Generating movement in the body

International Baccalaureate · IB Diploma · Sports, Exercise and Health Science · SL

Scope and prerequisites

This handout covers selected SL topics for the course first assessed in 2026; it is not the whole syllabus.

Prerequisites: read the stated quantities and units, and use arithmetic and the model conditions below.

The examples are original and fictional: they are not real measurements or real student investigations.

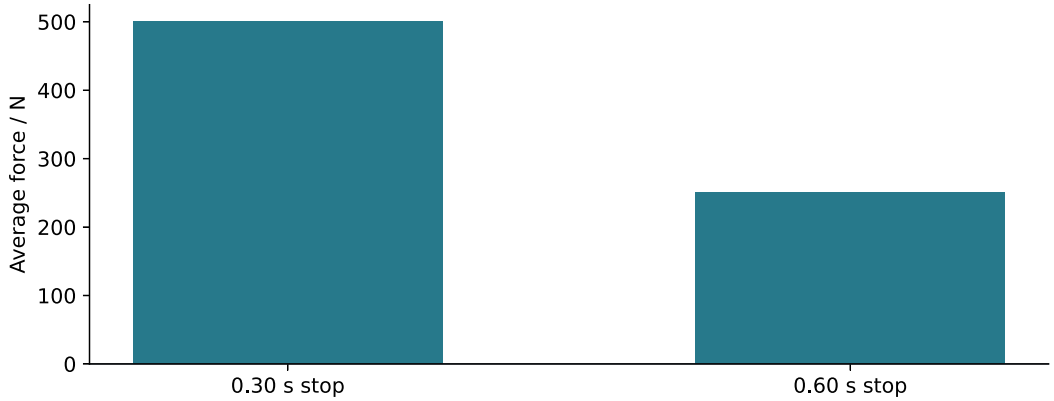
Biomechanics: movement and impulse

What would explain this observation?

- Landing with bent knees increases the time over which momentum changes. The movement can reduce average impact force for the same momentum change.

Build the model

- Joint movement results from muscle forces acting through lever systems.
- The centre of mass and **base of support** affect stability.
- **Impulse** connects force-time evidence to momentum change.
- impulse: Force integrated over time, equal to momentum change.
- base of support: The area supporting a body.



Same momentum change, 150 kg m/s: doubling the stopping time halves the average force

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Choose evidence that can test it

- A biomechanical analysis must define the segment, direction and phase of movement.
- Net force and a single muscle force are not interchangeable.
- A longer lever arm can change torque without changing applied force.

In the lab: Use teacher-approved video of a safe movement with consent. Calibrate distance and time, identify frames consistently, and avoid making medical claims from a two-dimensional recording. Camera perspective can bias apparent joint angles.

Work from known quantities

- Known: momentum changes by 150 kg metres per second.
- Average force magnitude = momentum change/stopping time.
- For 0.30 s, force = 150/0.30 = 500 N.
- For 0.60 s, force = 150/0.60 = 250 N.
- This idealized average excludes the detail of a changing force curve.

Your turn: Momentum change is 120 kg metres per second over 0.40 s. Find average force magnitude.

Check the conclusion and its limits

- The largest force is not the same as average force.
- A school movement study should not deliberately create high-impact landings to test a prediction.

Not true: A video from one angle proves the cause of a sports injury. One camera angle shows one projection of a complex movement; forces, surfaces, fatigue and individual anatomy are invisible in it. Injury causation needs multiple views, force data and medical evidence, not a single clip.

Key:

- Joint movement results from muscle forces acting through lever systems.
- A biomechanical analysis must define the segment, direction and phase of movement.
- Watch for: the largest force is not the same as average force.

Write from an average force of 360 N

- Momentum changes by 180 kg metres per second.
- Compare the average force over 0.50 s and over 1.00 s. One camera angle does not prove the cause of an injury.