

**CITYWIDE LEARNING STANDARDS
SUBJECT AREA SUMMARY**

Thomas W. Payzant - Superintendent
September, 2002

Mathematics 9-12

BPS CITYWIDE LEARNING STANDARDS: GRADES 9-12

INTRODUCTION



Goals

The Boston Public Schools Citywide Learning Standards are designed to produce *independent learners* who are encouraged to:

- Think, question, and communicate
- Gain and apply knowledge
- Work and contribute in meaningful, purposeful ways.

Students *think, question, and communicate* to make sense or meaning of their world and experiences.

Thinking includes being able to internalize new ideas and connect them to familiar concepts and prior knowledge.

Questioning includes the framing of thoughtful questions, and the pursuit of these questions until the student fully understands.

Communicating means putting learning into the language of speech or writing, and requires reflection in such forms as examination, clarification, analysis, and synthesis.

Students *gain and apply knowledge* to pursue ideas and experiences, and apply this new knowledge in real life contexts. This pursuit is interactive by nature. The more collaborative and experiential it is, the more powerful the learning.

Students' *work needs to be meaningful and purposeful*. The process and products of student work need to be valued contributions to the school and community, and the student. Embedded in powerful learning experiences are notions of persistence, self-discipline, hard work, effort, and pride in producing quality work.

Teaching and Learning in the Boston Public Schools

Learning is an active, constructive, creative, and often collaborative process that involves a variety of distinct cognitive strategies. Skillful learners use these strategies, largely unconsciously, to access content through text or other media, to make meaning of the content, to make connections with and apply the content in thoughtful and meaningful ways, and to retain the content for later use. In learning these strategies and coming to own them, students learn *how* to learn in addition to acquiring important knowledge. These strategies include the following:

Students will....

- Read, write, and think a lot about topics and ideas of importance to them.
- Set goals or purposes for their learning.
- Make personal connections between the content and other knowledge, experiences, text, or media.
- Ask questions as they read, listen, or view.
- Clarify the meaning of words or content they don't understand.
- Listen or watch for important elements, themes, or issues.
- Create sensory images.
- Make predictions, inferences and judgments.
- Get "in the shoes" of characters or participants.
- Create ongoing summaries or syntheses.
- Build on their understandings by sharing and discussing them with others.

- Assess their learning and make mid-course corrections.

Because we know this is how people learn, the system supports the *workshop* approach to teaching and learning. The workshop approach helps teachers organize their classrooms and instructional time to teach effective reading, writing, and learning strategies and to help students put them into practice. The most important goal of this approach is the development of *independent learners* who are equipped with the skills and knowledge they will need for a lifetime of learning.

The workshop approach derives from the insight that people learn best by doing and that teachers often need to provide students with more time to read, write, and use effective learning strategies to explore and understand the content they are studying. The approach also derives from the insight that students need to share in the ownership of the curriculum to increase their investment, engagement, and motivation. Students need to participate in the selection of “just right” books for independent and small group reading and writing activities, and they need to explore, read, and write about topics and ideas of importance to them (as well as the curriculum).

The workshop approach uses a mixture of whole-class, small group, partner, and one-on-one instruction that centers on conversations about content, strategies, and work routines. Each of these varied approaches to teaching and learning is essential to students’ development as independent readers, writers, and learners.

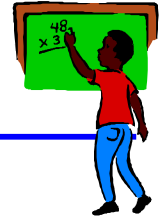
The Habits of Mind and Work

The following habits enable effective learning and are essential to students' success in school.

Developing these habits in students is the responsibility of every teacher, administrator, and other adult involved in the lives of our children.

- ***Curiosity and Critical Thinking:*** Students listen attentively, observe carefully, and ask thoughtful questions until they understand; they look for good evidence.
- ***Respect for Diversity:*** Students recognize and value racial, ethnic, cultural, age, gender, and individual commonalities and differences; they respect other people's points of view.
- ***Consideration and Compassion:*** Students treat themselves and others with care and respect; they build trusting relationships; they help, care for, and share with one another.
- ***Collaboration:*** Students work well with others, give and accept constructive criticism, try to be fair, and try to solve problems in a reasonable, peaceful manner.
- ***Self-Direction:*** Students check their own work, invite the critical response of others, and make appropriate adjustments.
- ***Perseverance:*** Students work hard until the job is done right, and are patient when the answers do not come quickly.
- ***Initiative:*** Students try new things, take reasonable risks, and reflect on their successes and mistakes.
- ***Courage:*** Students stand up for their rights and the rights of others in a positive manner that shows self-respect and respect for others; they resist harmful pressure.
- ***Responsibility:*** Students demonstrate personal responsibility and pursue important goals for themselves and their schools.

PERFORMANCE STANDARDS: HIGH SCHOOL MATH



All Courses

Students are expected to earn a passing grade (levels 2-4, 60-100%, D- to A+) on the tests, products and assignments required by their teacher, including any subject-area assessments that may be developed and administered by each school.

Citywide Assessments

Math: Students are expected to earn a passing grade (levels 2-4, 60-100%, D- to A+) on:

1. Citywide, BPS Math Tasks administered each marking term
2. Citywide, BPS mid- and end-of-year assessments in mathematics

Performance on these assessments should be factored into students' final grades.

Reading: Reading skills are essential to success on the citywide assessments and MCAS. Students are also expected to meet minimum competency benchmarks on the Scholastic Reading Inventory as a condition of promotion from grade 9 and in preparation for the MCAS. Teachers of all subjects are responsible for helping students develop and practice the comprehension strategies listed below, applied to subject area content, to assist in students' development as skillful readers, learners, and mathematicians.

Students will:

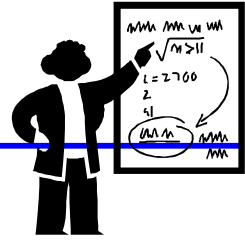
- Read, write, and think a lot about topics and ideas of importance to the curriculum.
- Set goals or purposes for their learning.
- Make personal connections between the content and other knowledge and experiences.
- Ask questions as they read word problems.
- Clarify the meaning of words or content they don't understand.
- Listen or watch for important elements, principles, or concepts.
- Create visual images of the content and problems they are studying.
- Make predictions, inferences and judgments.
- Consider content and problems from a variety of perspectives.
- Create ongoing summaries or syntheses of their learning.
- Build on their understandings by sharing and discussing them with others.
- Assess their learning and make mid-course corrections.

Massachusetts Comprehensive Assessment System (MCAS)

Grade 10: Students are expected to earn a passing score (levels 2-4) on the *MCAS Mathematics* assessment administered in the spring. Performance on this assessment is not factored into a student's final grade.

Grades 11-12: Students who have yet to pass the MCAS are expected to earn a passing score (levels 2-4) on the *Mathematics* assessment administered in the winter (make-up test) or spring. Performance on this assessment is not factored into a student's final grade.

MATHEMATICS: ALGEBRA 1A, COURSE 45A



Number Sense and Operations:

Students will...

- Understand numbers and ways of representing numbers, relationships among numbers, and number systems
- Understand meanings of operations and how they relate to one another.
- Compute fluently and make reasonable estimates.

They will...

- Understand numbers, ways of representing numbers, relationships among numbers.
- Understand meanings of operations and how they relate to one another.
- Compute fluently and make reasonable estimates.
- Identify and use the properties of operations on real numbers, including the associative, commutative, and distributive properties; the existence of the identity and inverse elements for addition and multiplication; the existence of n^{th} roots of positive numbers for any positive integer n ;
- Express and simplify numerical expressions involving real numbers.
- Understand and demonstrate algebraically and graphically the relationship between operations and their inverses, including exponential.
- Use estimation to judge the reasonableness of results of computations and of solutions to problems involving real numbers.
- Express real numbers in fractional and radical form as well as in exponential form using integral and fractional exponents.
- Use logical reasoning as well as estimation and mental computation to determine the validity of a solution in algebraic, and statistical problems.

Data Analysis, Statistics and Probability

Students will...

- Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.
- Select and use appropriate statistical methods to analyze data.
- Develop and evaluate inferences and predictions that are based on data.
- Understand and apply basic concepts of probability.

They will...

- Formulate questions that can be answered with data and collect, organize and display relevant data to answer them.
- Select and use appropriate statistical methods to analyze data.
- Develop and evaluate inferences and predictions that are based on data.
- Select, create, and interpret an appropriate graphical representation (e.g., scatterplot, table, stem-and-leaf plot, box-and-whisker plot, circle graph, line graph, and line plot) for a set of data and use appropriate statistics (e.g., mean, median, range, and mode) to communicate information about the data. Use these notions to compare different sets of data.
- Collect and graph data (using graphing calculators and/or computers when appropriate) and express relationships between variables, both verbally and symbolically.
- Collect, organize, and analyze data from real problems using graphing calculators and other technology to create tables and graphs.

- Approximate a line of best fit (trend line) given a set of data (e.g., scatterplot). Use technology when appropriate.
- Use scatter plots of sets of data points to graph a line of best fit.
- Use the basic set of operations with the help of Venn diagrams.
- Solve counting problems using Venn diagrams.
- Describe and explain how the relative sizes of a sample and the population affect the validity of predictions from a set of data.
- Understand and apply basic concepts of probability.
- Use tree diagrams, tables, organized lists, basic combinations (“fundamental counting principle”), and area models to compute probabilities for simple compound events, e.g., multiple coin tosses or rolls of dice.
- Carry out probability experiments, discuss the results.
- Conduct experiments to determine experimental probabilities and construct a table to establish theoretical

Patterns, Relations and Algebra

Students will...

- *Understand patterns, relations, and functions*
- *Represent and analyze mathematical situations and structures using algebraic symbols.*
- *Use mathematical models to represent and understand quantitative relationships.*
- *Analyze change in various contexts.*

They will...

- Represent and analyze mathematical situations and structures using algebraic symbols.
- Use mathematical models to represent and understand quantitative relationships.
- Analyze change in various contexts.
- Describe, complete, extend, analyze, generalize, and create a wide variety of patterns, including iterative, recursive (e.g., Fibonacci Numbers), and linear functional relationships.
- Use properties of the real number system to judge the validity of equations and inequalities, to prove or disprove statements, and to justify every step in a sequential argument.
- Translate between different representations of functions and relations: graphs, equations, point sets, and tabular.
- Demonstrate an understanding of the relationship between various representations of a line.
- Determine a line’s slope and x- and y-intercepts from its graph or from a linear equation that represents the line. Find a linear equation describing a line from a graph or a geometric description of the line, e.g., by using the “slope y-intercept” formulas.
- Explain the significance of a positive, negative, zero, or undefined slope.
- Find linear equations that represent lines parallel to a given line and through a point, e.g., by using the “point-slope” form of the equation.
- Solve equations apply to the solution of everyday problems.

Discussion, Presentation, Composition

Students will be able to...

- Use agreed upon rules to participate in discussions in large and small groups.
- Express ideas in an organized way.
- Explain their mathematical thinking in writing.
- Maintain a system for collecting, referring to, and sharing their work.

MATHEMATICS: ALGEBRA, COURSE 451



Number Sense and Operations

Students will...

- Understand numbers and ways of representing numbers, relationships among numbers, and number systems.
- Understand meanings of operations and how they relate to one another.
- Compute fluently and make reasonable estimates.

They will...

- Understand numbers, ways of representing numbers, relationships among numbers, and number systems.
- Understand meanings of operations and how they relate to one another.
- Compute fluently and make reasonable estimates.
- Identify and use the properties of operations on real numbers, including the associative, commutative, and distributive properties; the existence of the identity and inverse elements for addition and multiplication; the existence of n^{th} roots of positive numbers for any positive integer n ; and the inverse relationship between taking the n^{th} root of and the n^{th} power of a positive real number.
- Recognize when and how to apply the field properties in problems using real numbers.
- Express and simplify numerical expressions involving real numbers.
- Pose and solve problems using operations on whole numbers, integers, rational, irrational, and complex numbers.
- Simplify numerical expressions, including those involving positive integer exponents or the absolute value, e.g., $3(2^4 - 1) = 45$, $4|3 - 5| + 6 = 14$; apply such simplifications in the solution of problems.
- Express and simplify numerical expressions involving real numbers.
- Find the approximate value for solutions to problems involving square roots and cube roots without the use of a calculator. e.g., $\sqrt{3^2 - 1} \approx 2.8$.
- Understand and demonstrate algebraically and graphically the relationship between operations and their inverses, including exponential.
- Use estimation to judge the reasonableness of results of computations and of solutions to problems involving real numbers.

Data Analysis, Statistics and Probability

Students will...

- Formulate questions that can be answered with data and collect, organize and display relevant data to answer them.
- Select and use appropriate statistical methods to analyze data.
- Develop and evaluate inferences and predictions that are based on data.
- Select, create, and interpret an appropriate graphical representation (e.g., scatterplot, table, stem-and-leaf plot, box-and-whisker plot, circle graph, line graph, and line plot) for a set of data and use appropriate statistics (e.g., mean, median, range, and mode) to communicate information about the data. Use these notions to compare different sets of data.
- Use logical reasoning as well as estimation and mental computations to determine the validity of a solution in algebraic, geometric, and statistical problems.

- Collect, organize, analyze and graph data from real problems (using graphing calculators and/or computers when appropriate) and express relationships between variables, verbally, graphically and symbolically.
- Collect, organize, and analyze data from real problems using graphing calculators and other technology to create tables and graphs.
- Approximate a line of best fit (trend line) given a set of data (e.g., scatterplot). Use technology when appropriate.
- Describe and explain how the relative sizes of a sample and the population affect the validity of predictions from a set of data.

Patterns, Relations and Algebra:

Students will...

- *Understand patterns, relations, and functions.*
- *Represent and analyze mathematical situations and structures using algebraic symbols.*
- *Use mathematical models to represent and understand quantitative relationships.*
- *Analyze change in various contexts.*

They will...

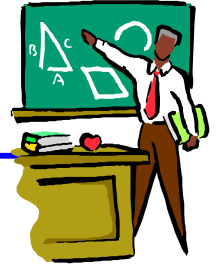
- Represent and analyze mathematical situations and structures using algebraic symbols.
- Use mathematical models to represent and understand quantitative relationships.
- Analyze change in various contexts.
- Describe, complete, extend, analyze, generalize, and create a wide variety of patterns, including iterative, recursive linear, quadratic, functional relationships.
- Demonstrate an understanding of relations and functions. Identify the domain, range, dependent, and independent variables of functions.
- Translate between different representations of functions and relations: graphs, equations, point sets, and tabular.
- Demonstrate an understanding of the relationship between various representations of a line. Determine a line's slope and x- and y-intercepts from its graph or from a linear equation that represents the line. Find a linear equation describing a line from a graph or a geometric description of the line, e.g., by using the "slope y-intercept" formulas. Explain the significance of a positive, negative, zero, or undefined slope.
- Find linear equations that represent lines either perpendicular or parallel to a given line and through a point, e.g., by using the "point-slope" form of the equation.
- Solve equations and apply to the solution of problems.
- Evaluate exponential functions and compare the effects of different growth rates.
- Describe compounding situations using exponential functions.
- Evaluate exponential functions and draw their graphs with a graphing calculator. Construct examples of functions on finite sets using diagrams and tables.
- Describe a sequence recursively and use that description to list its terms with a graphing calculator
- Describe a sequence algebraically and use that description to find specific terms.
- Identify and describe real world examples of step functions.
- Explain restrictions on the domains of functions.
- Use graphs to represent functions and to find images of domain elements.
- Interpret graphs of step function in real world situations.

Discussion, Presentation, Composition

Students will be able to...

- Use agreed upon rules to participate in discussions in large and small groups.
- Express ideas in an organized way.
- Explain their mathematical thinking in writing.
- Maintain a system for collecting, referring to, and sharing their work.

MATHEMATICS: ALGEBRA /GEOMETRY, COURSE 452



Number Sense and Operations:

Students will...

- Understand numbers and ways of representing numbers, relationships among numbers, and number systems.
- Understand meanings of operations and how they relate to one another.
- Compute fluently and make reasonable estimates.

They will...

- Understand numbers, ways of representing numbers, relationships among numbers.
- Understand meanings of operations and how they relate to one another.
- Compute fluently and make reasonable estimates.
- Identify and use the properties of operations on real numbers, including the associative, commutative, and distributive properties; the existence of the identity and inverse elements for addition and multiplication; the existence of n^{th} roots of positive numbers for any positive integer n .
- Express and simplify numerical expressions involving real numbers.
- Understand and demonstrate algebraically and graphically the relationship between operations and their inverses, including exponential.
- Use estimation to judge the reasonableness of results of computations and of solutions to problems involving real numbers.
- Express real numbers in fractional and radical form as well as in exponential form using integral and fractional exponents.
- Use logical reasoning as well as estimation and mental computation to determine the validity of a solution in algebraic, and statistical problems.

Patterns, Relations and Functions:

Students will...

- Understand patterns, relations, and functions
- Represent and analyze mathematical situations and structures using algebraic symbols.
- Use mathematical models to represent and understand quantitative relationships.
- Analyze change in various contexts.
- They will...
- Represent and analyze mathematical situations including geometric situations and structures using algebraic symbols.
- Use mathematical models to represent and understand quantitative relationships including geometric relationships.
- Analyze change in various contexts.
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- Demonstrate an understanding of relations and functions. Identify the domain, range, dependent, and independent variables of functions.
- Translate between different representations of functions and relations: graphs, equations, point sets, and tabular.
- Demonstrate an understanding of the relationship between various representations of a line. Determine a line's slope and x- and y-intercepts from its graph or from a linear equation that represents the line. Find a linear equation describing a line from a graph or a geometric description

of the line, e.g., by using the “slope y-intercept” formulas. Explain the significance of a positive, negative, zero, or undefined slope.

- Find linear equations that represent lines either perpendicular or parallel to a given line and through a point, e.g., by using the “point-slope” form of the equation.
- Solve equations and apply to the solution of problems including geometric problems.
- Evaluate exponential functions and compare the effects of different growth rates.
- Describe compounding situations using exponential functions.
- Evaluate exponential functions and draw their graphs with a graphing calculator. Construct examples of functions on finite sets using diagrams and tables.
- Describe a sequence recursively and use that description to list its terms with a graphing calculator
- Describe a sequence algebraically and use that description to find specific terms.
- Identify and describe real world examples of step functions.
- Explain restrictions on the domains of functions.
- Use graphs to represent functions and to find images of domain elements.
- Interpret graphs of step function in real world situations.

Geometry

Students will...

- *Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships.*
- *Specify locations and describe spatial relationships using coordinate geometry and other representational systems.*
- *Apply transformations and use symmetry to analyze mathematical situations.*
- *Use visualization, spatial reasoning, and geometric modeling to solve problems.*

They will...

- Identify figures using properties of sides, angles, and diagonals. Identify the figures’ type(s) of symmetry.
- Draw the results, and interpret transformations on figures in the coordinate plane, e.g., translations, reflections, rotations, scale factors, and the results of successive transformations. Apply transformations to the solution of problems.
- Recognize special types of polygons (e.g., isosceles triangles, parallelograms, and rhombuses). Apply properties of sides, diagonals, and angles in special polygons; identify their parts and special segments (e.g., altitudes, mid-segments); determine interior angles for regular polygons. Draw and label sets of points such as line segments, rays, and circles. Detect symmetries of geometric figures.
- Draw congruent and similar figures using a compass, straightedge, protractor, and other tools such as computer software. Make conjectures about methods of constructions. Justify the the conjectures by logical arguments.
- Use compass and straightedge to measure geometric figures to a high degree of accuracy
- Draw congruent and similar figures using a compass, straightedge, protractor, or computer software. Make conjectures about methods of construction. Justify the conjectures by logical arguments.
- Recognize and solve problems involving angles formed by transversals of coplanar lines. Identify and determine the measure of central and inscribed angles and their associated minor and major arcs. Recognize and solve problems associated with radii, chords, and arcs within or on the same circle.
- Identify congruence and similarity correspondences and properties of the figures to find missing parts of geometric figures, and provide logical justification.
- Solve simple triangle problems using the triangle angle sum property and/or the Pythagorean Theorem.

- Use the properties of special triangles (e.g. isosceles, equilateral, 30-60-90, 45-45-90) to solve everyday problems.
- Using rectangular coordinates, calculate the midpoints of segments, slopes of lines, and distances between two points. Apply the results of these calculations to find the solution to everyday problems.
- Demonstrate an understanding of the relationship between various representations of a line. Determine a line's slope and x- and y-intercepts from its graph or from a linear equation that represents the line. Find a linear equation describing a line from a graph or a geometric description of the line, e.g., by using the "point-slope" or "slope y-intercept" formulas. Explain the significance of a positive, negative, zero, or undefined slope.
- Find linear equations that represent lines either perpendicular or parallel to a given line and through a point, e.g., by using the "point-slope" form of the equation.
- Explore and use properties of parallel and perpendicular lines, bisectors of angles and segments, triangles and circles through constructions.
- Using rectangular coordinates, calculate midpoints of segments, slopes of lines and segments, and distances between two points, and apply the results to the solutions of problems
- Find linear equations that represent lines either perpendicular or parallel to a given line and through a point, e.g., by using the "point-slope" form of the equation.
- Draw the results, and interpret transformations on figures in the coordinate plane, e.g., translations, reflections, rotations, scale factors, and the results of successive transformations. Apply transformations to the solutions of problems.

Measurement

Students will...

- *Understand measurable attributes of objects and the units, systems, and processes of measurement.*
- *Apply appropriate techniques, tools, and formulas to determine measurements.*

They will...

- Calculate perimeter, circumference, and area of common geometric figures such as parallelograms, trapezoids, circles, and triangles.
- Use diagrams, models, and other manipulatives to determine methods of finding relationships and measurements of the two and three dimensional shapes.
- Relate changes in the measurement of one attribute of an object to changes in other attributes, e.g., how changing the radius or height of a cylinder affects its surface area or volume Describe the effects of approximate error in measurement and rounding on measurements and on computed values from measurements.
- Use appropriate measurement tools along with calculators and computers to solve problems in science, technology, consumer education, and other areas as well.

Data Analysis, Statistics, and Probability

Students will...

- *Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.*
- *Select and use appropriate statistical methods to analyze data.*
- *Develop and evaluate inferences and predictions that are based on data.*
- *Understand and apply basic concepts of probability.*

They will...

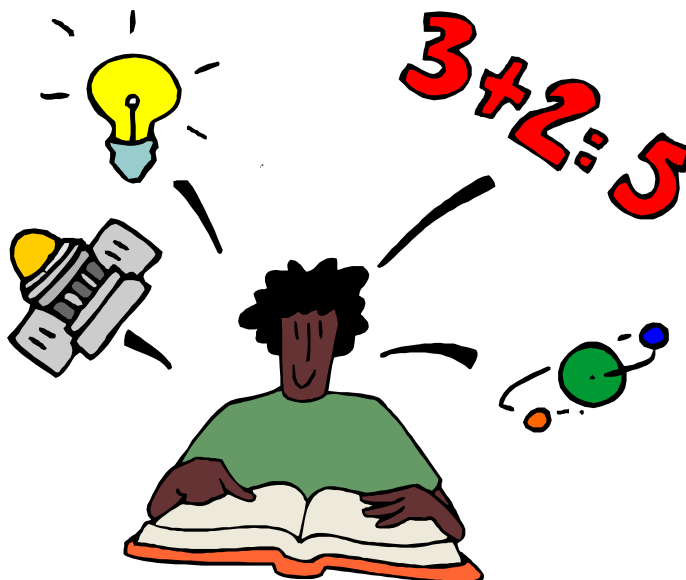
- Use the basic set of operations with the help of Venn diagrams.

- Solve counting problems using Venn diagrams.
- Solving counting problems using Venn diagrams.
- Describe and explain how the relative sizes of a sample and the population affect the validity of predictions from a set of data.
- Understand and apply basic concepts of probability.
- Use tree diagrams, tables, organized lists, basic combinations (“fundamental counting principle”), and area models to compute probabilities for simple compound events, e.g., multiple coin tosses or rolls of dice.
- Carry out probability experiments, discuss the results.
- Conduct experiments to determine experimental probabilities and construct a table to establish theoretical.

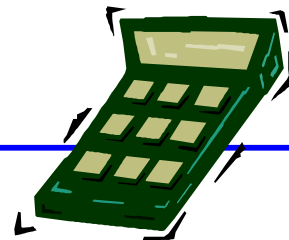
Discussion, Presentation, Composition

Students will be able to...

- Use agreed upon rules to participate in discussions in large and small groups.
- Express ideas in an organized way.
- Explain their mathematical thinking in writing.
- Maintain a system for collecting, referring to, and sharing their work.



MATHEMATICS: GEOMETRY, COURSE 454



Number Sense and Operations

Students will...

- Understand numbers and ways of representing numbers, relationships among numbers, and number systems.
- Understand meanings of operations and how they relate to one another.
- Compute fluently and make reasonable estimates.

They will...

- Understand numbers, ways of representing numbers, and relationships among numbers.
- Understand meanings of operations and how they relate to one another.
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- Identify and use the properties of operations on real numbers, including the associative, commutative, and distributive properties; the existence of the identity and inverse elements for addition and multiplication; the existence of n^{th} roots of positive numbers for any positive integer n .
- Express and simplify numerical expressions involving real numbers.
- Use estimation to judge the reasonableness of results of computations and of solutions to problems involving real numbers.
- Express real numbers in fractional and radical form.
- Use logical reasoning as well as estimation and mental computation to determine the validity of a solution in algebraic, geometric, and statistical problems.

Patterns, Relations and Functions

Students will...

- Understand patterns, relations, and functions.
- Represent and analyze mathematical situations and structures using algebraic symbols.
- Use mathematical models to represent and understand quantitative relationships.
- Analyze change in various contexts.

They will...

- Represent and analyze geometric situations and structures using algebraic symbols.
- Use mathematical models to represent and understand quantitative geometric relationships.
- Analyze change in various contexts.
- Use properties of the real number system to judge the validity of equations and inequalities, to prove or disprove geometric statements, and to justify every step in a sequential, geometric argument.
- Translate between different geometric and algebraic representations of functions and relations: graphs, equations, point sets, and tabular.
- Demonstrate an understanding of the relationship between various representations of a line.
- Determine a line's slope and x - and y -intercepts from its graph or from a linear equation that represents the line. Find a linear equation describing a line from a graph or a geometric description of the line, e.g., by using the "slope y -intercept" formulas.
- Explain the significance of a positive, negative, zero, or undefined slope.
- Find linear equations that represent lines parallel to a given line and through a point, e.g., by using the "point-slope" form of the equation.
- Solve equations apply to the solution of everyday geometric problems.

Data Analysis, Statistics, and Probability

Students will...

- *Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.*
- *Select and use appropriate statistical methods to analyze data.*
- *Develop and evaluate inferences and predictions that are based on data.*
- *Understand and apply basic concepts of probability.*

They will...

- Use the basic set of operations with the help of Venn diagrams.
- Solve counting problems using Venn diagrams.
- Solving counting problems using Venn diagrams.
- Describe and explain how the relative sizes of a sample and the population affect the validity of predictions from a set of data.
- Understand and apply basic concepts of probability.
- Use tree diagrams, tables, organized lists, basic combinations (“fundamental counting principle”), and area models to compute probabilities for simple compound events, e.g., multiple coin tosses or rolls of dice.
- Carry out probability experiments, discuss the results.
- Conduct experiments to determine experimental probabilities and construct a table to establish theoretical

Geometry

Students will...

- *Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships.*
- *Specify locations and describe spatial relationships using coordinate geometry and other representational systems.*
- *Apply transformations and use symmetry to analyze mathematical situations.*
- *Use visualization, spatial reasoning, and geometric modeling to solve problems.*

They will...

- Identify figures using properties of sides, angles, and diagonals. Identify the figures’ type(s) of symmetry.
- Draw the results, and interpret transformations on figures in the coordinate plane, e.g., translations, reflections, rotations, scale factors, and the results of successive transformations. Apply transformations to the solution of problems.
- Recognize special types of polygons (e.g., isosceles triangles, parallelograms, and rhombuses). Apply properties of sides, diagonals, and angles in special polygons; identify their parts and special segments (e.g., altitudes, midsegments); determine interior angles for regular polygons. Draw and label sets of points such as line segments, rays, and circles. Detect symmetries of geometric figures.
- Apply congruence and similarity correspondences and properties of the figures to find missing parts of geometric figures and to provide logical justifications.
- Draw congruent and similar figures using a compass, straightedge, protractor, and other tools such as computer software. Make conjectures about methods of constructions. Justify the conjectures by logical arguments.
- Use compass and straightedge to measure geometric figures to a high degree of accuracy
- Draw congruent and similar figures using a compass, straightedge, protractor, or computer software. Make conjectures about methods of construction. Justify the conjectures by logical arguments.

- Recognize and solve problems involving angles formed by transversals of coplanar lines. Identify and determine the measure of central and inscribed angles and their associated minor and major arcs. Recognize and solve problems associated with radii, chords, and arcs within or on the same circle.
- Apply properties of angles, parallel lines, arcs, radii, chords, tangents and secants to solve everyday problems.
- Solve simple triangle problems using the triangle angle sum property and/or the Pythagorean Theorem.
- Use the properties of special triangles (e.g. isosceles, equilateral, 30-60-90, 45-45-90) to solve everyday problems.
- Using rectangular coordinates, calculate the midpoints of segments, slopes of lines, and distances between two points. Apply the results of these calculations to find the solution to everyday problems.
- Demonstrate an understanding of the relationship between various representations of a line. Determine a line's slope and x- and y-intercepts from its graph or from a linear equation that represents the line. Find a linear equation describing a line from a graph or a geometric description of the line, e.g., by using the "point-slope" or "slope y-intercept" formulas. Explain the significance of a positive, negative, zero, or undefined slope.
- Find linear equations that represent lines either perpendicular or parallel to a given line and through a point, e.g., by using the "point-slope" form of the equation.
- Explore and use properties of parallel and perpendicular lines, bisectors of angles and segments, triangles and circles through constructions.
- Using rectangular coordinates, calculate midpoints of segments, slopes of lines and segments, and distances between two points, and apply the results to the solutions of problems
- Find linear equations that represent lines either perpendicular or parallel to a given line and through a point, e.g., by using the "point-slope" form of the equation.
- Draw the results, and interpret transformations on figures in the coordinate plane, e.g., translations, reflections, rotations, scale factors, and the results of successive transformations. Apply transformations to the solutions of problems.
- Demonstrate an understanding of the relationship between geometric and algebraic representations of circles.
- Apply algebraic and geometric principles and practices to solve everyday problems involving circles.
- Demonstrate the ability to visualize solid objects and to recognize their projections and cross sections.

Measurement

Students will...

- *Understand measurable attributes of objects and the units, systems, and processes of measurement.*
- *Apply appropriate techniques, tools, and formulas to determine measurements.*

They will...

- Calculate perimeter, circumference, and area of common geometric figures such as parallelograms, trapezoids, circles, and triangles.
- Use diagrams, models, and other manipulatives to determine methods of finding relationships and measurements of the two and three-dimensional shapes.
- Relate changes in the measurement of one attribute of an object to changes in other attributes, e.g., how changing the radius or height of a cylinder affects its surface area or volume Describe the effects of approximate error in measurement and rounding on measurements and on computed values from measurements.

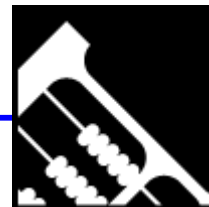
- Relate geometric and algebraic representations of lines, simple curves, and conic sections.
- Use appropriate measurement tools along with calculators and computers to solve everyday geometric problems in science, technology, consumer education, and other areas as well.

Discussion, Presentation, Composition:

Students will be able to...

- Use agreed upon rules to participate in discussions in large and small groups.
- Express ideas in an organized way.
- Explain their mathematical thinking in writing.
- Maintain a system for collecting, referring to, and sharing their work.

Mathematics: Advanced Algebra, Course 456



Number Sense and Operations:

Students will...

- Understand numbers and ways of representing numbers, relationships among numbers, and number systems.
- Understand meanings of operations and how they relate to one another.
- Compute fluently and make reasonable estimates.

They will...

- Define complex numbers (e.g., $a + bi$) and operations on them, in particular, addition, subtraction, multiplication, and division. Relate the system of complex numbers to the systems of real and rational numbers.
- Simplify numerical expressions with powers and roots, fractional and negative exponents.

Patterns Relations and Algebra:

Students will...

- Understand patterns, relations, and functions.
- Represent and analyze mathematical situations and structures using algebraic symbols.
- Use mathematical models to represent and understand quantitative relationships.
- Analyze change in various contexts.

They will...

- Describe, complete, extend, analyze, generalize, and create a wide variety of patterns, including iterative and recursive patterns.
- Identify arithmetic and geometric sequences and finite arithmetic and geometric series. Use the properties of such sequences and series to solve problems, including finding the formula for the general term and the sum, recursively and explicitly.
- Demonstrate an understanding of the binomial theorem; use it in the solution of problems.
- Demonstrate an understanding of polynomial and rational functions.
- Apply polynomial and rational functions to solve “real world” problems.
- Demonstrate an understanding of the exponential and logarithmic functions.
- Apply exponential and logarithmic functions to solve “real world” problems.
- Perform operations on functions, including composition.
- Find inverses of functions.
- Given algebraic, numeric and/or graphical representations, recognize functions as polynomial, rational, logarithmic, or exponential.
- Find solutions to quadratic equations (with real coefficients and real or complex roots) and apply to the solutions of problems.
- Solve a variety of equations and inequalities using algebraic, graphical, and numerical methods, including the quadratic formula; use graphing calculator technology where appropriate. Include polynomial, exponential, and logarithmic functions; expressions involving the absolute values; and simple rational expressions.
- Use matrices to solve systems of linear equations; apply to the solution of everyday problems.
- Use symbolic, numeric, and graphical methods to solve systems of equations and/or inequalities involving algebraic, exponential, and logarithmic expressions; use technology where appropriate.
- Solve everyday problems that can be modeled using polynomial, rational, exponential, logarithmic, and step functions, absolute values and square roots. Apply appropriate graphical, tabular, or

symbolic methods to the solution. Include growth and decay; logistic growth; joint (e.g., $I = Prt$, $y = k(w_1 + w_2)$), and combined ($F = G(m_1m_2)/d^2$) variation.

- Identify maximum and minimum values of functions in simple situations; apply to the solution of everyday problems.
- Describe the translations and scale changes of a given function $f(x)$ resulting from substitutions for the various parameters a , b , c , and d in $y = af(b(x + c/b)) + d$. In particular, describe the effect of such changes on polynomial, rational, exponential, and logarithmic functions.

Geometry

Students will...

- *Analyze characteristics and properties of two-dimensional and three-dimensional geometric shapes and develop mathematical arguments about geometrical relationships.*
- *Specify locations and describe spatial relationships using coordinate geometry and other representational systems.*
- *Apply transformations and use symmetry to analyze mathematical situations.*
- *Use visualization, spatial reasoning, and geometric modeling to solve problems.*

They will...

- Define the sine, cosine, and tangent of an acute angle. Apply to the solution of problems.
- Find values of trigonometric functions for acute angles.
- Solve everyday problems involving right triangles.
- Derive and apply basic trigonometric identities (e.g., $\sin^2\theta + \cos^2\theta = 1$, $\tan^2\theta + 1 = \sec^2\theta$) and the laws of sines and cosines.
- Relate geometric and algebraic representations of lines, simple curves, and conic sections.
- Change radian measure to degree measure and vice versa.
- Identify coterminal angles.
- Find values of trigonometric functions for general angles.
- Use reference angles to find the values of trigonometric functions.
- Solve everyday problems using the Law of Sines and the Law of Cosines.

Data Analysis, Statistics, and Probability:

Students will...

- *Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.*
- *Select and use appropriate statistical methods to analyze data.*
- *Develop and evaluate inferences and predictions that are based on data.*
- *Understand and apply basic concepts of probability.*

They will:

- Select an appropriate graphical representation for a set of data and use appropriate statistics (e.g., quartile or percentile distribution) to communicate information about the data.
- Find measures of variation for a set of data
- Use combinatorics (e.g., “fundamental counting principle,” permutations, combinations) to compute probabilities of compound events and solve other problems; use technology as appropriate.
- Find the probability of two independent events; of two dependent events.
- Solve everyday problems involving the probability of independent or dependent events.
- Determine whether a set of data appears to be normally distributed or skewed.
- Solve everyday problems involving normally distributed data.

Discussion, Presentation, Composition:

Students will be able to...

- Use agreed upon rules to participate in discussions in large and small groups.
- Express ideas in an organized way.
- Explain their mathematical thinking in writing.
- Maintain a system for collecting, referring to, and sharing their work.