YuMi Deadly Maths

Year 7 Teacher Resource:

SP – What are the odds?

Prepared by the YuMi Deadly Centre
Faculty of Education, QUT

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YuMi Deadly Maths Year 7 Teacher Resource: SP – What are the odds?

ACKNOWLEDGEMENT

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Year 7 Statistics and Probability

What are the odds?

Learning goal	Students will calculate the probability for single-step events using sample spaces.
Content description	Statistics and Probability – Chance • Construct sample spaces for single-step experiments with equally likely outcomes (ACMSP167) • Assign probabilities to the outcomes of events and determine probabilities for events (ACMSP168)
Big idea	Probability – theoretical vs frequentist
Resources	Numbers 0–1, fraction and chance cards, hula hoops, chalk of four colours, tally sheet, spinner, colour cards (blue, yellow, red, green), blue/yellow spinner, coins

Reality

Local knowledge

What are events that are certain, or impossible, or sometimes likely to happen in the students' local environment? Discuss the events or happenings and justify why these fall into the stated category.

Prior experience

Number line 0–1: Fraction cards in different formats (e.g. 2 fifths, $^{2}/_{5}$, 0.4, 40%, and other values between zero and one) and chance cards (e.g. equally likely, fair, biased, even chance, impossible, unlikely, some chance, possible, probable, maybe, certain, no chance). Distribute cards and have students peg or place the cards in the appropriate place on the line, zero to one. *What is the range of probability?* [zero or impossible to one or certain, with fractions in varying degrees in between zero and one]. Stress that **probability does not go beyond one**, which represents the certain chance or 100% probability.

Kinaesthetic

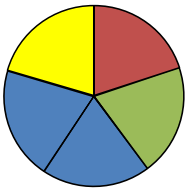
Group work: Students in groups of 4–6. Each group has a hula hoop marked in one place with a strip of black tape. Each group draws a large circle with chalk and divides it into four quadrants that are marked as blue, yellow, green, and red. Students will take turns to stand in the middle of the circle, swing the hula hoop, let it drop to the ground and note the quadrant where the black mark stops. Each student has five turns. Record the colour quadrant each time. Keep a tally of the colour results.

Stages/Questions

1. Identify the whole (i.e. the sample space):
   - *What colours could you spin on this spinner? Would it be possible to spin red? Purple?*
2. Examine the parts for equality:
   - *Has the sample space of this spinner been divided into equal parts? Would the pointer be just as likely to stop on one part as on any other part? (OR: Would you have the same chance of stopping on any of the parts?)*
3. Name the parts (establish the total number of chances, that is, the denominator):
   - *How many equal parts does this spinner have? How many chances do you have altogether of spinning a colour?*
4. Determine the parts to be considered (the outcome preferred, that is, the numerator):
   - *How many blue parts are there? How many chances do you have of spinning blue?*
5. Associate the two parts with the fraction name (the probability):
   - *What chance do you have of spinning blue?* [one chance out of four equal chances]
6. Record the probability: 1 quarter (informal); $^{1}/_{4}$ (formal), 0.25, 25%
7. Compare the theoretical with the group and class experimental probabilities.

Abstraction

Body



Theoretical: *What are the chances of spinning blue on this spinner?* Use questions as in Reality. Calculate the probability of spinning blue and express this as a fraction, decimal and percentage. *What are the chances of spinning yellow, red, green?* Express the probability as above. Place the colour cards equidistant on the ground. Students take turns to spin the pointer, then go to stand in a line behind the colour card where the pointer has stopped. When each student has had a turn, count the number of students in each colour line and calculate the fractions from the relative frequencies in relation to the sample space. Compare the theoretical and experimental probabilities

Hand

Find out if the spinner below is fair (gives each player the same chance of winning). Play with a partner. Decide who will be Blue and who will be Yellow. Take turns in spinning the pointer at least 15 times each. If blue is spun by either player, the Blue player draws a bow on the blue kite's tail. If yellow is spun by either player, the Yellow player draws a bow on the yellow kite's tail.

How many blue bows? How many yellow bows? Calculate the experimental probabilities as a fraction, decimal and percentage. *Did you get what you expected? What is the theoretical probability?* Repeat another 15 times and record on different kites. How do the second trial results compare with the first trial? Add the two trials together and calculate the probability as fraction, decimal and percentage. Is the sum of the two trials getting closer to the theoretical probability? Repeat a third time and observe the differences in experimental and theoretical probabilities.

Mind

Imagine a spinner that has six equal spaces. Use three different colours to make the spinner fair. Can you do this in more ways than one? Use the same colours to make the spinner unfair or biased towards one of the colours. What colour would be impossible to spin on your sample space?

Creativity

Students create their own spinners and explain probabilities and whether the spinners are fair or biased.

Mathematics

Language/ symbols

sample space, probability, likely, equally likely, experiment, favourable outcome, trial, event

Practice

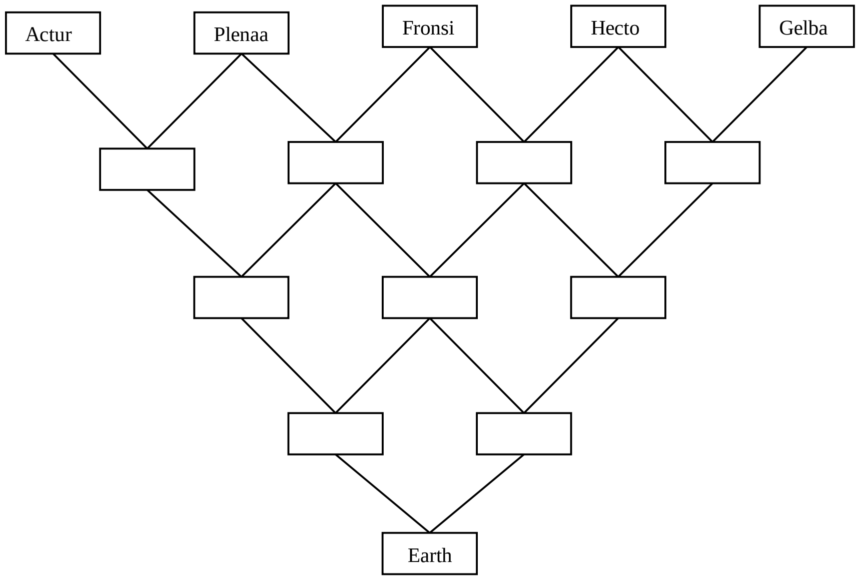
1. **Coin toss**. Answer these questions: Sam tosses a coin. *What outcomes are likely? Are these outcomes equally likely? What is the probability of a tail?* Conduct an experiment: Toss a coin 20 times and record the results for heads and tails. Calculate the experimental probability. *Is the fraction close to the fraction/percentage in the theoretical probability above?*

2. **Die throw**. Work with a partner to throw a die. Discuss the likely outcomes. *Are all numbers equally likely to be thrown? What is the theoretical probability of throwing a 6?* Conduct an experiment of 50 trials and record the outcomes in a tally table for each number. Express the probability as a fraction, decimal, percentage and compare results with the theoretical probability.

3. **Planetfall**

   Materials: one coin, counters, board as below right, 2–6 players.

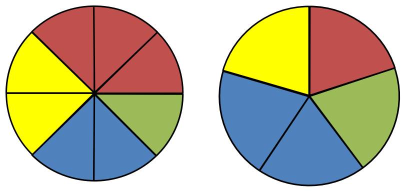
   Rules: Players place counters (spaceships) at start (Earth). Players in turn toss the coin and move left if heads and right if tails. Players score one point for reaching Fronsi, two points for reaching Plenaa or Hecto and three points for reaching Gelba or Actur. The first player to make 10 points wins.



Question (after many games): *What is the most likely planet to reach? Why?*

4. **What's the probability?**

I have been given these two spinners on right:



(a) I can pick the spinner and I can pick the colour. Then I spin the spinner and score a point each time my colour comes up.

(b) *Which spinner and which colour should I choose to get to five points in the least number of spins?* [second spinner, blue $\frac{2}{5} > \frac{3}{8}$ red; $\frac{16}{40} > \frac{15}{40}$]

(c) Set up an experiment: Trial each spinner 10 times. *Did you get what you expected?*

Connections Relate to inference, central tendency, data distribution.

Reflection

Validation Students discuss situations where chance and probability are found in the real world, e.g. board games, card games. They validate other groups' responses to the most likely planet to reach and justify their own response.

Application/ problems Provide applications and problems for students to apply to different real-world contexts independently; e.g. Lucky Jane problem. *Jane wanted to go on the end-of-year trip. Her father gave her five white and five black counters and two identical bags. He told her she could put counters in bags however she wanted but he would take the bags, mix them up and then she would have to choose the bag and one counter from it. If the counter was white she could go on the trip. If it was black she could not go on the trip.*

Jane was clever and so she chose a white and went on the trip. How did she place the counters in the bags to maximise her chance of getting a white?

Extension **Flexibility**. Use different materials to represent the sample space and a variety of approaches to stimulate deep thinking.

Reversing. Students are able to move between an event and its probability, and a probability and an event to fit that probability.

Generalising. *Theoretical probability is based on equally likely outcomes. The probability of what is wanted equals the number of outcomes giving what is wanted divided by the total number of outcomes. Probabilities go from 0 to 1 but not beyond 1. To ensure that* *calculation of fraction probabilities includes all possible outcomes, it is important to build sample spaces of all possible outcomes.*

Changing parameters. Extend to multi-step probability experiments; e.g. If two dice are thrown and added, the sample space is as shown below. It means, for example, that the chance of getting a 7 is the number of outcomes giving 7 divided by the total number of outcomes = $^{6}/_{36}$ or $^{1}/_{6}$.

Two-dice sample space:

2	1,1					
3	1,2	2,1				
4	1,3	2,2	3,1			
5	1,4	2,3	3,2	4,1		
6	1,5	2,4	3,3	4,2	5,1	
7	1,6	2,5	3,4	4,3	5,2	6,1
8	2,6	3,5	4,4	5,3	6,2	
9	3,6	4,5	5,4	6,3		
10	4,6	5,5	6,4			
11	5,6	6,5				
12	6,6					

Teacher's notes

- Ensure that students are able to identify the sample spaces and that they understand the probability rule to determine the fraction that describes an event's probability. Check that students have a sound knowledge and understanding of converting a fraction to a decimal to percentage starting from any given type and that they are able to make equivalent fractions.
- Students need to be taught the skill of visualising: closing their eyes and seeing pictures in their minds, making mental images; e.g. show a picture of a spinner, students look at it, remove the picture, students then close their eyes and see the picture in their mind; then make a mental picture of a different spinner.
- Suggestions in Local Knowledge are only a guide. It is very important that examples in Reality are taken from the local environment that have significance to the local culture and come from the students' experience of their local environment.
- Useful websites for resources: www.rrr.edu.au; https://www.qcaa.qld.edu.au/3035.html
- Explicit teaching that **aligns with students' understanding** is part of every section of the RAMR cycle and has particular emphasis in the Mathematics section. The RAMR cycle is not always linear but may necessitate revisiting the previous stage/s at any given point.
- Reflection on the concept may happen at any stage of the RAMR cycle to reinforce the concept being taught. Validation, Application, and the last two parts of Extension should not be undertaken until students have mastered the mathematical concept as students need the foundation in order to be able to validate, apply, generalise and change parameters.

