Cardiac Anatomy & Physiology
Cardiovascular and lymphatic systems make up the circulatory system, a vast network of organs and vessels responsible for the flow of:

- Blood
- Nutrients
- Hormones
- Oxygen and other gases
- To and from the Cells of the body

The heart is a hollow muscular organ made of specialised cells that allow it to act as a pump within the circulatory system.

The Lymphatic system:
- Lymph
- Lymph nodes
- Lymph vessels

The Cardiovascular system:
- Blood
- Blood vessels
- Heart
The Heart is:

- Located between the lungs in the centre and to the left of the midline
- It is cone shaped and about the size of your own clenched fist
- Can never stop pumping

**Primary Function** is to drive blood through the cardiovascular system delivering:

- Oxygenated blood to the tissues and organs of the body sufficient for their metabolic needs
- Deoxygenated blood to the lungs for gaseous exchange
The average human adult has **4-6 litres** of blood repeatedly cycled throughout the body in a closed circulatory system.

It is called a closed system because the blood is contained within the heart and blood vessels at all time and blood always flows in a forward direction.
Human heart is divided into 4 chambers

- 2 Atria and 2 Ventricles – these are hollow chambers which receive blood
- They are surrounded by myocardial cells which are able to relax and contract

The cardiovascular system consists of circuits:

- Pulmonary circuit provides blood flow between the heart and lungs
- Systemic circuit allows blood to flow to and from the rest of the body
- Coronary circuit provides blood to the heart

The heart valves ensure that blood flows in one direction through the system
Coronary Circuit
There are 2 basic types of cardiac cell (Myocytes)

- **Myocardial cells**
  contractile
  respond to an electrical impulse and contract

- **Specialised cells**
  the conduction system generates electrical impulses and transmits them through the myocardium

<table>
<thead>
<tr>
<th>Site of electrical impulse generation</th>
<th>Rate of impulse generation / min</th>
</tr>
</thead>
<tbody>
<tr>
<td>SA node</td>
<td>60 - 100</td>
</tr>
<tr>
<td>AV node</td>
<td>40 - 60</td>
</tr>
<tr>
<td>Ventricles</td>
<td>&lt; 40</td>
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</tbody>
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The Cardiac Cycle

Contraction of a chamber = **Systole**
Relaxation of a chamber = **Diastole**
**Introduction of Key Terms**

- **End Diastolic Volume** = amount of blood in the ventricles at the end of filling / diastole

- **End Systolic volume** = amount of blood in the ventricles at the end of contraction / systole

The ventricles never completely empty

**Stroke Volume** = The amount of blood pumped out of the ventricles per beat / contraction (approx 70mls in a healthy adult male)

\[ \text{EDV} - \text{ESV} = \text{SV} \]
Introduction of Key Terms

Cardiac Output (CO)

Amount of blood ejected by the heart per minute = cardiac output (CO)

In a healthy resting adult CO = approx 5-6 litres

\[
CO = \text{Heart Rate} \times \text{Stroke volume}
\]

Ejection fraction is a measurement of the percentage of blood leaving your heart each time it contracts. Usually measured with imaging e.g. ECHO / cardiac catheterisation / MRI.

Cardiac output and Ejection fraction are important indicators of how efficiently the heart can meet the demands of the body.
THANK YOU
Key points

The output form the right and left side of the heart must always balance.

- THE AMOUNT OF BLOOD IN THE VENTRICLES AT THE END OF FILLING BEFORE SYSTOLE = END DIASTOLIC VOLUME

- THE AMOUNT OF BLOOD IN THE VENTRICLES AT THE END OF CONTRACTION OR SYSTOLE = END SYSTOLIC VOLUME - THE VENTRICLES NEVER COMPLETELEY EMPTY

EDV – ESV = SV

End diastolic volume = 125mls
End systolic volume = 50mls

The amount of blood pumped out of the ventricles per beat = stroke volume - approximately 70mls in a healthy adult male. In this example: 125ml – 50 mls = 75mls
Key points

Amount of blood ejected by the heart per minute = cardiac output (CO)
in a healthy resting adult CO = approx 5-6 litres

\[ \text{CO} = \text{Heart Rate} \times \text{Stroke volume} \]

E.g. \( \text{CO} = 70 \text{bpm} \times 75 \text{mls} = 5,250 \text{mls} \)

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