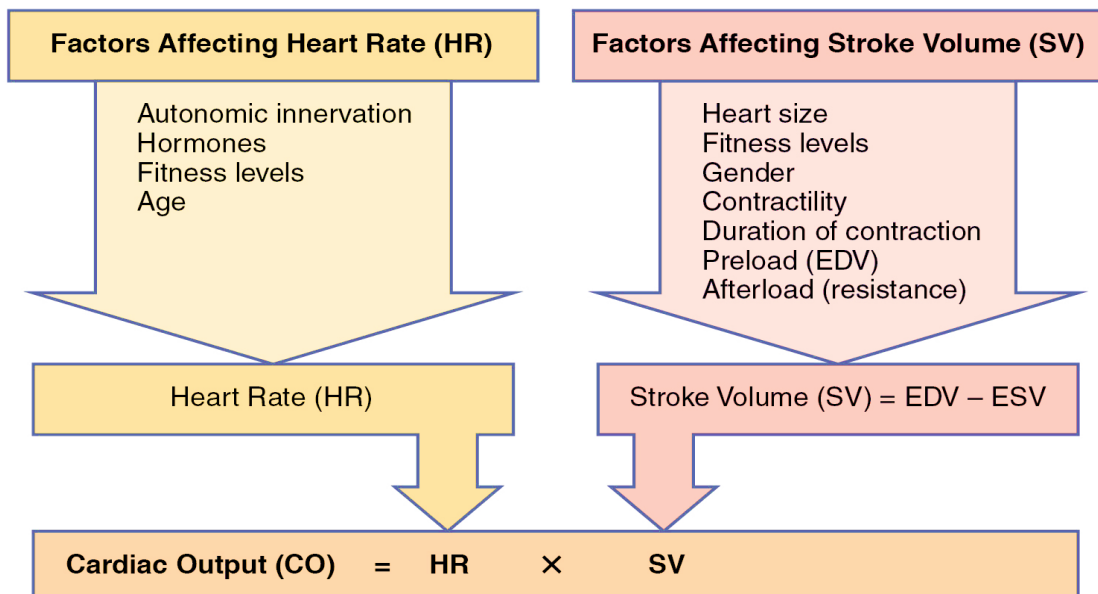
## Heart Sounds

- Can be heard with a stethoscope
- Two distinct sounds are “lub-dup”
- First sound is caused by the closing of the AV valves
- Second sound is caused by closing of the semilunar valves



## Cardiac Output

- The amount of blood pumped out by each side of the heart (each ventricle) in one minute.
- The product of heart rate and stroke volume (SV)
- Average adult SV = 70mL



- Stroke volume is the volume of blood pumped out by a ventricle with each heartbeat.
- Stroke volume is relatively constant in healthy people, but will decline if blood volume suddenly decreases or the heart is weakened.
- If stroke volume declines, the cardiac output will be maintained by a faster heart rate.
- The nervous system can temporarily control heart rate under certain conditions such as physical or emotional stress.
- Various hormones and ions can also affect heart activity.

---



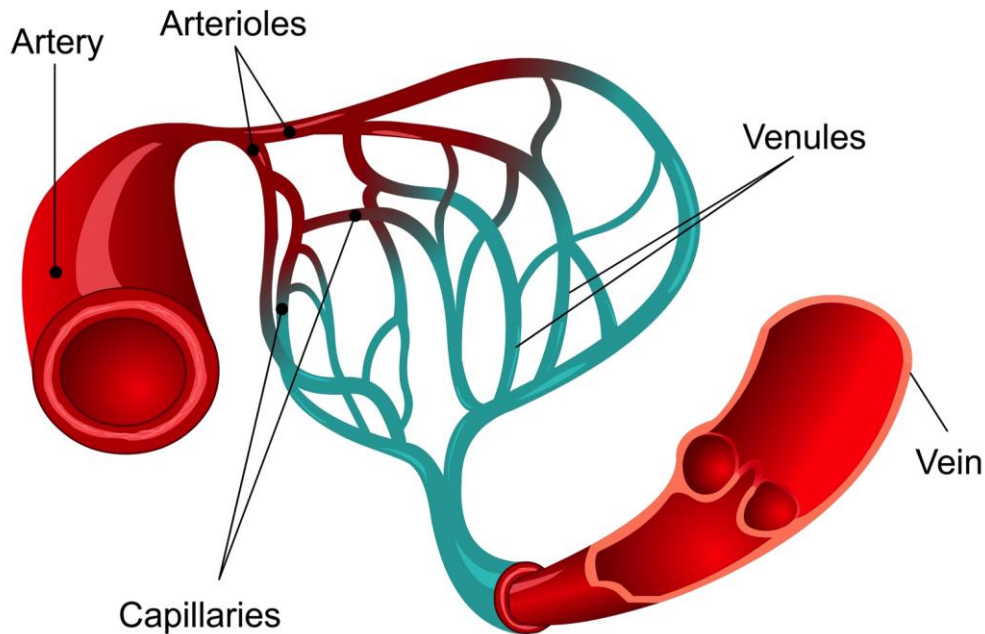
---



---

## Section 4: Anatomy of Blood Vessels

This section focuses on the anatomy of the blood vessels whose network carries blood all around the body.



*Answer these questions.*

What is the name of small arteries that feed capillary beds? \_\_\_\_\_

What happens in capillary beds? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Explain the gas exchange that occurs in capillaries. \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

What is the name of small veins that drain capillary beds? \_\_\_\_\_