Movement and the sarcomere

60 minutes • B3.3.1, B3.3.2 • Chapters 1, 2, 3

Motile and sessile organisms, the structure of a sarcomere, and the sliding filament model

TIMING

0–5	5 min	Do now: can it move?	
5–15	10 min	Motile and sessile	
15–28	13 min	Read a sarcomere	
28–53	25 min	Sliding	
53–60	7 min	Exit	
	60 min	One lesson	

STARTER

5 min

Do now: can it move?

Show a barnacle, a salmon and a Venus flytrap. Ask: which of these moves? Take votes, and keep them 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.

01 Everything alive moves, even if it stays put

CHAPTER 01 IN THE SLIDES

Switch the figure through Salmon (motile), Barnacle (sessile) and Flytrap (sessile), and have the class say what will change before each.

> **Predict box:** A barnacle is glued to a rock for its adult life. Which statement is correct? Hands up or mini whiteboards first.
>
> **Answer B: It is sessile but moves parts of its body, for feeding**

02 A muscle fibre is a stack of sarcomeres

CHAPTER 02 IN THE SLIDES

Tap the parts of the figure in turn: Thin filaments, Thick filaments, Z lines, M line, A band, I band and H zone.

03 Pull, let go, pull again

CHAPTER 03 IN THE SLIDES

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

1. One **sarcomere**, between two **Z discs**. Thin filaments of **actin** hang from each Z disc; thick filaments of **myosin**, bristling with heads, lie between them. Springs of **titin** tie the thick filaments to the Z discs.
2. Going deeper: a nerve impulse makes the **sarcoplasmic reticulum** release **calcium ions**. They bind **troponin**, which pulls **tropomyosin** off the binding sites on the actin.
3. **1 Cross-bridge.** One myosin head, close up. Cocked and carrying ADP and phosphate, it binds an uncovered site on the actin.
4. **2 Power stroke.** The phosphate leaves and the head swings, pulling the actin towards the M line. Then the ADP leaves.
5. **3 ATP binds.** A new ATP molecule fits into the head, and the head lets go of the actin: the cross-bridge breaks.
6. **4 Re-cock.** The head splits the ATP into ADP and phosphate, and the energy released cocks the head, ready to bind further along.
7. The cycle runs again and again. Thousands of heads cycle out of step, so some always hold on while others reach forward, and the actin never slips back.
8. The thin filaments have **slid** towards the M line. The sarcomere, the **I band** and the **H zone** are shorter; the **A band**, the length of the thick filament, has not changed.
9. When the impulses stop, calcium is pumped back, tropomyosin covers the sites and the heads let go. **Titin** and the pull of the antagonistic muscle stretch the sarcomere out again.

> **Predict box:** A muscle fibre is stimulated and its sarcomeres shorten from 2.6 to 2.0 micrometres. What happens to the length of the A band? Hands up or mini whiteboards first.
>
> **Answer B: It does not change, because the thick filaments do not shorten**

> **Remember it:** C U B P A (Calcium, Uncover, Bind, Pull, ATP).

THE LESSON

10 min

Motile and sessile

Chapter 1's predict box and the three-way switch. Sort six organisms into motile and sessile, and say how each sessile one still moves.

13 min

Read a sarcomere

Chapter 2's tap-to-explore. Students label a blank sarcomere with the six parts and bands from memory.

25 min

Sliding

Chapter 3's predict box, then the film. Pause at each caption. Students retell it with the C U B P A tiles, then run the film with Low calcium. Practise the "In the exam" points.

ACTIVITIES



PRACTICAL

Model a sarcomere

Each pair makes a sarcomere with two strips of card for thick filaments, four for thin, and two Z lines on a table. Slide the thin strips in to show contraction. Measure the A band, I band and H zone before and after with a ruler, and record which change.

Needs: card strips, scissors, rulers, tape.

PLENARY

7 min

Exit

A sarcomere shortens from 2.6 to 2.0 micrometres. Say which bands change and which do not, and why.

WHAT STUDENTS GET WRONG

"A sessile organism does not move." Sessile means fixed in place. Barnacles move their cirri to feed and plants bend and open and close parts of themselves.

"The filaments shorten when a muscle contracts." The filaments keep their length. They slide, so the sarcomere, the I band and the H zone shorten. The A band does not.

"Calcium provides the energy for contraction." ATP provides the energy. Calcium makes the binding sites on actin available.

STRETCH AND SUPPORT

Support: a labelled sarcomere with the bands in boxes to match to their lengths.

Stretch: predict what happens to the strength of contraction when a sarcomere is stretched so far that thick and thin filaments hardly overlap.

IN THE GUIDE

1 Everything alive moves, even if it stays put

2 A muscle fibre is a stack of sarcomeres

3 Pull, let go, pull again

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 B3.3 each time, marked as students go and saved to their Exam practice when they are signed in.

biologybybradford.com/exam-maker/sit?topics=B3.3&level=HL&paper=quiz&marks=15&src=ep

PRACTISE AND REVISE

BUILD FOR YOUR CLASS

- Tarsia puzzle, dominoes and picture reveal on B3.3, built from its key terms and ready to print
- A pub quiz with rounds on B3.3, to present or run with no projector
- An escape room built from the question bank on B3.3

ALREADY ON THE SITE FOR B3.3

- Quiz: Muscle & Motility (HL)
- Revision map: B3.3 Muscle and motility, to fill in
- Exam questions: B3.3 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.

- B3.3 Muscle and Motility (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.