What is a cell, and how big?

60 minutes • A2.2.1 and A2.2.2 • Chapters 1, 2

Cell theory from the evidence of the microscope, how to make a temporary mount and focus it, and magnification and actual size

BY THE END, STUDENTS CAN

- [ ] State cell theory and use it to make a prediction about a newly discovered organism A2.2.1
- [ ] Make and stain a temporary mount, focus it, measure a cell with a graticule, and calculate actual size, magnification and a scale bar A2.2.2

TIMING

0–6	6 min	**Do now: is it alive?**	
6–18	12 min	**Three hundred years of looking**	
18–32	14 min	**Name the parts, then focus**	
32–48	16 min	**Size, image, magnification**	
48–60	12 min	**Exit**	
	60 min	**One lesson**	

STARTER

6 min

Do now: is it alive?

The "Is it alive?" cards below: a virus, a seed, a red blood cell, a flame, a yeast cell. Pairs sort them and give the reason for each, before anyone says the word cell.

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 Every living thing is made of cells

CHAPTER 01 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. **1665:** Robert Hooke sees the walls of dead cells in cork, and names them **cells**.
2. **1670s:** Antonie van Leeuwenhoek, with lenses he ground himself, sees **living single cells** in pond water.
3. **1838 and 1839:** Schleiden finds that plants, and Schwann that animals, are **made of cells**.
4. **1855:** Rudolf Virchow argues that **every cell comes from a cell**.
5. **1860s:** Louis Pasteur's swan-neck flasks: broth only grows microbes when **cells from outside** get in.
6. **Today:** the theory lets us **predict** that any new organism will be made of cells.

> **Predict box:** Biologists find a new kind of organism in a hot spring. Before they look at it under a microscope, what does cell theory let them predict? Hands up or mini whiteboards first.
>
> **Answer B: That it will be made of one or more cells, each one made by another cell dividing**

02 Mount it, focus it, measure it

CHAPTER 02 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. The **eyepiece graticule**: 100 units across the field, but how big is a unit?
2. A **stage micrometer** underneath: 40 graticule units match 100 µm, so at ×400 **1 unit = 2.5 µm**.
3. Swap in cheek cells. One is **24 units** across: 24 × 2.5 µm = **60 µm**.
4. In a photo the cell is 30 mm across. **Magnification = image ÷ actual** = 30 000 µm ÷ 60 µm = **×500**.
5. A **scale bar** for 20 µm on this photo is 20 × 500 = 10 000 µm, so **10 mm long**.

> **Predict box:** A chloroplast is 5 µm long. In a photograph it is 25 mm long. What is the magnification? Hands up or mini whiteboards first.
>
> **Answer C: ×5000, since 25 000 µm divided by 5 µm gives 5000**

> **Remember it:** I Am Magnified (Image size, Actual size, Magnification).

THE LESSON

12 min

Three hundred years of looking

Chapter 1 and its timeline, stopping at each step. Students write the three claims of cell theory, and for each one the person or the observation that supports it. Then the predict box on a newly found organism.

14 min

Name the parts, then focus

The microscope labels below, then each pair focuses a prepared slide at low power and moves up through the objectives without losing it. Coarse focus only at low power.

16 min

Size, image, magnification

Chapter 2 and its figure, with the triangle tile. Students work the three practice calculations below, one for each unknown, writing the units at every step.

ACTIVITIES



CARD SORT

Is it alive?

Five cards: a virus, a dry seed, a red blood cell, a candle flame and a yeast cell. Pairs sort them into alive, not alive and not sure, writing the reason for each. A flame grows, uses oxygen and makes more flames; a seed does almost nothing for years. Collect the reasons, then show that being made of cells is the test cell theory sets.

Needs: the cards printed, one set per pair.

LABEL

Parts of the microscope

A drawing of the class microscope with the parts numbered: eyepiece, objectives, stage, clips, coarse and fine focus, light source, condenser and diaphragm. Students label it, then write one rule of use for each focus knob. Then the focusing routine: lowest power first, coarse focus up from the slide, fine focus only at high power.

Needs: the drawing printed; a microscope per pair; prepared slides.

CALCULATE

Three unknowns

Three calculations, one for each part of the triangle: a cell 20 µm long drawn 60 mm long (find the magnification); an image 45 mm long at ×1500 (find the actual size in µm); a mitochondrion 2 µm long at ×12 000 (find the image length in mm). The point to land: convert both lengths to the same unit before dividing.

Needs: calculators.

PLENARY

12 min

Exit

A micrograph with a scale bar on the board. Students find the magnification, then the actual length of the cell, each to two significant figures.

WHAT STUDENTS GET WRONG

"Magnification is image size times actual size." It is image size divided by actual size, both in the same unit.

"A higher magnification always shows more detail." Detail depends on resolution. A light microscope can magnify a blur further, but cannot separate points closer than about 0.2 µm.

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.

Support: a card of the magnification triangle and the unit ladder (mm to µm to nm, times 1000 each step) beside every calculation.

Stretch: skeletal muscle fibres, giant algae and fungal hyphae each test cell theory. Which part of the theory does each test, and does it break it?

IN THE GUIDE

1 Every living thing is made of cells

2 Mount it, focus it, measure it

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 A2.2 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=A2.2&level=SL&paper=quiz&marks=15&src=ep

PRACTISE AND REVISE

BUILD FOR YOUR CLASS

- Tarsia puzzle, dominoes and picture reveal on A2.2, built from its key terms and ready to print
- A pub quiz with rounds on A2.2, to present or run with no projector
- An escape room built from the question bank on A2.2

ALREADY ON THE SITE FOR A2.2

- Lesson: Cell Structure
- Lab: Modeling Pasteur's Experiments
- Quiz: Cell Structure
- Revision map: A2.2 Cell structure, to fill in
- Exam questions: A2.2 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.

- A2.2 Cell Structure

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.