Lipids

Triglycerides	Structure	A **glycerol** backbone and **three non-polar hydrophobic hydrocarbon tails** linked to glycerol via **ester linkages** through a **condensation** reaction.
	Ester Linkages	Ester linkages are formed between the –OH group and the –COOH group of glycerol and the fatty acid respectively. One water molecule is removed for each fatty acid joined to glycerol. Ester linkages are broken by hydrolysis into fatty acids and glycerol.
	Components	<u>Explain the solubility of the products of hydrolysis of triglycerides.</u> Glycerol is a **three carbon alcohol** with **polar hydroxyl groups** that form **hydrogen bonds** with water. Hence, it is **soluble** in water. Fatty acids are composed of a **long hydrocarbon chain** with a **carboxyl group** at the end. They have a **COO^- group** which can interact with water. Hence, **short** fatty acids are **soluble** in water. However, as the length of the **non-polar hydrophobic hydrocarbon tail** which **cannot form hydrogen bonds** with water increases, solubility decreases.

Triglycerides	Function	<u>Explain how the structure of triglycerides is related to its function.</u> There are **numerous H and C** and relatively **fewer O atoms** due to the **long hydrocarbon tails** with a **high proportion of C-H bonds** from which **energy** in the form of **ATP** can be released during **oxidation** during **respiration**. Hence, it is a **compact** energy store which stores more energy **per unit mass** ($38kJg^{-1}$) than other respiratory substrates. Oxidation also releases **metabolic water** that is a source of water especially for desert animals. The **long non-polar hydrophobic hydrocarbon tails** cannot form **hydrogen bonds** with water and hence triglycerides are **insoluble in water**. Hence, they do not affect the water potential of the cell. Triglycerides found beneath the layer of skin provide **thermal insulation** as they are poor conductors of heat. They are less dense than water and hence **improve buoyancy**. They **protect** the **internal organs** from mechanical damage, acting as shock absorbers. They function as a reservoir for **storage** of **fat soluble vitamins**.
Phospholipids	Structure	A **glycerol** backbone and **two non-polar hydrophobic hydrocarbon tails** linked to glycerol via **ester linkages** through a **condensation** reaction. The remaining hydroxyl group is joined to a negatively charged hydrophilic phosphate group. Hence, it is **amphipathic**. In an aqueous environment, they arrange to form a **phospholipid bilayer** with a **hydrophobic core** shielded from water.
	Function	Phospholipids are major components of the **phospholipid bilayer** of **cell membranes**. They act as a **barrier** to **polar** and **charged** molecules as the **hydrophobic core** has a low permeability to polar and charged molecules. This allows the passage of these molecules across the membrane to be **controlled** by transmembrane **transport proteins** or **ion channels**. Membranes also act as a **boundary** between the intracellular and extracellular aqueous environment and allow **compartmentalization**. Phospholipids are a major component of **liposomes** which are artificial vesicles surrounded by a phospholipid bilayer that can be used to carry therapeutic DNA into a target cell.

Cholesterol	Structure	Cholesterol has a **hydrophobic four fused ringed structure** with a **hydrophilic –OH end** making it an **amphipathic** molecule.
	Function	Cholesterol aligns with **phospholipids** in the cell membrane with the –OH group interacting with the hydrophilic phosphate heads and the hydrophobic ring structure interacting with the long hydrophobic hydrocarbon tails of phospholipids. It **regulates membrane fluidity** by preventing excessive fluidity at high temperatures by restricting phospholipid movement while preventing freezing at low temperatures by preventing close packing of phospholipids
Test for Lipids		Describe how a test for lipids can be carried out. Add 2cm^3 of **ethanol** to the test sample in a test tube. Mix well and allow to stand for 2 min. **Decant** the ethanol into another test tube containing 2cm^3 of **water**. Lipids are present if a **homogenous solution** is formed with ethanol and an **emulsion** is formed with water. If lipids are absent, a clear solution remains.