A membrane from scratch

60 minutes • 2.3.A, 2.3.B • Chapters 1, 2, 3, 4

Phospholipids and the bilayer, integral and peripheral proteins, the fluid mosaic model with cholesterol, glycoproteins and glycolipids, and fluidity

BY THE END, STUDENTS CAN

- [ ] Explain how the hydrophilic heads and hydrophobic tails of phospholipids arrange themselves into a bilayer with water on both sides 2.3.A
- [ ] Describe integral and peripheral proteins and explain how their hydrophobic and hydrophilic regions place them in the membrane 2.3.A
- [ ] Describe the fluid mosaic model, with cholesterol, glycoproteins and glycolipids, and explain what makes a membrane more or less fluid 2.3.B

TIMING

0–5	5 min	**Do now: oil and water**
5–17	12 min	**Three thought experiments**
17–26	9 min	**Setting proteins in**
26–38	12 min	**The mosaic**
38–48	10 min	**Stiff or runny**
48–60	12 min	**Exit**
	60 min	**One lesson**

STARTER

5 min

Do now: oil and water

A drop of washing-up liquid on water with pepper sprinkled on it, or a photo of one. Pairs write what the soap molecule must be like to sit at the surface. Keep the answer for the next step.

ON THE BOARD, FROM THE GUIDE

Open the guide on the projector at each chapter (the links work in this PDF). Every figure plays from its own buttons, and the lesson's slides have the same figures, step by step, in the order of this plan.

01 A barrier that builds itself

CHAPTER 01 IN THE SLIDES

Play the animation, Watch it happen: a bilayer builds itself. It loops; pause it on each moment below and ask what is happening (in the lesson slides it is a video).

1. Phospholipids stirred into water point every which way.
2. The tails cannot form hydrogen bonds with water, so water crowds the **tails** together.
3. No enzyme placed them and no energy was spent: **water** arranged them.

> **Predict box:** Phospholipids are shaken in oil instead of water. How would they arrange themselves? Hands up or mini whiteboards first.
>
> **Answer B: Turned the other way round, tails out into the oil and the heads hidden together in the middle**

02 Proteins in the bilayer

CHAPTER 02 IN THE SLIDES

Tap the parts of the figure in turn: .

> **Predict box:** A membrane protein has a stretch of about twenty amino acids with nonpolar R groups in the middle of its chain, and charged amino acids at both ends. Where is it? Hands up or mini whiteboards first.
>
> **Answer B: Spanning the membrane once, the nonpolar stretch among the tails and the charged ends in the water**

03 A fluid mosaic

CHAPTER 03 IN THE SLIDES

Tap the parts of the figure in turn: .

> **Predict box:** A mouse cell and a human cell are fused, each with its membrane proteins tagged a different color. An hour later, how are the colors spread? Hands up or mini whiteboards first.
>
> **Answer B: Mixed all over the new cell's membrane, because the proteins drift sideways through a fluid bilayer**

04 Not too stiff, not too runny

CHAPTER 04 IN THE SLIDES

Switch the figure through Saturated, Unsaturated and With cholesterol, and have the class say what will change before each.

> **Predict box:** A fish that lives in icy water is compared with one from a warm reef. What would you expect of its membranes? Hands up or mini whiteboards first.
>
> **Answer B: More unsaturated fatty acids, so the kinked tails keep the membrane fluid at low temperature**

THE LESSON

12 min

Three thought experiments

The whiteboard activity below: phospholipids in water, in oil, and with water on one side only. Pairs sketch each, then chapter 1's film plays the first through and chapter 1's predict box checks the second.

9 min

Setting proteins in

Chapter 2's figure: tap each protein. Then give a sequence of R groups (charged, ten nonpolar, charged) and ask where it sits and why. Link to the R groups of Unit 1.

12 min

The mosaic

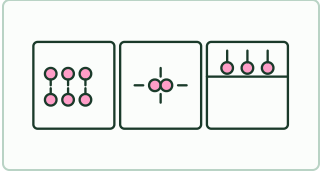
Chapter 3's figure on the board, then the card sort below: pairs place each component and write its job. Close with the mouse and human cell experiment in chapter 3's predict box: what would show a membrane is fluid?

10 min

Stiff or runny

Chapter 4's figure through saturated, unsaturated and cholesterol. Butter and olive oil from the fridge on the desk: which tails does each have? Ask what an arctic fish would do with its membranes.

ACTIVITIES

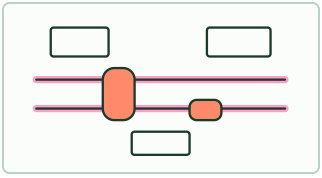


THINKING

Three thought experiments

Each pair has a mini whiteboard and draws a phospholipid as a circle with two lines. One: a handful dropped into water. Two: the same in oil. Three: a water surface with air above. Pairs sketch where the heads and tails end up and give a reason, then compare round the room before the film plays. Every arrangement follows from one rule: heads toward water, tails away from it.

Needs: mini whiteboards and pens.



CARD SORT

Build the mosaic

A large outline of a bilayer on A3 and a set of cards: phospholipid, cholesterol, channel protein, carrier protein, peripheral protein, glycoprotein, glycolipid, receptor. Pairs place each card where it belongs and write its job on a sticky note beside it. Any card on the wrong side (sugars facing the cytoplasm) gets a question from the next pair round.

Needs: an A3 outline and a set of eight cards per pair, sticky notes.

PLENARY

12 min

Exit

Draw and label a section of membrane with five components and a job for each (5 marks), then swap and mark with a partner against the figure.

WHAT STUDENTS GET WRONG

"The tails are bonded to each other." Water pushes them together; there is no bond between them.

"Peripheral proteins sit in the middle of the membrane." They sit on its surface; integral proteins are set into it.

"The membrane is a fixed layer." Its lipids and most proteins move sideways all the time.

"Cholesterol makes membranes stiffer." Only when warm; in the cold it keeps them fluid.

STRETCH AND SUPPORT

Stretch: soap breaks down cell membranes. Use the structure of a soap molecule and of a phospholipid to explain why.

Stretch: predict how the membranes of a bacterium change if it is moved from 37 °C to 15 °C, and why.

Support: a printed phospholipid to cut out and arrange, with "loves water" and "avoids water" on its parts.

For revision: students can drill this unit's key terms on Cramly.

IN THE GUIDE

1 A barrier that builds itself
2 Proteins in the bilayer
3 A fluid mosaic
4 Not too stiff, not too runny
All The whole guide, with the figures that play
PPTX This lesson's slides, in the order of this plan

EXAM PRACTICE

Check yourself

Set it for homework: a fresh paper of exam-bank questions on 2.3, 2.4 each time, marked as students go and saved to their Exam practice when they are signed in.

biologybybradford.com/exam-maker/sit?program=ap&units=U2&ced=2.3,2.4&paper=quiz&marks=15&src=ep

PRACTISE AND REVISE

BUILD FOR YOUR CLASS

- Tarsia puzzle, dominoes and picture reveal on Unit 2, built from its key terms and ready to print
- A pub quiz with rounds on Unit 2, to present or run with no projector
- The Cell Factory Lockdown escape room, or an escape room built from the question bank on Unit 2

ALREADY ON THE SITE FOR UNIT 2

- Lesson: Membranes & Permeability
- Lab: The Endomembrane System
- Quiz: Plasma Membrane & Permeability
- Exam questions: Unit 2 in the exam maker, a paper with scoring guidelines

CARD SETS ON SPLYCR

Open a set to host it as a class game, or make a copy to edit.

- Unit 2: Cell Structure and Function (part 1)
- Unit 2: Cell Structure and Function (part 2)
- Unit 2: Cell Structure and Function (part 3)

How this was made. The course structure, the activities and the teaching choices come from my own classroom, my presentations and my years of teaching IB and AP Biology. I use Claude, an AI, to help write and build the interactive guides, lesson plans, slides and practice questions, and to draw the diagrams and code the interactives. I direct the work and review it against the IB and AP specifications before it goes live.