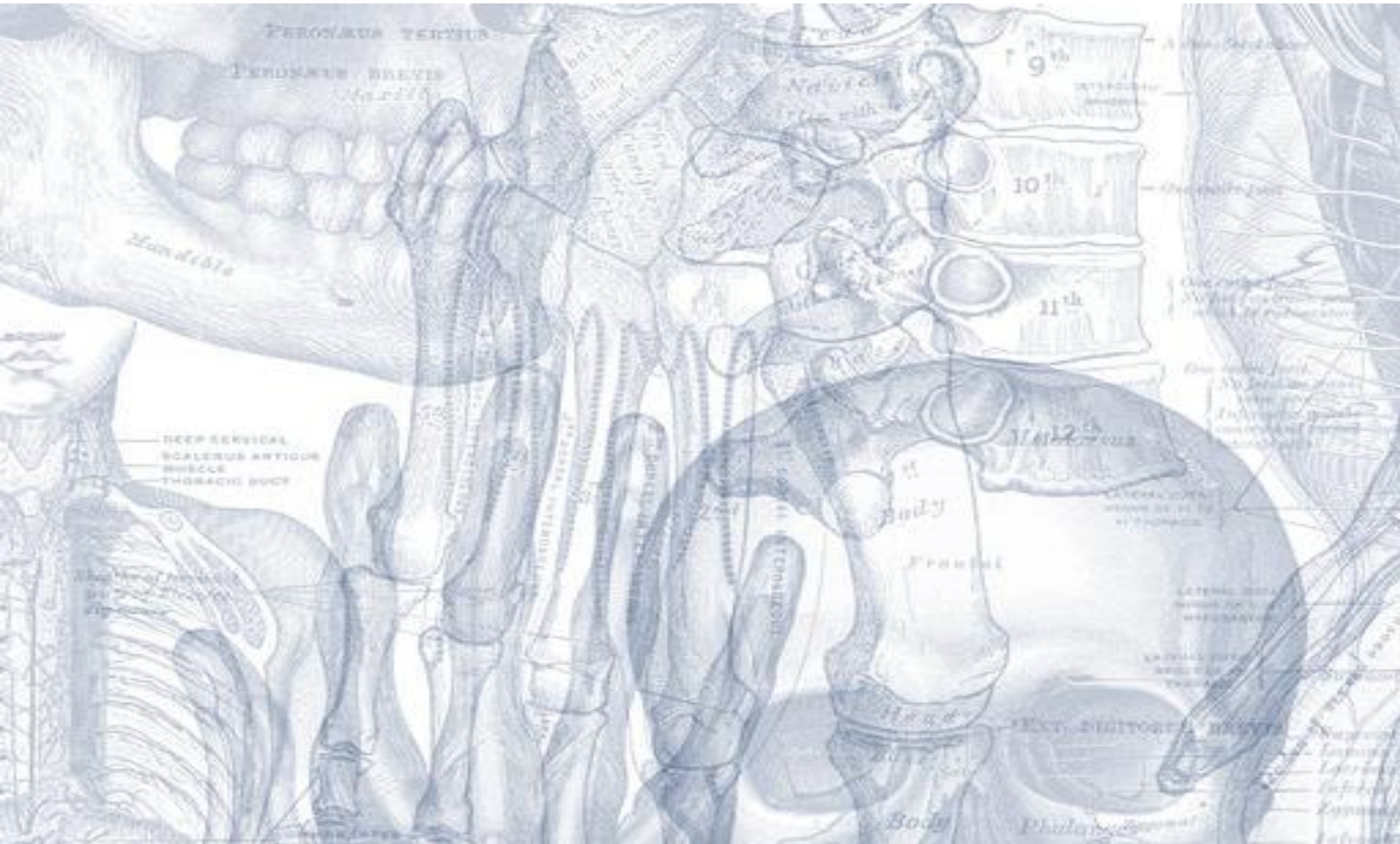


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Anatomy of the Heart

Please view our [Editing File](#) before studying this lecture to check for any changes.

Color Code

- **Important**
- **Doctors Notes**
- **Notes/Extra explanation**

Objectives

At the end of the lecture, the student should be able to :

- ✓ **Describe the shape of heart regarding** : apex, base, sternocostal and diaphragmatic surfaces.
- ✓ **Describe the interior of heart chambers** : right atrium, right ventricle, left atrium and left ventricle.
- ✓ **List the orifices of the heart** :
 - Right atrioventricular (Tricuspid) orifice.
 - Pulmonary orifice.
 - Left atrioventricular (Mitral) orifice.
 - Aortic orifice.
- ✓ **Describe the innervation of the heart.**
- ✓ Briefly describe the conduction system of the Heart.

The Heart

- It lies in the **middle mediastinum**.
- It consists of 4 chambers:
 - 2 atria (right & left) **that receive blood** &
 - 2 ventricles (right & left) **that pump blood**.
- The Heart is somewhat pyramidal in shape, having:
 1. **Apex**
 2. **Sterno-costal (anterior surface)**
 3. **Diaphragmatic** (inferior surface)
 4. **Base** (posterior surface).
- It is surrounded by a fibroserous sac called **pericardium** which is differentiated into:

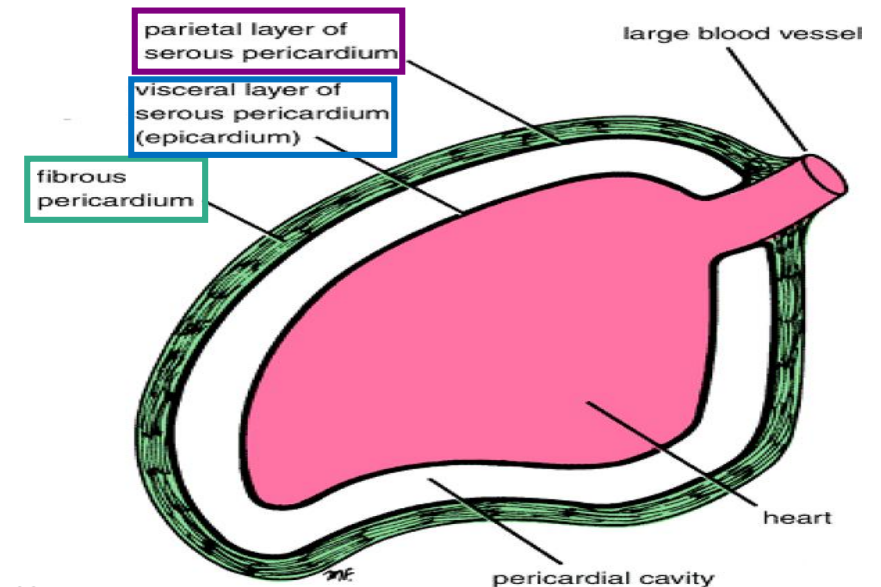
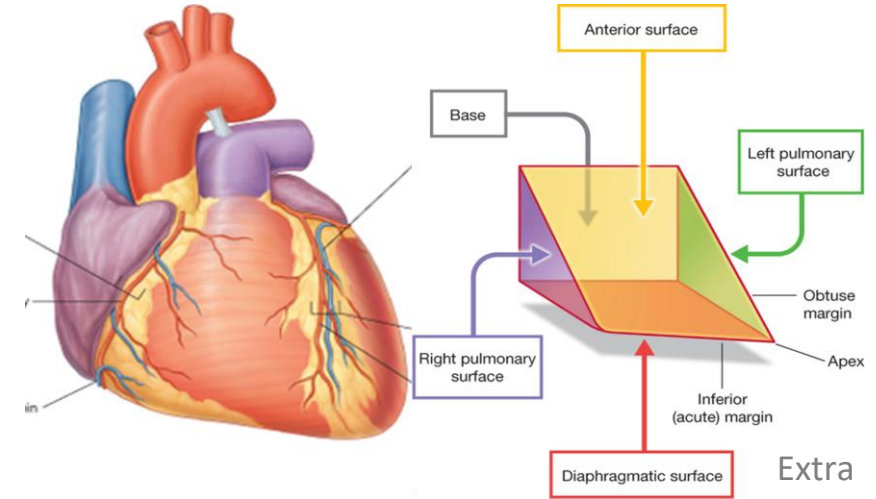
an **outer fibrous layer**
(Fibrous pericardium)

inner serous sac
(Serous pericardium).

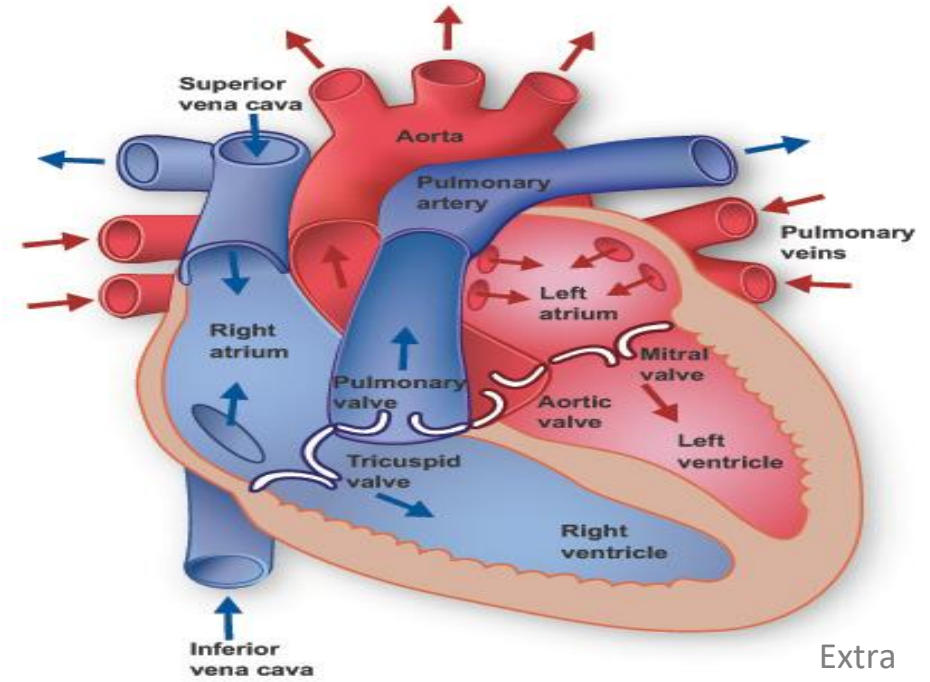
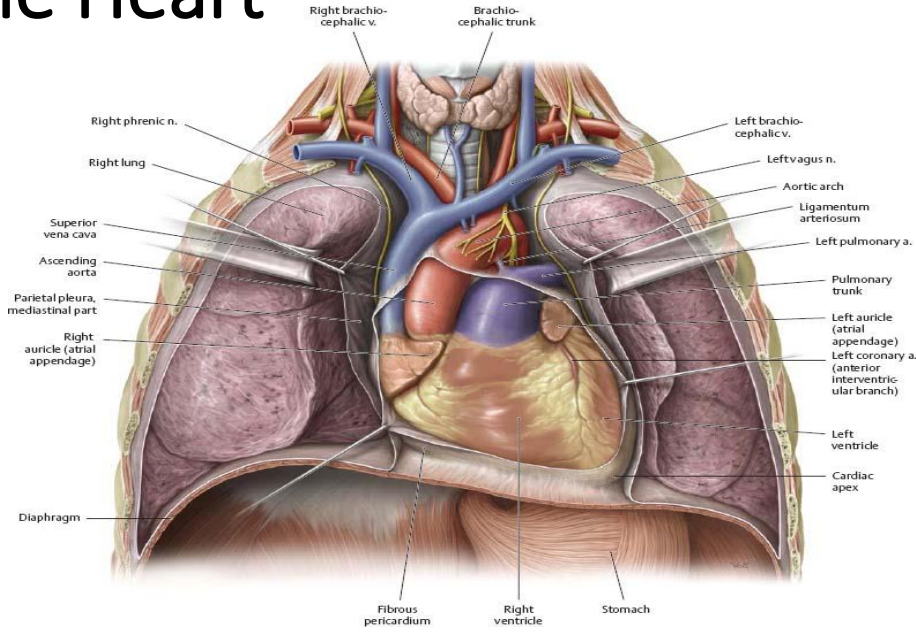
further divided into

Parietal

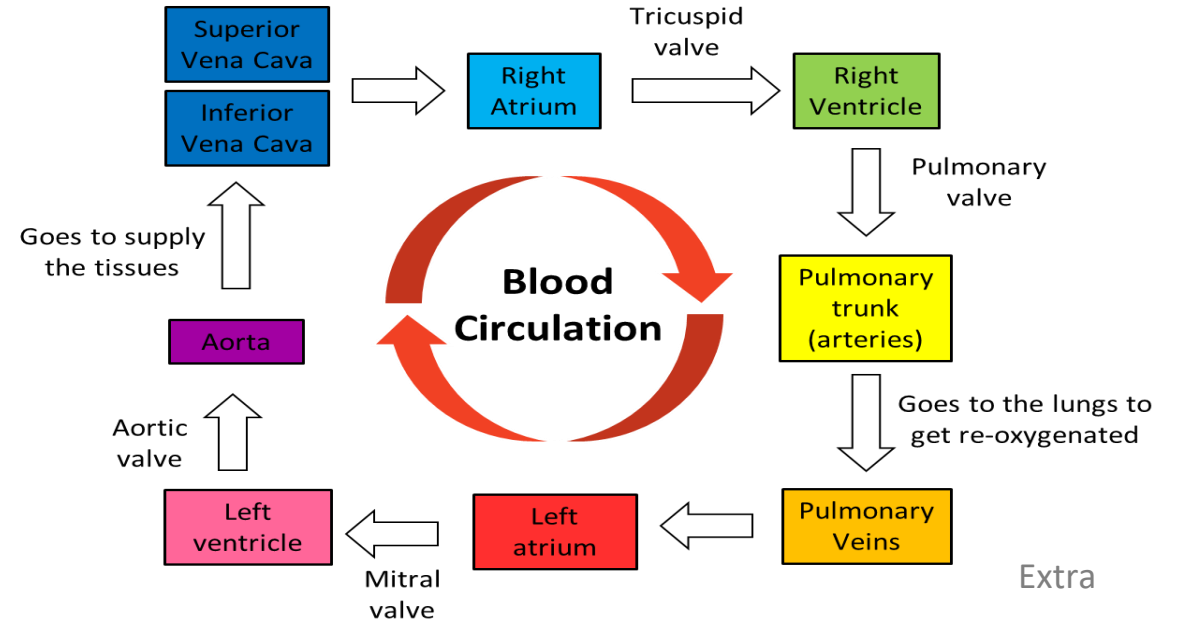
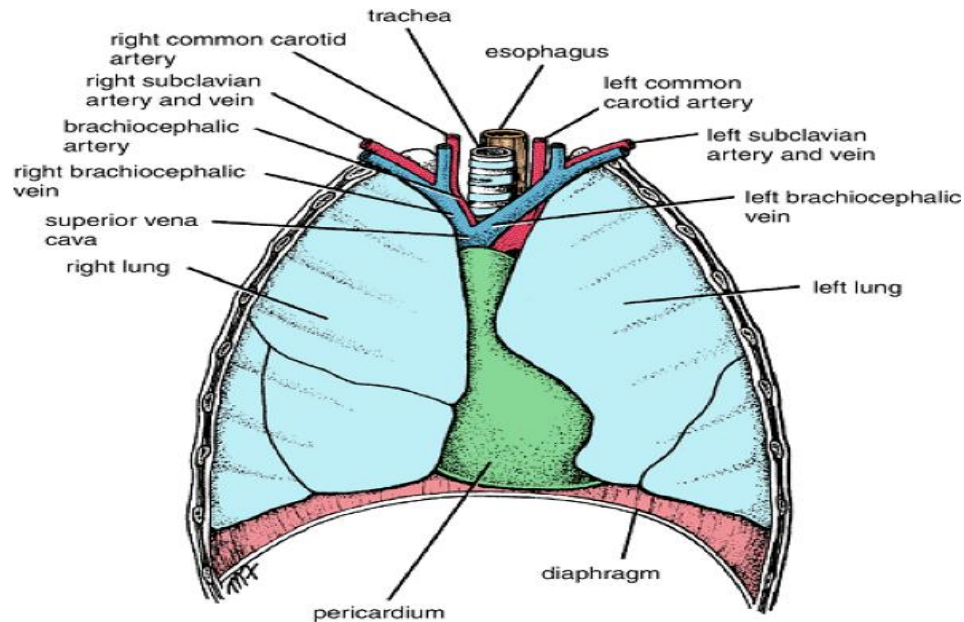
Visceral (Epicardium)



The Heart



Extra



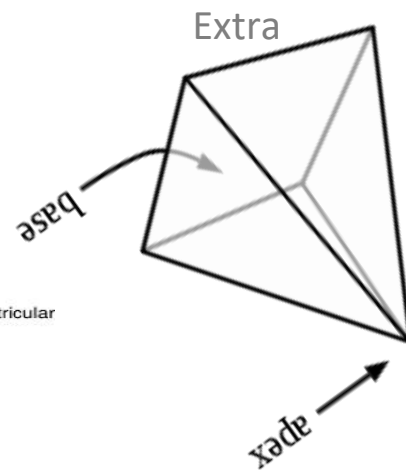
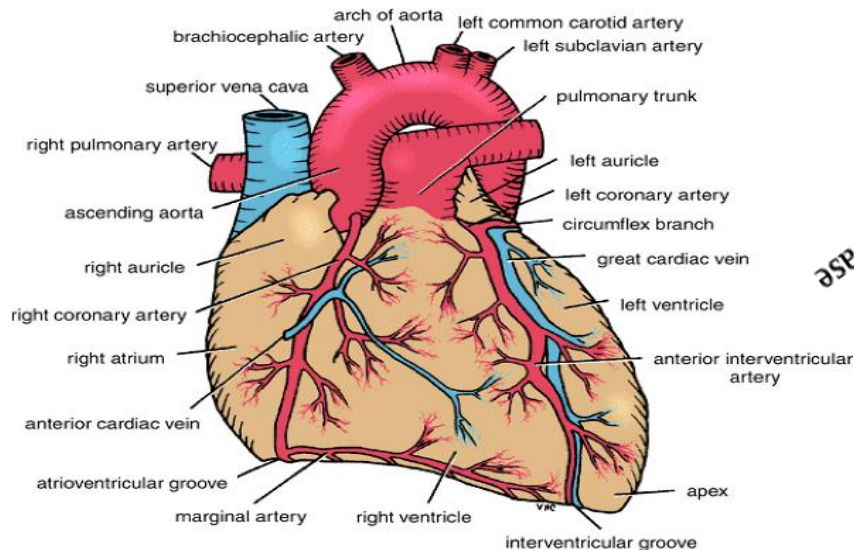
Extra

The Heart

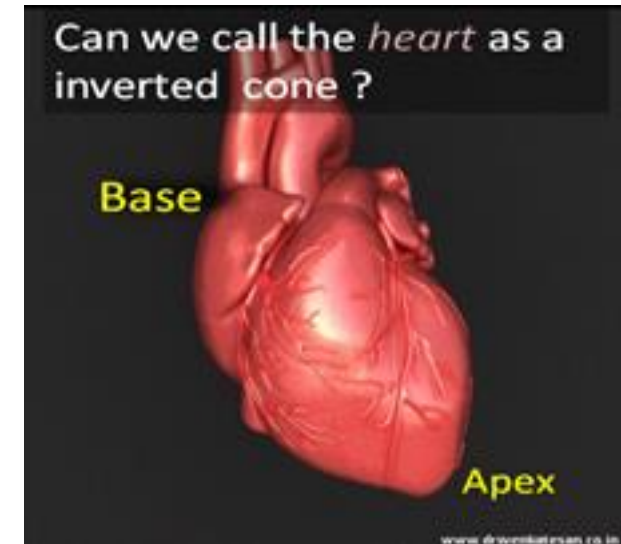
1- Apex

- Directed downwards, forwards and to the left.
- **It is formed by the left ventricle.**
- Lies at the level of **left 5th intercostal space** (the same level of the nipple) 3.5 inch from midline.

Note that the base of the heart is called the base because the heart is pyramid shaped; the base lies opposite to the apex. The heart does not rest on its base; it rests on its diaphragmatic (inferior) surface.



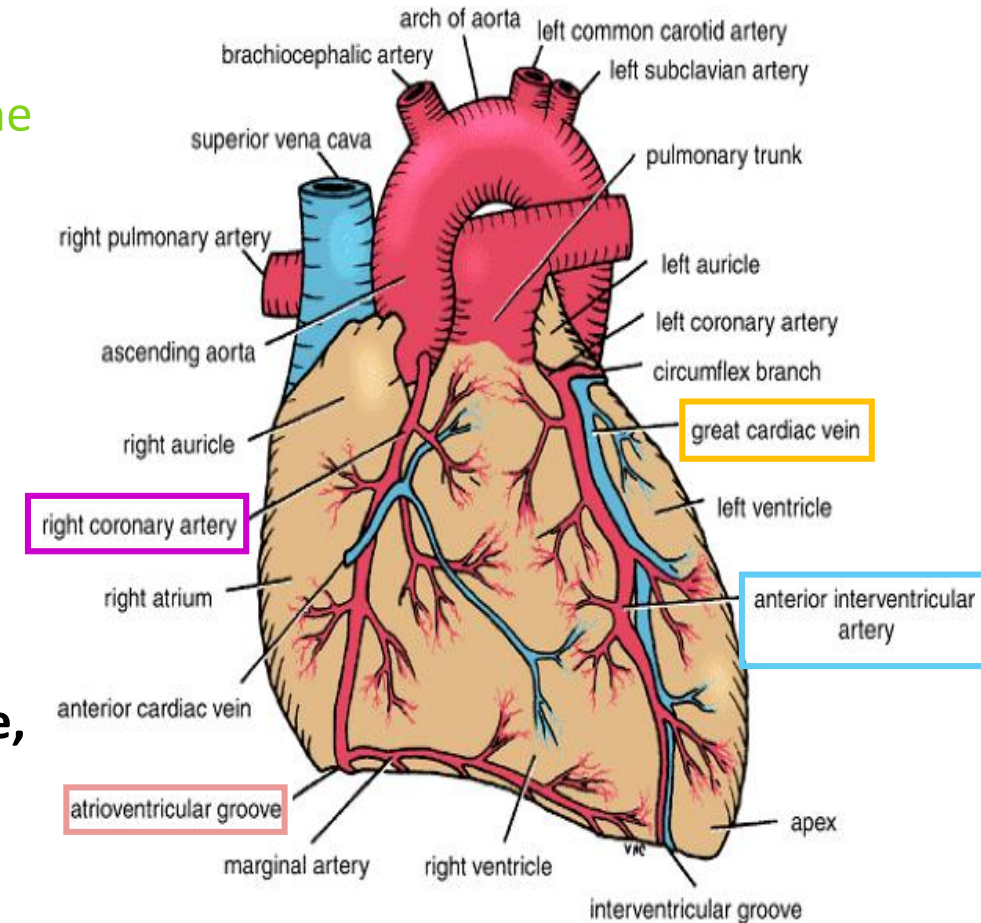
Explanation:
The heart is shaped like a pyramid so it has a base and apex. But the base is not at the bottom because the pyramid is inverted or upside down. So the heart doesn't sit on its base. It sits on the inferior or diaphragmatic surface.



The Heart

2- Sterno-Costal (Anterior) Surface

- This surface is formed mainly by the **right atrium** and the **right ventricle** (we said mainly because there is also a little part by of the left ventricle).
- Divided by coronary (atrio-ventricular) groove (which lodges* the right coronary artery) into :
 1. **Atrial part:** formed mainly by right atrium.
 2. **Ventricular part :** the right 2/3 is formed by *right ventricle*, while the left 1/3 is formed by *left ventricle*. So, it is also formed of some of the left ventricle.
- The 2 ventricles are separated by **anterior interventricular groove**, which lodges:
 - Anterior interventricular artery (branch of left coronary)
 - Great cardiac vein.



*Lodges = strongly attaches to, contains or embedded in.

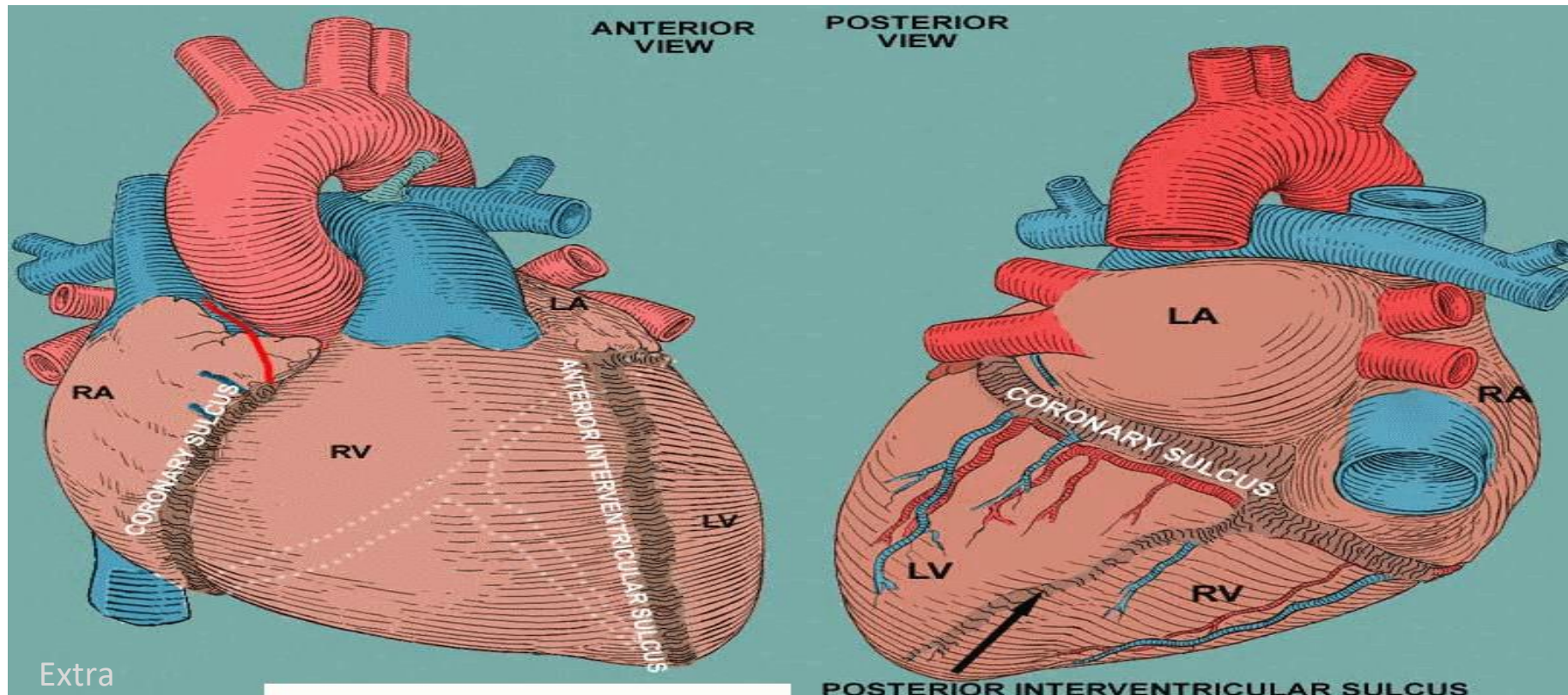
The Heart

2- Sterno-Costal (Anterior) Surface

It is formed mainly by the right atrium & the right ventricle, which are separated from each other by the vertical atrioventricular groove. superior and inferior borders of the heart. The right ventricle is separated from the left ventricle by an anterior interventricular groove.

Between the atrium and ventricle → atrioventricular groove (coronary sulcus)

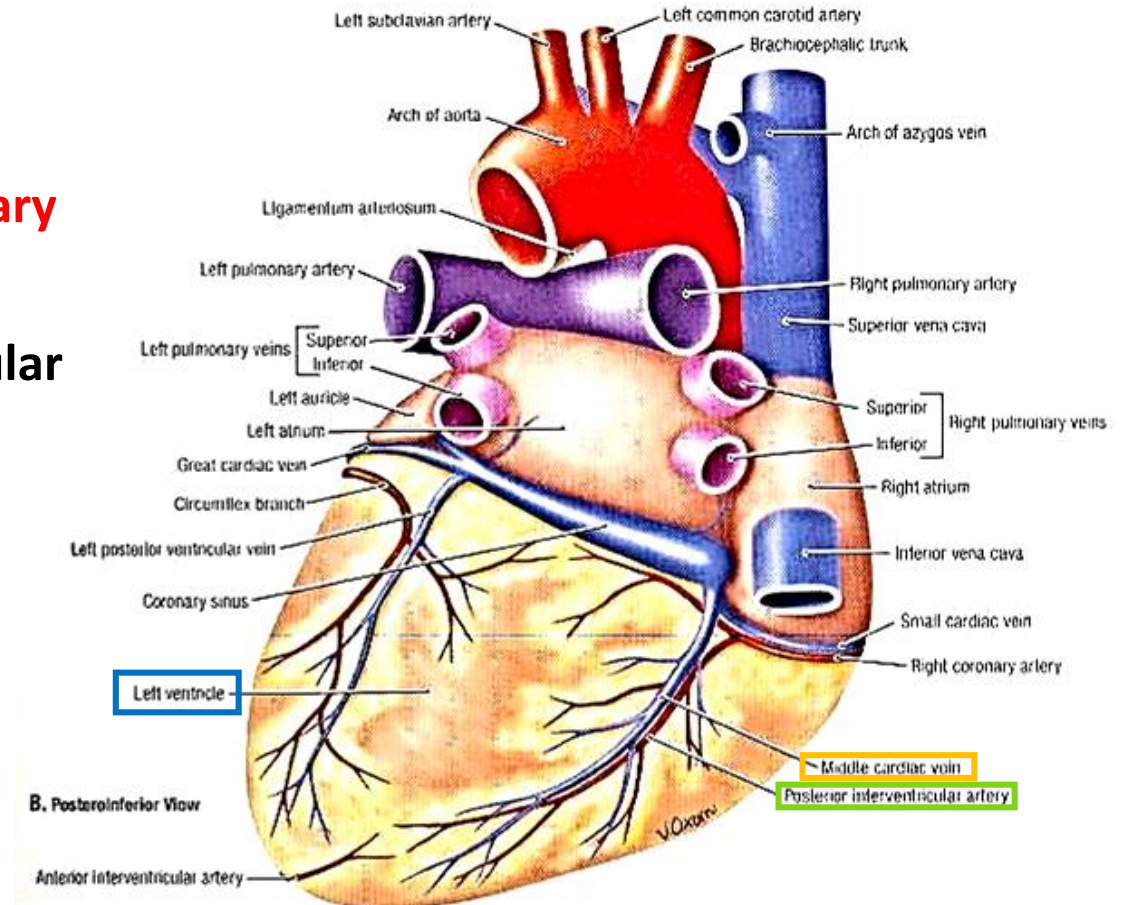
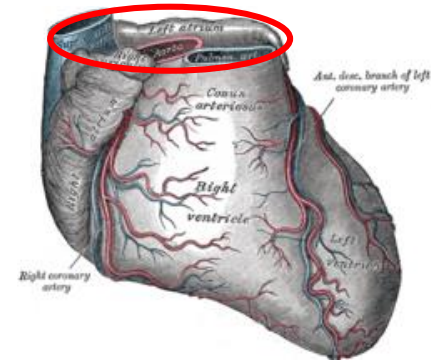
Between the 2 ventricles → interventricular groove (anterior / posterior)



The Heart

3- Diaphragmatic (Inferior) Surface

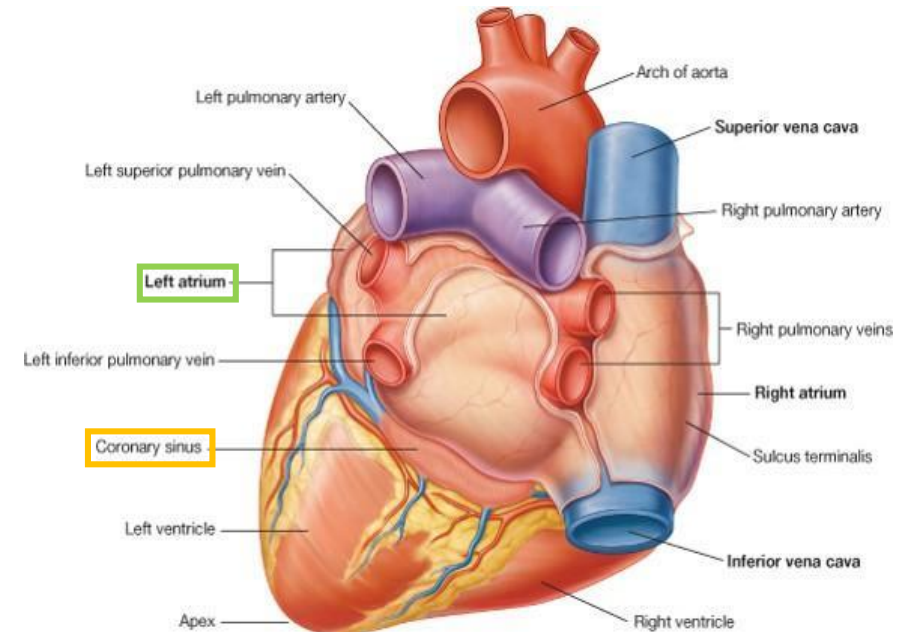
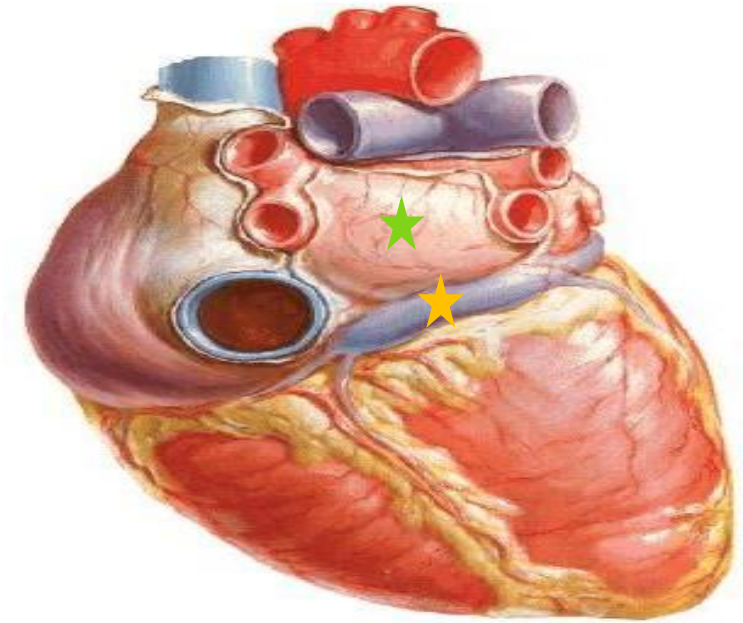
- Formed by the 2-ventricles, mainly **left ventricle** (left 2/3).
- Slightly concave as it rests on diaphragm.
- Directed *inferiorly & backward*.
- Separated from base of heart by **posterior part of coronary sulcus**.
- The 2-ventricles are separated by **posterior interventricular groove** which lodges:
 - Posterior interventricular artery
 - Middle cardiac vein.



The Heart

4- Base of the Heart (posterior surface)

- It is formed by the 2 atria, *mainly left atrium*, into which open the 4 pulmonary veins (2 right and 2 left).
- It is directed *backwards*.
- **Lies opposite middle thoracic vertebrae (5-7)** (T5, T6, T7).
- Is separated from the vertebral column by:
 - descending aorta,
 - esophagus and
 - **oblique sinus of pericardium** (will be discussed later)
- Bounded inferiorly by *posterior part of coronary sulcus*, which lodges the coronary sinus



Borders of the Heart

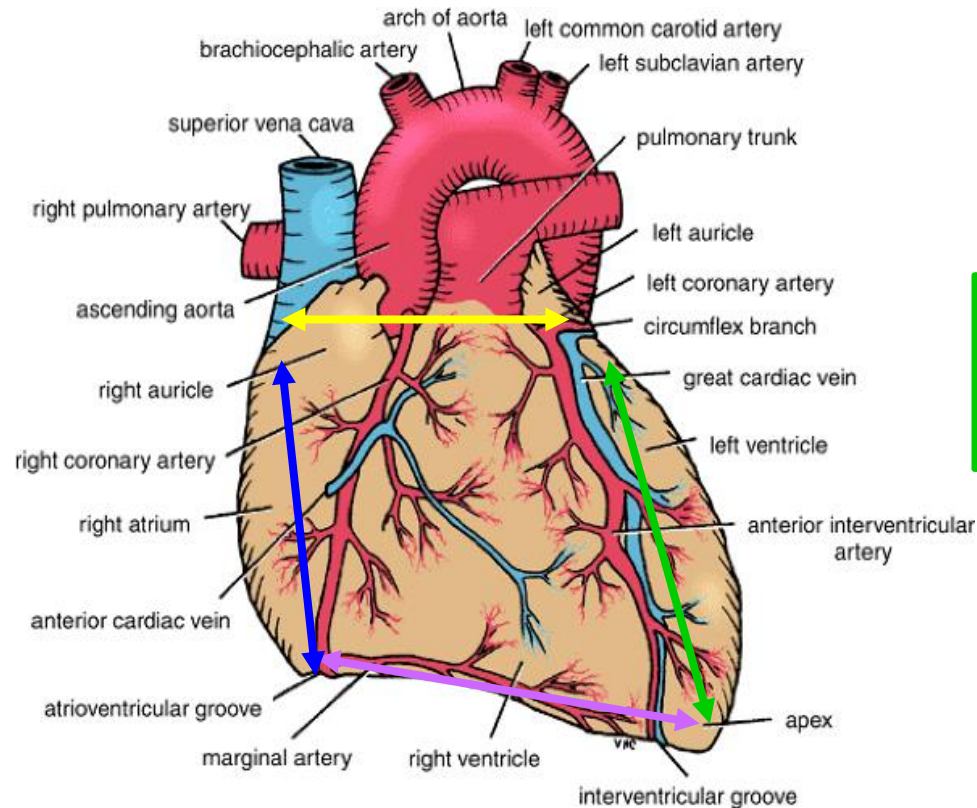
Upper border:

Is formed by the 2 atria.

It is concealed by ascending aorta & pulmonary trunk.

Right border:

Is formed by right atrium.



Left border:

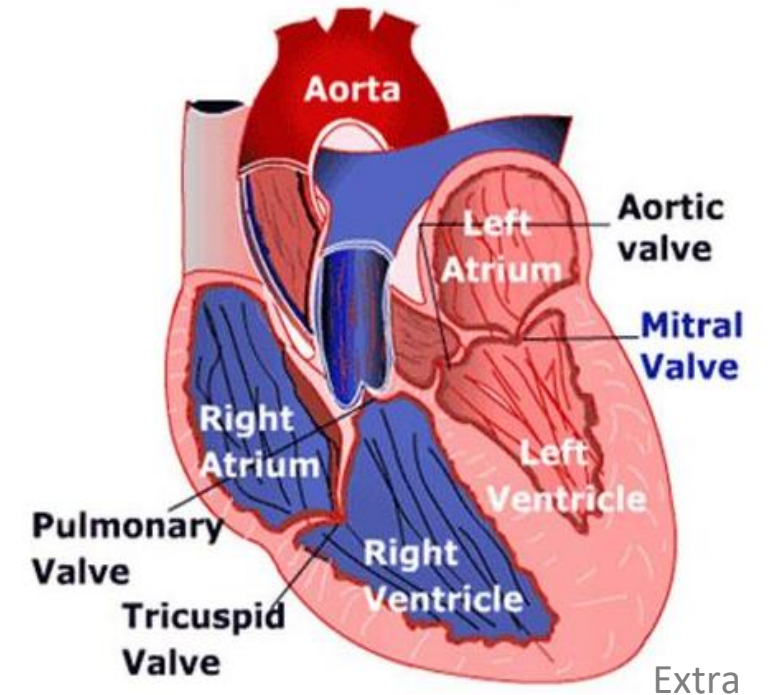
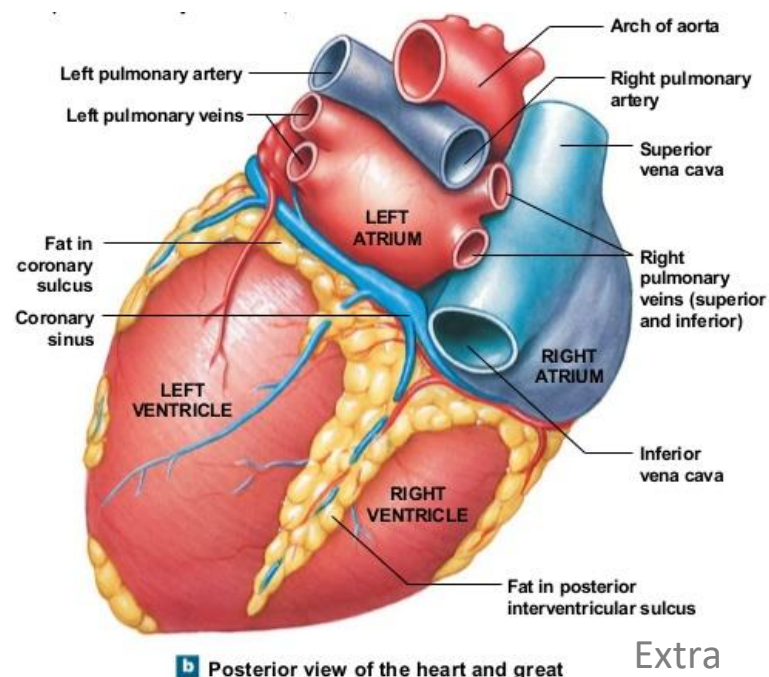
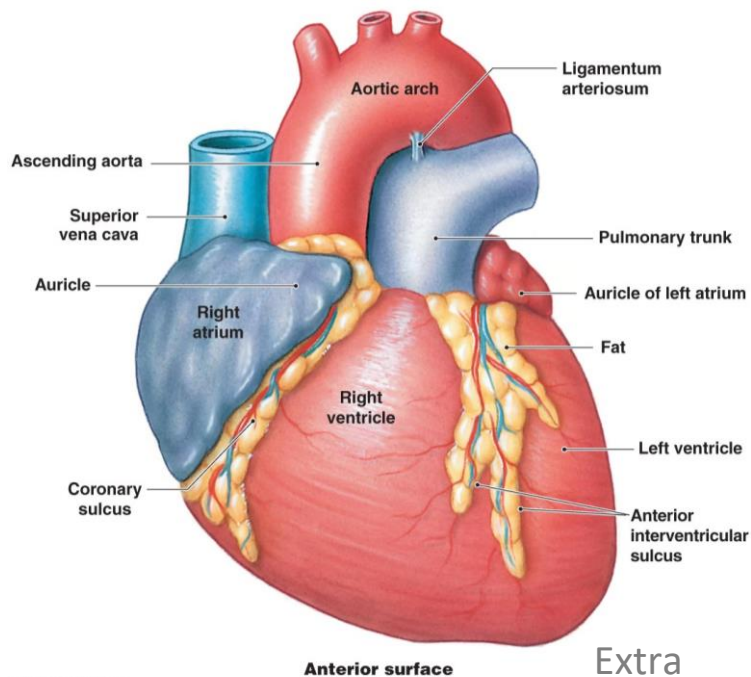
Is formed mainly by left ventricle + auricle of left atrium.

Lower border:

Is formed mainly by right ventricle + apical part of left ventricle.

Chambers of the Heart

- The heart is divided by vertical septa into four chambers:
 - the *right* and *left* atria
 - the *right* and *left* ventricles.
- The **right atrium** lies anterior to the left atrium, and the **right ventricle** lies anterior to the left ventricle.

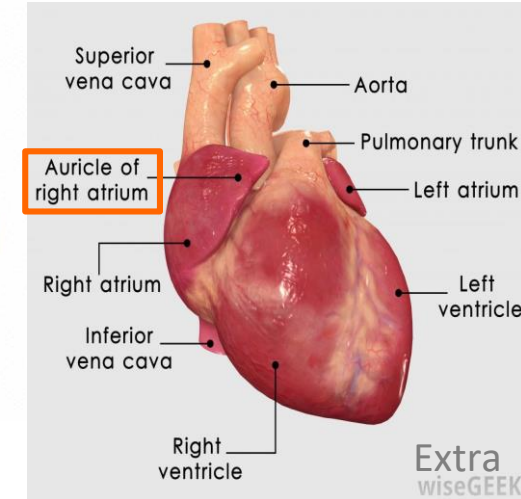
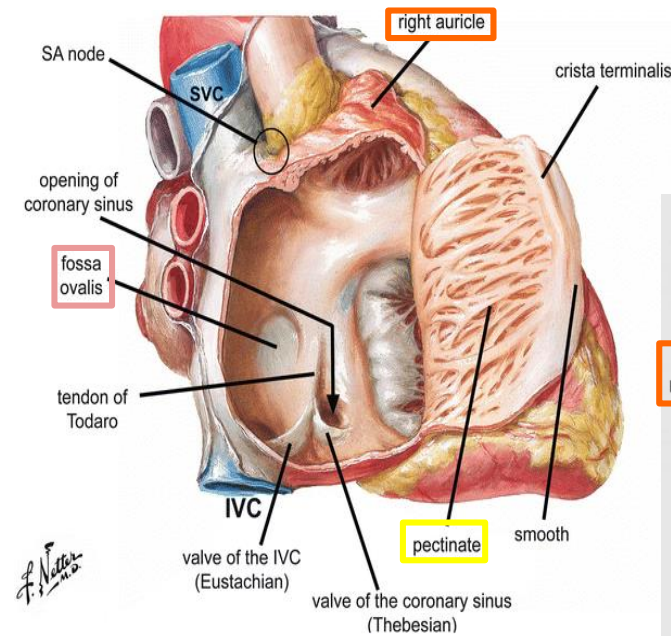


Chambers of the Heart



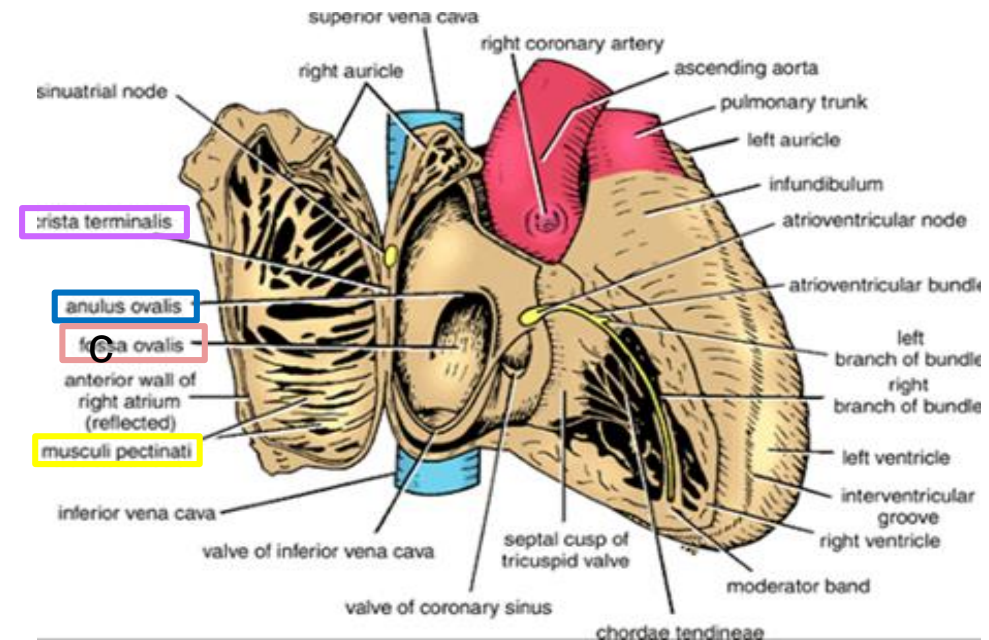
Right Atrium

- The right atrium consists of a main cavity and a small outpouching, the **auricle** (upward protrusion resembling ear).
- On the outside of the heart at the junction between the *right atrium* and the *right auricle* is a vertical groove, the **sulcus terminalis**, which *on the inside* forms a ridge, the **crista terminalis**.



Cavity of Right Atrium

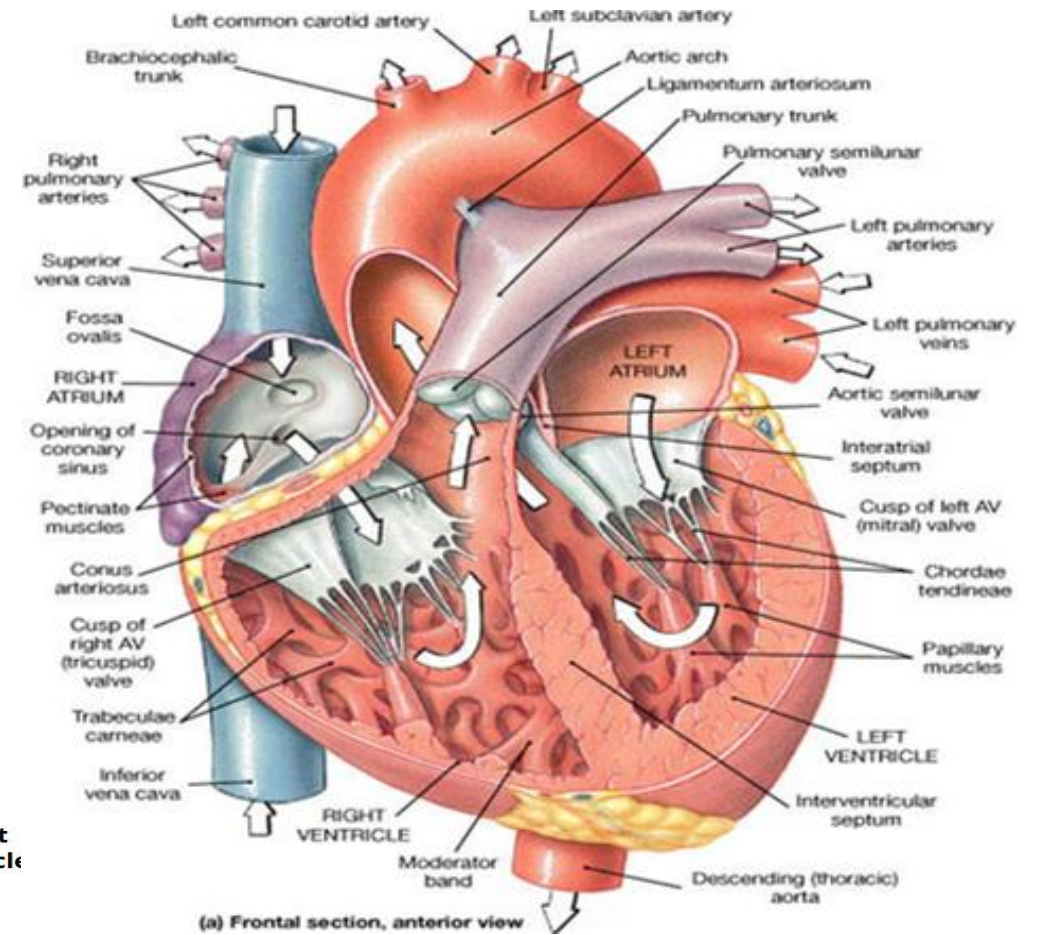
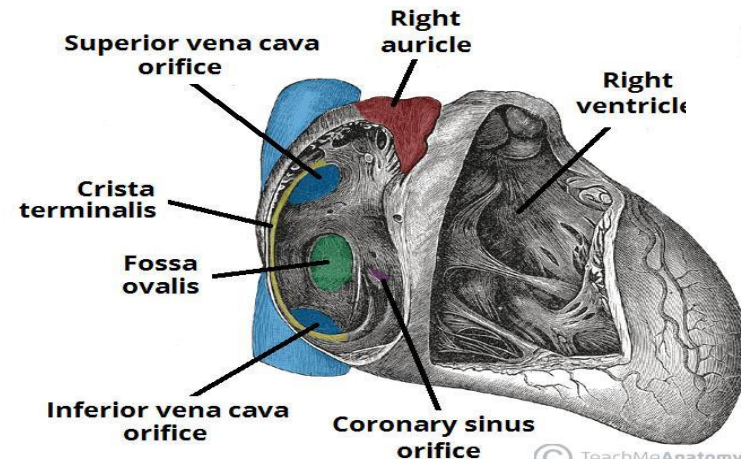
- **Crista terminalis** divides right atrium into:
 1. Anterior part: **rough** (because of muscles) and trabeculated by bundles of muscle fibres (**musculi pectinati** or **pectinate muscle**).
 2. Posterior part (**sinus venarum**) is smooth.
- The interatrial septum carries an oval depression called **Fossa ovalis**.
- The margin of this depression is called **Anulus ovalis**
- The blood leaves right atrium to right ventricle via **tricuspid valve**.



Chambers of the Heart

Right Atrium (openings) very important

- 1- **SVC** (superior vena cava) → has no valve
- 2- **IVC** (inferior vena cava) → guarded by a valve
- 3- **Coronary sinus** → has a well-defined valve
- 4- **Right atrioventricular orifice** lies anterior to IVC opening, it is surrounded by a fibrous ring which → gives attachment to the **tricuspid valve**
- 5- Small orifices of small veins



Chambers of the Heart

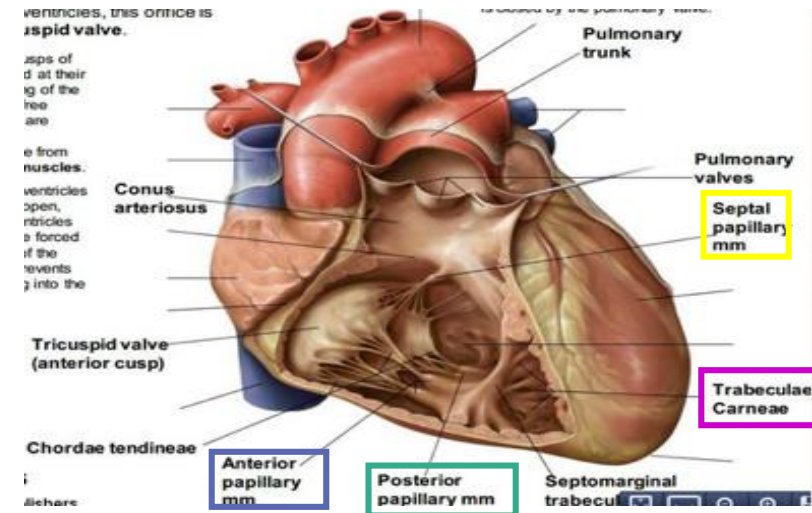


(*important: Wall thinner than left ventricle... left ventricle pumps the blood to ascending aorta so needs to be powerful and thick, so, right ventricle is thinner)

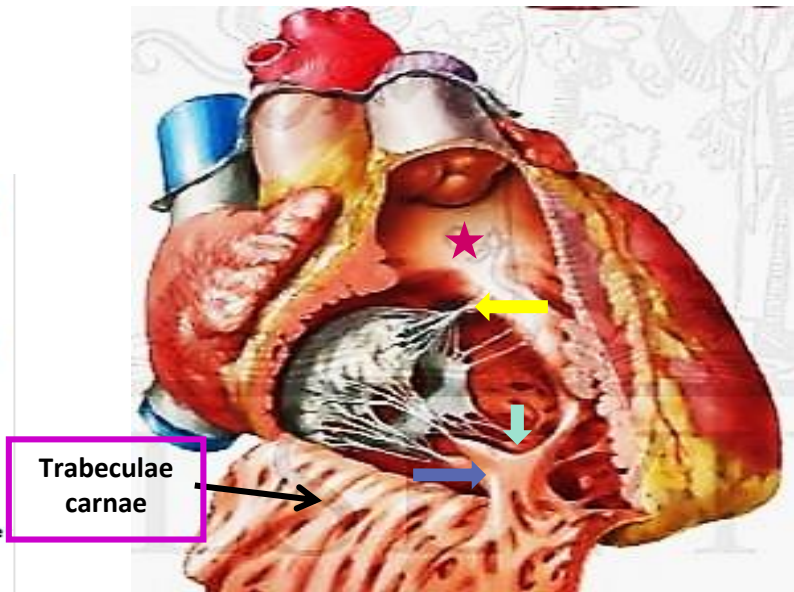
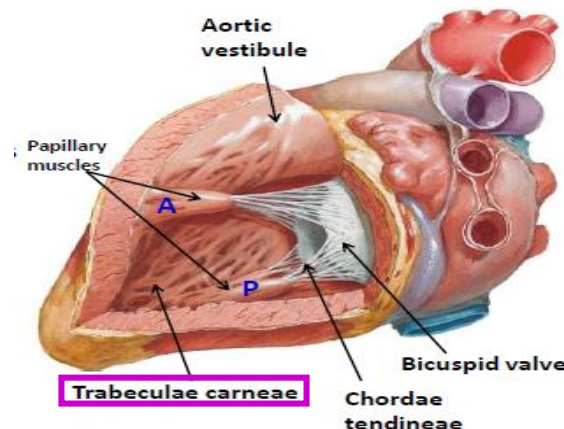
Cavity of right ventricle

- Its wall is **thinner*** than that of the left ventricle.
- Its wall contains projections called trabeculae carneae (irregular bands and bundles of muscle projecting from the inner surface).
- The right ventricle communicates with right atrium through right atrioventricular orifice & with pulmonary trunk through pulmonary orifice.
- As the cavity approaches the pulmonary orifice it becomes funnel** shaped, at which point it is referred to as the infundibulum. (also known as conus arteriosus)
- Large projections arise from the walls called papillary muscles :
 - Anterior papillary muscle
 - Posterior papillary muscle
 - Septal papillary muscle.

(left ventricle has no septal papillary muscle)
(septal means between the 2 ventricles: it is connected to the interventricular septum)



** Funnel = قمع



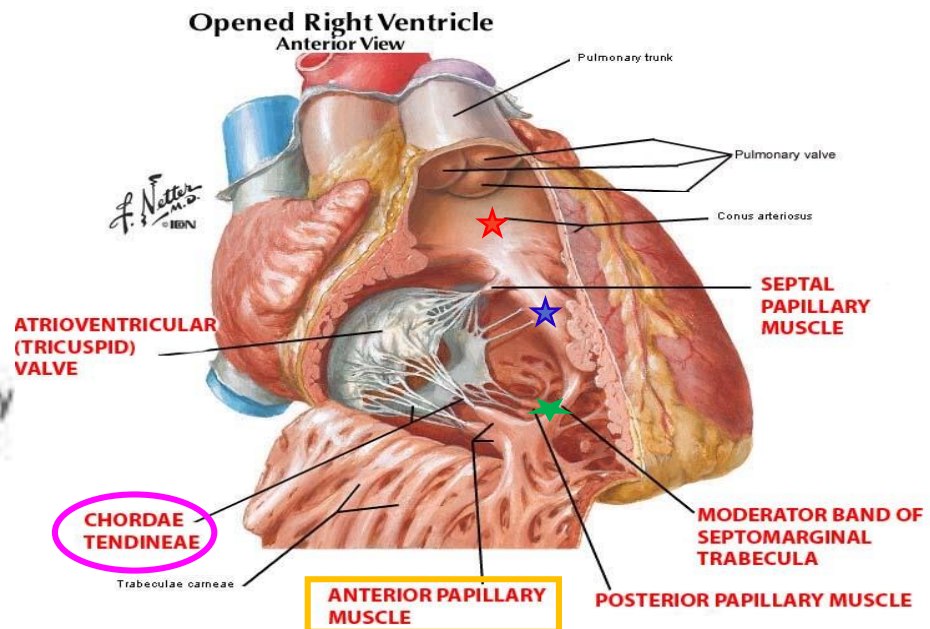
Chambers of the Heart

Cavity of right ventricle

- Each papillary muscle is attached to the cusps of tricuspid valve by tendinous threads called **chordae tendinae***.
- Blood leaves the right ventricle to pulmonary trunk through pulmonary orifice.
- The wall of **infundibulum** (conus arteriosus) is smooth and contains no trabeculae.
- **Interventricular septum** is connected to **anterior papillary** muscle by a muscular band called **moderator band** (the moderator band connects the anterior wall and the interventricular septum).

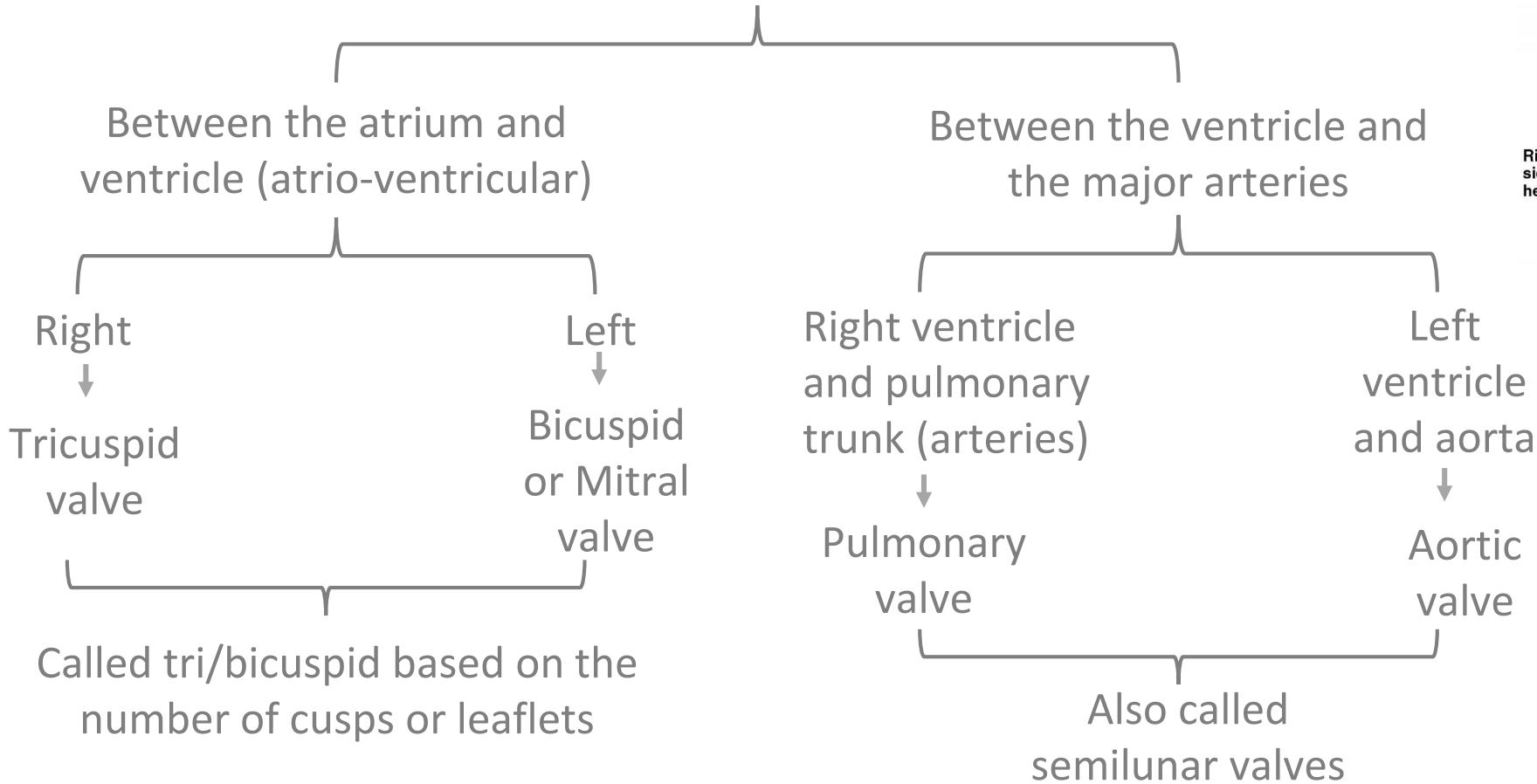


*تخيل عندك خيمة: الارض تمثل ال papillary muscle والحبل هو ال chordae tendinae والخيمه هي ال cusps. وال cusps تعطيك ال valves اذا كان 2 cusps نسميه bicuspid واذا 3 tricuspid.

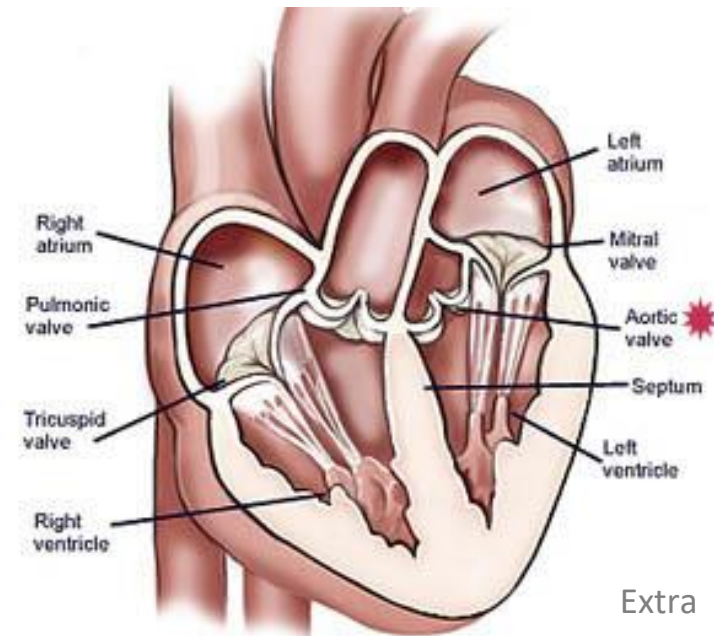
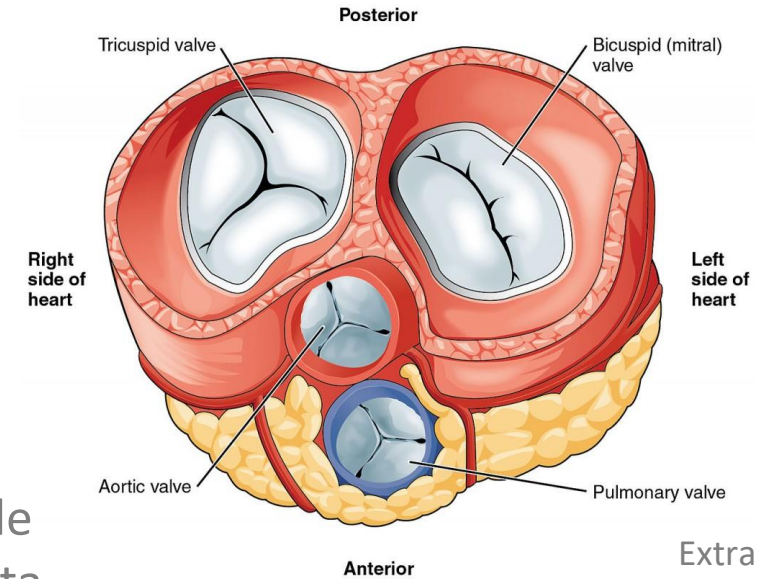


Extra explanation of the coming slides (orifices):

Orifice means opening and there are 4 main orifices in the heart:

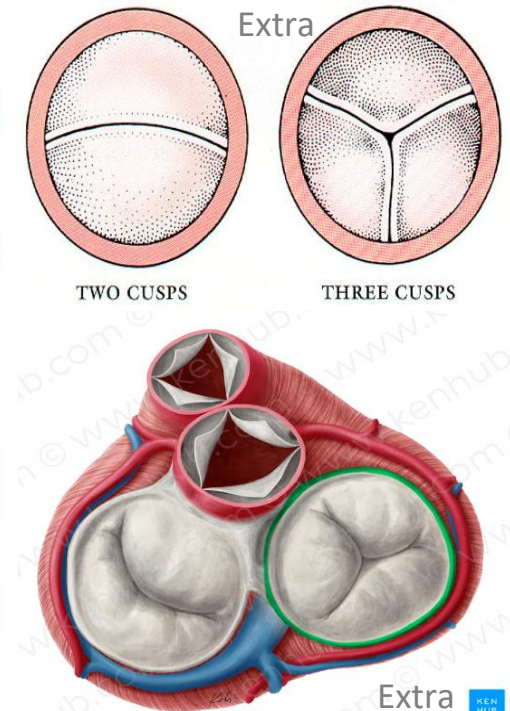
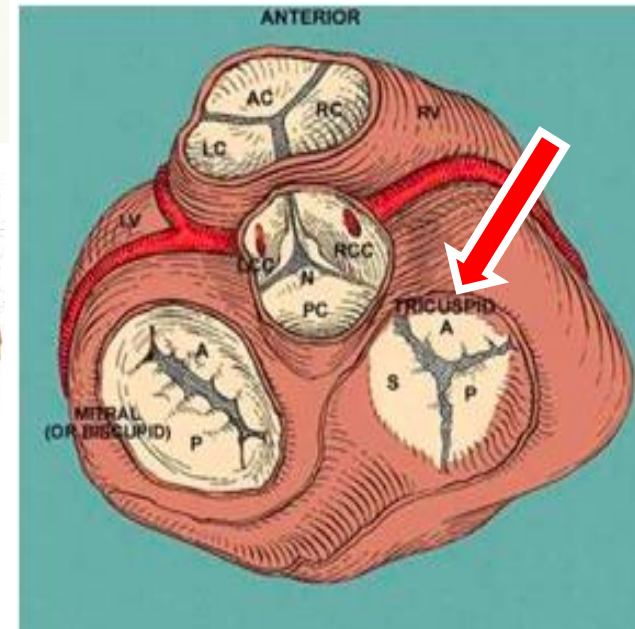
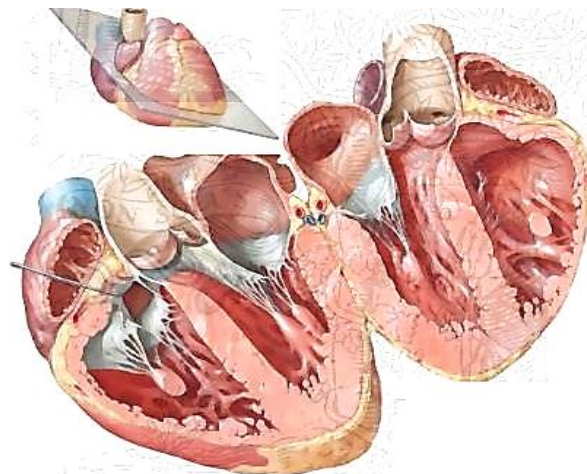
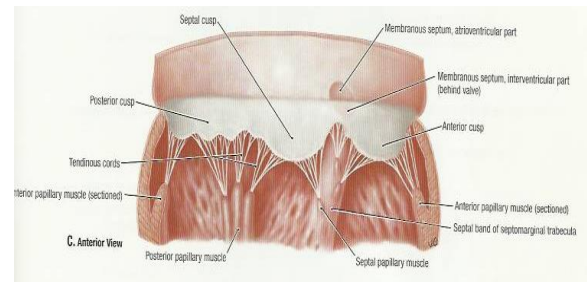
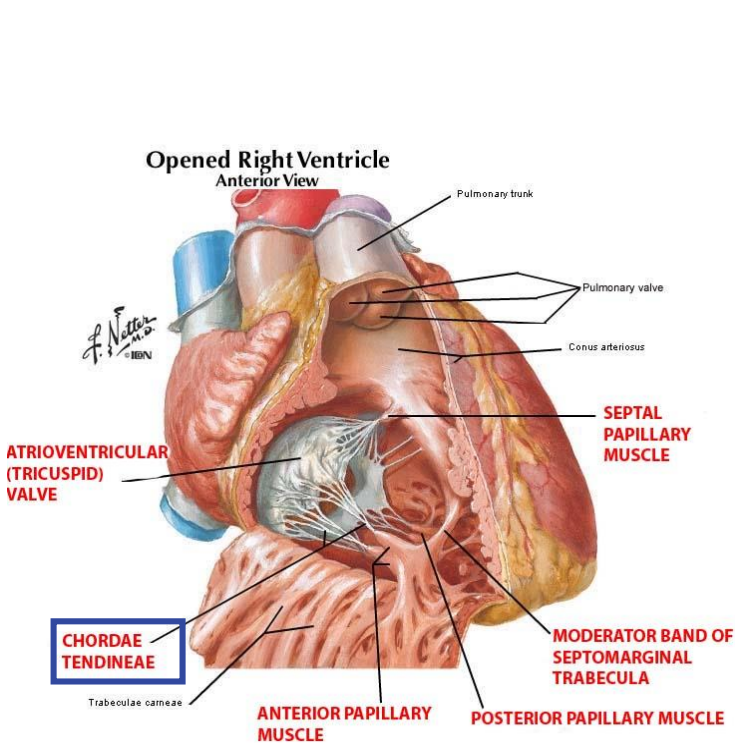


In order to make sure the blood travels in one direction the orifices are surrounded by a fibrous ring which helps to maintain the shape of the opening. Attached to this ring are cusps (نتوء). Two or three cusps make a valve (صمام). The valves guard the orifice.




Right Atrio-Ventricular (Tricuspid) Orifice

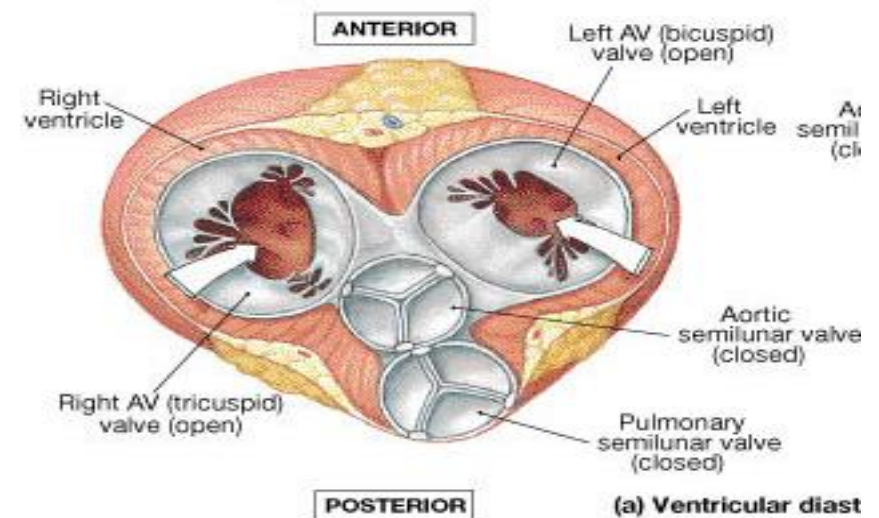
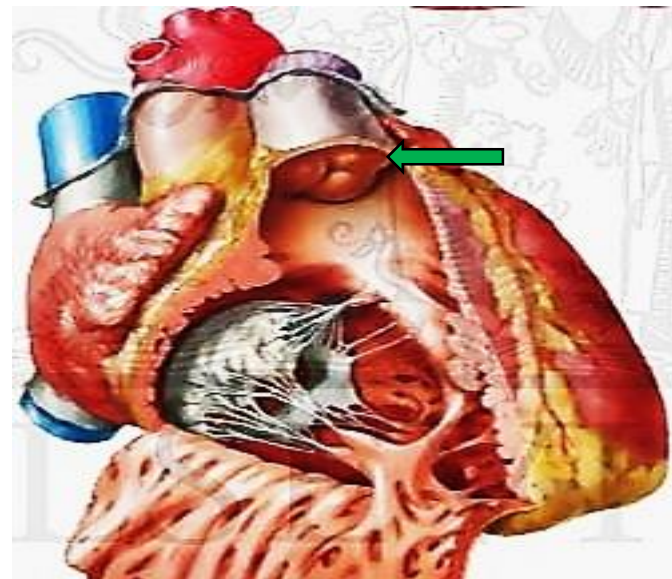
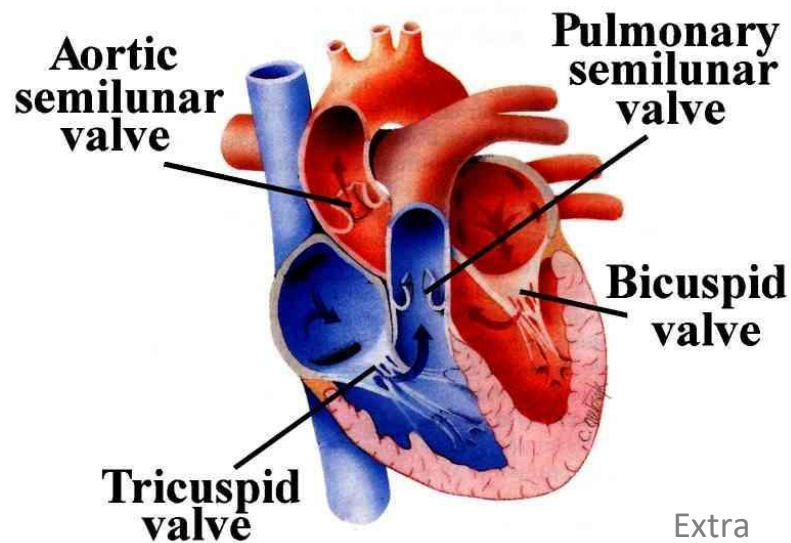
- About one inch wide, admitting tips of 3 fingers. (**wider than left atrio-ventricular orifice**)
- It is guarded by a fibrous ring which gives attachment to the cusps of tricuspid valve.
- It has 3-cusps (anterior – posterior - septal or medial).
- The atrial surface (superior) of the cusps are smooth, while their ventricular surfaces (inferior) give attachment to the chordae tendinae.



Pulmonary Orifice

To remember:
Aortic > 1 Anterior.
Pulmonary > 1 Posterior.

- Surrounded by a fibrous ring which gives attachment to the cusps of the pulmonary valve.
- The valve is formed of **3 semilunar** **cusps** : **2 anterior and one posterior** which are concave superiorly and convex inferiorly (like this ).
- **No chordae tendineae or papillary muscles** are attached to these cusps

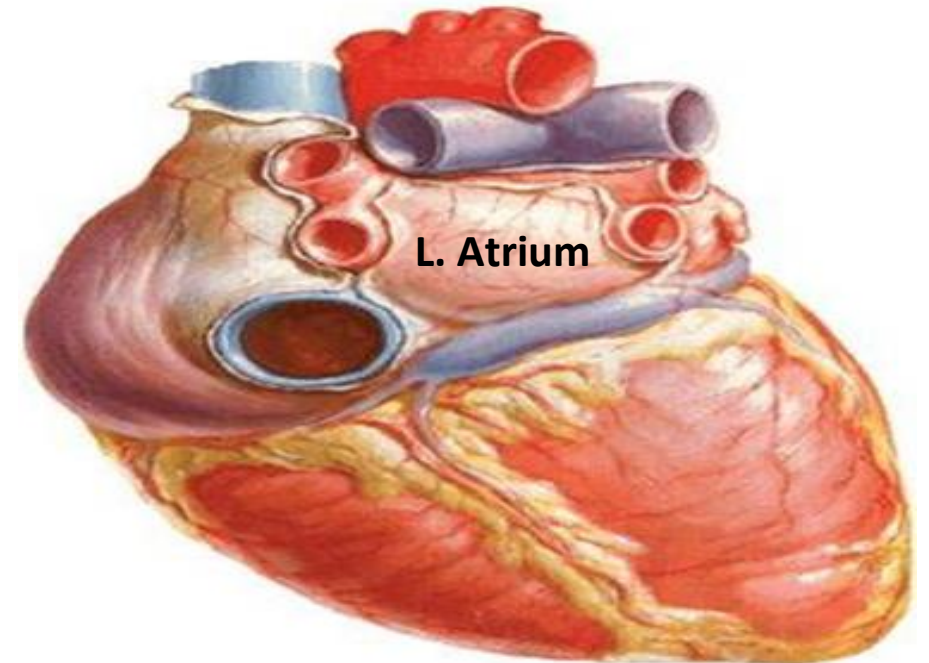
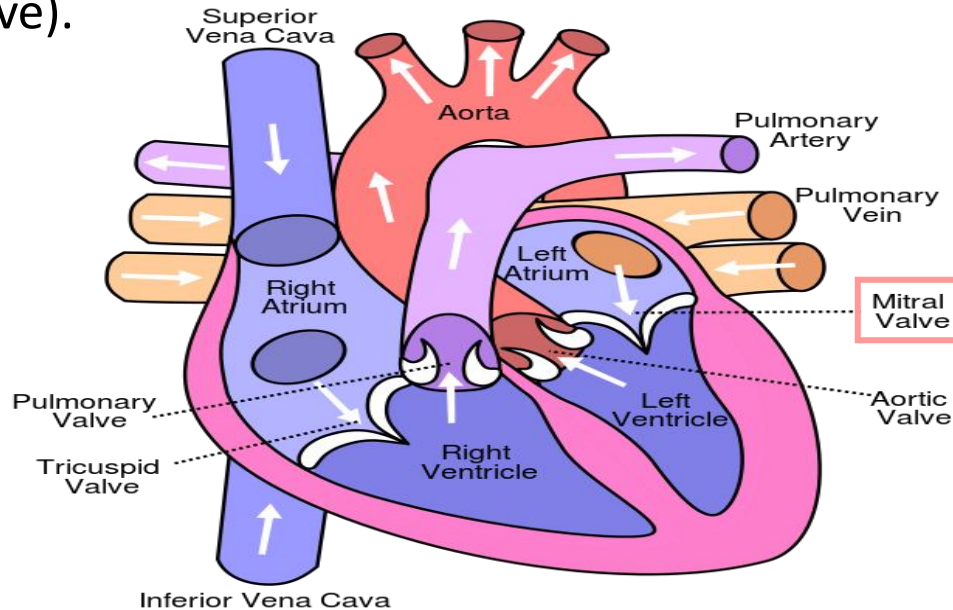


Chambers of the Heart

Left Atrium



- The left atrium communicates with the left ventricle through the **left atrioventricular orifice**.
- It forms the greater part of the **base** of heart.
- Its wall is smooth **except** for **small muscoli pectinati** (pectinate = مشط) in the left auricle.
- Receives 4 pulmonary veins (2 left & 2 right) which have no valves.
- Sends blood to left ventricle through the left atrioventricular orifice which is guarded by mitral valve (Bicuspid valve).

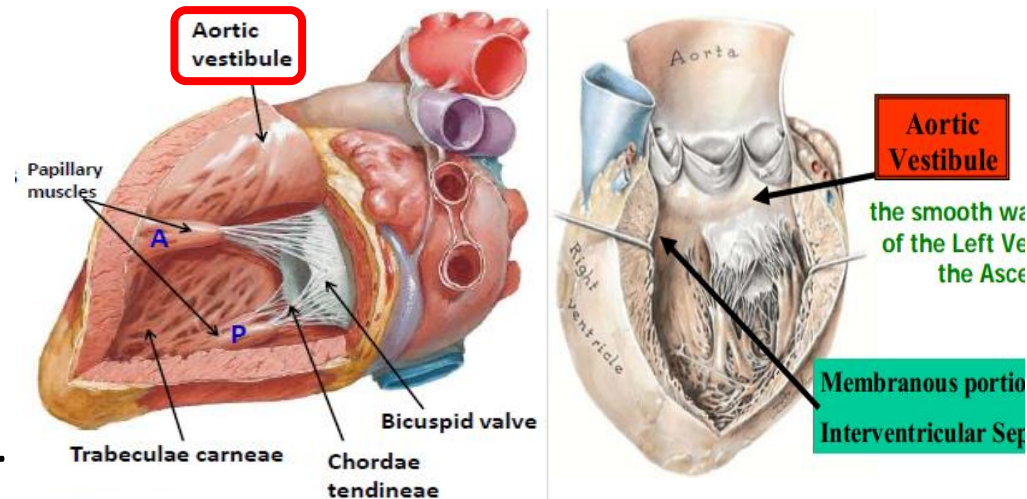
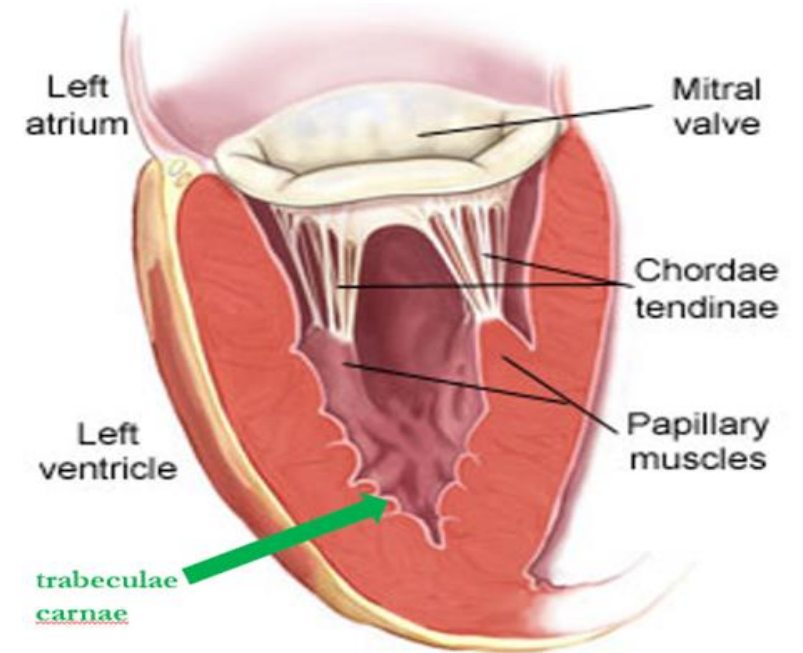


Chambers of the Heart

Left Ventricle

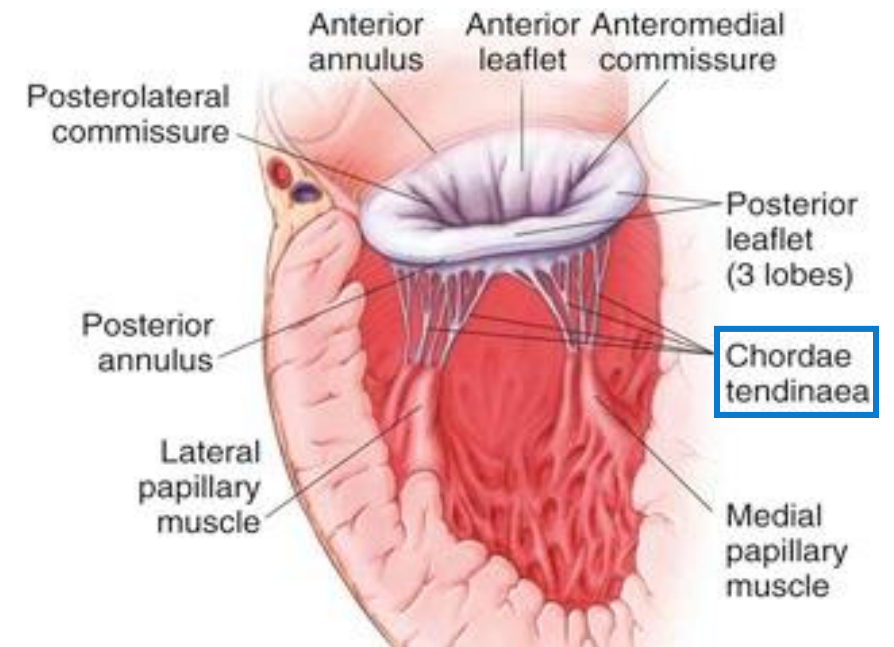
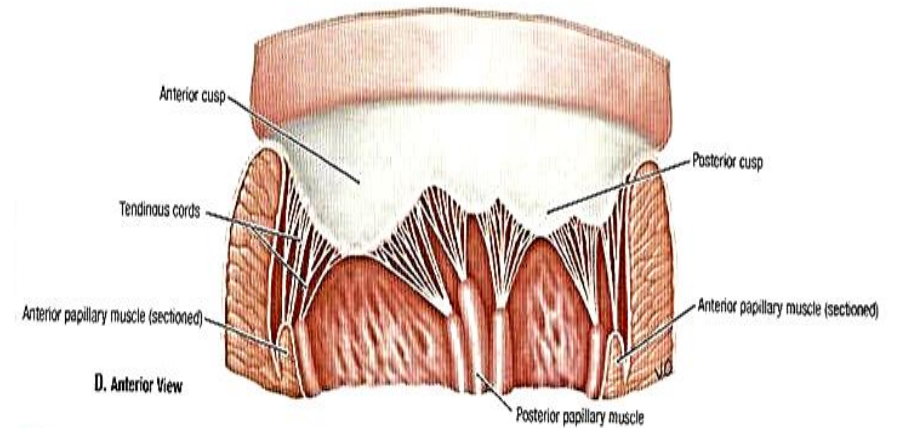


- Its wall is **thicker** than that of right ventricle.
- It receives blood from left atrium through left atrio-ventricular orifice which is guarded by **mitral valve (bicuspid)**
- The blood leaves the left ventricle to the ascending aorta through the **aortic orifice**.
- The part of left ventricle *leading to ascending aorta* is called **aortic vestibule**.
- The wall of this part is fibrous and smooth.
- The wall of the left ventricle contains **trabeculae carnae**.
- It also contains **2 large papillary muscles** (anterior & posterior).
- They are attached by **chordae tendinae** to cusps of mitral valve.



Left Atrio-Ventricular (Mitral) Orifice

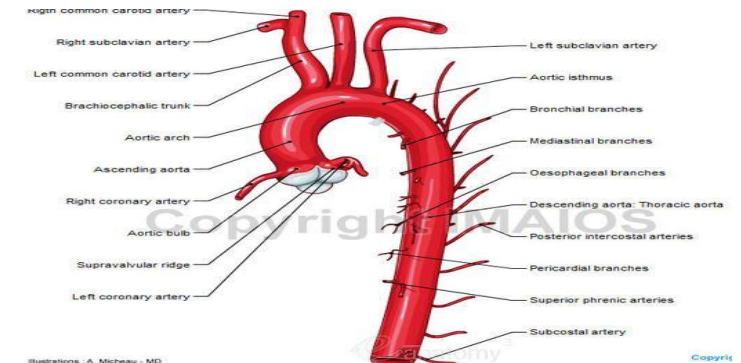
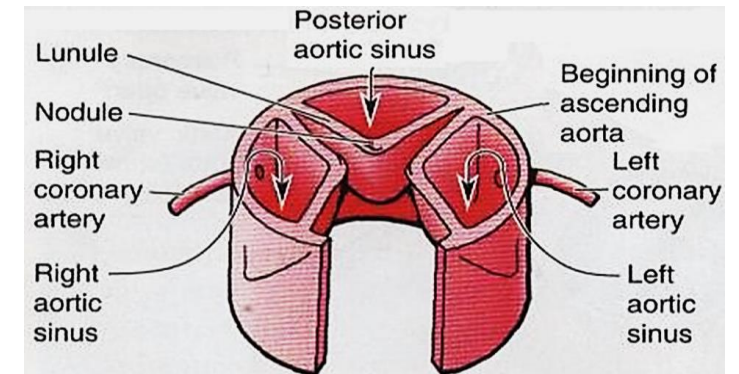
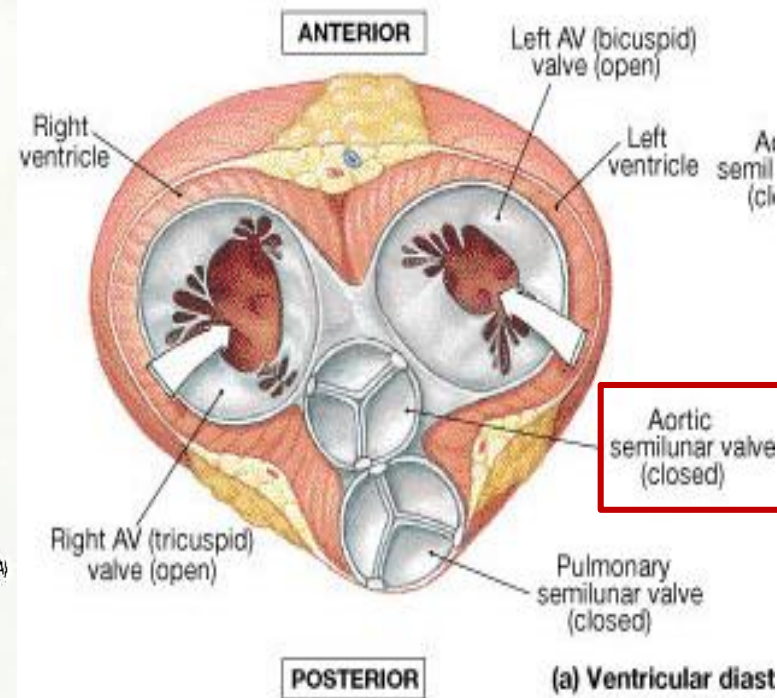
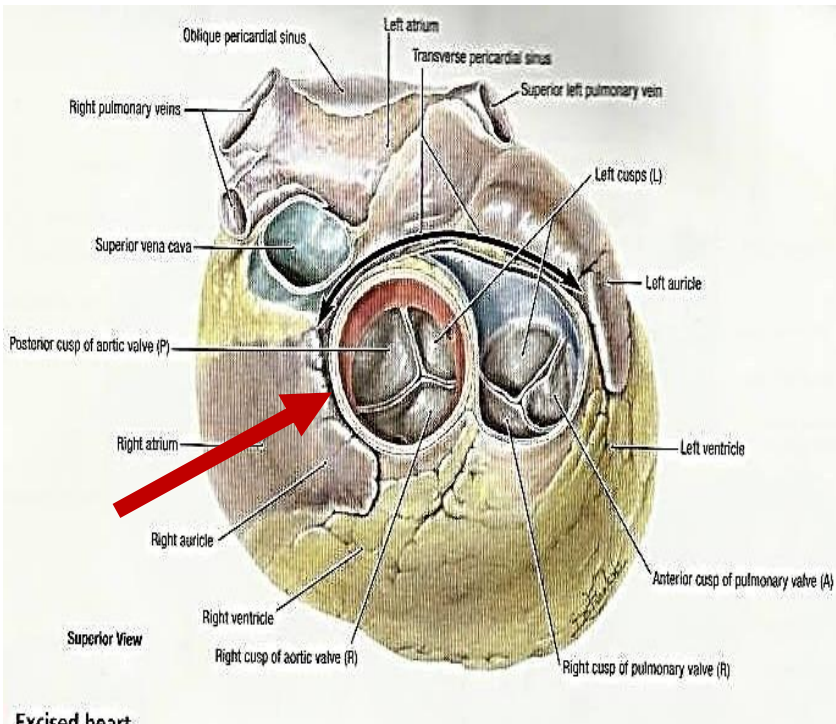
- Smaller than the right, admitting only tips of 2 fingers.
- Guarded by a **mitral valve**.
- Surrounded by a fibrous ring which gives attachment to the cusps of mitral valve.
- Mitral valve is composed of 2 cusps:
 - Anterior cusp : lies anteriorly and to right.
 - Posterior cusp : lies posteriorly and to left.
- The atrial surfaces of the cusps are smooth, while ventricular surfaces give attachment to **chordae tendinae**.



Aortic Orifice

To remember:
Aortic > 1 Anterior.
Pulmonary > 1 Posterior.

- Surrounded by a **fibrous ring** which gives attachment to the **cusps** of **aortic valve**.
- **Aortic valve** is formed of **3 semilunar cusps** which are similar to those of pulmonary valve, but the position of the cusps differs being **one anterior and 2 posterior**.



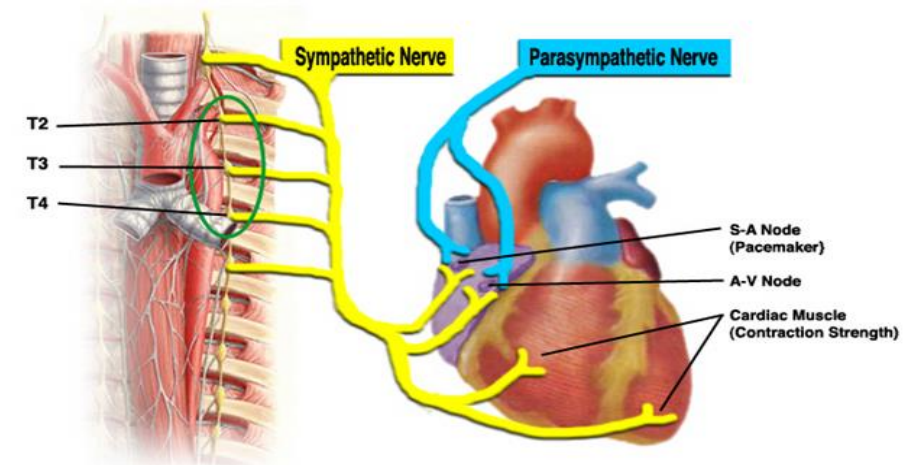
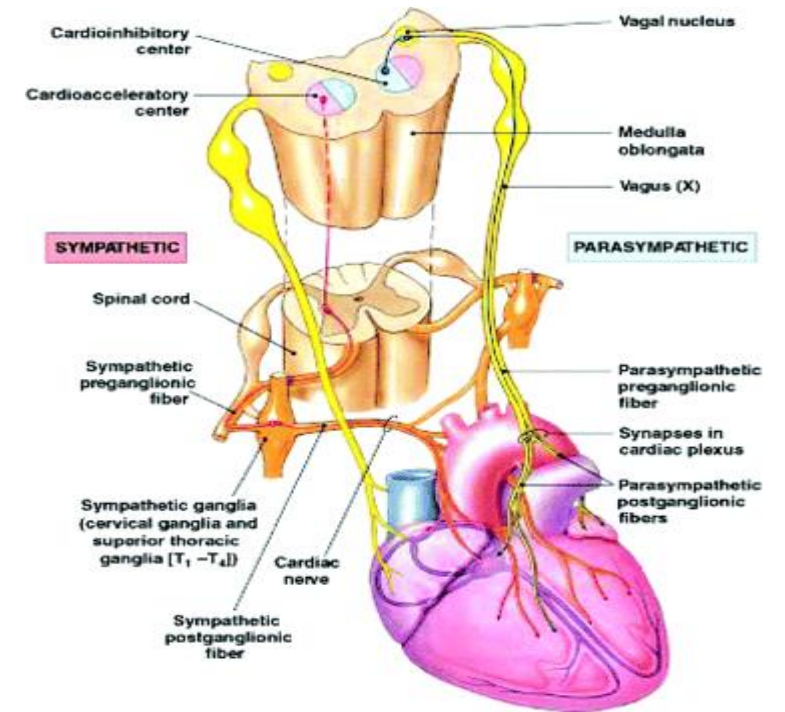
Extra

Nerve supply of the heart

- **Autonomic Supply:** by **sympathetic & parasympathetic fibers** via the **cardiac plexus** situated below arch of aorta.
- The **sympathetic fibres** arise from the cervical & upper thoracic (1, 2, 3, 4) ganglia of **sympathetic trunks**.
- The **parasympathetic fibres** arise from the **vagus nerves**.
- **Sympathetic Fibers** → accelerate heart rate but
- **Parasympathetic Fibers** → slow heart rate (constriction of coronary arteries)

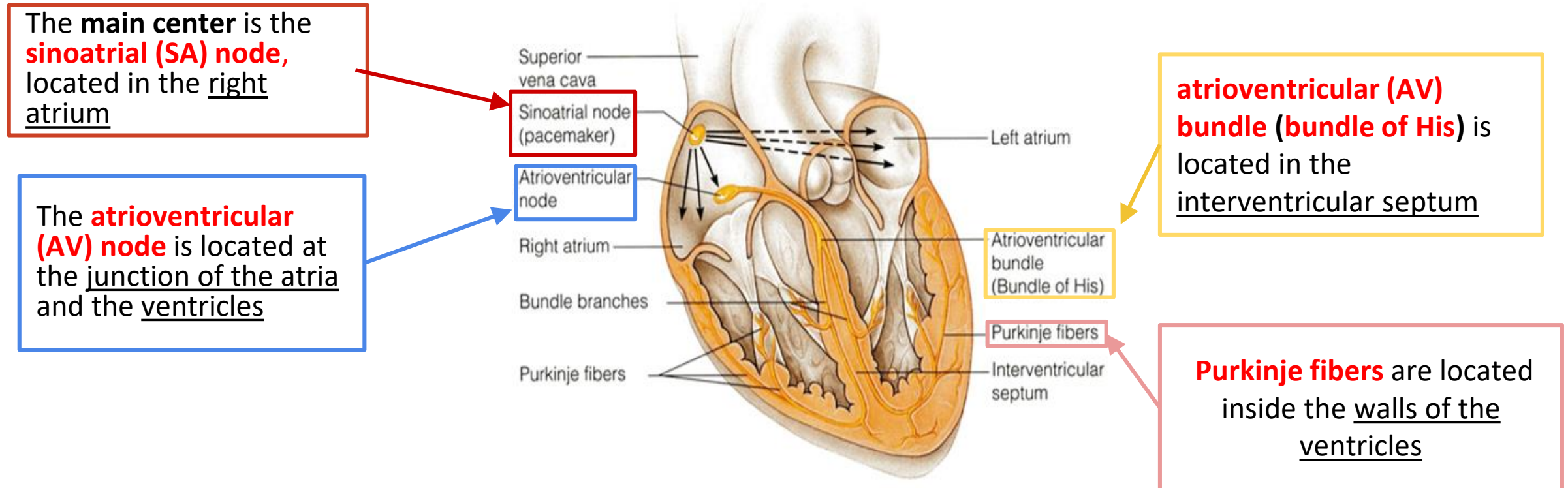
Postganglionic fibres reach heart along –

- (1) SAN(SINOATRIAL NODE)
- (2) AVN(ATRIOVENTICULAR NODE) &
- (3) nerve plexus around coronary arteries.



Conduction system of the heart

- The **beating of the heart** is regulated by the **intrinsic conduction (nodal) system**.
- Its function is to ensure that the chambers of the heart contract in the proper rhythm and sequence



The SA node is called the **pacemaker** of the heart, because it generates the impulse.

Note: Like we studied in physiology all of the following are capable of generating impulses but because the SA node is the fastest it is the pacemaker.

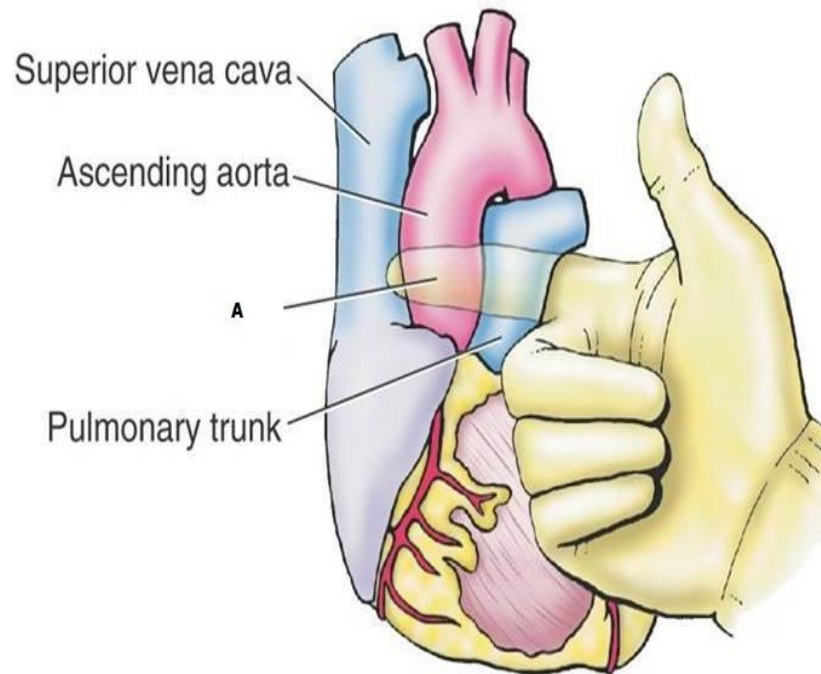
To read more about the conduction of the heart [click here](#).

Pericardial Sinuses

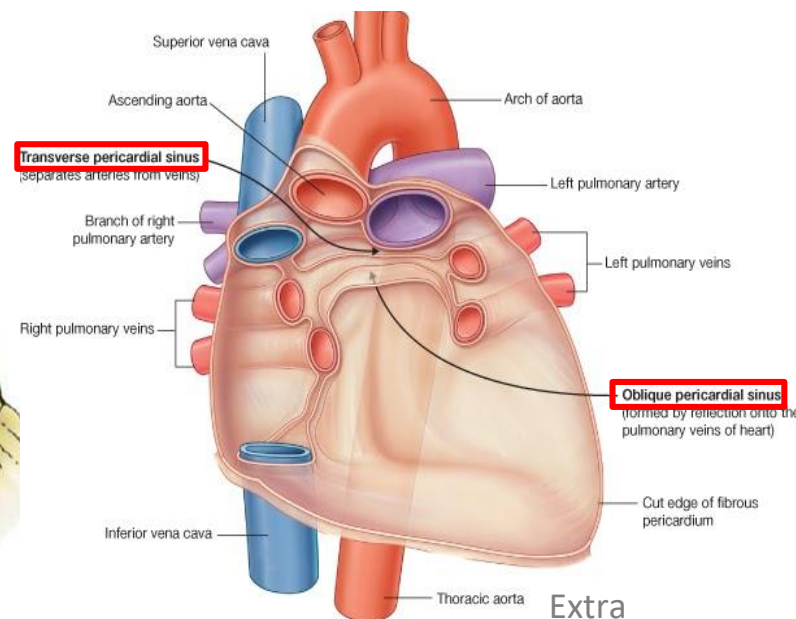
Transverse Sinus:

It is a recess (small space) of serous pericardium *between* ascending aorta & pulmonary trunk **anteriorly** , and upper parts of 2 atria & S.V.C (superior vena cava) **posteriorly**.

The pericardial sinuses are clinically important as in cases of pericardial effusion. Also in surgery as blood may accumulate (يتجمع) there and they provide the surgeon with access to structures related to them (such as the aorta/pulmonary trunk).



Transverse Sinus



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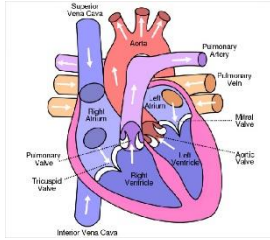
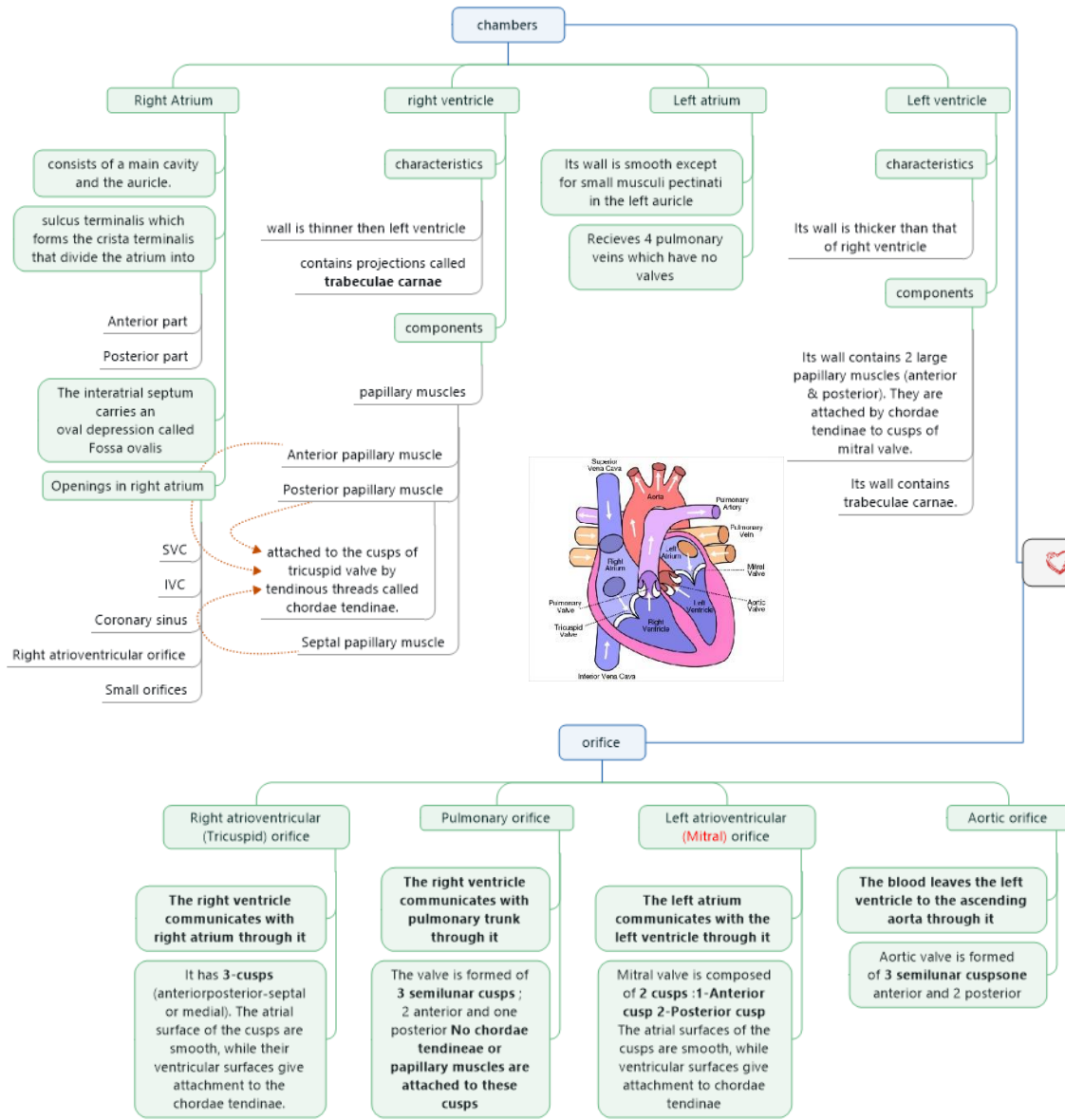
Oblique Sinus:

It lies *posterior* to the heart. It is a recess (small space) of serous pericardium **behind** the base of heart (left atrium), **separates base** from descending aorta & esophagus.

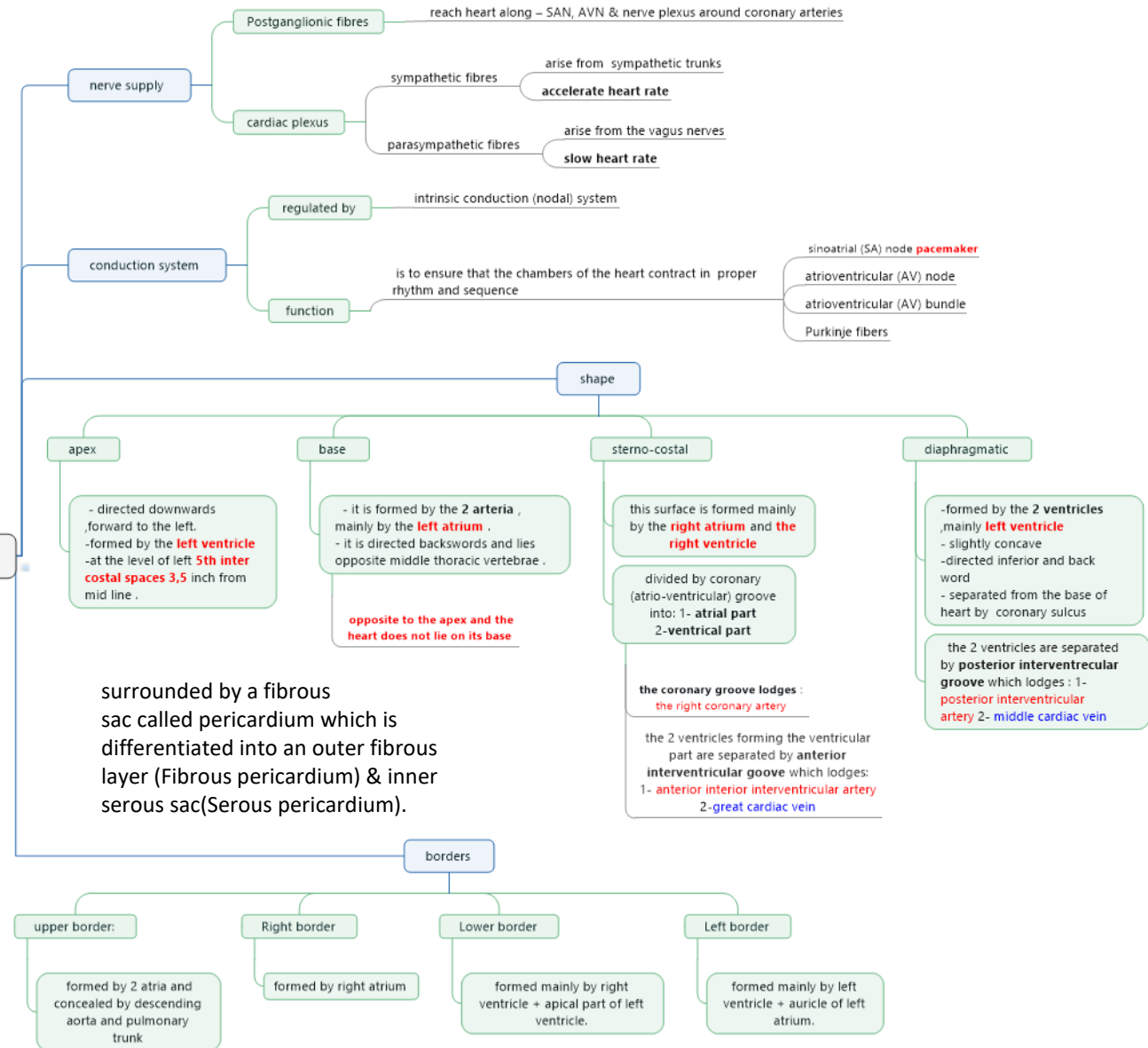


Oblique Sinus

Summary



Heart



Questions

1. The heart is placed in the:
 - a. Abdominal cavity
 - b. Middle mediastinum
 - c. Thoracic cavity
 - d. Superior mediastinum

Answer: B

2. The base of the heart lies:
 - a. Superiorly
 - b. Inferiorly
 - c. Anteriorly
 - d. Posteriorly

Answer: D

3. The anterior interventricular groove in the sternocostal surface lodges:
 - a. A branch of the right coronary artery
 - b. A branch of the left coronary artery
 - c. Both a and b
 - d. None of the above

Answer: B

4. The diaphragmatic surface is formed by:
 - a. Mainly the right atrium
 - b. Right atrium and right ventricle
 - c. Mainly the left ventricle
 - d. Left atrium and left ventricle

Answer: C

5. All of the following structures separates the base of the heart from the vertebral column except:
 - a. Oblique sinus of pericardium
 - b. Ascending aorta
 - c. Descending aorta
 - d. Esophagus

Answer: B

6. The left border of the heart is formed by:
 - a. Left ventricle and the auricle of the left atrium
 - b. Right ventricle and apical part of left ventricle
 - c. Right atrium
 - d. Right and left atria

Answer: A

Questions

7. The junction between the right atrium and the right auricle on the outside of the heart is called the:
- Musculi pectini
 - Sinus venarum
 - Sulcus terminalis
 - Crista terminalis

Answer: C

8. The anterior, rough, and trabeculated part of the crista terminalis is called the:
- Musculi pectini
 - Sinus venarum
 - Sulcus terminalis
 - None of the above

Answer: A

9. Which of the following openings in the right atrium has a well-defined valve?
- Superior vena cava
 - Inferior vena cava
 - Right atrioventricular orifice
 - Coronary sinus

Answer: D

10. Which of the following is not associated with atrioventricular valves?
- Chordae tendinae
 - Cusps
 - Papillary muscles
 - Arteries

Answer: D

11. Interventricular septum attached to through moderator band .
- anterior papillary muscle.
 - posterior papillary muscle.
 - septal papillary muscle.
 - conus arteriosus

Answer: A

12. Pulmonary valve has 3 cusps:
- 2-anterior ,1-posterior.
 - 1-posterior,2-anterior.
 - 2-anterior,1-superior.
 - 2-posterior,1-septal.

Answer: A

Questions

13. The valve between right atrium and right ventricle is.
a. mitral. b. tricuspid. c. none of them. d. no valve

Answer: B

14. Left ventricle and right ventricle papillary muscle respectively.
a. 2-2. b. 3-2. c. 2-1. d. 2-3

Answer: D

15. Left ventricle pumps the blood into ..
a. left atrium. b. right atrium.
c. ascending aorta. d. descending aorta.

Answer: C

16. Transverse sinus and oblique sinus are recesses of :
a. fibrous pericardium. b. serous pericardium.
c. both of them. d. none of them

Answer: B

17. Conduction system of the heart include :
a. SA node only.
b. AV node only.
c. SA and AV nodes.
d. CNS.

Answer: C

18. Purkinje fibers located in :
a. right atrium. b. Interventricular septum.
c. right ventricle. d. wall of ventricles

Answer: D

19. Nerve supply of the heart is by :cardiac plexus which is composed of :
a. phrenic+vagus.
b. vagus+sympathetic trunks.
c. phrenic+thoracic ganglia.
d. phrenic+cervical ganglia.

Answer: B

