Mathematics Stage 3 – Unit 18

Questions can be asked and answered by interpreting data

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# Unit description and duration

This unit develops the big idea that questions can be asked and answered by interpreting data.

In this 2-week unit students are provided opportunities to:

* represent probabilities of outcomes of chance experiments using fractions, decimals and percentages, comparing predicted outcomes with observed results
* describe, interpret and pose questions about data presented in tables, column graphs, line graphs and timelines
* investigate how data representations can be misleading or biased.

## Syllabus outcomes

* **MAO-WM-01** 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
* **MA3-RN-01** applies an understanding of place value and the role of zero to represent the properties of numbers
* **MA3-RN-02** compares and orders decimals up to 3 decimal places
* **MA3-RN-03** determines percentages of quantities, and finds equivalent fractions and decimals for benchmark percentage values
* **MA3-DATA-01** constructs graphs using many-to-one scales
* **MA3-DATA-02** interprets data displays, including timelines and line graphs
* **MA3-CHAN-01** conducts chance experiments and quantifies the probability

## Working mathematically

In the Mathematics K–10 Syllabus, there is one overarching Working mathematically outcome (**MAO-WM-01**). The Working mathematically processes should be embedded within the concepts being taught. The Working mathematically processes present in the Mathematics K–10 Syllabus are:

* communicating
* understanding and fluency
* reasoning
* problem solving.

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

## Student prior learning

Before engaging in these teaching and learning activities, students would benefit from prior experience with:

* understanding that probability can be represented numerically between zero to one
* creating random generators and recording possible outcomes using fractions
* representing and interpreting data presented in tables, column graphs and line graphs, with and without the use of digital technologies.

In NSW classrooms there is a diverse range of students, including Aboriginal and/or Torres Strait Islander students, students learning English as an additional language or dialect, high potential and gifted students, and students with disability. Some students may identify with more than one of these groups or possibly all of them. Refer to [Curriculum planning for every student – advice](https://education.nsw.gov.au/teaching-and-learning/curriculum/planning-programming-and-assessing-k-12/advice-on-curriculum-planning-for-every-student-k-12) for further information.

# Lesson overview and resources

The table below outlines the sequence and approximate timing of lessons, learning intentions and resources.

|  |  |  |
| --- | --- | --- |
| Lesson | Content | Duration and resources |
| [**Lesson 1**](#_Lesson_1)  **Daily number sense learning intention:**   * locate and represent integers on a number line | **Lesson core concept**: the probability of an outcome occurring has a value.  **Core concept learning intention**:   * list outcomes of chance experiments involving equally likely outcomes and represent probabilities | **Lesson duration**: 60 minutes   * [Resource 1 – integers](#_Resource_1_–) * [Resource 2 – chance representations](#_Resource_2_–) * [Resource 3 – ‘Greedy Goat’](#_Resource_3_–) * [Resource 4 – investigating likelihood](#_Resource_4_–) * 10-sided dice (one per small group) * Individual whiteboards * Whiteboards * Writing materials |
| [**Lesson 2**](#_Lesson_2)  **Daily number sense learning intention:**   * locate and represent integers on a number line | **Lesson core concept**: outcomes in chance experiments can be equally likely.  **Core concept learning intentions**:   * choose and use appropriate tables and graphs * list outcomes of chance experiments involving equally likely outcomes and represent probabilities | **Lesson duration**: 60 minutes   * [Resource 3 – ‘Greedy Goat’](#_Resource_3_–) * [Resource 5 – missing integers](#_Resource_5_–) * [Resource 6 – data types](#_Resource_6_–) * 10-sided dice * Writing materials * Whiteboards |
| [**Lesson 3**](#_Lesson_3)  **Daily number sense learning intentions:**   * locate and represent integers on a number line * describe and interpret different datasets in context | **Lesson core concept**: probability can be represented as a fraction.  **Core concept learning intentions**:   * make connections between benchmark fractions, decimals and percentages * list outcomes of chance experiments involving equally likely outcomes and represent probabilities * compare observed frequencies of outcomes with expected results | **Lesson duration**: 60 minutes   * [Resource 7 – integers below zero](#_Resource_7_–) * [Resource 8 – probability scales](#_Resource_8_–) * 10-sided dice * Writing materials * Whiteboards |
| [**Lesson 4**](#_Lesson_4)  **Daily number sense learning intention:**   * teacher-identified task based on student needs | **Lesson core concept**: probability can be represented from zero to one.  **Core concept learning intentions**:   * list outcomes of chance experiments involving equally likely outcomes and represent probabilities * compare observed frequencies of outcomes with expected results | **Lesson duration**: 75 minutes   * [Resource 8 – probability scales](#_Resource_8_–) * Various dice * Whiteboards * Writing materials |
| [**Lesson 5**](#_Lesson_5)  **Daily number sense learning intention:**   * recognise that the place value system can be extended beyond hundredths | **Lesson core concept**: data can help conceptualise events and history.  **Core concept learning intentions**:   * choose and use appropriate tables and graphs * interpret and compare a range of data displays | **Lesson duration**: 80 minutes   * [Resource 9 – more and less](#_Resource_9_–) * [Resource 10 – mobile phone timeline](#_Resource_10_–) * Digital devices * Rulers * Writing materials |
| [**Lesson 6**](#_Lesson_6)  **Daily number sense learning intention:**   * recognise that the place value system can be extended beyond hundredths | **Lesson core concept**: data is represented in different ways for different purposes.  **Core concept learning intention**:   * collect categorical and discrete numerical data by observation or survey | **Lesson duration**: 60 minutes   * [Resource 11 – ascending order](#_Resource_11_–) * [Resource 12 – data cycle](#_Resource_12_–) * [Resource 13 – council survey criteria](#_Resource_13_–) * Paper or digital applications: Microsoft Forms or Google Forms * Paper * Writing materials |
| [**Lesson 7**](#_Lesson_7)  **Daily number sense learning intentions:**   * recognise that the place value system can be extended beyond hundredths * make connections between benchmark fractions, decimals and percentages | **Lesson core concept**: data is represented in different ways for different purposes.  **Core concept learning intentions**:   * choose and use appropriate tables and graphs * describe and interpret different datasets in context | **Lesson duration**: 60 minutes   * [Resource 12 – data cycle](#_Resource_12_–) * [Resource 14 – What’s missing?](#_Resource_14_–) * [Resource 15 – best data representation](#_Resource_15_–) * Digital applications: Microsoft Excel or Google Sheets * Paper * Writing materials |
| [**Lesson 8**](#_Lesson_8)  **Daily number sense learning intention:**   * teacher-identified task based on student needs | **Lesson core concept**: statistical reasoning helps mathematicians interpret and make inferences about real-world data.  **Core concept learning intentions**:   * describe and interpret different datasets in context * interpret data presented in digital media and elsewhere | **Lesson duration**: 70 minutes   * [Resource 16 – languages data](#_Resource_16_–) * [Resource 17 – languages line graph](#_Resource_17_–) * [Resource 18 – data display 1](#_Resource_18_–) * [Resource 19 – data display 2](#_Resource_19_–) * [Resource 20 – data display 3](#_Resource_20_–) * Video: [How to spot a misleading graph (4:09)](https://ed.ted.com/lessons/how-to-spot-a-misleading-graph-lea-gaslowitz) |

# Lesson 1

**Core concept**: the probability of an outcome occurring has a value.

## Daily number sense – positive and negative integers – 10 minutes

Daily number sense activities for Lessons 1 to 3 ‘activate’ prior number knowledge and support the learning of new content in the unit. These activities can also assist teachers to identify the starting points for learning by revealing the extent of students’ existing knowledge.

The table below contains a suggested learning intention and success criteria. These are best co-constructed with students.

|  |  |
| --- | --- |
| Daily number sense learning intention | Daily number sense success criteria |
| Students are learning to:   * locate and represent integers on a number line. | Students can:   * recognise the location of negative whole numbers in relation to zero and place them on a number line * use the term integers to describe positive and negative whole numbers and zero. |

**Note:** integers are the negative and positive whole numbers and zero. Integers can be represented as a series, such as -3, -2, -1, 0, 1, 2, 3. Positive and negative numbers describe quantities having both magnitude and direction, for example, temperature above and below zero (Van De Walle et al. 2019). To further consolidate student understanding of negative and positive numbers, revise Lesson 4, [Stage 3 Unit 8](https://education.nsw.gov.au/teaching-and-learning/curriculum/mathematics/planning-programming-and-assessing-mathematics-k-6/mathematics-3-6-units#tabs_727018652_copy_11581087071:~:text=Unit%208%20%E2%80%93%20Visual%20representations%20help%20to%20understand%20aspects%20of%20the%20world%20(chance%20and%20position)).

1. Display [Resource 1 – integers](#_Resource_1_–) and provide students with individual whiteboards and writing materials. Ask the following questions:

* What is the same or different between the number lines A and B?
* What do you notice about the numerals on each number line? Are they whole numbers? Explain.
* What role does the zero have in both number lines?
* What is the lowest number on each of the number lines?
* How far could the number line A be extended in either direction?
* Where would you see and use negative numbers in real life situations? (temperature, finance)

1. Explain that integers are whole numbers and can be either positive or negative. Zero is an exception, as it is neither positive nor negative and has an important role as it sits in the middle, separating the negative and positive numbers.
2. Draw student attention to [Resource 1 – integers](#_Resource_1_–). Using their whiteboard, students draw the number line labelled ‘A’ and extend the number line by recording the next 3 positive and negative integers. Ask the following questions:

* What strategy did you use to determine the next integers?
* How do you know you are correct?

This table details opportunities for assessment.

|  |  |
| --- | --- |
| Assessment opportunities | Links |
| What to look for:   * Can students recognise the location of negative whole numbers in relation to zero and place them on a number line?  **[MAO-WM-01, MA3-RN-01]** * Can students use the term integers to describe positive and negative whole numbers and zero? **[MAO-WM-01, MA3-RN-01]** | Links to [National Numeracy Learning Progressions](https://www.australiancurriculum.edu.au/resources/national-literacy-and-numeracy-learning-progressions/version-3-of-national-literacy-and-numeracy-learning-progressions/) (NNLP):   * NPV9 * CPr8. |

## Core lesson 1 – language of chance – 15 minutes

The table below contains a suggested learning intention and success criteria. These are best co-constructed with students.

|  |  |
| --- | --- |
| Core concept learning intention | Core concept success criteria |
| Students are learning to:   * list outcomes of chance experiments involving equally likely outcomes and represent probabilities. | Students can:   * use the term probability to describe the numerical value of an outcome * record all outcomes in chance experiments where each outcome is equally likely to occur * discuss the imprecise meaning of commonly used chance words including possible, likely and unlikely. |

**Note:** the purpose of this lesson is to explore how everyday chance language can lead to misconceptions and how assigning numerical values or phrases to a chance outcome can support a more precise understanding. For each lesson on chance in this unit and [Stage 3 – Unit 28 and Unit 38](https://education.nsw.gov.au/teaching-and-learning/curriculum/mathematics/planning-programming-and-assessing-mathematics-k-6/mathematics-3-6-units#tabs_727018652_copy__41337542:~:text=DOCX%203.4%20MB)-,Stage%203%20%E2%80%93%20Year%20B,-NSW%20students%20in), students can enhance their understanding by using various representations or tools, featured in [Resource 2 – chance representations](#_Resource_2_–). These representations and tools can be collaboratively constructed with students or provided as a resource.

1. Draw a blank probability scale from 0–1 to be used as an anchor chart for discussions.
2. Label zero as impossible and one as certain.
3. Ask students to suggest where other commonly used terms to describe probability and numerical phrases would be placed along the scale. Ensure students are using fractional knowledge and precise language to justify their reasoning (see Figure 1).

Figure 1 – example probability scale

A probability scale drawn on a horizontal number line from zero to 1. The scale has benchmark fractions of one-quarter, half and three-quarters marked, including representations in fractional notation, percentages and words. 

Above the scale, common vocabulary words including: maybe, uncertain, unlikely, even chance, equally likely, very likely and almost certain are positioned in relevant locations. 

Above the vocabulary is a line that extends the width of the number line, labelled ‘possible outcomes’.

0 is labelled as: impossible, never, no chance, 0%.

The next marker is labelled as: 25%, 1/4 and 1 out of 4.

The next marker is labelled as: 1/2, 50% and 1 out of 2.

The next marker is labelled as: 3/4, 75% and 3 out of 4. 

1 is labelled as: certain, 100%, 1/1 and 1 whole.

1. Explain that colloquial terms can be misleading or provide an imprecise description of the probability of an event. For example, students may state that they will never go on a plane or that they always go to bed at 8:00 pm. Discuss how language may be exaggerated or describe a situation with 100% certainty, instead of accurately describing the chance of an event within a specific context.
2. Refer to the numerical phrases and explain that these convey a more precise description of probability. For example, 50% chance, 1 in 2, and 3 out of 4 are more exact than the terms ‘maybe’ or ‘almost certain’.

**Note:** to develop critical thinking skills and deepen their understanding of probability, students need to recognise that language used to describe chance can be mathematically misleading. Understanding probability requires students to recognise the range of possible outcomes, the likelihood of a specific outcome and the numerical value attributed to the outcome. This knowledge further supports students to develop skills and critical thinking when analysing and evaluating the chance of events in real life situations (Batanero et al. 2016).

1. Students [Think-Pair-Share](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/645) with a partner to discuss an event that can be described as:

* 100% certain (sunrise and sunset)
* impossible (win the lottery without buying a ticket)
* equally likely for each person (flipping a coin to land on heads)
* three-quarters possible (drawing a blue marble from a bag with 3 blue marbles and one red marble).

1. Select students to share examples and record these on the anchor chart.
2. Explain that mathematicians use the term *probability* to describe the numerical value that represents the likelihood of an outcome of a chance experiment. Share the syllabus definition of probability.

**Probability**: the chance of something happening shown on a scale from 0 and 1 (inclusive). For example, the probability that a fair coin toss will come up ‘heads’ is .

1. Reinforce the boundaries of the scale – probability cannot be smaller than zero or higher than one.

## Core lesson 2 – an equal chance – 25 minutes

This activity is an adaptation of [Greedy Pig](https://nzmaths.co.nz/resource/greedy-pig-0) from [NZ Maths](https://nzmaths.co.nz/) by the University of Cambridge.

**Note**: when teaching probability through games, provide the opportunity for students to play multiple times. Repetition assists in the development of mathematical understanding, probabilistic reasoning associated with chance and helps address common misconceptions.

1. Explain that, as a whole class, students will be playing a dice game called ‘Greedy Goat’. Provide students with individual whiteboards and writing materials.
2. Display and read [Resource 3 – ‘Greedy Goat’](#_Resource_3_–). Students draw a score chart on their whiteboard or in their workbook.
3. Play 3 to 5 rounds of the game. During each round, refer to the anchor chart and ask the following questions:

* What are all the possible numbers you can roll with a 10-sided die?
* How would you describe the chance of a one being rolled?
* How did you decide when to sit down and save your score?
* Was it equally likely for a 10 or a 1 to be rolled in one round?
* Is there anything about this game that is impossible or certain?
* What did you notice about this game?

1. After the whole class game, explain that students will play ‘Greedy Goat’ in small groups (3 to 4 players).
2. Provide groups with a 10-sided die and whiteboards or workbooks. Students draw a score chart and select one person to roll the die.
3. Allow time for students to play up to 10 rounds. Regroup and discuss the following questions:

* If you played 20 rounds, how many ones would you expect to roll? Explain.
* What numerical values can be used to describe a 1 out of 10 chance? What would it look like as a fraction? As a decimal? As a percentage?
* What number on the die was rolled the most and the least by your group?

This table details opportunities for differentiation.

|  |  |
| --- | --- |
| Too hard? | Too easy? |
| Students cannot use the term probability to describe the numerical value of an outcome.   * Explain that for a fair coin toss, the chance of a getting a head is . Students brainstorm other situations where there are even chances such as a spinner with equal halves or rolling an even number on a die. Students represent this on a probability scale. * Provide students with a copy of [Resource 2 – chance representations](#_Resource_2_–). Using the images on the resource, support students to identify the numerical value of an outcome for pulling a particular colour from the bag of counters ( or ), rolling a 4 on the dot dice (), landing on red on the spinner () and the fraction strips ( and ). | Students can use the term probability to describe the numerical value of an outcome.   * Revise the definition of frequency (see note below). In pairs, students explore the frequency of various outcomes for each player in the group while playing ‘Greedy Goat’. For example, what was the frequency of rolling an even number, an odd number or a number greater than 7? Students express the frequency as a fraction and compare it to the probability of each event explored. * Challenge students to predict how many rolls it will take to roll a one using a 10-sided die. Students create a table and record the frequency of ones rolled after 5 rolls, 10 rolls, 15 rolls and so on. After completing the task, students write a statement about the observed probability of rolling a one after a selected number of rolls. For example, in 10 rolls, I rolled 2 ones. The observed probability was . |

**Frequency**: frequency means the number of times that a particular value occurs in a data set. For example, when rolling a die 20 times, ‘the frequency of a 6’ means how many times the number 6 comes up.

## Discuss and connect the mathematics – 10 minutes

1. Display [Resource 4 – investigating likelihood](#_Resource_4_–) and refer to the anchor chart. Ask the following questions:

* What is the likelihood of drawing a blue marble from each bag?
* What information about the marbles within each bag can we use to help us arrange them along the probability scale? What numerical values can we use?
* Do any of the bags represent an impossible likelihood for an event?
* Which bag shows a 50% chance of drawing a purple marble? Where would you place that bag on the probability scale?
* Do any of the bags represent a certain likelihood or 100% chance of an event?
* Are there any bags that show a one-quarter chance of drawing a particular-coloured marble?
* Consider when you were playing ‘Greedy Goat’, was it equally likely for each player to roll a 7 during one round? (Yes, as there are 10 possible outcomes, each outcome has a probability of )
* Where would you record a 1 out of 10 chance on the probability scale?

This table details opportunities for assessment.

|  |  |
| --- | --- |
| Assessment opportunities | Links |
| What to look for:   * Can students use the term *probability* to describe the numerical value of an outcome? **[MAO-WM-01, MA3-CHAN-01]** * Can students record all outcomes in chance experiments where each outcome is equally likely to occur?  **[MAO-WM-01, MA3-CHAN-01]** * Can students discuss the imprecise meaning of commonly used chance words including *possible, likely* and *unlikely*?  **[MAO-WM-01, MA3-CHAN-01]** | Links to [National Numeracy Learning Progressions](https://www.australiancurriculum.edu.au/resources/national-literacy-and-numeracy-learning-progressions/version-3-of-national-literacy-and-numeracy-learning-progressions/) (NNLP):   * UnC2, UnC3, UnC4. |

# Lesson 2

**Core concept**: outcomes in chance experiments can be equally likely.

## Daily number sense – missing integers – 10 minutes

The table below contains a suggested learning intention and success criteria. These are best co-constructed with students.

|  |  |
| --- | --- |
| Daily number sense learning intention | Daily number sense success criteria |
| Students are learning to:   * locate and represent integers on a number line. | Students can:   * recognise the location of negative whole numbers in relation to zero and place them on a number line * use the term integers to describe positive and negative whole numbers and zero. |

1. Provide pairs with [Resource 5 – missing integers](#_Resource_5_–). Explain that each number line has a concealed part, and the Cartesian plane has 2 unlabelled axes.
2. Students draw their own number line to record all the integers, including zero, in the correct position.
3. Students also record the correct integers for the 2 blank axes on the Cartesian plane. Remind students that the integers for coordinates align with the lines, not the spaces.
4. As a class discuss:

* How did you know what the highest integer would be on number line A?
* How did you know where to place zero on number line B?
* What was different about number line C?
* Which number line was most challenging?
* What strategy did you use to label the unlabelled axes on the Cartesian plane? How did you know you were correct?

This table details opportunities for assessment.

|  |  |
| --- | --- |
| Assessment opportunities | Links |
| What to look for:   * Can students recognise the location of negative whole numbers in relation to zero and place them on a number line?  **[MAO-WM-01, MA3-RN-01]** * Can students use the term integers to describe positive and negative whole numbers and zero? **[MAO-WM-01, MA3-RN-01]** | Links to [National Numeracy Learning Progressions](https://www.australiancurriculum.edu.au/resources/national-literacy-and-numeracy-learning-progressions/version-3-of-national-literacy-and-numeracy-learning-progressions/) (NNLP):   * NPV9 * CPr8. |

## Core lesson – changing chance – 40 minutes

The table below contains suggested learning intentions and success criteria. These are best co-constructed with students.

|  |  |
| --- | --- |
| Core concept learning intentions | Core concept success criteria |
| Students are learning to:   * choose and use appropriate tables and graphs * list outcomes of chance experiments involving equally likely outcomes and represent probabilities. | Students can:   * tabulate collected data * record all outcomes in chance experiments where each outcome is equally likely to occur * discuss the imprecise meaning of commonly used chance words including possible, likely and unlikely. |

For each lesson on data in this unit and [Stage 3 – Unit 25 and Unit 38](https://education.nsw.gov.au/teaching-and-learning/curriculum/mathematics/planning-programming-and-assessing-mathematics-k-6/mathematics-3-6-units#tabs_727018652_copy__41337542:~:text=DOCX%203.4%20MB)-,Stage%203%20%E2%80%93%20Year%20B,-NSW%20students%20in), students can enhance their understanding by using consistent definitions such as those on [Resource 6 – data types](#_Resource_6_–).

1. Display [Resource 3 – ‘Greedy Goat’](#_Resource_3_–) and the co-constructed probability scale anchor chart from [Lesson 1](#_Lesson_1).
2. Revise the vocabulary of probability. Provide time for students to discuss and use the vocabulary to describe their experience playing ‘Greedy Goat’. Ask:

* Did you think it was certain or impossible that you could roll a one multiple times during the game? Explain.
* What is an instruction that can be changed so that the probability of scoring zero in a round is also changed? Explain.
* How would you test the change to make sure you are correct? How many rounds would you need to play to be sure you were right? What other things might you need to consider?

1. Explain that in this lesson, students will explore whether changes to the rules of ‘Greedy Goat’ affect the probabilities of scoring zero in a round.
2. Provide some examples of changes using the [think aloud strategy](https://evidenceforlearning.org.au/news/planning-a-think-aloud-in-mathematics), such as:

* How would the game change if the new rule was if you roll a 1 or a 10, your score is zero?
* How would playing with a 6-sided dice change the probability of scoring zero?
* If the new rule was rolling an even number allows you to double your score, how might this change the game?

1. As a class brainstorm new rules and create a class list of possible modifications. Keep the list for use in [Lesson 4](#_Lesson_4).
2. Explain that students will work within the same small groups as in [Lesson 1](#_Lesson_1). Students:

* select a modification idea from the class list and play ‘Greedy Goat’ using the new rule
* collect and record data in a table
* record an explanation of how the modified idea has changed the game (encourage students to use chance language and numerical phrases to justify their findings.)

1. Model how students can record the data and an example of an explanation (see Figure 2).

Figure 2 – example of data and comment

On the right, is a data table. The columns are labelled 1 to 10 to indicate the dice faces. The rows are labelled 1 to 5 to indicate the round being played.

On the left, 2 modifications to the game are listed – If a 5 is rolled, your score goes back to zero. If an even number is rolled, add 10 to your score.

Comments under the modifications are – There were more even numbers than odd numbers. Players stayed in the game for more rolls, trying to get a higher score. 

The number 5 was a good modification because it did come up more than once.

**Note:** student responses may include misconceptions such as past experiences influencing their view of chance and likelihood. For example, in Figure 2, students commented that choosing 5 was a good modification, even though the probability of rolling a 5 is equal to that of rolling a one. Such misconceptions should be addressed in discussions.

1. Provide each group with a 10-sided die, a whiteboard and writing materials. In their groups, students explore and trial their modifications.
2. Regroup as a class and discuss the following questions. Answers will vary depending on the modifications to the game.

The table below outlines stimulus prompts to generate conversation about the topic, along with anticipated responses from students.

|  |  |
| --- | --- |
| Prompts | Anticipated student responses |
| * How did the rule change the way you played the game? | * There were more numbers that made you get a zero, so rounds finished quickly as people saved their points and opted out. * We added a rule that doubled your score if you rolled a 6 or higher. People stayed in for longer to get higher scores. |
| * Did the modified instruction(s) change the probability of outcomes for players? Explain. | * We used two 6-sided dice. The rule was to roll 2 ones to get a zero score. The chance of rolling 2 ones at the same time is unlikely to happen. * We had 2 penalties: roll a one means get zero and roll a 10 means halve your score. We noticed that players stopped and saved their score after fewer rolls of the die because there were now 2 numbers that could affect their score. That is a 2 out of 10 chance. |
| * How did you use the probability scale to inform your decision? | * We thought about the chances as a fraction and compared the probability of scoring zero in a round to the original game of ‘Greedy Goat’. |

This table details opportunities for differentiation.

|  |  |
| --- | --- |
| Too hard? | Too easy? |
| Students cannot record all outcomes in chance experiments where each outcome is equally likely to occur and/or tabulate collected data.   * Play a modified version of ‘Greedy Goat’. As a small group, model the collection and recording of the data. * Provide students with a prepared data table. Guide each group on how to record the rolls for a modified version of ‘Greedy Goat’. | Students can record all outcomes in chance experiments where each outcome is equally likely to occur and tabulate collected data.   * Small groups of students explore [What Does Random Look Like?](https://nrich.maths.org/7250) by NRICH using data collected from 20 coin tosses and a ‘fake’ dataset. * Students select 2 dice to investigate the probability of combined scores using the steps set out in [A Bit of a Dicey Problem](https://nrich.maths.org/1077) by NRICH. |

## Discuss and connect the mathematics – 10 minutes

1. Display the co-constructed probability scale anchor chart.
2. As a class, select groups to share their experiences of the modified game. Ask the following questions:

* How did your group record the results? What did you notice?
* If you played an additional 10 rounds, do you think the outcomes would be very different or similar? Explain.
* Which modification do you think caused the biggest change in probability in scoring zero in a round? How did it change?
* How would playing for 20 rounds or 100 rounds make a difference? Does this depend on how many numbers are on the die? Explain.

This table details opportunities for assessment.

|  |  |
| --- | --- |
| Assessment opportunities | Links |
| What to look for:   * Can students tabulate collected data? **[MAO-WM-01, MA3-DATA-01]** * Can students record all outcomes in chance experiments where each outcome is equally likely to occur?  **[MAO-WM-01, MA3-CHAN-01]** * Can students discuss the imprecise meaning of commonly used chance words including possible, likely and unlikely?  **[MAO-WM**-**01, MA3-CHAN-01]** | Links to [National Numeracy Learning Progressions](https://www.australiancurriculum.edu.au/resources/national-literacy-and-numeracy-learning-progressions/version-3-of-national-literacy-and-numeracy-learning-progressions/) (NNLP):   * UnC2, UnC3, UnC4 * IRD2. |

# Lesson 3

**Core concept**: probability can be represented as a fraction.

## Daily number sense – integers below zero – 15 minutes

The table below contains suggested learning intentions and success criteria. These are best co-constructed with students.

|  |  |
| --- | --- |
| Daily number sense learning intentions | Daily number sense success criteria |
| Students are learning to:   * locate and represent integers on a number line * describe and interpret different datasets in context. | Students can:   * interpret integers in everyday contexts * interpret line graphs using the scales on the axes. |

1. Explain that sea level is the base level for measuring elevation and depth on Earth. For example, Mount Kosciuszko is 2228 metres above sea level. At its deepest point, the Mariana Trench is about 11 000 metres below sea level.
2. Display [Resource 7 – integers below zero](#_Resource_7_–). Explain that, like temperature, the measurement above and below sea level can be recorded with positive and negative integers.
3. Locate zero on the y-axis. Highlight that the negative numbers are continuous in one direction and the positive numbers are continuous in the opposite direction, like a mirror image.
4. Draw attention to the image of the submarine and share the HMAS Collins narrative. The submarine is being submerged to different levels. Draw student attention to the data recorded by the line graph. Ask students to [Think-Pair-Share](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/645) to answer:

* How is this graph similar and/or different to a column graph?
* What information is recorded on the x-axis?
* What information is recorded on the y-axis?
* How many times was the submarine at 20 metres below sea level (-20 m)?

1. Model how to describe the movement of the submarine. For example: At the beginning of Monday, the submarine was at sea level, 0 m. It dived 15 m to be at 15 metres below sea level, then rose 5 m to be at 10 metres below sea level by the end of the day.
2. Provide pairs with a whiteboard and writing materials. Ask the following questions:

* How can we use words to describe the daily movement of the submarine for another day of the week?
* What might have been the movements of the submarine on Saturday and Sunday?

1. Students write 2 questions that can be answered from the graph.

This table details opportunities for assessment.

|  |  |
| --- | --- |
| Assessment opportunities | Links |
| What to look for:   * Can students interpret integers in everyday contexts?  **[MAO-WM-01, MA3-RN-01]** * Can students interpret line graphs using the scales on the axes? **[MAO-WM-01, MA3-DATA-02]** | Links to [National Numeracy Learning Progressions](https://www.australiancurriculum.edu.au/resources/national-literacy-and-numeracy-learning-progressions/version-3-of-national-literacy-and-numeracy-learning-progressions/) (NNLP):   * NPV9 * CPr8 * MeT7 * IRD4. |

## Core lesson 1 – probability scales – 20 minutes

The table below contains suggested learning intentions and success criteria. These are best co-constructed with students.

|  |  |
| --- | --- |
| Core concept learning intentions | Core concept success criteria |
| Students are learning to:   * make connections between benchmark fractions, decimals and percentages * list outcomes of chance experiments involving equally likely outcomes and represent probabilities * compare observed frequencies of outcomes with expected results. | Students can:   * recall commonly used equivalent percentages, decimals and fractions including , and * use the term probability to describe the numerical value that represents the likelihood of an outcome of a chance experiment * represent probabilities of outcomes of chance experiments using fractions * distinguish between the frequency and the probability of an outcome in a chance experiment. |

**Note:** this lesson revisits chance content introduced in Lesson 6 of [Unit 8](https://education.nsw.gov.au/teaching-and-learning/curriculum/mathematics/planning-programming-and-assessing-mathematics-k-6/mathematics-3-6-units#tabs_727018652_copy_11581087071:~:text=Unit%208%20%E2%80%93%20Visual%20representations%20help%20to%20understand%20aspects%20of%20the%20world%20(chance%20and%20position)) and fractions content from [Unit 16](https://education.nsw.gov.au/teaching-and-learning/curriculum/mathematics/planning-programming-and-assessing-mathematics-k-6/mathematics-3-6-units#tabs_727018652_copy_11581087072:~:text=syllabus%20focus%20areas.-,Stage%203%20%E2%80%93%20Year%20A,-NSW%20students%20in).

1. Display and revise the anchor chart constructed [Lesson 1](#_Lesson_1). Ask the following questions:

* What probability is represented by zero?
* What probability is represented by one?
* What is the opposite of ‘impossible’? (certain)

1. Revise the syllabus definition of probability.

**Probability**: the chance of something happening shown on a scale from 0 and one (inclusive). For example, the probability that a fair coin toss will come up ‘heads’ is 0.5 (NESA 2022).

1. Display [Resource 8 – probability scales](#_Resource_8_–).
2. Remind students that fraction strips can also be used to represent probability.
3. Provide students with individual whiteboards and markers. Ask students to represent the probability of each activity (and fraction strip) on a probability scale (see Figure 3).

Figure 3 – completed probability scales

Example of a completed probability scale.

On the left, are images of random generators: a coin, a 3-part spinner, a bag with 4 differently coloured counters and a standard dot die.
Next to each random generator, a paper strip is drawn with the fractional representation of the chance of each outcome.

The coin strip is labelled half heads and half tails. The spinner strip is labelled in thirds. The bag or counter strip is labelled in quarters. The dice strip is labelled in sixths.

Next to each strip is a probability scale from zero to 1 marked with the associated fraction.

1. Ask the following questions:

* What do you notice about the probability recorded on the scale?
* How does your knowledge of benchmark fractions on a number line help you with probability?
* What is the same about the fraction strip and the probability scale?
* Why does the probability scale start at 0 and end at 1?

1. Remind students of the game ‘Greedy Goat’ that uses a 10-sided die. Ask the following questions:

* What is the probability of rolling any number on a 10-sided die?
* Can you represent this probability using a fraction strip?
* Can you represent this probability using a probability scale?
* Why does the fraction strip have 10 equal parts, but the probability scale only has one-tenth marked?

1. Students [Think-Pair-Share](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/645) to draw a fraction strip and probability scale for a 10-sided die (see Figure 4).

Figure 4 – ‘Greedy Goat’ probability

A 10-sided die showing the faces 8, 9 and 10. To the right, is a 2 by 5 array showing each of the numbers 1 to 10 as if they were the faces of the dice.

Under the array is a fraction strip divided into tenths with each 10th labelled using fractional notation. 

Under the fraction strip is a probability scale from zero to 1 with the fraction 1/10 marked.

## Core lesson 2 – data tables – 15 minutes

1. Explain that students are going to investigate whether the probability of rolling any number on a 10-sided die matches what happens when you roll the die many times.
2. Share the following syllabus definition for frequency:

**Frequency**: the number of times that a particular value occurs in a data set. For example, when rolling a die 20 times, ‘the frequency of a 6’ means how many times the number 6 comes up (NESA 2022).

1. Ask pairs of students to draw a data table with 10 columns, labelled 1–10.
2. Explain that students are going to record data from each roll to contribute to a whole class dataset.
3. Provide pairs of students with a 10-sided die. Students roll the die 50 times and after each roll, record the number in a data table.
4. Combine the data from each pair and create a table which shows the class data for students to view. Ask the following questions:

* What is the total number of rolls for the whole class?
* How often would you expect each number to be rolled? Why? (Total rolls ÷ 10, because there are 10 possible outcomes on the dice. Each outcome is equally likely. For example, with 50 rolls, to match probability, each outcome would occur 5 times.)
* Where do the class frequency results match the probability of rolling each number?
* Where do the class frequency results differ from the probability of rolling each number? Why is there a difference? (Dice are random.)
* Which outcome had the lowest or highest frequency in your pair data? How does this compare to the whole class data? Why is there a difference?

This table details opportunities for differentiation.

|  |  |
| --- | --- |
| Too hard? | Too easy? |
| Students cannot represent probabilities of outcomes of chance experiments using fractions.   * Fold paper strips to match those shown on [Resource 8 – probability scales](#_Resource_8_–). Use the strips to rule a line from 0–1, then label one fractional part, as shown in Figure 4 above. * Complete [Resource 8 – probability scales](#_Resource_8_–) then cut it into 12 cards. Students match the cards with each other, explaining their reasoning. | Students can represent probabilities of outcomes of chance experiments using fractions.   * Students use a 1–10 die to investigate what outcomes have a probability of or . Are there outcomes that have a probability of ? Why or why not? What dice in your classroom have outcomes with a probability of or ? Explain. * Students draw a probability scale from 0–1. Write a list of words to describe a chance and/or a chance. Share with the class. |

## Discuss and connect the mathematics – 10 minutes

1. Draw a probability scale from 0–1.
2. Students use a whiteboard and markers to draw a probability scale showing fractions, decimals and percentages for each of the scales in [Resource 8 – probability scales](#_Resource_8_–) and for ‘Greedy Goat’ (see Figure 5).

Figure 5 – fractions, decimals and percentages



**Note**: Stage 3 students are expected to make connections between benchmark fractions, decimals and percentages including , , and . Students are not expected to recall percentages and decimals for and , although these may be investigated in an exploratory way. To support place value conceptual understanding, read 0.1 as ‘one-tenth’, connecting the decimal fraction with common fractions.

1. Students add vocabulary labels from the anchor chart created in [Lesson 1](#_Lesson_1) to their probability scale.
2. Select students to share their labels.
3. Discuss the difference between imprecise language and exact probabilities. For example, does a 10% chance really mean that it is ‘unlikely’ that you would roll a one in a game of ‘Greedy Goat’?

This table details opportunities for assessment.

|  |  |
| --- | --- |
| Assessment opportunities | Links |
| What to look for:   * Can students recall commonly used equivalent percentages, decimals and fractions including , and ? **[MAO-WM-01, MA3-RN-03]** * Can students use the term probability to describe the numerical value that represents the likelihood of an outcome of a chance experiment? **[MAO-WM-01, MA3-CHAN-01]** * Can students represent probabilities of outcomes of chance experiments using fractions? **[MAO-WM-01, MA3-CHAN-01]** * Can students distinguish between the frequency and the probability of an outcome? **[MAO-WM-01, MA3-CHAN-01]** | Links to [National Numeracy Learning Progressions](https://www.australiancurriculum.edu.au/resources/national-literacy-and-numeracy-learning-progressions/version-3-of-national-literacy-and-numeracy-learning-progressions/) (NNLP):   * PrT2 * UnM8 * IRD3, IRD4, IRD5 * UnC4. |

# Lesson 4

**Core concept**: probability can be represented from zero to one.

## Daily number sense – 10 minutes

1. From a class need surfaced through formative assessment data, identify a short, focused activity that targets students’ knowledge, understanding and skills. Example activities may be drawn from the following resources:

* [Mathematics K–6 resources](https://education.nsw.gov.au/teaching-and-learning/curriculum/mathematics/mathematics-curriculum-resources-k-12/mathematics-k-6-resources)
* [Universal Resources Hub](https://resources.education.nsw.gov.au/home).

## Core lesson 1 – probabilities add to one – 40 minutes

The table below contains suggested learning intentions and success criteria. These are best co-constructed with students.

|  |  |
| --- | --- |
| Core concept learning intentions | Core concept success criteria |
| Students are learning to:   * list outcomes of chance experiments involving equally likely outcomes and represent probabilities * compare observed frequencies of outcomes with expected results. | Students can:   * establish that the total of the probabilities of the outcomes of a chance experiment equals one * distinguish between the frequency and the probability of an outcome. |

1. Revise the class anchor chart made in previous lessons.
2. Display [Resource 8 – probability scales](#_Resource_8_–).
3. Discuss each fraction strip to establish that the total probabilities of the outcomes of a chance experiment equals one.
4. Draw the 3 different spinners shown in Figure 6 on the whiteboard.

Figure 6 – different spinners

Three different spinners drawn on a whiteboard. 

The first spinner is divided into 4 even sections with one labelled ‘one-quarter’. 

The second spinner is divided into 3 sections: one-half and 2 quarters. The half is labelled with 0.5. 

The last spinner is divided into 5 sections of varying sizes. One is labelled 10% and another is labelled 30%.

1. Pose the following: Each spinner represents all the possible outcomes of a spin. How can you show that the total of the probabilities of the outcomes of a chance experiment equals one?
2. Students [Think-Pair-Share](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/645) before providing responses using addition of fractional parts, the complement principle or the subtraction of unit fractions.
3. Remind students of the game ‘Greedy Goat’ played in previous lessons. Ask the following questions:

* What is the probability of scoring zero by rolling a one? (One-tenth or 10%)
* What is the probability of scoring by rolling anything other than one? (Nine-tenths or 90%)
* How can you represent that probability as a fraction strip and on a probability scale? (see Figure 7)

Figure 7 – ‘Greedy Goat’ probability

A 10-sided die showing the faces 8, 9, 10. To the right is a 2 by 5 array showing the numbers 1 to 10 as if they were the faces of the dice. 

Underneath the array is a fraction strip with 9/10 shaded blue and labelled using fractional notation. The remaining 1/10 is shaded orange and labelled with fractional notation. 

Underneath the fraction strip is a line, 9/10 of which is blue and 1/10 of which is orange. The blue section is labelled ‘Score’ and the orange section is labelled ‘Lose’. 

Underneath the blue and orange line is a red probability scale from zero to 1, marked in tenths with the marker 9/10 labelled using fractional notation. Underneath the 0 is labelled ‘Impossible’. Underneath the 1 is labelled ‘Certain’.


1. Explain that the chance of scoring points and the chance of scoring zero in a round add to one.
2. Display and review the class list of modifications made to ‘Greedy Goat’ in [Lesson 2](#_Lesson_2).
3. In pairs, students select 3 modifications to ‘Greedy Goat’ and represent the probability of scoring zero in a round in the modified game (see Figure 8).

Figure 8 – modified rules example

A series of images to represent modified rules to the game ‘Greedy Goat’. 

The first image is labelled ‘Change 1’ and states you are out if you roll a 1 or a 10. Under that is a 2 by 5 array, a fraction strip and probability scale, all coloured to show that you have 2 out of 10 chances of getting out and 8 out of 10 chances of getting a score.

The second image is labelled ‘Change 2’ and states you are out if you roll a 6 on a 6-sided dice. Under that statement is an image of a 6-sided die, a 2 by 3 array, a fraction strip and a probability scale. The array, the fraction strip and probability scale are all labelled to show that you have a 1 in 6 chance of getting out and a 5 in 6 chance of getting a score.

The third image is labelled ‘Change 3’ and states you can double the score on any even roll. Under that statement is a 2 by 5 array, a fraction strip and a probability scale each of which is shaded to show that you have a 1 in 10 chance of getting out and a 9 in 10 chance of getting a score.

The table below outlines stimulus prompts to generate conversation about the topic, along with anticipated responses from students.

|  |  |
| --- | --- |
| Prompts | Anticipated student responses |
| * Do the probabilities of all the outcomes still add to one in the modified game? | * Change 1 – yes; 20% + 80% = 100%. * Change 2 – yes; + = 1 * Change 3 – yes, 10% + 90% = 100% |
| * Did the changes in the rules change the probabilities of scoring zero in a round? Explain why or why not? | * Change 1 – there is now a 20% chance of scoring zero in a round That is twice as likely as the original game of 10%. * Change 2 – there is now a probability of scoring zero in a round. That is a higher chance than probability from the original game. * Change 3 – the chance of scoring zero in a round is still the same. |
| * Would the change in the rules change the way you play? Why or why not? | * Answers will vary depending on students' attitude to winning or losing. * Change 1 – there is now a higher chance of scoring zero in a round so I would probably stop sooner than take my chances. * Change 2 – there is now a higher chance of scoring zero in a round, but the other player has the same rules so I will play the same way. * Change 3 – the chance of scoring zero in a round is still the same but I can get double points on even rolls so I am likely to take more rolls. |

## Core lesson 2 – data tables – 15 minutes

1. Students select a different modified game of ‘Greedy Goat’ than played previously.
2. Students record the rule changes and represent the probability of scoring zero in a particular round on a probability scale.
3. Students collect dice roll data from several games, choosing how to represent the data they collect.
4. Students consider if the collected data matches the expected probability of the modified game, and record their observations (see Figure 2).

This table details opportunities for differentiation.

|  |  |
| --- | --- |
| Too hard? | Too easy? |
| Students cannot establish that the total of the probabilities of the outcomes of a chance experiment equals one and/or tabulate collected data.   * Provide students with up to 4 identical strips of paper. Label one of the strips with the numeral 1. Fold and label the others with benchmark partitions of halves, quarters and tenths respectively using fractions, decimals and percentages. * Provide students with a large data table, for example A3 paper. Students use counters to track the rolls of the die during the game as a dot plot. Record the completed table using a digital device. | Students can establish that the total of the probabilities of the outcomes of a chance experiment equals one and tabulate collected data.   * Students learn the rules for the card game by viewing [The King’s Tax Maths Game (4:00)](https://www.youtube.com/watch?v=kAcBuOXiLwk). Provide students with a pack of playing cards. After playing a few rounds, students represent the chances of drawing a score card, doubling their score or being taxed (Russo 2020). * Provide students with playing cards. Pose the following: Using a small deck of cards, you have a chance of choosing a picture card and a 50% chance of drawing an even number. What might the cards in the deck be? (Sullivan and Lilburn 2017) |

## Discuss and connect the mathematics – 10 minutes

1. Select students to share the expected probability of scoring zero in a round of the modified game and the results of the games that they played. Ask the following questions:

* What differences or similarities did you notice between the probability and data?
* Did anyone have different data for the same game rules?
* What might happen to the data if you played 100 more games using the same rules?

This table details opportunities for assessment.

|  |  |
| --- | --- |
| Assessment opportunities | Links |
| What to look for:   * Can students establish that the total of the probabilities of the outcomes of a chance experiment equals one?  **[MAO-WM-01, MA3-CHAN-01]** * Can students distinguish between the frequency and the probability of an outcome? **[MAO-WM-01, MA3-CHAN-01]** | Links to [National Numeracy Learning Progressions](https://www.australiancurriculum.edu.au/resources/national-literacy-and-numeracy-learning-progressions/version-3-of-national-literacy-and-numeracy-learning-progressions/) (NNLP):   * UnC2, UnC3, UnC4. |

# Lesson 5

**Core concept**: data can help conceptualise events and history.

## Daily number sense – more and less – 10 minutes

Daily number sense activities for Lessons 5 to 7 ‘loop’ back to concepts and procedures covered in previous units to assist students to build an increasingly connected network of ideas. These concepts may differ from the core concepts being covered by the unit.

The table below contains a suggested learning intention and success criteria. These are best co-constructed with students.

|  |  |
| --- | --- |
| Daily number sense learning intention | Daily number sense success criteria |
| Students are learning to:   * recognise that the place value system can be extended beyond hundredths. | Students can:   * express thousandths as decimals * indicate the place value of digits in decimal numbers of up to 3 decimal places. |

1. Write the number 4.329 on the whiteboard.
2. Students [turn and talk](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/teaching-and-learning-resources/numeracy/talk-moves) to a partner to identify and record the value of each of the digits in the number. For example, the 4 has a value of 4 ones, the 3 has value of 3 thousandths, the 2 has a value of 2 hundredths and the 9 has value of 9 tenths.
3. Ask the students to identify and record the number one thousandth larger. Discuss strategies used to complete this task.
4. Ask the students to identify and record the number one thousandth smaller. Discuss strategies used to complete this task.
5. Display and read [Resource 9 – more and less](#_Resource_9_–).
6. Discuss the thousandth that comes before and after one. If needed, model how to record one as 1.000.
7. Students write the number one thousandth smaller and one thousandth larger than each displayed decimal number.
8. Select students to say a chosen decimal number aloud and identify the ones, tenths, hundredths and thousandths. Ask the following questions:

* Which of the decimals on this page is the largest? How do you know?
* Which of the decimals on this page is the smallest? How do you know?
* Which of the decimals on this page is closest to a whole number? Explain how you know.

This table details opportunities for assessment.

|  |  |
| --- | --- |
| Assessment opportunities | Links |
| What to look for:   * Can students express thousandths as decimals? **[MAO-WM-01, MA3-RN-02]** * Can students indicate the place value of digits in decimal numbers of up to 3 decimal places? **[MAO-WM-01, MA3-RN-02]** | Links to [National Numeracy Learning Progressions](https://www.australiancurriculum.edu.au/resources/national-literacy-and-numeracy-learning-progressions/version-3-of-national-literacy-and-numeracy-learning-progressions/) (NNLP):   * NPV7, NPV8.   Links to suggested [Interview for Student Reasoning](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/assessment-resources/ifsr) (IfSR) tasks:   * IfSR-NP: 4D.2. |

## Core lesson 1 – interpreting timelines – 25 minutes

The table below contains suggested learning intentions and success criteria. These are best co-constructed with students.

|  |  |
| --- | --- |
| Core concept learning intentions | Core concept success criteria |
| Students are learning to:   * choose and use appropriate tables and graphs * interpret and compare a range of data displays. | Students can:   * recognise which types of data display are appropriate to represent data * draw an accurate timeline using an appropriate scale * interpret data on a timeline using the given scale. |

**Note:** to ensure the scale is correct, print [Resource 10 – mobile phone timeline](#_Resource_10_–) on A4 size paper and do not resize.

1. Provide each student with a copy of [Resource 10 – mobile phone timeline](#_Resource_10_–). Ask the following questions:

* What information is being represented?
* What do you notice?
* What can we learn from this data?
* What is this type of data representation called?

1. Explain that a timeline is a representation of events listed in chronological order. To make the timeline accurate, a many-to-one scale is used. For example, on [Resource 10 – mobile phone timeline](#_Resource_10_–), the scale of 1 cm = 2 years is used.
2. Students [turn and talk](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/teaching-and-learning-resources/numeracy/talk-moves) with a partner to discuss the following questions. Ask:

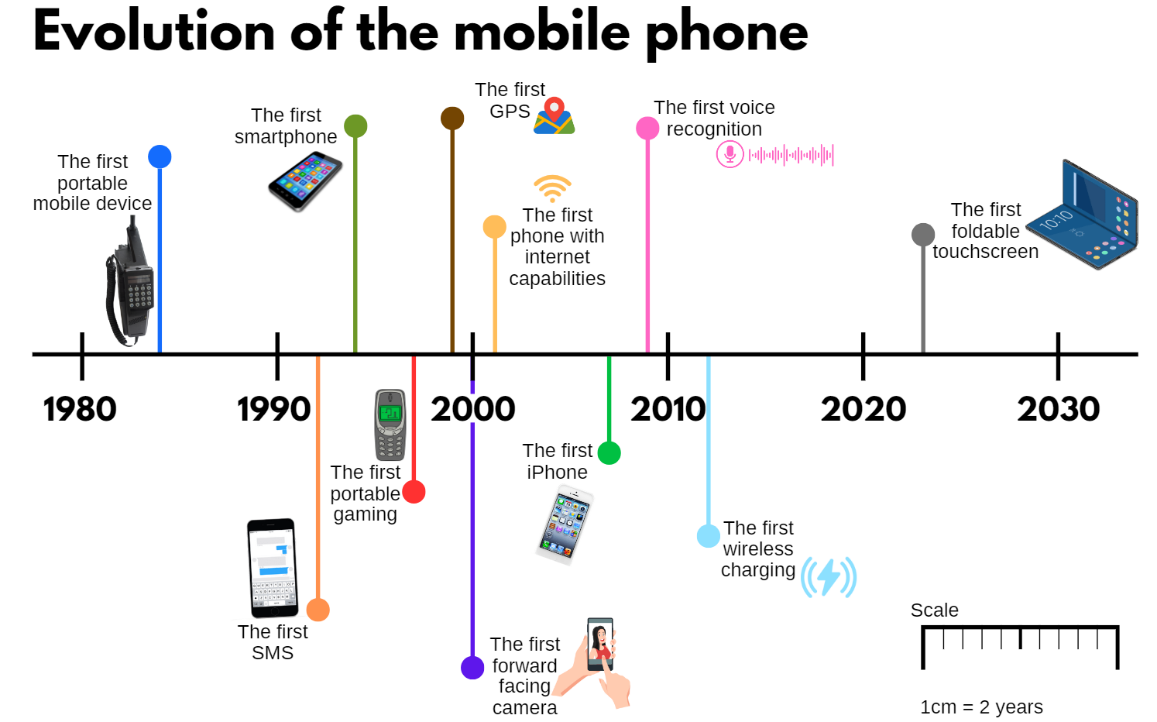
* How can the date of an event be determined if there is no year or date labelled?
* How would you determine 5 years on the mobile phone timeline?
* How would you determine 20 years on the mobile phone timeline?

1. Provide students with rulers and use the scale to mark out yearly increments along [Resource 10 – mobile phone timeline](#_Resource_10_–).
2. Display the following information for students to calculate and record the missing events on the timeline using the given scale:

* 1994 – the first smartphone
* 1992 – the first SMS
* 1999 – the first GPS
* 2000 – the first forward-facing camera
* 2009 – the first voice recognition
* 2012 – the first wireless charging.

1. Students compare their completed timeline with a partner (see Figure 9).

Figure 9 – completed timeline



1. Ask students the following questions:

* In what year did the first portable mobile device become available?
* When was it first possible to play games on a mobile device?
* Which decade has seen the most changes to mobile phones?
* How many years after the first portable mobile device became available was the first iPhone released?
* How many years after the first portable mobile device was available, did mobile phones begin using GPS?
* How many years before the first foldable touchscreen phone was a regular touchscreen mobile phone available?
* How many years would be represented by a section of the timeline that was 10 cm in length?
* How many years would be represented by a section of the timeline that was 7 cm in length? 11.5 cm?

**Note:** the touchscreen capability was a feature of the first smartphone.

## Core lesson 2 – creating timelines – 40 minutes

1. Explain that students will be creating a scaled timeline for an area of interest. Suggested topics include: popular toys, video games, movies, film or book franchises, well-known brands, sporting teams, famous musicians, characters from films or TV shows and so on.
2. Students research their chosen area of interest, identifying at least 5 major events.
3. Remind students that on a scaled timeline, the intervals may be marked evenly, but events are placed using the scale according to time elapsed between events. The main purpose is to communicate time-related information.
4. Students determine a scale that would be appropriate for their timeline.
5. Ensure students understand that the important part of the timeline is the line and scaled markings. Decorations can be added later if time permits.
6. Using rulers, students draw their timeline in their workbooks, adding at least 5 major events and a scale.
7. Once completed, students [turn and talk](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/teaching-and-learning-resources/numeracy/talk-moves) to compare their timeline with a partner. Discuss the following:

* How are your timelines similar?
* How are your timelines different?
* Was your scale appropriate? Did you need to adjust your scale for any reason?
* What did you learn about your chosen area of interest?

This table details opportunities for differentiation.

|  |  |
| --- | --- |
| Too hard? | Too easy? |
| Students cannot draw an accurate timeline using an appropriate scale.   * Provide students with a timeline with the intervals already marked. * Support students by reducing the number of events added to their timeline. | Students can draw an accurate timeline using an appropriate scale.   * Encourage students to use a digital application to create or design a timeline. Does this make it easier or harder to create a timeline? What tips would you give someone using this application to create a timeline for the first time? * Challenge students to add more events to the timeline they created on an area of interest. |

## Discuss and connect the mathematics – 5 minutes

1. Students look at the 2 timelines they have used or created this lesson. Ask the following questions:

* Was a timeline the best way to display this data? Why or why not?
* Would a column graph be an appropriate way to display this data? Why or why not?
* What impacts the scale used in each timeline?
* What can be challenging when interpreting a timeline with a scale?

This table details opportunities for assessment.

|  |  |
| --- | --- |
| Assessment opportunities | Links |
| What to look for:   * Can students recognise which types of data display are appropriate to represent data? **[MAO-WM-01, MA3-DATA-01]** * Can students draw an accurate timeline using an appropriate scale? **[MAO-WM-01, MA3-DATA-01]** * Can students interpret data on a timeline using the given scale? **[MAO-WM-01, MA3-DATA-02]** | Links to [National Numeracy Learning Progressions](https://www.australiancurriculum.edu.au/resources/national-literacy-and-numeracy-learning-progressions/version-3-of-national-literacy-and-numeracy-learning-progressions/) (NNLP):   * MeT4 * IRD4. |

# Lesson 6

**Core concept**: data is represented in different ways for different purposes.

## Daily number sense – making thousandths – 10 minutes

The table below contains a suggested learning intention and success criteria. These are best co-constructed with students.

|  |  |
| --- | --- |
| Daily number sense learning intention | Daily number sense success criteria |
| Students are learning to:   * recognise that the place value system can be extended beyond hundredths. | Students can:   * express thousandths as decimals * indicate the place value of digits in decimal numbers of up to 3 decimal places. |

1. Display [Resource 11 – ascending order](#_Resource_11_–).
2. Instruct students to make a list of decimals in ascending value using the numerals 0, 4 and 6 after then decimal point. Each numeral must be used and can only be used once. For example, the smallest decimal is 0.046 and the largest decimal is 0.640.

**Note:** the role of zero as a place holder assists in understanding how we say and write decimals. The number 0.2 has the same value as 0.20 and the number 2 has the same value as 2.0. In measurement, zeros at the end of a decimal have a different meaning as they are used to record precision. For example, a measurement recorded as 0.2 seconds is measured in tenths of a second whereas a measurement recorded as 0.20 seconds is measured in hundredths of a second.

1. Select students to share and explain solutions, referring to the place value of digits. Ask the following questions:

* How do you know your numbers are in ascending order?
* What strategy is most helpful?
* How did you check your solutions?
* If a digit was repeated, such as 0, 4 and 4, would the task be easier or more difficult?

1. For an additional challenge, invite students to use the digits 6, 4, 0, 0 and write all the decimal numbers in ascending order from 0.046 to 6.400.

This table details opportunities for assessment.

|  |  |
| --- | --- |
| Assessment opportunities | Links |
| What to look for:   * Can students express thousandths as decimals?  **[MAO-WM-01, MA3-RN-02]** * Can students indicate the place value of digits in decimal numbers of up to 3 decimal places? **[MAO-WM-01, MA3-RN-02]** | Links to [National Numeracy Learning Progressions](https://www.australiancurriculum.edu.au/resources/national-literacy-and-numeracy-learning-progressions/version-3-of-national-literacy-and-numeracy-learning-progressions/) (NNLP):   * NPV7, NPV8.   Links to suggested [Interview for Student Reasoning](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/assessment-resources/ifsr) (IfSR) tasks:   * IfSR-NP: 4D.2, 4D.6. |

## Core lesson – new park investigation 1 – 45 minutes

The table below contains a suggested learning intention and success criteria. These are best co-constructed with students.

|  |  |
| --- | --- |
| Core concept learning intention | Core concept success criteria |
| Students are learning to:   * collect categorical and discrete numerical data by observation or survey. | Students can:   * pose and refine questions to construct a survey to obtain categorical or discrete numerical data about a matter of interest * collect categorical data, and discrete numerical data through observation or by conducting surveys. |

**Note:** this activity is designed to be completed over [Lesson 6](#_Lesson_6) and [Lesson 7](#_Lesson_7) of this unit. Students will be following the data cycle to pose questions, collect data, represent the data in several ways and then interpret, analyse and draw conclusions from the data. While this activity has been written to follow the premise of building a new local park, it could be changed to suit the school or class situation while still following the same sequence. Students are given the option of designing survey questions for parents. If students select this option, the survey could be administered through electronic distribution, by inviting community members into the classroom or surveying other teachers at school.

1. Display [Resource 12 – data cycle](#_Resource_12_–). Explain the different components of the data cycle: posing questions, collecting data, representing data and interpreting data.
2. Pose the following scenario: The local council has approached the school. They would like to build a new park near to the school and want it to be a popular park that kids and adults would use.
3. Explain that the council has developed the following survey questions:

* What types of plants should be included in the park?
* How many times a week do you go to the park with your family?

1. Students [turn and talk](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/teaching-and-learning-resources/numeracy/talk-moves) to discuss and record their responses to the survey questions on whiteboards.
2. Regroup as a class and select students to share their responses.
3. Record student responses on the board underneath each survey question. Ask the following:

* Which of the survey questions had a wider range of responses? Why?
* How could the data about the plants be categorised? (Trees, cacti, flowers, herbs)
* Would the data collected from these survey questions be helpful for the council? How?
* Would they need to collect other data to help them plan the new park?

1. Explain that 2 different types of data were collected with the survey questions asked by the council. The question about plants collected categorical data. The question about visiting the park with the family collected discrete numerical data. Share the definition of categorical and discrete numerical data with students.

**Categorical data**: data that can be separated into distinct groups. For example, colour, gender, blood type.

**Discrete numerical data**: describes items or events that can only be counted in whole number values, where values in between the whole numbers cannot be found or labelled in the data display. For example, the number of children in a family.

**Note**: students in Stage 3 should develop an understanding of discrete numerical data and categorical data so that they are able to pose and refine questions accordingly. They are not expected to classify or describe data as numerical or categorical; this is an expectation of Stage 4 students.

1. Explain to students that the council would like their assistance with developing other survey questions to help them with their park planning. Display and read [Resource 13 – council survey criteria](#_Resource_13_–). Explain that the recording form can be paper-based or digital.
2. Provide small groups of students with writing materials, paper and [Resource 13 – council survey criteria](#_Resource_13_–). Students brainstorm possible survey questions and create a draft of their recording form.
3. Each group shares their questions and recording form with another group. Students give feedback according to [Resource 13 – council survey criteria](#_Resource_13_–) and refine their survey questions based on feedback received.
4. Groups transfer their survey questions onto paper or into a digital format such as [Microsoft Forms](https://app.education.nsw.gov.au/digital-learning-selector/LearningTool/Card/108) or [Google Forms](https://app.education.nsw.gov.au/digital-learning-selector/LearningTool/Card/89). Each student in the class completes the surveys created. If students have designed a survey for parents, they may choose to survey available staff members.

**Note**: if students choose to create their survey on paper, discuss survey collection methods with the class prior to Step 15. Students may wish to consider how they will keep track of who has been surveyed and how they will collate their data accurately.

1. Groups collect and view their survey data.
2. Each group shares their data with another group for peer feedback using the ‘[Two stars and a wish’ strategy](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/549), which can be recorded on an individual whiteboard (see Figure 10). Groups identify 2 things they liked about the survey and one thing they would like to change.

Figure 10 – two stars and a wish



1. Students read feedback and refine their questions further, if required.
2. Regroup as a class. Ask the following questions:

* Does the data collected help the council with their park planning?
* Which survey questions would be the most helpful for the council? Why?
* Has there been enough data collected for the council to design their park? How do you know?
* If more data needs to be collected, what other questions should the council ask?

This table details opportunities for differentiation.

|  |  |
| --- | --- |
| Too hard? | Too easy? |
| Students cannot pose and refine questions to construct a survey to obtain categorical or discrete numerical data about a matter of interest.   * Support students by providing a bank of questions to choose from. * Brainstorm questions as a class or small group, discussing what makes some questions better for this activity than others. | Students can pose and refine questions to construct a survey to obtain categorical or discrete numerical data about a matter of interest.   * Create a second survey with questions about a different school or community issue, such as canteen food, school or community garden, excursion ideas and so on. * Students administer their survey across multiple classes or cohorts in the school and present a summary of the data to the class. |

## Discuss and connect the mathematics – 5 minutes

1. Display [Resource 12 – data cycle](#_Resource_12_–) and discuss the data cycle and investigation so far. Prompts could include:

* What part of the cycle have we completed so far?
* Was there anything you found challenging during these parts of the cycle?
* What do you think the next part of the cycle will look like for this investigation?
* Is there anything in the next part of the data cycle that you are or are not looking forward to doing? Why or why not?

This table details opportunities for assessment.

|  |  |
| --- | --- |
| Assessment opportunities | Links |
| What to look for:   * Can students pose and refine questions to construct a survey to obtain categorical or discrete numerical data about a matter of interest? **[MAO-WM-01, MA3-DATA-01]** * Can students collect categorical data, and discrete numerical data through observation or by conducting surveys?  **[MAO-WM-01, MA3-DATA-01]** | Links to [National Numeracy Learning Progressions](https://www.australiancurriculum.edu.au/resources/national-literacy-and-numeracy-learning-progressions/version-3-of-national-literacy-and-numeracy-learning-progressions/) (NNLP):   * IRD3, IRD4, IRD5. |

# Lesson 7

**Core concept**: data is represented in different ways for different purposes.

## Daily number sense – missing decimal numbers – 10 minutes

The table below contains a suggested learning intention and success criteria. These are best co-constructed with students.

|  |  |
| --- | --- |
| Daily number sense learning intention | Daily number sense success criteria |
| Students are learning to:   * recognise that the place value system can be extended beyond hundredths * make connections between benchmark fractions, decimals and percentages. | Students can:   * indicate the place value of digits in decimal numbers of up to 3 decimal places * recall commonly used equivalent percentages, decimals and fractions including , , and . |

1. Display [Resource 14 – What’s missing?](#_Resource_14_–)
2. Explain that the labelled sticky notes fell off the number line and need to be placed back on in order.
3. Draw attention to the percentages on some sticky notes. Students [turn and talk](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/teaching-and-learning-resources/numeracy/talk-moves) to identify where 90% would be placed on the number line. Select students to explain their answer and reasoning.
4. Provide students with writing materials to draw the number line and place the sticky notes in the correct position.
5. Instruct students to read the number aloud as they place it on the number line. Remind students that the decimal 0.918 is read as ‘nine hundred and eighteen thousandths’, not ‘zero point nine one eight’.
6. Students [turn and talk](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/teaching-and-learning-resources/numeracy/talk-moves) with a partner to share strategies and their solution. Ask the following questions:

* Can you identify the place value for each of the digits in a chosen number, for example, 0.901?
* How can you check that you have placed the numbers in the correct order along the number line?
* Did you think differently to place the fractions and percentages?
* Did you place all the sticky notes? Why or why not?

This table details opportunities for assessment.

|  |  |
| --- | --- |
| Assessment opportunities | Links |
| What to look for:   * Can students indicate the place value of digits in decimal numbers of up to 3 decimal places? **[MAO-WM-01, MA3-RN-02]** * Can students recall commonly used equivalent percentages, decimals and fractions including , , and ?  **[MAO-WM-01, MA3-RN-03]** | Links to [National Numeracy Learning Progressions](https://www.australiancurriculum.edu.au/resources/national-literacy-and-numeracy-learning-progressions/version-3-of-national-literacy-and-numeracy-learning-progressions/) (NNLP):   * NPV7, NPV8 * PrT2 * UnM8.   Links to suggested [Interview for Student Reasoning](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/assessment-resources/ifsr) (IfSR) tasks:   * IfSR-NP: 4D.2, 4D.6. |

## Core lesson – new park investigation 2 – 40 minutes

The table below contains suggested learning intentions and success criteria. These are best co-constructed with students.

|  |  |
| --- | --- |
| Core concept learning intentions | Core concept success criteria |
| Students are learning to:   * choose and use appropriate tables and graphs * describe and interpret different datasets in context. | Students can:   * recognise which types of data display are appropriate to represent data * determine an appropriate scale (horizontal and vertical) to represent the data * construct column graphs using a many-to-one scale, with and without the use of digital technologies * determine the total number of data values represented in column graphs. |

**Note:** this activity is designed to be completed over [Lesson 6](#_Lesson_6) and [Lesson 7](#_Lesson_7) of this unit. Students will be following the data cycle to pose questions, collect data, represent the data in several ways and then interpret, analyse and draw conclusions from the data. While this activity has been written to follow the premise of building a new local park, it could be changed to suit the school or class situation while still following the same sequence.

1. Display [Resource 12 – data cycle](#_Resource_12_–). Remind students about the parts of the cycle they will be completing during this lesson.
2. Brainstorm the different ways data can be displayed.
3. Discuss the best way to display different types of data and which of these would be the best way to represent their data, including:

* picture graphs and dot plots – used to show a small number of data values, with one-to-one correspondence
* column graphs – used to display categorical or discrete numerical data
* line graphs – used to display continuous data.

1. Students examine the data they collected during [Lesson 6](#_Lesson_6) and determine which representation would be the most appropriate (column graph).

**Note:** a scale of many-to-one correspondence in a column graph or line graph means that one unit is used to represent more than one of what is being counted or measured. For example, 1 cm on the vertical axis could be used to represent 20 cm of body height.

Stage 3 students are only expected to create a column graph. For this activity, ensure students select a data set that is an appropriate use of a column graph as a data display.

1. Students choose one of their datasets to represent using a many-to-one scale column graph.
2. Remind students that a many-to-one column graph must include a title, axes names and labels and a scale.

**Note:** the following steps describe how to use a digital platform to construct a many-to-one column graph, however students could also construct the graph manually on paper or in their workbook.

1. Demonstrate in Microsoft Excel or Google Sheets how to create a many-to-one column graph. Students:
2. Open Microsoft Excel or Google Sheets on a device.
3. Open a blank spreadsheet.
4. Enter the category and observed frequency in columns A and B, such as equipment and number of students.
5. Highlight the dataset include the headings.
6. Use the top ribbon to select **Insert** and **Column chart**.
7. Add a graph title.
8. Edit the axis names and labels as needed.
9. Students [turn and talk](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/teaching-and-learning-resources/numeracy/talk-moves) with a partner to discuss and compare their graphs.
10. Ask students to identify:

* What is similar about their graphs?
* What is different about their graphs?
* What is the scale on your y-axis?
* How many people were surveyed to obtain the data for the data display? How do you know?
* Why is a scale of one not used for this data display?
* Would these datasets work using a line graph or timeline? Why or why not?

This table details opportunities for differentiation.

|  |  |
| --- | --- |
| Too hard? | Too easy? |
| Students cannot construct column graphs using a many-to-one scale, with and without the use of digital technologies.   * Reduce the size of the dataset students are expected to graph. * Determine the many-to-one scale for students to use. | Students can construct column graphs using a many-to-one scale, with and without the use of digital technologies.   * Students use the same dataset to create a horizontal column graph. Does this affect the way you read the graph? * Students recreate their graph using a different scale. Discuss with a classmate how the scale impacts the interpretation of the data and the conclusions drawn from the graph. |

## Discuss and connect the mathematics – 10 minutes

1. Display [Resource 15 – best data representation](#_Resource_15_–). Ask the following questions:

* What do you notice about these data displays?
* What types of data displays can you observe here?
* How many people were surveyed to obtain the data for the data display? How do you know?
* Which data display is the most appropriate to represent the data collected? Why?

This table details opportunities for assessment.

|  |  |
| --- | --- |
| Assessment opportunities | Links |
| What to look for:   * Can students recognise which types of data display are appropriate to represent data?  **[MAO-WM-01, MA3-DATA-01, MA3-DATA-02]** * Can students determine an appropriate scale (horizontal and vertical) to represent the data?  **[MAO-WM-01, MA3-DATA-01, MA3-DATA-02]** * Can students construct column graphs using a many-to-one scale, with and without the use of digital technologies?  **[MAO-WM-01, MA3-DATA-01]** * Can students determine the total number of data values represented in column graphs? **[MAO-WM-01, MA3-DATA-02]** | Links to [National Numeracy Learning Progressions](https://www.australiancurriculum.edu.au/resources/national-literacy-and-numeracy-learning-progressions/version-3-of-national-literacy-and-numeracy-learning-progressions/) (NNLP):   * IRD3, IRD4, IRD5. |

# Lesson 8

**Core concept**: statistical reasoning helps mathematicians interpret and make inferences about real-world data.

## Daily number sense – 10 minutes

1. From a class need surfaced through formative assessment data, identify a short, focused activity that targets students’ knowledge, understanding and skills. Example activities may be drawn from the following resources:

* [Mathematics K–6 resources](https://education.nsw.gov.au/teaching-and-learning/curriculum/mathematics/mathematics-curriculum-resources-k-12/mathematics-k-6-resources)
* [Universal Resources Hub](https://resources.education.nsw.gov.au/home).

## Core lesson 1 – differing datasets – 20 minutes

The table below contains suggested learning intentions and success criteria. These are best co-constructed with students.

|  |  |
| --- | --- |
| Core concept learning intentions | Core concept success criteria |
| Students are learning to:   * describe and interpret different datasets in context * interpret data presented in digital media and elsewhere. | Students can:   * describe and interpret data presented in tables, column graphs and line graphs * interpret data representations found in digital media and in factual texts * identify sources of possible bias in representations of data in the media * identify misleading representations of data in the media. |

This lesson uses resources adapted from the [Australian Bureau of Statistics](https://www.abs.gov.au/). To provide a context for the language and cultural diversity in your class, including indigenous languages, review cultural diversity data available on the [SBS Australian Census Explorer](https://www.sbs.com.au/news/creative/census-explorer/xtjxeqygs?lang=en&placeType=australia&places=australia&topic=cultural-diversity).

1. Display and read [Resource 16 – languages data](#_Resource_16_–). Explain that all information comes from the Australian Bureau of Statistics.
2. Students [Think-Pair-Share](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/645) to respond to:

* What are 3 things that are the same about the data displays?
* What are 3 things that are different about the data displays?
* Why might the ABS have chosen to present the data in these ways?
* Which display did you find easiest or most difficult to interpret? Why?
* Write a mathematical statement such as ‘In data display B there is no mention of German and Greek’ or ‘In data display A the year is not acknowledged’ for each of the displays.

1. Select students to share their responses with the class.
2. Display [Resource 17 – languages line graph](#_Resource_17_–).
3. Explain that this is data from 1991 to 2021. Ask the following questions:

* Why have some languages declined over this period of time?
* Why have some languages increased over this period of time?
* What might the graphs show in 2026? Explain your reasoning.

**Note:** there are no right or wrong answers for these questions. Students must use the information from the data sources to justify their responses.

This table details opportunities for differentiation.

|  |  |
| --- | --- |
| Too hard? | Too easy? |
| Students cannot describe and interpret data presented in tables, column graphs and line graphs.   * Support students to describe and interpret data from one or 2 of the sources in [Resource 16 – language data](#_Resource_16_–). | Students can describe and interpret data presented in tables, column graphs and line graphs.   * Use the data from [Resource 17 – language line graph](#_Resource_17_–) to make a side-by-side column graph using a digital device. Ask students to identify the strengths and limitations of each type of graph. |

## Core lesson 2 – biased and misleading data – 20 minutes

This activity is an adaptation of [How to spot a misleading graph](https://ed.ted.com/lessons/how-to-spot-a-misleading-graph-lea-gaslowitz) on [TED-Ed](http://ed.ted.com/) by Gaslowitz.

1. View the video [[How to spot a misleading graph (4:09)](https://ed.ted.com/lessons/how-to-spot-a-misleading-graph-lea-gaslowitz)](https://ed.ted.com/lessons/how-to-spot-a-misleading-graph-lea-gaslowitz).
2. Students [Think-Pair-Share](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/645) the strategies they noticed that were used to mislead people. Ensure students identify the manipulation of the data display labels, numbering, scale and context as the main ways data displays can be used to mislead.
3. Display [Resource 18 – data display 1](#_Resource_18_–). Ask the following questions:

* How could the data display be misleading?
* Which strategies could be used to make it misleading?
* Why might people want to make a display misleading?
* If you were going to explain to a younger student how data displays could be made to be misleading, what would you tell them?

1. In pairs, ask students to identify the ways the data display has been manipulated.
2. Select students to report back to the class, using examples from the data display to justify their choices (see Figure 11).

Figure 11 – student work examples

This is a student work example of how data displays can be manipulated.

There is a column graph of the Cool Cola Company and the amount of kilograms of waste created and recycled. Two students are displayed.

The first student has a speech bubble that reads ‘I wonder why the Cool Cola company has left some years off the data display?’

The second student has a speech bubble that reads ‘I wonder why they chose to start at 1.5 million?’

There is an arrow pointing to each of the students’ speech bubbles and is labelled ‘Context’. 

There is a second arrow pointing at the numbers down the y-axis and is labelled ‘Scale’. 

There is a third arrow pointing to the first number on the y-axis and is labelled ‘Numbering’. 

Finally, there is a fourth arrow pointing to the labels across the bottom of the x-axis and is labelled ‘Labels’.

1. Display [Resource 19 – data display 2](#_Resource_19_–) to discuss and highlight the features of the accurate data display and contrast with the misleading data display shown in [Resource 18 – data display 1](#_Resource_18_–).

This table details opportunities for differentiation.

|  |  |
| --- | --- |
| Too hard? | Too easy? |
| Students cannot identify misleading representations of data in the media.   * Explain the strategy used to mislead for each display and have students identify evidence where the strategy has been used on the data display. * View [BTN – World Statistics Day (4:20)](https://www.abc.net.au/btn/classroom/world-statistics-day/12769384). Students identify the different ways data can be manipulated. Pause the clip at each new data set to identify the way it is being used to mislead. | Students can identify misleading representations of data in the media.   * Students create a poster or digital resource to support other students to identify the ways data can be used to mislead. * Challenge students to design a data display with at least one misleading element. Students show the data display to a classmate and ask them to identify the misleading element(s). |

## Discuss and connect the mathematics – 20 minutes

1. Divide the class into 2 teams – Team Cool Cola and Team Super Soda.
2. Within each team, students pair up and review [Resource 20 – data display 3](#_Resource_20_–).
3. Students cut a hole in an A4 piece of paper to place over the data display to ‘spotlight’ the portion that would show their team in a more favourable light than the other team (see Figure 12).

Figure 12 – examples of team spotlights

Two versions of a line graph are displayed. The graph represents the 2023 Drink sales for Super Soda and Cool Cola.

The top image shows a line graph and a student with a speech bubble that says ‘Cool Cola is far superior to Super Soda as our sales have climbed significantly each month’. 

The months of April, May, June and July has been highlighted by a hollow black square, indicating the upward trend on the graph.

The bottom image shows the same graph with a hollow rectangle highlighting the months of September, October and November, which indicates Super Soda having an upward trend during those months.

The student next to this image has a speech bubble that says ‘Super Soda is a far more impressive product as its sales jumped during the last few months of the year’.

1. Select pairs to indicate the portion of the data display they have chosen and justify how choosing that section shows their team to be part of a more successful company than the other team.

This table details opportunities for assessment.

|  |  |
| --- | --- |
| Assessment opportunities | Links |
| What to look for:   * Can students describe and interpret data presented in tables, column graphs and line graphs? **[MAO-WM-01, MA3-DATA-02]** * Can students interpret data representations found in digital media and in factual texts? **[MAO-WM-01, MA3-DATA-02]** * Can students identify sources of possible bias in representations of data in the media? **[MAO-WM-01, MA3-DATA-02]** * Can students identify misleading representations of data in the media? **[MAO-WM-01, MA3-DATA-02]** | Links to [National Numeracy Learning Progressions](https://www.australiancurriculum.edu.au/resources/national-literacy-and-numeracy-learning-progressions/version-3-of-national-literacy-and-numeracy-learning-progressions/) (NNLP):   * IRD3, IRD4, IRD6. |

# Resource 1 – integers

A horizontal number line labelled ‘A’ and a thermometer labelled ‘B’. 

The number line is labelled from minus 2 to 2, with −2, −1, 0, 1, and 2 annotated on the line. There are 2 question marks on either side of the annotated numbers. 

The thermometer shows the temperatures −20 through to 50 degrees centigrade with the current temperature indicated as 37° C. In the corner of the image is a student thinking.

# Resource 2 – chance representations

A poster titled ‘Chance representations’ comprised of 6 images with related text.

Image 1 shows a number line from 0 to 1, and is titled ‘Linear scale’. The text asks: How can a scale from 0 to 1 help me to describe chance? 
How can I think about partitioning this scale to represent equal and unequal chance? 

Image 2 shows a bag of counters, a die and a 4 part spinner, and is titled ‘Random generators’. The text asks:
How do different generators represent different possible outcomes?
How can they support our reasoning about chance? 
How can they support our language?

Image 3 shows 3 highlighters, and is titled ‘Colour coding’. The text asks:
How can colour coding help me visualise chance as parts of a whole? 
How can colour coding help me to understand if things are equally likely or unequally likely? 

Image 4 shows 2 different fraction strips and is titled ‘Fraction strips/wall’. The text asks:
How do fraction strips help me to think about chance as a part of the total possibilities?
How can they help me to understand that the same chance can look different? 

Image 5 shows a half, 0.75 and 25%, and is titled ‘Numerical representation’. The text asks:
How does expressing chance as a fraction, decimal or percentage help us to build a shared understanding? 
How does it change the language we use when describing chance? 

Image 6 shows a dot plot graph, and is titled ‘Dot plots’. The text asks:
How can dot plots help me to visualise the outcomes of chance situations? 
How can they be used to compare expected frequency and observed frequency?  

# Resource 3 – ‘Greedy Goat’

**Greedy Goat**

1. One person is in charge of rolling a 10-sided die.
2. For each round, the person rolls and calls out the number rolled.
3. Players record the number on their score chart and add the number to the sum of the previous rolls.
4. To save their score, players can decide to stop playing after each roll.
5. The round ends when either:

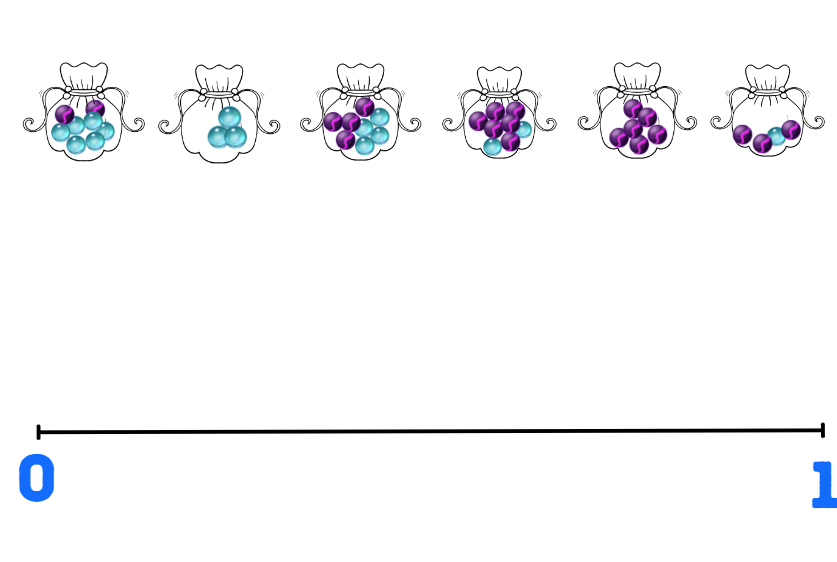
* all players have chosen to save their score
* a 1 is rolled, in which case any remaining players score zero for that round.

1. After 10 rounds, the player with the highest score is the Greedy Goat!

**Score chart**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Round | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Total score |
| Number(s) rolled |  |  |  |  |  |  |  |  |  |  |  |
| Running total |  |  |  |  |  |  |  |  |  |  |  |

# Resource 4 – investigating likelihood



# Resource 5 – missing integers

This resource has 4 separate images labelled ‘A’, ‘B’, ‘C’ and ‘D’. Image A shows a number line that is partially covered by a paper strip. Visible markings range from -7 to 0. The paper strip covers to the right of 0 and has a question mark on it. 

Image B shows a number line ranging from -11 to 11 with a paper strip covering the numbers from -7 to 7. The paper strip has a question mark on it. 

Image C is a vertical number line with the markings 0, 5 and -5 visible. The remainder of the number line has paper strips covering each side with question marks on them. 

Image D is a Cartesian plane showing 4 quadrants. the positive x-axis and the negative y-axis are not labelled and have question marks. 

# Resource 6 – data types

A multi-part resource that includes a flow diagram and a series of representations and descriptions of different data types. 

The flow diagram begins with a tile that says ‘collect data’. The diagram then splits into 2.  

On the left-hand side is a tile for continuous data, followed by a tile for numerical data and an image of a line graph. This element has a note to say that it is for Stage 3. 

The right-hand side of the flow chart begins with a tile that says ‘discrete’. Discrete is then separated into 2 more tiles called ‘numerical’ and ‘categorical’. Both of these are annotated to say that they are for Stage 2 and 3. The numerical tile is linked to an image of a column graph. 

The categorical tile is further split into tiles labelled ‘ordinal’ and ‘nominal’. Both of these data types are annotated to say that they are for Stage 3. Ordinal is linked to an image of a Likert scale. Nominal is linked to an image of 3 eyes of different colour.  

There are 7 additional elements to represent and describe different terms used in the syllabus. 

Variable - something measurable or observable that is expected to change either over time or between observations, such as hair colour. There is an image of different heads of hair – one blonde, one brunette. 

Numerical variable - variables that are numbers. Adding, subtracting or calculating an average makes sense such as the number of children in a family. There is an image of 3 babies. 

Discrete numerical data - describes items or events that can only be counted in whole number values, where number where values in between the whole numbers cannot be found or labelled in the data display such as the number of children in the family. There is an image of a column graph. 

Categorical data - describes the quality or characteristic of something. Values belong to exactly 1 category, such as blood type. There is an image of 4 blood bags with different blood type labels. 

Ordinal categorical data - categories can be ranked or ordered. The order is clear but not the distance between each position such as a feedback scale. There is an image of a Likert scale. 

Nominal data - no meaningful order between the categories such as eye colour. There is an image of 3 different coloured eyes – one blue, one green, one brown.  

Continuous numerical data - values between the whole numbers are meaningful and are labelled in the data display such as temperature 19.8° or fuel prices $1.78. There is an image of an unlabelled line graph with 2 variables. 

The resource has this note: 

Stage 2 teaching advice states that students are not expected to classify the type of data they are collecting. 


# Resource 7 – integers below zero

A line graph with text above reading: The submarine HMAS Collins has been in training. This line graph shows the depths of the submarine in the last week of training.

The graph has the sea level depths of 15 m to -30 m along the y-axis, and the days Monday to Friday marked along the x-axis. Within the graph there are images of a submarine indicating depths of 0m, -15m, -10m, -20m, -5m, -30m, -5m, -25m, -20m, -20m and 0m.

The path of the submarine is as follows. At the beginning of Monday it was at 0, then -15m then -10m. On Tuesday it went to -20 m, then -7m. On Wednesday it went to -30m and then up to -7m. On Thursday it went to -25m and then -20m. On Friday it stayed at -20m and then went up to 0m.

# Resource 8 – probability scales

A probability scale worksheet.

On the left, are images of random generators: a coin, a 3-part spinner, a bag with 4 differently coloured counters and a standard dot die. Next to each image is a labelled fraction bar.

The coin bar is labelled half heads and half tails.

The spinner bar is labelled in thirds.

The bag or counter bar is labelled in quarters.

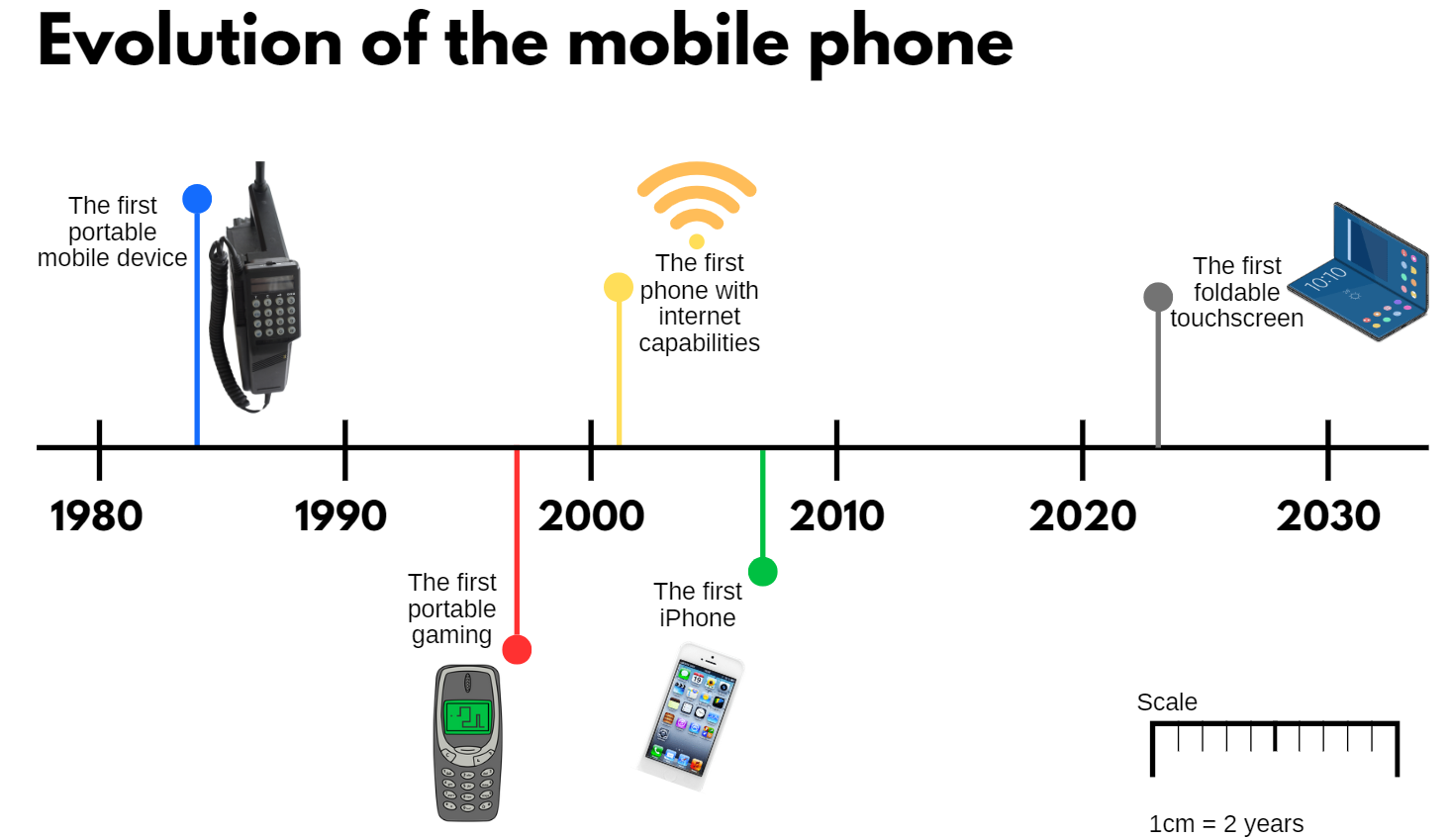
The dice bar is labelled in sixths.

Next to each bar is a probability scale from zero to one.

# Resource 9 – more and less

|  |  |  |
| --- | --- | --- |
| One thousandth less | Number | One thousandth more |
|  | 1 |  |
|  | 0.5 |  |
|  | 0.25 |  |
|  | 0.6 |  |
|  | 0.005 |  |
|  | 0.75 |  |

# Resource 10 – mobile phone timeline



# Resource 11 – ascending order

This image shows a table with 5 columns and 6 rows. The columns are labelled ‘ones’, ‘decimal point’, ‘tenths’, ‘hundredths’ and ‘thousandths’. The ones column has a zero in each of the rows. The decimals point column has a black dot in each of the rows. The remaining cells are empty. There are 3 beige cards under the table. Each card has one number on it. The numbers are 0, 4 and 6.


# Resource 12 – data cycle

Data cycle with 4 stages: 

1. Pose question – generate investigative questions that can be answered with data. 

2. Collect data – collect data through observation, survey or database. 

3. Represent data – represent data in lists, tables, timelines and graphs. 

4. Interpret data – describe the data. Determine conclusions and significance of the data.

# Resource 13 – council survey criteria

A whiteboard with the following text: Help the council gather data for their new park by designing a survey that meets the following criteria:

- Pose 2 -3 questions.
- Collect a range of categorical and numerical data.
- Design the survey questions for Stage 3 students or for parents.
- Create a recording form.

Next to it is a clipboard with feedback written at the top. There are 5 checkboxes with statements beside it.
- Are there 2-3 questions?
- Is there a question that collects categorical data?
- Is there a question that collects numerical data?
- Is it written for a specific audience?
- Does the recording form match the questions being asked?

# Resource 14 – What’s missing?

Number line with 0.9 at the far left, 1 at the far right and regular intervals marked along the line. 

Sixteen sticky notes are below the number line ready to be placed in order along it. 

These sticky notes have the numbers 100%, 0.901, 1.911, 0.900, 0.93, 9/10, 99%, 0.911, 0.940, 95%, 0.951, 0.96, 0.98, 0.917, 0.919 and 1.002.

# Resource 15 – best data representation

Two graphs are displayed with the title ‘Playground equipment preference’ – a column graph and a line graph. Both graphs represent the same information. 

Above the graphs, the text reads: ‘Jett asked students in his grade to choose which of the listed playground equipment they would like to see in the new park. He then created 2 different data displays.’

The y-axis is labelled 0–45. Along the x-axis, are the labels: giant slide, swings, sandpit, seesaw, spider web and trampoline. 

The giant slide had 42 votes, swings had 9 votes, sandpit had 6 votes, seesaw had 12 votes, spider web had 21 votes and the trampoline had 10 votes.

# Resource 16 – languages data

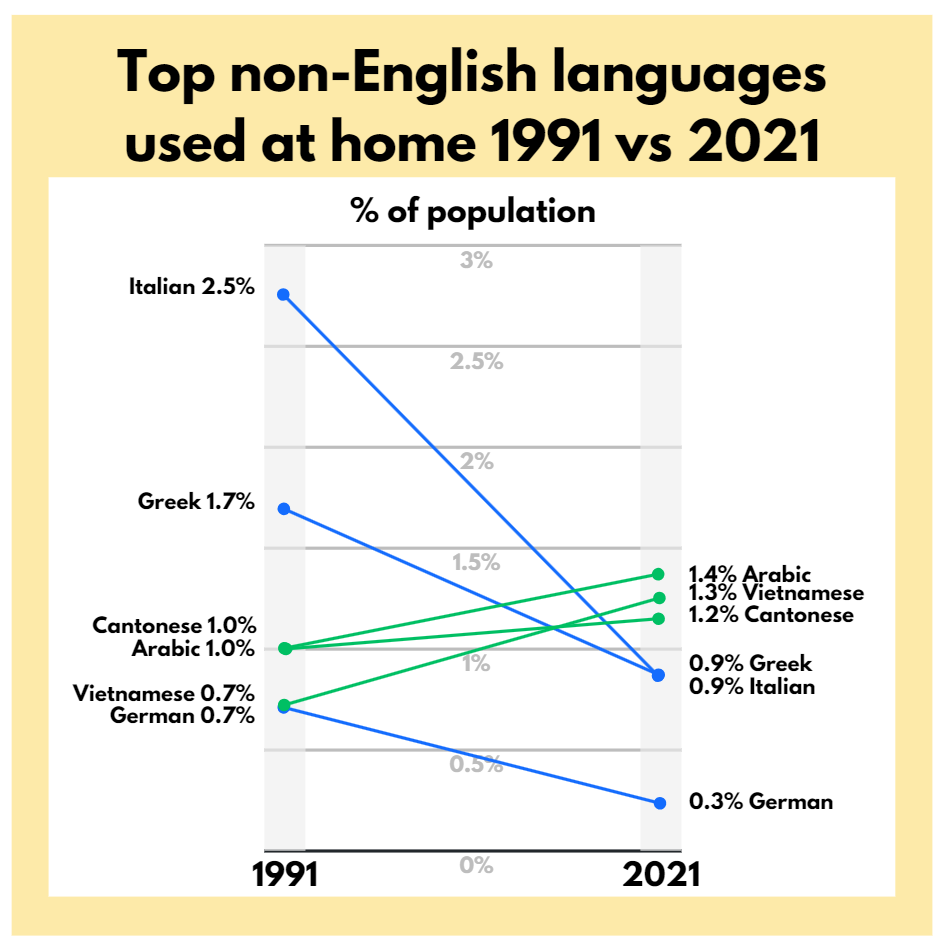
Three different images showing information about languages spoken in Australia. Image A is titled ‘Top 5 languages spoken in Australia’. Information contained in each speech bubble is as follows:
English only 72.7%, Arabic 1.4%, Vietnamese 1.2%, Cantonese 1.2% and Mandarin 2.5%. Each speech bubble has ‘hello’ written in the language spoken. 

Image B is titled ‘Top 5 languages spoken at home’. It has a photo of a family eating dinner under the title. It then has a table ranking the languages spoken in the years 2011 and 2016. In 2011, the top 5 languages were (from most popular to least popular) English only 76.8%, Mandarin 1.6%, Italian 1.4%, Arabic 1.3% and Cantonese 1.2%. In 2016, the top 5 languages were (from most popular to least popular) English only 72.7%, Mandarin 2.5%, Arabic 1.4%, Cantonese 1.2% and Vietnamese 1.2%. 

Image C is titled ‘Top non-English language used at home 1991 vs 2021’. The graph indicates in 1991 Italian 2.5%, Greek 1.7%, Cantonese 1.0%, Arabic 1.0%, Vietnamese 0.7% and German 0.7%. The graph indicates in 2021 Arabic 1.4%, Vietnamese 1.3%, Cantonese 1.2%, Greek 0.9%, Italian 0.9% and German 0.3%.

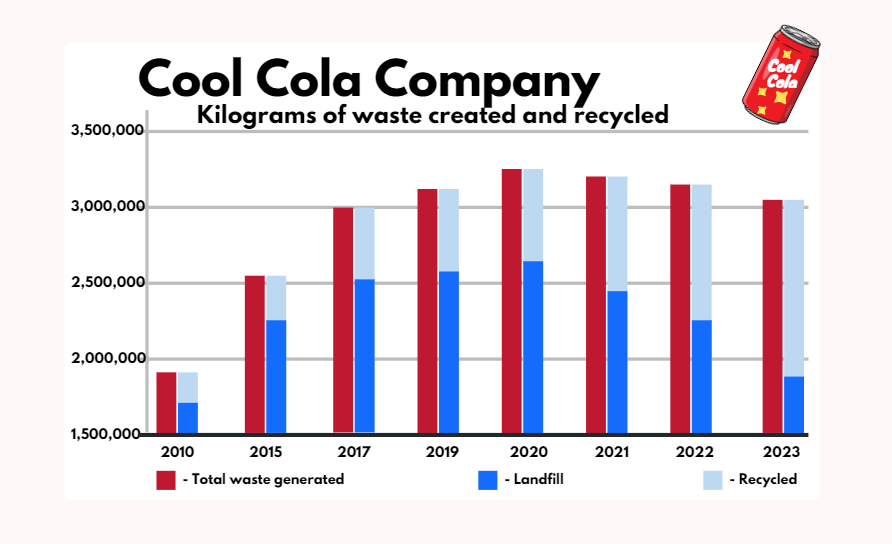
Adapted from Australian Bureau of Statistics (1991; 2017; 2021).

# Resource 17 – languages line graph



Adapted from Australian Bureau of Statistics (1991; 2021).

# Resource 18 – data display 1



# Resource 19 – data display 2

An accurate representation of a column graph of the kilograms of waste created and recycled by the Cool Cola Company. 

It indicates the amount of waste created, how much went to landfill and how much is recycled. 

The information along the y-axis is 0, 500000, 1000000, 1500000, 2000000, 2500000, 3000000, 3500000. 

The information along the x-axis is 2010, 2015, 2017, 2019, 2020, 2021, 2022, 2023; however, the years are correctly spaced.


# Resource 20 – data display 3

A line graph titled ‘2023 Drink sales’ of the monthly drinks sales for Cool Cola Company and Super Soda company. 

The information along the y-axis is 100 000, 200 000, 300 000, 400 000, 500 000. 

The information along the x-axis is April, May, June, July, August, September, October and November.

Cool Cola Sales are marked in red: April: 100 000, May: 150 000, June: 300 000, July: 500 000, Aug: 700 000, Sept: 300 000, Oct: 400 000, Nov: 180 000.

Super soda sales are marked in blue: April: 300 000, May: 310 000, June: 350 000, July: 370 000, August: 390 000, September: 200 000, October: 570 000, November: 670 000.


# Syllabus outcomes and content

The table below outlines the [syllabus outcomes](https://curriculum.nsw.edu.au/learning-areas/mathematics/mathematics-k-10-2022/overview) and range of relevant syllabus content covered in this unit. Content is linked to [National Numeracy Learning Progression](https://www.australiancurriculum.edu.au/resources/national-literacy-and-numeracy-learning-progressions/version-3-of-national-literacy-and-numeracy-learning-progressions/) (version 3).

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Outcomes and content | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| **Representing numbers A**: Decimals and percentages: Recognise that the place value system can be extended beyond hundredths  **MAO-WM-01, MA3-RN-01, MA3-RN-02** |  |  |  |  |  |  |  |  |
| * Express thousandths as decimals |  |  |  |  | x | x |  |  |
| * Indicate the place value of digits in decimal numbers of up to 3 decimal places |  |  |  |  | x | x | x |  |
| **Represents numbers A**: Decimals and percentages: Compare, order and represent decimals  **MAO-WM-01, MA3-RN-01, MA3-RN-02** |  |  |  |  |  |  |  |  |
| * Place decimal numbers of up to 3 decimal places on a number line |  |  |  |  |  |  | x |  |
| **Representing numbers B**: Whole numbers: Locate and represent integers on a number line  **MAO-WM-01, MA3-RN-01** |  |  |  |  |  |  |  |  |
| * Recognise the location of negative whole numbers in relation to zero and place them on a number line | x | x |  |  |  |  |  |  |
| * Use the term integers to describe positive and negative whole numbers and zero | x | x |  |  |  |  |  |  |
| * Interpret integers in everyday contexts |  |  | x |  |  |  |  |  |
| **Representing numbers B:** Decimals and percentages: Make connections between benchmark fractions, decimals and percentages  **MAO-WM-01, MA3-RN-02, MA3-RN-03** |  |  |  |  |  |  |  |  |
| * Recall commonly used equivalent percentages, decimals and fractions including , and . |  |  | x |  |  |  | x |  |
| **Data A**: Collect categorical and discrete numerical data by observation or survey  **MAO-WM-01, MA3-DATA-01** |  |  |  |  |  |  |  |  |
| * Pose and refine questions to construct a survey to obtain categorical or discrete numerical data about a matter of interest |  |  |  |  |  | x |  |  |
| * Collect ordinal or nominal categorical data, and discrete numerical data through observation or by conducting surveys |  |  |  |  |  | x |  |  |
| **Data A**: Choose and use appropriate tables and graphs  **MAO-WM-01, MA3-DATA-01** |  |  |  |  |  |  |  |  |
| * Tabulate collected data with and without the use of digital technologies such as spreadsheets |  | x | x | x |  |  |  |  |
| * Recognise which types of data display are appropriate to represent data (Statistical reasoning) |  |  |  |  | x |  | x |  |
| * Determine an appropriate scale (horizontal and vertical) to represent the data |  |  |  |  |  |  | x |  |
| * Construct column graphs using a many-to-one scale, with and without the use of digital technologies |  |  |  |  |  |  | x |  |
| * Draw an accurate timeline using an appropriate scale |  |  |  |  | x |  |  |  |
| **Data A**: Describe and interpret different datasets in context  **MAO-WM-01, MA3-DATA-01, MA3-DATA-02** |  |  |  |  |  |  |  |  |
| * Interpret line graphs using the scales on the axes |  |  | x |  |  |  |  |  |
| * Describe and interpret data presented in tables, column graphs and line graphs |  |  |  |  |  |  |  | x |
| * Determine the total number of data values represented in column graphs |  |  |  |  |  |  | x |  |
| **Data B**: Interpret and compare a range of data displays  **MAO-WM-01, MA3-DATA-02** |  |  |  |  |  |  |  |  |
| * Interpret data on a timeline using the given scale |  |  |  |  | x |  |  |  |
| **Data B**: Interpret data presented in digital media and elsewhere  **MAO-WM-01, MA3-DATA-02** |  |  |  |  |  |  |  |  |
| * Interpret data representations found in digital media and in factual texts |  |  |  |  |  |  |  | x |
| * Identify sources of possible bias in representations of data in the media (Statistical reasoning) |  |  |  |  |  |  |  | x |
| * Identify misleading representations of data in the media |  |  |  |  |  |  |  | x |
| **Chance A**: List outcomes of chance experiments involving equally likely outcomes and represent probabilities  **MAO-WM-01, MA3-CHAN-01** |  |  |  |  |  |  |  |  |
| * Use the term probability to describe the numerical value that represents the likelihood of an outcome of a chance experiment | x |  | x |  |  |  |  |  |
| * Record all outcomes in chance experiments where each outcome is equally likely to occur | x | x |  |  |  |  |  |  |
| * Represent probabilities of outcomes of chance experiments using fractions |  |  | x |  |  |  |  |  |
| * Establish that the total of the probabilities of the outcomes of a chance experiment equals one |  |  |  | x |  |  |  |  |
| * Discuss the imprecise meaning of commonly used chance words including possible, likely and unlikely | x | x |  |  |  |  |  |  |
| **Chance B**: Compare observed frequencies of outcomes with expected results  **MAO-WM-01, MA3-CHAN-01** |  |  |  |  |  |  |  |  |
| * Distinguish between the frequency of an outcome (the number of times it occurs) and the probability of an outcome in a chance experiment |  |  | x | x |  |  |  |  |

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