Light in, heat out

60 minutes • C4.2.1, C4.2.2, C4.2.6 to C4.2.9 • Chapters 1, 2

Open and closed systems, sunlight and its exceptions, autotrophs (photo and chemo), heterotrophs and respiration in all of them

BY THE END, STUDENTS CAN

- [ ] Describe an ecosystem as an open system that energy and matter enter and leave, and a closed system as one only energy crosses C4.2.1
- [ ] Explain why sunlight sustains most ecosystems, and name ecosystems it does not C4.2.2
- [ ] Describe autotrophs as making carbon compounds from inorganic substances with an external energy source C4.2.6
- [ ] Compare photoautotrophs, which use light, with chemoautotrophs such as iron-oxidising bacteria C4.2.7
- [ ] Describe heterotrophs as building their carbon compounds from those of other organisms C4.2.8
- [ ] Explain that autotrophs and heterotrophs both release energy by cell respiration C4.2.9

TIMING

0–6	6 min	**Do now: the jar**	
6–18	12 min	**Open or closed**	
18–26	8 min	**In the dark**	
26–50	24 min	**Make it or take it**	
50–60	10 min	**Exit**	
	60 min	**One lesson**	

STARTER

6 min

Do now: the jar

A photo of a sealed bottle garden that has grown for decades. Pairs list what must get in and what must get out for it to survive.

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 Light in, heat out

CHAPTER 01 IN THE SLIDES

Switch the figure through A wood: open and A sealed jar: closed, and have the class say what will change before each.

> **Predict box:** A student seals a jar with pond water, waterweed and snails and keeps it on a sunny windowsill. What must cross the glass for the jar to keep going for years? Hands up or mini whiteboards first.
>
> **Answer B: Light in and heat out, because only energy has to cross: the matter inside is recycled**

02 Make it or take it

CHAPTER 02 IN THE SLIDES

Switch the figure through Photoautotroph, Chemoautotroph and Heterotroph, and have the class say what will change before each.

> **Predict box:** Iron-oxidising bacteria live in a mine shaft with no light. What is the source of the carbon in their proteins? Hands up or mini whiteboards first.
>
> **Answer B: Carbon dioxide, which the bacteria fix using energy released by oxidising iron ions**

THE LESSON

12 min

Open or closed

Chapter 1 and its figure. Students sort a wood, a pond, a sealed jar, the International Space Station and the Earth as a whole into open and closed, with a reason each.

8 min

In the dark

The exceptions: a cave, the deep sea, a vent. Students say where the energy comes from in each, then read the nature of science box on laws.

24 min

Make it or take it

Chapter 2 and its three states. Students fill a three-row table (photoautotroph, chemoautotroph, heterotroph): energy source, carbon source, an example, and does it respire?

ACTIVITIES

MODEL

Bottle garden

Each group seals a jar with damp soil, moss, a small plant and a few woodlice, labels it with the date, and keeps it on the windowsill for the rest of the unit. Weekly, they note what has changed and whether anything had to cross the glass.

Needs: one clear jar with a lid a group, soil, moss, small plants.

PLENARY

10 min

Exit

Is a mushroom an autotroph or a heterotroph? Give the evidence from where it gets its carbon.

WHAT STUDENTS GET WRONG

"Plants get energy from the soil." Minerals and water, yes; energy and carbon, no. The energy is light; the carbon is carbon dioxide.

"Plants don't respire." Every living cell respires, day and night.

STRETCH AND SUPPORT

Support: give the captions of each figure and film as a cut-up storyboard to put in order, and use the key terms (tap the dotted words) as a glossary.

IN THE GUIDE

1 Light in, heat out

2 Make it or take it

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 C4.2 each time, marked as students go and saved to their Exam practice when they are signed in.

biologybybradford.com/exam-maker/sit?topics=C4.2&level=SL&paper=quiz&marks=15&src=ep

PRACTISE AND REVISE

BUILD FOR YOUR CLASS

- Tarsia puzzle, dominoes and picture reveal on C4.2, built from its key terms and ready to print
- A pub quiz with rounds on C4.2, to present or run with no projector
- An escape room built from the question bank on C4.2

ALREADY ON THE SITE FOR C4.2

- Quiz: Energy & Matter
- Revision map: C4.2 Transfers of energy and matter, to fill in
- Exam questions: C4.2 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.

- C4.2 Transfers of Energy and Matter (part 1)
- C4.2 Transfers of Energy and Matter (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.