# Mathematics Stage 4 – unit of learning – making predictions



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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 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 on 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 Fractions, decimals and percentages and Probability. The lessons and sequences in this program of learning are designed to allow students to explore the likelihood of chance events occurring, develop skills with fractions to describe and represent probabilities and make predictions about future events.

**Duration:** this program of learning is designed to be completed over a period of approximately 5 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**
* represents and operates with fractions, decimals and percentages to solve problems **MA4-FRC-C-01**
* solves problems involving the probabilities of simple chance experiments **MA4-PRO-C-01**

The identified Life Skills outcomes that relate to this unit are **MALS-FRC-01** – demonstrates knowledge of fractions in everyday contexts, **MALS-DEP-01** – demonstrates knowledge of decimals and percentages in everyday contexts, and **MALS-PRO-01** – applies chance and probability to everyday events.

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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 – alphabet soup

#### Teaching and learning activity

Students play a game using alphabet tiles based on their own name to observe that the chance of winning can be different for each player and can be compared.

#### Syllabus content

* Identify and describe theoretical (expected) probabilities as being the likelihood of outcomes occurring under fair or unbiased conditions

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Alphabet soup](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-01-alphabet-soup.docx)Duration: 1 lessonLearning intention* To understand that in a game, the chances of winning can be different and comparable.

Success criteria* I can determine my own maximum score.
* I can make decisions to increase my chance of winning.
* I can justify my comparisons of who has the greater chance of winning a game.
 | * Class set of alphabet tiles from [Appendix A](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-01-alphabet-soup.docx))
* Bags or containers to draw blind tiles from
 |  |

### Learning episode 2 – would you rather?

#### Teaching and learning activity

Students explore chance and likelihood by deciding what they would rather choose in different scenarios. Students then relate probability terms to these scenarios and consider their definitions and limitations.

#### Syllabus content

* Identify and describe theoretical (expected) probabilities as being the likelihood of outcomes occurring under fair or unbiased conditions

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Would you rather?](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-02-would-you-rather.docx)Duration: 1 lessonLearning intention* To be able to describe and compare probabilities using words or phrases.

Success criteria* I can explain the likelihood of an event using the terms of probability.
* I can rank the probability terms to describe the chance of everyday events.
* I can compare different terms of probability.
 | * [Appendix cards](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-02-would-you-rather.docx) cut into sets
* Adhesive putty, sticky tape or a clothesline and pegs to display probability terms on a scale
 |  |

### Learning episode 3 – rolling to 10

#### Teaching and learning activity

Students play a variety of dice games where each player has a different chance of winning, exploring sample space and numerical probability. Following this, students are explicitly taught the terms sample space and probability using visual representations.

#### Syllabus content

* List the sample space for chance experiments
* Express the probability of an event, which has a finite number of equally likely outcomes, as

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Rolling to 10](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-03-rolling-to-10.docx)Duration: 1–2 lessonsLearning intentions* To be able to list the sample space of simple events.
* To be able to express the probability of simple events as a fraction.

Success criteria* I can determine the sample space of events.
* I can determine the probability of simple events.
* I can compare the probability of different outcomes in events.
* I can explain how changes in a numerator or denominator change the size of a fraction.
 | * Six-sided and eight-sided dice (or an online equivalent)
* Class set of [Appendix](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-03-rolling-to-10.docx) handouts
* [*Rolling to 10* PowerPoint](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-3-rolling-to-10.pptx)
 |  |

### Learning episode 4 – sense of order

#### Teaching and learning activity

Students explore different events with a range of probabilities and attempt to order these accurately on a number line.

#### Syllabus content

* Compare and order fractions with different denominators
* Locate positive and negative fractions, decimals and mixed numbers on a number line to compare their relative values
* Express the probability of an event, which has a finite number of equally likely outcomes, as
* Recognise that probabilities range from 0 (impossible) to 1 (certain) and that equally likely outcomes have equal probabilities

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Sense of order](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-04-sense-of-order.docx)Duration: 1 lessonLearning intentions* To be able to use visual representations to compare the size of different probabilities.
* To be able to plot fractions with different denominators on a number line.

Success criteria* I can interpret visual representations of fractions to compare sizes.
* I can determine which fraction is larger or smaller.
* I can order fractions with different denominators on a number line.
* I can use fractions to describe probabilities to compare likelihood of events.
 | * [Appendix A](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-04-sense-of-order.docx) cards cut into sets
* Adhesive putty, sticky tape or a clothesline and pegs to display probability terms on a scale
* Class set of [Appendix B](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-04-sense-of-order.docx) handout
 |  |

### Learning episode 5 – same, same, but different

#### Teaching and learning activity

Students explore equivalent fractions by designing their own spinners and marble bags that have the same probability as a given event.

#### Syllabus content

* Examine methods of generating equivalent fractions
* Create fractions with the same denominator to compare their sizes
* Compare and order fractions with different denominators
* Express the probability of an event, which has a finite number of equally likely outcomes, as
* Recognise that probabilities range from 0 (impossible) to 1 (certain) and that equally likely outcomes have equal probabilities

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Same, same, but different](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-05-same-same-but-different.docx)Duration: 1–2 lessonsLearning intentions* To be able to recognise equivalent fractions.
* To understand how to generate equivalent fractions.

Success criteria* I can identify equivalent fractions.
* I can compare equivalent fractions.
* I can create equivalent fractions.
 | * Class set of [Appendix A](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-05-same-same-but-different.docx) handout for students
* Fraction wall (optional) or an online equivalent
* Two custom made dice or an online equivalent
* [*Same, same but different* PowerPoint](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-05-same-same-but-different.pptx)
 |  |

### Learning episode 6 – to be, or not to be

#### Teaching and learning activity

Students explore events that cannot happen at the same time by creating conditions for a game where no player can win a point at the same time.

#### Syllabus content

* Verify that the total of the probabilities of all possible outcomes of an event is 1
* Identify and describe the complement of an event
* Verify that the sum of the probability of an event and its complement is a total of 1
* Solve problems involving the probability of complementary events
* Represent the possible outcomes for complementary events in various forms

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [To be, or not to be](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-06-to-be-or-not-to-be.docx)Duration: 1 lessonLearning intention* To understand the relationship between an event and its complement.

Success criteria* I can identify 2 events that occur at once.
* I can describe the complement of an event.
* I can evaluate the correct probability of the complement of an event.
* I can justify that sum of the probability of an event and its complement is a total of 1.
 | * 1 six-sided dice and 1 eight-sided dice per pair, or an online dice simulator equivalent
* Class set printed of [Appendix A](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-06-to-be-or-not-to-be.docx)
* [*To be, or not to be* PowerPoint](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-06-to-be-or-not-to-be.pptx)
 |  |

### Learning episode 7 – rock paper scissors

#### Teaching and learning activity

Students explore the game of rock, paper, scissors and analyse if the outcomes are equally likely, the potential for bias and whether adding in 2 elements changes the chances of winning.

#### Syllabus content

* Express the probability of an event, which has a finite number of equally likely outcomes, as
* Identify and describe theoretical (expected) probabilities as being the likelihood of outcomes occurring under fair or unbiased conditions

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Rock paper scissors](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-07-rock-paper-scissors.docx)Duration: 1 lessonLearning intentions* To understand the concept of randomness.
* To understand what makes events equally likely.

Success criteria* I can determine if a game has equally likely outcomes.
* I can determine if a game is fair and unbiased.
* I can evaluate and compare the probability of winning games.
 | * Two dice or an online equivalent
* Score sheets printed for students
* [*Rock paper scissors* PowerPoint](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-7-rock-paper-scissors)
 |  |

### Learning episode 8 – myths and misconceptions

#### Teaching and learning activity

Students analyse 2 theories of how many heads and tails will appear on 20 cent coins by physically conducting the experiment and then simulating this experiment multiple times.

#### Syllabus content

* Identify and describe theoretical (expected) probabilities as being the likelihood of outcomes occurring under fair or unbiased conditions
* Explore relative frequencies by using a random number generator to repeat a chance experiment a number of times

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Myths and misconceptions](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-08-myths-and-misconceptions.docx)Duration: 1 lessonLearning intentions* To be able to make a prediction based on theoretical probability.
* To be able to justify a prediction based on the relative frequency of an experiment.

Success criteria* I can make a prediction of the outcome of an event.
* I can create simulations of tossing a coin.
* I can make a prediction based on relative frequency of an experiment conducted.
 | * Coin for each pair of students
* [*Myths and misconceptions* spreadsheet](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-08-myths-and-misconceptions.xlsm)
* Students will need one device per pair or small group
* [Appendix B](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-08-myths-and-misconceptions.docx) printed for all students
 |  |

### Learning episode 9 – fakes on trial

#### Teaching and learning activity

Students explore randomness when flipping a coin and try to detect if a set of results are fake or real by investigating the relative frequency and comparing observed probabilities with theoretical probabilities.

#### Syllabus content

* Compare and order fractions with different denominators
* Explain that observed probability is the relative frequency resulting from repeated trials of a simulation and determine observed probabilities
* Explore relative frequencies by using a random number generator to repeat a chance experiment a number of times

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Fakes on trial](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-09-fakes-on-trial.docx)Duration: 1 lessonLearning intentions* To understand and recognise randomness in the outcome of an event.
* To be able to find and explore relative frequency.

Success criteria* I can explain randomness in the outcome of an event.
* I can make a prediction for the outcome of an event.
* I can justify a prediction of an event.
* I can find the relative frequency.
 | * [*Fakes on trial* spreadsheet](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-09-fakes-on-trial.xlsm)
* [*Fakes on trial* PowerPoint](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-9-fakes-on-trial.pptx)
* Students will need one device per pair or small group
* [Appendix B](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-09-fakes-on-trial.docx) printed for all students
 |  |

### Learning episode 10 – what’s the chance?

#### Teaching and learning activity

Students explore the difference between theoretical and observed probability using a chore spinner and conduct simulations of their own.

#### Syllabus content

* Identify and describe theoretical (expected) probabilities as being the likelihood of outcomes occurring under fair or unbiased conditions
* Explain that observed probability is the relative frequency resulting from repeated trials of a simulation and determine observed probabilities
* Explore relative frequencies by using a random number generator to repeat a chance experiment a number of times

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [What’s the chance?](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-10-whats-the-chance.docx)Duration: 1 lessonLearning intentions* To be able to compare the outcome of different events.
* To understand the difference between theoretical and observed probability.

Success criteria* I can evaluate the probability of an event occurring from a range of different spinners.
* I can compare theoretical and observed probability.
* I can conduct repeated trials of a simulation.
 | * Students will need one device per pair or small group
* Class set printed of [Appendix A](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-10-whats-the-chance.docx)
 |  |

### Learning episode 11 – predicting evens

#### Teaching and learning activity

Students explore the relationship between theoretical probability and the relative frequency of rolling a dice and predicting how many even numbers should occur.

#### Syllabus content

* Explain that observed probability is the relative frequency resulting from repeated trials of a simulation and determine observed probabilities
* Explore relative frequencies by using a random number generator to repeat a chance experiment a number of times

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Predicting evens](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-11-predicting-evens.docx)Duration: 1 lessonLearning intention* To understand the relationship between theoretical probability and the relative frequency of events.

Success criteria* I can make predictions for events.
* I can justify my predictions using my theoretical probability knowledge.
* I can compare theoretical probability with observed probability.
* I can explain how the number of trials of an experiment is likely to change the relationship between theoretical probability and relative frequency.
 | * [*Predicting evens* spreadsheet](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-11-predicting-evens.xlsx)
* Students will need one device per pair or small group
* Students are to be issued a digital copy of a board game, or a printed copy from Appendix A
* Student handout of [Appendix C](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-11-predicting-evens.docx) and [Appendix D](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-11-predicting-evens.docx) printed for students
 |  |

### Learning episode 12 – alphabet soup the sequel

#### Teaching and learning activity

Students return to the game using alphabet tiles based on their own name to investigate if the probability can be calculated, and ultimately use relative frequency in an attempt to describe their chances, and compare with peers.

#### Syllabus content

* Explain that observed probability is the relative frequency resulting from repeated trials of a simulation and determine observed probabilities

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Alphabet soup the sequel](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-12-alphabet-soup-the-sequel.docx)Duration: 1–2 lessonsLearning intentions* To understand that a calculation of relative frequency can describe the probability of future success.
* To know the limitations of relative frequencies, and the nature of their calculation.

Success criteria* I can explain why the probability of me winning this game cannot be easily calculated.
* I can use my results from the game to express the chances of me winning future games.
* I can predict who is likely to win a game between 2 classmates, based on their past results.
 | * Class set of alphabet tiles from [Appendix A](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-12-alphabet-soup-the-sequel.docx)
* Bags or containers to draw blind tiles from
* [Appendix B](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/mathematics/media/documents/mathematics-s4-unit-1-lesson-12-alphabet-soup-the-sequel.docx) handout printed for students
 |  |

## 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 (NSW Education Standards Authority) (2022) ‘[Programming](https://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/understanding-the-curriculum/programming)’, Understanding the curriculum, NESA website, accessed 14 March 2023.

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