

ISPS Math Standards & Benchmarks

(Adapted from AERO standards)

Grade 8

Standard 1 - Students will apply a wide variety of mathematical concepts, processes, and skills to solve a broad range of problems in various content areas and everyday situations.

Benchmarks - By the end of Grade 8, students will:

- 1 – 1 Formulate algebraic expressions that include real numbers to describe and solve real-world problems.
- 1 – 2 Use symbols, variables, expressions, inequalities, equations, and simple systems of equations to represent problem situations that involve variables or unknown quantities
- 1 – 3 Differentiate between rational and irrational numbers.
- 1 – 4 Approximate, mentally and with calculators, the values of irrational numbers as they arise from problem situation.
- 1 – 5 Use graphs, tables, and algebraic representations to make predictions and solve problems that involve change.
- 1 – 6 Use appropriate problem-solving strategies (looking for a pattern, systematic guessing and checking, making a table or graph, working a simpler problem, writing an algebraic expression or working backward) to solve problems that involve change.
- 1 – 7 Solve multi-step problems that involve changes in rate, average speed, distance, and time.
- 1 – 8 Recognize the same general pattern of change presented in different representations (Pascal's Triangle, triangular numbers, pentagonal numbers)
- 1 – 9 Use estimation to solve problems.

Standard 2 - Students will apply mathematical reasoning skills to investigate, evaluate, justify, and connect approaches and solutions to situations in mathematics and in other disciplines.

Benchmarks - By the end of Grade 8, students will:

- 2 – 1 Generate different representations to model a specific numerical relationship given one representation of data (e.g., a table, a graph, an algebraic expressions or equation, a verbal description.).
- 2 – 2 Select the appropriate measure of central tendency to describe a set of data for a particular problem situation.
- 2 – 3 Develop an appropriate strategy using a variety of data from surveys, samplings, estimations, and inferences to address a specific problem.

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- 2 – 4 Generate, organize, and interpret real number and other data in a variety of situations.
- 2 – 5 Use algebraic expression to represent reader bias or measurement errors in the interpretation of data

Standard 3 - Students will understand mathematical information presented and obtained in a variety of ways and will accurately and clearly present and justify mathematical ideas in diverse formats.

Benchmarks - By the end of Grade 8, students will:

- 3 – 1 Estimate, find, and justify solutions to problems that involve change using tables, graphs, and algebraic expressions.
- 3 – 2 Move between numerical, tabular, and graphical representations of linear relationships.
- 3 – 3 Use variables to generalize patterns and information presented in tables, charts, and graphs.
- 3 – 4 Analyze data to make decisions and to develop convincing arguments from data displayed in a variety of formats that include:
 - plots
 - distributions
 - graphs
 - scatter plots
 - diagrams
 - pictorial displays
 - charts and tables
 - Venn diagrams

Standard 4 - Students will select and use a wide variety of tools and technology to support and validate mathematical results, when appropriate.

Benchmarks - By the end of Grade 8, students will:

- 4 – 1 Generate different representations to model a specific numerical relationship given one representation of data (e.g., a table, a graph, an equation, a verbal description).

Standard 5 - Students will understand and apply numbers, ways of representing numbers, relationships among numbers, and number systems.

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Benchmarks - By the end of Grade 8, students will:

- 5 – 1 Categorize all sets of real numbers by their properties (e.g., prime, composite, square, square root).
- 5 – 2 Demonstrate the magnitude of rational numbers (e.g., trillions to millions).
- 5 – 3 Express numbers in scientific notation (including negative exponents) in appropriate problem situations using a calculator.
- 5 – 4 Differentiate between rational and irrational numbers.
- 5 – 5 Use algebra to solve problems with ratios, proportions, and percents, including solving for the missing term in a proportion.
- 5 – 6 Select and use appropriate forms of rational numbers to solve real-world problems including those involving proportional relationships.

Standard 6 - Students will estimate, compute, and assess reasonableness of solutions.

Benchmarks - By the end of Grade 8, students will:

- 6 – 1 Use real number properties (e.g., commutative, associative, distributive) to perform various computational procedures.
- 6 – 2 Use a variety of computational methods to estimate quantities involving real numbers.
- 6 – 3 Use real number properties (e.g., commutative, associative, distributive) to perform various computational procedures.
- 6 – 4 Perform arithmetic operations and their inverses (e.g., addition/subtraction, multiplication/division, square roots of perfect squares, cube roots of perfect cubes) on real numbers.
- 6 – 5 Find roots of real numbers using calculators.
- 6 – 6 Perform and explain computations with rational numbers, pi, and first-degree algebraic expressions in one variable in a variety of situations.
- 6 – 7 Use estimation to solve problems.
- 6 – 8 Estimate volume in cubic units.
- 6 – 9 Approximate, mentally and with calculators, the value of irrational numbers as they arise from problem situations.

Standard 7 - Students will estimate and measure to a required degree of accuracy and precision by selecting and using appropriate units, tools, and technologies.

Benchmarks - By the end of Grade 8, students will:

- 7 – 1 Estimate answers and use formulas to solve application problems involving surface area and volume.

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- 7 – 2 Understand the concept of volume and use the appropriate units in common measuring systems (e.g., cubic centimeter, cubic inch, cubic yard) to compute the volume of rectangular solids.
- 7 – 3 Use changes in measurement units (e.g., square inches, cubic feet) to perform conversions from one-, two-, and three-dimensional shapes.
- 7 – 4 Perform conversions with multiple terms between metric and U.S. customary measurement systems.
- 7 – 5 Solve simple problems involving rates and derived measurements for such properties as velocity and density.

Standard 8 - Students will use algebraic methods to represent, analyze, and solve abstract and practical mathematical situations involving patterns and functional relationships.

Benchmarks - By the end of Grade 8, students will:

- 8 – 1 Translate verbal models to algebraic models and use to solve multi-step problems.
- 8 – 2 Solve algebraic equations with variables on both sides of the equation.
- 8 – 3 Solve inequalities.
- 8 – 4 Evaluate formulas using substitution.
- 8 – 5 Evaluate problems that involve the relationship between ratios, proportions, and percent and solve for a missing term in the proportion.
- 8 – 6 Use symbols, variables, expressions, inequalities, equations and systems of equations to represent problem situations that involve variables or unknowns quantities.
- 8 – 7 Generalize a pattern of change using algebra and show the relationship among the equation, graph, and table of values.
- 8 – 8 Solve two-step linear equations and inequalities in one variable with rational solutions.
- 8 – 9 Graph linear functions noting that the vertical change per unit of horizontal change (the slope of the graph) is always the same.
- 8 – 10 Plot the values of quantities whose ratios are always the same, fit a line to the plot, and understand that the slope of the line equals the quantities.

Standard 9 - Students will use spatial reasoning and apply the properties and relationships of geometric figures to represent, investigate, analyze, and solve problems.

Benchmarks - By the end of Grade 8, students will:

- 9 – 1 Develop and use formulas for circumference and volume,(spheres and pyramids)

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- 9 – 2 Use the Pythagorean Theorem and its converse to find the missing side of a right triangle and the lengths of the other line segments.
- 9 – 3 Recognize and apply properties of corresponding parts of similar and congruent triangles and quadrilaterals.
- 9 – 4 Represent and solve problems relating to size, shape, area, and volume using geometric models.
- 9 – 5 Analyze characteristics and properties of two- and three dimensional geometric shapes and develop mathematical arguments about relationships.
- 9 – 6 Construct two-dimensional pattern for three-dimensional models (cylinder, prism, cones) and use to solve problems relating to size, shape, surface area and volume.
- 9 – 7 Develop and use formulas for area, perimeter, circumference, and volume including that of three dimensional geometric shapes/ models.
- 9 – 8 Describe and perform single and multiple transformations using translation.

Standard 10 - Students will pose a question, collect, organize, analyze, and represent data in order to make decisions and predictions.

Benchmarks – By the end of Grade 8, students will:

- 10 – 1 Represent two numerical variables on a plot, describe how the data points are distributed, and identify relationships that exist between the two variables.
- 10 -2 Organize, analyze, and display appropriate quantitative and qualitative data to address specific questions including:
 - frequency distributions
 - plots
 - histograms
 - bar, line, and pie graphs
 - diagram and pictorial displays
 - charts and tables
- 10 – 3 Simulate an event selecting and using different models.
- 10 – 4 Use changes in scales, intervals, or categories to help support a particular interpretation of data.
- 10 – 5 Interpret and analyze data from graphical representations and draw simple conclusions (e.g., line of best fit).
- 10 – 6 Evaluate and defend the reasonableness of conclusions drawn from data analysis.
- 10 – 7 Use appropriate central tendency and spread as a means for effective decision-making in analyzing data and outliers.
- 10 – 8 Identify simple graphic misrepresentations and distortions of sets of data (e.g., unequal interval sizes, omission of parts of axis range, scaling).

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10 – 9 Use appropriate technology to display data as lists, tables, matrices, graphs, and plots and to analyze the relationships of variables in the data displayed.

Standard 11 - Students will understand and apply basic concepts of probability.

Benchmarks – By the end of Grade 8, students will:

- 11- 1 Describe how changes in scale, intervals, or categories influence arguments for a particular interpretation of the data.
- 11 – 2 Conduct experiments and/or simulations, record results in charts, tables, or graphs, and use the results to draw conclusions and make predictions.
- 11 – 3 Compare expected results with experimental results and information used in predictions and inferences.

Geometry

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Standard 1 - Students will apply a wide variety of mathematical concepts, processes, and skills to solve a broad range of problems in various content areas and everyday situations.

Benchmarks - By the end of Geometry, students will:

- 1 – 1 Explore the validity and efficiency of various problem-posing and problem-solving strategies; develop alternative strategies and generalizations as needed
- 1 – 2 Monitor progress toward solutions
- 1 – 3 Generalize strategies and reflect on their proficiency and merit.

Standard 2 - Students will apply mathematical reasoning skills to investigate, evaluate, justify, and connect approaches and solutions to situations in mathematics and in other disciplines

Benchmarks - By the end of Geometry, students will:

- 2 – 1 Construct, follow and evaluate arguments, judging their validity using reasoning and logic
- 2 – 2 Use a variety of methods of proofs (for example, direct, indirect, informal, truth tables, paragraph) to validate conjectures
- 2 – 3 Use the connections among mathematical topics to develop multiple approaches to problems
- 2 – 4 Demonstrate how graphs can be used to model real-world situations and to determine solutions to numerous problems involving algebraic functions

Standard 3 - Students will understand mathematical information presented and obtained in a variety of ways and will accurately and clearly present and justify mathematical ideas in diverse formats.

Benchmarks - By the end of Geometry, students will:

- 3 – 1 Formulate questions, conjectures, and generalizations about data, information, and problem situations
- 3 – 2 Present complete and convincing arguments and justifications adapted to be effective for various audiences
- 3 – 3 Use technology (such as graphics calculators, spreadsheets, graphing programs) to present information and ideas
- 3 – 4 Use properties, models, known facts, and relationships to explain and defend thinking

Standard 4 - Students will select and use a wide variety of tools and technology to support and validate mathematical results, when appropriate.

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Benchmarks - By the end of Geometry, students will:

- 4 – 1 Use graphing calculators and computer software effectively and efficiently to define and solve various types of problems

Standard 5 - Students will estimate and measure to a required degree of accuracy and precision by selecting and using appropriate units, tools, and technologies.

Benchmarks - By the end of Geometry, students will:

- 5 – 1 Apply indirect methods, such as ratios and trigonometry, to find missing dimensions

Standard 6 - Students will use spatial reasoning and apply the properties and relationships of geometric figures to represent, investigate, analyze, and solve problems.

Benchmarks - By the end of Geometry, students will:

- 6 – 1 Use coordinate geometry to graph linear and quadratic equations, determine slopes of lines, identify parallel and perpendicular lines, and find possible solutions to sets of equations
- 6 – 2 Construct geometric models, transformations, and scale drawings using a variety of methods and tools (such as paper folding or protractor)
- 6 – 3 Identify congruent and similar figures; apply this information to solve problems

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Algebra I

Standard 1 - Students will apply a wide variety of mathematical concepts, processes, and skills to solve a broad range of problems in various content areas and everyday situations.

Benchmarks - By the end of Algebra I, students will:

- 1 – 1 Explore the validity and efficiency of various problem-posing and problem-solving strategies; develop alternative strategies and generalizations as needed
- 1 – 2 Monitor progress toward solutions
- 1 – 3 Generalize strategies and reflect on their proficiency and merit

Standard 2 - Students will apply mathematical reasoning skills to investigate, evaluate, justify, and connect approaches and solutions to situations in mathematics and in other disciplines.

Benchmarks - By the end of Algebra I, students will:

- 2 – 1 Use the connections among mathematical topics to develop multiple approaches to problems
- 2 – 2 Demonstrate how graphs can be used to model real-world situations and to determine solutions to numerous problems involving algebraic functions

Standard 3 - Students will understand mathematical information presented and obtained in a variety of ways and will accurately and clearly present and justify mathematical ideas in diverse formats.

Benchmarks - By the end of Algebra I, students will:

- 3 – 1 Formulate questions, conjectures, and generalizations about data, information, and problem situations
- 3 – 2 Present complete and convincing arguments and justifications adapted to be effective for various audiences
- 3 – 3 Use technology (such as graphics calculators, spreadsheets, graphing programs) to present information and ideas
- 3 – 4 Use properties, models, known facts, and relationships to explain and defend thinking

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Standard 4 - Students will select and use a wide variety of tools and technology to support and validate mathematical results, when appropriate.

Benchmarks - By the end of Algebra I, students will:

4 – 1 Use graphing calculators and computer software effectively and efficiently to define and solve various types of problems

Standard 5 - Students will estimate, compute, and assess reasonableness of solutions.

Benchmarks - By the end of Algebra I, students will:

5 – 1 Apply factorials and exponents to solve practical problems

Standard 6 - Students will use spatial reasoning and apply the properties and relationships of geometric figures to represent, investigate, analyze, and solve problems.

Benchmarks - By the end of Algebra I, students will:

6 – 1 Use coordinate geometry to graph linear and quadratic equations, determine slopes of lines, identify parallel and perpendicular lines, and find possible solutions to sets of equations

Standard 7 - Students will understand and apply basic concepts of probability.

Benchmarks - By the end of Algebra I, students will:

7 – 1 Find the probability of simple events, compound events, and independent events using a variety of methods including the fundamental counting principle

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Algebra II

Standard 1 - Students will apply a wide variety of mathematical concepts, processes, and skills to solve a broad range of problems in various content areas and everyday situations.

Benchmarks - By the end of Algebra II, students will:

- 1 – 1 Explore the validity and efficiency of various problem-posing and problem-solving strategies; develop alternative strategies and generalizations as needed
- 1 – 2 Monitor progress toward solutions
- 1 – 3 Generalize strategies and reflect on their proficiency and merit

Standard 2 - Students will apply mathematical reasoning skills to investigate, evaluate, justify, and connect approaches and solutions to situations in mathematics and in other disciplines.

Benchmarks - By the end of Algebra II, students will:

- 2 – 1 Use the connections among mathematical topics to develop multiple approaches to problems
- 2 – 2 Demonstrate how graphs can be used to model real-world situations and to determine solutions to numerous problems involving algebraic functions.

Standard 3 - Students will understand mathematical information presented and obtained in a variety of ways and will accurately and clearly present and justify mathematical ideas in diverse formats.

Benchmarks - By the end of Algebra II, students will:

- 3 – 1 Formulate questions, conjectures, and generalizations about data, information, and problem situations

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- 3 – 2 Present complete and convincing arguments and justifications adapted to be effective for various audiences
- 3 – 3 Use technology (such as graphics calculators, spreadsheets, graphing programs) to present information and ideas
- 3 – 4 Use properties, models, known facts, and relationships to explain and defend thinking

Standard 4 - Students will select and use a wide variety of tools and technology to support and validate mathematical results, when appropriate.

Benchmarks - By the end of Algebra II, students will:

- 4 – 1 Use graphing calculators and computer software effectively and efficiently to define and solve various types of problems.

Standard 5 - Students will understand and apply numbers, ways of representing numbers, relationships among numbers, and number systems.

Benchmarks - By the end of Algebra II, students will:

- 5 – 1 Understand the concept of infinity

Standard 6 - Students will estimate, compute, and assess reasonableness of solutions.

Benchmarks - By the end of Algebra II, students will:

- 6 – 1 Demonstrate proficiency with and memorize addition and subtraction facts through 20 and multiplication facts through 10

Standard 7 - Students will use algebraic methods to represent, analyze, and solve abstract and practical mathematical situations involving patterns and functional relationships.

Benchmarks - By the end of Algebra II, students will:

- 7 – 1 Define functions and their properties and find the inverse of a function; understand the relationship between a function and its inverse
- 7 – 2 Create and solve linear and quadratic equations and inequalities

Standard 8 - Students will use spatial reasoning and apply the properties and relationships of geometric figures to represent, investigate, analyze, and solve problems.

Benchmarks - By the end of Algebra II, students will:

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- 8 – 1 Use coordinate geometry to graph linear and quadratic equations, determine slopes of lines, identify parallel and perpendicular lines, and find possible solutions to sets of equations
- 8 – 2 Construct geometric models, transformations, and scale drawings using a variety of methods and tools (such as the protractor)

Standard 9 - Students will pose a question, collect, organize, analyze, and represent data in order to make decisions and predictions.

Benchmarks - By the end of Algebra II, students will:

- 9 – 1 Determine regression equations to model and draw inferences from data; summarize and interpret single-variable data by choosing measures of central tendency and dispersion