Sums of Jumanji

Probability

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Published by *K20 Center*

Grade Level	6th – 7th Grade	**Time Frame**	2-3 class period(s)
Subject	Mathematics	**Duration**	120 minutes
Course	Middle School Mathematics		

Essential Question

When might we use probability and why? Why do we need probability?

Summary

This multiple-day collaborative group lesson uses dice to explore the probability of simple events similar to those in the book "Jumanji" by Chris Van Allsburg. Students will examine sample space, theoretical probability, and experimental probability and make predictions using outcomes of probability. (NOTE: Allow approximately two to three days to complete all activities and discussions. Estimated times are provided below in the lesson snapshot. These amounts may vary depending upon how much time is needed for class discussion, reflection, each activity, and the length of each class period.)

Snapshot

Engage

Students read the book *Jumanji* to engage and activate prior knowledge regarding likelihood of an simple event.

Explore

Students experiment with a partner to explore the probability of sums when rolling dice.

Explain

Students discuss and explain the connections and differences between sample space, theoretical probability, and experimental probability.

Extend

Students explore other games and activities recording sample space and theoretical probability for a game of students' choice. Engage in "game stations" that explore the experimental probability associated with games.

Evaluate

Students reflect through writing with a focus on learning sample space, theoretical probability, experimental probability and making predictions based on these concepts.

Standards

ACT College and Career Readiness Standards - Mathematics (6-12)

S403: Determine the probability of a simple event
S503: Compute straightforward probabilities for common situations

Oklahoma Academic Standards for Mathematics (Grade 6)

6.D.2.3: Demonstrate simple experiments in which the probabilities are known and compare the resulting relative frequencies with the known probabilities, recognizing that there may be differences between the two results.

Oklahoma Academic Standards for Mathematics (Grade 6)

7.D.2.1: Determine the theoretical probability of an event using the ratio between the size of the event and the size of the sample space; represent probabilities as percents, fractions and decimals between 0 and 1.

Attachments

- Game Stations Probability Data Sheet—Sums of Jumanji - Spanish.docx
- Game Stations Probability Data Sheet—Sums of Jumanji - Spanish.pdf
- Game Stations Probability Data Sheet—Sums of Jumanji.docx
- Game Stations Probability Data Sheet—Sums of Jumanji.pdf
- Lesson Slides—Sums of Jumanji.pptx
- Sums of Jumanji Recording Sheet—Sums of Jumanji - Spanish.docx
- Sums of Jumanji Recording Sheet—Sums of Jumanji - Spanish.pdf
- Sums of Jumanji Recording Sheet—Sums of Jumanji.docx
- Sums of Jumanji Recording Sheet—Sums of Jumanji.pdf

Materials

- Lesson Slides (attached)
- *Jumanji* by Chris Van Allsburg
- Dice (two per group)
- Sums of *Jumanji* Recording Sheet (attached; printed front and back; one or two per student)
- Game Stations Probability Data Sheet (attached; one per student)
- Board games or other probability-based activities
- Paper
- Pencils

20 minutes

Engage

Teacher's Note: Choose a method to facilitate

This lesson provides two options for facilitating the Engage activity based on the availability of the book *Jumanji* by Chris Van Allsburg. If the book is unavailable use the Juamnig clips provided. The remainder of the lesson will only refer back to the storyline connected to probability. Once you have decided which is best for you and your class, download and adjust the slides based on the details below.

Option 1: Facilitate using the book, Jumanji by Chris Van Allsburg (use slides 7-10 and hide slides 11-15).

Option 2: Facilitate using the movie clips from YouTube: "Jumanji (7/8)" and "Jumanji (8/8)" (use slides 11-15 and hide slides 7-10).

Introduce the lesson using the attached **Lesson Slides**. Display **slide 2** to share the title of the lesson. Go to **slide 3** to display the lesson's essential questions: *When might we use probability and why? Why do we need probability?* Go to **slide 4** to share the lesson's learning objective with students. Review this with your class to the extent you feel necessary.

Go to **slide 5**. Ask the following question:

Have you read the book or seen one of the *Jumanji* movies?

If you have students who have read the book or seen the movies, ask one or two of them to provide a brief description of the story.

Teacher's Note: Different Versions of Jumanji

The newest movie with Dwayne "The Rock" Johnson and Jack Black may be different from the original, but students who have only seen the new version would still have the main idea of the storyline: kids get trapped in a game and must complete it before life can return to normal.

Optional

If students have not heard the story or seen the movie, unhide **slide 6** and ask, "What dangers might someone encounter in the jungle or rainforest?" Encourage them to think about the weather, animals, bugs, plants, etc. This brainstorm provides a little context for the story.

Option 1: Reading the Book

Go to **slide 7**. Read the book to the class, stopping on page 22 after Judy is told by Peter "*If you roll a 12, you can get out of the jungle*."

Display **slide 8**. Instruct students to find a partner and use the Think-Pair-Share strategy to reflect on the question, "*What is the likelihood that Judy will roll a 12 to end the game?*"

Think: Students will individually reflect using the spectrum of likelihood (impossible, 0; unlikely, between 0 and 1/2; likely as not, 1/2; likely, between 1/2 and 1; or certain, 1). **Pair:** Instruct students to turn to their partner and take turns sharing and explaining their responses. **Share:** Student pairs should then share with the whole class what they discussed (what they agreed or disagreed upon and why).

Possible Student Responses:

Judy is unlikely to roll a 12 because there is only one way to add together two of the numbers to equal 12.

Judy is likely to roll a 12 because there are two numbers that can be added together to equal 12. So therefore, there is a chance of it occurring.

Display **slide 9** and finish reading the book.

Display **slide 10** and return to the question about Judy and the game, but this time have students consider "Which sum or sums would Judy most likely have rolled with two standard dice?" Have students participate in another Think-Pair-Share.

Option 2: Watching the Movie Clips

Display **slide 11** and play the first 39 seconds of the video clip Jumanji 7/8, stopping the video right before Sarah rolls the dice.

Display **slide 12** and instruct students to find a partner and use the Think-Pair-Share strategy to reflect on the question: "What is the likelihood Sarah will roll a 7 to end the game?"

Think: Students will individually reflect using the spectrum of likelihood (impossible, 0; unlikely, between 0 and 1/2; likely as not, 1/2; likely, between 1/2 and 1; or certain, 1). **Pair:** Instruct students to turn to their partner and take turns sharing and explaining their responses. **Share:** Student pairs should then share with the whole class what they discussed (what they agreed or disagreed upon and why).

Possible Student Responses:

Sara is unlikely to roll a 7 because there are only six ways [(6,1); (5,2); (4,3); (1,6); (2,5); (3,4)] to add together two of the numbers to equal 7, but 36 possible outcomes.

Sara is likely to roll a 7 because there are six different combinations that can be added together to equal 7. Therefore, it is more likely to roll a 7 than any other number.

Once the whole class discussion has finished, display **slide 13** and finish watching Jumanji (7/8), then move to **slide 14** to show Jumanji (8/8).

Display **slide 15** and ask the following questions:

- "What was the likelihood that Alan was going to roll a number that was three or greater?"
- "Was the likelihood greater for Sarah or Alan to finish the game? Why?".
- *"Which sums were Sarah and Alan most likely to roll with two standard dice?"*

Have students participate in another Think-Pair-Share.

Both options pick back up here:

Go to **slide 16**. As a whole group discuss the question: "What sums are impossible to roll with two standard dice?" Allow students time to consider a few sums that would be impossible to create when rolling two standard dice. Students will hopefully come to a consensus that the sums can only be 2-12. Nothing less and nothing more would be possible unless they were to use dice with more sides or different values.

Teacher's Note

If students have difficulty remembering what standard dice look like, allow them time to play with the dice and look more closely at them.

Go to **slide 17**. Ask students to define Sample Space. Call on a few students to answer then briefly conclude that the range of possible outcomes is called the Sample Space. In the story, Sample Space the possible sums.

15 minutes

Explore

Display **slide 18**. Students move into collaborative pairs. For the experimental probability activity, students need two dice and one **Sums of Jumanji Recording Sheet**. Student pairs predict and record what sum would be rolled the most often on the top of their page. These predictions and justifications can be shared aloud after being recorded. Student pair will then complete the experimental probability activity using the instructions on **slide 19**. Go over the directions on the slides. Tell students they will roll both dice 15 times and record each time a sum appears. Emphasize that after each roll, students should record the value of the sum under the corresponding column. (See the image below for an example.)

Roll Number	Sum										
	2	3	4	5	6	7	8	9	10	11	12
1			2+2								
2						3+4					
3		1+2									
4							2+6				
5									4+6		
6	1+1										
7									5+5		
8			2+2								
9					4+2						

Go to **slide 20**. After student pairs have completed their rolls and recorded all data, instruct pairs to flip to the back of their handout and begin making predictions based on their data considering the scenarios below.

Teacher's Note: Number of Rolls and Scenarios

The number of rolls might be altered depending on the student's prior experience and knowledge of proportional relationships. If students are not familiar with solving proportions as an equation but can find equivalent ratios or fractions by multiplication and division, use a number that might be easily manipulated to make predictions in the next activity on slide 20.

For example, using 15 rolls in the experiment will not be easily related to a prediction of 100 rolls unless students can solve proportions as an equation. Instead, use 10 or 20 rolls in their experiment so they can make predictions using ratios.

- "What might happen to the results if we continued to roll the dice another 10 times, 15 times, 100 times, etc.? What would you expect to happen to the sums?"
- "If we rolled the dice ____ more times, how many times would you expect to get a sum that equals ____?"
- "If we had rolled the dice only ____ times, how many times would you expect to have received a sum that equals ____?"

Student pairs should use proportional reasoning (or knowledge to make equivalent fractions or ratios) to discuss and answer these questions. Each group will receive different answers based on their experimental data. Also, for the groups who cannot solve for a whole number, discuss the implications and meaning of "part of whole" for these instances. For example, ask, "Can you roll the sum '6' 13.2 times? Is that a good representation? Why or why not?"

Each group will have different quantities for each sum because each experiment will vary slightly in outcomes. These differences can be explored later during the Explain portion of the lesson.

15 minutes

Explain

After student pairs make their claims based on the scenarios from slide 20, display **slide 21** and ask open-ended questions to facilitate a class discussion. Allow students to reflect on their results before asking them to share aloud. This reflection time provides an opportunity for all to consider and formulate a response in order to contribute to the group discussion.

Teacher's Note

During open-ended questioning and discussion, listen carefully to each student's response and adjust your questions as needed. Try not to ask leading/guiding questions and instead help students understand through class discussion that there are multiple "correct" answers justifiable by their data. Students should be allowed to ask questions when a shared answer doesn't make sense. Students should make conclusions and connections through proper open-ended questioning by the teacher or follow-up questioning by the other students, not the teacher telling them what is correct or incorrect. As students begin to construct knowledge and make connections, refine and connect their thinking with academic vocabulary terms like sample space, theoretical probability, and experimental probability. For example, if students are sharing thoughts about the chance of rolling a set of double numbers only once because they are only on each die once, you can connect that thinking back to formal terms such as sample space or theoretical probability.

These are possible open-ended questions to help facilitate class discussion. Answers should come from the student pairs' experience based on the previous activity.

- What do you notice about your experimental probability results?
- Which sums appeared most often during the experiment? Least often? Why do you think that occurred? Why do you think each group got different/similar answers?
- What might happen to the results if we continued to roll the dice another 10 times, 15 times, 100 times, etc.? If we rolled it ____ many more times, how many times would you expect to get a sum that equals ____? (Students should use proportional reasoning to answer these questions, but, again, each group will have different answers based on the experimental data. Also, for the groups that don't receive a whole number, discuss the implication and meaning of part of a whole in these instances. For example, "Can you roll a sum 13.2 times?")
- Think about the sample space of the sums created when using the two dice. What sums might you (theoretically) expect to see most/least often when considering the possible sums created between the dice? How is theoretical probability different from experimental probability? (You might have to lead with questions like *"What is the sample space of the sums?"* and *"What is the theoretical probability of each sum?"* if students don't reach the connection on their own from the previous question.)
- Considering the theoretical probability, how many times would you expect to roll a sum of ____ during 15 rolls?
- Discuss the difference between sample space, theoretical probability, and experimental probability. *(This is a great opportunity to refine students' thinking and connect back to academic vocabulary.)*

Allow discussion for multiple students to share out about their experiences and findings.

Extend

Following the discussion, display **slide 22** and instruct students to think about other games or activities that they have at home that might have a sample space, theoretical probability, and experimental probability. Hand out the **Game Station Probability Data Sheet** to each student. As a whole group, brainstorm and list games or activities on the board while students record them on their handout.

Optional Digital Activity

Consider having students record these values in a shared digital document (Google Docs, Google Slides, etc.). Create handout and provide a link to the students.

Display **slide 23** and introduce the student's homework. Students find sample space and theoretical probability using a game or activity that they have access to at home. *(Optional: Ask students to bring the game or activity that they used for homework to school the next day so that their data for sample space and theoretical probability directly connect to the experimental data that they will record from the game stations).*

Day 2

Teacher's Note: Extra Handouts

Consider having some extra Game Station Probability Data Sheets available for students who have run out of space on their handout.

In class the next day, go to **slide 24** and set up game stations around the classroom. Students will work in groups recording the experimental probability of the games that they choose to play.

Teacher's Note: Consistency in the Activity

You might specify how many times each event should happen, for example, roll 10 times, choose a card 10 times, take a total of 10 turns among the group, etc. This guidance will maintain some consistency between each game or activity. Also, it can allow time for students to interact with multiple games or activities during the class period.

Using the hangout Game Station Probability Data Sheet from the night before, students record their experimental probability findings for each game they play. See the example below for what it might look like.

GAME STATIONS PROBABILITY DATA SHEET

Game	Sample Space	Theoretical Probability	Experimental Probability
Candy Land Drawing a colored card	{Blue, Red, Yellow, Green, Orange, Purple, Double Blue, D. Red, D. Green, D. Orange, D. Yellow, D. Purple, Special Cards}	Blue (8/66), Yellow (8/66), Green (8/66), ... Special Cards (6/66)	Blue (2/20), Red (0/20), Yellow (1/20), Green (4/20), ... Special Cards (3/20)
Chutes and Ladders Spinning a number	{1, 2, 3, 4, 5, 6}	1 (1/6), 2 (1/6), 3 (1/6), 4 (1/6), 5 (1/6), 6 (1/6),	1 (5/20), 2 (4/20), 3 (1/20), 4 (5/20), 5 (3/20), and 5 (2/20)
Standard Deck of Cards (not including Jokers) Drawing a card	{Ace, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, Jack, Queen, King} (and/or more detail to include the suits and colors)	Ace (4/52), 2 (4/52), 3 (4/52), etc.	
Bag of Marbles Drawing a colored marble	{Yellow, Blue, Red, Black, Green}	Yellow (2/10), Blue (1/10), Red (1/10), Black (3/10), Green (4/10)	

Evaluate

Display **slide 25**. After all findings have been recorded, each student should individually reflect through a detailed writing using the strategy What Did I Learn Today. Writing should specifically focus on the connections (similarities and differences) between the experimental findings compared to the sample space and theoretical probability for each game listed or just the games they played in class. Students should also create and record examples of possible predictions based on the data from the experimental probability and the theoretical probability for each game (or just the games that they played in class).

Teacher's Note: Sentence Frame

"If I rolled/selected/went ___ times, then the probability of getting ___ would be ___.

Resources

- Davis. B. (n.d.). Teaching mathematics through literature. LEARN North Carolina. http://web.archive.org/web/20180131132522/http://www.learnnc.org/lp/pages/3326?ref=search
- K20 Center. (n.d.). Google Docs. Tech Tool. https://learn.k20center.ou.edu/tech-tool/2327
- K20 Center. (n.d.). Google Slides. Tech Tool. https://learn.k20center.ou.edu/tech-tool/2335
- K20 Center. (n.d.). Think-pair-share. Strategies. https://learn.k20center.ou.edu/strategy/139
- K20 Center. (n.d.). What did I learn today. Strategies. https://learn.k20center.ou.edu/strategy/169
- Van Allsburg, C. (2011). *Jumanji*. Houghton Mifflin Harcourt.
- YouTube. (n.d.-b). *Jumanji (7/8) Movie Clip - earthquake*. YouTube. https://www.youtube.com/watch?v=SiUT8u1LckQ
- YouTube. (n.d.-c). *Jumanji (8/8) Movie Clip - Jumanji*. YouTube. https://www.youtube.com/watch?v=M0TjT53qpFY