# Rock paper scissors

This activity is adapted from [Probability: Rock Paper Scissors](https://www.resolve.edu.au/probability-rock-paper-scissors) by [reSolve: Mathematics by Inquiry](https://www.resolve.edu.au/) ([bit.ly/resolverockpaperscissors](https://bit.ly/resolverockpaperscissors)). Students explore the game of rock, paper, scissors and analyse if the outcomes are equally likely, the potential for bias and whether adding in 2 elements changes the chances of winning.

## Visible learning

### Learning intentions

* To understand the concept of randomness.
* To understand what makes events equally likely.

### Success criteria

* I can determine if a game has equally likely outcomes.
* I can determine if a game is fair and unbiased.
* I can evaluate and compare the probability of winning games.

### 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**
* solves problems involving the probabilities of simple chance experiments **MA4-PRO-C-01**

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## Activity structure

### Launch

#### Round 1

1. In pairs, students play 10 games of rock, paper, scissors (RPS), recording their results using [Appendix A](#_Appendix_A). Students may need a demonstration of how to play the game.
2. At the conclusion of the activity, student reflection questions could include:
3. Is RPS a fair game?
4. Could you predict what your opponent was going to select?
5. What was your strategy?
6. Is there one option that wins more than the others?

#### Round 2

1. Show Player 1 only, a clip that outlines a theory on how to win at [Rock Paper Scissors (3:08)](https://www.abc.net.au/education/catalyst-how-to-win-at-rock-paper-scissors/13720728) ([bit.ly/abchowtowin](https://bit.ly/abchowtowin)). Students then play another 10 games of RPS, recording their results to test out the theory.
2. At the conclusion of this round, student reflection questions could include:
3. Did Player 1 win more times this round?
4. Did each game have an equally likely outcome of a draw, Player 1 winning or Player 2 winning?

The purpose of this activity is for students to realise that each outcome is not equally likely as all players bring their own personal biases to the game. When they choose scissors, paper or rock, they are not doing so completely randomly, but are taking into consideration what has been chosen before and what they think the other player will choose.

### Explore

1. Students discuss how to make the game fair by removing personal bias and making each outcome equally likely.
2. Students replay 10 games of RPS and record their results, using either:
3. Option 1: Two dice, dice 1 representing Player 1 and dice 2 representing Player 2.

Table 1 – rock, paper, scissors and dice outcomes

|  |  |
| --- | --- |
| Outcome on dice | RPS outcome |
| 1 or 2 | Rock |
| 3 or 4 | Paper |
| 5 or 6 | Scissors |

1. Option 2: [online simulator](https://www.online-stopwatch.com/chance-games/rock-paper-scissors/) for RPS ([bit.ly/rockpaperscissorssimulator](https://bit.ly/rockpaperscissorssimulator)).
2. Students explore the chances of winning now that the outcomes are equally likely. The first part of the Rock paper scissors PowerPoint can be used for this. Students can use the results from their experiments to calculate the relative frequency or they can list the sample space by considering the different combinations of moves and calculate the theoretical probability.

The PowerPoint contains extension material on using tree diagrams and tables to list the sample space. This is not part of the Stage 4 course, but teachers may choose to show students for extension purposes.

1. The class watches the Big Bang Theory’s explanation of [rock, paper, scissors, lizard, Spock (1:26)](https://www.youtube.com/watch?app=desktop&v=_PUEoDYpUyQ) (RPSLS) ([bit.ly/bigbangRPSLS](https://bit.ly/bigbangRPSLS)).
2. Students play 10 rounds of RPSLS using their hands, recording their results using [Appendix B](#_Appendix_B):
3. Did they have a strategy?
4. Was it easier to win playing RPSLS than it was playing RPS?
5. Are the outcomes equally likely?
6. Students are to now design a way of playing RPSLS where the outcomes would be equally likely with no strategy involved. They may like to use a dice to allocate numbers for each of the outcomes or an [online random number generator](https://www.google.com/search?q=random+number+generator&rlz=1C1GCEA_enAU952AU952&oq=random+number+gen&aqs=chrome.1.69i57j0i131i433i512j0i512l7.4015j0j7&sourceid=chrome&%7bgoogle:instantExtendedEnabledParameter%7die=UTF-8) ([bit.ly/Googlenumbergenerator](https://bit.ly/Googlenumbergenerator)).
7. Following this, students explore the chances of winning RPSLS. Students should use the results of their experiment to determine the relative frequency or list the sample space by considering the different combinations of moves and determine the theoretical probability.

Teachers could choose to extend students by using the table in [Appendix C](#_Appendix_C) and the second part of the Rock paper scissors PowerPoint which demonstrates how to list the sample space using a table.

### Summarise

Reflection questions to be considered by students:

* Did each game (RPS and RPSLS) have an equal chance of winning?
* Which game would give you the greater odds of winning?
* Why was the game fair when you played using dice as opposed to playing with your hands?

### Apply

1. To revisit fractions on a number line, students are to draw a 15 cm number line and plot the chances of winning for each of the outcomes for each game. They will need to have the chance of winning each game listed as fraction.
2. Students should then be challenged to come up with a new game where the chances of winning are increased. Students can extend on the rock, paper, scissors game or create their own using dice (any number of sides), coins and/or spinners.
3. Discussion questions could include:
4. If the chances of winning are increased, does the probability of winning get closer or further away from one?
5. What changes can you see in the numerator and/or denominator if the chances of winning are increased?

## Assessment and Differentiation

### Suggested opportunities for differentiation

Visual representations of each of the probabilities may be used to support students.

**Launch**

* Students may need a few demonstrations of how to play rock, paper, scissors.

**Explore**

* Students could be extended by showing them how to use tables and tree diagrams to help them list the sample space.

**Apply**

* Students should play their games with the class and check that their predictions are correct.

### Suggested opportunities for assessment

* Monitor responses in class discussions to check student understanding of what makes a game fair.

## Appendix A

### Rock, paper, scissors



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#### Score sheet

|  |  |  |
| --- | --- | --- |
| Player 1 | Player 2 | Result |
| R P S | R P S | P1 P2 Draw |
| R P S | R P S | P1 P2 Draw |
| R P S | R P S | P1 P2 Draw |
| R P S | R P S | P1 P2 Draw |
| R P S | R P S | P1 P2 Draw |
| R P S | R P S | P1 P2 Draw |
| R P S | R P S | P1 P2 Draw |
| R P S | R P S | P1 P2 Draw |
| R P S | R P S | P1 P2 Draw |
| R P S | R P S | P1 P2 Draw |

## Appendix B

### Rock, paper, scissors, lizard, Spock



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#### Score sheet

|  |  |  |
| --- | --- | --- |
| Player 1 | Player 2 | Result |
| R P Sc L Sp | R P Sc L Sp | P1 P2 Draw |
| R P Sc L Sp | R P Sc L Sp | P1 P2 Draw |
| R P Sc L Sp | R P Sc L Sp | P1 P2 Draw |
| R P Sc L Sp | R P Sc L Sp | P1 P2 Draw |
| R P Sc L Sp | R P Sc L Sp | P1 P2 Draw |
| R P Sc L Sp | R P Sc L Sp | P1 P2 Draw |
| R P Sc L Sp | R P Sc L Sp | P1 P2 Draw |
| R P Sc L Sp | R P Sc L Sp | P1 P2 Draw |
| R P Sc L Sp | R P Sc L Sp | P1 P2 Draw |
| R P Sc L Sp | R P Sc L Sp | P1 P2 Draw |

## Appendix C

### Exploring RPSLS probability



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