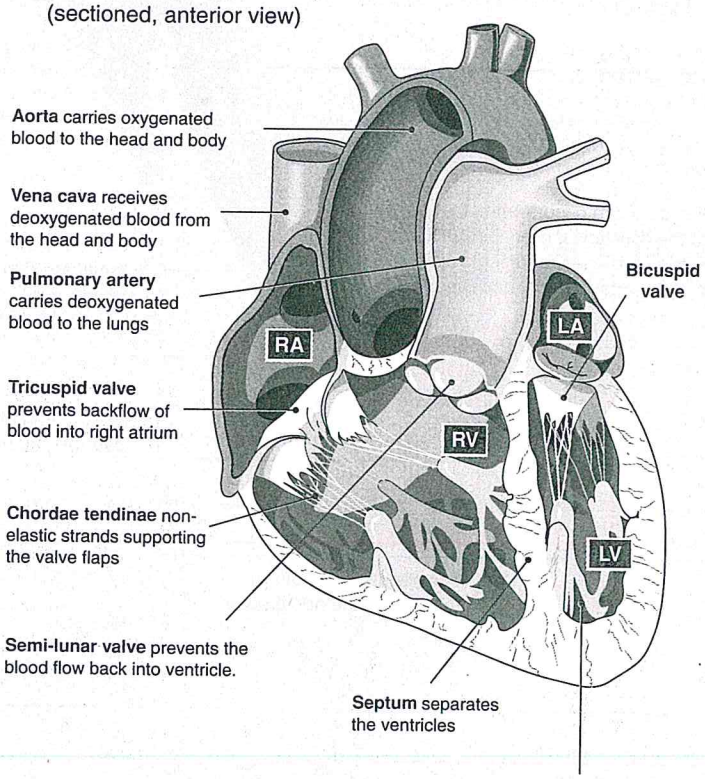
The Human Heart

The heart is at the center of the human cardiovascular system. It is a hollow, muscular organ, weighing on average 342 grams. Each day it beats over 100,000 times to pump 3780 litres of blood through 100,000 kilometers of blood vessels. It comprises a system of four muscular chambers (two **atria** and two **ventricles**) that alternately fill and empty of blood, acting as a double pump. The left side pumps blood to the body tissues and the right side pumps blood to the lungs. The heart lies between the lungs, to the left of the body's midline, and it is surrounded by a double layered **pericardium** of tough fibrous connective tissue. The pericardium prevents over-distension of the heart and anchors the heart within the **mediastinum**.

Human heart structure

(sectioned, anterior view)

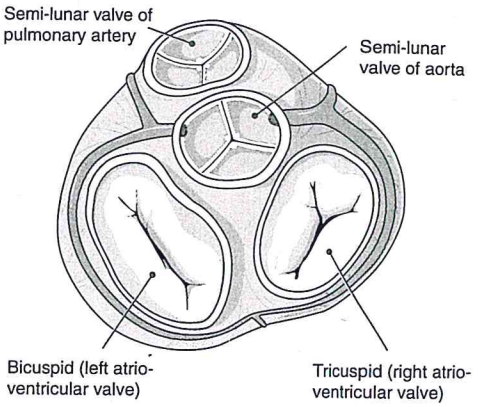


The heart is not a symmetrical organ. Although the quantity of blood pumped by each side is the same, the walls of the left ventricle are thicker and more muscular than those of the right ventricle. The difference affects the shape of the ventricular cavities, so the right ventricle is twisted over the left.

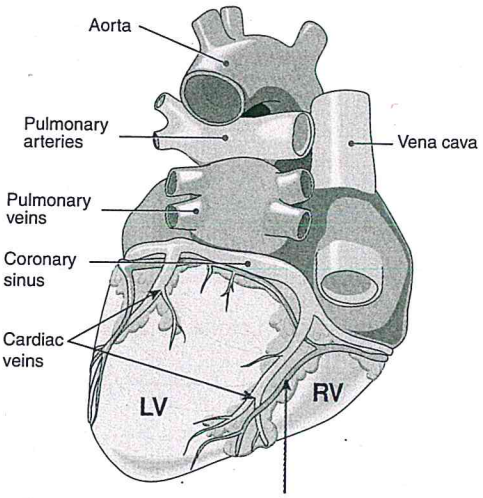
Key to abbreviations

- **RA** Right atrium: receives deoxygenated blood via the anterior and posterior vena cava
- **RV** Right ventricle: pumps deoxygenated blood to the lungs via the pulmonary artery
- **LA** Left atrium: receives blood returning to the heart from the lungs via the pulmonary veins
- **LV** Left ventricle: pumps oxygenated blood to the head and body via the aorta

Top view of a heart in section, showing valves

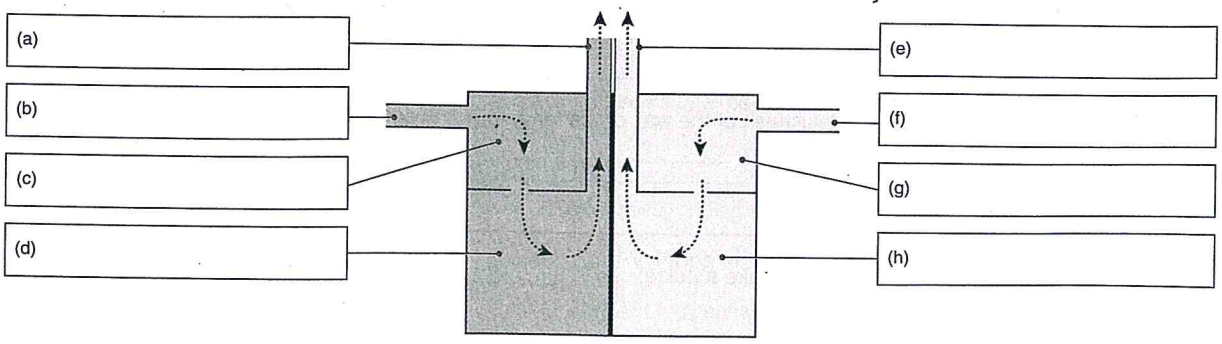


Posterior view of heart



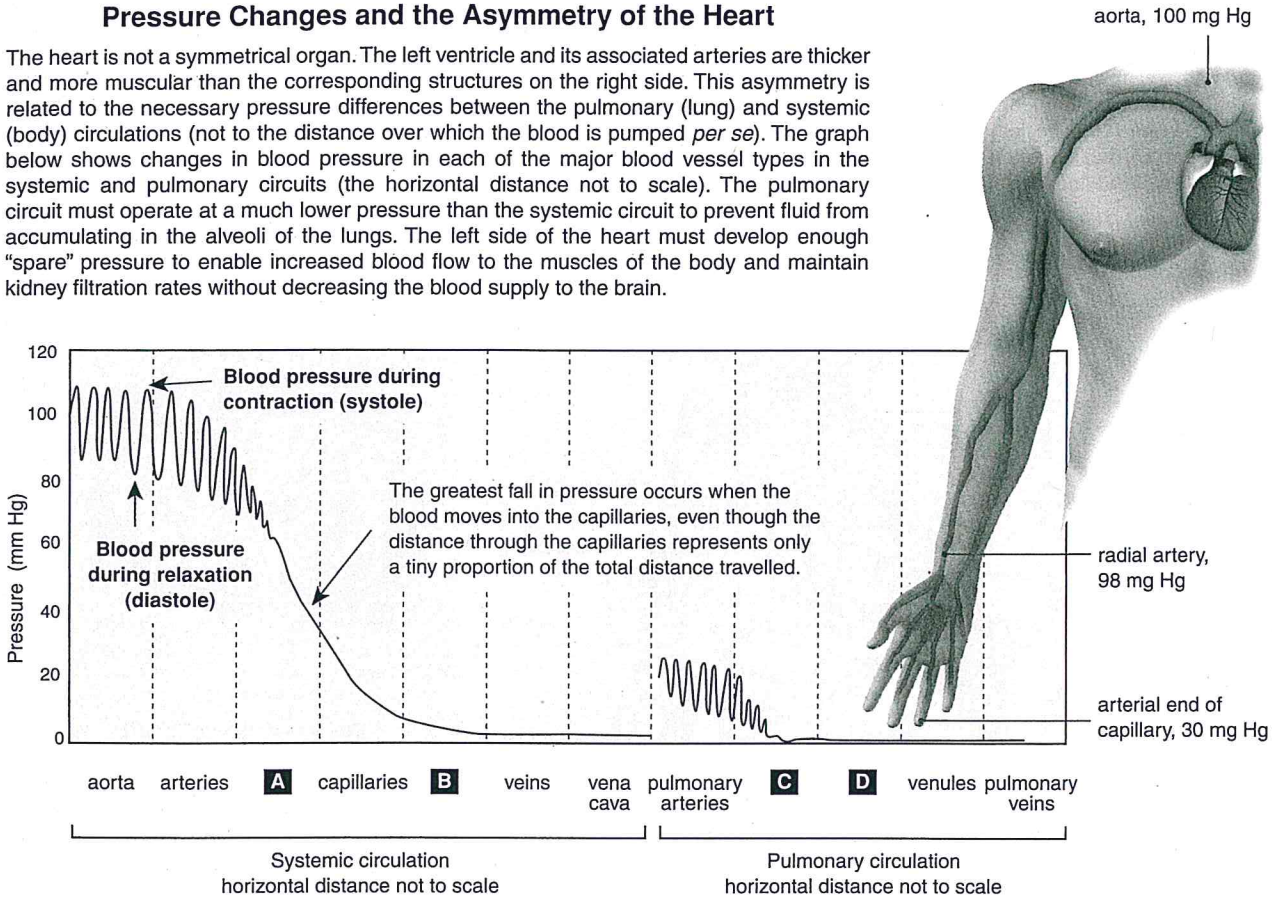
Coronary arteries: The high oxygen demands of the heart muscle are met by a dense capillary network. Coronary arteries arise from the aorta and spread over the surface of the heart supplying the cardiac muscle with oxygenated blood. Deoxygenated blood is collected by cardiac veins and returned to the right atrium via a large coronary sinus.

1. In the schematic diagram of the heart, below, label the four chambers and the main vessels entering and leaving them. The arrows indicate the direction of blood flow. Use large colored circles to mark the position of each of the four valves.



Pressure Changes and the Asymmetry of the Heart

The heart is not a symmetrical organ. The left ventricle and its associated arteries are thicker and more muscular than the corresponding structures on the right side. This asymmetry is related to the necessary pressure differences between the pulmonary (lung) and systemic (body) circulations (not to the distance over which the blood is pumped *per se*). The graph below shows changes in blood pressure in each of the major blood vessel types in the systemic and pulmonary circuits (the horizontal distance not to scale). The pulmonary circuit must operate at a much lower pressure than the systemic circuit to prevent fluid from accumulating in the alveoli of the lungs. The left side of the heart must develop enough "spare" pressure to enable increased blood flow to the muscles of the body and maintain kidney filtration rates without decreasing the blood supply to the brain.



2. Explain the purpose of the valves in the heart: _____

_____

3. The heart is full of blood. Suggest two reasons why, despite this, it needs its own blood supply:

   (a) _____

   (b) _____

4. Predict the effect on the heart if blood flow through a coronary artery is restricted or blocked: _____

_____

_____

5. Identify the vessels corresponding to the letters **A-D** on the graph above:

   A: _____ B: _____ C: _____ D: _____

6. (a) Explain why the pulmonary circuit must operate at a lower pressure than the systemic system: _____

_____

_____

   (b) Relate this to differences in the thickness of the wall of the left and right ventricles of the heart: _____

_____

_____

7. Explain what you are recording when you take a pulse: _____

_____