

Muscle and motility · supported focus

International Baccalaureate · IB Diploma · Biology · HL

Scope and prerequisites

Supported HL focus. First assessment 2025; current subject brief acquired; full Biology guide not acquired. Remaining guide, assessment and practical requirements retain their recorded holds.

Prerequisites: read the stated quantities and units, use arithmetic and the model conditions below. Each lesson develops its own method before independent transfer.

These are original or explicitly fictional teaching examples, not actual measurements or completed assessed learner investigations.

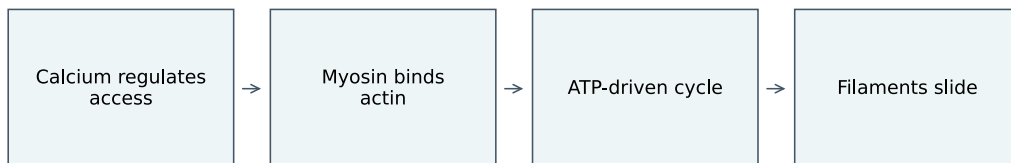
Muscle contraction: filaments slide

■ What would explain this observation?

- A **sarcomere** becomes shorter during contraction although its thick and thin filaments keep approximately the same length.
- Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

■ Build the model

- Actin and myosin interact in a sliding-filament mechanism. Calcium permits the interaction through regulatory proteins; ATP binding and hydrolysis support the **cross-bridge** cycle. Skeletal muscles pull through tendons and work in co-ordinated groups.
- sarcomere: The repeating contractile unit between two Z lines; cross-bridge: A myosin-actin interaction during the contraction cycle.



■ Choose evidence that can test it

- During shortening, overlap increases. The A-band length stays approximately constant while I bands and the H zone become smaller. Movement at a joint also depends on tendon insertion, lever geometry and opposing muscle activity.
- Annotate two sarcomere diagrams at different lengths using the same scale. Track band widths separately from filament length. Use prepared models or existing images, not painful or maximal-exertion tasks.

■ Work from known quantities

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- Known: sarcomere length changes from 2.5 to 2.0 micrometres. Percentage shortening = $(2.5 - 2.0)/2.5 \times 100 = 20\%$. This does not mean either filament shortened by 20%.

Example:

A sarcomere shortens from 3.0 to 2.4 micrometres. Calculate percentage shortening. Use the same sequence: known quantities → model → relation → substitution → unit and interpretation.

■ Check the conclusion and its limits

- ATP is required for myosin detachment as well as the continuing cycle. A muscle pulling harder does not mean all its fibres become shorter under every load.
- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Warn:

Contracting muscle shortens by shrinking every actin filament. This claim is false: ATP is required for myosin detachment as well as the continuing cycle. A muscle pulling harder does not mean all its fibres become shorter under every load.

Key:

Muscle contraction: filaments slide: During shortening, overlap increases. The A-band length stays approximately constant while I bands and the H zone become smaller. Movement at a joint also depends on tendon insertion, lever geometry and opposing muscle activity.