**Rock, paper, scissors**

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| **Year level****Strand(s)****Lesson length****CD Code** | * Year 7
* Probability
* 50 mins
* [AC9M7P02](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/content-description?subject-identifier=MATMATY7&content-description-code=AC9M7P02&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick)
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| **Lesson summary** | In this lesson, students compare theoretical and experimental probabilities by completing repeated trials of the game ‘Rock, paper, scissors’.In a follow-up lesson students complete repeated trials of the game ‘Rock, paper, scissors’ with extensions to include lizard and Spock. |
| **Learning intention** | * We are learning to run a probability simulation.
* We can understand the difference between theoretical and experimental probability and the law of large numbers.
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| **Success criteria** | By the end of this lesson, students can:* calculate theoretical probabilities for equally likely and unlikely outcomes
* use digital tools to simulate probability experiments and calculate experimental probabilities
* explain differences between predicted and observed results and state the law of large numbers and its relevance to the simulation
* explain and justify different game strategies.
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| **Why are we learning about this?** | Learning about theoretical and experimental probabilities equips students with an understanding of chance and risk assessment, that helps promote critical thinking and fosters informed decision-making in an increasingly data-driven world. Real-life applications include financial decisions, health choices or daily activities, such as understanding a weather forecast. In the workplace, probability simulations are used in areas including finance, medicine, engineering, climatology and sports analytics. |
| **Prerequisite student knowledge and language** | It is assumed that students have knowledge of expressing probabilities as a fraction, decimal or percentage.Language: Equally likely outcomes, chance experiment, relative frequency, trial, experimental probability |
| **Resources** | * Teacher’s slides (PowerPoint)
* Rock, paper, scissors recording sheet (Word)
* Exit ticket (Word)
* Laptops/tablets for each student.
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Curriculum information

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| Achievement standard | [By the end of Year 7, students conduct repeated single-step chance experiments and run simulations using digital tools, giving reasons for differences between predicted and observed results.](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10?detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick) |
| Content description(s) | Students conduct repeated chance experiments and run simulations with a large number of trials using digital tools; compare predictions about outcomes with observed results, explaining the differences. [AC9M7P02](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/content-description?subject-identifier=MATMATY7&content-description-code=AC9M7P02&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick) |
| General capabilitiesCross-curriculum priority | **General capabilities**Numeracy * Understanding chance([Level 5](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/general-capability-snapshot?subject-identifier=MATMATY7&content-description-code=AC9M7P02&general-capability-code=N&element-code=NS&sub-element-index=0&sub-element-code=NSUnC&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick))

Digital literacy * Acquiring and collating data ([Level 5](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/general-capability-snapshot?subject-identifier=MATMATY7&content-description-code=AC9M7P02&general-capability-code=DL&element-code=DLI&sub-element-index=0&sub-element-code=DLIB&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick))
* Interpreting data, selecting ([Level 5](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/general-capability-snapshot?subject-identifier=MATMATY7&content-description-code=AC9M7P02&general-capability-code=DL&element-code=DLI&sub-element-index=1&sub-element-code=DLIC&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick))
* Select and operating tools ([Level 5](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/general-capability-snapshot?subject-identifier=MATMATY7&content-description-code=AC9M7P02&general-capability-code=DL&element-code=DLMO&sub-element-index=0&sub-element-code=DLMOC&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick))
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| Areas of challenge | * Some students may have misconceptions about what is fair. Although in the whole-class game, from the outset students have an equal chance of being crowned the class champion, students might think the game is unfair if they immediately lose in their first game and so only get one go at the game.
* Students may think that a predictable sequence like ‘scissors-scissors-scissors’ or ‘rock-paper-scissors-rock-paper-scissors’ is less likely to win compared to a random sequence (in a game where the opponent chooses randomly), which is a common misconception although each individual random sequence is just as likely or unlikely as these two that show a pattern.
* Students may believe that they can make random choice and think that they are good at making random choices, failing to recognise the inherent bias. Include instruction to guide the student to overcome the misconceptions.
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| Strategies | [Using games](https://www.mathematicshub.edu.au/plan-teach-and-assess/teaching/teaching-strategies/using-games-and-storybooks/) [Mathematics investigation](https://www.mathematicshub.edu.au/plan-teach-and-assess/teaching/teaching-strategies/mathematics-investigation/)[Questioning](https://www.mathematicshub.edu.au/plan-teach-and-assess/teaching/teaching-strategies/questioning/) |

**Lesson structure**

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| Learning hook15 mins | **Introduction**Begin with slide 2 from the teacher’s slides. Explain to the students that we are going to play a whole-class game of Rock, paper, scissors to find the champion of the class. Ask if students know how to play and ask a pair of students to demonstrate/explain. Use the Teacher’s slides to clarify how the game works so all learners are clear. Playing the Rock, paper, scissors game provides students with opportunities to follow rules (understand the game algorithm), plan a strategy (problem-solving) and develop their understanding of probability.Have students form pairs. Initially, they will play one game, but if there is a tie, they keep playing until there is a winner. The loser is eliminated (and joins the cheer squad). The winner finds a winner from another pair and again plays. The goal is to keep playing until the class champion is found. The game can be repeated to see if a different class champion is found.Go to slide 3. Ask students the following questions:* How would you classify this game? More towards skill or luck? Why?
* How do you perceive the fairness of the game? Why might some people feel they have an equal chance or not?
* How would you calculate the probability of winning a single game? What factors might influence this probability?

Emphasise that there is a $\frac{1}{3}$ chance of each of a win, loss or tie in a random game. This can be demonstrated by considering the different possibilities. For example, if you play scissors, your opponent could play scissors (tie), paper (win), rock (lose), each with a $\frac{1}{3}$ probability. The same is true if you chose paper or rock first. Use the [questioning](https://www.mathematicshub.edu.au/plan-teach-and-assess/teaching/teaching-strategies/questioning/) strategy specifically here to promote mathematical communication and critical thinking skills.* How do you approach the game strategically?
* What thought process do you go through when deciding on your moves?
* In what ways do you think your experience or strategy might change when playing against a computer compared to a human opponent? Why?

Explain the learning intention and success criteria; next define the terminology (slide 4). Explain that a chance experiment is an investigative process that involves planning and conducting a repeated experiment involving chance with more than one possible outcome; that a trial is a repeated procedure in a chance experiment. Further explain that experimental probability (also known as relative frequency) is the observed probability from a chance experiment, and can be represented as a word equation and calculated as: $\frac{the number of times event occured}{number of trials}$. |
| Body25 mins | * Explain that we are going to run a simulation playing [Rock, paper, scissors](https://www.geogebra.org/m/tn7wppdp#material/U972JMNR) against a computer. Demonstrate on-screen how the simulation works and emphasise that the students must drag the green dot to the centre so that the probabilities as to whether the computer chooses scissors, paper or rock are all 0.33 or 0.34 (slide 5).
* Ask students why they think these probabilities have been chosen. (This is an opportunity to explore equally likely outcomes, the fact that probabilities covering the whole sample space sum to 1, and to discuss rounding and the fact that $\frac{1}{3}≈0.33.$)

Note that in this game, the computer makes a random choice from scissors, paper and rock and does not take account of the human player’s previous choices.* Distribute the Rock, paper, scissors recording sheet. Students work in pairs, with one student playing against the computer and the other counting the number of trials and recording the results. The player should stop after 3, 6, 12, 24 and 48 trials, so their partner can record their results on the recording sheet. Then the two roles will swap (slide 7).
* The results displayed (wins, losses, ties) on screen are from the student player perspective. There are a range of different strategies that students can choose to play.
	+ Students must choose a strategy for a round of 48.
	+ Always play the same move, for example, scissors, scissors, scissors ...
	+ Follow a repeating pattern, for example, rock, paper, scissors, rock, paper, scissors ...
	+ Make their own strategic choice using their judgement.
	+ Make a random choice.

As students complete their trials, they enter their results (48 trials only) into a collective tool (a whiteboard or shared spreadsheet) and complete the questions on their recording sheet. |
| Summary and reflection10 mins | Collect and collate the students’ results after 48 trials (using a whiteboard or projected spreadsheet) and calculate the average experimental probability for the class of a winning, losing and tying (slide 8). Ask: ‘If you compare your results for 3, 6, 12, 24 and 48 trials and those of the whole class what do you notice and wonder?’Explains the law of large numbers: ‘As the number of trials increases, the observed or experimental probability approaches the theoretical or expected probability.’ |
| Assessment | The following opportunity for assessment is suggested for this lesson.Download, print and pre-cut the exit tickets and distribute them to students. They can be accessed in the What you need section.* Calculate! If a player consistently chooses rock every time, what is the probability that they will win against an opponent who chooses randomly?
* Explain! Explain the law of large numbers in your own words and how you saw this in today’s lesson.
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