

Counting and pairing chromosomes

60 minutes • A3.1.6, A3.1.7 • Chapters 4, 5

Chromosome numbers, karyograms, and testing the hypothesis that human chromosome 2 is a fusion

BY THE END, STUDENTS CAN

- ☐ Say that species differ in chromosome number, using humans (46) and chimpanzees (48), and why diploid numbers are even A3.1.6
- ☐ Classify chromosomes in a karyogram by banding, length and centromere position, and evaluate the evidence that human chromosome 2 arose from a fusion A3.1.7

TIMING

0-6	6 min	Do now: guess the count	
6-16	10 min	Counting chromosomes	
16-36	20 min	Build a karyogram	
36-52	16 min	Chromosome 2 on trial	
52-60	8 min	Testable or not?	
	60 min	One lesson	

STARTER

- 6 min** **Do now: guess the count**
- On mini whiteboards, students guess the number of chromosomes in a body cell of a fruit fly, a human, a chimpanzee and a dog. Reveal the four (8, 46, 48, 78) and ask what every number has in common. Hold the answer for [chapter 4](#)'s predict box.

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.

04 Every species has its own count

CHAPTER 04 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 fruit fly has 8 chromosomes in its body cells: **4 pairs**. A garden pea has 14: 7 pairs. Different species, different numbers.
2. A human has **46**: 23 pairs.
3. A chimpanzee has **48**: 24 pairs, one more pair than a human.
4. A dog has 78. More chromosomes does **not** mean a bigger or more complex animal. Every number is **even**, because chromosomes come in pairs.

Predict box: Why does a diploid cell always have an even number of chromosomes? Hands up or mini whiteboards first.

Answer A: One of each pair comes from each parent, so the total is even

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 cell is stopped part-way through **dividing**, when its chromosomes are short and thick.
2. The chromosomes are **stained**, so dark bands show, and **photographed**.
3. Each is cut out and matched with its partner by **length, banding pattern** and **centromere position**.
4. The pairs are lined up with the centromeres in a row and numbered from the **longest**: a karyogram. (Simplified: six pairs.)

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. Chromosomes from one cell, condensed and doubled. Pair them by **length, centromere position** and **bands**.
2. A pair matches on all three. A karyogram puts the pairs in order, **longest first**.
3. Human **chromosome 2** beside two chimpanzee chromosomes, 2A and 2B. Do they fit together?

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Predict box: If two chromosomes had fused end to end, what would you expect in the middle of the new, longer chromosome? Hands up or mini whiteboards first.

Answer C: Telomere DNA, normally found only at a chromosome's end

THE LESSON

10
min

Counting chromosomes

Chapter 4's figure, then its predict box. Stress that 46 and 48 are the only numbers to learn, and that a bigger number does not mean a more complex animal. Define diploid, haploid and homologous chromosomes with the figure's pairs.

20
min

Build a karyogram

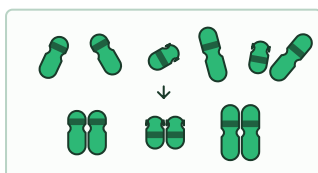
Four minutes on [chapter 5's](#) first figure, stopping on each caption. Then pairs pair up the paper chromosomes below by length, banding and centromere position, and line them up longest first. Check against [chapter 5's](#) pairing tool, which tells them what matched.

16
min

Chromosome 2 on trial

Chapter 5's chromosome 2 tool on the board. Groups complete the evidence cards below: for each of the three pieces of evidence, say what it shows and how strongly it supports the fusion. Then take [chapter 5's](#) predict box on what to expect in the middle of a fused chromosome.

ACTIVITIES

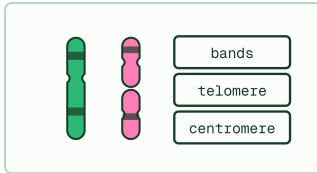


CARD SORT

Pair the paper chromosomes

Teacher-made sets of twelve paper chromosomes, six matching pairs that differ in length, centromere position and the bands drawn on them with a marker. Students match them, line them up longest first, and say which of the three clues settled each pair. They then check their karyogram with the pairing tool.

Needs: twelve paper chromosomes per pair (cut from card, bands in marker); the tool on a device.

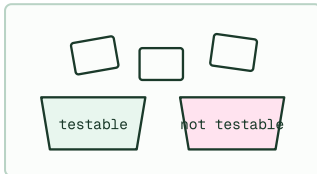


EVIDENCE

Chromosome 2 on trial

Evidence cards from the chromosome 2 tool: the banding of human chromosome 2 against two ape chromosomes, the telomere DNA in its middle, the remains of a second centromere, and the numbers, 46 against 48. For each card, students write what it shows, how strongly it supports the fusion, and one more piece of evidence they would want. A last line says what would make the hypothesis fail.

Needs: evidence cards; the chromosome 2 tool.



NATURE OF SCIENCE

Testable or not?

Students write six statements about chromosome 2, apes or anything in the lesson, three they believe are testable and three that are not, shuffle them and swap. The partner sorts them into two bins and explains each choice, saying what evidence would count against the testable ones.

Needs: six blank slips per student; two labelled bins.

PLENARY

8

min

Testable or not?

Chapter 5's testable or not drill, then students write one testable and one non-testable hypothesis on any topic they like, and swap with a partner to sort. Exit: why is testability what makes a hypothesis scientific?

WHAT STUDENTS GET WRONG

More chromosomes means a more complex organism.

A dog has 78 and a human 46. Number says nothing about complexity.

A karyogram shows the genes. It shows chromosomes only: their number, size, banding and centromere. The genes are in the DNA along them.

Evidence for chromosome 2 means we came from chimpanzees. Humans and chimpanzees share an ancestor that was neither. The fusion happened in the line that led to us.

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: give the first three pairs of paper chromosomes already matched, and ask students to explain why before they match the rest.

Stretch: predict what a karyogram of an orangutan would look like beside a human's, and which chromosomes you would compare first.

IN THE GUIDE

- 4 [Every species has its own count](#)
- 5 [Laying out the chromosomes](#)
- 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 standard 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=SL&paper=quiz&marks=15&src=ep

