Y4 The Great Coin Toss Challenge

NEW September 2025

Year level: 4

Approximate number of lessons: 2

Learning goals

- Engage in chance-based investigations with equally likely outcomes by:
  - posing an investigative question
  - anticipate and then identify possible outcomes for the investigative question
  - generating all possible ways to get each outcome (a theoretical approach), or undertaking a probability experiment and recording the occurrences of each outcome
  - creating data visualisations for possible outcomes
  - describe what these data visualisations show
  - finding probabilities as fractions
  - answering the investigative question
  - reflecting on anticipated outcomes
- Agree or disagree with others' conclusions about chance based investigations

Resources

- Year 4 Probability **Glossary**
- Coins, enough for three coins for each group
- Large paper or whiteboard
- Whiteboard markers, pens
- Post it notes
- **The Great Coin Toss Challenge MM1** - for listing outcomes for various numbers of coins
- **The Great Coin Toss Challenge MM2** - table to record outcomes from a probability experiment for tossing two coins
- **The Great Coin Toss Challenge MM3** - bar graph blank to record results of the probability experiment
- Optional - Digital modelling tool with a bar graph generator such as Google Sheets or Microsoft Excel.

Activity | Lesson One

Introduction

Tossing or flipping coins (or similar shaped objects with marked sides) to make a decision has an interesting history across many parts of our world. It is still used today in many sports contexts. Explore the use of coin tossing with ākonga, highlighting the history of the vocabulary ‘heads’ and ‘tails’, and the physical art of flipping the coin with your thumb so that it spins in the air.

It is important to note that ākonga experiences of coin tossing are decreasing as we move towards becoming more of a cashless society. You may like to discuss what ākonga experience instead and why this has come about, for example ‘hide the whistle’ is now often used to determine sides in a sports game.

The first activity explores possible outcomes of a single, double and triple coin toss and makes use of a theoretical approach to find the number of outcomes for a ten coin toss. In the second activity ākonga are guided to conduct a probability experiment to test the theoretical probability of a two coin toss.

? PROBLEM:

- Discuss with ākonga their own experiences flipping coins. Which outcome did they choose, heads or tails? Why did they choose that outcome?

  Ākonga may discuss aspects such as always choosing tails because they feel it is lucky, or maybe choosing tails because it has a kiwi on a particular coin and they love kiwis. They will have many varied reasons that are personal to them. Some ākonga may have never flipped a coin before.

- Have any ākonga experienced a multi-toss, where either there are three coins tossed, or one coin is tossed three times? In a multi-toss the odd outcome is the one that is ‘out’.

  This experience may need to be modelled prior to the lesson. It could be integrated into a PE lesson or utilised as a way of choosing leaders for groups of three within classroom small group learning. Integration will bring purpose to the multi-toss as a useful tool.

- Support ākonga to pose the investigative question, ‘**if we flip a coin a certain number of times, what are the chances of getting H (heads) or T (tails)?**’

PLAN:

- Support ākonga to anticipate the possible outcomes of a single toss - H or T.
  - Ask ākonga, are these outcomes equally likely to happen? Why do you think that? Discuss the concept of a fair coin. *In some children’s magic kits there are two headed and two tailed coins. It may be that children have had an experience with an unfair coin.*
  - Support ākonga to list the possible outcomes of a single coin toss. H or T. Note that there are two possible outcomes.

- Pose the question, what would be the possible outcomes if you flipped the coin twice?
  - Allow ākonga time to discuss and record their own anticipated outcomes for flipping the coin twice. Note that there are four possible outcomes. HH. HT, TT, TH. (HT and TH are similar but different.) Ākonga may record their anticipated outcomes onto post-it notes that are displayed on the whiteboard as ‘anticipated outcomes’.

- Provide each ākonga with a coin. Allow them time to explore coin tossing. Ensure they are flipping accurately with their thumb. You may need to come to a consensus on how the coin lands, whether it lands in one's palm and is then inverted, or whether the way it lands is the end result.

- Guide ākonga to systematically list the possible outcomes of a single and double coin toss displaying the outcomes in a **table** as below.

Number of Tosses	Possible Outcomes	Number of Possible Outcomes
1	H T	2
2	HH, HT TT, TH	4

- Invite ākonga to explore the possible outcomes of a three coin toss. Guide them to systematically record the possible outcomes in the table.

Number of Tosses	Possible Outcomes	Number of Possible Outcomes
1	H T	2
2	HH, HT TT, TH	4
3	HHH, HHT, HTH, HTT, THH, THT, TTH, TTT	8

- Explain the term 'theoretical approach'. For example you might say "when we find a pattern and use the pattern to list all of the different possible outcomes, we call this using a theoretical approach." We can use a theoretical approach to anticipate what might happen if we were to flip a coin four times.
    - Extend the table to make room for a fourth row.

Number of Tosses	Possible Outcomes	Number of Possible Outcomes
1	H T	2
2	HH, HT TT, TH	4
3	HHH, HHT, HTH, HTT, THH, THT, TTH, TTT	8
4		?

- Guide ākonga to notice the pattern in the column 'Number of Possible Outcomes', what number will come next in the pattern? (16 because 2x 8 is 16), *the number of possible outcomes is doubling each time*.
  - Support ākonga to recognise that each number doubles with each added coin toss.
  - Provide time for ākonga to work backwards and systematically check the pattern by recording the 16 possible outcomes for a four coin toss. Did the pattern predict the correct answer?
  - Explore this pattern further by finding out how many possible outcomes would exist for a ten flip coin toss. (There are 1024 possible outcomes)
  - Discuss with ākonga the advantages of a theoretical approach. For example the likelihood of making an error in listing *all 1024 possible outcomes for a ten flip coin toss is high. We are best to find a pattern and use a theoretical approach.*
  - Ākonga may wish to extend this table and explore this pattern further. Allow them time to work with bigger numbers. See **teacher notes** for extension possibilities.

Activity | Lesson Two

❓PROBLEM:

- Restate the investigative question, '**if we flip a coin a certain number of times, what are the chances of getting H (heads) or T (tails)?**'

📋PLAN:

- Remind ākonga that previously you have explored possible outcomes of a coin toss using a theoretical approach, a table.
- Discuss the flipping of two coins and that the occurrence of each of the four outcomes being fair.
  - Guide ākonga to express these outcomes as fractions. This is the theoretical probability.

HH	HT	TH	TT

There is a 1 in 4 chance ($\frac{1}{4}$) that the outcome is HH.

There is a 1 in 4 chance ($\frac{1}{4}$) that the outcome is HT.

There is a 1 in 4 chance ($\frac{1}{4}$) that the outcome is TH.

There is a 1 in 4 chance ($\frac{1}{4}$) that the outcome is TT.

- Discuss with ākonga that in this lesson they will undertake a probability experiment to find out the experimental probability of what actually happens when we toss two coins. We want to find out if our theoretical probability is right, are these outcomes actually equally likely?
    - Support ākonga to make a plan to flip two coins at a time, twenty times. You will need to guide ākonga to design a table to record their results.

Outcome	Tally	Total
HH		
HT		
TH		
TT		
		20 trials

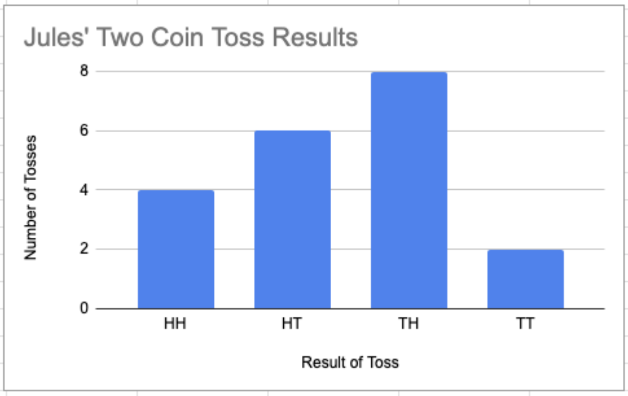
𝍸 DATA:

- Support ākonga to work in groups to flip two coins twenty times, recording their data on the table. See **Material Master 2**.

ANALYSIS:

- Engage ākonga in a discussion of results based on their tally charts. The total for each outcome is the experimental frequency of that outcome. We can find the experimental probability by finding a fraction, a fraction that has the number of times each outcome occurred (Total tally marks) as the numerator and the total number of trials (in this case 20) as the denominator.
    - What does the tally chart show us?
    - Which outcome is most likely?
    - Which outcome is least likely?
- Support ākonga to create a bar chart to display their own findings. You might use a bar graph generator such as Google Sheets or EXCEL, or ākonga may draw their own. A template for a **bar graph** is given in the resources.

My Two Coin Toss Results, by Jules	
HH	4
HT	6
TH	8
TT	2



- Support ākonga to calculate the fractions for each outcome based on the data.

  HH = $\frac{4}{20}$

  HT = $\frac{6}{20}$

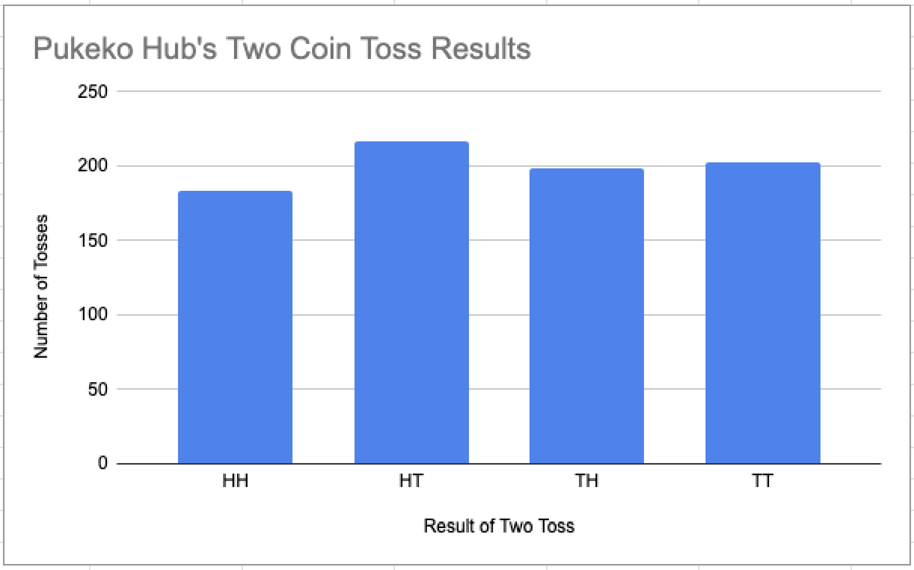
  TH= $\frac{8}{20}$

  TT= $\frac{2}{20}$

- Support ākonga to compare and contrast their findings with other ākonga.
  - Do all ākonga have the same results?
  - The theoretical probability anticipated that each outcome would occur $\frac{1}{4}$ of the time. Was this prediction correct?

- Use a bar graph generator such as Google Sheets or EXCEL to generate a graph that represents the combined data from the whole class.

Pukeko Hub's Two Coin Toss Results	
HH	183
HT	217
TH	198
TT	202
Total Tosses	800



- Engage ākonga is a discussion about the whole class bar graph.
  - What does this bar graph show us?
  - Are all the bars the same?
  - Which result is most likely?
  - Which result is least likely?

- Ask ākonga to compare their own bar graphs with the whole class graph.
  - What do ākonga notice?
    - How are the graphs the same?
    - How are the graphs different?
  - What do ākonga wonder?

- Support ākonga to answer the investigative question **- 'if we flip a coin a certain number of times, what are the chances of getting H (heads) or T (tails)?'**
  - Their answers will hopefully include reference to their theoretical modelling and their own or collective experimental results.

CONCLUSION:

- Guide ākonga to discuss the theoretical probability of a double coin toss.
  - Remind ākonga that the likelihood of each result occurring was $\frac{1}{4}$.

- Guide ākonga to look once more at their own dataset, where the experimental probability was calculated.

- Guide ākonga to look once more at the whole class dataset, where the experimental probability was calculated.
  - Remind ākonga what the likelihood of each result occurring was.

- Discuss the differences observed.

- Which graph displays the most even result?
- Which graph shows the most difference between results?
- Which graph shows an experimental probability closest to the theoretical probability?
- Anticipate what a bar graph might look like that has 1,000,000 two coin tosses.
  - Do ākonga think the bars will look more even? Why?
  - Support ākonga to make a link between the number of tosses and the theoretical probability, that is, the higher the number of tosses, the greater the chance of the results more closely representing the theoretical probability.

Notes for teachers

- **Here** is a clip for kaiako about the history of the coin toss that you may like to watch prior to teaching this lesson. Some themes you may feel are not appropriate for ākonga.
- Lesson One extension could include exploring the algebraic pattern. Some ākonga may recognise this and express it as “2^x, with x = Number of tosses.

Number of Tosses	Possible Outcomes	Pattern	Number of Possible Outcomes
1	H T	2	2
2	HH, HT TT, TH	2x2	4
3	HHH, HHT, HTH, HTT, THH, THT, TTH, TTT	2x2x2	8
4		2x2x2x2	16
10		2x2x2x2x2x2x2x2x2x2	1024

- It is important that ākonga record results as fractions as we provide ākonga with the correct vocabulary to express chance and allow them opportunities to connect their learning with their growing understandings around fractions. Keep in mind that they may hold some misconceptions here and that they will need the visual bar charts to compare and contrast data more accurately.

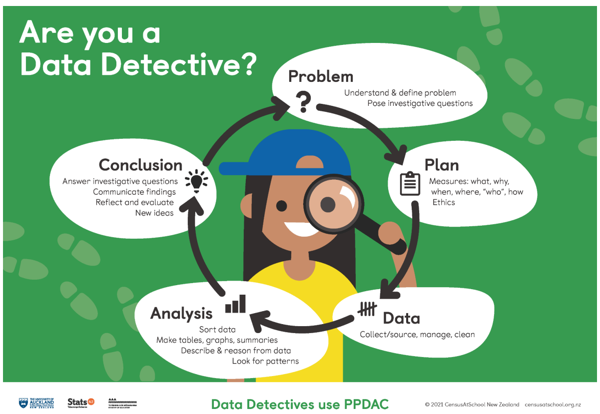
- As a possible extension you could review the purpose of theoretical modelling by posing the following situations.
  - Two coins are being tossed and an ākonga is asked to predict if the result would be the same or different. If they are correct they will win a chocolate bar.
    - Which outcome should the ākonga choose, the same, or different, or does it not matter?
  - Two coins are being tossed, ākonga are asked to predict if they think that both coins will or will not land on heads. If they are correct they will win a chocolate bar.

- Which outcome should the ākonga choose, they will both be heads, or they will not both be heads, or does it not matter?

- Further extension could include a probability experiment around the multi-toss. Are you more likely to get 'out' if you call heads or tails in a multi-toss?
- Home links may include ākonga asking their parents or grandparents about their experiences with coin tosses. They may discuss other ways of making quick decisions such as 'rock, paper, scissors' or 'hide the whistle'.

Year 4 Probability Glossary

The purpose of this glossary is to support kaiako to understand the probability vocabulary that they will be using throughout their teaching. It can act as a discussion tool for staff hui prior to probability being taught.



Data Detective Poster - CensusAtSchool New Zealand

The great coin toss challenge student materials

Resource list with preparation

Resource	Preparation required	Approx numbers
The Great Coin Toss Challenge MM1	Print	Enough for one per ākonga.
The Great Coin Toss Challenge MM2	Print	Enough for one per group. Groups of 2-3 ākonga.
The Great Coin Toss Challenge MM3	Print	Two per page, enough for one per group.

The Great Coin Toss Challenge MM1

Name ___________

Number of Tosses	Possible Outcomes	Number of Possible Outcomes
1		
2		
3		

The Great Coin Toss Challenge MM2

Group Members ______________________________

Data:

Outcome	Tally	Total
HH		
HT		
TH		
TT		
		20 trials

The Great Coin Toss Challenge MM3