**Unit Abstract:** Students develop and use probability models to predict the occurance of specific events. Students also learn to explain descripences that arise when the theoretical probability does not match actual frequencies produced during an experiment.

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| **Overarching Question:**  How can predictions to real-world problems be made based on *just* data? | | | | | | |
|  | | **This Unit:** How likely an event is to occur represented with a number from 0 to 1, finding probability of single and compound events using lists, models, tree diagrams, and simulations, comparing probabilities of experimental outcomes with theoretical probabilities | | | |  |
| **Questions to Focus Assessment and Instruction:**   * How is probability expressed numerically? * How can probability models be developed? * How can you use a probability model to determine the probabilities of given events? * How can theoretical probability of an event (single or compound) be used to predict the occurance of certain events? * How can you explain when a probability prediction does not match the observed experimental frequencies? | | | | **Standards for Mathematical Practice**  1.Make sense of problems and persevere in solving them.  2.Reason abstractly and quantitatively.  3.Construct viable arguments and critique the reasoning of others.  **4.Model with mathematics.**  5.Use appropriate tools strategically.  6.Attend to precision.  7.**Look for and make use of structure.**  8.Look for and express regularity in repeated reasoning. | | |
| **Academic Vocabulary**  *(5-8 most important content specific vocabulary words)* | Theoretical probability  Experimental probability  Event (single or compound)  Outcome  Favorable outcome  Sample space  Observed frequency | |  | |  | |

| **Standards** | **Learning Targets** *(including relevant practice standards)* | **Explanations and Examples\*** | **Assured Experiences**  *(common assessments and learning activities)* |
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| List number and text of the content standard; priority standards are bold-faced  7.SP.5. 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 around 1/2 indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event.  **7.SP.7. Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy.**   1. **Develop a uniform probability model by assigning equal probability to all outcomes, and use the model to determine probabilities of events.** *For example, if a student is selected at random from a class, find the probability that Jane will be selected and the probability that a girl will be selected.* 2. **Develop a probability model (which may not be uniform) by observing frequencies in data generated from a chance process.** *For example, find the approximate probability that a spinning penny will land heads up or that a tossed paper cup will land open-end down. Do the outcomes for the spinning penny appear to be equally likely based on the observed frequencies?*   7.SP.6. Approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability. *For example, when rolling a number cube 600 times, predict that a 3 or 6 would be rolled roughly 200 times, but probably not exactly 200 times.*  7.SP.8 Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation.   1. Understand that, just as with simple events, the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs. 2. Represent sample spaces for compound events using methods such as organized lists, tables and tree diagrams. For an event described in everyday language (e.g., “rolling double sixes”), identify the outcomes in the sample space which compose the events. 3. Design and use a simulation to generate frequencies for compound events. *For example, use random digits as a simulation tool to approximate the answer to the question: If 40 percent of donors have type A blood, what is the probability that it will take at least 4 donors to find one with type A blood* | Students will….  Describe how the probabablity of an event occurring or not occurring is expressed numerically.  Identify all outcomes for a given single probability event.  Identify favorable outcomes for a given single probability event.  Develop probability models and use them to predict probability of events.  Explain discrepancies between theoretical probabilities and experimental probabilies.  Develop probability models given frequencies to determine the likelihood of equal or unequal outcomes.  Use data of an event to predict frequency.  Identify all outcomes for a given compound probability event.  Identify favorable outcomes for a given compound probability event.    Find probabilities of compound events. | From state document  7.SP.5. Probability can be expressed in terms such as impossible, unlikely, likely, or certain or as a number between 0 and 1 as illustrated on the number line. Students can use simulations such as Marble Mania on AAAS or the Random Drawing Tool on NCTM’s Illuminations to generate data and examine patterns.  Marble Mania [http://www.sciencenetlinks.com/interactives/marble/marblemania.html](http://www.sciencenetlinks.com/interactives/marble/marblemania.html%20)  Random Drawing Tool **-** [http://illuminations.nctm.org/activitydetail.aspx?id=67](http://illuminations.nctm.org/activitydetail.aspx?id=67%20)    Example:  • The container below contains 2 gray, 1 white, and 4 black marbles. Without looking, if you choose a marble from the container, will the probability be closer to 0 or to 1 that you will select a white marble? A gray marble? A black marble? Justify each of your predictions.  7.SP.7 Students need multiple opportunities to perform probability experiments and compare these results to theoretical probabilities. Critical components of the experiment process are making predictions about the outcomes by applying the principles of theoretical probability, comparing the predictions to the outcomes of the experiments, and replicating the experiment to compare results. Experiments can be replicated by the same group or by compiling class data. Experiments can be conducted using various random generation devices including, but not limited to, bag pulls, spinners, number cubes, coin toss, and colored chips. Students can collect data using physical objects or graphing calculator or web-based simulations. Students can also develop models for geometric probability (i.e. a target).  7.SP.6. Students can collect data using physical objects or graphing calculator or web-based simulations. Students can perform experiments multiple times, pool data with other groups, or increase the number of trials in a simulation to look at the long-run relative frequencies.  Example:  Each group receives a bag that contains 4 green marbles, 6 red marbles, and 10 blue marbles. Each group performs 50 pulls, recording the color of marble drawn and replacing the marble into the bag before the next draw. Students compile their data as a group and then as a class. They summarize their data as experimental probabilities and make conjectures about theoretical probabilities (How many green draws would you expect if you were to conduct 1000 pulls? 10,000 pulls?). Students create another scenario with a different ratio of marbles in the bag and make a conjecture about the outcome of 50 marble pulls with replacement. (An example would be 3 green marbles, 6 blue marbles, 3 blue marbles.) Students try the experiment and compare their predictions to the experimental outcomes to continue to explore and refine conjectures about theoretical probability.  7.SP.8 Examples:  • Students conduct a bag pull experiment. A bag contains 5 marbles. There is one red marble, two blue marbles and two purple marbles. Students will draw one marble without replacement and then draw another. What is the sample space for this situation? Explain how you determined the sample space and how you will use it to find the probability of drawing one blue marble followed by another blue marble.  • Show all possible arrangements of the letters in the word FRED using a tree diagram. If each of the letters is on a tile and drawn at random, what is the probability that you will draw the letters F-R-E-D in that order? What is the probability that your “word” will have an F as the first | * Unit # common summative assessment * Learning activity:   Frayer model vocabulary exploring the meaning of the word “event” compared to probability and sports or rock concert.  Weblink:  <https://www.engageny.org/sites/default/files/resource/attachments/math-g7-m5-teacher-materials.pdf>  Movie problem  Weblink: rolling dice in class  <http://rda.aps.edu/RDA/Performance_Task_Bank/Documents/7th_Grade/RollingDice_1216.pdf>  Hyperlink: rolling dice in class activity  [resources\rolling dice in class activity.docx](resources/rolling%20dice%20in%20class%20activity.docx)  Weblink red, green, or blue?  <https://www.illustrativemathematics.org/content-standards/7/SP/C/8/tasks/1442>  Hyperlink:  [resources\Illustrative mathematics red, green, or blue.docx](resources/Illustrative%20mathematics%20red,%20green,%20or%20blue.docx)  Weblink illustrative mathematics dice twice  <https://www.illustrativemathematics.org/content-standards/7/SP/C/8/tasks/890>  Hyperlink to dice twice  [resources\Illustrative mathematics dice twice.docx](resources/Illustrative%20mathematics%20dice%20twice.docx) |

**Instructional resources** (including manipulatives, literature connections, professional resources)

Standard #1

Standard #2

Standard #3

Standard #4

Standard #5