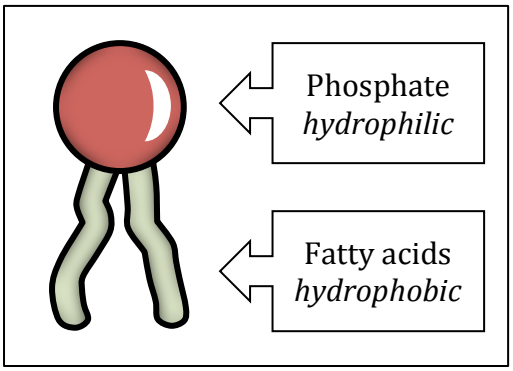
1.3 Membrane Structure

Phospholipids

Draw the structure of a phospholipid and identify its properties



Phospholipids consist of:

- Phosphate head (hydrophilic = water loving)
- 2 x Fatty acid tails (hydrophobic = water hating)

The phosphate group is connected to the fatty acid tails via a glycerol group

Explain how the properties of phospholipids help to maintain the structure of cell membranes

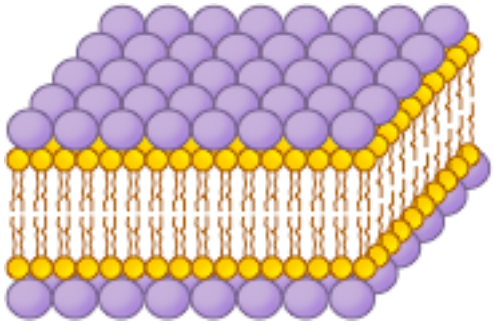
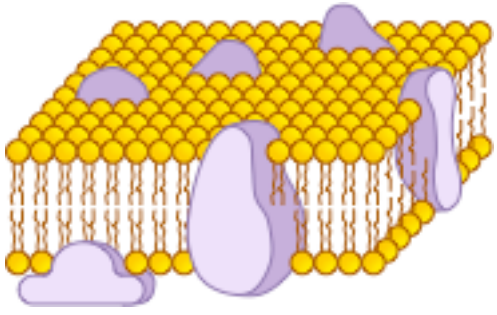
The phospholipids form a phospholipid BILAYER

The hydrophilic phosphate heads face outwards into the aqueous solutions (intracellular and extracellular)

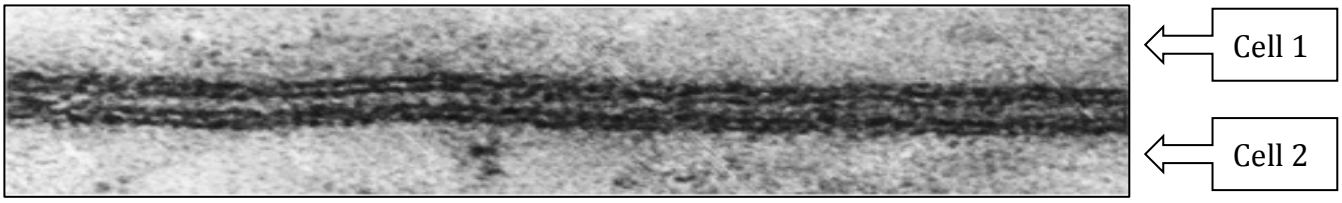
The hydrophobic fatty acid tails face inwards and are held in place by weak hydrophobic associations

Because the associations are weak, phospholipids are able to move within the bilayer (membrane fluidity)

Identify and describe the two main models for membrane structure based on the diagrams below

Model A: Davson-Danielli Model	**Model B:** Nicolson-Singer Model
	
According to this model: Two layers of protein flank a central phospholipid bilayer This model is also referred to as a 'lipo-protein sandwich'	According to this model: Transmembrane proteins are embedded within a phospholipid bilayer This model is also referred to as the 'fluid-mosaic model'

Describe how the following electron micrograph supports the structure of model A



The micrograph shows a trilaminar (three layer) structure: 2 dark outer layers and a light inner layer

This supports the idea of two layers of protein (dark) flanking a central phospholipid bilayer (light)

However this interpretation is incorrect

Outline the evidence that lead to the falsification of model A and acceptance of model B

BIOCHEMICAL EVIDENCE:

Not all membranes have a constant ratio of lipid:protein (precludes 'sandwich' model)

Membrane proteins vary in size and are insoluble in water (can't form an outer layer)

FLUORESCENT ANTIBODY TAGGING:

Membrane proteins are mobile and are not fixed in place (do not form a static layer)

FREEZE FRACTURING:

Fracturing the membrane reveals a rough and irregular internal surface

These irregularities are interpreted as transmembrane proteins

Cholesterol

Explain what is meant by the term 'membrane fluidity'

Membrane fluidity means that the bilayer is not static and membrane components (such as proteins) can

move positions (allows membranes to change shape and to break and reform)

Outline the role of cholesterol in animal cell membranes

Cholesterol interacts with phospholipids to moderate membrane properties:

- It reduces membrane fluidity (immobilises phospholipids at higher temperatures)
- It also reduces membrane permeability (to hydrophilic ions)
- It prevents crystallisation (increase flexibility at lower temperatures)
- It helps secure peripheral proteins by forming high density lipid rafts capable of anchoring the protein

Membrane Proteins

Differentiate between integral and peripheral membrane proteins

- Integral proteins are permanently attached to the membrane and are typically transmembrane (they span across the bilayer and may contain hydrophilic pores to mediate material transfer)
- Peripheral proteins are temporarily attached by non-covalent interactions and associate with only one surface of the membrane

List the functions of membrane proteins

J Junctions – Serve to connect and join two cells together

E Enzymes – Fixing to membranes localises metabolic pathways

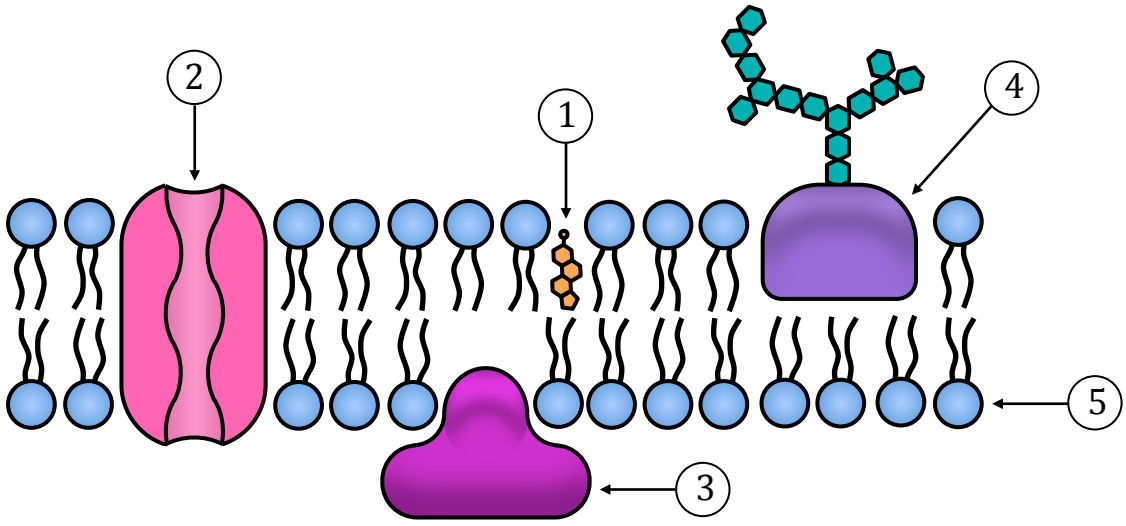
T Transport – Responsible for facilitated diffusion and active transport

R Recognition – May function as markers for cellular identification

A Anchorage – Attachment points for cytoskeleton and extracellular matrix

T Transduction – Function as receptors for peptide hormones

Label the following diagram of a plasma membrane



1. Cholesterol (animal cell membrane)
2. Integral protein (transmembrane)
3. Peripheral Protein
4. Glycoprotein (receptor molecule)
5. Phospholipid (part of a bilayer)