LESSON PLAN PROJECT- FINAL LESSON

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SECTION I – INTRODUCTION

This lesson is a basic introduction to probability lecture intended for Grade 7. The overall course will be a common grade 7 math class based on the common core guidelines for math for grade 7, and we will be covering an introductory unit on probability. We will apply our knowledge of some of the misconceptions identified by Shaughnessy in their article "Research on Students' Understandings of Probability." In this paper, Shaughnessy identified several misconceptions that students without previous probability education struggle with. One such misconception is that students tend to struggle with the concept of ratios, and have trouble distinguishing between two groups of objects with 2 categories. The one with the higher proportion of "success" category objects are more likely to be interpreted as more likely than the same favorable condition in the other group, even when the ratios of the two groups are the same. Essentially, students have trouble distinguishing the relationship between the part and the whole. We ensured that students would have a chance to explore this misconception by including a choice question in our worksheet that has students decide between two groups of berries, where they know the ratio but choose blindly. The group of berries with more successes has a lower ratio of successes, isolating this misconception that students may have. We made this a challenge question to let students discuss and learn from each other, using cooperative learning to help each other fix their misconception. We as instructors will guide the groups to help students arrive at an understanding of ratios.

Similarly, students struggle with equiprobability, which means that students misinterpret that all events in a scenario are equally likely, regardless of the number of possible "successes" and "failures" in a given scenario. This includes logic like "any number of successes will happen in one go" and "anything can happen," failing to consider how likely these events are. We addressed this possible misconception with two different examples. Our ranking activity at the beginning of the worksheet allows students to explore the difference between likely events and unlikely events. Practice problem #4 also addresses the misconception of equiprobability, by directly allowing students to explore the relationship between different probabilities in one example.

We also want to ensure that students recognize that even if an event has a large probability of occurring, it does not mean that there is a guarantee of the event occurring (coincidences happen), and that expressing that an event with a lower probability can occur before an event with a higher probability. This concept is covered in multiple examples, and the worksheet emphasizes that a guaranteed outcome is only present with a probability of 0 or 1.

Our lesson assumes no prior knowledge of probability. We expect them to be comfortable with basic math skills like fractions and division, and our lesson utilizes simple calculations with probability that we expect will be easy for seventh graders. The only preparation required is that students bring a calculator to class. Because we are doing an intro to probability, our lesson would be the first in a series of probability lessons. The next lesson would be the basics of long run probability.

Some learning goals for this lesson are for students to be able to recognize that probability is a number between 0 and 1 that indicates how likely or unlikely an event is to occur, distinguish between events with low and high probabilities and what that means in context (e.g. which of these two probabilities is higher), and recognize that high probabilities do not guarantee outcomes occurring, and that low probabilities do not guarantee outcomes not occurring. The Common Core Standard that is relevant to our lesson is 7.SP.C.5, which is for students to "understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability near .5 indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event." We hope that

our lesson will help students make more informed decisions by providing them with a better understanding of chance and ratios, and how to determine simple probabilities.

SECTION II – DATA AND TECHNOLOGY

We will not be using a formal dataset for this lesson. Our lesson doesn't require the use of a dataset, as we are covering a very basic introduction to probability. Instead we will be utilizing spinner wheels to demonstrate simple probabilities, and simple choice scenarios like dice rolls to display chance. We will be presenting with Google Slides, but our lesson won't involve the use of applets or any kind of computer simulation. We are going to have the students use calculators to divide (for calculating probabilities as a decimal from a ratio). Other instructors could use our slideshow presentation and our worksheet handout, which includes all the information students need throughout the lesson, to teach this class.

SECTION III – OUTLINE OF THE LESSON

Students should bring a calculator on the day of the lesson in preparation for the lesson. We will provide paper worksheets, and will use a slideshow presentation to guide the lesson. We will start with a welcome to the class, giving them a brief overview of what we will be covering during our lesson for the day. The examples that we are using at the beginning exercise of the lesson are applicable to students' lives and are likely of interest to them (from familiar/engaging contexts). We created applicable examples to instruct students that probability is a concept they experience every day, even if they didn't have a name for the concepts. We are utilizing the idea of constructivism by building on students' preconceived knowledge of likelihood and creating new knowledge of probability. For this exercise, we will start by introducing probability without formally defining it first, having them do a ranking activity similar to the questions below where students will place the "events" described like the ones below in order of least likely to most likely of occurring. We will present 5 prompts to students with 5 varying degrees of certainty: Impossible (The likelihood that you see a dinosaur on your way to class), Not likely (The likelihood of a winning the lottery), 50/50 (The likelihood a coin will land on head), Very likely (The likelihood that it is a sunny day in San Luis Obispo), and Certain (The likelihood that tomorrow is Thursday). Students will consider these options individually first, then in small groups of about 3, which they will work in throughout the lesson. We will be encouraging group discussion throughout the lesson, allowing students to build on each others' knowledge of probability situations. Instructors will walk around the class supporting students, challenging them if they start to get off track. We will then reconvene as a class and have groups share and defend their answers, giving students an opportunity to reconstruct misconceptions and providing them with an incentive to make sure their groups come to an agreement.

From there, we will briefly explore the formal definition of probability. We will then ask students to practice their knowledge of the concept with an activity involving spinners. We will ask students to create multiple spinners that represent given probability scenarios by having them sketch out the spinner designs on a worksheet. For example, we will ask students to create a spinner that is more likely to land on red than blue. Then we will ask them to predict what the spinner will land on. Students will spin the spinner (using a paper clip) and report what the spinner landed on. We will ask the students to explain why they think the spinner landed on whichever color it landed on. Students will work individually and then have partner discussions about the spinner activity. As instructors, we will have them pair up with a nearby partner. We will encourage cooperative work by having people work toward a mutual goal by having the students answer the five event prompts individually to hold them accountable and then have them "pair-share" in hopes of the students achieving similar findings. We are planning for the students to discuss with their partner as they are completing the activities. The students are still working individually, but are able to work toward a mutual goal with their partner. For the spinner activity discussion, we will

ask the students ‘What do you predict the spinner will land on?’ ‘Why do you think the spinner landed on the given color?’ ‘What does this represent?’ The students will demonstrate their knowledge of probability by creating spinners that represent pre-determined probabilities, and we will guide them to understand that there are many different correct solutions for some probabilities on a spinner. This activity will help students see how probability is a number between zero and one.

After students have demonstrated a mastery of simple probabilities, we will begin to teach them how to calculate simple probabilities with a worksheet. We designed the worksheet to have all the necessary information they need about probability, with the goal of ensuring that students can identify the numerator and denominator in a scenario to calculate the probability of an outcome. The worksheet will be completed by the small groups of students, with instructors monitoring their progress and challenging them to explain the probabilities in context. The worksheet builds to challenge questions that challenge students to use their knowledge of probability in a more complex situation, like describing the difference between two ratios and determining a student’s logical error. These questions utilize scaffolding, because the students will have to use critical thinking about the concepts they have already learned to get to a desired level of competency. We will go through each question one-by-one on screen after the students have completed them and have defended their answers, and when we are confident that each group understands how to solve the problems.

To assess that students have understood the basic probability concepts, there will be an exit ticket activity where students are given a description of a level of probability, and they will have to come up with an example that matches the same level of probability, and an explanation (see worksheet). Students will work on this individually to prove that they were participating in the group discussions and can explain the topic on their own.

SECTION IV – ACTIVITY AND LECTURE NOTES

We are using the EngageNY guidelines to help develop our handout. No other material is being implemented for students in this lesson. See the attached handouts on Canvas for the lesson handout. If the students draw their spinner incorrectly, instead of making them undo it, we will ask them what their spinner represents. Another potential error could be if students answering the first challenge question say that the probabilities are equally likely for picking a chocolate or cashew because of the common equiprobability misconception where students would say that “anything could happen” or “there are 4 categories so there is an equal probability of picking from each”, when failing to consider the size of each group. Instructors (e.g. the presenters, we) could ask students “how is probability defined? What does it mean for an answer to be a valid probability?” as some example questions to help if they are lost. The challenge questions in the handout are meant to be harder, and we expect students to struggle, because although they make use of probability concepts that should be thoroughly understood from the lesson, the challenge questions are presented in ways that the students would not have seen before, like comparing two ratios and determining a logical error. When students get stuck, we will encourage them to consider what they already know about determining numerator and denominator and using those to make an informed decision. We referenced the Engage NY probability lessons to create warm-up activities and knowledge checks, and we made sure to import a focus on group understanding by adjusting the activities for a classroom setting.

When walking around the class while students are working on the activities/exercises that they are to do themselves or in groups, the instructors will check in with students to ask if they need help or clarification on an exercise. If students appear mostly done or off-task, this will be a signal to either regroup the class to discuss the problems, or gently remind people to finish up. Throughout the worksheet section of the class, the instructors will ask students to explain their reasoning on various questions, to make students synthesize their understanding into words. We will also ask deeper content-related questions when students are on track to challenge students to get to the next level.

SECTION V – ASSESSMENT

We are assessing students throughout our lesson with our worksheet, by incorporating two multiple-choice questions to test the Ratio Concept in multiple choice question 4 II. We are hoping students will recognize that choosing a raisin or an almond is the same probability of occurring. In multiple-choice question 4 I, we are examining if students can determine the greater probability, while understanding that even though we have a greater probability, it does not guarantee that the correct answer will always be chosen. Both questions address the learning goal of distinguishing between events with low and high probabilities, and what that means in context. For our open-ended questions, we involved an exit ticket where we ask students to construct their own ideas of event descriptions in terms of the probability of the event occurring. From there, we ask the students to explain their reasoning to expand the students' thinking. We address the previous learning goal as well as the Common Core Standard of recognizing that probability is a number between 0 and 1, which indicates how likely or unlikely an event is to occur.