



UNIVERSITÀ  
DEGLI STUDI  
DI PADOVA

**DNS** DEPARTMENT OF NEUROSCIENCE

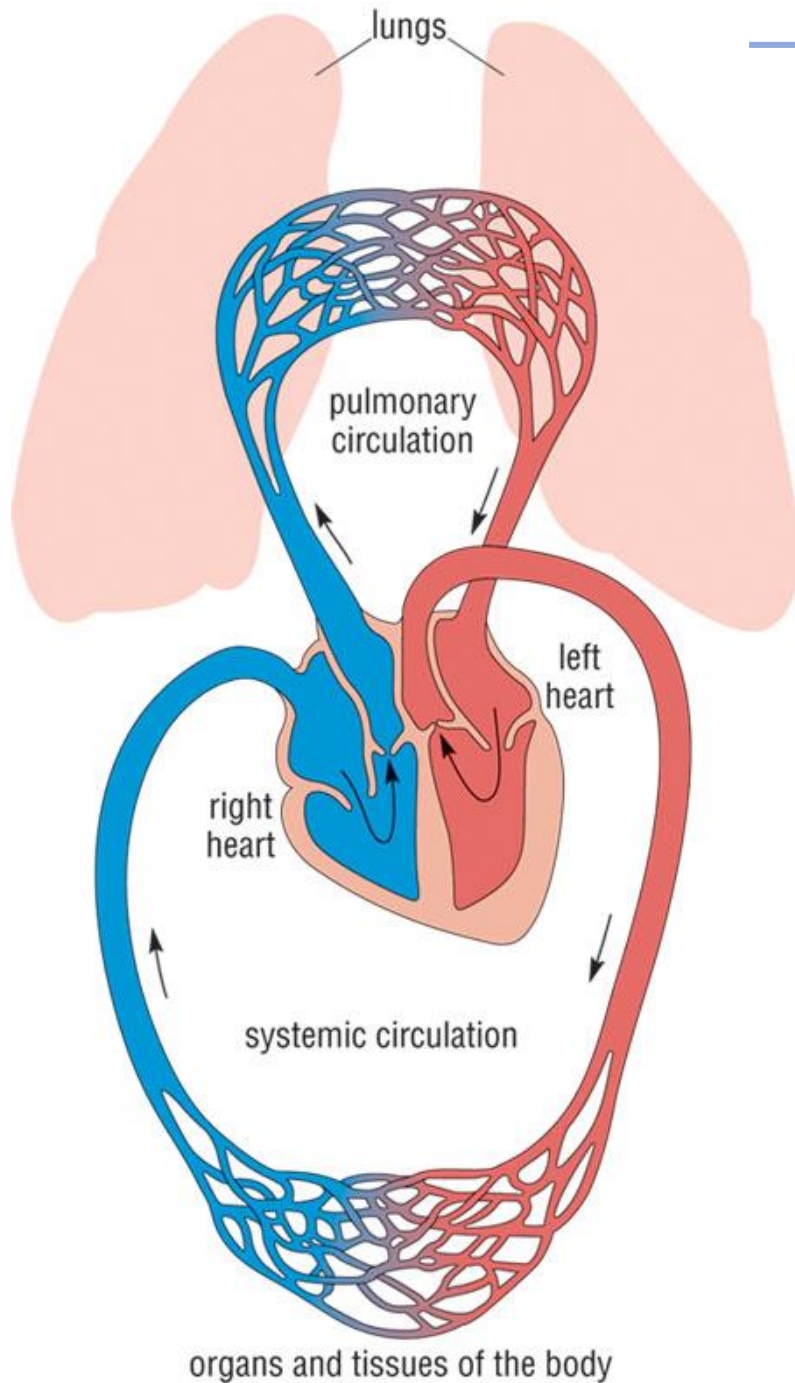


ANATOMY AND PHYSIOLOGY (C.I.)

HUMAN ANATOMY  
(Mod. A)

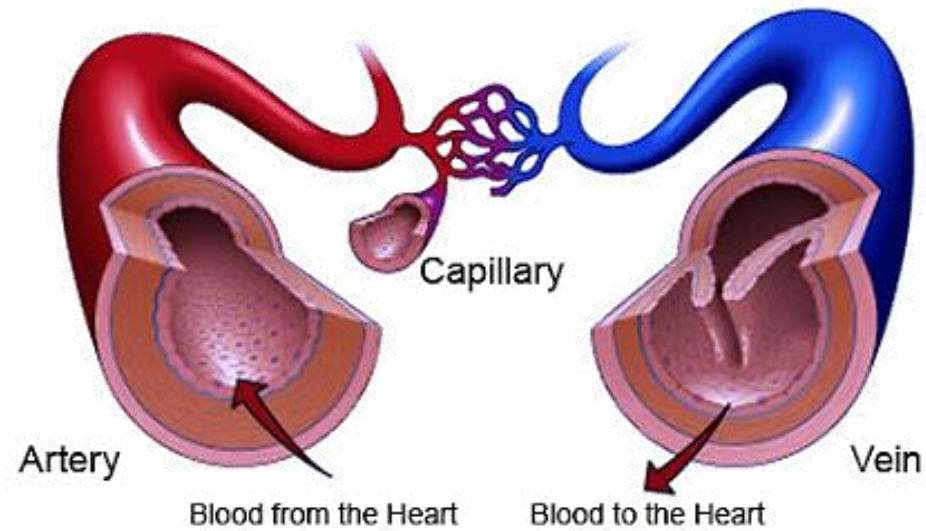
THE CARDIOVASCULAR SYSTEM

# INTRODUCTION TO THE CARDIOVASCULAR SYSTEM



It is composed by:

- **HEART**
- **BLOOD VESSELS**, including **ARTERIES**  
**VEINS**  
**CAPILLARIES**



## ARTERIES

## VEINS

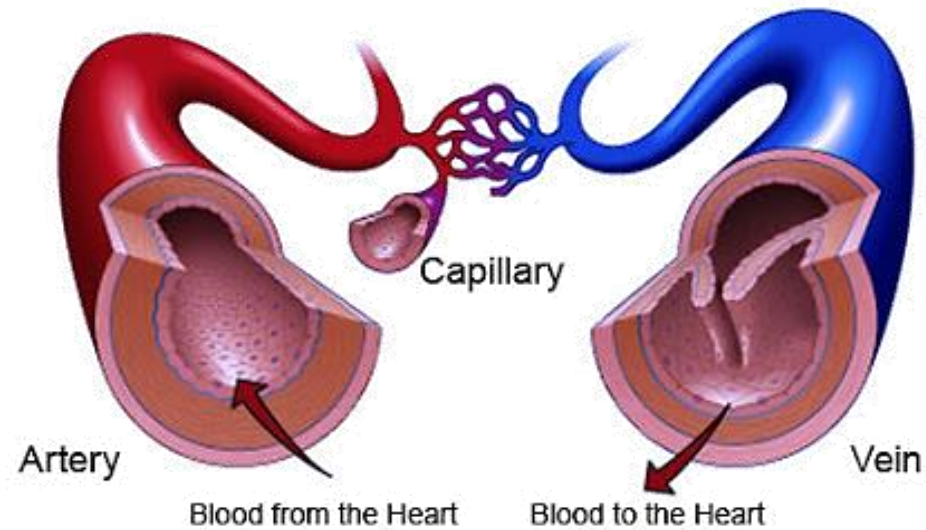
- Blood vessels that carry blood from the heart to the peripheral tissues
- They divide into smaller and smaller branches

↓  
**ARTERIOLES**

↓  
**CAPILLARIES**

↓

Vessels with a smaller diameter, with a thinner wall, where the **exchange of oxygen and nutrients** between the blood and tissues takes place



## ARTERIES

- They carry **arterial (oxygenated) blood**, but can also carry non-oxygenated blood (e.g. pulmonary artery, which carries blood to the lungs to be oxygenated)

## VEINS

- Once the exchanges between blood and tissues have taken place, the capillaries flow into larger and larger vessels:

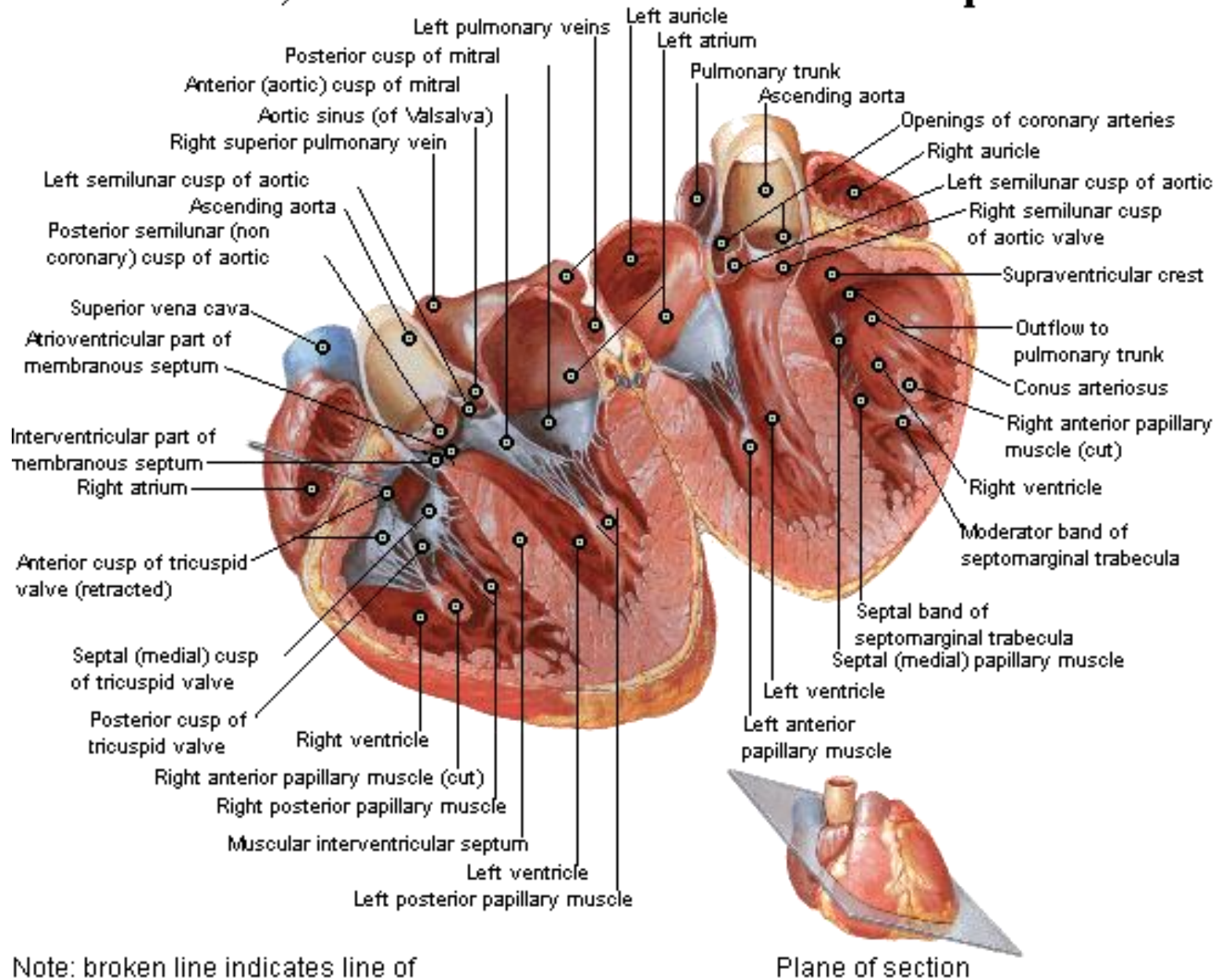
**VENULES**



**VEINS**

- Blood vessels that carry blood from the peripheral tissues to the heart
- They carry **venous (non-oxygenated) blood**, but can also transport **oxygenated blood** (e.g. pulmonary vein, which carries oxygenated blood from the lungs to the heart)

# Atria, Ventricles and Interventricular Septum



It consists of **4 CARDIAC or HEART CHAMBERS** (4 hollow spaces) that function as blood pumps

The cardiac chambers are:

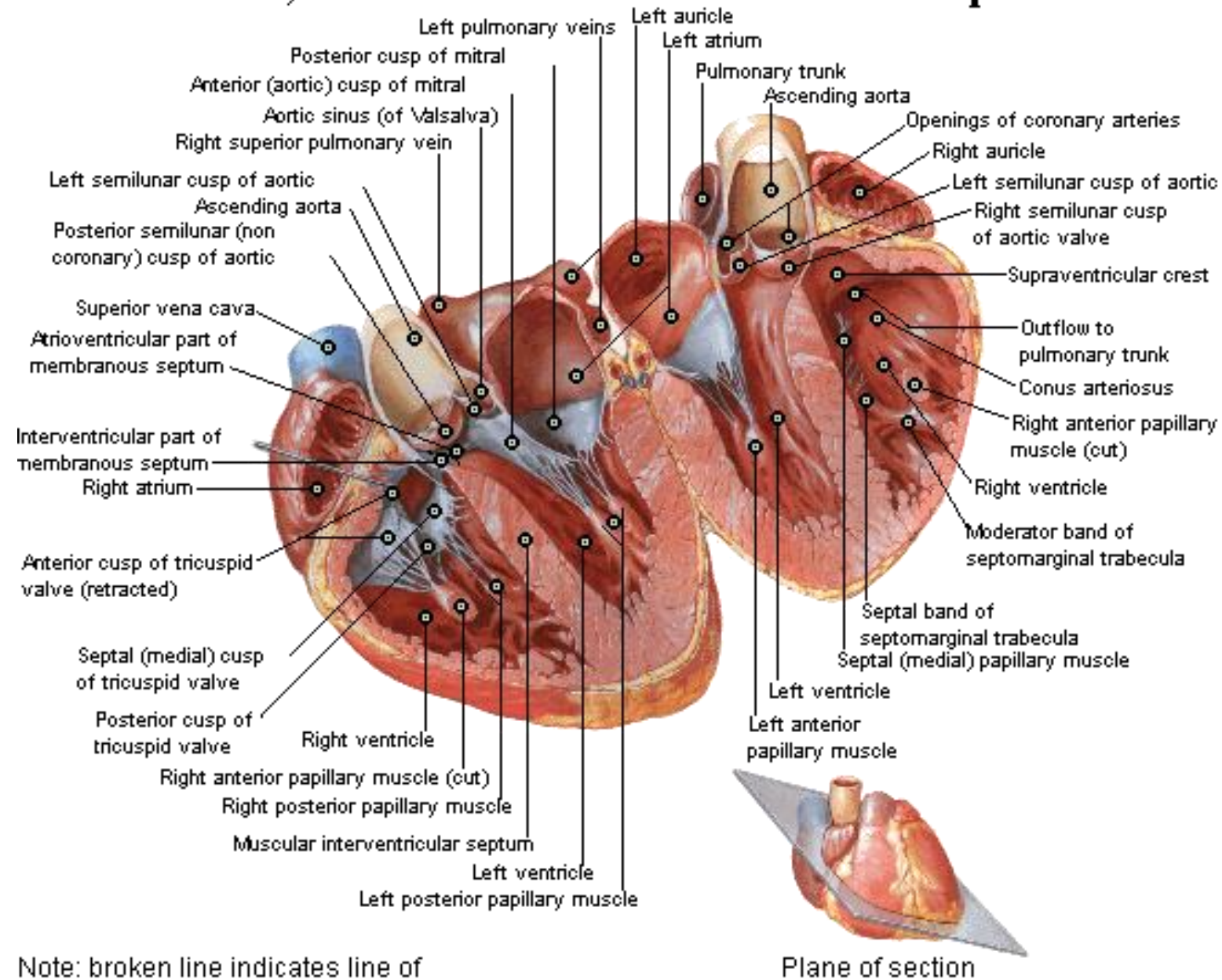
- right atrium
- left atrium
- right ventricle
- left ventricle

The walls of the heart chambers are made up mainly of heart muscle, the **myocardium**

Note: broken line indicates line of attachment of septal leaflet of tricuspid valve.



# Atria, Ventricles and Interventricular Septum



The right half and the left half of the heart are separated by **septa** → walls which completely divide chambers and are made up of muscle tissue (myocardium).

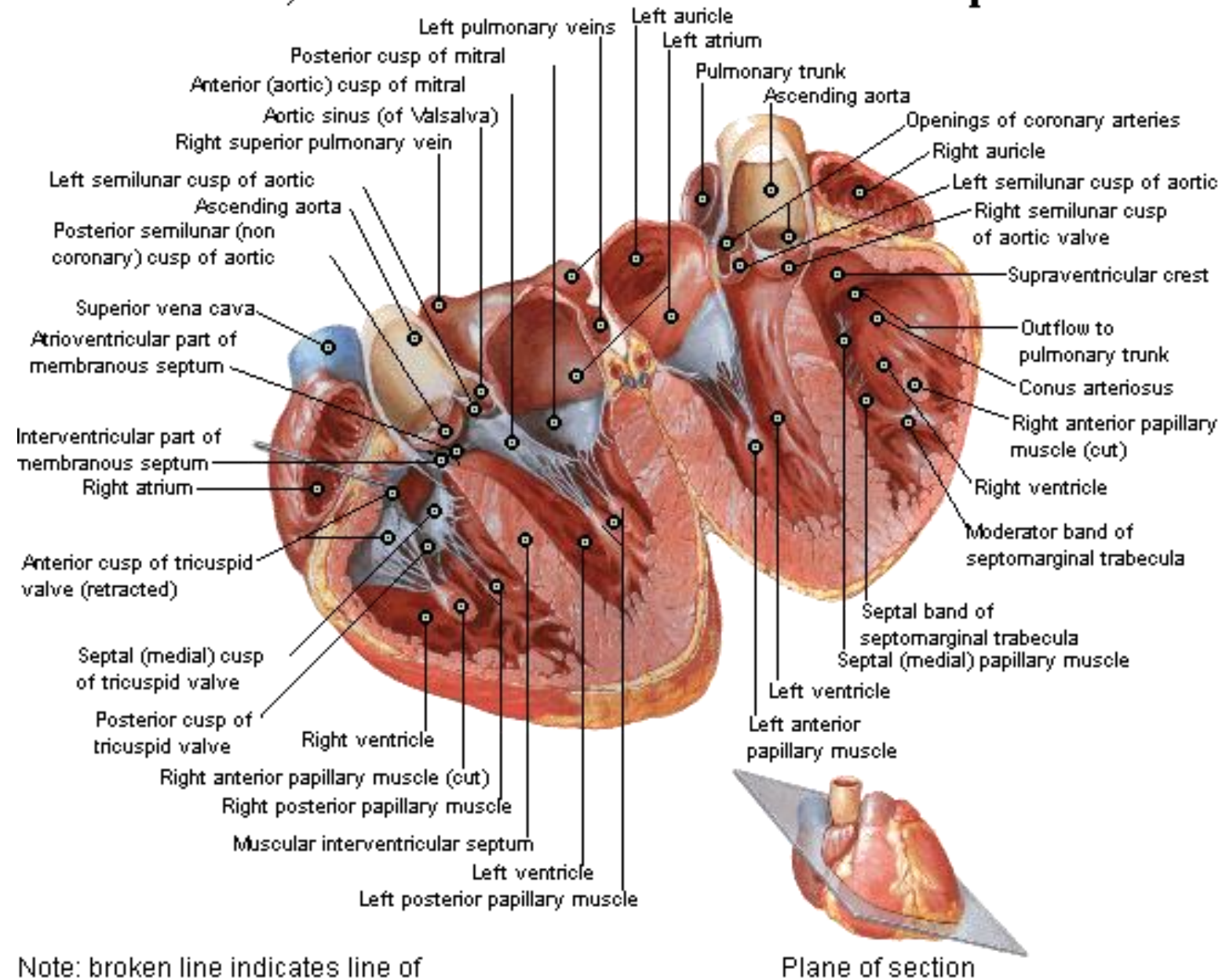
They are:

- **interatrial septum:** muscular wall that separates the right atrium from the left atrium
- **interventricular septum:** muscular wall that divides the right ventricle from the left ventricle

*Being complete septa, they completely separate the blood flowing on the right of the heart from the blood flowing on the left*

Note: broken line indicates line of attachment of septal leaflet of tricuspid valve.

# Atria, Ventricles and Interventricular Septum



The atria are connected with the two ventricles through two foramina

## Right and left atrioventricular foramina

They allow the passage of blood:

- from the right atrium to the right ventricle
- from the left atrium to the left ventricle

Valves are found in these orifices:

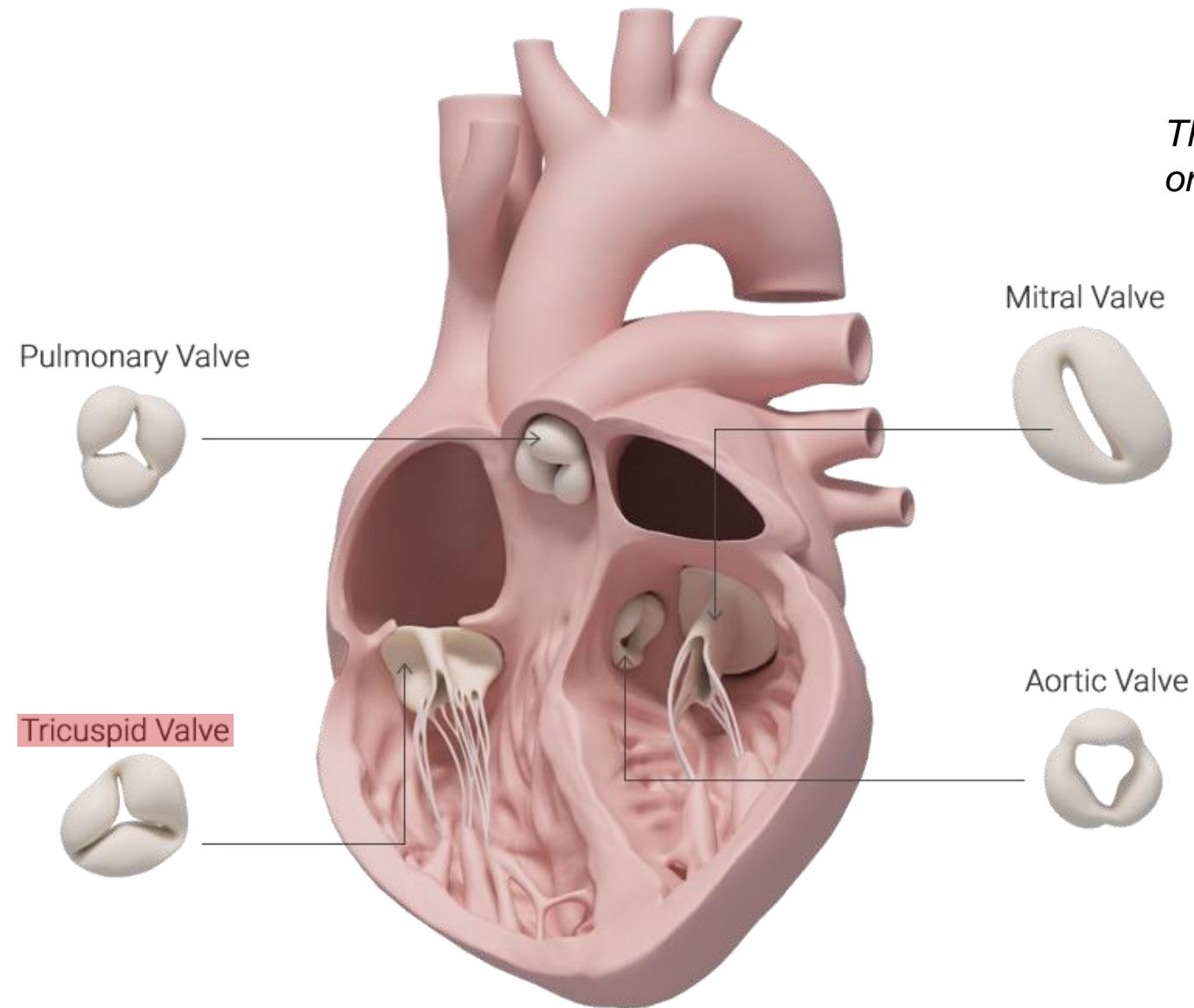
## ATRIOVENTRICULAR VALVES

they have the function of guaranteeing the UNIDIRECTIONALITY OF THE BLOOD, which must flow from the atrium to the ventricle, and not in the opposite direction!

Note: broken line indicates line of attachment of septal leaflet of tricuspid valve.



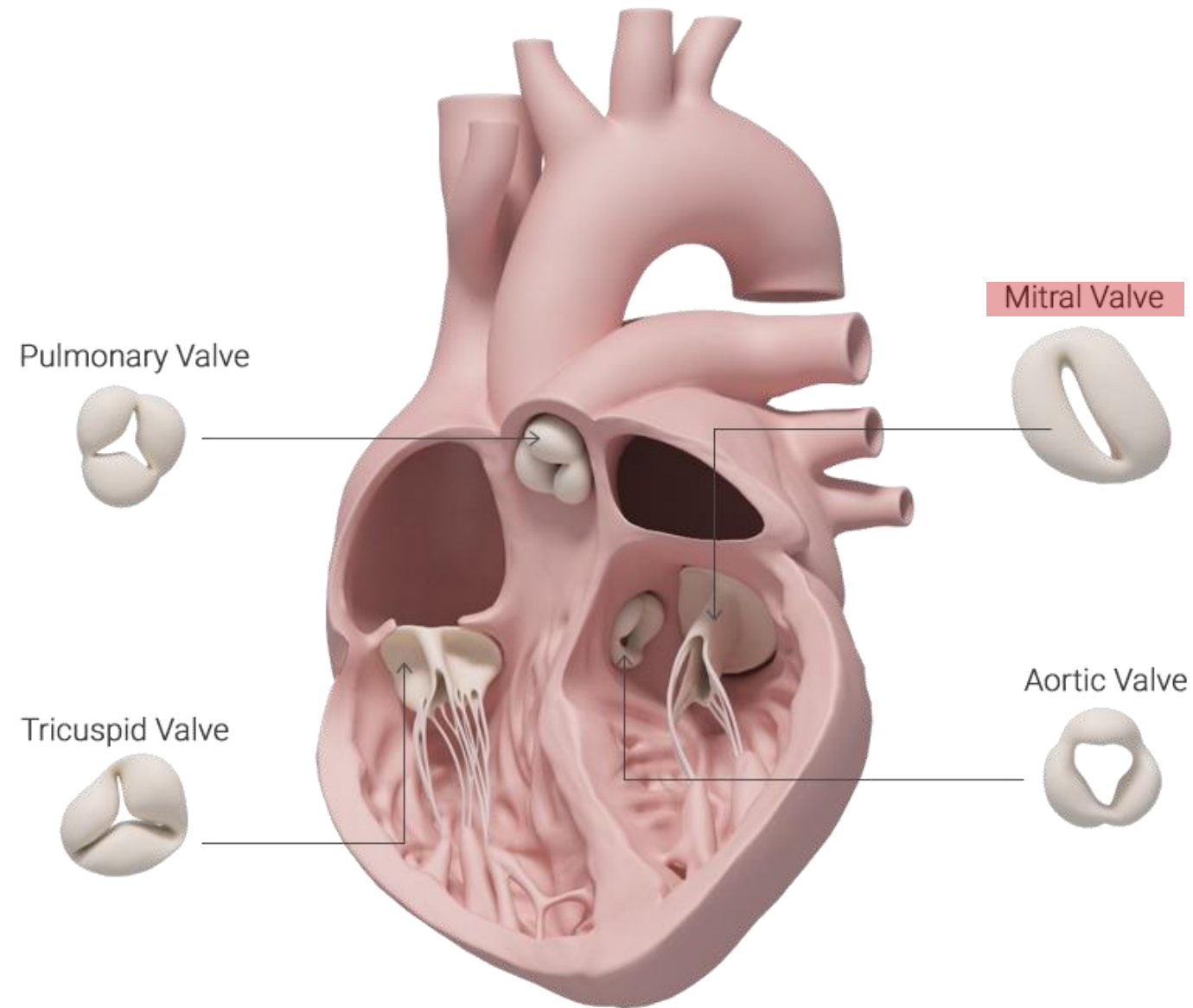
*The two atrioventricular valves have different characteristics on the right side of the heart compared to the left side:*



## RIGHT ATRIOVENTRICULAR VALVE

↓  
made up of 3 valve leaflets ► CUSPS

↓  
It is called **TRICUSPID VALVE**

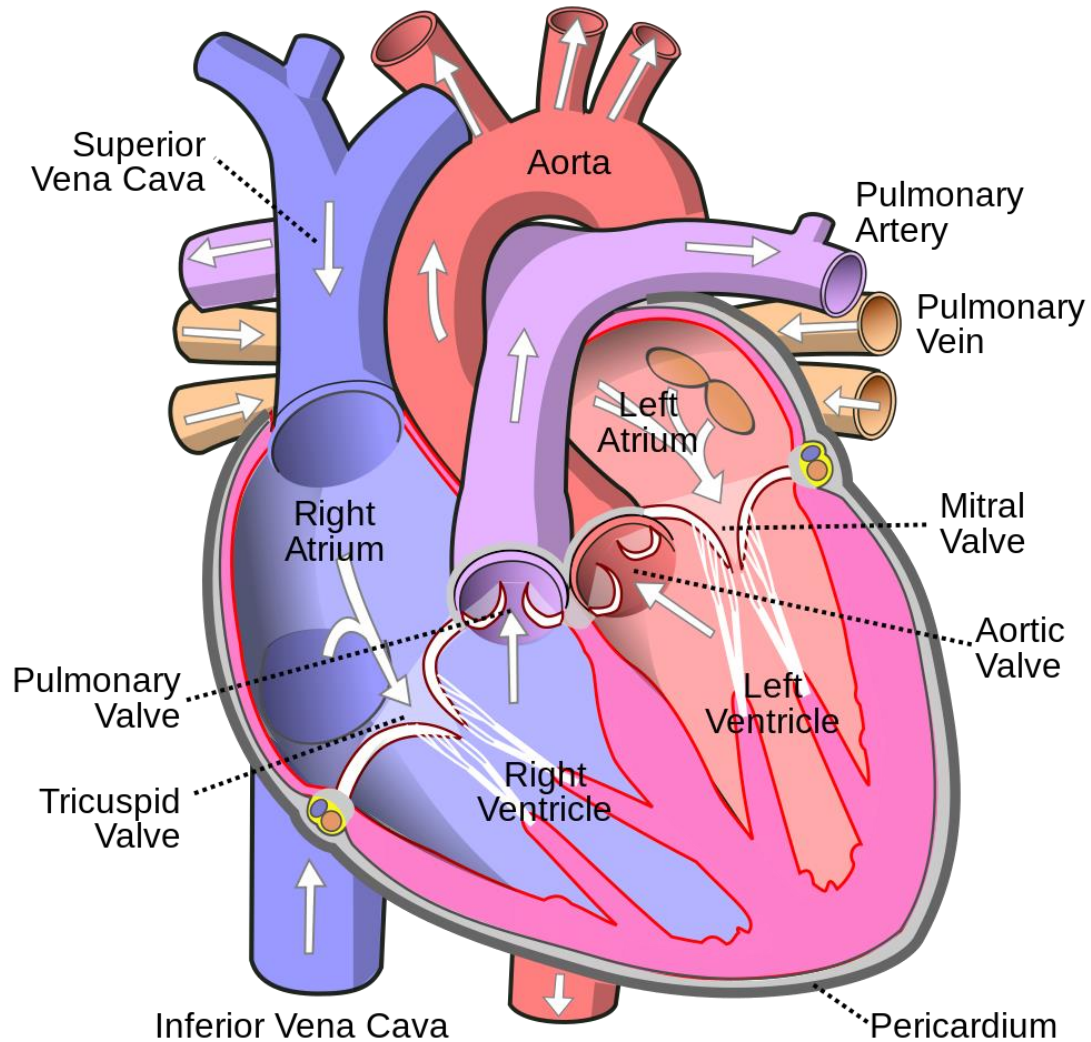


## LEFT ATRIOVENTRICULAR VALVE

↓  
Made of 2 valve leaflets = 2 CUSPS

↓  
It is called **BICUSPID VALVE**

*It is more commonly known as **MITRAL VALVE***



## VASCULAR CONNECTIONS OF THE HEART:

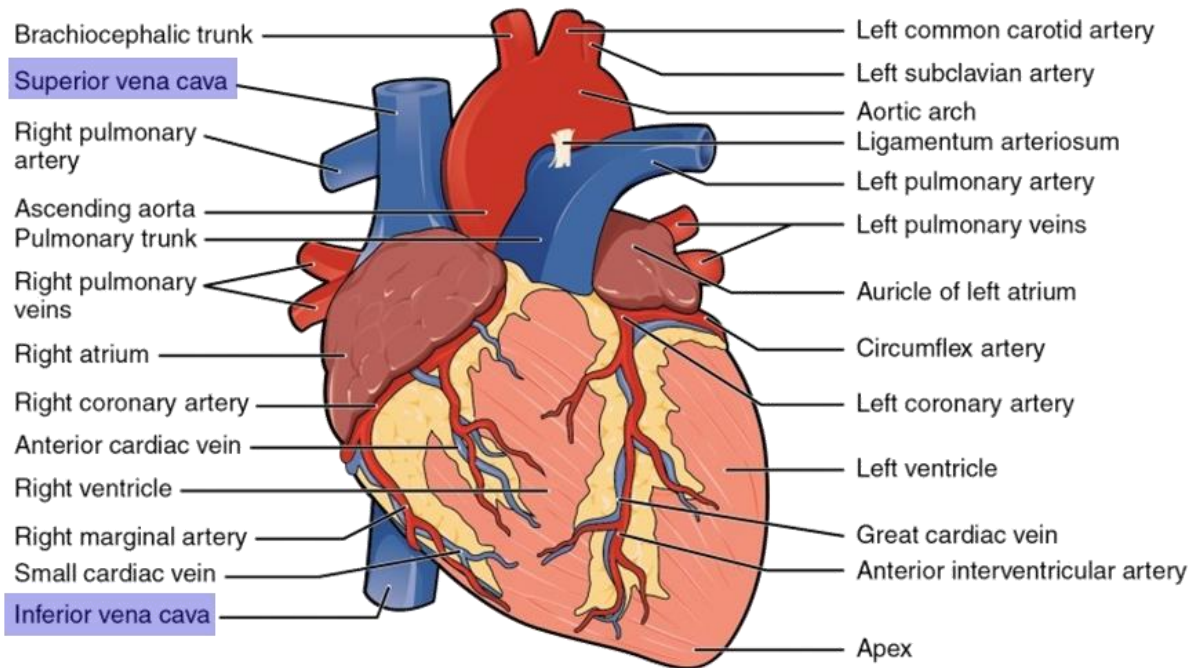
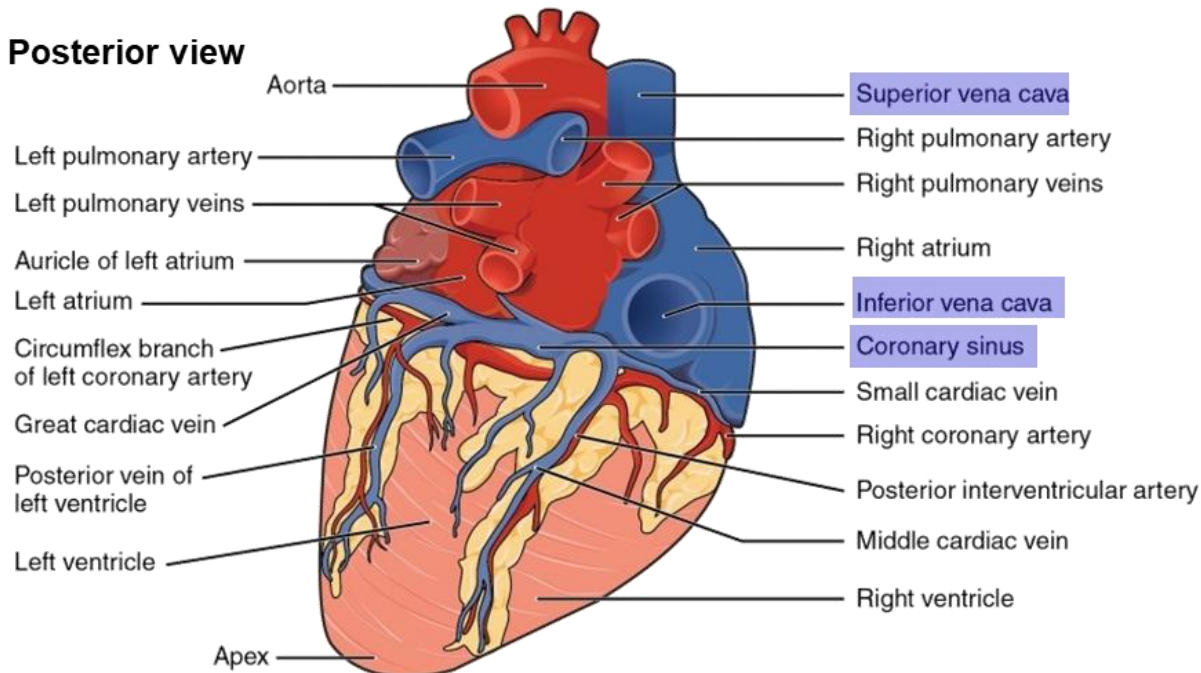
The **ATRIA** receive blood from the peripheral tissues of the body through the **VEINS**

Only veins reach the atria that carry blood from peripheral structures to the heart

**ARTERIES** emerge from the two **VENTRICLES**, which carry blood from the heart to the peripheral structures

*The upper chambers, the right and left atria, receive incoming blood.*

*The lower chambers, the right and left ventricles, pump blood out of the heart.*

**Anterior view****Posterior view**

*By following the blood flow, it is possible to distinguish the vessels that reach the heart and those that depart from the heart*

Three important veins reach the right atrium and carry venous blood from the peripheral tissues (intended as all the tissues of the body except the lung, which is the tissue for blood oxygenation)

The 3 VEINS which reach the RIGHT ATRIUM are:

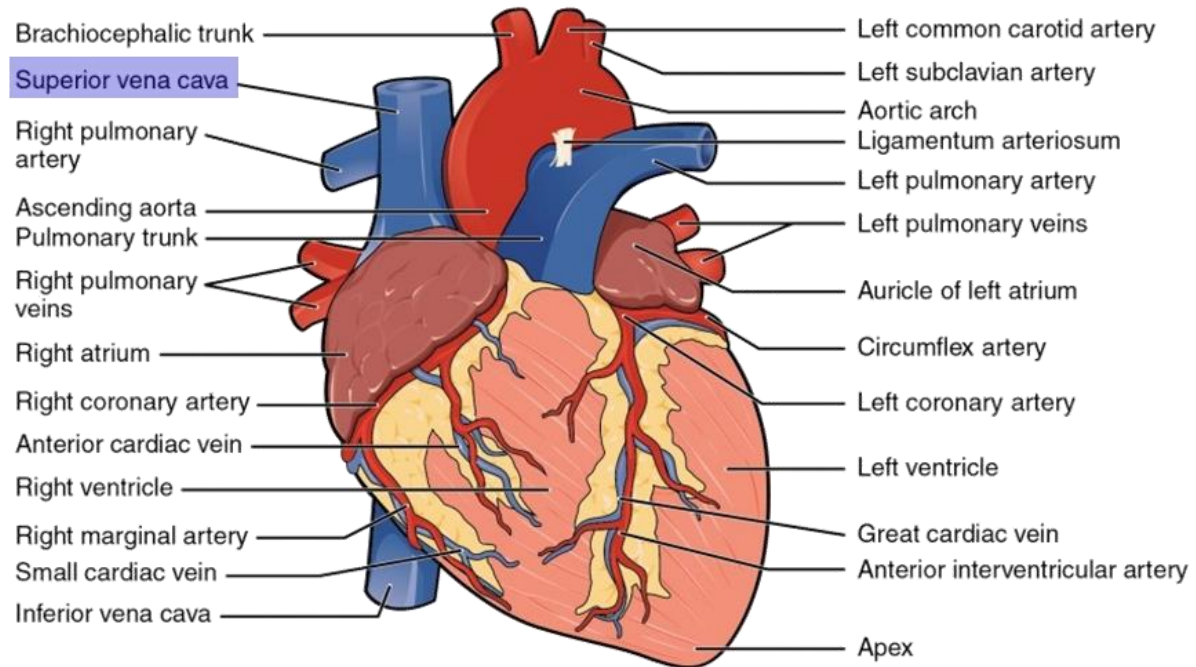
the **SUPERIOR VENA CAVA**

the **INFERIOR VENA CAVA**

the **CORONARY SINUS**



## Anterior view

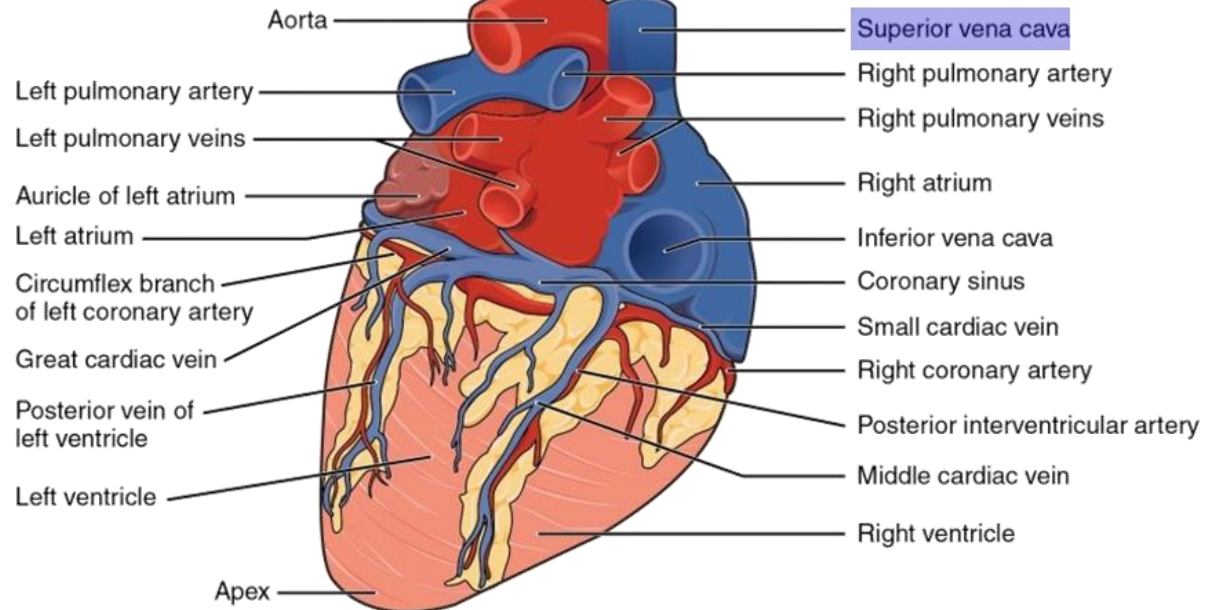


## SUPERIOR VENA CAVA

Carries blood from the upper half of the body (i.e., chest, neck, head and upper limbs) to the right atrium

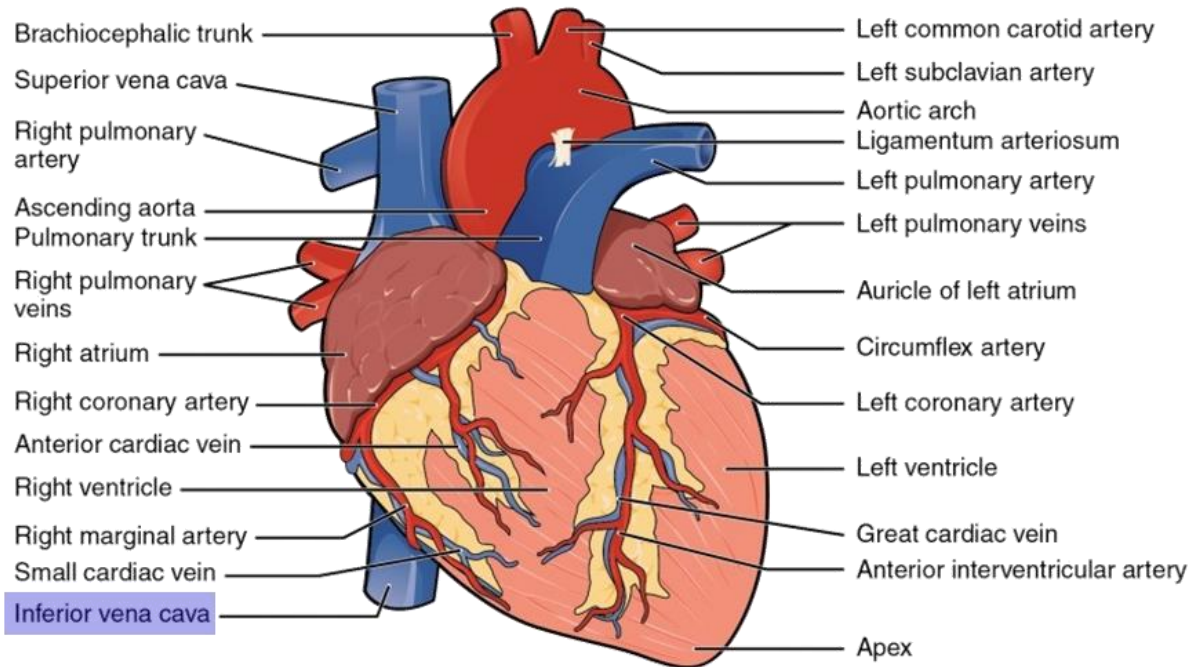
It opens into the right atrium without the need for valves that regulate blood flow

## Posterior view





## Anterior view



## INFERIOR VENA CAVA

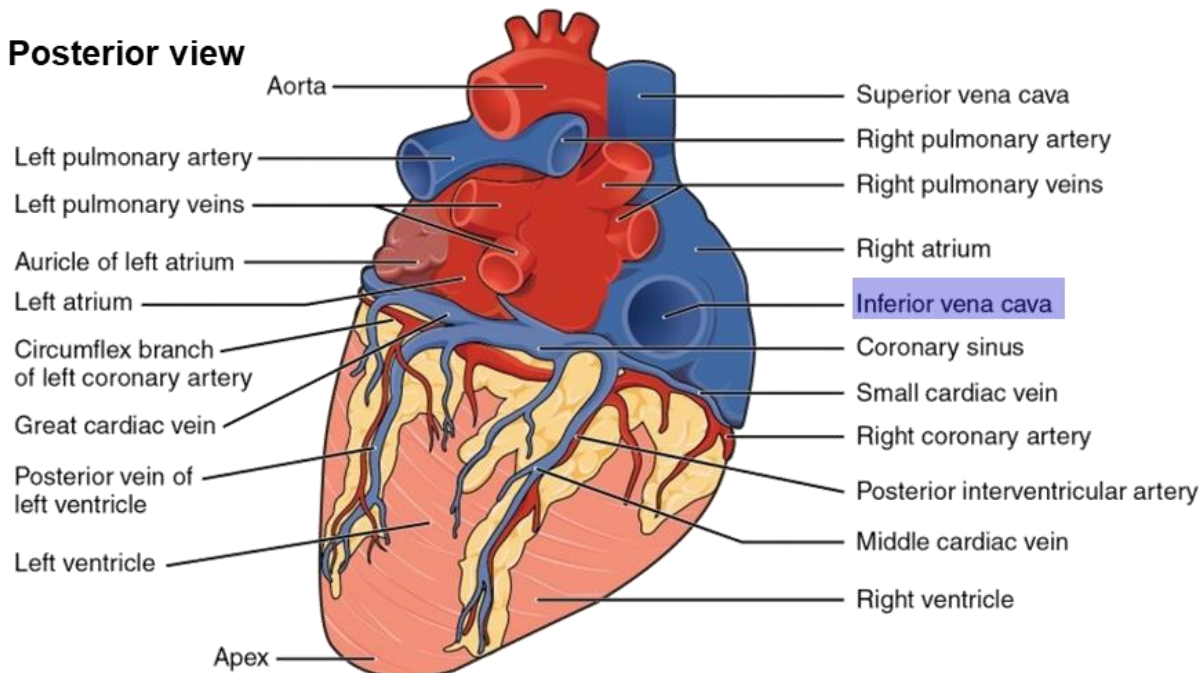
Large vein that carries all the blood that rises from the lower limbs, pelvis and abdomen, crosses the diaphragm and reaches the right atrium

It opens into the right atrium through a **rudimentary valve structure** (not a true functional valve)



Embryonic residue = **EUSTACHIAN VALVE**

## Posterior view



## CORONARY SINUS

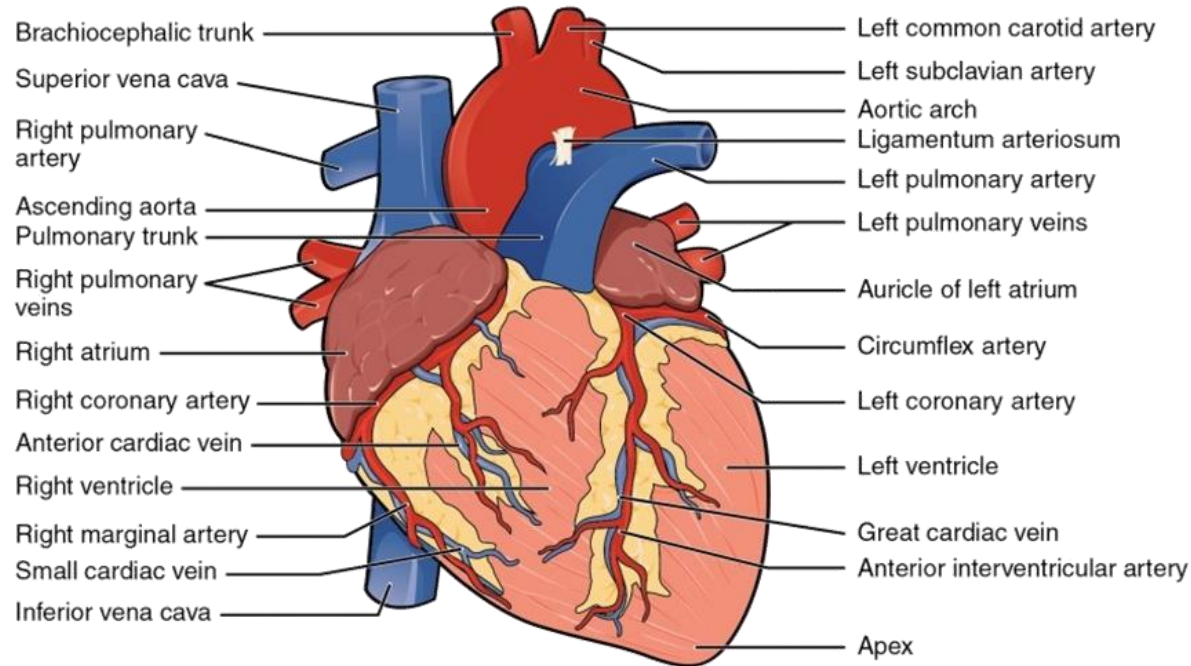
It is **the main vein of the heart**. Even the heart, in fact, like all viscera, needs its own blood circulation, that is, to be supplied by its own vascular network

*The heart receives arterial blood through the coronary arteries, which in the myocardial tissue give rise to capillaries and supply the heart wall, promoting the exchange of oxygen and nutrients*

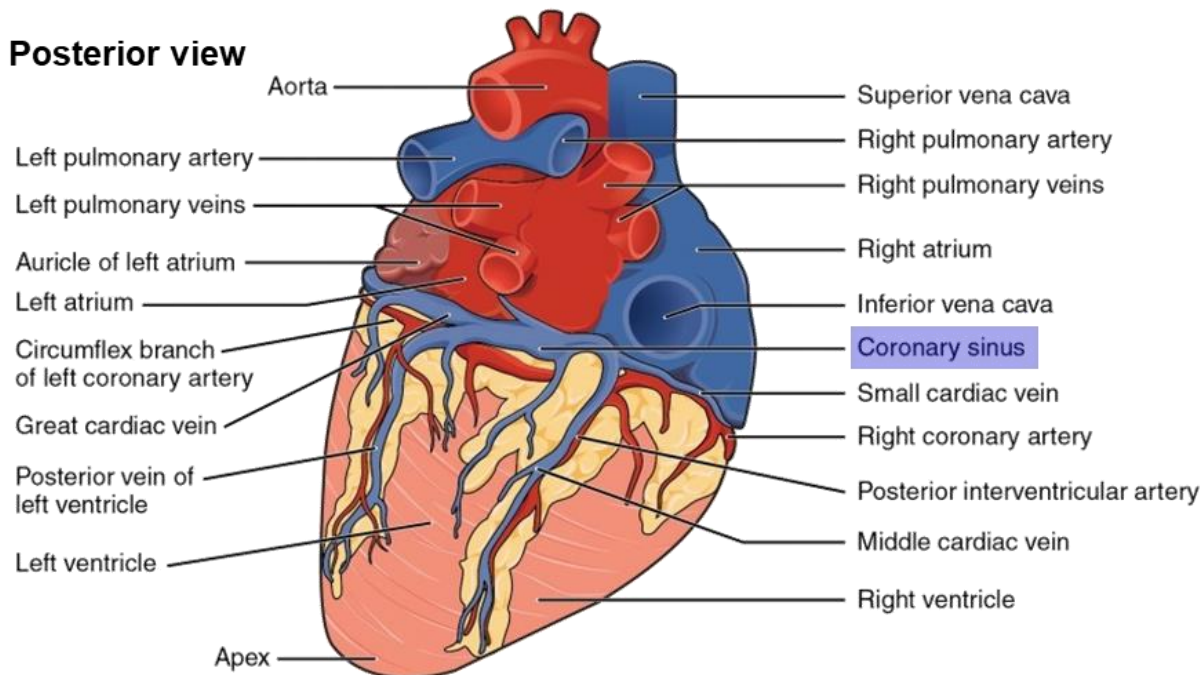
*From these capillaries venules emerge that flow into some veins, the most important and largest of which is the CORONARY SINUS. It carries non-oxygenated blood to the right atrium of the heart*

It opens into the right atrium through a rudimentary valve structure → **THEBESIUM VALVE**

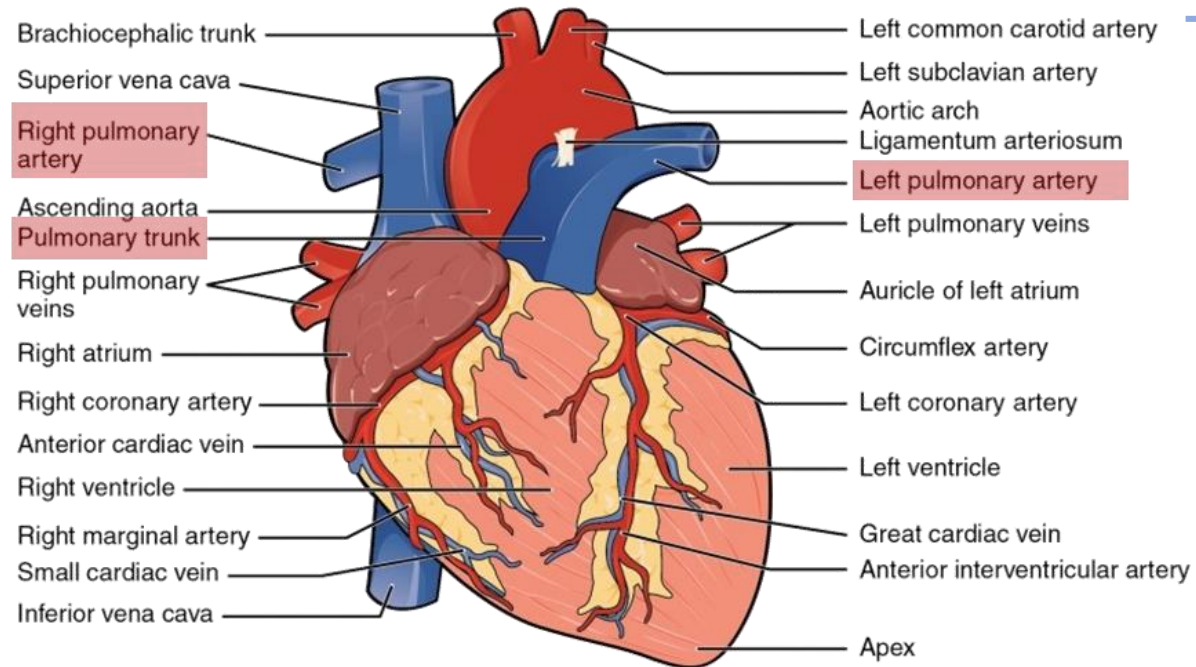
## Anterior view



## Posterior view



## Anterior view



## PULMONARY ARTERIES

**Venous blood**, poor in oxygen, arrives from the **peripheral tissues** to the **right atrium**

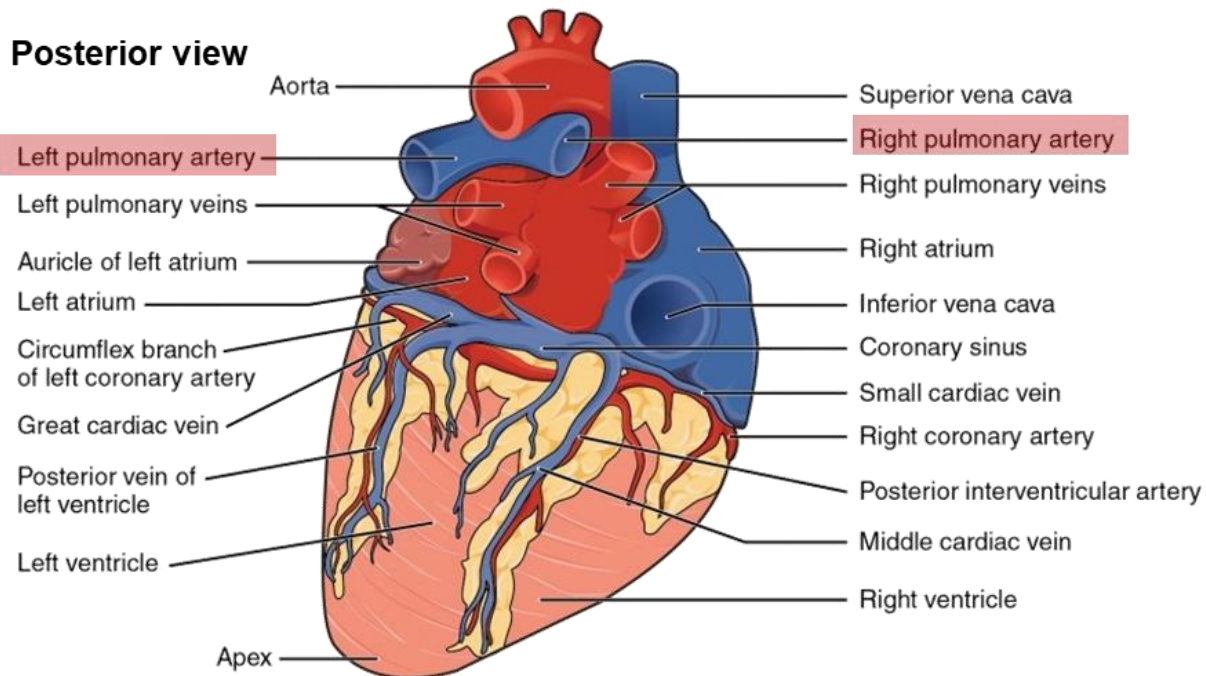
From the **right atrium**, blood flows to the **right ventricle** through the orifice regulated by the **right atrioventricular valve**, or **tricuspid valve**

A single artery originates from the right ventricle, called the **PULMONARY TRUNK** → it divides into 2 **PULMONARY ARTERIES**, the right one and the left one

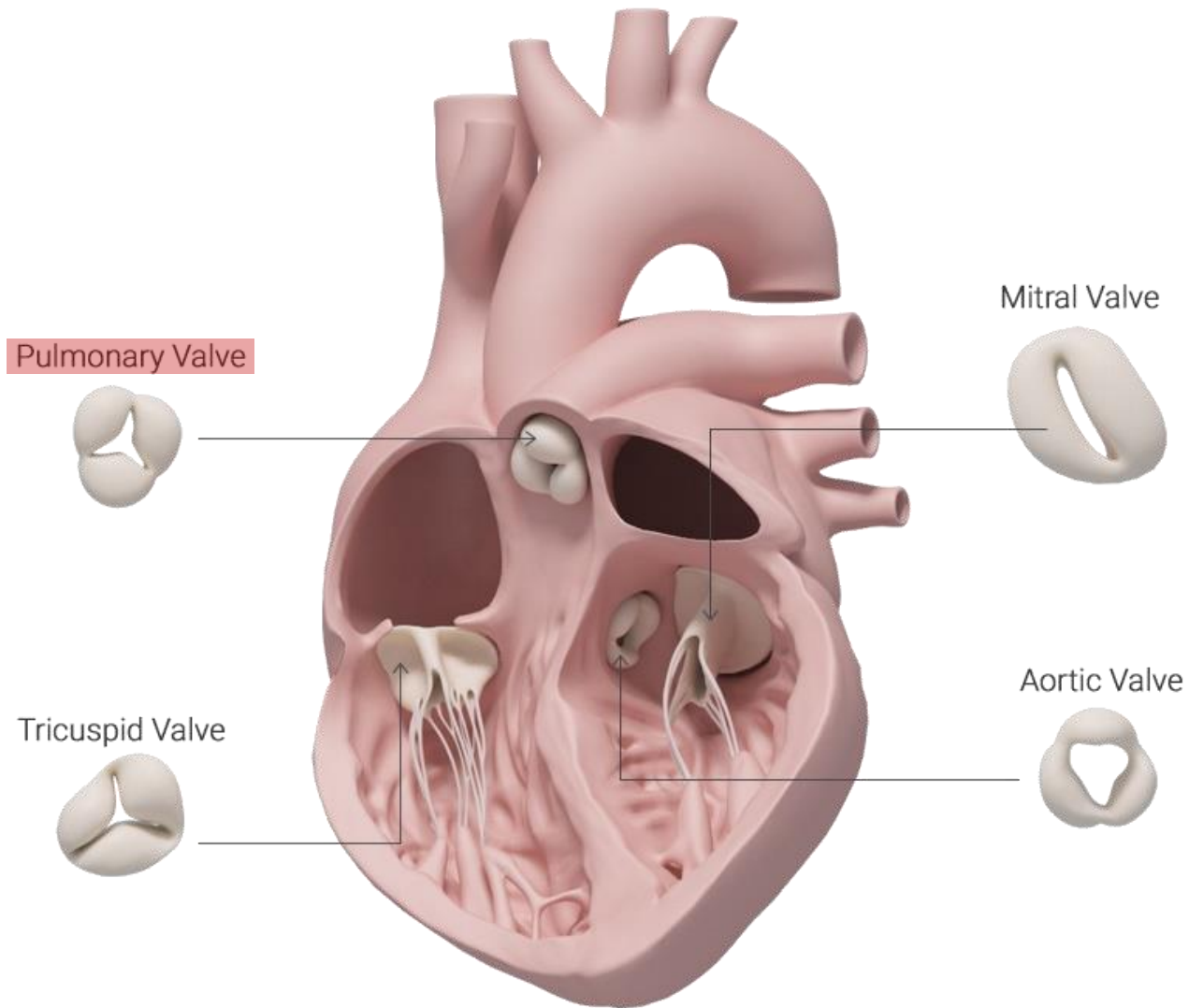


They carry **non-oxygenated blood** in the lungs, to be oxygenated

## Posterior view







## PULMONARY VALVE

The trunk of the pulmonary artery has a fully functional valve, which guarantees the unidirectionality of the blood

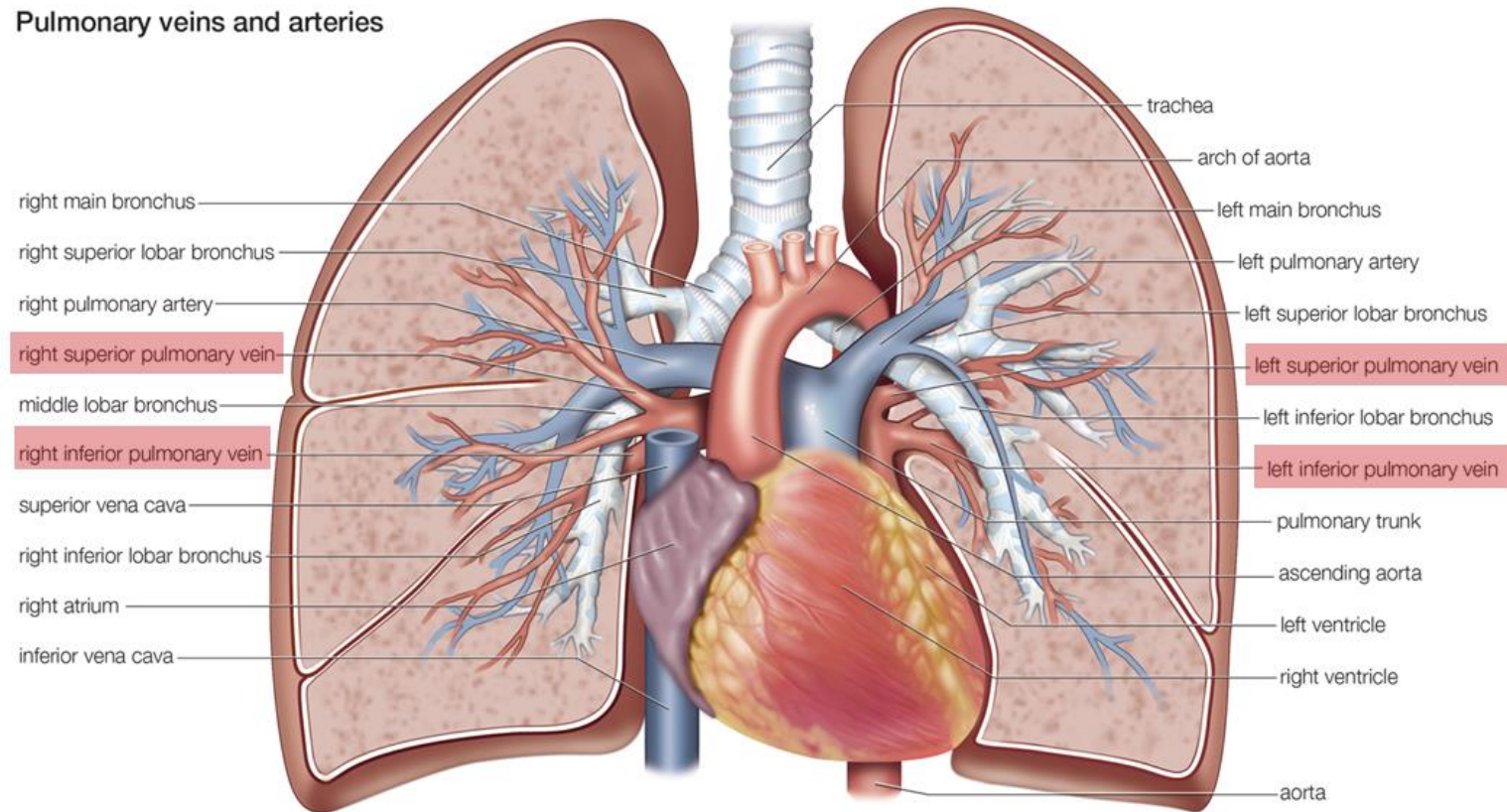
it is the **PULMONARY VALVE**



It is a valve of the heart that lies between the right ventricle and the pulmonary artery.

It consists of three valve leaflets or cusps with semilunar morphology → SEMILUNAR VALVE

## Pulmonary veins and arteries



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## PULMONARY VEINS

The blood enters the pulmonary trunk and passes into the pulmonary arteries which enter the lungs

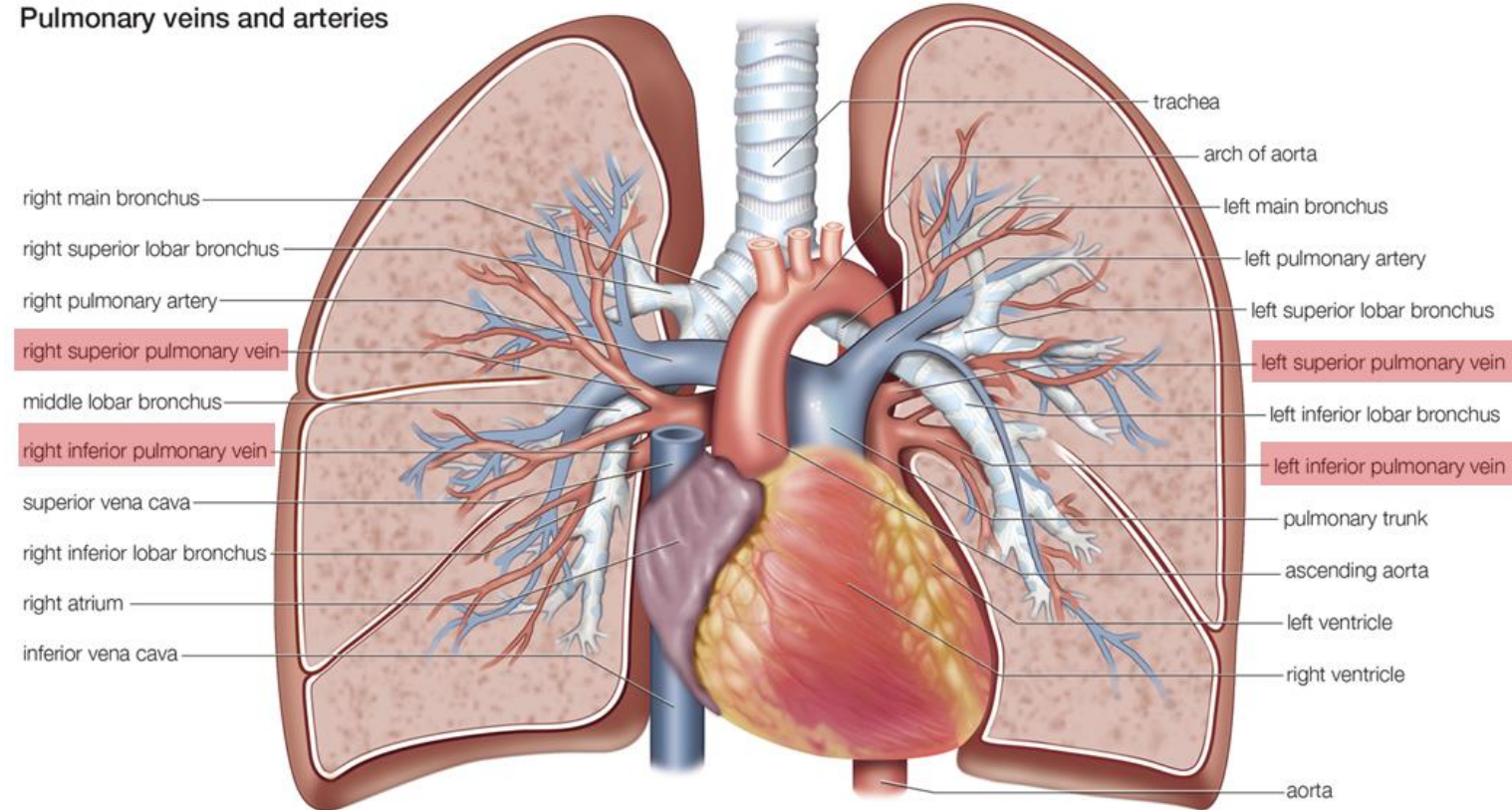
The pulmonary arteries divide into increasingly smaller branches, until they reach the capillary bed (the set of capillaries at the level of the lungs), **where gas exchange occurs (i.e., blood oxygenation takes place)**

From the pulmonary capillary bed, increasingly larger veins emerge which will give rise to the **PULMONARY VEINS**, which come back to the heart



## PULMONARY VEINS

## Pulmonary veins and arteries



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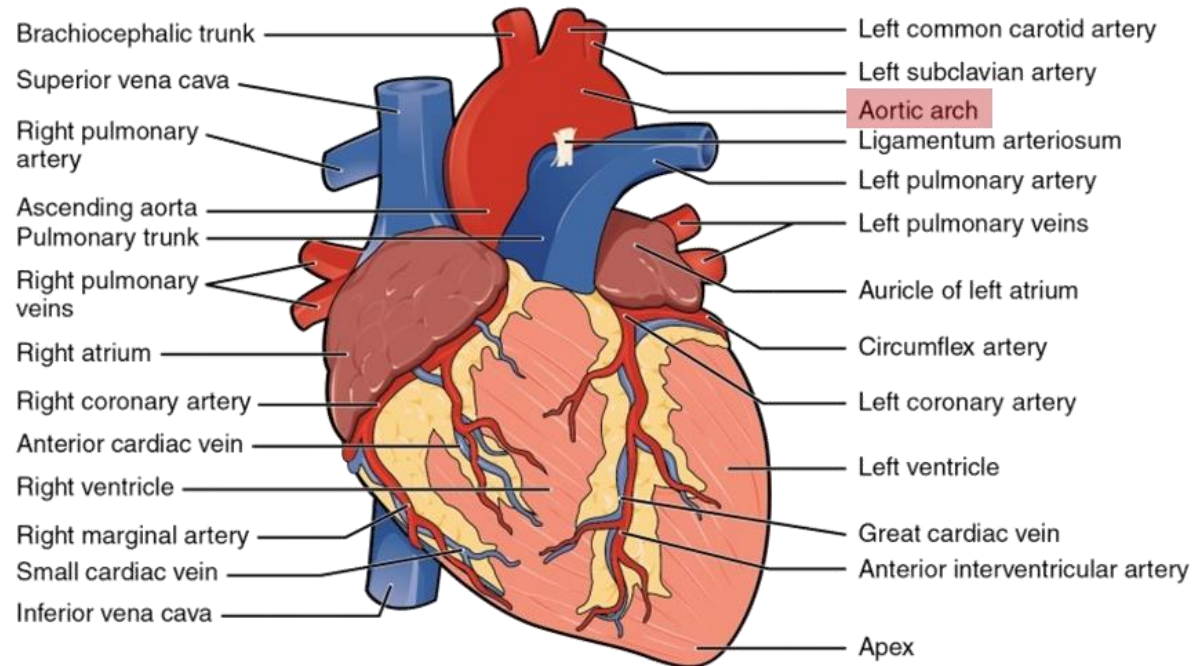
They are two per lung:

- the **right superior and inferior pulmonary veins** exit the right lung
- the **left superior and inferior pulmonary veins** exit the left lung

These 2 pairs of pulmonary veins flow into the left atrium carrying arterial, or oxygenated, blood (even if it flows into the veins!)

Oxygenated blood reaches the left atrium **without the presence of valves**

*The pulmonary veins, therefore, have no valves, even not rudimentary ones*

**Anterior view****AORTA**

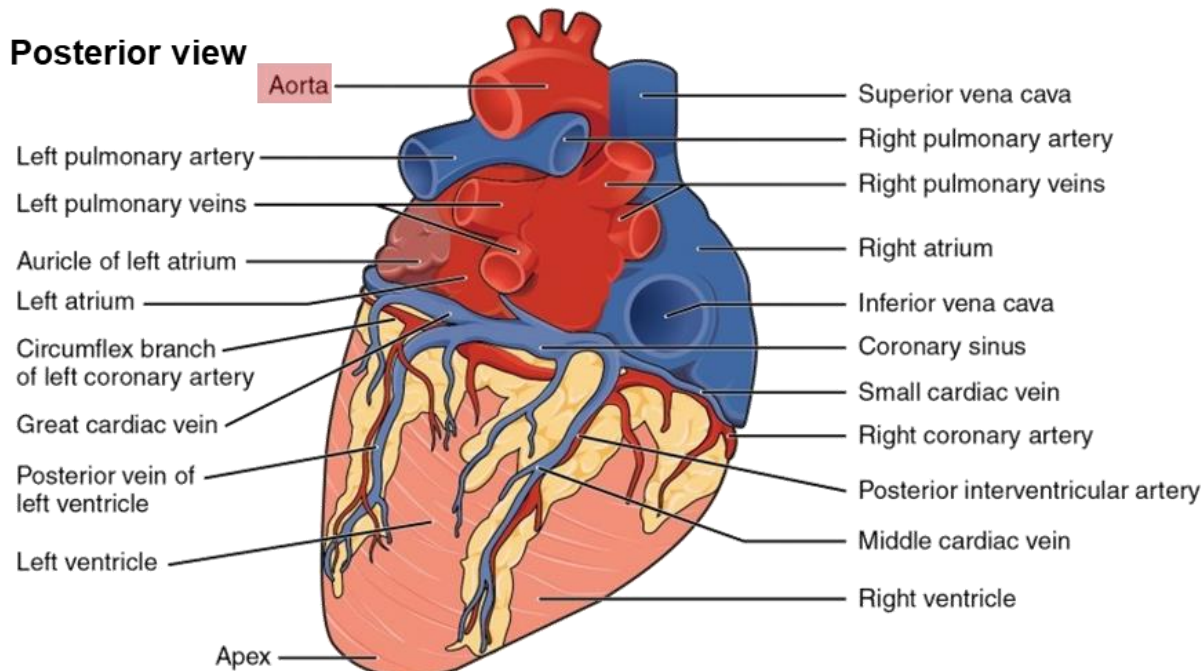
Once it has reached the left atrium, the blood passes to the left ventricle via the **left atrioventricular orifice regulated by the mitral valve**

The left ventricle, which is the heart chamber with the thickest wall, pumps blood into the **AORTA**

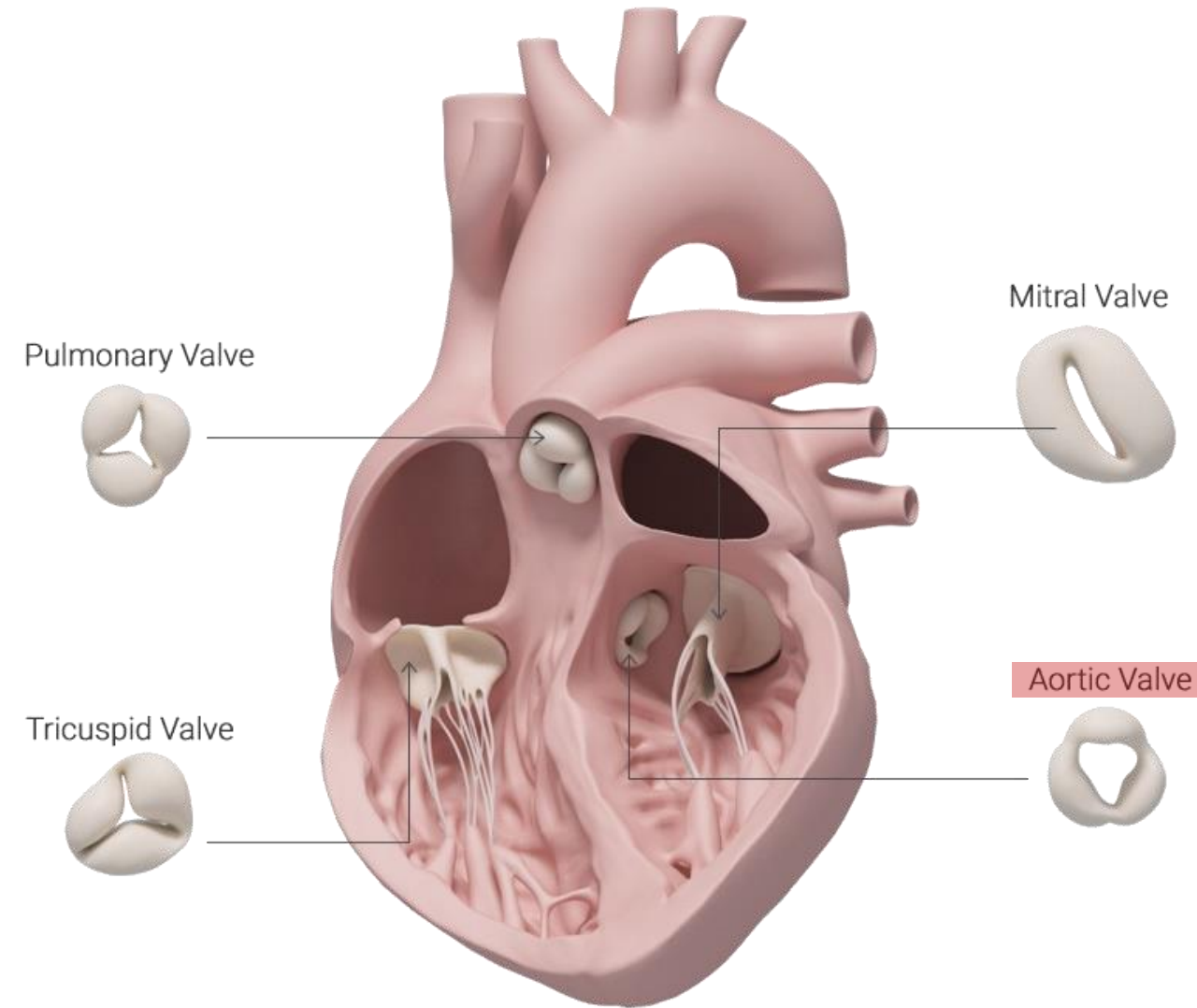
The aorta is the main artery that originates from the left ventricle

It is the largest artery in the body, with numerous branches, which has the function of carrying arterial blood - oxygenated - to the entire body

*Through the aorta the arterial blood is carried to the peripheral tissue, where it releases oxygen at the level of the capillaries, and then returns to the right atrium through the veins*

**Posterior view**

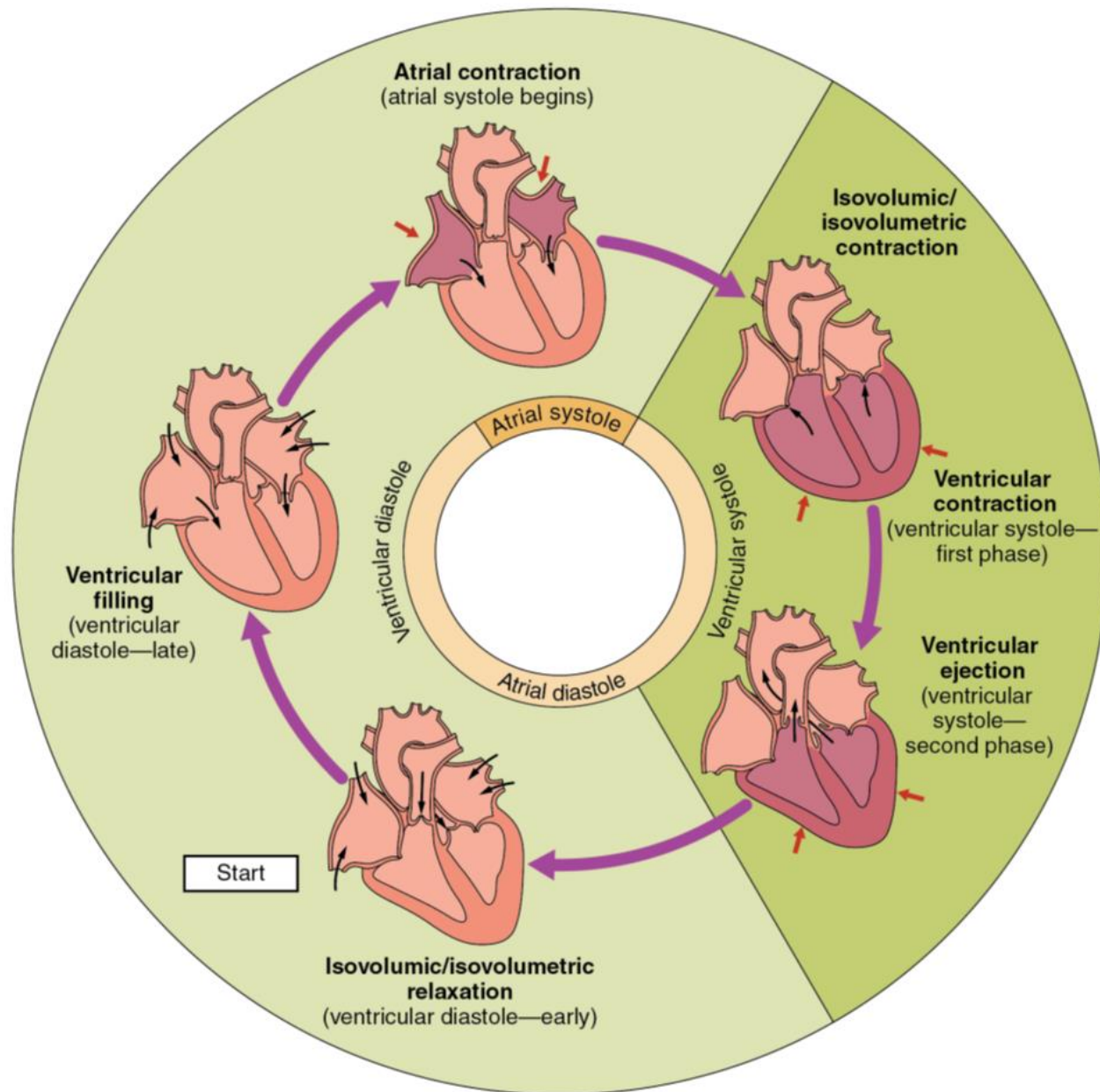
## AORTIC VALVE



It is a valve of the heart that lies between the left ventricle and the aorta.

Very similar to the pulmonary valve, it is made up of three cusps with semilunar morphology → SEMILUNAR VALVE





## SYSTOLE and DIASTOLE

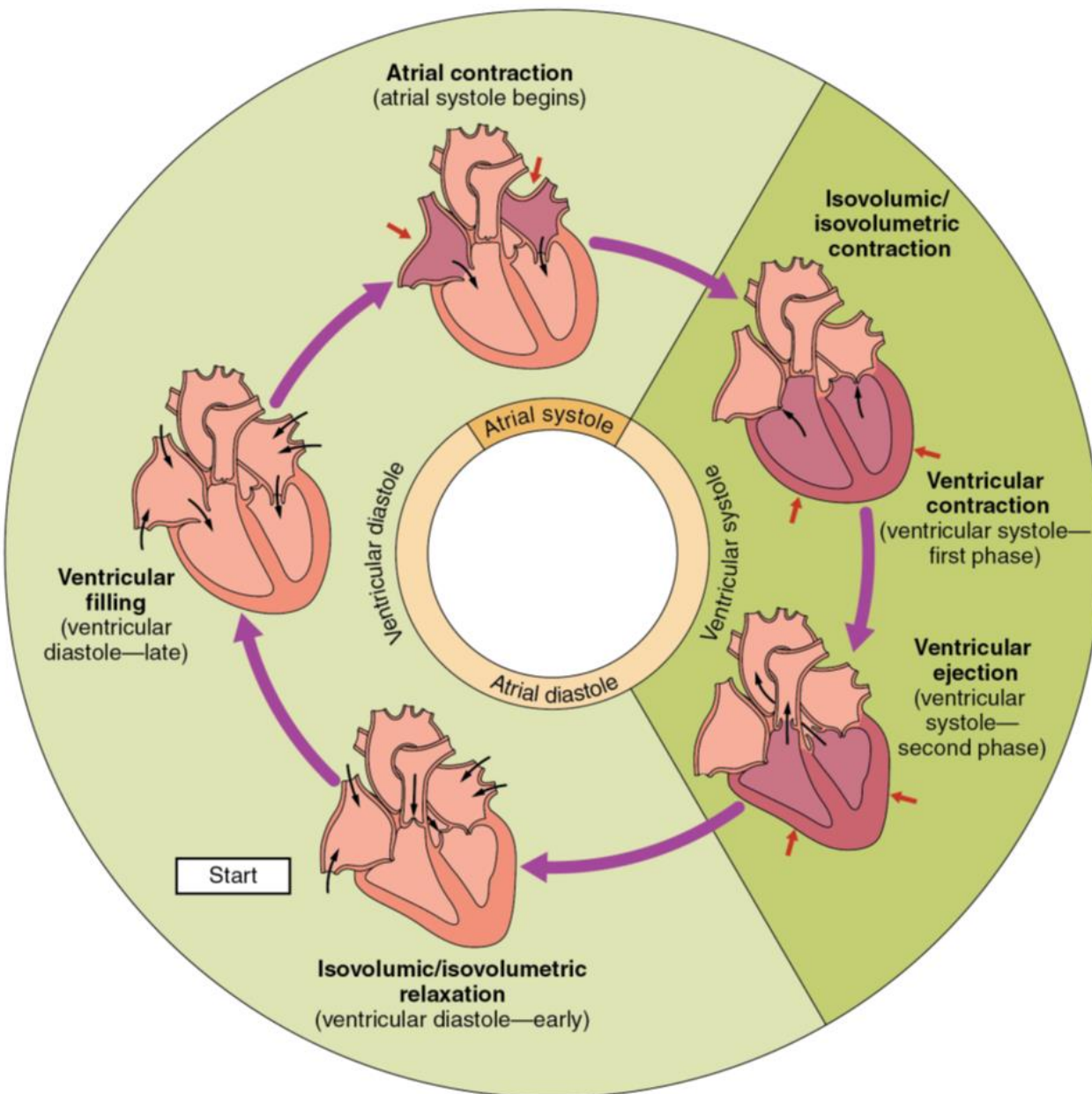
Blood flows from the atria to the ventricles through the **CONTRACTION** of the heart chambers

The walls of these chambers are made up of muscle tissue, the myocardium, so they are able to contract to pump blood

**SYSTOLE:** phase of contraction that the cardiac chambers undergoes while they pump blood into circulation

**DIASTOLE:** relaxation phase that occurs as the chambers fill with blood

*Both the atria and ventricles undergo systole and diastole, and it is essential that these components be carefully regulated and coordinated to ensure blood is pumped efficiently to the body.*



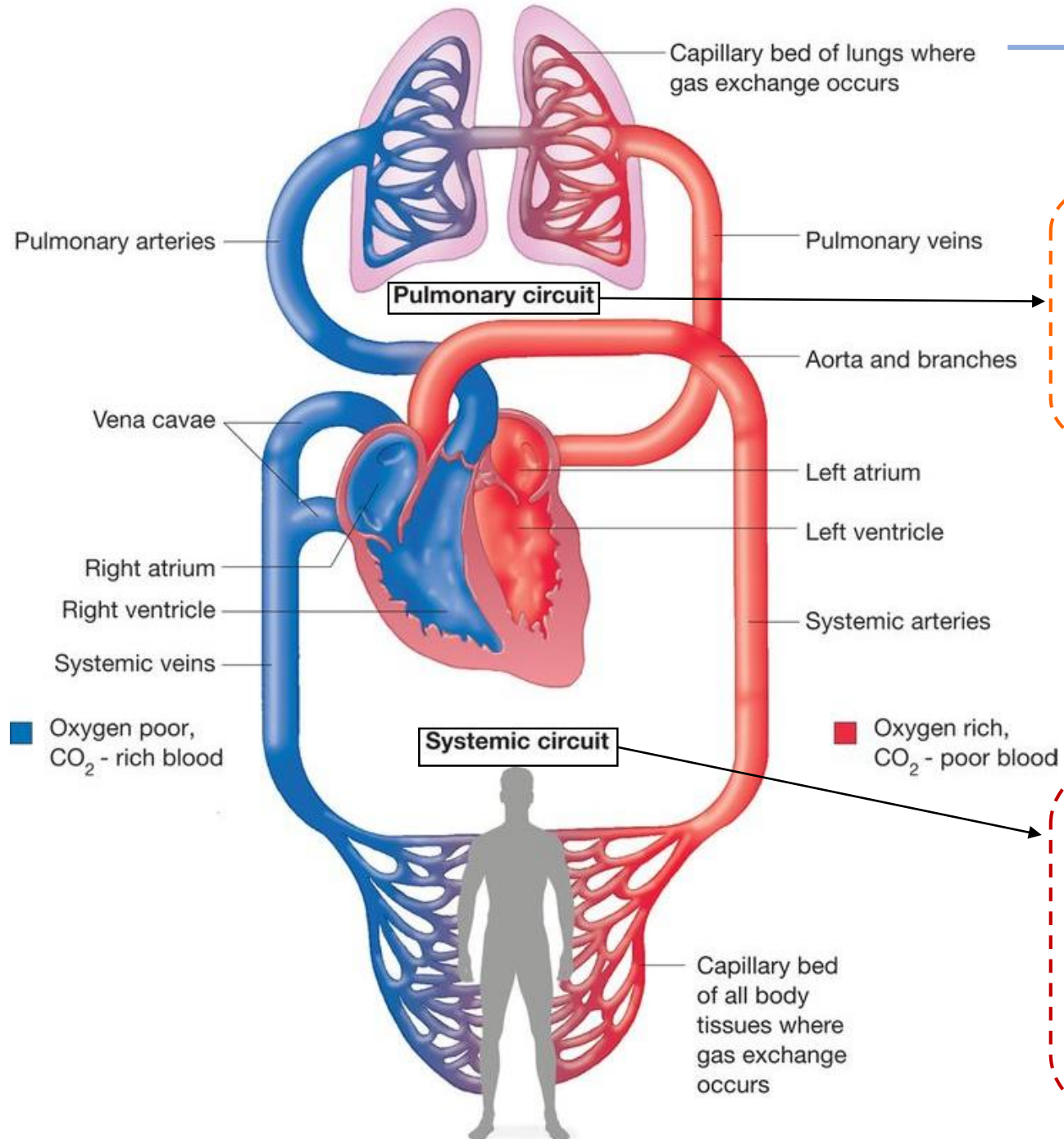
- The right and left atria contract simultaneously pumping blood into the ventricles
- Next, the two ventricles contract together, pumping blood into the two arteries

*Generally we can say that:*

- During **atrial systole** the ventricles are in diastole
- During **ventricular systole** the atria are in diastole

*If we talk generically about systole, we are referring to the ventricles*





## PULMONARY CIRCULATION

It occurs in the LUNGS, with blood flowing from the right ventricle to the lungs, and then to the left atrium

## SYSTEMIC CIRCULATION

Blood flows from the left ventricle to the aorta and therefore to all the peripheral tissues, and finally returns to the heart at the level of the right atrium, through the veins that were previously described