

Unit 9: Probability

Content Area: **Template**
Course(s):
Time Period: **Full Year**
Length: **9 Weeks**
Status: **Published**

Module 20: Understand and Apply Experimental Probability

Unit Rationale

Understanding and applying probability is a fundamental aspect of mathematics that is essential for making informed decisions and predictions. In this module, students will learn to **calculate and interpret experimental probability**—the probability of an event occurring based on the results of an experiment. This hands-on approach to probability allows students to connect mathematical theory to real-world scenarios, enhancing their understanding of chance and uncertainty.

This module is designed to provide students with the tools to engage in practical experiments, conduct trials, and collect data to estimate the likelihood of various outcomes. By comparing experimental probabilities with theoretical probabilities, students will deepen their understanding of the nature of probability and how it can be refined through repeated trials.

The real-world applications of experimental probability are emphasized throughout the module, with students working on experiments such as coin flipping, rolling dice, drawing cards, and more. These engaging activities not only build students' interest but also help them understand how probability is used in games, decision-making, weather forecasting, and many other areas of daily life.

This module also prepares students for more complex statistical concepts by fostering skills in data collection, analysis, and interpretation. By the end of the module, students will be able to:

- **Calculate experimental probability** based on actual outcomes from experiments.
- **Compare experimental probability with theoretical probability** and identify sources of discrepancies.
- **Analyze experimental data** and use repeated trials to refine probability estimates.
- **Apply experimental probability** to solve real-world problems and make predictions.

Throughout the module, students will engage with key Standards for Mathematical Practice, including:

- **MP2: Reason abstractly and quantitatively**—Students will translate real-world problems into mathematical models and make sense of data to understand the likelihood of events.
- **MP4: Model with mathematics**—Through experiments, students will model real-world situations using probability concepts.
- **MP6: Attend to precision**—Students will ensure accuracy in calculating probability and interpreting data, especially when conducting multiple trials.

By the end of this module, students will have a solid understanding of how to use experimental probability to

make predictions and decisions. This knowledge will not only enhance their mathematical thinking but also provide them with valuable skills for analyzing uncertainty in everyday situations.

Essential Questions

- **What is experimental probability, and how is it different from theoretical probability?**
- **How can conducting an experiment help estimate the probability of an event?**
- **What role do repeated trials play in refining experimental probability estimates?**
- **How can we use experimental probability to make predictions about real-world events?**
- **Why do experimental probabilities sometimes differ from theoretical probabilities, and how can we explain these differences?**
- **How can probability experiments, like rolling dice or flipping coins, be applied to real-life situations?**
- **How does the size of a sample affect the accuracy of experimental probability estimates?**
- **In what ways can we ensure our probability experiments are fair and unbiased?**
- **How can understanding experimental probability help in making informed decisions in uncertain situations?**
- **How do we interpret and analyze the results of probability experiments to draw meaningful conclusions?**

Pre-Assessments

Benchmark assessments are given within the first semester using HMH Into Math.

1. Readiness Check (Diagnostic Assessment)

- Found at the beginning of each module/unit.
- Assesses prerequisite skills necessary for success in the upcoming lessons.
- Usually includes a mix of multiple-choice and short answer items.
- Great for determining small-group needs or identifying which students might benefit from additional support.

2. Diagnostic Assessments in Ed: Your Friend in Learning

- Online assessments tied to Into Math.
- Adaptive in nature (depending on your district's setup) and aligned with the lesson standards.

- Can provide recommendations for intervention or enrichment based on results.

3. Module Quizzes (Pre-Use)

- While designed for post-instruction, some teachers use the Module Quiz or Mid-Module Checkpoint as a pre-assessment to gauge student background knowledge.
- Use selectively, focusing on concepts that build directly on prior grades' standards.

4. Lesson-Specific Checks

- Some lessons include "Are You Ready?" sections or warm-ups that can double as informal pre-assessments.
- Often appear in the Teacher Edition or digital platform and can be used as bell-ringers or exit tickets.

Instructional Plan

Lesson 1: Understand Probability of an Event

Student Learning Intentions (WALT)

- We are learning to:
 - Understand and define probability.
 - Calculate the probability of a simple event.
 - Identify the range of possible outcomes and the likelihood of each.

Student Success Criteria (I Can Statements)

- I can:
 - Define probability as the likelihood of an event occurring, expressed as a number between 0 and 1.
 - Calculate the probability of a simple event using the formula
$$P(E) = \frac{\text{Number of favorable outcomes}}{\text{Total number of possible outcomes}}$$

$$P(E) = \frac{\text{Number of favorable outcomes}}{\text{Total number of possible outcomes}}$$
 - Recognize and interpret different types of events, including certain, impossible, and unlikely events.
 - Use probability to describe the likelihood of real-world events.

Instructional Strategies and Activities

1. Direct Instruction (Teacher-led):

- Begin by defining **probability** and explaining its significance. Discuss how probability represents the likelihood that a particular event will occur, ranging from 0 (impossible event) to 1 (certain event).
- Introduce the formula for probability:

$$P(E) = \frac{\text{Number of favorable outcomes}}{\text{Total number of possible outcomes}}$$
$$P(E) = \frac{\text{Number of favorable outcomes}}{\text{Total number of possible outcomes}}$$

- Show examples of simple probability problems (e.g., rolling a six-sided die, flipping a coin).

2. Guided Practice:

- Use a virtual or physical die to demonstrate how to calculate the probability of a specific outcome (e.g., rolling a "3").
- Walk through several examples together, ensuring students understand how to count favorable outcomes and total outcomes.
- Allow students to practice calculating probabilities for different simple events, such as drawing a red card from a deck or picking a blue marble from a bag.

3. Interactive Activity:

- **Probability Spinner:** Create or use a virtual spinner divided into equal sections. Ask students to calculate the probability of landing on a specific color or section.
- **Coin Toss Simulation:** Students will predict the probability of getting heads or tails and compare the theoretical probability (50%) with experimental results from a series of 10 coin tosses.

4. Discussion:

- Discuss **certain**, **impossible**, and **unlikely** events. Have students identify examples from their own lives (e.g., "It is certain that the sun will rise tomorrow," or "It is impossible to roll a 7 on a standard six-sided die").

Formative Assessments

- **Exit Ticket:** At the end of the lesson, students will complete a short exit ticket that includes:
 1. Define probability in your own words.

2. Calculate the probability of drawing a green ball from a bag of 4 red, 2 green, and 1 blue ball.
 3. Provide an example of a certain event and an impossible event.
- **Classwork:** Students will complete a worksheet with simple probability problems, including calculating the probability of various events and classifying events as certain, impossible, or unlikely.
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Instructional Materials and Resources

- Whiteboard and markers
 - Dice (physical or virtual)
 - Spinner (physical or digital)
 - Deck of cards or a set of colored marbles
 - Probability worksheet (handout or digital)
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Reflections and Suggested Modifications

- **Reflection:**
 - Assess student understanding through participation in the class discussion and activities. If students struggle with the concept of favorable outcomes vs. total outcomes, revisit the examples and practice more with hands-on activities.
- **Modifications:**
 - For students who may need more support: Use physical objects like dice, spinners, or cards to make the concept more concrete.
 - For students who need an extension: Challenge them to calculate the probability of compound events (e.g., rolling two dice and calculating the probability of the sum being greater than 8).
- **Future Adjustments:**
 - Consider reviewing real-world applications of probability (e.g., weather forecasts, games of chance) to connect the concept to students' lives.

Lesson 2: Find Experimental Probability of Simple Events

Student Learning Intentions (WALT)

- **We are learning to:**

- Understand the concept of experimental probability.
- Calculate the experimental probability of a simple event based on actual data collected from an experiment.
- Compare experimental probability with theoretical probability.

Student Success Criteria (I Can Statements)

- **I can:**

- Define experimental probability as the ratio of the number of favorable outcomes to the total number of trials in an experiment.
 - Conduct a simple experiment to collect data.
 - Calculate the experimental probability based on the data I collect.
 - Compare experimental probability with theoretical probability and explain any differences.
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Instructional Strategies and Activities

1. Direct Instruction (Teacher-led):

- Begin by reviewing the concept of probability. Introduce **experimental probability** as the probability of an event occurring based on the results of an actual experiment.
- Provide the formula for experimental probability:
$$P(E) = \frac{\text{Number of favorable outcomes}}{\text{Total number of trials}}$$
$$P(\text{heads}) = \frac{6}{10} = 0.6$$
- Explain that experimental probability is based on data collected from real-world trials, which may differ slightly from theoretical probability (e.g., flipping a coin 10 times versus predicting it will land heads 50% of the time).
- Provide a step-by-step example: If we flip a coin 10 times and get heads 6 times, the experimental probability of getting heads is:

$$P(\text{heads}) = \frac{6}{10} = 0.6$$

2. Guided Practice:

- Conduct a simple experiment as a class. For example, use a coin or dice and record the number of heads or specific numbers rolled over 20 trials.
- After completing the experiment, calculate the experimental probability together using the

formula. Compare the result with the theoretical probability.

- For a fair coin, the theoretical probability of heads is 0.5.
- For a standard six-sided die, the theoretical probability of rolling a 4 is $\frac{1}{6}$.
- Discuss any differences between experimental and theoretical probabilities.

3. Independent Practice:

- **Activity 1: Coin Toss:** Students will toss a coin 20 times and record the number of heads and tails. Afterward, they will calculate the experimental probability of heads and tails.
- **Activity 2: Dice Roll:** Students will roll a six-sided die 30 times and calculate the experimental probability of rolling a specific number (e.g., 3).
- **Activity 3: Spinner Spin:** Using a spinner divided into equal sections (e.g., 4 equal sections with colors), students will spin the spinner 20 times, recording the results and calculating the experimental probability of landing on each color.

4. Class Discussion:

- After the independent practice, have students share their results. Lead a discussion about how the experimental probability may approach the theoretical probability as the number of trials increases.
- Highlight the importance of conducting enough trials to get a more accurate representation of the true probability.

Formative Assessments

- **Exit Ticket:**

At the end of the lesson, students will complete an exit ticket with the following questions:

1. What is experimental probability?
2. If you flipped a coin 30 times and got 18 heads, what is the experimental probability of getting heads?
3. If you roll a six-sided die 12 times and get a 2 only once, what is the experimental probability of rolling a 2?

- **Peer Feedback:**

Students can pair up and discuss their results from the dice roll or coin toss activity. They should compare their experimental probabilities and share their reasoning behind any differences in results.

Instructional Materials and Resources

- Coins or dice (physical or virtual)
 - Spinner (physical or digital)
 - Worksheet for recording data from the experiment
 - Whiteboard/Markers for group calculations
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Reflections and Suggested Modifications

- **Reflection:**

- Assess student understanding by checking their exit tickets and the accuracy of their experimental probability calculations. If there is confusion, revisit the formula and clarify how to distinguish between theoretical and experimental probability.
- If students struggled with performing the experiments, offer additional practice in smaller groups or provide virtual simulations of experiments that allow for more trials.

- **Modifications:**

- **For students needing extra support:** Provide visual aids and examples of simpler experiments to help them grasp the concept of experimental probability. Allow students to conduct fewer trials if they have difficulty with the recording process.
- **For advanced students:** Challenge them to conduct experiments with more complex events (e.g., rolling two dice and calculating the probability of the sum being an even number). Have them consider how increasing the number of trials impacts the experimental probability.

- **Future Adjustments:**

- Consider exploring the concept of **law of large numbers** in future lessons to explain how larger numbers of trials lead to experimental probabilities that are closer to theoretical probabilities.

Lesson 3: Find Experimental Probability of Compound Events

Student Learning Intentions (WALT)

- **We are learning to:**

- Understand the concept of compound events and how to calculate the experimental probability for them.
- Conduct experiments to find the experimental probability of compound events by considering multiple outcomes.

- Compare the experimental probability of compound events with theoretical probability.

Student Success Criteria (I Can Statements)

- **I can:**

- Define compound events as events that involve two or more simple events happening together.
 - Conduct an experiment to collect data on compound events (e.g., rolling two dice or drawing two cards).
 - Calculate the experimental probability of compound events based on the results of my experiment.
 - Compare experimental probability with theoretical probability and explain any differences.
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Instructional Strategies and Activities

1. Direct Instruction (Teacher-led):

- Review the concept of **compound events** as events involving the combination of two or more individual events. Provide examples, such as:
 - Rolling two dice and getting a sum of 7.
 - Drawing two cards from a deck, without replacement, and getting a red card followed by a black card.
- Explain that the experimental probability of a compound event is the ratio of favorable outcomes (the events of interest) to the total number of trials.
- Discuss how to calculate experimental probability for compound events:
 - If two dice are rolled 20 times, how many times do we get a sum of 7? The experimental probability is the number of times this happens divided by the total trials.
 - Similarly, for drawing cards, calculate the probability based on observed outcomes.

2. Guided Practice:

- **Activity 1: Rolling Two Dice:**
As a class, roll two dice 30 times. Record the sum of the dice in each trial. Discuss which sums are compound events (e.g., rolling a sum of 7 is a compound event that requires both dice). Calculate the experimental probability of rolling a sum of 7.
 - Example: Out of 30 rolls, a sum of 7 appeared 5 times. The experimental probability is $\frac{5}{30}$.
- **Activity 2: Drawing Two Cards:**
Use a deck of cards (or a virtual deck). Have students draw two cards in succession and record the color of the cards (e.g., red then black). Repeat the experiment 20 times. Calculate the

experimental probability of drawing a red card followed by a black card.

- Example: Out of 20 trials, this happened 4 times. The experimental probability is $\frac{4}{20}$.

3. Independent Practice:

○ Activity 1: Coin Toss and Dice Roll:

Students will perform a combined experiment where they flip a coin and roll a die 20 times. They will record the outcome of the coin flip (heads or tails) and the number rolled on the die. Students will calculate the experimental probability of a compound event, such as getting heads and a 3 on the die.

○ Activity 2: Spinner and Dice Experiment:

Students will spin a spinner with 4 equal sections (e.g., red, blue, yellow, green) and roll a die (1-6). They will perform the experiment 20 times and calculate the experimental probability of landing on red and rolling a 4.

4. Class Discussion:

- After the independent practice, discuss the differences between the experimental probabilities calculated by different students. Have students explain the reasoning behind their results.
 - Compare the results to theoretical probabilities:
 - For two dice, the theoretical probability of rolling a sum of 7 is $\frac{6}{36}$ (since there are 6 possible outcomes that give a sum of 7 out of 36 total possible outcomes).
 - For drawing two cards in a specific order (without replacement), discuss how to calculate the theoretical probability based on the number of favorable outcomes and the total possible outcomes.
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Formative Assessments

● Exit Ticket:

At the end of the lesson, students will complete an exit ticket with the following questions:

1. What is a compound event? Give an example.
2. If you roll two dice 30 times and get a sum of 7 six times, what is the experimental probability of rolling a sum of 7?
3. If you flip a coin and roll a die 15 times and get heads and a 5 four times, what is the experimental probability of this compound event?

● Peer Feedback:

Students pair up and share their findings from the spinner and dice experiment. They compare the experimental probabilities they calculated and discuss why there may be slight variations in their results.

Instructional Materials and Resources

- Two dice
 - A deck of cards (or virtual deck)
 - Spinner (physical or digital)
 - Dice (six-sided)
 - Worksheet for recording data from experiments
 - Whiteboard/Markers for group calculations
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Reflections and Suggested Modifications

- **Reflection:**

- Assess student understanding by reviewing the accuracy of their experimental probability calculations. Use their exit tickets to check for understanding and clarify any confusion about compound events and how to calculate their probability.
- If students have difficulty with the concept of compound events, provide more examples and break down the steps more clearly. Use visuals to show how different events combine to form a compound event.

- **Modifications:**

- **For students needing extra support:** Break compound events into smaller steps and perform the experiments with them. Allow additional time for practice and clarification of concepts.
- **For advanced students:** Have students explore more complex compound events, such as finding the probability of two independent events occurring (e.g., getting heads on two coin flips in a row) and explain how to calculate the probability of independent vs. dependent events.

- **Future Adjustments:**

- Consider adding a discussion of **dependent and independent events** in future lessons. For example, explain how the probability changes if events are dependent (like drawing cards without replacement) versus independent (like rolling dice or flipping coins).
- Plan for additional practice in using simulations or virtual experiments to conduct large numbers of trials and demonstrate how experimental probability converges to theoretical probability with more trials.

Modifications and/or Accommodations

English Language Learners (ELL)

- **Native Language Support:**

- The teacher provides auditory or written content to students in their native language.

- **Adjusted Speech:**

- The teacher changes speech patterns to increase student comprehension. This could include facing the students, paraphrasing, clearly indicating the most important ideas, and speaking more slowly.

- **Visuals:**

- The teacher uses graphics, pictures, visuals, and manipulatives. This helps ELL students better understand and comprehend the subject matter.

- **Front-Loading Vocabulary:**

- The teacher front-loads vocabulary by providing students with a list of important vocabulary words they will need to know for a lesson before it is taught. Including pictures with vocabulary words is also beneficial for students.
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Special Education Students

- **Chunking:**

- The teacher presents information in a way that is easy for students to understand and remember. Chunking organizes information into meaningful units to prevent working memory overload, which can be helpful for students with special needs.

- **Checking for Understanding:**

- It is important to consistently check for understanding, especially for students who have accommodations, to ensure they comprehend the concepts in a way that makes sense to them.

- **Extra Time:**

- The teacher provides students with special needs extra time to complete work or answer questions, giving them adequate time to process their thoughts.

- **Oral Reading:**

- The teacher will read work aloud to students, which can include class work, tests, and literature circles.

- **Timers:**

- The teacher uses timers to help students manage time when completing tasks, especially for

students who struggle to finish tasks within time limits.

Students with 504 Plans

- **Chunking:**

- The teacher organizes information into manageable units to ensure students with 504 plans are not overwhelmed by excessive detail.

- **Checking for Understanding:**

- Teachers will continuously check for understanding, ensuring students with accommodations comprehend the lesson content.

- **Extra Time:**

- Students with 504 plans are given extra time to complete assignments, ensuring they have ample time to process information.
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Gifted & Talented Strategies

- **Extensions/Enrichments:**

- Teachers provide gifted and talented students with enrichment projects that challenge them to deepen their understanding, apply knowledge, or produce something in relation to what they have learned.

- **Modify/Change Activities:**

- Teachers monitor and adjust activities for students who need more of a challenge. This may involve additional reading, problem-solving, writing, or project work, allowing gifted students to progress at an accelerated rate compared to their peers.
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Students at Risk of School Failure

- **Directions or Instructions:**

- Directions/instructions are provided in limited numbers, both verbally and in simple written format. Teachers may ask students to repeat the instructions to ensure understanding and check back to ensure they haven't forgotten.

- **Peer Support:**

- Peers can build confidence by helping others. Teachers can set up a system where specific students are assigned to assist at-risk students with clarification before approaching the teacher.

- **Alternate or Modified Assignments:**

- Teachers should consider modifying assignments for students at risk by simplifying tasks, reducing length, or offering alternative delivery modes (e.g., oral reports instead of written assignments).

- **Increase One-on-One Time:**

- Teachers should check in with at-risk students regularly, even for brief periods, to offer support and guidance as needed.

- **Contracts:**

- A working contract helps prioritize tasks and ensures completion. Students and teachers can track progress together by marking off completed tasks with checkmarks or symbols, encouraging accountability.

- **Hands-On Tasks:**

- Provide concrete, hands-on activities to support at-risk students. This may include using tools like calculators or counters in math or having students use audio recordings for comprehension tasks instead of reading themselves.

- **Tests/Assessments:**

- Tests can be administered orally, or broken into smaller sections. Teachers may administer parts of a test in the morning, after lunch, and on subsequent days if necessary.

- **Seating:**

- Seat students near a helping peer or with quick access to the teacher. For students with hearing or vision issues, seat them at the front for better access to instruction.

Integration of Diversity, Equity and Inclusion; Climate Change; Informational and Media Literacy

Provide students with opportunities to give feedback to teachers about the classroom and instruction

- **Verbal Example:**

- Fist to five: "How well do you understand what we talked about today?"
- Fist to five: "How well did I teach this today?"

- **Classroom Activity:**

- Exit tickets or surveys asking students to identify how well teachers taught, what helped them learn, what got in the way of their learning, etc.

Treat mathematics as a language that everyone is learning while authentically centering students' home languages

- **Classroom Strategies:**
 - Color-coding ideas
 - Learning vocabulary in student languages
 - Visual and kinesthetic learning
 - Representations of learning without words
- **Classroom Activity:**
 - Multilingual Frayer Models for definitions or concepts

Incorporate true culturally relevant pedagogy, practice, and curriculum

- **Verbal Example:**
 - "What are some of your family traditions that you are proud of? Would you be okay if we brought some of those into the classroom?"
- **Classroom Activity:**
 - Use Ankara fabric to teach mathematical concepts such as tessellations, fractions, area, percentages, etc.

Incorporate the history of mathematics into lessons

- **Verbal Example:**
 - "Why do you think we call it Pythagorean's theorem, when it was used before he was even born? What should we call it instead?"
- **Classroom Activity:**
 - Learn about different bases and numerical ideas:
 - Base 2 (binary) and connections to computer programming
 - How the Yoruba of Nigeria used base 20
 - How the Mayans conceptualized the number 0 before the first recording of it

Solicit student ways of thinking and processing

- **Verbal Example:**

- "How might you all go about this?"
- "What do you notice?"

- **Classroom Activity:**

- Incorporate explorations where students interact with mathematics in a way that allows them to “discover” or experience mathematics.
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Reorganize your classroom teaching around concepts, and teach them more like a web rather than discrete sets of knowledge

- **Verbal Example:**

- "How does this connect to what you’ve learned in the past?"
- "How can you use that knowledge today?"

- **Classroom Activity:**

- Learning webs that connect content
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Start with more complex math problems and scaffold as necessary

- **Verbal Example:**

- "If we wanted to build a rocket, what are all the things we might need to know before we get started? Along the way, we decided that we want the rocket to reach the moon. What do we need to consider now?"

- **Classroom Activity:**

- When solving equations, start with the most complex problem, generate ideas for how to solve it, and use the simpler equations as examples to support those ideas.
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Offer a variety of ways to demonstrate thinking and knowledge

- **Verbal Example:**

- "Show your thinking with words, pictures, symbols."

Ask other questions that will demonstrate learning when it is not clear to you how students know the answer

- **Verbal Example:**

- "If you were working with a fellow mathematician who was absent this day, what might you tell them to help them learn it?"

Learn about, engage with, and incorporate ethnomathematics

- **Verbal Example:**

- "Reflect on your day so far. What math have you already used today?"

- **Classroom Activity:**

- Community walks to engage with slope.

Co-construct knowledge in the classroom

- **Verbal Example:**

- "Let's get into partners and do a think-pair-share. We will incorporate everyone's ideas and try to synthesize them."

- **Classroom Activity:**

- Have students create mathematical definitions in their own words in groups, and bring the groups together to co-construct mathematical definitions as a class.

Choose problems that have complex, competing, or multiple answers

- **Verbal Example:**

- "Come up with at least two answers that might solve this problem."

- **Classroom Activity:**

- Challenge standardized test questions by getting the "right" answer, but justify other answers by unpacking the assumptions that are made in the problem.

- **Classroom Activity:**

- Deconstructed Multiple Choice: Given a set of multiple-choice answers, students

discuss why these answers may have been included. This can also be used to highlight common mistakes.

Identify what is right about the thinking, and highlight the mistake in what is factually or procedurally accepted

- **Verbal Example:**

- "You recognized that you had to combine the constants 27 and 9, could you explain your thinking?"

- **Classroom Activity:**

- Error Analysis worksheets that highlight what is the right idea behind the mistake.
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Use thoughtful questioning to solicit mathematical thoughts rather than telling

- **Verbal Example:**

- "What would a mathematician who is confused ask about this question?"

- **Classroom Activity:**

- After students demonstrate knowledge of a topic, have them play a game where they have to explain their topic to a fellow mathematician and a skeptic. Develop their own reflective questioning/explaining in all three roles.
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Create multiple ways of participating that honor myriad ways of thinking and being

- **Verbal Example:**

- "For this section, feel free to work alone, in pairs, trios, or quads (let them choose)."

- **Classroom Activity:**

- Community circles or storytelling circles, incorporating dance, music, song, call and response, and other cultural ways of communicating.
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Math Climate Change Companion Guide

- **G.MG.A.2 Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).**

- **Climate Change Example:**

- Students may apply the concept of population density of different urban areas, including calculations of population density, and discuss different environmental factors (e.g., air and water quality, waste disposal, energy consumption) that might be exacerbated by increased population density.

21st Century Life and Career

CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP6	Demonstrate creativity and innovation.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.

New Jersey Student Learning Standards: Content Area

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.3	Construct viable arguments and critique the reasoning of others.
MA.K-12.4	Model with mathematics.
MA.K-12.5	Use appropriate tools strategically.
MA.K-12.6	Attend to precision.
MA.K-12.7	Look for and make use of structure.
MA.K-12.8	Look for and express regularity in repeated reasoning.
MATH.9-12.A.REI	Reasoning with Equations and Inequalities

Integration of Career Readiness. Life Literacies and Key Skills

CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP6	Demonstrate creativity and innovation.
CRP.K-12.CRP7	Employ valid and reliable research strategies.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.K-12.CRP11	Use technology to enhance productivity.

Integration of Computer Science and Design ThinkingNew Section

CS.9-12.8.1.12.AP.1 Design algorithms to solve computational problems using a combination of original and

existing algorithms.

CS.9-12.8.1.12.AP.5 Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects.

Interdisciplinary Connections: NJSL Standards for ELA, Social Studies, Science and/or Math

LA.RH.9-10.8	Assess the extent to which the reasoning and evidence in a text support the author's claims.
LA.RST.9-10.5	Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).
LA.RST.9-10.7	Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
LA.RST.9-10.8	Determine if the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.

Module 21: Understand and Apply Theoretical Probability

Unit Rationale

The concept of **theoretical probability** provides students with a framework for understanding the likelihood of events based on established reasoning, without the need for experimental trials. This module introduces students to the principles of theoretical probability, which is rooted in the idea of equally likely outcomes and can be used to predict the probability of future events under ideal conditions. Students will explore how to calculate probabilities using ratios and fractions based on the number of possible outcomes.

The theoretical probability of an event is calculated by dividing the number of favorable outcomes by the total number of possible outcomes. This concept lays the groundwork for understanding more complex topics in probability and statistics, including the use of probabilities in decision-making and predictions.

By studying theoretical probability, students are equipped with the necessary tools to reason about events logically, which is crucial not only in mathematics but also in everyday life, where decisions often involve understanding risks and likelihoods. For example, understanding the probability of rolling a specific number on a die or drawing a certain card from a deck can help students make informed predictions and decisions.

This module will also serve as a natural extension of earlier probability concepts, such as experimental probability, and will guide students in recognizing the difference between theoretical and experimental results. While experimental probability is based on actual trials, theoretical probability focuses on idealized outcomes. Understanding both concepts allows students to assess the reliability and accuracy of predictions and results, leading to stronger reasoning and problem-solving skills.

Key areas of focus include:

- **Equally likely outcomes:** Students will learn how to use the number of favorable outcomes and the

total possible outcomes to calculate theoretical probabilities.

- **Understanding probability models:** This module introduces students to various probability models, including those for coin flips, dice rolls, card draws, and spinners.
- **Comparing theoretical and experimental probability:** Students will compare the predictions made using theoretical probability with the results of actual experiments to deepen their understanding of both concepts.

The relevance of theoretical probability is emphasized through real-world examples such as games of chance, lotteries, and predicting outcomes in scenarios like flipping a coin or rolling a die. By applying these principles to solve problems, students not only solidify their mathematical understanding but also enhance their critical thinking and analytical skills.

Throughout the module, students will engage with the following Standards for Mathematical Practice:

- **MP1: Make sense of problems and persevere in solving them**
- **MP2: Reason abstractly and quantitatively**
- **MP4: Model with mathematics**
- **MP5: Use appropriate tools strategically**

By the end of this module, students will be able to apply theoretical probability to predict the likelihood of various events and compare those predictions to experimental results. This foundational understanding of probability will serve as a stepping stone to more advanced studies in statistics, probability, and data analysis in future grades.

Essential Questions

- **What is theoretical probability, and how is it calculated?**
- **How does the probability of an event relate to the number of favorable outcomes and total possible outcomes?**
- **How can theoretical probability be used to predict the likelihood of events in real-world situations?**
- **How do probability models help us understand random events and make predictions?**
- **What is the difference between theoretical and experimental probability, and why is it important to compare them?**
- **How can we use theoretical probability to make informed decisions and solve problems in everyday life?**
- **In what ways can we apply theoretical probability to games of chance, like flipping a coin or**

rolling a die?

- **What are some real-life examples where understanding theoretical probability can help us make better decisions or predictions?**

Pre-Assessments

Benchmark assessments are given within the first semester using HMH Into Math.

1. Readiness Check (Diagnostic Assessment)

- Found at the beginning of each module/unit.
- Assesses prerequisite skills necessary for success in the upcoming lessons.
- Usually includes a mix of multiple-choice and short answer items.
- Great for determining small-group needs or identifying which students might benefit from additional support.

2. Diagnostic Assessments in Ed: Your Friend in Learning

- Online assessments tied to Into Math.
- Adaptive in nature (depending on your district's setup) and aligned with the lesson standards.
- Can provide recommendations for intervention or enrichment based on results.

3. Module Quizzes (Pre-Use)

- While designed for post-instruction, some teachers use the Module Quiz or Mid-Module Checkpoint as a pre-assessment to gauge student background knowledge.
- Use selectively, focusing on concepts that build directly on prior grades' standards.

4. Lesson-Specific Checks

- Some lessons include "Are You Ready?" sections or warm-ups that can double as informal pre-assessments.
- Often appear in the Teacher Edition or digital platform and can be used as bell-ringers or exit tickets.

Instructional Plan

Lesson 3: Use Theoretical Probability and Proportional Reasoning to Make Predictions

Student Learning Intentions (WALT)

- **WALT (We Are Learning To):**

- Apply theoretical probability and proportional reasoning to make predictions in various contexts.
 - Understand the relationship between probability and proportional reasoning in predicting outcomes.
 - Use theoretical probability to make predictions in real-world situations, such as predicting outcomes in games, experiments, or events.
-

Student Success Criteria (I Can Statements)

- **I can** use theoretical probability to make predictions about the likelihood of events occurring.
 - **I can** apply proportional reasoning to make predictions based on the probability of compound events.
 - **I can** analyze real-world situations and use theoretical probability to make informed predictions.
 - **I can** explain how probability and proportional reasoning are connected and how they can be used to predict outcomes.
-

Instructional Strategies and Activities

1. Introduction to Making Predictions:

- **Direct Instruction:** Explain how theoretical probability is a valuable tool for predicting the likelihood of an event occurring. Discuss how proportional reasoning can help translate theoretical probability into practical predictions.
 - **Example:** If the probability of drawing a red marble from a bag is $\frac{1}{4}$, and you draw 100 marbles, how many red marbles would you predict?
 - **Proportional Reasoning:** This involves scaling the probability to the number of trials or events. For example, if the probability of drawing a red marble is $\frac{1}{4}$, you would expect $\frac{1}{4} \times 100 = 25$ red marbles in 100 trials.

2. Real-World Applications:

- **Sports Example:** Calculate the probability of a basketball player making a shot and use this probability to predict the number of successful shots out of 50 attempts.
 - If the probability of making a shot is $\frac{3}{5}$, then for 50 shots, you would predict:
 $\frac{3}{5} \times 50 = 30$ Predicted successful shots

- **Weather Example:** Use theoretical probability to predict the likelihood of rain on a specific day given the forecast. If the forecast gives a 40% chance of rain, discuss how this prediction affects planning for outdoor events.

3. Interactive Examples:

- **Marble Bag Problem:** Have students calculate the expected number of red, blue, and green marbles drawn from a bag containing 4 red, 3 blue, and 5 green marbles, assuming they draw 120 marbles.
 - Theoretical probability for red: $4/12 = 1/3$
 - Predict the number of red marbles in 120 draws: $1/3 \times 120 = 40$
- Discuss how this prediction aligns with expected frequencies and the role of theoretical probability in making predictions.

4. Guided Practice:

- Provide students with a series of problems that require them to use theoretical probability and proportional reasoning to make predictions.
 - **Example Problem:** A spinner has 5 equal sections: 1 red, 2 blue, and 2 green. If the spinner is spun 100 times, predict how many times it will land on blue.
 - Probability of landing on blue: $2/5$
 - Prediction for 100 spins: $2/5 \times 100 = 40$
- Work through the steps with the class, ensuring students understand how to calculate the probability first, then apply proportional reasoning to make predictions.

5. Independent Practice:

- Assign practice problems where students are asked to calculate the theoretical probability of various events and then use proportional reasoning to make predictions. These problems can include a variety of real-world contexts (e.g., predicting the outcome of a coin toss, dice rolls, or outcomes in simple games).

6. Predictive Modeling Activity:

- **Hands-On Activity:** In pairs or small groups, have students simulate a simple experiment (e.g., tossing a coin, rolling a die) multiple times and compare the actual outcomes to their predictions based on theoretical probability.
 - Discuss how the results from the experiment may vary from the predictions and what this means in terms of probability.
 - Students can also create a graph comparing predicted and actual outcomes.
-

Formative Assessments

1. Exit Ticket:

- Ask students to answer a quick question before leaving class:
 - "If the probability of winning a prize in a game is $\frac{1}{51}$, and you play the game 30 times, how many times would you predict to win?"

2. Quick Check:

- Provide a set of problems where students calculate the theoretical probability and make predictions. Example:
 - "If a die is rolled 60 times, how many times would you expect to roll a 4?"

3. Peer Review:

- Students can check each other's answers to the predictive problems and compare their reasoning. This encourages collaboration and helps identify any misunderstandings.
-

Instructional Materials and Resources

• Materials:

- Whiteboard and markers
- Dice, coins, spinners, and marbles for hands-on simulations
- Printed worksheets with prediction problems
- Graphing tools (optional for visual representation of predictions)

• Resources:

- Probability simulation apps or online tools (optional)
 - Visual aids for probability (e.g., spinners, number lines)
 - Real-life examples of predictions (sports statistics, weather forecasting)
-

Reflections and Suggested Modifications

- **Reflection:** After the lesson, reflect on whether students were able to apply both theoretical probability and proportional reasoning accurately to make predictions. Note any areas where students struggled with applying proportional reasoning to make predictions in more complex scenarios.

- **Modifications:**

- For students who need additional support, provide more visual examples or guided practice with simpler numbers and situations.
- For advanced students, offer more complex prediction problems involving compound events or multiple trials, and discuss how predictions change with different probabilities.
- If students are having difficulty with proportional reasoning, revisit the concept and provide additional practice with real-world examples that emphasize the connection between probability and proportionality.

By the end of this lesson, students should be able to effectively apply theoretical probability and proportional reasoning to make predictions in various real-world scenarios and mathematical contexts.

Lesson 4: Conduct Simulations

Student Learning Intentions (WALT)

- **WALT (We Are Learning To):**

- Conduct simulations to estimate probabilities.
- Understand how simulations can be used to approximate real-world probabilities and outcomes.
- Use experimental data from simulations to make inferences about probability and to test predictions.
- Recognize the relationship between theoretical probability and experimental probability through simulations.

Student Success Criteria (I Can Statements)

- **I can** conduct simulations to estimate the probability of an event.
- **I can** compare the results of simulations with theoretical probability.
- **I can** use the results of a simulation to make predictions about future events.
- **I can** explain the process of conducting a simulation and the importance of repetition in obtaining accurate results.

Instructional Strategies and Activities

1. Introduction to Simulations:

- **Direct Instruction:** Introduce the concept of a simulation, explaining that a simulation is a model used to approximate real-world outcomes through repeated trials. Emphasize that simulations help estimate probabilities when conducting actual experiments is impractical or impossible.
 - **Example:** Rolling a die 100 times in real life to determine the probability of rolling a 6, versus simulating it through a computer or rolling a smaller number of times and predicting the result.

2. How to Conduct a Simulation:

- **Demonstration:** Model how to conduct a simple simulation using dice, coins, or spinners to simulate the occurrence of certain events. For example:
 - **Coin Flip Simulation:** Simulate flipping a coin 50 times to estimate the probability of heads.
 - **Die Roll Simulation:** Simulate rolling a die 30 times to estimate the probability of rolling a 4.
 - Discuss how to record the outcomes of each trial and calculate the relative frequency of each event (e.g., heads, tails, a specific number on the die).

3. Guided Practice:

- **Class Activity:** In pairs or small groups, have students conduct a simulation using a coin, die, or spinner. Provide students with clear instructions on how to record their results and calculate the experimental probability after a set number of trials (e.g., flipping the coin 50 times, rolling a die 100 times).
 - After the trials, students will calculate the experimental probability by dividing the number of successful outcomes by the total number of trials.
 - **Example:** If they flip a coin 50 times and get 30 heads, the experimental probability of getting heads is $\frac{30}{50} = 0.6$.

4. Connecting Simulations to Probability:

- **Discussion:** After conducting the simulation, guide students in comparing their experimental results with the theoretical probability. For example, the theoretical probability of getting heads in a fair coin flip is $\frac{1}{2}$, or 50%. Compare this with the experimental probability they calculated (e.g., 0.6 or 60%).
- Discuss the idea that as the number of trials increases, the experimental probability will approach the theoretical probability.

5. Real-World Application:

- **Real-Life Simulation Example:** Introduce a scenario such as predicting the probability of a particular outcome in a sports event or a game of chance. Students can simulate a set number of trials to predict the likely outcome.

- **Example:** Simulate 100 rolls of a 6-sided die to predict how often a particular number will appear. Theoretical probability is $\frac{1}{6}$, so students will compare their experimental results with this value.

6. Independent Practice:

- Provide students with a set of problems where they conduct their own simulations and use the results to make inferences about probability. Example problems include simulating the probability of drawing a red card from a deck of cards, predicting the outcome of a spinner, or estimating the likelihood of a certain number being rolled on a die.
-

Formative Assessments

1. Simulation Worksheet:

- After conducting their simulations, students will complete a worksheet where they summarize their results, calculate the experimental probability, and compare it with the theoretical probability.

2. Exit Ticket:

- Ask students to answer a quick question:
 - "After conducting a simulation of flipping a coin 50 times, you got 35 heads. What is the experimental probability of getting heads? How does this compare to the theoretical probability?"

3. Observation and Peer Review:

- During the group simulation activity, walk around and observe the students' process, checking if they are accurately conducting the simulations, recording their results, and calculating the probabilities correctly. Peer review can also help ensure accurate work.
-

Instructional Materials and Resources

• Materials:

- Dice, coins, or spinners for conducting simulations
- Worksheets for recording trial results and calculating probabilities
- Graph paper or software for plotting results (optional)
- Probability simulation software or apps (optional for digital simulations)

• Resources:

- Pre-prepared simulation templates (for tracking results of multiple trials)

- Visual aids explaining theoretical vs. experimental probability
 - Examples of real-world scenarios where simulations are useful (e.g., sports statistics, weather prediction, medical trials)
-

Reflections and Suggested Modifications

- **Reflection:**

- After the lesson, reflect on whether students were able to conduct simulations independently and use the data to make meaningful comparisons between experimental and theoretical probability. Take note of any challenges they faced, especially when simulating more complex events.

- **Modifications:**

- If students are struggling with the concept of probability, review the basic principles and provide more guided practice before conducting simulations.
- For advanced learners, consider introducing more complex simulations, such as simulating compound events (e.g., rolling two dice and calculating the sum).
- If time allows, allow students to use technology to run simulations, which can increase the scale and provide more complex data sets to analyze.

By the end of this lesson, students should be able to conduct simulations, use experimental data to estimate probabilities, and compare the results with theoretical probability. They should also understand the value of repetition in simulations to approximate real-world outcomes.

Modifications and/or Accommodations

English Language Learners (ELL)

- **Native Language Support:**

- The teacher provides auditory or written content to students in their native language.

- **Adjusted Speech:**

- The teacher changes speech patterns to increase student comprehension. This could include facing the students, paraphrasing, clearly indicating the most important ideas, and speaking more slowly.

- **Visuals:**

- The teacher uses graphics, pictures, visuals, and manipulatives. This helps ELL students better

understand and comprehend the subject matter.

- **Front-Loading Vocabulary:**

- The teacher front-loads vocabulary by providing students with a list of important vocabulary words they will need to know for a lesson before it is taught. Including pictures with vocabulary words is also beneficial for students.
-

Special Education Students

- **Chunking:**

- The teacher presents information in a way that is easy for students to understand and remember. Chunking organizes information into meaningful units to prevent working memory overload, which can be helpful for students with special needs.

- **Checking for Understanding:**

- It is important to consistently check for understanding, especially for students who have accommodations, to ensure they comprehend the concepts in a way that makes sense to them.

- **Extra Time:**

- The teacher provides students with special needs extra time to complete work or answer questions, giving them adequate time to process their thoughts.

- **Oral Reading:**

- The teacher will read work aloud to students, which can include class work, tests, and literature circles.

- **Timers:**

- The teacher uses timers to help students manage time when completing tasks, especially for students who struggle to finish tasks within time limits.
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Students with 504 Plans

- **Chunking:**

- The teacher organizes information into manageable units to ensure students with 504 plans are not overwhelmed by excessive detail.

- **Checking for Understanding:**

- Teachers will continuously check for understanding, ensuring students with accommodations comprehend the lesson content.

- **Extra Time:**

- Students with 504 plans are given extra time to complete assignments, ensuring they have ample time to process information.
-

Gifted & Talented Strategies

- **Extensions/Enrichments:**

- Teachers provide gifted and talented students with enrichment projects that challenge them to deepen their understanding, apply knowledge, or produce something in relation to what they have learned.

- **Modify/Change Activities:**

- Teachers monitor and adjust activities for students who need more of a challenge. This may involve additional reading, problem-solving, writing, or project work, allowing gifted students to progress at an accelerated rate compared to their peers.
-

Students at Risk of School Failure

- **Directions or Instructions:**

- Directions/instructions are provided in limited numbers, both verbally and in simple written format. Teachers may ask students to repeat the instructions to ensure understanding and check back to ensure they haven't forgotten.

- **Peer Support:**

- Peers can build confidence by helping others. Teachers can set up a system where specific students are assigned to assist at-risk students with clarification before approaching the teacher.

- **Alternate or Modified Assignments:**

- Teachers should consider modifying assignments for students at risk by simplifying tasks, reducing length, or offering alternative delivery modes (e.g., oral reports instead of written assignments).

- **Increase One-on-One Time:**

- Teachers should check in with at-risk students regularly, even for brief periods, to offer support and guidance as needed.

- **Contracts:**

- A working contract helps prioritize tasks and ensures completion. Students and teachers can track progress together by marking off completed tasks with checkmarks or symbols, encouraging accountability.

- **Hands-On Tasks:**

- Provide concrete, hands-on activities to support at-risk students. This may include using tools like calculators or counters in math or having students use audio recordings for comprehension tasks instead of reading themselves.

- **Tests/Assessments:**

- Tests can be administered orally, or broken into smaller sections. Teachers may administer parts of a test in the morning, after lunch, and on subsequent days if necessary.

- **Seating:**

- Seat students near a helping peer or with quick access to the teacher. For students with hearing or vision issues, seat them at the front for better access to instruction.

Integration of Diversity, Equity and Inclusion; Climate Change; Informational and Media Literacy

Provide students with opportunities to give feedback to teachers about the classroom and instruction

- **Verbal Example:**

- Fist to five: "How well do you understand what we talked about today?"
- Fist to five: "How well did I teach this today?"

- **Classroom Activity:**

- Exit tickets or surveys asking students to identify how well teachers taught, what helped them learn, what got in the way of their learning, etc.

Treat mathematics as a language that everyone is learning while authentically centering students' home languages

- **Classroom Strategies:**

- Color-coding ideas
- Learning vocabulary in student languages
- Visual and kinesthetic learning
- Representations of learning without words

- **Classroom Activity:**

- Multilingual Frayer Models for definitions or concepts
-

Incorporate true culturally relevant pedagogy, practice, and curriculum

- **Verbal Example:**

- "What are some of your family traditions that you are proud of? Would you be okay if we brought some of those into the classroom?"

- **Classroom Activity:**

- Use Ankara fabric to teach mathematical concepts such as tessellations, fractions, area, percentages, etc.
-

Incorporate the history of mathematics into lessons

- **Verbal Example:**

- "Why do you think we call it Pythagorean's theorem, when it was used before he was even born? What should we call it instead?"

- **Classroom Activity:**

- Learn about different bases and numerical ideas:
 - Base 2 (binary) and connections to computer programming
 - How the Yoruba of Nigeria used base 20
 - How the Mayans conceptualized the number 0 before the first recording of it
-

Solicit student ways of thinking and processing

- **Verbal Example:**

- "How might you all go about this?"
- "What do you notice?"

- **Classroom Activity:**

- Incorporate explorations where students interact with mathematics in a way that allows them to "discover" or experience mathematics.
-

Reorganize your classroom teaching around concepts, and teach them more like a web rather than discrete sets of knowledge

- **Verbal Example:**

- "How does this connect to what you've learned in the past?"
- "How can you use that knowledge today?"

- **Classroom Activity:**

- Learning webs that connect content
-

Start with more complex math problems and scaffold as necessary

- **Verbal Example:**

- "If we wanted to build a rocket, what are all the things we might need to know before we get started? Along the way, we decided that we want the rocket to reach the moon. What do we need to consider now?"

- **Classroom Activity:**

- When solving equations, start with the most complex problem, generate ideas for how to solve it, and use the simpler equations as examples to support those ideas.
-

Offer a variety of ways to demonstrate thinking and knowledge

- **Verbal Example:**

- "Show your thinking with words, pictures, symbols."
-

Ask other questions that will demonstrate learning when it is not clear to you how students know the answer

- **Verbal Example:**

- "If you were working with a fellow mathematician who was absent this day, what might you tell them to help them learn it?"
-

Learn about, engage with, and incorporate ethnomathematics

- **Verbal Example:**

- "Reflect on your day so far. What math have you already used today?"

- **Classroom Activity:**

- Community walks to engage with slope.
-

Co-construct knowledge in the classroom

- **Verbal Example:**

- "Let's get into partners and do a think-pair-share. We will incorporate everyone's ideas and try to synthesize them."

- **Classroom Activity:**

- Have students create mathematical definitions in their own words in groups, and bring the groups together to co-construct mathematical definitions as a class.
-

Choose problems that have complex, competing, or multiple answers

- **Verbal Example:**

- "Come up with at least two answers that might solve this problem."

- **Classroom Activity:**

- Challenge standardized test questions by getting the "right" answer, but justify other answers by unpacking the assumptions that are made in the problem.

- **Classroom Activity:**

- **Deconstructed Multiple Choice:** Given a set of multiple-choice answers, students discuss why these answers may have been included. This can also be used to highlight common mistakes.
-

Identify what is right about the thinking, and highlight the mistake in what is factually or procedurally accepted

- **Verbal Example:**

- "You recognized that you had to combine the constants 27 and 9, could you explain your thinking?"

- **Classroom Activity:**

- Error Analysis worksheets that highlight what is the right idea behind the mistake.
-

Use thoughtful questioning to solicit mathematical thoughts rather than telling

- **Verbal Example:**

- "What would a mathematician who is confused ask about this question?"

- **Classroom Activity:**

- After students demonstrate knowledge of a topic, have them play a game where they have to explain their topic to a fellow mathematician and a skeptic. Develop their own reflective questioning/explaining in all three roles.
-

Create multiple ways of participating that honor myriad ways of thinking and being

- **Verbal Example:**

- "For this section, feel free to work alone, in pairs, trios, or quads (let them choose)."

- **Classroom Activity:**

- Community circles or storytelling circles, incorporating dance, music, song, call and response, and other cultural ways of communicating.
-

Math Climate Change Companion Guide

- **G.MG.A.2 Apply concepts of density based on area and volume in modeling situations** (e.g., persons per square mile, BTUs per cubic foot).

- **Climate Change Example:**

- Students may apply the concept of population density of different urban areas, including calculations of population density, and discuss different environmental factors (e.g., air and water quality, waste disposal, energy consumption) that might be exacerbated by increased population density.

New Jersey Student Learning Standards: Content Area

21st Century Life and Career

CRP.K-12.CRP1	Act as a responsible and contributing citizen and employee.
CRP.K-12.CRP7	Employ valid and reliable research strategies.

Integration of Career Readiness. Life Literacies and Key Skills

PFL.9.1.4.B	Money Management
PFL.9.1.4.F.2	Explain the roles of philanthropy, volunteer service, and charitable contributions, and analyze their impact on community development and quality of living.

Integration of Computer Science and Design Thinking

CS.CS	Computing Systems
CS.K-2.DA	Data & Analysis

Interdisciplinary Connections: NJSLs for ELA, Social Studies, Science and/or Math

ELA.K-12.L	Language
ELA.K-12.R.AA	Analysis of an Argument: By the end of grade 12, evaluate the argument and specific claims in a text, including the validity of the reasoning, the credibility and accuracy of each source as well as the relevance and sufficiency of the evidence.
ELA.K-12.SL	Speaking and Listening
SCI.K-2-ETS1-3	Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.