

MATHEMATICS

Education must equip all students with mathematical skills and ways of thinking that provide them with the flexibility, adaptability, and creativity to function as productive citizens in the changing society of the 21st century. Mathematical understanding must extend beyond the skills of calculation and manipulation of numbers and symbols to the use of mathematics to investigate, predict, analyze, interpret, create, and evaluate.

Deep mathematical understanding develops over time. While performance indicators describe the knowledge and skills expected at a given grade level, these concepts and skills may be introduced in previous years. They will also be used in later years as the foundations for more advanced topics or in new problem situations.

The use of “understand” in this document is intended to communicate the desired depth and breadth of mathematics programs for Maine students. To understand a procedure or concept means to be able to:

- communicate its meaning, its use, the results of its application, and its implications for a given context,
- reason about it by making conjectures and justifying conclusions,
- represent it in a variety of ways,
- connect it to other ideas in and outside of mathematics, and
- know when and how to apply it to solve problems in mathematics and in other contexts.

Central to mathematical understanding is learning through problems that arise in mathematics and applied contexts. To this end, students learn to identify problems, formulate approaches, carry out these approaches, and communicate and justify solutions. Mathematical reasoning pervades all areas of mathematics. Mathematical reasoning is manifested through classification, comparison, deduction, induction, generalization, justification, verification, and spatial visualization.

As growing mathematicians, students need to do mathematics and see themselves as capable of developing their own understanding of mathematical concepts, properties, and procedures. Mathematics classrooms should provide practical experiences using mathematics in everyday applications and in other content areas, as well as explorations solely within mathematics. Discussing mathematics is an important component of developing mathematical understanding. Technology should be used as an aid to understanding mathematical ideas. Classrooms that reflect these beliefs prepare students to be confident and effective mathematical thinkers.

As lifelong learners students will research mathematics concepts and methods. They must learn about sources of mathematics information, how to read and comprehend mathematics, how to employ the mathematical ideas they learn, and how to communicate what they learn.

The State of Maine should expect its students to enjoy, appreciate, and use mathematics. Students who are challenged to master the Mathematics Standards and are supported in reaching them will be better prepared for a future in which mathematics will be increasingly important in all areas of endeavor.

 OUTLINE OF MATHEMATICS STANDARDS AND PERFORMANCE INDICATORS

A. Number

Whole Number
Rational Number
Real Number

	Whole Number	Rational Number	Real Number
Performance Indicators PreK - 2	1, 2	3	none
Performance Indicators 3	1, 2, 3	4	none
Performance Indicators 4	1, 2, 3	4, 5	none
Performance Indicators 5	1, 2, 3	4, 5, 6	none
Performance Indicators 6	1	2, 3, 4, 5	none
Performance Indicators 7	none	1, 2, 3, 4	none
Performance Indicators 8	none	none	1
Performance Indicators 9 - Diploma	none	none	1

B. Data

Measurement and Approximation
Data Analysis
Probability

	Measurement and Approximation	Data Analysis	Probability
Performance Indicators PreK - 2	1	2	none
Performance Indicators 3	1	2	none
Performance Indicators 4	1	2	none
Performance Indicators 5	1	2, 3	none
Performance Indicators 6	1	2, 3	none
Performance Indicators 7	none	1	2

Performance Indicators 8	1, 2	3	4
Performance Indicators 9 - Diploma	1	2, 3, 4	5

C. Geometry

Geometric Figures

Geometric Measurement

Transformations

	Geometric Figures	Geometric Measurement	Transformations
Performance Indicators PreK - 2	1	2	none
Performance Indicators 3	1	2	none
Performance Indicators 4	1	2	3
Performance Indicators 5	1	2, 3, 4	3
Performance Indicators 6	1	2, 3	4, 5
Performance Indicators 7	1	2	3
Performance Indicators 8	1, 2, 3	4	none
Performance Indicators 9 - Diploma	1, 2, 3	4	none

D. Algebra

Symbols and Expressions

Equations and Inequalities

Functions and Relations

	Symbols and Expressions	Equations and Inequalities	Functions and Relations
Performance Indicators PreK - 2	1	2	3, 4
Performance Indicators 3	1	2	3
Performance Indicators 4	1	2	3

Performance Indicators 5	1	2	3
Performance Indicators 6	1	2	3
Performance Indicators 7	1	2	3
Performance Indicators 8	1, 2	2, 3	4
Performance Indicators 9 - Diploma	1	2, 3	4, 5

A. **NUMBER:** Students use numbers in everyday and mathematical contexts to quantify or describe phenomena, develop concepts of operations with different types of numbers, use the structure and properties of numbers with operations to *solve* problems, and perform mathematical computations. Students develop number sense related to magnitude, estimation, and the effects of mathematical operations on different types of numbers. It is expected that students use numbers flexibly, using forms of numbers that best match a situation. Students compute efficiently and *accurately*. *Estimation* should always be used when computing with numbers or solving problems.

Whole Number

Pre-K-2 Performance Indicators & Descriptors	
1	Students <i>understand</i> and use number notation and place value to 1000 in numerals. <ul style="list-style-type: none"> a. Read and write numbers to 1000 using numerals. b. Recognize the place values of digits in numbers (hundreds, tens, and ones). c. Compare and order one-digit, two-digit, and three-digit numbers.
2	Students <i>understand</i> and use procedures to add and subtract whole numbers with one and two digits. <ul style="list-style-type: none"> a. Use and explain multiple strategies for computation. b. Use an operation appropriate to a given situation.

Whole Number

Performance Indicators & Descriptors					
3	4	5	6	7	8
1 Students <i>understand</i> and use number	1 Students <i>understand</i> and use number	1 Students <i>understand</i> and use number	1 Students use factors and multiples.	No performance indicator.	No performance indicator.

Performance Indicators & Descriptors					
3	4	5	6	7	8
<p>notation and place value to 10,000 in numerals.</p> <p>a. Read and write numbers up to 10,000 in numerals and words.</p> <p>b. Recognize the place values of digits in numbers up to 10,000.</p> <p>c. Compare and order numbers with up to four digits.</p> <p>2 Students <i>understand</i> and use procedures to add and subtract whole numbers with up to four digits.</p> <p>a. Display an understanding of the base ten place value system.</p> <p>b. Use an operation appropriate to a</p>	<p>notation and place value to 100,000 in numerals.</p> <p>a. Read and write numbers up to 100,000 in numerals and words.</p> <p>b. Recognize the place value of digits in numbers to 100,000.</p> <p>c. Compare and order numbers with up to five digits.</p> <p>d. Round numbers to the nearest 100 or 1000.</p> <p>2 Students <i>understand</i> and use the concepts of factor and multiple.</p> <p>a. Determine if a single-digit number is a factor of a given whole number.</p> <p>b. Determine if a whole number is a multiple</p>	<p>notation to 10 million in numerals and words.</p> <p>a. Read and write numbers to 10 million in numerals.</p> <p>b. Round numbers to the place value appropriate for given contexts.</p> <p>c. Compare and order numbers up to 10 million.</p> <p>2 Students multiply and divide numbers up to four digits by numbers up to two digits, and by tens, hundreds, and thousands and <i>interpret</i> any remainders.</p> <p>3 Students <i>solve</i> problems requiring multiple operations (addition,</p>	<p>a. Identify prime numbers and composite numbers and use their properties to <i>solve</i> problems.</p> <p>b. Use the property that every integer greater than one is a prime number or can be written as a unique product of prime numbers.</p> <p>c. <i>Interpret</i> and use exponential notation as repeated multiplication.</p> <p>d. Find the least common multiple and greatest common factor of two numbers.</p>	<p>It is expected that students continue to use prior concepts and skills in new and familiar contexts.</p>	<p>It is expected that students continue to use prior concepts and skills in new and familiar contexts.</p>

Performance Indicators & Descriptors					
3	4	5	6	7	8
<p>given situation.</p> <p>3 Students <i>understand</i> and apply meanings of multiplication and division.</p> <p>a. Multiply single-digit numbers and divide using single-digit divisors and up to two-digit dividends (division facts only, but remainders may be present).</p> <p>b. Use an operation appropriate to a given situation.</p> <p>c. Recognize and use models for multiplication and division situations.</p> <p>d. Use multiple strategies for multiplication and division.</p>	<p>of a given single-digit number.</p> <p>c. List the first ten multiples of a given number.</p> <p>3 Students <i>understand</i> and use procedures to multiply and divide whole numbers by two-digit numbers.</p> <p>a. Multiply up to four-digit numbers by a single-digit number.</p> <p>b. Multiply three-digit numbers by two-digit numbers.</p> <p>c. Divide whole numbers up to four digits by a single-digit number and by ten (remainders may be present).</p>	<p>subtraction, multiplication, and division) and use the conventions of order of operations (no exponents expected).</p>			

Whole Number

9-Diploma Performance Indicators & Descriptors

No performance indicator.

Although no performance indicators are stated, students are expected to continue to use prior concepts and skills in new and familiar contexts.

Rational Number

Pre-K-2 Performance Indicators & Descriptors

3 Students recognize unit fractions including $\frac{1}{2}$, $\frac{1}{4}$, and $\frac{1}{3}$.

Rational Number

Performance Indicators & Descriptors

3	4	5	6	7	8
<p>4 Students recognize, name, compare, illustrate, and use simple fractions.</p> <p>a. Recognize, name, and illustrate fractions with denominators from two to ten.</p> <p>b. Recognize, name, and illustrate parts of a whole.</p> <p>c. Compare and order fractions with like numerators or with like denominators.</p>	<p>4 Students <i>understand</i>, name, compare, illustrate, combine, and use fractions.</p> <p>a. Add and subtract fractions with like denominators and use repeated addition to multiply a unit fraction by a whole number.</p> <p>b. List equivalent fractions.</p> <p>c. Represent fractions greater than one as mixed numbers and mixed numbers as</p>	<p>4 Students <i>understand</i>, name, compare, illustrate, compute with, and use fractions.</p> <p>a. Add and subtract fractions with unlike denominators.</p> <p>b. Multiply a fraction by a whole number.</p> <p>5 Students <i>understand</i> and use number notation and place value in numbers with three decimal places.</p>	<p>2 Students express fractions greater than 0 as decimals and compare positive numbers that are written as fractions and decimals and place them on the number line.</p> <p>3 Students add, subtract, multiply, and divide numbers expressed as fractions and as decimals including mixed numbers.</p>	<p>1 Students use negative and positive rational numbers expressed as integers, fractions, and decimals.</p> <p>a. Recognize rational numbers as quotients of integers with a non-zero denominator and recognize that rational numbers can be negative or positive.</p> <p>b. Compare signed rational numbers</p>	<p>1 Students express or <i>interpret</i> numbers using scientific notation from real-life contexts.</p> <p>a. Use positive and negative integer exponents for powers of ten.</p> <p>b. Convert between standard and scientific notation forms and compare the relative size of numbers including the <i>interpretation</i> of numbers as</p>

Performance Indicators & Descriptors					
3	4	5	6	7	8
	fractions. 5 Students understand and use number notation and place value in numbers with two decimal places in real-world contexts including money. a. Compare, order, read, round, and <i>interpret</i> decimals with up to two decimal places. b. Add and subtract decimals with up to two decimal places. c. Multiply and divide decimals with up to two decimal places by a one- digit whole number. d. Connect equivalent decimals and fractions for 1/10s, 1/4s and 1/2s in meaningful contexts.	a. Compare, order, read, round, and <i>interpret</i> decimals with up to three decimal places. b. Add and subtract decimals with up to three decimal places. c. Multiply and divide decimals with up to three decimals places by a two-digit whole number. d. Develop the concept of a fraction as division through expressing fractions with denominators of two, four, five, and 10, as decimals and decimals as fractions. 6 Students understand concepts of positive and negative integers.	4 Students understand how to express relative quantities as percentages and as decimals and fractions. a. Use ratios to describe relationships between quantities. b. Use decimals, fractions, and percentages to express relative quantities. c. <i>Interpret</i> relative quantities expressed as decimals, fractions, and percentages. 5 Students multiply and divide decimals with up to three decimal places by tens, hundreds, and	and place them on the number line. 2 Students compute with signed rational numbers. a. Use and <i>interpret</i> exponents. b. Follow conventions of order of operations including exponents. c. Solve problems using signed rational numbers. 3 Students understand that when the ratio of two varying quantities is constant, the two quantities are in direct proportion. a. Use ratios to compare quantities and use comparison to solve problems.	displayed on calculators and computers.

Performance Indicators & Descriptors					
3	4	5	6	7	8
		<ul style="list-style-type: none"> a. Place positive and negative integers on a number line or scale. b. Compare and order positive and negative integers. c. Find the distance between two integers in a context. 	<p>thousands.</p>	<ul style="list-style-type: none"> b. Identify proportional relationships. c. Use proportions to <i>solve</i> problems. <p>4 Students <i>interpret</i> and use percents to <i>solve</i> problems.</p> <ul style="list-style-type: none"> a. Use percents when comparing fractional parts of sets of unequal size. b. <i>Solve</i> practical problems involving percents. 	

Rational Number

9-Diploma Performance Indicators & Descriptors

No performance indicator.

Although no performance indicators are stated, students are expected to have instructional experiences in which they continue to use prior concepts and skills in new and familiar contexts.

Real Number

Pre-K-2 Performance Indicators & Descriptors

No performance indicator.

Although no performance indicators are stated, students are expected to use only rational numbers at this level.

Real Number					
Performance Indicators & Descriptors					
3	4	5	6	7	8
No performance indicator.	No performance indicator.	No performance indicator.	No performance indicator.	No performance indicator.	1 Students <i>understand</i> the set of real numbers as containing the rational numbers and the irrational numbers.
Although no performance indicators are stated, students are expected to have instructional experiences in which they use only rational numbers.	Although no performance indicators are stated, students are expected to have instructional experiences in which they use only rational numbers.	Although no performance indicators are stated, students are expected to have instructional experiences in which they use only rational numbers.	Although no performance indicators are stated, students are expected to have instructional experiences in which they use rational numbers including rational approximations for pi or square roots.	Although no performance indicators are stated, students are expected to have instructional experiences in which they use rational numbers including rational approximations for pi or square roots.	<ul style="list-style-type: none"> a. Know that there are real numbers that are not rational numbers. b. Know some common examples of irrational numbers including pi or those arising from square roots. c. Use square roots. Be able to <i>estimate</i> the value of the square roots of whole numbers and place them on the number line.

Real Number

9-Diploma Performance Indicators & Descriptors

1 Students know how to represent and use real numbers.

- a. Use the concept of n^{th} root.
- b. *Estimate* the value(s) of roots and use technology to approximate them.
- c. Compute using laws of exponents.
- d. Multiply and divide numbers expressed in scientific notation.
- e. *Understand* that some quadratic equations do not have real solutions and that there exist other number systems to allow for solutions to these equations.

- B. **DATA:** Students make measurements and collect, display, evaluate, analyze, and compute with data to describe or *model* phenomena and to make decisions based on data. Students compute statistics to summarize data sets and use concepts of probability to make predictions and describe the uncertainty inherent in data collection and measurement. It is expected that when working with measurements students:
- *understand* that most measurements are approximations and that taking repeated measurements reveals this variability;
 - *understand* that a number without a *unit* is not a measurement, and that an appropriate *unit* must always be attached to a number to provide a measurement;
 - *understand* that the *precision* and *accuracy* of a measurement depends on selecting the appropriate tools and *units*; and
 - use *estimation* comparing measures to *benchmarks* appropriate to the type of measure and *units*.

Measurement and Approximation

Pre-K-2 Performance Indicators & Descriptors

1 Students *understand* and use *units* of time, temperature, and money.

- a. Apply and use sequences of hours in a day, days in a week, and months in a year.
- b. Tell time to the hour and half hour.
- c. Identify and give the value of different coins.
- d. Find the total value of collections of coins up to \$1.00.
- e. Read temperature on thermometers with scales marked with one degree intervals.

Measurement and Approximation

LEARNING RESULTS: PARAMETERS FOR ESSENTIAL INSTRUCTION

2007

Highlighted = Maine Department of Education Regulation 131

Words in *blue italics* are defined in the glossary.

Performance Indicators & Descriptors					
3	4	5	6	7	8
<p>1 Students <i>understand</i> and use measurement of time and temperature.</p> <p>a. Select appropriate tools and <i>units</i> for these measures.</p> <p>b. <i>Solve</i> and <i>justify</i> problems with these measures.</p>	<p>1 Students <i>understand</i> and use measurement of time, capacity, and temperature.</p> <p>a. Select appropriate tools and <i>units</i> for these measures.</p> <p>b. <i>Solve</i> and <i>justify</i> problems with these measures.</p>	<p>1 Students <i>understand</i> and use measures of elapsed time, temperature, capacity, mass, and use measures of mass and weight.</p> <p>a. Select and use appropriate tools and <i>units</i> (mass in grams, weight in pounds) for these measures.</p> <p>b. <i>Solve</i> and <i>justify</i> problems with these measures.</p>	<p>1 Students convert within measurement systems.</p> <p>a. <i>Solve</i> problems where different <i>units</i> are used within the metric and traditional systems of measurement.</p>	<p>No performance indicator.</p> <p>Although no performance indicators are stated at this level, it is expected that students continue to use prior concepts and skills in new and familiar concepts.</p>	<p>1 Students <i>understand</i> and use <i>derived measures</i> (measurements expressed as rates).</p> <p>a. Calculate measures using multiple attributes including speed (distance per time).</p> <p>b. <i>Solve</i> for an unknown component of a measure including finding time given average speed and distance.</p> <p>2 Students convert across measurement systems and within a system for different <i>units</i> in <i>derived measures</i>.</p> <p>a. Approximate metric and customary</p>

Performance Indicators & Descriptors					
3	4	5	6	7	8
					equivalents given a conversion factor. b. Convert <i>derived measures</i> , including feet per second to miles per hour.

Measurement and Approximation

9-Diploma Performance Indicators & Descriptors

<p>1 Students <i>understand</i> the relationship between <i>precision</i> and <i>accuracy</i>.</p> <p>a. Express answers to a reasonable degree of <i>precision</i> in the context of a given problem.</p> <p>b. Represent an approximate measurement using appropriate numbers of significant figures.</p> <p>c. Know that most measurements are approximations and explain why it is useful to take the mean of repeated measurements.</p>

Data Analysis

Pre-K-2 Performance Indicators & Descriptors

<p>2 Students read, construct, and <i>interpret</i> picture graphs.</p>

Data Analysis

Performance Indicators & Descriptors					
3	4	5	6	7	8
<p>2 Students read, construct, and <i>interpret</i> bar graphs.</p>	<p>2 Students collect and represent data in tables, line plots, and bar graphs, and read and <i>interpret</i> these types of data</p>	<p>2 Students read, construct, and <i>interpret</i> line graphs.</p> <p>3 Students find and use median, mode,</p>	<p>2 Students read and <i>interpret</i> pie charts.</p> <p>3 Students find and compare the mean, median, mode, and</p>	<p>1 Students use graphs and charts to represent, organize, <i>interpret</i>, and draw inferences from data.</p>	<p>3 Students use the mean, median, mode, range, and quartiles to <i>solve</i> problems involving raw data and information from</p>

Performance Indicators & Descriptors					
3	4	5	6	7	8
	displays.	and range for a set of data.	range for sets of data.	a. <i>Create</i> tables, pictograms, bar graphs, line graphs, pie charts, stem and leaf plots, box and whiskers plots, and histograms using pencil and paper and electronic technologies. b. Draw conclusions based on graphs and charts including tables, pictograms, bar graphs, line graphs, pie charts, stem and leaf plots, box and whiskers plots, and histograms.	data displays.

Data Analysis

9-Diploma Performance Indicators & Descriptors

2 Students *understand* correlation and cause and effect.

- a. Recognize when correlation has been confused with cause and effect.
- b. *Create* and *interpret* scatter plots and *estimate* correlation and lines of best fit.
- c. Recognize positive and negative correlations based on data from a table or scatter plot.
- d. *Estimate* the strength of correlation based upon a scatter plot.

3 Students *understand* and know how to describe distributions and find and use descriptive statistics for a set of data.

- a. Find and apply range, quartiles, mean absolute deviation, and standard deviation (using technology) of a set of data.
- b. *Interpret*, give examples of, and describe key differences among different types of distributions: uniform, normal, and skewed.
- c. For the sample mean of normal distributions, use the standard deviation for a group of observations to establish 90%, 95%, or 99% confidence intervals.

4 Students *understand* that the purpose of random sampling is to reduce bias when creating a representative sample for a set of data.

- a. Describe and account for the difference between sample statistics and statistics describing the distribution of the entire population.
- b. Recognize that sample statistics produce *estimates* for the distribution of an entire population and recognize that larger sample sizes will produce more reliable *estimates*.
- c. Apply methods of *creating* random samples and recognize possible sources of bias in samples.

Probability

Pre-K-2 Performance Indicators & Descriptors

No performance indicator.

Although no performance indicators are stated, students are expected to have experiences with probability in these grades, but it is not expected that the knowledge will be secure.

Probability

Performance Indicators & Descriptors

3	4	5	6	7	8
No performance indicator.	No performance indicator.	No performance indicator.	No performance indicator.	2 Students <i>understand</i> and apply concepts of probability to simple events.	4 Students <i>understand</i> and apply concepts of probability.
Although no performance indicators are stated, students are expected to have experiences with	Although no performance indicators are stated, students are expected to have experiences with	Although no performance indicators are stated, students are expected to have experiences with	Although no performance indicators are stated, students are expected to have experiences with	a. Describe events as likely or unlikely and	a. Use appropriate terminology to describe

Performance Indicators & Descriptors					
3	4	5	6	7	8
probability in grade three, but it is not expected that the knowledge will be secure.	probability in grade four, but it is not expected that the knowledge will be secure.	probability in grade five, but it is not expected that the knowledge will be secure.	probability in grade six, but it is not expected that the knowledge will be secure.	<p>discuss the concept of likelihood using such words phrases as "certain", "equally likely", and "impossible".</p> <p>b. Predict the probability of outcomes of simple experiments and verify predictions using the <i>understanding</i> that the probability of an occurrence is the ratio of the number of actual occurrences to the number of possible occurrences.</p> <p>c. <i>Interpret</i> probabilities between and including zero and one and explain why zero and one are the upper and lower limits for probability values.</p>	<p>complementary and mutually exclusive events.</p> <p>b. Use an <i>understanding</i> of relative frequency to make and test conjectures about results of experiments and simulations.</p> <p>c. Compute probabilities for compound events, using such methods as organized lists, tree diagrams, and area models.</p>

Probability

9-Diploma Performance Indicators & Descriptors

5 Students *understand* the relationship of probability to relative frequency and know how to find the probability of compound events.

- a. Find the expected frequency of an event.
- b. Find the expected value of events.
- c. Find the probability of compound events including independent and dependent events.

C. GEOMETRY: Students use measurement and observation to describe objects based on their sizes and shapes; *model* or construct two-dimensional and three-dimensional objects; *solve* problems involving geometric properties; compute areas and volumes based on object properties and dimensions; and perform transformations on geometric figures. When making or calculating measures students use *estimation* to check the reasonableness of results.

Geometric Figures

Pre-K-2 Performance Indicators & Descriptors

1 Students recognize, *classify*, and *create* geometric figures in two and three dimensions.

- a. Identify shapes in the physical environment.
- b. *Classify* figures as circles, triangles, and quadrilaterals by focusing on their properties.
- c. *Create* shapes by using objects to combine and *decompose* other shapes.

Geometric Figures

Performance Indicators & Descriptors

3	4	5	6	7	8
<p>1 Students identify, describe, and <i>classify</i> familiar two-dimensional shapes.</p> <p>a. Describe and</p>	<p>1 Students identify and name angles, lines, relationships between lines, quadrilaterals, and triangles.</p>	<p>1 Students identify, describe, and <i>classify</i> solid figures.</p> <p>a. Identify edges, vertices, and faces</p>	<p>1 Students represent solid figures in two dimensions.</p> <p>a. Represent cubes, prisms, and square-based or triangular-</p>	<p>1 Students <i>understand</i> angle properties of lines in the plane.</p> <p>a. Identify and name straight angles,</p>	<p>1 Students know and use properties of polygons.</p> <p>a. Apply the triangle inequality.</p> <p>b. Find the sum of the</p>

Performance Indicators & Descriptors					
3	4	5	6	7	8
<p><i>classify</i> two-dimensional shapes according to the number of vertices and by number, length and shape of sides.</p> <p>b. Know how to put shapes together and take them apart to form other shapes.</p> <p>c. Identify edges, vertices, and right angles in two-dimensional shapes.</p> <p>d. Tell whether a given angle is greater or smaller than a right angle.</p>	<p>a. Identify perpendicular and parallel lines and sides.</p> <p>b. Identify and sketch the following quadrilaterals: rectangle, square, parallelogram, rhombus, and trapezoid.</p> <p>c. Identify and sketch the following triangles: isosceles, equilateral, acute, obtuse, and right.</p>	<p>in three-dimensional figures.</p> <p>b. Describe and <i>classify</i> solid figures according to the number of edges, faces, and vertices as well as the shapes of faces.</p>	<p>based pyramids using <i>nets</i>.</p> <p>b. Recognize and <i>classify</i> solids presented in picture views.</p> <p>c. Sketch three-dimensional figures.</p>	<p>angles at a point, and vertical angles and use these measures to find the measures of unknown angles.</p> <p>b. Recognize that the measures that form straight angles add to 180 degrees and the measures of angles at a point add to 360 degree and apply this property to solve problems.</p> <p>c. Recognize that vertical angles are congruent and apply this property to solve problems.</p>	<p>measures of the interior angles of a polygon.</p> <p>c. Apply the property that the sum of the measures of the exterior angles of a polygon is 360 degrees.</p> <p>2 Students know and use angle properties of parallel lines to <i>solve</i> problems and determine geometric relationships.</p> <p>a. Know and use properties of angles created when parallel lines are cut by a transversal.</p> <p>b. Use angle properties to determine whether lines are parallel.</p> <p>c. Know and use properties of angles</p>

Performance Indicators & Descriptors					
3	4	5	6	7	8
					<p>created by parallel lines and transversals to determine the angle properties of trapezoids and parallelograms, and apply these properties in problem situations.</p> <p>3 Students know and use the Pythagorean Theorem.</p>

Geometric Figures

9-Diploma Performance Indicators & Descriptors

1 Students *justify* statements about polygons and *solve* problems.

- a. Use the properties of triangles to prove theorems about figures and relationships among figures.
- b. *Solve* for missing dimensions based on congruence and similarity.
- c. Use the Pythagorean Theorem in situations where right triangles are created by adding segments to figures.
- d. Use the distance formula.

2 Students *justify* statements about circles and *solve* problems.

- a. Use the concepts of central and inscribed angles to *solve* problems and *justify* statements.
- b. Use the relationships among arc length and circumference, and areas of circles and sectors to *solve* problems and *justify* statements.

3 Students *understand* and use basic ideas of trigonometry.

- a. Identify and find the value of trigonometric ratios for angles in right triangles.
- b. Use trigonometry to *solve* for missing lengths in right triangles.
- c. Use inverse trigonometric functions to find missing angles in right triangles.

Geometric Measurement

Pre-K-2 Performance Indicators & Descriptors

2 Students *understand* how to measure length and capacity and use appropriate *units*.

- a. Measure length and capacity by *direct and indirect comparison*.
- b. Measure the length and capacity of objects using non-standard *units*.
- c. Measure the length of objects to whole inches and centimeters.

Geometric Measurement

Performance Indicators & Descriptors

3	4	5	6	7	8
<p>2 Students <i>understand</i> how to find the distance around a figure.</p> <ul style="list-style-type: none"> a. Calculate and measure the distance around a figure whose perimeter is comprised of straight edges. 	<p>2 Students <i>understand</i> the concept of area of a figure.</p> <ul style="list-style-type: none"> a. Find the area of shapes in non-standard <i>units</i>. b. Find the area of squares and other rectangles in standard <i>units</i>. c. Recognize and 	<p>2 Students find the area of triangles and quadrilaterals.</p> <ul style="list-style-type: none"> a. Know how to derive and use the formula, $A = (1/2) bh$ for the area of a triangle. b. Find the area of parallelograms. <p>3 Students <i>understand</i> how to</p>	<p>2 Students find the perimeters and areas of geometric figures.</p> <ul style="list-style-type: none"> a. Triangles b. Quadrilaterals c. Circles <p>3 Students find the volume and surface areas of right prisms with</p>	<p>2 Students <i>solve</i> problems involving perimeter and area.</p> <ul style="list-style-type: none"> a. <i>Solve</i> problems involving the area and perimeter of regions in the plane bounded by line segments and circular arcs. b. <i>Solve</i> problems involving the area of 	<p>4 Students find the volume and surface area of prisms, pyramids, cylinders, and other figures <i>composed</i> of these solids.</p> <ul style="list-style-type: none"> a. Apply the <i>understanding</i> that the volume of prisms and cylinders can be

Performance Indicators & Descriptors					
3	4	5	6	7	8
	<p><i>estimate</i> the relative sizes of one square meter and one square centimeter and one square inch and one square foot.</p>	<p>find the volume and surface area of rectangular prisms.</p> <p>a. Know how to build solids with unit cubes and find their volume.</p> <p>b. Recognize and <i>estimate</i> the relative sizes of one cubic meter and one cubic centimeter or one cubic inch and one cubic foot.</p> <p>c. Know how to derive and use the formula (length x width x height) for the volume of a rectangular prism.</p> <p>d. <i>Create nets</i> to aid visualization and computation.</p> <p>4 Students <i>understand</i> how to describe position and direction in</p>	<p>bases that are triangles and quadrilaterals.</p>	<p>combined figures.</p>	<p>found by multiplying the area of a base by the height of the solid.</p> <p>b. Apply the <i>understanding</i> that the volume of pyramids can be found by multiplying the area of a base by 1/3 the height of the solid.</p> <p>c. Apply the <i>understanding</i> that the surface area of a figure is the sum of the areas of its faces and find the surface areas of cylinders.</p>

Performance Indicators & Descriptors					
3	4	5	6	7	8
		<p>two dimensions.</p> <p>a. Locate points on the Cartesian plane.</p> <p>b. Determine horizontal and vertical distance on the coordinate plane.</p> <p>c. Measure angles in degrees.</p>			

Geometric Measurement

9-Diploma Performance Indicators & Descriptors

4 Students find the surface area and volume of three-dimensional objects.

- a. Find the volume and surface area of three-dimensional figures including cones and spheres.
- b. Determine the effect of changes in linear dimensions on the volume and surface area of similar and other three-dimensional figures.

Transformations

Pre-K-2 Performance Indicators & Descriptors

No performance indicator.

Although no performance indicators are stated, students are expected to have experiences with symmetry, transformations, and congruence in these grades, but it is not expected that the knowledge will be secure.

Transformations

Performance Indicators & Descriptors					
3	4	5	6	7	8
No performance	3 Students recognize	5 Students reflect,	4 Students	3 Students	No performance

Performance Indicators & Descriptors					
3	4	5	6	7	8
<p>indicator.</p> <p>Although no performance indicators are stated, students are expected to have experiences with symmetry, transformations, and congruency in grade three, but it is not expected that the knowledge will be secure.</p>	<p>congruent figures and line symmetry in figures.</p> <p>a. Recognize whether a line is a line of symmetry in a figure.</p> <p>b. Recognize congruent figures.</p>	<p>slide, and rotate plane figures.</p> <p>a. Identify figures with rotational or line symmetry.</p> <p>b. <i>Create</i> figures with rotational or line symmetry</p> <p>c. Slide, rotate or reflect figures to create patterns or demonstrate congruence.</p>	<p><i>understand</i> and use reflections, rotations, and translations to define and identify congruent plane figures.</p> <p>a. Apply the <i>understanding</i> that if a plane figure can be laid on top of another plane figure by rotations, translations, or reflections then the figures are congruent.</p> <p>5 Students <i>understand</i> how to use proportional relationships to make indirect linear measurements and use scale drawings to make linear measurements.</p>	<p><i>understand</i> and use the concept of scale drawings to enlarge or reduce two-dimensional plane figures.</p> <p>a. Use the concept of scale factors when enlarging or reducing and recognize the invariance of shape.</p> <p>b. Apply the <i>understanding</i> that enlargement or reduction by a scale factor leaves angle measures unchanged.</p> <p>c. Identify similar figures and name corresponding parts.</p>	<p>indicator.</p> <p>Although no performance indicators are stated, students are expected to continue to use prior concepts and skills in new and familiar contexts.</p>

Transformations

9-Diploma Performance Indicators & Descriptors

No performance indicator.

Although no performance indicators are stated, students are expected to continue to use prior concepts and skills in new and familiar contexts. Methods of transformational geometry might also be used in Geometric Figures 9-Diploma Performance Indicator 1.

D. **ALGEBRA:** Students use symbols to represent or *model* quantities, patterns, and relationships and use symbolic manipulation to *evaluate* expressions and *solve* equations. Students *solve* problems using symbols, tables, graphs, and verbal rules choosing the most effective representation and converting among representations.

Symbols and Expressions

Pre-K-2 Performance Indicators & Descriptors

1 Students *understand* how to represent quantities as simple expressions using addition and subtraction.

- a. Show that any quantity can be represented by multiple equivalent expressions where each represents the quantity ten.
- b. Know that addition is commutative and apply this *understanding* in computation and problem-solving.
- c. Know that addition and subtraction are inverse operations and apply this *understanding* in computation and problem-solving.

Symbols and Expressions

Performance Indicators & Descriptors

3	4	5	6	7	8
1 Students use equivalent expressions to aid computation such as knowing that $43 + 56$ is the same as $40 + 3 + 50 + 6$.	1 Students <i>create</i> and <i>evaluate</i> simple expressions in the context of numbers and operations as described in Standard 2.1:	1 Students <i>create</i> and <i>evaluate</i> simple expressions in the context of numbers and operations as described in <u>2.1: Number</u> * for this	1 Students <i>create</i> and <i>evaluate</i> expressions. a. <i>Create</i> and <i>evaluate</i> expressions using whole numbers. b. <i>Create</i> and <i>evaluate</i> expressions using	1 Students <i>create</i> and <i>evaluate</i> expressions. a. <i>Create</i> and <i>evaluate</i> expressions using integers. b. <i>Create</i> and <i>evaluate</i> expressions using	1 Students <i>create</i> , <i>evaluate</i> , and manipulate expressions. a. Create and evaluate expressions using real numbers. b. Add and subtract

Performance Indicators & Descriptors					
3	4	5	6	7	8
	<p>Number * for this grade level.</p> <p>a. <i>Create</i> and <i>evaluate</i> expressions with no more than two variables.</p> <p>* <u>Standard 2.1</u> referenced here in the language of Me. Dept of Ed Reg. 131 refers to <u>Standard A</u> of this document.</p>	<p>grade level.</p> <p>a. <i>Create</i> and <i>evaluate</i> expressions with no more than three variables.</p> <p>* <u>Standard 2.1</u> referenced here in the language of Me. Dept of Ed Reg. 131 refers to <u>Standard A</u> of this document.</p>	<p>positive fractions including decimals.</p>	<p>rational numbers.</p>	<p>linear expressions.</p> <p>c. Apply the properties of the real number system, including distributive and associative laws, to create equivalent expressions.</p>

Symbols and Expressions

9-Diploma Performance Indicators & Descriptors

1 Students *understand* and use polynomials and expressions with rational exponents.

- a. *Simplify* expressions including those with rational exponents.
- b. Add, subtract, and multiply polynomials.
- c. Factor the common term out of polynomial expressions.
- d. Divide polynomials by $(ax+b)$.

Equations and Inequalities

Pre-K-2 Performance Indicators & Descriptors

2 Students *understand* that the equal sign means, "is the same as."

- a. Identify true and false number sentences.
- b. Describe what makes number sentences true or false and apply this knowledge.
- c. Find solutions for unknowns in simple open number sentences such as $12 = 4 + []$.

Equations and Inequalities

Performance Indicators & Descriptors					
3	4	5	6	7	8
<p>2 Students find the unknown in simple equations (or open sentences) in the context of numbers and operations as described in <u>Standard 2.1: Number</u> * for this grade level such as:</p> <p>$3 + 5 = [] + 3$ $3 + 9 = [] + 10$ $[] + () = 10.$</p> <p>* <u>Standard 2.1</u> referenced here in the language of Me. Dept of Ed Reg. 131 refers to <u>Standard A</u> of this document.</p>	<p>2 Students find the unknown in simple equations in the context of numbers and operations as described in <u>Standard 2.1: Number</u> * for this grade level such as:</p> <p>$3 \cdot b = 12$ $3 + 4 = x + 5$ $6 \times 5 = 3 \times []$.</p> <p>* <u>Standard 2.1</u> referenced here in the language of Me. Dept of Ed Reg. 131 refers to <u>Standard A</u> of this document.</p>	<p>2 Students find the unknown in simple equations in the context of numbers and operations as described in <u>Standard 2.1: Number</u> * for this grade level such as:</p> <p>$39 - k = 39 - 40$ $78 + b = 57 + 79$ $30 \times A = 276$ $(3 + 4) \times 6 = 6 \times []$ $3 \times 15 = 3 \times (10 + [])$.</p> <p>* <u>Standard 2.1</u> referenced here in the language of Me. Dept of Ed Reg. 131 refers to <u>Standard A</u> of this document.</p>	<p>2 Students recognize and <i>solve</i> problems involving linear equations and recognize examples and non-examples of linear equations.</p> <p>a. <i>Solve</i> equations of the form $ax \pm b = c$ where a, b, and c are whole numbers.</p> <p>b. Recognize from a table whether a relationship has a constant rate of change.</p>	<p>2 Students <i>understand</i> and <i>solve</i> problems involving linear equations and know that a linear equation can be written in the form $0 = ax + b$.</p> <p>a. <i>Solve</i> equations of the form $ax + b = c$ where a, b, and c are positive rational numbers or positive or negative integers.</p> <p>b. Convert equations to $0 = ax + b$ form.</p>	<p>2 Students <i>understand</i> and <i>solve</i> problems involving linear equations.</p> <p>a. <i>Solve</i> any linear equation including linear equations of the form $ax + b = cx + d$.</p> <p>b. Recognize that, in general, linear equations have just one solution—but know also that some linear equations can have no solution and those linear equations that are identities have every value of x as a solution.</p> <p>c. Use graphs to <i>estimate</i> solutions to equations and systems of equations, check</p>

Performance Indicators & Descriptors					
3	4	5	6	7	8
					<p>algebraic approaches, provide alternative solution paths, and communicate the solution to a problem.</p> <p>3 Students <i>understand</i> and <i>solve</i> linear inequalities in one unknown.</p> <p>a. Represent problem situations as inequalities.</p> <p>b. <i>Solve</i> linear inequalities.</p> <p>c. <i>Interpret</i> the solutions to linear inequalities.</p>

Equations and Inequalities

9-Diploma Performance Indicators & Descriptors

2 Students *solve* families of equations and inequalities.

- a. *Solve* systems of linear equations and inequalities in two unknowns and interpret their graphs.
- b. *Solve* quadratic equations graphically, by factoring in cases where factoring is efficient, and by applying the quadratic formula.

- c. *Solve* simple rational equations similar to $\frac{1}{2x+1} = 5$.
- d. *Solve* absolute value equations and inequalities and interpret the results.
- e. Apply the *understanding* that the solution(s) to equations of the form $f(x) = g(x)$ are the x -value(s) of the point(s) of intersection of the graphs of $f(x)$ and $g(x)$ and common outputs in table of values.
- f. Explain why the coordinates of the point of intersection of the lines represented by a system of equations is its solution and apply this *understanding* to solving problems.

3 Students *understand* and apply ideas of logarithms.

- a. Use and *interpret* logarithmic scales.
- b. *Solve* equations in the form of $x = b^y$ using the equivalent form $y = \log_b x$.

Functions And Relations

Pre-K-2 Performance Indicators & Descriptors

- 3** Students *understand* how to *create*, identify, describe, and extend patterns given a pattern or a rule.
 - a. Describe, extend, and *create* repeating patterns.
 - b. Describe, extend, and *create* growing patterns.

Functions And Relations

Performance Indicators & Descriptors					
3	4	5	6	7	8
3 Students <i>understand</i> arithmetic relationships among positive whole numbers.	3 Students use tables, rules, diagrams, and patterns to represent the relationship between quantities	3 Students use tables, rules, diagrams, and graphs to represent and analyze the relationship	3 Students use tables, formulas, diagrams, and graphs to analyze relationships between quantities.	3 Students <i>understand</i> and use directly proportional relationships, $y = kx$.	4 Students <i>understand</i> and use the basic properties of linear relationships, $y = kx + b$.

Performance Indicators & Descriptors					
3	4	5	6	7	8
<p>a. Use the inverse relationships between addition and subtraction and between multiplication and division and the commutative laws of multiplication and addition to <i>solve</i> problems.</p> <p>b. Be able to show that for whole numbers subtraction and division are not commutative and show that multiplication and addition are commutative.</p> <p>4 Students <i>create</i>, describe, explain and extend patterns with numbers and geometric objects.</p>	<p>and to extend sequences.</p>	<p>between quantities.</p>	<p>a. Use tables, formulas and graphs to analyze constant difference (additive) relationships.</p> <p>b. Use tables, formulas, and graphs to analyze constant ratio (multiplicative) relationships.</p>	<p>a. Recognize directly proportional relationships by information in a table, graph, or formula.</p> <p>b. Translate common directly proportional relationships into symbolic statements and graphs.</p> <p>c. <i>Interpret</i> the slope and y-intercept of the graph of $y = kx$ in terms of a given context.</p>	<p>a. <i>Understand</i> that linear relationships are characterized by a constant rate of change, k.</p> <p>b. <i>Understand</i> that the graph of a linear relationship $y = kx + b$ is a line where the slope is k and b is the y-coordinate of the point where the graph crosses the y-axis (i.e., value of y when $x = 0$).</p> <p>c. Translate common linear phenomena into symbolic statements and graphs, and interpret the slope and y-intercept of the graph of $y = kx + b$ in terms of the original situation.</p>

Functions And Relations

9-Diploma Performance Indicators & Descriptors

4 Students *understand* and *interpret* the characteristics of functions using graphs, tables, and algebraic techniques.

a. Recognize the graphs and sketch graphs of the basic functions

$$f(x) = x^n, \text{ where } n = 1 \text{ to } 3;$$

$$f(x) = ax^2 + bx + c;$$

$$f(x) = \sqrt{x};$$

$$f(x) = |x|;$$

$$f(x) = \frac{a}{x};$$

$$f(x) = a^x; \text{ and}$$

$$f(x) = kx + b$$

b. Apply functions from these families to problem situations.

c. Use concepts such as domain, range, zeros, intercepts, and maximum and minimum values.

d. Use the concepts of average rate of change (table of values) and increasing and decreasing over intervals, and use these characteristics to compare functions.

5 Students express relationships *recursively* and use *iterative* methods to *solve* problems.

a. Express the $(n+1)^{\text{st}}$ term in terms of the n^{th} term and describe relationships in terms of a starting point and rule followed to transform one term to the next.

b. Use technology to perform repeated calculations to develop solutions to real life problems involving linear, exponential, and other patterns of change.