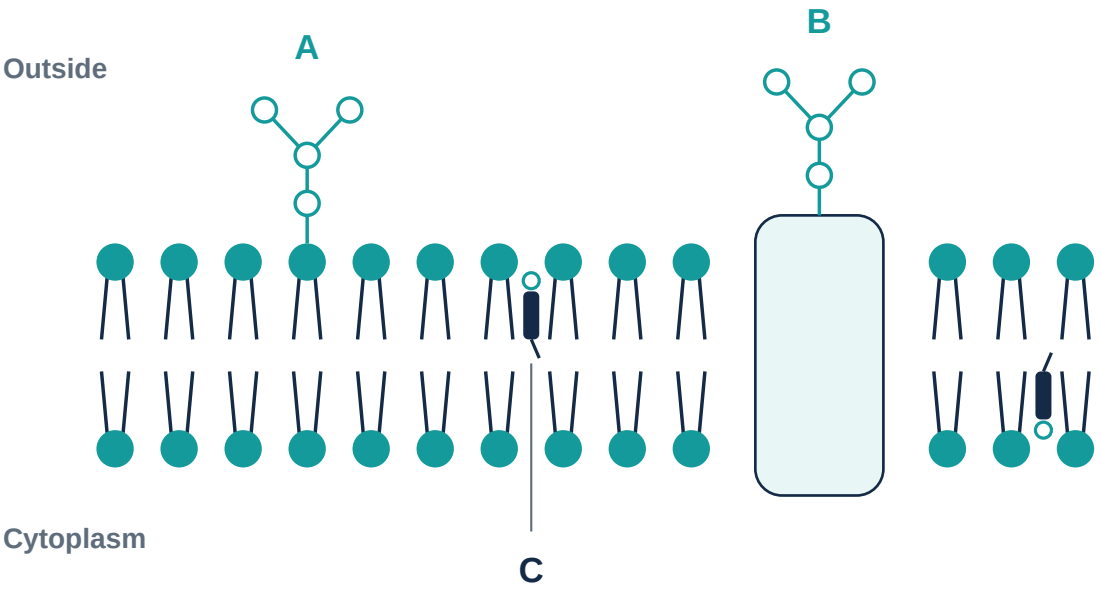
Locate the three components

Use the phospholipid bilayer as a reference. Cholesterol lies among the lipids; carbohydrate chains on glycolipids and glycoproteins project from the external surface.

1. AN ANIMAL CELL SURFACE MEMBRANE



Simplified symbols; not to scale. Unlabelled circles with paired tails are phospholipids.

A. GLYCOLIPID

A carbohydrate chain is attached to a lipid in the outer leaflet. The lipid region anchors it in the membrane; the sugar chain faces the external solution.

B. GLYCOPROTEIN

A carbohydrate chain is attached to a protein. The example spans the bilayer, but its carbohydrate projects only from the outside-facing region.

C. CHOLESTEROL

A small amphipathic lipid among the phospholipids, not a protein or a sugar chain. The symbols show molecules in both leaflets of the bilayer.

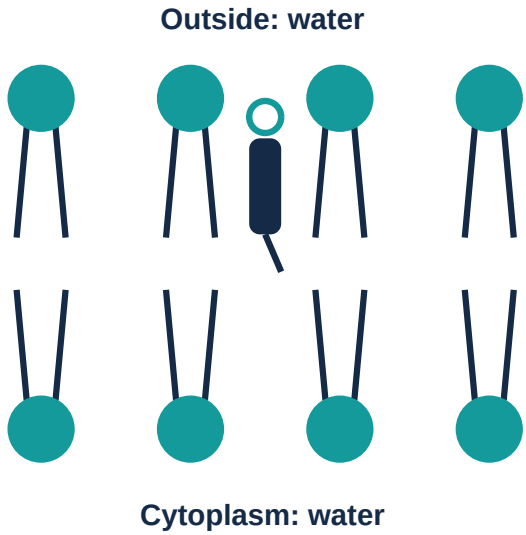
Component map: OpenStax Biology 2e, section 5.1, Components and Structure.

Scope: Cambridge Biology 9700 syllabus, section 4.1, outcome 2, p. 21.

Cholesterol sits between lipids

In animal cell membranes, cholesterol is interspersed among phospholipids. Its small polar region and much larger non-polar region determine its orientation.

1. MATCH EACH REGION TO ITS SURROUNDINGS



Small hydroxyl (-OH) group near the polar head groups at the water-lipid interface.

Non-polar rings and hydrocarbon tail among the fatty acid tails.

Ring region = dark bar. Symbol shows orientation, not the chemical structure.

2. A STEROL, NOT A PHOSPHOLIPID

Cholesterol has four fused carbon rings, a hydrocarbon tail and one hydroxyl group. It does not have a phosphate head with two fatty acid tails. Its hydrophobic region occupies part of the membrane core rather than forming a separate layer.

3. POSITION IS DIFFERENT FROM FUNCTION

Describe the arrangement first: between phospholipids, with the hydroxyl group near the heads. This positioning influences lipid packing. The detailed effects on fluidity, stability and permeability belong to Lesson 4.1.3.

Do not draw cholesterol as a membrane-spanning protein or place its entire molecule outside the bilayer.

Cholesterol orientation and structure: Alberts et al., The Lipid Bilayer.

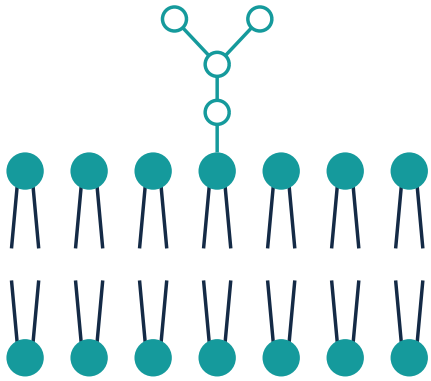
Scope: Cambridge Biology 9700 syllabus, section 4.1, outcome 2, p. 21.

Carbohydrate, different anchors

The prefix glyco- refers to carbohydrate. The distinguishing feature is what the chain is attached to: a lipid in a glycolipid, or a protein in a glycoprotein.

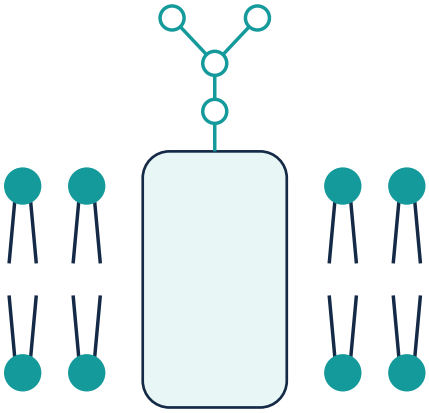
1. FOLLOW THE CHAIN TO ITS ANCHOR

GLYCOLIPID



Carbohydrate attached to lipid

GLYCOPROTEIN



Carbohydrate attached to protein

2. THE CARBOHYDRATE CHAINS FACE OUTWARDS

At the cell surface, these chains project into the extracellular space, not into the cytoplasm or hydrophobic core. They are covalently attached components, not loose sugars passing through the membrane. Their distribution makes the two membrane surfaces different.

3. ORIENT AN UNLABELLED DIAGRAM

Find the attached carbohydrate chains: that side is the cell exterior. Then identify whether each chain joins a lipid or a protein. Do not use the protein alone to decide which side is outside, because proteins may be exposed on both faces.

These chains contribute to the carbohydrate-rich cell coat (glycocalyx). Their exposed position allows interactions with the surroundings. Functions such as recognition and signalling are explored in the following lessons.

Carbohydrate attachments and cell coat: Alberts et al., Membrane Proteins.
External orientation: OpenStax Biology 2e, section 5.1.

Scope: Cambridge Biology 9700 syllabus, section 4.1, outcome 2, p. 21.