**Circulation**

William Harvey proposed the modern understanding of the circulatory system.

According to Harvey:
- The major blood vessels (arteries & veins) are connected by a single network.
- Blood flow is unidirectional (due to the presence of one-way valves).
- The heart is a central pump (arteries = from heart; veins = to heart).
- Blood flows continuously and is not consumed by the body.

It has further been discovered that:
- Arteries and veins are connected by capillaries (via arterioles & venules).
- There is a separate circulation for the lungs (pulmonary versus systemic).

**Blood Vessels**

**Arteries**
- Transport blood from the heart.
- Blood at high pressure (80-120 mmHg).
- Walls are thick (muscle and elastin).
- Walls stretch or contract with pulse.

**Veins**
- Transport blood to the heart.
- Blood at low pressure (<15 mmHg).
- Walls are thin (with wider lumen).
- Have valves to prevent pooling.

**Capillaries**
- Facilitate material exchange.
- Blood at low pressure (~10 mmHg).
- Walls made of single layer of cells.
- Extremely narrow lumen (~10 µm).

Capillaries may be categorised as:
- Continuous (intact basement membrane).
- Fenestrated (have endothelial pores).
- Sinusoidal (discontinuous membrane).

**Blood**

Blood contains three main elements:
- Red blood cells (transport oxygen).
- White blood cells (fight infections).
- Platelets (responsible for clotting).

The blood fluid (plasma) transports:
- Nutrients (e.g. glucose).
- Antibodies.
- Carbon dioxide.
- Hormones.
- Oxygen.
- Urea.
- Heat.

**Blood Flow**

A heart pumps blood around the body via two distinct circulatory pathways.

**Right Side (of heart):**
- Deoxygenated blood (from tissues) enters right atrium via the vena cava.
- Blood in the right ventricle is pumped to lungs via the pulmonary artery.
- Gas exchange at the lungs (capillaries ↔ alveoli) oxygenates the blood.

**Left Side (of heart):**
- Oxygenated blood (from lungs) enters left atrium via the pulmonary vein.
- Blood in the left ventricle is pumped to the body tissues via the aorta.
- Material exchange occurs at the respiring tissue (deoxygenates the blood).

Valves in veins ensure proper circulation by preventing backflow of blood.
- Contraction of skeletal muscles may compress veins to aid blood flow.