TITLE: *What are the chances?*

SUBJECT: Mathematics/Algebra 1

Grade level: High school

ALIGNMENTS:
  Standards: 2.7.A1.A
  Anchors: A1.2.3.3.1
  Eligible Content: M11.E.3.1.1

VOCABULARY :

- Probability: A number from 0 to 1 that indicates how likely something is to happen. Can be expressed as a decimal, fraction, or percent.
- Compound events: Compound events consist of two or more events.
- Independent events: If the outcome of one event does not affect the outcome of the other event, the events are said to be independent.
- Dependent events: If the outcome of one event affects the outcome of the other event, the events are said to be dependent.

OBJECTIVES:

- Students will find the probability of simple, independent, and dependent events in fractions, decimals, or percents.

ESSENTIAL QUESTIONS:
- How do we calculate the probability of simple events?
- How do we calculate the probability of compound events?
- How do we calculate the probability of dependent compound events?

DURATION: 45-60 min

MATERIALS:
- Board/Interactive white board
- Partner/Team Worksheet
- Dice
- Jar with colored balls or marbles
- Internet access
- Calculators

INSTRUCTIONAL PROCEDURES:

W: For a warm up, have decimal numbers that students have to convert to a percent, percent that they have to convert to decimal, decimal they have to convert to fraction, fraction they have to convert to percent. Here are some examples you could have on the board/interactive white board as a warm up.

1. Convert the decimal 0.64 to a fraction.   A: 16/25

2. Convert the fraction 2/7 to a percent.   A: 28.57%

3. Convert the fraction 3/11 to a decimal.   A: 0.27

4. Convert the percent 42% to a decimal.   A: 0.42

5. Convert the percent 42% to a fraction.   A: 21/50

Check answers before moving on to lesson.

   "Today we are going to extend your knowledge of probability to include compound events. Compound events are two or more events. We are going to do a few guided problems together, then you and your partner will do 7 problems, and when you are done with that, we will get to use the internet game, *"What are the Chances?"* to evaluate your understanding.

H: **"Let's go over some definitions first. Compound events: Compound events consist of two or more events. Independent events: If the outcome of one event does not affect the outcome of the other event, the events are said to be independent. Dependent events: If the outcome of one event affects the outcome of the other event, the events are said to be dependent."** Write on board.

   "We know what probability means and we know how to find it for one event. Let's say the probability of rolling a 6 on a fair dice. Show students dice. **What is the probability?** Allow students time to respond. Students should come up with an answer 1/6. **The probability is 1/6 or 0.17, or 17% as a fraction, decimal, and percent."**

   "But now let's say I want to roll the dice twice and I want to know what is the probability of getting a 2 on the first try and a 6 on the second try. Show students dice. **Now before we compute that, do you think this is an independent event or dependent event? Talk amongst your teams about this. Refer to the definitions on board."** Allow time for students to talk in teams. If a student/team says independent, allow them to share out why they think it is independent. **"These are independent events because what number you get on the first roll does NOT affect the number on the second roll. Okay, so let's find the probability of the events. The probability of rolling a 2 is 1/6 and the probability of rolling a 6 is 1/6. To find probability of this compound event, you multiply. So the probability is 1/6*1/6 = 1/36, or 0.0278, or 2.78%."**

   "Let's say a jar contains three red balls, two white balls, and one green ball." Write on board and get jar with 3 red balls, 2 white balls, and 1 green ball.

"What is the probability of picking two white balls if the first ball is replaced? (Write on board – show students that you would select it then put it back.) **Ask yourself, independent or dependent events? It is independent because if you put the ball back into the jar, it will not affect the outcome of the second pick. Let's find the probability. The probability of selecting one white is 2/6 and the probability of selecting another white after you replaced the first one is 2/6. So multiply 2/6*2/6 = 1/9, or 0.11, or 11%."**

"Let's still use the same jar but what is the probability of selecting a red marble and then putting it back, then a green one?" Write on board. Show students the jar. Take it around to students who need to physically see it. Have students try this on their own in their teams or with a partner. Give them a time limit that you think is appropriate. **"The probability of selecting a red one is 3/6 and the probability of selecting a green one (after you put the red one back) is 1/6 so the answer is 3/6*1/6 = 1/12 or 0.083 or 8.3%."**

"Okay, lets put some more in the jar. Let's have 4 red balls, 6 white ones, 3 blue, and 2 yellow." Write on board for students to refer to.

"What is the probability of selecting a white one then a yellow one WITHOUT replacing the white one? This is a dependent event. Can someone tell me why? Talk it out with your group. Then I will randomly call on someone." Allow students time to talk about why it is dependent. Randomly call on a student to explain why it is dependent. The student's response should be it is dependent because if you don't replace the white one, that changes the number of items in the jar. So the results of the green one depend on the results of the first pick. If students don't get that answer, then explain and show them why with the jar. Physically take out the white one and give it to a student or set it aside and explain why it affects the result of the green one.

"Okay, so now find the probability. The probability of the white one is 6/15. Take out a white one from jar **and now the probability of the yellow is 2/14. Why is it 14 again?** Allow student time to think. Select a student to state why. **Because the white one was not put back! So the probability is 6/15*2/14 = 2/35 or 0.057 or 5.7 %."**

"Okay, I want you to try this one with your partner (or teams). What is the probability of selecting a blue one first and NOT replacing it, then getting another blue one?" Allow students time to work on this either in teams or partners. Give them an appropriate time limit. Go around the room and check student answers. Encourage them to talk it out if they are having problems. Show them the jar for those that need to actually see it. Randomly select a student to give the answer and EXPLAIN how they got the answer. Answer: $3/15*2/14 = 1/35$ or 0.029 or 2.9%. If further explanation is needed, physically go through the steps with the jar and work out the problem. Some students might need to physically see why there are now only 2 blue ones and only 14 total balls in the jar.

E: "Okay, now we are going to do 7 problems with your partner. When you are done, let me check them and then you can get on the computer and play *"What are the chances?"* Hand out the Partner/Team worksheet. You could have students work in teams or partners, however things work in your classroom. The main thing here is to make sure students check their work with someone before moving onto the next problem. Answers:

1. 1/169 or 0.59% or 0.0059
2. 1/15 or 0.067 or 6.7%
3. 24/91 or 0.263 or 26.3%
4. 1/12 or 0.083 or 8.3%
5. 12/35 or 0.34 or 34%
6. 1/4 or 0.25 or 25%
7. 9/16 or 0.5625 or 56.25%

R: As students are working in partners, monitor student performance. Visit each group and have students explain their thinking and clarify any misunderstandings.

Once they have shown mastery, have students get on the Internet for activity below.

E: For individual practice, have students go to http://wpsu.org/games/Probability1.swf

**Please Note: *You can determine what you would like them to work on. There are simple, compound, and dependent events. Then you can select whether you want them to select their answer as a fraction, decimal, or percent. This is where you need to look at your students and see where they struggle or excel and tell them individually what they should be selecting. You can select all 3 types of probability and all 3 types of answers (fractions, decimal, and percent).*

SUGGESTED INSTRUCTIONAL STRATEGIES:

T: For those students who are showing strong proficiency of the concepts, you can have one of the partners make up their own dependent word problem and the other partner will then work it out. Then they have to check the work. Also, on the internet activity, you can have them select all three probability types (simple, compound, and dependent) and all three types of answers (fractions, decimals, and percent).

For those still struggling with the concept, use baggies full of balls for them to physically see what is happening. A good substitute for the balls are small "pom poms" sold in craft stores. They are soft and students can't roll them or throw them. For the partner worksheet, you can also give them a deck of cards; red, white, and blue chips; a coin and dice; and other materials that would help them answer the questions. To imitate the Internet activity, you can give the students 6 red things and 8 green things (some type of counters). You could also pull aside a small group of students who are still struggling and give them more one-on-one assistance with some additional problems. Also for the internet activity, have them start off with simple probability and fractions. Then once they master that, have them move to compound with fractions and once they master that, then have them move onto dependent with fractions.

O: The goal of this lesson is to find probability of compound events: independent and dependent events. The activities in this lesson are intended to move the student from the teacher guided items to independent rigorous problems for finding probability of compound events.

FORMATIVE ASSESSMENT:

- Ongoing teacher observation during partner work, student interaction, and computer activity
- Partner worksheet

KEY WORDS: probability, compound, event, dependent, independent, fractions, decimals, percents

RELATED MATERIALS AND RESOURCES:

Interactive: http://wpsu.org/games/Probability1.swf

Student Handout – See next page.

COMPOUND EVENTS

Partner/Team Worksheet.   Name: _____

1. What is the probability of selecting an eight followed by a nine from a regular deck of 52 cards if the first card **is replaced** before the second card is drawn?

2. A bag contains 6 marbles: 2 red, 1 green, and 3 blue. Two marbles are randomly selected **without replacement**. Find the probability of selecting 1 green marble and then 1 red marble.

3. A box contains 6 red scarves and 8 green scarves. A green scarf is drawn out the box and **set aside**. What is the probability that the next scarf drawn at random will be red?

4. Tracy has a box that contains 12 pens. She chooses a pen without looking, **replaces it**, and then picks another. There are 4 black pens, 3 red pens, and 5 blue pens. What is the probability that she will choose a black and then a red pen?

5. The names of nine boys and six girls from your class are put into a hat. What is the probability that the first two names chosen (one first then the other **without** replacement) will both be boys' names?

6. You flip a coin and toss a dice. What is the probability that you will roll a four or greater on the dice and get tails on the coin?

7. A bag contains 6 red chips, 9 white chips, and 5 blue chips. A chip is selected and then **replaced**. Then a second chip is selected. Find the probability that **neither chip is blue**.