Plasma

- A tissue, and pale yellow liquid that transport/carries:
    - Red Blood Cells, White Blood Cells, Platelets
    - Digested food products (from gut to body cells)
    - Carbon dioxide (dissolved in plasma)
    - Urea - excess protein (dissolved from liver to kidneys)
    - Hormones
- Plasma, as it is a liquid, can carry heat energy. Blood flow changes to increase or decrease the amount of heat lost by the body.

Platelets

- Small fragments of cells (no nucleus) that help with Blood Clotting
    - Platelets trigger blood clotting at wound sites.
    - It reduces blood loss
    - It prevents microorganisms from entering blood.
- Platelets clump together to plug damaged areas.
- These are held together by a mesh of protein called fibrin. (proteins called clotting factors are also required)

Red Blood Cells

- They are adapted for carrying oxygen (also called erythrocytes):
    - Small size to pass through tiny capillaries.
    - Biconcave shape allows more surface area for rapid diffusion (of oxygen)
    - No nucleus increases the amount of oxygen they can carry.
    - Contain haemoglobin - bind with oxygen in lungs (to become oxyhaemoglobin) (contain lots of iron, gives red colour)

The immune system

- Deals with pathogens (microorganisms that cause diseases.
- Pathogens reproduce rapidly after entering the body, unless destroyed by the immune system and white blood cells (component of immune system).
- There are two types of White Blood Cells: Phagocytes and Lymphocytes.

Phagocytes

- Process called Phagocytosis:
    - Phagocytes detect pathogens (or anything 'foreign' to the body)
    - They engulf (ingest/absorb) them by changing shape, and digest to destroy them.
- Phagocytes are non-specific: destroy anything (regardless of if it is or isn't a pathogen)

Lymphocytes

- Pathogens have molecules called antigens on the surface
- Lymphocytes come across forign antigen, and produce proteins called antibodies.
- They lock onto pathogens and mark them for destruction by other white blood cells.
- Specific antibodies lock only onto specific antigens.
- Antibodies are rapidly produced and flow around the body to mark similar pathogens.

Memory cells

- Memory cells are produced when antigens are detected, and stay in the body. They remember a specific antigen.
- If the (same) antigen enters the body, the memory cells reproduce fast. This means cells can quickly produce antibodies. Therefore, people are immune to most diseases if they have already had the disease.

Vaccination

- Lymphocytes take a while to produce antibodies to deal with new pathogens.
- Vaccination (usually) is the injection of dead or inactive pathogens that carry antigens.
- They are harmless, but the lymphocytes produce antibodies regardless of if they are harmless as a result of detecting antigens. They start producing antibodies.
- The memory cells will also be produced and remain in blood, so if live pathogens of the same type appear, antibodies are produced in greater number and quicker (than if not vaccinating)

Exercise and Heart Rate:

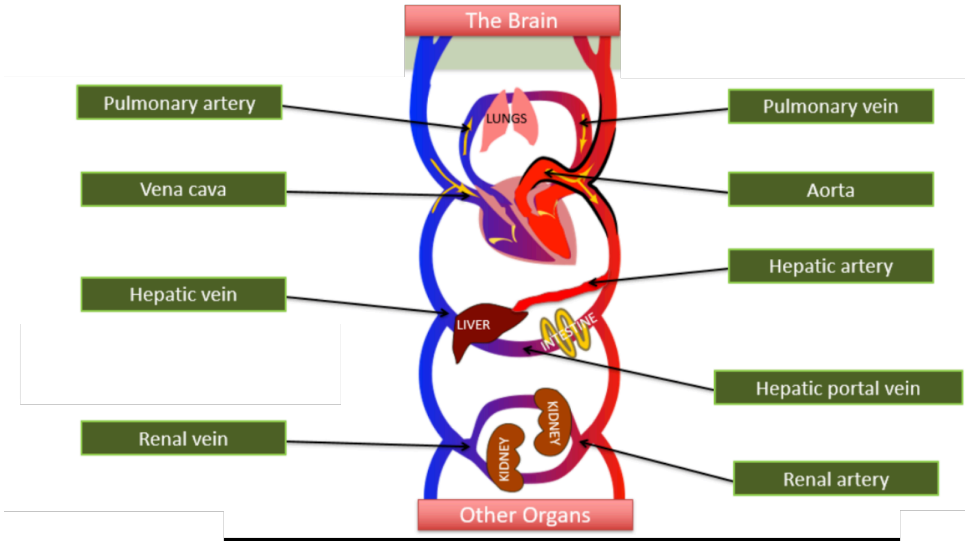
- In exercise, muscles need more oxygen, and produce more carbon dioxide due to increased respiration to make more energy.
  - More oxygen needs to be provided, and more CO_2 needs to be removed.
- Receptors (sensors) in Aorta and carotid arteries (neck) detect CO_2 levels in blood.
- Receptors send signals into the medulla (brain)
  - Accelerator nerve to speed up the heart rate (contracting more frequently with more force).
  - Decelerator nerve to slow down the heart rate (less contracting with less force).

Adrenaline and Heart Rate:

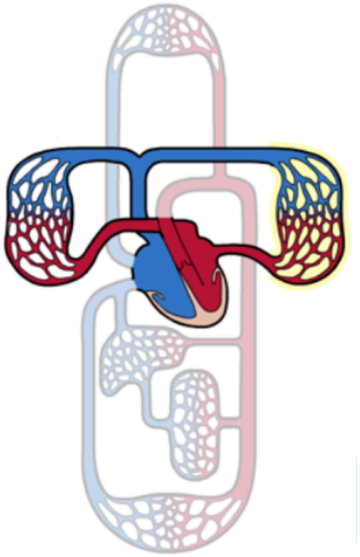
- Adrenal glands release adrenaline ('fight or flight' hormone - prepares to fight or run away) when the organism feels threatened/stressed.
- Adrenaline binds to specific receptors in the heart, causing it to contract faster with more force (increasing heart rate), providing tissues more oxygen and glucose for action.

Structure of Circulatory System:

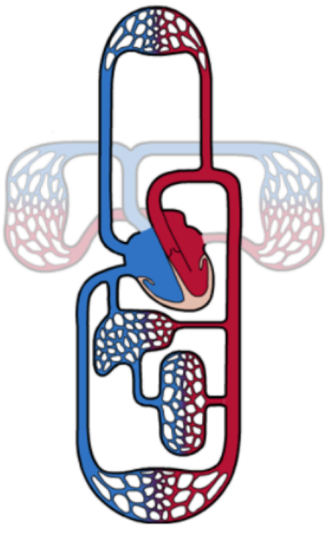
- Pulmonary - associated with the lungs
- Hepatic - associated with the liver
- Renal - associated with the kidneys
- Exceptions:
  - Pulmonary artery - brings deoxygenated blood to lungs (usually oxygenated)
  - Pulmonary vein - brings oxygenated blood to the heart (usually deoxygenated)



- Pulmonary Circulation - Vessels transporting blood between <u>heart</u> and <u>lungs.</u>



- Systemic Circulation - Vessels transporting blood between <u>heart</u> and <u>body</u> (not lungs).



Coronary Heart Disease:

- Coronary Heart Disease is when the coronary arteries that supply the blood to heart muscles get blocked by the buildup of plaque (fatty material)

- This build up is called *atherosclerosis* caused by the following:

    - Smoking - increases blood pressure. Its chemicals also cause damage.

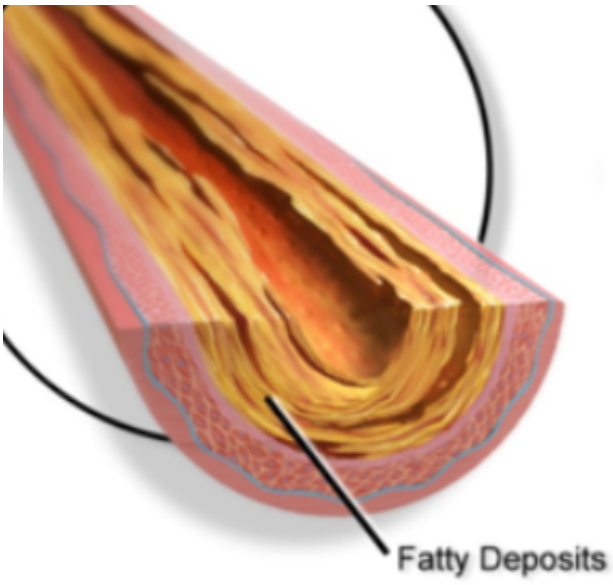
    - High cholesterol diet - A diet in high saturated fat leads to fatty deposits forming in arteries, narrowing the artery.

    - Lack of Exercise - lead to high blood pressure

    - Family history

- Increase in blood pressure damages the lining of the coronary arteries, increasing likelihood of fatty deposits, narrowing the artery, and leading to coronary heart disease.

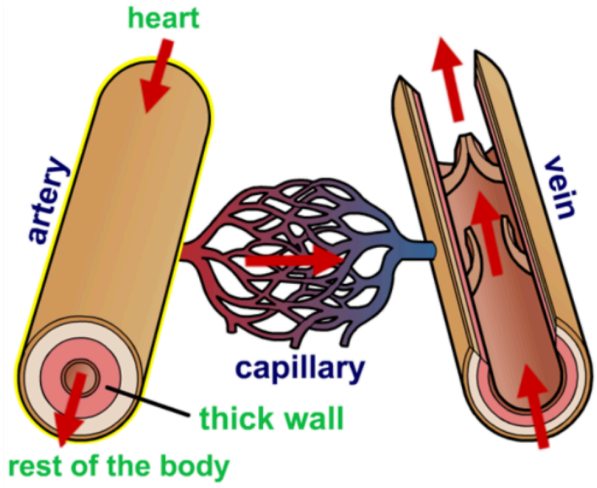
- This causes the arteries to become narrow and blocks the flow of blood, lacking oxygen in heart muscles. If a <u>blood clot</u> is formed, the artery is entirely blocked, causing a Heart attack.



- Standard treatment for Coronary heart disease is bypass surgery.

Structure and Function of Arteries:

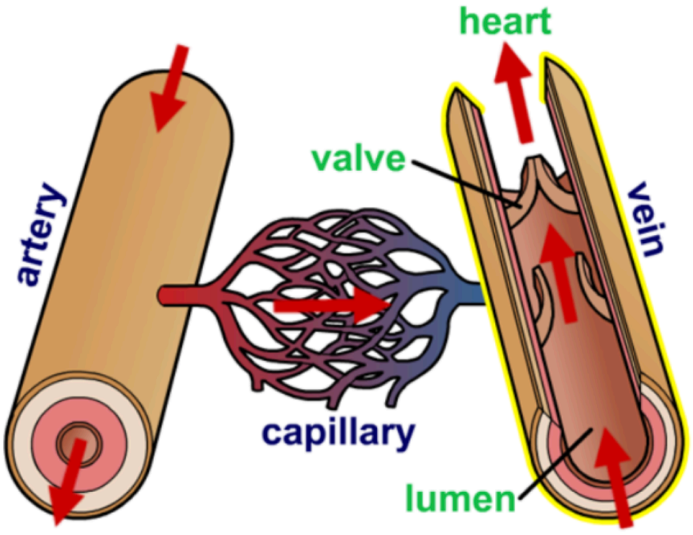
- Arteries carry (generally oxygenated) blood away from the heart into organs.



- Blood from the heart is pumped at high pressure, therefore the arteries have thick muscular and elastic walls for strength and flexibility/elasticity.
- Elasticity allows them to expand.
- The walls are thick compared to the lumen (the hole, or tube).
- Abundant muscle fibre in walls are innervated to be constricted or dilated.
- Arterioles - small arteries.
- The largest artery is the Aorta.

Structure and Function of Veins:

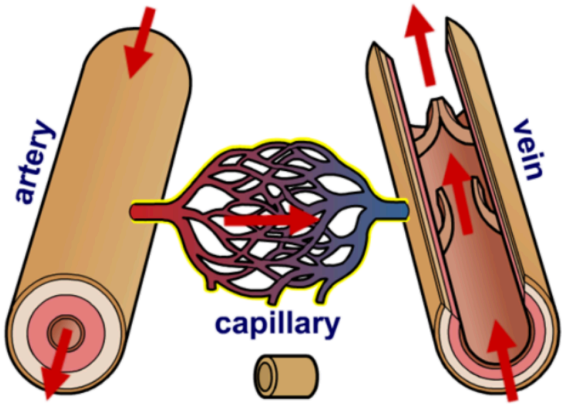
- Veins carry (generally deoxygenated) blood to the heart.



- Blood in the veins are at low pressure, and the walls do not need to be thick (like arteries).
- The veins have a large lumen allowing them to carry more blood.
- They have 'watch-pocket' valves to keep blood flowing the right direction/ preventing backflow (as they have a low pressure)
- The largest vein is the Vena Cava.

Structure and Function of Capillaries:

- Capillaries are involved in exchange of materials at the tissues (blood to the body cells).
- Walls are thin and permeable, to allow exchange of substances through diffusion.
- Very small (too small to see) - very small lumen.
- Carry blood very close to all cells to exchange substances.
- Supply food and oxygen, take away wastes including CO2



- Walls are one cell thick, increasing rate of diffusion by decreasing distance.

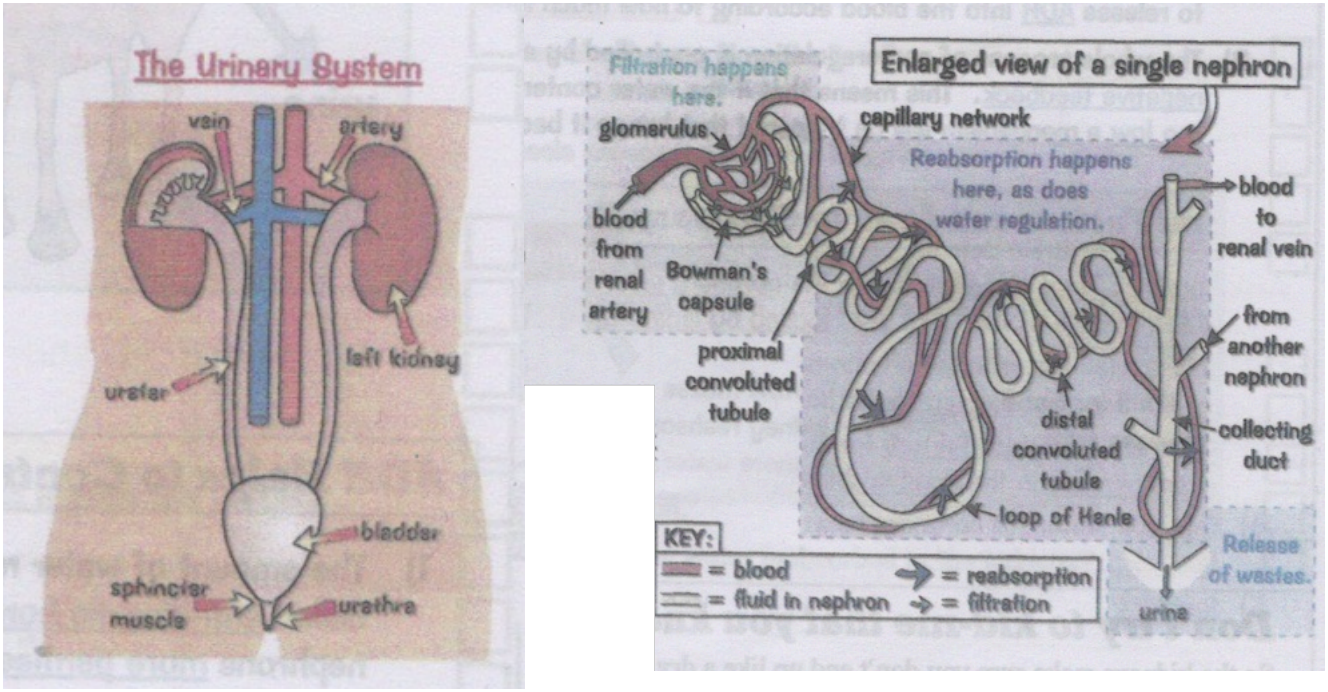
Arteries	Veins	Capillaries
• Thick walls, lots of muscles fibre and elastic tissue. • Small lumen. • Carry blood away from heart to organs.	• Thin walls, little muscle and elastic tissue. • Large lumen. • Carry blood into the heart from organs. • Contain valves (prevent backflow)	• Thin permeable walls. • Carries blood to and from cells around body. • Walls are one cell thick.

Kidneys:

- Part of the urinary system, with 3 main roles:
    - Removal of urea (produced in liver from excess amino acids) from the blood.
    - Adjust iron (salt) levels in the blood.
    - Adjust water content of the blood.
- Filter substances from blood under high pressure, then reabsorb the useful substances. The end product is urine.

Nephrons (filtration units in Kidneys)

- Each kidney contains thousands of nephrons.
- Three steps include: Ultrafiltration, Reabsorption, and Release of Waste.
- Ultrafiltration:
    - Blood from the renal artery flows through glomerulus (capillaries at the start of nephron).
    - High pressure squeezes water, urea, ions, glucose out of blood into Bowman’s capsule.
    - Membranes between blood vessels in glomerulus and Bowman's capsule filter big molecules (proteins). Blood cells stay in blood.
    - Filtered liquid in Bowman's capsule is called glomerular filtrate.
- Reabsorption:
    - Filtrate flows along the nephron, and useful substances selectively reabsorbed back into blood.
        - Glucose reabsorbed from proximal convoluted tubes to be used in respiration. Process requires active transport (against conc. gradient)
        - Sufficient ions reabsorbed. Excess ions are not.
        - Sufficient water reabsorbed from collecting duct into bloodstream by osmosis.



- Release of Waste:
    - Remaining substances (water, ions, urea) form urine. Continues out of the nephron, through the ureter and down bladder to be stored before being released via urethra.

Kidneys Adjust Water Content:

- Water taken into the body is lost in three ways: sweating, breathing, and urinating.
- Body needs to constantly balance water coming in against water going out (osmoregulation).
    - Adjust the amount of water excreted by kidneys in urine (If lacking water, kidneys reabsorb more water so less water is lost in urine).
    - When kidneys reabsorb more water, urine has smaller volume, and is more concentrated.

ADH Helps Control Water Content:

- Amount of water reabsorbed by the kidney is controlled by a hormone called Anti-diuretic hormone (ADH).

- Makes collecting ducts of nephrons more permeable, and more water is reabsorbed back into the blood.

- Brain monitors water content of blood, instructing the pituitary gland (base of the brain) to release ADH into blood.

- Osmoregulation controlled by a mechanism called negative feedback - if water content is too high or too low, mechanism triggered to bring it back to normal.