

Circulatory System

Blood vessels

Arteries

Capillaries

Veins

Heart

Chambers

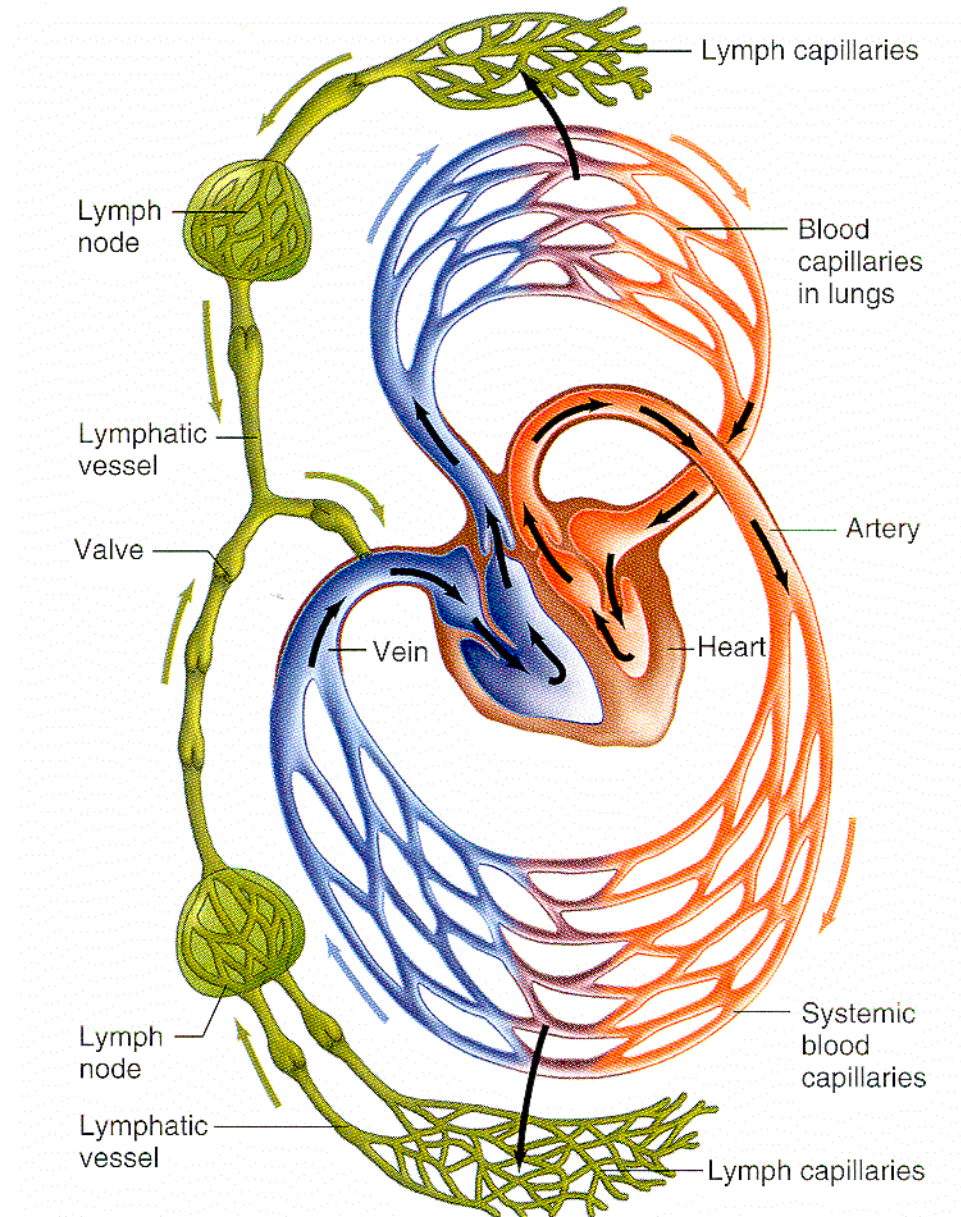
Surfaces

Coronary circulation

Internal features

Conducting system

Fetal Circulation

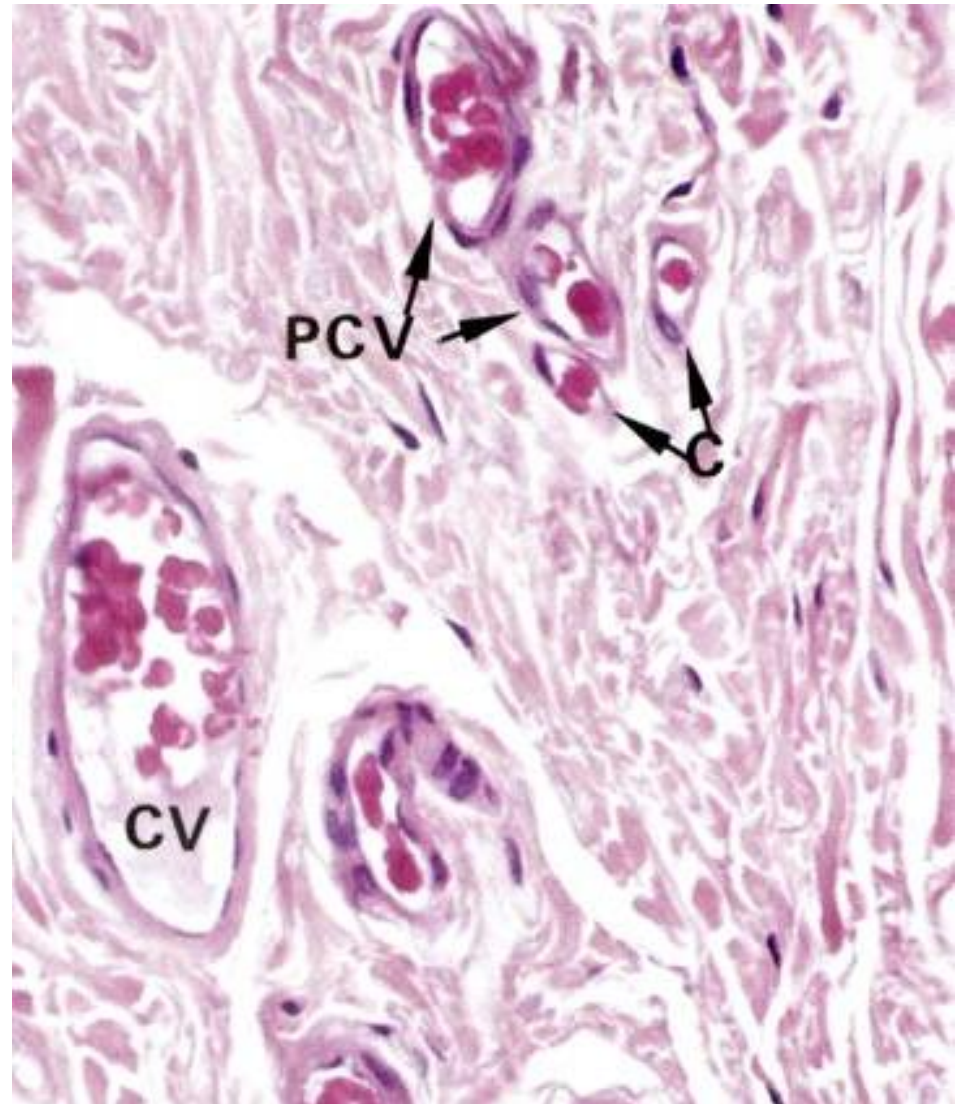


Circulatory system

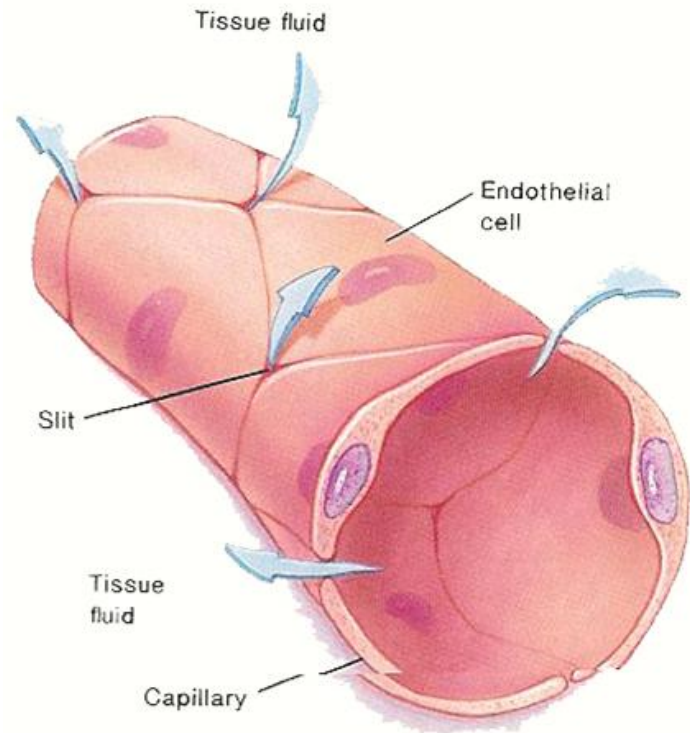
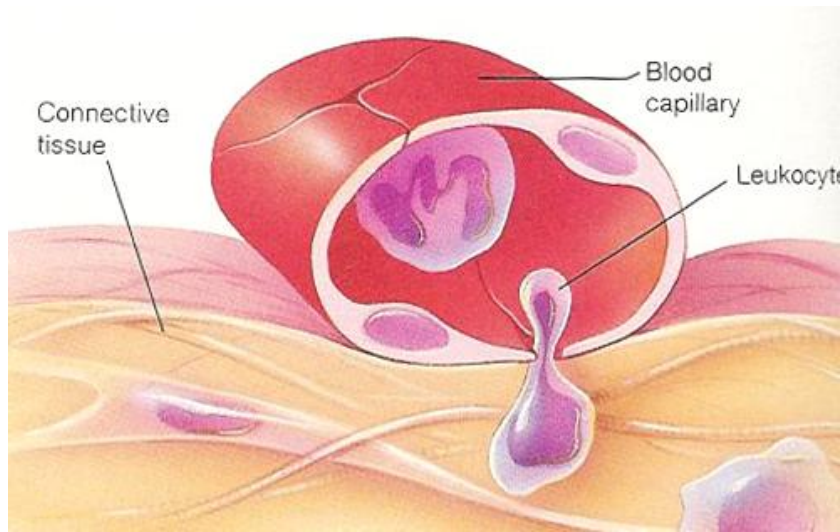
Circulating blood

Source of tissue fluid

Supplies nutrients,
removes waste

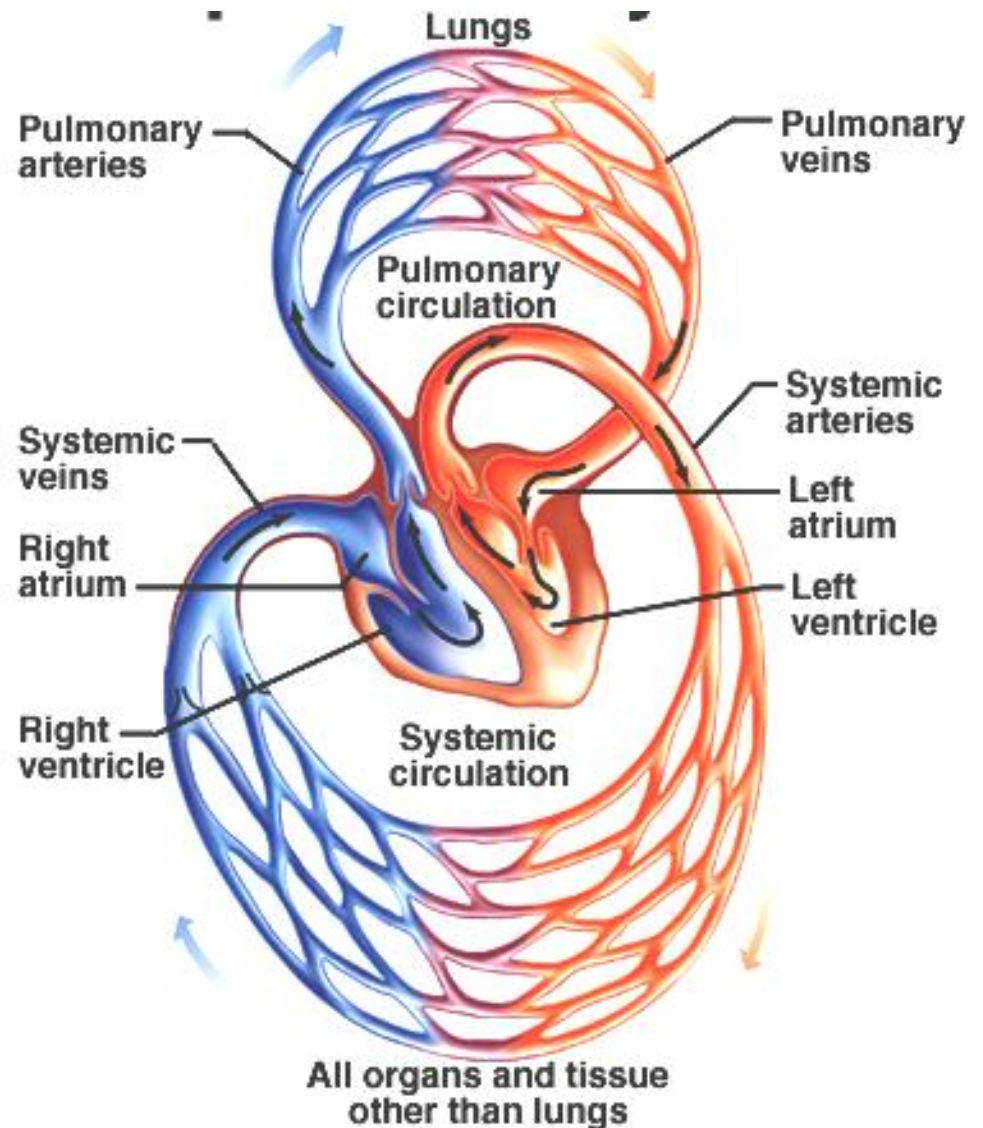


Blood plasma and tissue fluids freely exchange through permeable walls of capillaries, the smallest blood vessels. Capillaries are in intimate contact with almost all tissues.



System Components

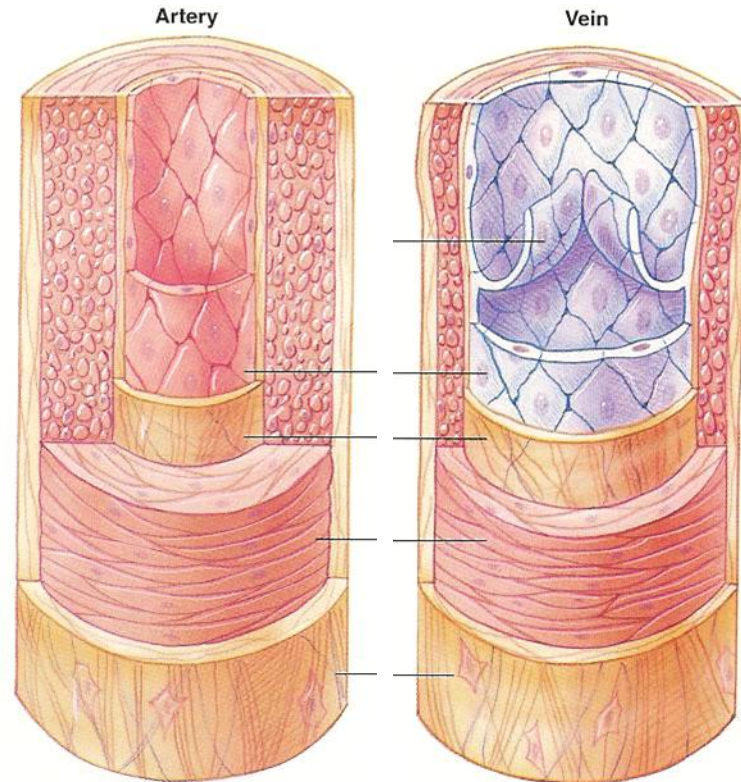
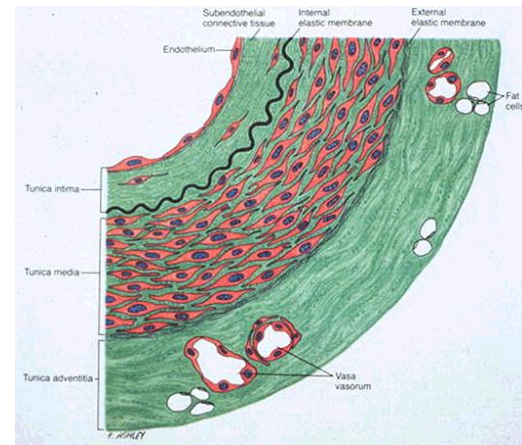
- 1) **Heart** – pump
- 2) **Systemic vessels** – closed circuit, supplies tissues of body
- 3) **Pulmonary vessels** – circuit to lungs, exchange oxygen and carbon dioxide with the atmosphere



Blood Vessels

3 coats

- 1) Tunica intima
- 2) Tunica media
- 3) Tunica adventitia



Blood Vessels

1) Tunica intima

Endothelium – simple squamous epithelium

Loose CT

Internal elastic membrane (lamina) – sheet of protein elastin (like elastic fibers)

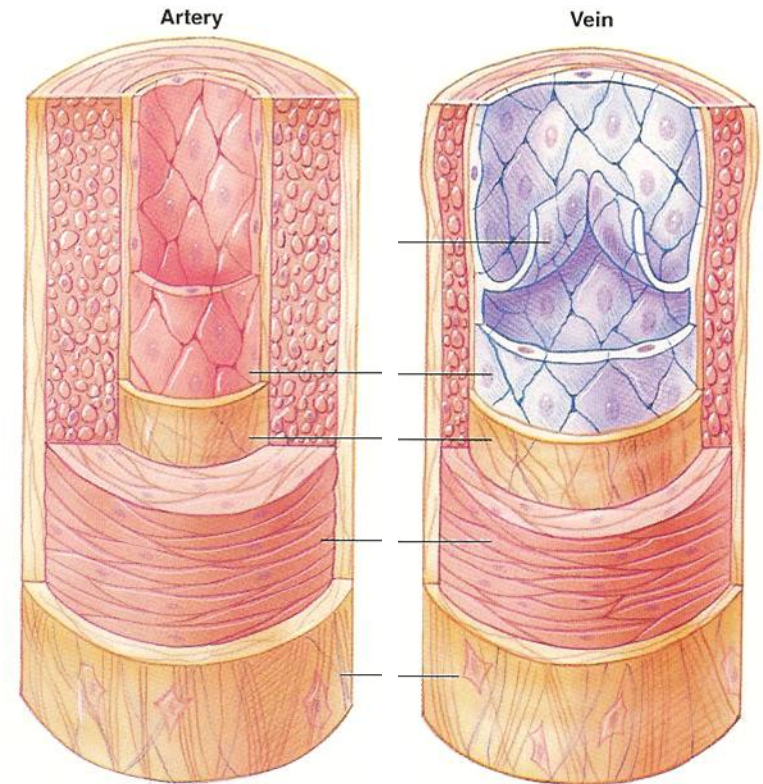
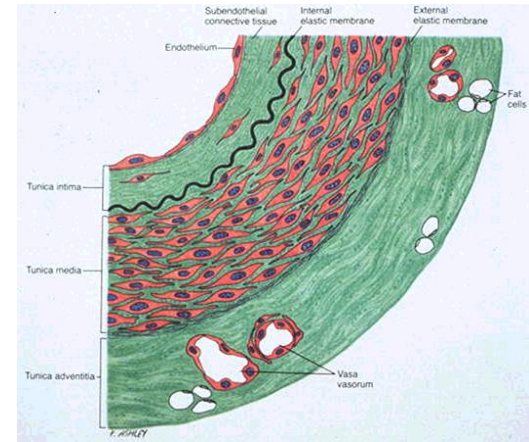
2) Tunica media

Mix: CT, smooth muscle, elastic fibers

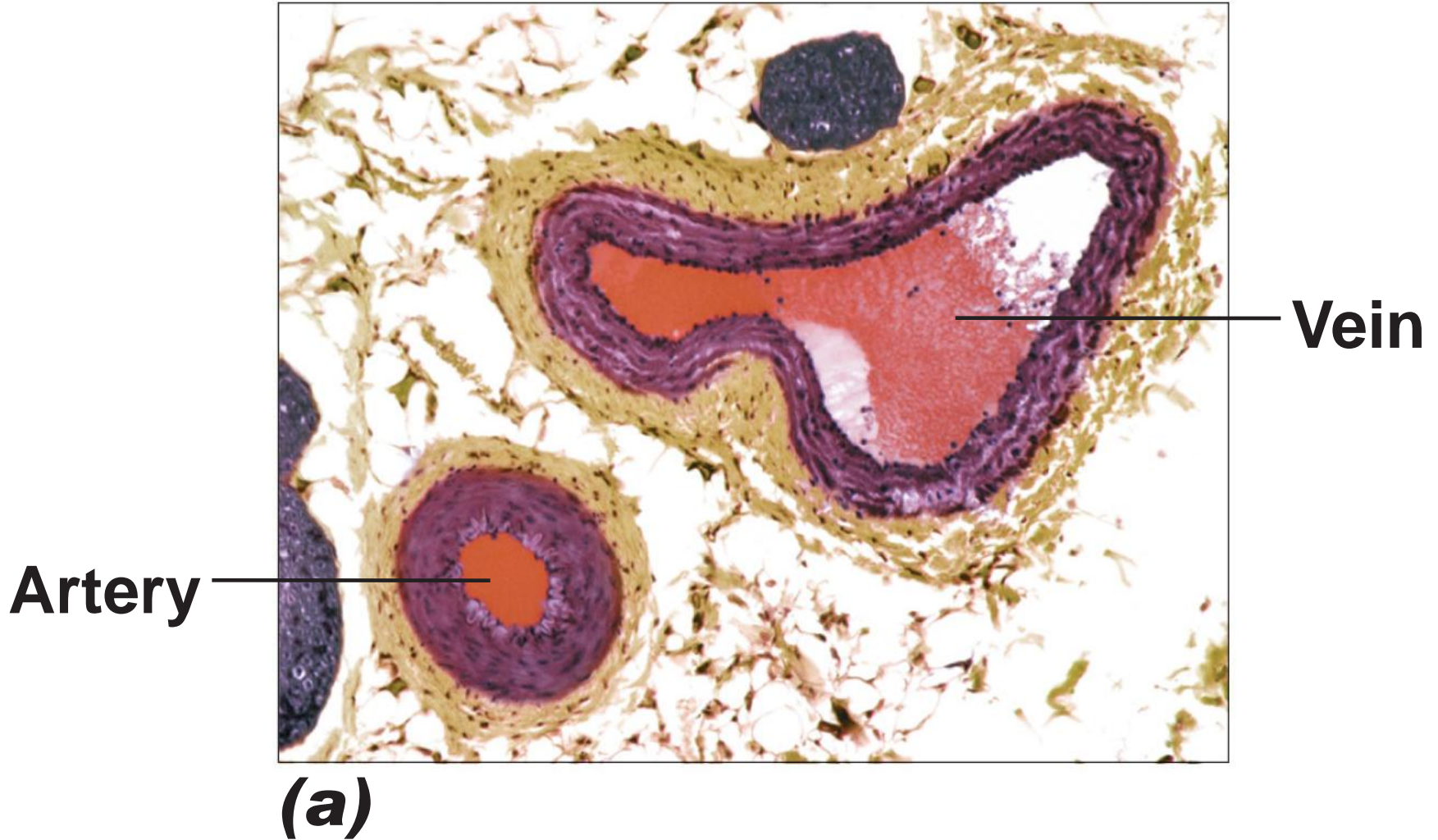
3) Tunica adventitia

External elastic lamina

CT, vasa vasorum = small blood vessels that supply wall of very large arteries

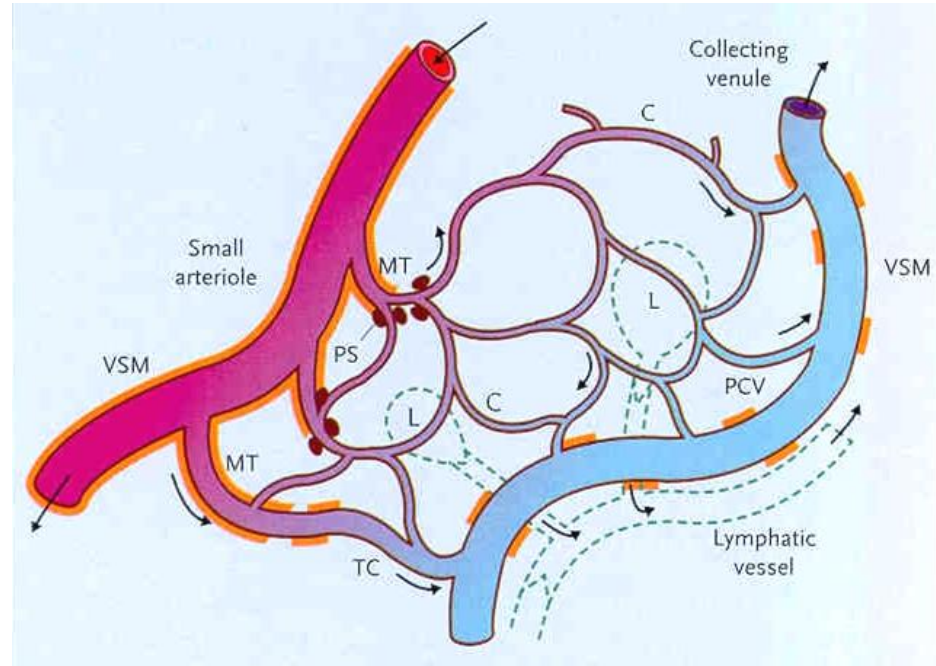


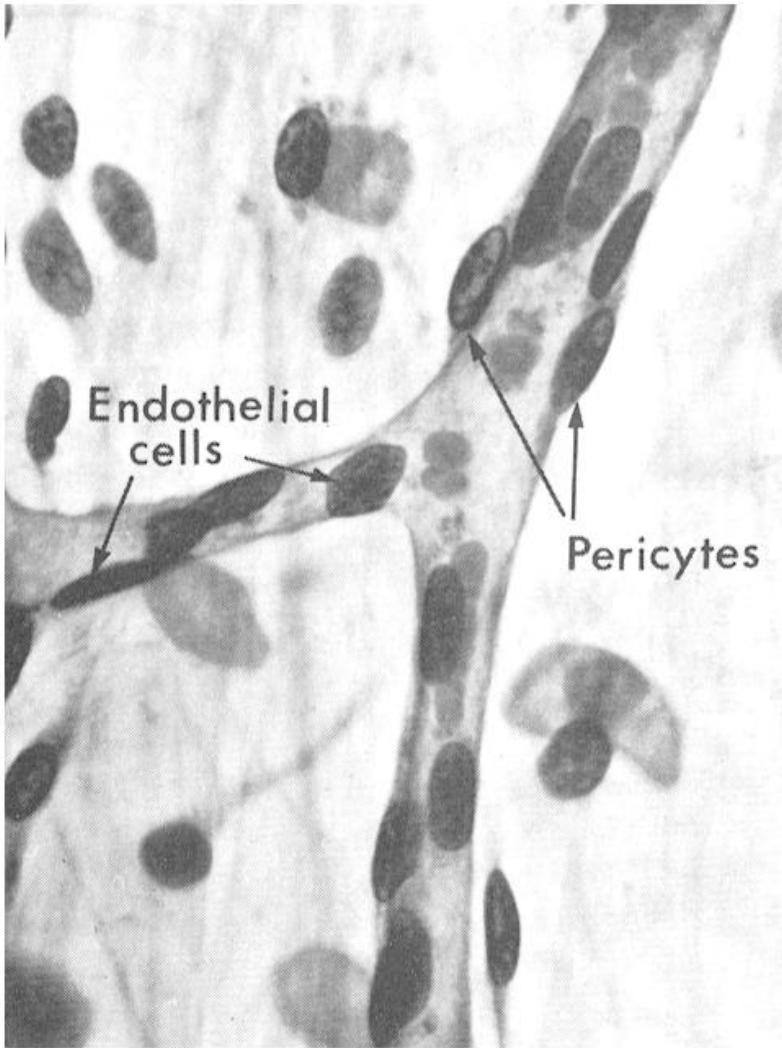
Structure of Arteries & Veins

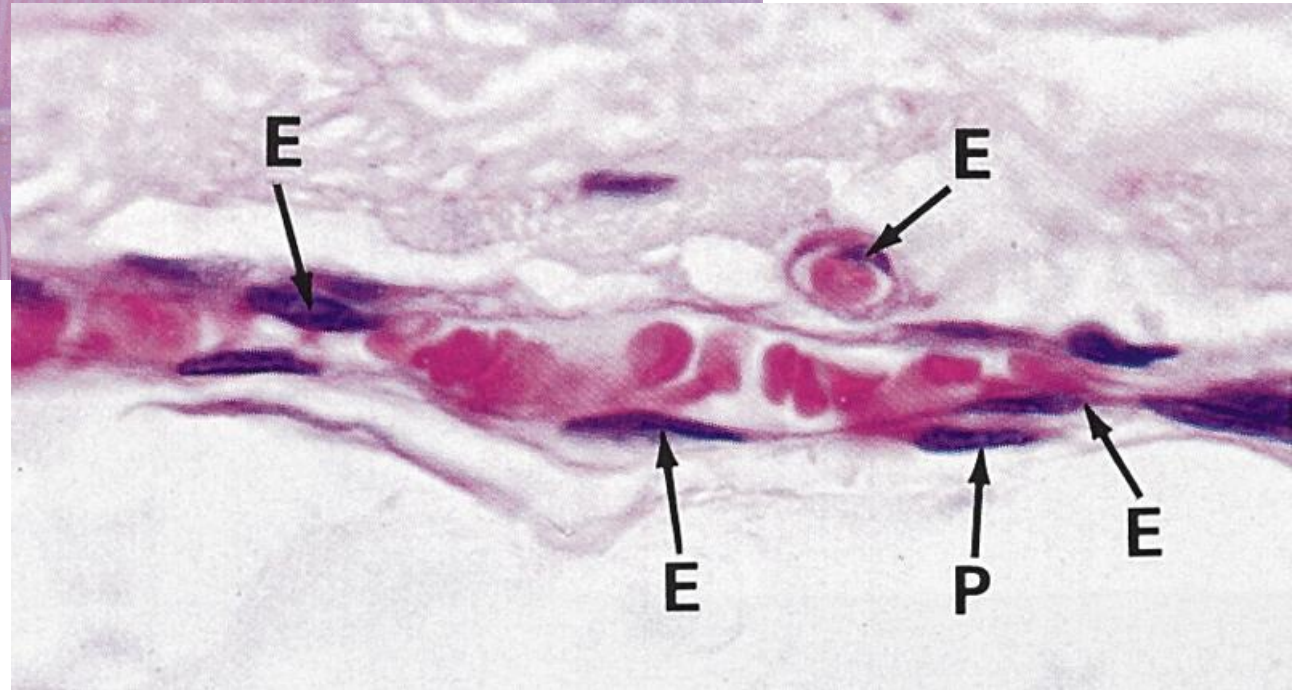
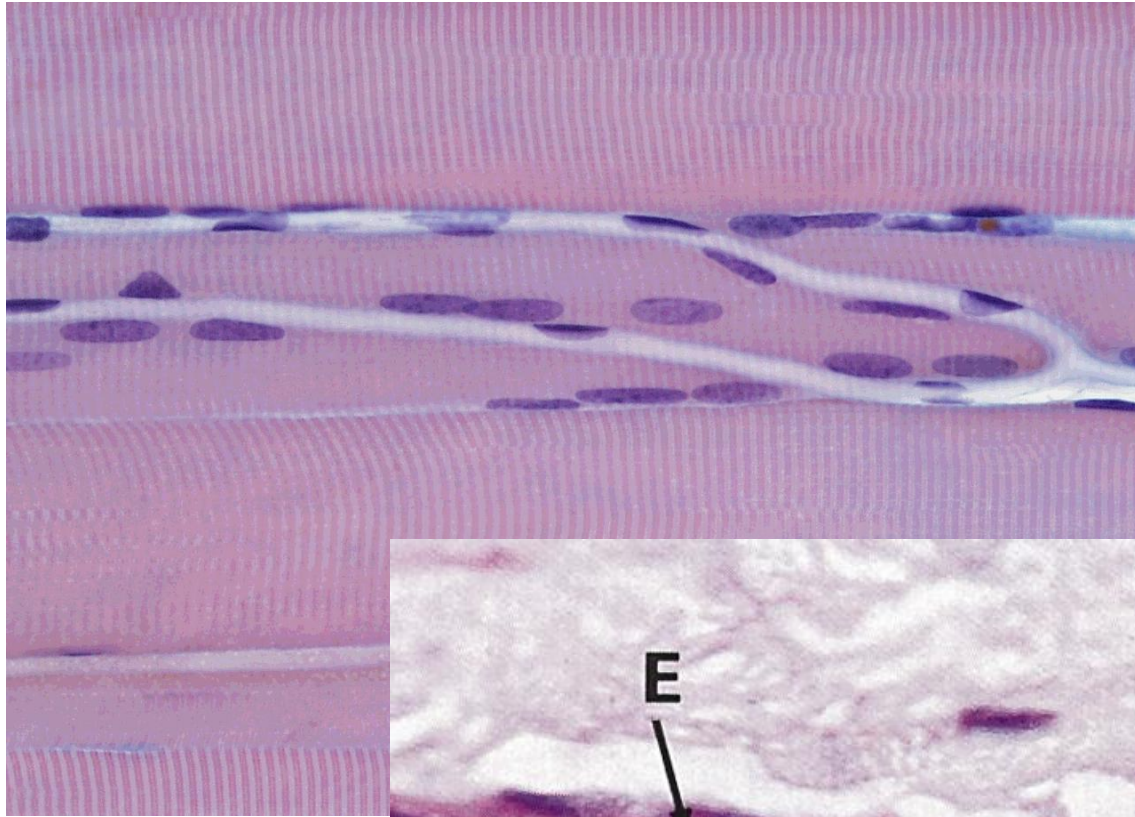


Classes of Vessels

- 1) Arteries – leave the heart
 - a) Elastic arteries
 - b) Muscular arteries
 - c) Arterioles
- 2) Capillaries
- 3) Veins – return blood to heart
 - a) Venules
 - b) Small, medium, large veins







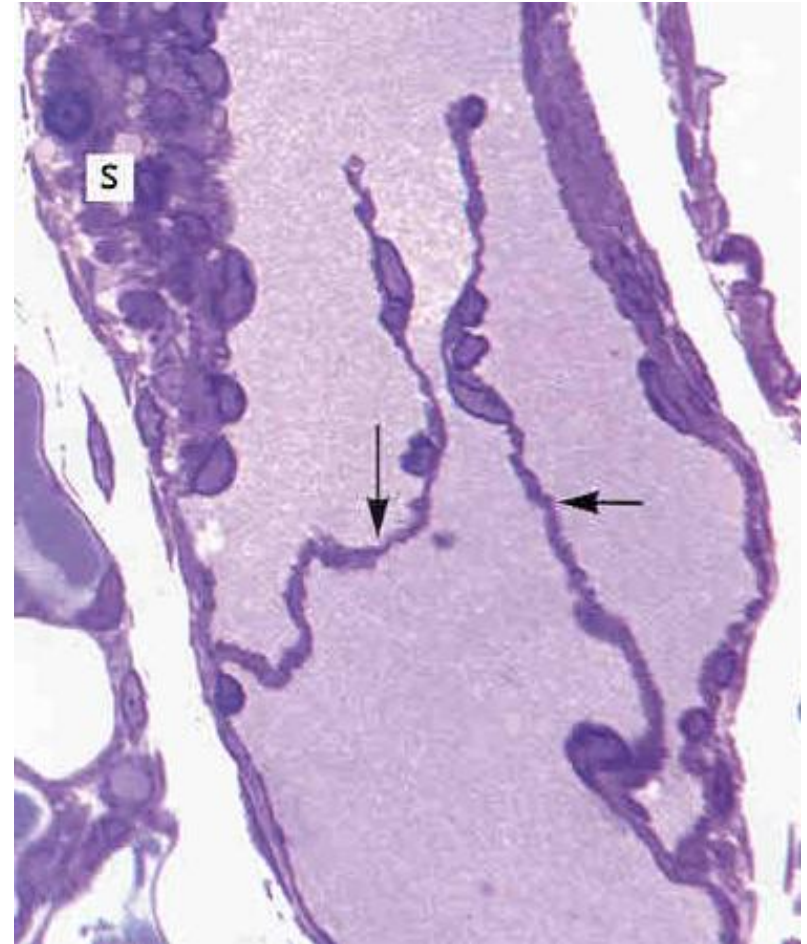
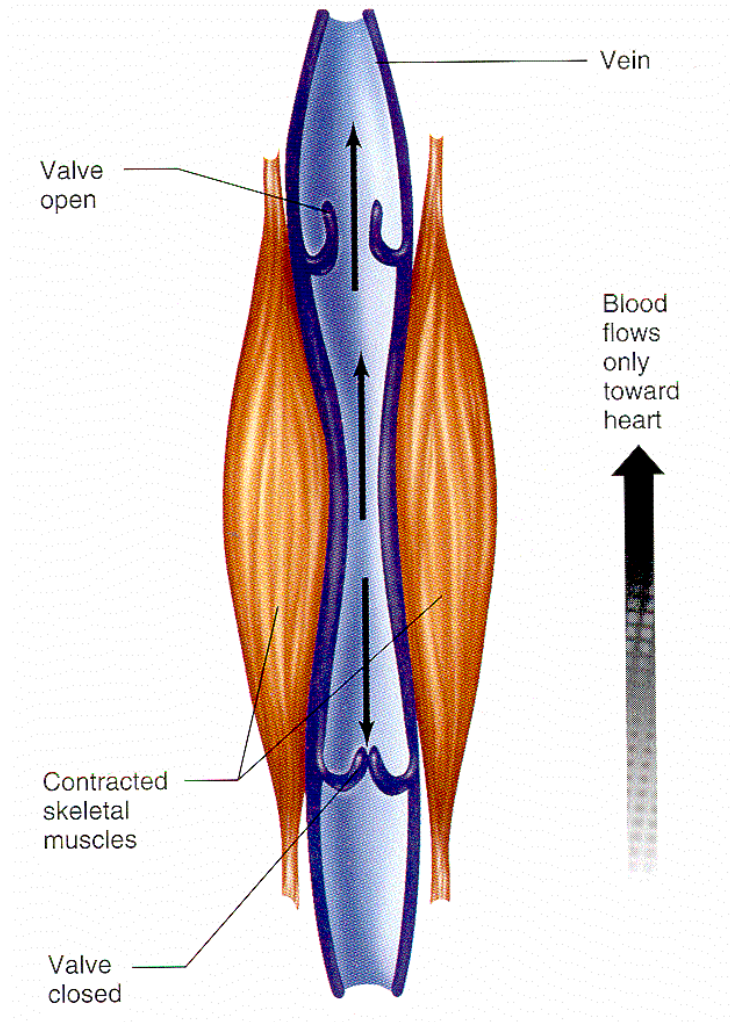
Low Permeability Capillaries

- Blood-brain barrier
 - Capillaries have complete tight junctions
 - No intercellular clefts are present
 - Vital molecules pass through
 - Highly selective transport mechanisms
 - Not a barrier against:
 - Oxygen, carbon dioxide, anesthetics, other drugs

Sinusoids

- Wide, leaky capillaries found in some organs
 - Usually fenestrated
 - Intercellular clefts are wide open
- Occur in bone marrow and spleen
 - Sinusoids have a large diameter and twisted course

Valves – prevent backflow, blood propelled by muscle pump



Heart

Pericardium

3 Tunics

4 Chambers

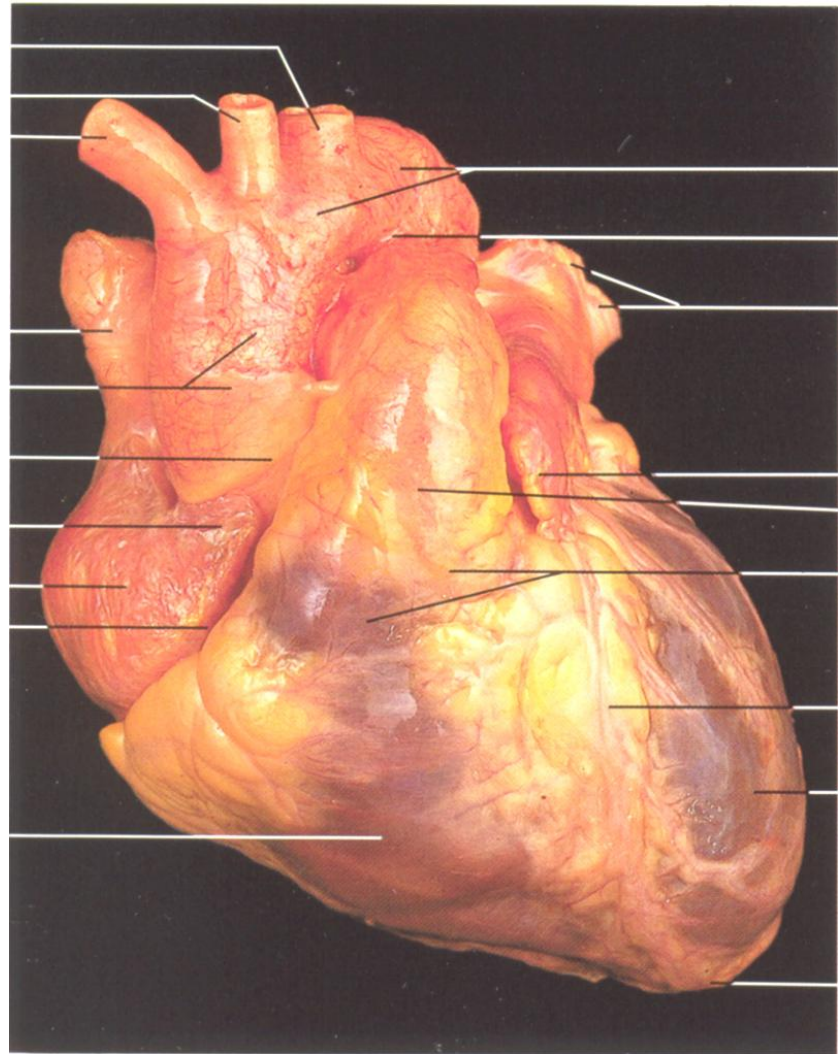
Position of heart

Surfaces

Coronary circulation

Internal features

Conducting system



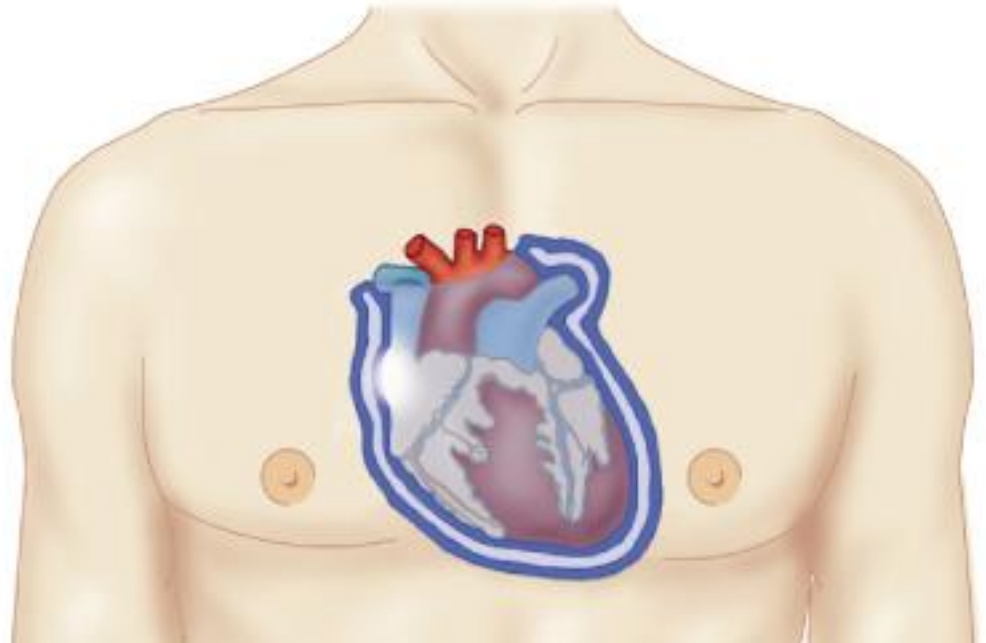
Pericardium

=double walled serous sac

simple squamous epithelium (mesothelium) and some loose C.T.

- 1) Parietal layer
- 2) Visceral layer

Separated by serous fluid which decreases friction



Parietal pericardium

Fibrous pericardium

Serous pericardium =
mesothelium

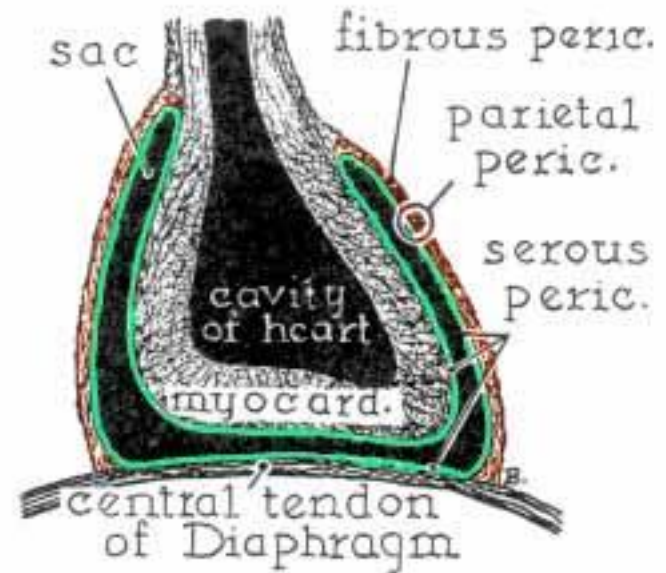
Visceral pericardium

= mesothelium of epicardium

(may see the 2 terms, visceral
pericardium & epicardium,
used interchangeably)

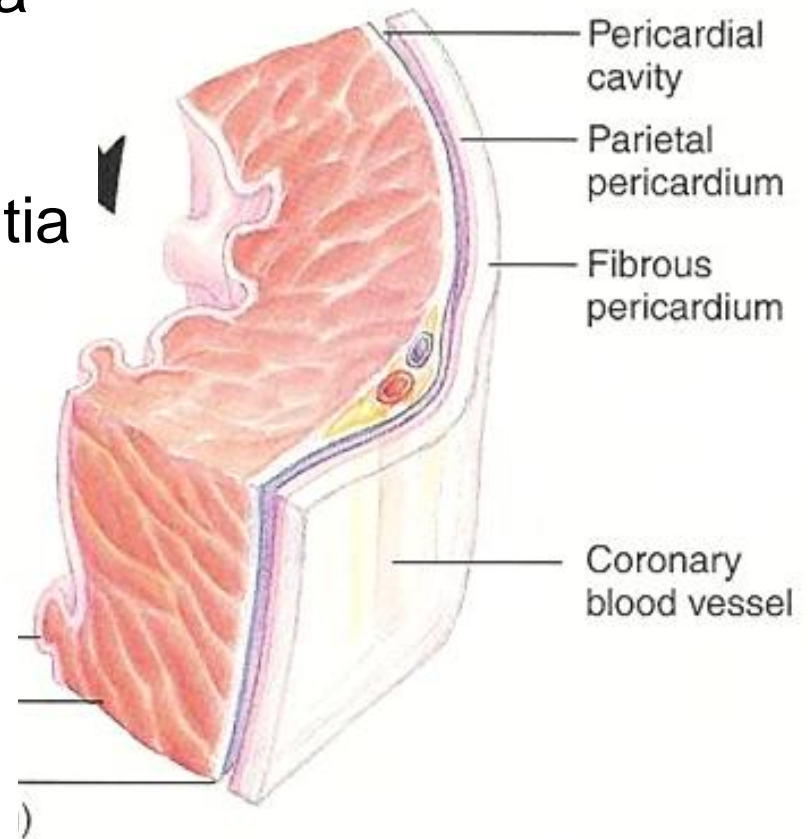
Pericardial cavity

filled with pericardial fluid



Heart has same 3 tunics as blood vessels but with different names:

- 1) **Endocardium** – tunica intima
- 2) **Myocardium** – tunica media
- 3) **Epicardium** – tunica adventitia



4 Chambers of the Heart

2 atria

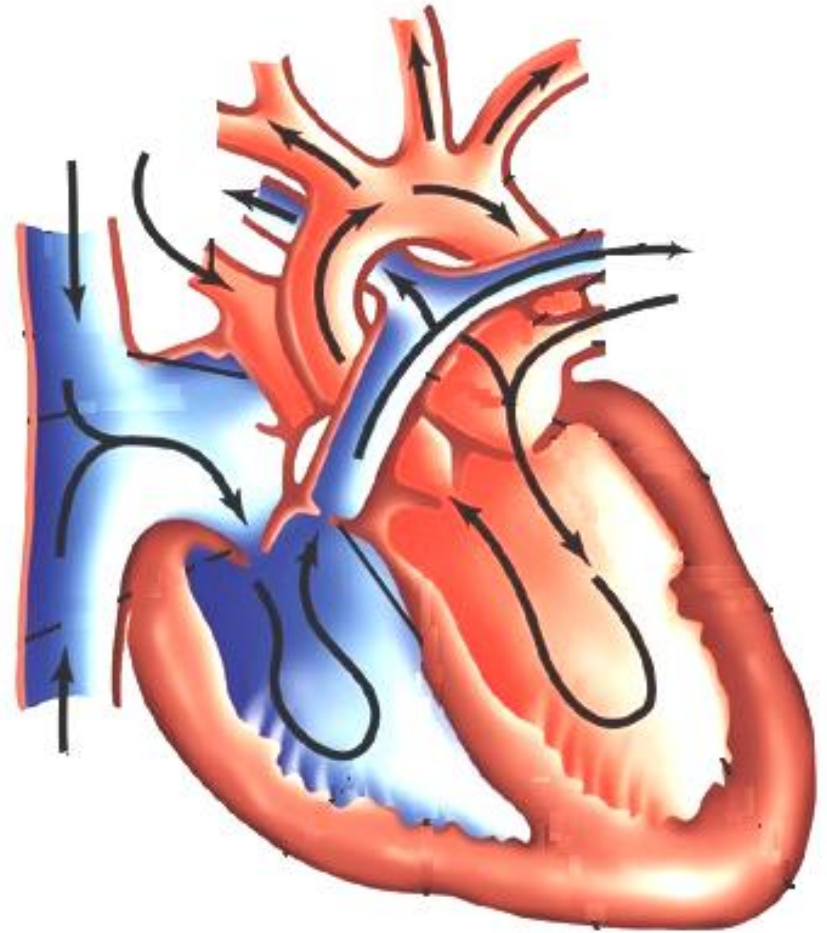
2 ventricles

Right side pumps to pulmonary circulation

Left to systemic circulation

Veins enter the atria

Arteries exit at the ventricles



Position of Heart

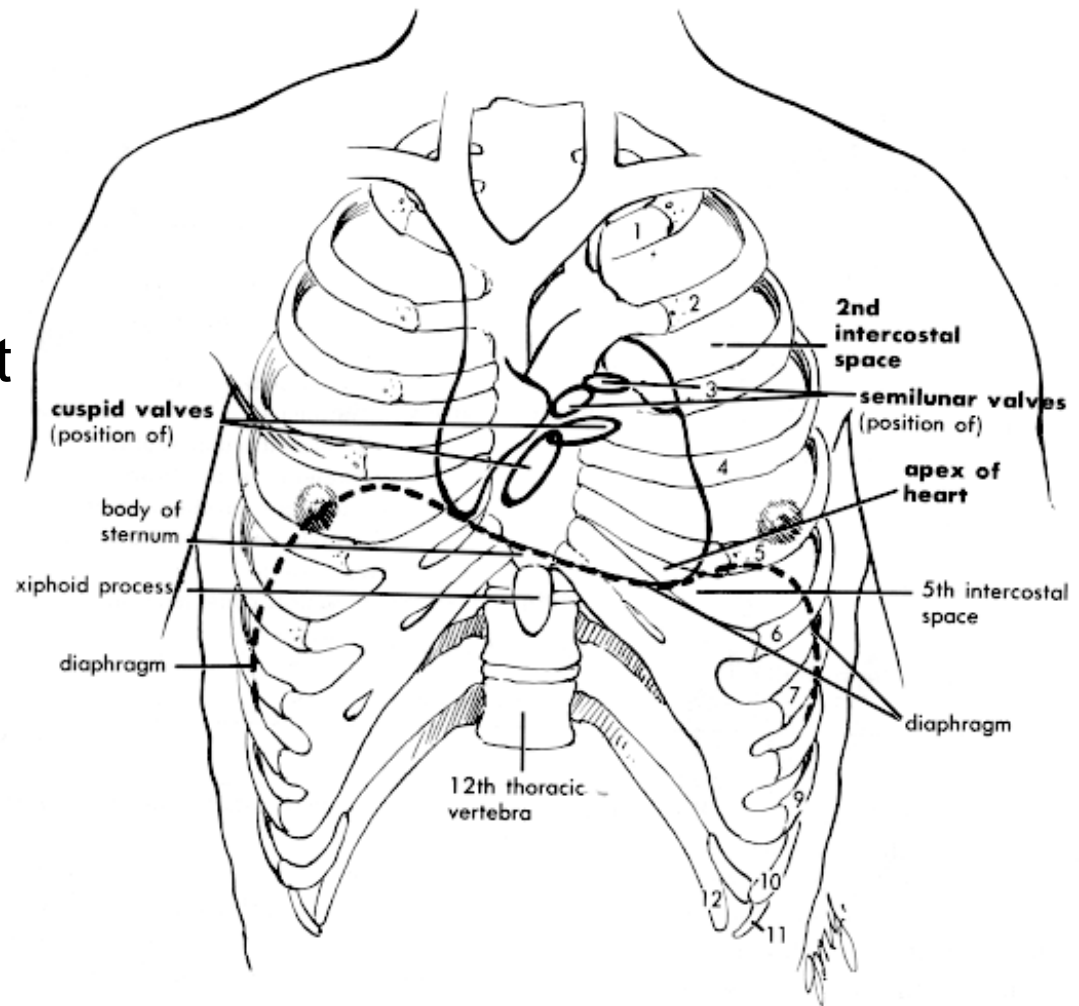
Behind body of sternum

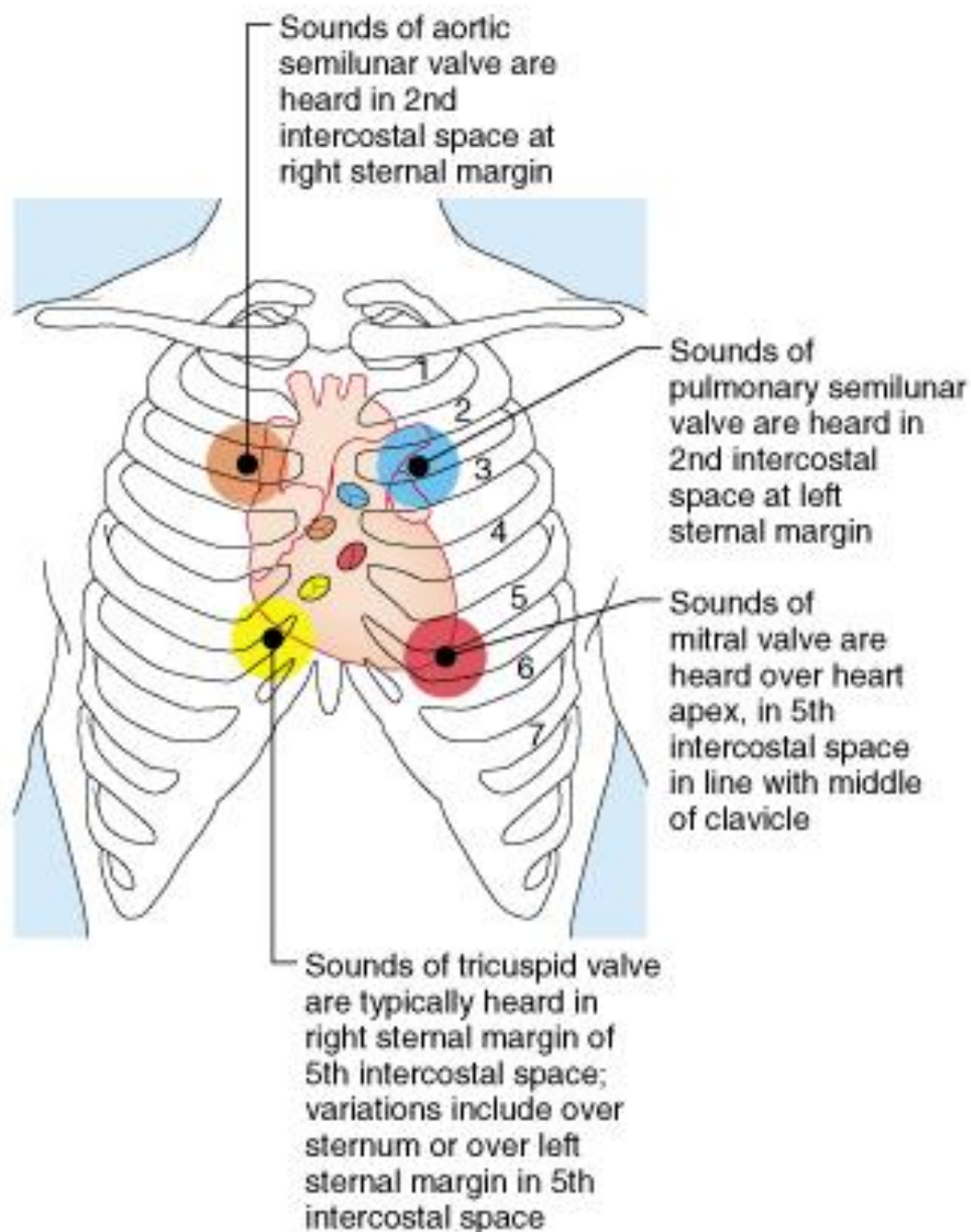
Anterior to vertebrae T5 to T8

Anterior and slightly to left in thorax

Region = **mediastinum**

Between the 2 lungs

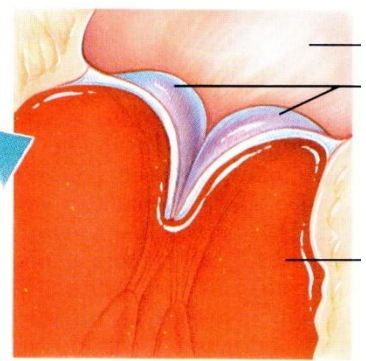
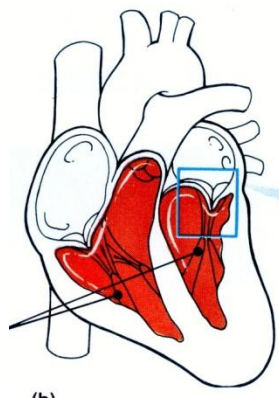
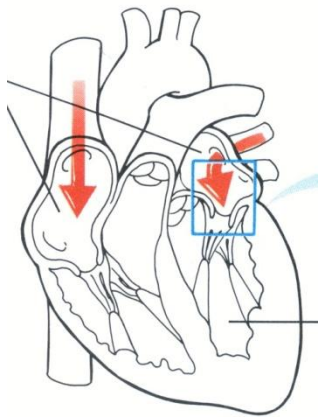




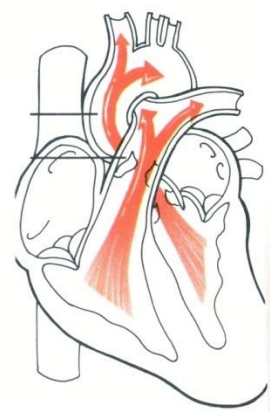
Heart Sounds / Cardiac Cycle

1) Close AV valves “Lub”

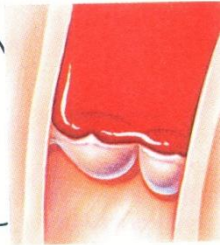
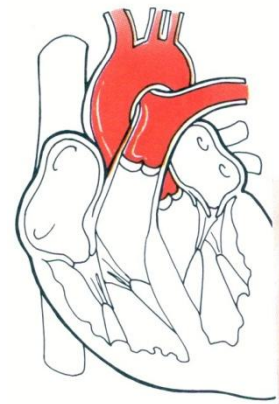
2) Close semilunar valves “Dup”



Atrioventricular valve closed



Semilunar valve open



Semilunar valve closed

Right and left coronary arteries

Travel within atrioventricular groove (= coronary sinus)

Left coronary artery branches:

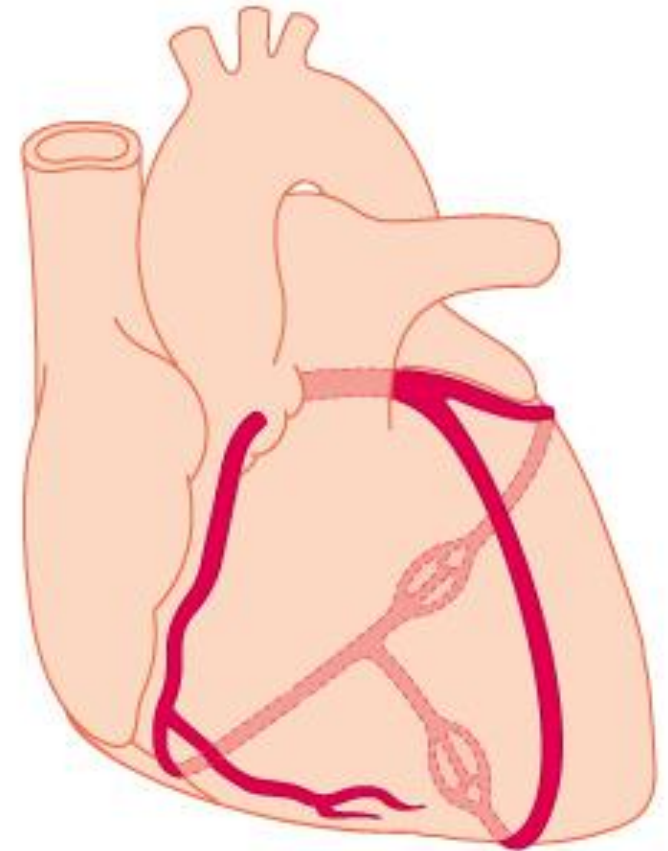
Anterior Interventricular branch

Travels in interventricular sulcus

Anastomoses on posterior surface

Circumflex branch

Anastomoses on posterior surface with right coronary



Right and left coronary arteries

Travel within atrioventricular groove (= coronary sinus)

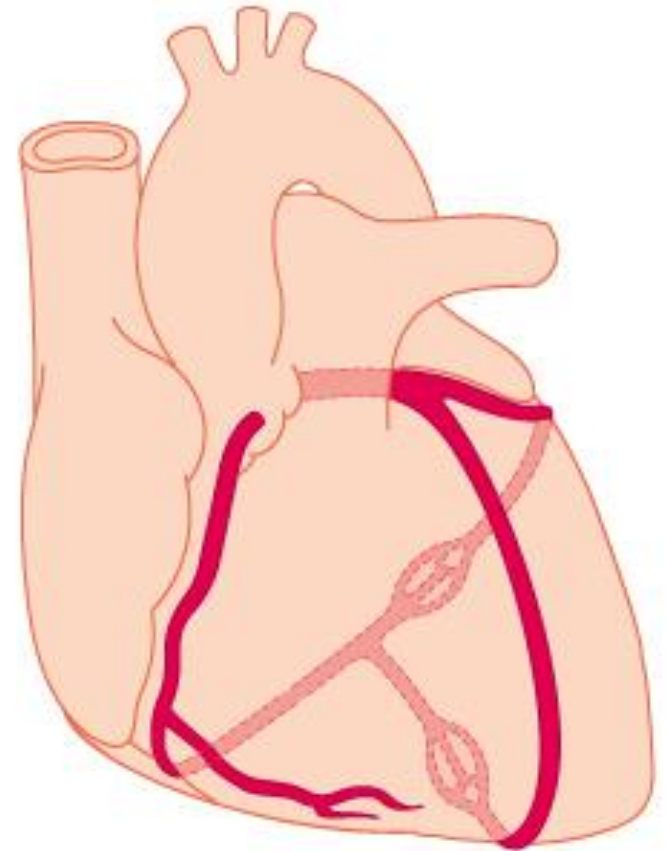
Right coronary artery branches:

- **Marginal branch**

along inferior border/margin

- **Posterior interventricular branch**

In interventricular sulcus

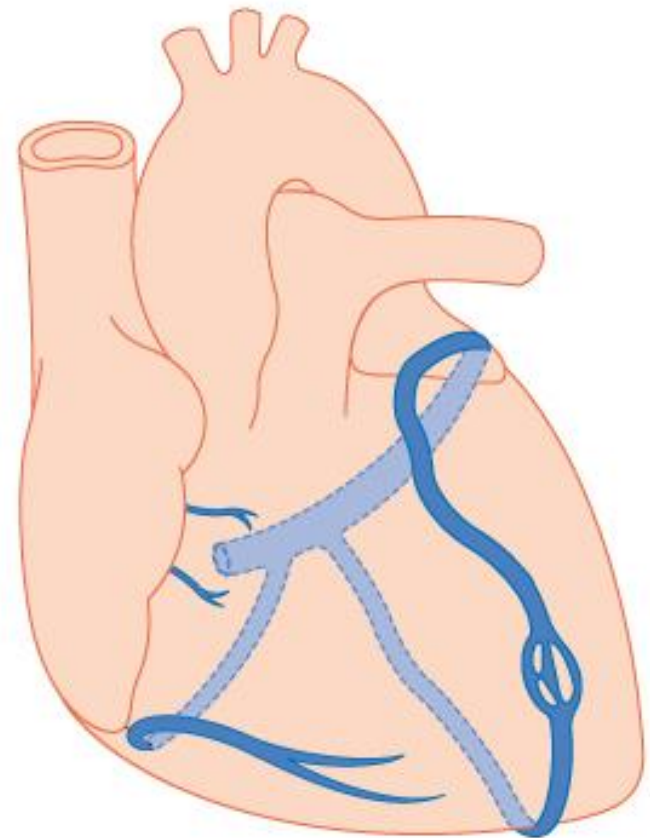


Cardiac Veins:

- Great cardiac vein
 - In anterior interventricular sulcus
- Middle cardiac vein
 - In posterior interventricular sulcus
- Small cardiac vein
 - Along inferior margin

Coronary sinus:

- found in posterior atrioventricular groove (coronary sulcus)
- Empties into Right Atrium



Internal Features of the Heart

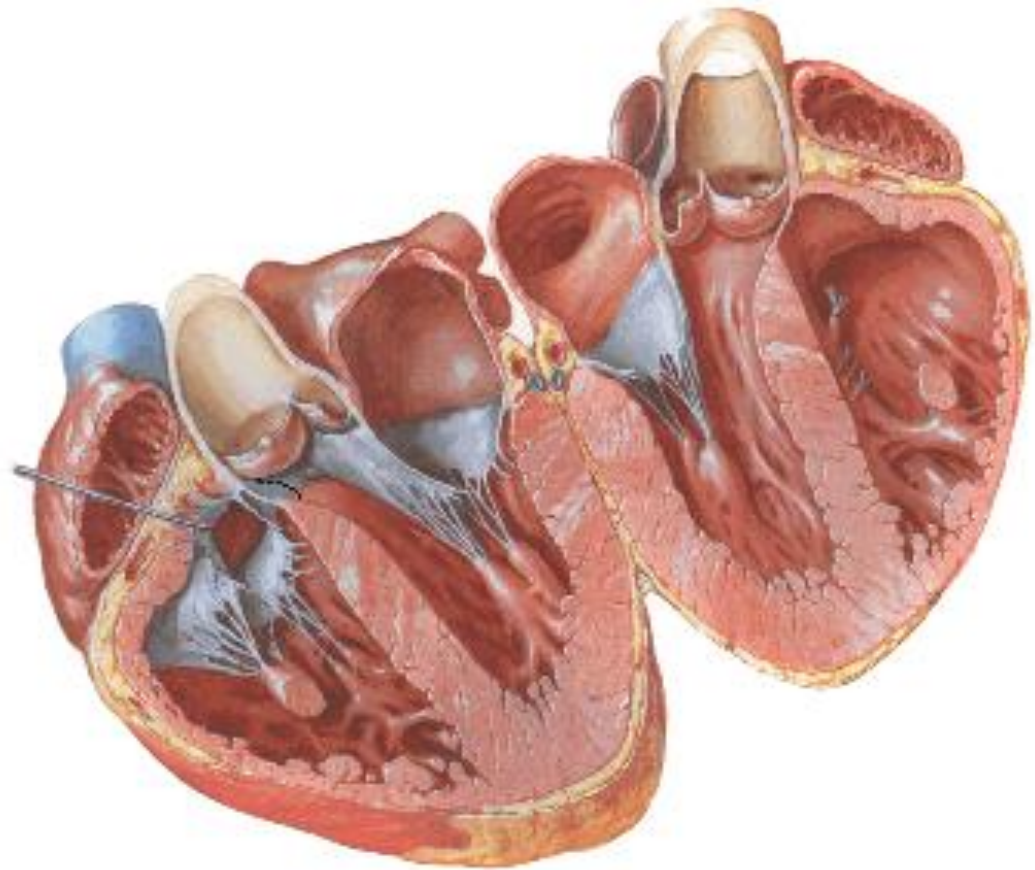
Chambers

Right atrium

Right ventricle

Left atrium

Left ventricle



Right atrium

Openings SVC, IVC, coronary sinus

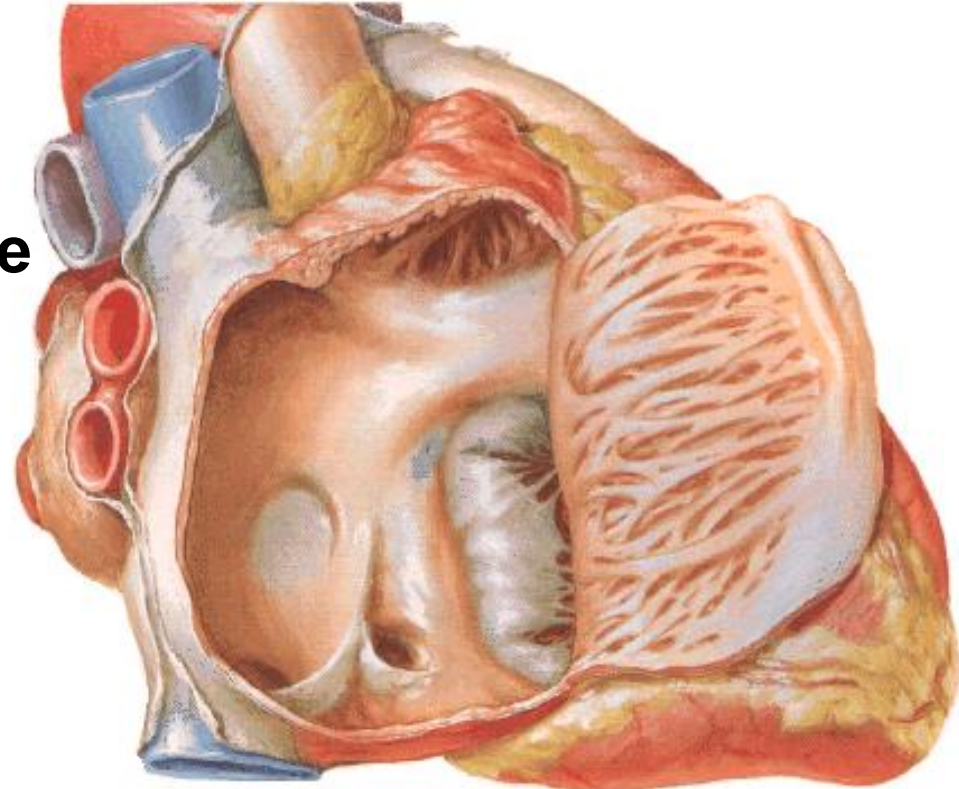
Fossa ovalis

Depression in interatrial septum

Right atrioventricular orifice

Tricuspid valves

Pectinate muscles
in auricle



Fossa ovalis

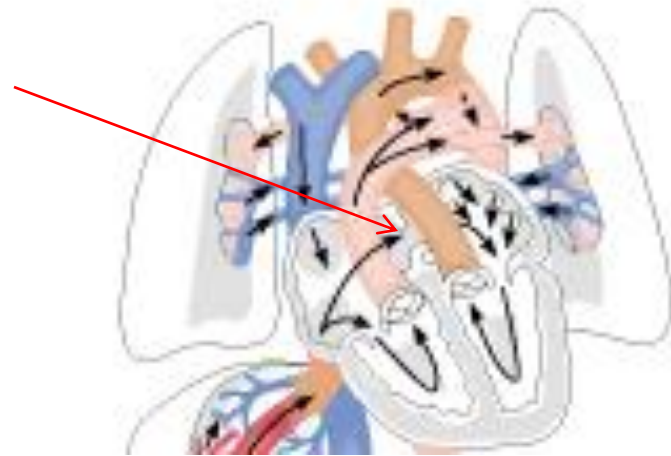
A depression in the location of foramen ovale

Foramen ovale = opening through the interatrial septum which opens to left atrium in fetus

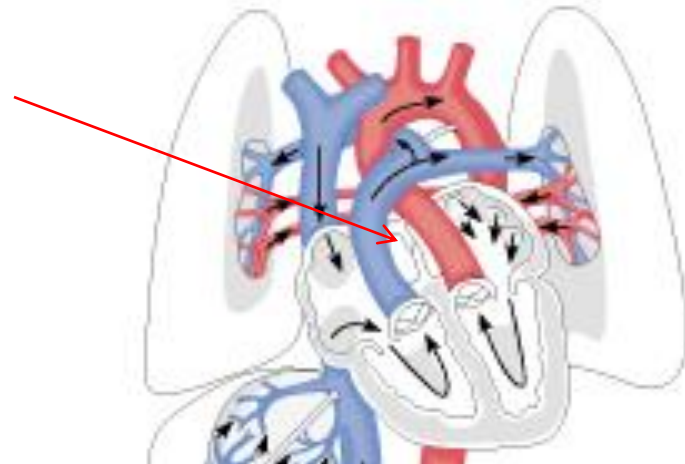
Valve of IVC directs blood through foramen ovale during fetal life

Foramen closes after birth

Fetus



Newborn



Right Ventricle

2 openings

1) Right atrioventricular orifice

Tricuspid valve – AV valve

**Chordae tendineae – fibrous
cords**

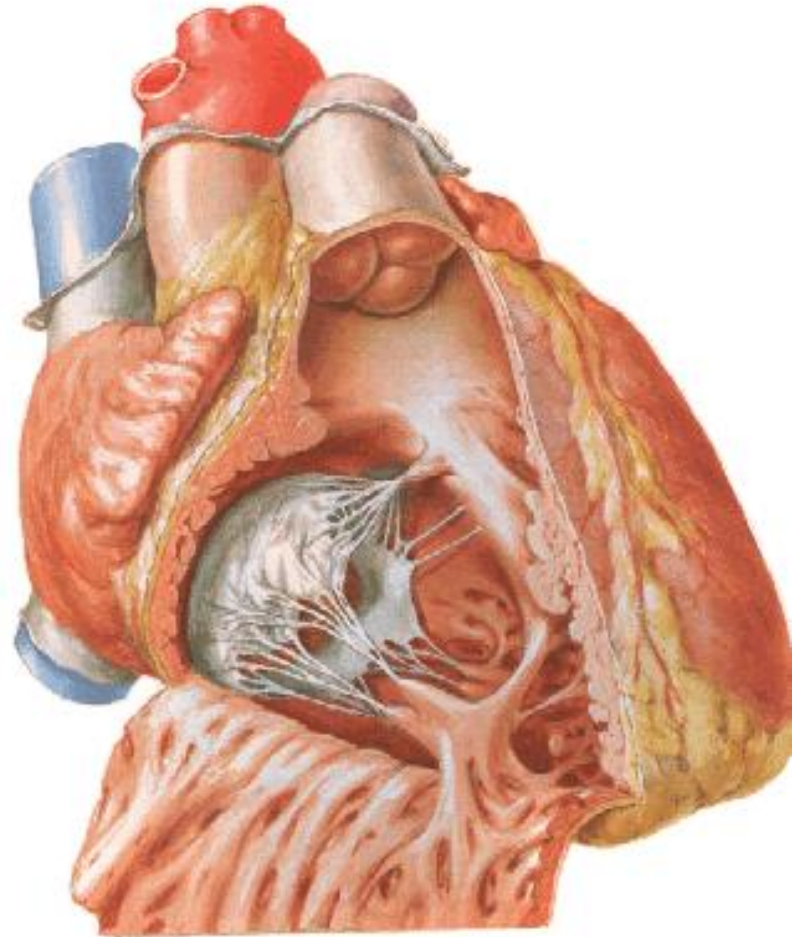
2) Orifice to pulmonary trunk

**Pulmonary semilunar
valves**

Papillary muscles

Trabeculae carneae

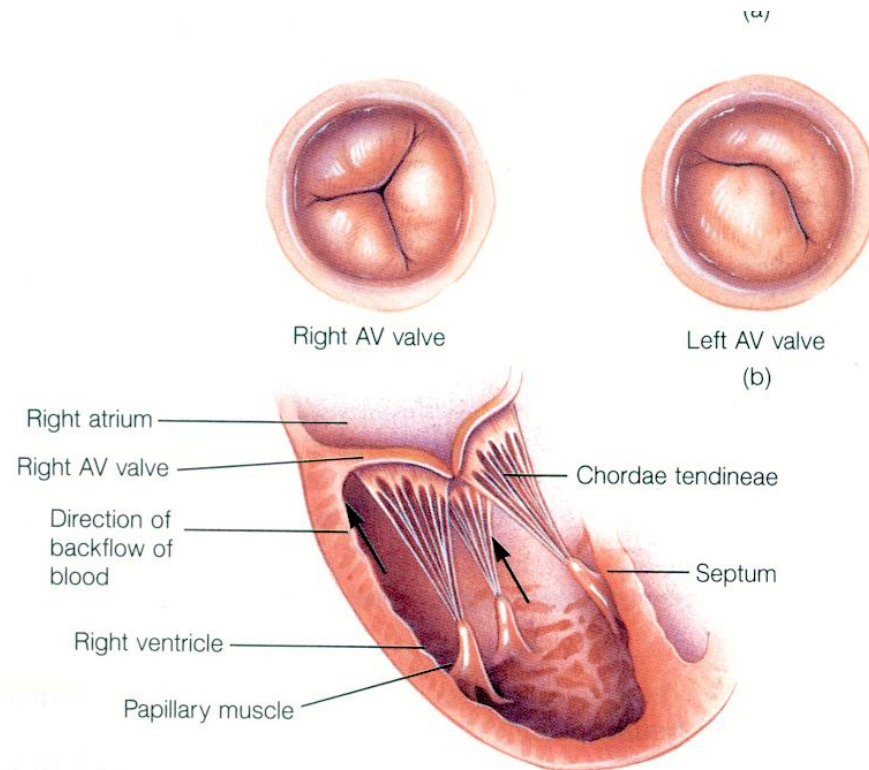
Muscle ridges throughout wall



Tricuspid valve – AV valve

3 Triangular cusps, attach by cordae tendineae to papillary muscles

Prevent backflow during ventricular contraction

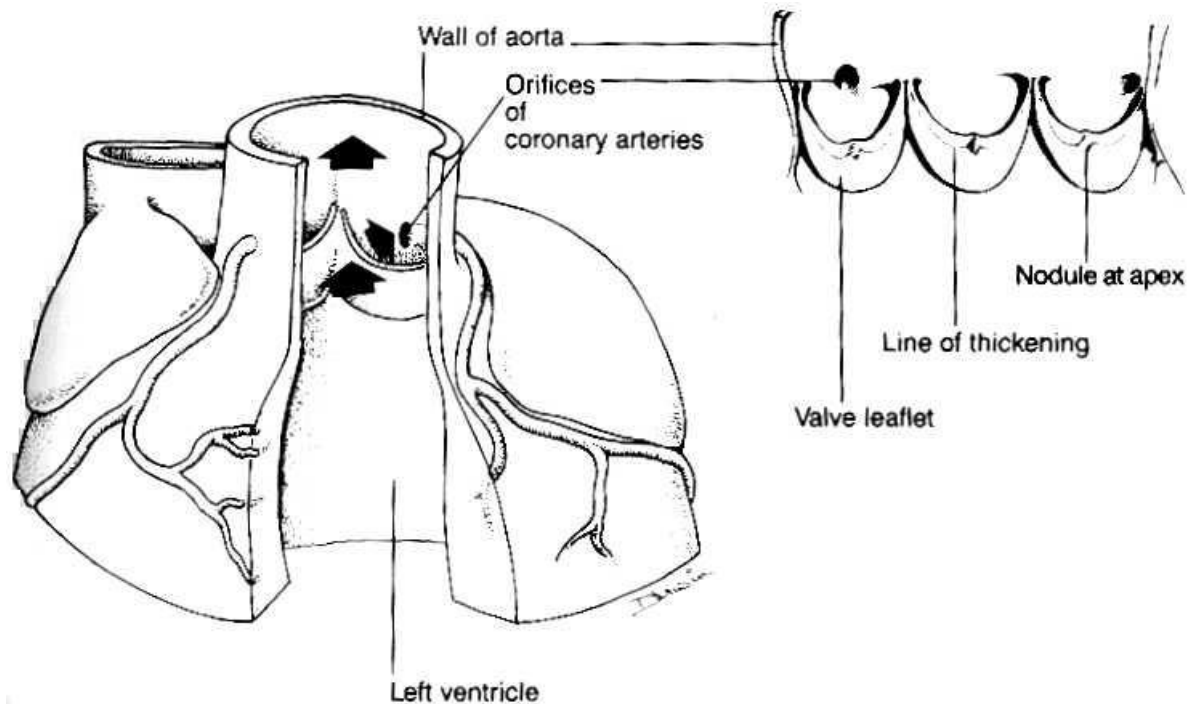


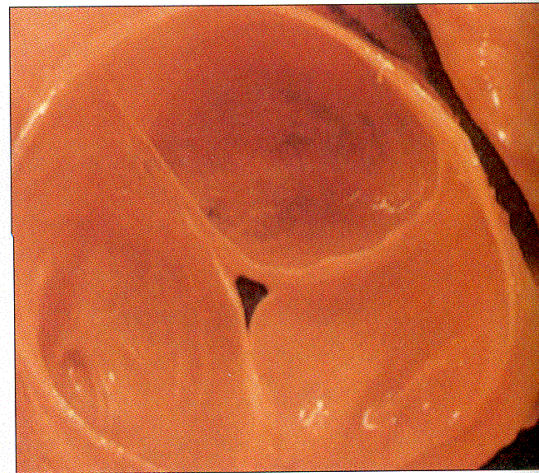
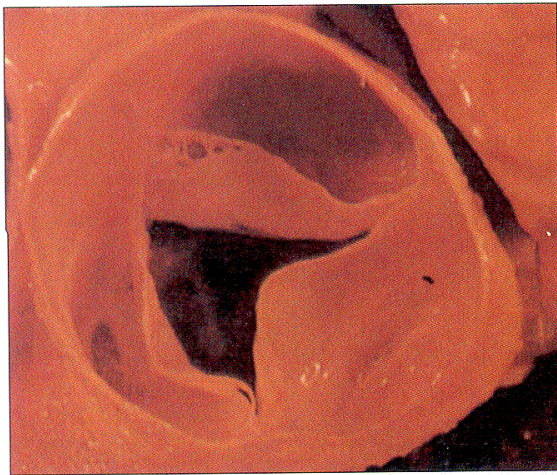
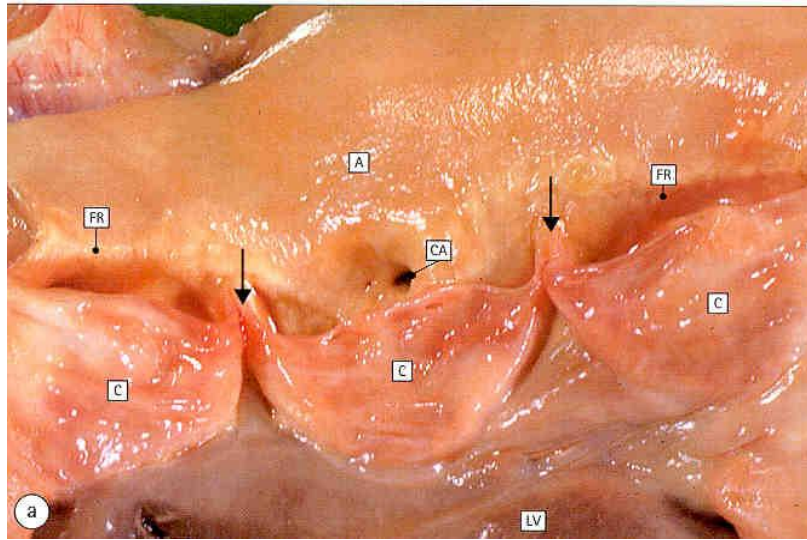
Pulmonary semilunar valve

3 pouches

Opens during ventricular contraction due to flow of blood pushing pouches against wall

Closes due to backflow of blood caused by elastic recoil in pulmonary artery, filling pouches





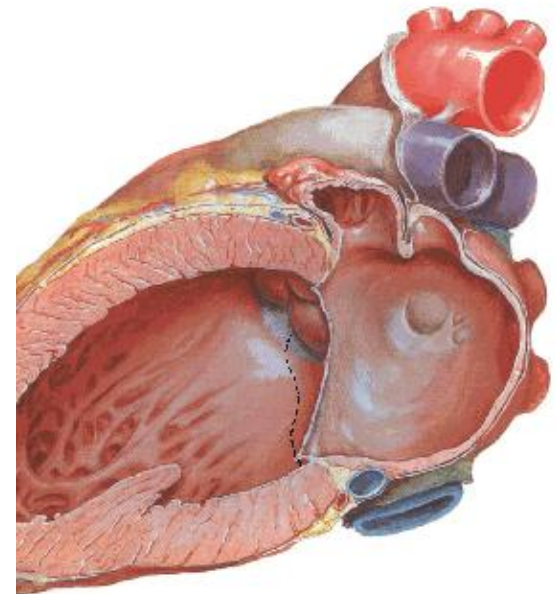
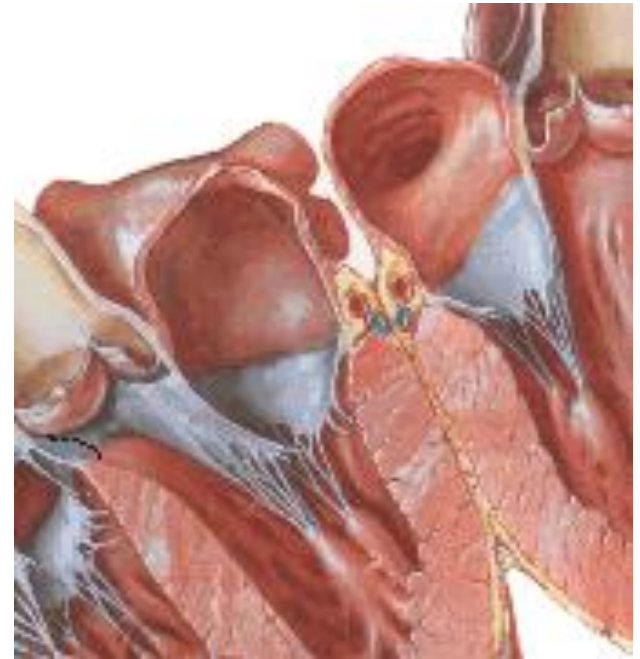
Left Atrium

Chamber = confluence of 4 vessels, therefore smooth wall

Receive oxygenated blood from lungs via 4 **pulmonary veins**, 2 each side

Wall structure similar to Right Atrium

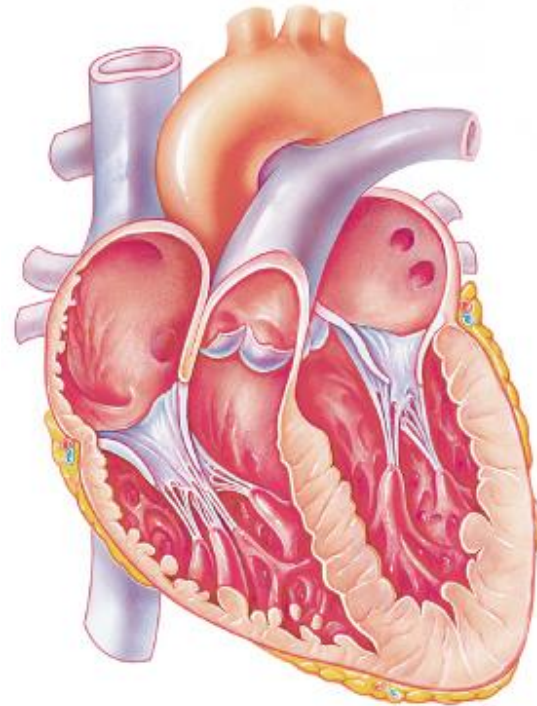
Mitral valve = bicuspid = left AV valve



Left Ventricle

Lumen volume the same as right ventricle

Walls 3X as thick to overcome systemic resistance



Left Ventricle

2 openings

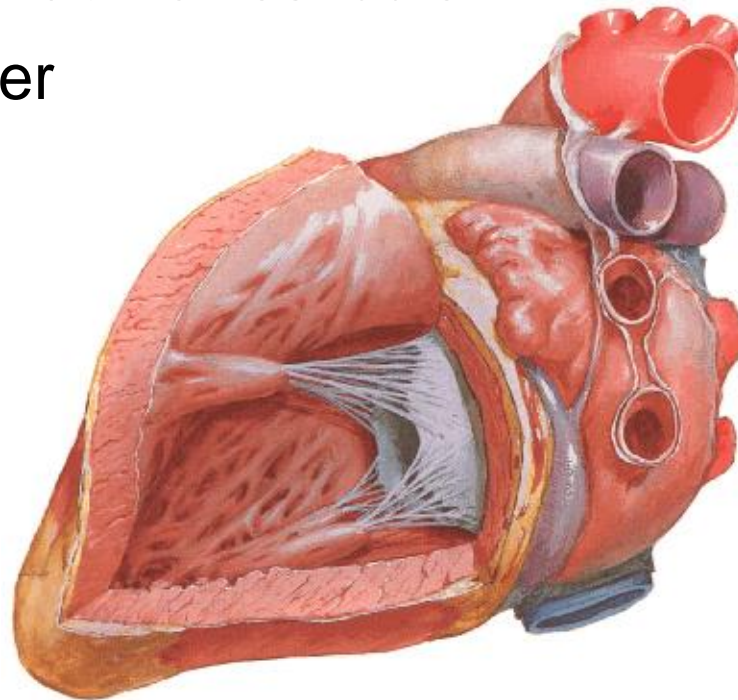
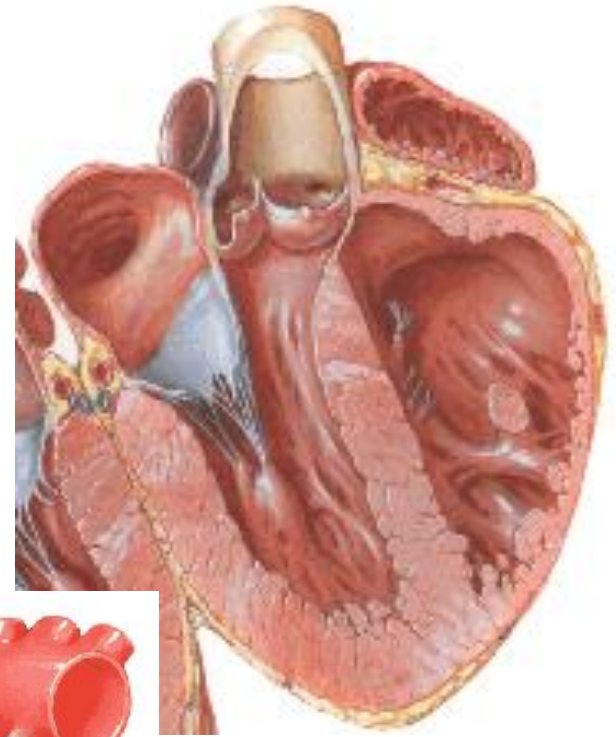
- 1) Left AV orifice – mitral (bicuspid) valve; chordae tendineae
- 2) Aortic orifice – semilunar valve

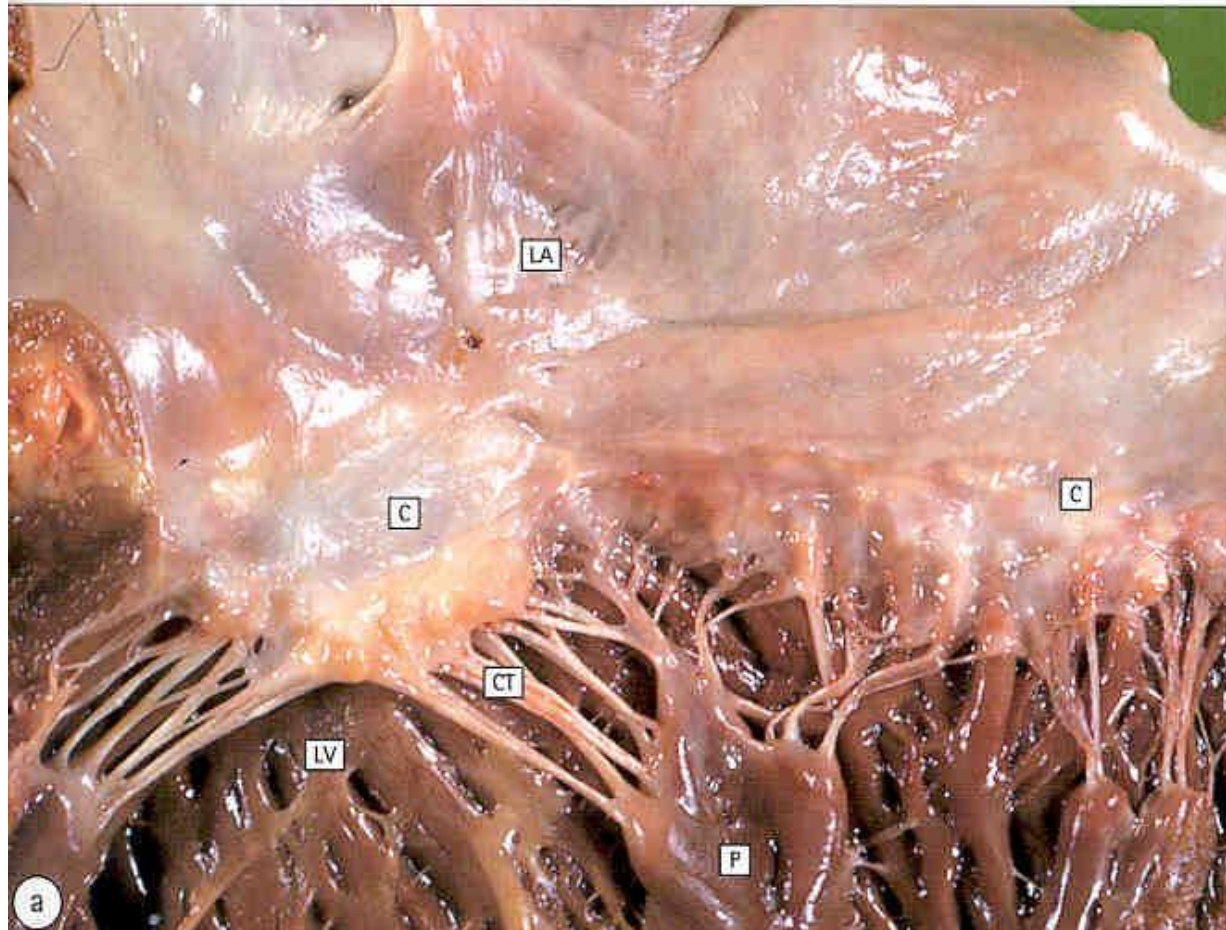
At peak of aortic vestibule

Valve flaps thicker

Papillary mms.

Pectinate mms.





Mitral valve
Chordae tendineae
Papillary muscles

Conduction System of Heart

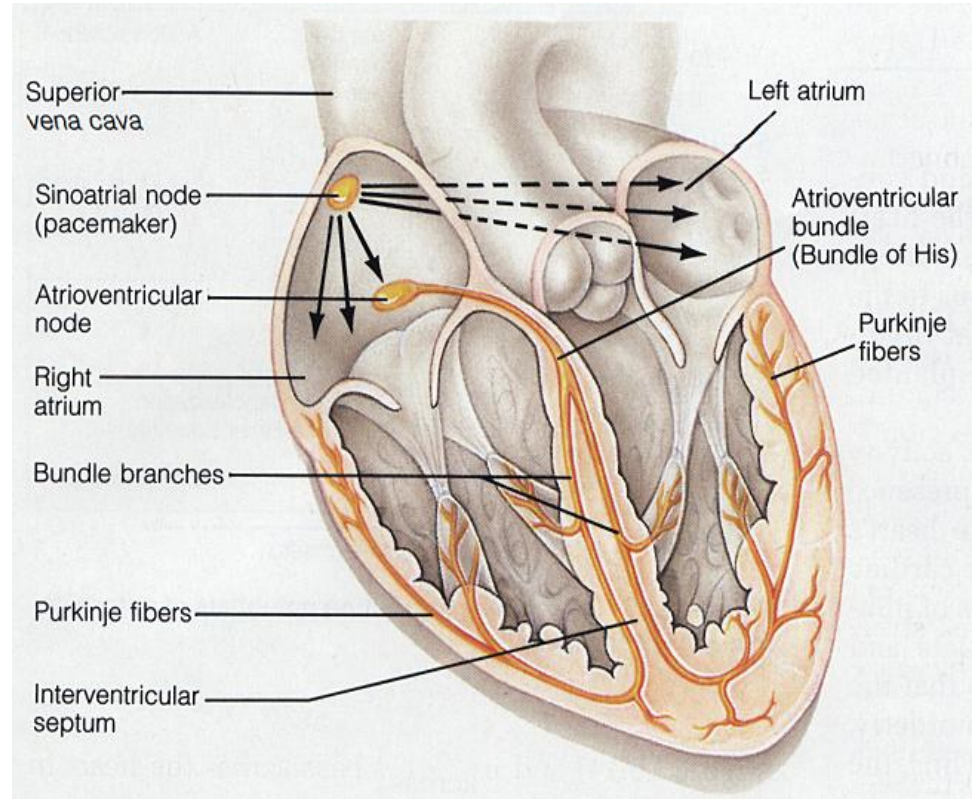
Sinoatrial (SA) node

Atrioventricular (AV) node

Bundle of His

Purkinje fibers

Skeleton of heart



Sinoatrial node

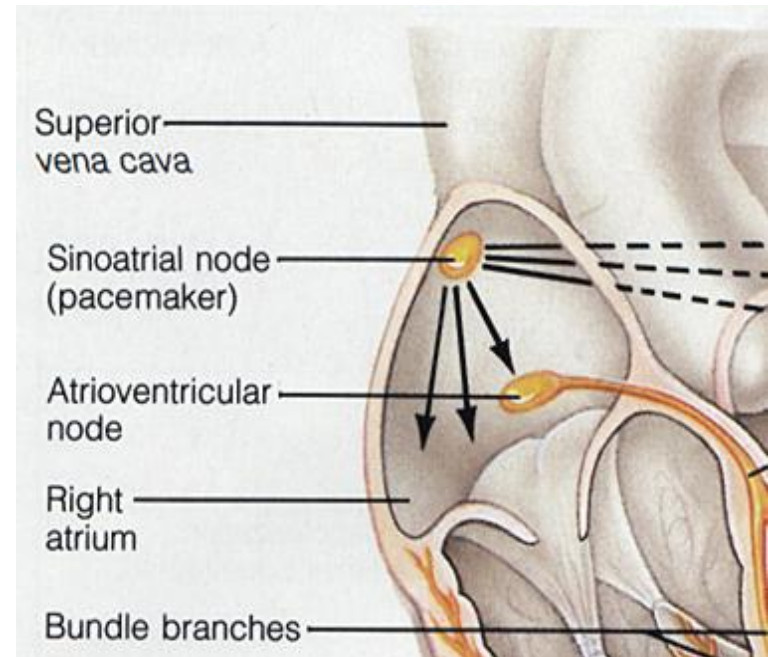
Pacemaker of heart

In wall of right atrium near opening of SVC

Not recognizable

Cardiac fibers with the lowest threshold, therefore have fastest rhythm

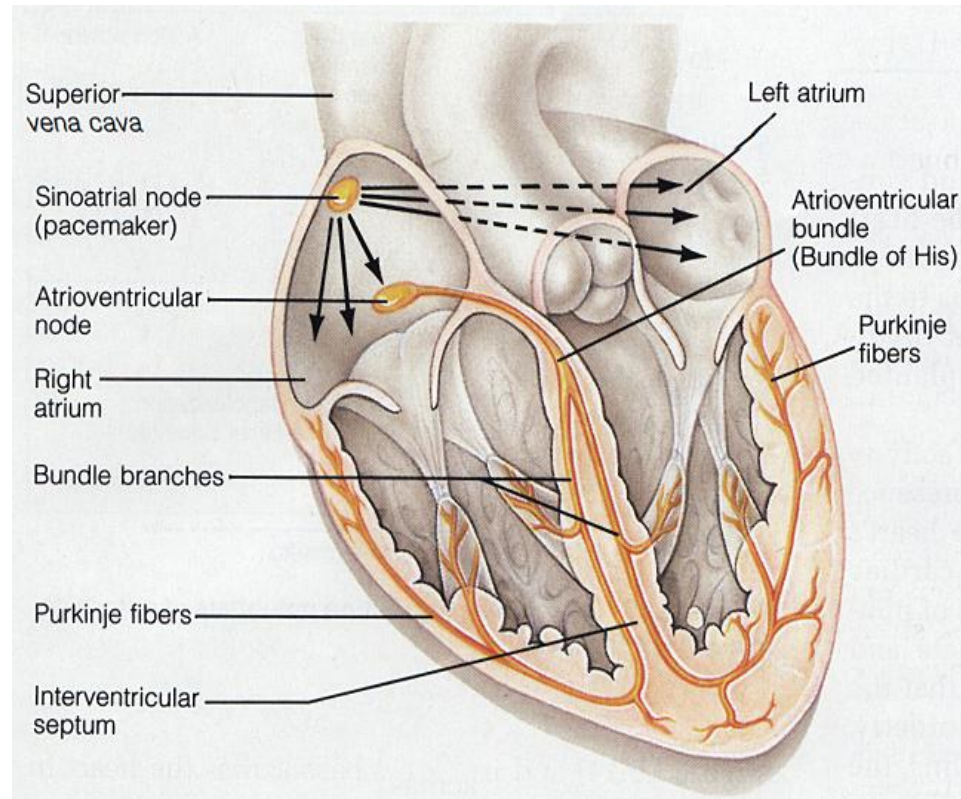
Impulse spreads over 2 atria via gap junctions between cardiac muscle cells



Atrioventricular (AV) node

In floor of atrium near coronary sinus

After a short delay (millisecond) an impulse is conducted along interventricular septum via Bundle of His

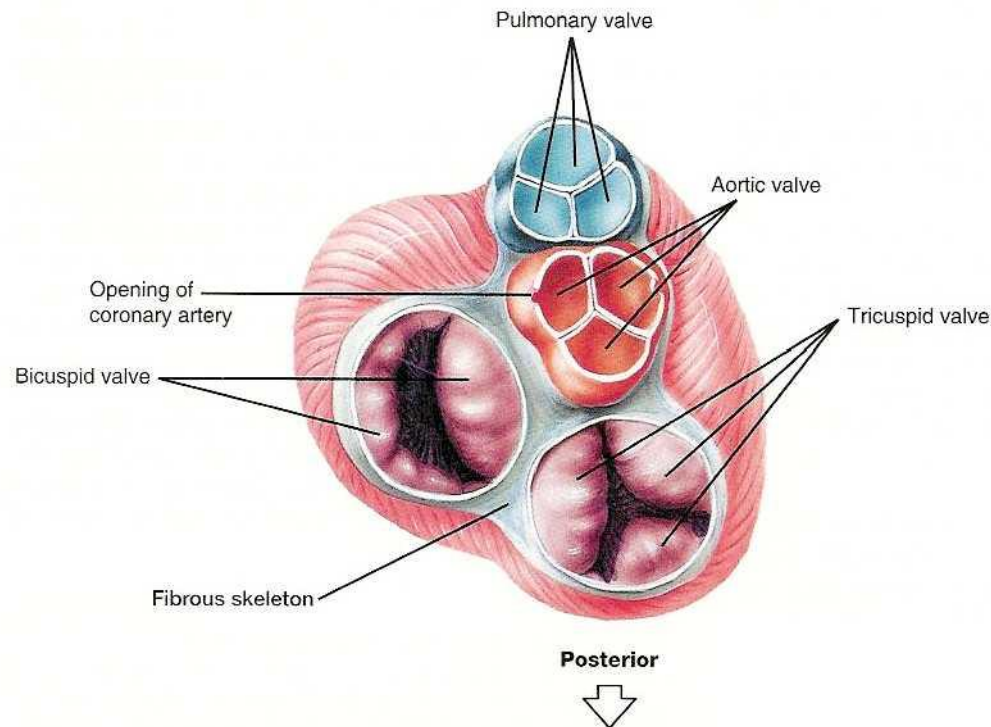


Skeleton of Heart

Fibrous rings around AV and semilunar valves

Muscle of atria and ventricles attach to rings

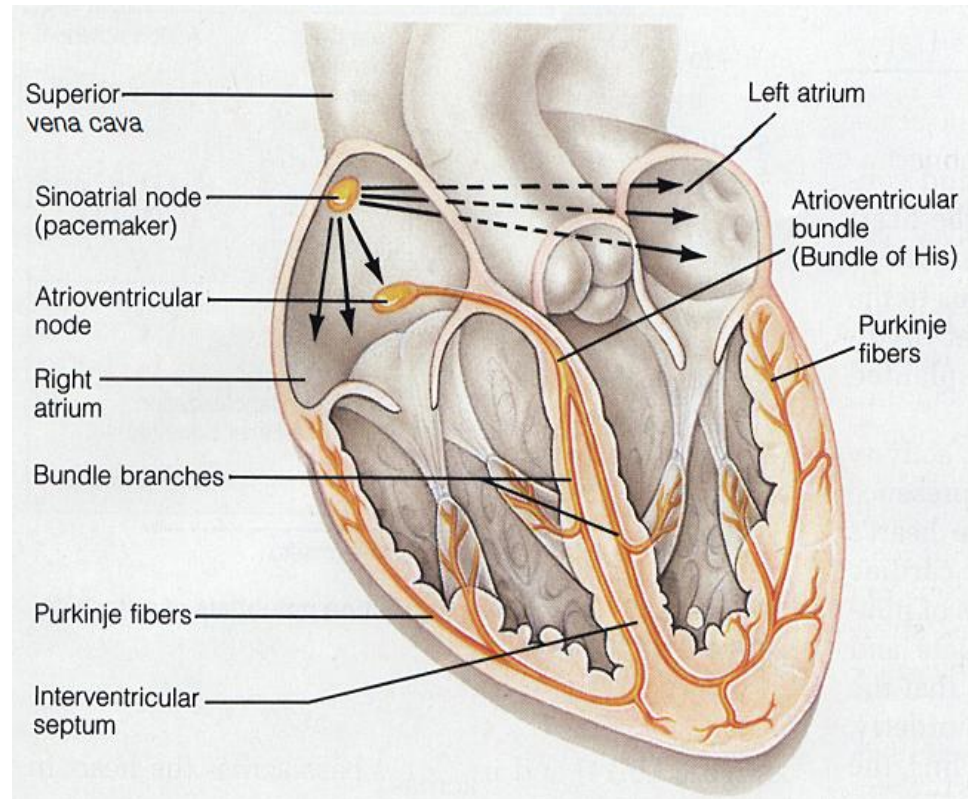
Prevent conduction of impulse from atria to ventricles



Bundle of His = bundle of Purkinje cells passes through cardiac skeleton, down interventricular septum

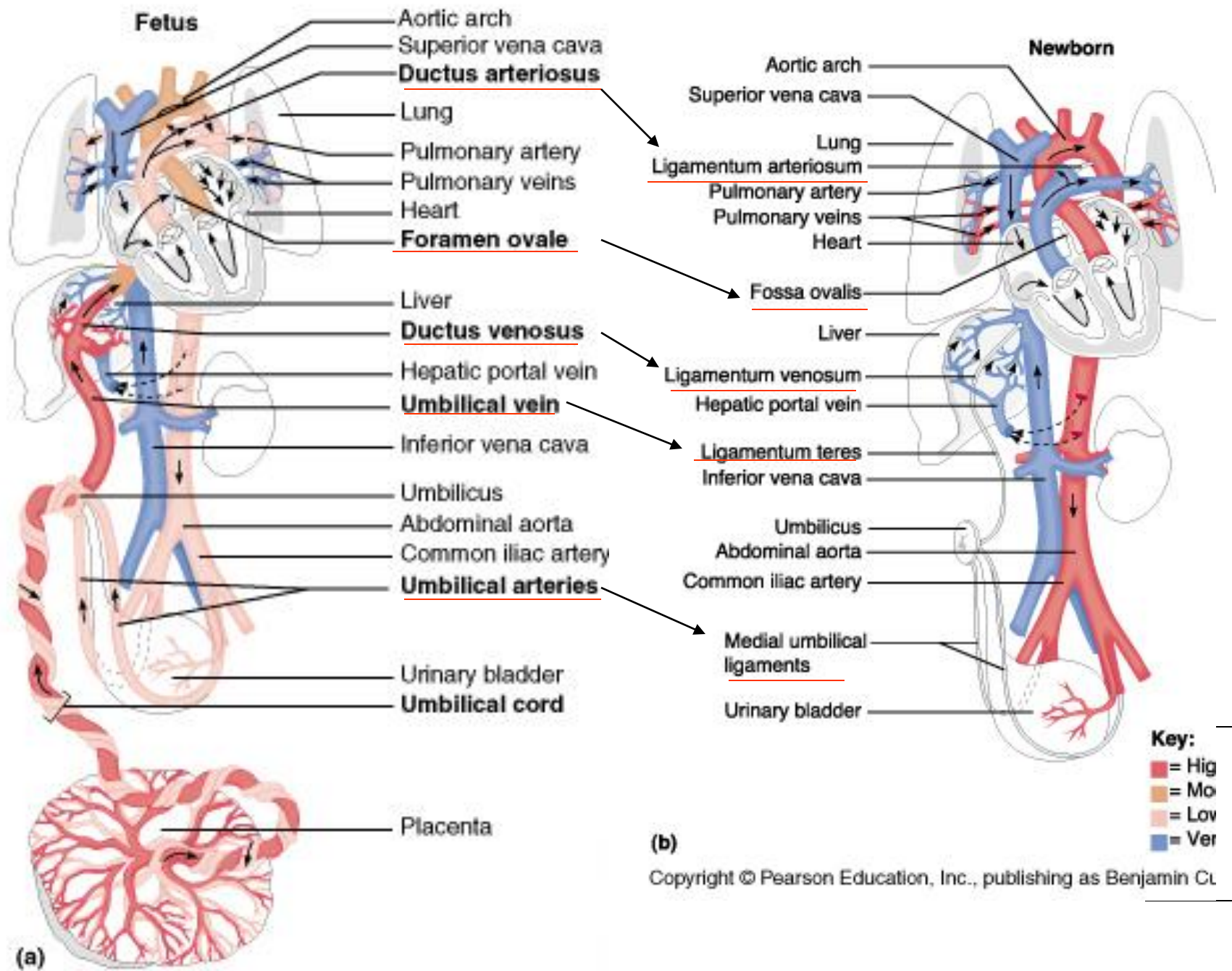
AV node > AV septum > 2 branches (right and left ventricles)

Branches =
Purkinje fibers
(cells)



Fetal Circulation and Changes at Birth

- Foramen ovale
 - Passage between RA and LA
 - Becomes fossa ovalis
- Ductus Arteriosus
 - Passage between pulmonary trunk and aortic arch
 - Becomes ligamentum arteriosum
- Umbilical Arteries
 - Inside anterior body wall to umbilicus
 - Become medial umbilical ligaments
- Umbilical Veins
 - From umbilicus to liver
 - Become ligamentum teres
- Ductus Venosus
 - Continuation of umbilical veins through liver to inferior vena cava
 - Becomes ligamentum venosum



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