Health and movement science Stage 6 (Year 11)

Focus area 2 – biomechanics – sample learning program

Contents

[Overview 3](#_Toc178068138)

[Prior learning 3](#_Toc178068139)

[Purpose 3](#_Toc178068140)

[Syllabus 4](#_Toc178068141)

[Outcomes 4](#_Toc178068142)

[Content 4](#_Toc178068143)

[Focus area 2 – The body and mind in motion 4](#_Toc178068144)

[Learning sequence 1 – introducing biomechanical principles 6](#_Toc178068145)

[Learning intentions and success criteria 6](#_Toc178068146)

[Understanding terminology and the biomechanical principles 6](#_Toc178068147)

[Learning sequence 2 – practical application of biomechanical principles 8](#_Toc178068148)

[Learning intentions and success criteria 8](#_Toc178068149)

[Applying the concepts to movement and sporting examples 8](#_Toc178068150)

[Activity 1 – standing long jump (summation of force) 9](#_Toc178068151)

[Activity 2 – catching eggs and a cricket ball activity (absorbing force) 9](#_Toc178068152)

[Activity 3 – basketball and tennis ball activity (applying force) 10](#_Toc178068153)

[Activity 4 – partner activity (base of support) 11](#_Toc178068154)

[Activity 5 – sprint position stability (centre of gravity and base of support) 12](#_Toc178068155)

[Activity 6 – swimming (fluid mechanics) 13](#_Toc178068156)

[Activity 7 – linear motion when swimming 14](#_Toc178068157)

[Additional information 16](#_Toc178068158)

[Support and alignment 16](#_Toc178068159)

[References 18](#_Toc178068160)

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 11Focus area 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 is intended to be used as a lead into the **Year 11 Focus area 2 – biomechanics depth study**. This depth study can be accessed on the [Planning, programming and assessing 11–12 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).

# Prior learning

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

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

# Purpose

The purpose of this learning sequence is to introduce students to the fundamental principles of biomechanics, focusing on how and why we move the way we do. Through exploring key concepts such as motion, balance and stability, fluid mechanics and force, students will gain a foundational understanding of biomechanical principles. Practical activities will allow students to apply their knowledge, reinforcing concepts and demonstrating how these principles contribute to safe and efficient movement.

# 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**

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## Content

### Focus area 2 – The body and mind in motion

**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 (**Example(s):**

Walking.

Squatting.

Lifting.)

* how biomechanical principles can be used to increase movement efficiency (**Example(s):**

Movements to reduce injury.

People with specific needs such as disability.)

# Learning sequence 1 – introducing biomechanical principles

This learning sequence is intended to support the teaching of Year 11 Focus area 2 – The body and mind in motion. Opportunities for reflection and adjustments can be made depending on student interest.

## Learning intentions and success criteria

**Explicit teaching note:** learning intentions and success criteria are most effective when they are contextualised to meet the needs of students in the class. The examples provided in this document are generalised to demonstrate how learning intentions and success criteria could be created.

Through these activities, students will:

* develop an understanding of the biomechanical principles of motion, balance and stability, fluid mechanics and force and how they affect movement
* 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**

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 through 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 intended to support the teaching of Year 11 Focus area 2 – The body and mind in motion. It has been designed to be delivered across 5 hours. There is flexibility to alter this timeline and make any necessary adjustments according to needs and context.

## Learning intentions and success criteria

**Explicit teaching note:** learning intentions and success criteria are most effective when they are contextualised to meet the needs of students in the class. The examples provided in this document are generalised to demonstrate how learning intentions and success criteria could be created.

Through these activities, students will:

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

Reflective questioning after each practical activity has been provided and can be used to gain effective feedback on student knowledge and understanding. Further learning should be considered for those students still developing an understanding of each of the key biomechanical concepts (motion, balance and stability, fluid mechanics and force).

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

Students undertake the following practical experiences:

1. Hop off one leg without using your arms.
2. Jump off 2 legs without using your arms.
3. Jump off 2 legs while using both arms.
4. 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? Explain your answer.

### 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 successful outcome and why?
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.

**Note:** an alternate activity to explore this principle could be 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.

1. Stand with feet together. Partner uses chalk to draw around their feet or base of support.
2. While still standing, partner pushes them lightly.
3. 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:
4. standing on one leg
5. widening the stance on both feet
6. kneeling on hands and knees.
7. 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.

1. With a partner, students complete a 10-metre sprint from the following positions:
2. standing straight with arms by their side
3. feet apart with a slight forward lean and arms in the ready positions (standing start)
4. crouch start with hands on the floor and using blocks if possible.
5. 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 to 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? For example, there is air trapped in the bucket and air is lighter than water.
4. Where is the centre of buoyancy located in the body? For example, usually in the middle of the lung area.
5. What is the similarity between the bucket of air and the centre of buoyancy?
6. Why would holding your breath support floating?
7. 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 and for 10 to 15 seconds.
* 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.

# 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.

**Differentiation:** further advice to support Aboriginal and/or Torres Strait Islander students, EAL/D students, students with a disability and/or additional needs and High Potential and gifted students can be found on the [Planning, programming and assessing 7–12](https://education.nsw.gov.au/teaching-and-learning/curriculum/planning-programming-and-assessing-k-12/planning-programming-and-assessing-7-12) webpage. This includes the [Inclusion and differentiation advice 7–10](https://education.nsw.gov.au/teaching-and-learning/curriculum/planning-programming-and-assessing-k-12/planning-programming-and-assessing-7-12/inclusion-and-differentiation-advice-7-10) webpage.

**Assessment**: further advice to support formative assessment is available on the [Planning, programming and assessing 7–12](https://education.nsw.gov.au/teaching-and-learning/curriculum/planning-programming-and-assessing-k-12/planning-programming-and-assessing-7-12) webpage.

**Explicit teaching:** further advice to support explicit teaching is available on the [Explicit teaching](https://education.nsw.gov.au/teaching-and-learning/curriculum/explicit-teaching) webpage. This includes the CESE [Explicit teaching – Driving learning and engagement](https://education.nsw.gov.au/about-us/education-data-and-research/cese/publications/research-reports/what-works-best-2020-update/explicit-teaching-driving-learning-and-engagement) webpage.

**Alignment to system priorities and/or needs:** [School Excellence Policy](https://education.nsw.gov.au/policy-library/policies/pd-2016-0468), [Our Plan for NSW Public Education](https://education.nsw.gov.au/about-us/strategies-and-reports/plan-for-nsw-public-education)

**Alignment to the School Excellence Framework:** this resource supports the [School Excellence Framework](https://education.nsw.gov.au/inside-the-department/directory-a-z/strategic-school-improvement/school-excellence-framework) 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/proficient-teacher) 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 health and movement science Stage 6 can be found on the [Planning, programming and assessing PDHPE 11–12](https://education.nsw.gov.au/teaching-and-learning/curriculum/pdhpe/planning-programming-and-assessing-pdhpe-k-12/planning-programming-and-assessing-pdhpe-11-12) curriculum webpage and 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).

**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).

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