Mathematics
Curriculum Framework

THIS PAGE INTENTIONALLY LEFT BLANK

Mathematics Curriculum Framework

Archdiocese of Louisville

According to *Principles and Standards for School Mathematics* from the National Council of Teachers of Mathematics, new knowledge, tools, and ways of doing and communicating mathematics continue to emerge and evolve in an ever-changing world. The need to understand and be able to use mathematics in everyday life and in the workplace has never been greater and will continue to increase.

-Adapted from *Principles and Standards for School Mathematics*

In alignment with the *National Mathematics Standards* from the National Council of Teachers of Mathematics, the Archdiocese of Louisville Mathematics Curriculum Framework uses the content goals as organizers.

The Content Goals are:

- Number and Operations
- Algebra
- Geometry
- Measurement
- Data Analysis and Probability

To view the *National Mathematics Standards* or for further information and resources, contact: www.nctm.org.

- Mathematics Curriculum Committee, Archdiocese of Louisville

Archdiocese of Louisville Standards for Mathematics

The Archdiocese of Louisville Mathematics Curriculum Framework incorporates the work of the *Common Core State Standards for Mathematics,* stressing the importance of conceptual understanding of key ideas. The Standards for Mathematical Content and the Standards for Mathematical Practice are embedded in the curriculum framework.

The Standards for Mathematical Content outlined in the *Common Core State Standards for Mathematics* by domain are:

- Counting and Cardinality
- Operations and Algebraic Thinking
- Number and Operations in Base Ten
- Number and Operations – Fractions
- Measurement and Data
- Geometry
- Ratios and Proportional Relationships
- The Number System
- Expressions and Equations
- Functions
- Statistics and Probability

To view the *Common Core State Standards for Mathematics* or for further information and resources, visit: www.corestandards.org/the-standards/mathematics.

Archdiocese of Louisville Standards for Mathematics

According to the *Common Core State Standards for Mathematics,* eight processes and proficiencies are essential to the mathematical development of all students. These "Standards for Mathematical Practice" represent the processes outlined by the National Council of Teachers of Mathematics and the proficiencies outlined by the National Research Council.

The NCTM processes include: "problem solving, reasoning and proof, communication, representation, and connections". In the INational Research Council's report, *Adding it Up,* the proficiencies are described as: "adaptive reasoning, strategic competence, conceptual understanding, procedural fluency, and productive disposition". Complete descriptions of the "Standards for Mathematical Practice" can be found in the introduction section of the *Common Core State Standards for Mathematics*.

The Standards for Mathematical Practice are:

1) Make sense of problems and persevere in solving them
2) Reason abstractly and quantitatively
3) Construct viable arguments and critique the reasoning of others
4) Model with mathematics
5) Use appropriate tools strategically
6) Attend to precision
7) Look for and make use of structure
8) Look for and express regularity in repeated reasoning

In addition, emphasis is placed on the responsibility of all mathematics educators to connect these "Standards for Mathematical Practice" with the "Standards for Mathematical Content" in order to provide a balanced combination of procedure and understanding.

- Adapted from the *Common Core State Standards for Mathematics*
www.corestandards.org/the-standards/mathematics

The Archdiocese of Louisville Mathematics Curriculum Framework provides teachers with guidelines that focus on a balance between conceptual understanding and procedural skills. In addition, mathematical skills are not intended to be taught in isolation. Connections should be made within the mathematics curriculum, as well as with other content areas, whenever appropriate.

Problem Solving

Problem solving should be a daily occurrence used to provide students with the opportunity to develop concepts and skills and apply them to real-world situations. Students will learn to determine and apply appropriate strategies for problem solving and explain their reasoning.

Vocabulary and Communication

Teachers and students will use the language of mathematics to express mathematical ideas precisely. This includes consistent and appropriate use of vocabulary throughout the curriculum in both written and oral expression.

Spiral Review

This mathematics curriculum framework focuses on concepts and skills to be learned at each grade level. However, new concepts always build upon previously learned concepts. Therefore, continuous review is essential in a spiraling format for retention, consistency, and continuity.

In the Archdiocese of Louisville Mathematics Curriculum Framework, Performance Standards listed in bold print indicate first exposure.

ALGEBRA I

History

The Archdiocese of Louisville initiated an Algebra I program in 1987 to meet the needs of students with a high level of mathematics ability and the motivation to work independently in respect to mathematics instruction. A video program was developed and implemented from 1988 – 2000 as an option for schools. Other schools were able to include Algebra I in their curriculum by providing a certified instructor or by transporting students to a local Catholic high school for instruction.

In September 2000, the Algebra I program was restructured and the *Eighth Grade Honors Algebra I Handbook* was developed and distributed to direct and coordinate the program. Revised admission requirements, the core content and standards, new instructional resources, forms to assist with local administration, a timeline, and an entrance and exit exam were added to enhance the program.

During the 2008-2009 school year, elementary and high school teachers, a principal, university representatives, and archdiocesan representatives conducted an in-depth study of research and practices in the area of mathematics in order to make recommendations for the future of mathematics in the Archdiocese of Louisville. As a result of that intensive study, it was determined that beginning in September 2010, all eighth grade students in the Archdiocese of Louisville would participate in Algebra I instruction. All seventh grade students would participate in pre-Algebra instruction.

Philosophy

The program is based on the belief that mathematics literacy is a key component in preparing students for future success academically and in life situations. The local school is responsible for developing and maintaining a rigorous K-8 mathematics program that is based on standards, has clearly stated core content and outcomes, aligns instruction and assessment, and culminates in a comprehensive and rigorous eighth grade Algebra I program.

THIS PAGE INTENTIONALLY LEFT BLANK

Number and Operations – Kindergarten

Essential Understandings	Guided Questions
• Numbers are used to name, count, and place objects in order.	• How are numbers used to name, count, and place objects in order? • When counting, what does the next number in the sequence say about its value? • When counting, what does the last number said mean? • Why is it helpful to be able to count from a given number instead of from one?
• Estimation approximates exact values.	• How is estimation used to determine if a number is reasonable?
• A variety of methods are used to develop understanding and skill in estimation and computation.	• When is it appropriate to use mental math, concrete objects, pencil and paper, or computers to do estimation and computation? • How are concrete materials used to model and solve mathematical problems?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 2.7 Students understand number concepts and use numbers appropriately and accurately. **Academic Expectation 2.8** Students understand various mathematical procedures and use them appropriately and accurately.	• Number sense • Ordinals • Addition and subtraction	Students will: • **count by ones, fives, and tens to 100** • **count by two up to 20** • **understand that each successive number name refers to a quantity that is one larger** • **read numerals up to 100** • **count 20 or more objects with one-to-one correspondence when arranged in a line, a rectangular array, or a circle or as many as 10 objects in a scattered configuration** • **understand that the last number name said tells the number of objects counted** • **write numerals 0-30** • **represent a number of objects with a written numeral 0-20** • **compare and order numbers and quantities 1-20 using greater than, less than, and equal to** • **compare two numbers between 1 and 10 presented as written numerals** • **count forward from any given number instead of beginning at one** • **identify sequence of ordinal numbers from first to tenth** • **understand addition as putting together and adding to, and understand subtraction as taking apart and taking from** • **use objects, drawings, sounds, or mental images to represent addition and subtraction of numbers less than or equal to ten by acting out situations, using verbal explanations, expressions, or equations**

	• Base Ten • Fractions	• **use concrete objects, pictures, and mental math to solve single digit addition and subtraction stories and number sentences** • **write number sentences using symbols +, -, and =** • **determine the number that makes ten when added to a given number (1-9)** • **decompose numbers less than or equal to 10 into pairs in more than one way (e.g., 5 = 2 + 3)** • **fluently add and subtract within five** • **understand that numbers from 11 to 19 are composed of ten ones and from one to nine additional ones** • **compose and decompose numbers from 11 to 19 into ten ones and some further ones** • **recognize equal parts of a whole** • **identify simple fractions using pictures**

Geometry – Kindergarten

Essential Understandings	Guided Questions
• Geometric shapes and positions of objects are used to describe the world.	• How are geometric shapes used to describe things? • How is the location of an object described in relation to other things?
• Geometric shapes and relationships are used to design and create.	• What are examples of geometric shapes and relationships in architecture, art, and nature? • How can shapes and relationships be used to create things?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 2.9 Students understand space and dimensionality concepts and use them appropriately and accurately.	• Plane figures (two-dimensional) • Solid figures (three-dimensional) • Geometric and spatial relationship concepts	Students will: • **recognize and name the attributes of these plane figures: circle, square, rectangle, triangle, oval, and hexagon** • **recognize solid figures: cube, sphere, cone, and cylinder** • **locate and describe objects and pictures using spatial relationship concepts: inside, outside, right, left, above, below, beside, near, top, middle, bottom, front, behind, over, between, under, on** • **distinguish between two-dimensional and three-dimensional shapes** • **analyze and compare two- and three-dimensional shapes, in different sizes and orientations, using informal language to describe their similarities, differences, parts (e.g., sides, corners, curves)** • **model shapes in the world by building shapes from components and drawing shapes** • **combine simple shapes to form larger shapes (e.g., use two triangles to make a rectangle)**

Measurement – Kindergarten

Essential Understandings	Guided Questions
• Measurement is used to communicate about size and shape.	• How are length, weight, time, and money used to describe and compare things? • How are nonstandard and standard units used to compare things? • When is it useful to estimate measurements? • What kinds of tools are used to find measurements?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 2.10 Students understand measurement concepts and use measurements appropriately and accurately.	• Nonstandard and standard measurement	Students will: • **use nonstandard and standard units to estimate, measure, and compare length and weight** • **identify standard measuring tools** • **describe measurable attributes of objects, such as length or weight** • **directly compare two objects with a measurable attribute in common, to see which object has "more of" or "less of" the attribute, and describe the difference**
	• Money	• **identify the name and value of a penny, nickel, dime, and quarter**
	• Time	• **describe the features of an analog clock** • **tell time to the hour and half-hour on an analog and digital clock**
	• Calendar skills	• **name the days of the week and months of the year** • **use a calendar**

Algebra – Kindergarten

Essential Understandings	Guided Questions
• Patterns are used to investigate, understand, and describe the world.	• What is a pattern? • What kinds of patterns can be found in natural and human-designed environments? • How are patterns in the environment represented by such things as number, color, and shape? • How can objects be classified? • How can patterns be extended or changed?
• Patterns and number relationships are used to understand and solve problems.	• How are number patterns used to solve problems?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 1.10 Students organize information through development and use of classification rules and systems. **Academic Expectation 2.11** Students understand mathematical change concepts and use them appropriately and accurately. **Academic Expectation 2.12** Students understand mathematical structure concepts including the properties and logic of various mathematical systems.	• Patterns • Classification	Students will: • **extend, describe, and create patterns using pictures, objects, colors, sounds, and movement** • **sort and order objects by size, color, number, and other properties**

Data Analysis and Probability – Kindergarten

Essential Understandings	Guided Questions
• Data can be used to predict outcomes and support conclusions.	• What kinds of data can be collected? • How can data be organized? • How can data be used to draw conclusions and make decisions? • What factors need to be considered in making a prediction?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 2.13 Students understand and appropriately use statistics and probability.	• Graphing	Students will: • **collect and organize data to create tally charts, pictographs, and bar graphs** • **use graphs to answer questions**

Number and Operations – Grade One

Essential Understandings	Guided Questions
• Numbers are used to name, count, and place objects in order.	• How are numbers used to name, count, and place objects in order? • How do fractions describe parts of a whole? • How does position of a digit in a multi-digit number determine its value? • Why is it helpful to be able to count from a given number instead of from one?
• Estimation is used to approximate exact values.	• How do people know if an estimate is reasonable?
• A variety of methods are used to develop understanding and skill in estimation and computation.	• When is it appropriate to use mental math, pencil and paper, calculators, or computers to do rounding and computation? • How are concrete materials used to model and solve mathematical problems?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 2.7 Students understand number concepts and use numbers appropriately and accurately. **Academic Expectation 2.8** Students understand various mathematical procedures and use them appropriately and accurately**.**	• Addition and subtraction	Students will: • **use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, and comparing, with unknowns in all positions** • **solve word problems that call for addition of three whole numbers whose sum is less than or equal to 20** • write and solve **vertical and horizontal** addition and subtraction problems • relate counting to addition **and subtraction** (e.g., by counting to 2 to add 2) • **master** addition and subtraction facts **up to 12 using mental math** • use strategies such as counting on, making ten, decomposing a number leading to a ten, and using the relationship between addition and subtraction
	• Place value	• count **to 120** starting at any number • **estimate, compare, write, and order numbers to 120** • identify, count, and demonstrate tens and ones using models and pictures • understand that the two digits of a two-digit number represent amounts of tens and ones • compare two-digit numbers using symbols <, >, or = based on the meanings of the tens and ones digits • **understand that when adding two-digit numbers, add tens with tens, ones with ones, and sometimes it is necessary to compose a ten**

.		• **add within 100, including adding a two-digit number and a one-digit number, and adding a two-digit number and a multiple of 10, using concrete models or drawings and various strategies** • **add within 100, including adding a two-digit number and a multiple of 10, using concrete models or drawings and various strategies**
	• Numbers to 120	• **read and order ordinal numbers from eleventh to twentieth** • **master** counting and **writing** by ones, twos, fives, and tens increasing and **decreasing** the value
	• Fractions	• recognize and **model halves, thirds, and fourths of a whole or set understand that decomposing a whole or set into more equal shares creates smaller shares**

Geometry – Grade One

Essential Understandings	Guided Questions
• Geometric shapes and positions of objects are used to describe the world.	• How are geometric shapes used to describe things? • How can three-dimensional shapes be combined to create a new shape? • How do plane figures differ from solid figures? • What distinguishes defining attributes from non-defining attributes?
• Geometric shapes and relationships are used to design and create.	• What are examples of geometric shapes and relationships in architecture, art, and nature? • How can shapes and relationships be used to create things?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 2.9 Students understand space and dimensionality concepts and use them appropriately and accurately.	• Plane and solid figures	Students will: • name and **classify** plane figures (rectangle, square, triangle, **trapezoid, and half-circle**) and solid figures (cone, sphere, cube, cylinder, **pyramid**, **and rectangular prism**) • **distinguish between defining attributes (e.g., closed, three-sided) and non-defining attributes (e.g., color, size)** • compose two- or **three-dimensional shapes to create a composite shape and compose new shapes from the composite shapes**

Measurement – Grade One

Essential Understandings	Guided Questions
• Measurement is used to communicate about size and shape.	• How are length, weight, time, and money used to describe and compare things? • How are nonstandard and standard units used to compare things? • When is it useful to estimate measurements? • What kinds of tools are used to find measurements?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 2.10 Students understand measurement concepts and use measurements appropriately and accurately.	• Length and weight	Students will: • **order three objects by length** • **compare the lengths of two objects by using a third object** • **understand that the length measurement of an object is the number of same-size length units that span it with no gaps or overlaps** • estimate and measure length in **inches and centimeters** • **estimate and compare weight using a balance scale**
	• Time	• tell and **write** time in hours and half-hours using analog and digital clocks • name the days of the week and months of the year • locate and identify days and **dates** on a calendar
	• Money	• **trade coins to show the same money amount, using different coin combinations**

Algebra – Grade One

Essential Understandings	Guided Questions
• Patterns are used to investigate, understand, and describe the world.	• What kinds of patterns can be found in natural and human-designed environments? • How are patterns in the environment represented by such things as number, color, and shape? • How can objects be classified? • How can patterns be extended or changed?
• Patterns and number relationships are used to understand and solve problems.	• How are number patterns used to solve problems? • In an open sentence, how can the unknown number be determined from the known numbers and the operation?
• Number operations are used to solve problems.	• How do characteristics of a problem lead to a choice of a number operation? • What rules/properties influence the ways operations can be used to solve problems? • In a number sentence, what does the equal sign mean? • How is subtraction related to addition?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectations 2.11 Students understand mathematical change concepts and use them appropriately and accurately. **Academic Expectations 2.12** Students understand mathematical structure concepts including the properties and logic of various mathematical systems.	• Missing addends and subtrahends • Properties of operations • Patterns	Students will: • **understand the meaning of the equal sign, and determine if equations involving addition and subtraction are true or false** • **determine the missing addend or subtrahend in a problem (3 + _ = 5 or _ - 2 = 3)** • **understand subtraction as an unknown addend problem** • add and subtract **using commutative and associative properties** • identify and create **complex patterns using more than one attribute**

Data Analysis and Probability – Grade One

Essential Understandings	Guided Questions
• Data can be used to predict outcomes and support conclusions. • Probability describes the likelihood that an event will occur.	• How can data be organized? • How can data be used to draw conclusions and make decisions? • What factors need to be considered in making a prediction? • Why are some events more likely to occur than others? • How is probability used to make predictions?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectations 2.13 Students understand and appropriately use statistics and probability.	• Graphs and charts • Prediction	Students will: • organize, represent, and **interpret data with up to three categories using charts, tables, pictographs, and bar graphs** • **answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another** • **predict the likelihood of an event happening**

Number and Operations – Grade Two

Essential Understandings	Guided Questions
• Place value is used to determine the value of each digit in the number.	• How does position of a digit in a multi-digit number determine its value? • When adding two- or three-digit numbers, what happens when the two digits in the ones column equal a number greater than 10?
• Number operations are used to solve problems.	• How do characteristics of a word problem lead to a choice of a number operation? • What rules/properties influence the ways operations can be used to solve problems?
• A variety of methods are used to develop understanding and skill in rounding and computation.	• When is it appropriate to use mental math, pencil and paper, and calculators or computers to do estimation and computation? • How are concrete materials used to model and solve mathematical problems?
• Whole figures can be divided into fractional parts.	• Why is it possible for equal shares of the same whole to have different shapes?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 2.7 Students understand number concepts and use numbers appropriately and accurately. **Academic Expectation 2.8** Students understand various mathematical procedures and use them appropriately and accurately.	• Number sense	Students will: • count by one, five, ten, and **one hundred to 1000** • round and order numbers up to **1000** • identify even and odd numbers • compare numbers, including equality and inequality up to **three-digit numbers** (<, >, or =)
	• Place value	• **understand that 100 can be thought of as a bundles of ten tens** • show place value in standard, word, and **expanded** forms to **1000** • **understand that the three digits of a three-digit number represent amounts of hundreds, tens, and ones**
	• Addition and subtraction	• **master** addition and subtraction facts **to 20** using mental strategies • **mentally add or subtract 10 or 100 to or from a given number between 100 and 900** • **use addition to find the total number of objects arranged in a rectangular array with up to 5 rows and up to 5 columns** • **understand that when adding or subtracting three-digit numbers, add or subtract hundreds and hundreds, tens and tens, ones and ones, and sometimes it is necessary to compose or decompose tens or hundreds**

	• Multiplication • Fractions	• use addition and subtraction **within 100** to solve one- and two-digit word problems involving situations of adding to, taking from, and comparing, with unknowns in all positions • **fluently add and subtract within 100 using strategies based on place value, properties of operations, and/or the relationship between addition and subtraction** • solve **two- and three-digit** addition and subtraction problems **with** and without **regrouping within 1000** • **add up to four two-digit numbers using strategies based on place value and properties of operations** • solve one- and two-step word problems involving addition and subtraction • explain why addition and subtraction strategies work, using place value and the properties of operations • **model basic multiplication concepts for 2, 5, and 10** • draw and compare fractions using models and pictures • recognize and model parts of a whole or set using the words halves, thirds, half of, a third of, etc. • **recognize that equal shares of identical wholes need not have the same shape**

Geometry – Grade Two

Essential Understandings	Guided Questions
• Geometric shapes are used to describe the world. • Geometric shapes and relationships are used to design and create.	• How are geometric shapes used to describe things? • How are symmetry and congruence used to describe and compare things? • What are examples of geometric shapes and relationships in architecture, art, and nature? • How can shapes and relationships be used to create things?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 2.9 Students understand space and dimensionality concepts and use them appropriately and accurately.	• Plane and solid figures	Students will: • identify triangles, hexagons, cubes, **quadrilaterals, and pentagons** • identify patterns, **symmetry, and congruency** • **recognize and draw shapes having specified attributes, such as a given number of angles or a given number of equal faces**

Measurement – Grade Two

Essential Understandings	Guided Questions
• Measurement is used to communicate about size, shape, time, and money.	• How are length, weight, time, and money used to describe and compare things? • How are nonstandard and standard (customary and metric) units used to compare things? • How are standard (customary and metric) units of measurement used? • When is it useful to estimate measurements? • What kinds of tools are used to find measurements? • What strategies can be used to measure and compare objects?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 2.10 Students understand measurement concepts and use measurements appropriately and accurately.	• Length and weight	Students will: • estimate, measure, compare, **add, and subtract**, length and weight by selecting and using appropriate nonstandard and standard (customary and metric) measurement tools • estimate lengths using units of inches, **feet**, centimeters, and **meters** • **measure the length of an object twice using length units of different lengths for the two measurements and describe how the two measurements relate to the size of the unit chosen** • **generate measurement data by measuring lengths of several objects to the nearest whole unit, or by making repeated measurements of the same object** • **show measurements by making a line-plot, where the horizontal scale is marked off in whole-number units** • **relate addition and subtraction to length by representing whole number sums and differences within 100 on a number line diagram**
	• Time and calendar	• tell and write time to **five minutes** and calculate **time intervals** on an analog and digital clock using **a.m. and p.m.** • analyze and use the calendar
	• Money	• calculate the value of a set of coins **up to two dollars** • use $ and ¢ symbols appropriately

Algebra – Grade Two

Essential Understandings	Guided Questions
• Patterns are used to investigate, understand, and describe the world. • Patterns and number relationships are used to understand and solve problems.	• What is a pattern? • How are patterns in the environment represented by number, color, and shape? • How can patterns be extended or changed? • How are number patterns used to solve problems? • In an open sentence, how can the unknown number be determined from the known numbers and the operation?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 2.11 Students understand mathematical change concepts and use them appropriately and accurately. **Academic Expectation 2.12** Students understand mathematical structure concepts including the properties and logic of various mathematical systems.	• Algebraic equations • Patterns	Students will: • calculate equations by finding missing addend and subtrahend with the unknown in all positions • extend and create patterns with more than **two attributes**

Data Analysis and Probability – Grade Two

Essential Understandings	Guided Questions
• Data can be used to predict outcomes and support conclusions. • Probability describes the likelihood that an event will occur.	• What kind of data can be collected? • How can data be organized? • How is data used to draw conclusions and make decisions? • What factors need to be considered in making a prediction? • Why are some events more likely to occur than others? • How is probability used to make predictions?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 2.13 Students understand and appropriately use statistics and probability.	• Graphs and charts • Probability	Students will: • collect, record, and interpret data **(up to four categories**) with bar graphs, pictographs, and tally charts • **interpret data to predict probability**

Number and Operations – Grade Three

Essential Understandings	Guided Questions
• Mathematics can be used to describe, understand, and communicate about the world in order to solve problems and make decisions**.**	• What does mathematics reveal about the world? • What situations require the use of mathematical understanding? • How can concrete materials model mathematical situations? • How can patterns and properties of operations be used when adding and subtracting? • What is the relationship between multiplication and division?
• Characteristics of a situation or problem influence the choice of numbers, operations, strategies, and tools.	• How can strategies be used to determine the reasonableness of an answer? • How do the characteristics of a problem influence the choice of numbers, operations, strategies, and tools? • What strategies help determine if a solution is reasonable, accurate, and complete?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 2.7 Students understand number concepts and use numbers appropriately and accurately.	• Place value	Students will: • interpret the value of whole numbers up to **100,000** • order and compare whole numbers using >, <, or = • apply place value concepts to round numbers (up to four digits) to the nearest 10 and 100 • estimate by rounding for self-checking and approximation
Academic Expectation 2.8 Students understand various mathematical procedures and use them appropriately and accurately.	• Addition and subtraction	• fluently add and subtract whole numbers with **three or more digits** (with and without regrouping) using strategies and algorithms • apply patterns and properties of operations as strategies to add and subtract including **commutative, associative, and distributive properties**
	• Multiplication and division	• **apply properties of operations as strategies to multiply and divide including commutative, associative, and distributive properties** • **master multiplication facts up to 10** • **multiply one-digit numbers by a multiple of ten (10-90) using strategies based on place value and properties of operations** • **interpret products of whole numbers (e.g., interpret 5 x 7 as the total number of objects in 5 groups of 7 objects each)** • **interpret whole number quotients (e.g., interpret 56 ÷ 8 as the number of objects in each share when 56 objects are partitioned equally into 8 shares)** • **recognize that division is the inverse of multiplication and is an unknown factor problem** • **fluently divide within 100**

		• **use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities**
	• Problem solving	• synthesize number and operation concepts to solve **complex, multi-step word problems using all four operations** • assess the reasonableness of answers using mental computation and estimation strategies including rounding
	• Fractions	• understand a fraction as a quantity formed when a whole is divided into equal parts • **understand two fractions as equivalent (equal) if they are the same size, or the same point on a number line** • use models to compare and order **equivalent** fractions • **express whole numbers as fractions and recognize fractions that are equivalent to whole numbers** • **use models to add and subtract fractions with like denominators**

Geometry – Grade Three

Essential Understandings	Guided Questions
• Attributes and relationships of shapes, objects, and patterns can be used to describe, understand, and communicate about the world.	• How can objects in the natural and human-designed world be identified and described in geometric terms? • How do models and drawings enhance understanding? • How can shared attributes help to define categories of shapes?
• Geometry has many real-world applications including design, architecture, and art.	• How do the attributes of geometric shapes and figures influence their use in aesthetic and functional designs? • How are geometric shapes and relationships manipulated to create different visual effects? • How are models and drawings used in problem solving and design?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 2.9 Students understand space and dimensionality concepts and use them appropriately and accurately.	• Plane and solid figures	Students will: • describe and build plane (two-dimensional) and solid (three-dimensional) figures • recognize and check figures for congruency and similarities • explain that shapes in different categories (e.g., rectangle, rhombus) may share attributes (e.g., having four sides) and that the shared attributes can define a larger category (e.g., quadrilaterals) • classify the subcategories of quadrilaterals (e.g., rectangle, rhombus, and square) as quadrilaterals and draw quadrilaterals that do not belong to any of these subcategories
	• Symmetry	• find symmetry in figures and create symmetrical drawings (line, flip, slide, rotational)
	• Perimeter	• recognize perimeter as an attribute of plane figures • calculate the perimeter of a plane figure by using whole number side lengths or finding an unknown side length • solve real-world problems involving perimeter
	• Area	• recognize area as an attribute of plane figures • measure area by counting unit squares • relate area to the operations of multiplication and addition • **solve real-world problems about area**

Measurement – Grade Three

Essential Understandings	Guided Questions
• Measurement allows description, understanding, and communication about the world.	• How is measurement used to quantify information about objects and events? • How do characteristics of objects and events influence the choice of measurement strategies and tools? • How does the precision required for a measurement influence the choice of strategies and tools? • How is understanding and communication about measurement used to solve problems and make decisions?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 2.10 Students understand measurement concepts and use measurements appropriately and accurately.	• Linear measurement	Students will: • measure using customary and metric linear units to nearest **1/2 or 1/4** or whole inch or whole centimeter
	• Customary and metric weight and capacity	• **measure mass of an object using customary and metric capacity units (ounces, pounds, grams, and kilograms)** • **measure and estimate liquid volume using customary and metric capacity units (cups, pints, quarts, gallons, milliliters, liters)** • **add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units**
	• Temperature	• **read and interpret temperature using Fahrenheit scale**
	• Time	• tell and write time to the **nearest minute** using analog and digital clocks • **solve word problems involving addition and subtraction of elapsed time**
	• Money	• calculate the value of coins and bills and apply to real-world situations • **determine equivalency among coins and bills** • **add and subtract decimals with money**

Algebra – Grade Three

Essential Understandings	Guided Questions
• Patterns aid description, understanding, and communication about the world. • Patterns and number relationships can be used to investigate, understand, and solve problems.	• How and why are patterns used? • How are patterns and number relationships represented with symbols? • How are tables and equations used to represent, analyze, and extend patterns? • How do patterns help to solve problems and communicate information? • What kinds of strategies help to reveal patterns and number relationships? • How are tables, graphs, and equations used to discover, analyze, and extend patterns and number relationships?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 2.11 Students understand mathematical change concepts and use them appropriately and accurately. **Academic Expectation 2.12** Students understand mathematical structure concepts including the properties and logic of various mathematical systems.	• Fact families • Variables • Equality and inequality	Students will: • use fact families **to relate the four operations** • solve for one variable in addition, subtraction, **multiplication, and division (a + 4 = 12)** • **solve real-world problems involving one variable** • represent word problems using equations with a letter standing for the unknown quantity • **solve simple function tables (input/output)** • **recognize that the equal sign means that both sides of the equation are balanced (6 + 2 = 5 + 3, 8 = 6 + 2)** • **determine the unknown number in multiplication and division equations (e.g., 8 x □ = 48, 5 = □ ÷ 3, 6 x 6 = □)**

Data Analysis and Probability – Grade Three

Essential Understandings	Guided Questions
• Data collection and analysis can be used to predict outcomes, solve problems, and make decisions.	• What factors influence the way data is collected and organized? • How is the reliability of data affected by the source, quantity, and method of collection? • How is the analysis of data used to solve problems? • How is the presentation used to support different kinds of data? • Why would one style of graph, chart, or table be more appropriate than another when depicting data?
• Probability supports making predictions, drawing conclusions, and solving problems.	• How is the probability of an event determined and expressed? • What factors influence the certainty or uncertainty? • How is probability used to make predictions and draw conclusions?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 2.13 Students understand and appropriately use statistics and probability.	• Data Analysis • Probability	Students will: • collect, record, and interpret data • build and interpret scaled graphs (pictograph, bar, **line, circle**), charts, and tables with **several categories** • investigate outcomes **(likely / unlikely, certain / impossible)**

Number and Operations – Grade Four

Essential Understandings	Guided Questions
• Mathematics can be used to describe, understand, and communicate about the world in order to solve problems and make decisions**.** • Characteristics of a situation or problem influence the choice of numbers, operations, strategies, and tools.	• What does mathematics reveal about the world? • How is mathematics used in the everyday world? • What situations require the use of mathematical understanding? • How can concrete materials model mathematical situations? • Using place value, what does the position of each digit reveal about its value? • How do the characteristics of a problem influence the choice of numbers, operations, strategies, and tools? • What strategies help determine if a solution is reasonable, accurate, and complete?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 2.7 Students understand number concepts and use numbers appropriately and accurately. **Academic Expectation 2.8** Students understand various mathematical procedures and use them appropriately and accurately.	• Whole numbers • Place value • Multiplication	Students will: • use place value understanding to identify, order, round, read, and write (in all forms) numbers through **one million** • recognize that in a multi-digit whole number, the digit in one place represents ten times what it represents in the place to its right • read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form • compare two multi-digit numbers based on meanings of the digits in each place, using >, <, or = symbols • fluently add and subtract **multi-digit** whole numbers using place value understanding and properties of operations • calculate and explain products multiplying 2-, **3-, and 4-** digit numbers by 1-digit numbers with regrouping, using strategies based on place value and the properties of operations • master multiplication facts of **11 and 12** • **find all factor pairs for a whole number in the range 1-100** • **recognize that a whole number is a multiple of each of its factors** • **determine whether a given whole number in the range 1-100 is a multiple of a given one-digit number** • **determine whether a given whole number in the range 1-100 is prime or composite** • apply problem solving skills in multi-step word problems, using the four operations

	• Division	• **name the divisibility rules for 2, 3, 5, and 10** • **calculate quotients with and without remainders for 2-, 3-, and 4-digit dividends and 1-digit divisors, based on place value, the properties of operations, and/or the relationship between multiplication and division** • **illustrate and explain a calculation by using equations, rectangular arrays, and/or area models** • **apply problem solving skills in multi-step word problems including problems in which remainders must be interpreted, using the four operations**
	• Fractions	• **explain why one fraction is equivalent to another fraction by using visual fraction models** • recognize and **generate** equivalent fractions • **compare and order fractions with both like and unlike numerators and denominators using >, <, or = (e.g., by creating common denominators or numerators, or by comparing to a benchmark fraction)** • **recognize that comparisons are valid only when the two fractions refer to the same whole** • **recognize and convert improper fractions and mixed numbers** • **decompose a fraction into a sum of fractions with the same denominator in more than one way, recording each decomposition by an equation** • understand addition and subtraction of fractions as joining and separating parts referring to the same whole • **solve addition and subtraction of fractions and mixed numbers with like denominators in equations and word problems and express the answer in simplest terms using equivalent fractions** • **multiply a fraction by a whole number** • **solve word problems involving multiplication of a fraction by a whole number by using visual fraction models and equations to represent the problem**
	• Decimals	• **identify, read, and write decimals through hundredths (including greater than 1)** • **express and model decimals as a fraction equivalent** • **compare and order decimals through hundredths using >, <, or = signs** • **recognize that comparisons are valid only when the two decimals refer to the same whole**

Geometry – Grade Four

Essential Understandings	Guided Questions
• Geometry has many real-world applications including design, architecture, and art.	• How do the characteristics of geometric figures influence their use in designs? • How are models and drawings used in problem solving and design? • How can attributes be used to classify figures?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 2.9 Students understand space and dimensionality concepts and use them appropriately and accurately. **Academic Expectation 2.10** Students understand measurement concepts and use measurements appropriately and accurately	• Plane and solid figures	Students will: • **classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines, or the presence or absence of angles of a specified size** • **draw and identify points, lines, line segments, rays, angles (right, acute, obtuse) and perpendicular and parallel lines**
	• Triangles	• **recognize right triangles as a category and identify right triangles**
	• Angles	• **measure angles in whole number degrees using a protractor** • **sketch angles of specified measures** • **recognize angles as geometric shapes that are formed wherever two rays share a common endpoint** • **understand that an angle is measured with reference to a circle with its center at the common endpoint of the rays** • **understand that an angle that turns through *n* one-degree angles is said to have an angle measure of *n* degrees** • **solve unknown angle measurements** • **recognize that angle measure is additive and is the sum of the angle measures of the parts**
	• Symmetry	• recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into two matching parts • identify line-symmetric figures and draw lines of symmetry

Measurement– Grade Four

Essential Understandings	Guided Questions
• Measurement allows description, understanding, and communication about the world.	• How do the characteristics of objects and events influence the choice of measurement strategies and tools? • How does the precision required for a measurement influence the choice of strategies and tools? • How is the understanding and communication about measurement used to solve problems and make decisions?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 2.9 Students understand space and dimensionality concepts and use them appropriately and accurately. **Academic Expectation 2.10** Students understand measurement concepts and use measurements appropriately and accurately	• Linear measurement • Units of measure • Perimeter	Students will: • **make a line plot to display a data set of measurements in fractions of a unit (1/2,1/4,1/8)** • **express measurements in a larger unit in terms of a smaller unit within a single system of units** • **record measurement equivalents in a conversion table** • use the four operations to solve word problems involving distances, **intervals of time**, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals • **apply the perimeter and area formulas for rectangles in real-world and mathematical problems** • calculate perimeter of **polygons**

Algebra – Grade Four

Essential Understandings	Guided Questions
• Patterns aid description, understanding, and communication about the world.	• How and why are patterns used? • How are patterns and number relationships represented symbolically? • How are tables and equations used to represent, analyze, and extend patterns? • Why do the components of a pattern continue to alternate in a particular way?
• Patterns and number relationships can be used to investigate, understand, and solve problems.	• How do patterns help to solve problems and communicate information? • What kinds of strategies help to reveal patterns and number relationships? • What is the meaning of a variable in an equation or number expression? • How are strategies used to assess the reasonableness of an answer?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 2.11 Students understand mathematical change concepts and use them appropriately and accurately. **Academic Expectation 2.12** Students understand mathematical structure concepts including the properties and logic of various mathematical systems.	• Variables	Students will: • **differentiate between algebraic expressions and equations** • use fact families to determine the value of a variable in multiplication and division equations ($6x = 36$, $x \div 3 = 9$) • use a letter to represent the unknown quantity in an equation
	• Patterns	• **generate number or shape patterns that follow a given rule** • **identify features of the pattern that are not explicit in the rule** • **explain informally why the components of a pattern will continue to alternate in a particular way** • **identify rules to complete function tables and understand two variable relationships**
	• Order of operations	• **solve equations beginning with the operations inside the parentheses**
	• Mental computation and estimation	• assess the reasonableness of answers using mental computation and estimation strategies, including rounding

Data Analysis and Probability – Grade Four		
Essential Understandings	**Guided Questions**	
• Data collection and analysis can be used to predict outcomes, solve problems, and make decisions.	• How is the analysis of data used to solve problems? • How is the presentation of data used or misused to support an outcome or decision?	
Academic Expectations	**Content Guidelines**	**Performance Standards**
Academic Expectation 2.13 Students understand and appropriately use statistics and probability.	• Measures of central tendency	Students will: • **define and find the mean (average), median, and mode of a set of data**

Number and Operations – Grade Five

Essential Understandings	Guided Questions
• Mathematics can be used to describe, understand, and communicate about the world in order to solve problems and make decisions. • Characteristics of a situation or problem influence the choice of numbers, operations, strategies, and tools.	• What does mathematics reveal about the world? • What situations require the use of mathematical understandings? • How does mathematics enable people to work with things they cannot see? • How do concrete materials model mathematical situations? • What does the position in a multi-digit number reveal about its value? • How do the characteristics of a situation influence the choice of numbers, operations, strategies, and tools? • How is a solution determined to be reasonable, accurate, and complete? • Why are comparisons of two fractions only valid when they refer to the same whole?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 2.7 Students understand number concepts and use numbers appropriately and accurately. **Academic Expectation 2.8** Students understand various mathematical procedures and use them appropriately and accurately.	• Whole numbers	Students will: • **fluently multiply multi-digit whole numbers using the standard algorithm** • find whole number quotients with **2-digit divisors (4-digit by 2-digit)** using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division • show remainders as **fractions and decimals** • **recognize and determine the greatest common factor (GCF) and least common multiple (LCM) and interpret remainders in problem solving** • estimate quotients using compatible numbers • **apply divisibility rules for** 2, 3, **4,** 5, **6, 9,** 10
	• Place value	• recognize that in a multi-digit number, a digit in one place represents ten times as much as it represents in the place to its right and **1/10 of what it represents in the place to its left** • **explain patterns in the number of zeros of the product when multiplying a number by powers of 10** • **explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10**
	• Decimals	• read, write, compare, and order decimals to the **ten-thousandths place** using base-ten numerals, number names, and expanded form • compare decimals using >, <, or = and symbols • round decimals to the indicated place value position

		• **add, subtract, and multiply, and divide decimals through the hundredths place** using concrete models or drawings and strategies based on place value, properties of operations, rounding, and/or the relationship between addition and subtraction and explain the reasoning
	• Fractions	• add and subtract fractions and mixed numbers with **unlike denominators by replacing given fractions with equivalent fractions in order to produce an equivalent sum or difference of fractions with like denominators** • **apply greatest common factor (GCF) to express sums and differences in simplest form** • recognize that comparisons are valid only when the two fractions refer to the same whole • solve real-world problems involving addition and subtraction of fractions, **including cases of unlike denominators (**e.g., by using visual fraction models or equations) • **solve real-world problems involving multiplication of fractions and mixed numbers (e.g., by using visual fraction models or equations)** • **use benchmark fractions and number sense of fractions to estimate mentally and assess the reasonableness of answers** • **interpret a fraction as division of the numerator by the denominator** • **interpret multiplication of fractions as scaling (resizing) by comparing the size of a product to the size of one factor on the basis of the size of the other factor, without performing the indicated multiplication** • **explain why multiplying a given number by a fraction greater than 1 results in a product greater than the given number** • **explain why multiplying a given number by a fraction less than 1 results in a product smaller than the given number** • **interpret division of a whole number by a unit fraction (e.g., 4 ÷ 1/5 = 20 because 20 x 1/5 = 4) and a unit fraction by a whole number or non-zero number, compute, and apply to real-world problem solving**

Geometry – Grade Five

Essential Understandings	Guided Questions
• Attributes and relationships of shapes, objects, and patterns can be used to describe, understand, and communicate about the world.	• How can objects in the natural and human-designed world be identified and described in geometric terms? • How are distance, direction, and coordinates used to understand and explain the arrangement of objects and locations? • How do models and drawings enhance understanding?
• Geometry has many real-world applications including design, architecture, and art.	• How do the characteristics of geometric shapes and figures influence their use in aesthetic and functional designs? • How are geometric shapes and relationships manipulated to create a visual or emotional effect? • How are models and drawings used in problem solving and design?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 2.9 Students understand space and dimensionality concepts and use them appropriately and accurately.	• Plane and solid figures	Students will: • **identify the following attributes: sides, vertices, faces, edges,** and angles (obtuse, acute, right, or straight) • **understand that attributes belonging to a category of two-dimensional figures also belong to all subcategories of that category (e.g., all squares are rectangles but not all rectangles are squares)** • **classify two-dimensional figures in a hierarchy based on properties**

Measurement – Grade Five		
Essential Understandings	**Guided Questions**	
• Measurement allows description, understanding, and communication about the world.	• How is measurement used to quantify information about objects and events? • How do the characteristics of objects and events influence the choice of measurement strategies and tools? • How does the precision required for a measurement influence the choice of strategies and tools? • How is the understanding and communication about measurement used to solve problems and make decisions?	
Academic Expectations	**Content Guidelines**	**Performance Standards**
Academic Expectation 2.10 Students understand measurement concepts and use measurements appropriately and accurately.	• Customary system	Students will: • **apply conversion of linear units from inches through miles** • **apply conversion of mass units from ounces through tons** • **apply conversion of capacity units from fluid ounces through gallons** • **use conversions to solve multi-step real-world problems**
	• Metric system	• **apply conversion of linear units from millimeters through kilometers, excluding decimals** • **apply conversion of mass units from milligrams through kilograms, excluding decimals** • **apply conversion of capacity units from milliliters through liters, excluding decimals** • **use conversions to solve multi-step real-world problems**
	• Area	• **find the area of a rectangle with fractional side lengths by tiling it with unit squares of the appropriate unit fraction side lengths, and show that the area is the same as would be found by multiplying the side lengths** • **multiply fractional side lengths to find areas of rectangles, and represent fraction products as rectangular areas**
	• Volume	• **recognize volume as an attribute of solid figures and understand concepts of volume measurement** • **find the volume of a right rectangular prism with whole-number side lengths by packing it with unit cubes, and show that the volume is the same as it would be by multiplying the edge lengths** • **develop and apply formula for volume of a rectangular prism (V = l x w and V = b x h) to find volumes of right rectangular prisms, using whole numbers and decimals to solve real-world and mathematical problems** • **measure volume by counting unit cubes, using cubic cm., cubic in., cubic ft., and improvised units** • **recognize volume as additive in three-dimensional figures** • **determine volume of solid figures composed of two non-overlapping right rectangular prisms by adding the volume of the non-overlapping parts, and apply to real-world problems**

Algebra – Grade Five

Essential Understandings	Guided Questions
• Patterns aid description, understanding, and communication about the world.	• How and why are patterns used? • How are patterns and number relationships represented symbolically? • What kinds of patterns can be found in natural and human-designed environments? • How are tables and equations used to represent, analyze, and extend patterns?
• Patterns and number relationships can be used to investigate, understand, and solve problems.	• How do patterns help people to solve problems and communicate information? • What kinds of strategies help to reveal patterns and number relationships? • How are function tables and equations used to discover, analyze, and extend patterns and number relationships?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 2.11 Students understand mathematical change concepts and use them appropriately and accurately. **Academic Expectation 2.12** Students understand mathematical structure concepts including the properties and logic of various mathematical systems.	• Expressions and equations	Students will: • differentiate between numeric and algebraic expressions and equations • translate word problems into algebraic expressions • **use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols using order of operations** • write and interpret simple numerical expressions
	• Coordinate system	• **understand that the first number in an ordered pair indicates how far to travel from the origin along the x-axis, and the second number indicates how far to travel along the y-axis** • **form ordered pairs consisting of corresponding terms from two patterns and graph on a coordinate plane** • **represent real-world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation**
	• Patterns and relationships	• **generate two numerical patterns using two given rules** • identify the apparent relationships between two corresponding terms

Data Analysis and Probability – Grade Five

Essential Understandings	Guided Questions
• Data collection and analysis can be used to predict outcomes, solve problems, and make decisions.	• What factors influence the way data is collected and organized? • How is the reliability of data affected by the source, quantity, and method of collection? • How is the analysis of data used to solve problems? • How is the presentation of data used or misused to support different points of view?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 2.13 Students understand and appropriately use statistics and probability.	• Data analysis	Students will: • collect, organize, and interpret data for the creation and interpretations of **stem and leaf plots** • make a line plot to display a data set of measurements in fractions of a unit (1/2,1/4,1/8) • **use operations on fractions to solve problems involving information presented in line plots** • calculate and apply **range,** median, mode, and mean with whole numbers

Number and Operations – Grade Six

Essential Understandings	Guided Questions
• Mathematics can be used to describe, understand, and communicate about the world in order to solve problems and make decisions.	• What does mathematics reveal about the world? • What situations require the use of mathematical understandings? • How do concrete materials model mathematical situations?
• Characteristics of a situation or problem influence the choice of numbers, operations, strategies, and tools.	• How do the characteristics of a situation influence the choice of numbers, operations, strategies, and tools? • How is a solution determined to be reasonable, accurate, and complete?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 2.7 Students understand number concepts and use numbers appropriately and accurately.	• Whole numbers	Student will: • **determine the prime factorization of any whole number** • determine the greatest common factor and least common multiple **using prime factorization**
Academic Expectation 2.8 Students understand various mathematical procedures and use them appropriately and accurately.	• Decimals	• compare and order decimals • multiply a whole number by a decimal or multiply two decimals using the standard algorithm • divide a whole number by a decimal or divide two decimals using the standard algorithm • **convert decimals to fractions**
	• Fractions	• compare and order fractions • multiply and divide fractions (proper, improper, mixed numbers) • **convert fractions to decimals**
	• Ratios	• **understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities** • **understand and solve real-world and mathematical ratio and rate problems** • **make tables of equivalent ratios relating quantities and use tables to compare ratios** • **solve unit rate problems including those involving unit pricing and constant speed**

	• Integers and rational numbers	• **find a percent of a quantity as a rate per 100** • **solve problems involving finding the whole, given a part and the percent** • **use ratio reasoning to convert measurement units** • **understand that positive and negative numbers are used together to describe quantities having opposite directions or values** • **use positive and negative numbers to represent quantities in real-world context** • **understand the absolute value of a rational number as its distance from 0 on the number line** • **understand ordering and absolute value of rational numbers** • **write, interpret, and explain statements of order for rational numbers in real-world contexts**

Geometry and Measurement – Grade Six

Essential Understandings	Guided Questions
• Attributes and relationships of plane and solid figures, objects, and patterns can be used to describe, understand, and communicate about the world.	• How can geometry be seen in the natural and human-designed world? • How are distance, direction, coordinates, and scale used to understand and explain the arrangement of objects and locations?
• Geometry has many real-world applications including design, architecture, and art.	• How do the characteristics of plane and solid figures influence their use in aesthetic and functional designs? • How can one shape be used to calculate the area of another?
• Measurement allows description, understanding, and communication about the world.	• How is measurement used to quantify information about objects and events? • How do the characteristics of objects and events influence the choice of measurement strategies and tools? • How does the precision required for a measurement influence the choice of strategies and tools? • How is the understanding and communication about measurement used to solve problems and make decisions?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 2.9 Students understand space and dimensionality concepts and use them appropriately and accurately. **Academic Expectation 2.10** Students understand measurement concepts and use measurements appropriately and accurately.	• Coordinate system	Student will: • locate, plot, and name ordered pairs in **all four quadrants** on the coordinate grid • **use coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate** • **draw polygons in the coordinate plane given coordinates for the vertices**
	• Plane figures	• draw angles using protractors • **calculate the sum of angle measures in triangles** • **estimate angle measurement** • **identify, describe, classify, name, and draw pairs of angles (adjacent, vertical, complementary, supplementary, and alternate interior and alternate exterior angles)** • **calculate area of a right triangle, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes**
	• Solid figures	• **calculate surface area** and volume **of simple geometric solids as they apply to real-world and mathematical problems**

		• find the volume of a right rectangular prism **with fractional edge lengths** by packing it with unit cubes of the appropriate unit fraction edge lengths, and show that the volume is the same as it would be by multiplying the edge lengths of the prism • apply formula for volume of a rectangular prism (V = l x w and V = b x h) to find volumes of right rectangular prisms **with fractional edge lengths** to solve real-world and mathematical problems

Algebra – Grade Six

Essential Understandings	Guided Questions
• Patterns aid description, understanding, and communication about the world. • Patterns and number relationships can be used to investigate, understand, and solve problems.	• How and why are patterns used and where can they be found in human-designed environments? • How are patterns and number relationships represented symbolically (such as consecutive odd numbers)? • How are tables, graphs, and equations used to represent, analyze, and extend patterns? • How are patterns used to solve problems and communicate information? • What kinds of strategies help reveal patterns and number relationships?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 2.11 Students understand mathematical change concepts and use them appropriately and accurately. **Academic Expectation 2.12** Students understand mathematical structure concepts including the properties and logic of various mathematical systems.	• Order of operations • Expressions • Exponents • One-variable linear equations	Student will: • apply the **complete order** of operations in evaluating expressions • **simplify and evaluate expressions using substitution, following the order of operations** • translate and evaluate written and verbal expressions to algebraic expressions • **identify parts of an expression using mathematical terms (sum, term, product, factor, quotient, and coefficient)** • **understand that a variable can represent an unknown number** • **evaluate expressions at specific values of their variables in formulas (2x + 7 when x = 3)** • **recognize two expressions as equivalent (e.g., y + y + y and 3y are equivalent expressions)** • **write and evaluate numerical expressions involving whole-number exponents** • **write in exponential format** • **evaluate an exponential expression** • **apply the addition, subtraction, multiplication, and division properties of equality to solve and check one-step algebraic equations (2x = 4; x + 5 = 8)** • solve real-world and mathematical problems by writing and solving equations • **recognize that inequalities of the form x > c or x < c have infinitely many solutions** • **represent solutions of inequalities on number line diagrams**

	• Properties	• **represent and analyze quantitative relationships between dependent and independent variables** • recognize, identify, and apply the inverse property of addition and multiplication • recognize, identify, and apply the addition, subtraction, multiplication, and division properties of equality • recognize, identify, and apply the identity properties of addition and multiplication • identify and apply the distributive property of addition and multiplication

Data Analysis and Probability – Grade Six

Essential Understandings	Guided Questions
• Data collection and analysis can be used to predict outcomes, solve problems, and make decisions.	• What factors influence the way data is collected and organized? • How is the analysis of data used to solve problems? • How is the reliability of data affected by the source, quantity, and method of collection? • How is the presentation of data used or misused to support different points of view?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 2.13 Students understand and appropriately use statistics and probability.	• Graphs	Student will: • determine the appropriate or best use of bar, line, and circle graphs • summarize, describe, and answer questions with regard to data in **histograms**, bar, line, circle, stem and leaf, **dot plots**, and **box and whisker graphs** • construct **complex** bar, line, or circle graphs on gathered or given data sets
	• Measures of central tendency	• **develop an understanding of statistical variability** • calculate mean, median, mode, and range and **interpret and explain their meaning** • **determine the appropriate or best use of mean, median, mode, and range** • **interpret the meaning of fractional and decimal values as related to mean**

Archdiocese of Louisville
Curriculum Framework
Mathematics

Number and Operations – Grade Seven

Essential Understandings	Guided Questions
• Mathematics can be used to describe, understand, and communicate about the world in order to solve problems and make decisions.	• What does mathematics reveal about the world? • What situations require the use of mathematical understandings? • How does mathematics enable people to work with intangible phenomena (such as distance, space, and nanosecond)? • How do concrete materials model mathematical situations?
• Characteristics of a situation or problem influence the choice of numbers, operations, strategies, and tools.	• How do the characteristics of a situation influence the choice of operations, strategies, and tools? • How is a solution determined to be reasonable, accurate, and complete?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 2.7 Students understand number concepts and use numbers appropriately and accurately. **Academic Expectation 2.8** Students understand various mathematical procedures and use them appropriately and accurately.	• Integers	Student will: • identify, order, and compare integers • **graph integers on a number line** • **add, subtract, multiply, and divide integers and explain their operational processes**
	• Rational numbers	• identify, order, and compare rational numbers • **graph rational numbers on a number line** • **apply properties of operations as strategies to add, subtract, multiply, and divide rational numbers and explain their operational processes** • **describe situations in which opposite quantities combine to make 0** • **understand subtraction of rational numbers as adding the additive inverse** • **convert rational numbers to decimals and classify as terminating, non-terminating, and repeating** • **solve real-world and mathematical problems involving the four operations of rational numbers**
	• Real numbers	• **classify real numbers as rational, irrational, whole, integer, or natural**
	• Percents	• **convert between decimal, fraction, and percent formats** • **compare and order percents (including those less than one and greater than 100)**

.		• **calculate the percent of a number (20% of 50) including applications to**
		  ○ **tax and discount**
		  ○ **simple interest**
		  ○ **commissions**
		  ○ **gratuities**
		  ○ **percent of change**

	• Ratios	• recognize and represent proportional relationships between quantities • identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships • solve ratio equations **using cross-multiplication** • solve word problems involving **ratios and proportions, including the percent proportion** (16 is what percent of 90) • **apply ratios and solve problems involving scale, models, and unit rates**
	• Exponents and roots	• **calculate perfect square roots** • **estimate the value of a non-perfect square root to a given decimal point value**

Geometry and Measurement – Grade Seven

Essential Understandings	Guided Questions
• Attributes and relationships of plane and solid figures, objects, and patterns can be used to describe, understand, and communicate about the world.	• How can geometry be seen in the natural and human-designed environments? • How are distance, direction, coordinates, and scale used to understand and explain the arrangement of objects and locations? • How do models and scale drawings enhance understanding used in problem-solving and design?
• Geometry has many real-world applications including design, architecture, and art.	• How do the characteristics of geometric shapes and figures influence their use in aesthetic and functional designs?
• Measurement allows description, understanding, and communication about the world.	• How is measurement used to quantify information about objects and events? • How do the characteristics of objects and events influence the choice of measurement strategies and tools? • How does the precision required for a measurement influence the choice of strategies and tools? • How is the understanding and communication about measurement used to solve problems and make decisions?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 2.9 Students understand space and dimensionality concepts and use them appropriately and accurately. **Academic Expectation 2.10** Students understand measurement concepts and use measurements appropriately and accurately.	• Plane figures	Student will: • prove the similarity of plane figures **by identifying congruent angles and proportional sides** • **solve problems involving scale drawings** • calculate the lengths of sides of similar plane figures • **sketch, draw, and construct geometric shapes with given conditions using ruler, protractor, compass, and technology** • **construct triangles from three measures of angles or sides** • **verify the properties of dilations, rotations, reflections, and translations and use these properties to compare two-dimensional figures**
	• Solid figures	• **describe the two-dimensional figures that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids**
	• Formulas	• **develop and/or use formulas** to calculate surface area and volume for solid figures (cone, sphere, pyramid, prism, cylinders) • **develop and/or use formulas to calculate the area and circumference of circles** • **develop and/or use formulas** to calculate the area and perimeter of plane figures

Algebra – Grade Seven

Essential Understandings	Guided Questions
• Patterns aid description, understanding, and communication about the world. • Patterns and number relationships can be used to investigate, understand, and solve problems.	• How and why are patterns used and where can they be found in human-designed environments? • How are patterns and number relationships represented symbolically (such as consecutive odd numbers)? • How are tables, graphs, and equations used to represent, analyze, and extend patterns? • How are patterns used to solve problems and communicate information? • What kinds of strategies help to reveal patterns and number relationships?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 2.11 Students understand mathematical change concepts and use them appropriately and accurately. **Academic Expectation 2.12** Students understand mathematical structure concepts including the properties and logic of various mathematical systems.	• Expressions • One-variable linear equations and inequalities	Student will: • **apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients** • **translate an expression from written to algebraic form and from algebraic to written form** • **identify and combine like terms** (2x + 3x = 5x) • solve and check **two-step equations** (2x + 3 = 5) **using rational numbers and the distributive property** [2 (x + 3) = 8] • **solve, check, and graph the solution to one- and two-step one-variable linear inequalities, excluding multiplication or division by a negative** [2x > 8; x – 5 < -9] • solve **multi-step** real-life mathematical problems posed with positive and negative rational numbers in any form by constructing simple equations and inequalities • evaluate solutions for reasonableness, accuracy, and completeness

Data Analysis and Probability – Grade Seven

Essential Understandings	Guided Questions
• Data collection and analysis can be used to predict outcomes, solve problems, and make decisions. • Probability supports making predictions, drawing conclusions, and solving problems.	• What factors influence the way data is collected and organized? • How is the analysis of data used to solve problems? • How is the reliability of data affected by the source, quantity, and method of collection? • How is the presentation of data used or misused to support different points of view? • How are the probability and odds of an event determined and expressed? • What factors influence the certainty and uncertainty of an event? • How is probability used to make predictions and draw conclusions?

Academic Expectations	Content Guidelines	Performance Standards
Academic Expectation 2.13 Students understand and appropriately use statistics and probability.	• Probability and statistics	Student will: • **differentiate between theoretical and experimental probability** • **investigate chance processes and develop, use, and evaluate probability models** • **calculate and interpret the probability of simple events** • **understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring** • **find probabilities of compound events using organized lists, tables, tree diagrams, and simulation**
	• Graphs	• **predict and infer** data from a variety of graphs • use random sampling to draw inferences about a population • draw informal comparative inferences about two populations

Archdiocese of Louisville
Curriculum Framework
Mathematics

Algebra – Grade Eight

Essential Understandings	Guided Questions
• Mathematics can be used to describe, understand, and communicate about the world in order to solve problems and make decisions. • Characteristics of a situation or problem influence the choice of numbers, operations, strategies, and tools.	• What does mathematics reveal about the world? • What situations require the use of mathematical understandings? • How does mathematics enable people to work with intangible phenomena (such as distance, space, and nanosecond)? • How do concrete materials model mathematical situations? • How do the characteristics of a situation influence the choice of numbers, operations, strategies, and tools? • How is it determined that a solution is reasonable, accurate, and complete?

Academic Expectations	Content Guidelines	Performance Standards

Academic Expectation 2.7
Students understand number concepts and use numbers appropriately and accurately.
 	
Academic Expectation 2.8
Students understand various mathematical procedures and use them appropriately and accurately.
 	
Academic Expectation 2.9
Students understand space and dimensionality concepts and use them appropriately and accurately.
 	
Academic Expectation 2.10
Students understand measurement concepts and use measurements appropriately and accurately.
	• Expressions	Student will:
		• **interpret parts of an expression, such as terms, factors, and coefficients**
		• **apply the appropriate properties of real numbers and the steps for order of operations to write, evaluate, simplify, add, subtract, multiply, and divide expressions:**
		  ○ **polynomial**
		  ○ **rational**
		  ○ **radical**
		  ○ **exponential including concept of scientific notation**
		• **derive the formula for the sum of a finite geometric series and use to solve problems**
		• **understand that a function, y = f (x), is a rule that assigns to each input (domain) exactly one output (range) – the graph of a function is the set of ordered pairs consisting of an input and the corresponding output**
		  ○ **compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal description)**
		• **use function notation to evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context**

Academic Expectation 2.11
Students understand mathematical change concepts and use them appropriately and accurately.
 	
Academic Expectation 2.12
Students understand mathematical structure concepts including the properties and logic of various mathematical systems.
 	
Academic Expectation 2.13
Students understand and appropriately use statistics and probability.
	• Equations, functions, and inequalities	• **solve one-variable linear equations and inequalities**
		  ○ **interpret the solution to identify the number of acceptable solutions (e.g., zero, one, infinitely many solutions)**
		  ○ **solve, graph, and check the solution to any one-variable linear equation or inequality**
		  ○ **solve and graph the solution to compound linear equations and inequalities including absolute value** ($x > 2$ and $x < 3$; $\|x\| = 3$)
		  ○ **rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations (linear equations)**
		• **analyze and solve linear equations, functions, and pairs of linear equations and functions**
		  ○ **understand the connections between proportional relationships, lines, linear equations, and inequalities with relation to slope**
		  ○ **solve two-variable linear equations, functions, and inequalities**
		  • **interpret the solution to identify the number of acceptable solutions (e.g., zero, one, infinitely many solutions)**
		  • **solve, graph, and check the solution to two-variable linear equations and inequalities including absolute value**
		  • **understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously**
		  • **solve, graph, and check the solution to two-variable systems of linear equations and inequalities using:**
		  • **substitution**
		  • **graphing**
		  • **linear combination (elimination)**
		  • **write the equation of a line using:**
		  • **data table**
		  • **linear graph**
		  • **point-slope form**
		  • **slope-intercept form**
		  • **standard form**
		  • **slope formula**
		  • **x-intercept and y-intercept**
		  • **parallel and perpendicular slopes**
		  • **construct a viable argument to justify a solution method**
		• **solve quadratic equations**
		  ○ **understand that solutions to a quadratic equation correspond to the x-intercepts of their graphs**
		  ○ **interpret the solution to identify the number of acceptable solutions (e.g., zero, one, and two)**

		○ **solve and check the solution to any quadratic equation and inequality using:** • **graphing – intercepts, vertex, maxima, minima, and line of symmetry** • **quadratic formula: $x = [-b +/- (b^2 – 4ac)^{1/2}] /2a$** • **factoring** • **formula for the line of symmetry: x = -b/2a** • **completing the square** • **standard graphing form: $y = a(x-b)^2 + c$** • **standard form: $y = ax^2 + bx + c$** ○ **construct a viable argument to justify a solution method** ○ **write a quadratic equation given a graph of a parabola or set of values** • **radical equations** ○ **interpret the solution to identify the number of acceptable solutions (e.g., extraneous solutions)** ○ **solve and check the solution to radical equations by:** • **completing the square** • **squaring both sides of the equation** • **applying Pythagorean Theorem** ○ **construct a viable argument to justify a solution method** • **rational equations** ○ **interpret the solution to identify the number of acceptable solutions (e.g., extraneous solutions)** ○ **solve and check the solution to rational equations using the concepts of:** • **the conjugate** • **least common denominator** • **cross-multiplication** ○ **construct a viable argument to justify a solution method**
	• Problem solving	• **create equations and inequalities in one or two variables and use them to solve problems** • **solve standard word problems using one or two variables including:** ○ **uniform motion or distance** ○ **consecutive integers** ○ **geometric properties of perimeter, area, and Pythagorean Theorem** ○ **mixture or solution** ○ **work** ○ **combination** ○ **place value or digit**

	• Statistics and probability	○ **age** ○ **scientific notation** • **interpret the solution to identify the number of acceptable solutions (e.g., extraneous solutions)** • **evaluate solutions for reasonableness, accuracy, and completeness** • **investigate patterns of association in two-variable data** ○ **construct and interpret scatter plots to investigate patterns of association such as positive and negative correlation, linear and nonlinear associations, and outliers**

.

Examples of Formative and Summative Assessments

Primary	Intermediate	Middle School
Observations Anecdotal records Pre- and post-assessments Multiple choice assessments Open response questions Drawing software Oral presentations Graphic organizers K-W-L charts Summaries Entry / exit tickets Models Video productions Dramatizations Mobiles Brochures Diagrams Groups projects Art, dance, and music performances Math portfolio entries Math talks PowerPoint presentations Math centers Collages and posters	Pre- and post-assessments Simple Solutions (or similar type of daily spiral review) Problem solving Word problems Student generated questions "Where's the Math?" Math-related current events Estimation jars Math centers Group projects Anchor activities Open response questions Brochures Art, dance, and music performances Textbook and teacher created tests and quizzes Diagrams Persuasive, informative, and descriptive essays File folder games Concept mapping Real-life applications Function machines Problems or number of the day WebPages PowerPoint presentations Oral presentations Graphic organizers Models K-W-L charts Debates Interviews Poetry Entry / exit tickets Video productions Multiple choice assessments	Teacher created / book generated tests and quizzes Posters / graphic organizers / brochures Student created tests and quizzes Student written word problems Speeches ("How does the real world use order of operations?") Songs related to mathematical topics Real-life task performances related to taxes, cooking, sports, investments, etc. Geometric models / mobiles Essays Error analysis Student taught lessons Oral response Scale maps / drawings Cumulative exams / tests K-W-L charts Pre-assessment of prior knowledge Slide show presentations Cooperative group presentations Self-evaluation Informal observations Homework Warm-up activities Data gathered to model function rules

Examples of Applications for Technology/Library Media – Primary

General Applications
- Use applicable software and web pages for problem solving and skills practice.
- Create multimedia presentations and web pages on topics in mathematics.
- Use alternate technologies to reinforce content curriculum (e.g., scanners, interactive whiteboards, projectors, computers, calculators, cameras, videos, and microphones).
- Use student response systems to assess student understanding.

Number and Operations
- Use books to expand on skills (e.g., counting books, pattern books, and shape books).
- Relate place value and ordering with call numbers.

Geometry
- Use content appropriate electronic tools (e.g., use camera to photograph shapes around learning environment).

Measurement
- Use applicable computer drawing tools (e.g., paint and graphics).

Algebra
- Use graphic applications (e.g., use clip art to make patterns).

Data Analysis
- Use database, templates, and spreadsheets (e.g., record information from class graphs, surveys, and daily observations).

Examples of Applications for Technology/Library Media – Intermediate

General Applications
- Use grade appropriate problem solving and skills practice software.
- Create multimedia presentations on topics in mathematics.
- Use alternate technologies to reinforce content curriculum (e.g., electronic white boards, scanners, projectors, calculators, etc.).
- Use student response systems to assess student understanding.

Number and Operations
- Create a spreadsheet to demonstrate knowledge of operations (+, -, x,÷).
- Use calculator to search for numerical patterns.
- Relate call numbers/Dewey Decimal System to ordering and place value.

Geometry
- Create geometric figures using a drawing program.
- Use camera to find examples of geometric shapes in the world.

Measurement
- Use encyclopedias, almanacs, and other reference tools to find real world measurements (e.g., perimeter, volume, area).
- Use drawing program to demonstrate knowledge of measurement (e.g., area of a room).

Algebra
- Use spreadsheet to create a function machine**.**
- Use a drawing program to design arrays to demonstrate multiplicative properties.

Data Analysis and Probability
- Use grade appropriate software to create different graphs/charts and compare/interpret data in multiple layouts.

Examples of Applications for Technology/Library Media – Middle School

General Applications
- Use applicable software and online resources for problem solving, skill practice, supplemental lessons, and simple programming.
- Research mathematics topics using library media or Internet resources.
- Create multimedia presentation or web pages on topics in mathematics.
- Reinforce content using alternate technologies (e.g., scanners, electronic white boards, projection devices, computers, calculators, cameras, videos).
- Use student response systems to assess student understanding.

Number and Operations
- Use spreadsheet software to solve real-world or simulated real-world problems (e.g., balancing a check book, calculating credit card or loan payments with interest).

Geometry
- Use geometry web sites or software to demonstrate geometric principles or theorems.
- Use software to create tessellations.

Algebra
- Use a spreadsheet to demonstrate functional relationships.
- Use a graphing calculator for graphing equations and exploring algebraic concepts.

Measurement
- Use a spreadsheet to create a conversion table for different units of measurement.
- Use CAD or home design software to design a room or house and calculate area, volume, and costs.

Data Analysis and Probability
- Use Internet resources to gather real-world data for statistical analysis.
- Use spreadsheet software to collect and represent data in a variety of forms (e.g., compile survey results and display information in appropriate graph format).

Archdiocese of Louisville
Curriculum Framework
Mathematics