

Keys and barcodes HL

60 minutes • A3.1.14, A3.1.15 • Chapters 11, 12

Building and testing a dichotomous key, and identifying species from environmental DNA

BY THE END, STUDENTS CAN

- ☐ Build and test a dichotomous key for local organisms A3.1.14
- ☐ Explain how DNA barcodes and environmental DNA identify the species in a habitat rapidly A3.1.15

TIMING

0–8	8 min	Do now: a key to the pencil case	
8–20	12 min	What makes a good key	
20–42	22 min	The local key	
42–54	12 min	Barcodes from a sample	
54–60	6 min	Exit: limits of eDNA	
	60 min	One lesson	

STARTER

8 min Do now: a key to the pencil case

Each pair empties a pencil case and writes a yes or no key that names six of the items. Swap with another pair and test it: does every item end at its own name? Note what went wrong, 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.

11 Building a key

CHAPTER 11 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.

- Every step is a question with **two** answers. A leaf made of leaflets leads to one more question, and then to horse chestnut or ash.
- A leaf in one piece leads to the next question. **Deep lobes:** oak.
- Each remaining question uses an **edge** that is easy to see: spiny, toothed, or neither. Every leaf reaches exactly one name.
- Check a key by following one leaf through it: holly is **no** to leaflets, **no** to deep lobes and **yes** to a spiny edge.

Step through the figure (2 steps, the arrow keys on a projector). Stop on each caption and ask what changed before you go on.

- Eight animals from leaf litter and soil. A **dichotomous key** tells them apart with questions that each have two answers.
- Each question **splits** the group in two; the next question splits each part again, until each animal is alone with its name.

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Predict box: Which feature is best for a key that tells the leaves of different trees apart? Hands up or mini whiteboards first.

Answer C: Whether the edge is toothed or smooth

12 Barcodes from the soil

CHAPTER 12 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. A barcode is a short stretch of DNA with **two ends the same in every species** and a **middle that differs** between species.
2. Because the ends match everywhere, one pair of **primers** can copy the barcode from any species in a mixed sample.
3. Each species in the reference library has its own barcode. Pink marks where a barcode differs from species A. (Letters invented.)
4. A barcode read from a sample is **matched** against the library. Here it is identical to one species' barcode.

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

1. Collect a sample: a bottle of pond water. The DNA in it is **environmental DNA** (eDNA).
2. Push the water through a fine filter. Cells and DNA from every species are caught on it.
3. **Extract** the DNA from the filter: a mixture from every species living there.
4. **PCR** copies one short stretch, the **barcode**, from every species at once. The primers fit ends that all of them share; the barcode between them differs.
5. **Sequence** the copies: each read is one barcode's base sequence.
6. **Match** each read to a reference library of barcodes from identified species.
7. A list of the species present, from one bottle of water, much faster than searching and trapping. One of them nobody saw.

Predict box: A water sample from a pond is barcoded and matched. What can the result tell you? Hands up or mini whiteboards first.

Answer B: Which listed species have left DNA in the water

Remember it: Cats Eat Any Sausage Mostly (Collect, Extract, Amplify, Sequence, Match).

THE LESSON

12 **What makes a good key**

Chapter 11's figure, step by step, then trace the holly through it. Take chapter 11's predict box. Build a class list of good and poor features, sorted by whether they change with age or season. Students fix their pencil case keys.

22 **The local key**

The local key activity below: collect or photograph six to eight local organisms, write a key, swap and test it. In wet weather use the two key tools under chapter 11's figure instead, with the leaves of trees or the garden animals.

12 **Barcodes from a sample**

Chapter 12's film, then its figure on the board. Students put the five step cards of the sample to species activity in order and say what each step needs. Turn over chapter 12's Remember it tiles.

STARTER · HL

A key to the pencil case

Pairs write a yes or no key for six items from a pencil case and swap with another pair to test it. Common faults appear at once: a question with more than two answers, a feature that two items share, and an item that reaches two names. Keep the faults on the board for the lesson.

Needs: a pencil case per pair; scrap paper.

PRACTICAL · HL

The local key

Groups collect or photograph six to eight local plants or animals from the school grounds, a hedge or a park. They list the features that tell them apart, build a key, swap with another group and test each other's. Take only a leaf from a plant that has many, never tear a plant up, and put every animal back where you found it. In wet weather use photographs or leaves brought in.

Needs: hand lenses, clipboards, phones for photographs, a field guide if you have one; permission for the site.

CARD SORT · HL

From sample to species

Five step cards (collect a sample, extract the DNA, amplify the barcode region, sequence it, match it to a reference library) and five cards saying what each step produces or needs. Pairs put both sets in order and pair them up. A last card asks what would go wrong if the library lacked the species in the sample.

Needs: ten cards per pair.

PLENARY

6
min

Exit: limits of eDNA

Chapter 12's predict box. Then one sentence: give two things an eDNA barcode survey cannot tell you.

WHAT STUDENTS GET WRONG

Colour and size make good key features. They change with age and season. Use features that are easy to see and do not change.

eDNA tells you how many. It tells you which species in the library left DNA there, not how many or whether they are still there.

STRETCH AND SUPPORT

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

Support: the three Remember it sets (Green Sloths Inch Along; Five Apes Hug Grumpy Aunts Happily; Cats Eat Any Sausage, Mostly) as a starter or an exit.

Stretch: design an eDNA survey for the school pond: what would you collect, what could contaminate it, and what could it never tell you?

Support: give the key for the local organisms with two steps missing and ask students to complete it.

IN THE GUIDE

- 11** [Building a key](#)
- 12** [Barcodes from the soil](#)
- A11** [The whole guide, with the figures that play](#)
- PPTX** [This lesson's slides, in the order of this plan](#)

PRACTISE AND REVISE

BUILD FOR YOUR CLASS

- [Tarsia puzzle, dominoes and picture reveal](#) on A3.1, built from its key terms and ready to print
- A [pub quiz](#) with rounds on A3.1, to present or run with no projector
- An [escape room built from the question bank](#) on A3.1

ALREADY ON THE SITE FOR A3.1

- [Quiz: Diversity of Organisms](#)
- Revision map: [A3.1 Diversity of organisms](#), to fill in
- Exam questions: [A3.1 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.
- [A3.1 Diversity of Organisms](#)

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.

EXAM PRACTICE

Check yourself

Set it for homework: a fresh paper of exam-bank questions on A3.1 at higher level each time, marked as students go and saved to their Exam practice when they are signed in.

biologybybradford.com/exam-maker/sit?topics=A3.1&level=HL&paper=quiz&marks=15&src=ep

