Probability Matters (Level 2)

Description	The learner will explore the concept of chances and probability and learn how to calculate probability. They will use these concepts to design games based on probability.
Leading Question	Can you design a game using probability?
Total Time Required	5 hours over 5 days
Supplies Required	A4 papers, cardboard, pencil, colors, ruler, household items: any dish or circle-shaped tray, glass, scissors, glue, empty plastic bottles.
Learning Outcomes	1. Learners will create coins and dice and use them to understand chance and calculate probability. 2. Learners will create a spinner and use it to understand and compute probabilities 3. Collect data on the chances of an outcome using tables. 4. Understanding how to use a Venn diagram to represent and calculate the probability of outcomes. 5. Investigate chance processes and develop, use, and evaluate probability models.
Previous Learning	• Counting up to 100. • Drawing a straight line. • Multiplication tables • Knowledge of the different types of animals (live in sea or land)

Day 1

Today you will learn about what chances and probability are.

Suggested Duration	Activity and Description

10 minutes	• Introduce the concept of chances and probability
	• Here are some questions to learn about probability. Note that:
	  ○ Some of the questions have one answer
	  ○ Some answers are either true or false

	○ Some questions have multiple choices that means you must choose the correct answer. ○ Some have no right or wrong answers. ● Questions: 1- What is your name? 2- How many sisters/brothers do you have? 3- How many wings does a bird have? 4- How many tails does a cat have? 5- Do fish live in the desert? True or False 6- Can snakes run? True or False 7- Does an elephant have a trunk? True or False 8- Do airplanes need railways to travel on? True or False 9- Choose the correct answer: Falcons can (fly walk swim) 10- Choose the correct answer: A football team has (3 11 14) players. 11- If I have two pencils, one is red and one is green, which one would you choose? 12- If there are three pieces of biscuits with the same taste but different shapes: one is shaped like a circle, one is shaped like a car, one is shaped like a flower, which one will you choose? 13- If there are two storybooks, one about Batman (or any hero that you are familiar with) and one about traveling around the world, which one would you choose? Reflect on questions 11, 12, and 13. ● There are outcomes (the possible result of an experiment or trial) in life that there are no rights or wrongs. ● By the end of this project you will learn how to calculate possibilities or probability for each outcome. ● Probability can be defined as the extent to which an event is likely to occur, measured by the ratio of the favorable cases to the whole number of cases possible.
15 minutes	● Design your own two coins: - Find any household shaped like a small circle then use it to draw two circles on cardboard. Cut out those two circles. - Draw two animals: one lives in the sea (dolphin, shark, etc.) and the other animal lives on land (sheep, cow, fox, etc.) - On one side draw the head of the animal and on the other side draw the tail of the same animal for each coin. - Color (with a color of your own choice) the animals as well, because you are going to play some games with those coins.
20 minutes	● **One Coin Experiment**

- Choose one of the two coins to toss 6 times and each time write which side it landed on: heads or tails.
- Count how many times the coin landed on heads or tails out of the six times. This data can be captured in a table like the one in the example below.
- Calculate the probability or chances of getting one outcome e.g., probability of coin toss landing on the head of the coin.
- For example, if you get heads 4 times out 6, explain how we calculate the probability or chances of heads falling 4 out of 6. Older learners with knowledge of writing fractions can write:
- P (H) = $\frac{4}{6}$ or P (H) is 4 out of 6 times.

1	H
2	T
3	H
4	H
5	H
6	T

Two coin Experiment

- Repeat the same activity with two coins by tossing the two coins and on a table of three columns write what the outcomes are each time you toss the coin. For example:

	Dolphin	Rabbit
1	H	T
2	H	H
3	T	H
4	H	H
5	T	T
6	H	H

- How many times did both coins land on heads (HH)? How many times did both coins land on tails (TT)? How many times did the coins land heads and tails (HT) or (TH)?

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In the above table above table (HH)=3 (TT)=1 (HT)=2

So this is how we calculate the probability P(HH)= $\frac{3}{6}$ P(TT)= $\frac{1}{6}$ P(HT)= $\frac{2}{6}$

Add the probability of HH, TT, HT. What do they observe when you add them up?
When we add the probabilities of the 6 tosses, it will equal $\frac{6}{6}$ and this is for all outcomes when we add all the probabilities the numerator will be equal to the denominator which is equal to 1.

Three coin Experiment

Repeat the same activity with three coins
On a table of 4 columns, write down what the outcomes are of each trial.

Example:
<table>
<tr><td></td><td>Dolphin</td><td>Rabbit</td><td>Falcon</td></tr>
<tr><td>1</td><td>H</td><td>H</td><td>H</td></tr>
<tr><td>2</td><td>H</td><td>H</td><td>T</td></tr>
<tr><td>3</td><td>H</td><td>T</td><td>H</td></tr>
<tr><td>4</td><td>H</td><td>H</td><td>H</td></tr>
<tr><td>5</td><td>T</td><td>T</td><td>H</td></tr>
<tr><td>6</td><td>T</td><td>T</td><td>T</td></tr>
</table>

For example, the three coins landed on heads 2 out of 6 trials
That means P(HHH)= $\frac{2}{6}$

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Calculate the following outcomes:

All three coins landed on tails TTT
Coins landed on two tails and one heads TTH or HTT or THT
Coins landed on two heads and one tails HHT or THH or HTH

Remember that the sum of all the probabilities will eventually equal one.
Reflect on the three experiments, what are the expected outcomes in each experiment?
Solution:

One coin experiment has 2 possible outcomes 2 x 1 (T or H)
Two coin experiment has 4 possible outcomes 2 x 2 (HH,HT,TH,TT)

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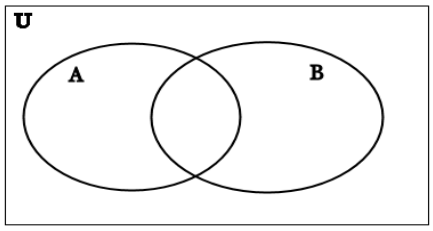
	- Three coins landed eight possible outcomes 2 × 2 × 2 = 8 (HHH, HHT, HTH, HTT, THH, THT, TTH, and TTT) - Some outcomes will not happen so there is no right or wrong. The calculation of the outcome equals to zero. previous example P(THT)= 0 ● One coin experiment has 2 possible outcomes 2 x 1 (T or H) ● Two-coin experiment has 4 possible outcomes 2 x 2 (HH, HT, TH, TT) ● Three coins landed eight possible outcomes 2 × 2 × 2 = 8 (HHH, HHT, HTH, HTT, THH, THT, TTH, and TTT) Some outcomes will not happen so there is no right or wrong. The calculation of the outcome equals zero. previous example P(THT)= 0

Day 2

Today you will learn about Venn diagrams.

Suggested Duration	Activity and Description
10 minutes	● Draw two circles to represent the following: ● In a classroom, there are 10 students who like football, 6 students who like basketball and 4 students who like both basketball and football. ● Circle A represents students that like football, circle B represents students that like basketball and the center where the two circles intersect, represents the students that like both football and basketball. We call this a **VENN diagram**. We use it to represent probability.  ● U = total number of students in the classroom = 20 ● Football, A = 10, Basketball, B = 6, Football and basketball = 4 ● Circle A represents students that like football, circle B represents students that like basketball and the center where the two circles intersect, represents the students that like both football and basketball. We call this a VENN diagram. We use it to represent probability. - Calculate the probability of students that like football. P(f)=$\frac{10}{20}$= $\frac{1}{2}$

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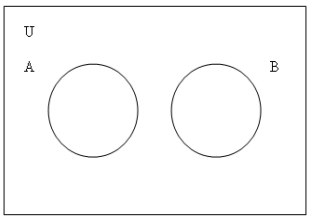
	- Answer: P(football or A)= $\frac{10}{20}$= $\frac{1}{2}$ - Calculate the probability of students that like basketball. P(b)= $\frac{6}{20}$= $\frac{3}{10}$ - Answer: P(basketball or B)= $\frac{6}{20}$= $\frac{3}{10}$ - Calculate the probability of students that like basketball and football. Answer: P (football and basketball) = $\frac{4}{20}$= $\frac{1}{5}$. Always simplify fractions.
10 minutes	● Draw a Venn diagram to represent your favorite colors/ animals/household items or any other item you choose and your friend's favorite colors /animals/household items or any other item they choose. ● If there are common colors/animals/household items or any other item they have chosen, the diagram will be similar to the above diagram. ● Calculate the probability of your favorite colors/animals/household items or any other item you chose and your friend's favorite colors/animals/household items or any other item they choose. ● If there are no common favorite colors/animals/household items or any other item they choose, the diagram will be two separate circles.  ● Calculate the probability of your favorite colors/animals/household items or any other item you chose. ● Calculate the probability of your friend's favorite colors/animals/household items or any other item they choose.
10 minutes	● Teach your friends and family members how to design 3 creative coins and play different rounds of the game, for example: 1. Toss 2 coins, 20 times. Players will draw their table and record the outcomes. Then the player who has the highest number of the two coins landing Heads P (HH) wins. 2. Tossing 2 coins, 30 times. The player who has the highest number of two coins landed on heads and tails P(HT) wins 3. Tossing 3 coins, 20 times. Each player will draw their table and record the outcomes. The player who has the highest number of 3 coins landed with two heads and one tails P(HHT) wins
15 minutes	Present all the day's work to your parents or family members for feedback and suggestions for improvement. The parents or family members should provide feedback using the following format:

	• Praise: What did you like about the learner's work done? • Question: Any questions or clarifications you have about the work? • Suggestions: In what areas does the learner need to improve their work?

Day 3

Today you will create a spinner and play a game with it.

Suggested Duration	Activity and Description
20 minutes	• Draw a circle on cardboard,the bigger the better (dish, tray, bicycle wheel) to draw a circle on cardboard paper, and cut out this circle. • Divide the circle into four equal parts by drawing two lines that intersect in the center of the circle. Color each part with a different color (red, green, blue, yellow, etc.) • Draw a line and cut it out to use as a pointer. • In the center of the circle, make a hole with a pencil and use a thread to locate this pointer to the center of the circle. It should not be too tight and not too loose but easy to spin. (Use a pin instead of thread if that does not work.)  • Develop a table for this experiment. Spin the pointer and calculate the probability for each color if you repeat it for six times.

1	R
2	G
3	B
4	G

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	<table><tr><td>5</td><td>B</td></tr><tr><td>6</td><td>R</td></tr></table> • Calculating Probability: E.g. If you use the spinner 6 times, and the pointer lands on green 2 times out of 6: P(G)= $\frac{2}{6}$ • If the pointer landed on red 2 times out of 6: P(R) = $\frac{2}{6}$ and so on • Add up all the probabilities computed through this activity. What do you observe? • Reflect and find out that the addition of the probability of all four colors in each experiment will be $\frac{6}{6}$.
20 minutes	• Draw a new circle and cut it out. Divide it into 8 parts. • Draw 8 different items with the same theme like school stationary, kitchen items, food items, clothes, etc. • Teach your friends and family to create their own spinner with the same theme. • Each player spins the spinner 20 times and writes it down on their own piece of paper and then finds out the outcomes. • For example, if you are using the food theme, the one who has the highest pointer landed on bread will be the winner.
15 minutes	• If a friend sent you a message saying, “I heard that probability is a very interesting topic, I wish I knew more about it”, could you write a paragraph to explain what you have learnt about probability (include what you liked, what did not like, what you have learnt) with simple examples.

Day 4

Today you will learn about the probability of outcomes based on dice.

Suggested Duration	Activity and Description

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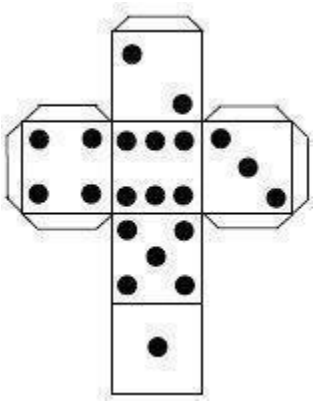
Design a cube:
Draw, cut and glue the below to make your own dice, the lines will be folded and stuck together in the shape of a cube.


Color your dice with a color of your own choice.
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<td>10 minutes</td>
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The outcomes of rolling a dice are (1, 2, 3, 4, 5, 6)
Draw a table of two columns like the one below and roll the dice 10 times
Record the outcome of each roll
Example of table:

<table>
<tr><td>Roll</td><td>Number on Dice</td></tr>
<tr><td>1</td><td>4</td></tr>
<tr><td>2</td><td>6</td></tr>
<tr><td>3</td><td>…</td></tr>
<tr><td>… 10</td><td>…</td></tr>
</table>

Calculate the probability of getting 4 or 1, P(4) or P(1), e.g., if 4 showed up 2 times on the dice, then P(4) = $\frac{}{10} = \frac{}{5}$
Calculate the probability of all the outcomes you had in this experiment depending on the numbers that showed up on the dice each time it was rolled.
Add them all and reflect. What do you observe when you add them up? Answer: The sum is 10/10 which is equal to 1.

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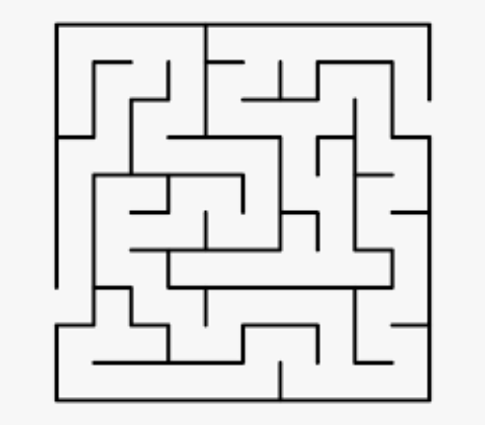
</table>

20 minutes	● Who will get to the end first? - Teach a friend to draw and create a dice. - On the floor draw two mazes divided into steps with some cushions or chairs (make sure both mazes are the same difficulty) See example of a maze below:  - Each player rolls his dice according to the number the dice lands on and moves that amount of steps. - The one who finishes first wins.
15 minutes	Present all the day's work to your parents or family members for feedback and suggestions for improvement. The parents or family members should provide feedback using the following format: ● Praise: What did you like about the learner's work? ● Question: Any questions or clarifications you have about the work? ● Suggestions: In what areas does the learner need to improve their work?

Day 5

Today you are going to learn how to compute probability when we roll two dice and create our own game club.

Suggested Duration	Activity and Description
10 minutes	● Make a second dice and color it. ● Challenge: Discover how many possible outcomes can happen when you roll two dice at the same time.

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- The answer is 36 outcomes
  (1, 2). (1, 1), (1, 3). (1, 4)….

	1	2	3	4	5	6
1	(1,1)	(1,2)	(1,3)	(1,4)	(1,5)	(1,6)
2	(2,1)	(2,2)	(2,3)	(2,4)	(2,5)	(2,6)
3	(3,1)	(3,2)	(3,3)	(3,4)	(3,5)	(3,6)
4	(4,1)	(4,2)	(4,3)	(4,4)	(4,5)	(4,6)
5	(5,1)	(5,2)	(5,3)	(5,4)	(5,5)	(5,6)
6	(6,1)	(6,2)	(6,3)	(6,4)	(6,5)	(6,6)

  - Roll the two dice 10 times. Draw a table and calculate the probability of P (6, 3), P (5, 1), and P (3, 2).
  - Remember that if one of the outcomes did not happen the probability equals zero.
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<tr><td>20 minutes</td><td>

- Create your own game using one or two dice. Be creative!
- Try the game and play it with other players. Remember to write down and draw the details of your game.
</td></tr>
<tr><td>30 minutes</td><td>

- Collect 3 empty, equal sized plastic bottles.
- How can we get rid of any item made of plastic?

  - Fill two plastic bottles halfway with water.
  - Flip both bottles at the same time. What are the possible outcomes of this experiment? They are top, bottom and side of the bottle.
  - Which outcome has more chances of happening? Which outcome has less chances of happening? Why?
  - The chances of the bottle landing on its side has more chances to happen, so we would say this outcome is ‘likely’ to happen.
  - The chances of the bottle landing on its top has less chances to happen, so we would say this outcome is ‘unlikely’ to happen.
  - Ask friends and family members to each fill 2 bottles halfway with water. Make sure all bottles are the same size.
  - Each player flips the two water bottles at the same time 10 times
  - The one who lands the bottles on the bottom most wins.
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<tr><td>30 minutes</td><td>

- Create your own “game club” and display all the games you have created. Invite friends and siblings to join and play all the games you have created.
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Think about all the exercises you have done for the past 3 days and take note of “TWO” of the following:

- What is the most important lesson you have learnt through this project?
- What are you found challenging, puzzling or difficult to understand?
- What question would you most like to discuss?
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	• What is something you found interesting?

Additional enrichment activities:	• Develop more games using probability to add to their "game club" • If students have internet they can play this game online: https://www.youtube.com/watch?v=4IQpe3J-2AU

ASSESSMENT CRITERIA

A majority of my learners were able to:

- Show creativity in designing the coins using drawing of animals (heads and tails).
- Show creativity in designing spinners and posters.
- Accurately calculate the probabilities of different basic outcomes in different experiments.
- Show creativity in designing the game club.
- Draw accurate squares.
- Build an accurate 3D shape (cube).
- Show creativity in developing new games using probability.