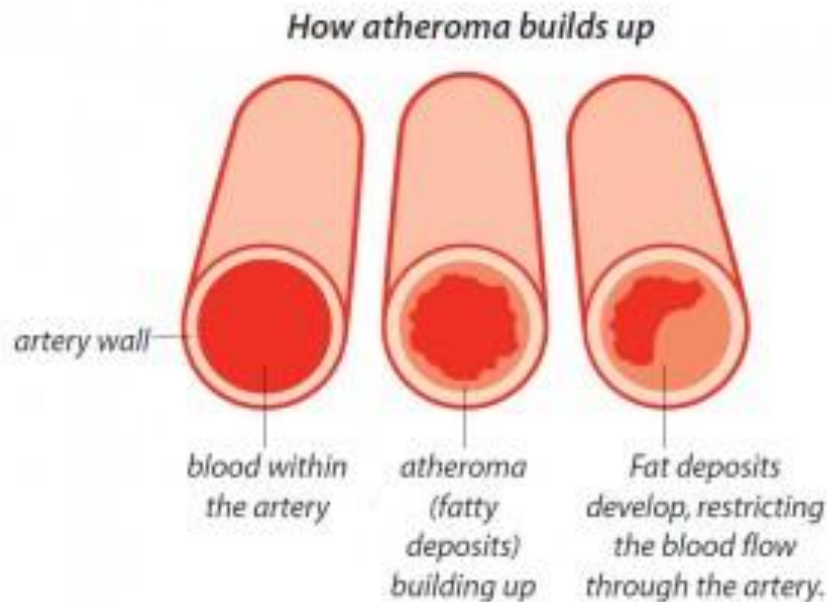


Physiology and Health

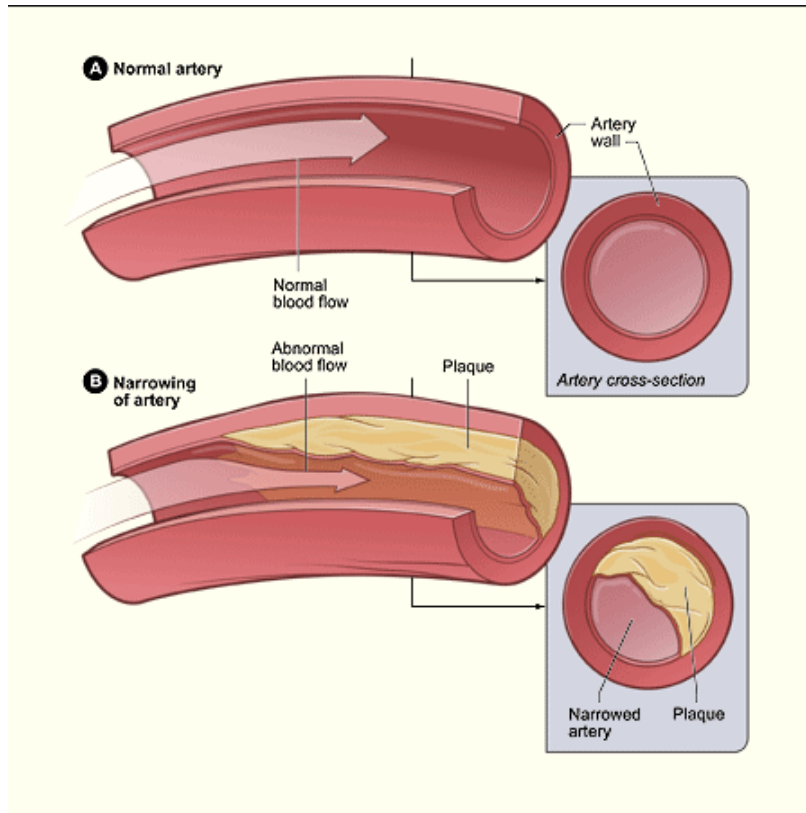
Pathology of Cardio Vascular Disease (CVD)

I can describe Atherosclerosis

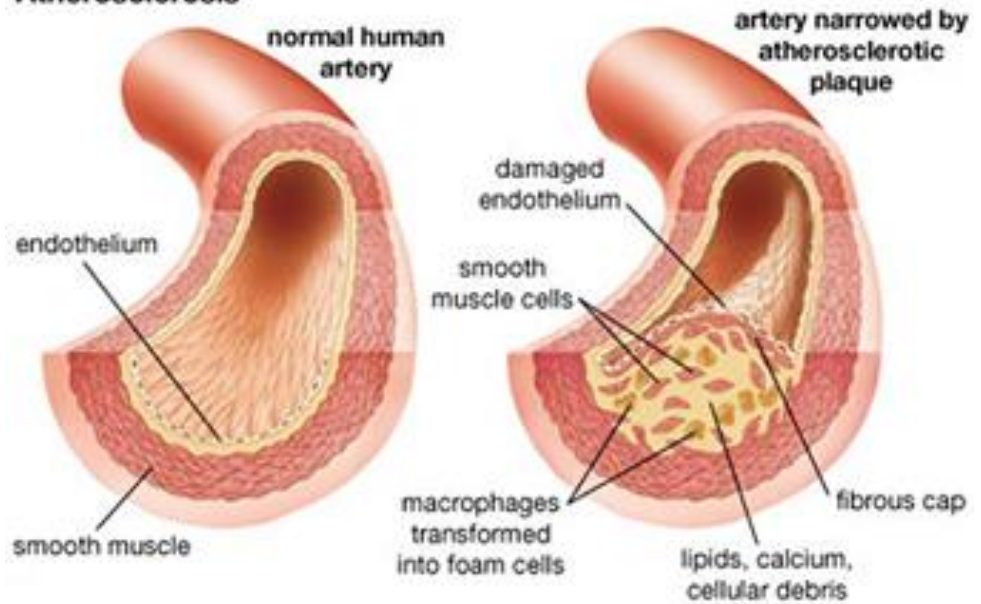
- **Atherosclerosis** is the accumulation of fatty material (consisting mainly of **cholesterol**), fibrous material and **calcium** forming an **atheroma** or **plaque** beneath the endothelium.



I can describe Atherosclerosis



Atherosclerosis



I can describe the effects of Atherosclerosis

- As the **atheroma** grows the artery thickens causing it to lose **elasticity**.
- This results in a **decrease in the diameter** of the artery restricting blood flow and consequently an **increase in blood pressure**.

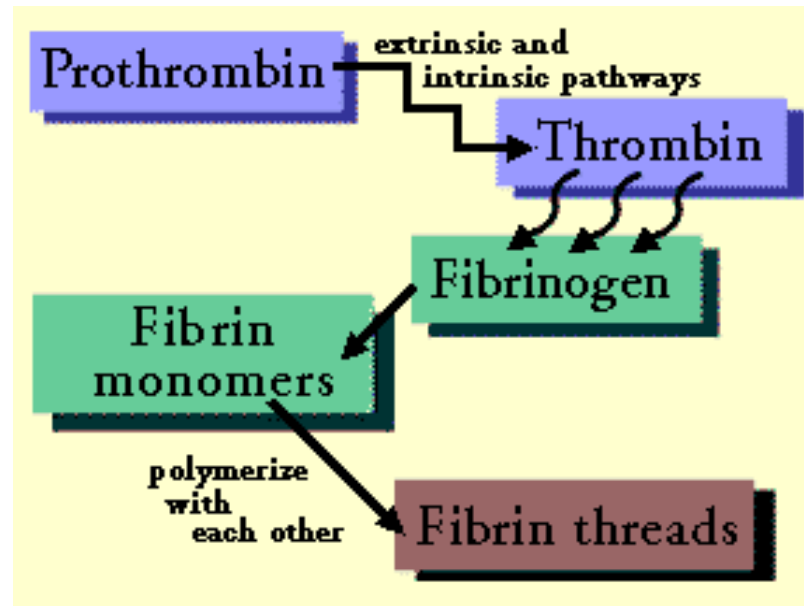
I can describe the effects of Atherosclerosis

- **Atherosclerosis** is the root cause of various cardio vascular diseases including:
 - Angina
 - Heart attack
 - Stroke
 - Peripheral vascular disease

Thrombosis

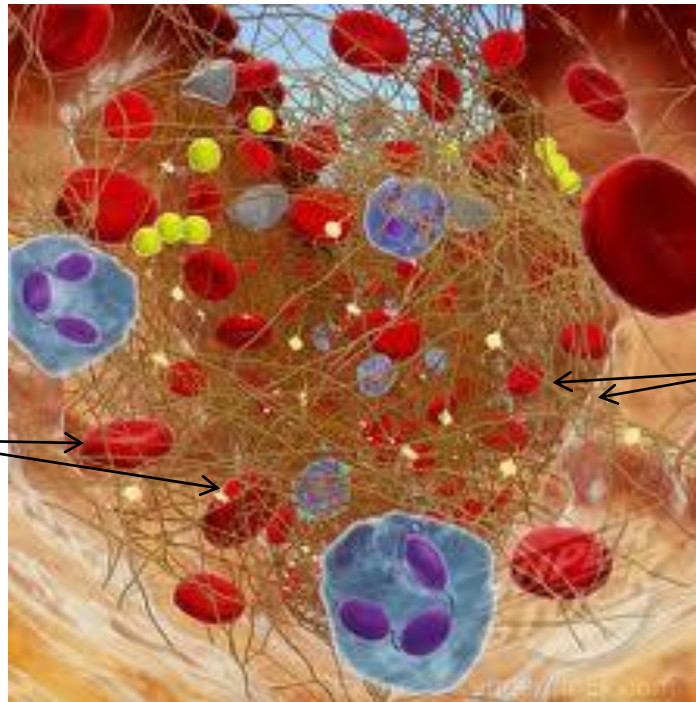
I can describe thrombosis

- **Atheromas** may rupture damaging the endothelium which releases **clotting factors**.
- The release of clotting factors results in the conversion of the enzyme **prothrombin** into the active form **thrombin**.



I can describe thrombosis

- Thrombin is responsible for causing molecules of **fibrinogen** (plasma proteins) to form **threads of fibrin**.
- The threads form a meshwork that **clots the blood**, seals the wound and provides a scaffold for the formation of scar tissue.



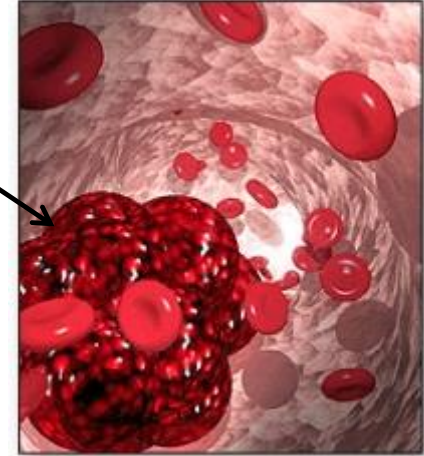
Red blood
cells

Fibrin threads

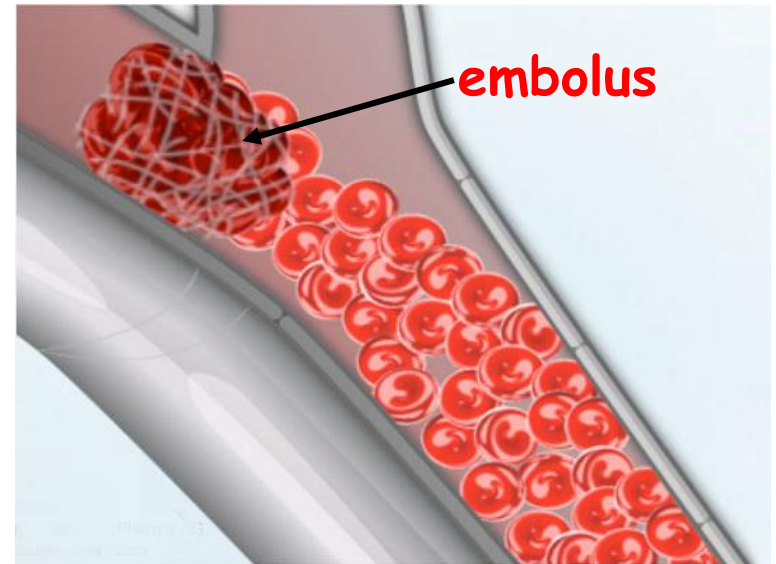
I can describe thrombosis

- The formation of a clot (thrombus) is known as **thrombosis**.
- In some cases a **thrombus** may **break loose** forming an **embolus** and travel through the bloodstream until it **blocks** a blood vessel.

thrombus

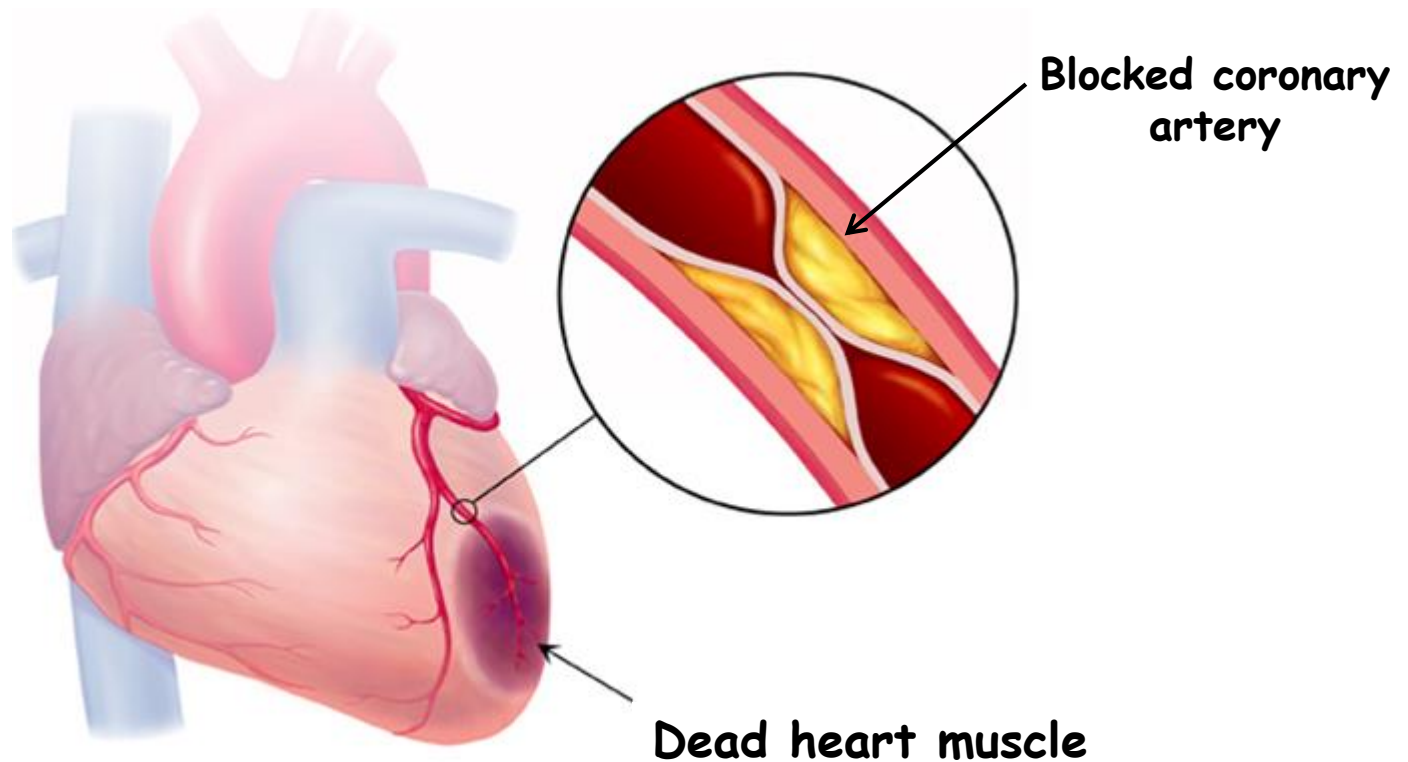


embolus



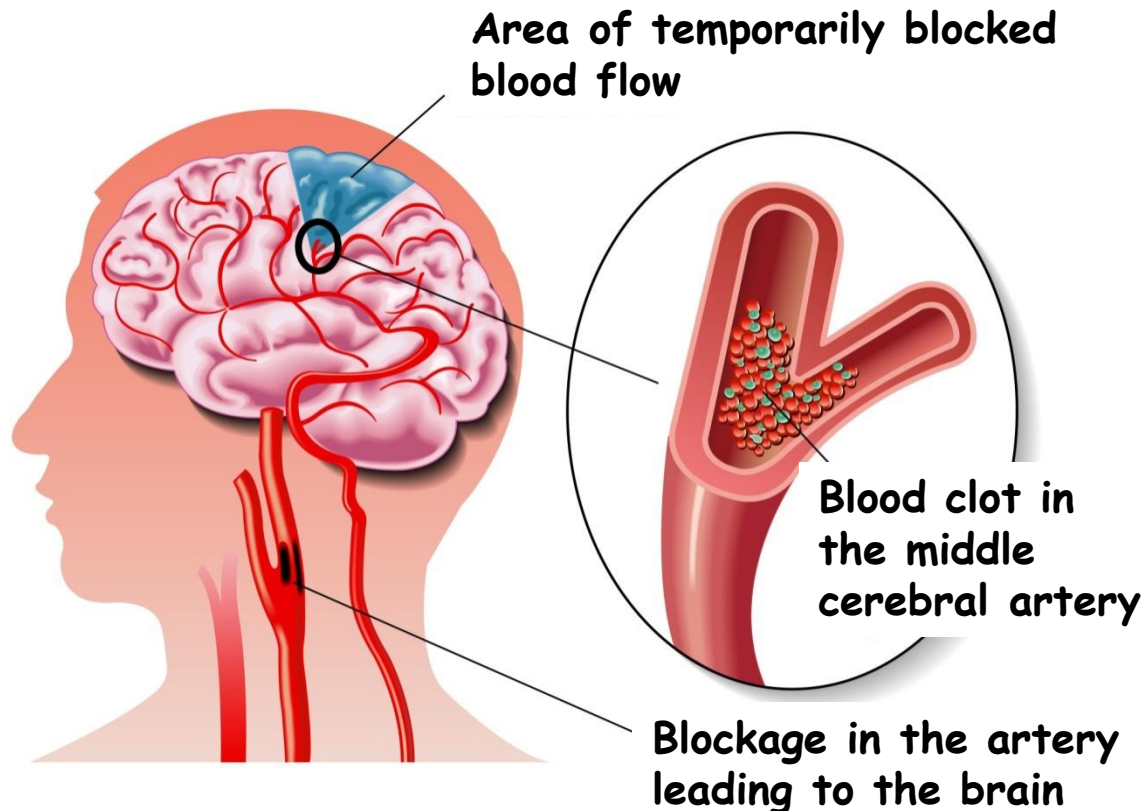
I can describe thrombosis

- If a thrombosis occurs in a **coronary artery** it may lead to a **heart attack** (myocardial infarction).



I can describe thrombosis

- If a thrombosis occurs in an **artery in the brain** this may lead to a **stroke**.
- When cells have been deprived of oxygen the tissue eventually dies.



Peripheral Vascular Disease

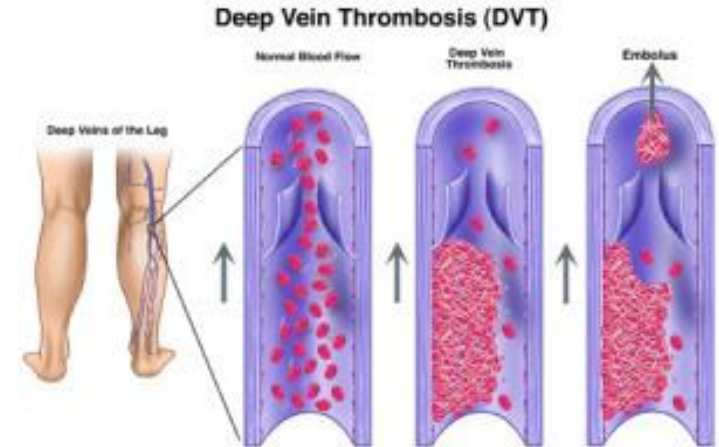
I can describe peripheral vascular disease

- **Peripheral vascular disease** is the **narrowing** of the arteries due to atherosclerosis in arteries other than those leading to the heart and brain.
- The most commonly affected parts of the body are the **legs**.
- Pain is experienced in the leg muscles due to a **limited supply of oxygen**.



I can describe peripheral vascular disease

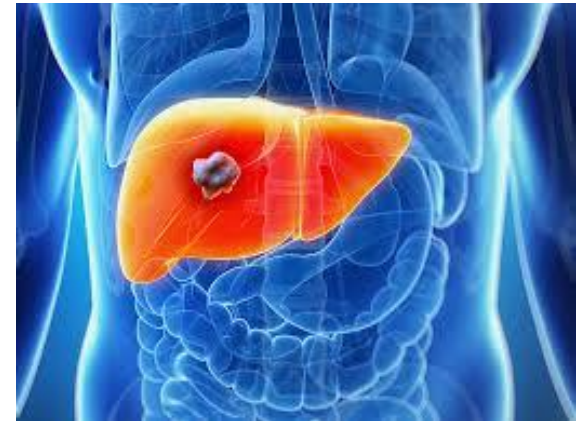
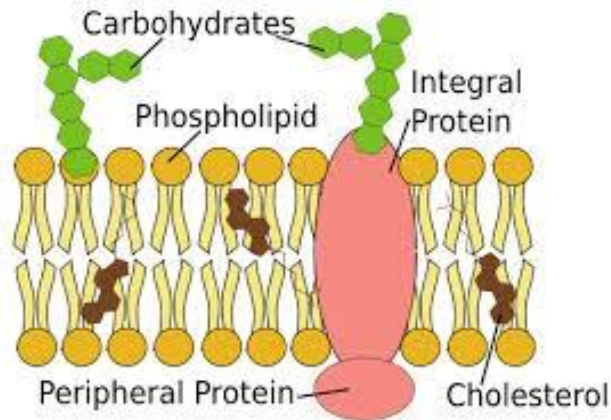
- A deep vein thrombosis is a **blood clot** that forms in a deep vein most commonly in the leg.
- If the clot becomes loose and travels through the bloodstream it may result in a **pulmonary embolism**.



Cholesterol and Atherosclerosis

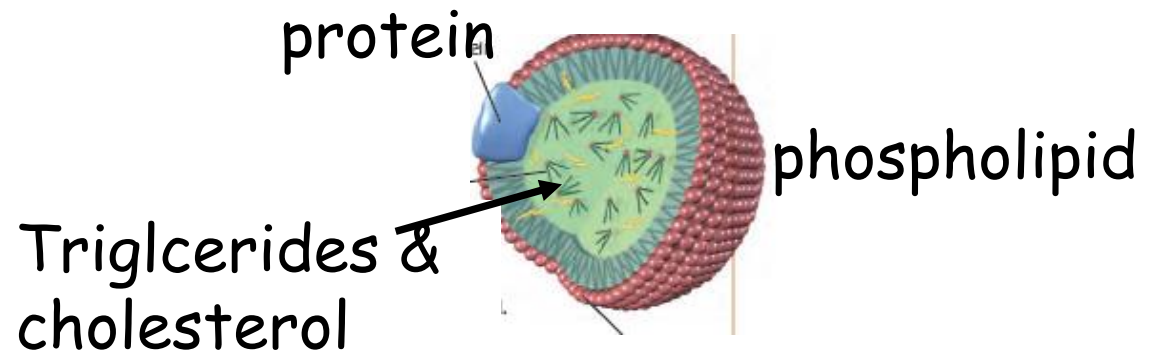
I can describe cholesterol

- Cholesterol is an **essential component** of the body. It is required to build and maintain **cell membranes** and **for synthesis of steroids e.g. sex hormones**.
- Cholesterol is synthesised by all cells; **25% produced in the liver**. It is also taken in as apart of our diet.



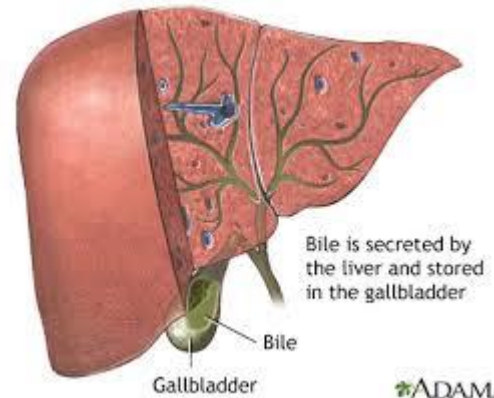
I can describe cholesterol

- A diet high in saturated fats or cholesterol causes an increase in the cholesterol levels in the blood.
- Cholesterol cannot travel around the body on its own because it does not dissolve in water. Instead, it is carried in the blood by molecules called **lipoproteins**.
- The two main lipoproteins are **LDL (low density lipoprotein)** and **HDL (high density lipoprotein)**.

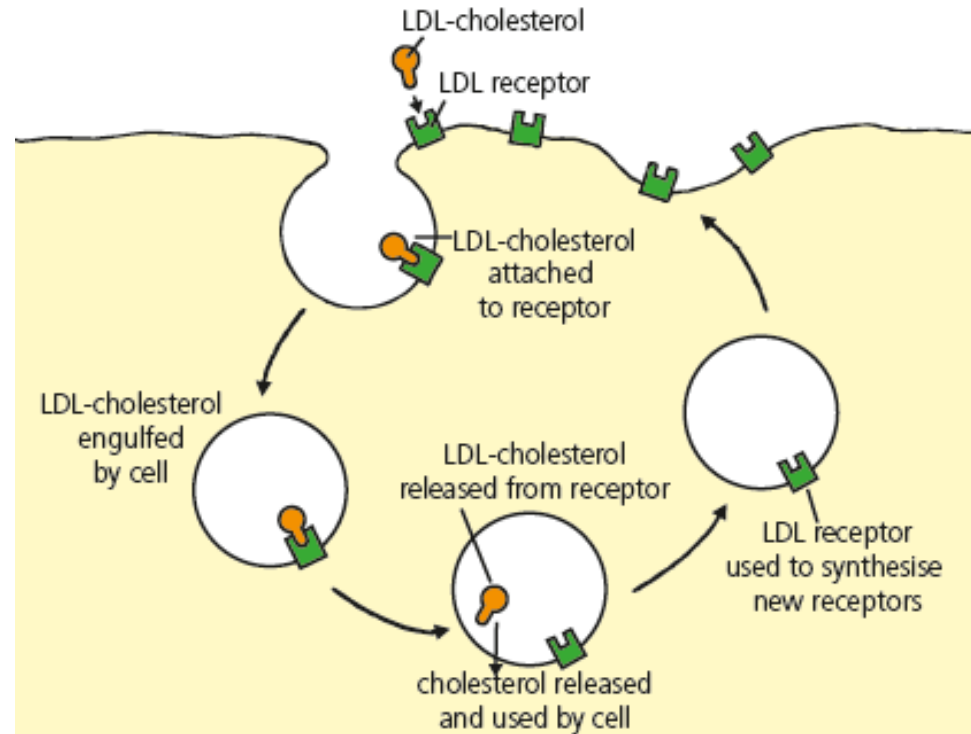


I can describe HDL

- HDL transports excess cholesterol **away from body cells** and back to the **liver** for elimination.
- This prevents accumulation of cholesterol in the blood.



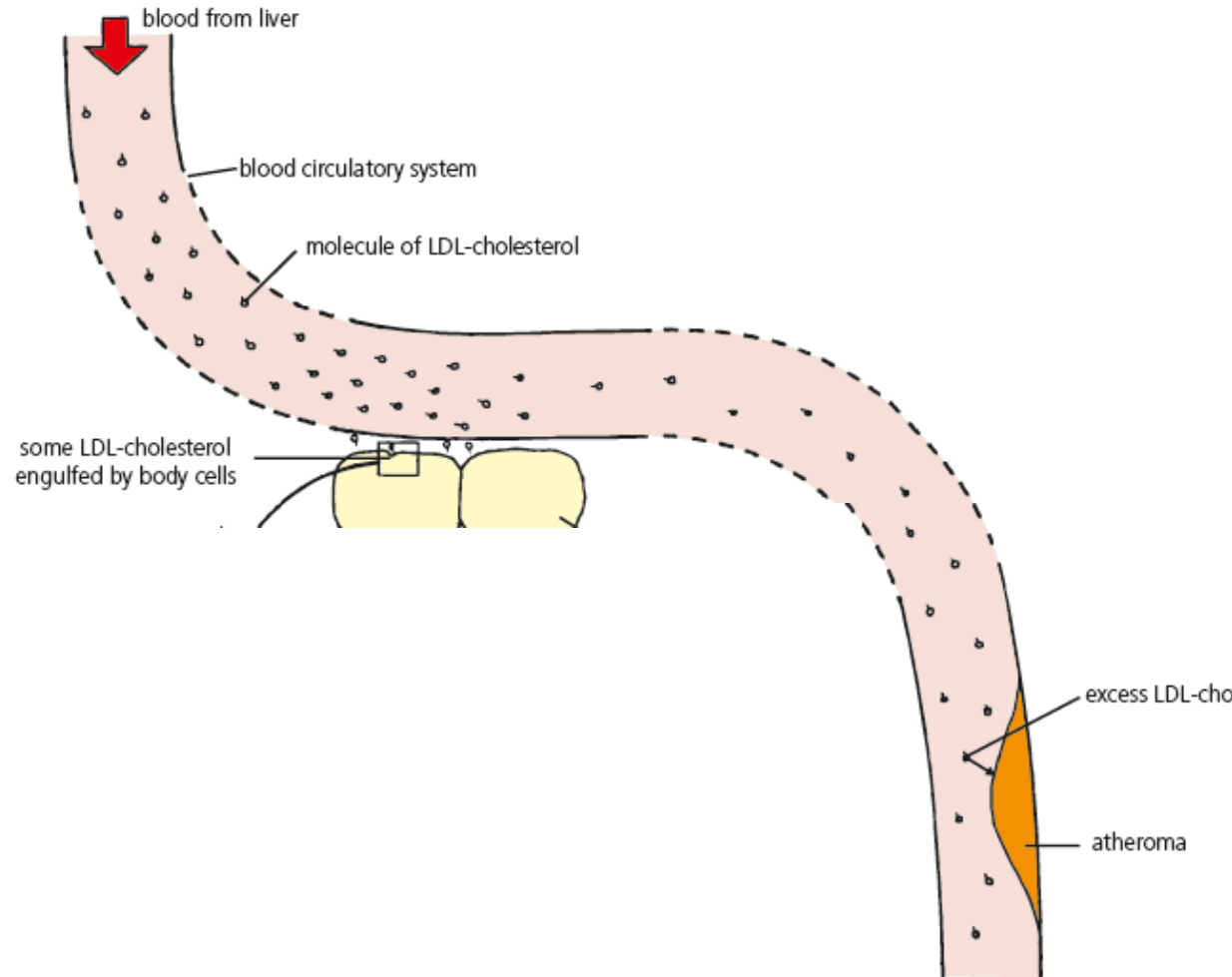
- LDL is the main cholesterol transporter and carries cholesterol from your **liver** to the cells that need it.
- Most cells have **LDL receptors** that take LDL into the cell where it releases cholesterol.



L.I.
Pathology of
CVD

Once a cell has sufficient cholesterol, a **negative feedback system** inhibits the synthesis of new LDL receptors and LDL circulates in the blood where it may deposit cholesterol in the arteries forming **atheromas**.

I can describe LDL



I can discuss HDL to LDL ratio

- A **higher** ratio of HDL to LDL is important for **lowering** blood cholesterol.
- This in turn **reduces** the chance of **atherosclerosis** and maintains good health.
- A higher HDL ratio can be achieved by **increasing physical activity**, eating a **low fat diet** (replacing saturated with unsaturated fats) and through **prescribed medications**.
 - E.g. **statins** reduce blood cholesterol by inhibiting the synthesis of cholesterol by liver cells.

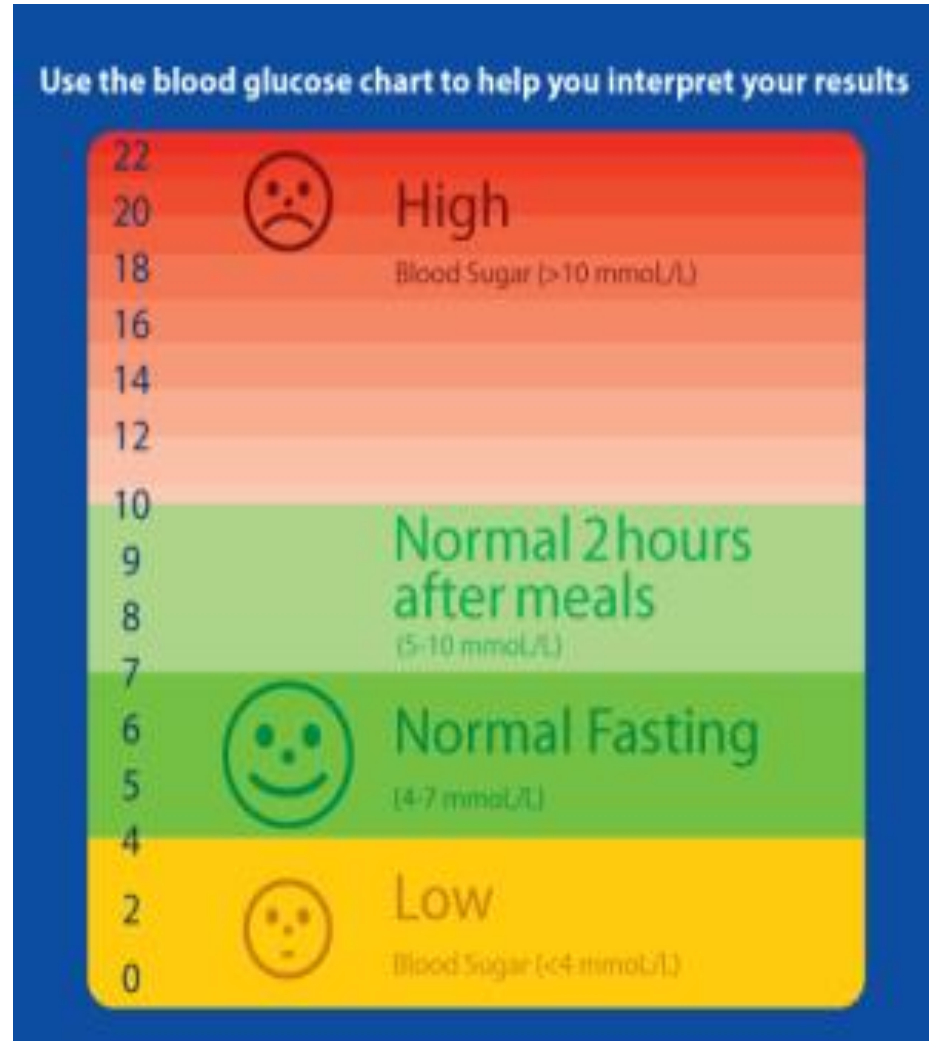
I can discuss Familial Hypercholesterolaemia (FH)

- This is caused by an **autosomal dominant gene** which predisposes individuals to developing **high** levels of cholesterol
- FH causes a **reduction** in the number of **LDL receptors** or an **altered structure** of the receptor.
- **Genetic screening** can be used to determine if the FH gene has been inherited.
- **Lifestyle modifications** and **drugs** are used in the treatment of FH.

Blood Glucose levels and Obesity

I can state the effects of elevated blood glucose levels

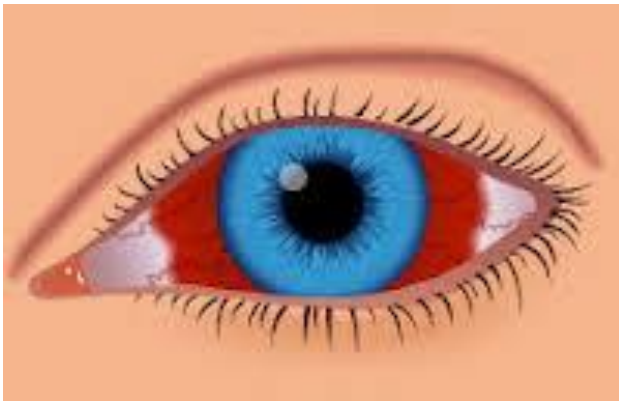
- Normal blood glucose levels are **5 mmol/l**
- If a person has **untreated** diabetes blood glucose levels become elevated
- **Chronic elevation** of blood glucose levels (30mmol/l) leads to **damage** to blood vessels because the endothelial cells take up **more** glucose than normal.



I can state the effects of elevated blood glucose levels

The damage may develop into **atherosclerosis** and lead to cardiovascular disease, **stroke** or **peripheral vascular disease**.

Damaged smaller blood vessels (microvascular disease) may result in **haemorrhage** of blood vessels in the **retina**, renal failure or **peripheral nerve dysfunction**.



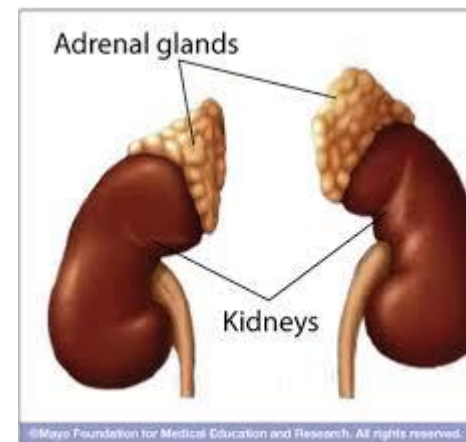
haemorrhage of blood vessels in the retina

I can describe how blood glucose levels are regulated by pancreatic receptors.

- The process of **negative feedback** is responsible for regulating blood glucose concentration.
- The **pancreas** has receptors which respond to **high** glucose levels by producing the hormone **insulin**.
- Insulin **activates** the conversion of **glucose to glycogen** in the liver, **decreasing** blood glucose concentration.
- The pancreas also has receptors that respond to **low** glucose levels by producing **glucagon**.
- Glucagon activates the conversion of **glycogen to glucose** in the liver **increasing** blood glucose levels.

I can describe how blood glucose levels are regulated.

- During **exercise** or **fight or flight** responses, glucose levels are raised by **adrenaline**.
- Adrenaline is released from the **adrenal glands** stimulating **glucagon** secretion and **inhibiting insulin** secretion.

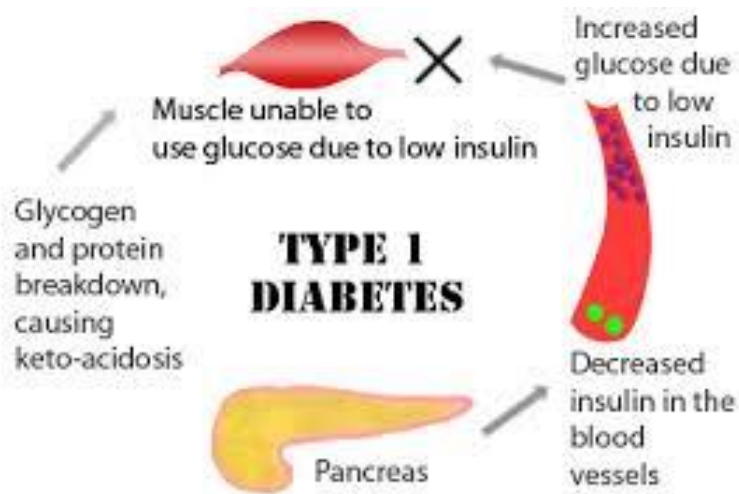


I can state that diabetics cannot regulate blood glucose levels

- A diabetic is **unable** to control their glucose levels
- Vascular disease can be a chronic complication of diabetes
- There are two types of diabetes:
 - **Type 1**
 - **Type 2 or adult onset diabetes**

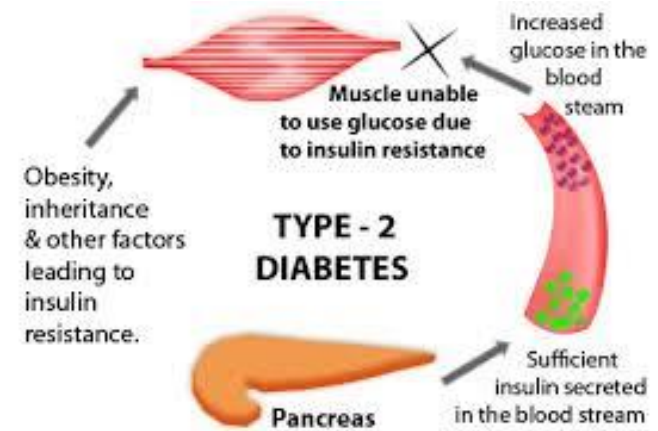
I can describe Type 1 diabetes

- Type 1 diabetes usually occurs in **childhood**.
- The person is unable to produce **insulin**.
- Treatment would involve regular doses of **insulin**.



I can describe Type 2 diabetes

- Type 2 diabetes or adult onset diabetes typically develops **later in life** and occurs mainly in **overweight** individuals.
- The person is able to produce insulin but their cells are **less sensitive** to it.
- The insulin resistance is linked to a **decrease in the number of insulin receptors** in the liver leading to a failure in converting glucose into glycogen.

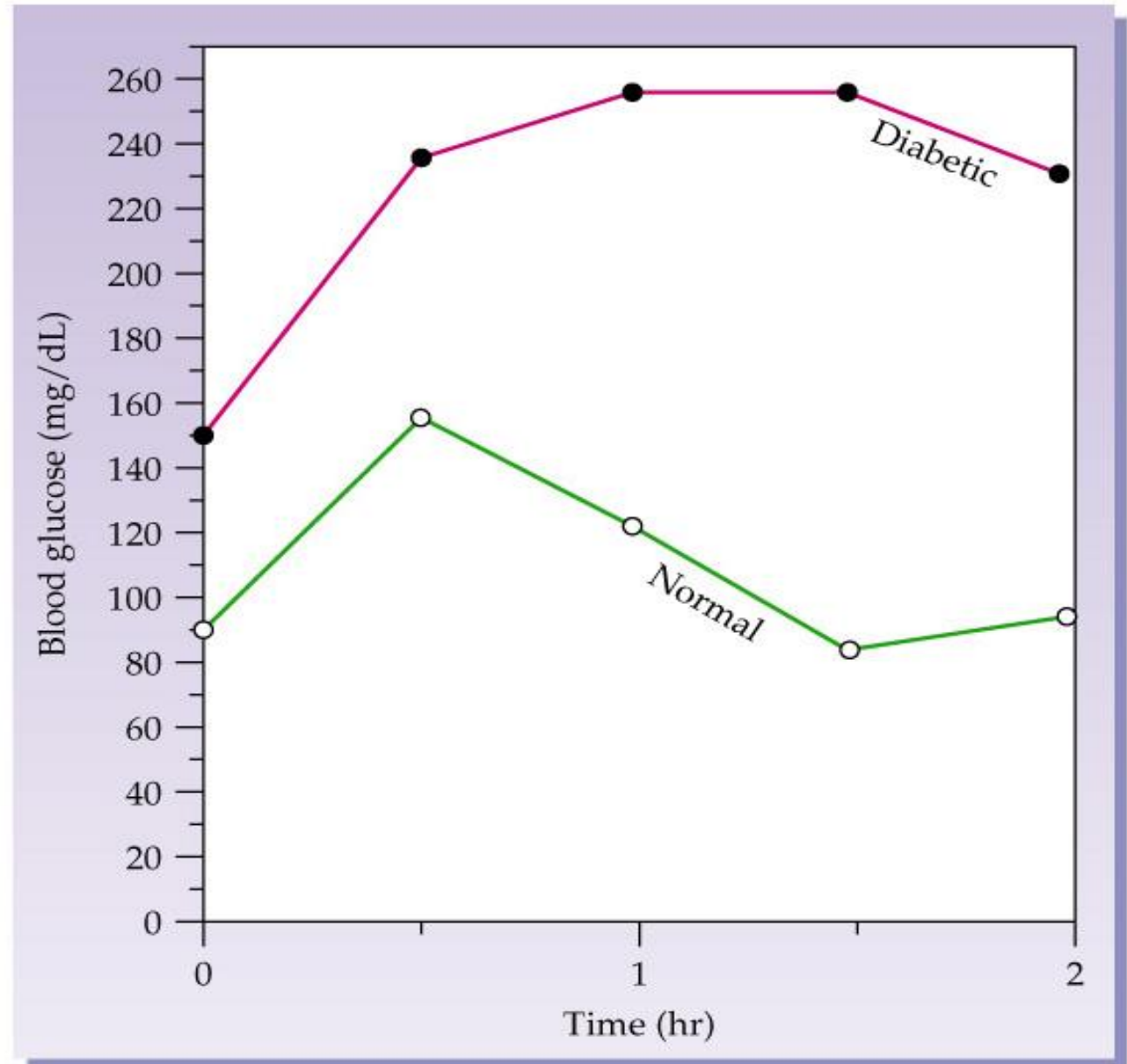


I can describe how diabetes is detected

- In both types of diabetes, individuals blood glucose will **rise** rapidly after a meal and the **kidneys** are unable to cope resulting in glucose being **lost** in the **urine**.
- Testing urine for the presence of glucose is often used as an **indicator** of diabetes.
- **Glucose tolerance test** can be used to diagnose diabetes.
- The blood glucose levels of the individual are measured after fasting and two hours after drinking 250-330ml glucose solution.

I can describe how diabetes is detected

Glucose Tolerance Test



I can describe obesity and state risks.

- Obesity is a major risk factor for cardiovascular disease and type 2 diabetes.
- Obesity is characterised by excess body fat in relation to lean body tissue (muscle).
- A body mass index (BMI) greater than 30 is used to indicate obesity.

$$\text{BMI} = \frac{\text{weight}}{\text{height}^2}$$

I can describe ways of measuring obesity

- To achieve accurate measurements of body fat other tests can be carried out.
- It is important to measure **body density** to allow the degree of accuracy to be increased.
- Other tests that can be carried out to measure body fat are:
 - **Densitometry**
 - **Skin fold thickness**
 - **Bioelectrical impedance**
 - **Waist-hip ratio**
 - **BMI**



Skin fold thickness



Densitometry



Bioelectrical Impedence

I can describe ways to reduce obesity.

- Obesity is linked to high fat diets and decrease in physical activity.
- In the diet fats and free sugars should be limited due to the high calorific value of fats and free sugars don't require the expenditure of metabolic energy to digest them.
- Exercise increases the energy expenditure and preserves lean tissue.

I can describe ways to reduce obesity.

- Exercise can help to reduce the risk factors for CVD by:
 - Keeping weight under control
 - Minimising stress
 - Reducing hypertension
 - Improving HDL blood lipid profiles