# Mathematics Stage 5 – unit of learning – geometrical representations



Contents

[Rationale 2](#_Toc129850516)

[Overview 3](#_Toc129850517)

[Outcomes 4](#_Toc129850518)

[Lesson sequence and details 6](#_Toc129850519)

[Learning episode 1 – how long is a blue whale? 6](#_Toc129850520)

[Learning episode 2 – scaled copies or fakes? 8](#_Toc129850521)

[Learning episode 3 – similar figures in art 10](#_Toc129850522)

[Learning episode 4 – how many angles? 12](#_Toc129850523)

[Learning episode 5 – corresponding sides and angles 14](#_Toc129850524)

[Learning episode 6 – scale factor 17](#_Toc129850525)

[Learning episode 7 – scale factor in similar triangles 19](#_Toc129850526)

[Learning episode 8 – movie magic 21](#_Toc129850527)

[Learning episode 9 – maps and scale 23](#_Toc129850528)

[Learning episode 10 – comparing representations 25](#_Toc129850529)

[Learning episode 11 – scale factor and area 27](#_Toc129850530)

[References 29](#_Toc129850531)

## 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/school processes.

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](https://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/understanding-the-curriculum/programming) 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. The units 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 Properties of geometrical figures A, as well as Path focus areas, Properties of geometrical figures B and Introduction to networks. The lessons and sequences in this program of learning are designed to allow students to understand and use geometrical representations, applying concepts including proportion, scale factors, similarity and connections (networks) to represent real-life objects, spaces, situations and concepts.

**Duration**: this program of learning is designed to be completed over a period of approximately 5 weeks, and considers a range of factors and variables. This approach to timing 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**
* identifies and applies the properties of similar figures and scale drawings to solve problems **MA5-GEO-C-01**

Related Path outcomes:

* establishes conditions for congruent triangles and similar triangles and solves problems relating to properties of similar figures and plane shapes **MA5-GEO-P-01**
* solves problems involving the characteristics of graphs/networks, planar graphs and Eulerian trails and circuits **MA5-NET-P-01**

The identified Life Skills outcome that relates to this unit is **MALS-GEO-01** – explores 2-dimensional shapes and 3-dimensional objects.

[Mathematics K–10 Syllabus](https://curriculum.nsw.edu.au/syllabuses/mathematics-k-10-2022) © 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 – how long is a blue whale?

#### Teaching and learning activity

Students explore the concept of proportion by exploring relationships between their own height and objects they can't easily see or measure.

#### Syllabus content

* Solve problems involving scale drawings, with or without digital tools

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Whales and chihuahuas](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-1-whales-and-chihuahuas.docx)Duration:1 lessonLearning intention* **To visualise lengths by comparing familiar objects.**

Success criteria* I can make approximate comparisons between familiar lengths and unseen long and short objects.
* I can estimate the length of objects larger and smaller than me.
* I can visualise proportion to check if my answers are logical.
 | * Tape measure or trundle wheel
* Mini whiteboards and markers
* Device per pair of students and internet access
* Printed class set of [Appendix A](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-1-whales-and-chihuahuas.docx)
* [*Whales and chihuahuas* PowerPoint](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-1-whales-and-chihuahuas.pptx) for displaying images
 |  |

### Learning episode 2 – scaled copies or fakes?

#### Teaching and learning activity

Students define similarity by exploring the concept of scaled versus distorted copies.

#### Syllabus content

* Describe similar figures as having the same shape but not necessarily the same size
* Verify and explain that in similar polygons, the corresponding angles are equal and the corresponding side lengths are in the same proportion

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Scaled copies or fakes?](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-2-scaled-copies-or-fakes.docx)Duration: 1 lessonLearning intention* To be able to describe characteristics of similar figures.

Success criteria* I can identify similar figures.
* I can explain why figures are similar or not similar.
 | * Devices with internet access (preferably one per student)
* Rulers (one per student)
* Printed class sets of [Appendix A](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-2-scaled-copies-or-fakes.docx) and [Appendix B](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-2-scaled-copies-or-fakes.docx)
* [*Scaled copies or fakes?* PowerPoint](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-2-scaled-copies.pptx) for displaying images
 |  |

### Learning episode 3 – similar figures in art

#### Teaching and learning activity

Students are provided with opportunities to explore similar figures and scale in art.

#### Syllabus content

* Match the corresponding sides and angles of similar polygons
* Solve problems involving scale drawings, with or without digital tools

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Similar figures in art](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-3-similar-figures-in-art.docx)Duration: 2 lessonsLearning intentions* To explore the use of similar figures and scale.
* To explore the meaning behind symbols used in Aboriginal artwork.

Success criteria* I can use a grid to draw similar figures.
* I can use a vanishing point to draw similar figures.
* I can recognise symbols in Aboriginal artwork and appreciate their meaning.
 | * Rulers (one per student)
* Printed class sets of [Appendix A](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-3-similar-figures-in-art.docx) and [Appendix B](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-3-similar-figures-in-art.docx)
* [*Similar figures in art* PowerPoint](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-3-similar-figures-in-art.pptx)for displaying images
 |  |

### Learning episode 4 – how many angles?

#### Teaching and learning activity

Students construct triangles and explore the minimum requirements to know 2 triangles are similar.

#### Syllabus content

* Verify and explain that in similar polygons, the corresponding angles are equal and the corresponding side lengths are in the same proportion
* Match the corresponding sides and angles of similar polygons
* Examine the minimum conditions needed and establish the 4 tests for 2 triangles to be similar (Path)
* Apply the minimum conditions needed and determine whether 2 triangles are similar using an appropriate test (Path)

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [How many angles?](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-4-how-many-angles.docx)Duration: 1 lessonLearning intention* To be able to determine if 2 triangles are congruent, similar, or neither based on the number of angles known.

Success criteria* I can determine if 2 triangles are congruent, similar, or neither.
* I can state whether 2 triangles will be similar based on the number and position of congruent angles.
 | * Straight pasta, for example, spaghetti (1–2 packets for the class)
* Sticky tape
* Ruler
* Printed class set of [Appendix A](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-4-how-many-angles.docx)
* Printed and cut class set of [Appendix B](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-4-how-many-angles.docx)
 |  |

### Learning episode 5 – corresponding sides and angles

#### Teaching and learning activity

Students are introduced to formal similarity statements for corresponding sides and angles through explicit teaching with faded examples.

#### Syllabus content

* Verify and explain that in similar polygons, the corresponding angles are equal and the corresponding side lengths are in the same proportion
* Name the vertices in matching order when using the similar symbol ($\~$) in a similarity statement
* Match the corresponding sides and angles of similar polygons

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Corresponding sides and angles](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-5-corresponding-sides-and-angles.docx)Duration: 2 lessonsLearning intentions* To match corresponding sides and angles of similar figures.
* To write similarity statements using appropriate notation.

Success criteria* I can locate sides and angles indicated using labelled vertices.
* I can identify corresponding sides and angles within similar figures.
* I can explain the meaning of symbols used in similarity statements.
* I can write similarity statements.
 | * Printed set of [Appendix A](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-5-corresponding-sides-and-angles.docx) (one sheet to 4 students)
* Printed class sets of [Appendices B, C and D](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-5-corresponding-sides-and-angles.docx)
* [*Corresponding sides and angles* PowerPoint](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-5-corresponding-sides-and-angles.pptx) for displaying images
 |  |

### Learning episode 6 – scale factor

#### Teaching and learning activity

Students are first introduced to the definition of scale factor, then utilise their prior knowledge of corresponding sides to apply the scale factor and find the scale factor between 2 similar figures.

#### Syllabus content

* Determine the scale factor for pairs of similar polygons and circles
* Apply knowledge of scale factor to find unknown sides in similar polygons

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Scale factor](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-6-scale-factor.docx)Duration: 2 lessonsLearning intentions* To understand and be able to determine the scale factor between 2 similar figures.
* To be able to use scale factors to find missing sides in similar figures.

Success criteria* I can identify and name corresponding sides of similar figures.
* I can use a scale factor to find missing sides in similar figures.
* I can use given information to determine the scale factor between 2 similar figures.
 | * A device with internet access for Desmos activity (preferably one device per student)
* Printed class sets of [Appendix A](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-6-scale-factor.docx) and [Appendix B](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-6-scale-factor.docx)
* [*Scale factor* PowerPoint](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-6-scale-factor.pptx) for displaying images
 |  |

### Learning episode 7 – scale factor in similar triangles

#### Teaching and learning activity

Students explore similar triangles in routine and non-routine problems, with a focus on exploring shadows.

#### Syllabus content

* Solve problems involving unknown lengths and scale factors of similar figures and related practical problems
* Solve problems involving scale drawings, with or without digital tools

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Scale factor in similar triangles](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-7-scale-factor-in-similar-triangles.docx)Duration: 2 lessonsLearning intention* To solve routine and non-routine problems involving similar triangles.

Success criteria* I can solve routine problems using similar triangles.
* I can recognise problems I can solve using similar triangles.
 | * Optional activities require additional resources:
* a device with internet access for GeoGebra activity
* chalk
* tape measures
* Printed class set of [Appendix A](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-7-scale-factor-in-similar-triangles.docx)
* [*Scale factor in similar triangles* PowerPoint](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-7-scale-factor-in-similar-triangles.pptx) for displaying images
 |  |

### Learning episode 8 – movie magic

#### Teaching and learning activity

Students apply scale in non-routine ways. Students explore scale models used in The Lord of the Rings and the Harry Potter movies and answer questions using a scale given as a ratio.

#### Syllabus content

* Apply an appropriate scale to enlarge or reduce a diagram
* Solve problems involving unknown lengths and scale factors of similar figures and related practical problems
* Solve problems involving scale drawings, with or without digital tools

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Movie magic](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-8-movie-magic.docx)Duration: 1 lessonLearning intentions* To develop students’ understanding of scale.
* To solve problems involving ratios and scales.

Success criteria* I can describe how scale is used in real life situations.
* I can solve scale problems using ratios.
 | * Printed class sets of [Appendices A, B and C](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-8-movie-magic.docx)
* [*Movie magic* PowerPoint](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-8-movie-magic.pptx) for displaying images
 |  |

### Learning episode 9 – maps and scale

#### Teaching and learning activity

Students explore and solve problems involving various graphical representations, including maps and floor plans.

#### Syllabus content

* Apply an appropriate scale to enlarge or reduce a diagram
* Solve problems involving scale drawings, with or without digital tools

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Maps and scale](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-9-maps-and-scale.docx)Duration: 2 lessonsLearning intentions* To explore the similarities and differences of various graphical representations.
* To apply scale in context.

Success criteria* I can read various graphical displays, including maps and floorplans.
* I can solve scale problems using ratios.
 | * A device with internet (minimum of one device between 2 students)
* Printed class sets of [Appendix A](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-9-maps-and-scale.docx) and [Appendix B](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-9-maps-and-scale.docx)
* [*Maps and scale* PowerPoint](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-9-maps-and-scale.pptx) for displaying images
 |  |

### Learning episode 10 – comparing representations

#### Teaching and learning activity

Students explore the similarities and differences between maps and network diagrams.

#### Syllabus content

* Describe a network as a collection of objects (nodes or vertices) interconnected by lines (edges) that can represent systems in the real world (Path)
* Examine real-world applications of networks such as social networks, supply chain networks and communication infrastructure, and explore other applications of networks (Path)
* Identify and define elements of a graph including vertex, edge and degree (Path)
* Explain that a given graph can be drawn in different ways (Path)

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Comparing representations](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-10-comparing-representations.docx)Duration: 1 lessonLearning intention* To recognise the similarities and differences between networks and maps.

Success criteria* I can explain the similarities and differences between networks and maps.
* I can use network diagrams to solve problems.
 | * Printed class set of [Appendix A](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-10-comparing-representations.docx)
* [*Comparing representations* PowerPoint](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-10-comparing-representations.pptx) for displaying images
 |  |

### Learning episode 11 – scale factor and area

#### Teaching and learning activity

Students explore the relationship between scale factor and area. Students can take this further with an investigation into the relationship between scale factor and surface area and volume.

#### Syllabus content

* Solve problems involving unknown lengths and scale factors of similar figures and related practical problems
* Solve problems involving areas and volumes of similar shapes and solids (Path)

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required Resources | Registration, adjustments and evaluation notes |
| [Scale factor and area](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-11-scale-factor-and-area.docx)Duration: 1 lessonLearning intention* To solve problems involving similar figures and area.

Success criteria* I can solve problems involving similar figures and area.
* I can use scale factor to calculate the areas of similar figures.
 | * Pattern tiles or a device with internet
* Printed class sets of [Appendices A, B and C](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s5-unit-1-lesson-11-scale-factor-and-area.docx)
 |  |

## References

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

NESA (NSW Education Standards Authority) (2022) ‘[Advice on units](https://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/understanding-the-curriculum/programming/advice-on-units)’, Understanding the curriculum, NESA website, accessed 16 March 2023.

NESA (2022) ‘[Programming](https://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/understanding-the-curriculum/programming)’, Understanding the curriculum, NESA website, accessed 16 March 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) licence](https://creativecommons.org/licenses/by/4.0/).



This licence 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 licence:

* 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.