Niches and modes of nutrition

60 minutes • B4.2.1 to B4.2.7 • Chapters 1, 2, 3, 4, 5, 6, 7

What a niche is, tolerance of oxygen, and the modes of nutrition: photosynthesis, holozoic, mixotrophic, saprotrophic and the archaea

BY THE END, STUDENTS CAN

- [ ] Describe the ecological niche of a species as its role, with its biotic and abiotic interactions B4.2.1
- [ ] Distinguish obligate anaerobes, facultative anaerobes and obligate aerobes by their tolerance of oxygen B4.2.2
- [ ] Outline photosynthesis as the mode of nutrition of plants, algae and some prokaryotes B4.2.3
- [ ] Describe holozoic nutrition: ingestion, digestion, absorption and assimilation B4.2.4
- [ ] Explain mixotrophic nutrition in protists such as Euglena, obligate and facultative B4.2.5
- [ ] Explain how saprotrophic fungi and bacteria feed, and their role as decomposers B4.2.6
- [ ] Outline the three energy sources archaea use to make ATP B4.2.7

TIMING

0–5	5 min	Do now: address or job?	
5–13	8 min	One cliff, five niches	
13–21	8 min	Three tubes	
21–41	20 min	Five ways to feed	
41–49	8 min	Holozoic in order	
49–60	11 min	Exit	
	60 min	One lesson	

STARTER

5 min

Do now: address or job?

"Your address is your habitat. What would your niche be?" Students list five things: where, when, what they eat, who they compete with, what they need.

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 habitat is an address; a niche is a job

CHAPTER 01 IN THE SLIDES

Tap the parts of the figure in turn: Habitat, Predator, Interactions, Activity, Food and Abiotic factors.

> **Predict box:** Two species of bird live in the same oak wood. Which statement must be true? Hands up or mini whiteboards first.
>
> **Answer B: They share a habitat, but their niches differ in some way, such as food or feeding place**

> **Remember it:** Hungry Ants Raid Insects (Habitat, Activity, Resources, Interactions).

02 Oxygen: needed, optional or poison

CHAPTER 02 IN THE SLIDES

Show the figure.

> **Predict box:** A bacterium grows all the way down a tube of broth, but most thickly near the top. Which is it? Hands up or mini whiteboards first.
>
> **Answer C: A facultative anaerobe, growing without oxygen but faster with it near the top**

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03 Making food from light

CHAPTER 03 IN THE SLIDES

Show the figure.

> **Predict box:** Why are photosynthetic organisms called producers in a food chain? Hands up or mini whiteboards first.
>
> **Answer A: They make the carbon compounds, from carbon dioxide and light, that every other organism depends on**

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04 Swallow it, then break it down

CHAPTER 04 IN THE SLIDES

Play the animation, From mouth to cell. It loops; pause it on each moment below and ask what is happening (in the lesson slides it is a video).

1. **Ingestion.** A grey heron spears a fish and swallows it whole: the food is taken into its gut.
2. **Digestion.** Inside the gut, enzymes cut the large molecules of the fish into small, soluble ones: proteins into amino acids, fats into fatty acids and glycerol.
3. **Absorption.** The small molecules cross the wall of the intestine, through the cells of each villus, into the blood.
4. **Assimilation.** The blood carries them to the body cells, which use them to build their own molecules: here, a muscle cell joins amino acids into heron protein.
5. **Egestion.** What could not be digested leaves the body as faeces. Herons also cough up pellets of bones and scales.
6. Holozoic nutrition: food is taken in, then digested inside the body. **I** **D**espise **A**ll **A**lgebra **E**xams.

> **Predict box:** A Hydra catches a water flea with its tentacles, pushes it through its mouth and digests it in its body cavity. Which step of holozoic nutrition is the pushing through the mouth? Hands up or mini whiteboards first.
>
> **Answer B: Ingestion, because the food is taken into the body before it is digested**

> **Remember it:** I Despise All Algebra Exams (Ingestion, Digestion, Absorption, Assimilation, Egestion).

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05 Both at once

CHAPTER 05 IN THE SLIDES

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

1. A pond turned green in summer. The colour is a bloom of **Euglena**, single cells far too small to see one by one.
2. One cell of *Euglena gracilis*, about 50 µm long: a **flagellum** to swim, an **eyespot**, **chloroplasts**, and grains of **paramylon**, its stored carbohydrate.
3. Lamp on. The eyespot shades a light sensor at the base of the flagellum, so the cell steers **towards the light**.
4. In the light it photosynthesises: **carbon dioxide** in, **oxygen** out. It makes its own carbon compounds: an **autotroph**.
5. Lamp off. With no light the chloroplasts shrink and pale, and the paramylon store is used up.
6. In the dark it absorbs **organic molecules** from the water and respires them: a **heterotroph**. Able to do both, it is a **facultative mixotroph**.

> **Predict box:** A protist in a lake photosynthesises in the light and eats bacteria. Grown in the light with no bacteria, it dies. What kind of nutrition does it have? Hands up or mini whiteboards first.
>
> **Answer B: Obligate mixotrophic, since it needs both photosynthesis and food to grow and survive**

06 Digesting from the outside

CHAPTER 06 IN THE SLIDES

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

1. Oyster mushrooms on a fallen log. The mushrooms are only the fruiting bodies: the fungus itself is a web of fine threads, **hyphae**, through the dead wood and leaves.
2. **Grow into the food.** Hyphae grow into a dead leaf, branching between and through its cells.
3. **Secrete enzymes; digest outside.** The hyphal tip releases enzymes onto the dead matter: cellulase cuts cellulose into glucose, outside the fungus.
4. **Absorb.** The small, soluble products, glucose and amino acids, are absorbed through the hyphal wall and carried back along the hypha.
5. **Recycle.** The leaf crumbles away. Respiring the sugars releases carbon dioxide, and mineral ions are left in the soil for plants: saprotrophs are decomposers.

> **Predict box:** What is the main difference between how a fungus and how an animal digests its food? Hands up or mini whiteboards first.
>
> **Answer C: The fungus digests its food outside its body, while an animal digests it once inside**

07 The third domain, and its three fuels

CHAPTER 07 IN THE SLIDES

Play the animation, Three ways to power a cell. It loops; pause it on each moment below and ask what is happening (in the lesson slides it is a video).

1. A salt pan, ten times saltier than the sea. The water is pink with **archaea** that live nowhere less salty.
2. One archaeon among the salt crystals. Its membrane carries patches of a **purple pigment**.
3. **Light** hits the pigment, which pumps a **proton** out of the cell. The protons flow back in through **ATP synthase**, which makes **ATP**.
4. A black smoker on the deep sea floor: no light at all, and water at over 300 °C full of hydrogen sulfide.
5. Archaea coat the chimney. They live on the **inorganic chemicals** pouring out of it.
6. They **oxidise** hydrogen and hydrogen sulfide. The electrons pass along the membrane, pumping protons out, and ATP synthase makes **ATP**. With it they fix carbon dioxide.
7. Mud at the bottom of a marsh, full of dead leaves and roots, and no oxygen.
8. Archaea live among the grains, next to the dead matter that feeds them.
9. They take in **carbon compounds** and **oxidise** them to carbon dioxide. The electrons pump protons out, and ATP synthase makes **ATP**.

> **Predict box:** An archaean lives in a hot spring rich in hydrogen sulfide, in complete darkness, with almost no organic matter. Where does its energy most likely come from? Hands up or mini whiteboards first.
>
> **Answer B: From the oxidation of inorganic chemicals, such as the hydrogen sulfide**

THE LESSON

8 min — One cliff, five niches

Play the opening film on the board and pause on each bird: where does it nest, where does it feed? Then chapter 1's puffin figure: tap each part and sort it as biotic or abiotic, and the mnemonic Hungry Ants Raid Insects.

8 min — Three tubes

Chapter 2's figure with the labels covered. Pairs name each tube's group from where it grows, then the predict box.

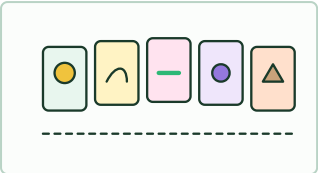
20 min — Five ways to feed

Chapters 3 to 7 as a jigsaw: each group reads one mode of nutrition and makes a card with its inputs, process and outputs and one organism. Groups teach each other; the class completes the table.

8 min — Holozoic in order

Chapter 4's figure, step by step, with I Despise All Algebra Exams.

ACTIVITIES

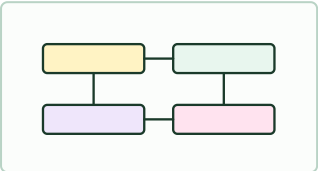


JIGSAW

Five ways to feed

Groups of five, each with one mode of nutrition (photosynthesis, holozoic, mixotrophic, saprotrophic, archaea). Each expert reads the chapter, then teaches the group, which completes a table of inputs, process, outputs and an example organism.

Needs: the guide on devices, a blank table for each student.



GAME

The loop game

Strips with an answer on the left and a question on the right, one per student. The first reads a question; whoever holds the answer reads theirs next, until the loop closes. Write the strips from the chapter's key terms: niche, habitat, obligate anaerobe, autotroph, assimilation, saprotroph.

Needs: one strip per student, printed and cut.

PLENARY

11 min

Exit

Distinguish between holozoic and saprotrophic nutrition (3 marks), then state the three energy sources archaea use to make ATP (3 marks).

WHAT STUDENTS GET WRONG

"Niche and habitat mean the same." The habitat is where a species lives; the niche is its whole role there.

"Facultative anaerobes cannot use oxygen." They use it when it is there and grow better with it.

"Only plants photosynthesise." Algae and some prokaryotes, such as cyanobacteria, do too, and prokaryotes have no chloroplasts.

"Fungi are plants." Fungi are heterotrophs: they absorb food after digesting it outside their bodies.

"Absorption and assimilation are the same." Absorption takes the molecules into the body; assimilation builds them into its own tissues.

STRETCH AND SUPPORT

Support: a table to fill with the five modes of nutrition: autotroph or heterotroph, inside or outside digestion, one example.

Stretch: the first chloroplast was a cyanobacterium. What evidence would you look for inside a chloroplast to test this?

IN THE GUIDE

1 A habitat is an address; a niche is a job
2 Oxygen: needed, optional or poison
3 Making food from light
4 Swallow it, then break it down
5 Both at once
6 Digesting from the outside
7 The third domain, and its three fuels
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 B4.2 each time, marked as students go and saved to their Exam practice when they are signed in.

biologybybradford.com/exam-maker/sit?topics=B4.2&level=SL&paper=quiz&marks=15&src=ep

PRACTISE AND REVISE

BUILD FOR YOUR CLASS

- Tarsia puzzle, dominoes and picture reveal on B4.2, built from its key terms and ready to print
- A pub quiz with rounds on B4.2, to present or run with no projector
- An escape room built from the question bank on B4.2

ALREADY ON THE SITE FOR B4.2

- Quiz: Ecological Niches
- Revision map: B4.2 Ecological niches, to fill in
- Exam questions: B4.2 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.

- B4.2 Ecological Niches

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.