Mathematics Stage 4 (Year 8) – unit of learning

Geometrical relationships

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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 Angle relationships and Properties of geometrical figures. The lessons and sequences in this program of learning are designed to allow students to explore angles between lines, including those in transversals on sets of parallel lines and those within known shapes.

**Duration**: this program of learning is designed to be completed over a period of approximately 6 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.

**Accessing the resources**: this program of learning includes a range of student-facing and teacher resources. All resources can be accessed from the [Stage 4 Unit 11 – geometrical relationships](https://education.nsw.gov.au/teaching-and-learning/curriculum/mathematics/mathematics-curriculum-resources-k-12/mathematics-7-10-resources/stage-4-unit-11-geometrical-relationships) catalogue page.

# 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**
* applies angle relationships to solve problems, including those related to transversals on sets of parallel lines **MA4-ANG-C-01**
* identifies and applies the properties of triangles and quadrilaterals to solve problems **MA4-GEO-C-01**

The identified Life Skills outcomes that relate to this unit are **MALS-GEO-01 –** explores 2-dimensional shapes and 3-dimensional objectsand **MALS-POS-01 –** demonstrates knowledge of position and direction 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 – draw it out

### Teaching and learning activity

Students explain how to draw geometrical diagrams to discover the need for naming conventions and definitions for lines, rays and intervals.

### Syllabus content

* Use appropriate terminology and conventions to define, label and name points, rays, lines and intervals using capital letters
* Use common conventions to indicate right angles, equal angles and intervals on diagrams

Table 1 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| Draw it out Duration**:** 1 lessonLearning intention* To be able to use the terminology and conventions of geometrical diagrams.

Success criteria* I can explain the similarities and differences between a line, ray and interval.
* I can identify and describe lines, rays and intervals in diagrams.
 | * Appendix A, printed, (one per pair of students)
* Appendix B, printed (class set)
* *Draw it out* PowerPoint
 |  |

## Learning episode 2 – supplementary seesaws

### Teaching and learning activity

Students explore supplementary angles by finding the size of angles on a seesaw. They discover and use the terms ‘common arm’, ‘common vertex’ and ‘adjacent angles’.

### Syllabus content

* Identify right angles, straight angles, angles of complete revolution and vertically opposite angles
* Apply the terms *complementary* and *supplementary* to a pair of angles adding to 90°and 180°, respectively
* Apply the term *adjacent angles* to a pair of angles with a common arm and common vertex
* Apply the knowledge of angle relationships including angles at a point to find the sizes of unknown angles embedded in diagrams and give reasons

Table 2 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| Supplementary seesaws Duration**:** 1 lessonLearning intention* To understand the relationship between supplementary angles.

Success criteria* I can identify common arms, common vertices and adjacent angles
* I can define supplementary angles
* I can use supplementary angles to find unknown angles
 | * *Supplementary seesaws* PowerPoint
* Devices, per pair (optional)
* Appendix A, printed, per pair (if not using devices)
* Appendix B, printed and cut into cards (one set per pair)
 |  |

## Learning episode 3 – the cake thief

### Teaching and learning activity

Students will investigate angles at a point and vertically opposite angles in circles and will solve equations to find the size of unknown angles.

### Syllabus content

* Identify right angles, straight angles, angles of complete revolution and vertically opposite angles
* Apply the knowledge of angle relationships including angles at a point to find the sizes of unknown angles embedded in diagrams and give reasons

Table 3 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| The cake thief Duration**:** 1 lessonLearning intention* To understand the relationship between angles at a point and vertically opposite angles.

Success criteria* I can find an unknown angle at a point.
* I can identify vertically opposite angles.
* I can solve simple equations.
 | * Appendix A and B, printed A3 (per group of 3)
* Appendix C and D, printed (class sets)
* Appendix E, printed (per pair of students)
* *The cake thief* PowerPoint
 |  |

## Learning episode 4 – complements to you

### Teaching and learning activity

Students start by exploring complementary angles before being introduced to how to denote perpendicular lines.

### Syllabus content

* Use common conventions to indicate right angles, equal angles and intervals on diagrams
* Identify right angles, straight angles, angles of complete revolution and vertically opposite angles
* Apply the terms *complementary* and *supplementary* to a pair of angles adding to 90°and 180°, respectively
* Identify and describe perpendicular lines using the symbol for *is perpendicular to* (⊥)
* Apply the knowledge of angle relationships including angles at a point to find the sizes of unknown angles embedded in diagrams and give reasons

Table 4 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| Complements to you Duration**:** 1 lessonLearning intention* To be able to use the terms perpendicular and complementary to describe angles.

Success criteria* I can explain what a complementary angle is.
* I can use complementary angles to find unknown values.
* I can describe and identify symbols that represent perpendicular lines.
 | * Appendix A, printed (per pair of students)
* Appendix B, printed (class set)
* Download, print and cut into tasks the Starting point maths activity ‘Complementary angles’ ([bit.ly/complementaryangles1](https://bit.ly/complementaryangles1)) (one copy per 6 students)
* *Complements to you* PowerPoint
* A mini whiteboard (one per pair of students)
* Device (one per pair of students)
 |  |

## Learning episode 5 – the corresponding connection

### Teaching and learning activity

Students explore transversals in parallel lines and corresponding angles.

### Syllabus content

* Apply the common conventions to indicate parallel lines on diagrams
* Identify and describe pairs of parallel lines using the symbol for *is parallel to* (∥)
* Identify and define transversals, including transversals of parallel lines
* Identify, name and measure alternate angle pairs, corresponding angle pairs and co-interior angle pairs for 2 lines cut by a transversal
* Verify and identify corresponding angles and alternate angles as equal, and co-interior angles as supplementary, when a pair of parallel lines is cut by a transversal
* Apply the knowledge of angles associated with parallel lines to find the sizes of unknown angles embedded in related diagrams and give reasons

Table 5 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| The corresponding connection Duration****:**** 1 lessonLearning intention* To understand the relationship between corresponding angles in parallel lines.

Success criteria* I can represent sets of parallel lines in a diagram and by writing a statement.
* I can identify and define a transversal.
* I can identify and name corresponding angles in parallel lines.
* I can find the sizes of unknown angles, giving reasons.
 | * Appendices A and C, printed (one per pair of students)
* Appendix B, printed (class set)
* *The corresponding connection* PowerPoint.
* A4 plastic pocket (one per pair of students)
* Adhesive putty
 |  |

## Learning episode 6 – alternate views

### Teaching and learning activity

Students explore alternate angles in parallel lines through their understanding and application of the angle sum of a triangle and supplementary angles.

### Syllabus content

* Identify, name and measure alternate angle pairs, corresponding angle pairs and co-interior angle pairs for 2 lines cut by a transversal
* Verify and identify corresponding angles and alternate angles as equal, and co-interior angles as supplementary, when a pair of parallel lines is cut by a transversal

Table 6 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| Alternate views Duration****:**** 1 lessonLearning intentions* To understand the relationship between alternate angles and parallel lines.
* To apply knowledge of alternate angles and other geometrical relationships to solve problems.

Success criteria* I can identify and name alternate angles in parallel lines.
* I can calculate the size of unknown angles using knowledge of alternate angles in parallel lines.
 | * Appendix A, printed (per group of 3 and cut into cards)
* Appendix B printed (class set)
* Appendix C, printed (one copy per group).
* A4 paper, scissors, and adhesive putty (per group of 3)
* Alternate views PowerPoint.
 |  |

## Learning episode 7 – come inside

### Teaching and learning activity

Students look at situations where we need parallel lines to explore co-interior angles.

### Syllabus content

* Identify, name and measure alternate angle pairs, corresponding angle pairs and co-interior angle pairs for 2 lines cut by a transversal
* Verify and identify corresponding angles and alternate angles as equal, and co-interior angles as supplementary, when a pair of parallel lines is cut by a transversal

Table 7 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| Come inside Duration****:**** 1 lessonLearning intention* To understand the relationship between co-interior angles and parallel lines.

Success criteria* I can identify a transversal.
* I can identify a set of parallel lines.
* I can identify and name co-interior angles in parallel lines.
* I can calculate the size of unknown angles, using knowledge of co-interior angles of parallel lines.
 | * Appendix A, printed (per group of 3).
* Appendix B, printed (class set)
* Appendix C, printed (per pair of students)
* *Come inside* PowerPoint.
* A3 plastic pocket (per group of 3)
* Adhesive putty
* Protractor (one per student)
 |  |

## Learning episode 8 – all in this together

### Teaching and learning activity

Students apply their knowledge of transversals in parallel lines and angles at a point to find unknowns.

### Syllabus content

* Justify that 2 lines are parallel by using properties of alternate, corresponding or co-interior angles on parallel lines
* Apply the knowledge of angle relationships including angles at a point to find the sizes of unknown angles embedded in diagrams and give reasons
* Apply the knowledge of angles associated with parallel lines to find the sizes of unknown angles embedded in related diagrams and give reasons
* Apply the properties of triangles and quadrilaterals to determine the unknown sides and angles to solve problems, giving reasons

Table 8 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| All in this together Duration****:**** 2 lessonsLearning intention* To be able to apply knowledge of angle relationships to find unknowns.

Success criteria* I can identify alternate, corresponding, and co-interior angles on a diagram,
* I can identify supplementary and vertically opposite angles on a diagram.
* I can justify the size of an angle using angle relationships.
* I can find the size of an unknown angle in multiple ways.
 | * Appendix A, printed and cut into cards (per group of 3)
* Appendix B, printed A3 (per group of 3)
* Appendix C and D, printed (class set)
* *All in this together* PowerPoint
* Protractor (one per student)
 |  |

# 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 7 August 2024.

NESA (NSW Education Standards Authority) (2022) ‘[Programming](https://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/understanding-the-curriculum/programming/advice-on-units)’, Understanding the curriculum, NESA website, accessed 7 August 2024.

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