One cell becomes many kinds

60 minutes • B2.3.1 and B2.3.2 • Chapters 1, 2

How a zygote's daughter cells become specialised through gradients of signals and gene expression, and the two properties of stem cells

BY THE END, STUDENTS CAN

- [ ] Explain how a zygote's unspecialised daughter cells become specialised, and how gradients of signals switch on different genes B2.3.1
- [ ] State the two properties of stem cells: they divide again and again, and they can differentiate along different pathways B2.3.2

TIMING

0–6	6 min	**Do now: same genes?**	
6–21	15 min	**Zygote to tissues**	
21–35	14 min	**Signals switch genes**	
35–51	16 min	**What makes a stem cell**	
51–60	9 min	**Exit**	
	60 min	**One lesson**	

STARTER

6 min

Do now: same genes?

A nerve cell and a skin cell from the same person: do they have the same genes? Students vote, then write one reason. Keep the votes for the end.

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 From one cell to many kinds

CHAPTER 01 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 **zygote**: one cell, with one set of chromosomes from each parent.
2. It divides by mitosis. The first cells are all alike: **unspecialised**.
3. About five days on, a hollow **blastocyst**. Its inner cell mass will make the body.
4. A signal spreads from one end. Each cell reads its concentration and **switches on different genes**.
5. Different genes, different cells: they **differentiate** into nerve, muscle and blood cells.

> **Predict box:** A signal molecule is made at one end of an early embryo. A cell near that end and a cell at the far end have exactly the same genes. Why do they end up different? Hands up or mini whiteboards first.
>
> **Answer B: They receive different concentrations of the signal, so they switch on different genes**

02 Cells that can still choose

CHAPTER 02 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 stem cell divides. One daughter **stays a stem cell**; the other starts to specialise.
2. The stem cell can do it **again and again**: self-renewal.
3. The other daughter's line can go down **different pathways**, here a red or a white blood cell.

> **Predict box:** A stem cell divides and both daughters differentiate into red blood cell precursors. If this happened every time, what would go wrong? Hands up or mini whiteboards first.
>
> **Answer B: The stem cells would run out, and no new blood cells could be made**

THE LESSON

15 min

Zygote to tissues

Chapter 1 and its figure, stopping at each step. Students fill the embryo strip below as you go: zygote, eight cells, blastocyst, then the gradient that tells cells where they are.

14 min

Signals switch genes

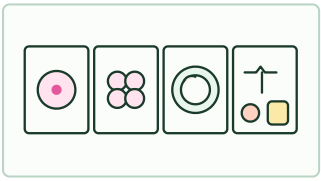
The gradient game below: students stand in a line as cells, the "signal" passed down the line weakens, and each cell reads its card to find which gene it switches on.

16 min

What makes a stem cell

Chapter 2 and its figure. Students write the two properties in their own words, then sort the six cell cards below into stem cells and specialised cells, with the property each card shows or lacks.

ACTIVITIES



STORYBOARD

The embryo strip

A strip of five boxes for the five steps of chapter 1's figure. In each box a sketch and one line: what the cells are like, and what has changed since the last box. The last box names three specialised cells and one gene each might switch on. Students finish it for homework from the guide.

Needs: the strip printed, one per student.

GAME

The gradient line

Ten students stand in a line as embryo cells. The first holds a cup of ten counters, the signal. Each cell counts the counters in the cup, takes one and passes it on, so the signal fades down the line. Each cell then reads a card: seven or more counters, switch on gene A; three to six, gene B; fewer, gene C. The point to land: every cell has the same cards (genes), and only its place in the gradient decides which it uses.

Needs: counters and ten identical gene cards.

SORT

Stem or specialised?

Six cell cards, each with two facts: a cell in a hair follicle bulge, a red blood cell, a cell of the inner cell mass, a neuron, a cell of the bone marrow, a sperm. Pairs sort them into stem cells and specialised cells and name, for each, the property it has or lacks: dividing again and again, and differentiating along different pathways.

Needs: the cards printed, one set per pair.

PLENARY

9 min — Exit

Back to the do now: revote, then two sentences on why a nerve cell and a skin cell look so different when their genes are the same.

WHAT STUDENTS GET WRONG

"Specialised cells have different genes." They have the same genes as every other body cell; they differ in which genes are switched on.

"A stem cell is any cell that can divide." It must also be able to differentiate along different pathways, and keep dividing again and again.

STRETCH AND SUPPORT

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

IN THE GUIDE

- 1 From one cell to many kinds
- 2 Cells that can still choose
- 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 B2.3 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=B2.3&level=SL&paper=quiz&marks=15&src=ep

PRACTISE AND REVISE

BUILD FOR YOUR CLASS

- Tarsia puzzle, dominoes and picture reveal on B2.3, built from its key terms and ready to print
- A pub quiz with rounds on B2.3, to present or run with no projector
- An escape room built from the question bank on B2.3

ALREADY ON THE SITE FOR B2.3

- Lesson: Cell Specialisation
- Quiz: Cell Specialisation
- Revision map: B2.3 Cell specialization, to fill in
- Exam questions: B2.3 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.

- B2.3 Cell Specialization

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.