# Health and movement science Stage 6 (Year 11) – biomechanics – sample learning program



Contents

[Overview 2](#_Toc144447341)

[Syllabus 2](#_Toc144447342)

[Outcomes 2](#_Toc144447343)

[Content 2](#_Toc144447344)

[Learning sequence 1 – introducing biomechanical principles 4](#_Toc144447345)

[Learning intentions and success criteria 4](#_Toc144447346)

[Understanding terminology and the biomechanical principles 4](#_Toc144447347)

[Learning sequence 2 – practical application of biomechanical principles 7](#_Toc144447348)

[Learning intentions and success criteria 7](#_Toc144447349)

[Applying the concepts to movement and sporting examples 8](#_Toc144447350)

[Further reading 14](#_Toc144447351)

[Additional information 15](#_Toc144447352)

[Support and alignment 15](#_Toc144447353)

[References 17](#_Toc144447354)

This resource has been developed to assist teachers in NSW Department of Education schools to create learning that is contextualised to their classroom. It can be used as a basis for the teacher’s own program, assessment, or scope and sequence, or be used as an example of how the new curriculum could be implemented. The resource has suggested timeframes that may need to be adjusted by the teacher to meet the needs of their students.

## Overview

This learning program is intended to be completed in Year 11 Core 2 – The body and mind in motion. It is comprised of 2 learning sequences.

Five hours have been allocated to this program of learning.

This learning program could be used to lead into the **Year 11 Core 2 – biomechanics depth study**. This depth study will be published on the department’s PDHPE 11–12 webpages.

## Syllabus

The following syllabus outcomes and content is addressed if all the teaching activities are completed. Teachers are to use their professional judgement to ensure that the suggested syllabus content is addressed.

### Outcomes

A student:

* analyses the systems of the body in relation to movement **HM-11-03**
* Analysis: analyses the relationships and implications of health and movement concepts **HM-11-06**
* Problem-solving: proposes and evaluates solutions to health and movement issues **HM-11-09**

### Content

How do the systems of the body influence and respond to movement?

* Outline the interrelationship between biomechanical principles and the muscles, bones and joints of the body for safe movement

Including:

* how biomechanical principles are applied to human movement, including motion, balance and stability, fluid mechanics and force
* how biomechanical principles can be used to enhance safe movements for example, walking, squatting, lifting
* how biomechanical principles can be used to increase movement efficiency for example, movements to reduce injury, people with specific needs such as disability.

## Learning sequence 1 – introducing biomechanical principles

Before undertaking this learning sequence, students should have demonstrated sound understanding of the:

* skeletal and muscular systems of the body and their interrelationship
* biomechanical principles including motion, balance and stability, fluid mechanics and force.

Opportunities for reflection and adjustments can be made depending on student interest.

### Learning intentions and success criteria

**Note:** these learning intentions and success criteria are general and should be contextualised to suit your school and students’ needs.

Students will further develop an understanding of the biomechanical principles of motion, balance and stability, fluid mechanics and force and how they affect movement.

Students will:

* define and understand the terms ‘safe movement’ and ‘movement efficiency’
* recognise the importance of functional movement in everyday living.

### Understanding terminology and the biomechanical principles

Introduce or review biomechanics.

Biomechanics is the science of how and why the human body moves the way it does. This includes how muscles, bones and joints work together to produce movement. When used in sport, it can help to minimise the potential risk of injury and allow an athlete to pursue their potential, be more efficient and hence improve sport performance.

**Biomechanical principles**

* Motion – is the movement of the body or an object through space. Speed, acceleration and momentum are important parts of motion.
* Balance and stability – are the alignment of the body’s centre of gravity over the base of support. This includes centre of gravity, line of gravity and base of support.
* Fluid mechanics – is the study of forces and flows throw fluid. This includes flotation, centre of buoyancy and fluid resistance.
* Force – is a push or pull that causes a person or object to speed up, slow down, stop or change direction. The body applies force, the body absorbs force, the body can apply force to an object.

Brainstorm and define the following terms:

* safe movement
* functional movement
* movement efficiency.

**Sample answers:**

* Safe movement – using good form when moving or exercising. This means applying correct biomechanical principles. If you are applying good force, your form and movement will also be sound, which reduces the risk of injury.
* Functional movement – the ability to move the body with proper muscle and joint function for effortless, pain-free movement.
* Movement efficiency – to what degree individuals move both safely and effectively. It is about achieving the best movement with minimum wasted effort or expense.

**Note:** application of the basic biomechanical principles (motion, balance and stability, fluid mechanics and force) to a range of sporting examples will support student learning. Using simplified examples of movement, such as a standing long jump, allows students to see how the principles are practically applied and connect them to other sporting contexts. Learning through practical activities helps to cement concepts. It will help them analyse sporting movements and understand how to minimise the risk of injury and improve sport performance or efficiency.

## Learning sequence 2 – practical application of biomechanical principles

This learning sequence is designed to be delivered across 5 hours. There is flexibility to alter this timeline and make any necessary adjustments according to needs and context.

Before undertaking this learning sequence, students should have demonstrated sound understanding of:

* the terms safe movement, functional movement and movement efficiency
* skeletal and muscular systems of the body and their interrelationship
* biomechanical principles including motion, balance and stability, fluid mechanics and force.

### Learning intentions and success criteria

**Note:** these learning intentions and success criteria are general and should be contextualised to suit your school and students’ needs.

Students apply the basic biomechanical principles (motion, balance and stability, fluid mechanics and force) to a range of sporting examples.

Students will:

* analyse sporting movements
* make predictions about the impact of a biomechanical principle on the outcome of a practical application
* justify their observations through applying their understanding of biomechanical principles
* understand how to minimise the risk of injury and improve sport performance or movement efficiency
* work collaboratively with peers.

### Applying the concepts to movement and sporting examples

After foundational knowledge of the biomechanical principles has been established, you may wish to use the following practical activities to consolidate and strengthen understanding of these principles. Before each practical activity ask students to propose what they expect to observe to establish their prior knowledge of the biomechanical principles.

#### Activity 1 – standing long jump (summation of force)

Students undertake the following practical experiences.

* Hop off one leg without using your arms.
* Jump off 2 legs without using your arms.
* Jump off 2 legs while using both arms.
* Run up, jump off 2 legs and use both arms.

Based on the practical experiences, students answer the following questions.

1. What allowed you to jump forward regardless of the technique or posture used?
2. What do you notice about the distance that you were able to travel in each jump?
3. Why do you think that is?
4. What were the differences between the jumps? Explain using your understanding of the principles of force.
5. How effective would a high jumper or basketball player be if suspended in mid-air with nothing to push against?

#### Activity 2 – catching eggs and a cricket ball activity (absorbing force)

Students undertake the following practical experiences. Use an underarm throw for both objects.

* Catch an egg with a partner and gradually increase the distance between throws by stepping back after each catch.
* Repeat the same process with a cricket ball.

Based on the practical experiences, students answer the following questions.

1. How did you avoid breaking the egg? Describe the techniques you used.
2. How did your techniques change when the distance was increased? What was the outcome?
3. Which technique led to the most successful outcomes? Provide reasons for its success.
4. Why do you think the techniques of catching an egg might be applied to catching a hard object such as a cricket ball.
5. Using your knowledge of absorbing force, account for the different techniques used to catch both objects.
6. Where in other sports might this principle of absorbing force be applied?
7. How do you think this can be applied to something like rugby league? Why is technique important to allow a smaller opponent to tackle a larger person? How do they absorb shock or force?

#### Activity 3 – basketball and tennis ball activity (applying force)

Students undertake the following practical experiences.

* Place a basketball and a tennis ball on a line.
* Push both balls at the same time using the same force.

Based on the practical experiences, students answer the following questions.

1. Although the same amount of force was used, did one ball move further than the other? Propose why this occurred.
2. Explain the difference in distances travelled in terms of application of force to the masses of each ball.
3. Explain what you would expect to happen in the following situations and how each situation impacts the amount of force applied to the ball:
4. It was raining and the ball became wet.
5. The basketball was only half inflated.

An alternate activity to explore this principle is to use simple throwing techniques, such as throwing:

* without stepping forward
* with stepping forward
* with body rotation.

Questions should focus on why more force is generated with a stepping motion or rotation of the body.

#### Activity 4 – partner activity (base of support)

Students undertake the following practical experiences.

* Stand with feet together. Partner uses chalk to draw around their feet or base of support.
* While still standing, partner pushes them lightly.
* Repeat steps 1 and 2 with their partner using the same amount of force, but change the positioning of the feet to change the base of support such as:
* standing on one leg
* widening the stance on both feet
* kneeling on hands and knees.
* Introduce line of gravity by using a wide base of support with a sideways lean or movement towards the force before it makes contact.

Based on the practical experiences, students answer the following questions.

1. What did you notice as the base of support becomes bigger?
2. How does a person’s base of support affect their stability?
3. Account for reasons why an improved or greater base of support improves stability in relation to centre of gravity and line of gravity.
4. Identify 2 examples of when a wide base of support is needed in a sporting situation and explain why.
5. What did you notice when you had a wide base of support and moved towards the force before contact? Why do you think this is the case?

**Sample answer:** in this position someone is more stable and able to withstand the force because they are moving their line of gravity towards the direction of the force. This allows more movement to occur after the force before their line of gravity is being pushed outside the base of support.

1. Describe how athletes who perform skills with a narrow base of support control their upper body movement to assist in maintaining balance.

#### Activity 5 – sprint position stability (centre of gravity and base of support)

Students undertake the following practical experiences.

With a partner, students complete a 10-metre sprint from the following positions:

* standing straight with arms by their side
* feet apart with a slight forward lean and arms in the ready positions (standing start)
* crouch start with hands on the floor and using blocks if possible.

Partners record each sprint time in a table.

Table 1 – 10-metre sprint recording table

|  |  |
| --- | --- |
| Starting position | Time |
| A |  |
| B |  |
| C |  |

Based on the practical experiences, students answer the following questions.

1. Describe the effect of the height of the centre of gravity on balance and stability.
2. Explain the impact of the area of base of support on balance and stability.
3. Which starting position was the fastest and why?
4. Are there other biomechanical principles, for example, force that play a part in influencing the times? What is happening and why?

#### Activity 6 – swimming (fluid mechanics)

Students undertake the following practical experiences.

Students work in pairs. One student is in the water performing a variety of float positions for 10–15 seconds each. The other student is outside of the pool recording what they observe, including what happens to their partner’s arms, legs, trunk and hips.

**Float positions**

* floating on back
* floating on back with head held out of water
* prone float (floating face down) with arms by side and legs together
* prone float with arms and legs spread
* prone float while breathing out
* deep inhalation and then prone float, holding breath
* back sculling
* floating while holding knees to chest.

Based on the practical experiences, students answer the following questions.

1. What did you observe with the different floats performed by your partner? How did shifting different body parts (together, tucked, spread, out of water) impact the float?
2. Which body position resulted in the most effective float position for the time? Explain why.
3. If you were to turn an empty bucket upside down and push down on it, would it float? Why or why not?

**Sample answer:** there is air trapped in the bucket and air is lighter than water.

1. Where is the centre of buoyancy located in the body?

**Sample answer:** usually in the middle of the lung area.

1. Why would holding your breath support floating?
2. Why does the centre of buoyancy keep changing with the different floats?

#### Activity 7 – linear motion when swimming

Students undertake the following practical experiences.

Students work in pairs. One student is in the water performing a variety of swim and stroke techniques. The other student is outside of the pool recording what they observe, including the effect that the variations in swimming techniques have on linear motion and smooth, efficient motion through the water.

**Swim and stroke techniques**

* dog paddle
* freestyle with head out of water while swimming
* freestyle, lifting head up out of water to breathe
* freestyle with no leg kick
* freestyle with breath taken by rolling whole body onto side
* freestyle with hand slapping the water on entry
* identify any other technique faults that would affect linear motion and make movements less smooth.

Based on the practical experiences, students answer the following questions.

1. What did you notice about the variations in swim and stroke techniques? Account for why this occurs.
2. Why does being streamlined create a smooth efficient motion through the water?
3. How can we create less drag?
4. Outside of swim or stroke techniques, what other options are available to reduce drag and increase efficiency in the water?

**Note:** students should consider the impact of technology such as racing swimsuits, designs to boats or kayaks in their answer.

## Further reading

CESE (Centre for Education Statistics and Evaluation) (2020a) [*What works best: 2020 update*](https://education.nsw.gov.au/about-us/educational-data/cese/publications/research-reports/what-works-best-2020-update), NSW Department of Education, accessed 14 August 2023.

CESE (Centre for Education Statistics and Evaluation) (2020b) [*What works best in practice*](https://education.nsw.gov.au/about-us/educational-data/cese/publications/practical-guides-for-educators-/what-works-best-in-practice), NSW Department of Education, accessed 14 August 2023.

## Additional information

The information below can be used to support teachers when using this teaching resource for Health and movement science.

### Support and alignment

**Resource evaluation and support:** all curriculum resources are prepared through a rigorous process. Resources are periodically reviewed as part of our ongoing evaluation plan to ensure currency, relevance and effectiveness. For additional support or advice contact the PDHPE Curriculum team by emailing PDHPEcurriculum@det.nsw.edu.au.

**Alignment to system priorities and/or needs:** [School Excellence Policy](https://education.nsw.gov.au/policy-library/policies/pd-2016-0468), [School Success Model.](https://education.nsw.gov.au/public-schools/school-success-model/school-success-model-explained)

**Alignment to the School Excellence Framework:** this resource supports the [School Excellence Framework](https://education.nsw.gov.au/about-us/strategies-and-reports/school-excellence-and-accountability/school-excellence#:~:text=SPaRO%20platform.-,School%20Excellence%20Framework,-The%20school%20planning) elements of curriculum (curriculum provision) and effective classroom practice (lesson planning, explicit teaching).

**Alignment to Australian Professional Teaching Standards:** this resource supports teachers to address [Australian Professional Teaching Standards](https://educationstandards.nsw.edu.au/wps/portal/nesa/teacher-accreditation/meeting-requirements/the-standards) 3.2.2, 3.3.2.

**Consulted with:** Curriculum and Reform and subject matter experts

**NSW syllabus:** Health and Movement Science 11–12 Syllabus

**Syllabus outcomes:** HM-11-03, HM-11-06, HM-11-09

**Author:** PDHPE Curriculum Team.

**Publisher:** State of NSW, Department of Education.

**Resource:** Learning program.

**Related resources:** further resources to support Stage 6 Health and movement science can be found on the [Planning, programming and assessing PDHPE 11-12 curriculum webpage](https://education.nsw.gov.au/teaching-and-learning/curriculum/pdhpe/planning-programming-and-assessing-pdhpe-k-12/planning-programming-and-assessing-pdhpe-11-12) and the [HSC hub](https://hschub.nsw.edu.au/).

**Professional learning:** relevant professional learning is available through the [PDHPE statewide staffroom](https://teams.microsoft.com/l/team/19%3A93bb42a54e4b4779b28ab5b737b9e642%40thread.tacv2/conversations?groupId=d759a943-a680-4d0b-bdfe-88a8998f709e&tenantId=05a0e69a-418a-47c1-9c25-9387261bf991).

**Universal Design for Learning:** [Curriculum planning for every student in every classroom](https://education.nsw.gov.au/teaching-and-learning/learning-from-home/teaching-at-home/teaching-and-learning-resources/universal-design-for-learning). Support the diverse learning needs of students using inclusive teaching and learning strategies.

**Creation date:** 14 August 2023

**Rights:** © State of New South Wales, Department of Education.

## References

This resource contains NSW Curriculum and syllabus content. The NSW Curriculum is developed by the NSW Education Standards Authority. This content is prepared by NESA for and on behalf of the Crown in right of the State of New South Wales. The material is protected by Crown copyright.

Please refer to the NESA Copyright Disclaimer for more information <https://educationstandards.nsw.edu.au/wps/portal/nesa/mini-footer/copyright>.

NESA holds the only official and up-to-date versions of the NSW Curriculum and syllabus documents. Please visit the NSW Education Standards Authority (NESA) website <https://educationstandards.nsw.edu.au/> and the NSW Curriculum website <https://curriculum.nsw.edu.au/home>.

[Health and Movement Science 11–12 Syllabus](https://curriculum.nsw.edu.au/syllabuses/health-and-movement-science-11-12-2023) © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales, 2023.

**© State of New South Wales (Department of Education), 2023**

The copyright material published in this resource is subject to the *Copyright Act 1968* (Cth) and is owned by the NSW Department of Education or, where indicated, by a party other than the NSW Department of Education (third-party material).

Copyright material available in this resource and owned by the NSW Department of Education is licensed under a [Creative Commons Attribution 4.0 International (CC BY 4.0) license](https://creativecommons.org/licenses/by/4.0/).



This license allows you to share and adapt the material for any purpose, even commercially.

Attribution should be given to © State of New South Wales (Department of Education), 2023.

Material in this resource not available under a Creative Commons license:

* the NSW Department of Education logo, other logos and trademark-protected material
* material owned by a third party that has been reproduced with permission. You will need to obtain permission from the third party to reuse its material.

**Links to third-party material and websites**

Please note that the provided (reading/viewing material/list/links/texts) are a suggestion only and implies no endorsement, by the New South Wales Department of Education, of any author, publisher, or book title. School principals and teachers are best placed to assess the suitability of resources that would complement the curriculum and reflect the needs and interests of their students.

If you use the links provided in this document to access a third-party's website, you acknowledge that the terms of use, including licence terms set out on the third-party's website apply to the use which may be made of the materials on that third-party website or where permitted by the Copyright Act 1968 (Cth). The department accepts no responsibility for content on third-party websites.