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Instructional Design Project

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<schlosser.instructionaldesignproject.doc>

**The Problem**

The skills found in Ohio’s Learning Standards for Probability and Statistics in seventh grade are found in everyday life. Unfortunately, they are easily and often misused. For statistics, according to the *Principles and Standards for School Mathematics*, data is used all the time with business, politics, research and everyday life, statistics are often misrepresented in order to influence public opinion on issues or distorted for a product to suggest quality and effectiveness (NCTM 2000). For probability, games use probability incorrectly by having unfair games which is a disadvantage to particular players. Students need to be able to reason statistically and logically in order to be informed citizens and intelligent consumers. *Principles and Standards for School Mathematics* addresses that “the kind of reasoning used in probability and statistics is not always intuitive, and so students will not necessarily develop it if it is not included in the curriculum” (NCTM 2000). By teaching how to formulate questions, analyze data and evaluate validity, students will have the critical thinking skills needed to apply to their everyday life.

**Rationale**

 This instructional design addresses the problem head on, by getting to the root of popular misconceptions and misuses of probability in the real world. Through hands-on activities and real world simulations, students are able to gain a deeper understanding of probability and how to use it properly. In order to target this problem, I used the Synectic Model. By using this model, I hope my students will grow in their creative minds while also using their critical thinking skills to prepare them for the real world. The three stages of this model will allow students to stretch, explore, and create something new. Before we begin the unit, about two weeks before, I will give students the pre-assessment. While it addresses specifics to some degree, I want to see how much students are familiar with the particular strategies that way I do not spend too much time on concepts that the students have a good understanding of. In this pre-assessment, students also have the ability to share with me how they feel about their understanding of each component of this unit. That way, I will know where students are when we begin the unit and lessons.

In the first stage, students will dive deeper into probability. In the beginning of the unit, students will learn how to find the probability of an event by finding how many favorable outcomes there are out of how many possible outcomes there are. This type of probability is theoretical. They have had brief experiences with probability in their past grades in terms of discussing “less likely” versus “more likely.” However, they will challenged to find probability themselves and then determine if the event is more likely or less likely. This lesson will be taught using notes in the beginning in order for students to understand how probability is expressed. But then, in order to allow students to stretch their imagination, they will have the chance to find examples in their normal school day of things they know are less likely or more likely to happen. They connecting mathematics with their everyday life.

 The second lesson (that is detailed later in this design) is exploring the unfamiliar. Most students are not familiar with the difference between theoretical and experimental probability. Often, it can be misconstrued that they are the same thing. Students will be able to explore and see the differences. *Ohio’s Learning Standards* encourage the engagement of the Standards for Mathematical Practice. One particular practice that applies to this lesson is “Use appropriate tools strategically” (*Ohio’s Learning Standards*, 2010). By using these common probability tools, students are strategically exploring probability and understanding the dimensions of probability. They will be exploring by going to stations. While these are not the typical stations with differentiating tasks at the stations, these stations still break up the work for students and allow them to move around. At the end of this lesson, students will define experimental and theoretical probability using Frayer Models. All About Adolescent Literacy discusses the benefits of Frayer Models, where they are used to allow for students to draw on prior knowledge and make connections to new concepts by comparing attributes (n.d.). Students gain a deeper understanding of vocabulary when they write their own definition and break down the word.

 In the next lesson (detailed later in this design), we are still in the second stage of the model, where students are exploring the unfamiliar. They will get a chance to play two probability games. Little do they know that there is a catch. The first game is unfair. Students will explore why the same player mostly wins and what makes a game fair This exploratory learning will show students probability in the real world and how to analyze games they might play in the future.

 The third lesson (detailed later in this design) goes back to the first stage of the model where students are still stretching their understanding. While it is not opportune to go back to this stage, this particular topic is difficult for students to understand and needs more teacher-directed guidance and instruction. Students will discover how to show the sample space, through tables and tree diagrams. They understand the importance of seeing the sample space, because it allows to see if games are fair but also all the options are laid out quickly. Throughout these notes, I will guide them on how to do each method and provide opportunities for them to try each method on their own. This lesson supports them for the final project on the unit.

 To achieve the final stage of the model where students create something new, the final project addresses the last outcome about designing and conducting their own simulation. Students have been running simulation throughout the lessons, using the appropriate tool strategically. The final project will allow students to discover the probability of compound events that they are interested in. they will design the simulation and then conduct it. There will two assessments at the end of this unit, the final project and post-assessment. The post-assessment has scenarios and situational events for students to demonstrate their knowledge of finding the probability without the common misuses and misconceptions. The post-assessment also provides a chance for students to pinpoint how they feel about the concepts of this unit. Hopefully, we will see an increase in their feelings where they are closer to the expert end of the spectrum.

References

All About Adolescent Literacy. (n.d.). Retrieved October 13, 2015.

NCTM (2000). *Principles and Standards for School Mathematics.* Reston, VA: NCTM.

Ohio Department of Education (2010). *Ohio’s Learning Standards*. Columbus, OH: State Board of Education.

**Unit Outcomes**

For the Probability Sub-Unit, these are the Unit Learner Outcomes. They are categorized by Bloom’s Revised Taxonomy. Within *A Taxonomy for Teaching, Learning, and Assessment*, the revised domains are listed in order of the degree of difficult (starting from simplest to most complex): remembering, understanding, applying, analyzing, evaluating, and creating (2001). The categorization of each outcome will be listed in italicized parentheses at the end of each outcome.

* Students will be able to express the likelihood of an event as the probability ranging from 0 (impossible) to 1 (absolute). *(Remembering, Understanding)*
* Students will be able to collect data on a chance process and approximate the probability of the chance event. *(Understanding, Applying)*
* Students will predict the approximate frequency based on the probability. *(Applying, Analyzing)*
* Student will be able to determine and list the sample space for an event and identify all possible outcomes. *(Understanding)*
* Students will be able to determine if an event is fair or unfair based on the sample event. *(Evaluating)*
* Students will be able to find the probability of compound event using tables, tree diagrams, simulations, and the Fundamental Counting Principle. *(Understanding, Applying)*
* Students will be able to design and run a simulation to generate frequencies for compound events. *(Creating)*

**Pre-Assessment**

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Per. \_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_

**Probability Pre-Assessment**

**Directions:** Circle the number that best resembles your knowledge of the following.

**1 – never seen 2 – below average 3 – average 4 – above average 5 – expert**

1. **Expressing Probability 1 2 3 4 5**
2. **Theoretical Probability 1 2 3 4 5**
3. **Experimental Probability 1 2 3 4 5**
4. **Finding Probability 1 2 3 4 5**
5. **Predicting Outcomes 1 2 3 4 5**
6. **Finding Sample Space 1 2 3 4 5**
7. **Determining Game Fairness 1 2 3 4 5**
8. **Creating a Tree Diagram 1 2 3 4 5**
9. **Simulating Events 1 2 3 4 5**
10. **Fundamental Counting Principle 1 2 3 4 5**
11. **Compound Events 1 2 3 4 5**

**Directions:** Read and follow the directions for each question. Show your work when necessary. You may use a calculator. Simply all answers.

**Expressing Probability**

1. There are 10 M&Ms in a snack-size pack. There are 4 red, 2, brown, 2 blue, 1 green, and 1 orange. What is the probability of picking a blue M&M?

**Approximating Probability and Frequency**

1. Using a number cube, roll it 20 times and record your results in the blank table below.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Number Rolled | 1 | 2 | 3 | 4 | 5 | 6 |
| Number of Times |  |  |  |  |  |  |

According the results in your table, what is the probability you will roll the number 6 on your 21st roll?

1. Robin rolled number cube 60 times in an experiment. Her results are shown below.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Number Rolled | 1 | 2 | 3 | 4 | 5 | 6 |
| Number of Times | 8 | 5 | 9 | 12 | 11 | 15 |

According to Robin’s results, if she rolls the number cube 60 more times, then how many times will she roll the number 4?

**Sample Space**

1. Pinky and the Brain are playing a number cube game where they roll two number cubes and multiply them. If the product is even, then Pinky gets a point. If the product is odd, then Brain gets a point. Please show the all possible outcomes below.

**Game Fairness**

1. Pinky and the Brain are playing a number cube game where they roll two number cubes and multiply them. If the product is even, then Pinky gets a point. If the product is odd, then Brain gets a point. Is this game fair? Why or why not?

**Compound Events**

1. Use the following scenario to answer parts a, b, and c:

Tony has four shirts: one red, one green, one blue, and one white. He has two pants: one black and one blue.

* 1. Show the probability using a tree diagram below.
	2. What is the correct representation of this problem using the Fundamental Counting Principle? Circle one:
		+ 1. 4 X 2
			2. 1 X 1 X 1 X 1 X 1 X 1
			3. 4 + 1
			4. 1 + 1 + 1 + 1 + 1 + 1
	3. What is the probability he chooses a white shirt and black pants?

**Pre-Assessment Answer Key (answers in red)**

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Per. \_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_

**Probability Pre-Assessment**

**Directions:** Read and follow the directions for each question. Show your work when necessary. You may use a calculator. Simply all answers.

**Expressing Probability**

1. There are 10 M&Ms in a snack-size pack. There are 4 red, 2, brown, 2 blue, 1 green, and 1 orange. What is the probability of picking a blue M&M?

The probability of picking a blue M&M is 1/5. Half-credit to those your do not simplify and get 2/10.

**Approximating Probability and Frequency**

1. Using a number cube, roll it 20 times and record your results in the blank table below.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Number Rolled | 1 | 2 | 3 | 4 | 5 | 6 |
| Number of Times |  |  |  |  |  |  |

According the results in your table, what is the probability you will roll the number 6 on your 21st roll?

Check that the number of times for each number adds up to 20. Then, the answer is a simplified fraction where the number of times the number 6 is rolled is in the numerator and 20 is in the denominator.

1. Robin rolled number cube 60 times in an experiment. Her results are shown below.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Number Rolled | 1 | 2 | 3 | 4 | 5 | 6 |
| Number of Times | 8 | 5 | 9 | 12 | 11 | 15 |

According to Robin’s results, if she rolls the number cube 60 more times, then how many times will she roll the number 4?

She will roll the number 4, 24 times.

**Sample Space**

1. Pinky and the Brain are playing a number cube game where they roll two number cubes and multiply them. If the product is even, then Pinky gets a point. If the product is odd, then Brain gets a point. Please show the all possible outcomes below.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **1** | **2** | **3** | **4** | **5** | **6** |
| **1** | 1 | 2 | 3 | 4 | 5 | 6 |
| **2** | 2 | 4 | 6 | 8 | 10 | 12 |
| **3** | 3 | 6 | 9 | 12 | 15 | 18 |
| **4** | 4 | 8 | 12 | 16 | 20 | 24 |
| **5** | 5 | 10 | 15 | 20 | 25 | 30 |
| **6** | 6 | 12 | 18 | 24 | 30 | 36 |

**Game Fairness**

1. Pinky and the Brain are playing a number cube game where they roll two number cubes and multiply them. If the product is even, then Pinky gets a point. If the product is odd, then Brain gets a point. Is this game fair? Why or why not?

The game is not fair, because Pinky and the Brain do not have equal chances of getting a point. Pinky has ¾ chance of getting a point. Brain has ¼ chance of getting a point.

**Compound Events**

1. Use the following scenario to answer parts a, b, and c:

Tony has four shirts: one red, one green, one blue, and one white. He has two pants: one black and one blue.

* 1. Show the probability using a tree diagram below.
	2. What is the correct representation of this problem using the Fundamental Counting Principle? Circle one:
		+ 1. 4 X 2
			2. 1 X 1 X 1 X 1 X 1 X 1
			3. 4 + 1
			4. 1 + 1 + 1 + 1 + 1 + 1
	3. What is the probability he chooses a white shirt and black pants?

The probability is 1/8.

**Lesson Plans**

|  |
| --- |
| **Lesson 1: Experimental Probability** |
| **Your Name** | Megan Schlosser | **Date** | N/A |
| **Subject/ Course**  | 7th Grade Math | **Grade** | 7th |
| **Unit Topic or Theme** | Probability | **# of Students** | 25 |
| **Class Length** | 55 min. |  |  |  |
| **Learning Objectives** |
| * Students will be able to collect data on a chance process and approximate the probability of the chance event.
* Students will predict the approximate frequency based on the probability.
 |
|  |
| **Academic Language** |
| * Probability
* Chance
* Frequency
* Experimental Probability
* Theoretical Probability
 |
| **List Resources and Materials**  |
| * Marbles
* Cups
* Decks of cards
* Coins
* Number cubes
 |
| **THE LESSON** |
| **1. MOTIVATION Allotted Time:\_\_\_\_5 min.\_\_\_\_*** As students enter, they will take their seats. Once all students have sat down, the teacher will pull up the sorter on the SMARTBoard. The teacher will break the class into two teams. Each player will sort a fraction into one of the following categories: impossible, less likely, more likely, absolute.

Transition Statement: “Today we will practice experimental probability. So we get to do some experiments today.”**2. LESSON PROCEDURE Allotted Time:\_\_\_\_45 min.\_\_\_\_*** “We will be doing stations today, where you get to do experiments. You’ll be collecting data to find the experimental probability versus the theoretical probability. There are 4 stations, which means 10 minutes at each station. I have generated partners that will work together at each station. Please go to your first station with a pencil, sit with your partner, and begin the station.”
* Students will break up into stations and begin working. Teacher will observe, assist when necessary, and ask guiding questions.
	+ What is the theoretical probability of this?
	+ Are you getting the same results that the theoretical probability says?
	+ Based on your results, what is the probability of [particular outcome]?
	+ Based on your results, how many times will [particular outcome] happen?
* Every 10 minutes, the teacher will have students move to the next station.

Transition Statement: “Now that we’ve finished our last station. Please turn in the sheets from each station in the turn-in tray and go to your seat.” **3. CLOSURE Allotted Time:\_\_\_5 min.\_\_\_*** “We learned about theoretical probability yesterday. Please create a Frayer Model for both theoretical and experimental probability. When you are done, put them in the turn-in tray.”
 |

**Station: Marbles**

There are 20 marbles in this cup: 4 red(R), 5 green(G), 5 blue(B), 2 pink(P), and 4 orange(O). Shake the cup with spilling the marbles and then pull out a marble. Record the color for 20 trials.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Once you have finished collecting your data, fill in the table below:

|  |  |  |
| --- | --- | --- |
|  | Theoretical Probability | Experimental Probability |
| Pulling a red marble |  |  |
| Pulling a green marble |  |  |
| Pulling a pink marble |  |  |
| Pulling an orange marble |  |  |
| Pulling a blue marble |  |  |

If you pulled a marble one more time, what color do you predict it will be? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Station: Deck of Cards**

The deck of cards has four suits: clubs (C), hearts (H), spades (S), and diamonds (D). Each suit has 2, 3, 4, 5, 6 ,7, 8, 9, 10, J, Q, K, and A. Shuffle the cards, then draw a card form the top 20 times. Record the suit, color, and number in the table below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Suit |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Color |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| NumberLetter |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Once you are done collecting data, complete the table below.

|  |  |  |
| --- | --- | --- |
|  | Theoretical Probability | Experimental Probability |
| Pulling hearts |  |  |
| Pulling clubs |  |  |
| Pulling spades |  |  |
| Pulling diamonds |  |  |
| Pulling a red |  |  |
| Pulling a black |  |  |
| Pulling odds |  |  |
| Pulling evens |  |  |
| Pulling J, Q, K, and A |  |  |

**Station: Coins**

The coin has one head and one tail. Flip the coin twenty times. Record your results in the table below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

When you are finished collecting data, complete the table.

|  |  |  |
| --- | --- | --- |
|  | Experimental Probability | Theoretical Probability |
| Flipping heads |  |  |
| Flipping tails |  |  |

Based on your results, what do you predict you flip next? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Station: Number Cubes**

The number cube has six sides, numbered 1-6. Roll the number cubes twenty times. Record your results in the table below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

When you are finished collecting data complete the table below.

|  |  |  |
| --- | --- | --- |
|  | Experimental Probability | Theoretical Probability |
| Rolling 1 |  |  |
| Rolling 2 |  |  |
| Rolling 3 |  |  |
| Rolling 4 |  |  |
| Rolling 5 |  |  |
| Rolling 6 |  |  |

 Based on your results, what do you predict you will roll next? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



|  |
| --- |
| **Lesson 2: Exploration of Sample Space and Game Fairness** |
| **Your Name** | Megan Schlosser | **Date** | N/A |
| **Subject/ Course**  | 7th Grade Math | **Grade** | 7th  |
| **Unit Topic or Theme** | Probability | **# of Students** | 20 |
| **Class Length** | 55 min. |  |  |  |
| **Learning Objectives** |
| * Students will be able to determine and list the sample space for an event and identify all possible outcomes.
* Students will be able to determine if an event is fair or unfair based on the sample event.
 |
|  |
| **Academic Language** |
| * Probability: the likelihood of an event happening (ranges from 0-1).
 |
|  |
| **Differentiated Instructional Strategies** |
| * The activities appeal to the Kinesthetic learners who learn by doing
* The drawing of sample space appeals to the Visual learners who learn by pictorial representations.
 |
| **List Resources and Materials**  |
| * SMARTBoard
* Probability Fair: <http://mrnussbaum.com/probfair/>
* Whiteboards
* Handouts of Probability Games
* 24 number cubes
* 12 cups (each cup has one red-red chip and one red-yellow chip inside)
* 24 chips (12 red-red, 12 red-yellow)
 |
| **THE LESSON** |
| **1. MOTIVATION Allotted Time:\_\_\_\_10 min.\_\_\_\_*** The teacher will pull up the Probability Fair game for the class. Students will answer on their whiteboards.

Transition Statement: “Today we will be exploring more about probability. I have paired each of you with a partner on the board. Please move and find seats by your partner.”**2. LESSON PROCEDURE Allotted Time:\_\_\_40 min.\_\_\_\_*** Students will break into pairs.
* “Please determine who will be Player Genius and who will be Player Brilliant in the next 15 seconds. [Countdown]. Now, listen first. I would like all Player Geniuses to come get handouts for your pair from me. I would like all Player Brilliants to get two die from the resource table. You may get up now.”
	+ Students will retrieve the materials for the assignment.
* Teacher will explain the rules of the game: Player Genius versus Player Brilliant:
	+ Player Brilliant and Player Genius will take turns rolling two die.
	+ Each time the sum of the numbers on the face of the die is 5, 6, 7, 8, or 9, Player Brilliant gets 1 point
	+ Each time the sum of the numbers of the face of the die is 2, 3, 4, 10, 11, or 12, Player Genius gets 1 point
	+ First player who gets 20 pts wins!
* “You will play 3 rounds of this game. Please record your tallies.”
	+ Students will play the game while teacher observes and assists as needed.
	+ Guiding questions:
		- [Player Brilliant will most likely win which will result in student comments about not having good luck or the game not being fair.]
			* Why do you think you have bad luck?
			* Why do you think the game is not fair?
			* What makes a game fair?
* “Since everyone is done, raise your hand if Player Brilliant won the best of 3 rounds.” [Students will raise hands.] “Raise your hand if Player Genius won the best of 3 rounds.” [Students will raise hands.]
* “Why do you think mostly Player Brilliant’s won this game?”
	+ Students will respond and discuss the game.
* “How often does Player Brilliant get a point? Let’s find out. Please flip over your game page. Let’s fill out the table together.”
* “What do we notice about this table?” {
	+ Students will notice that 5, 6, 7, 8, and 9 appear more often than 2, 3,4, 10, 11, and 12.
	+ “What is the probability that Player Brilliant will get a point?” [Students will figure 24/36 which is 2/3].
	+ “What is the probability that Player Genius will get a point?” [Students will figure 12/36 which is 1/3.]
	+ “Is that fair?” [Students will respond with no.]
	+ “Since they don’t have an equal chance of winning, is this game fair?” [Students should respond with no.]
* “Let’s try the second game. Listen first, I need Player Brilliant to return dice to the resource table and pick up one cup with chips in them. You may go now.”
	+ Students will return dice and retrieve cups and chips.
* “Now, you have 15 seconds to determine who will be Player Macaroni and who will be Player Cheese. [Countdown]”
* Teacher will explain the rules of the game:
	+ Player Macaroni and Player Cheese will take turns shaking a red-red chip and a red-yellow chip in a cup and tossing the chips on the table.
	+ Player Macaroni scores a point if one of each color lands up.
	+ Player Cheese scores a point if the same color lands up.
	+ First player with 10 pts wins!
* “You will play this game for three rounds and record with tallies.”
	+ Students will play the game. Teacher will walk around and observe – assisting as needed.
	+ Guiding Questions:
		- Is this game fair?
		- How can you tell?
* “Now that everyone has finished, raise your hand if Player Macaroni won the best of 3 rounds.” [Students will raise hands.] “Raise your hand if Player Cheese won the best of 3 rounds.” [Students will raise hands.]”
* “What do we think? Is this game fair or not?” [Students will respond and discuss as a class.]
* “How can we tell? Can we see all the possible outcomes? Let’s try on the back.”
	+ Students will fill out table as a class.
	+ “What is the probability that Player Macaroni will get a point?” [Students will respond with ½]
	+ “What is the probability that Player Cheese will get a point?” [Students will respond with ½]
	+ “If both players have the same chance of winning, is the game fair?” {Students will respond with yes.]

Transition Statement: “Good. I would like Player Cheese to take the cup with chips back to the resource table. And have everyone go back to their assigned seats.”**3. CLOSURE Allotted Time:\_\_\_\_5 min.\_\_\_\_*** “Can someone summarize for me what makes a game fair?” [Student will respond.]
* “Great, we seem to have an understanding of what makes a game fair! For your exit ticket, I would like you to change the rules of the Player Brilliant versus Player Genius game to make it fair. When you are done, please put your new rules in the turn-in tray and grab your homework from the resource table.”
* Students will work on creating rules. When they are done, they will turn in.
 |

****Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Per. \_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_

**In-Class Activity: Probability Games**

**Game 1: Player Brilliant vs. Player Genius**

Pick who will be Player Brilliant and who will be Player Genius.

* Player Brilliant and Player Genius will take turns rolling two die.
* Each time the sum of the numbers on the face of the die is 5, 6, 7, 8, or 9, Player Brilliant gets 1 pt
* Each time the sum of the numbers of the face of the die is 2, 3, 4, 10, 11, or 12, Player Genius gets 1 pt
* First player who gets 20 pts wins!

For each point the player gets, place a tally in their box. See who gets 20 tallies first!

|  |  |  |
| --- | --- | --- |
| **Round 1** | **Round 2** | **Round 3** |
| Player Brilliant | Player Genius | Player Brilliant | Player Genius | Player Brilliant | Player Genius |
|  |  |  |  |  |  |
| Who won? | Who won? | Who won?  |

Who won best out of 3 rounds? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Game 2: Player Macaroni vs. Player Cheese**

Pick who will be Player Macaroni and who will be Player Cheese.

* Player Macaroni and Player Cheese will take turns shaking a red-red chip and a red-yellow chip in a cup and tossing the chips on the table.
* Player Macaroni scores a point if one of each color lands up.
* Player Cheese scores a point if the same color lands up.
* First player with 10 pts wins!

For each point the player gets, place a tally in their box. See who gets 10 tallies first!

|  |  |  |
| --- | --- | --- |
| **Round 1** | **Round 2** | **Round 3** |
| Player Macaroni | Player Cheese | Player Macaroni | Player Cheese | Player Macaroni | Player Cheese |
|  |  |  |  |  |  |
| Who won? | Who won? | Who won?  |

Who won best out of 3 rounds? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Probability Games and Sample Spaces**

**Game 1: Player Brilliant vs. Player Genius**

Pick who will be Player Brilliant and who will be Player Genius.

* Player Brilliant and Player Genius will take turns rolling two die.
* Each time the sum of the numbers on the face of the die is 5, 6, 7, 8, or 9, Player Brilliant gets 1 pt
* Each time the sum of the numbers of the face of the die is 2, 3, 4, 10, 11, or 12, Player Genius gets 1 pt
* First player who gets 20 pts wins!

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**Game 2: Chip Game**

Pick who will be Player Macaroni and who will be Player Cheese.

* Player Macaroni and Player Cheese will take turns shaking a red-red chip and a red-yellow chip in a cup and tossing the chips on the table.
* Player Macaroni scores a point if one of each color lands up.
* Player Cheese scores a point if the same color lands up.
* First player with 10 pts wins!

|  |
| --- |
| **Lesson 3: Sample Space Methods** |
| **Your Name** | Megan Schlosser | **Date** | N/A |
| **Subject/ Course**  | 7th Grade Math | **Grade** | 7th |
| **Unit Topic or Theme** | Probability | **# of Students** | 25 |
| **Class Length** | 55 min. |  |  |  |
| **Learning Objectives** |
| * Students will be able to determine and list the sample space for an event and identify all possible outcomes.
* Students will be able to find the probability of compound events using tables, tree diagrams, simulations, and the Fundamental Counting Principle.
 |
|  |
| **Academic Language** |
| * Sample Space
* Event
* Probability
 |
| **List Resources and Materials**  |
| * SMARTBoard
* Sample Space Notes
* Exit ticket
 |
| **THE LESSON** |
| **1. MOTIVATION Allotted Time:\_\_\_\_5 min.\_\_\_\_*** Students will turn in homework when they arrive.
* “Yesterday we explored fairness of games. Check out this game. In your own words, write to me whether it is fair or unfair. See if you can list all possible outcomes.”
	+ Teacher will pass out game and rules. Students will write answers. Teacher will observe answers to structure discussion.
* “I see most of us are finished. How did we find our answers?” [Students will respond with strategies.]
* “Good, this is an unfair game. But how would you make it fair? Any ideas?” [Students will respond with ideas.]
* “Good ideas. Please put away the game and rules.”

Transition Statement: “We have listed out possible outcomes before, so let’s start simplifying our language. Please put your name and date on the top of this note page.”**2. LESSON PROCEDURE Allotted Time:\_\_\_\_35 min.\_\_\_\_*** “The correct term for listing all the possible outcomes is the ‘sample space.’ Today we will be learning about all the different ways to represent the sample space. Yesterday, we used the table method. There is one other methods: Tree Diagrams. Then, you can check your work by doing the Fundamental Counting Principle. Can I have a volunteer to read the first example?” [Student will read the example.]
* Example 1: “What do we think is important about this example?” [Students will respond with what they think is important.]
	+ Sum
	+ Number cubes 1-6
	+ “Let’s find the sample space by filling out the table with the sums.”
* Example 2: “Try example 2 on your own.” Students will work on the questions. Teacher will observe. When most students are done, class will discuss.
* Example 3: “What do you think is important about this example?” [Students will respond with what they think is important.]
	+ Doctors: Dr. Smyth, Dr. Cho
	+ Days: Monday, Wednesday
	+ Times: 9am, 10am, 11am
	+ “So each doctor has two different days and then each day has three different times. Let’s see if we can show this using a tree diagram.”
* Example 4: “Try example 4 on your own.” Students will work on the questions. Teacher will observe. When most students are done, the class will discuss.
* Example 1 with FCP: “We can double check our sample sets by using the Fundamental Counting Principle. In order to find out the total outcomes, you can multiply the individual event outcomes together. For example 1, there are 6 outcomes for each number cube, so 6 times 6 is 36 total outcomes.”
* Example 2 with FCP: “Check example by yourself using the Fundamental Counting Principle.” Students will work on the question. Teacher will observe. When most students are done, class will discuss.
* Example 3 with FCP: “Let’s try example 3. We had two doctor options, 2 day options, and 3 time options, so the product is 12 outcomes.”
* Example 4 with FCP: “Check example by yourself using the Fundamental Counting Principle.” Students will work on the question. Teacher will observe. When most students are done, class will discuss.

Transition Statement: “I think we have an overall understanding of sample space. Let’s see how we do individually.”**3. CLOSURE Allotted Time:\_\_\_15 min.\_\_\_*** “Please complete this exit ticket. Once you are done, put it in the turn in tray and grab the homework from the resource table.”
 |

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Per. \_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Notes: Sample Space (students will fill in what is in red)**

Sample Space: all possible outcomes of an event

Compound Event: an event that contains two or more independent events

**Tables**

Ex. 1 – As a Class

Alex rolls two number cubes, each with sides numbered 1 through 6. He then finds the sum of the numbers on the tops of the cubes. Use a table to show the sample space.

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

Ex. 2 – Do it Yourself!

A spinner and a number cube are used to play a game. The sides of the cube are numbered 1 through 6. A player’s score is the sum of the numbers on which the spinner lands and the number rolled on the cube. The spinner was in 4 equal parts labeled 5, 10, 15, and 20. Use a table to show the sample space.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 | 6 |
| 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |

**Tree Diagrams**

Ex. 3 – As a Class

Mia is going to a doctor’s office for the first time. She looks online and see that Dr. Smythe and Dr. Cho only have appointments on Monday and Wednesday at 9am, 10am, and 11am.

What’s important:

* Doctors: 2
* Days: 2
* Times: 3

Ex. 4 – Do it Yourself!

At a sandwich shop, there were three bread options: rye, wheat, and white. There are three meat options: tuna, egg salad, and cold cuts.

What’s important:

* Bread: 3 options
* Meat: 3 options

**Check yourself: Fundamental Counting Principle**

Ex. 1 – As a Class

Alex rolls two number cubes, each with sides numbered 1 through 6. He then finds the sum of the numbers on the tops of the cubes. How many outcomes will there be?

\_\_6\_\_ X \_\_6\_\_ = \_\_36\_\_ outcomes

Ex. 2 – Do it Yourself!

A spinner and a number cube are used to play a game. The sides of the cube are numbered 1 through 6. A player’s score is the sum of the numbers on which the spinner lands and the number rolled on the cube. The spinner was in 4 equal parts labeled 5, 10, 15, and 20. How many outcomes are there?

\_\_4\_\_ X \_\_6\_\_ = \_\_24\_\_ outcomes

Ex. 3 – As a Class

Mia is going to a doctor’s office for the first time. She looks online and see that Dr. Smythe and Dr. Cho only have appointments on Monday and Wednesday at 9am, 10am, and 11am.

\_\_2\_\_ X \_\_3\_\_ X \_\_2\_\_ = \_\_12\_\_ outcomes

Ex. 4 – Do it Yourself!

At a sandwich shop, there were three bread options: rye, wheat, and white. There are three meat options: tuna, egg salad, and cold cuts.

\_\_3\_\_ X \_\_3\_\_ = \_\_9\_\_ outcomes

**Post-Assessment**

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Per. \_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_

**Probability Post-Assessment**

**Directions:** Circle the number that best resembles your knowledge of the following.

**1 – never seen 2 – below average 3 – average 4 – above average 5 – expert**

1. **Expressing Probability 1 2 3 4 5**
2. **Theoretical Probability 1 2 3 4 5**
3. **Experimental Probability 1 2 3 4 5**
4. **Finding Probability 1 2 3 4 5**
5. **Predicting Outcomes 1 2 3 4 5**
6. **Finding Sample Space 1 2 3 4 5**
7. **Determining Game Fairness 1 2 3 4 5**
8. **Creating a Tree Diagram 1 2 3 4 5**
9. **Simulating Events 1 2 3 4 5**
10. **Fundamental Counting Principle 1 2 3 4 5**
11. **Compound Events 1 2 3 4 5**

**Directions:** Read and follow the directions for each question. Show your work when necessary. You may use a calculator. Simplify your answers.

**Expressing Probability**

1. In your science class, you were growing bean plants. The bean plants were put on the ledge and received lots of sunlight. 17 of the plants survived and 4 died. What would be the probability of a plant surviving? Please express as a percent.
2. The following is the Preamble of the Constitution of the United States.

We the People of the United States, in Order to form a more perfect Union, establish Justice, insure domestic Tranquility, provide for the common defense, promote the general Welfare, and secure the Blessings of Liberty to ourselves and our Posterity, do ordain and establish this Constitution for the United States of America.

If you close your eyes and put your finger randomly on the page, then what is the probability you will land on the letter “t”?

**Approximating Probability and Frequency**

1. There are four marbles in a jar. The colors of the marbles are red, purple, green, and pink. You pull out a marble, record the color, and put it back in 20 times. Your results are in the table below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Color of Marble | Red | Purple | Green | Pink |
| Number of Times | 8 | 2 | 3 | 7 |

Using the results above, what is the probability of pulling a pink marble on your 21st time?

1. A deck contains 75 different cards. The colors of the cards are red, blue, and green. I pull a random sample of 5 cards and 3 are red. Make an inference about how many red cards are in the deck.

**Sample Space**

1. Beyoncé and Jay-Z are playing a game with a spinner and a number cube. The spinner can be seen below. The Number cube is 1-6. For each turn, the player must spin the spinner and roll the number cube. The score of each player’s turn is the sum of the numbers on which the spinner lands and the number rolled on the cube. It’s Beyoncé’s turn. Show all possible outcomes that Beyoncé could get.



**Game Fairness**

1. Beyoncé and Jay-Z are playing a game with a spinner and a number cube. The spinner can be seen below. The Number cube is 1-6. For each turn, the player must spin the spinner and roll the number cube. The score is the sum of the numbers on which the spinner lands and the number rolled on the cube. Jay-Z suggest playing a twist to the game. He says that no matter who it rolling and spinning, if the sum is even, then he gets a point. But if the sum is odd, then Beyoncé gets a point. Is this game fair? Why or why not?

**Compound Events**

1. Archie rolls two number cubes, each with sides numbered 1 through 6. Using a table, what is the probability that Archie will roll two even numbers?
2. At Burritos R Us, you pick from the following options:

Meat: Steak, Pork, Chicken

Rice: White, Brown

Salsa: Mild, Medium, Extreme

Veggies: Green Peppers, Lettuce, Corn

Toppings: Cheese, Sour Cream, Guacamole

You can only pick one meat, one rice, one salsa, one veggie, and one topping. Using the Fundamental Counting Principle, how many options are there at Burritos R Us?

1. At Build-A-Bear, you have the following options:

Color: Brown, White, Purple, Blue

Size: Big, Mini

Outfit: Firefighter, Princess, Minion

Using a tree diagram, find the probability of picking out a Purple, Mini Princess.

**Post-Assessment Answer Key (answers in red)**

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Per. \_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_

**Probability Post-Assessment**

**Directions:** Read and follow the directions for each question. Show your work when necessary. You may use a calculator. Simplify your answers.

**Expressing Probability**

1. In your science class, you were growing bean plants. The bean plants were put on the ledge and received lots of sunlight. 17 of the plants survived and 4 died. What would be the probability of a plant surviving? Please express as a percent.

The probability of a plant surviving is 81%.

Half credit if they answer as a fraction: 17/21.

1. The following is the Preamble of the Constitution of the United States.

We the People of the United States, in Order to form a more perfect Union, establish Justice, insure domestic Tranquility, provide for the common defense, promote the general Welfare, and secure the Blessings of Liberty to ourselves and our Posterity, do ordain and establish this Constitution for the United States of America.

If you close your eyes and put your finger randomly on the page, then what is the probability you will land on the letter “t”?

The probability of landing on the letter “t” would be 29/276.

**Approximating Probability and Frequency**

1. There are four marbles in a jar. The colors of the marbles are red, purple, green, and pink. You pull out a marble, record the color, and put it back in 20 times. Your results are in the table below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Color of Marble | Red | Purple | Green | Pink |
| Number of Times | 8 | 2 | 3 | 7 |

Using the results above, what is the probability of pulling a pink marble on your 21st time?

The probability is 7/20.

1. A deck contains 75 different cards. The colors of the cards are red, blue, and green. I pull a random sample of 5 cards and 3 are red. Make an inference about how many red cards are in the deck.

There are 45 red cards.

**Sample Space**

1. Beyoncé and Jay-Z are playing a game with a spinner and a number cube. The spinner can be seen below. The number cube is 1-6. For each turn, the player must spin the spinner and roll the number cube. The score of each player’s turn is the sum of the numbers on which the spinner lands and the number rolled on the cube. It’s Beyoncé’s turn. Show all possible outcomes that Beyoncé could get.



|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Spinner | 10 | 10 | 10 | 10 | 10 | 10 |
| Number Cube | 1 | 2 | 3 | 4 | 5 | 6 |
| Sum | 11 | 12 | 13 | 14 | 15 | 16 |
|  |
| Spinner | 20 | 20 | 20 | 20 | 20 | 20 |
| Number Cube | 1 | 2 | 3 | 4 | 5 | 6 |
| Sum | 21 | 22 | 23 | 24 | 25 | 26 |
|  |
| Spinner | 30 | 30 | 30 | 30 | 30 | 30 |
| Number Cube | 1 | 2 | 3 | 4 | 5 | 6 |
| Sum | 31 | 32 | 33 | 34 | 35 | 36 |
|  |
| Spinner | 40 | 40 | 40 | 40 | 40 | 40 |
| Number Cube | 1 | 2 | 3 | 4 | 5 | 6 |
| Sum | 41 | 42 | 43 | 44 | 45 | 46 |

**Game Fairness**

1. Beyoncé and Jay-Z are playing a game with a spinner and a number cube. The spinner can be seen below. The Number cube is 1-6. For each turn, the player must spin the spinner and roll the number cube. The score is the sum of the numbers on which the spinner lands and the number rolled on the cube. Jay-Z suggest playing a twist to the game. He says that no matter who it rolling and spinning, if the sum is even, then he gets a point. But if the sum is odd, then Beyoncé gets a point. Is this game fair? Why or why not?

The game is far, because Beyoncé and Jay-Z both have equal chances of winning. There are an equal number of times that you can spin/roll to get an even sum as there is to get an odd sum.

**Compound Events**

1. Archie rolls two number cubes, each with sides numbered 1 through 6. Using a table, what is the probability that Archie will roll two even numbers?

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | 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 |

The probability is ¼.

Half credit if they do not simply the fraction 9/36.

1. At Burritos R Us, you pick from the following options:

Meat: Steak, Pork, Chicken

Rice: White, Brown

Salsa: Mild, Medium, Extreme

Veggies: Green Peppers, Lettuce, Corn

Toppings: Cheese, Sour Cream, Guacamole

You can only pick one meat, one rice, one salsa, one veggie, and one topping. Using the Fundamental Counting Principle, how many options are there at Burritos R Us?

 3 X 2 X 3 X 3 X 3 = 162

 There are 162 options at Burritos R Us.

1. At Build-A-Bear, you have the following options:

Color: Brown, White, Purple, Blue

Size: Big, Mini

Outfit: Firefighter, Princess, Minion

Using a tree diagram, find the probability of picking out a Purple, Mini Princess.

 The probability is 1/24.