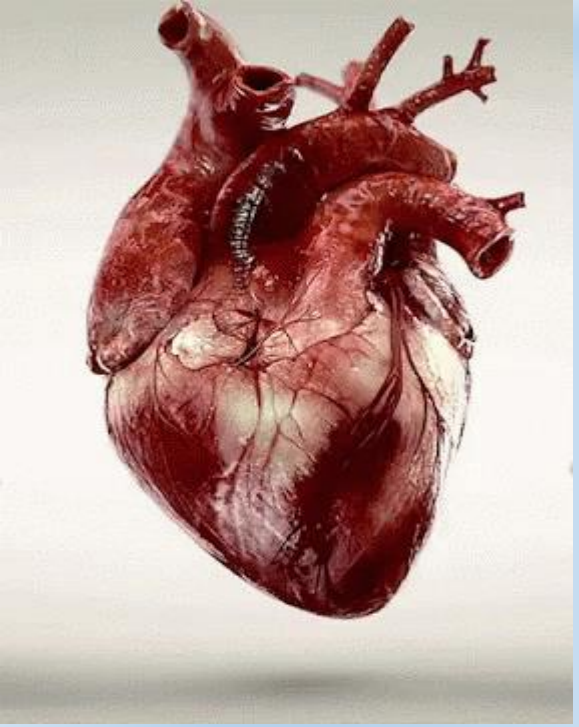


Biology Grade 9

CHAPTER 3: CARDIAC SYSTEM

INSTRUCTOR: SUHAIB AUDI

Activity 1: Heart and Cardiac Activity

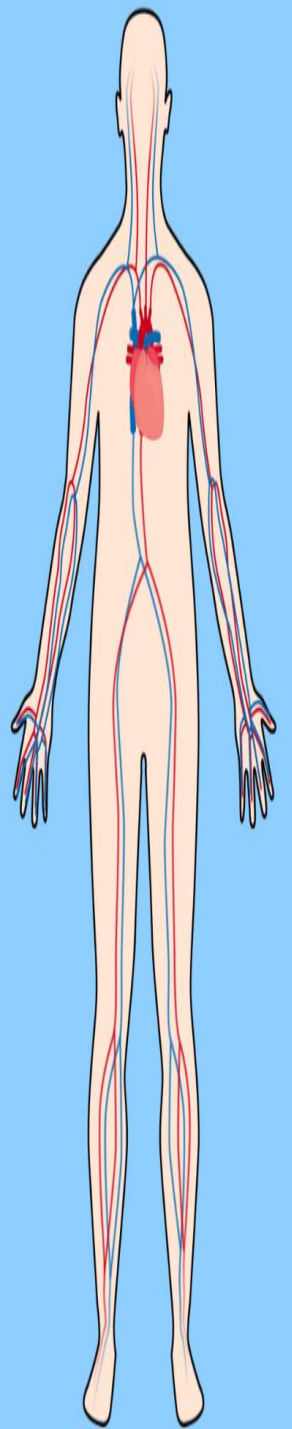
❖ Introduction:

The Cardiac System: The Engine of Life.

1. Main Function

- The cardiac system is responsible for transporting **oxygen, nutrients,** and **waste products** throughout the body. It's like a delivery service and garbage collector, all powered by a single pump: the **HEART**.

- The heart is an organ formed of hollow muscle, the **myocardium**.
- The main function of the heart is to **force blood through blood vessels to all the body organs**.
- Myocardium which is a cardiac muscle makes about 95% of the heart and is responsible for its **pumping action**.



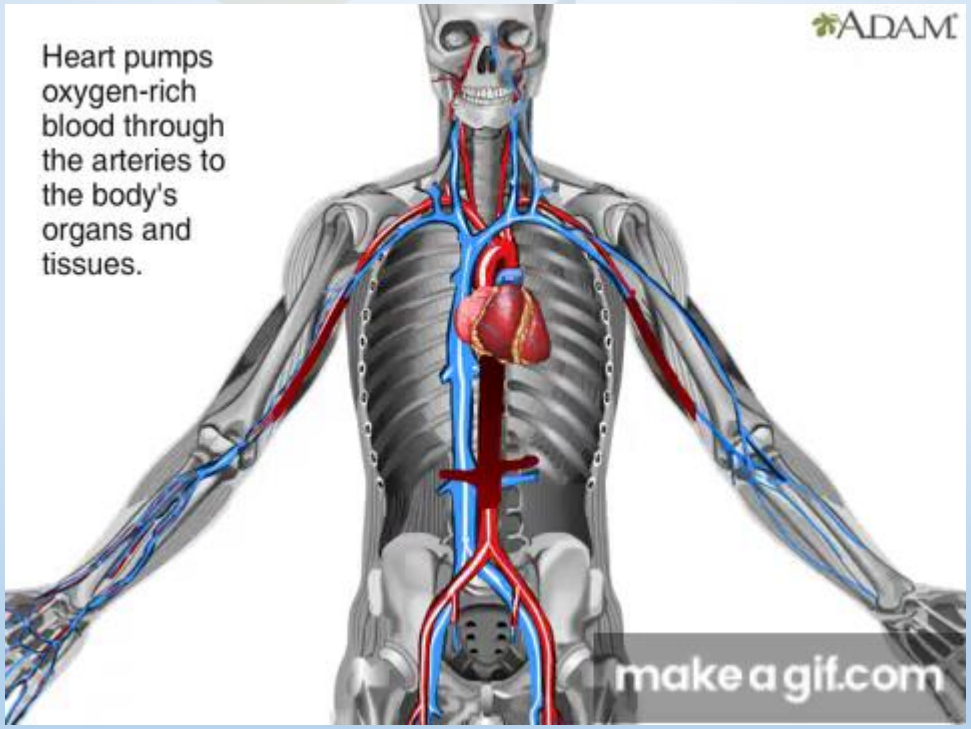
- **Blood, heart, and blood vessels are all parts of circulatory system of the body.**

➢ State the role of each part.

✓ Blood is a complex fluid which carries substances to and from the cells.

✓ The heart acts as a pump which moves the blood through blood vessels.

✓ Blood vessels are networks of tubes that transport blood to and from the heart.

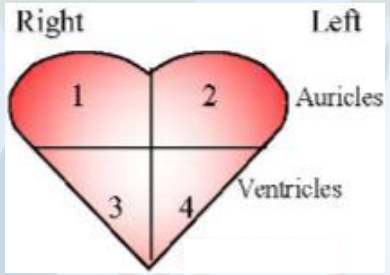


❖ Structure of the Heart (4 × 4 × 4)

- For a better understanding for the different structure... let's follow the next steps:

1. Suppose heart as a home.

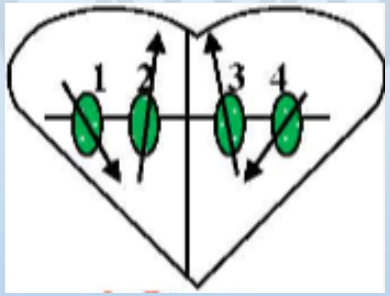
2. Divide heart into rooms.



Rooms are chambers/cavities:

1. Right auricle
2. Left auricle
3. Right ventricle
4. Left ventricle

3. Rooms need doors.



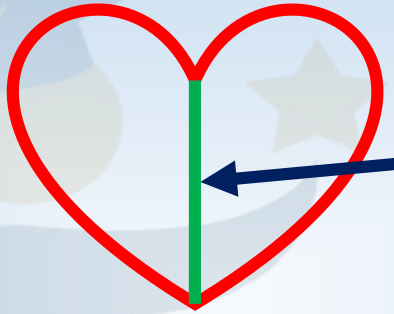
Doors are valves that allow the blood to pass only in one direction.

Since we have 4 rooms, we must have 4 doors:

1. Tricuspid valve
2. Sigmoid valve (pulmonary valve)
3. Sigmoid valve (Aortic valve)
4. Bicuspid valve

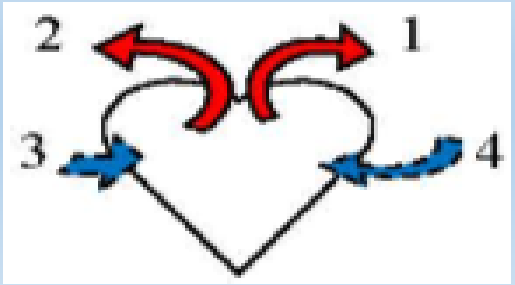
4. This home needs an Outer wall to protect and internal wall to separate rooms.

Heart wall is a muscular wall that makes heart contracts all the time. It's called: **Myocardium**



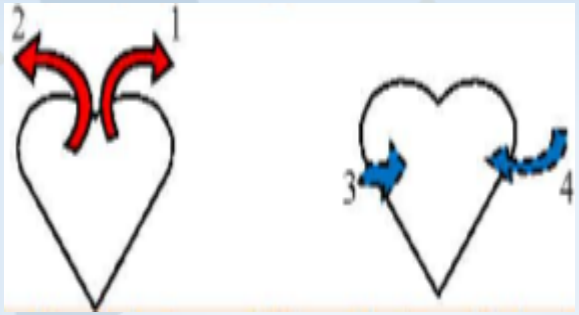
A wall is needed to separate left from right sides, it's called: **Septum**

5. This home needs ways to import and export stuff.



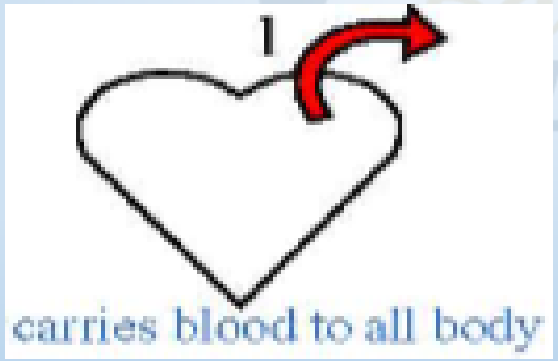
Since we have 4 cavities and 4 valves, we must have 4 ways (vessels). They are grouped to 2 types.

- 1 and 2 carry blood from the heart.
- They are called: Arteries



- 3 and 4 carry blood toward the heart.
- They are called: Veins

Pulmonary Artery



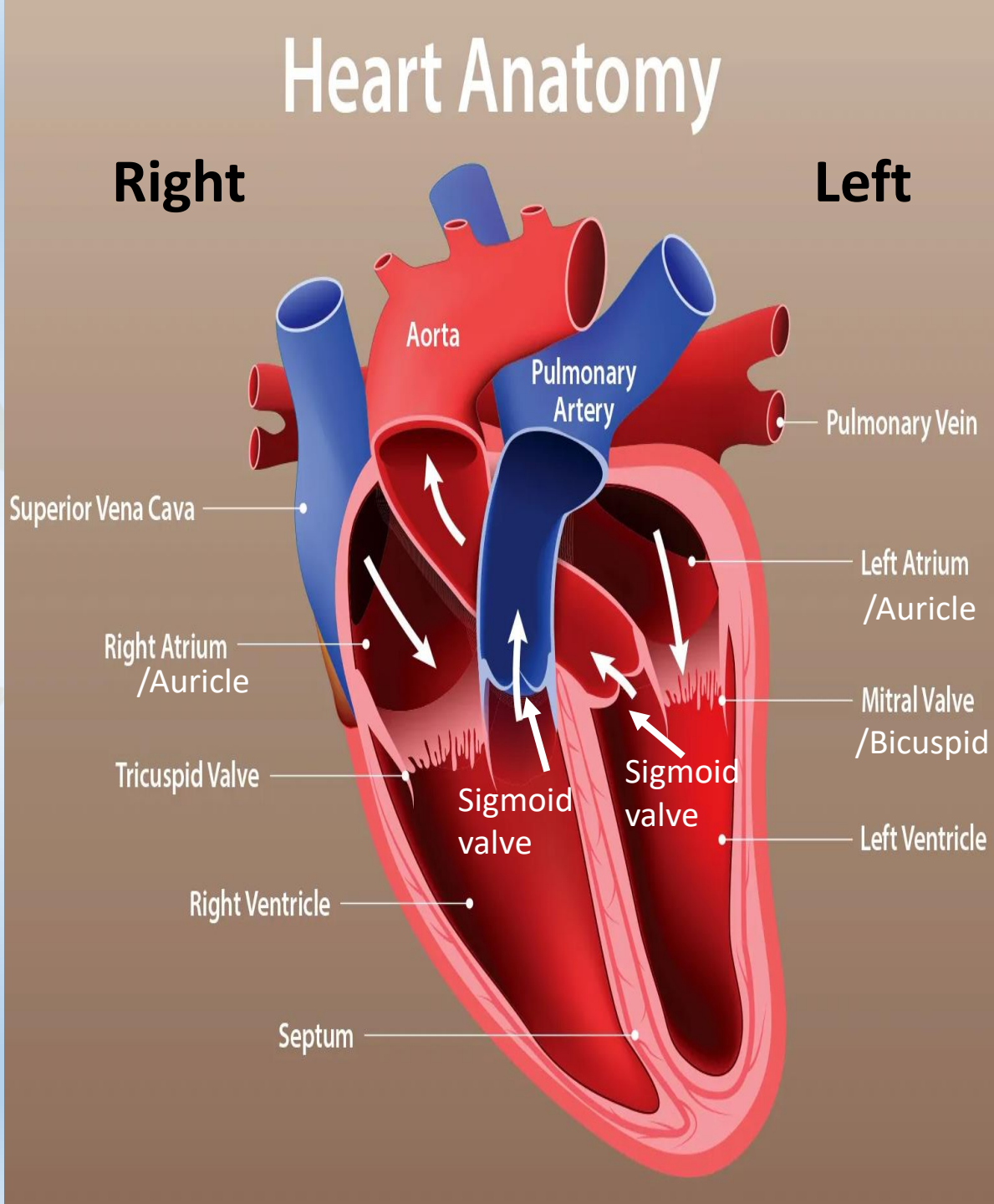
Aorta

Vena Cava

Pulmonary Vein

❖ General structure of the heart:

- The heart is divided into the **left** and **right** heart.
- The two parts don't communicate; they are separated by a **septum**.
- The heart is made up of **4 cavities, 4 blood vessels and 4 valves. (4 × 4 × 4)**



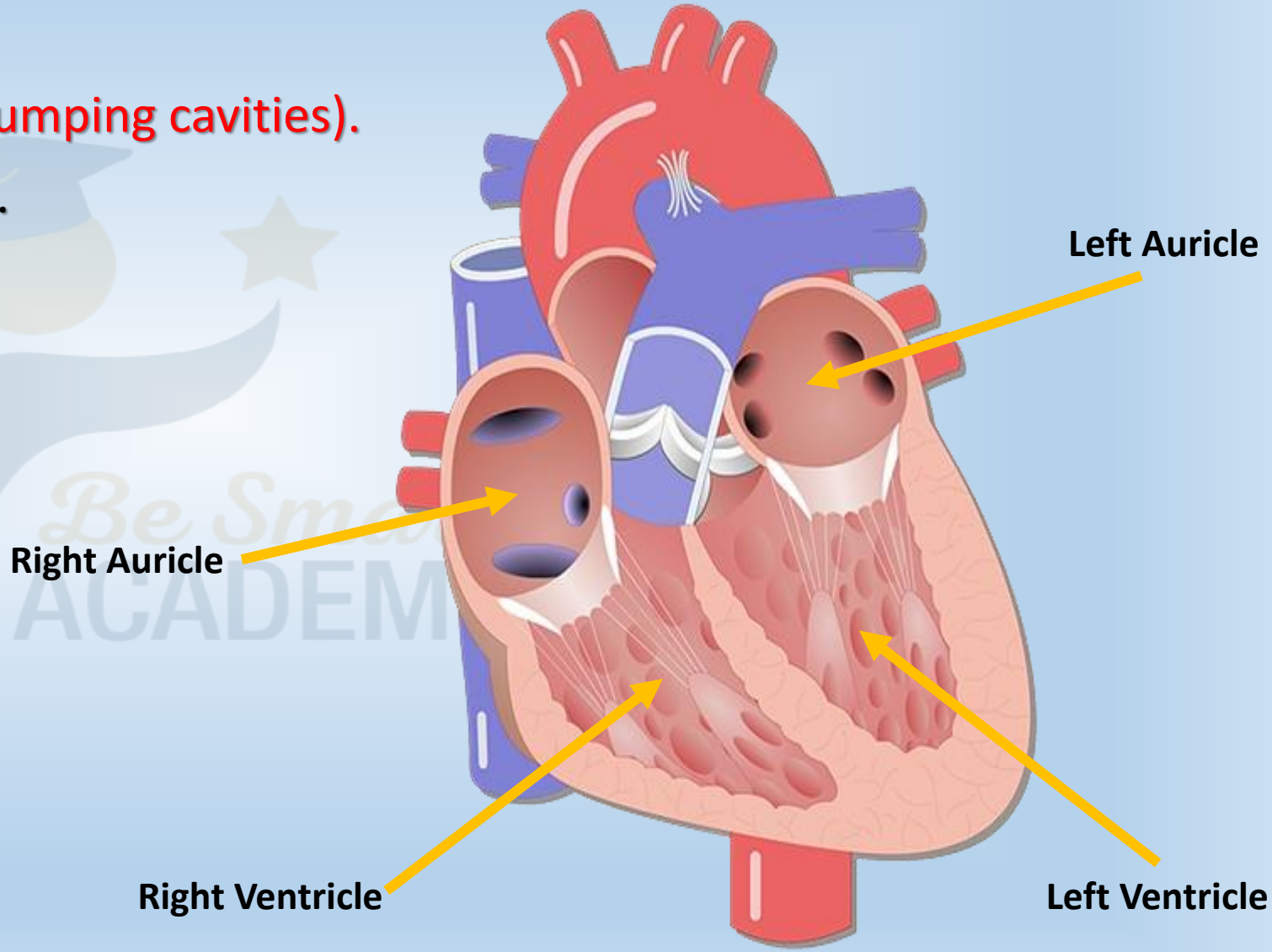
❑ The cavities are:

1. Auricles (atria): Two upper cavities (receiving cavities).

- ➢ Right auricle and Left auricle.

2. Ventricles: Two lower cavities (pumping cavities).

- ➢ Right ventricle and left ventricle.



- **Cavities:**

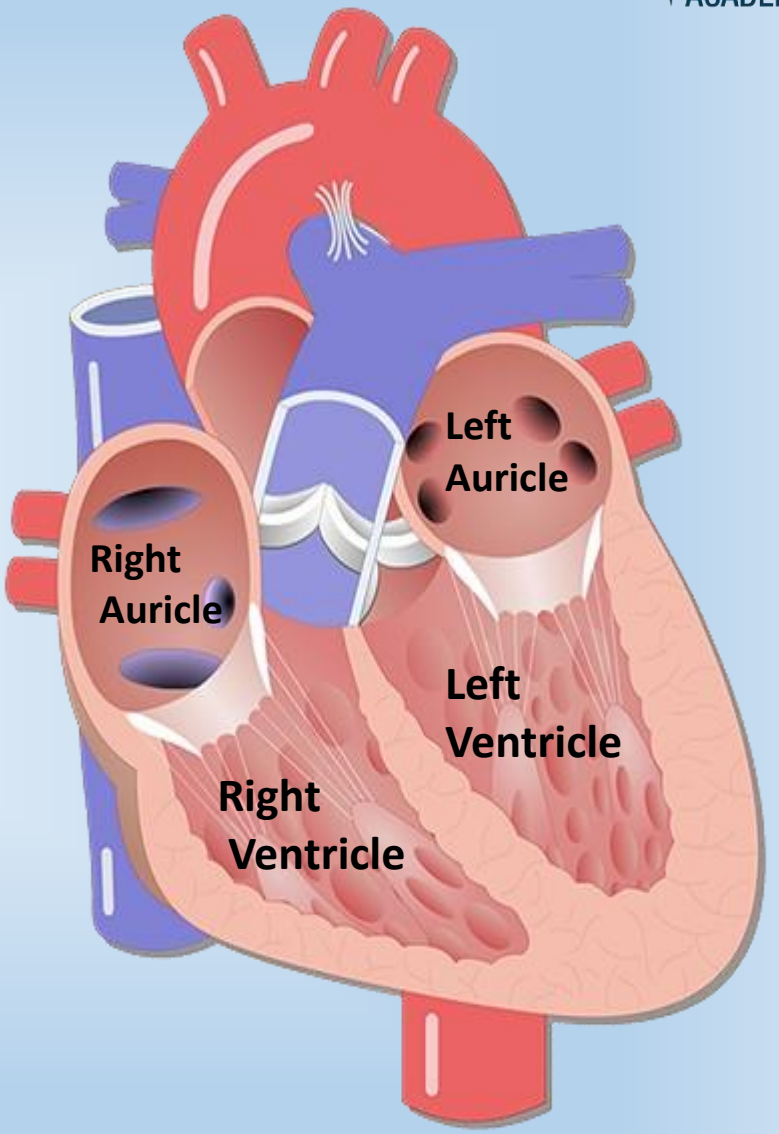
• The auricles have **thin wall** and they pump blood into the ventricles.

• The ventricles have **thick wall** and they pump blood into the aorta and pulmonary arteries.

- The left ventricle has thicker wall than the right ventricle due to the high pressure of blood in the left part.

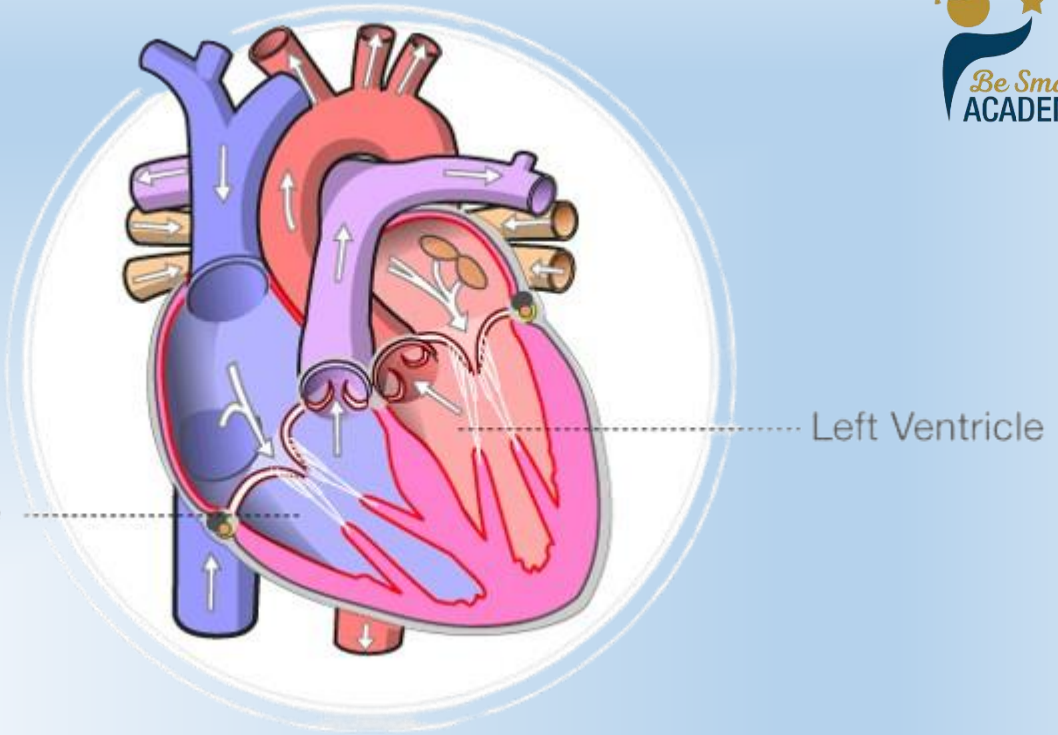
- Explain why the thickness of the walls of auricles and ventricles is different.

Since the ventricles pump blood under high pressure over greater distance whereas auricles deliver blood under less pressure into the adjacent ventricles.



- “The wall of the left ventricle is thicker than the wall of the right ventricle”. Justify this statement.

The left ventricle pumps the blood under high pressure to the whole body organs whereas the right ventricle pumps blood under less pressure to the lungs, therefore the wall of the left ventricle is thicker compared to the wall of the right ventricle.



❖ The Blood Vessels are:

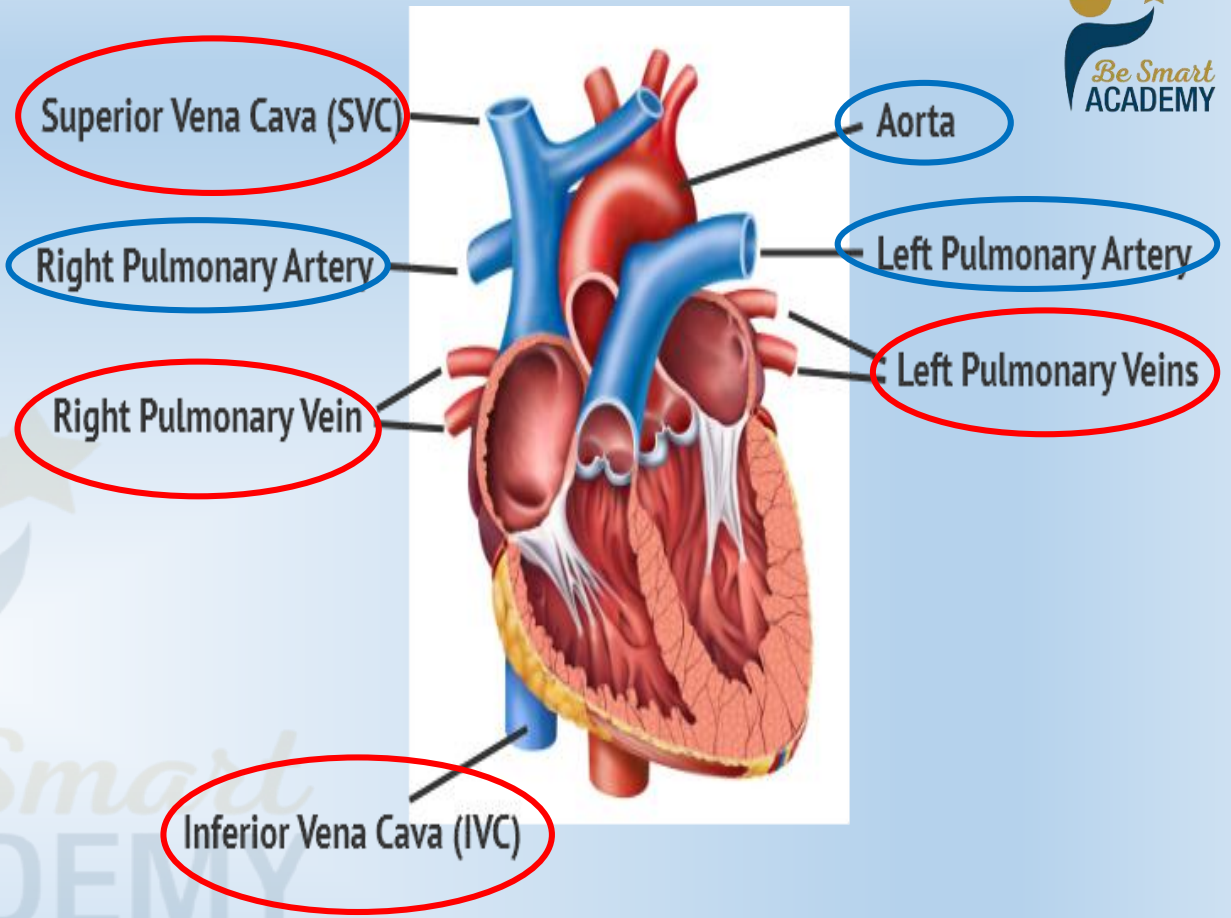
- Arteries: carry blood **away** from the heart (leaving the heart).

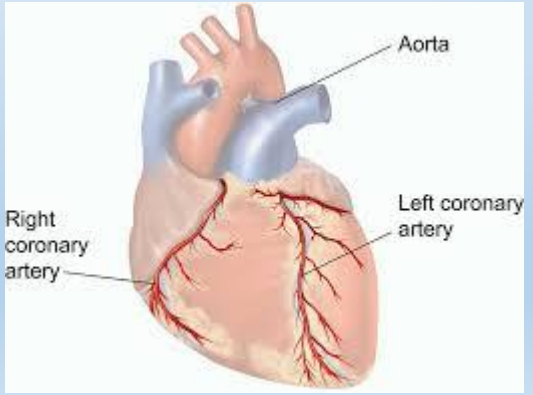
1. Aorta: from the left ventricle.
2. Pulmonary arteries: from the right ventricle.

- Veins: carry blood **into** the heart (arriving at the heart).

1. Superior and inferior Vena cava: into the right auricle.
2. Pulmonary veins: into the left auricle.

- Note: **Coronary arteries:** carry blood from the heart into the heart itself.





❖ Blood vessels:

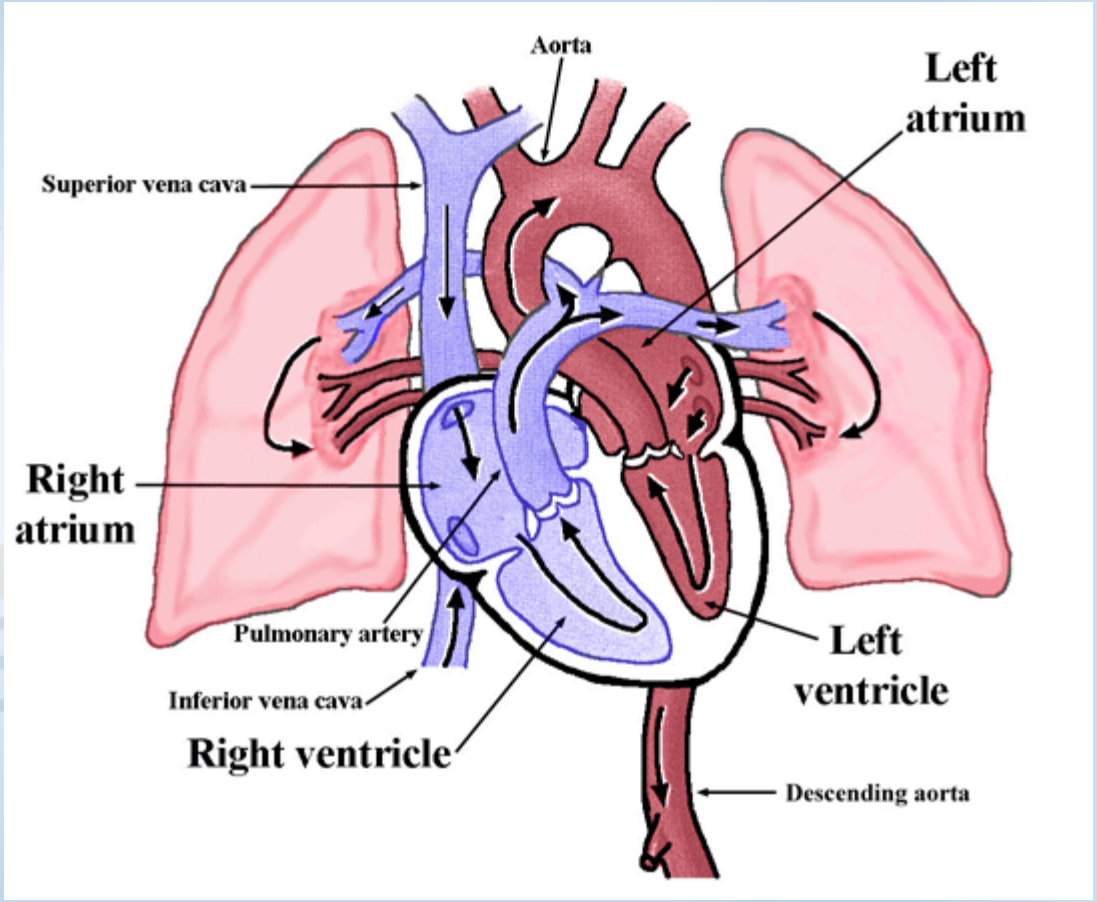
1) vena cava:

- **Superior vena cava:** carries blood rich in **carbon dioxide** from the **upper part** of the body to the right auricle.
- **Inferior vena cava:** carries blood rich in **carbon dioxide** from the **lower part** of the body (abdomen and legs) to the right auricle.

2) pulmonary artery: carries blood rich in **carbon dioxide** from the heart (right ventricle) into the lungs.

3) Pulmonary veins: Carry blood rich in **oxygen** gas from the lungs into the left auricle.

4) Aorta: carries **oxygenated blood** from the heart (left ventricle) into body organs.

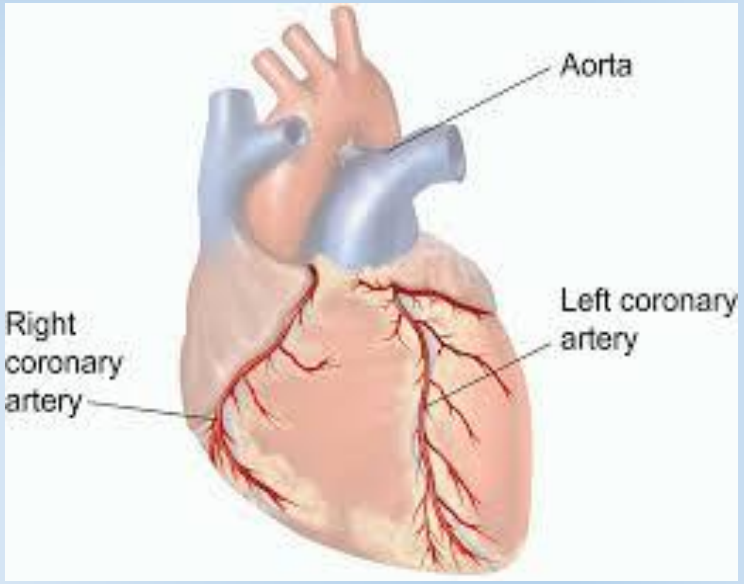


❖ Coronary arteries:

Some of the blood in the aorta flows into the coronary arteries which branch from the aorta.

1. Indicate the role of coronary arteries.

Coronary arteries carry blood to the heart wall. The two coronary arteries, the left and right one branch from the aorta and supply oxygenated blood to the heart wall.



2. Explain why the heart has its own network of blood vessels.

Because oxygen and nutrients are not able to diffuse from the blood into the cavities of the heart to supply all its cells. Therefore, the heart has its own network of blood vessels; the coronary arteries.

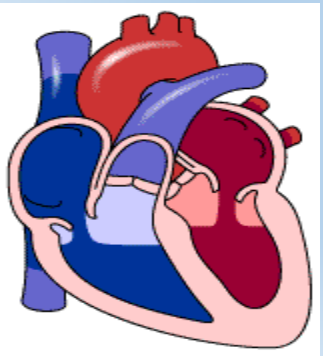
❖ Valves:

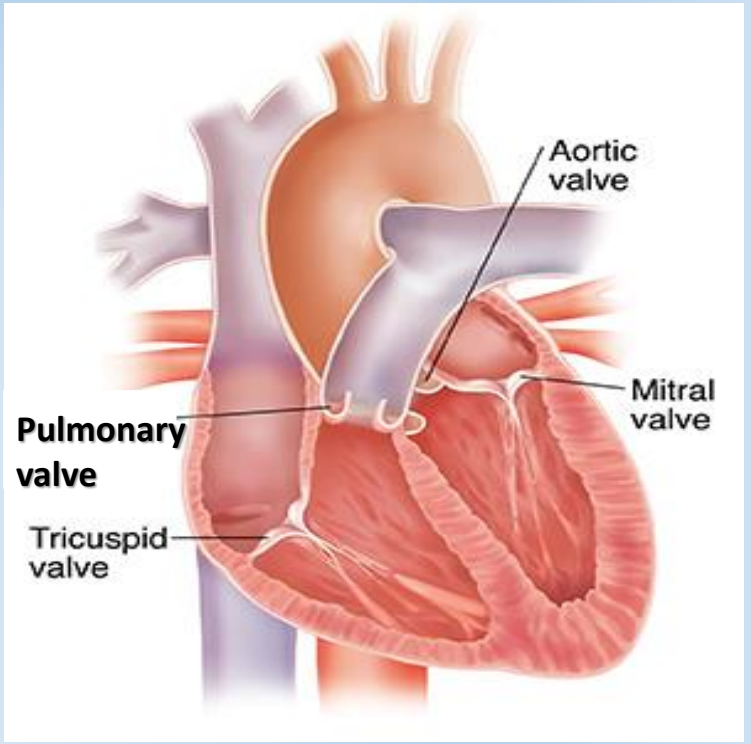
- The left auricle is separated from the left ventricle by **Bicuspid valves (Mitral valve).**
- The right auricle is separated from the right ventricle by **Tricuspid valves.**

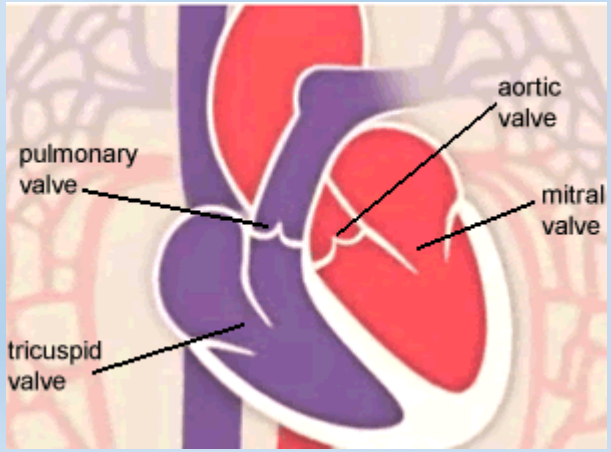
➢ These valves allow one direction of blood from the auricles into the ventricles and **prevent the backflow** of blood into the auricles.

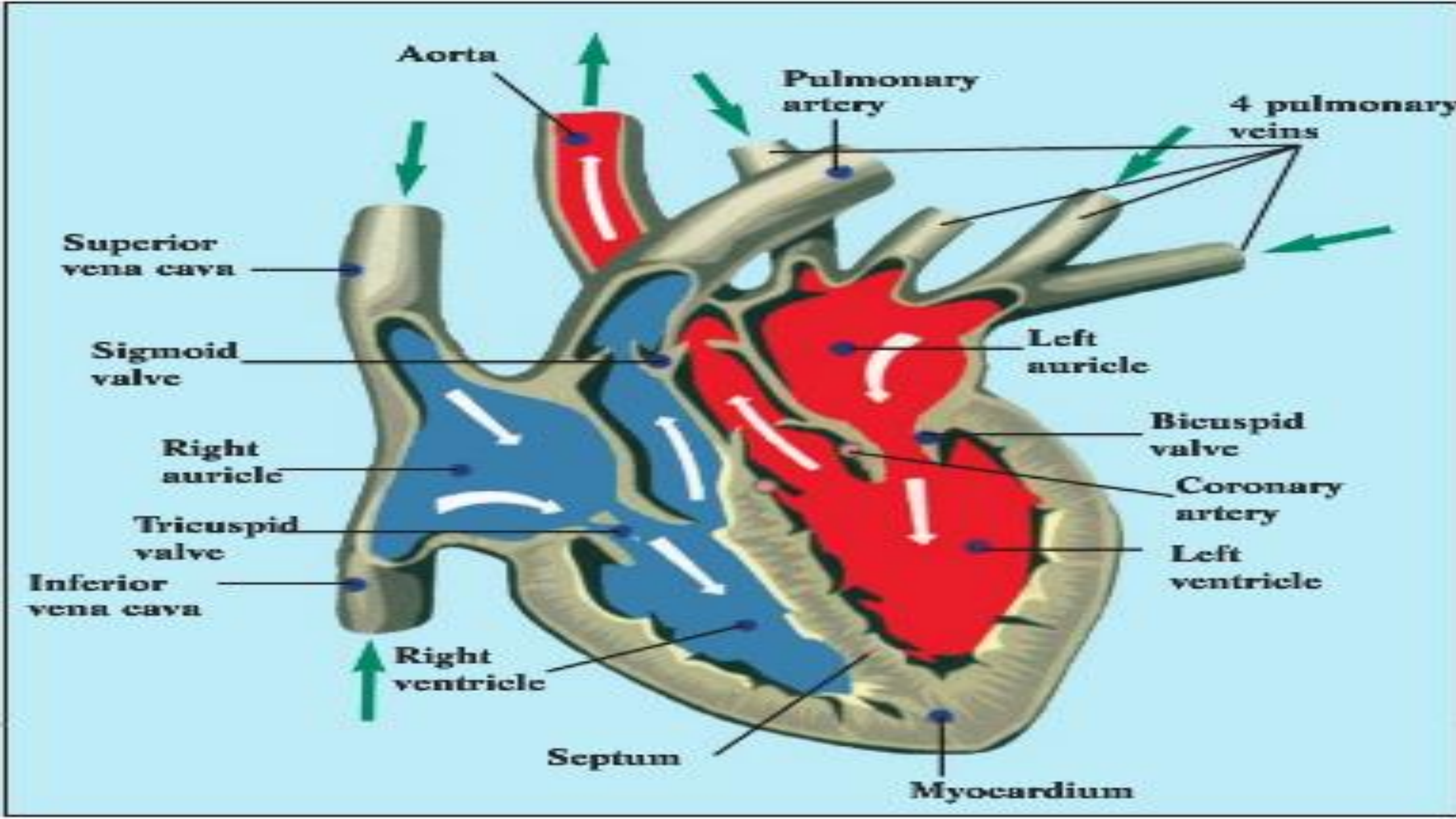
- **Sigmoid valves** are located at the base of the aorta **(Aortic valve)** and pulmonary artery **(Pulmonary valve).**

➢ These valves allow blood to flow in one direction from the ventricles into the arteries **and prevent the backflow** of blood into the ventricles.



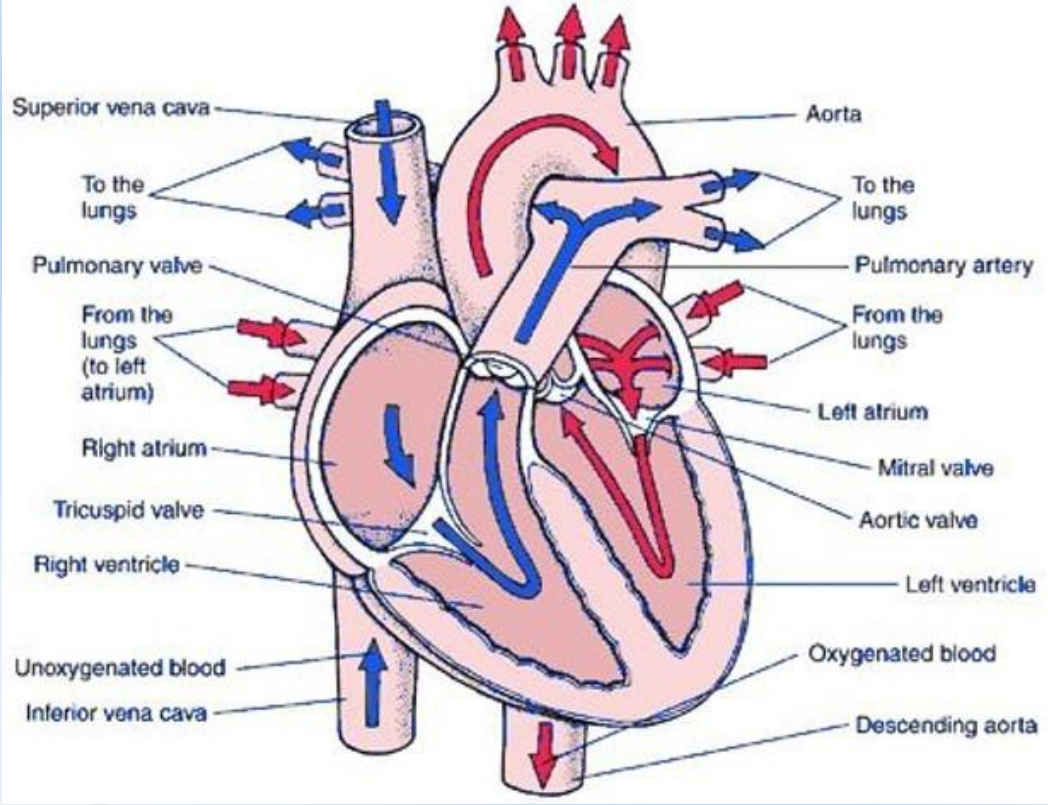


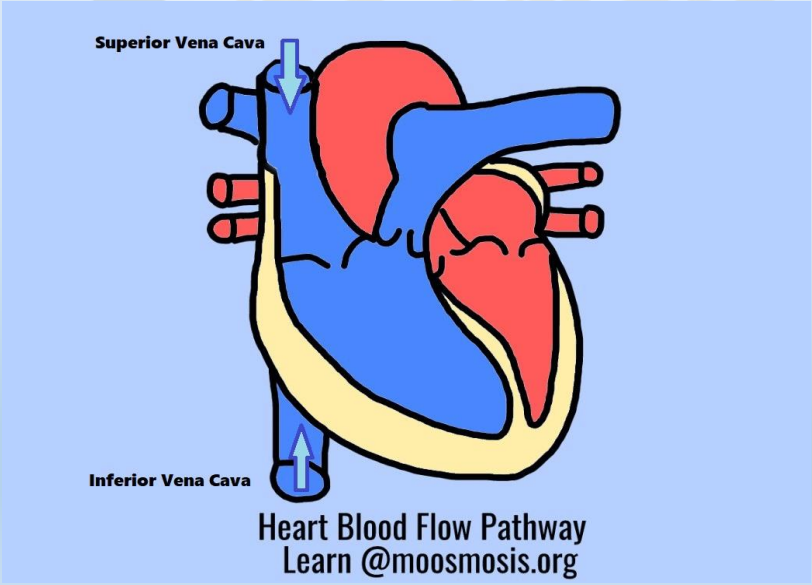


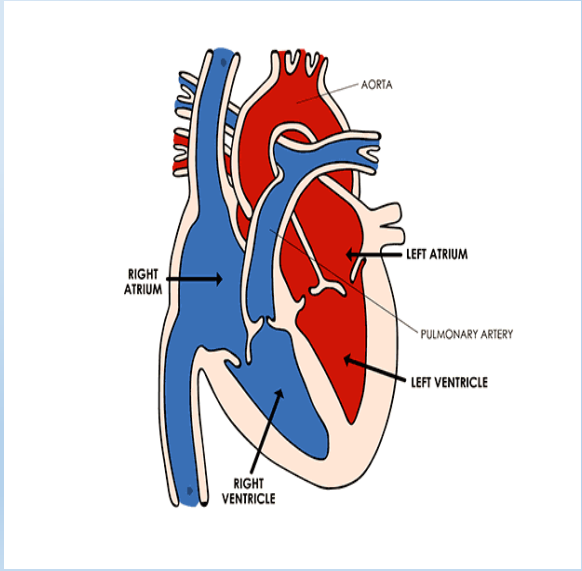

Aorta
Pulmonary artery
4 pulmonary veins
Superior vena cava
Sigmoid valve
Left auricle
Bicuspid valve
Right auricle
Coronary artery
Tricuspid valve
Left ventricle
Inferior vena cava
Right ventricle
Septum
Myocardium

- State the pathway of blood flow inside the **right** side of the heart.

- The right auricle receives deoxygenated blood from superior vena cava and inferior vena cava.
- Blood passes from the right auricle into the right ventricle through a valve that is called tricuspid valve.
- Blood then passes from the right ventricle through the pulmonary valve (or sigmoid valve) into a large artery which divides into left and right pulmonary arteries.

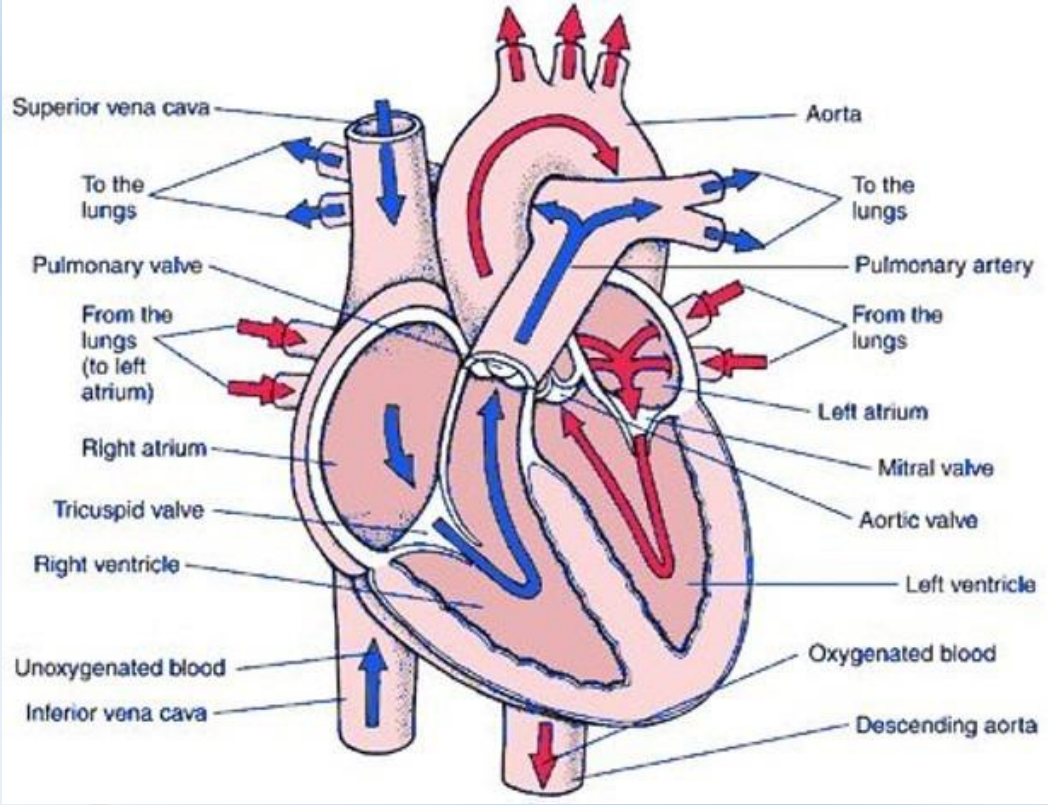


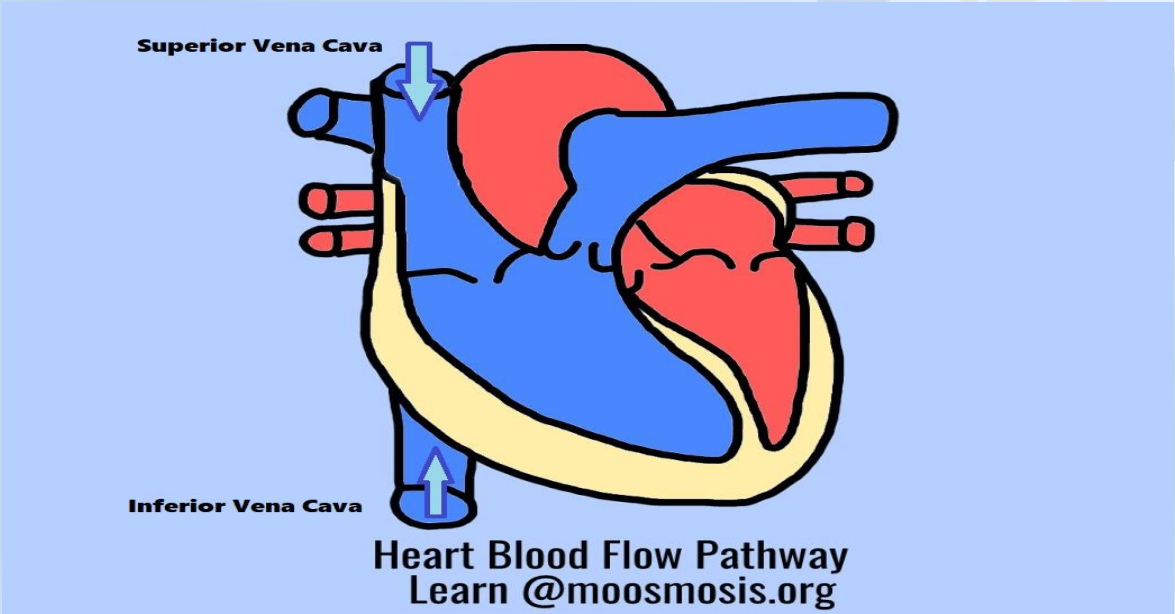




- State the pathway of blood flow inside the **left** side of the heart.

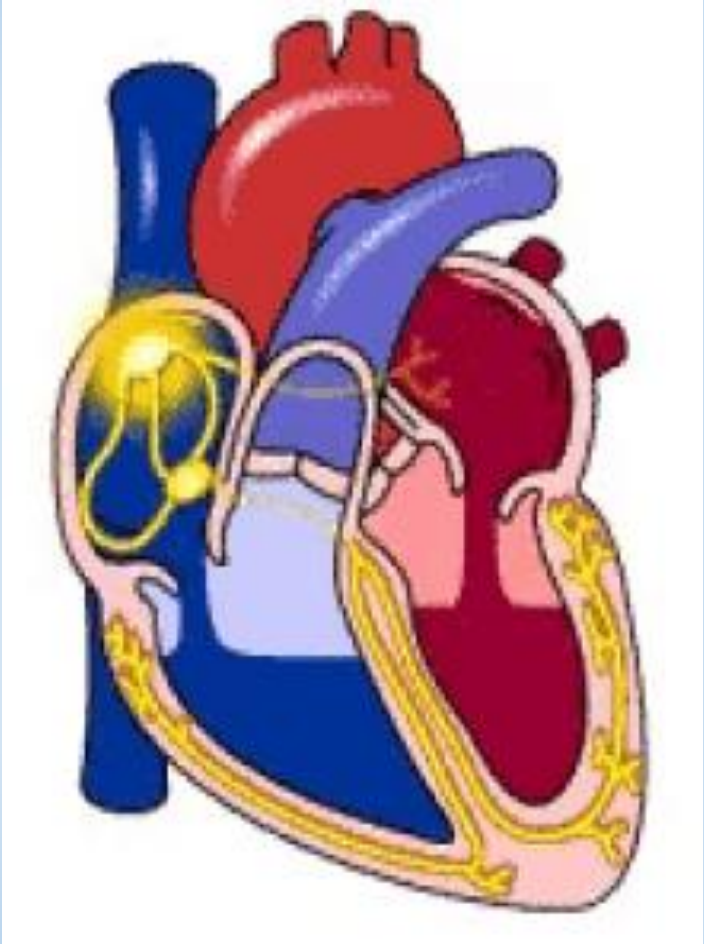
- The left auricle receives **oxygenated blood** from the lungs through four pulmonary veins.
- Blood passes from the left auricle to the left ventricle through the bicuspid valve.
- Blood then passes from the left ventricle through the aortic valve (or sigmoid valve) into the aorta.





❖ The Cardiac cycle:

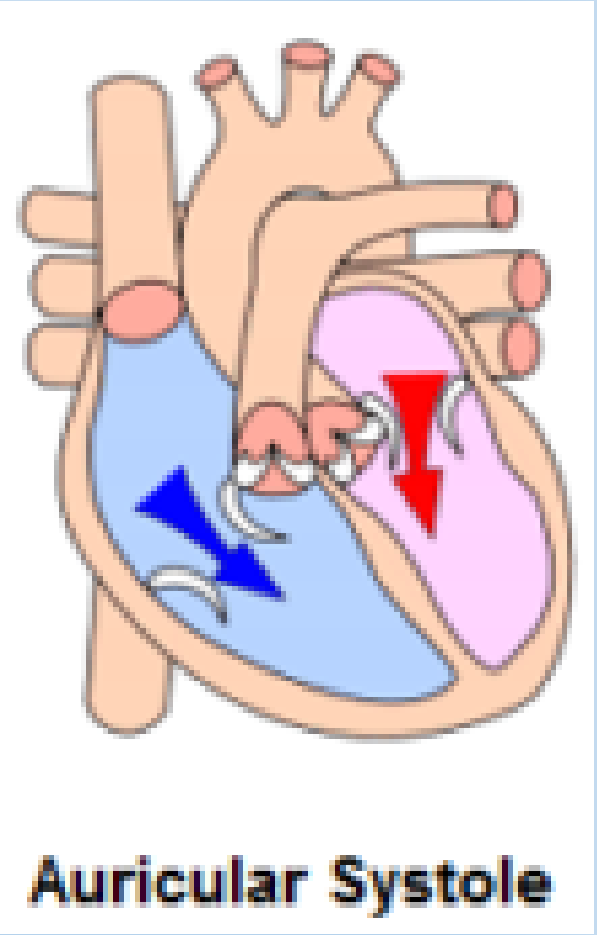
- The cardiac cycle means **heartbeat**.
- The heart beats about 70 heartbeats/minute.
- Each heartbeat takes 0.8 sec.
- Each heartbeat ensures that blood is pumped to all body organs.
- The term **Systole refers to the phase of contraction**, and the term **Diastole refers to the phase of relaxation**.
- Thus, a cardiac cycle consists of systole and diastole of the auricles plus systole and diastole of the ventricles and general diastole.
- In each cardiac cycle, the auricles and the ventricles alternately contract and relax, thus controlling blood movement.
- A single cardiac cycle includes all the events associated with one heartbeat.



The cardiac cycle consists of three phases.

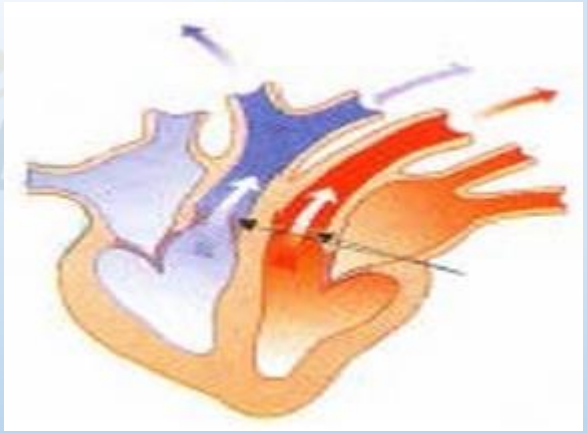
❑ 1st phase: Auricular Systole (0.1 seconds)

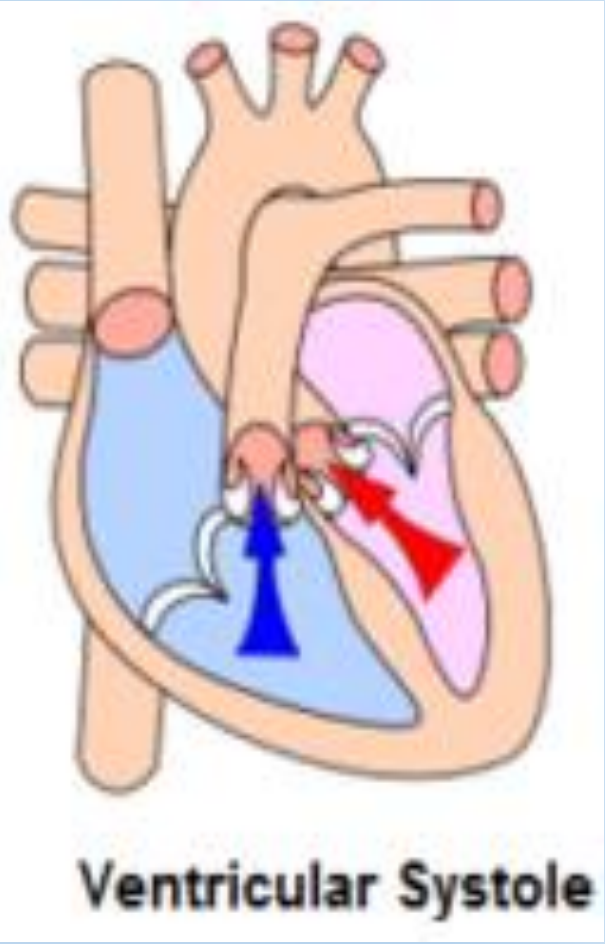
- Auricles contract.
- Ventricles relax.
- The blood is pumped from the left and the right auricles into the left and right ventricles through opened bicuspid and tricuspid valves respectively.
- The sigmoid valves are closed.



❑ 2nd phase: Ventricular Systole (0.3 seconds)

- The bicuspid and tricuspid valves are closed to prevent the backflow of blood into the auricles.
- Sigmoid valves open.
- Auricles relax.
- Ventricles contract; The blood is pumped from the left and right ventricle into the aorta and pulmonary arteries respectively through opened sigmoid valves. (The heart is empty of blood).



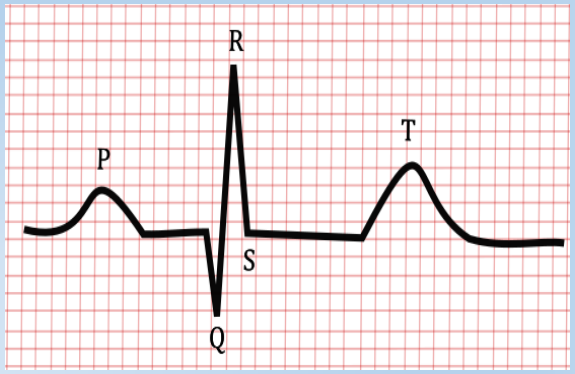


❑ 3rd phase: General diastole (0.4 seconds)

- The sigmoid valves are closed to prevent the backflow of blood into the ventricles.
- Tricuspid and bicuspid valves opened.
- The auricles and the ventricles are at rest.
- The blood enters the left auricle through pulmonary veins and to the right auricle through the inferior and superior vena cava and slowly fills into the ventricles through opened bicuspid and tricuspid valves.

❖ Electrocardiography:

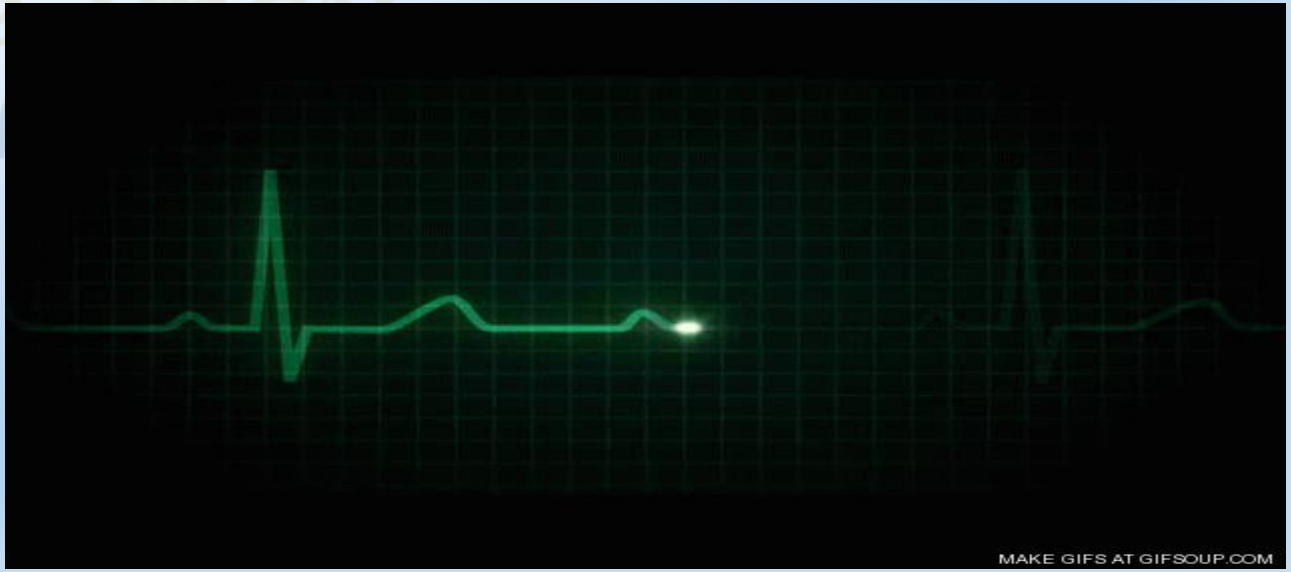
- Electrocardiography is a medical examination that provides information about the regularity of the cardiac activity.
- An electrocardiogram (ECG) is a recording of the electrical activity of the heart.



✓ P wave: corresponds to the auricular systole.

✓ QRST wave: corresponds to the ventricular systole.

✓ The general diastole has no wave since the heart is at rest.

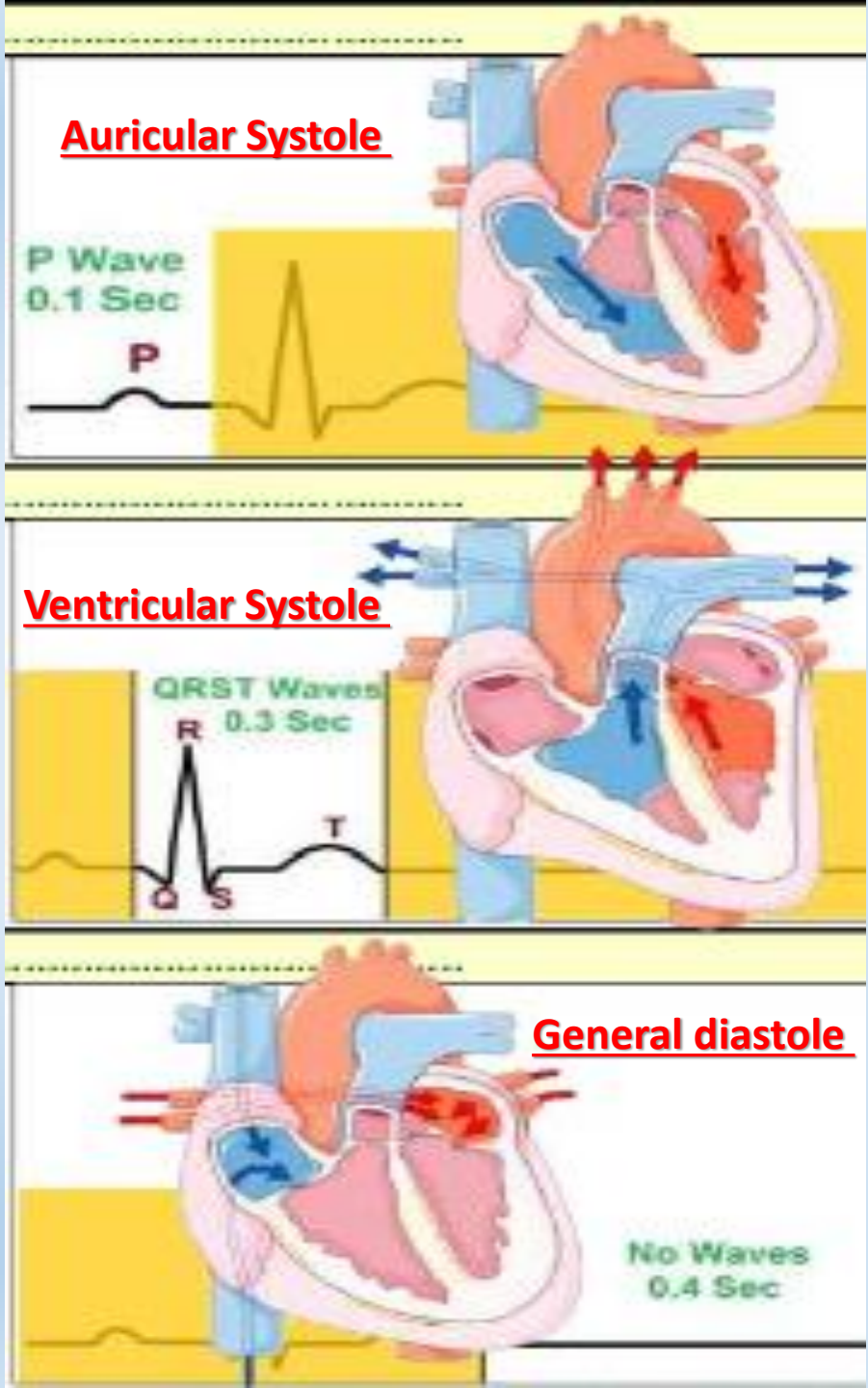


❑ Calculate the total duration of the cardiac cycle.

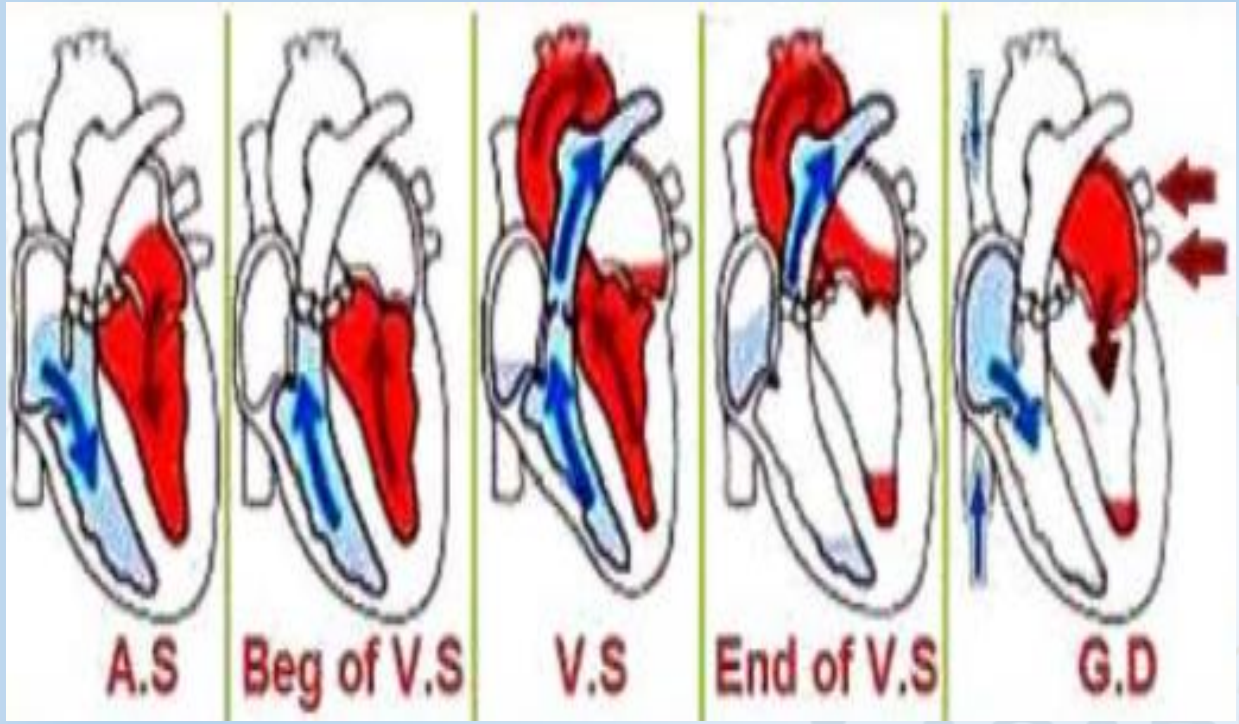
- The total duration of the cardiac cycle is:

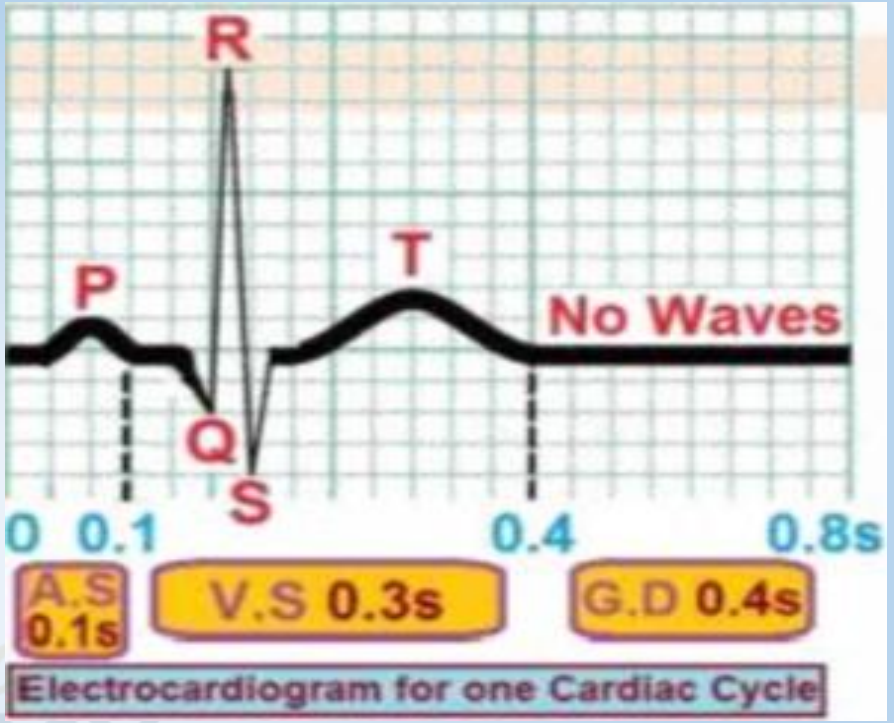
0.1s (AS) + 0.3s (VS) + 0.4s (GD) = 0.8s.

- Therefore, **duration of systole= 0.1s + 0.3s = 0.4s**
- **Duration of diastole= 0.4s**
- Duration of action = duration of relaxation = 0.4s, so the heart doesn't get tired.



❖ Summary


A.S
Beg of V.S
V.S
End of V.S
G.D


R
P
T
No Waves
Q
S
0
0.1
0.4
0.8s
A.S 0.1s
V.S 0.3s
G.D 0.4s
Electrocardiogram for one Cardiac Cycle