Mathematics Stage 5 – 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 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 area of Probability. The lessons and sequences in this program of learning are designed to allow students to explore multistage events and simulations to make predictions.

**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

## 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**
* solves problems involving probabilities in multistage chance experiments and simulations **MA5-PRO-C-01**

## Path

* solves problems involving Venn diagrams, 2-way tables and conditional probability **MA5-PRO-P-01**

The identified Life Skills outcomes that relate to this unit is**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 – prediction palette

### Teaching and learning activity

Students begin by making a prediction of the colour inside their chocolate. Throughout the lesson, they collect data and discuss strategies to improve their predictions. The difference between dependent and independent events is also discovered.

### Syllabus content

* Explain the difference between dependent and independent events in experiments involving 2 stages
* Explain how the probability of independent and dependent events differs in relation to replacement
* Record and use the results of a probability simulation to predict future events
* Apply reasoning to evaluate the simulation and its related outcomes
* Identify and explain common misconceptions relating to chance experiments (Path)

Table 1 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| [Prediction palette (DOCX 252.6 KB)](https://education.nsw.gov.au/content/dam/main-education/en/home/teaching-and-learning/curriculum/mathematics/documents/mathematics-s5-unit-07-l01-prediction-palette.docx)Duration**:** 1–3 lessonsLearning intentions* To be able to use data to improve predictions.
* To understand the difference between dependent and independent events.

Success criteria* I can collect data for an experiment in a frequency table.
* I can use data to improve my strategy when making a prediction.
* I can describe the difference between dependent and independent events.
* I can identify dependent and independent events.
 | * Chocolate coated colour centred candy (green, yellow or pink), 2 per student
* Packets of chocolate coated colour centred candy (green, yellow or pink) split into small bags of 6–10 chocolates. Each group of 3 students will need a bag and the number of chocolates in each bag should be consistent for each group
* Digital devices (1 per pair of students)
* [*Prediction palette* (XLSM 199.5 MB) Excel](https://education.nsw.gov.au/content/dam/main-education/en/home/teaching-and-learning/curriculum/mathematics/documents/mathematics-s5-unit-07-l01-prediction-palette.xlsx)
 | Determine if any students have known food allergies and change the candy used if required. |

## Learning episode 2 – the skunk game

### Teaching and learning activity

Students will use the skunk game to review sample space and complementary events. The skunk game allows students to move from single-stage events into multistage events, with multiple outcomes.

### Syllabus content

* Record all possible outcomes for multistage chance experiments
* Determine the probabilities of outcomes for multistage independent events using P(A and B) = P(A) x P(B), where necessary
* Associate complementary events with probabilities in multistage chance experiments
* Identify and explain common misconceptions relating to chance experiments (Path)

Table 2 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| [The skunk game (DOCX 338.1 KB)](https://education.nsw.gov.au/content/dam/main-education/en/home/teaching-and-learning/curriculum/mathematics/documents/mathematics-s5-unit-07-l02-the-skunk-game.docx)Duration**:** 1–2 lessonsLearning intentions* To be able to display the outcomes for multi-step events in a table.
* To be able to use a sample space to make predictions.

Success criteria* I can list sample spaces for single-stage events.
* I can list sample spaces for multistage events.
* I can calculate probabilities using sample spaces.
* I can make predictions based on calculated probabilities.
 | * 1 copy of Appendix A ‘Scorecard’ per student
* 2 dice (physical or virtual)
* [*The skunk game* (PPTX 1.3 MB) PowerPoint](https://education.nsw.gov.au/content/dam/main-education/en/home/teaching-and-learning/curriculum/mathematics/documents/mathematics-s5-unit-07-l02-the-skunk-game.pptx)
* Paper, scissors, sticky tape or glue for each group of 3
 |  |

## Learning episode 3 – random relay

### Teaching and learning activity

This learning episode introduces tree diagrams as a visual representation to recognise sample spaces and calculate probabilities. Students consider the impact replacement has on tree diagram probabilities.

### Syllabus content

* Record all possible outcomes for multistage chance experiments
* Determine the probabilities of outcomes for multistage independent events using P(A and B) = P(A) x P(B), where necessary
* Associate complementary events with probabilities in multistage chance experiments

Table 3 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| [Random relay (DOCX 610.4 KB)](https://education.nsw.gov.au/content/dam/main-education/en/home/teaching-and-learning/curriculum/mathematics/documents/mathematics-s5-unit-07-l03-random-relay.docx)Duration**:** 1–2 lessonsLearning intentions* To use tree diagrams to solve problems.

Success criteria* I can draw a tree diagram.
* I can draw a multistage tree diagram.
* I can make predictions using tree diagrams.
 | * Coins (1 per group of 3)
* Dice (1 per group of 3)
* 15 red counters and 5 yellow counters (per group of 3)
* 1 copy of Appendix A ‘Tree diagrams’ per student
* [*Random relay* (PPTX 3.2 MB) PowerPoint](https://education.nsw.gov.au/content/dam/main-education/en/home/teaching-and-learning/curriculum/mathematics/documents/mathematics-s5-unit-07-l03-random-relay.pptx)
 |  |

## Learning episode 4 – toadal eclipse

### Teaching and learning activity

Students use gene therapy in cane toads to investigate dependent events. Weighted tree diagrams for dependent events are created to discover the impact that changing the gender of cane toads is having on population.

### Syllabus content

* Explain the difference between dependent and independent events in experiments involving 2 stages
* Explain how the probability of independent and dependent events differs in relation to replacement
* Record all possible outcomes for multistage chance experiments
* Determine the probabilities of outcomes for multistage independent events using P(A and B) = P(A) x P(B), where necessary
* Determine the probabilities of outcomes for multistage dependent events
* Design and conduct a probability simulation, modelling probabilities of events, using digital tools
* Record and use the results of a probability simulation to predict future events
* Apply reasoning to evaluate the simulation and its related outcomes
* Identify and explain common misconceptions relating to chance experiments (Path)

Table 4 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| [Toadal eclipse (DOCX 346.4 KB)](https://education.nsw.gov.au/content/dam/main-education/en/home/teaching-and-learning/curriculum/mathematics/documents/mathematics-s5-unit-07-l04-toadal-eclipse.docx)Duration**:** 1–2 lessonsLearning intentions* To know how to create a tree diagram.
* To understand the difference between dependent and independent events.

Success criteria* I can use a tree diagram to represent multistage events.
* I can describe the difference between dependent and independent events.
* I can explain how dependent and independent events change a tree diagram.
 | * *[Toadal eclipse](https://education.nsw.gov.au/content/dam/main-education/en/home/teaching-and-learning/curriculum/mathematics/documents/mathematics-s5-unit-07-l04-toadal-eclipse.ppt)* [(PPTX 3.5 MB) PowerPoint](https://education.nsw.gov.au/content/dam/main-education/en/home/teaching-and-learning/curriculum/mathematics/documents/mathematics-s5-unit-07-l04-toadal-eclipse.ppt)
* Appendix A ‘Which event type is it’ (1 per student)
 |  |

## Learning episode 5 – Monty Hall

### Teaching and learning activity

Students explore the Monty Hall problem to discover that sometimes probabilities do not work out how people expect. Students create a simulation to demonstrate how probability can help us make predictions.

### Syllabus content

* Design and conduct a probability simulation, modelling probabilities of events, using digital tools
* Record and use the results of a probability simulation to predict future events
* Apply reasoning to evaluate the simulation and its related outcomes
* Explain the validity of conditional statements when describing chance situations, referring to dependent and independent events (Path)
* Identify and explain common misconceptions relating to chance experiments (Path)

Table 5 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| [Monty Hall (DOCX 484.4 KB)](https://education.nsw.gov.au/content/dam/main-education/en/home/teaching-and-learning/curriculum/mathematics/documents/mathematics-s5-unit-07-l05-monty-hall.docx)Duration**:** 1–2 lessonsLearning intentions* To use a probability simulation to predict future events.
* To challenge common misconceptions relating to chance experiments.

Success criteria* I can design and conduct a probability simulation.
* I can display my simulation results using tables and graphs.
* I can apply reasoning to evaluate the results of a probability simulation.
 | * Digital devices (1 per pair of students) (optional)
* Decks of cards, counters and cups, scrap paper (optional)
* [*Monty Hall* (PPTX 1.4 MB) PowerPoint](https://education.nsw.gov.au/content/dam/main-education/en/home/teaching-and-learning/curriculum/mathematics/documents/mathematics-s5-unit-07-l05-monty-hall.pptx)
* Appendix A ‘Monty Hall sample space’ (1 per pair)
 |  |

## Learning episode 6 – demystifying the birthday paradox

### Teaching and learning activity

Students will use simulations and theoretical probability to make sense of the well-known birthday paradox problem.

### Syllabus content

* Determine the probabilities of outcomes for multistage dependent events
* Associate complementary events with probabilities in multistage chance experiments
* Design and conduct a probability simulation, modelling probabilities of events, using digital tools
* Record and use the results of a probability simulation to predict future events
* Apply reasoning to evaluate the simulation and its related outcomes
* Identify and explain common misconceptions relating to chance experiments (Path)
* Describe events using the terms ‘at least’, ‘at most’, ‘not’ and ‘and’ (Path)

Table 6 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| [Demystifying the birthday paradox (DOCX 242.5 KB)](https://education.nsw.gov.au/content/dam/main-education/en/home/teaching-and-learning/curriculum/mathematics/documents/mathematics-s5-unit-07-l06-demystifying-the-birthday-paradox.docx)Duration**:** 1–3 lessonsLearning intentions* To use complementary probabilities to solve problems.
* To use simulations to model complicated situations.

Success criteria* I can use complementary events to find the probability of an event.
* I can draw conclusions based on a simulation.
 | * Digital devices (1 per pair of students)
* [*Demystifying the birthday paradox* (PPTX 1.3 MB) PowerPoint](https://education.nsw.gov.au/content/dam/main-education/en/home/teaching-and-learning/curriculum/mathematics/documents/mathematics-s5-unit-07-l06-demystifying-the-birthday-paradox.pptx)
 |  |

## Learning episode 7 – what’s on the packet is in the packet

### Teaching and learning activity

Students interact with Venn diagrams in a range of contexts, from considering animals on packaging to grouping polygons based on geometrical properties. The tasks have a low floor and high ceiling approach, meaning all students should be able to engage in the activities while providing deep exploration for all students.

### Syllabus content

* Represent and interpret data in Venn diagrams for exclusive and non-mutually exclusive events (Path)
* Construct Venn diagrams to represent all possible combinations of 2 attributes from given or collected data (Path)
* Define a set as a collection of distinct objects (Path)
* Use Venn diagrams, set language and notation for events, those for the complement of an event, the intersection of events and the union of events and recognise mutually exclusive events (Path)
* Explain the difference between mutually exclusive and non-mutually exclusive events (Path)
* Calculate the probability of compound events using strategies including Venn diagrams and 2-way tables (Path)

Table 7 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| [What’s on the packet is in the packet (DOCX 1.9 MB)](https://education.nsw.gov.au/content/dam/main-education/en/home/teaching-and-learning/curriculum/mathematics/documents/mathematics-s5-unit-07-l07-whats-on-the-packet-is-in-the-packet.docx)Duration**:** 1–3 lessonsLearning intentions* To be able to interpret Venn diagrams.
* To be able to construct Venn diagrams.

Success criteria* I can describe what a Venn diagram represents.
* I can describe what each section of a Venn diagram represents.
* I can read and use set notation.
 | * Digital devices, 1 per pair of students (optional)
* Appendix A ‘Packet Venn’ printed A3, in plastic pockets (1 per group of 3)
* Appendix B ‘Exploring Venn diagrams’ printed (1 per pair)
* Appendix C ‘Colour in Venn diagrams’ printed (1 per student)
* Optional: Appendix D ‘Cut and sort Venn diagrams’ can be printed and cut into individual cards (1 per pair of students)
* Appendix E ‘Venn for polygons’ printed A3, in plastic pockets (1 per group of 3)
* [*What’s on the packet is in the packet* (PPTX 110 MB) PowerPoint](https://education.nsw.gov.au/content/dam/main-education/en/home/teaching-and-learning/curriculum/mathematics/documents/mathematics-s5-unit-07-l07-whats-on-the-packet-is-in-the-packet.pptx)
 |  |

## Learning episode 8 – tables 2 ways

### Teaching and learning activity

This lesson follows directly on from the previous Venn diagrams lesson. 2-way tables are discovered, and data is interchanged between 2-way tables and Venn diagrams. Venn diagrams and 2-way tables are compared to determine where each would be used.

### Syllabus content

* Represent and interpret data in Venn diagrams for mutually exclusive and non-mutually exclusive events (Path)
* Construct Venn diagrams to represent all possible combinations of 2 attributes from given or collected data (Path)
* Interpret data in 2-way tables to represent relationships between attributes (Path)
* Construct 2-way tables to represent the relationships between attributes (Path)
* Convert between representations of the relationships between 2 attributes in Venn diagrams and 2-way tables (Path)
* Calculate the probability of compound events using strategies including Venn diagrams and 2-way tables (Path)
* Use Venn diagrams, set language and notation for events, those for the complement of an event, the intersection of events and the union of events and recognise mutually exclusive events (Path)

Table 8 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| [Tables 2 ways (DOCX 508.6 KB)](https://education.nsw.gov.au/content/dam/main-education/en/home/teaching-and-learning/curriculum/mathematics/documents/mathematics-s5-unit-07-l08-tables-2-ways.docx)Duration**:** 1–2 lessonsLearning intentions* To understand how data is represented using 2-way tables and Venn diagrams.
* To know when data should be presented using 2-way tables or Venn diagrams.

Success criteria* I can interpret information presented in 2-way tables and Venn diagrams.
* I can calculate probabilities from 2-way tables and Venn diagrams.
* I can compare 2-way tables and Venn diagrams.
 | * Appendix A ‘If I know… then I know…’ printed (1 per student)
* [*Tables 2 ways* (PPTX 1.3 MB) PowerPoint](https://education.nsw.gov.au/content/dam/main-education/en/home/teaching-and-learning/curriculum/mathematics/documents/mathematics-s5-unit-07-l08-tables-2-ways.pptx)
 |  |

## Learning episode 9 – home ground advantage

### Teaching and learning activity

Students develop an understanding of conditional probability through the analysis of the win rate of a chosen sport team, given that the team played at their home ground.

### Syllabus content

* Calculate the probabilities of events where a condition restricts the sample space (Path)
* Describe the effect of a given condition on the sample space (Path)
* Identify conditional statements used in descriptions of chance situations (Path)
* Explain the validity of conditional statements when describing chance situations, referring to dependent and independent events (Path)

Table 9 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| [Home ground advantage (DOCX 241.9 KB)](https://education.nsw.gov.au/content/dam/main-education/en/home/teaching-and-learning/curriculum/mathematics/documents/mathematics-s5-unit-07-l09-home-ground-advantage.docx)Duration**:** 1–2 lessonsLearning intentions* To be able to solve problems involving conditional probabilities.

Success criteria* I can interpret conditional probabilities.
* I can calculate conditional probabilities.
* I can construct if… then… statements.
 | * Digital devices (1 per pair of students)
* Appendix A printed on A3 (1 per pair)
* [*Home ground advantage* (PPTX 2.2 MB) PowerPoint](https://education.nsw.gov.au/content/dam/main-education/en/home/teaching-and-learning/curriculum/mathematics/documents/mathematics-s5-unit-07-l09-home-ground-advantage.pptx)
 |  |

## Learning episode 10 – poker machines

### Teaching and learning activity

This lesson has been written by the Office of Responsible Gambling as part of their GambleAware educational program. In the span of 5 months, from June to November 2020, NSW residents lost $2.17 billion to poker machines. This lesson breaks down how poker machines work and the likelihood of payouts.

### Syllabus content

* Explain how the probability of independent and dependent events differs in relation to replacement
* Explain how the probability of independent and dependent events differs in relation to replacement
* Record all possible outcomes for multistage chance experiments
* Record and use the results of a probability simulation to predict future events
* Apply reasoning to evaluate the simulation and its related outcomes
* Identify and explain common misconceptions relating to chance experiments (Path)

Table 10 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| Poker machinesDuration**:** 1–2 lessonsLearning intentions* To understand how repeated small losses over time can be significant.
* To understand that it is very easy to lose track of time while playing poker machines.
* To understand the concept of a Return to Player percentage.

Success criteria* I can calculate the potential money lost while playing poker machines.
* I can discuss the difference between money you have lost, and money you have gambled with.
 | * Link to [GambleAware lesson 3 Poker machines](https://www.gambleaware.nsw.gov.au/for-professionals/for-teachers-and-youth-workers/free-classroom-resources/maths-school-resources)
 |  |

## Learning episode 11 – loot boxes

### Teaching and learning activity

This lesson has been written by the Office of Responsible Gambling as part of their GambleAware educational program. Loot boxes or digital lucky dips are seen as a fun and easy way for video game players to win important in-game items. In this learning episode loot boxes are explored and students are asked to create their own video game concept to calculate the probability of obtaining all unique items to form a complete set.

### Syllabus content

* Record all possible outcomes for multistage chance experiments
* Determine the probabilities of outcomes for multistage independent events using P(A and B) = P(A) x P(B), where necessary
* Determine the probabilities of outcomes for multistage dependent events
* Associate complementary events with probabilities in multistage chance experiments
* Design and conduct a probability simulation, modelling probabilities of events, using digital tools
* Record and use the results of a probability simulation to predict future events
* Apply reasoning to evaluate the simulation and its related outcomes
* Identify and explain common misconceptions relating to chance experiments (Path)

Table 4 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| Loot boxesDuration**:** 1–2 lessonsLearning intentions* To understand what a loot box is, and how they can exist outside of computer games.
* To understand why loot boxes are a form of gambling.

Success criteria* I can explain the links between loot boxes and gambling.
* I can calculate the probability of a loot box containing a desired item.
* I can calculate how many loot boxes are needed on average to complete a set of items.
 | * Link to [GambleAware lesson 5 Loot boxes](https://www.gambleaware.nsw.gov.au/for-professionals/for-teachers-and-youth-workers/free-classroom-resources/maths-school-resources)
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# References

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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 28 February 2024.

NSW Department of Education (n.d.) ‘[Teaching resources for Maths](https://www.gambleaware.nsw.gov.au/for-professionals/for-teachers-and-youth-workers/free-classroom-resources/maths-school-resources)’, *GambleAware,* NSW Department of Education website, accessed 5 March 2024. .

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