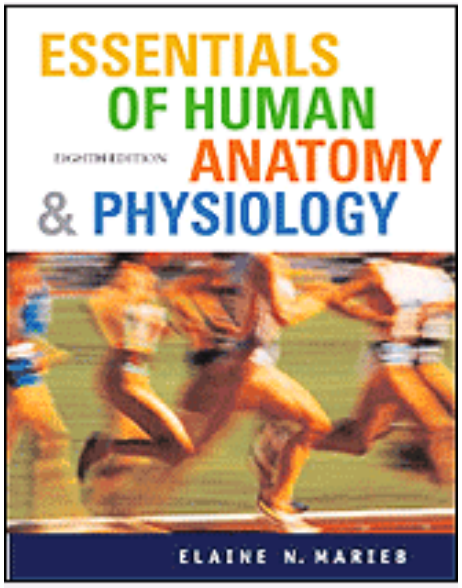
Human Anatomy and Physiology

CLS 224



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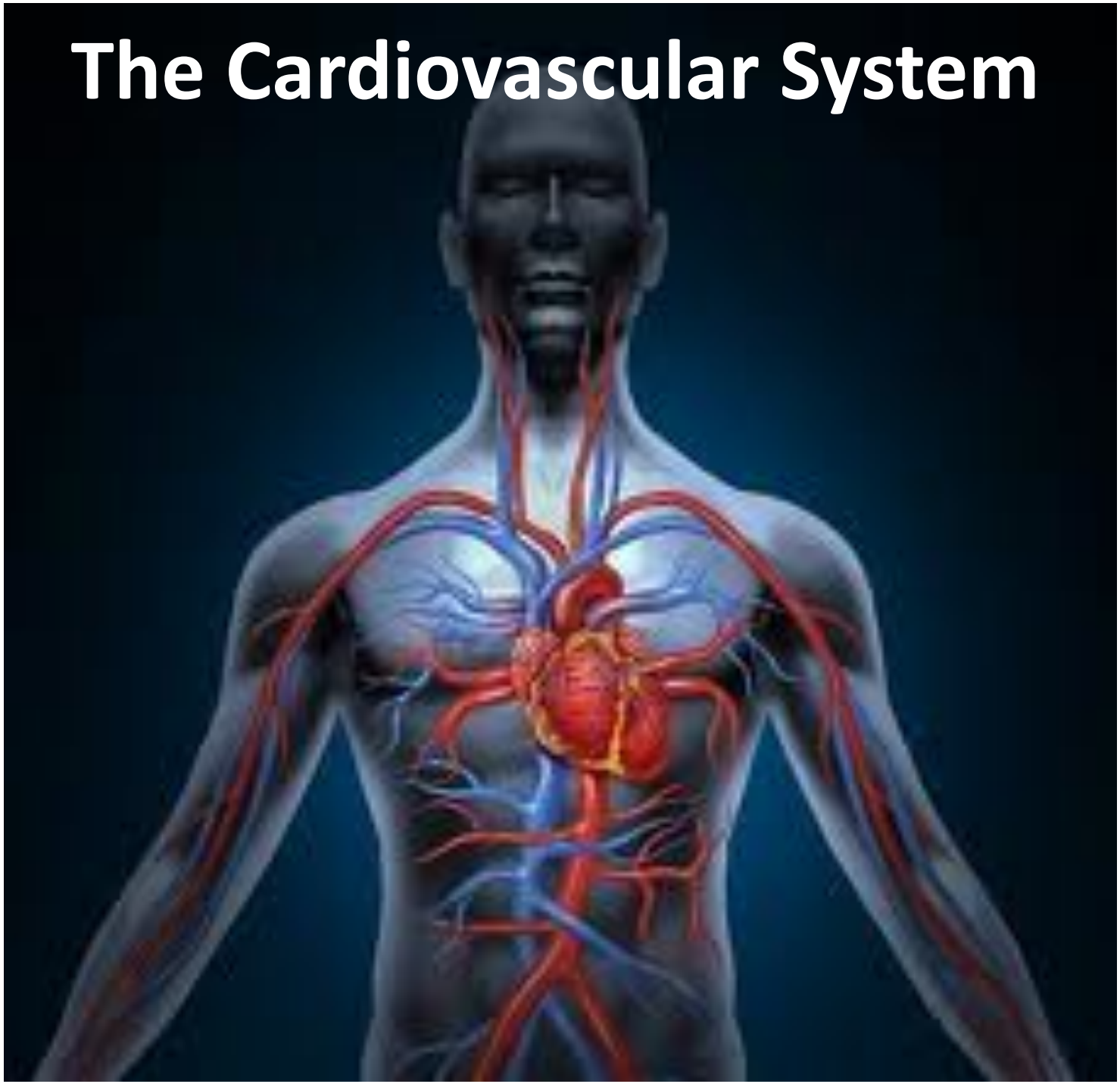
The Cardiovascular System



1)The Heart

- Anatomy of the heart.
- Physiology of the heart.

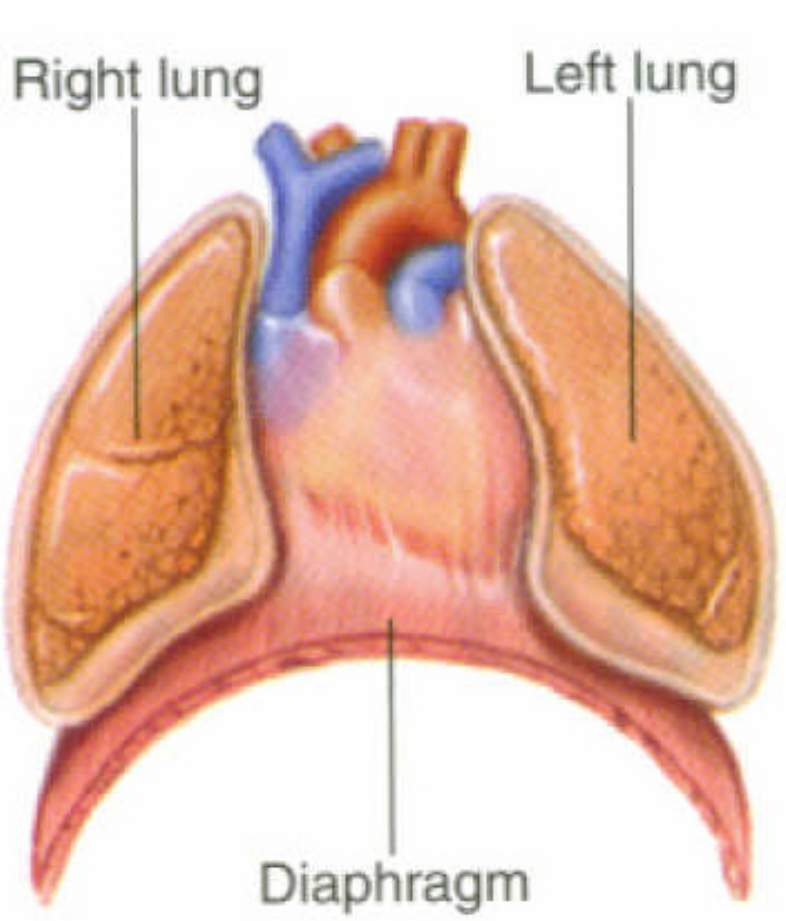
2)Blood vessels

- Microscopic anatomy of the blood vessels.

Introduction

- The cardiovascular system consists of heart and blood vessels.
- The major function of the cardiovascular system is transportation. Using blood as the transport vehicle.
- The system carries respiratory gases, nutrients, waste productes..ect to and from the cells.

1) The Heart



- **Anatomy of the heart:**

About the **Size** of a closed fist.

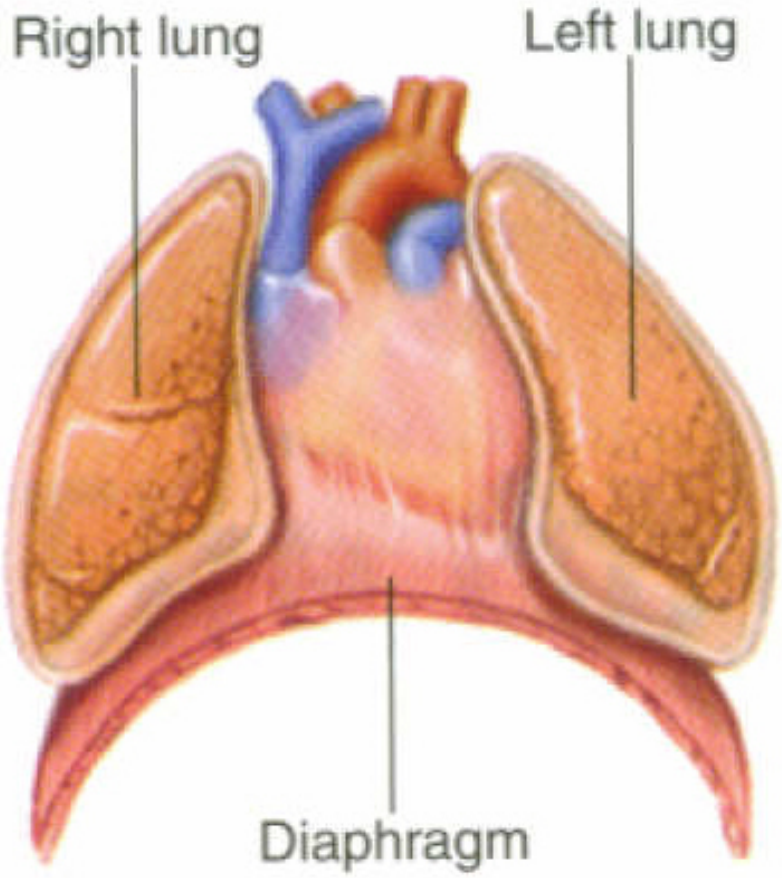
Shape:

–Apex: Rounded point of the cone, rests on the diaphragm.

–Base: Flat part at opposite end of the cone, where great vessels of the body emerge.

Located in the thoracic cavity in the mediastinum.

- Heart is <u>bordered:</u>
  - Laterally by the lungs.
  - Posteriorly by the vertebral column.
  - Anteriorly by the sternum.
- Rests on the diaphragm inferiorly.



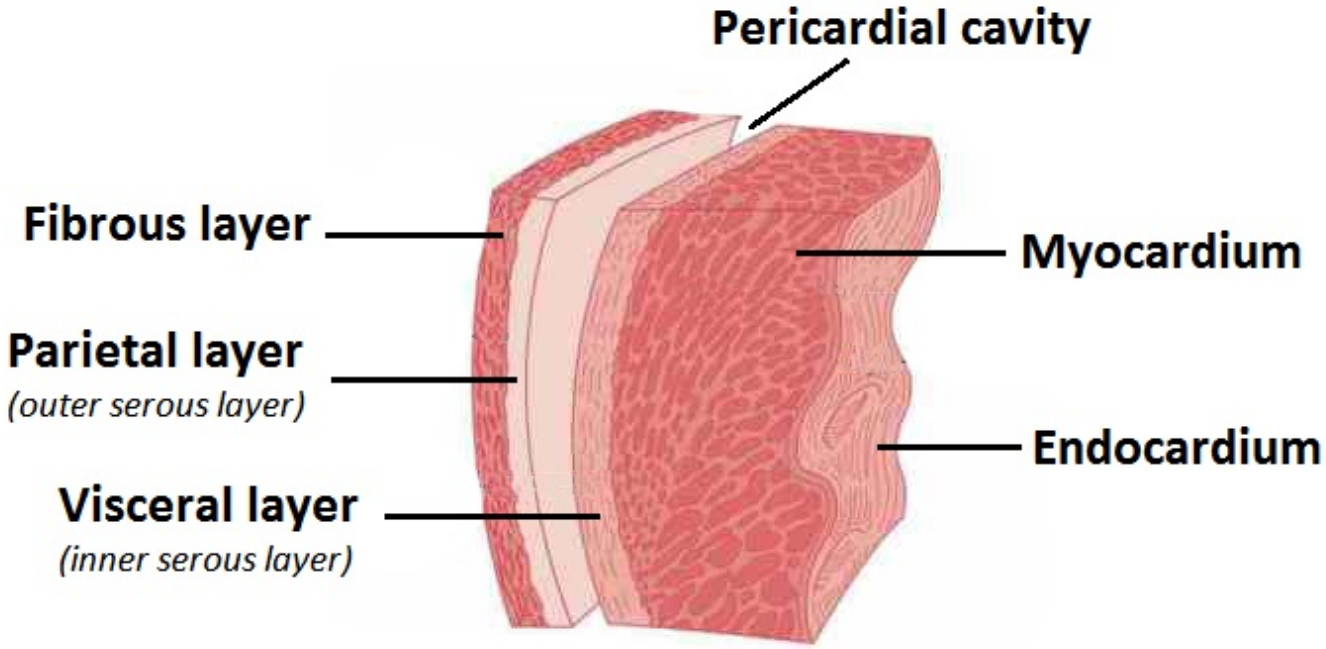
Enclosed by a double membrane called the **pericardium**

1) **Fibrous pericardium:**

dense irregular connective tissue ---protects the heart, anchors heart to surrounding structures.

2) **Serous pericardium**: thin, more delicate. divided into:

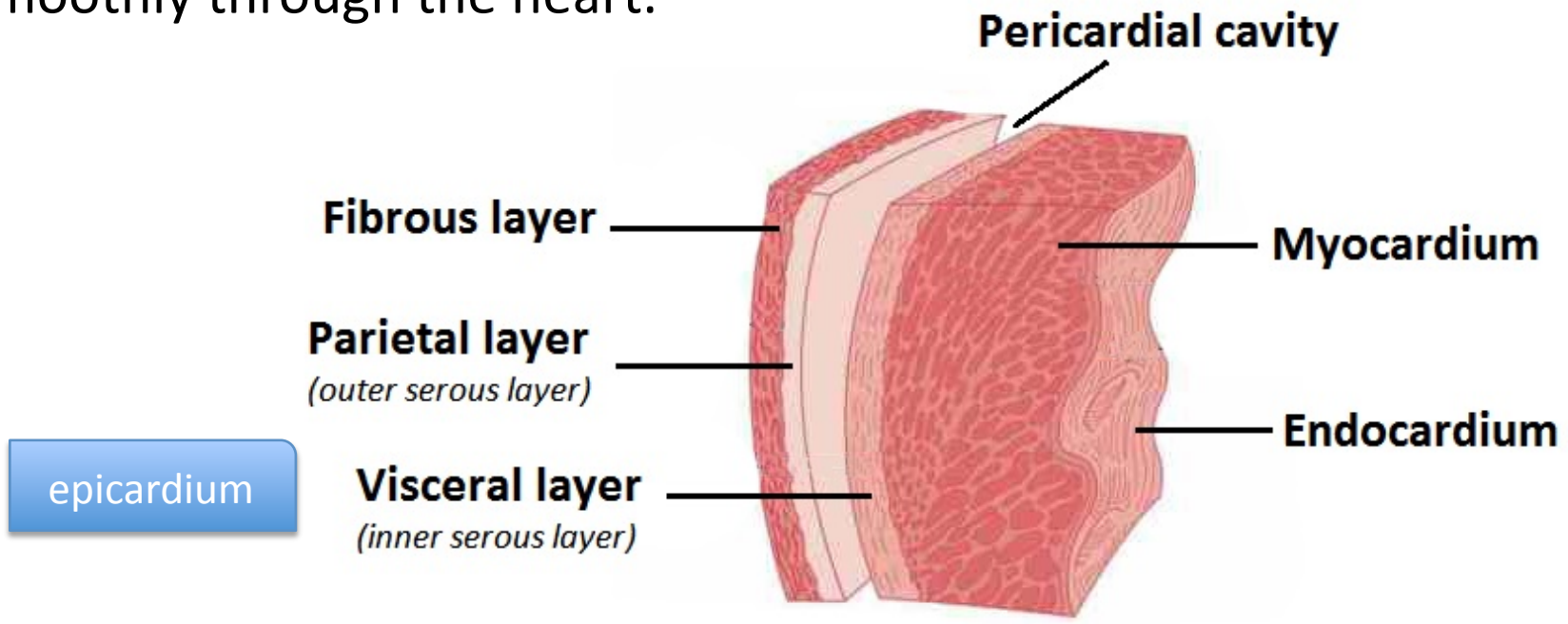
parietal pericardium and visceral pericardium (epicardium).



Pericardial cavity has serous fluid that allows the heart to beat easily in a frictionless environment

The heart wall are composed of three layers: (from out to in)

- Epicardium = Visceral layer of serous pericardium.
- Myocardium = Middle layer, composed of cardiac muscle cells, and responsible for heart contracting.
- Endocardium = Smooth lining of the chambers, helps blood flow smoothly through the heart.



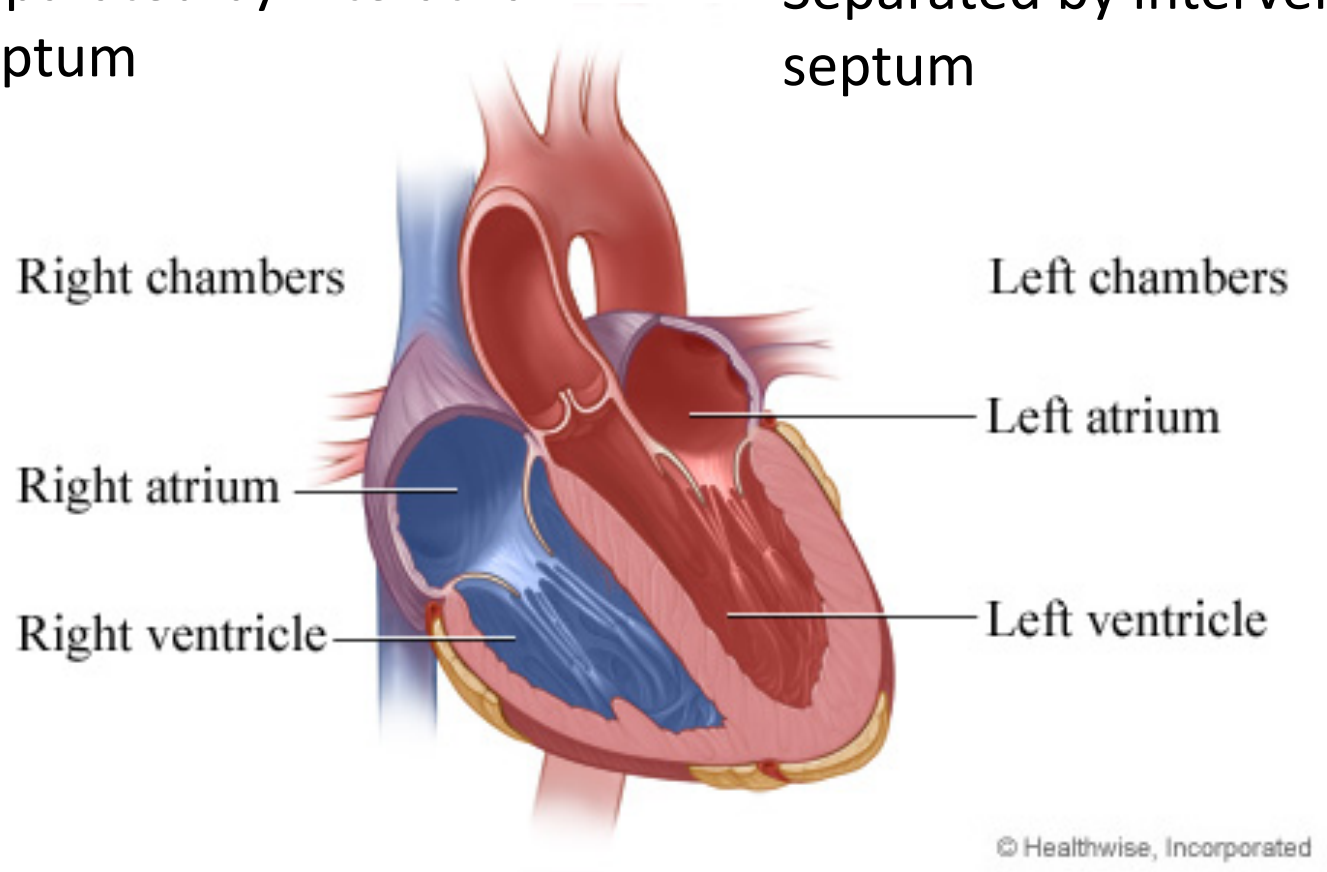
The heart has 4 **chambers**

Two atria:

- Upper chambers
- Receiving chambers
- Left and right
- Separated by interatrial septum

Two ventricles:

- Lower chambers
- Discharging chambers
- Left and right
- Separated by interventricular septum



Heart valves:

•Atrioventricular

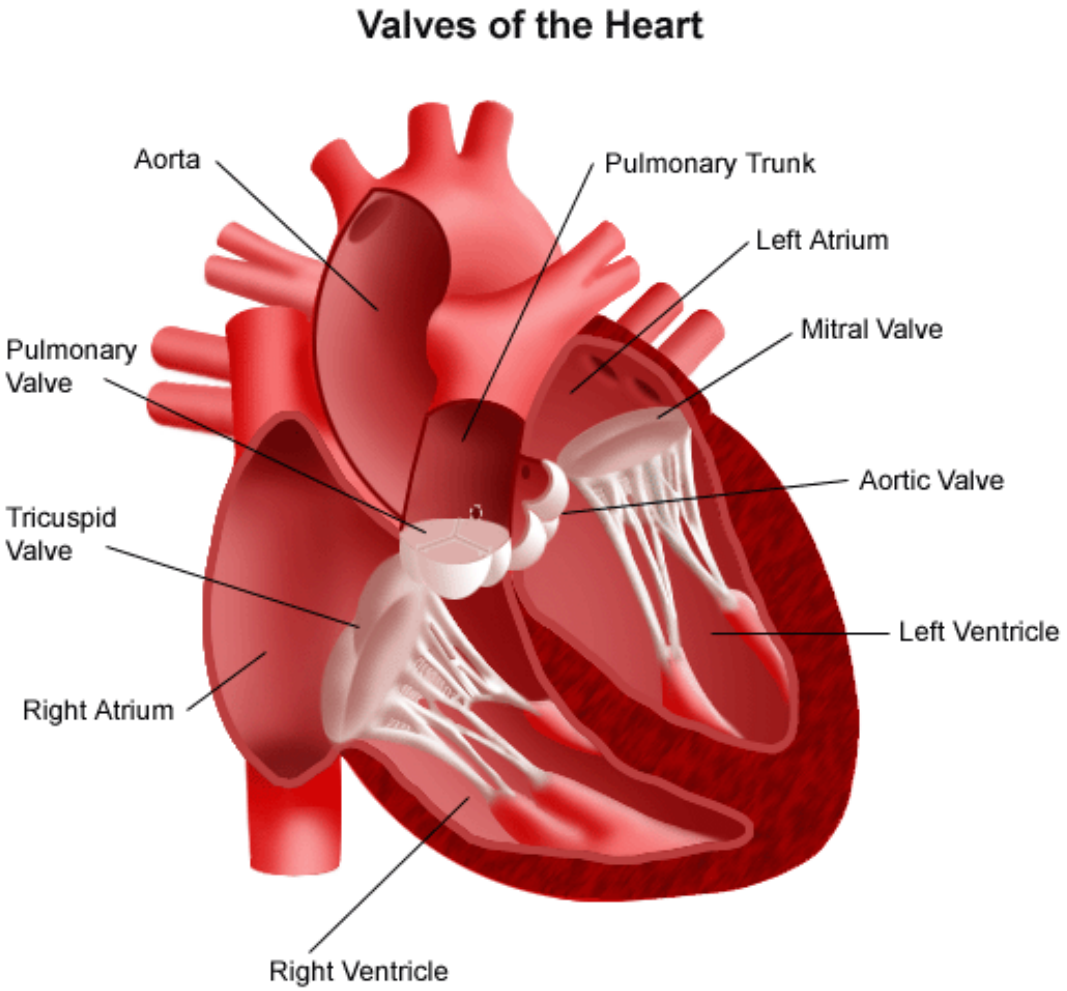
---Tricuspid RA to RV.

--Bicuspid or mitral LA to LV.

•Semilunar

–Aortic LV to aorta.

–Pulmonary RV to pulmonary trunk.



Valves Prevent blood from flowing backwards (keeping th blood flowing in one direction).

Types of Circulation

- Pulmonary circulation: The blood pathway between the right side of the heart, to the lungs, and back to the left side of the heart.

- Systemic circulation: The pathway between the left and right sides of the heart.

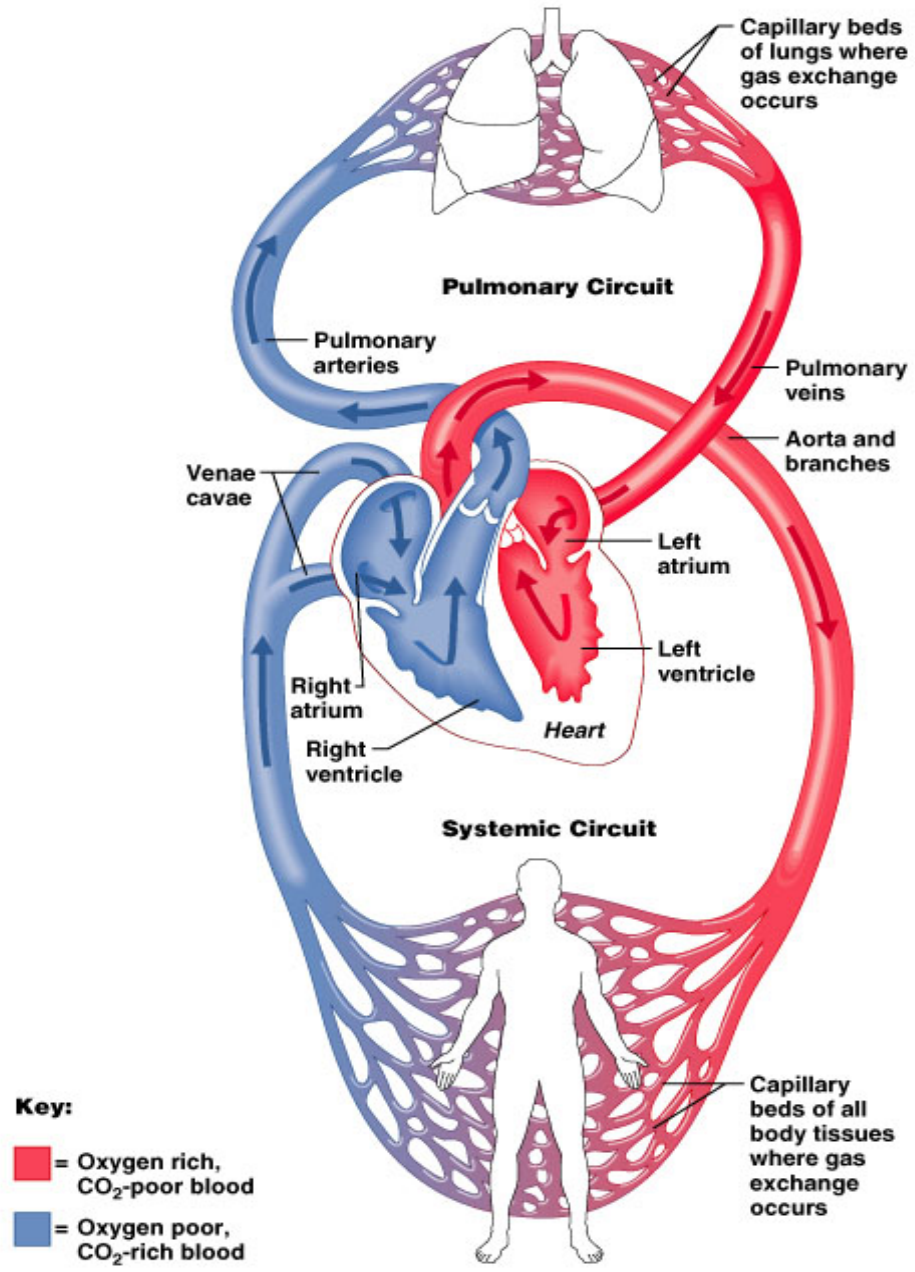
- Coronary circulation:

-Remember, the heart is an organ and needs nutrients, oxygen and creates wastes.

-The blood contained in the heart doesn't nourish the myocardium.

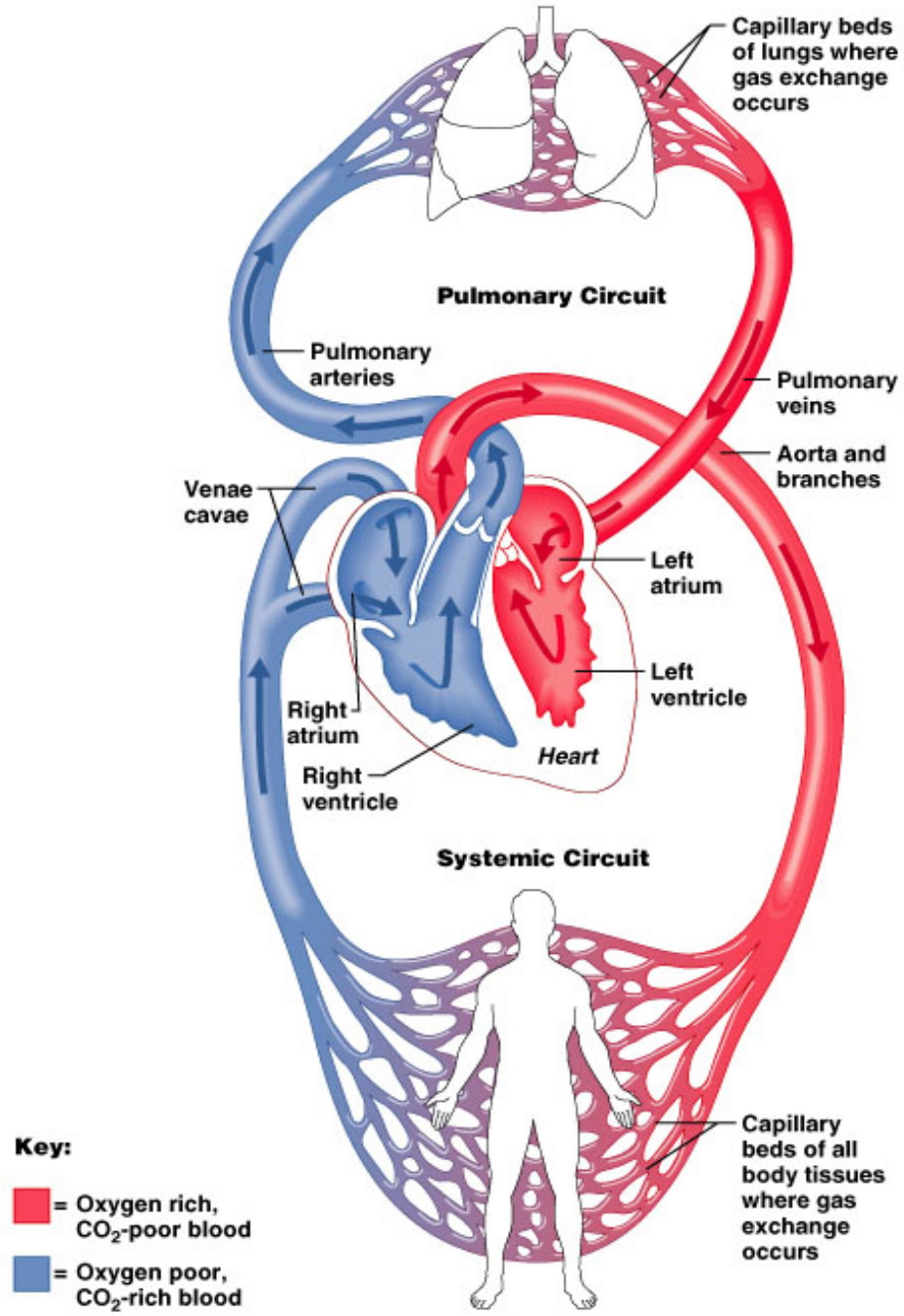
- Blood is supplied to the heart by coronary arteries and drained by coronary veins.

SYSTEMIC AND PULMONARY CIRCULATION

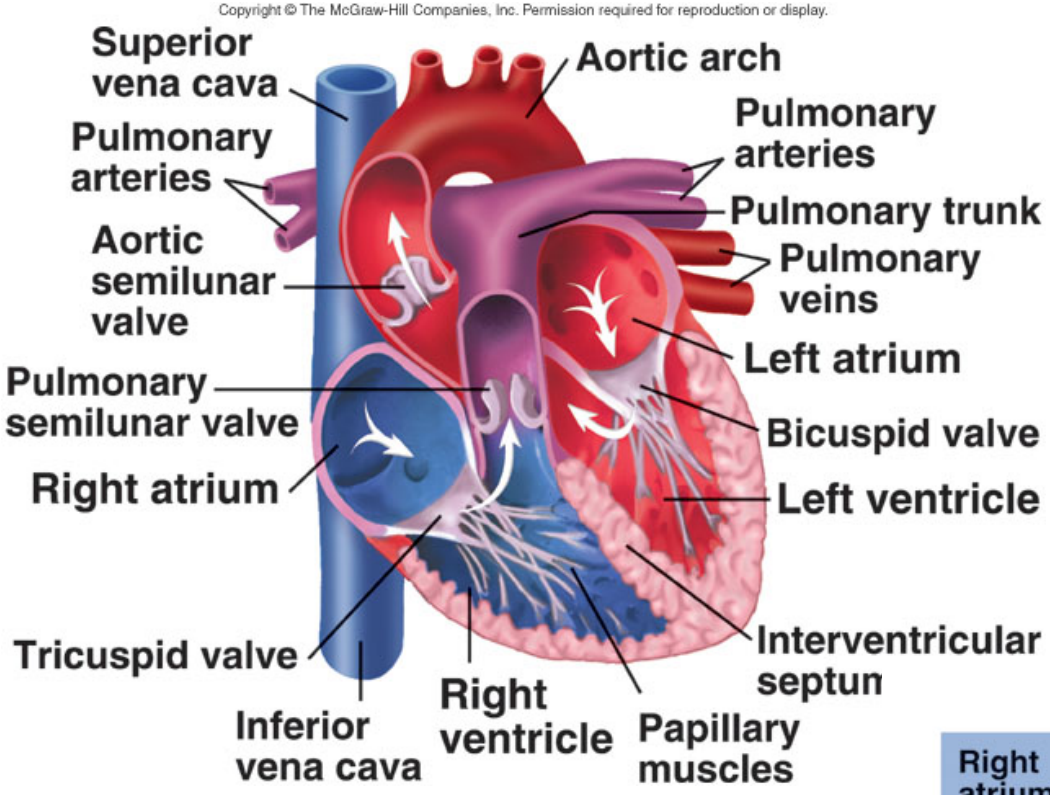


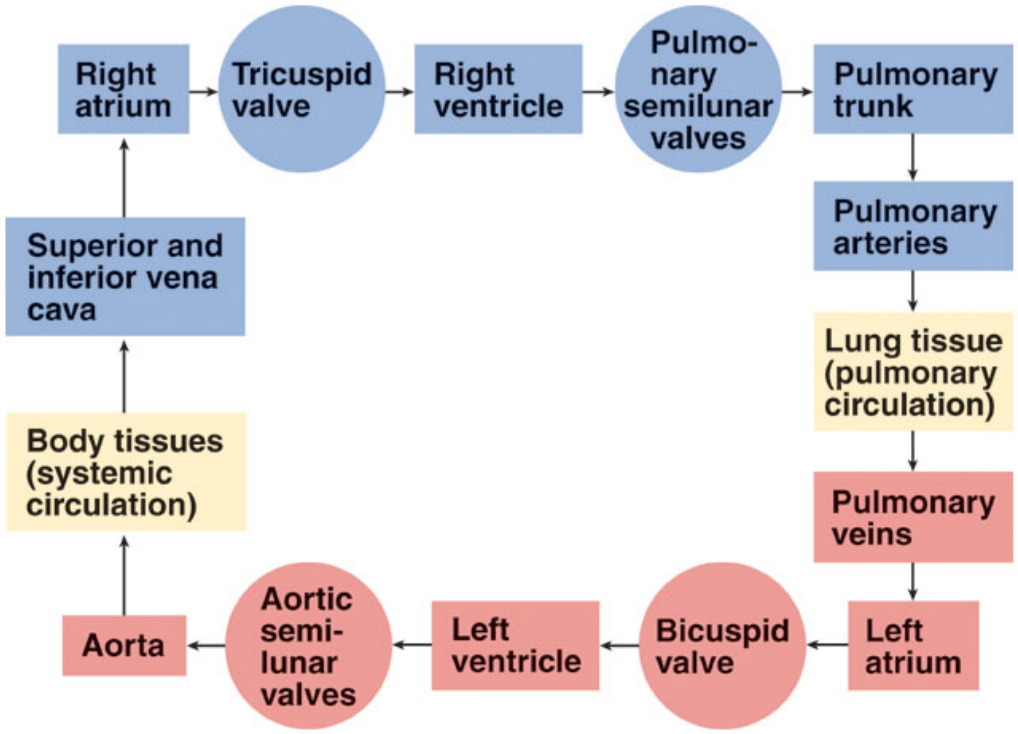
- Blood leaves the heart in arteries, and blood returns to heart in veins.

- Oxygenated blood returns from the lungs through the pulmonary veins to the left atrium.
- Oxygenated blood is pumped from the left atrium through the mitral valve to the left ventricle.
- Oxygenated blood leaves the left ventricle through the aortic valve to the aorta, which is the largest artery of your body.
- The aorta branches into various arteries pumping blood through your body.



- Deoxygenated blood returns from the top of your body through the superior vena cava and from the bottom of your body through the inferior vena cava to the right atrium.
- Deoxygenated blood is pumped from the right atrium through the tricuspid valve to the right ventricle.
- Deoxygenated blood leaves the right ventricle through the pulmonary valve to the pulmonary arteries.
- The pulmonary arteries pump blood to the lungs to absorb oxygen and release carbon dioxide.





Relative thickness of muscular walls

Atrial walls are thin because Blood flows into the atria under low pressure from the veins and then continues to fill the ventricles by gravity, requiring little atrial effort while ventricles are thick-walled as they require to propel blood out of the heart and into the circulation.

LV thicker than RV because it forces blood out against more resistance; the systemic circulation is much longer than the pulmonary circulation.

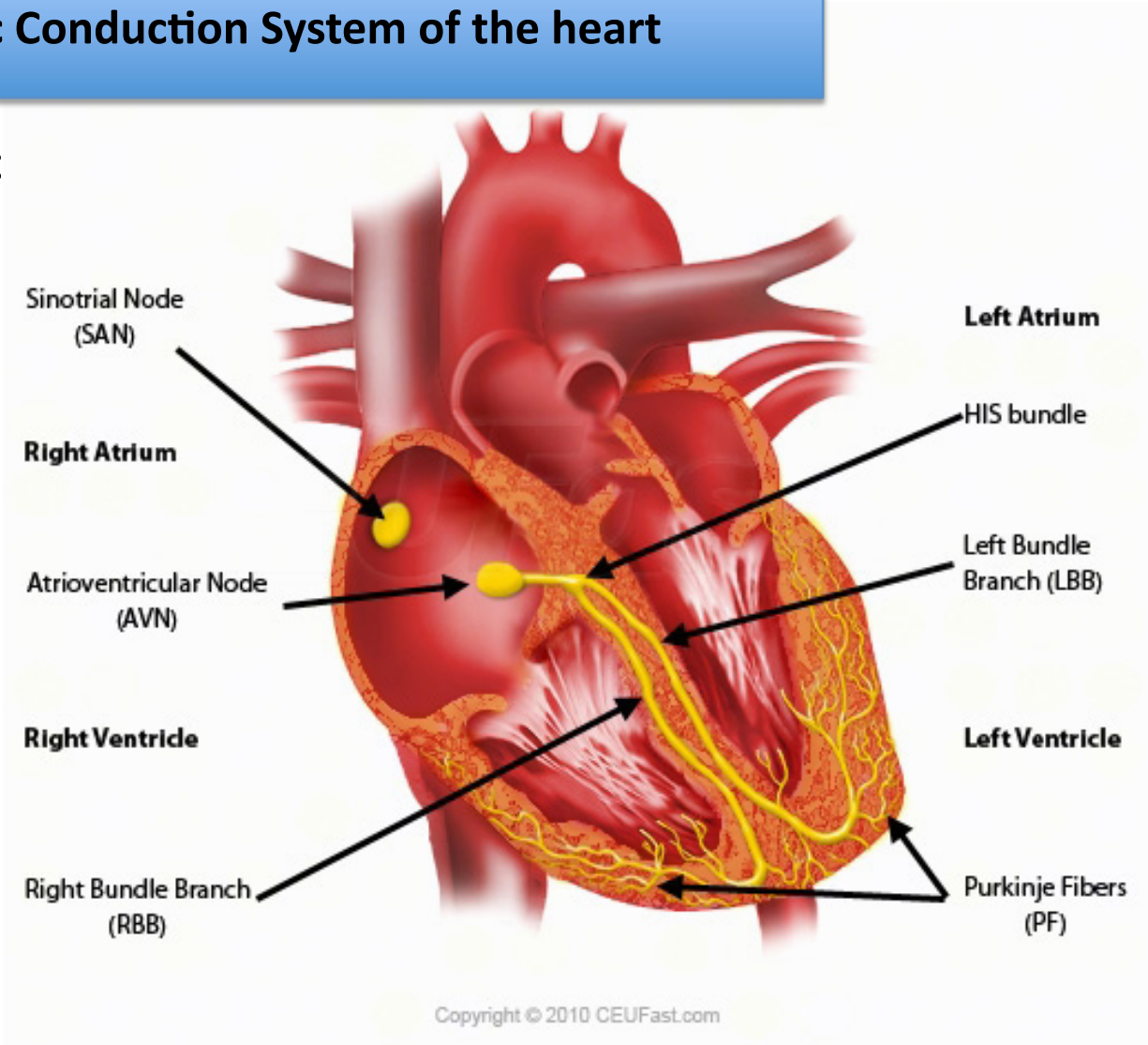
- **Physiology of the heart:**

The Intrinsic Conduction System of the heart

This system sets the basic rhythm of the heart.

Composed of special tissue not found anywhere else in the body.

This system causes heart muscle depolarization in only one direction- from atria to ventricles.



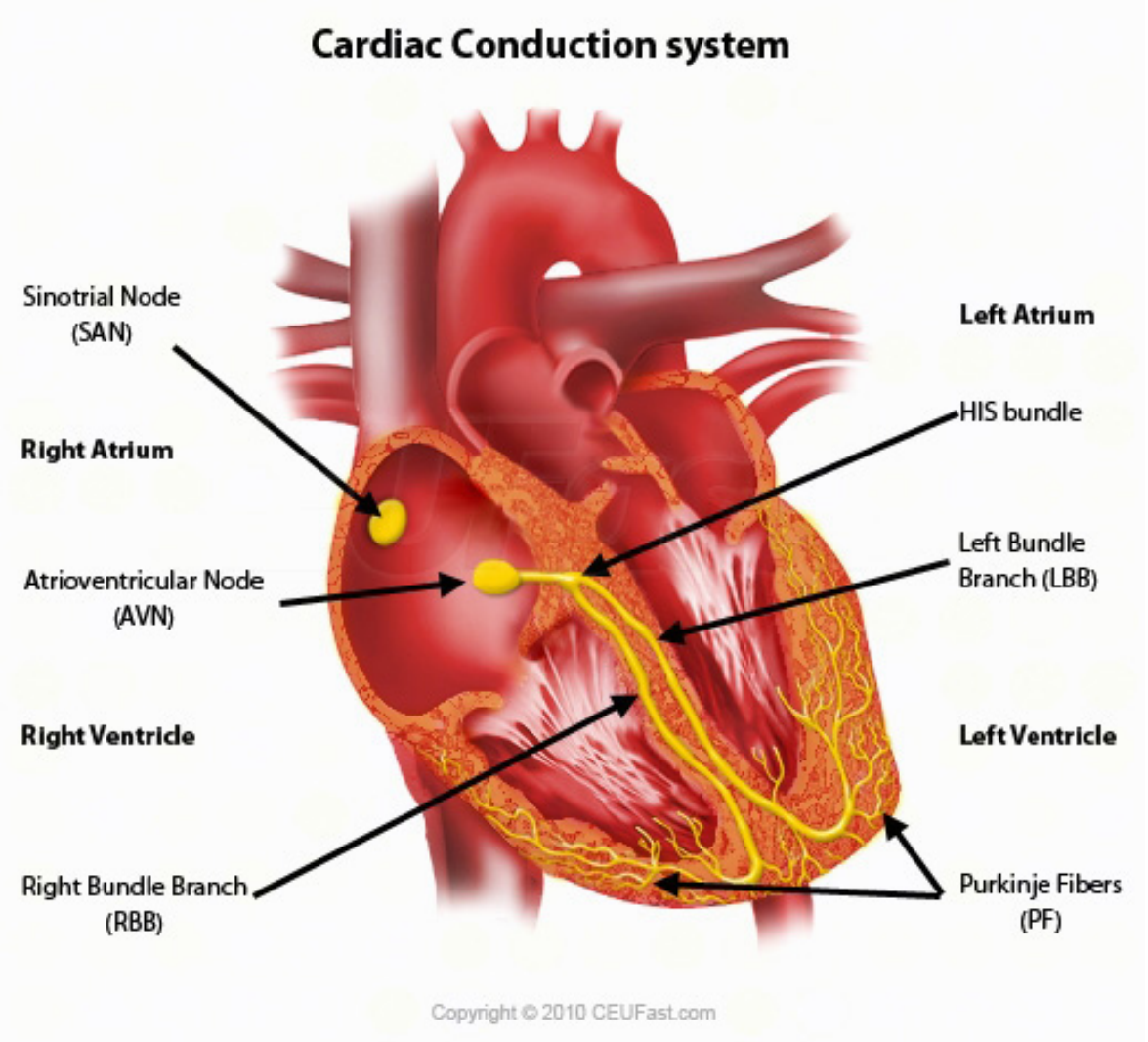
- The system Consists of :

1) Sinotrial node (SA node) the " natural pacemaker":
   - Wall of right atrium.
   - Generates impulse (depolarization wave).
   - Sends impulse to AV node.

2) Atrioventricular node (AV node):

   -Atria contracts then,

   -Sends impulse to the bundle of His.

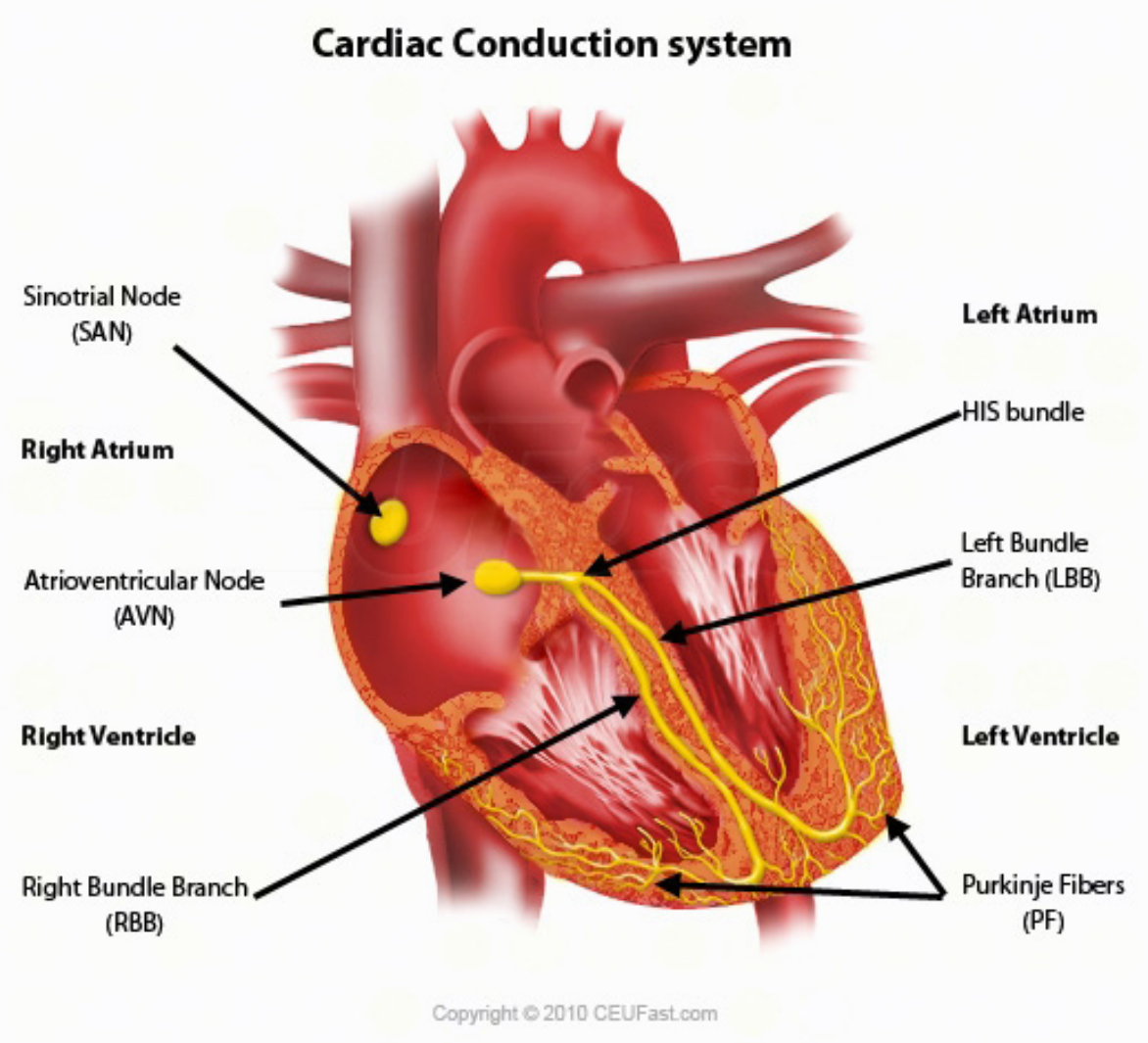


3) Bundle of His

- Between ventricles.
- Two branches in the interventricular septum.
- Sends impulse to Purkinje fibers.

4)Purkinje fibers

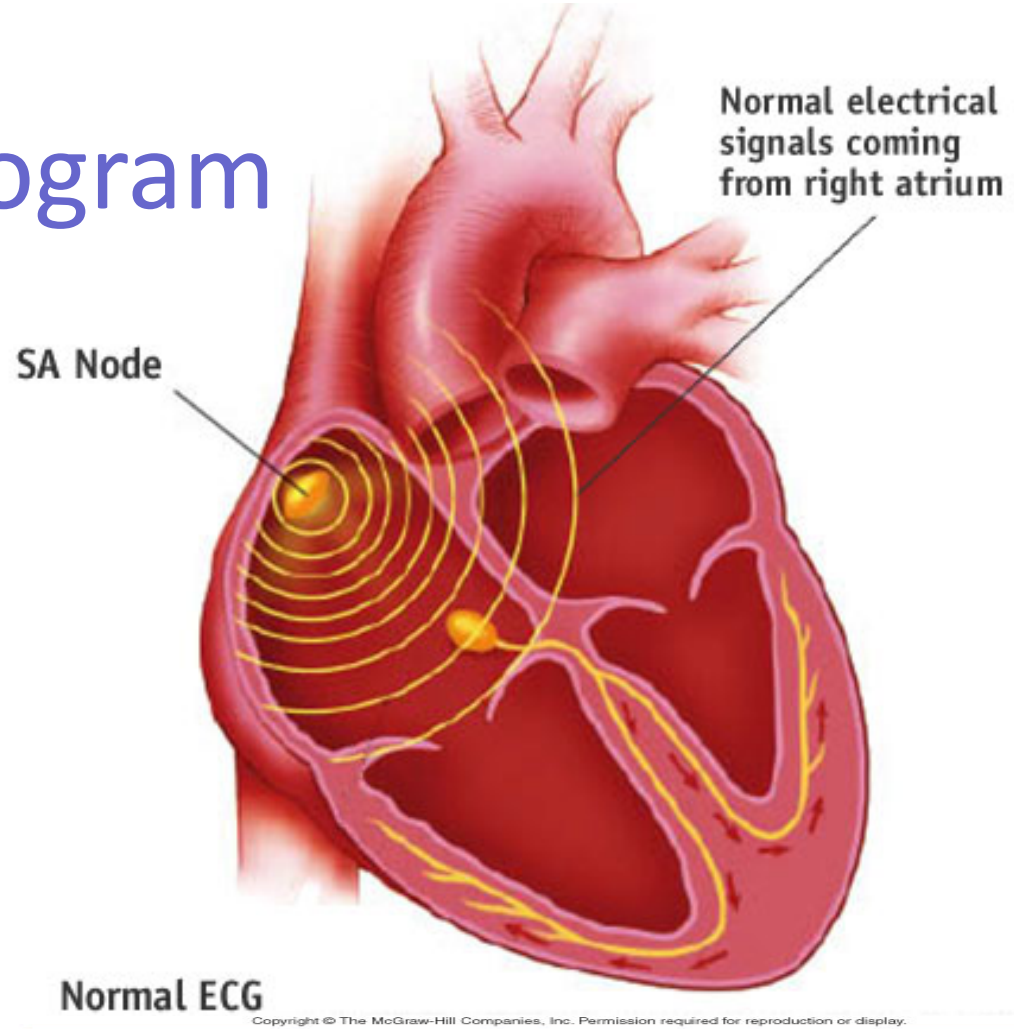
- Lateral walls of ventricles.
- Ventricles contract.



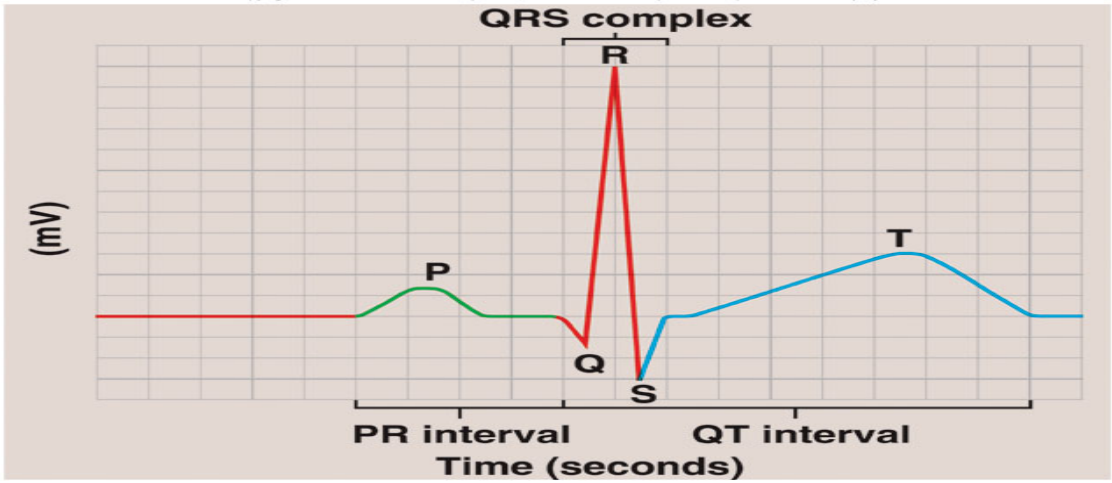
When the atria contract, blood flows into the ventricles. When the ventricle contract, blood flows out of the heart.

Electrocardiogram

- Electrical activity is recorded by electrocardiogram (ECG).
- P wave corresponds to Atrial depolarization.
- QRS complex corresponds to ventricular depolarization.
- T wave corresponds to ventricular repolarization.
- Atrial repolarization record is masked by the larger QRS complex



Normal ECG



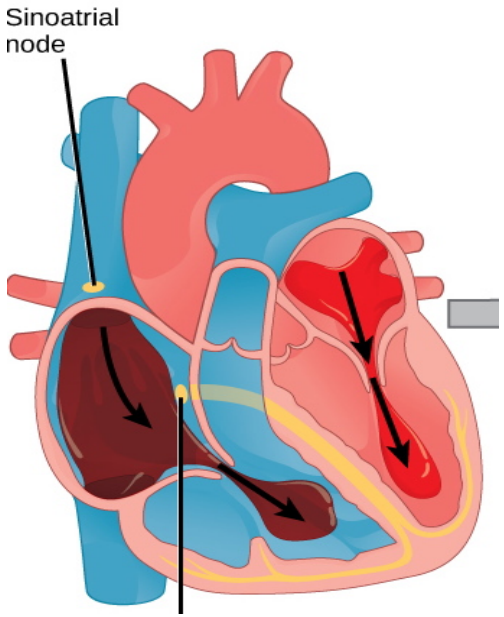
Cardiac Cycle

- Cardiac cycle refers to events of one complete heart beat, during which both atria and ventricles contract (systol) and relax (diastol).
- A normal cardiac cycle takes about 0.8 seconds.

Cardiac Cycle

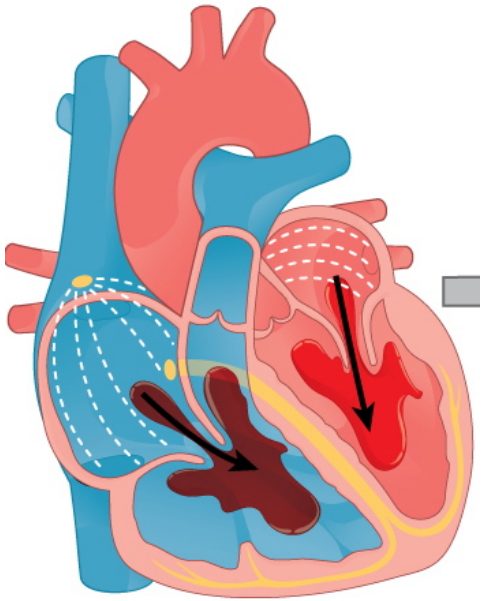
Phases

1. Mid to late diastole:



mid:

-Heart is in complete relaxation.
-Semilunar valves are closed.
-Pressure in the heart is low.
-AV valves are open.
-Blood is flowing passively from atria into ventricles from the pulmonary and systemic circulations.



Late:

-Atria contracts.
-Remained blood in the atrium is forced into the ventricle.

2. Ventricular systol:

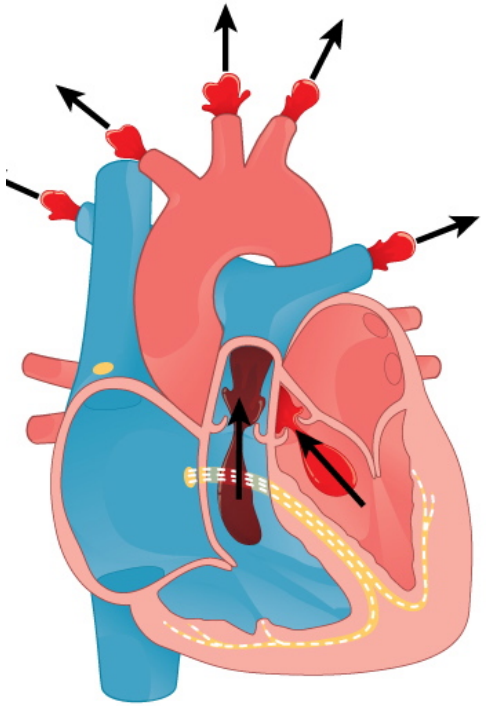
-Ventricles contract.

-pressure within ventricles increase!

-AV valves close.

-Semilunar valves opens and blood rushes out of the ventricles.

-The atria are relaxed and their chambers are again filling with blood.



3.Early diastol:

-Ventricles relax.

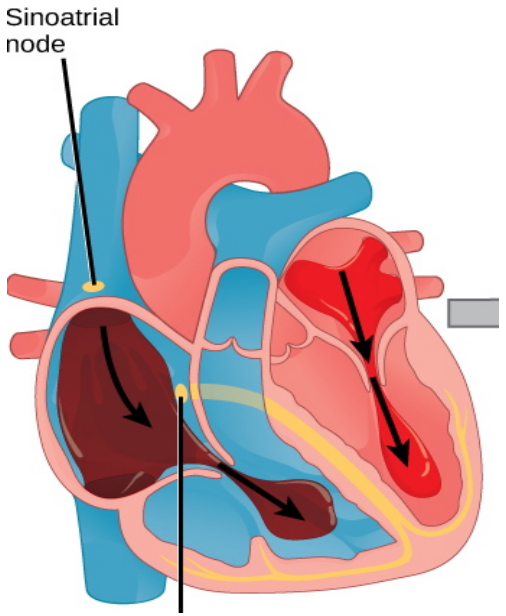
-Semilunar valves shut (preventing back flow).

-The interventricular pressure drops.

-AV valves open (mid diastol phase).

-Ventricles again begin to fill rapidly with blood.

-Complete cycle!



Heart Sounds

- One cardiac cycle – two heart sounds (lubb and dubb) when valves in the heart snap shut.
  - **First sound Lubb:** occurs as AV valves close.
  - **Second sound dubb:** occurs when Semilunar valves close.
  - The first heart sound is longer and louder than the second one.

1)The heart

Objectives:

- Describe the location of the heart and the major anatomical areas.
- Trace the pathway of blood through the heart.
- Compare pulmonary and systemic circulations.
- Explain the operation of heart valve.
- Name the elements of the intrinsic conduction system of the heart, and describe the pathway of impulses through this system.
- Define systol, diastol, cardiac cycle, and heart sounds.

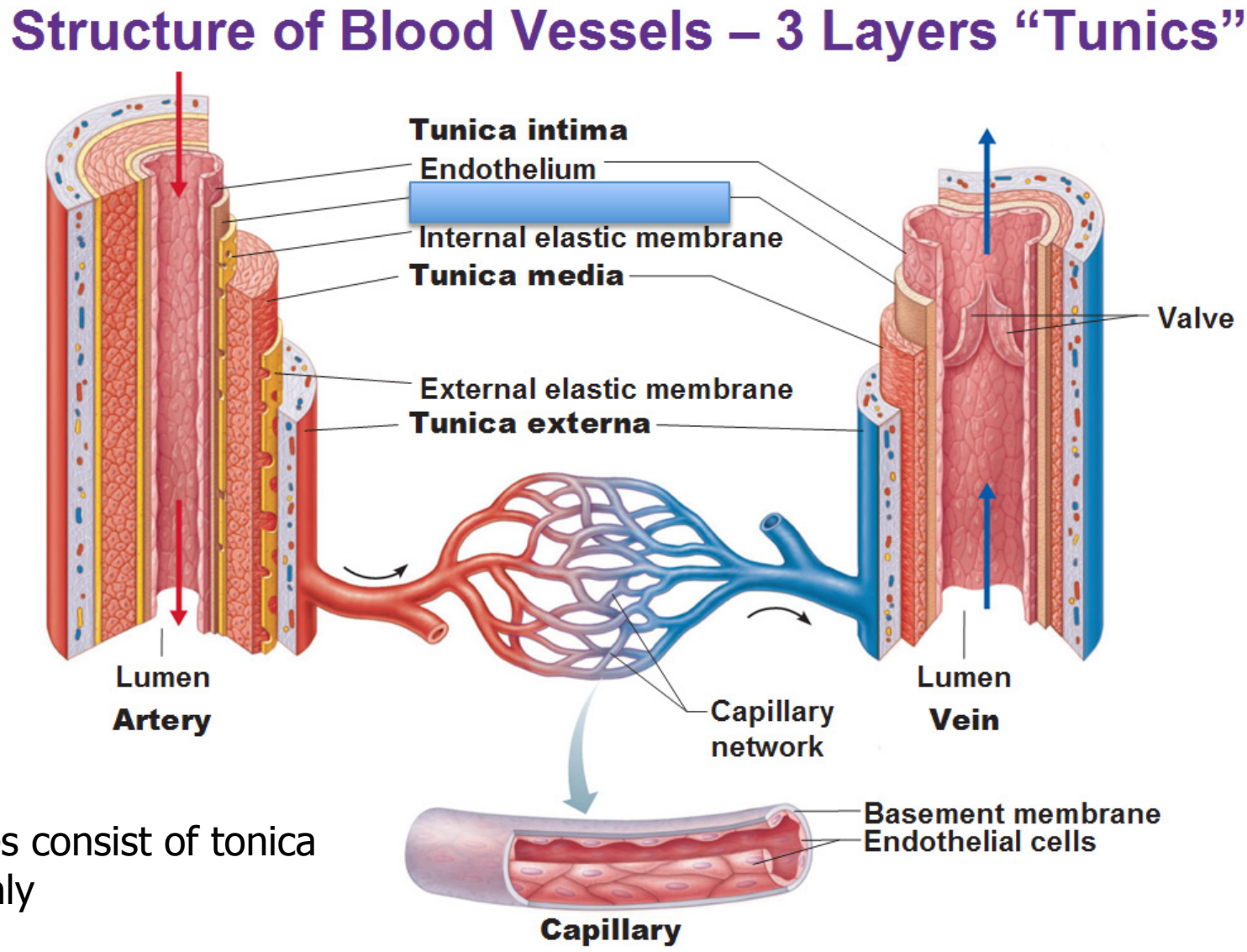
2)Blood vessels

- Microscopic anatomy of the blood vessels.

Introduction

- Humans have a closed circulatory system (blood circulates inside the blood vessels)
- Blood circulates in one direction.
- Three types of blood vessels:
  - Arteries
  - Capillaries
  - Veins

Microscopic anatomy of the blood vessels



Capillaries consist of tonica intima only

- Tunica intima

Thin layer of endothelium (simple squamous epithelium).

The inner most layer that Lines the lumen of the vessels---- decrease friction as blood flows through the lumen.

- Tunica media:

Thick middle layer formed of:

- Mostly Smooth muscle----changes the diameter of the vessel.
- Elastic fibers.
- Elastic lamina (in large arteries only).

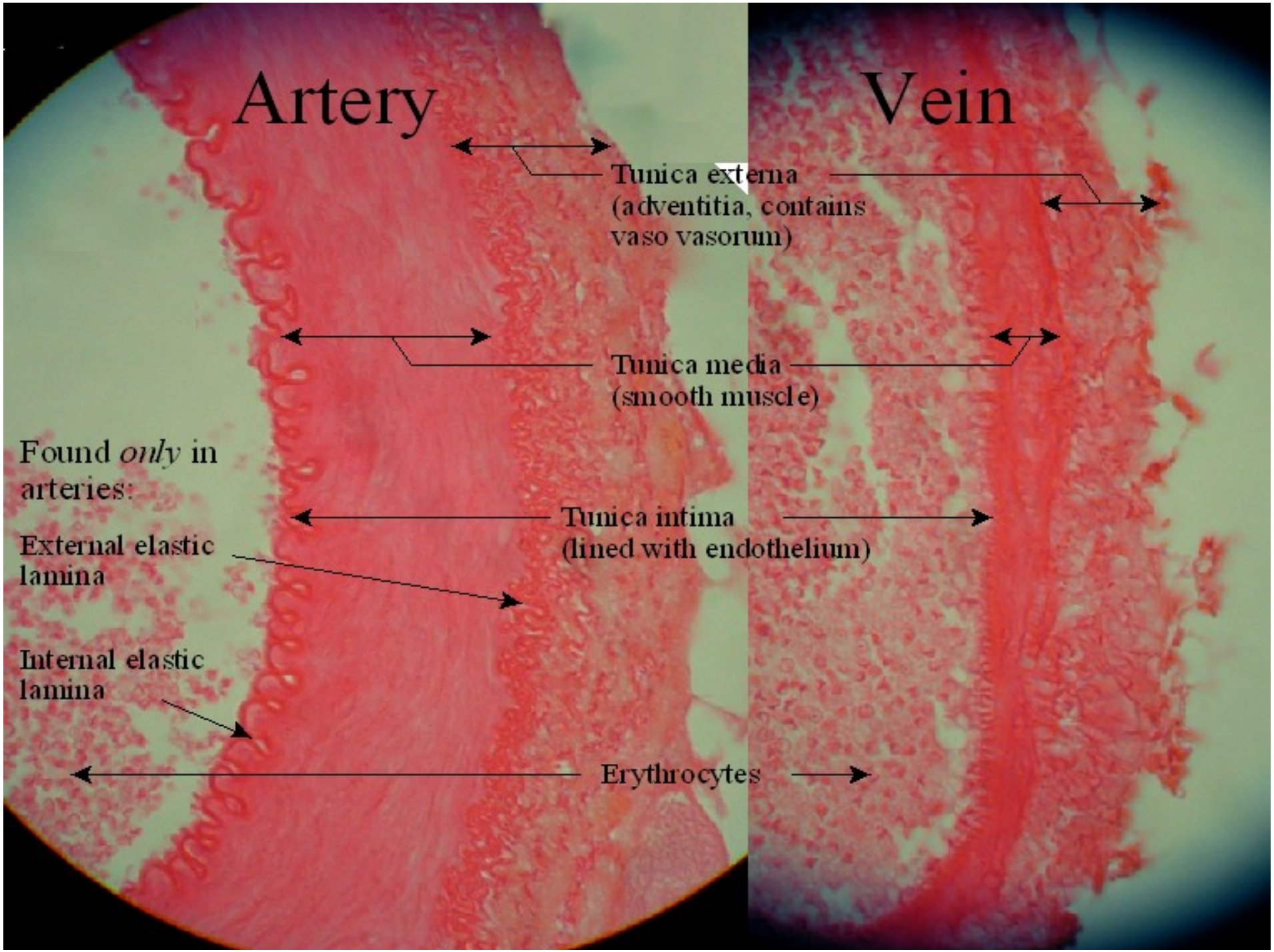
- Tunica externa:

The outermost layer.

Composed mainly of fibrous connective tissue---protect and support the vessels.

The structural difference ----- functional difference?

	artery	vein	capillaries
Tunica intima	present	present	present
Tunica media	Much Thicker (More muscular)+ Elastic lamina in large arteries	Thinner (less muscular and less elastic fibers. No elastic lamina	X
Tunica externa	present	present	X
valves	X	present	X


Artery
Vein
Tunica externa
(adventitia, contains
vaso vasorum)
Tunica media
(smooth muscle)
Found *only* in
arteries:
Tunica intima
(lined with endothelium)
External elastic
lamina
Internal elastic
lamina
Erythrocytes

Artries

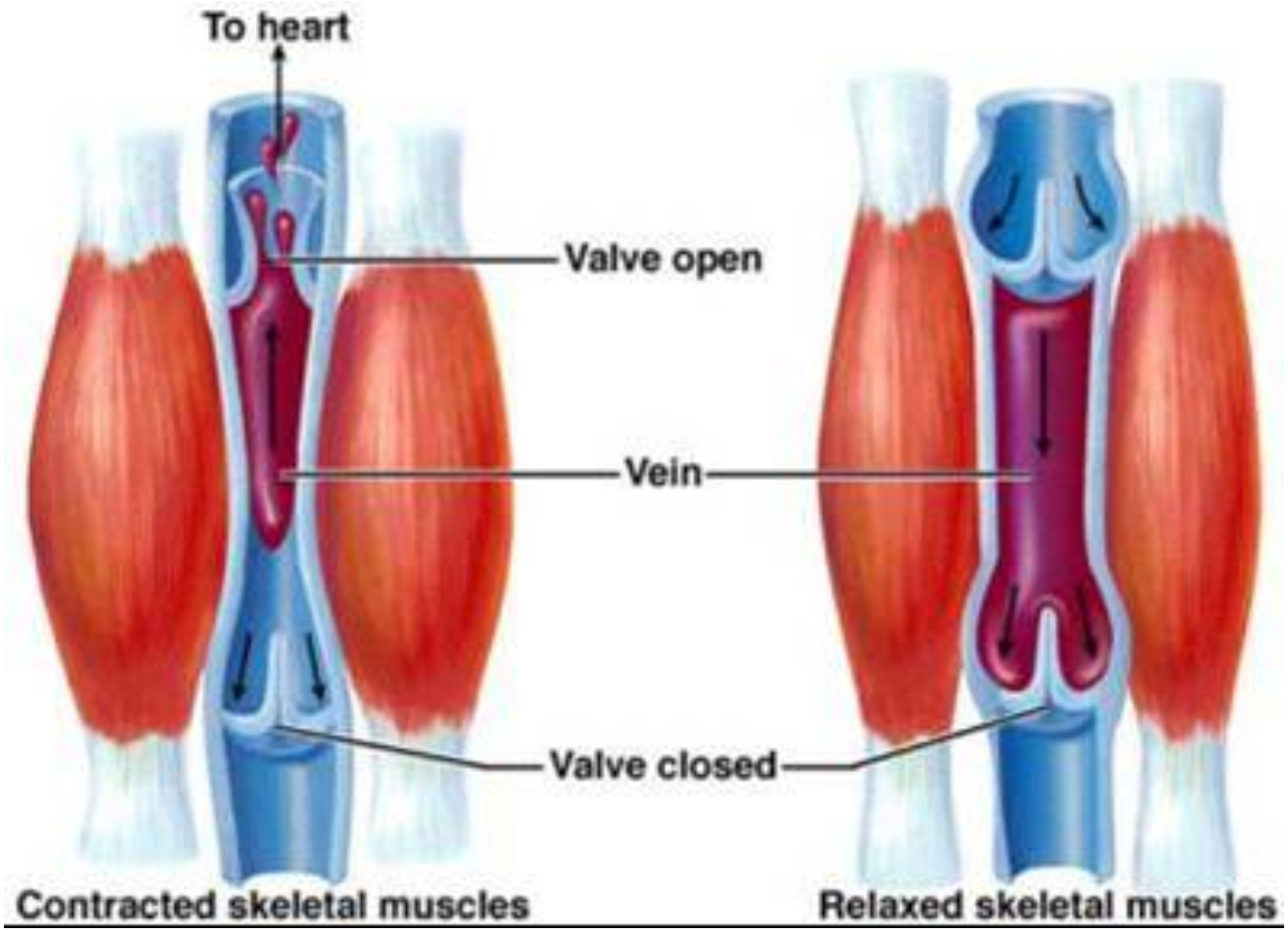
- Arteries are closer to the pumping action of the heart so they must be able to expand and recoil with every heart beat.

- Their structure makes them strong and stretchy so they can handle the changes in pressure resulting from the heart pumping action.

veins

- Veins are far from the heart, and the pressure in them is low.
- Since the pressure is too low, how is the blood forced back into the heart (against gravity)??

1) Large veins have valves that prevent backflow of blood.
2) Skeletal muscle activity helps venous return.
3) Respiratory pump also helps.


To heart
Valve open
Vein
Valve closed
Contracted skeletal muscles
Relaxed skeletal muscles

capillaries

- Capillaries are only one cell layer thick (just tunica intima) → easy exchange made between the blood and the tissue cells.

2)Blood vessels

Objectives:

- Compare and contrast the structure and function of artries, viens, and capillaries.
- Name some of the major arteries and veins.