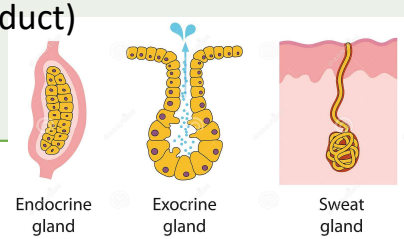
L11_Structural organization of the body - the four major types of tissues

Types	Epithelial		Connective	Muscle	Nervous
	Covering	**Glandular**			
Characteristics	• Cover all body surfaces • Cell tightly joined together • No blood vessels (avascular) • Supplied by nerves (e.g. epidermis) • Apical surface faces body surface or lumen • Basal surface faces underlying tissues • Attached to underlying connective tissue through basal lamina • Rapid regeneration		• Most abundant, many different forms with different functions (e.g. blood, tendon, ligament, bone…) • Vascularized (except cartilage) • Supplied by nerves	• **Excitable** (i.e. able to generate action potential) • Striated (with banding pattern) – skeletal and cardiac • Non-striated (no banding pattern) – smooth (organs)	• **Excitable** • Central nervous system (brain, spinal cord) • Peripheral nervous system – the rest

Function	• Protection
	• Absorption
	• Filtration
	• Sensation
	• **Goblet cells** for secretion of mucus on mucosa (e.g. GI tract)
		• **Exocrine glands** – secretion fluid to body surfaces through ducts (e.g. sweat glands, gastric glands)
		• **Endocrine glands** secrete hormone into the blood (no duct)
			• Protection, support and integration
			• Specialized connective tissues with specific functions
			  • Adipose tissue – store fat, insulation
			  • Cartilage – protect ends of long bones
			• Bone – mechanical support
				• Contraction and relaxation for movement	• Transmits and processes information
					• Controls movements, reflexes, receives sensory information



Classification of epithelium

<u>According to number of cell layers</u>

- Simple = single layer
- Stratified = multiple layers
- Pseudostratified = look like having multiple layers due to arrangement of nucleus but actually there's just 1 layer of cell

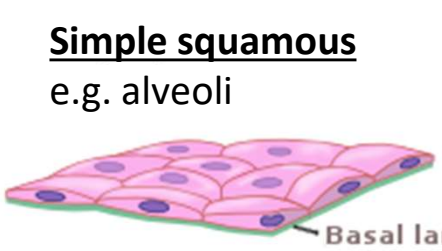
<u>According to cell shape</u> (count outermost layer if stratified)

- squamous – cells are flat
- cuboidal – cube shaped
- columnar - elongated
- transitional – cell shape changes according to degree of distention

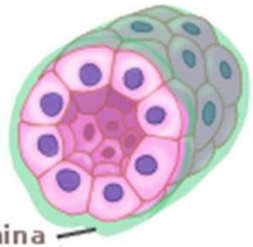
Ciliated
– have cilia on apical surface (e.g. respiratory tract)
Keratinized
– contain keratin (e.g. epidermis)

Simple

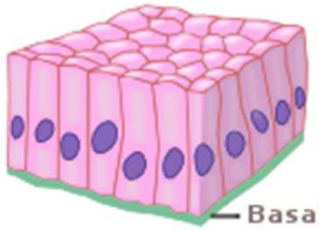
<u>Simple squamous</u>
e.g. alveoli



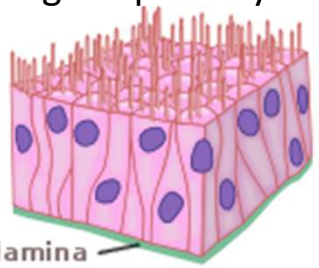
<u>Simple cuboidal</u>
e.g. renal tubule



<u>Simple columnar</u>
e.g. small intestine

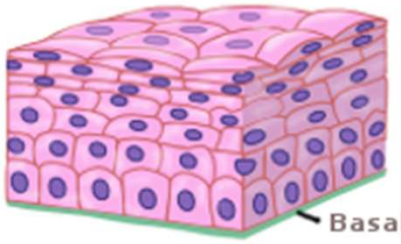


<u>Pseudostratified columnar</u>
e.g. respiratory tract

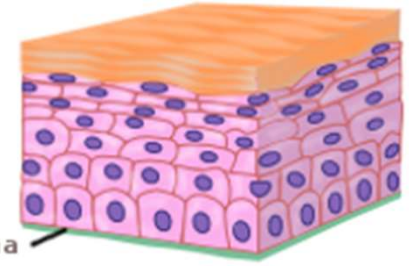


Stratified

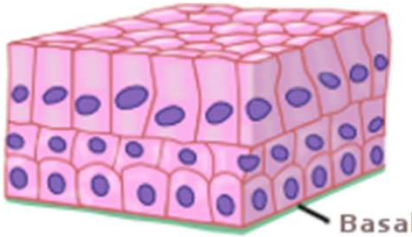
<u>Stratified squamous</u>
(e.g. **mouth, oesophagus**)



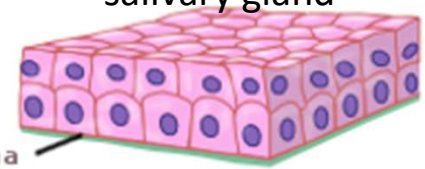
<u>Keratinized stratified squamous</u>
(e.g. epidermis)



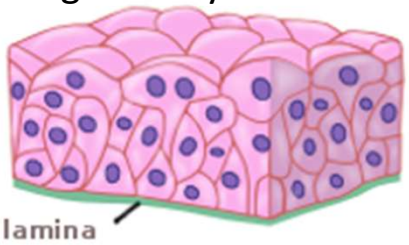
<u>Stratified columnar</u>
e.g. mammary glands



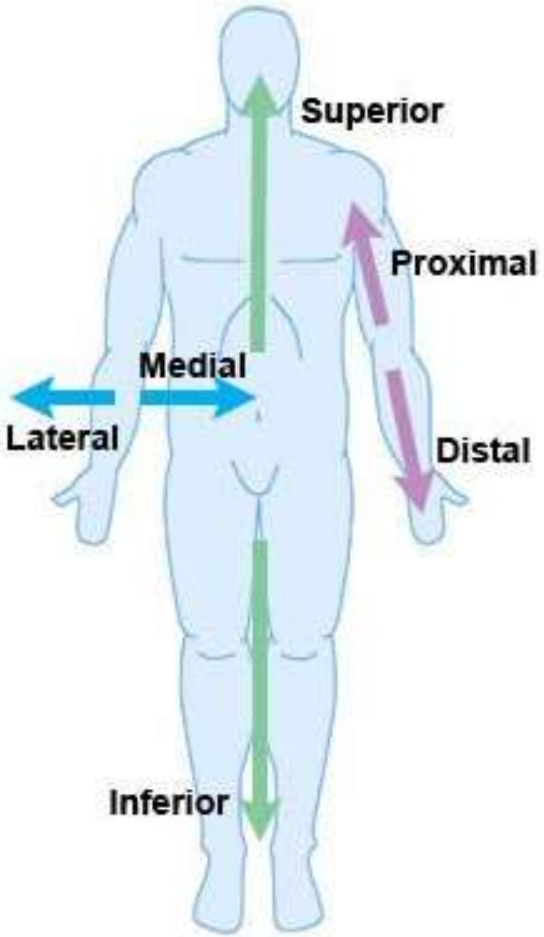
<u>Stratified cuboidal</u>
e.g. sweat gland,
salivary gland

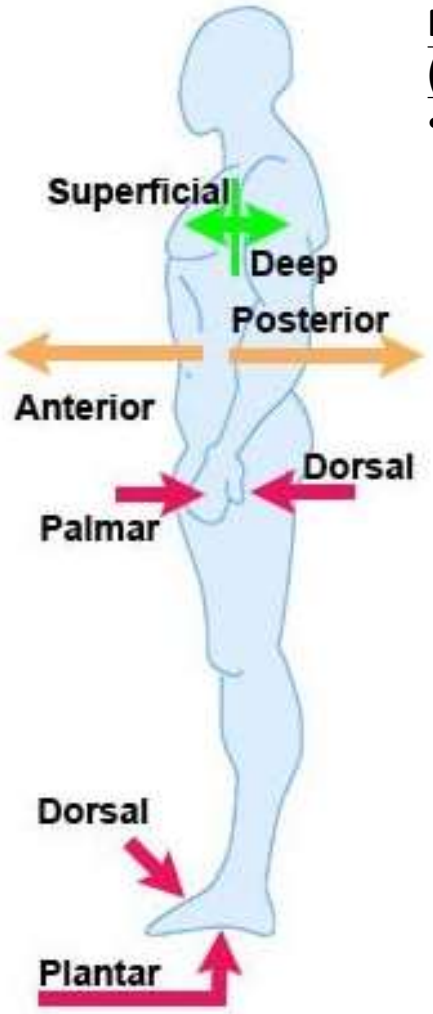


<u>Transitional</u>
e.g. urinary bladder



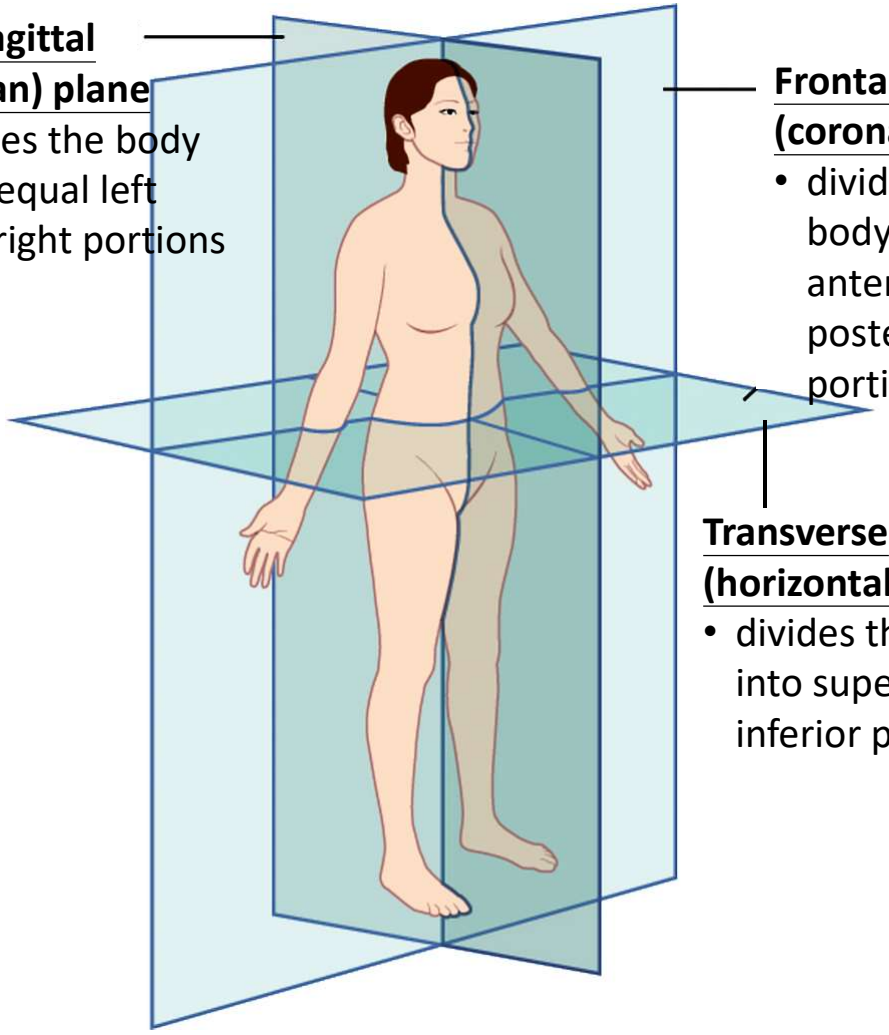
Anatomical terms & Anatomical planes





Mid-sagittal (median) plane

- divides the body into equal left and right portions



Frontal (coronal) plane

- divides the body into anterior and posterior portions

Transverse (horizontal) plane

- divides the body into superior and inferior portions

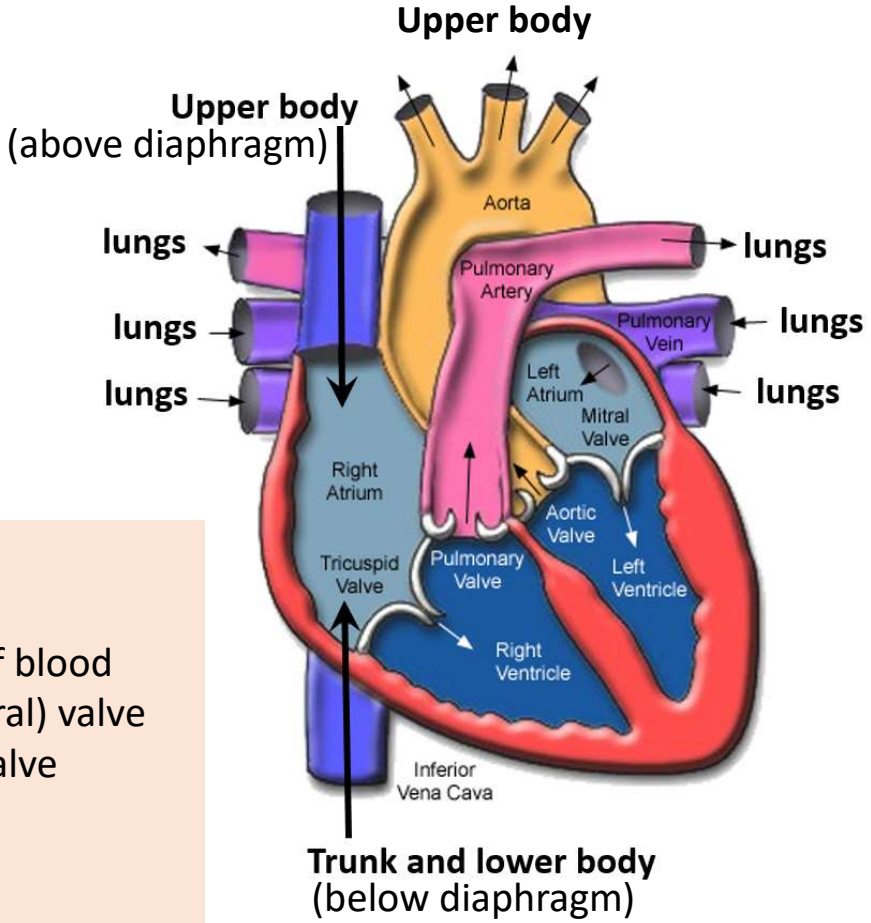
L12-14_The circulatory system

The circulatory system is a transport system

- Heart (pump) – provide force (energy) for moving blood
- Blood vessels – conduits in which blood flows in
- Blood – carry various substances to and from various organs

Function circulatory system

- transports various substances around the body, e.g.
  - nutrients, O_2, wastes (e.g. CO_2 and urea), hormones, WBCs, antibodies, platelet, coagulation factors
- regulates body temperature



<u>Location of heart</u>: mediastinum

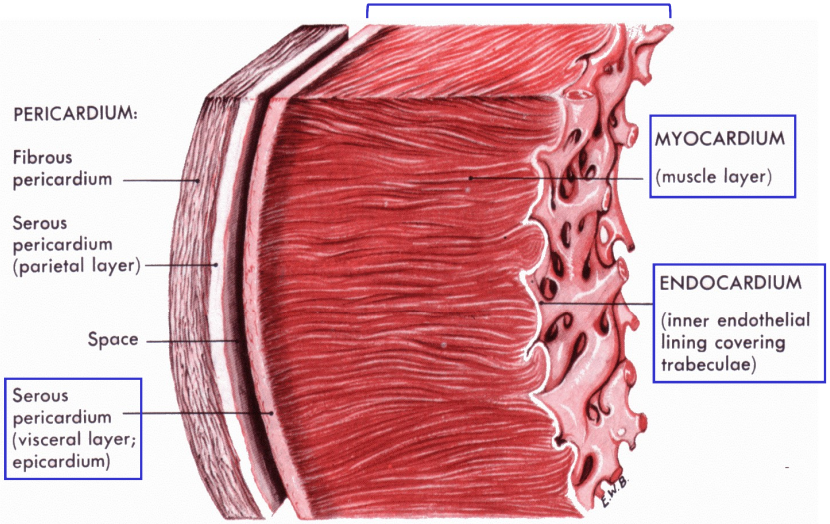
<u>Anatomy of the heart</u>

- **4 chambers**
  - right atrium
  - right ventricle
  - left atrium
  - left ventricle
- **4 heart valves** – prevent back flow of blood
  - left atrioventricular (bicuspid/mitral) valve
  - right atrioventricular (tricuspid) valve
  - aortic valve
  - pulmonary valve
- **great vessels connected to the heart**
  - superior and inferior vena cava
  - pulmonary trunk → left and right pulmonary arteries
  - 4 pulmonary veins
  - aorta (ascending, aortic arch, descending aorta)

The heart is surrounded by <u>pericardium</u>

- fibrous pericardium (tough fibres)
- serous pericardium
  - – parietal layer
  - – visceral layer (aka **epicardium**)
    - * *Fluid-filled space between the layers fluid for lubrication*
- **myocardium** – cardiac muscle
- **endocardium** – a single layer of endothelial cell, contact with blood
  - * *The inner surface of the entire cardiovascular system is covered by endothelium.*

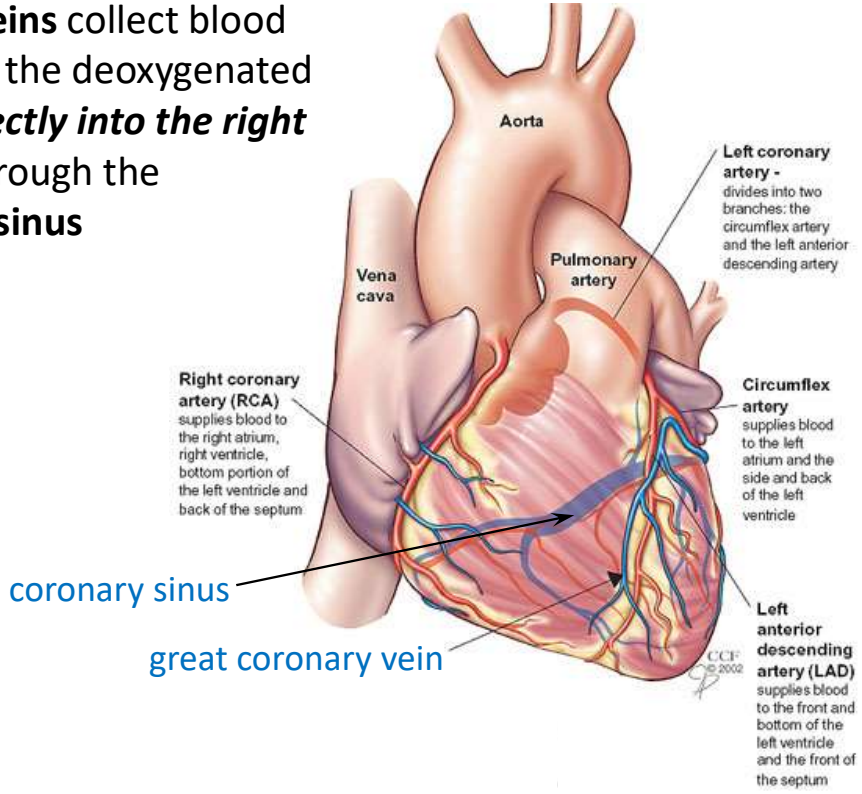
Wall of the heart



Section of the heart wall showing the components of the outer pericardium (heart sac), muscle layer (myocardium), and inner lining (endocardium).

<u>Coronary circulation</u>

- **Left and right coronary arteries arise** from ***ascending aorta***
  - Major branches of left coronary artery
    - **Left anterior descending** (interventricular)
      - – supplies anterolateral surface of left heart
    - **Left circumflex** – supply the side and back of left heart
  - **Right coronary artery**
    - – supplies right heart, SA node, AV node
- **Cardiac veins** collect blood and ***drain*** the deoxygenated blood ***directly into the right atrium*** through the **coronary sinus**



Conducting system of the heart

- Specialized cardiac cells that automatically generate action potential (electrical impulse) and transmit action potential for coordination of contraction
- Firing rate (rate of generation of action potential) at **sinoatrial (SA) node** (in right atrium at the base of superior vena cava) determines the heart rate
- The action potential is then spread along the other components of the conducting system throughout the heart to cause contraction of the cardiac muscles
- **SA node**
  → **AV node** (base of right atrium)
  → **Bundle of His** (septum)
  → **left and right bundle branches** (septum)
  → **Purkinje fibres** (ventricular wall)

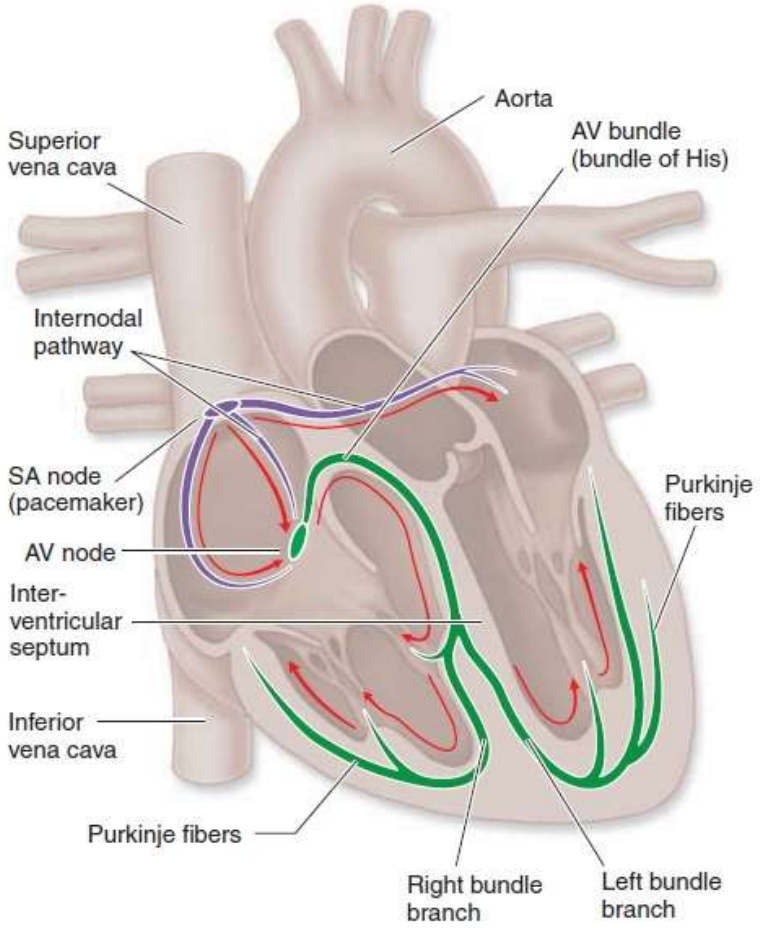
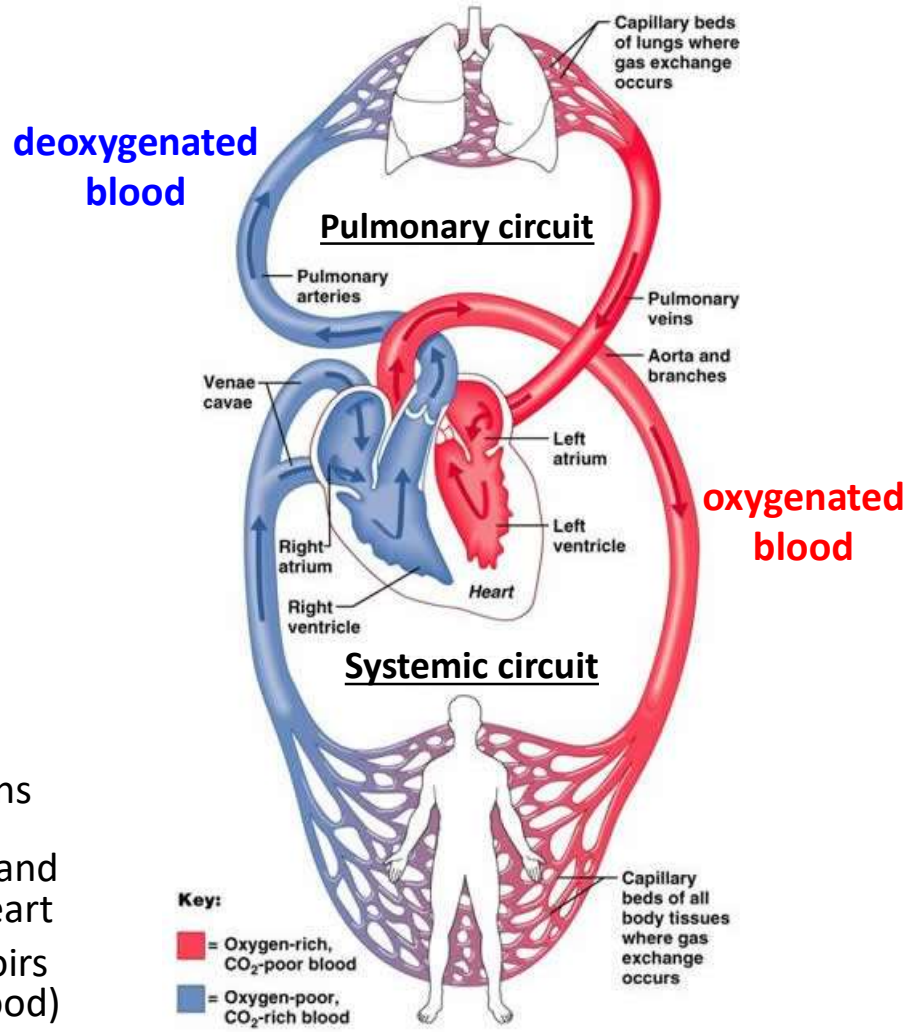


FIGURE 8.10. The Conducting System of the Heart

There are 2 circuits in the circulatory system

- **The pulmonary circuit/circulation**
  - **Function:** for sending blood to the lungs for obtaining oxygen (oxygenation) and removing carbon dioxide
  - **Path:** Right ventricle → pulmonary arteries → lungs → pulmonary veins → left atrium
  - Lower resistance & blood pressure (24/10 mmHg)
- **The systemic circuit/circulation**
  - **Function:** for distribution of oxygenated blood to all body systems
  - **Path:** Left ventricle → aorta → all parts of body except lungs ------> superior vena cava (collect deoxygenated blood from structures above diaphragm) and inferior vena cava (collect deoxygenated blood from structures below diaphragm) → right atrium
  - Higher resistance & blood pressure (120/80 mmHg)

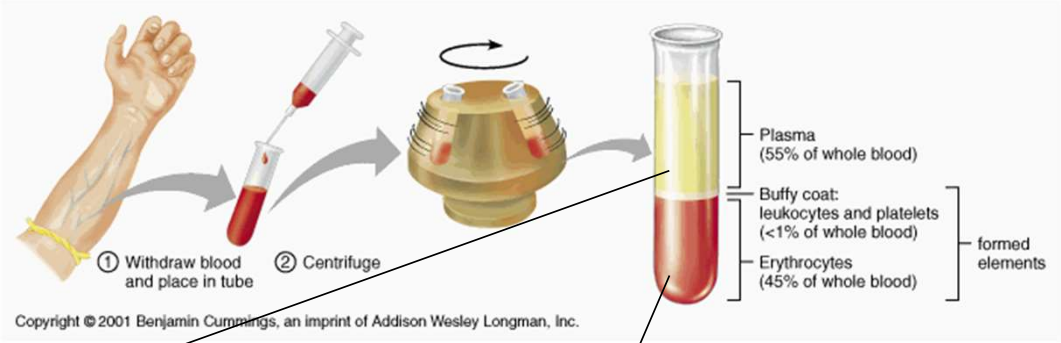


Blood vessel

Arteries → arterioles ----------> capillaries ----------> venues → veins

Carry blood away from heart Vasoconstriction and vasodilation control blood flow	**Exchange of substances** one cell layer (endothelium), large total surface area	Collect blood and return it to heart Blood reservoirs (store 70% blood)

The blood



White blood cells - for immune defence

- **Macrophage** and **neutrophils** (most abundant) are **phagocytes** that play a major role in inflammation
- **Monocytes** circulates in the blood and they mature when they enter tissues to become **macrophages**
- **Eosinophils** – role in parasitic worm infection
- **Basophils** – release heparin and histamine
- **Lymphocytes** – specific (adaptive) immune response
  - B lymphocytes – humoral response (produces antibody)
  - T lymphocytes – cell-mediated response

Plasma (~ 55%)

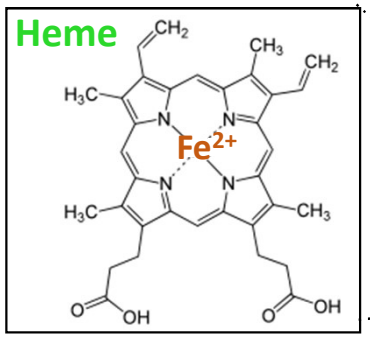
Proteins (e.g. albumin)
Nutrients (glucose, amino acids)
Ions (Na^+, K^+, HCO_3^- etc.)
Hormones
Enzymes
Wastes (e.g. urea, CO_2)

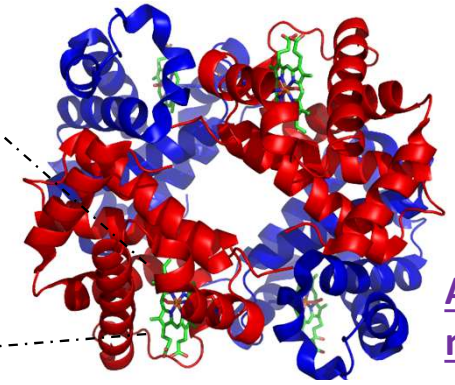
Formed elements (~ 45%)

Red blood cells (erythrocytes)
White blood cells (leukocytes)
Platelets – blood clotting

Red blood cells (erythrocytes)

- biconcave shape – more surface area for gas diffusion & higher flexibility
- no organelles and nucleus – more space for Hb
- no mitochondrion – cannot undergo aerobic respiration
- filled with **haemoglobin (Hb) for carrying O_2** (and CO_2)
- each haemoglobin consists of **4 subunits**.
- each subunit contains 1 polypeptide chain called **globin** (red and blue) and 1 **iron**-containing **heme** group. (HbA: $\alpha_2\beta_2$)





A hemoglobin molecule

The body fluids

Factors that affects body fluid volume

- amount of body water decrease with ↑ age and body fat
- female has less body water than male due to the high body fat content

Body fluids in different compartments

Total body fluid = Intracellular fluid (2/3)+ Extracellular fluid (1/3)
Extracellular fluid = interstitial fluid + intravascular fluid (plasma) + transcellular fluid (e.g. pleural fluid, GI fluid)

Osmolality is a measure of the amount of dissolved solute per Kg solvent.
Osmolarity is a measure of the amount of dissolved solute per L solvent.

When comparing osmolarity of a solution to that of plasma,

- same osmolarity --> isotonic (e.g. 0.9% saline)
- lower osmolarity --> hypotonic (e.g. 0.45% saline (NaCl)) --> water flows into body cells if infused
- higher osmolarity --> hypertonic (e.g. 3% saline) --> water flows out of body cells if infused

Saline solutions are crystalloids which contains water & solutes that can move across capillary wall and cell wall
Colloids (e.g. albumin solutions) are used to expand the volume of plasma as colloids stay in the blood vessels

The Lymphatic System

Components

1. Lymphoid organs & tissues
   - Primary lymphoid organs
     - Bone marrow
       – where B lymphocytes mature
     - Thymus
       – where T lymphocytes mature
   - Secondary lymphoid tissues
     - Lymph nodes
     - Spleen
     - Tonsils…
2. The lymphatic circulation
   - lymphatic vessels
   - lymph - interstitial fluid

Functions

1. Maintain fluid balance
   - to absorb excessive tissue fluid and return it to the blood
2. Immune defence
3. Absorption of fat in small intestine (lacteals)