NEW MEXICO
Public Education Department

7.SP: STATISTICS & PROBABILITY

Cluster Statement: C: Investigate chance processes and develop, use, and evaluate probability models.

Supporting Cluster (Students should spend the large majority of their time (65-85%) on the major work of the grade/course. Supporting work and, where appropriate, additional work should be connected to and engage students in the major work of the grade.)

Standard Text	**Standard for Mathematical Practices**	**Students who demonstrate understanding can:**
7.SP.C.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.	SMP 2: Students reason abstractly and quantitatively about the numerical values used to represent probabilities as values between 0 and 1. SMP 7: Students look for and make use of structure when recognizing that probability can be represented in tables, visual models, or as a rational number.	• In writing, express the likelihood of a chance event with a probability range from 0 to 1. • Recognize that the probability of any single event can be expressed with the terms impossible, unlikely, equally likely, likely, or certain. • Express probability as a fraction, decimal or percent. **Webb's Depth of Knowledge:** 1 **Bloom's Taxonomy:** Understand
Standard Text	**Standard for Mathematical Practices**	**Students who demonstrate understanding can:**
7.SP.C.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.*	SMP 4: Students model with mathematics when applying this standard to a real-world context using mathematical probability representations that are algebraic, tabular or graphic. SMP 8: Students look for and express regularity in repeated reasoning by using repeated reasoning when approximating probabilities. They refine their approximations based upon experiences with data.	• Collect data on chance events (hands-on events such as spinning a spinner and simulations) and approximate the relative frequency of an event given the probability. • Students recognize that as the number of trials increase, the relative frequency approaches the probability • Explain the difference between relative frequency and theoretical probability using appropriate language • Determine the sample space for a probability model **Webb's Depth of Knowledge:** 2-3

<table>
<tr><td></td><td></td><td>Bloom’s Taxonomy:
Understand, Apply</td></tr>
<tr><td rowspan="3">Standard Text

7.SP.C.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.

• 7.SP.C.7. A: 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.
• 7.SP.C.8: 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?</td><td rowspan="3">Standard for Mathematical Practices

SMP 3: Students construct viable arguments and critique the reasoning of others by approximating probabilities, creating probability models and explaining the reasoning for their approximations. They also question each other about the representations they create to represent probabilities.

SMP 6: Students attend to precision by using precise language and calculations to represent probabilities in mathematical and real-world contexts.</td><td>Students who demonstrate understanding can:
• Calculate the probability of a (simple) event as a fraction, decimal, or percent.
• Determine the probability of events by developing uniform and non-uniform probability models (theoretical probability).
• Compare the models to the observed frequency and explain their reasoning for any discrepancies between the model and the observed frequency using appropriate vocabulary.
• Develop their understanding of probability by making predictions, comparing the predictions, replicating experiments, and comparing results.</td></tr>
<tr><td>Webb’s Depth of Knowledge: 2-3</td></tr>
<tr><td>Bloom’s Taxonomy:
Apply, Analyze, Evaluate</td></tr>
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<td>Standard Text

7.SP.C.8: Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation.

• 7.SP.C.8.A: 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.
• 7.SP.C.8.B: 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 event.
• 7.SP.C.8.C: 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% 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?</td>
<td>Standard for Mathematical Practices

SMP 1: Students make sense of probability situations by creating visual, tabular and symbolic models to represent the situations. They persevere through approximating probabilities and refining approximations based upon data.

SMP 6: Students attend to precision by using precise language and calculations to represent probabilities in mathematical and real-world contexts.</td>
<td>Students who demonstrate understanding can:
• Understand similarities and differences between compound events and simple events.
• Find the sample space of a compound event.
• Create organized lists, tables, tree diagrams, and simulations to find the probability of a compound event.
• Represent the probability of a compound event as a fraction, decimal, or percent.
• Design and use a simulation (using a random number table, calculator, dice, cards, or other manipulatives) to generate frequencies of compound events.
• Justify their selection of a particular situation and explain how it models a compound event

Webb's Depth of Knowledge: 1-2

Bloom's Taxonomy:
Understand, Apply</td>
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<td><u>Previous Learning Connections</u>
• The 6.SP standards connect directly to this standard. In 6th grade, students approximated the probability of a chance event by collecting data on the chance process that produces it and observing</td>
<td><u>Current Learning Connections</u>
• In 7th grade, students will recognize and represent proportional relationships between quantities. In 7th grade, students also use proportional relationships to solve multistep ratio and</td>
<td><u>Future Learning Connections</u>
• In 8th grade, learners construct and interpret a two-way table summarizing data on two categorical variables collected from the same subject. In high school, learners recognize the purposes of and differences</td>
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</table>

its long-run relative frequency, and predict the approximate relative frequency given the probability. Students also used ratio and rate reasoning to solve real-world and mathematical problems.	percent problems. These skills continue	among sample surveys, experiments, and observational studies; explain how randomization relates to each. In high school, learners find the conditional probability of A given B as the fraction of B's outcomes that also belong to A, and interpret the answer in terms of the model.

Clarification Statement:
This cluster focuses on probability and is the first-time students encounter this topic formally. Students learn the likelihood of chance events and approximate probabilities. They investigate chance using probability models they develop. The cluster begins with single events and builds up to finding the probability of compound events using tree diagrams, lists, tables, and simulations.

Common Misconceptions

- Relative frequency may be difficult to understand, students may want to express this as probability. Explain how probability helps determine the approximate relative frequency.
- Reviewing and understanding vocabulary words is crucial for this standard. Use words frequently and have students discuss them during class discussion.
- Keeping lines straight when using tree diagrams can be difficult. Encourage students to use graph paper and a ruler in order to keep the outcomes apart from each other. There is a greater chance when students create lists randomly, they will miss one or more outcomes.

Multi-Layered System of Supports (MLSS)/Suggested Instructional Strategies

Pre-Teach

Pre-teach (targeted): *What pre-teaching will prepare students to productively struggle with the mathematics for this cluster within your HQIM?*

- For example, some learners may benefit from targeted pre-teaching that provides additional time for confusion to happen with new mathematical ideas when studying; Investigate chance processes and develop, use, and evaluate probability models because the probability model is first introduced in this grade level and students may get confused more easily.

Pre-teach (intensive): *What critical understandings will prepare students to access the mathematics for this cluster?*

- 6.RP.A.3: This standard provides a foundation for work with Investigate chance processes and develop, use, and evaluate probability models because understanding ratio concepts and using ration reasoning to solve problems will help in solving probability models. If students have unfinished learning within this standard, based on assessment data, consider ways to provide intensive pre-teaching support prior to the start of the unit to ensure students are ready to access grade level instruction and assignments.

Core Instruction

Access

Interest: *How will the learning for students provide multiple options for recruiting student interest?*

- For example, learners engaging with investigating chance processes and developing, using, and evaluating probability models benefit when learning experiences include ways to recruit interest such as providing novel and relevant problems to make sense of complex ideas in creative ways because of the application aspect of this cluster of

standards students will have an increased interest in applying the design of probability to areas of their own interest. Including students in the choice and creation of ways to test their ideas around data to examine probability and chance will support recruiting student interest.

Build

Effort and Persistence: *How will the learning for students provide options for sustaining effort and persistence?*

- For example, learners engaging with investigating chance processes and developing, using, and evaluating probability models benefit when learning experiences attend to students attention and affect to support sustained effort and concentration such as using prompts or scaffolds for visualizing desired outcomes because providing students with clear targets as they are creating and developing probability models will support them moving towards that target.

Language and Symbols: *How will the learning for students provide alternative representations to ensure accessibility, clarity and comprehensibility for all learners? (e.g., a graph illustrating the relationship between two variables may be informative to one learner and inaccessible or puzzling to another; picture or image may carry very different meanings for learners from differing cultural or familial backgrounds)*

- For example, learners engaging with investigating chance processes and developing, using, and evaluating probability models benefit when learning experiences attend to the linguistic and nonlinguistic representations of mathematics to ensure clarity and comprehensibility for all learners such as making relationships between elements explicit because the terms involved in this cluster, e.g. probability, chance event, frequencies, can be easily mistaken for common words used, e.g. probably, by change, frequently, which can cause students learning content in a second language to struggle with mathematical meaning.

Expression and Communication: *How will the learning provide multiple modalities for students to easily express knowledge, ideas, and concepts in the learning environment?*

- For example, learners engaging with investigating chance processes and developing, using, and evaluating probability models benefit when learning experiences attend to the multiple ways students can express knowledge, ideas, and concepts such as providing multiple examples of novel solutions to authentic problems because learners often connect well to how mathematical concepts play out in authentic problems and with this cluster heavily focused on students being able to develop probability models students will benefit from expressing their ideas and understandings from examples.

Internalize

Self-Regulation: *How will the design of the learning strategically support students to effectively cope and engage with the environment?*

- For example, learners engaging with investigating chance processes and developing, using, and evaluating probability models benefit when learning experiences set personal goals that increase ownership of learning goals and support healthy responses and interactions (e.g., learning from mistakes), such as supporting students with metacognitive approaches to frustration when working on mathematics because students are being asked to work in a creative mindset supplying students with metacognitive approaches to frustrations will give them strategies for coping when they make mistakes. Students reflecting on what did work

in their thinking and what they can glean from their mistakes will provide an improved outcome to their models.

Re-teach

Re-teach (targeted): *What formative assessment data (e.g., tasks, exit tickets, observations) will help identify content needing to be revisiting during a unit?*

- Examine assessments for evidence of lingering misconceptions (see common misconceptions). If students exhibit one more of these misconceptions, consider addressing the misconception by re-engaging with content during a unit on investigation of chance processes and developing, using, and evaluating probability models by clarifying mathematical ideas and/or concepts through a short mini-lesson because the probability model is first introduced in this grade level and students may need time to clarify the concept.

Re-teach (intensive): *What assessment data will help identify content needing to be revisited for intensive interventions?*

- Examine assessments for evidence of students still developing the underlying ideas as some students may benefit from intensive extra time during and after a unit on investigation of chance processes and developing, using, and evaluating probability models by offering opportunities to understand and explore different strategies because students can find probabilities by using organized lists, tables, tree diagrams, and simulations

Extension

What type of extension will offer additional challenges to 'broaden' your student's knowledge of the mathematics developed within your HQIM?

- To extend students learning: For example, some learners may benefit from an extension such as the opportunity to explore links between various topics when studying investigation of chance processes and developing, using, and evaluating probability models because students can apply probabilities to real-life scenarios that link science disciplines for example, genetics and a Punnett square.

Culturally and Linguistically Responsive Instruction:

Validate/Affirm: How can you design your mathematics classroom to intentionally and purposefully legitimize the home culture and languages of students and reverse the negative stereotypes regarding the mathematical abilities of students of marginalized cultures and languages?
Build/Bridge: How can you create connections between the cultural and linguistic behaviors of your students' home culture and language the culture and language of school mathematics to support students in creating mathematical identities as capable mathematicians that can use mathematics within school and society?

Building Procedural Fluency from Conceptual Understanding: Instruction should build from conceptual understanding to allow students opportunities to make meaning of mathematics before focusing on procedures. When new learning begins with procedures it privileges those with strong prior familiarity with school mathematics procedures for solving problems and does not allow learning to build for more methods for solving tasks that occur outside of school mathematics. For example, when studying Investigating chance processes and developing, using, and evaluating probability models, the types of mathematical tasks are critical because probability models are encountered in everyday life, especially seen in news reporting or studies that students might see. With a little building of procedural fluency from conceptual understanding, students can understand probability meanings and interpret meanings on their own.

Standards Aligned Instructionally Embedded Formative Assessment Resources:

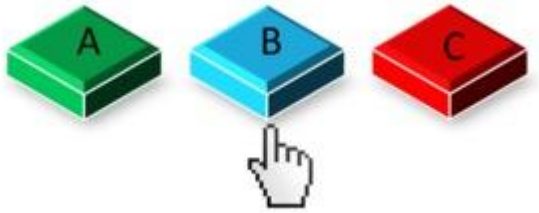
Source: http://tasks.illustrativemathematics.org/content-standards/7/SP/C/tasks/1581

Stay or Switch?

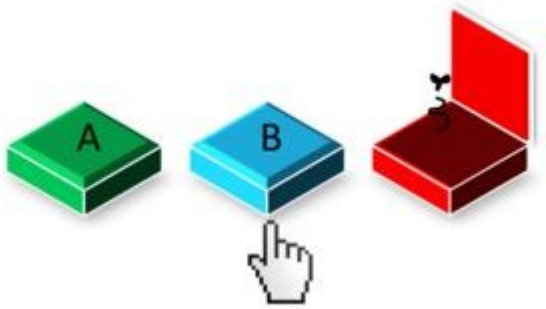
You are playing a video game. At the end of every level, there are three boxes. One contains 10,000 points, and the other two are empty. You can choose one of the boxes, but before the one you choose opens, one of the other boxes always opens to show that it is empty. The game allows you to either (1) stay with your first choice or (2) switch to the other unopened box.

For example, there are three boxes, A, B, and C.

Suppose you choose box B:

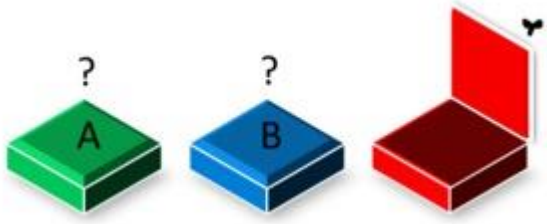


Before box B opens, one of the other boxes opens to show that it is empty. Imagine that in this case it is box C:



The game allows you to stay with your first choice or to switch to the other unopened box.

Should you stay or should you switch?



This type of assessment question requires students to find the theoretical probability of an event by systematically recording all the possible outcomes in the sample space and identifying those that correspond to the event. The tricky thing about the problem is that most people assume that it doesn't matter if they stay or switch, thinking that because there are two choices, the chances of getting the points is "50-50."

<table>
<tr><td colspan="2">Because the final result is often counter-intuitive, students will need to actively debate and try to convince one another that these probabilities are correct.</td></tr>
<tr><td>Relevance to families and communities:
How can you create connections between the cultural and linguistic behaviors of your students' home culture and language the culture and language of school mathematics to support students in creating mathematical identities as capable mathematicians that can use mathematics within school and society?
During a unit focused on Investigating chance processes and developing, using, and evaluating probability models, consider options for learning from your families and communities the cultural and linguistic ways this mathematics exists outside of school to create stronger home to school connections for students, for example, learning how to interpret probability or design models can be used in their daily life and connecting these examples to the work within the classroom.</td><td>Cross-Curricular Connections:

Science:
Make an argument on growth and development of organisms: animal reproductions, plant reproduction for specialized features. MS-LS1-4
Develop a model and identify components. Describe relationships between components. Model data they create. Identify limitations of models. Describe how the data they generate can be used to create designs through testing and modification. Engineering Design Process. MS-ETS1-4
Model genetic information and sexual reproduction results. Punnett squares. MS-LS3-2 Scatterplots of temperatures of water vs mass of ice added MS-PS3
Model genetic information and sexual reproduction results. Punnett squares. MS-LS3-2 Use simulations to generate data that can be used to modify a proposed object, tool, or process MS-ETS1</td></tr>
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