Fats, oils and membranes

60 minutes • 1.5.A • Chapters 1, 2, 3 • The dry lab

Lipids as nonpolar molecules, triglycerides, saturation and melting point, and phospholipid bilayers

BY THE END, STUDENTS CAN

- [ ] Explain why lipids are nonpolar and hydrophobic, and describe a triglyceride and the water released in making one 1.5.A
- [ ] Explain how saturated and unsaturated fatty acids differ in structure, and how that sets the melting point of a fat 1.5.A
- [ ] Explain how the polar head and nonpolar tails of phospholipids make them form a bilayer in water 1.5.A

TIMING

0–5	5 min	Do now: butter and oil	
5–13	8 min	Why lipids avoid water	
13–21	8 min	Kinks and melting	
21–37	16 min	Fats on the bench	
37–52	15 min	A membrane builds itself	
52–60	8 min	Exit	
	60 min	One lesson	

STARTER

5 min

Do now: butter and oil

A dish of butter and a dish of olive oil, both at room temperature. Pairs write one difference they can see and one guess at the reason. Keep the guesses for the saturation chapter.

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 The molecules water will not touch

CHAPTER 01 IN THE SLIDES

Step through the figure (5 steps, the arrow keys on a projector). Stop on each caption and ask what changed before you go on.

1. Shake oil with **water**,
2. and it separates and floats: it does not dissolve.
3. In a **nonpolar solvent** such as hexane, it dissolves.
4. Butter is mostly fat, with some water and, in salted butter, salt.
5. Melted, the **fat** separates from the watery layer, and the salt stays dissolved in the water.

Switch the figure through Triglyceride and Phospholipid, and have the class say what will change before each.

Show the figure: Assumes 10 000 kJ a day, 37 kJ g^{-1} for fat, 17 kJ g^{-1} for glycogen, and 3 g of water stored with every gram of glycogen.

> **Predict box:** You have salted butter but need it unsalted. What could you do? Hands up or mini whiteboards first.
>
> **Answer B: Melt it, leave it to settle, then pour the fat off the watery layer**

02 Every double bond puts a kink in the tail

CHAPTER 02 IN THE SLIDES

Switch the figure through Saturated, Monounsaturated and Polyunsaturated, and have the class say what will change before each.

Show the figure: The bench: a frozen sample in a capillary tube, banded to the tip of a probe in a bath that warms slowly. Watch the tube under the lens, and read the probe when the first liquid shows and when the last crystal goes.

> **Predict box:** Olive oil's fatty acids mostly have one double bond, and sunflower oil's mostly two or more. Both are liquid at room temperature. You put a bottle of each in the fridge at 5 °C. Which turns cloudy and thick? Hands up or mini whiteboards first.
>
> **Answer B: Olive oil, because with fewer double bonds its chains pack better, so its melting point is higher**

> **Remember it:** Double Kinks Leave Liquids (C=C double bond, Kinked chain, Loose packing, Low melting point).

03 Half loves water, half does not

CHAPTER 03 IN THE SLIDES

Step through the figure (4 steps, the arrow keys on a projector). Stop on each caption and ask what changed before you go on.

1. One molecule, two natures: **amphipathic**.
2. Mixed into water,
3. the tails turn away from water and the heads face it,
4. forming a **bilayer**, with water on both sides.

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. Which way do they turn? Hands up or mini whiteboards first.
>
> **Answer C: Tails out into the oil and heads gathered together inside, the reverse of how they sit in water**

THE LESSON

8 min

Why lipids avoid water

Chapter 1's figure a step at a time: oil in water, oil in hexane, melted butter. Then the switch under it: count the waters released in making a triglyceride and a phospholipid.

8 min

Kinks and melting

Chapter 2's figure: saturated, one double bond, two. Ask before revealing the packed rows: "Which of these can lie closest together?" Back to the do now: now explain the butter.

16 min

Fats on the bench

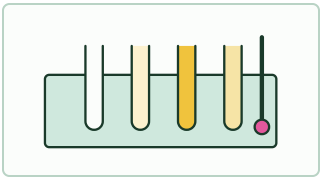
The fats dry lab in pairs (activity below): predict the order of four fatty acids, melt each three times, then the kitchen fats.

15 min

A membrane builds itself

Chapter 3's figure, then the bilayer film with labels on, then off: students name each part. Then the soap bubble demo (activity below): a membrane that seals itself.

ACTIVITIES

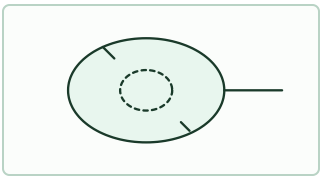


DRY LAB

Fats on the bench

The fats dry lab under chapter 2: frozen fatty acids warmed slowly in a bath until each melts. Students predict the order from the number of double bonds, run three repeats and graph the means, then try butter, lard and plant oils. For real, a quick version: butter, coconut oil and olive oil in test tubes in a beaker of warm water, timed to melt.

Needs: phones or laptops. For the real version: test tubes, a beaker of water at about 40 °C, a thermometer, butter, coconut oil, olive oil, a timer.



DEMO

A membrane that seals itself

Dip a wire loop in bubble solution to make a film, then push a wet pencil through it: the film closes round it and seals when it is pulled out. A dry pencil pops it. Ask why: soap, like a phospholipid, has a hydrophilic head and a hydrophobic tail, and the film holds together by the same attractions as a bilayer, not by fixed bonds.

Needs: a wire loop or pipe cleaner, bubble solution with a little glycerol, a pencil, water.

PLENARY

8 min

Exit

On paper: "Explain why phospholipids form a bilayer in water" (3 marks). Then chapter 3's predict box (phospholipids in oil) for anyone who finishes.

WHAT STUDENTS GET WRONG

"Lipids are polymers of fatty acids." A triglyceride is four parts, glycerol and three fatty acids, not a repeating chain.

"Saturated means full of fat." Saturated with hydrogen: no C=C double bonds.

"Melting breaks the bonds in a fat." It separates whole molecules; no covalent bond breaks.

"The heads are hydrophobic." The phosphate heads are polar and face the water; the tails hide from it.

STRETCH AND SUPPORT

Stretch: predict how the fatty acids in the membranes of a fish in cold water differ from a fish in warm water, and why.

Support: a labeled diagram of a phospholipid and of a nucleotide to annotate before drawing either from memory.

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

IN THE GUIDE

1 The molecules water will not touch
2 Every double bond puts a kink in the tail
3 Half loves water, half does not
Lab Dry lab: Getting DNA out
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 1.5 and 1.6 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=U1&ced=1.5,1.6&paper=quiz&marks=15&src=ep

PRACTISE AND REVISE

BUILD FOR YOUR CLASS

- Tarsia puzzle, dominoes and picture reveal on Unit 1, built from its key terms and ready to print
- A pub quiz with rounds on Unit 1, to present or run with no projector
- The Frozen Lake Station escape room, or an escape room built from the question bank on Unit 1

ALREADY ON THE SITE FOR UNIT 1

- Lesson: Lipids & Nucleic Acids
- Quiz: Lipids & Nucleic Acids
- Exam questions: Unit 1 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 1: Chemistry of Life (part 1)
- Unit 1: Chemistry of Life (part 2)

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.