



InspireData™ Standards Match

OHIO



Academic Content Standards: K-12 Mathematics

Meeting curriculum standards is a major focus in education today. This document highlights the correlation of **InspireData™** with the **Ohio Academic Content Standards for Mathematics**.

The Inspired Standards Match is designed to demonstrate the many ways InspireData supports the standards and to give educators ideas for using this tool to meet learning goals.

How to read the InspireData Standards Match:

- ▶ **Yellow** highlight indicates a standard or objective that can be supported by the use of InspireData databases, database templates, user generated databases, lesson plans or program features.
- ▶ **Green** notes list details about how InspireData can be used to meet the standards, including examples of specific databases, lesson plans or features that support them.

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K-12 Mathematics

Benchmarks and Indicators by Grade-Level



Grade Four

Number, Number Sense and Operations Standard

*Number and
Number Systems*

1. Identify and generate equivalent forms of fractions and decimals.
For example:
 - a. Connect physical, verbal and symbolic representations of fractions, decimals and whole numbers; e.g., $\frac{1}{2}$, $\frac{5}{10}$, “five tenths,” 0.5, shaded rectangles with half, and five tenths.
 - b. Understand and explain that ten tenths is the same as one whole in both fraction and decimal form.
2. Use place value structure of the base-ten number system to read, write, represent and compare whole numbers through millions and decimals through thousandths.
3. Round whole numbers to a given place value.
4. Identify and represent factors and multiples of whole numbers through 100, and classify numbers as prime or composite.
5. Use models and points of reference to compare commonly used fractions.

*Meaning of
Operations*

6. Use associative and distributive properties to simplify and perform computations; e.g., use left to right multiplication and the distributive property to find an exact answer without paper and pencil, such as $5 \times 47 = 5 \times 40 + 5 \times 7 = 200 + 35 = 235$.
7. Recognize that division may be used to solve different types of problem situations and interpret the meaning of remainders; e.g., situations involving measurement, money.

*Computation and
Estimation*

8. Solve problems involving counting money and making change, using both coins and paper bills.
9. Estimate the results of computations involving whole numbers, fractions and decimals, using a variety of strategies.
10. Use physical models, visual representations, and paper and pencil to add and subtract decimals and commonly used fractions with like denominators.

11. Develop and explain strategies for performing computations mentally.
12. Analyze and solve multi-step problems involving addition, subtraction, multiplication and division using an organized approach, and verify and interpret results with respect to the original problem.
13. Use a variety of methods and appropriate tools for computing with whole numbers; e.g., mental math, paper and pencil, and calculator.
14. Demonstrate fluency in adding and subtracting whole numbers and in multiplying and dividing whole numbers by 1- and 2-digit numbers and multiples of ten.

Measurement Standard

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Measurement Units

1. Relate the number of units to the size of the units used to measure an object; e.g., compare the number of cups to fill a pitcher to the number of quarts to fill the same pitcher.
2. Demonstrate and describe perimeter as surrounding and area as covering a two-dimensional shape, and volume as filling a three-dimensional object.



3. Identify and select appropriate units to measure:

- a. perimeter – string or links (inches or centimeters).
- b. area – tiles (square inches or square centimeters).
- c. volume – cubes (cubic inches or cubic centimeters).

*Use Measurement
Techniques and
Tools*

4. Develop and use strategies to find perimeter using string or links, area using tiles or a grid, and volume using cubes; e.g., count squares to find area of regular or irregular shapes on a grid, layer cubes in a box to find its volume.



5. Make simple unit conversions within a measurement system; e.g., inches to feet, kilograms to grams, quarts to gallons.

6. Write, solve and verify solutions to multi-step problems involving measurement.

Geometry and Spatial Sense Standard

Characteristics and Properties

1. Identify, describe and model intersecting, parallel and perpendicular lines and line segments; e.g., use straws or other material to model lines.
2. Describe, classify, compare and model two- and three-dimensional objects using their attributes.
3. Identify similarities and differences of quadrilaterals; e.g., squares, rectangles, parallelograms and trapezoids.
4. Identify and define triangles based on angle measures (equiangular, right, acute and obtuse triangles) and side lengths (isosceles, equilateral and scalene triangles).

Spacial Relationships

5. Describe points, lines and planes, and identify models in the environment.
6. Specify locations and plot ordered pairs on a coordinate plane, using first quadrant points.

Transformations and Symmetry

7. Identify, describe and use reflections (flips), rotations (turns), and translations (slides) in solving geometric problems; e.g., use transformations to determine if 2 shapes are congruent.

Visualization and Geometric Models

8. Use geometric models to solve problems in other areas of mathematics, such as number (multiplication/division) and measurement (area, perimeter, border).

Patterns, Functions and Algebra Standard

Use Patterns, Relations and Functions

1. Use models and words to describe, extend and make generalizations of patterns and relationships occurring in computation, numerical patterns, geometry, graphs and other applications.



2. Represent and analyze patterns and functions using words, tables and graphs.

Use Algebraic Representation

3. Construct a table of values to solve problems associated with a mathematical relationship.

4. Use rules and variables to describe patterns and other relationships.

- Analyze Change*
5. Represent mathematical relationships with equations or inequalities.
 6. Describe how a change in one variable affects the value of a related variable; e.g., as one increases the other increases or as one increases the other decreases.

Data Analysis and Probability Standard

- Data Collection*
1. Create a plan for collecting data for a specific purpose.
 2. Represent and interpret data using tables, bar graphs, line plots and line graphs.
 3. Interpret and construct Venn diagrams to sort and describe data.
 4. Compare different representations of the same data to evaluate how well each representation shows important aspects of the data, and identify appropriate ways to display the data.
 5. Propose and explain interpretations and predictions based on data displayed in tables, charts and graphs.
- Statistical Methods*
6. Describe the characteristics of a set of data based on a graphical representation, such as range of the data, clumps of data, and holes in the data.
 7. Identify the median of a set of data and describe what it indicates about the data.
 8. Use range, median and mode to make comparisons among related sets of data.
- Probability*
9. Conduct simple probability experiments and draw conclusions from the results; e.g., rolling number cubes or drawing marbles from a bag.
 10. Represent the likelihood of possible outcomes for chance situations; e.g., probability of selecting a red marble from a bag containing 3 red and 5 white marbles.
 11. Relate the concepts of impossible and certain-to-happen events to the numerical values of 0 (impossible) and 1 (certain).

12. Place events in order of likelihood and use a diagram or appropriate language to compare the chance of each event occurring; e.g., impossible, unlikely, equal, likely, certain.
13. List and count all possible combinations using one member from each of several sets, each containing 2 or 3 members; e.g., the number of possible outfits from 3 shirts, 2 shorts and 2 pairs of shoes.

Grade Five

Number, Number Sense and Operations Standard

*Number and
Number Systems*



1. Use models and visual representation to develop the concept of ratio as part-to-part and part-to-whole, and the concept of percent as part-to-whole.

2. Use various forms of “one” to demonstrate the equivalence of fractions; e.g., $\frac{18}{24} = \frac{9}{12} \times \frac{2}{2} = \frac{3}{4} \times \frac{6}{6}$.

3. Identify and generate equivalent forms of fractions, decimals and percents.

4. Round decimals to a given place value and round fractions (including mixed numbers) to the nearest half.

5. Recognize and identify perfect squares and their roots.

*Meaning of
Operations*

6. Represent and compare numbers less than 0 by extending the number line and using familiar applications; e.g., temperature, owing money.

7. Use commutative, associative, distributive, identity and inverse properties to simplify and perform computations.

8. Identify and use relationships between operations to solve problems.

9. Use order of operations, including use of parentheses, to simplify numerical expressions.

10. Justify why fractions need common denominators to be added or subtracted.

11. Explain how place value is related to addition and subtraction of decimals; e.g., $0.2 + 0.14$; the two tenths is added to the one tenth because they are both tenths.

*Computation and
Estimation*

12. Use physical models, points of reference, and equivalent forms to add and subtract commonly used fractions with like and unlike denominators and decimals.

13. Estimate the results of computations involving whole numbers, fractions and decimals, using a variety of strategies.

Measurement Standard

Measurement Units

1. Identify and select appropriate units to measure angles; i.e., degrees.
2. Identify paths between points on a grid or coordinate plane and compare the lengths of the paths; e.g., shortest path, paths of equal length.
3. Demonstrate and describe the differences between covering the faces (surface area) and filling the interior (volume) of three-dimensional objects.
4. Demonstrate understanding of the differences among linear units, square units and cubic units.

Use Measurement Techniques and Tools



5. Make conversions within the same measurement system while performing computations.
6. Use strategies to develop formulas for determining perimeter and area of triangles, rectangles and parallelograms, and volume of rectangular prisms.
7. Use benchmark angles (e.g.; 45° , 90° , 120°) to estimate the measure of angles, and use a tool to measure and draw angles.

Geometry and Spatial Sense Standard

Characteristics and Properties

1. Draw circles, and identify and determine relationships among the radius, diameter, center and circumference; e.g., radius is half the diameter, the ratio of the circumference of a circle to its diameter is an approximation of π .
2. Use standard language to describe line, segment, ray, angle, skew, parallel and perpendicular.
3. Label vertex, rays, interior and exterior for an angle.
4. Describe and use properties of congruent figures to solve problems.
5. Use physical models to determine the sum of the interior angles of triangles and quadrilaterals.

Spatial Relationships

6. Extend understanding of coordinate system to include points whose x or y values may be negative numbers.

Visualization and Geometric Models

7. Understand that the measure of an angle is determined by the degree of rotation of an angle side rather than the length of either side.
8. Predict what three-dimensional object will result from folding a two-dimensional net, then confirm the prediction by folding the net.



Patterns, Functions and Algebra Standard

Use Patterns, Relations and Functions

1. Justify a general rule for a pattern or a function by using physical materials, visual representations, words, tables or graphs.
2. Use calculators or computers to develop patterns, and generalize them using tables and graphs.

Use Algebraic Representation

3. Use variables as unknown quantities in general rules when describing patterns and other relationships.
4. Create and interpret the meaning of equations and inequalities representing problem situations.

5. Model problems with physical materials and visual representations, and use models, graphs and tables to draw conclusions and make predictions.

Analyze Change

6. Describe how the quantitative change in a variable affects the value of a related variable; e.g., describe how the rate of growth varies over time, based upon data in a table or graph.

Data Analysis and Probability Standard

Data Collection

1. Read, construct and interpret frequency tables, circle graphs and line graphs.





2. Select and use a graph that is appropriate for the type of data to be displayed; e.g., numerical vs. categorical data, discrete vs. continuous data.

3. Read and interpret increasingly complex displays of data, such as double bar graphs.



4. Determine appropriate data to be collected to answer questions posed by students or teacher, collect and display data, and clearly communicate findings.

Grade Five

5. Modify initial conclusions, propose and justify new interpretations and predictions as additional data are collected.
- Statistical Methods*  6. Determine and use the range, mean, median and mode, and explain what each does and does not indicate about the set of data.
- Probability* 7. List and explain all possible outcomes in a given situation.
8. Identify the probability of events within a simple experiment, such as three chances out of eight.
9. Use 0, 1 and ratios between 0 and 1 to represent the probability of outcomes for an event, and associate the ratio with the likelihood of the outcome.
-  10. Compare what should happen (theoretical/expected results) with what did happen (experimental/actual results) in a simple experiment.
11. Make predictions based on experimental and theoretical probabilities.

Grade Six

Number, Number Sense and Operations Standard

*Number and
Number Systems*

1. Decompose and recompose whole numbers using factors and exponents (e.g., $32 = 2 \times 2 \times 2 \times 2 \times 2 = 2^5$), and explain why “squared” means “second power” and “cubed” means “third power.”
2. Find and use the prime factorization of composite numbers. For example:
 - a. Use the prime factorization to recognize the greatest common factor (GCF).
 - b. Use the prime factorization to recognize the least common multiple (LCM).
 - c. Apply the prime factorization to solve problems and explain solutions.
3. Explain why a number is referred to as being “rational,” and recognize that the expression $\frac{a}{b}$ can mean a parts of size $\frac{1}{b}$ each, a divided by b , or the ratio of a to b .
4. Describe what it means to find a specific percent of a number, using real-life examples.
5. Use models and pictures to relate concepts of ratio, proportion and percent, including percents less than 1 and greater than 100.

*Meaning of
Operations*

6. Use the order of operations, including the use of exponents, decimals and rational numbers, to simplify numerical expressions.
7. Use simple expressions involving integers to represent and solve problems; e.g., if a running back loses 15 yards on the first carry but gains 8 yards on the second carry, what is the net gain/loss?
8. Represent multiplication and division situations involving fractions and decimals with models and visual representations; e.g., show with pattern blocks what it means to take $2\frac{2}{3} \div \frac{1}{6}$.
9. Give examples of how ratios are used to represent comparisons; e.g., part-to-part, part-to-whole, whole-to-part.

- Computation and Estimation*
10. Recognize that a quotient may be larger than the dividend when the divisor is a fraction; e.g., $6 \div \frac{1}{2} = 12$.
 11. Perform fraction and decimal computations and justify their solutions; e.g., using manipulatives, diagrams, mathematical reasoning.
 12. Develop and analyze algorithms for computing with fractions and decimals, and demonstrate fluency in their use.
 13. Estimate reasonable solutions to problem situations involving fractions and decimals; e.g., $\frac{7}{8} + \frac{12}{13} \approx 2$ and $4.23 \times 5.8 \approx 25$.
 14. Use proportional reasoning, ratios and percents to represent problem situations and determine the reasonableness of solutions.
 15. Determine the percent of a number and solve related problems; e.g., find the percent markdown if the original price was \$140, and the sale price is \$100.

Measurement Standard

- Measurement Units*
1. Understand and describe the difference between surface area and volume.
- Use Measurement Techniques and Tools*
2. Use strategies to develop formulas for finding circumference and area of circles, and to determine the area of sectors; e.g., $\frac{1}{2}$ circle, $\frac{2}{3}$ circle, $\frac{1}{3}$ circle, $\frac{1}{4}$ circle.
 3. Estimate perimeter or circumference and area for circles, triangles and quadrilaterals, and surface area and volume for prisms and cylinders by:
 - a. estimating lengths using string or links, areas using tiles or grid, and volumes using cubes;
 - b. measuring attributes (diameter, side lengths, or heights) and using established formulas for circles, triangles, rectangles, parallelograms and rectangular prisms.

4. Determine which measure (perimeter, area, surface area, volume) matches the context for a problem situation; e.g., perimeter is the context for fencing a garden, surface area is the context for painting a room.
5. Understand the difference between perimeter and area, and demonstrate that two shapes may have the same perimeter, but different areas or may have the same area, but different perimeters.
6. Describe what happens to the perimeter and area of a two-dimensional shape when the measurements of the shape are changed; e.g. length of sides are doubled.

Geometry and Spatial Sense Standard

Characteristics and Properties

1. Classify and describe two-dimensional and three-dimensional geometric figures and objects by using their properties; e.g., interior angle measures, perpendicular/parallel sides, congruent angles/sides.
2. Use standard language to define geometric vocabulary: vertex, face, altitude, diagonal, isosceles, equilateral, acute, obtuse and other vocabulary as appropriate.
3. Use multiple classification criteria to classify triangles; e.g., right scalene triangle.
4. Identify and define relationships between planes; i.e., parallel, perpendicular and intersecting.

Spatial Relationships

5. Predict and describe sizes, positions and orientations of two-dimensional shapes after transformations such as reflections, rotations, translations and dilations.

Transformations and Symmetry

6. Draw similar figures that model proportional relationships; e.g., model similar figures with a 1 to 2 relationship by sketching two of the same figure, one with corresponding sides twice the length of the other.

Visualization and Geometric Models

7. Build three-dimensional objects with cubes, and sketch the two-dimensional representations of each side; i.e., projection sets.

Patterns, Functions and Algebra Standard

Use Patterns, Relations and Functions

1. Represent and analyze patterns, rules and functions, using physical materials, tables and graphs.
2. Use words and symbols to describe numerical and geometric patterns, rules and functions.

Use Algebraic Representations

3. Recognize and generate equivalent forms of algebraic expressions, and explain how the commutative, associative and distributive properties can be used to generate equivalent forms; e.g., perimeter as $2(l + w)$ or $2l + 2w$.
4. Solve simple linear equations and inequalities using physical models, paper and pencil, tables and graphs.



5. Produce and interpret graphs that represent the relationship between two variables.

6. Evaluate simple expressions by replacing variables with given values, and use formulas in problem-solving situations.

Analyze Change

7. Identify and describe situations with constant or varying rates of change, and compare them.

8. Use technology to analyze change; e.g., use computer applications or graphing calculators to display and interpret rate of change.

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Data Analysis and Probability Standard



Data Collection

1. Read, construct and interpret line graphs, circle graphs and histograms.
2. Select, create and use graphical representations that are appropriate for the type of data collected.
3. Compare representations of the same data in different types of graphs, such as a bar graph and circle graph.

Statistical Methods



4. Understand the different information provided by measures of center (mean, mode and median) and measures of spread (range).

5. Describe the frequency distribution of a set of data, as shown in a histogram or frequency table, by general appearance or shape; e.g., number of modes, middle of data, level of symmetry, outliers.

 6. Make logical inferences from statistical data.

 *Probability*

7. Design an experiment to test a theoretical probability and explain how the results may vary.

Grade Seven

Number, Number Sense and Operations Standard

*Number and
Number Systems*

1. Demonstrate an understanding of place value using powers of 10 and write large numbers in scientific notation.
2. Explain the meaning of exponents that are negative or 0.
3. Describe differences between rational and irrational numbers; e.g., use technology to show that some numbers (rational) can be expressed as terminating or repeating decimals and others (irrational) as non-terminating and non-repeating decimals.

*Meaning of
Operations*

4. Use order of operations and properties to simplify numerical expressions involving integers, fractions and decimals.
5. Explain the meaning and effect of adding, subtracting, multiplying and dividing integers; e.g., how adding two integers can result in a lesser value.

*Computation and
Estimation*

6. Simplify numerical expressions involving integers and use integers to solve real-life problems.
7. Solve problems using the appropriate form of a rational number (fraction, decimal or percent).
8. Develop and analyze algorithms for computing with percents and integers, and demonstrate fluency in their use.
9. Represent and solve problem situations that can be modeled by and solved using concepts of absolute value, exponents and square roots (for perfect squares).

Measurement Standard

Measurement Units

1. Select appropriate units for measuring derived measurements; e.g., miles per hour, revolutions per minute.
2. Convert units of area and volume within the same measurement system using proportional reasoning and a reference table when appropriate; e.g., square feet to square yards, cubic meters to cubic centimeters.

*Use Measurement
Techniques and
Tools*

3. Estimate a measurement to a greater degree of precision than the tool provides.
4. Solve problems involving proportional relationships and scale factors; e.g., scale models that require unit conversions within the same measurement system.
5. Analyze problem situations involving measurement concepts, select appropriate strategies, and use an organized approach to solve narrative and increasingly complex problems.
6. Use strategies to develop formulas for finding area of trapezoids and volume of cylinders and prisms.
7. Develop strategies to find the area of composite shapes using the areas of triangles, parallelograms, circles and sectors.
8. Understand the difference between surface area and volume and demonstrate that two objects may have the same surface area, but different volumes or may have the same volume, but different surface areas.
9. Describe what happens to the surface area and volume of a three-dimensional object when the measurements of the object are changed; e.g., length of sides are doubled.

Geometry and Spatial Sense Standard

*Characteristics and
Properties*

1. Use proportional reasoning to describe and express relationships between parts and attributes of similar and congruent figures.
2. Determine sufficient (not necessarily minimal) properties that define a specific two-dimensional figure or three-dimensional object. For example:
 - a. Determine when one set of figures is a subset of another; e.g., all squares are rectangles.
 - b. Develop a set of properties that eliminates all but the desired figure; e.g., only squares are quadrilaterals with all sides congruent and all angles congruent.

- 3. Use and demonstrate understanding of the properties of triangles.
For example:
 - a. Use Pythagorean Theorem to solve problems involving right triangles.
 - b. Use triangle angle sum relationships to solve problems.
- 4. Determine necessary conditions for congruence of triangles.
- 5. Apply properties of congruent or similar triangles to solve problems involving missing lengths and angle measures.
- Spatial Relationships* 6. Determine and use scale factors for similar figures to solve problems using proportional reasoning.
- Transformations and Symmetry* 7. Identify the line and rotation symmetries of two-dimensional figures to solve problems.
- 8. Perform translations, reflections, rotations and dilations of two-dimensional figures using a variety of methods (paper folding, tracing, graph paper).
- Visualization and Geometric Models* 9. Draw representations of three-dimensional geometric objects from different views.

Patterns, Functions and Algebra Standard

Use Patterns, Relations and Functions

- 1. Represent and analyze patterns, rules and functions with words, tables, graphs and simple variable expressions.
- 2. Generalize patterns by describing in words how to find the next term.
- 3. Recognize and explain when numerical patterns are linear or nonlinear progressions; e.g., 1, 3, 5, 7... is linear and 1, 3, 4, 8, 16... is nonlinear.

Use Algebraic Representations

- 4. Create visual representations of equation-solving processes that model the use of inverse operations.
- 5. Represent linear equations by plotting points in the coordinate plane.
- 6. Represent inequalities on a number line or a coordinate plane.

7. Justify that two forms of an algebraic expression are equivalent, and recognize when an expression is simplified; e.g., $4m = m + m + m + m$ or $a \cdot 5 + 4 = 5a + 4$.

8. Use formulas in problem-solving situations.

9. Recognize a variety of uses for variables; e.g., placeholder for an unknown quantity in an equation, generalization for a pattern, formula.

Analyze Change

10. Analyze linear and simple nonlinear relationships to explain how a change in one variable results in the change of another.

11. Use graphing calculators or computers to analyze change; e.g., distance-time relationships.


Data Analysis and Probability Standard

 *Data Collection*

1. Read, create and interpret box-and-whisker plots, stem-and-leaf plots, and other types of graphs, when appropriate.

2. Analyze how decisions about graphing affect the graphical representation; e.g., scale, size of classes in a histogram, number of categories in a circle graph.

Statistical Methods

 3. Analyze a set of data by using and comparing combinations of measures of center (mean, mode, median) and measures of spread (range, quartile, interquartile range), and describe how the inclusion or exclusion of outliers affects those measures.

4. Construct opposing arguments based on analysis of the same data, using different graphical representations.

5. Compare data from two or more samples to determine how sample selection can influence results.

6. Identify misuses of statistical data in articles, advertisements, and other media.

*Probability*

7. Compute probabilities of compound events; e.g., multiple coin tosses or multiple rolls of number cubes, using such methods as organized lists, tree diagrams and area models.
8. Make predictions based on theoretical probabilities, design and conduct an experiment to test the predictions, compare actual results to predicted results, and explain differences.

Grade Eight

Number, Number Sense and Operations Standard

*Number and
Number Systems*

1. Use scientific notation to express large numbers and small numbers between 0 and 1.
2. Recognize that natural numbers, whole numbers, integers, rational numbers and irrational numbers are subsets of the real number system.

*Meaning of
Operations*

3. Apply order of operations to simplify expressions and perform computations involving integer exponents and radicals.
4. Explain and use the inverse and identity properties and use inverse relationships (addition/subtraction, multiplication/division, squaring/square roots) in problem solving situations.

*Computation and
Estimation*

5. Determine when an estimate is sufficient and when an exact answer is needed in problem situations, and evaluate estimates in relation to actual answers; e.g., very close, less than, greater than.
6. Estimate, compute and solve problems involving rational numbers, including ratio, proportion and percent, and judge the reasonableness of solutions.
7. Find the square root of perfect squares, and approximate the square root of non-perfect squares as consecutive integers between which the root lies; e.g., $\sqrt{130}$ is between 11 and 12.
8. Add, subtract, multiply, divide and compare numbers written in scientific notation.

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Measurement Standard

Measurement Units

1. Compare and order the relative size of common U.S. customary units and metric units; e.g., mile and kilometer, gallon and liter, pound and kilogram.



2. Use proportional relationships and formulas to convert units from one measurement system to another; e.g., degrees Fahrenheit to degrees Celsius.

*Use Measurement
Techniques and
Tools*

3. Use appropriate levels of precision when calculating with measurements.
4. Derive formulas for surface area and volume and justify them using geometric models and common materials. For example, find:
 - a. the surface area of a cylinder as a function of its height and radius;
 - b. that the volume of a pyramid (or cone) is one-third of the volume of a prism (or cylinder) with the same base area and height.
5. Determine surface area for pyramids by analyzing their parts.
6. Solve and determine the reasonableness of the results for problems involving rates and derived measurements, such as velocity and density, using formulas, models and graphs.
7. Apply proportional reasoning to solve problems involving indirect measurements or rates.
8. Find the sum of the interior and exterior angles of regular convex polygons with and without measuring the angles with a protractor.
9. Demonstrate understanding of the concepts of perimeter, circumference and area by using established formulas for triangles, quadrilaterals, and circles to determine the surface area and volume of prisms, pyramids, cylinders, spheres and cones. (Note: Only volume should be calculated for spheres and cones.)
10. Use conventional formulas to find the surface area and volume of prisms, pyramids and cylinders and the volume of spheres and cones to a specified level of precision.



Geometry and Spatial Sense Standard

*Characteristics and
Properties*

1. Make and test conjectures about characteristics and properties (e.g., sides, angles, symmetry) of two-dimensional figures and three-dimensional objects.
2. Recognize the angles formed and the relationship between the angles when two lines intersect and when parallel lines are cut by a transversal.

Grade Eight

- 3. Use proportions in several forms to solve problems involving similar figures (part-to-part, part-to-whole, corresponding sides between figures).
- Spatial Relationships* 4. Represent and analyze shapes using coordinate geometry; e.g., given three vertices and the type of quadrilateral, find the coordinates of the fourth vertex.
- Transformations and Symmetry* 5. Draw the results of translations, reflections, rotations and dilations of objects in the coordinate plane, and determine properties that remain fixed; e.g., lengths of sides remain the same under translations.
- Visualization and Geometric Models* 6. Draw nets for a variety of prisms, pyramids, cylinders and cones.



Patterns, Functions and Algebra Standard

Use Patterns, Relations and Functions

- 1. Relate the various representations of a relationship; i.e., relate a table to graph, description and symbolic form.
- 2. Generalize patterns and sequences by describing how to find the n th term.
- 3. Identify functions as linear or nonlinear based on information given in a table, graph or equation.

Use Algebraic Representations

- 4. Extend the uses of variables to include covariants where y depends on x .
- 5. Use physical models to add and subtract monomials and polynomials, and to multiply a polynomial by a monomial.
- 6. Describe the relationship between the graph of a line and its equation, including being able to explain the meaning of slope as a constant rate of change and y -intercept in real-world problems.
- 7. Use symbolic algebra (equations and inequalities), graphs and tables to represent situations and solve problems.
- 8. Write, simplify and evaluate algebraic expressions (including formulas) to generalize situations and solve problems.
- 9. Solve linear equations and inequalities graphically, symbolically and using technology.

10. Solve 2 by 2 systems of linear equations graphically and by simple substitution.
11. Interpret the meaning of the solution of a 2 by 2 system of equations; i.e., point, line, no solution.
12. Solve simple quadratic equations graphically; e.g., $y = x^2 - 16$.
13. Compute and interpret slope, midpoint and distance given a set of ordered pairs.

Analyze Change

14. Differentiate and explain types of changes in mathematical relationships, such as linear vs. nonlinear, continuous vs. noncontinuous, direct variation vs. inverse variation.
15. Describe and compare how changes in an equation affects the related graphs; e.g., for a linear equation changing the coefficient of x affects the slope and changing the constant affects the intercepts.
16. Use graphing calculators or computers to analyze change; e.g., interest compounded over time as a nonlinear growth pattern.

Data Analysis and Probability Standard



Data Collection

1. Use, create and interpret scatterplots and other types of graphs as appropriate.
2. Evaluate different graphical representations of the same data to determine which is the most appropriate representation for an identified purpose; e.g., line graph for change over time, circle graph for part-to-whole comparison, scatterplot for relationship between two variants.
3. Differentiate between discrete and continuous data and appropriate ways to represent each.

Statistical Methods



4. Compare two sets of data using measures of center (mean, mode, median) and measures of spread (range, quartiles, interquartile range, percentiles).
5. Explain the mean's sensitivity to extremes and its use in comparison with the median and mode.
6. Make conjectures about possible relationship in a scatterplot and approximate line of best fit.



7. Identify different ways of selecting samples, such as survey response, random sample, representative sample and convenience sample.

8. Describe how the relative size of a sample compared to the target population affects the validity of predictions.

9. Construct convincing arguments based on analysis of data and interpretation of graphs.

Probability 10. Calculate the number of possible outcomes for a situation, recognizing and accounting for when items may occur more than once or when order is important.

11. Demonstrate an understanding that the probability of either of two disjoint events occurring can be found by adding the probabilities for each and that the probability of one independent event following another can be found by multiplying the probabilities.

Grade Nine

Number, Number Sense and Operations Standard

*Number and
Number Systems*

1. Identify and justify whether properties (closure, identity, inverse, commutative and associative) hold for a given set and operations; e.g., even integers and multiplication.

2. Compare, order and determine equivalent forms for rational and irrational numbers.

*Meaning of
Operations*

3. Explain the effects of operations such as multiplication or division, and of computing powers and roots on the magnitude of quantities.

*Computation and
Estimation*

4. Demonstrate fluency in computations using real numbers.

5. Estimate the solutions for problem situations involving square and cube roots.

Measurement Standard

Measurement Units



1. Convert rates within the same measurement system; e.g., miles per hour to feet per second; kilometers per hour to meters per second.

*Use Measurement
Techniques and
Tools*

2. Use unit analysis to check computations involving measurement.

3. Use the ratio of lengths in similar two-dimensional figures or three-dimensional objects to calculate the ratio of their areas or volumes respectively.

4. Use scale drawings and right triangle trigonometry to solve problems that include unknown distances and angle measures.

5. Solve problems involving unit conversion for situations involving distances, areas, volumes and rates within the same measurement system.

Geometry and Spatial Sense Standard

*Characteristics and
Properties*

1. Define the basic trigonometric ratios in right triangles: sine, cosine and tangent.

Visualization and Geometric Models

2. Apply proportions and right triangle trigonometric ratios to solve problems involving missing lengths and angle measures in similar figures.
3. Analyze two-dimensional figures in a coordinate plane; e.g., use slope and distance formulas to show that a quadrilateral is a parallelogram.



Patterns, Functions and Algebra Standard

Use Patterns, Relations and Functions

1. Define function with ordered pairs in which each domain element is assigned exactly one range element.
2. Generalize patterns using functions or relationships (linear, quadratic and exponential), and freely translate among tabular, graphical and symbolic representations.
3. Describe problem situations (linear, quadratic and exponential) by using tabular, graphical and symbolic representations.
4. Demonstrate the relationship among zeros of a function, roots of equations, and solutions of equations graphically and in words.
5. Describe and compare characteristics of the following families of functions: linear, quadratic and exponential functions; e.g., general shape, number of roots, domain, range, rate of change, maximum or minimum.

Use Algebraic Representations

6. Write and use equivalent forms of equations and inequalities in problem situations; e.g., changing a linear equation to the slope-intercept form.
7. Use formulas to solve problems involving exponential growth and decay.
8. Find linear equations that represent lines that pass through a given set of ordered pairs, and find linear equations that represent lines parallel or perpendicular to a given line through a specific point.
9. Solve and interpret the meaning of 2 by 2 systems of linear equations graphically, by substitution and by elimination, with and without technology.

Grade Nine

- Analyze Change*
10. Solve quadratic equations with real roots by factoring, graphing, using the quadratic formula and with technology.
 11. Add, subtract, multiply and divide monomials and polynomials (division of polynomials by monomials only).
 12. Simplify rational expressions by eliminating common factors and applying properties of integer exponents.
 13. Model and solve problems involving direct and inverse variation using proportional reasoning.
 14. Describe the relationship between slope and the graph of a direct variation and inverse variation.
 15. Describe how a change in the value of a constant in a linear or quadratic equation affects the related graphs.

Data Analysis and Probability Standard

 *Data Collection*

1. Classify data as univariate (single variable) or bivariate (two variables) and as quantitative (measurement) or qualitative (categorical) data.
2. Create a scatterplot for a set of bivariate data, sketch the line of best fit, and interpret the slope of the line of best fit.

Statistical Methods

3. Analyze and interpret frequency distributions based on spread, symmetry, skewness, clusters and outliers.
4. Describe and compare various types of studies (survey, observation, experiment), and identify possible misuses of statistical data.




5. Describe characteristics and limitations of sampling methods, and analyze the effects of random versus biased sampling; e.g., determine and justify whether the sample is likely to be representative of the population.
6. Make inferences about relationships in bivariate data, and recognize the difference between evidence of relationship (correlation) and causation.

Probability

7. Use counting techniques and the Fundamental Counting principle to determine the total number of possible outcomes for mathematical situations.

8. Describe, create and analyze a sample space and use it to calculate probability.

9. Identify situations involving independent and dependent events, and explain differences between, and common misconceptions about, probabilities associated with those events.

 10. Use theoretical and experimental probability, including simulations or random numbers, to estimate probabilities and to solve problems dealing with uncertainty; e.g., compound events, independent events, simple dependent events.

Grade Ten

Number, Number Sense and Operations Standard

*Number and
Number Systems*

1. Connect physical, verbal and symbolic representations of irrational numbers; e.g., construct $\sqrt{2}$ as a hypotenuse or on a number line.

*Meaning of
Operations*

2. Explain the meaning of the n th root.

*Computation and
Estimation*

3. Use factorial notation and computations to represent and solve problem situations involving arrangements.
4. Approximate the n th root of a given number greater than zero between consecutive integers when n is an integer; e.g., the 4th root of 50 is between 2 and 3.

Measurement Standard

*Use Measurement
Techniques and
Tools*

1. Explain how a small error in measurement may lead to a large error in calculated results.
2. Calculate relative error.
3. Explain the difference between absolute error and relative error in measurement.
4. Give examples of how the same absolute error can be problematic in one situation but not in another; e.g., compare “accurate to the nearest foot” when measuring the height of a person versus when measuring the height of a mountain.
5. Determine the measures of central and inscribed angles and their associated major and minor arcs.

Geometry and Spatial Sense Standard

*Characteristics and
Properties*

1. Formally define and explain key aspects of geometric figures, including:
 - a. interior and exterior angles of polygons;
 - b. segments related to triangles (median, altitude, midsegment);

- c. points of concurrency related to triangles (centroid, incenter, orthocenter, circumcenter);
 - d. circles (radius, diameter, chord, circumference, major arc, minor arc, sector, segment, inscribed angle).
2. Recognize and explain the necessity for certain terms to remain undefined, such as point, line and plane.
 3. Make, test and establish the validity of conjectures about geometric properties and relationships using counterexample, inductive and deductive reasoning, and paragraph or two-column proof, including:
 - a. prove the Pythagorean Theorem;
 - b. prove theorems involving triangle similarity and congruence;
 - c. prove theorems involving properties of lines, angles, triangles and quadrilaterals;
 - d. test a conjecture using basic constructions made with a compass and straightedge or technology.
- Spatial Relationships*
4. Construct right triangles, equilateral triangles, parallelograms, trapezoids, rectangles, rhombuses, squares and kites, using compass and straightedge or dynamic geometry software.
 5. Construct congruent figures and similar figures using tools, such as compass, straightedge, and protractor or dynamic geometry software.
- Transformation and Symmetry*
6. Identify the reflection and rotation symmetries of two- and three-dimensional figures.
 7. Perform reflections and rotations using compass and straightedge constructions and dynamic geometry software.
 8. Derive coordinate rules for translations, reflections and rotations of geometric figures in the coordinate plane.
 9. Show and describe the results of combinations of translations, reflections and rotations (compositions); e.g., perform compositions and specify the result of a composition as the outcome of a single motion, when applicable.
- Visualization and Geometric Models*
10. Solve problems involving chords, radii and arcs within the same circle.

Grade Ten

Patterns, Functions and Algebra Standard

*Use Patterns,
Relations
and Functions*

1. Define function formally and with $f(x)$ notation.
2. Describe and compare characteristics of the following families of functions: square root, cubic, absolute value and basic trigonometric functions; e.g., general shape, possible number of roots, domain and range.

*Use Algebraic
Representations*

3. Solve equations and formulas for a specified variable; e.g., express the base of a triangle in terms of the area and height.
4. Use algebraic representations and functions to describe and generalize geometric properties and relationships.
5. Solve simple linear and nonlinear equations and inequalities having square roots as coefficients and solutions.
6. Solve equations and inequalities having rational expressions as coefficients and solutions.
7. Solve systems of linear inequalities.
8. Graph the quadratic relationship that defines circles.
9. Recognize and explain that the slopes of parallel lines are equal and the slopes of perpendicular lines are negative reciprocals.
10. Solve real-world problems that can be modeled using linear, quadratic, exponential or square root functions.
11. Solve real-world problems that can be modeled, using systems of linear equations and inequalities.

Analyze Change

12. Describe the relationship between slope of a line through the origin and the tangent function of the angle created by the line and the positive x -axis.

Data Analysis and Probability Standard

Data Collection



1. Describe measures of center and the range verbally, graphically and algebraically.

2. Represent and analyze bivariate data using appropriate graphical displays (scatterplots, parallel box-and-whisker plots, histograms with more than one set of data, tables, charts, spreadsheets) with and without technology.



3. Display bivariate data where at least one variable is categorical.

4. Identify outliers on a data display; e.g., use interquartile range to identify outliers on a box-and-whisker plot.



Statistical Methods

5. Provide examples and explain how a statistic may or may not be an attribute of the entire population; e.g., intentional or unintentional bias may be present.

6. Interpret the relationship between two variables using multiple graphical displays and statistical measures; e.g., scatterplots, parallel box-and-whisker plots, and measures of center and spread.

Probability

7. Model problems dealing with uncertainty with area models (geometric probability).

8. Differentiate and explain the relationship between the probability of an event and the odds of an event, and compute one given the other.

Grade Eleven

Number, Number Sense and Operations Standard

*Number and
Number Systems*

1. Determine what properties hold for matrix addition and matrix multiplication; e.g., use examples to show addition is commutative and when multiplication is not commutative.
2. Determine what properties hold for vector addition and multiplication, and for scalar multiplication.
3. Represent complex numbers on the complex plane.

*Meaning of
Operations*

4. Use matrices to represent given information in a problem situation.
5. Model, using the coordinate plane, vector addition and scalar multiplication.

*Computation and
Estimation*

6. Compute sums, differences and products of matrices using paper and pencil calculations for simple cases, and technology for more complicated cases.
7. Compute sums, differences, products and quotients of complex numbers.
8. Use fractional and negative exponents as optional ways of representing and finding solutions for problem situations; e.g., $27^{2/3} = (27^{1/3})^2 = 9$.
9. Use vector addition and scalar multiplication to solve problems.

Measurement Standard

Measurement Units

1. Determine the number of significant digits in a measurement.
2. Use radian and degree angle measures to solve problems and perform conversions as needed.

*Use Measurement
Techniques and
Tools*

3. Derive a formula for the surface area of a cone as a function of its slant height and the circumference of its base.
4. Calculate distances, areas, surface areas and volumes of composite three-dimensional objects to a specified number of significant digits.
5. Solve real-world problems involving area, surface area, volume and density to a specified degree of precision.

Grade Eleven

Geometry and Spatial Sense Standard

- | | |
|---|---|
| <i>Spatial Relationships</i> | 1. Use polar coordinates to specify locations on a plane. |
| <i>Transformations and Symmetry</i> | 2. Represent translations using vectors. |
| | 3. Describe multiplication of a vector and a scalar graphically and algebraically, and apply to problem situations. |
| | 4. Use trigonometric relationships to determine lengths and angle measures; i.e., Law of Sines and Law of Cosines. |
| <i>Visualization and Geometric Models</i> | 5. Identify, sketch and classify the cross sections of three-dimensional objects. |

Patterns, Functions and Algebra Standard

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|--|--|
| <i>Use Patterns, Relations and Functions</i> | 1. Identify and describe problem situations involving an iterative process that can be represented as a recursive function; e.g., compound interest. |
| | 2. Translate a recursive function into a closed form expression or formula for the n th term to solve a problem situation involving an iterative process; e.g., find the value of an annuity after 7 years. |
| | 3. Describe and compare the characteristics of the following families of functions: quadratics with complex roots, polynomials of any degree, logarithms, and rational functions; e.g., general shape, number of roots, domain and range, asymptotic behavior. |
| | 4. Identify the maximum and minimum points of polynomial, rational and trigonometric functions graphically and with technology. |
| | 5. Identify families of functions with graphs that have rotation symmetry or reflection symmetry about the y -axis, x -axis or $y = x$. |
| <i>Use Algebraic Representations</i> | 6. Represent the inverse of a function symbolically and graphically as a reflection about $y = x$. |
| | 7. Model and solve problems with matrices and vectors. |
| | 8. Solve equations involving radical expressions and complex roots. |
| | 9. Solve 3 by 3 systems of linear equations by elimination and using technology, and interpret graphically what the solution means (a point, line, plane, or no solution). |



10. Describe the characteristics of the graphs of conic sections.

Analyze Change

11. Describe how a change in the value of a constant in an exponential, logarithmic or radical equation affects the graph of the equation.

Data Analysis and Probability Standard



Data Collection

1. Design a statistical experiment, survey or study for a problem; collect data for the problem; and interpret the data with appropriate graphical displays, descriptive statistics, concepts of variability, causation, correlation and standard deviation.

2. Describe the role of randomization in a well-designed study, especially as compared to a convenience sample, and the generalization of results from each.

Statistical Methods

3. Describe how a linear transformation of univariate data affects range, mean, mode and median.

4. Create a scatterplot of bivariate data, identify trends, and find a function to model the data.



5. Use technology to find the Least Squares Regression Line, the regression coefficient, and the correlation coefficient for bivariate data with a linear trend, and interpret each of these statistics in the context of the problem situation.

6. Use technology to compute the standard deviation for a set of data, and interpret standard deviation in relation to the context or problem situation.

7. Describe the standard normal curve and its general properties, and answer questions dealing with data assumed to be normal.

8. Analyze and interpret univariate and bivariate data to identify patterns, note trends, draw conclusions, and make predictions.

9. Evaluate validity of results of a study based on characteristics of the study design, including sampling method, summary statistics and data analysis techniques.

Probability

10. Understand and use the concept of random variable, and compute and interpret the expected value for a random variable in simple cases.

11. Examine statements and decisions involving risk; e.g., insurance rates and medical decisions.

Grade Eleven

Grade Twelve

Number, Number Sense and Operations Standard

*Number and
Number Systems*

1. Determine what properties (closure, identity, inverse, commutative and associative) hold for operations with complex numbers.

*Computation and
Estimation*

2. Apply combinations as a method to create coefficients for the Binomial Theorem, and make connections to everyday and workplace problem situations.

Measurement Standard

*Use Measurement
Techniques and
Tools*

1. Solve problems involving derived measurements; e.g., acceleration and pressure.

2. Use radian measures in the solution of problems involving angular velocity and acceleration.

3. Apply informal concepts of successive approximation, upper and lower bounds, and limits in measurement situations; e.g., measurement of some quantities, such as volume of a cone, can be determined by sequences of increasingly accurate approximations.

Geometry and Spatial Sense Standard

*Transformations and
Symmetry*

1. Use matrices to represent translations, reflections, rotations, dilations and their compositions.

2. Derive and apply the basic trigonometric identities; i.e., angle addition, angle subtraction and double angle.

*Visualization and
Geometric Models*

3. Relate graphical and algebraic representations of lines, simple curves and conic sections.

4. Recognize and compare specific shapes and properties in multiple geometries; e.g., plane, spherical and hyperbolic.

Patterns, Functions and Algebra Standard

*Use Patterns,
Relations
and Functions*

1. Analyze the behavior of arithmetic and geometric sequences and series as the number of terms increases.
2. Translate between the numeric and symbolic form of a sequence or series.
3. Describe and compare the characteristics of transcendental and periodic functions; e.g., general shape, number of roots, domain and range, asymptotic behavior, extrema, local and global behavior.
4. Represent the inverse of a transcendental function symbolically.

*Use Algebraic
Representations*

5. Set up and solve systems of equations using matrices and graphs, with and without technology.
6. Make arguments about mathematical properties using mathematical induction.
7. Make mathematical arguments using the concepts of limit.
8. Compare estimates of the area under a curve over a bounded interval by partitioning the region with rectangles; e.g., make successive estimates using progressively smaller rectangles.
9. Translate freely between polar and Cartesian coordinate systems.

Analyze Change

10. Use the concept of limit to find instantaneous rate of change for a point on a graph as the slope of a tangent at a point.

Data Analysis and Probability Standard

Data Collection



1. Identify and use various sampling methods (voluntary response, convenience sample, random sample, stratified random sample, census) in a study.

Statistical Methods

2. Transform bivariate data so it can be modeled by a function; e.g., use logarithms to allow nonlinear relationship to be modeled by linear function.



3. Describe the shape and find all summary statistics for a set of univariate data, and describe how a linear transformation affects shape, center and spread.

4. Apply the concept of a random variable to generate and interpret probability distributions, including binomial, normal and uniform.
5. Use sampling distributions as the basis for informal inference.



6. Use theoretical or experimental probability, including simulations, to determine probabilities in real-world problem situations involving uncertainty, such as mutually exclusive events, complementary events, and conditional probability.