# Cells from cells, and splitting the cytoplasm

60 minutes • D2.1.1 to D2.1.6 • Chapters 1, 2, 3

**Cell division from a parent cell to two daughter cells, cytokinesis in animal and plant cells, equal and unequal division, and replication, condensation and movement of chromosomes**

## BY THE END, STUDENTS CAN

- [ ] Outline how new cells are made by a parent cell dividing into two daughter cells D2.1.1
- [ ] Compare cytokinesis in animal cells and plant cells D2.1.2
- [ ] Explain why cytokinesis is usually equal, give two examples of unequal cytokinesis, and say what every daughter cell must receive D2.1.3
- [ ] Explain why nuclear division comes before cell division, and the different roles of mitosis and meiosis D2.1.4
- [ ] Explain why DNA replication must happen before mitosis or meiosis, and what a chromosome is made of afterwards D2.1.5
- [ ] Outline how chromosomes condense and how they are moved D2.1.6

## TIMING

| | | | |
|---|---|---|---|
| 0–8 | 8 min | **Do now: where did you come from?** | |
| 8–16 | 8 min | **One becomes two** | |
| 16–30 | 14 min | **Three ways to split** | |
| 30–36 | 6 min | **Unequal division** | |
| 36–52 | 16 min | **Copy, coil, move** | |
| 52–60 | 8 min | **Exit** | |
| | 60 min | **One lesson** | |

## STARTER

**8** min

### Do now: where did you come from?

The cell theory starter below: one statement of cell theory on the board and a photo of a crowd. Students write how many divisions separate them from the fertilised egg they started as, then compare estimates.

## 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 One cell becomes two

CHAPTER 01 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. A **parent cell** grows to about twice its starting size.
2. Its **nucleus divides** first, so there are two.
3. Then the cytoplasm divides: two **daughter cells**, each with a nucleus.

> **Predict box:** Why does a eukaryotic cell divide its nucleus before it divides its cytoplasm? Hands up or mini whiteboards first.
>
> **Answer B: So that each daughter cell gets a nucleus and none is left without one**

## 02 Splitting the cytoplasm

CHAPTER 02 IN THE SLIDES

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

1. In an **animal cell**, a ring of **actin and myosin** just inside the membrane contracts and pinches the cell in two.
2. Mitochondria are only made by dividing old ones, so **each daughter cell must get at least one**.
3. A **plant cell** has a wall, so it cannot be pinched. Vesicles carry membrane and wall material to the equator.
4. The vesicles fuse into a **cell plate**, which grows outwards until it meets the side walls.
5. The plate becomes two membranes with **new cell wall** between them: two cells.
6. Cytokinesis is usually equal, but not always. A human **egg cell** keeps almost all the cytoplasm and pinches off a tiny **polar body**.
7. **Yeast** divides by **budding**: a small bud grows out, one nucleus moves into it, and it pinches off.

> **Predict box:** In a human egg cell's last division, why might keeping almost all the cytoplasm in one cell be an advantage? Hands up or mini whiteboards first.
>
> **Answer B: The egg has the food and organelles an embryo needs before it can feed itself**

## 03 Copy, coil, move

CHAPTER 03 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. Before replication, a chromosome is **one DNA molecule**, long and thin.
2. After replication it is **two sister chromatids**, joined at the centromere.
3. In prophase the DNA winds round **histones** and supercoils into a short, thick chromosome.
4. **Microtubules** from both poles attach at the centromere and pull.

> **Predict box:** A cell has 8 chromosomes in G1. How many DNA molecules does its nucleus hold at the start of mitosis? Hands up or mini whiteboards first.
>
> **Answer B: 16, because each of the 8 chromosomes is now 2 chromatids, each one molecule**

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THE LESSON

**8** min

### One becomes two

Chapter 1 and its figure. Why divide the nucleus first? The predict box, then students give one reason why a cell divides rather than keeps growing.

**14** min

### Three ways to split

The cytokinesis film in chapter 2, stopping at each caption. Students draw an animal and a plant cell in cytokinesis side by side, labelling the actin and myosin ring and the cell plate. Then the "Where did I go wrong?" answer below.

**6** min

### Unequal division

The egg cell and yeast in the film. Ask: what must every daughter cell get, however small, and why can it not make its own?

**16** min

### Copy, coil, move

Chapter 3 and its figure. Students fill the chromosome counting table below for a cell with 8 chromosomes: G1, after S, metaphase, each daughter. Then the predict box.

ACTIVITIES

STARTER

### Cells from cells

On the board: "All cells come from pre-existing cells." Students estimate how many times a cell must double to turn one fertilised egg into about 30 trillion cells (a calculator helps: 2 to the power 45 is about 35 trillion). Then ask where the very first cell of a new plant or animal came from, and why that does not break the rule.

**Needs:** calculators.

FIX IT

### Where did I go wrong?

Show a made-up exam answer comparing cytokinesis in plants and animals, with three errors: the plant cell forms a furrow, the ring is made of microtubules, and a cell plate forms "after the wall has divided". Students mark it like an examiner, correct each error and rewrite it to earn full marks.

**Needs:** the answer on the board or a slip; chapter 2.

TABLE

### Count the chromosomes

A table with rows G1, after S phase, metaphase, each daughter cell, and columns chromosomes, chromatids and DNA molecules. Students fill it for a cell with 8 chromosomes, then for a human cell. The point to land: the chromosome number only changes when the chromatids separate in anaphase.

**Needs:** the table printed or drawn.

PLENARY

**8** min

### Exit

Compare cytokinesis in a plant cell and an animal cell: two differences and one similarity.

WHAT STUDENTS GET WRONG

**"The parent cell is still there after dividing."** It becomes the two daughter cells.

**"Cytokinesis is the last phase of mitosis."** Mitosis divides the nucleus; cytokinesis is the separate division of the cytoplasm that follows it.

**"A replicated chromosome is two chromosomes."** It is one chromosome of two chromatids until the centromere splits in anaphase.

STRETCH AND SUPPORT

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

**Stretch:** a mature red blood cell has no nucleus. How is it made, and why can it not divide?

IN THE GUIDE

1 One cell becomes two

2 Splitting the cytoplasm

3 Copy, coil, move

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 D2.1 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=D2.1&level=SL&paper=quiz&marks=15&src=ep

PRACTISE AND REVISE

BUILD FOR YOUR CLASS

- Tarsia puzzle, dominoes and picture reveal on D2.1, built from its key terms and ready to print
- A pub quiz with rounds on D2.1, to present or run with no projector
- An escape room built from the question bank on D2.1

ALREADY ON THE SITE FOR D2.1

- Lesson: The Cell Cycle
- Quiz: Cell and Nuclear Division (HL)
- Quiz: Cell and Nuclear Division
- Revision map: D2.1 Cell and nuclear division, to fill in
- Exam questions: D2.1 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.

- D2.1 Cell and Nuclear Division

**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.