

# THE CARDIOVASCULAR SYSTEM: THE HEART

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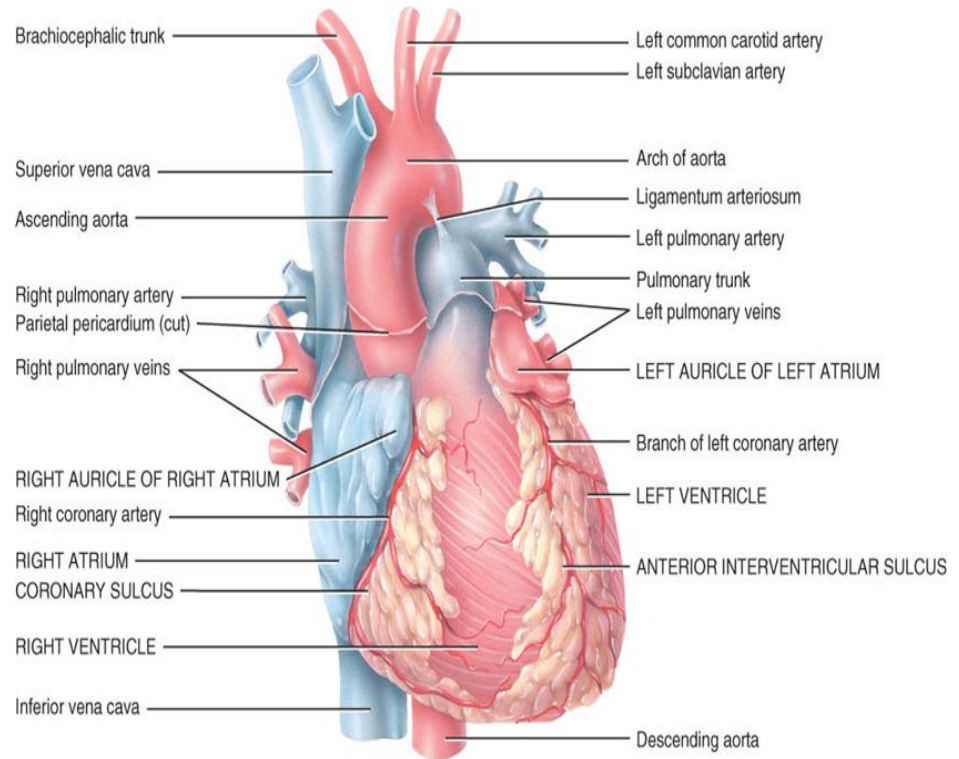
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# INTRODUCTION

The cardiovascular system consists of the blood, heart, and blood vessels.

The heart is the pump that circulates the blood through blood vessels.

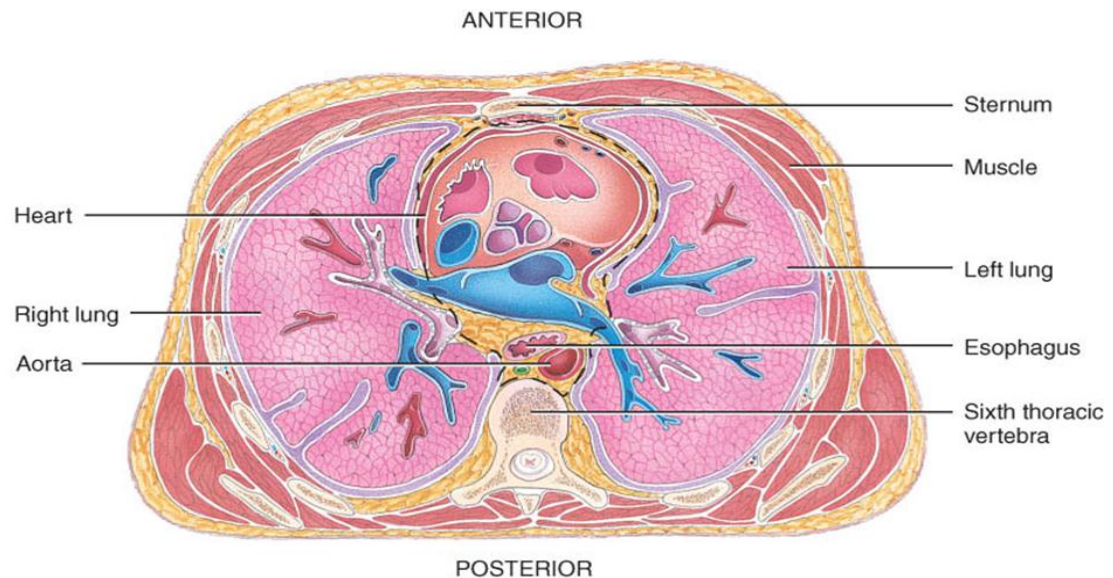
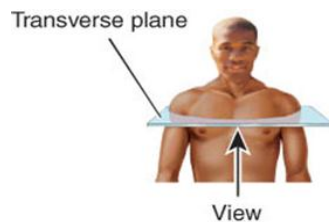
The study of the normal heart and diseases associated with it is known as *cardiology*.



(a) Anterior external view showing surface features

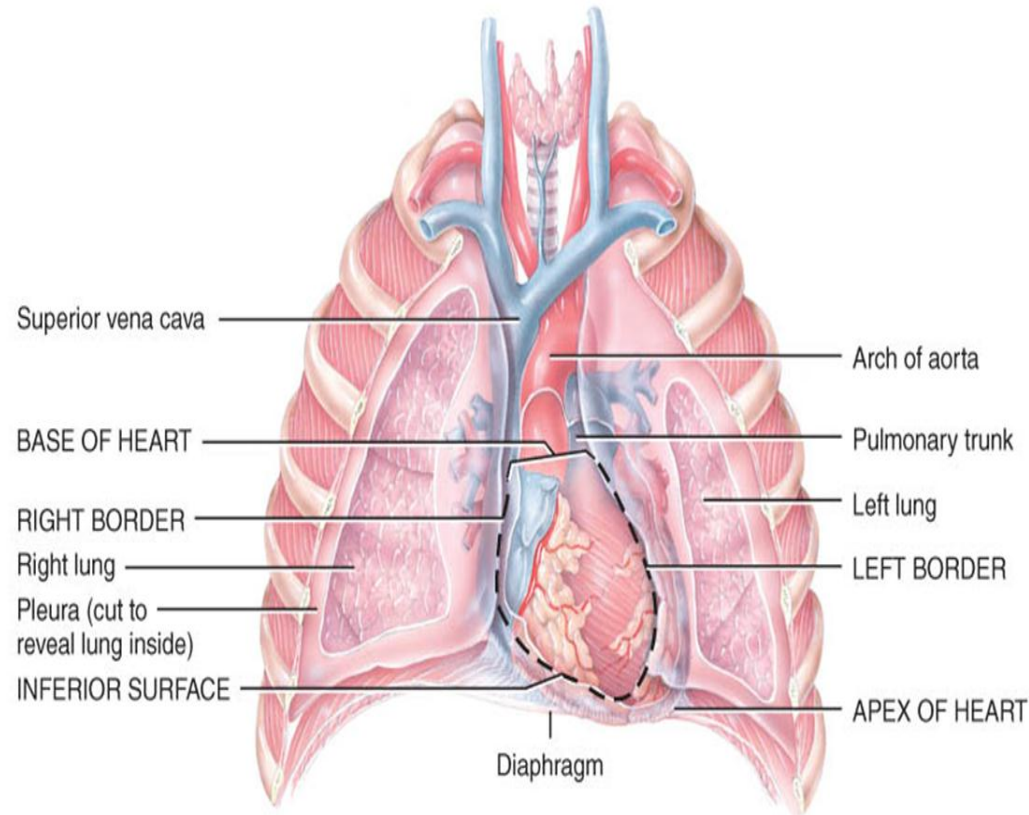
# Location of the heart

- The heart is situated between the lungs in the mediastinum with about two-thirds of its mass to the left of the midline.
- Heart is located in the **mediastinum**: area from the sternum to the vertebral column and between the lungs.

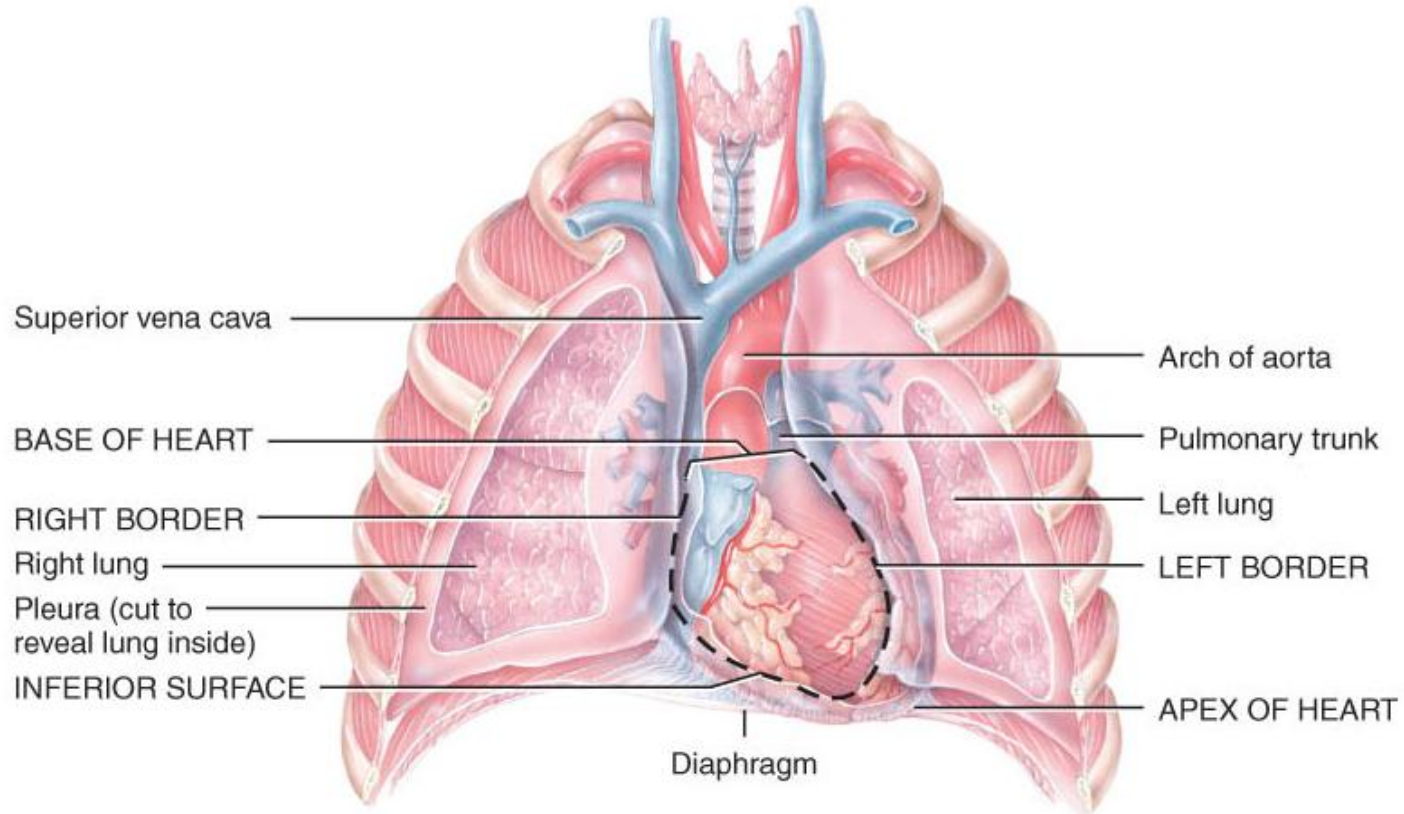


# Heart Orientation

- Apex - directed anteriorly, inferiorly and to the left
- Base - directed posteriorly, superiorly and to the right
- Anterior surface - deep to the sternum and ribs
- Inferior surface - rests on the diaphragm
- Right border - faces right lung
- Left border - faces left lung



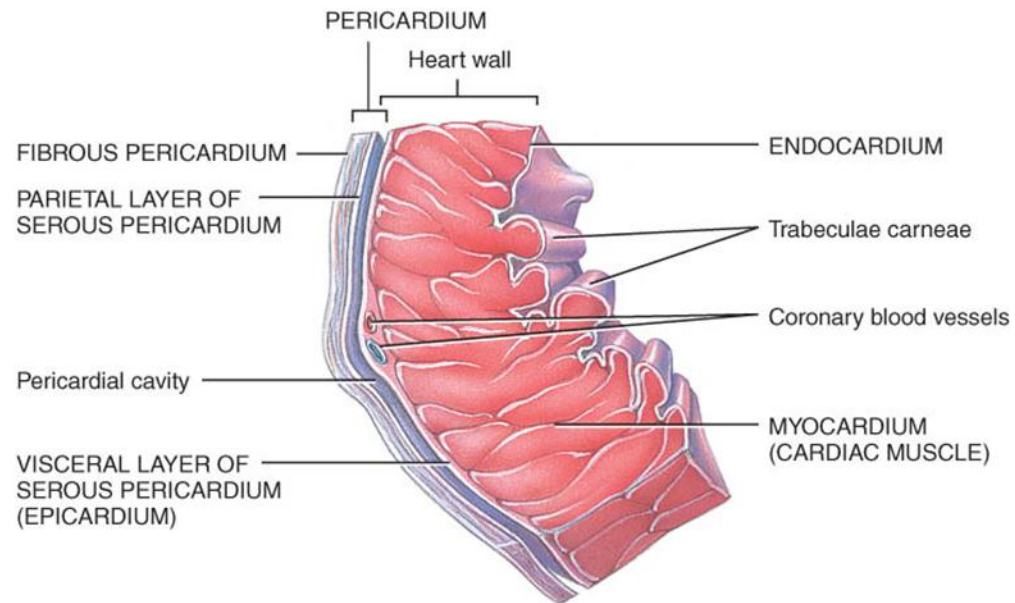
# Heart Orientation



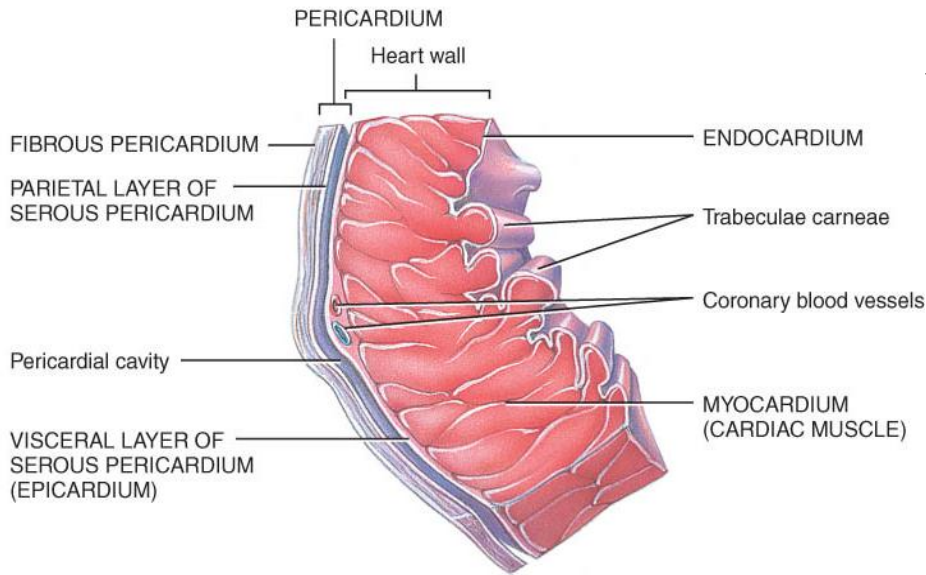
Heart has 2 surfaces: anterior and inferior, and 2 borders: right and left, has apex and base

# Pericardium

- The heart is enclosed and held in place by the *pericardium*.
  - The pericardium consists of an outer *fibrous pericardium* and an inner *serous pericardium*.
- The serous pericardium is composed of a *parietal layer* and a *visceral layer*.
  - Between the parietal and visceral layers of the serous pericardium is the *pericardial cavity*, a potential space filled with pericardial fluid that reduces friction between the two membranes



# Pericardium



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## Fibrous pericardium

- protects and anchors the heart, prevents overstretching

## Serous pericardium

- contains
  - parietal layer-outer layer
  - pericardial cavity with pericardial fluid
  - visceral layer (epicardium)

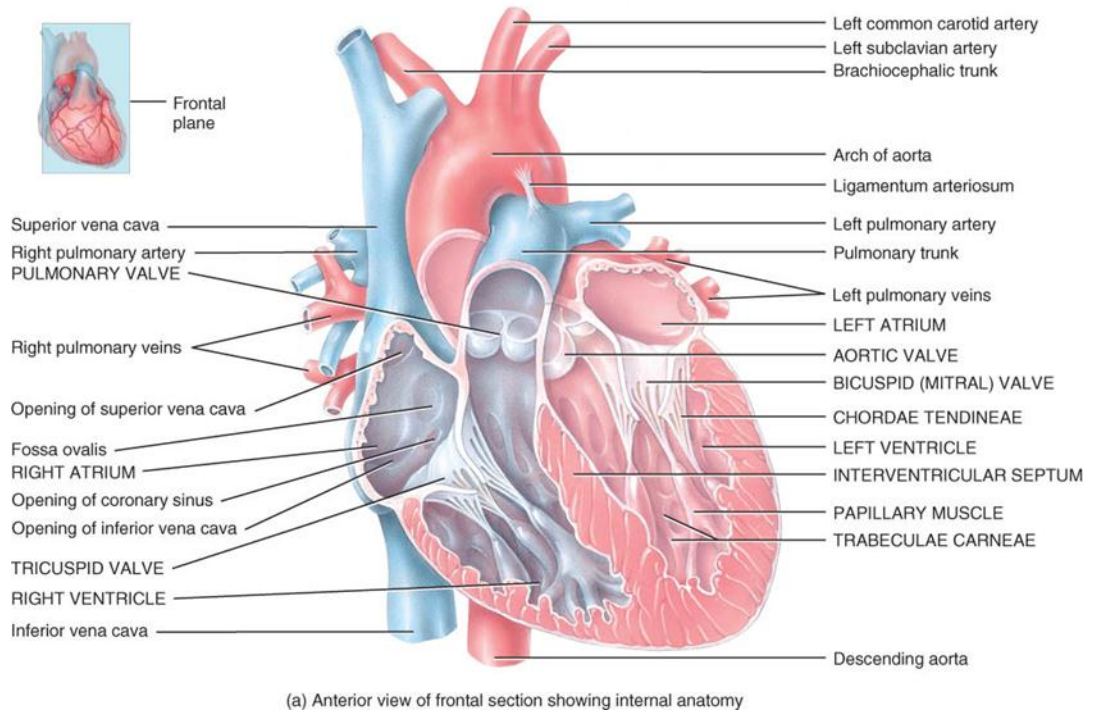
# Chambers and Sulci of the Heart

## Four chambers

- 2 upper atria
- 2 lower ventricles

**Sulci** - grooves on surface of heart containing coronary blood vessels and fat

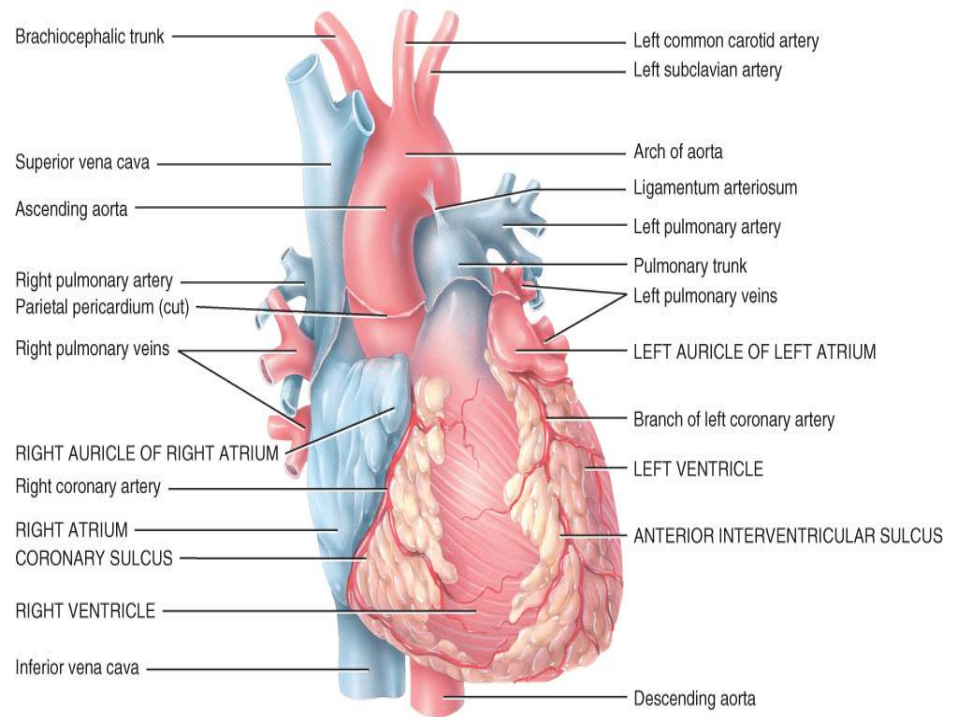
- **coronary sulcus**
  - encircles heart and marks the boundary between the atria and the ventricles
- **anterior interventricular sulcus**
  - marks the boundary between the ventricles anteriorly
- **posterior interventricular sulcus**
  - marks the boundary between the ventricles posteriorly





# Chambers and Sulci

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- **coronary sulcus** encircles heart and marks the boundary between the atria and the ventricles
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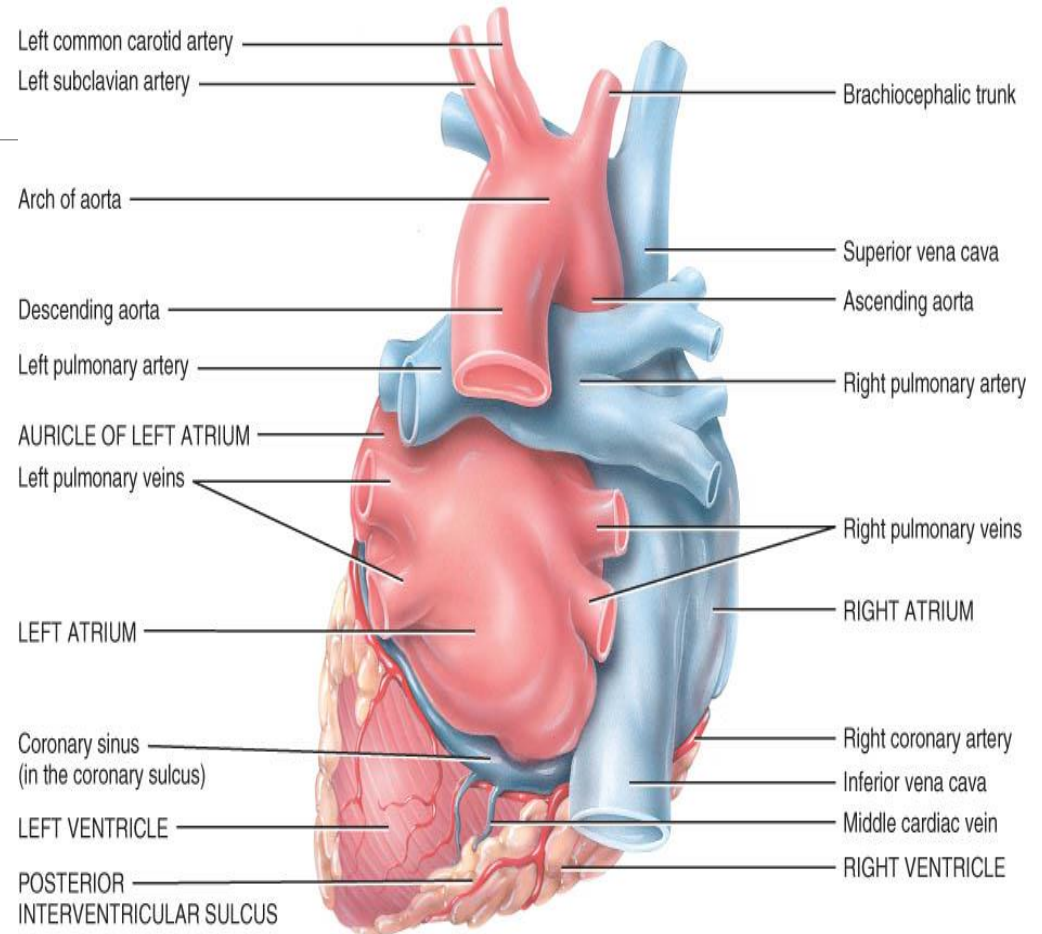


(a) Anterior external view showing surface features

## Anterior View

# Chambers and Sulci

- **Sulci** - grooves on surface of heart containing coronary blood vessels and fat
- **coronary sulcus**  
encircles heart and marks the boundary between the atria and the ventricles
- **anterior interventricular sulcus**  
marks the boundary between the ventricles anteriorly
- **posterior interventricular sulcus**  
marks the boundary between the ventricles posteriorly



(c) Posterior external view showing surface features

## Posterior View

# Right Atrium

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Receives blood from 3 sources

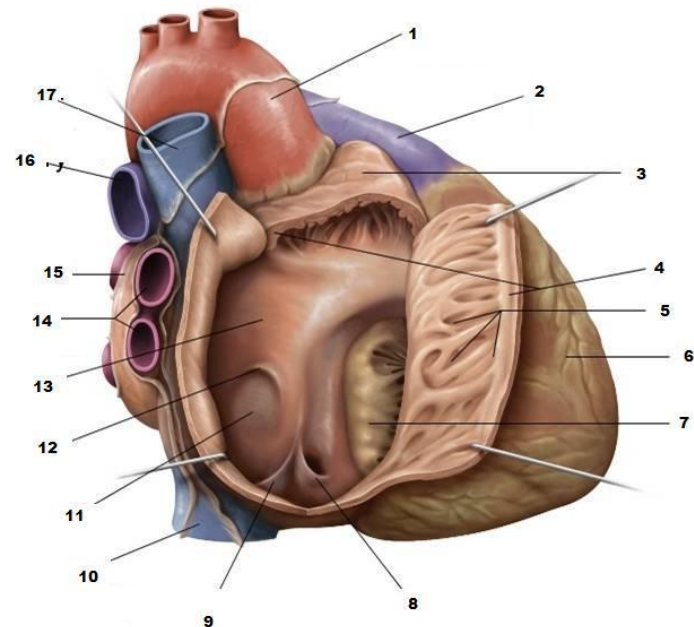
- superior vena cava, inferior vena cava and coronary sinus

Interatrial septum partitions the atria

Fossa ovalis is a remnant of the fetal foramen ovale

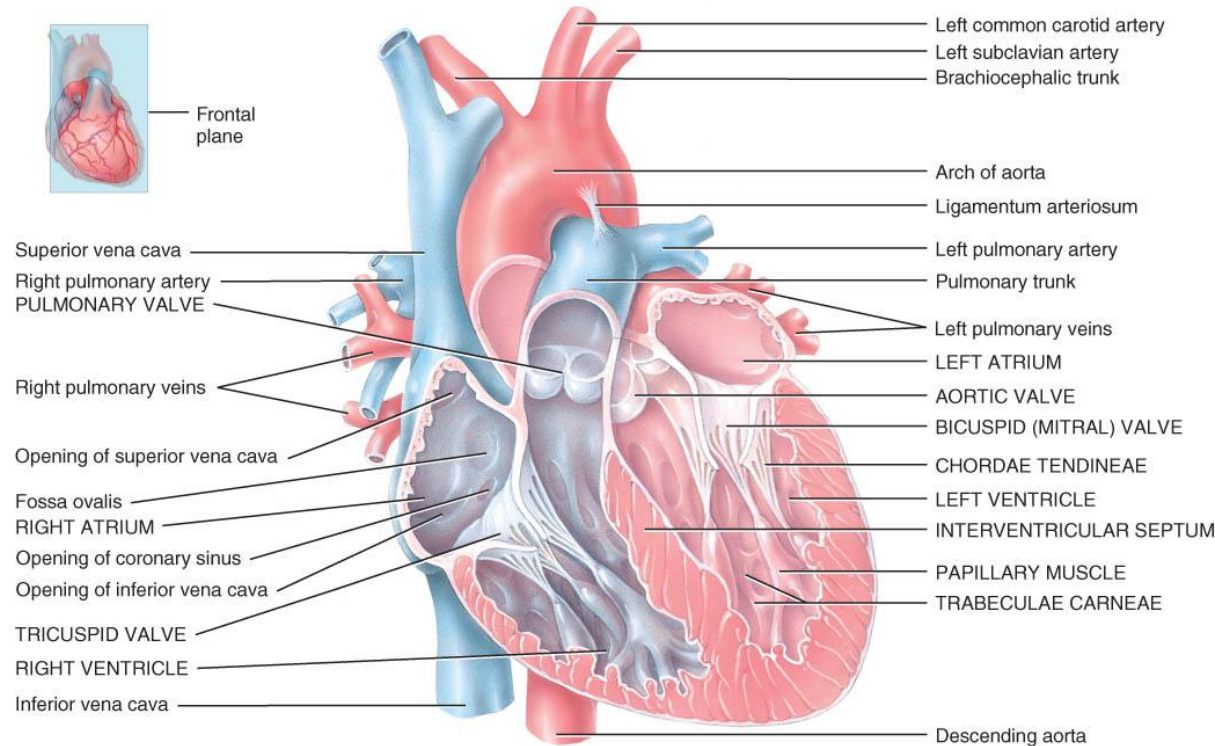
Tricuspid valve

- Blood flows through into right ventricle
- has three cusps



# Right Ventricle

- Forms most of anterior surface of heart
- Papillary muscles are cone shaped
- Chordae tendineae: cords between valve cusps and papillary muscles
- Interventricular septum: partitions ventricles
- Pulmonary semilunar valve: blood flows into pulmonary trunk



(a) Anterior view of frontal section showing internal anatomy

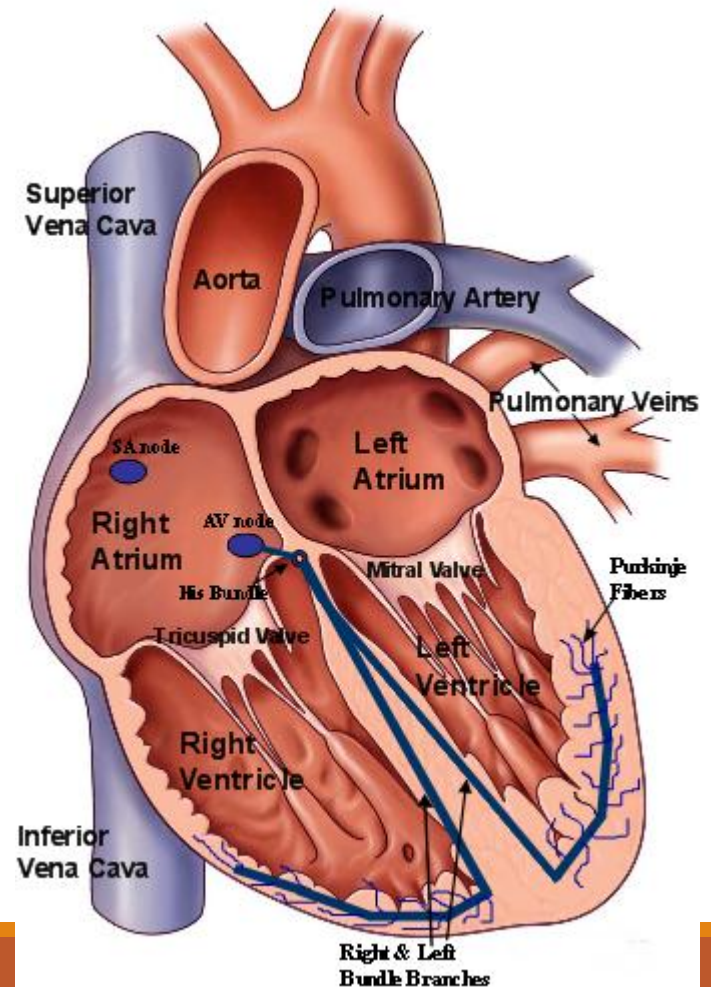
# Left Atrium

Forms most of the base of the heart

Receives blood from lungs - 4 pulmonary veins (2 right + 2 left)

**Bicuspid valve (mitral):** blood passes through into left ventricle

- has two cusps

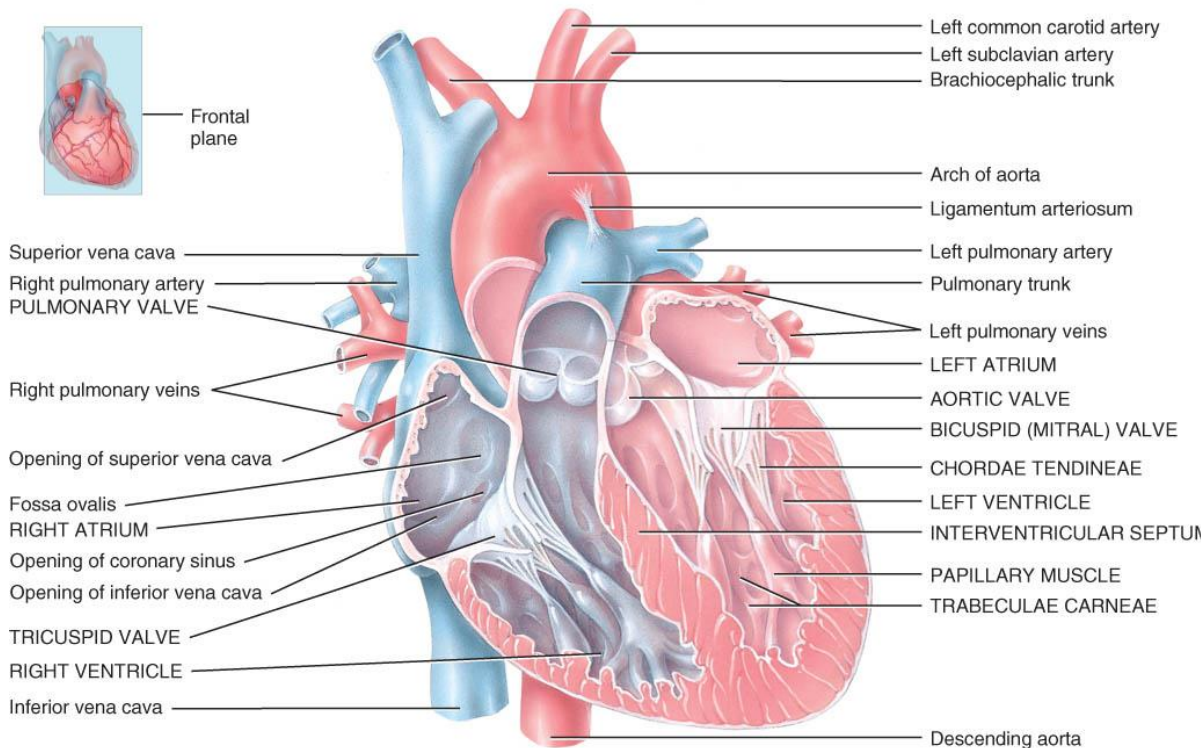


# Left Ventricle

- Forms the apex of heart
- Chordae tendineae anchor bicuspid valve to papillary muscles.

Aortic semilunar valve:

- blood passes through valve into the ascending aorta



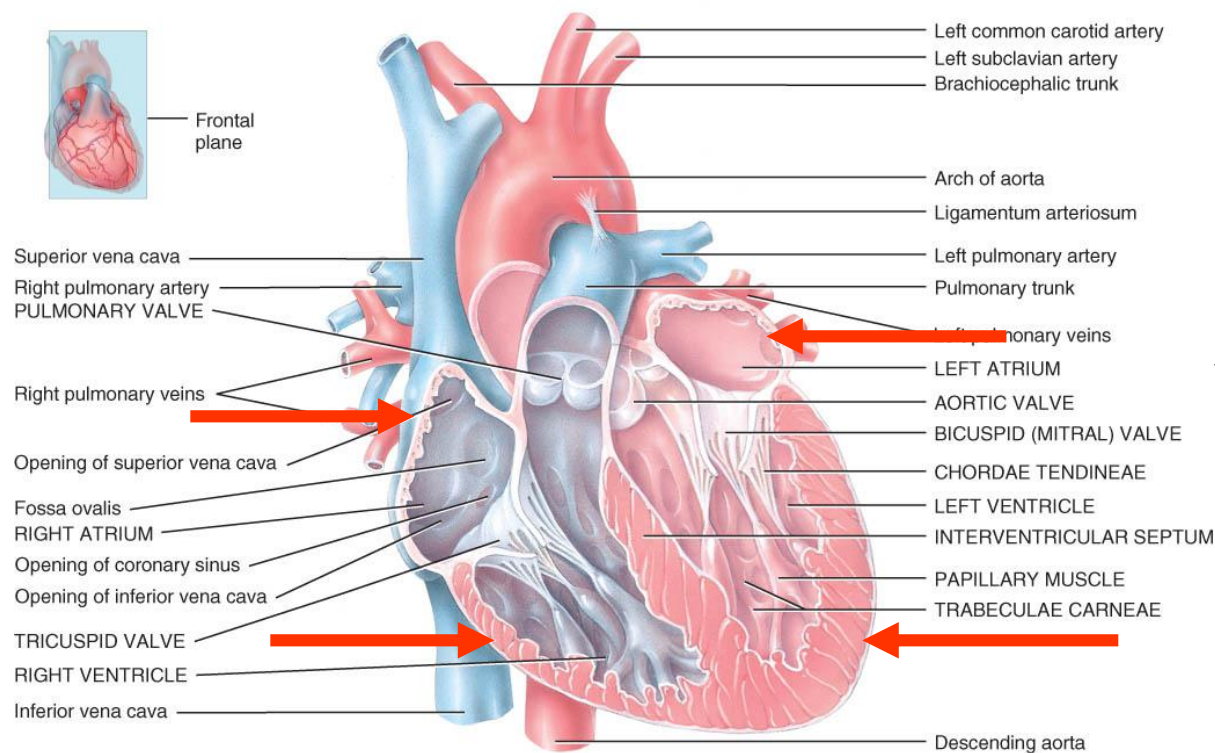
(a) Anterior view of frontal section showing internal anatomy

# Myocardial Thickness and Function

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The thickness of the myocardium of the four chambers varies according to the function of each chamber.

- The atria walls are thin because they deliver blood to the ventricles.
- The ventricle walls are thicker because they pump blood greater distances.
- The right ventricle walls are thinner than the left because they pump blood into the lungs, which are nearby and offer very little resistance to blood flow.
- The left ventricle walls are thicker because they pump blood through the body where the resistance to blood flow is greater.



(a) Anterior view of frontal section showing internal anatomy

## Myocardial Thickness and Function

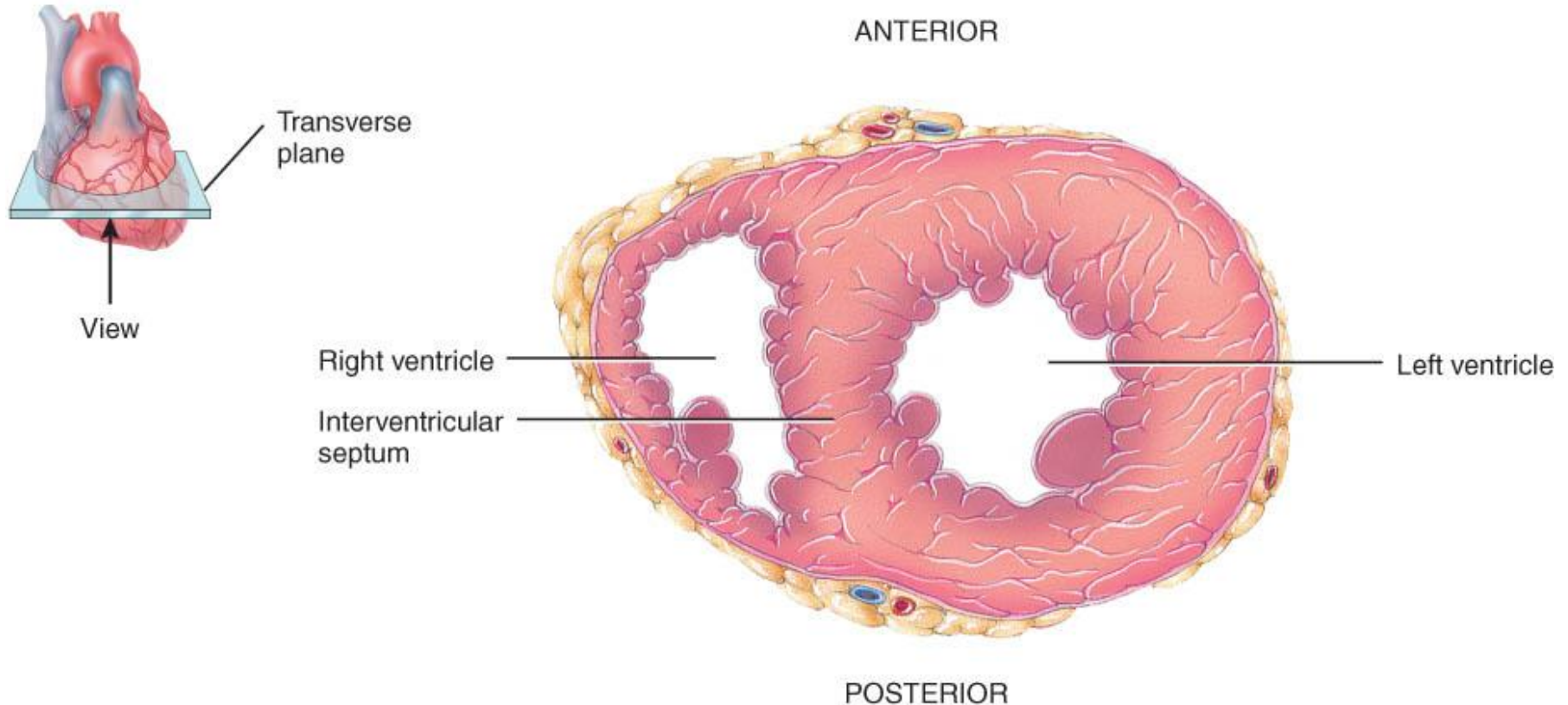
Thickness of myocardium varies according to the function of the chamber

Atria are thin walled, deliver blood to adjacent ventricles

- Ventricle walls are much thicker and stronger
  - right ventricle supplies blood to the lungs (little flow resistance)
  - left ventricle wall is the thickest to supply systemic circulation



# Thickness of Cardiac Walls



(c) Inferior view of transverse section showing differences in thickness of ventricular walls

Myocardium of left ventricle is much thicker than the right.

# Blood Circulation

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Two closed circuits, the systemic and pulmonary

Systemic circulation

left side of heart pumps blood through body

- left ventricle pumps oxygenated blood into aorta
- aorta branches into many arteries that travel to organs
- arteries branch into many arterioles in tissue
- arterioles branch into thin-walled capillaries for exchange of gases and nutrients
- deoxygenated blood begins its return in venules
- venules merge into veins and return to right atrium

# Blood Circulation (cont.)

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## Pulmonary circulation

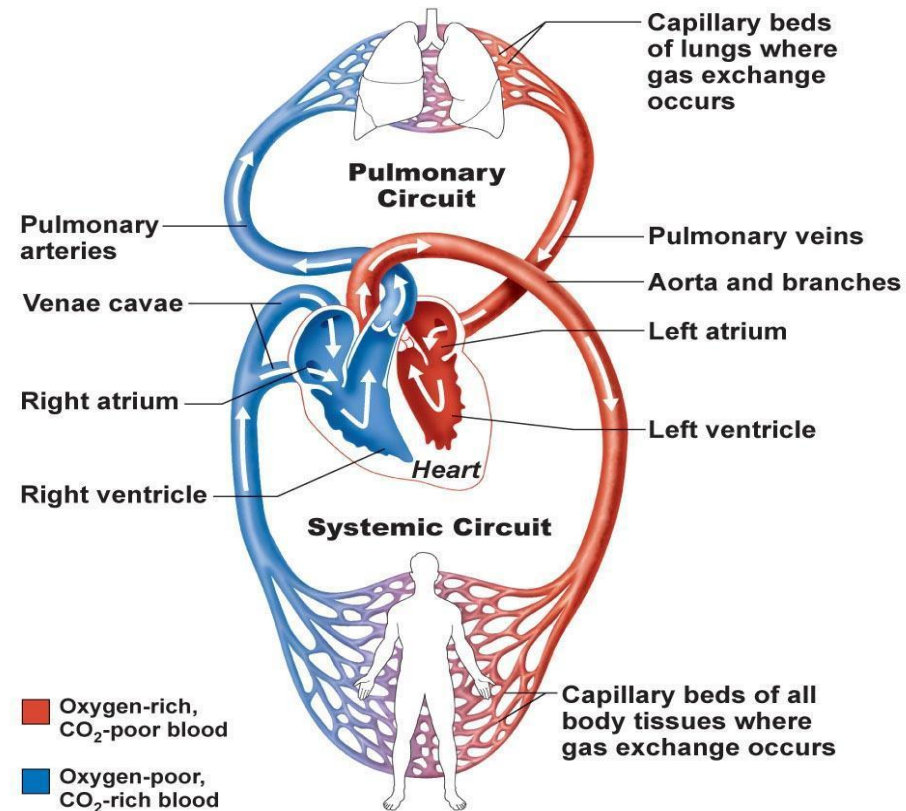
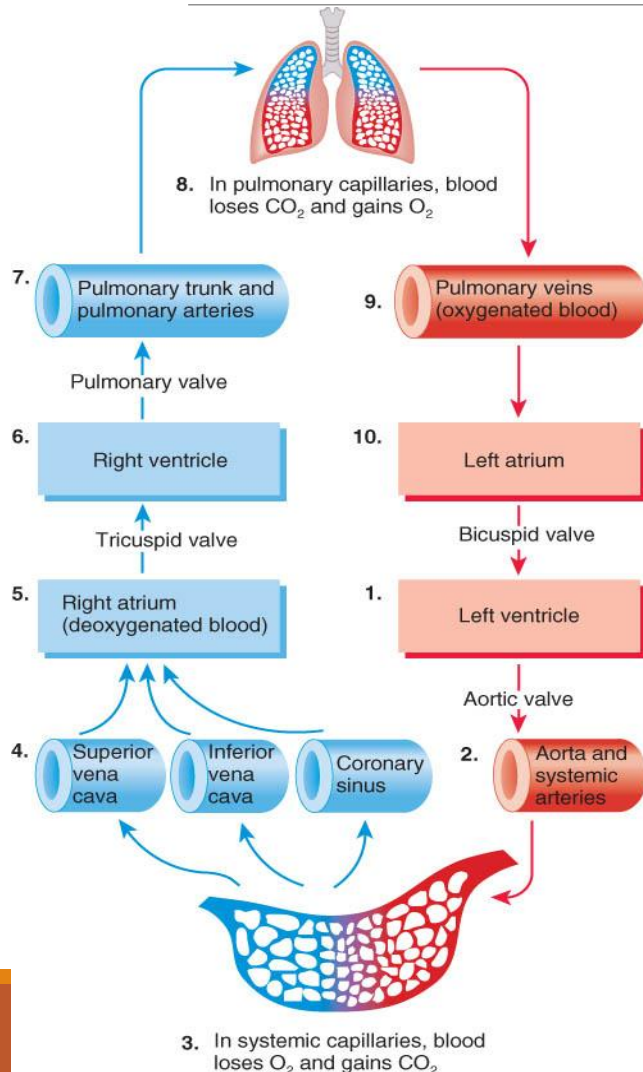
right side of heart pumps deoxygenated blood to lungs

- right ventricle pumps blood to pulmonary trunk
- pulmonary trunk branches into pulmonary arteries
- pulmonary arteries carry blood to lungs for exchange of gases
- oxygenated blood returns to heart in pulmonary veins

# Blood Circulation

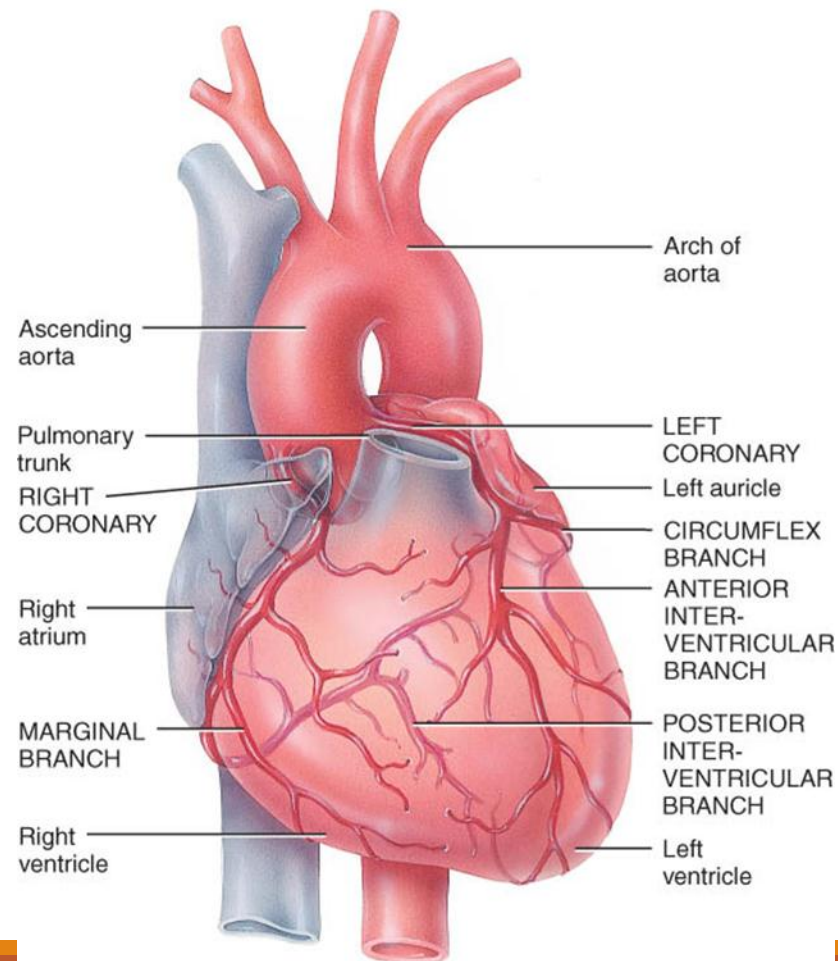
## Blood flow

- blue = deoxygenated
- red = oxygenated



# Coronary Circulation

- The flow of blood through the many vessels that flow through the myocardium of the heart is called the *coronary (cardiac) circulation*; it delivers oxygenated blood and nutrients to and removes carbon dioxide and wastes from the myocardium.



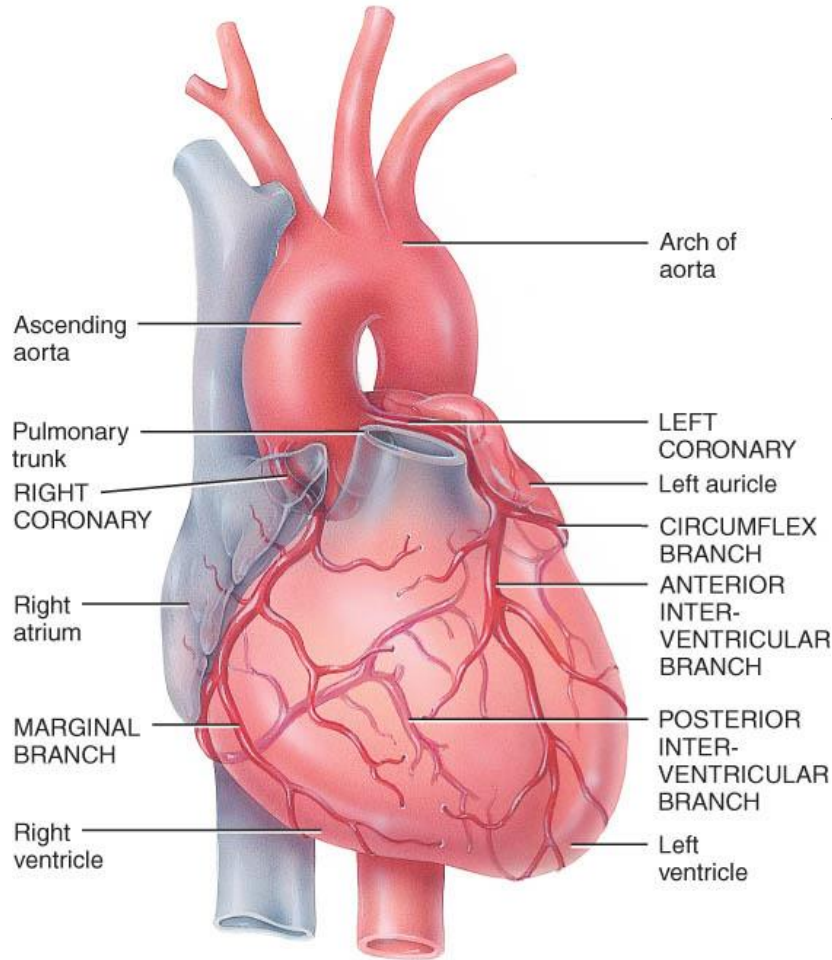
(a) Anterior view of coronary arteries

# Coronary Circulation

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- Coronary circulation is blood supply to the heart
- Heart as a very active muscle needs lots of O<sub>2</sub>
- Many anastomoses
  - connections between arteries supplying blood to the same region, provide alternate routes if one artery becomes occluded

# Coronary Arteries



(a) Anterior view of coronary arteries

Branches off aorta above aortic semilunar valve

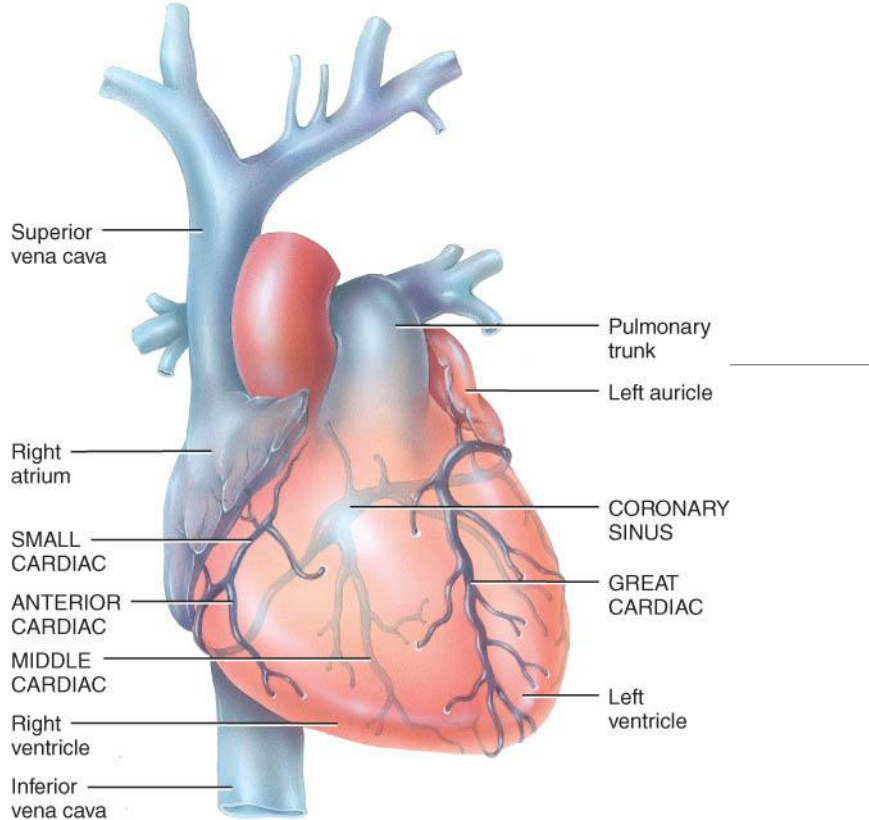
## Left coronary artery

- **circumflex branch**
  - in coronary sulcus, supplies left atrium and left ventricle
- **anterior interventricular artery**
  - supplies both ventricles

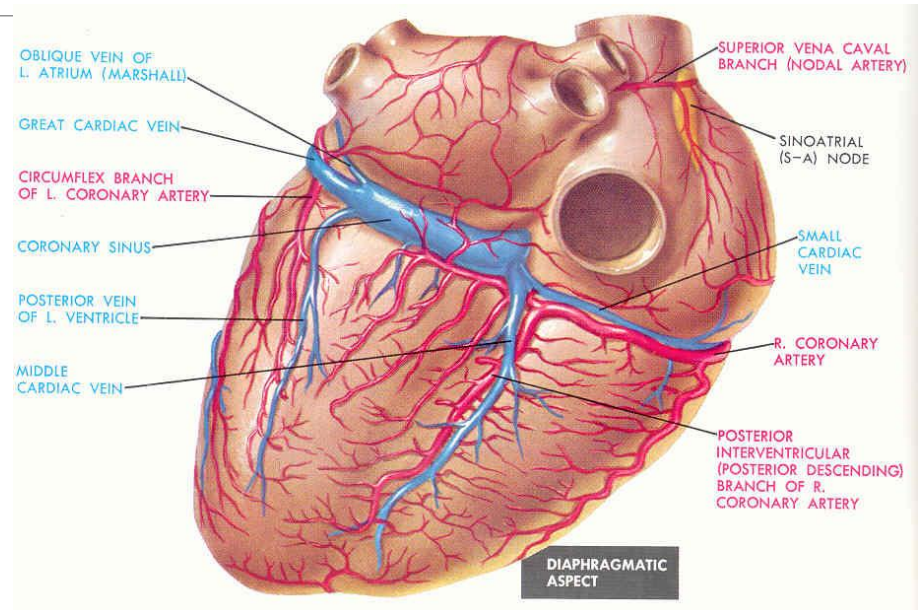
## Right coronary artery

- **marginal branch**
  - supplies right ventricle
- **posterior interventricular artery**
  - supplies both ventricles

# Coronary Veins



(b) Anterior view of coronary veins



- Collects wastes from cardiac muscle
- Drains into a large sinus on posterior surface of heart called the **coronary sinus**
- Coronary sinus empties into **right atrium**