➢ The first organ in the body to start functioning is the heart. It begins beating and pumping blood about day 21 or 22.

➢ Through the blood vessels in the umbilical cord, the fetus receives all the necessary nutrition, oxygen, and life support from the mother, but at some point the embryo needs more blood. So it develops its own blood supply.
- The heart is slightly deviated to the left, that's why the left lung is smaller than the right lung.
- Pleura is the grey membrane over the lungs.
Conical fibroserous sac which contains the heart and the roots of the great vessels in the middle mediastinum.

It is formed of 2 sacs:

- Outer fibrous
- Inner serous:
  - Parietal pericardium
  - Visceral pericardium

- There’s a fluid in the potential space between the visceral and serous parietal pericardium. It is this fluid that allows the heart to expand and contract.

- Remains of the thymus present above the heart in front of the great vessels.
- The two brachiocephalic veins join together to form the superior vena cava which terminates in the right atrium.
Fibrous Pericardium

It is the most superficial layer of the pericardium.

It is made up of dense **irregular** connective tissue which acts to:

- Protect the heart
- Anchoring it to the surrounding walls, and **the sternopericardiac ligaments present in the anterior mediastinum** prevent it from overfilling with blood **because it's not that much elastic to expand.**
- Checks down the upward movement of the heart

It is fused with the central tendon of the diaphragm and continuous with the outer adventitial layer of the neighboring great blood vessels.

There are variable amounts of loose CT between the dense irregular CTs

This layer is called **tunica adventitia** is a tough layer consisting mainly of collagen fibres.
Anteriorly:

- Lung and pleurae separating it from the thymus.
- Body of the sternum
- Cartilage of 2-6 ribs

On the left side the pericardium is closely related to the lower part of the sternum and the left 4th and 5th costal cartilages.
Posteriorly:
- Bronchi
- Oesophagus
- Oesophageal plexus
- Descending aorta
- T5-T8 vertebra

Inferiorly:
- Diaphragm (The heart is resting on the central tendon of the Diaphragm)

Laterally:
- Pleura and mediastinal surfaces of both lungs
- Phrenic nerves and musculophrenic vessels

- The inferior vena cava is piercing the central tendon of the Diaphragm to the right atrium
- We retract the lungs to expose the heart
Formed of two tubes:

- **1st tube**: closes the aorta and pulmonary trunk
- **2nd tube**: closes the S.V.C, I.V.C and the 4 pulmonary veins and shows two sinuses:
  - Oblique
  - Transverse

- Superior and inferior vena cava open in the right atrium
- The 4 pulmonary veins open in the left atrium
The outer layer of the visceral pericardium is lining the fibrous pericardium from the inside.

The visceral pericardium is in direct contact with the heart (it’s impossible to separate it from the heart. The shining appearance of the heart is because of the present of this pericardium).

The serous cavities in the body (peritoneal, pericardial, and pleural cavities) are lined with simple squamous epithelium specifically Mesothelium.

The blood vessels are lined with Endothelium. In the heart it’s called Endocardium.

Note: All mentioned types of epithelium originates from Mesoderm (it’s wrong to say that it’s endothelium so it originates from Endoderm and so on).

Endo means it’s lining the inner cavity of the structure (either the blood vessels or the heart).
The Oblique Sinus (1): lies behind the left atrium and the pericardium.

The Transverse sinus (2): lies between the ascending thoracic aorta, pulmonary trunk and the left atrium.
- The Oblique Sinus has no clinical importance
- The Tranverse Sinus is important during heart surgeries
  - During heart surgery, when the pericardium is opened and the surgeon wants to stop the blood flowing in the pulmonary trunk and the aorta (the surgeon positions his finger behind the pulmonary trunk and the Ascending aorta, then he puts the forceps to close them so the blood will get out to the Extracorporeal circulation
  - Now surgeon work on the heart inside the thorax while it’s pumping

- Extracorporeal circulation: A procedure in which blood is taken from a patient’s circulation to have a process applied to it before it is returned to the circulation.
The APEX: lies in the 5th intercostal space on the left side, slightly medial to the mid clavicular line, 9 cm from the midline. This point is important for auscultating the mitral valve by the Stethoscope.

The heart sounds are produced by the closure and opening of the valves and the flow of blood on them. (four valves existing in the heart)

The four valves of the heart:
- a) tricuspid.
- b) Mitral.
- c) Pulmonary.
- d) Aortic.

Apex is the most tapering end
The BASE: formed mainly by the left atrium and part of the right atrium.

The base lies exactly opposite to the apex (not the site where the heart is resting on the diaphragm).

The apex is formed by the left ventricle, while the base is formed by the left atrium (more than 2/3) and part of the right atrium (less than 1/3).
The RIGHT BORDER: formed by the S.V.C, right atrium and I.V.C.
The LEFT BORDER: formed the left ventricle.
The CORONARY SULCUS: a groove on the external surface of the heart marks the division between the atria and the ventricles.

atrioventricular groove is another name for the coronary sulcus.
Surfaces of the Heart

**Anterior (sternocostal) surface**, formed mainly by the right ventricle.

**Diaphragmatic (inferior) surface**, formed mainly by the left ventricle and partly by the right ventricle; it is related mainly to the central tendon of the diaphragm.

**Right pulmonary surface**, formed mainly by the right atrium.

**Left pulmonary surface**, formed mainly by the left ventricle; it forms the cardiac impression in the left lung.
Surface anatomy of the Heart
Right border: a curved line on the right side between:
- Upper border of the 3rd costal cartilage 3cm from midline, and
- 6th costal cartilage 3cm from midline

Left border: a curved line on the left between:
- Lower border of the 2nd costal cartilage 4cm from midline
- 5th left intercostal space 9cm from midline

Upper and lower borders: join corresponding points

We use the surface anatomy of the heart to describe its position

- The length of the lower border is almost twice of that of the upper border.
- The upper border of the heart is from the upper border of the 3rd costal cartilage to the lower border of the 2nd costal cartilage
- The lower border is from the 6th cartilage 5th intercostal space

✓ The ribs from 1 to 7 are joined to the vertebrae posteriorly, and when it comes anteriorly it joins the sternum (they are called true ribs).
✓ Ribs 8,9,10,11 and 12 are called false ribs; as they join the vertebrae posteriorly but anteriorly, the cartilage of each rib of the ribs 8,9 and 10 joins the cartilage of rib above.
✓ The cartilage of ribs number 11 and 12 is so small and doesn’t reach anteriorly. (They are called Floating ribs).
Heart Valves and Their Surface Projections

Pulmonary Valve (P):
- At the 3rd left sternocostal junction
- Heard at the 2nd left space

Aortic Valve (A):
- 3rd space at the left sternal border
- Heard at the 2nd right space

Mitral Valve (M):
- At the 4th left intercostal space
- Heard at the apex of the heart

Tricuspid Valve:
- At the level of the 4th space behind the sternum
- Heard at the xiphesternal junction

✓ The surface anatomy of the valve (purple circles) is different from the place of auscultation (red circles).
✓ The stethoscope is usually placed on the closest point where blood reaches the anterior chest wall.
Internal Anatomy of the Heart
Right Atrium

Larger than the left and has thinner wall because it's receiving blood only, it doesn't have contraction against force (resistance)

Its walls are smooth except for the presence of pectinate muscles (1).

The right auricle (2) covers the beginning of RCA. (Right coronary artery)

Sulcus terminalis (3) separates the smooth and rough parts.

Fossa ovalis represents the position of the foramen ovale in the embryo.

- Foramen ovale was open in the embryo. When it's born and it breathes for the first time, this foramen ovale closes and its name is changed to fossa ovalis.
- The blood flow from the right atrium to the left atrium through it.
- In the right atrium, below the S.V.C is the position where you find the SA node (the pacemaker of the heart because the pulse starts here (it represents the beginning of the conductive system in the heart).
- I.V.C looks leveled with the diaphragm.
- Practically speaking, the course of I.V.C is very short, so when you cut it at this place, few millimeters go with the heart and almost 1 or 2 millimeters go with the diaphragm.
The most posterior of the 4 chambers.

Its walls are smooth except for few pectinate muscles in the auricle.

Receives the 4 pulmonary veins.

➢ The blow arrow is the area which is opposite to foramen ovalis from the other side, it has a valve which doesn't permit the flowback of blood (there is no need for it)

➢ Left atrium --> the biggest portion of the base of the heart (2/3 of the heart)
Forms the largest part of the anterior surface of the heart, a small part of the diaphragmatic surface, and almost the entire inferior border of the heart.

Superiorly it tapers into an arterial cone, the conus arteriosus (infundibulum), which leads into the pulmonary trunk.

The interior of the right ventricle has irregular muscular elevations (trabeculae carneae).

A thick muscular ridge, the supraventricular crest, separates the ridged muscular wall of the inflow part of the chamber from the smooth wall of the conus arteriosus, or outflow part.

The ventricle receives blood from the right atrium through the right AV (tricuspid) orifice, located posterior to the body of the sternum.

The right AV orifice is surrounded by one of the fibrous rings of the fibrous skeleton of the heart.
right auricle of the right atrium
The beginning of the right coronary artery
Superior vena cava
Inferior vena cava
conus arteriosus (smooth)
or infundibulum of the right ventricle
pulmonary trunk (there are 3 valves)
The tricuspid valve (it has 3 leaflets which have tendonous structures (corda tendini) attached to three muscles which are called papillary muscles
posterior papillary muscle
anterior papillary muscle
Septal papillary muscle
The right AV orifice is surrounded by one of the fibrous rings of the fibrous skeleton of the heart.

The fibrous ring keeps the caliber of the orifice constant (large enough to admit the tips of three fingers).

Chordae tendineae attach to the free edges and ventricular surfaces of the anterior, posterior, and septal cusps, much like the cords attaching to a parachute.

The tendinous cords arise from the apices of papillary muscles, which are conical muscular projections with bases attached to the ventricular wall.
Three papillary muscles in the right ventricle correspond to the cusps of the tricuspid valve

- **Anterior papillary muscle** (1), the largest and most prominent of the three,
- **Posterior papillary muscle** (2), smaller than the anterior muscle, may consist of several parts
- **Septal papillary muscle** (3) arises from the interventricular septum, and its tendinous cords attach to the anterior and septal cusps of the tricuspid valve.

- Contraction of the muscles prevents the prolapse of the valves into the right atrium consequently it prevents regurgitation of the blood from the right ventricle to the right atrium
- In the case of Rheumatic fever, these cordi tendoni might be destroyed so the blood returns to the atrium and valves become incompetent

These muscles contract when the ventricle contracts so when the blood pressure in the right ventricle goes up, it pushes the valves to close so the three valves become close to each other and forbid the blood to return into the right atrium.
Forms the apex of the heart, nearly all its left surface and border, and most of the diaphragmatic surface.

Its wall is (3 times) thicker than that of the right ventricle.

The interior of the left ventricle has:

- Walls that are mostly covered with a mesh of trabeculae carneae that are finer and more numerous than those of the right ventricle.

> It's pumping the blood into the systemic circulation that's why its wall must be thick and strong to overcome the peripheral resistance.
Its cavity is longer than that of the right ventricle.

Anterior and posterior papillary muscles are larger than those in the right ventricle.

A smooth-walled, non-muscular, superoanterior outflow part, the aortic vestibule, leading to the aortic orifice and aortic valve.

A double-leaflet mitral valve guards the left AV orifice.

The aortic orifice lies in its right posterosuperior part and is surrounded by a fibrous ring to which the right posterior, and left cusps of the aortic valve are attached; the ascending aorta begins at the aortic orifice.

- Each papillary muscle is attached to adjacent halves of the mitral valve to make the valves as competent as possible.