# Rolling to 10

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

## Visible learning

### Learning intentions

* To be able to list the sample space of simple events.
* To be able to express the probability of simple events as a fraction.

### Success criteria

* I can determine the sample space of events.
* I can determine the probability of simple events.
* I can compare the probability of different outcomes in events.
* I can explain how changes in a numerator or denominator change the size of a fraction.

### Syllabus outcomes

A student:

* develops understanding and fluency in mathematics through exploring and connecting mathematical concepts, choosing and applying mathematical techniques to solve problems, and communicating their thinking and reasoning coherently and clearly **MAO-WM-01**
* represents and operates with fractions, decimals and percentages to solve problems **MA4-FRC-C-01**
* solves problems involving the probabilities of simple chance experiments
**MA4-PRO-C-01**

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## Activity structure

### Launch

In randomly selected groups of 3, students will rotate through 5 games (Appendix A) that have been set up around the classroom.

#### Equipment

One 6-sided dice and one 8-sided dice per group. Digital dice simulators like Polypad ([mathigon.org/polypad](https://mathigon.org/polypad)) can also be used.

#### Method

1. Within each group of 3, students will need to assign themselves as Player A, B or C.

To keep things random and to get students thinking about probability, have them choose who is player A, B and C using a die.

* First player rolls a die, 1 or 2 makes them player A, 3 or 4 makes them player B, 5 or 6 makes them player C.
* Second player rolls the dice, 1, 2 or 3 makes them player B, 4, 5 or 6 makes them player C.
1. Once players are assigned, students will work through each of the games in Appendix A to see which player makes it to 10 points first.
2. At the conclusion of the activity have a discussion with students to determine if the games were fair, prompting questions could include:
3. Were the games fair? Can you justify why or why not?
4. Did each game have an equal chance of each player getting a point?

### Explore

Students determine: ‘Would you rather be Player A, B or C?’ for each game using Appendix B as a student handout.

This activity allows students to consider *sample space* without formalising it, to start thinking about numerical probability and finally to compare the different outcomes for each player.

1. Hand out Appendix B, one per student.
2. Remind students of the definitions of the probability terms impossible, unlikely, even chance, likely and certain.
3. Have students complete the table, discussing with their groups.

### Summarise

#### Explicitly teach sample space and probability

Use the *Rolling to 10* PowerPoint for explicit teaching of the skills required for finding the probability of an event. This includes:

* sample space
* the probability of an event
* writing probabilities as fractions.

The explicit teaching technique used in the PowerPoint is ‘Your turn’. The first slide is a worked example which should be displayed for the students and then use the following steps.

1. Reveal the question to the students and its solution.
2. Students read in silence.
3. Students individually think and explain to themselves what is happening in each step.
4. Students hold up a thumbs up to the teacher when they have finished reading and have some sort of understanding.
5. Think-Pair-Share. Students explain the solution to their partner.
6. In pairs students then answer the self-explanation questions.
7. Finally, randomly select students to share their answers with the whole class.

#### Numerators and denominators

1. Students use the Desmos graph – fraction size ([bit.ly/fractionsize](https://bit.ly/fractionsize)) to answer the questions:
2. What happens to the size of a fraction and thus, the probability, when you change the numerator?
3. What happens to the size of a fraction and thus, the probability, when you change the denominator?
4. Students can also engage in the Desmos activity – Numerators and denominators ([bit.ly/numeratorsdenominators](https://bit.ly/numeratorsdenominators)) to complete this task.

#### Calculating probabilities from rolling to 10 games

1. Hand out Appendix C, one per student.
2. Have students complete the table.
3. Students compare their responses with those from Appendix B.

### Apply

1. Students are to design their own game to be played either using a regular 6-sided dice and/or 8-sided dice with 3 players.
2. Once they have created their game students are to:
3. List the sample space for the game.
4. Write the probability of each player winning, as a fraction.
5. Consider making games with specific conditions, such as player C has double the probability of player A, or all 3 players have the same chance but in different ways.

### Assessment and Differentiation

#### Suggested opportunities for differentiation

**Launch**

* Students may need to be reminded what odd and even numbers are

**Summarise**

* Challenge students to decide which player, A, B or C, has the greatest chance of performing best across all five games, and to justify their choice?

**Apply**

* Consideration could be made to create certain conditions for the game that students create, such as Player C has double the probability of Player A, and so on.

#### Suggested opportunities for assessment

* Monitor student responses in the **Your turn** section to check for understanding.
* Appendix C could be collected and used as summative assessment for this unit of learning.

## Appendix A

### Rolling to 10 games

|  |  |  |  |
| --- | --- | --- | --- |
| Game | Equipment | Instructions | Points |
| 1 | One 6-sided dice per group | Roll the dice and record points.Continue to roll the dice and record points until a player reaches 10 or more points. | Player A gets 1 point if it shows an even number.Player B gets 1 point if it shows an odd number.Player C gets 1 point if it shows a 1, 2 or 3.  |
| 2 | One 6-sided dice per group | Roll the dice and record points. Continue to roll the dice and record points until a player reaches 10 or more points. | Player A gets 1 point if it shows an even number.Player B gets 1 point if it shows an odd number.Player C gets 1 point if it shows a 1 or a 2.  |
| 3 | One 8-sided dice per group | Roll the dice and record points.Continue to roll the dice and record points until a player reaches 10 points. | Player A gets 1 point if it shows an even number.Player B gets 1 point if it shows an odd.Player C gets 1 point if it shows a 1, 2 or 3. |
| 4 | One 6-sided and one 8-sided dice per group | Roll both dice at the same time and record points.Continue to roll the dice and record points until a player reaches 10 points. | Player A gets 1 point if it shows 1, 2 or 3 on the 6-sided dice.Player B gets 1 point if it shows 1, 2 or 3 on the 8-sided dice.Player C gets 1 point if it shows a 6, 7 or 8 on the 8-sided dice. |
| 5 | One 6-sided and one 8-sided dice per group | Roll both dice at the same time and record points.Continue to roll the dice and record points until a player reaches 10 points. | Player A gets 1 point if it shows an even number on the 6-sided dice.Player B gets 1 point if it shows an even number on the 8-sided dice.Player C gets 1 point if a 6 is not rolled on either dice. |

## Appendix B

### Exploring the games

#### Game 1

* List the numbers that can be rolled.
* How many different numbers can the dice show?
* Complete the table below.

|  |  |  |  |
| --- | --- | --- | --- |
| Questions | Player A | Player B | Player C |
| For which numbers does the player win 1 point? |  |  |  |
| Describe the likelihood of the player winning 1 point in words |  |  |  |

Would you rather be player A, B or C? Justify your choice.

#### Game 2

* List the numbers that can be rolled.
* How many different numbers can the dice show?
* Complete the table below.

|  |  |  |  |
| --- | --- | --- | --- |
| Question | Player A | Player B | Player C |
| For which numbers does the player win 1 point? |  |  |  |
| Describe the likelihood of the player winning 1 point in words |  |  |  |

Would you rather be player A, B or C? Justify your choice.

#### Game 3

* List the numbers that can be rolled.
* How many different numbers can the dice show?
* Complete the table below.

|  |  |  |  |
| --- | --- | --- | --- |
| Questions | Player A | Player B | Player C |
| For which numbers does the player win 1 point? |  |  |  |
| Describe the likelihood of the player winning 1 point in words |  |  |  |

Would you rather be player A, B or C? Justify your choice.

#### Game 4

* List the numbers that can be rolled.
* How many different numbers can the dice show?
* Complete the table below.

|  |  |  |  |
| --- | --- | --- | --- |
| Question | Player A | Player B | Player C |
| For which numbers does the player win 1 point? |  |  |  |
| Describe the likelihood of the player winning 1 point in words |  |  |  |

Would you rather be player A, B or C? Justify your choice.

#### Game 5

* List the numbers that can be rolled.
* How many different numbers can the dice show?
* Complete the table below.

|  |  |  |  |
| --- | --- | --- | --- |
| Question | Player A | Player B | Player C |
| For which numbers does the player win 1 point? |  |  |  |
| Describe the likelihood of the player winning 1 point in words |  |  |  |

Would you rather be player A, B or C? Justify your choice.

## Appendix C

### Exploring the games

#### Game 1

* List the sample space.
* How many different numbers can the dice show?

|  |  |  |  |
| --- | --- | --- | --- |
| Questions | Player A | Player B | Player C |
| For which numbers does the player win 1 point? |  |  |  |
| Write the probability of each player winning |  |  |  |

Would you rather be player A, B or C? Justify your choice.

#### Game 2

* List the sample space.
* How many different numbers can the dice show?

|  |  |  |  |
| --- | --- | --- | --- |
| Question | Player A | Player B | Player C |
| For which numbers does the player win 1 point? |  |  |  |
| Write the probability of each player winning |  |  |  |

Would you rather be player A, B or C? Justify your choice.

#### Game 3

* List the sample space.
* How many different numbers can the dice show?

|  |  |  |  |
| --- | --- | --- | --- |
| Questions | Player A | Player B | Player C |
| For which numbers does the player win 1 point? |  |  |  |
| Write the probability of each player winning |  |  |  |

Would you rather be player A, B or C? Justify your choice.

#### Game 4

* List the sample space.
* How many different numbers can the dice show?

|  |  |  |  |
| --- | --- | --- | --- |
| Question | Player A | Player B | Player C |
| For which numbers does the player win 1 point? |  |  |  |
| Write the probability of each player winning |  |  |  |

Would you rather be player A, B or C? Justify your choice.

#### Game 5

* List the sample space.
* How many different numbers can the dice show?

|  |  |  |  |
| --- | --- | --- | --- |
| Question | Player A | Player B | Player C |
| For which numbers does the player win 1 point? |  |  |  |
| Write the probability of each player winning |  |  |  |

Would you rather be player A, B or C? Justify your choice.

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