Mathematics Stage 5 – unit of learning

Constant rates of change

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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/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. 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 Linear relationships A, Linear relationships B and Equations A, as well as Path focus areas Varation and rates of change A, Equations C and Linear Relationships C. The lessons and sequences in this program of learning are designed to allow students to explore the representations of linear relationships and how they are used to model situations and solve problems.

**Duration:** this program of learning is designed to be completed over a period of approximately 7 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

### Core

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**
* **determines the midpoint, gradient and length of an interval, and graphs linear relationships, with and without digital tools   
  MA5-LIN-C-01**
* **graphs and interprets linear relationships using the gradient/slope-intercept form MA5-LIN-C-02**
* **solves linear equations of up to 3 steps, limited to one algebraic fraction MA5-EQU-C-01**

### Path

A student:

* **identifies and solves problems involving direct and inverse variation and their graphical representations MA5-RAT-P-01**
* **describes and applies transformations, the midpoint, gradient/slope and distance formulas, and equations of lines to solve problems   
  MA5-LIN-P-01**
* solves linear equations of more than 3 steps, monic and non-monic quadratic equations, and linear simultaneous equations   
  **MA5-EQU-P-02**

The identified Life Skills outcomes that relate to this unit are uses strategies for addition and subtraction **MALS-ADS-01,** uses strategies for multiplication and division **MALS-MDI-01** and demonstrates knowledge of position and direction in everyday contexts **MALS-POS-01.**

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**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 – journey to linearity

#### Teaching and learning activity

Students explore different ways to identify and represent linear relationships. They do this through exploring the relationships between the lengths of leaves and examples and non-examples.

#### Syllabus content

* Recognise that equations of the form represent linear relationships or straight lines
* Construct tables of values and use coordinates to graph a variety of linear relationships on the Cartesian plane, with and without digital tools

Table 1 – Lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required Resources | Registration, adjustments and evaluation notes |
| [Journey to linearity [DOCX 898 KB]](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s5-unit-06-lesson-01-journey-to-linearity.docx)  Duration: 1–2 lessons  Learning intention   * To be able to identify linear relationships in a variety of forms.   Success criteria   * I can identify a linear relationship when represented as a graph. * I can identify a linear relationship when represented as an equation. * I can identify a linear relationship when represented as a table of values. * I can explain the characteristics of a linear relationship. | * Class set of rulers * Class set of Appendix A, B, C, D and E |  |

### Learning episode 2 – money matters

#### Teaching and learning activity

By exploring financial options, students discover different ways to represent linear relationships and the power that each representation holds, including equations, graphs and tables of values.

#### Syllabus content

* Solve linear equations arising from substitution into formulas
* Construct tables of values and use coordinates to graph a variety of linear relationships on the Cartesian plane, with and without digital tools
* Determine whether a point lies on a line using substitution
* Recognise and describe linear relationships in real-life contexts

Table 2 – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required Resources | Registration, adjustments and evaluation notes |
| [Money matters [DOCX 772KB]](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s5-unit-06-lesson-02-money-matters.docx)  Duration: 1 lesson  Learning intention   * To understand the connections between representations of linear relationships.   Success criteria   * I can substitute values into an equation to complete a table of values. * I can graph linear relationships given the equation and table of values. * I can explain the advantages and disadvantages of each representation. | * [*Money matters* [PPTX 773KB]](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s5-unit-06-lesson-02-money-matters.pptx) PowerPoint * Class set of Appendix A, B and C, printed |  |

### Learning episode 3 – slope-a-palooza

#### Teaching and learning activity

By exploring a Desmos Mableslides activity, students investigate how changing the gradient changes the slope of a line. They are required to estimate gradients, as well as identify and write equations with different gradients.

#### Syllabus content

* Interpret the coefficient of as the gradient/slope, and the constant () as the -intercept for equations of the form
* Graph vertical and horizontal lines
* Explain the effect of increasing or decreasing the gradient with or without digital tools

Table 3 – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required Resources | Registration, adjustments and evaluation notes |
| [Slope-a-palooza [DOCX 785 KB]](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s5-unit-06-lesson-03-slope-a-palooza.docx)  Duration: 1 lesson  Learning intention   * To understand how the value of the gradient in an equation changes the graph.   Success criteria   * I can identify where the gradient is represented in a linear equation. * I can describe how a graph would look when given the gradient. * I can write an equation for a linear graph, given the gradient. | * Digital device per pair of students (optional) * Appendix A, printed (1 per group of 3) * If computers are unavailable a class set of Appendix B, and D, printed * If computers are unavailable a class set of Table 1 from Appendix C, cut into cards |  |

### Learning episode 4 – How efficient is my car?

#### Teaching and learning activity

Students explore fuel efficiency and circles to understand the concept of direct variation.

#### Syllabus content

* Describe typical examples of direct variation/proportion (Path)
* Apply the language of direct variation to everyday contexts: is directly proportional to , is proportional to , varies directly as (Path)
* Identify and represent direct variation/proportion as is proportional to , or , where is the constant of variation (Path)
* Solve problems involving direct or inverse variation using an equation (Path)

Table 4 – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required Resources | Registration, adjustments and evaluation notes |
| [How efficient is my car? [DOCX 1.1 MB]](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s5-unit-06-lesson-04-how-efficient-is-my-car.docx)  Duration: 3 lessons  Learning intentions   * To be able to understand direct variation. * To be able to solve problems involving direct variation.   Success criteria   * I can identify a direct relationship. * I can find the value of the constant of variation. * I can explain the meaning of the constant of variation in a given context. * I can model and solve real-world problems with a direct relationship. | * Computers * [*How efficient is my car* [PPTX 1.3MB]](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s5-unit-06-lesson-04-how-efficient-is-my-car.pptx) PowerPoint * Class set of Appendix A, B, C, D and E, printed |  |

### Learning episode 5 – holiday money

#### Teaching and learning activity

Students create and solve problems by using and creating conversion graphs to estimate the amount of money they would need to travel overseas.

#### Syllabus content

* Recognise that equations of the form represent linear relationships or straight lines
* Construct table so values and use coordinates to graph a variety of linear relationships on the Cartesian plane, with and without digital tools
* Use linear conversion graphs to convert from one unit to another (Path)
* Graph equations representing direct variation, with or without digital tools (Path)

Table 5 – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required Resources | Registration, adjustments and evaluation notes |
| [Holiday money [DOCX 802 KB]](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s5-unit-06-lesson-05-holiday-money.docx)  Duration: 1 lesson  Learning intention   * To know how to create and use conversion graphs.   Success criteria   * I can create a conversion graph. * I can compare values using a conversion graph. * I can explain the characteristics of a direct relationship. | * Device with internet access per pair of students * [*Holiday money* [PPTX 966KB]](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s5-unit-06-lesson-05-holiday-money.pptx) PowerPoint * Class set of Appendix A, printed |  |

### Learning episode 6 – Yubercept

#### Teaching and learning activity

Students explore the -intercept through the context of ride-share costs. They look at the effect of the -intercept on the graph and equation and establish the meaning in different contexts.

#### Syllabus content

* Identify the - and - intercepts of lines
* Interpret the coefficient of as the gradient/slope, and the constant () as the -intercept for equations of the form
* Find the equation of a straight line in the form *,* given the gradient/slope and the-intercept of the line
* Determine the gradient and the -intercept of a straight line from its graph and apply these values to determine the equation of the line

Table 6 – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required Resources | Registration, adjustments and evaluation notes |
| [Yubercept [DOCX 270 KB]](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s5-unit-06-lesson-06-yubercept.docx)  Duration: 1–2 lessons  Learning intention   * To know how the -intercept affects the equation and graph of a line.   Success criteria   * I can identify the -intercept of a graph. * I can identify the -intercept in an equation. * I can explain how the -intercept affects the graph of a linear relationship. * I can explain what the-intercept represents in different contexts. | * Dice, 2 per pair * [*Yubercept* [PPTX 934KB]](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s5-unit-06-lesson-06-yubercept.pptx) PowerPoint * Class set of Appendix A and C, printed * Three sets of Appendix B printed, cut into separate scenarios * Device with internet access per pair of students (optional) |  |

### Learning episode 7 – What’s the line?

#### Teaching and learning activity

Through the contexts of landing planes and sinking battleships, students explore graphing using the gradient and -intercept, as well as finding the equation of a line using the gradient and -intercept.

#### Syllabus content

* Interpret the coefficient of ) as the gradient/slope, and the constant () as the -intercept for equations of the form
* Find the equation of a straight line in the form , given the gradient/slope and the -intercept of the line
* Graph equations of the form by using the gradient and the -intercept
* Determine the gradient and the-intercept of a straight line from its graph and apply these values to determine the equation of the line

Table 7 – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required Resources | Registration, adjustments and evaluation notes |
| [What’s the line? [DOCX 754 KB]](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s5-unit-06-lesson-07-whats-the-line.docx)  Duration: 1 lesson  Learning intention   * To be able to graph a straight line.   Success criteria   * I can explain how to find the gradient and the -intercept from a graph. * I can explain how to find the gradient and the -intercept from an equation. * I can write the equation of a line given the graph. * I can graph the equation of a line using the gradient and -intercept. | * A3 plastic sleeves * Adhesive putty * Computer * [*What’s the line?* [PPTX 856KB]](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s5-unit-06-lesson-07-whats-the-line.pptx) PowerPoint * Class set of Appendix B, C and D, printed * Set of Appendix A, for every 3 students, printed A3 |  |

### Learning episode 8 – line it up

#### Teaching and learning activity

This lesson will explore the features that define lines and linear relationships as parallel or perpendicular to one another and explore ways to determine this both graphically and algebraically.

#### Syllabus content

* Explain that parallel lines have equal gradients/slopes
* Explain that 2 straight lines are perpendicular if the product of their gradients is
* Find the equation of a straight line that is parallel or perpendicular to another given line by applying
* Determine and justify whether 2 given lines are parallel or perpendicular (Path)

Table 8 – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required Resources | Registration, adjustments and evaluation notes |
| [Line it up [DOCX 651 KB]](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s5-unit-06-lesson-08-line-it-up.docx)  Duration: 1–2 lessons  Learning intention   * To understand what makes linear relationships parallel or perpendicular.   Success criteria   * I can identify and define the features of parallel lines in equations and graphs. * I can identify and define the features of perpendicular lines in equations and graphs. * I can write equations of lines that are parallel and perpendicular to other lines. * I can justify whether 2 lines are parallel or perpendicular. | * Device with internet access per pair of students * [*Line it up* [PPTX 1.4 MB]](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s5-unit-06-lesson-08-line-it-up.pptx)  PowerPoint * Class set of Appendix A and B, printed |  |

### Learning episode 9 – cutting through lines

#### Teaching and learning activity

Students find intercepts of equations and use them to graph linear relationships, including horizontal and vertical lines.

#### Syllabus content

* Identify the - and -intercepts of lines
* Explain why the -axis has the equation and the -axis has the equation
* Recognise as a line parallel to the -axis and as a line parallel to the y-axis
* Graph vertical and horizontal lines
* Find the- and -intercepts of a straight line in any form (Path)
* Graph the equation of a straight line in any form (Path)

Table 9 – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required Resources | Registration, adjustments and evaluation notes |
| [Cutting through lines [DOCX 1.6 MB]](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s5-unit-06-lesson-09-cutting-through-lines.docx)  Duration: 1 lesson  Learning intention   * To know how to graph linear relationships.   Success criteria   * I can identify intercepts from a linear graph. * I can find intercepts from equations. * I can use intercepts to graph linear equations. * I can graph horizontal and vertical lines. | * [*Cutting through lines* [PPTX 6.6 MB]](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s5-unit-06-lesson-09-cutting-through-lines.pptx) PowerPoint * Class set of Appendix A, printed (if not using technology) * Single set of Appendix B printed. * Copy of Appendix C per pair of students * Device with internet access per pair of students (optional) |  |

### Learning episode 10 – graphing general mayhem

#### Teaching and learning activity

This lesson develops students’ ability to graph lines given in a variety of forms using algebraic skills to rearrange or by finding gradient and intercepts.

#### Syllabus content

* Interpret the coefficient of as the gradient/slope, and the constant as the-intercept for equations of the form
* Rearrange linear equations from gradient-intercept form () to general form () and vice versa (Path)
* Graph the equation of a straight line in any form (Path)

Table 10 – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required Resources | Registration, adjustments and evaluation notes |
| [Graphing general mayhem [DOCX 473KB]](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s5-unit-06-lesson-10-graphing-general-mayhem.docx)  Duration: 1 lesson  Learning intention   * To know how to rearrange linear equations. * To understand and apply the most appropriate form of linear equation to efficiently solve problems.   Success criteria   * I can explain the characteristics of equations in general form. * I can convert between general form and gradient-intercept form. * I can graph lines given in any form. * I can model linear relationships from real-world scenarios. | * [*Graphing general mayhem* [PPTX 474KB]](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s5-unit-06-lesson-10-graphing-general-mayhem.pptx) PowerPoint * Class set of Appendix A printed, cut into cards * A set for every 3 students of Appendix B, printed * Class set of Appendix C, D and E, printed |  |

### Learning episode 11 – it’s getting hot in here

#### Teaching and learning activity

Students will derive the point-gradient formula and use it to find the equation of a line which will allow them to convert between the 3 different units of temperature.

#### Syllabus content

* Use the point-gradient form () or the gradient-intercept form () to find the equation of a line passing through a point (), with a given gradient m (Path)
* Use the gradient and the point-gradient form to find the equation of a line passing through 2 points (Path)

Table 11 – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required Resources | Registration, adjustments and evaluation notes |
| [It’s getting hot in here [DOCX 450 KB]](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s5-unit-06-lesson-11-its-getting-hot-in-here.docx)  Duration: 1–2 lessons  Learning intention   * To know how to find the equation of a line.   Success criteria   * I can find the gradient of a line. * I can identify what information is needed to find the equation of a line. * I can find the equation of a line, given 2 points, using the point-gradient formula. * I can explain how the point-gradient formula is developed. | * [*It’s getting hot in here* [PPTX 765 KB]](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s5-unit-06-lesson-11-its-getting-hot-in-here.pptx)  PowerPoint * Class set of Appendix A, B and C, printed * Single set of Appendix D, printed, cut into cards |  |

### Learning episode 12 – Tortoise and the Hare

#### Teaching and learning activity

Students explore solving simultaneous linear equations, graphically through the story of the Tortoise and the Hare.

#### Syllabus content

* Solve linear simultaneous equations by finding the point of intersection of their graphs (Path)
* Model and solve word problems using simultaneous questions and interpret their solution (Path)

Table 12 – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required Resources | Registration, adjustments and evaluation notes |
| [Tortoise and the Hare [DOCX 960 KB]](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s5-unit-06-lesson-12-tortoise-and-the-hare.docx)  Duration: 1–2 lessons  Learning intention   * To graphically find the point of intersection of simultaneous linear equations.   Success criteria   * I can read and write the coordinate of a point on the Cartesian plane. * I can interpret the meaning of the gradient and intercepts of a linear graph. * I can interpret the meaning of the point of intersection of 2 linear graphs. | * Device with internet access per pair of students (optional) * If you do not have access to devices, a class set of Appendix A, printed * Class set of Appendix B, printed |  |

### Learning episode 13 – simultaneous shopping

#### Teaching and learning activity

Students explore solving simultaneous equations through shopping scenarios. In this lesson they are introduced to bar models as a method to solve simultaneous equations.

#### Syllabus content

* Model and solve word problems using simultaneous questions and interpret their solution (Path)

Table 13 – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required Resources | Registration, adjustments and evaluation notes |
| [Simultaneous shopping [DOCX 1.4 MB]](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s5-unit-06-lesson-13-simultaneous-shopping.docx)  Duration: 1–2 lessons  Learning intention   * To be able to solve simultaneous linear equations using substitution.   Success criteria   * I can draw a bar model to represent an equation. * I can substitute a value into an equation. * I can determine the solution to linear simultaneous equations by using a bar model. | * Device with internet access per pair of students (optional) * [*Simultaneous shopping* [PPTX 751 KB]](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s5-unit-06-lesson-13-simultaneous-shopping.pptx) PowerPoint * Copy of Appendix A, printed, per pair of students * Class set of Appendix B and C, printed |  |

### Learning episode 14 – Sums and differences

#### Teaching and learning activity

Students continue to use bar models to assist them in solving simultaneous linear equations. In this lesson, they extend their bar models to include differences in the equations as well as sums.

#### Syllabus content

* Model and solve word problems using simultaneous questions and interpret their solution (Path)

Table 14 – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required Resources | Registration, adjustments and evaluation notes |
| [Sums and differences [466 KB]](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s5-unit-06-lesson-14-sums-and-differences.docx)  Duration: 1–2 lessons  Learning intention   * To be able to solve simultaneous equations.   Success criteria   * I can draw a bar model to represent 2 unknown variables. * I can combine 2 bar models to eliminate an unknown variable. * I can apply my knowledge of bar models and simultaneous equations to solve problems. | * Device with internet access per pair of students * [*Sums and differences*[PPTX 466 KB]](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s5-unit-06-lesson-14-sums-and-differences.pptx) PowerPoint * Class set of Appendix B and C, per group of 3 students, printed |  |

## References

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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](https://curriculum.nsw.edu.au/).

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