

Discovering Math: Probability and Chance

Teacher's Guide

Grade Level: 3–5

Curriculum Focus: Mathematics

Lesson Duration: Three class periods

Program Description

Discovering Math: Probability and Chance – From the concept of chance to statistical predictions to basic sample spaces, introduce elementary students to more advanced concepts of probability.

Lesson Plan

Student Objectives

- Demonstrate an understanding that chance refers to the likelihood of an event.
- Demonstrate an understanding of likely, unlikely, certain, and impossible events.
- Make predictions about an event based on what is known about the history of the event.
- Use basic sample spaces to describe and predict events.

Materials

- *Discovering Math: Probability and Chance* video
- Spinner Template (see below)
- Crayons, colored pencils, or markers
- Paperclips
- Map of school playground, divided into four sections
- Prediction Chart (see below)

Procedures

1. Display the word chance. Ask students to discuss the word chance and share their thoughts about its meaning in the context of the video. Chance refers to the likelihood that a specific event will occur.

Ask students to identify words used to describe the chance of an event occurring. Create a list of words that should include likely, unlikely, certain, and impossible. Have students give examples of likely, unlikely, impossible, and certain events (students can draw on personal experiences or examples from the video).

- Distribute four copies of the Spinner Template and one paperclip to each student. Tell them that they will be creating spinners that should produce likely, unlikely, certain, and impossible events.

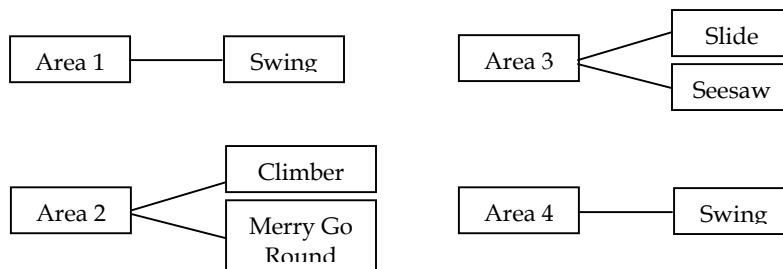
Have students create a spinner that has a likely chance of landing on red.

- They should divide the circle into sections and color each so there is a likely chance of landing on red (e.g., half of the circle is red, one-fourth is blue, and one-fourth is green). Spinners will vary.
 - When complete, have students trade spinners. Model how to use the spinner. Place the point of the pencil through the paperclip and center it on the dot in the middle of the circle. Flick the paperclip so it spins around the pencil. When the paperclip stops spinning, the section it is in is the outcome of the spin.
 - Have students spin their spinners ten times and record the outcomes. They should determine if the spinners are more likely to land on red than any other color and explain their conclusions.
- Have students create a spinner that has an unlikely chance of landing on red.
 - They should divide the circle into sections and color each so there is an unlikely chance of landing on red (e.g., half of the circle is blue, one-eighth is red, and seven-eighths is green). Spinners will vary.
 - When complete, have students trade spinners. Have them spin the spinners ten times and record the outcomes. They should determine if the spinners are less likely to land on red than any other color and explain their conclusions.
 - Have students create a spinner that has a certain chance of landing on red.
 - They should color the circle so there is a certain chance of landing on red (e.g., the whole circle is red).
 - When complete, have students trade spinners. Have them spin the spinners ten times and record the outcomes. They should determine if the spinners are certain to land on red and explain their conclusions.
 - Have students create a spinner that has an impossible chance of landing on red.
 - They should color the circle so there is an impossible chance of landing on red (e.g., there is no red on the circle).
 - When complete, have students trade spinners. Have them spin the spinners ten times and record the outcomes. They should determine if the chance of landing on red is impossible and explain their conclusions.
2. Ask students how they can predict what someone will do in a certain situation. For example, if someone is hungry and there is a refrigerator nearby, what might the person do? Ask students how and why they make predictions, and have them share their ideas and thoughts. Remind them to think about what they learned in the video. They should recall that history, patterns, and given information can help make accurate predictions.

- Tell students they will be predicting where students will initially play at recess. Distribute a copy of the playground map to each student. Have them discuss where they think students will play at recess. Remind them to consider past events (past recesses) and any other given information (if it rained the night before the might be a puddle at the bottom of the slide).
 - Have students predict where students will go first at recess. Tell them the approximate number of students that will be out at recess. They should identify how many students will be play in each area and record their predictions in the Prediction Chart.
 - Students should explain their predictions in writing. Model an explanation: I predict that only 10 kids will play in area 3 because it is not a large area.
 - During recess have students observe and record the where students are playing during the first five minutes of recess (if they are the only ones on the playground, the teacher will have to record the number of students at each area).
 - After recess (or the next class period) have students compare their predictions to the actual data. They should discuss the accuracy of their predictions and explain why or why not their predictions were accurate.
3. Display the term sample space. Ask students to describe a sample space, thinking about examples from the video. They should recall that a sample space is a list of all the possible outcomes of an event.

Tell students they will create the sample space for the playground.

- Remind students of the sample space that was modeled in the video (at bats in baseball). Model another sample space if they need more review.
- Have students create the sample space for the playground. They can use a tree diagram to organize the information. If the playground was divided into four sections the students should have four starting points: Area 1, Area 2, Area 3, and Area 4. Each piece of equipment in an area will be a branch (or outcome) on the tree diagram (see example below).



- Ask students to describe how they could use the sample space to make future predictions of where students will play on the playground.
4. Extension: Have students think of another event they could predict. Have them create a sample space diagram and predict the outcomes. They can record the data, make conclusions about their predictions, and share with the class.

Assessment

Use the following three-point rubric to evaluate students' work during this lesson.

- **3 points:** Students were highly engaged in class discussions; produced accurate spinners and charts, including all the requested information; clearly demonstrated an understanding of likely, unlikely, certain, and impossible events; clearly demonstrated an understanding of and the ability to make predictions about events based on history and given information; and clearly demonstrated an understanding of sample spaces.
- **2 points:** Students participated in class discussions; produced adequate spinners and charts, including most of the requested information; satisfactorily demonstrated an understanding of likely, unlikely, certain, and impossible events; satisfactorily demonstrated an understanding of and the ability to make predictions about events based on history and given information; and satisfactorily demonstrated an understanding of sample spaces.
- **1 point:** Students participated minimally in class discussions; produced incomplete spinners and charts with little or none of the requested information; did not demonstrate an understanding of likely, unlikely, certain, and impossible events; did not demonstrate an understanding of and the ability to make predictions about events based on history and given information; and did not demonstrate an understanding of sample spaces.

Vocabulary

certain event

Definition: an event that will definitely occur

Context: The sun rising every morning is a certain event.

chance

Definition: the likelihood that an event will happen

Context: The chance that it will rain on a sunny day is unlikely.

impossible event

Definition: an event that will never occur

Context: A rose bush growing from an apple seed is an impossible event.

likely event

Definition: an event that has a good chance of occurring

Context: Having someone say happy birthday to you on your birthday is a likely event.

sample space

Definition: all the possible outcomes of an event

Context: The students determined that the sample space for flipping a coin is head and tails.

unlikely event

Definition: an event that has a poor chance of occurring

Context: Selecting a red marble from a bag is an unlikely event when only 1 out of 50 marbles in the bag is red.

Academic Standards

Mid-continent Research for Education and Learning (McREL)

McREL's Content Knowledge: A Compendium of Standards and Benchmarks for K-12 Education addresses 14 content areas. To view the standards and benchmarks, visit

<http://www.mcrel.org/compendium/browse.asp>.

This lesson plan addresses the following benchmarks:

- Understands that the word "chance" refers to the likelihood of an event
- Recognizes events that are sure to happen, events that are sure not to happen, and events that may or may not happen
- Understands that when predictions are based on what is known about the past, one must assume that conditions stay the same from the past event to the predicted future event
- Understands that statistical predictions are better for describing what proportion of a group will experience something rather than which individuals within the group will experience something, and how often events will occur rather than exactly when they will occur
- Uses basic sample spaces to describe and predict events

National Council of Teachers of Mathematics (NCTM)

The National Council of Teachers of Mathematics (NCTM) has developed national standards to provide guidelines for teaching mathematics. To view the standards online, go to

<http://standards.nctm.org>.

This lesson plan addresses the following standards:

- Describe events as likely or unlikely and discuss the degree of likelihood using such words as certain, equally likely, and impossible
- Predict the probability of outcomes of simple experiments and test the predictions
- Understand that the measure of the likelihood of an event can be represented by a number from 0 to 1
- Propose and justify conclusions and predictions that are based on data and design studies to further investigate the conclusions or predictions

Support Materials

Develop custom worksheets, educational puzzles, online quizzes, and more with the free teaching tools offered on the Discoveryschool.com Web site. Create and print support materials, or save them to a Custom Classroom account for future use. To learn more, visit

- <http://school.discovery.com/teachingtools/teachingtools.html>



DVD Content

This program is available in an interactive DVD format. The following information and activities are specific to the DVD version.

How to Use the DVD

The DVD starting screen has the following options:

Play Video – This plays the video from start to finish. There are no programmed stops, except by using a remote control. With a computer, depending on the particular software player, a pause button is included with the other video controls.

Video Index – Here the video is divided into chapters indicated by title. Each chapter is then divided into four sections indicated by video thumbnail icons; brief descriptions are noted for each section. To play a particular segment, press Enter on the remote for TV playback; on a computer, click once to highlight a thumbnail and read the accompanying text description and click again to start the video.

Quiz – Each chapter has four interactive quiz questions correlated to each of the chapter's four sections.

Standards Link – Selecting this option displays a single screen that lists the national academic standards the video addresses.

Teacher Resources – This screen gives the technical support number and Web site address.

Video Index

I. Chance (7 min.)

Chance: Introduction

Chance is defined as the likelihood that an event will happen. Environmental factors affect the chance of an event occurring.

Example 1: Likely Events

Circles divided into three and four equal sections are used to model the likelihood of an event occurring. Equally likely, more likely, and less likely events are modeled and explained.

Example 2: Unlikely Events

A spinner divided into 10 equal sections is used to model an unlikely event.

Example 3: Changing Chances by Changing Conditions

A spinner is modified so the chance of an event becomes more likely. People change the chances of events by changing their behavior in ways that make the events more or less likely to occur.

II. Certainty and Likelihood (5 min.)

Certainty and Likelihood: Introduction

Probability is the likelihood of events occurring. Probabilities can be high or low, certain, likely, uncertain, unlikely, or impossible. Behaviors can affect the probability of events occurring.

Example 1: Certain and Impossible Events

The probability of events that will defiantly occur is 1. The probability of impossible events is 0. Certain and impossible events are explained and modeled with flower seeds.

Example 2: Likely and Unlikely Events

Seasonal weather patterns are used to model likely and unlikely events. Likely events have a high probability and unlikely events have a low probability.

Example 3: Uncertainty, Possibility, and Probability

Weather forecasters predict the possibility of rain. The percentage they give represents the probability of rain.

III. Uniformity (7 min.)

Uniformity: Introduction

The humpback whale population is used to show how changes in conditions can affect future events such as population increases or decreases.

Example 1: Predictions That Require Stable Conditions

Some predictions require stable conditions. Rain forest and desert ecosystems survive due to conditions such as rainfall and temperature.

Example 2: Changing Conditions Affect Predictions

Alaskan bear behavior shows how changing conditions affect predictions.

Example 3: Reliability of Predictions Under Variable Conditions

Predictions based on variable conditions can be unreliable. Pineapple farmers predict their crops based on average yearly rainfall. When the rainfall varies from the average, the crop prediction is unreliable.

IV. Group and Individual Predictions (6 min.)

Group and Individual Predictions: Introduction

It is easier to make general predictions about what will happen with a large group of people rather than specific predictions for individuals.

Example 1: Group Predictions Based on Random Possibilities

A deck of 20 cards shows how accurate predictions can be made about the probability of specific events occurring based on random possibilities – like picking specific types of cards.

Example 2: Group Predictions Based on Historical Data

Historical data is used to make general predictions about large groups, such as sea turtle populations, which is used as a model. Making predictions about specific individuals within a group is difficult.

Example 3: Individual Probabilities Over Time

A baseball player's batting average shows how predictions about an individual change based on performance. Predictions about a large number of events are more reliable than ones made about individual events.

V. Sample Spaces (10 min.)

Sample Spaces: Introduction

A sample space is all the possible outcomes of an event. Tree diagrams are used to organize the sample space and find the probability of each outcome.

Example 1: Listing All Possible Outcomes

Tossing a coin shows equally likely outcomes. Making a list to show all the possible outcomes can represent how the event will turn out.

Example 2: Tree Diagram for a Sample Space

A tree diagram is used to show the outcomes of being at bat. It lists all possible outcomes of an event and indicates the structure of a sample space.

Example 3: Describing Likelihood of Outcomes

It is possible to describe the likelihood or probability of a specific outcome based on the sample space.

Quiz

I. Chance

1. Carol has a bag with 10 marbles. Inside are 5 red marbles, 2 blue marbles, 2 yellow marbles, and 1 green marble. Which color marble is more likely to be chosen from the bag?
 - A. red
 - B. blue
 - C. green
 - D. yellow

Answer: A

2. Carol has a bag with 10 marbles. Inside are 5 red marbles, 2 blue marbles, 2 yellow marbles, and 1 green marble. Which color marble is less likely to be chosen from the bag?
 - A. red
 - B. blue
 - C. green
 - D. yellow

Answer: C

3. Carol has a bag with 10 marbles. Inside are 5 red marbles, 2 blue marbles, 2 yellow marbles, and 1 green marble. How can Carol increase her chances of choosing a green marble from the bag?
- A. add more blue marbles to the bag
 - B. add more green marbles to the bag
 - C. add more yellow marbles to the bag
 - D. remove the green marble from the bag

Answer: B

II. Certainty and Likelihood

1. Lisa jumped off the diving board into the pool. Which event is certain and has a probability of 1.
- A. Lisa will be wet.
 - B. Lisa will do a flip in the air.
 - C. Lisa will jump off the diving board again.
 - D. Lisa will swim to the other side of the pool before getting out of the water.

Answer: A

2. John planted only tomato plant seeds in his garden. Which event is impossible?
- A. John will water the seeds to help them grow.
 - B. Sunflowers will grow where John planted the seeds.
 - C. Tomato plants will grow where John planted the seeds.
 - D. Tomato plants will not grow where John planted the seeds.

Answer: B

3. You are traveling to Aspen, Colorado, to go skiing in January. Which event has the highest probability of occurring?
- A. It will snow.
 - B. The snow will melt.
 - C. You will be able to go swimming outside.
 - D. It will be hot enough to wear a bathing suit.

Answer: A

4. The weather forecaster predicts a 90 percent chance of rain. What should you take with you when you leave your house?
- A. a scarf
 - B. an umbrella
 - C. sunglasses
 - D. snow boots

Answer: B

III. Uniformity

1. Devin wants to move to an environment that gets between one and two feet of rain a year. He collected yearly rainfall data on four environments. If yearly rainfall is a stable condition, predict the environment that Devin will choose.
 - A. desert
 - B. grassland
 - C. rainforest
 - D. temperate forest

Environment	Yearly Rainfall
Desert	Less than 12 inches
Grassland	10–30 inches
Rain forest	80–400 inches
Temperate Forest	30–60 inches

Answer: B

2. Jack and Ryan were playing outside in the morning until 11:00 a.m., when they saw thunder, lightning, and rain. What prediction can you make based on the change in conditions?
 - A. Jack and Ryan will go inside to play.
 - B. Jack and Ryan will continue to play outside.
 - C. Jack and Ryan will bring their lunches outside to have a picnic.
 - D. Jack and Ryan will get their bikes out of the garage and ride around the block.

Answer: A

3. When the variability of conditions increases, the reliability of predictions _____.
 - A. increases
 - B. decreases
 - C. stays the same
 - D. cannot be determined

Answer: B

IV. Group and Individual Predictions

1. About one-fourth of the people who play the Pop-the-Balloon game at the carnival win. If 60 people play the game, predict how many people will win.
 - A. 4
 - B. 12
 - C. 15
 - D. 30

Answer: C

2. Paula has a deck of 30 cards: 10 are blue, 10 are yellow, and 10 are green. Predict the probability of choosing a yellow card from the deck.
- A. $\frac{1}{30}$
 - B. $\frac{1}{10}$
 - C. $\frac{3}{10}$
 - D. $\frac{1}{3}$

Answer: D

3. A hundred students went on a field trip to the zoo and one-fifth of them saw the dolphin show. Based on this information, what prediction can be made about the students?
- A. the other shows the students saw at the zoo
 - B. the specific students that saw the dolphin show
 - C. the number of students that saw the dolphin show
 - D. the number of students that visited the monkey house

Answer: C

4. Nick's batting average is .320. What percentage of the time can you predict Nick will get a hit when he's at bat?
- A. 20%
 - B. 30%
 - C. 32%
 - D. 68%

Answer: C

V. Sample Spaces

1. What term describes all the possible outcomes of an event?
- A. probability
 - B. tree diagram
 - C. sample space
 - D. sample outcomes

Answer: C

2. Harry flips a coin 10 times. He records the results in a chart. What is the probability of getting a tail on the 10th flip of the coin?

- A. $\frac{1}{10}$
 B. $\frac{2}{10}$
 C. $\frac{1}{2}$
 D. $\frac{6}{10}$

Flip	Outcome
1	heads
2	tails
3	tails
4	tails
5	tails
6	tails
7	heads
8	heads
9	tails
10	?

Answer: C

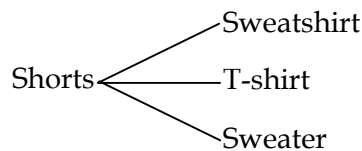
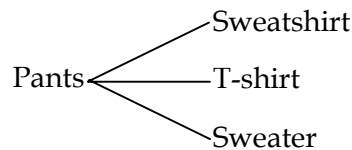
3. What tool can be used to organize and display the possible outcomes of an event and show the structure of the sample space?

- A. tree chart
 B. tree diagram
 C. possibility chart
 D. outcome diagram

Answer: B

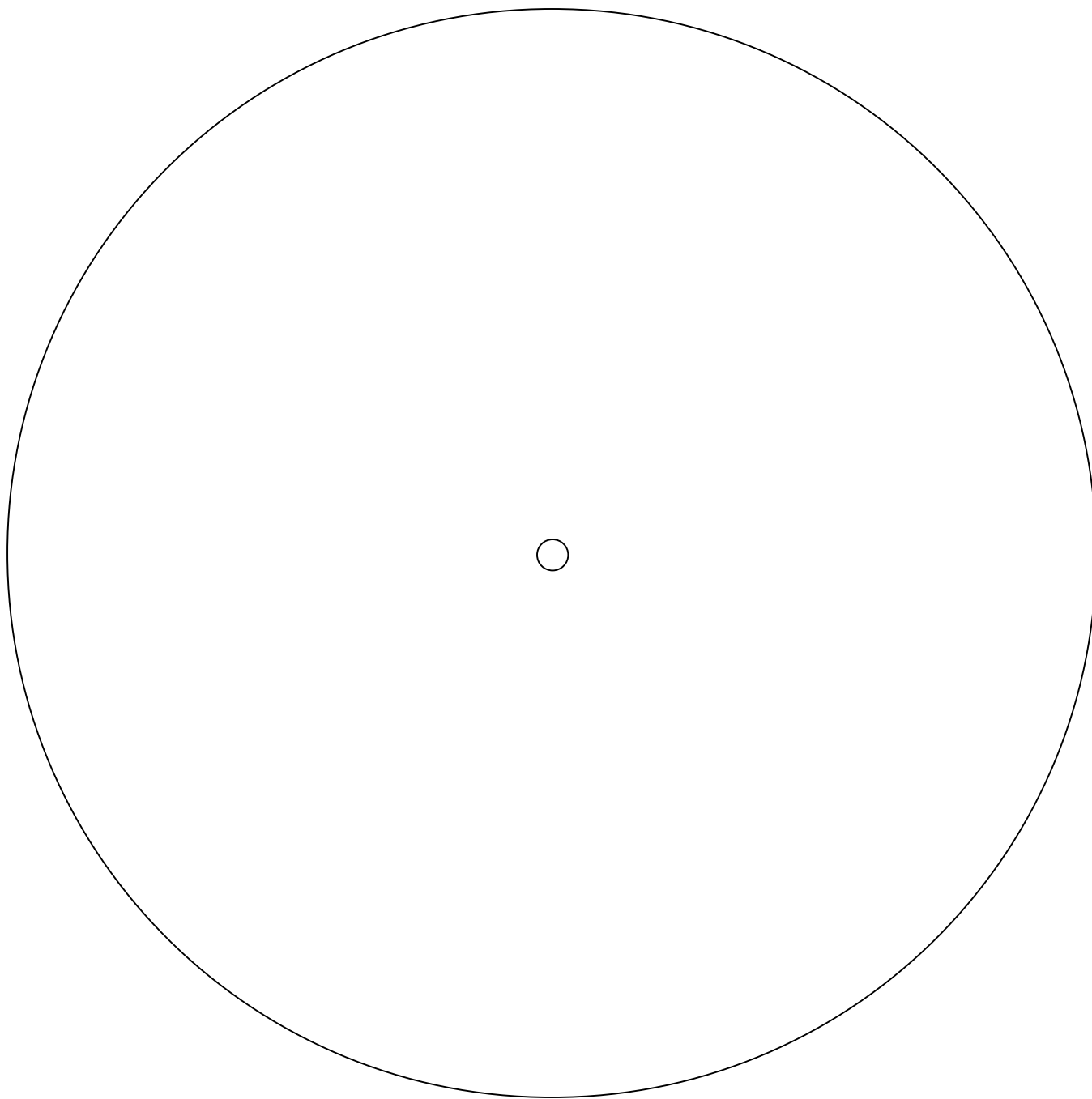
4. Erin is going to wear pants or shorts. She will also wear a sweatshirt, sweater, or T-shirt. What is the probability that Erin will wear shorts and a sweatshirt?

- A. $\frac{1}{6}$
 B. $\frac{1}{3}$
 C. $\frac{1}{2}$
 D. $\frac{2}{3}$



Answer: A

Spinner Template



Prediction Chart

Playground Area	Predicted Number of Students	Actual Number of Students
Area 1		
Area 2		
Area 3		
Area 4		