

Figworts, three domains and putting it together

HL

60 minutes • A3.2.8, A3.2.9 • Chapters 8, 9

Cladistics testing an old classification, rRNA and the three domains, and an exam question on the whole subtopic

BY THE END, STUDENTS CAN

- ☐ Use the figwort family to show how cladistics tests a classification, and why a claim can be falsified A3.2.8
- ☐ Explain how rRNA sequences led to the three domains, and what was new about them A3.2.9

TIMING

0-6	6 min	Do now: look-alikes	
6-20	14 min	Two trees for the figworts	
20-26	6 min	A hypothesis that failed	
26-40	14 min	Three domains	
40-54	14 min	Exam practice	
54-60	6 min	Plenary: back to the sort	
	60 min	One lesson	

STARTER

- 6 min** **Do now: look-alikes**
- Two plants with almost the same flowers, one DNA result that puts them in different clades. Students say which evidence they trust and why. Leave the answers up for the plenary.

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.

08 Testing the boxes

CHAPTER 08 IN THE SLIDES

Step through the figure (3 steps, the arrow keys on a projector). Stop on each caption and ask what changed before you go on.

1. Grouped by **flower structure**: six plants with similar flowers sit together as the figwort family (a simplified sketch).
2. Grouped by **chloroplast DNA** instead. The same plants now fall into several different clades, with other plants between them.
3. Only a small clade is still the figwort family. The flower resemblance was **convergence**, so the old family was not a real clade.

Predict box: Chloroplast DNA places two plants with almost identical flowers in different clades. What is the best explanation? Hands up or mini whiteboards first.

Answer C: Their flowers probably evolved separately, by convergent evolution

Step through the figure (3 steps, the arrow keys on a projector). Stop on each caption and ask what changed before you go on.

1. The tree from **rRNA sequences**: three main branches, the **domains** Bacteria, Archaea and Eukarya. Relationships inside each domain are not shown.
2. Archaea look like bacteria under a microscope, but their rRNA shows they share a more recent ancestor with **Eukarya**.
3. A new top level of classification, **above kingdom**, proposed in 1977.

Play the animation, Watch it happen: the tree of life from rRNA. It loops; pause it on each moment below and ask what is happening (in the lesson slides it is a video).

1. Before 1977, life was sorted by its cells: **prokaryotes**, with no nucleus, and **eukaryotes**, with one. All prokaryotes looked alike, so they were grouped together.
2. Carl Woese compared the base sequence of **ribosomal RNA**, which every cell has. Some prokaryotes, the archaea, differed from bacteria at many bases.
3. In this made-up stretch the archaeon differs from the bacterium at 9 bases but from the eukaryote at 7: **not a bacterium at all**, and a little nearer to us.
4. So the tree of life has three main branches, the **three domains**: Bacteria, Archaea and Eukarya. Archaea and eukaryotes share a more recent common ancestor.
5. So the tree of life has three main branches, the **three domains**: Bacteria, Archaea and Eukarya. Archaea and eukaryotes share a more recent common ancestor.
6. Woese and Fox proposed the three groups in 1977: a new level above kingdom. In 1990 they were named **domains**.
7. Every organism is now classed first by its **domain**, then kingdom, phylum, class, order, family, genus and species.

Predict box: Why was rRNA a good choice for comparing all of life? Hands up or mini whiteboards first.

Answer A: Every organism has ribosomes, so every organism has rRNA that can be compared

THE LESSON

14 min **Two trees for the figworts**

Chapter 8's figure, then the figwort cards below: students group the nine plants by flower structure, then regroup them from the DNA. Use the word convergent evolution, and the nature of science point that a claim can be falsified.

6 min **A hypothesis that failed**

Think, pair, share: "Is it a failure of science that the figwort family had to be broken up?" Land on: it was a prediction that was tested, which is science working.

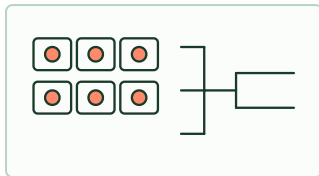
14 min **Three domains**

The rRNA table task below, then chapter 9's figure and the film. Students say which two groups the table joins first and why the result was a surprise. Then the predict box on why rRNA is a good molecule to compare.

14 min **Exam practice**

A written question on A3.2 from the exam maker (in Practise and revise, below), set at HL, in 10 minutes, then peer-marked against the markscheme. For homework, the Check step: a fresh paper on A3.2 from the exam bank, marked as students go.

ACTIVITIES

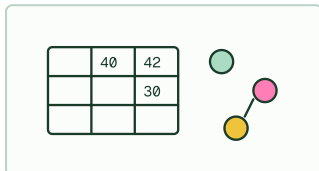


CARD SORT

Two trees for the figworts

Cards for nine plants (foxglove, snapdragon, monkeyflower, yellow rattle, mullein, figwort, plantain, broomrape and mint) with a note on their flowers. Round one: group them by flower structure. Round two: the teacher reveals which are in which clade from the chloroplast gene (use [chapter 8's](#) figure), and groups redraw. Ask what the flower resemblance turned out to be, and what that says about trusting structure alone.

Needs: printed cards, one set per group; [chapter 8's](#) figure hidden until round two.



DATA TASK

Three domains, from a table

A made-up table of rRNA differences (out of 100 compared sites) between a bacterium, a methane-making archaeon and a yeast: 40 between the bacterium and the archaeon, 42 between the bacterium and the yeast, and 30 between the archaeon and the yeast. Students say which two organisms the table joins first, draw the tree, and say why the result was a surprise to biologists who thought the archaeon was just a kind of bacterium. Make clear that the numbers are invented to show the method.

Needs: the table on the board or printed; no devices needed.

PLENARY

6
min

Plenary: back to the sort

Return to the rules on the board from lesson 1. Which of those rules would a cladist accept, and why? One sentence each.

WHAT STUDENTS GET WRONG

"Humans evolved from chimpanzees." Both descend from a shared ancestor, and are sister groups on the tree.

"Archaea are a kind of bacteria." Under a microscope they look alike, but their rRNA puts Archaea nearer to Eukarya. "Prokaryote" does not name a clade.

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.

Stretch: bacteria can pass genes sideways to other cells. How would that make a tree of all life harder to draw?

Stretch: use a sequence database to compare one real gene across five species and build a tree by parsimony.

IN THE GUIDE

- 8 [Testing the boxes](#)
- 9 [A new level above kingdom](#)
- 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 A3.2, built from its key terms and ready to print
- A [pub quiz](#) with rounds on A3.2, to present or run with no projector
- An [escape room built from the question bank](#) on A3.2

ALREADY ON THE SITE FOR A3.2

- [Quiz: Cladistics \(HL\)](#)
- Revision map: [A3.2 Classification and cladistics](#), to fill in
- Exam questions: [A3.2 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.
- [A3.2 Classification and Cladistics \(HL\)](#)

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 A3.2 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=A3.2&level=HL&paper=quiz&marks=15&src=ep

