Receptors, bacteria and the chemical toolkit

60 minutes • C2.1.1 to C2.1.5 • Chapters 1, 2, 3, 4

Receptors and ligands, quorum sensing, the four categories of signalling chemical and their chemical diversity

TIMING

0–5	5 min	Do now: how does a cell know?	
5–17	12 min	Lock and key	
17–32	15 min	Bacteria that count	
32–50	18 min	Four ways to send a message	
50–60	10 min	Exit	
	60 min	One lesson	

STARTER

5 min

Do now: how does a cell know?

Ask: a liver cell and a skin cell are both bathed in blood. Why does only one respond to a hormone? Collect ideas and return to them at the end.

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 lock that only one key opens

CHAPTER 01 IN THE SLIDES

Switch the figure through Circle, Square and Triangle, and have the class say what will change before each.

> **Predict box:** Three ligands, a circle, a square and a triangle, are added to a receptor with a triangular binding site. Which one will switch the receptor on? Hands up or mini whiteboards first.
>
> **Answer B: The triangle, because its shape fits the binding site**

02 Bacteria that count each other

CHAPTER 02 IN THE SLIDES

Play the animation, Bacteria counting each other. It loops; pause it on each moment below and ask what is happening (in the lesson slides it is a video).

1. A few **Vibrio fischeri** cells in seawater. Each releases a little of a signalling molecule, an **autoinducer**, but it drifts away. The cells stay dark.
2. The cells divide, and more of them are making the autoinducer.
3. The molecules now arrive faster than they drift away, so the **concentration builds up**. Each cell is measuring how many cells are around it.
4. At a **threshold** concentration the signal binds receptors in every cell and switches on the genes for light: **quorum sensing**.
5. Lit cells make even more autoinducer, so the whole population switches on together. Move the slider to start with more or fewer cells.

> **Predict box:** A single Vibrio fischeri cell in a large volume of seawater is given the genes for light. Will it glow? Hands up or mini whiteboards first.
>
> **Answer B: No, because the autoinducer it makes spreads out and never reaches the threshold**

03 Four ways to send a message

CHAPTER 03 IN THE SLIDES

Switch the figure through Hormone, Neurotransmitter, Cytokine and Calcium ions, and have the class say what will change before each.

> **Predict box:** Which signalling chemical would be the best choice for a message that has to reach every muscle in the body, and last for several minutes? Hands up or mini whiteboards first.
>
> **Answer B: A hormone, because it travels in the blood to all target cells and lasts**

04 Why so many kinds of chemical?

CHAPTER 04 IN THE SLIDES

Tap the parts of the figure in turn: Amines, Proteins and peptides, Steroids, Amino acids, Peptides, Amines and Nitric oxide (NO).

THE LESSON

12 min

Lock and key

Chapter 1's predict box, then the circle, square and triangle in the figure. Students explain in a sentence why binding depends on the shape and chemistry of the site.

15 min

Bacteria that count

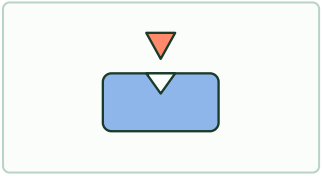
Chapter 2's predict box first, then the quorum film. Run it with the slider at 5, 20 and 40 starting cells and ask when the light comes on each time.

18 min

Four ways to send a message

Chapter 3's predict box and the four-way switch, then chapter 4's tap-to-explore. Pairs fill a table: made where, travels how, acts how fast. Check the nitric oxide / nitrous oxide note.

ACTIVITIES



PRACTICAL

Lock and key with paper

Give each pair a receptor card with a cut-out binding site and a set of ligand shapes, some close but not exact. Pairs test each and record which bind, then add a 'look-alike' that fits but does not switch the receptor on, and discuss what a drug that does this would do.

Needs: card, scissors, a set of shapes.

PLENARY

10 min

Exit

Give two differences between a hormone and a neurotransmitter, and one reason for having many chemicals as signals.

WHAT STUDENTS GET WRONG

"A cell responds to any chemical that touches it." Only a cell with a receptor that fits the ligand responds. Other cells ignore it.

"Quorum sensing means bacteria vote." Each cell makes the same signal; the concentration tells the population how many there are. No cell counts.

"Nitrous oxide is a neurotransmitter." The gas is nitric oxide, NO. Nitrous oxide, N_2O, is laughing gas.

STRETCH AND SUPPORT

Support: a labelled diagram of a receptor, ligand and binding site to colour.

Stretch: why might a bacterial population benefit from lighting up only when it is dense?

IN THE GUIDE

1 A lock that only one key opens
2 Bacteria that count each other
3 Four ways to send a message
4 Why so many kinds of chemical?
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 C2.1 each time, marked as students go and saved to their Exam practice when they are signed in.

biologybybradford.com/exam-maker/sit?topics=C2.1&level=HL&paper=quiz&marks=15&src=ep

PRACTISE AND REVISE

BUILD FOR YOUR CLASS

- Tarsia puzzle, dominoes and picture reveal on C2.1, built from its key terms and ready to print
- A pub quiz with rounds on C2.1, to present or run with no projector
- An escape room built from the question bank on C2.1

ALREADY ON THE SITE FOR C2.1

- Lab: Signal Lab
- Quiz: Chemical Signalling (HL)
- Revision map: C2.1 Chemical signalling, to fill in
- Exam questions: C2.1 in the exam maker, a paper with its markscheme

CARD SETS ON SPLYCR

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

- C2.1 Chemical Signaling (HL)

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.