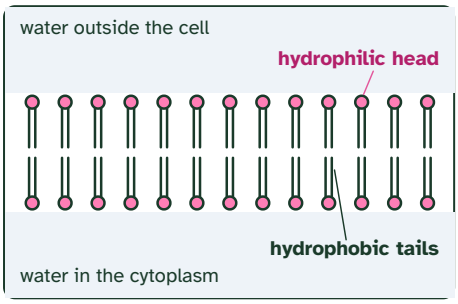
AP BIOLOGY | UNIT 2 | TOPICS 2.3, 2.4 | REVISION ON TWO PAGES

The membrane: a *fluid* barrier

What to know, what to draw and what to say. Nothing else.

THE ONE IDEA

Phospholipids form a bilayer with a hydrophobic core. That core decides what crosses; proteins let through the rest.



Draw it like this. A circle for each head, two lines for its tails, water on both sides.

2.3.A START HERE

A barrier that *builds itself*

- A phospholipid has two ends. Its charged phosphate head is **hydrophilic**: it mixes with water. Its two nonpolar fatty acid tails are **hydrophobic**: water pushes them out.
- A cell has water on both sides, so phospholipids settle into a **bilayer**: heads facing the water on each side, tails facing each other in the middle.
- Nothing arranges them. Water hydrogen bonds with itself and squeezes the tails together: the **hydrophobic effect**. That is why a torn membrane seals itself.

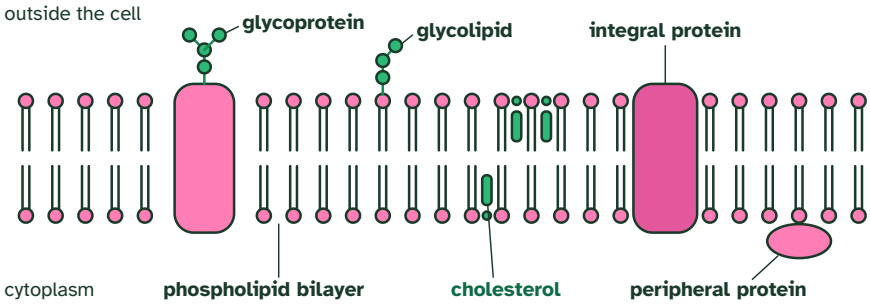
WHAT THE PROTEINS IN A MEMBRANE DO

T Transport: carry substances across	**S** Signals: receive them	**J** Joining: cell to cell	**E** Enzymes: speed up reactions

2.3.B

The *fluid mosaic* model

- **Mosaic:** a framework of phospholipids with other molecules set in it like tiles: **proteins, cholesterol** (in eukaryotes), **glycoproteins and glycolipids**.
- **Fluid:** nothing is fixed. Phospholipids and most proteins **move sideways** within the membrane, like a film of oil.
- Fluidity lets a membrane seal itself, and bud off or take in vesicles.



2.3.A PLACED BY R GROUPS

Proteins in the bilayer

- Where a protein sits depends on its **amino acids**. Nonpolar R groups are hydrophobic and stay **among the tails**; charged and polar R groups face the water.
- An integral protein has both: a hydrophobic region in the core and hydrophilic regions out in the water.

Integral in the bilayer
Set into it; many span it from one side to the other. One set in a single layer still counts.

Peripheral on the surface
Hydrophilic all over. Held to the heads or to an integral protein.

2.3.B THREE CONTROLS

Not too stiff, *not too runny*

- **Temperature:** warmer is more fluid, colder is stiffer.
- **Tails:** saturated tails pack tightly; the kinks in **unsaturated tails** keep them apart. Cold-water fish and plants in the cold make more of these.
- **Cholesterol** steadies fluidity: it holds phospholipids back when warm and stops tails packing when cold.



saturated
straight: stiffer

unsaturated
kinked: more fluid

2.3.B CELL RECOGNITION

Sugar *name tags*

- A **glycoprotein** is a protein with sugar chains; a **glycolipid** is a lipid with them.
- The sugars face **outward only**. The side of the membrane facing the cytoplasm has none.
- Each cell type has its own pattern, so cells **recognize each other** and the immune system tells your cells from invaders.

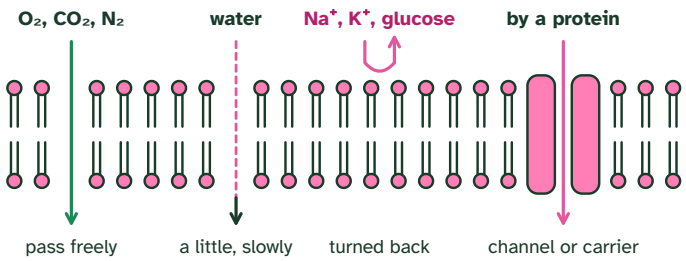
A, B, O
blood groups are differences in the sugar chains on red blood cells

What *gets through*, and the wall outside

2.4.A

Selectively permeable

- A membrane lets only some things across: it is **selectively permeable**, and its structure decides which.
- To cross unaided, a molecule must pass the **hydrophobic core** of tails. Small nonpolar molecules dissolve in it and pass straight through.
- Charged and strongly polar molecules are turned back. They cross through **channel and carrier proteins**, each fitting only some substances, so the cell chooses what comes in.



2.4.A SIZE AND CHARGE DECIDE

What crosses the *bilayer itself*

KIND OF MOLECULE	EXAMPLES	CROSSES UNAIDED?	WHY
Small, nonpolar	O_2, CO_2, N_2	**Yes, freely**	It dissolves in the hydrophobic core.
Small, polar, uncharged	Water	**In small amounts**	Polar, but small enough to slip between the phospholipids.
Ions	Na^+, K^+	**No**	Charge holds a shell of water around the ion; the core will not let it in.
Large, polar	Glucose	**No**	Too polar and too large for the core.

Size is not the whole story: Na^+ is smaller than O_2, yet cannot cross.

Ions and large polar molecules need a transport protein

2.4.B

A *wall* outside the membrane

- Plants, fungi and most prokaryotes have a **cell wall** outside the plasma membrane, made of complex carbohydrates.
- It is a **structural boundary**: it gives the cell its shape, supports the plant and stops the cell bursting when water rushes in.
- It is a barrier only to some substances: very large molecules and many viruses.

2.4.B ALL COMPLEX CARBOHYDRATES

Three walls, *three carbohydrates*

CELLS	WALL OF	MADE FROM
Plants	**Cellulose**	Long chains of glucose lying side by side.
Fungi	**Chitin**	Chains of glucose units that carry nitrogen.
Bacteria	**Peptidoglycan**	Sugar chains cross-linked by short peptides.

Animal cells have no wall: the cytoskeleton and materials such as collagen support them.

WATCH OUT

Five mistakes that *cost points*

- ✕ **No bonds hold the tails together.** Water pushes them together, because it bonds with itself and not with them.
- ✕ **Cholesterol does not always stiffen.** It firms a warm membrane and keeps a cold one fluid.
- ✕ **Sugar chains are on the outside only.** None face the cytoplasm.
- ✕ **Small does not mean it crosses.** An ion is tiny, but its charge keeps it out of the core.
- ✕ **A wall is not a second membrane.** Water, ions and small molecules pass through it; the membrane does the choosing.

COVER THE SHEET

Can you *answer these?*

1. Explain why phospholipids form a bilayer in water.
2. Describe where an integral and a peripheral protein sit.
3. Explain why a membrane-spanning region has nonpolar R groups.
4. Describe what "fluid" and "mosaic" each mean.
5. Predict how a cold-water fish's tails differ from a reef fish's.
6. Explain how cholesterol steadies fluidity.
7. Identify which crosses a bilayer fastest: CO_2, K^+ or glucose.
8. Identify the wall material of plants, fungi and bacteria.

IN THE EXAM

Give the property, then the consequence: "K^+ is charged, so it cannot pass the hydrophobic core and needs a channel protein" earns the point. "It is too big" does not.

GO FURTHER

Animated figures, a dry lab and a marked Check are in the full guide online.