Mathematics Stage 4 (Year 8) – unit of learning

Investigating triangles

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# Rationale

The NSW Department of Education publishes a range of curriculum support materials, including samples of lesson sequences, scope and sequences, assessment tasks, examinations, student and teacher resource booklets, and curriculum planning and curriculum evaluation templates. The samples are not exhaustive and do not represent the only way to complete or engage in each of these processes. Curriculum design and implementation is a dynamic and contextually-specific process. While the mandatory components of syllabus implementation must be met by all schools, it is important that the approach taken by teachers is reflective of their needs, and faculty or school processes.

The NSW Education Standards Authority (NESA) defines [programming](https://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/understanding-the-curriculum/programming) as ‘the process of selecting and sequencing learning experiences which enable students to engage with syllabus outcomes and develop subject specific skills and knowledge’ (NESA 2022). A program is developed collaboratively within a faculty. It differs from a unit in important ways, as outlined by NESA on their [Advice on units](https://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/understanding-the-curriculum/programming/advice-on-units) page. A unit is a contextually-specific plan for the intended teaching and learning for a particular class for a particular period. The organisation of the content in a unit is flexible and it may vary according to the school, the teacher, the class and the learning space. They should be working documents that reflect the thoughtful planning and reflection that takes place during the teaching and learning cycle. There are mandatory components of programming and unit development, and this template provides one option for the delivery of these requirements. The NESA and department guidelines that have influenced this template are elaborated upon at the end of the document.

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

**Description**: this program of learning addresses content from the focus areas of Equations and Right-angled triangles (Pythagoras’ theorem). The lessons and sequences in this program of learning are designed to allow students to explore solving quadratic equations, justifying if a triangle is a right-angled triangle and finding the lengths of unknown sides in right-angled triangles.

**Duration**: this program of learning is designed to be completed over a period of approximately 3 weeks but can be adapted to suit the school context.

**Explicit teaching**: suggested learning intentions and success criteria are available for some lessons provided. 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.

# Outcomes

A student:

* develops understanding and fluency in mathematics through exploring and connecting mathematical concepts, choosing and applying mathematical techniques to solve problems, and communicating their thinking and reasoning coherently and clearly **MAO-WM-01**
* solves linear equations of up to 2 steps and quadratic equations of the form **MA4-EQU-C-01**
* applies Pythagoras’ theorem to solve problems in various contexts **MA4-PYT-C-01**

The identified Life Skills outcomes that relate to this unit are **MALS-PAT-01** – recognises and applies patterns in everyday contexts and **MALS-LEN-01** – measures and uses length in everyday contexts.

[Mathematics K**–**10 Syllabus](https://curriculum.nsw.edu.au/learning-areas/mathematics/mathematics-k-10-2022/overview) © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales, 2022.

**Prior to planning for teaching and learning, please consider the following**:

**Engagement**

* How will I provide authentic, relevant learning opportunities for students to personally connect with lesson content?
* How will I support every student to grow in independence, confidence, and self-regulation?
* How will I facilitate every student to have high expectations for themselves?
* How will I identify and provide the support each student needs to sustain their learning efforts?

**Representation**

* What are some different ways I can present content to enable every student to access and understand it?
* How will I identify and address language and/or cultural considerations that may limit access to content for students?
* How will I make lesson content and learning materials more accessible?
* How will I plan learning experiences that are relevant and challenging for the full range of students in the classroom?

**Expression**

* How will I provide multiple ways for students to respond and express what they know?
* What tools and resources can students use to demonstrate their understanding?
* How will I know every student has understood the concepts and language presented in each lesson?
* How will I monitor if every student has achieved the learning outcomes and learning growth?

# Lesson sequence and details

## Learning episode 1 – ways of working – equations

### Teaching and learning activity

Students use backtracking diagrams to develop their understanding of the order of operations required to solve linear equations of up to 2 steps. A variety of ways of showing working out are explored to formalise students’ approaches to solving equations.

### Syllabus content

* Solve linear equations with integer and non-integer solutions using algebraic techniques that involve up to 2 steps, including equations with pronumerals on both sides

Table 1 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| [Ways of working – equations (DOCX 716 KB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s4-unit-10-l01-ways-of-working-equations.docx)  Duration**:** 1 lesson  Learning intention   * To be able to solve linear equations involving 2 steps.   Success criteria   * I can determine the order of operations to solve an equation. * I can determine the order of operations to solve an equation. * I can solve equations involving 2 steps. | * A class set of Appendix A * A class set of Appendix B, printed (one per 3 students) * [*Ways of working – equations* (PPTX 2.2 MB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s4-unit-10-l01-ways-of-working-equations-slideshow.pptx) PowerPoint |  |

## Learning episode 2 – quadratic equations

### Teaching and learning activity

Students are introduced to quadratic equations in the form and explore why they have 2 solutions.

### Syllabus content

* Reason why there are 2 values of x that satisfy a quadratic equation of the form if
* Solve problems involving quadratic equations of the form , giving answers in exact form and as decimal approximations
* Solve quadratic equations arising from substitution into a formula

Table 2 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| [Quadratic equations (DOCX 974.7 KB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s4-unit-10-l02-quadratic-equations.docx)  Duration**:** 1 lesson  Learning intention   * To understand why a quadratic equation may have 2 solutions   Success criteria   * I can find the square root of a number. * I can solve quadratic equations in the form . * I can justify why a quadratic equation in the form has a positive and negative solution. * I can identify when a quadratic equation has zero, one or 2 solutions. | * Appendix A, printed (one per 2 students) * A class set of Appendix B * [*Quadratic equations* (PPTX 2.2 MB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s4-unit-10-l02-quadratic-equations-slideshow.pptx) PowerPoint * Digital device (one per 2 students) |  |

## Learning episode 3 – Pythagoras’ theorem

### Teaching and learning activity

Students explore a visual representation of Pythagoras’ theorem and then apply the theorem to find the hypotenuse of right-angled triangles.

### Syllabus content

* Identify and describe the hypotenuse as the side opposite the right angle and the longest side in any right-angled triangle
* Establish the relationship between the lengths of the sides of a right-angled triangle
* Use the relationship to record and define Pythagoras’ theorem both algebraically and in words
* Apply Pythagoras’ theorem to find the unknown length of a side in a right-angled triangle, giving answers in an exact form or as decimal approximations

Table 3 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| [Pythagoras’ theorem (DOCX 849.7 KB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s4-unit-10-l03-pythagoras-theorem.docx)  Duration**:** 1–2 lessons  Learning intention   * To understand why Pythagoras’ theorem can be used to find the hypotenuse of right-angled triangles.   Success criteria   * I can find the square root of a square. * I can explain why using a visual representation. * I can apply Pythagoras’ theorem to find the hypotenuse of a right-angled triangle. | * A class set of Appendix A * [*Pythagoras’ theorem* (PPTX 2.6 MB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s4-unit-10-l03-pythagoras-theorem-slideshow.pptx) PowerPoint * Rulers or measuring tape (one per pair of students) * Optional: digital device (one per 2 students) |  |

## Learning episode 4 – almost exactly

### Teaching and learning activity

Students apply Pythagoras’ theorem to find the hypotenuse of right-angled triangles, giving answers in exact form or as decimal approximations. Students focus on why exact form can be beneficial in some instances.

### Syllabus content

* Solve quadratic equations arising from substitution into a formula
* Apply Pythagoras’ theorem to find the unknown length of a side in a right-angled triangle, giving answers in an exact form or as decimal approximations

Table 4 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| [Almost exactly (DOCX 627.7 KB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s4-unit-10-l04-almost-exactly.docx)  Duration**:** 1 lesson  Learning intention   * To understand the purpose of giving answers in exact form.   Success criteria   * I can define exact form and decimal approximations. * I can explain when it is appropriate to give answers in exact form. * I can use Pythagoras’ theorem to find the hypotenuse of a right-angled triangle, giving answers in an exact form. | * A class set of Appendices A and B * [*Almost exactly* (PPTX 2.5 MB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s4-unit-10-l04-almost-exactly-slideshow.pptx) PowerPoint * A class set of rulers |  |

## Learning episode 5 – hole in one

### Teaching and learning activity

Students discover how to find the length of the shorter side (leg) in a right-angled triangle by exploring how to find the shortest distance over an obstacle on a golf course.

### Syllabus content

* Solve quadratic equations arising from substitution into a formula
* Apply Pythagoras’ theorem to find the unknown length of a side in a right-angled triangle, giving answers in an exact form or as decimal approximations
* Solve practical problems involving Pythagoras’ theorem before exploring a variety of related problems

Table 5 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| [Hole in one (DOCX 1 MB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s4-unit-10-l05-hole-in-one.docx)  Duration**:** 1 lesson  Learning intention   * To be able to use Pythagoras’ theorem to find unknown lengths.   Success criteria   * I can correctly substitute values into Pythagoras’ theorem. * I can draw visual representations of equations using Pythagoras’ theorem. * I can solve an equation to find a distance. | * Appendix A, printed (one per 2 students) * A class set of Appendix B * Appendix C, printed (one per 3 students) * [*Hole in one* (PPTX 3.4 MB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s4-unit-10-l05-hole-in-one-slideshow.pptx) PowerPoint * Tape measure or trundle wheel (one per 3 students) * Digital device (one per 3 students) |  |

## Learning episode 6 – What’s square?

### Teaching and learning activity

Students explore how to find and verify Pythagorean triads. These are then used to justify whether a shape is a square.

### Syllabus content

* Solve quadratic equations arising from substitution into a formula
* Apply the converse of Pythagoras’ theorem to establish whether a triangle is right angled
* Solve practical problems involving Pythagoras’ theorem before exploring a variety of related problems
* Justify whether a set of 3 integers is a Pythagorean triad

Table 6 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| [What’s square? (DOCX 373.9 KB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s4-unit-10-l06-whats-square.docx)  Duration**:** 1 lesson  Learning intention   * To know when a shape has a right angle.   Success criteria   * I can define a Pythagorean triad. * I can verify if 3 numbers are a Pythagorean triad. * I can use Pythagorean triads to determine if a shape is a square. | * [*What’s square?* (PPTX 1.3 MB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s4-unit-10-l06-whats-square-slideshow.pptx) PowerPoint * A class set of rulers * A class set of mini whiteboards * 4 pegs (one per 3 students) * Ball of string (one per 3 students) * Tape measure (one per 3 students) |  |

# References

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NESA (NSW Education Standards Authority) (n.d.) ‘[Advice on units](https://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/understanding-the-curriculum/programming/advice-on-units)’, Programming, NESA website, accessed 17 June 2024.

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