

Higher level HL

60 minutes • A4.1.8 to A4.1.11 • Chapters 7, 8, 9

Allopatric and sympatric speciation, adaptive radiation, and new plant species by polyploidy

BY THE END, STUDENTS CAN

- ☐ Compare allopatric and sympatric speciation, and explain how adaptive radiation fills vacant niches A4.1.8, A4.1.9
- ☐ Explain why a mule is sterile, and how hybridisation and polyploidy make a new plant species at once A4.1.10, A4.1.11

TIMING

0-5	5 min	Do now: Grumpy Birds Tweet	
5-15	10 min	Apart or together	
15-30	15 min	Beak buffet	
30-45	15 min	Paper chromosomes	
45-55	10 min	Chromosome arithmetic	
55-60	5 min	Exit	
	60 min	One lesson	

STARTER

5
min

Do now: Grumpy Birds Tweet

Six one-line cases to sort into geographic, behavioural and temporal isolation (the crickets that sing in different seasons, the frogs in March and May, the apes either side of a river, fireflies with different flash codes, and two more of your own).

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.

07 Apart or together: two routes to a new species

CHAPTER 07 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.

- Two populations, each of **one species**: finches on an island, flies on hawthorn trees.
- Left: the sea rises and **splits** the island. Right: apple trees arrive and some flies **switch** to them; no barrier.
- Left: different seeds each side select different beaks. Right: apple flies mate earlier, on apples. **Gene flow stops** in both.
- Both groups diverge. What stopped gene flow differs: **geography**, or **timing and behaviour**.

Predict box: Two populations of a cricket share one meadow. One sings and mates in spring, the other in late summer. Which kind of isolation is this, and which route to speciation? Hands up or mini whiteboards first.

Answer B: Temporal isolation: sympatric speciation

Remember it: Grumpy Birds Tweet (Geographic, Behavioural, Temporal).

08 One ancestor, many niches

CHAPTER 08 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. A seed-eating finch arrives on islands with **vacant niches**: foods no other small bird is using.
2. The first split: one line takes to eating **insects**, with a thin, pointed beak.
3. The rest split into **ground finches** and **tree finches**.
4. Each line splits again, each species with a beak **suited to its food**.
5. Different foods mean **little competition**: many related species live side by side.

Predict box: Suppose the first finches had landed on islands already full of small birds of many kinds. What would you expect? Hands up or mini whiteboards first.

Answer A: Fewer finch species: most niches would already be filled

09 The mule's dead end, the plant's way out

CHAPTER 09 IN THE SLIDES

Step through the figure (6 steps, the arrow keys on a projector). Stop on each caption and ask what changed before you go on.

1. A horse gamete (32 chromosomes) and a donkey gamete (31) make a **mule** with 63. A few of each set are drawn.
2. At meiosis, matching chromosomes pair up, but horse and donkey sets differ in **number and arrangement**: some cannot pair.
3. So the gametes get **unbalanced** sets and do not work: the mule is sterile.
4. Two smartweed species make a hybrid with $11 + 11 = 22$. No chromosome has a matching partner: **sterile**, like the mule.
5. The chromosome number **doubles** to 44: every chromosome now has an identical partner, so meiosis works.
6. A fertile **polyploid** whose offspring with either parent are sterile: a new species, made in a generation or two.

Predict box: Redshank ($2n = 44$) is crossed with one of its parents, pale persicaria ($2n = 22$). How many chromosomes do the offspring have, and are they fertile? Hands up or mini whiteboards first.

Answer B: 33: three sets that cannot pair evenly, so sterile

THE LESSON

10
min

Apart or together

Chapter 7's figure, then the apple maggot fly. Students make a Venn diagram of allopatric and sympatric speciation: what is the same (gene flow stops, then divergence) and what differs (how it stops).

15
min

Beak buffet

The short version of the practical below, then chapter 8's figure. Link each tool to a finch and each food to a niche, and ask why the species can share an island.

15
min

Paper chromosomes

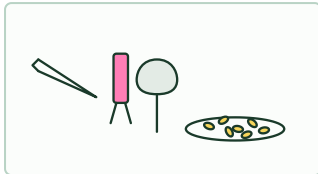
The model below: pair up a mule's chromosomes and fail, then double a smartweed hybrid's and succeed. Chapter 9's figure confirms it.

10
min

Chromosome arithmetic

Three quick problems: gamete numbers, hybrid number, doubled number (one with an odd parental number). Then a higher level written question on polyploidy from the A4.1 exam maker, set at HL.

ACTIVITIES

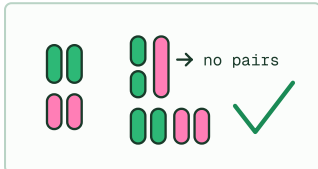


PRACTICAL · HL

Beak buffet

Each student gets a "beak" (tweezers, clothes peg, pliers, chopsticks, a teaspoon) and 30 seconds per food station: sunflower seeds, rice grains, marbles in a dish, a raisin wedged in foam, water in a test tube. Count items moved to a cup. Pool the class's results in a table: which beak wins where? Then ask what would happen to the tweezers birds if a plier-beaked species already ate every seed.

Needs: five kinds of tool, foods, cups, a timer, a results table on the board.



MODEL · HL

Paper chromosomes

Strips of card in two colours: a horse set (with two short chromosomes) and a donkey set (with one long chromosome matching those two). Students make a mule cell and try to pair every chromosome for meiosis: they cannot. Then a smartweed hybrid with three of each colour, no pairs; photocopy the set (doubling) and pair again: every strip finds its twin.

Needs: printed chromosome strips in two colours, scissors, glue.

PLENARY

5
min

Exit

Chapter 9's predict box: a 44-chromosome redshank crossed with a 22-chromosome parent.

WHAT STUDENTS GET WRONG

The hybrid's number is the parents' numbers added. It is the gametes' numbers added: $32 + 31 = 63$, not 126.

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 mnemonics (Dragons Breathe Heat; Hungry Rats Chew My Pencils; Grumpy Birds Tweet) as a starter on each lesson.

Stretch: why is sympatric speciation commoner in plants than in animals?

IN THE GUIDE

- 7 [Apart or together: two routes to a new species](#)
- 8 [One ancestor, many niches](#)
- 9 [The mule's dead end, the plant's way out](#)
- 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 A4.1, built from its key terms and ready to print
- A [pub quiz](#) with rounds on A4.1, to present or run with no projector
- An [escape room](#) built from the [question bank](#) on A4.1

ALREADY ON THE SITE FOR A4.1

- Quiz: [Evolution & Speciation](#)
- Revision map: [A4.1 Evolution and speciation](#), to fill in
- Exam questions: [A4.1 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.

- [A4.1 Evolution and Speciation \(SL\)](#)
- [A4.1 Evolution and Speciation \(HL\)](#)

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.

EXAM PRACTICE

Check yourself

Set it for homework: a fresh paper of exam-bank questions on A4.1 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=A4.1&level=HL&paper=quiz&marks=15&src=ep

