Overview

Number of instructional days: 7 (1 day = 45 minutes)

Content to be learned

- Derive the formulas for volume of a prism, cylinder, pyramid, and cone.
- Use and apply Cavalieri’s principle to visualize volume of solids.
- Use geometric shapes as abstract representations of real-world objects (e.g., modeling a tree trunk as a cylinder).

Mathematical practices to be integrated

Make sense of problems and persevere in solving them.

- Understand and explain the meaning of volume as the product of the area of a base and its height.
- Consider similar volume problems such as oblique cylinders and prisms.
- Check answers using multiple methods, including Cavalieri’s principle.

Reason abstractly and quantitatively.

- Decontextualize from real-world objects to abstract geometric solids to solve volume problems.
- Contextualize from abstract geometric solids to real-world objects to solve volume problems.
- Develop understanding of three-dimensional units of measurement.

Construct viable arguments and critique the reasoning of others.

- Make conjectures for formulating volume of solids.
- Justify conclusions and communicate them to others.
- Reason inductively to derive formulas for oblique solids.
Model with mathematics.

- Make assumptions and approximations to simplify a complicated situation (e.g., the volume between a prism and pyramid; modeling natural objects such as a lake or river).
- Analyze mathematical relationships to draw conclusions between the different volume formulas.
- Interpret measurements in the context of a problem situation and make revisions for accuracy.

**Essential questions**

- How is the volume of a solid derived?
- How can Cavalieri’s principle be used to find the volume of solids?
- How can real-world objects be modeled using compositions of simple geometric solids?

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**Written Curriculum**

**Common Core State Standards for Mathematical Content**

**Modeling with Geometry**

G-MG

Apply geometric concepts in modeling situations

G-MG.1 Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).

**Geometric Measurement and Dimension**

G-GMD

Explain volume formulas and use them to solve problems

G-GMD.1 Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. *Use dissection arguments, Cavalieri’s principle, and informal limit arguments.*

G-GMD.2 (+) Give an informal argument using Cavalieri’s principle for the formulas for the volume of a sphere and other solid figures.
Common Core Standards for Mathematical Practice

1 Make sense of problems and persevere in solving them.

Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem.

Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, “Does this make sense?” They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

2 Reason abstractly and quantitatively.

Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to decontextualize—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to contextualize, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.

3 Construct viable arguments and critique the reasoning of others.

Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is.

Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.
Model with mathematics.

Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

Clarifying the Standards

Prior Learning

In grades 5 and 6, students learned and applied the formula for the volume of a rectangular prism. They modeled the volume using unit cubes.

In grade 7, students solved real-world and mathematical problems involving area, volume, and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms. (7.GM.6)

In grade 8, students learned and applied the formulas for the volumes of cones, cylinders, and spheres and used them to solve real-world and mathematical problems. (8.GM.9)

Current Learning

Students derive the volume formulas of a prism, cylinder, pyramid, and cone. They apply Cavalieri’s principle for the volume of other solid figures. Students model different volumes using real-world objects.

Cylinders can be modeled using a Slinky™.

The CCSS do not address the area of regular polygons.

Future Learning

Students will apply formulas for volumes of various solids to solve problems in the next unit of study.

Additional Findings

Benchmarks for Science Literacy by the American Association for the Advancement of Science states, “In the upper grades, considerable emphasis should be placed on the mathematical modeling, because it optimizes the nature and power of models and provides a context for integrating knowledge from many different domains.” (p. 270)
Geometry, Quarter 4, Unit 4.2
Applying Volume Formulas, Identifying Cross Sections and Objects Generated by Rotations, and Applying Density Concepts

Overview

Number of instructional days: 5  (1 day = 45 minutes)

Content to be learned

- Apply volume formulas for prisms, cylinders, pyramids, cones, and spheres to solve problems.
- Classify the shape of two-dimensional cross sections of three-dimensional objects.
- Classify three-dimensional objects generated by rotations of two-dimensional objects.
- In modeling situations, apply concepts of density based on area and volume (e.g., BTUs per cubic foot).

Mathematical practices to be integrated

- Reason abstractly and quantitatively.
- Make sense of how measurements are used to calculate volume of solids.
- Understand the derivation of cubic units.
- Apply the division and density of a solid into cubic units to solve real-world problems.

Model with mathematics.

- Apply volume formulas to solve real-world problems.
- Analyze measurements and diagrams to draw conclusions about density and volume.
- Visualize cross sections of three-dimensional objects and rotations of two-dimensional objects.

Attend to precision.

- Communicate solutions using accurate units of measure.
- Calculate accurately and efficiently.
- Express numerical answers with a degree of precision appropriate for the problem context.

Essential questions

- What are the cross-sections of three-dimensional objects?
- How are rotations used to generate three-dimensional figures?
- How is volume and area used to find the density of an object?
- How can volume formulas be applied to solve real-world problems?
Written Curriculum

Common Core State Standards for Mathematical Content

Geometric Measurement and Dimension G-GMD

Explain volume formulas and use them to solve problems

G-GMD.3 Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.*

Visualize relationships between two-dimensional and three-dimensional objects

G-GMD.4 Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.

Modeling with Geometry G-MG

Apply geometric concepts in modeling situations

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

Common Core Standards for Mathematical Practice

2 Reason abstractly and quantitatively.

Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to decontextualize—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to contextualize, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.

4 Model with mathematics.

Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

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6   **Attend to precision.**

Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.

**Clarifying the Standards**

*Prior Learning*

In grades 5 and 6, students learned and applied the formula for the volume of a rectangular prism. They modeled the volume using unit cubes.

In grade 7, students solved real-world and mathematical problems involving area, volume, and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms. (7.GM.6)

In grade 8, students learned and applied the formulas for the volumes of cones, cylinders, and spheres and used them to solve real-world and mathematical problems. (8.GM.9)

*Current Learning*

Students apply derivations of formulas for volumes of solids learned in the previous unit of study to solve real-world problems. They visualize two-dimensional cross sections from three-dimensional objects. Students visualize the three-dimensional solids from the rotation of a two-dimensional shape. They learn and apply concepts of density to solve real-world problems.

*Future Learning*

In future course work and careers in science and engineering, students will need to measure and apply volume of solids.

**Additional Findings**

*Benmarks for Science Literacy* by the American Association for the Advancement of Science states, “In the upper grades considerable emphasis should be placed on the mathematical modeling, because it optimizes the nature and power of models and provides a context for integrating knowledge from many different domains.” (p. 270)
Geometry, Quarter 4, Unit 4.3
Fundamental Set Theory, Counting Methods, and Probability

Overview

Number of instructional days: 10 (1 day = 45 minutes)

Content to be learned
- Introduce/review illustrations of unions, intersections, complements, and subsets, using Venn diagrams and introduce/review counting methods (Fundamental Counting Principle).
- Understand and describe subsets of a sample space.
- Categorize outcomes as unions, intersections, or complements of other events.
- Derive and apply the permutation and combination formulas to solve probability problems.
- Define mutually exclusive events and overlapping events.
- Apply the Addition Rule, \( P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B) \) for mutually exclusive and overlapping events. Prove the Addition Rule with a Venn diagram.

Mathematical practices to be integrated
- Make sense of problems and persevere in solving them.
- Identify and execute appropriate strategies to solve the problem.
- Continually ask, “Does this make sense?”
- Discuss when to apply the Addition Rule and combination or permutation formulas.
  - Distinguish between mutually exclusive and overlapping events for the Addition Rule.
  - Distinguish if the order matters when counting outcomes of an event (combination versus permutation).
- Develop an understanding of how to illustrate and prove probability theory with Venn Diagrams.
- Use the Fundamental Counting Principle to explain factorial computation.
- Look for mathematically sound shortcuts when evaluating permutation/combination formulas.

Essential questions
- How can set theory be used to help calculate theoretical probabilities?
- What are permutations and combinations and how can they be used to calculate probabilities?
- How are the probabilities of mutually exclusive events and overlapping events found?
**Written Curriculum**

**Common Core State Standards for Mathematical Content**

<table>
<thead>
<tr>
<th>Conditional Probability and the Rules of Probability*</th>
<th>S-CP</th>
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**Understand independence and conditional probability and use them to interpret data** [Link to data from simulations or experiments]

S-CP.1 Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events (“or,” “and,” “not”).

**Use the rules of probability to compute probabilities of compound events in a uniform probability model**

S-CP.7 Apply the Addition Rule, \( P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B) \), and interpret the answer in terms of the model.*

S-CP.9 (+) Use permutations and combinations to compute probabilities of compound events and solve problems.*

**Common Core Standards for Mathematical Practice**

1. **Make sense of problems and persevere in solving them.**

Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, “Does this make sense?” They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

2. **Reason abstractly and quantitatively.**

Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to decontextualize—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to contextualize, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.

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7 Look for and make use of structure.

Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount as seven and three more, or they may sort a collection of shapes according to how many sides the shapes have. Later, students will see $7 \times 8$ equals the well remembered $7 \times 5 + 7 \times 3$, in preparation for learning about the distributive property. In the expression $x^2 + 9x + 14$, older students can see the 14 as $2 \times 7$ and the 9 as $2 + 7$. They recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, they can see $5 - 3(x - y)^2$ as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers $x$ and $y$.

8 Look for and express regularity in repeated reasoning.

Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts. Upper elementary students might notice when dividing 25 by 11 that they are repeating the same calculations over and over again, and conclude they have a repeating decimal. By paying attention to the calculation of slope as they repeatedly check whether points are on the line through (1, 2) with slope 3, middle school students might abstract the equation $(y - 2)/(x - 1) = 3$. Noticing the regularity in the way terms cancel when expanding $(x - 1)(x + 1)$, $(x - 1)(x^2 + x + 1)$, and $(x - 1)(x^3 + x^2 + x + 1)$ might lead them to the general formula for the sum of a geometric series. As they work to solve a problem, mathematically proficient students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results.

Clarifying the Standards

Prior Learning

In grade 7, students investigated chance processes and developed, used, and evaluated probability models. They represented sample spaces for compound events using methods such as organized lists, tables, and tree diagrams. Students may know the Fundamental Counting Principle from prior course.

Current Learning

Students learn the basics of set theory. Using Venn diagrams, students illustrate unions, intersections, complements, and subsets. Students are introduced to the Fundamental Counting Principle and derive the formulas for counting permutations and combinations. Students use Venn diagrams and set theory to apply rules of probability such as the Addition Rule. Students develop an understanding between mutually exclusive and overlapping events.

The depth of this unit is a new element for the geometry course, therefore, proper preparation and additional resources may be needed.

Future Learning

If students choose to take a probability and statistics course either in high school or college, this content will provide them with a foundation.
Additional Findings

*Benchmarks for Science Literacy* states, “One of the many misunderstandings of probability that teachers have to deal with is that a well-established probability will be changed by the most recent history: [for example] People tend to believe that a coin that has come up heads ten times in a row is more likely on the next flip to come up tails than heads or that the number that won the lottery last week is less likely to win this week. Those and other confusions about probability are purely mathematical and can be addressed as such, but it is also important to take up some of the questions related to how probabilities are established. Examples should come from medicine, natural catastrophes such as floods and earthquakes, weather patterns, sports events, stock market events, elections, and other topical contexts.” (p. 226)

*Benchmarks for Science Literacy* states, “By the end of 12th grade, students should know that a physical or mathematical model can be used to estimate the probability of real-world events.” (p. 230)
Geometry, Quarter 4, Unit 4.4
Conditional Probability, Independent and Dependent Events

Overview

Number of instructional days: 13 (1 day = 45 minutes)

Content to be learned

- Define conditional probability and explain that a condition effectively restricts a sample space (e.g. the probability of rolling a 6, given the die lands on a number greater than 4, restricts the sample space to {5,6}).
- Construct and interpret two-way frequency tables of data to determine if the condition affects the outcome and calculate conditional probability.
- Apply the general Multiplication Rule, \( P(A \text{ and } B) = P(A) \cdot P(B|A) = P(B) \cdot P(A|B) \).
- Understand the difference and implications of independent and dependent events.

Mathematical practices to be integrated

- Make sense of problems and persevere in solving them.
- Understand and explain the meaning of independent and dependent events and conditional probability.
- Check for reasonableness of the solution.
- Model with mathematics.
- Read, understand, and draw conclusions from two-way tables.
- Apply probability theory to solve real-world problems.
- Attend to precision.
- Use clear definitions when communicating with others.
- Use the correct symbols consistently and appropriately.

Essential questions

- How is conditional probability calculated?
- How is it determined if two events are independent?
- How is the probability of dependent events found?
- How can probability be used to analyze decisions?
Written Curriculum

Common Core State Standards for Mathematical Content

Conditional Probability and the Rules of Probability*  S-CP

Understand independence and conditional probability and use them to interpret data [Link to data from simulations or experiments]

S-CP.2  Understand that two events $A$ and $B$ are independent if the probability of $A$ and $B$ occurring together is the product of their probabilities, and use this characterization to determine if they are independent.*

S-CP.3  Understand the conditional probability of $A$ given $B$ as $P(A \text{ and } B)/P(B)$, and interpret independence of $A$ and $B$ as saying that the conditional probability of $A$ given $B$ is the same as the probability of $A$, and the conditional probability of $B$ given $A$ is the same as the probability of $B$.*

S-CP.4  Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.*

S-CP.5  Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.*

Use the rules of probability to compute probabilities of compound events in a uniform probability model

S-CP.6  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.*

S-CP.8  (+) Apply the general Multiplication Rule in a uniform probability model, $P(A \text{ and } B) = P(A)P(B|A) = P(B)P(A|B)$, and interpret the answer in terms of the model.*

Common Core Standards for Mathematical Practice

1  Make sense of problems and persevere in solving them.

Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and
relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, “Does this make sense?” They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

4  Model with mathematics.

Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

6  Attend to precision.

Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.

Clarifying the Standards

Prior Learning

In grade 7, students investigated chance processes and developed, used, and evaluated probability models. They represented sample spaces for compound events using methods such as organized lists, tables and tree diagrams.

Current Learning

Students study conditional probability and read and interpret two-way tables. Students learn the difference between dependent and independent events, and they calculate the probability of dependent events. Students apply the multiplication rule.

The content and depth of this unit is new for the geometry course, therefore, proper preparation and additional resources may be needed.

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Future Learning

If students choose to take a probability and statistics course either in high school or college, then this content will provide them with a foundation.

Additional Findings

“Statements of probability appear frequently in newspapers and magazines. Educated readers should be able to understand how reported probabilities, such as the probability of being struck by lightning, of being involved in an automobile accident, or of winning the lottery, have been determined and can be interpreted. Students need to develop an understanding of basic concepts of probability so that they can reason successfully about uncertain events, assess risks, and grasp the logic of making decisions in the presence of uncertainty.” (Navigating through Probability in Grades 9 – 12, NCTM, 2004, p. 4)

“In high school, students can apply the concepts of probability to predict the likelihood of an event by constructing probability distributions for simple sample spaces. Students should be able to describe sample spaces such as the set of possible outcomes when four coins are tossed and the set of probabilities for the sum of the values on the faces that are down when two tetrahedral dice are rolled.

High school students should learn to identify mutually exclusive, joint, and conditional events by drawing on their knowledge of combinations, permutations and counting to compute the probabilities associated with such events.” (Principles and Standards for School Mathematics, NCTM, 2000, p. 331)