# To be, or not to be

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

## Visible learning

### Learning intention

* To understand the relationship between an event and its complement.

### Success criteria

* I can identify 2 events that can occur at once.
* I can describe the complement of an event.
* I can evaluate the probability of the complement of an event.
* I can justify that the sum of the probability of an event and its complement is a total of one.

### 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

1. Verbally call out each of the scenarios below or display them on the board.
2. Ask the students which of the 5 scenarios below doesn’t belong.
3. Students to do a [Think-Pair-Share](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/645), followed by an online poll, like [Mentimeter](mentimeter.com) ([mentimeter.com](https://www.mentimeter.com/)) to see student responses.

#### Which one doesn’t belong?

* On a school day, you can either go to school or not go to school.
* Your birthday will either be in summer or winter.
* If you toss a coin, you can either get heads or tails.
* If you roll a die, you either get an odd number or an even number.
* When you finish school, you will either go to university or get a job.

At the conclusion of this activity, discuss some other possible events including:

* For point 2, there are other things that can happen, for example, your birthday could be in spring.
* For point 5, you could do neither, but you could also do both.

### Explore

#### Equipment

* One 6-sided dice and one 8-sided dice per pair, or an online dice simulator equivalent.
* [Appendix A](#_Appendix_A) handout

#### Method

1. Students are to work in pairs and are revisiting the Rolling to 10 game from Lesson 3.
2. Using [Appendix A](#_Appendix_A) as a handout, students are given the criteria for Player A to win and need to find the criteria for Player B to win. In each round, exactly one person must get a point. For example, there cannot be a round where both players get a point and there cannot be a roll where no one gets a point.
3. For each game, the students will determine the probability for each player to win, predict who’s more likely to win based on the theoretical probability and test this by playing the game.

This activity explores complementary events and their related probabilities whilst revisiting comparing fractions.

### Summarise

1. As a class, discuss what students noticed about the relationship between the 2 fractions representing each player’s probability of winning.

Students may notice that these fractions total to one.

1. Use the To be, or not to be PowerPoint for explicit teaching of:
2. complementary events
3. the sum of the probability of an event and its complement.

Students will further explore equally likely, which leads into the following lesson.

### Apply

1. To check student understanding conduct an agree or disagree activity as a whole class. It’s important to get an answer from all students for formative assessment, so this could be by:
2. students using mini whiteboards to show their answers
3. students holding one finger up in front of them for agree and 2 fingers for disagree
4. using different sides of the room for the agree side and the disagree side, students move to the side they choose. Students can then have a discussion with someone on the same side of the room as them to voice their reasoning.
5. Use questions similar to the ones below:
6. Since the probability of rolling a 3 on a die is $\frac{1}{6}$, then the probability of not rolling a 3 on a die is $\frac{5}{6}$.
7. If the probability of spinning a yellow is $\frac{1}{4}$, then the probability of the complementary event is also $\frac{1}{4}.$

## Assessment and Differentiation

### Suggested opportunities for differentiation

**Launch**

* Students may need some prompting and scaffolding to understand how each of the events in Which one doesn’t belong relate.

**Explore**

* Students could be encouraged to list the sample space and cross out the outcomes that Player A has for winning to reveal the conditions for Player B to win.

**Summarise**

* Some students may be able to find the probability of a complementary event without needing the visual representations and should be challenged with more complex fractions for probabilities.

**Apply**

* Students may need to be provided with visual representations to help with their answers.
* Students can be challenged with questions that involve more complex fractions.

### Suggested opportunities for assessment

* Monitor student responses in [Appendix A](#_Appendix_A) to check for their understanding of listing all the outcomes in the sample space that Player A doesn’t have.
* An [exit ticket](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/543) ([bit.ly/exitticketstrategy](https://bit.ly/exitticketstrategy)), such as the traffic light template could be used at the conclusion of the lesson.

## Appendix A

### Rolling to 10, 2.0

1. In pairs, determine who is Player A or Player B.
2. Roll a die and whoever wins will get a point. The first player to 10 points wins the round:
3. Exactly one person must get a point with every roll, for example, there cannot be a roll where both people get a point and there cannot be a roll where no one gets a point.
4. The conditions for Player A to win have been given in each round.
5. Complete the table, describing the conditions for Player B to win, the probability for each player and answer the questions before playing each round.
6. Play round 0 as a class first, if needed, where the table has been completed for you.

#### Round 0

Dice to be used: One 6-sided dice

|  |  |  |
| --- | --- | --- |
| Player | Conditions for winning | Theoretical probability of winning |
| A | Rolling a 1 | $$P\left(Player A\right)=\frac{1}{6}$$ |
| B | Rolling a 2, 3, 4, 5 or 6 | $$P\left(Player B\right)=\frac{5}{6}$$ |

* Predict who you think should win based on the theoretical probability.
* What do you notice about the relationship between the fractions representing each player's probability?
* Play the game. Was your prediction correct?

#### Round 1

Dice to be used: One 6-sided dice

|  |  |  |
| --- | --- | --- |
| Player | Conditions for winning | Theoretical probability of winning |
| A | Rolling a 2 or a 4 |  |
| B |  |  |

* Predict who you think should win based on the theoretical probability.
* What do you notice about the relationship between the fractions representing each player's probability?
* Play the game. Was your prediction correct?

#### Round 2

Dice to be used: One 8-sided dice

|  |  |  |
| --- | --- | --- |
| Player | Conditions for winning | Theoretical probability of winning |
| A | Rolling a 2 or a 4 |  |
| B |  |  |

* Predict who you think should win based on the theoretical probability.
* What do you notice about the relationship between the fractions representing each player's probability?
* Play the game. Was your prediction correct?

#### Round 3

Dice to be used: One 8-sided dice

|  |  |  |
| --- | --- | --- |
| Player | Conditions for winning | Theoretical probability of winning |
| A | Rolling a multiple of 3 |  |
| B |  |  |

* Predict who you think should win based on the theoretical probability.
* What do you notice about the relationship between the fractions representing each player's probability?
* Play the game. Was your prediction correct?

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