Archdiocese of Cincinnati

Mathematics

Graded Course of Study

Aligned with:

The Ohio New Learning Standards for Social Studies

Infused with:

Catholic Identity Initiatives

Grades K-8

Updated 2021

Approved by:

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ARCHDIOCESE OF
CINCINNATI
Catholic Schools Office

Summer, 2021

Dear Catholic School Educators,

On behalf of the Catholic Schools Office, I am pleased to present the 2021 Archdiocesan Graded Course of Study (GCS) for Mathematics. This curriculum is the product of excellent research, effort, and was prepared to ensure the continuation of high-quality teaching and learning in our classrooms. Our Catholic schools have inherited a rich history of superior instruction for our students, and this body of work seeks to enhance that tradition as we incorporate data informed instruction with pedagogy.

The new Graded Course of Study for Mathematics is designed to provide a strong foundation for educators teaching this subject. It continues to be aligned with National Core Curriculum and Ohio New Learning Standards while also including learning strands, anchor standards and curriculum maps; to support teachers as they plan lessons and incorporate these standards. Lastly, I invite you to review the portion related to the alignment with Catholic Identity and the Principles of Catholic Social Teaching. Our Church has been in the forefront of mathematical research and implementation, and it is important that connections continue to be made between the subject matter and our Catholic faith.

Your dedication to students, your vocation as Catholic school educators, and your continued support of our common mission is a gift to our entire Archdiocese.

Sincerely yours in Christ,

Susan M. Gibbons

Susan M. Gibbons
Director of Educational Services and
Superintendent of Catholic Schools

INTRODUCTION TO MATHEMATICS

In 2021, the Catholic Schools Office revised the K-8 Mathematics Graded Course of Study to provide clarity on curriculum standards outlining the academic expectations throughout our schools within the Archdiocese of Cincinnati. By our definition, the Graded Course of Study provides curriculum standards to identify the content knowledge and skills students are expected to demonstrate within courses and across grade levels. These standards provide normative targets and expectations for student performance. When a student has successfully completed a course or grade level, he or she will have demonstrated competence in the knowledge, skills, or attitudes required of that course or grade level.

Principles for Mathematics for the Archdiocese of Cincinnati Catholic Schools

***Equity*.** Excellence in mathematics education requires equity – high expectations and strong support for all students.

- Achieving equity requires a significant allocation of human and material resources in schools and classrooms. Instructional tools, curriculum materials, special supplemental programs and the skillful use of community resources undoubtedly play important roles. An even more important component is the professional development of teachers. Teachers need help to understand the strengths and needs of students who come from diverse linguistic and cultural background who have specific disabilities or who possess a special talent and interest in mathematics. To accommodate differences among students effectively and sensitively, teachers also need to understand and confront their own beliefs and biases.

***Curriculum*.** A curriculum is more than a collection of activities; it must be coherent, focused on important mathematics and well-articulated across the grades.

- A school mathematics curriculum is a strong determinant of what students have an opportunity to lean and what they do learn. In a coherent curriculum, mathematical ideas are linked to and build on one another so that students' understanding, and knowledge deepens and their ability to apply mathematics expands. An effective mathematics curriculum focuses on important mathematics – mathematics that will prepare students for continued study and for solving problems in a variety of school, home, and work settings. A well-articulated curriculum challenges student to learn increasingly more sophisticated mathematical ideas as they continue their studies.

***Teaching*.** Effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well.

- To be effective, teachers must know and understand deeply the mathematics they are teaching and be able to draw on that knowledge with flexibility in their teaching tasks. They need to understand and be committed to their students as learners of mathematics and as human beings and be skillful in choosing from and using a variety of pedagogical and assessment strategies (National Commission on Teaching and America's Future 1996). In addition, effective teaching requires reflection and continual efforts to seek improvement. Teachers must have frequent and ample opportunities and resources to enhance and refresh their knowledge.

***Learning*.** Students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge.

- The kinds of experiences teachers provide clearly play a major role in determining the extent and quality of students' learning. Students' understanding of mathematical ideas can be built throughout their school years if they actively engage in tasks and experiences designed to deepen and connect their knowledge. Learning with understanding can be further enhanced by classroom interactions, as students propose mathematical ideas and conjectures learn to evaluate their own thinking and that of others and develop mathematical reasoning skills. Classroom discourse and social interaction can be used to promote the recognition of connections among ideas and the reorganization of knowledge. By having students talk about their informal strategies, teachers can help them become aware of, and build on, their implicit informal knowledge. Moreover, in such settings, procedural fluency and conceptual understanding can be developed through problem solving reasoning and argumentation.

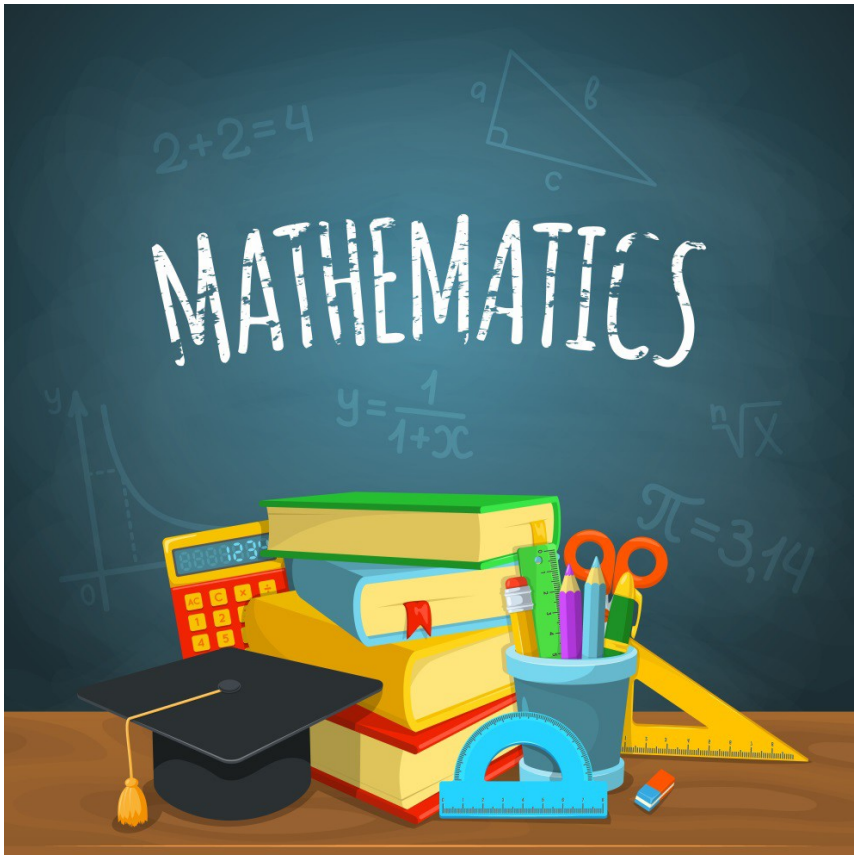
Assessment. Assessment should support the learning of important mathematics and furnish useful information to both teachers and students.

- The *Assessment Standards for School Mathematics* (NCTM, 1995) presented six standards about exemplary mathematics assessment. They addressed how assessment should - reflect the mathematics that students should know and be able to do; enhance mathematics learning; promote equity; be an open process; promote valid inference; be a coherent process.

Technology. Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning.

- Electronic technologies – calculators and computers – are essential tools for teaching, learning, and doing mathematics. They furnish visual images of mathematical ideas; they facilitate organizing and analyzing data and they compute efficiently and accurately. They can support investigation by students in every area of mathematics, including geometry, statistics, algebra, measurement, and number. When technological tools are available, students can focus on decision making, reflection, reasoning and problem solving.

National Council of Teachers of Mathematics (2000). Principles and standards for school mathematics. Reston, VA: NCTM, Inc.



Standards for Mathematical Practice

The K-8 Mathematics Graded Course of Study is aligned to Ohio's Learning Standards and includes critical areas for instruction incorporating the same Mathematical Practices throughout all grade levels.

The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in students. These practices rest on important "processes and proficiencies" with longstanding importance in mathematics education. The first of these are the NCTM process standards of problem solving, reasoning and proof, communication, representation, and connections. The second are the strands of mathematical proficiency specified in the National Research Council's report Adding It Up: adaptive reasoning, strategic competence, conceptual understanding (comprehension of mathematical concepts, operations and relations), procedural fluency (skill in carrying out procedures flexibly, accurately, efficiently and appropriately), and productive disposition (habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy).

1.) Make sense of problems and persevere in solving them.

Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems and try special cases and simpler forms of the original problem to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, "Does this make sense?" They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

2.) Reason abstractly and quantitatively.

Mathematically proficient students make sense of the quantities and their relationships in problem situations. Students bring two complementary abilities to bear on problems involving quantitative relationships: the ability to decontextualize – to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents – and the ability to contextualize, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; knowing and flexibly using different properties of operations and objects.

3.) Construct viable arguments and critique the reasoning of others.

Mathematically proficient students understand, and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They can analyze situations by breaking them into cases and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that consider the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and – if there is a flaw in an argument – explain what it is. Elementary students can construct arguments using concrete referents such as objects drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Student at all grades can listen or read the arguments of others, decide whether they made sense, and ask useful questions to clarify or improve the arguments.

4.) Model with mathematics.

Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They can identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts, and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

5.) Use appropriate tools strategically.

Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and another mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels can identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They can use technological tools to explore and deepen their understanding of concepts.

6.) Attend to precision.

Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.

7.) Look for and make use of structure.

Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount at seven and three more, or they may sort a collection of shapes according to how many sides the shapes have. Later, students will see 7 x 8 equals the well-remembered 7 x 5 + 7 x 3, in preparation for learning about the distributive property. In the expression xx2 + 9x + 14, older students can see the 14 as 2 x 7 and the 9 as 2 + 7. They recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For examples, they can see 5 - 3(x - y)² as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers x and y.

8.) Look for and express regularity in repeated reasoning.

Mathematically proficient students notice if calculations are repeated and look both for general methods and for shortcuts. Upper elementary students might notice when dividing 25 by 11 that they are repeating the same calculations repeatedly, and conclude they have a repeating decimal. By paying attention to the calculation of slope as they repeatedly check whether points are on the line through (1, 2) with slope 3, middle school students might abstract the equation (y – 2)/(x -1) = 3. Noticing the regularity in the way terms cancel when expanding (x – 1)(x = 1), (x – 1)(x² + x + 1), and (x – 1)(xx ³ + xx ² + x +1) might lead them to the general formula for the sum of a geometric series. As they work to solve a problem, mathematically proficient students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results.

Connecting the Standards for Mathematical Practice to the Standards for Mathematical Content

The standards for Mathematical Practice describe ways in which developing student practitioners of the discipline of mathematics increasingly ought to engage with the subject matter as they grow in mathematical maturity and expertise throughout the elementary, middle, and high school years. Designers of curricula, assessments, and professional development should all attend to the need to connect the mathematical practices to mathematical content in mathematics instruction.

The Standards for Mathematical Content are a balanced combination of procedure and understanding. Expectations that begin with the word "understand" are often especially good opportunities to connect the practices to the content. Students who lack understanding of a topic may rely on procedures too heavily. Without a flexible base from which to work, they may be less likely to consider analogous problems, represent problems coherently, justify conclusions, apply the mathematics to practical situations, use technology mindfully to work with the mathematics, explain the mathematics to practical situations, use technology mindfully to work with the mathematics, explain the mathematics accurately to other students, step back for an overview, or deviate from a known procedure to find a shortcut. In short, a lack of understanding effectively prevents a student from engaging in the mathematical practices.

In this respect, those content standards which set an expectation of understanding are potential "points of intersection" between the Standards for Mathematical Content and the Standards for Mathematical Practice. These points of intersection are intended to be weighted toward central and generative concepts in the school mathematics curriculum, which most merit the time, resources, innovative energies, and focus necessary to qualitatively improve the curriculum, instruction, assessment, professional development, and student achievement in mathematics.

Source: Ohio Department of Education

PRIORITY and SUPPORTING STANDARDS

Priority Standards

Standards that have been identified as most essential to a particular grade level and content area. Students will receive instruction on all standards listed in the Archdiocese of Cincinnati Graded Course of Study, however teachers are expected to devote significant time and resources to ensuring that Prioritized Standards are mastered. Summative Assessments should have an emphasis on Priority Standards and teachers must focus on utilizing student data to drive instruction. It is essential for students to master all the Priority Standards to ensure they are prepared for the following grade.

Criteria for Prioritized Standards

Endurance – Knowledge and skills that last beyond one grade or one course.

Leverage – Knowledge and skills that are cross-curricular and traverse into many domains of learning.

Readiness – Knowledge and skills that are essential for success in the next grade level.

Assessment – Knowledge and skills that will be measured on high stakes assessments.

Supporting Standards

Standards that connect, support, and enhance the Priority Standards to serve as instructional scaffolds. Although Supporting Standards do not receive the same degree of instruction and assessment emphasis as the Priority Standards, instruction on these standards is expected.

ASSESSMENT

Assessment is one of the most powerful strategies for improving student learning.

Formative Assessment is described as "assessment for meaning" and is an ongoing process to monitor each student's learning on a continuous basis. Formative assessments measure a few things frequently and are intended to inform teachers regarding the effectiveness of the objective/s taught to scaffold the learning of the students. Formative assessment should advance and motivate students rather than merely generate a report on student learning. (Stiggins & DuFour, 2009)

Summative Assessment assesses what students have learned by a specific deadline after the formative assessments have occurred. Examples of a summative assessment are paper and pencil tests after completely learning a particular standard or a quarterly exam. Summative assessments are the results after formative assessments and scaffolding have transpired.

KINDERGARTEN MATHEMATICS

The Archdiocese of Cincinnati has established the following mathematics standards to make clear to teachers, students, and parents what knowledge, understanding and skills students should acquire to satisfy the math requirements for Kindergarten.

In Kindergarten, math instructional time needs to focus on two critical areas.

1. **Representing, relating, and operating on whole numbers, initially with sets of objects.**
2. **Describing shapes and space. More learning time in Kindergarten should be devoted to number than to other topics.**

DOMAIN – COUNTING AND CARDINALITY - CC

Students learn to order numbers as they become more familiar with whole numbers. They learn to identify and duplicate simple number and non-numeric repeating and growing patterns. Students will become fluent in adding and subtracting numbers, students compare two numbers between 0 and 10 presented as written numerals.

DOMAIN – OPERATION AND ALGEBRAIC THINKING - OA

Students learn to understand that putting together is adding and taking apart, or from, is subtraction. They learn to compose and decompose numbers. Students record compositions for numbers less than or equal to 10 into pairs in multiple ways using objects, drawing an equation.

DOMAIN – NUMBERS, NUMBER SENSE AND OPERATIONS IN BASE TEN - NBT

Understanding the number system is the basis of mathematics. Students first need to learn the concept of knowing number names and the count sequence. Students also develop the understanding and relationship between numbers and quantities, compose and decompose numbers and gain foundations for place values.

DOMAIN – MEASUREMENT AND DATA - MD

Students learn to describe and compare measurable attributes by length, weight, time, bigger than or less than. They learn to count and sort objects by categories. Students also become familiar with time using indicators such as morning, night, day, week, month, and year. Students classify objects into given categories and sort the categories by count.

DOMAIN – GEOMETRY (DIMENSIONAL SHAPES) - G

Students learn to describe, sort, and identify shapes, sizes, and positions of shapes. They identify and name objects and shapes (squares, circles, triangles, rectangles, hexagons) and escribe their relative positions using above, below, near, joining, next to, etc.

Kindergarten Mathematics
Priority Standards and Exiting Skills

The Archdiocese of Cincinnati stipulates the following Priority Standards and Exiting Skills in Mathematics for Kindergarten students:

Domain: Counting and Cardinality

Anchor: Know number names and the count sequence.

- ✓ Know numbers and be able to write numbers: 0-20.
- ✓ Order whole numbers.
- ✓ Identify simple and duplicate numbers.
- ✓ Count forward within 100 from any given number.
- ✓ Represent a number of objects with a written numeral, 0-20 in standard order.

Anchor: Count to tell the number of objects.

- ✓ Count objects saying the number names in the standard order.
- ✓ Understand that the last number name said tells the number of objects counted
- ✓ Understand that the number of objects is the same regardless of their arrangement or order in which they were counted.
- ✓ Count to answer "how many" questions about as many as 20 objects.

Anchor: Compare Numbers

- ✓ Compare two numbers between 0-10 as written numbers.

Domain: Operations of Algebraic Thinking

Anchor: Understand addition as putting together and adding to, and understand subtraction as taking apart and taking from.

- ✓ Represent addition and subtraction with objects and verbal explanations onequations.
- ✓ Solve addition and subtraction problems within 10.
- ✓ Decompose numbers and record compositions for numbers less than or equal to 10 into pairs.
- ✓ Fluently add and subtract 5.

Kindergarten Mathematics
Supporting Standards and Exiting Skills

The Archdiocese of Cincinnati stipulates the following Supporting Standards and Exiting Skills in Mathematics for Kindergarten students:

Domain: Number Operations in Base Ten

Anchor: Work with numbers 11-19 to gain foundation for place value.

- ✓ Compare and decompose numbers from 11-19 into a group of ten ones.
- ✓ Understand that numbers 11-19 are composed of a group of ten ones and one, two, three, four, five, six, seven, eight, or nine ones.

Domain: Measurement and Data

Anchor: Identify, describe, and compare measurable attributes.

- ✓ Identify and describe measurable attributes using vocabulary terms such as long/short, heavy/light, tall/short.
- ✓ Directly compose to objects to measure "more or less" and describe the difference.

Anchor: Classify objects and count the number of objects in each category.

- ✓ Classify objects into categories: count the number and sort by categories.

Domain: Geometry

Anchor: Identify and describe shapes.

- ✓ Describe objects and name.
- ✓ Describe relative positions of objects: before, above, next to, etc.
- ✓ Identify shapes as two dimensional, or three dimensional.

Anchor: Describe, compare, and compose shapes.

- ✓ Describe and compare two- and three-dimensional shapes using language to describe commonalities, differences, parts, and other attributes.
- ✓ Model shapes in the world by building shapes.
  - ✓ Combine simple shapes from larger shapes.

Kindergarten Mathematics

COUNTING AND CARDINALITY - CC

ANCHOR STANDARD

M.CC.K.1 **Know number names and the count sequence.**

STANDARD

M.CC.K.1.1 Count to 100 by ones and tens.

M.CC.K.1.2 Count forward within 100 beginning from a given number within the known sequence (instead of having to begin at 1).

M.CC.K.1.3 Write numbers from 0 to 20.

M.CC.K.1.4 Represent a number of objects with a written numeral 0 -20 (with 0 representing a count of no objects).

ANCHOR STANDARD

M.CC.K.2 **Count to tell the number of objects.**

STANDARD

M.CC.K.2.1 Count objects saying the number names in the standard order.

M.CC.K.2.2 Pair each object with one and only one number name and each number name with one and only one object.

M.CC.K.2.3 Understand that the last number name said tells the number of objects counted.

M.CC.K.2.4 Understand that the number of objects is the same regardless of their arrangement or order in which they were counted.

M.CC.K.2.5 Understand that each successive number name refers to a quantity that is the larger.

M.CC.K.2.6 Count to answer "how many" questions about as many as 20 things arranged in a line, a rectangular array, or a circle, or as many as 10 things in a scattered configuration, given a number from 1 -20, count out that many objects.

	ANCHOR STANDARD
M.CC.K.3	**Compare numbers**
	STANDARD
M.CC.K.3.1	Orally identify (without using inequality symbols) whether the number of objects in one group is greater/more than, less/fewer than, or the same as the number of objects in another group, not to exceed 10 objects in each group
M.CC.K.3.1.2	Compare two numbers between 0 and 10 presented as written

OPERATIONS OF ALGEBRAIC THINKING - OA

	ANCHOR STANDARD
M.OA.K.1	**Understand addition as putting together and adding to, and understand subtraction as taking apart and taking from.**
	STANDARD
M.OA.K.1.1	Represent addition and subtraction with objects, fingers, mental images, drawings, sounds, such as claps, acting out situations, verbal explanations, or equations.
M.OA.K.1.2	Solve addition and subtraction problems, (written or oral), and add and subtract within 10 by using objects or drawings to represent the problem.
M.OA.K.1.3	Decompose numbers, and record compositions for numbers less than or equal to 10 into pairs in more than one way by using objects and, when appropriate drawing an equation.
M.OA.K.1.4	For any number from 1 to 9, find the number that makes 10 when added to the given number, e.g. by using objects or drawings, and record the answer with a drawing or an equation.
M.OA.K.1.5	Fluently add and subtract within 5.

NUMBER AND OPERATIONS IN BASE TEN - NBT

	ANCHOR STANDARD
M.NBT.K.1	**Work with numbers 11 -19 to gain foundations for place value.**
	STANDARD
M.NBT.K.1.1	Compose and decompose numbers from 11 -19 into a group of ten ones and some further ones by using objects, drawings, or equations.
M.NBT.K.1.2	Understand that numbers 11 -19 are composed of a group of ten ones and one, two, three, four, five, six, seven, eight or nine ones.

MEASUREMENT AND DATA - MD

	ANCHOR STANDARD
M.MD.K.1	**Identify, describe, and compare measurable attributes.**
	STANDARD
M.MD.K.1.1	Identify and describe measurable attributes (length, weight, and height) of a single object using vocabulary terms such as long/short, heavy/light, or tall/short.
M.MD.K.1.2	Directly compare two objects with a measurable attribute in common to see which object has “more of”/ “less of” attribute the and describe the difference.
M.MD.K.2	**Classify objects and count the number of objects in each category.**
M.MD.K.2.1	Classify objects into given categories, count the numbers of objects in each category and sort the categories by count.

GEOMETRY - G

	ANCHOR STANDARD
M.G.K.1	**Identify and describe shapes (squares, circles, triangles, rectangles, hexagons, cubes, cones, cylinders, and spheres).**
	STANDARD
M.G.K.1.1	Describe objects in the environment using names of shapes.
M.G.K.1.2	Describe the relative positions of these objects using terms such as above, below, besides, in front of, behind, and next to.
M.G.K.1.3	Correctly name shapes regardless of their orientations or overall size.
M.G.K.1.4	Identify shapes as two-dimensional (lying in a plane, "flat") or three dimensional ("Solid")
	ANCHOR STANDARD
M.G.K.2	**Describe, compare, create, and compose shapes.**
	STANDARD
M.G.K.2.1	Describe and compare two- or three-dimensional shapes in different sizes and orientations, using informal language to describe their commonalities, differences, parts, and other attributes.
M.G.K.2.2	Model shapes in the world by building shapes from component, e.g., sticks and clay balls and drawing shapes.
M.G.K.2.3	Combine simple shapes to form larger shapes.

GRADE 1 MATHEMATICS

The Archdiocese of Cincinnati has established the following mathematics standards to make clear to teachers, students, and parents what knowledge, understanding and skills students should acquire to satisfy the math requirements for Grade 1.

In Grade 1, math instructional time needs to focus on four critical areas.

1. **Developing understanding of addition, subtraction, and strategies for addition and subtraction with 20.**
2. **Developing understanding of whole number relationships and place value, including grouping in tens and ones.**
3. **Developing understanding of linear measurement and measuring lengths as iterating length units.**
4. **Reasoning about attributes of and composing and decomposing geometric shapes.**

DOMAIN – OPERATION AND ALGEBRAIC THINKING - OA

Students learn the language of patterns, rules, and symbols (Algebra). They can relate word problems to number sentences in symbols, such as 4 + 5 = 9, and learn some of the rules relating addition and subtraction by comparing a variety of solution strategies. Students will construct and interpret graphs with at least three categories.

DOMAIN - NUMBER AND OPERATIONS IN BASE TEN - NBT

Understanding the number system is the basis of mathematics. Students develop this understanding by first counting sets of objects and then moving on to writing numbers in figures. The learn how to group numbers in tens and ones, allowing them to write numbers up to 120. Students develop strategies for adding and subtracting whole numbers based on their prior work with small numbers. They find the number one more or one less than a given number. They can put numbers up to 10 in order of size and use the terms, first, second, third, etc. Students also learn about fractions, understanding that fractions compare a part of a set to the whole set.

DOMAIN – MEASUREMENT AND DATA - MD

Students begin the study of measurement by comparing objects' length, weight, temperature, etc. They develop an understanding of the meaning and process of measurement. Students become more precise in their predictions as they learn to mentally and physically compare and contrast lengths, weights, temperatures, etc. Students' progress towards understanding the terms for units of length: inch, foot, yard, and can identify these units. They next learn how to tell time on an analog clock to the nearest half hour. Students also learn about money. They understand value and can recognize coins by their nomenclature.

DOMAIN – GEOMETRY - G

Students develop an understanding about geometric shapes and develop a sense of space. They describe and draw simple shapes, comparing and sorting them to compose or decompose planes or solid figures (two triangles together to make a quadrilateral). They compare and sort shapes by size and number of sides. Students learn to identify objects as two- or three- dimensions and can describe the faces of solid objects. Students recognize shapes from different perspectives, can describe their geometric attributes and determine how they are alike and different. Students develop a background for measurement and for initial understandings of properties (congruent and symmetry).

Grade 1 Mathematics

Priority Standards and Exiting Skills

The Archdiocese of Cincinnati stipulates the following exiting skills in Mathematics for Grade 1 students:

Domain: Operation and Algebraic Thinking

Anchor: Represent and solve problems involving addition and subtraction.

- ✓ Use addition and subtraction with 20 to solve problems involving addition to, taking from, putting together, taking apart, and comparing with unknowns.
- ✓ Use objects, drawings, and equations with a symbol for the unknown number to represent the problem.
- ✓ Add and subtract within 20 to solve word problems.
- ✓ Solve word problems with three whole numbers whose sum is less than 20.
- ✓ Use objects, drawings, or equations with a symbol for the unknown number to representthe problem.

Anchor: Understand and apply "properties of operations" and the relationship between addition and subtraction.

- ✓ Understand subtraction as an unknown addend problem.

Anchor: Add and subtract within 20.

- ✓ Add and subtract within 20, demonstrating fluency.
- ✓ Decompose a number leading to a 10.
- ✓ Recognize the relationship between addition and subtraction.

Anchor: Work with addition and subtraction equations.

- ✓ Understand the meaning of the equal sign =.
- ✓ Identify true or false equations involving addition and subtraction.
- ✓ Determine the unknown whole number in addition or subtraction equation relating three whole numbers.

Domain: Number and Operations in Base Ten

Anchor: Understand place value.

- ✓ Understand two-digit number represent amounts of tens and ones.
- ✓ The numbers from 11-19 are composed of a ten and ones.

- ✓ Compare two-digit numbers based on meanings of the tens and one's digits.
- ✓ Create and use counting strategies and number patterns to compare whole numbers up to 120.
- ✓ Record the results of comparisons with symbols <,+,> and arrange them in numerical order.

Anchor: Use place value understanding and properties of operations to add and subtract.

- ✓ Add with 100 including adding a two-digit and one-digit number.
- ✓ Add a two-digit and multiple of ten using concrete models or drawings, and strategies based on place value, properties of operations, and relationship between addition and subtraction.
- ✓ Understand that in adding two-digit numbers, tens are added to tens and ones are added to ones.
- ✓ Subtract multiples of 10 in the range 10-90 from multiples of 10 in the range 10-90.
- ✓ Using concrete models or drawing and strategies based on place value "properties of operations" relate the strategy to a written method and explain the reasoning used.

Domain: Measurement and Data

Anchor: Measure lengths indirectly and by iterating length units.

- ✓ Compare three objects by lengths by comparing two objects using third object.
- ✓ Express the length of an object as a whole number of length units by comparing shorter units.

Grade 1 Mathematics
Supporting Standards and Exiting Skills

Domain: Number and Operations in Base Ten

Anchor: Extend the counting sequence.

- ✓ Count to 120, starting at any number less than 120.
- ✓ Read and write numerals.
- ✓ Represent a number of objects with a written numeral.
- ✓ Read, write, count, and compare whole numbers up to 120.
- ✓ Separate, group and count objects in ones and tens.
- ✓ Identify, name, and write the number that is one more or less than any number up to120.
- ✓ Solve routines of matching number names (first, second, third, etc.) with ordered set of at least ten numbers.

Domain: Measurement and Data

Anchor: Tell and write time and distinguish money.

- ✓ Tell and write time hours and half-hours using analog and digital clocks.
- ✓ Identify pennies and dimes by name and value.

Anchor: Represent and interpret data.

- ✓ Organize, represent, and interpret data up to three categories.
- ✓ Compare and ask questions in each category.

Anchor: Reason with the shapes and their attributes.

- ✓ Distinguish between defining attributes, i.e. *triangles or three sided*.
- ✓ Compose two-dimensional shapes or three-dimensional shapes to create a composite shape.
- ✓ Describe and label the shapes using: *halves, fourths, and quarters*.
- ✓ Use the phases and demonstrate *half of, fourths, and quarter of*.

GRADE 1 MATHEMATICS

OPERATIONS AND ALGEBRACIC THINKING - OA

ANCHOR STANDARD

M.OA.1.1 **Represent and solve problems involving addition and subtraction.**

STANDARD

M.OA.1.1.1 Use addition and subtraction within 20 to solve work problems involving situations of adding to, taking from, putting together, taking apart, and comparing with unknowns in all positions.

M.OA.1.1.2 Use objects, drawings, and equations with a symbol for the unknown number to represent the problem of adding and subtracting within 20 to solve word problems.

M.OA.1.1.3 Solve word problems that call for addition of three whole numbers whose sum is less than or equal to 20, use objects drawings or equations with a symbol for unknown number to represent the problem.

ANCHOR STANDARD

M.OA.1.2 **Understand and apply "properties of operations" and the relationship between addition and subtraction.**

STANDARD

M.OA.1.2.2 Understand subtraction as an unknown addend problem. For example subtract 10 – 8 by finding the number that make 10 when added to 8.

ANCHOR STANDARD

M.OA.1.3 **Add and subtract within 20.**

STANDARD

M.OA.1.3.1	Add and subtract within 20, demonstrating fluency with various strategies for addition and subtraction within 10. For example, 8 + 6 = 8 + 2 + 4 = 10 + 4 = 14.
M.OA.1.3.2	Decompose a number leading to a 10. For example, 13 – 4 = 13 – 3 – 1 + 10 – 1 = 9
M.OA.1.3.3	Using the relationship between addition and subtraction. For example, knowing that 8 + 4 = 12, one knows 12 – 8 =4; and creating equivalent but easier or known sums, e.g., adding 6 + 7 by creating the known equivalent 6 + 6 + 1 = 12 + 1 = 13.

ANCHOR STANDARD

M.OA.1.4	**Work with addition and subtraction equations.**

STANDARD

M.OA.1.4.1	Understand the meaning of the equal sign (=).
M.OA.1.4.2	Determine if equations involving addition and subtraction are true or false. For example, which are true, and which are false? 6 = 6, 7 = 8 – 1, 5 + 2 = 2 + 5, 4 + 1 = 5 + 2.
M.OA.1.4.3	Determine the unknown whole number in addition or subtraction equation relating three whole numbers. For example, determine the unknown number that makes the equations true in each of the equations 8 + □ = 11, 5 = □ - 3, 6 + 6 = □.

NUMBER AND OPERATIONS IN BASE TEN - NBT

ANCHOR STANDARD

M.NBT.1	**Extend the counting sequence.**

STANDARD

M.NBT.1.1	Count to 120, starting at any number less than 120.
M.NBT.1.1.2	Read and write numerals and represent a number of objects with a written numeral.

M.NBT.1.1.3	Read, write, count, and compare whole numbers up to
120.M.NBT.1.1.4	Separate, group, and count objects in ones and tens.
M.NBT.1.1.5	Identify, name, and write the number that is one more than or one less than any number up to 120.
M.NBT.1.1.6	Solve routines of matching the number names (first, second, third, etc.) with an ordered set of at least ten numbers.
	ANCHOR STANDARD
M.NBT.1.2	**Understand place value.**
	STANDARD
M.NBT.1.2.1	Understand that the two digits of a two-digit number represent amounts of tens and ones.
M.NBT.1.2.2	Understand the following special cases: - 10 can be thought of as a bundle of tens ones called a "ten".
M.NBT.1.2.3	The numbers from 11 - 19 are composed of a ten and one, two, three, four, five, six, seven, eight or nine ones.
M.NBT.1.2.4	The numbers 10, 20, 30. 40, 50, 60, 70, 80, 90 refer to one, two, three, four, five six, seven, eight, or nine tens (and 0 ones).
M.NBT.1.2.5	Compare two-digit numbers based on meanings of the tens and ones digits recording the results of comparisons.
M.NBT.1.2.6	Create and use counting strategies and number patterns to compare whole numbers up to 120 recording the results of comparisons with symbols ≤, =, and ≥ and arrange them in numerical order.
	ANCHOR STANDARD
M.NBT.1.3	**Use place value understanding and properties of operations to add and subtract.**
	STANDARD

M.NBT.1.3.1 Add within 100, including adding a two-digit number and a one- digit number.

M.NBT.1.3.2	Add a two-digit and a multiple of ten using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction.
M.NBT.1.3.3	Relate the strategy to a written method and explain the reasoning used.
M.NBT.1.3.4	Understand that in adding two-digit numbers, tens are added to tens, ones are added to ones, and sometimes a ten needs to be composed.
M.NBT.1.3.5	Given a two-digit number mentally find 10 more or 10 less than the number, without having to count and be able to explain the reasoning used.
M.NBT.1.3.6	Subtract multiples of 10 in the range 10 – 90 from multiples of 10 in the range 10 - 90 (positive or zero differences).
M.NBT.1.3.7	Using concrete models or drawings and strategies based on place value “properties of operations”, and/or the relationship between addition and subtraction, relate the strategy to a written method and explain the reasoning used.

MEASUREMENT AND DATA - MD

ANCHOR STANDARD

M.MD.1.1 **Measure lengths indirectly and by iterating length units.**

STANDARD

M.MD.1.1.1 Order three objects by length; compare the lengths of two objects indirectly by using a third object.

M.MD.1.1.2 Express the length of an object as a whole number of length units, by laying multiple copies of a shorter object (the length unit) end to end.

M.MD.1.1.3 Understand that the length measurement of an object is the number of same-size length units that span it with not gaps or overlaps.

ANCHOR STANDARD

M.MD.1.2 **Tell and write time and distinguish money.**

STANDARD

M.MD.1.2.1 Tell and write time hours and half-hours using analog and digital clocks.

M.MD.1.2.2 Identify pennies and dimes by name and value.

ANCHOR STANDARD

M.MD.1.3 **Represent and Interpret Data**

STANDARD

M.MD.1.3.1 Organize, represent, and interpret data with up to three categories. Ask and answer questions about the total number of data points; how many in each category and how many is in one category than in another.

GEOMETRY - G

	ANCHOR STANDARD
M.G.1.1	**Reason with the shapes and their attributes.**
	STANDARD
M.G.1.1.1	Distinguish between defining attributes, e.g., triangles are closed and three-sided, versus non-defining attributes, e.g., color orientation, overall size.
M.G.1.1.2	Build and draw shapes to possess defining attributes.
M.G.1.1.3	Compose two-dimensional shapes (rectangles, squares trapezoids, triangles, half-circles, and quarter-circles) or three-dimensional shapes (cubes, right rectangular prisms, right circular cones, and right circular cylinders) to create a composite shape.
M.G.1.1.4	Compose new shapes from the previous composite shape.
M.G.1.1.5	Partition circles and rectangles into two and four equal squares.
M.G.1.1.6	Describe and label the shapes using the words, halves, fourths, and quarters.
M.G.1.1.7	Use the phases and demonstrate half of, fourths, and quarter of.
M.G.1.1.8	Describe the whole as two of, or four of the shares.
M.G.1.1.9	Understand for these examples that decomposing into more equal shares creates smaller shares.

GRADE 2 MATHEMATICS

The Archdiocese of Cincinnati has established the following mathematics standards to make clear to teachers, students, and parents what knowledge, understanding and skills students should acquire to satisfy the math requirements for Grade 2.

In Grade 2, math instructional time needs to focus on four critical areas.

1. **Extending understanding of base-ten notation.**
2. **Building fluency with addition and subtraction.**
3. **Using standard units of measure.**
4. **Describing and analyzing shapes.**

DOMAIN – OPERATIONS AND ALGEBRAIC THINKING - OA

Algebra is a language of patterns, rules, and symbols. Students learn how to solve number sentence problems, situations involving addition and subtraction. They also learn to use commutative and associative properties to simplify mental calculations. Students will collect, record, and interpret data in systematic ways.

DOMAIN – NUMBER AND OPERATIONS IN BASE TEN - NBT

Understanding the number system is the basis of mathematics. Grade 2 students continue to develop this understanding by transferring their learning of sets of objects into writing numbers in figures. They fluently learn to count by ones, twos, fives, and tens and can identify odd and even numbers. Their mathematical vocabulary expands with comprehension to first, second, third, etc. Students extend their knowledge of fractions, understanding how to com pare sizes of simple fractions as well as how to write simple fractions.

DOMAIN – MEASUREMENT AND DATA - MD

Students learn to measure to compare objects: lengths, areas, weights, temperatures, etc. They are introduced to measurement vocabulary such as: inch, foot, yard, and meter as well as pound, ounce, capacity, and temperature. Students learn about time, calendar and seasons and can tell time on an analog clock to the nearest five minutes. Grade 2 students also learn to value of coins and how to add and subtract coins and dollars.

DOMAIN – GEOMETRY - G

Students can identify and describe simple geometric shapes and develop a sense of space. They can conduct two- and three-dimensional shapes, describing and sorting them by geometrical characteristics. Their geometry vocabulary expands as they identify congruent and parallel shapes and positions. Students become more cognizant and are able to recognize geometric shapes in the world around them.

Grade 2 Mathematic
Primary Standards and Exiting Skills

The Archdiocese of Cincinnati stipulates the following exiting skills in Mathematics for Grade 2 students:

Domain: Operation and Algebraic Thinking

Anchor: Represent and solve problems involving addition and subtraction.

- ✓ Use addition and subtraction with 100 to solve one and two step problems.
- ✓ Use drawing and equations with a symbol for the unknown number (within 100) to represent the problem.

Anchor: Add and subtract within 20.

- ✓ Add and subtract fluently within 20 mentally.

Domain: Number and Operations in Base Ten

Anchor: Use place value understanding and properties of operations to add and subtract.

- ✓ Add and subtract within 100 fluently using previously learned place value strategies, properties of operations, and/or relationship between addition and subtraction.
- ✓ Add up to four two-digit numbers using place value strategies and properties of operations.
- ✓ Add and subtract within 1000 using concrete models or drawings and place value strategies, properties of operations, and/or relationship between addition and subtraction.
- ✓ Understand that in adding or subtracting three-digit numbers, hundreds are subtracted from hundreds, tens are subtracted from tens, ones are subtracted from ones, and, sometimes it is necessary to compose or decompose tens and hundreds.
- ✓ Mentally add or subtract 10 or 100 to a given number.
- ✓ Using place value and properties of operations, explain why addition and subtraction work.

Domain: Measurement and Data

Anchor: Relate addition and subtraction to length.

- ✓ Solve word problems involving lengths, using addition and subtraction of whole number units.
- ✓ Represent whole numbers and whole number sums and differences as lengths on a number line.

Domain: Geometry

Anchor: Reason with shapes and their attributes.

- ✓ Recognize and draw shapes having specified attributes.
- ✓ Partition rectangle into equal size squares in rows and columns and count them.
- ✓ Partition circles and rectangles into two, three, or four equal shares and describe using the appropriate words.

Grade 2 Mathematic
Supporting Standards and Exiting Skills

Domain: Operation and Algebraic Thinking

Anchor: Work with equal groups of objects to gain foundations from multiplication.

- ✓ Determine that a group of objects are either odd or even by counting them by 2's.
- ✓ Write equations to express even numbers as a sub of two equal parts.
- ✓ Write an equation to express the total sum of equal addends.
- ✓ Find total number of objects arranged in rectangular arrays with up to 5 rows and 5 columns.
- ✓ Write an equation to express the total as a sum of equal addends.

Domain: Number and Operations in Base Ten

Understand place value.

- ✓ Understand that the three digits of a three-digit number represent amounts of hundreds, tens, and ones.
- ✓ Count forwards and backwards within 1000s; skip count by 5s, 10s, and 100s.
- ✓ Read and write numbers to 1000 using base-ten numerals, number names, and expanded forms.
- ✓ Using ≥, =, and ≤ to record comparisons of two three-digit numbers based onmeanings of hundreds, tens, and one's digits.

Domain: Measurement and Data

Anchor: Measure and estimate lengths in standard units.

- ✓ Using appropriate tools, measure the length of objects; measure the length of objects twice using different lengths for the two measurements.
- ✓ Estimate lengths in inches, feet, centimeters, and meters.
- ✓ Measure to determine how much longer one object is than another, expressing the length difference in terms of a standard-length unit.
- ✓

Anchor: Work with Time and Money.

- ✓ Tell and write time from analog and digital clocks to the nearest five minutes, using a.m. and p.m.
- ✓ Identify nickels and quarters by name and value.
- ✓ Find the value of a collection of quarters, times, nickels, and pennies.
- ✓ Solve word problems involving dollar bills, quarters, dimes, nickels, and pennies using $ and ¢ symbols appropriately.

Anchor: Represent and interpret data.

- ✓ Generate measurement data by measuring to the nearest whole number several objects or the same object repeatedly.
- ✓ Show measurements by creating a horizontal number line scale of whole number units.
- ✓ Draw picture and bar graphs to represent a data set with up to four categories.
- ✓ Solve simple problems using information represented in bar graph.

GRADE 2 MATHEMATICS

OPERATIONS AND ALGEBRAIC THINKING - OA

ANCHOR STANDARD

M.OA.2.1 **Represent and solve problems involving addition and subtraction.**

STANDARD

M.OA.2.1.1 Use addition and subtraction within 100 to solve one – and two – step word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions.

M.OA.2.1.2 Use drawings and equations with a symbol for the unknown number (within 100) to represent the problem.

ANCHOR STANDARD

M.OA.2.2 **Add and subtract within 20**

STANDARD

M.OA.2.2.1 Fluently add and subtract within 20 using mental strategies. Know from memory all sums of two one-digit numbers by the end of Grade 2.

ANCHOR STANDARD

M.OA.2.3 **Work with equal groups of objects to gain foundations from multiplication.**

STANDARD

M.OA.2.3.1 Determine whether a group of objects (up to 20) has an odd or even number of numbers. For examples, by pairing objects or counting them by 2's.

M.OA.2.3.2	Write an equation to express an even number as a sum of two equal parts.
M.OA.2.3.3	Use addition to find the total number of objects arranged in rectangular arrays with up to 5 rows and up to 5 columns.
M.OA.2.3.4	Write an equation to express the total as a sum of equal addends.

NUMBERS AND OPERATIONS IN BASE TEN - NBT

ANCHOR STANDARD

M.NBT.2.1 **Understand place value.**

STANDARD

M.NBT.2.1.2	Understand that the three digits of a three-digit number represent amounts of hundreds, tens, and ones. For example, 706 equals 7 hundred, 0 tens and 6 ones.
M.NBT.2.1.3	100 can be thought of as a bundle of tens – called a "hundred"
M.NBT.2.1.4	The numbers 100, 200, 300, 400, 500, 600, 700, 800, 900 refer to one, two, three four, five, six, seven, eight, or nine hundred (and 0 tens and 0 ones).
M.NBT.2.1.5	Count forwards and backwards within 1000; skip count by 5s, 10s and 100s.
M.NBT.2.1.6	Read and write numbers to 1000 using base-ten numerals, number names, and expanded forms.
M.NBT.2.1.7	Compare two three-digit numbers based on meanings of the hundreds, tens, and one's digits, using ≥, =, and ≤ symbols, to record the results of comparison.

ANCHOR STANDARD

M.NBT.2.2 **Use place value understanding and properties of operations to add and subtract.**

STANDARD

M.NBT.2.2.1	Fluently add and subtract within 100 using strategies based on place value, "properties of operations" and/or the relationship between addition and subtraction.
M.NBT.2.2.2	Add up to four two-digit numbers using strategies based on place value and "properties of operations".
M.NBT.2.2.3	Add and subtract within 1000 using concrete models or drawings and strategies based on place value, "properties of operations, and/or the relationship between addition and subtraction.
M.NBT.2.2.4	Record the prior benchmark strategy with a written numerical method (drawings and, when appropriate, equations) and explain the reasoning used.
M.NBT.2.2.5	Understand that in adding or subtraction three-digit numbers, hundreds are added or subtracted from hundreds, tens are added or subtracted from tens, ones are added or subtracted from ones and sometimes it is necessary to compose or decompose tens or hundreds.
M.NBT.2.2.6	Mentally add 10 or 100 to a given number 100 – 900, andmentally subtract 10 or 100 from a given number 100 – 900.
M.NBT.2.2.7	Explain why addition and subtraction strategies work, using place value and the properties of operations.

MEASUREMENT AND DATA - MD

ANCHOR STANDARD

M.MD.2.1	**Measure and estimate lengths in standard units.**

STANDARD

M.MD.2.1.1	Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes.
M.MD.2.1.2	Measure the length of an object twice, using length units of different lengths, for the two measurements; describe how the two measurements relate to the size of the unit chosen.

M.MD.2.1.3	Estimate lengths using units of inches, feet, centimeters and meters.
M.MD.2.1.4	Measure to determine how much longer one object is than another, expressing the length difference in terms of a standard
M.MD.2.2.1	Use addition and subtraction within 100 to solve word problems involving lengths that are given in the same whole number units. For example, by using drawings (such as drawings of rulers) and equations with a symbol for the unknown number to represent the problem.
M.MD.2.2.2	Represent whole numbers as lengths from 0 on a number line diagram with equally spaced points corresponding to the numbers 0, 1, 2…., and represent whole – number sums and differences within 100 on a number line diagram.
	ANCHOR STANDARD
M.MD.2.3	**Work with Time and Money**
	STANDARD
M.MD.2.3.1	Tell and write time from analog and digital clocks to the nearest five minutes, using a.m. and p.m.
M.MD.2.3.2	Identify nickels and quarters by name and value.
M.MD.2.3.3	Find the value of a collection of quarters, dimes, nickels and pennies.
M.MD.2.3.4	Solve word problems involving dollar bills, quarters, dimes, nickels, and pennies, using $ and ¢ symbols appropriately.
	ANCHOR STANDARD
M.MD.2.4	**Represent and interpret data.**
	STANDARD
M.MD.2.4.1	Generate measurement data by measuring lengths of several objects to the nearest whole unit or by making repeated measurements of the same object.

M.MD.2.4.2	Show the measurements by creating a line plot, where the horizontal scale is marked off in whole number units.
M.MD.2.4.3	Draw a picture graph and a bar graph (with single–unit scale) to represent a data set with up to four categories.
M.MD.2.4.4	Solve simply put-together, take-apart, and compare problems using information presented in a bar graph.

GEOMETRY - G

ANCHOR STANDARD

M.G.2.1 **Reason with shapes and their attributes.**

STANDARD

M.G.2.1.1	Recognize and draw shapes having specified attributes such as identifying triangles, quadrilaterals, pentagons, and hexagons and cubes based on the number of sides or vertices. Also, recognize rectangles, prisms, cones, and cylinders.
M.G.2.1.2	Partition a rectangle into rows and columns of same-size squares and count to find the total number of them.
M.G.2.1.3	Partition circles and rectangles into two, three, or four equal shares, describing the shares using the words halves, thirds, half of, a third of etc.
M.G.2.1.4	Describe the whole as two halves, three thirds, four fourths.
M.G.2.1.5	Recognize that equal shares of identical wholes need not have the same shape.

GRADE 3 MATHEMATICS

The Archdiocese of Cincinnati has established the following mathematics standards to make clear to teachers, students, and parents what knowledge, understanding and skills students should acquire to satisfy the math requirements for Grade 3.

In Grade 3, math instructional time needs to focus on five critical areas.

1. **Developing understanding or multiplication and division and strategies for multiplication and division within 100.**
2. **Developing understanding of fractions, especially unit fractions (fractions with numerator 1).**
3. **Developing understanding of the structure of rectangular arrays and of area.**
4. **Describing and analyzing two-dimensional shapes.**
5. **Solving multi-step problems.**

DOMAIN – OPERATION AND ALGEBRAIC THINKING - OA

Students learn to represent and solve problems involving multiplication and division. Understand properties of multiplication and the relationship between multiplications and division. Multiply and divide within 100. Solve problems involving the four operations and identify and explain patterns in arithmetic.

DOMAIN – NUMBER AND OPERATIONS IN BASE TEN - NBT

Students will use place value understanding and properties of operations to perform multi-digit arithmetic. A range of strategies and algorithms may be used.

DOMAIN – NUMBERS AND OPERATIONS – FRACTIONS - NF

Students will develop understanding of fractions as number. Grade 3 expectations in this domain are limited to fractions with denominators 2, 3, 4, 6, and 8.

DOMAIN – MEASUREMENT AND DATA - MD

The study of measurement is essential because of its used in many aspects of everyday life. Students measure length to the nearest half-inch, add units of length and find the perimeter and area of shapes. They learn to estimate area and volume in preparation for developing formulas to do calculations. Students learn to estimate measure and compare weights, capacities, and temperatures. They learn to count and know the value of coins and dollars as they problem-solve using economic decisions.

DOMAIN – GEOMETRY - G

Students learn about geometric shapes and develop a sense of space. They identify two-dimensional shapes. Geometric basic vocabulary is mastered, and right angles are examined and compared to other angles. Students learn to create, analyze, and represent patterns and relationships.

Grade 3 Mathematic
Primary Standards and Exiting Skills

The Archdiocese of Cincinnati stipulates the following exiting skills in Mathematics for Grade 3 students:

Domain: Operation and Algebraic Thinking

Anchor: Represent and solve problems involving multiplications and divisions.

- ✓ Interpret products of whole numbers.
- ✓ Interpret quotients of whole numbers.
- ✓ Use multiplication and division (within 100) to solve word problems involving equal groups.
- ✓ Use drawing and equations to solve for the unknowns in word problems involving equal groups.
- ✓ Determine the unknown number in multiplication or division equation.

Anchor: Understand the properties of multiplication and the relationship between multiplication and division.

- ✓ Apply the properties of operations (Commutative, Associative and Distributive) to multiply and divide.
- ✓ Understand division as an unknown factor problem.

Anchor: Multiply and Divide within 100.

- ✓ Multiply and divide within 100 fluently using strategies such as the relationship between multiplication and division.

Anchor: Solve problems involving the four operations and identify and explain patterns in arithmetic.

- ✓ Solve two-steps word problems using the properties of operation and represent the problems as equations with a letter standing for the unknown.
- ✓ Assess answers using mental computation and estimation.
- ✓ Identify and explain patterns using the properties of operations.

Domain: Numbers and Operations – Fractions

Anchor: Develop understanding of fractions as numbers.

- ✓ Understand fractions limited to denominators of 2, 3, 4, 6, and 8.
- ✓ Understand that 1/b as a one part of a whole partitioned in b equal parts.
- ✓ Understand that a/b as the quantity formed by parts of 1/b.
- ✓ Understand and represent fractions on a number line.
- ✓ Represent, locate, and recognize each 1/b on a number line as the whole portioned into

equal parts.

- ✓ Represent a/b on a number line by marking off lengths of 1/b to locate a/b.
- ✓ Understand, explain, and compare fractions as equal if they are at the same point on the number line.
- ✓ Recognize and generate equivalent fractions such as 1/2=2/4 and explain why they are equivalent.
- ✓ Express whole numbers as fractions and recognize fractions that are equivalent to whole numbers.
- ✓ Compare fractions with same numerator or denominator through reasoning aboutsize.
- ✓ Recognize that valid comparisons of fractions refer to the same whole.
- ✓ Use symbols $>$, =, or $<$ to record comparisons in visual fractionmodels.

Grade 3 Mathematic
Supporting Standards Exiting Skills

Domain: Numbers and Operation in Base Ten

Anchor: Use place value understanding and the properties of operations to perform multi-digit arithmetic.

- ✓ Round whole numbers to the nearest 10 or 100.
- ✓ Fluently add and subtract within 1000.
- ✓ Multiply one-digit whole numbers by multiples of 10 in range 10-90.

Domain: Measurement and Data

Anchor: Solve problems involving money, measurement, and estimation of intervals of time, liquid volumes, and masses of objects.

- ✓ Tell and write time to the nearest minute.
- ✓ Measure time intervals in minutes (within 90 minutes).
- ✓ Add and subtract minutes using number line or clock.
- ✓ Add and subtract money within 1000 using dollars with dollars and cents with cents.
- ✓ Use the $ and ¢ appropriately.
- ✓ Use grams, kilograms, and liters to measure volumes and masses.
- ✓ Use drawings to solve one-step word problems involving masses and volumes ofthe same unit.

Anchor: Represent and interpret data.

- ✓ Create scaled picture and bar graphs representing a data set with several categories.
- ✓ Solve one and two-step problems with information presented in scaled bar graphs.
- ✓ Using rulers with halves and fourths on an inch, measure lengths and create data sets. Show data online plot marked in wholes, halves, and quarters.
- ✓ Understand and recognize area as an attribute of a plane figure and the relationship of area to multiplication and addition.
- ✓ Understand a “unit square”, how it relates to area and count unit squares (square cm., square m., square in., square ft.) to measure area.
- ✓ Find area of rectangle by tiling it and show that area is the same as multiplying sides.
- ✓ Use multiplying side lengths to find area of a rectangle to solve real world problems.
- ✓ Use tiling to show understanding that side lengths a, b, + c is the sum of a x b and a x c.
- ✓ Solve real world problems by finding areas by decomposing rectangles into non-overlapping rectangles and adding the non-overlapping parts.

Anchor: Geometric measure: Recognize perimeters as an attribute of plane figure and distinguish between linear and area measure.

- ✓ Solve real world and mathematical problems by finding perimeters, finding an unknown side length, and exhibiting same perimeter and different areas or same area and different perimeters.

Domain: Geometry

Anchor: Reason with shapes and their attributes.

- ✓ Draw and understand different categories of shapes that share attributes and can define larger categories.
- ✓ Partition shapes into equal parts and understands each part as a fraction of thewhole.
- ✓

GRADE 3 MATHEMATICS

OPERATIONS AND ALGEBRAIC THINKING - OA

ANCHOR STANDARD

M.OA.3.1 **Represent and solve problems involving multiplications and divisions.**

STANDARD

M.OA.3.1.1 Interpret products of whole numbers. For example, interpret 5 x 7 as the total number of objects in 5 groups of 7 objects each.

M.OA.3.1.2 Interpret whole-number quotients of whole numbers. For example interpret 56 ÷ 8 as the of objects in each share when 56 objects are portioned equally into 8 shares, or as a number of shares when 56 objects are partitioned into equal shares of 8 objects each.

M.OA.3.1.3 Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities.

M.OA.3.1.4 Using drawings and equations with a symbol for the unknown to represent the problems, solve word problems involving equal groups, arrays, and measurement quantities.

M.OA.3.1.5 Determine the unknown whole number in a multiplication or division equation relating three whole numbers. For example, determine the unknown number that makes the equation true. 8 x □ = 48, 5 = □ + 3, 6 x 6 = □.

ANCHOR STANDARD

M.OA.3.2 **Understand properties of multiplication and the relationship between multiplication and division.**

	STANDARD
M.OA.3.2.1	Apply properties of operations as strategies to multiply anddivide. For example, if 6 x 4 = 24 is the known, then 4 x 6 = 24 is also known (Commutative Property of Multiplication). For example, 3 x 5 x 2 can be found by 3 x 5 = 15, then 15 x 2 = 30, or by 5 x 2 = 10, then 3 x 10 = 30 (Associative Property of Multiplication); for example, knowing that 8 x 5 = 40 and 8 x 2 = 16, one can find 8 x 7 as 8 x (5 + 2) = (8 x 5) + (8 x 2) = 40 + 16 = 56 (Distributive Property).
M.OA.3.2.2	Understand division as an unknown-factor problem. For example, 32 ÷ 8 by finding the number that makes 32 when multiplied by 8.
	ANCHOR STANDARD
M.OA.3.3	**Multiply and Divide within 100.**
	STANDARD
M.OA.3.3.1	Fluently multiple and divide within 100, using strategies such as the relationship between multiplication and division. For example, knowing that 8 x 5 = 40, one knows 40 ÷ 5 = 8 or properties of operations.
	ANCHOR STANDARD
M.OA.3.4	**Solve problems involving the four operations and identify and explain patterns in arithmetic.**
	STANDARD
M.OA.3.4.1	Solve two-steps word problems using the four operations. Represent these problems using equations with a letter standing for the unknown quantity.
M.OA.3.4.2	Assess the reasonableness of answers using mental computation and estimation strategies including rounding.
M.OA.3.4.3	Identify arithmetic patters (including patterns in the additiontable or multiplication table) and explain them using properties of operations. For example, identify that 4 times a number is always even, and explain why 4 times a number can be decomposed into two equal addends.

NUMBERS AND OPERATION IN BASE TEN - NBT

ANCHOR STANDARD

M.NBT.3.1	**Use place value understanding and properties of operations to perform multi-digit arithmetic.**

STANDARD

M.NBT.3.1.1	Use place value understanding to round whole numbers to the nearest 10 or 100.
M.NBT.3.1.2	Fluently add and subtract within 1000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction.
M.NBT.3.1.3	Multiply one-digit whole numbers by multiples of 10 in the range 10 – 90. For example, 9 x 80, 5 x 60 using strategies based on place value and properties of operations.

NUMBERS AND OPERATIONS – FRACTIONS - NF

ANCHOR STANDARD

M.NF.3.1	**Develop understanding of fractions as numbers.**

STANDARD

M.NF.3.1.1	Grade 3 expectations for fractions are limited to denominators of 2, 3, 4, 6, and 8.
M.NF.3.1.2	Understand a fraction 1/b as the quantity formed by 1 part when a whole is partitioned into b equal parts.
M.NF.3.1.3	Understand a fraction a/b as the quantity formed by a part of size 1/b.
M.NF.3.1.4	Understand a fraction as a number on the number line; represent fractions on a number line diagram.

M.NF.3.1.5	Represent a fraction 1/b on a number line diagram by defining the interval from 0 to 1 as the whole and portioning it into b equal parts. Recognize that each part has size 1/b and that the endpoint of the part based at 0 locates the number 1/b on the number line.
M.NF.3.1.6	Represent a fraction a/b on a number line diagram by marking off a lengths 1/b from 0. Recognize that the resulting interval has size a/b and that its endpoint locates the number a/b on the number line.
M.NF.3.1.7	Explain equivalence of fractions in special cases and compare fractions by reasoning about their size.
M.NF.3.1.8	Understand two fractions as equivalent (equal) if they are the same size or the same point on a number line.
M.NF.3.1.9	Recognize and generate as equivalent fractions, for example, 1/2 = 2/4, 4/6 = 2/3. Explain why the fractions are equivalent, for example, by using a visual fraction model.
M.NF.3.1.10	Express whole numbers as fractions and recognize fractions that are equivalent to whole numbers. Example: Express 3 in the form 3 = 3/1, recognize that 6/1 = 6; locate 4/4 and 1 at the same point on a number line.
M.NF.3.1.11	Compare two fractions with the same numerator or the same denominator by reasoning about their size.
M.NF.3.1.12	Recognize that comparisons of fractions are valid only when two fractions refer to the same whole.
M.NF.3.1.13	Record the results of comparisons with the symbols ≥, =, or ≤, and justify the conclusion, for example by using a visual fraction model.

MEASUREMENT AND DATA - MD

ANCHOR STANDARD

M.MD.3.1 **Solve problems involving money, measurement, and estimation of intervals of time, liquid volumes, and masses of objects.**

STANDARD

M.MD.3.1.1 Work with time and money. Tell and write time to the nearest minute.

M.MD.3.1.2 Measure time intervals in minutes (within 90 minutes).

M.MD.3.1.3 Solve problems involving addition and subtraction of time intervals in minutes, for example, by representing the problem on a number line diagram or clock.

M.MD.3.1.4 Solve word problems by adding and subtracting within 1,000 dollars with dollars, and cents with cents (not using dollars and cents simultaneously).

M.MD.3.1.5 Use the $ and ¢ symbol appropriately (not including decimal notation).

M.MD.3.1.6 Measure and estimate liquid volumes and masses of objects using standard units of grams, kilograms, and liters.

M.MD.3.1.7 Add, subtract, multiply or divide whole numbers to solve one-step word problems involving masses or volumes that are given in the same units, for example, by using drawing (such as a beaker with a measurement scale) to represent a problem.

ANCHOR STANDARD

M.MD.3.2 **Represent and interpret data.**

STANDARD

M.MD.3.2.1 Create scaled picture graphs to represent a data set with several categories.

M.MD.3.2.2	Create scaled bar graphs to represent a data set with several categories.
M.MD.3.2.3	Solve one – and two steps "how many more" and "how many less" problems using information presented in the scaled bar graphs. For example, draw a bar graph in which each square in the bar graph might represent 5 pets, then determine how many more/less in two given categories.
M.MD.3.2.4	Generate measurement data by measuring lengths using rulers marked with halves and fourths on an inch. Show this data by creating a line plot, where the horizontal scale is marked off in appropriate units, whole numbers, halves, or quarters.
	ANCHOR STANDARD
M.MD.3.3	**Geometric measurement: Understand concepts of area and relate area to multiplication and to addition.**
	STANDARD
M.MD.3.3.1	Recognize area as an attribute of plane figures and understand concepts of area measurement.
M.MD.3.3.2	A square with side length 1 unit, called " a unit square, is said to have "one square unit" of area and can be used to measure area.
M.MD.3.3.3	A plane figure which can be covered without gaps or overlaps by *n* unit squares are said to have an area of *n* square units.
M.MD.3.3.4	Measure areas by counting unit squares (square cm, square m, square in, square ft., and improvised units).
M.MD.3.3.5	Relate area to the operation of multiplication and addition.
M.MD.3.3.6	Find the area of a rectangle with whole – numbers side lengths by tiling it and show that the area is the same as would be found by multiplying the side length.
M.MD.3.3.7	Multiply side lengths to find areas of rectangles with whole –

	number side lengths in the context of solving real – world and mathematical problems and represent whole – number products as rectangular areas in mathematical reasoning.
M.MD.3.3.8	Use tiling to show in a concrete case that the area of a rectangle with whole – number side lengths a and b + c is the sum of a x b and a x c.
M.MD.3.3.9	Recognize area as additive. Find the area of figures composed of rectangles by decomposing into non-overlapping rectangles and adding the area of the non-overlapping parts, applying this technique to solve real world problems.
	ANCHOR STANDARD
M.MD.3.4	**Geometric measure: Recognize perimeter as an attribute of plane figure and distinguish between linear and area measure.**
	STANDARD
M.MD. 3.4.1	Solve real world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles withthe same perimeter and different areas or with the same area and different perimeters.

GEOMETRY - G

	ANCHOR STANDARD
M.G.3.1	**Reason with shapes and their attributes.**
	STANDARD
M.G.3.1.1	Draw and understand that shapes in different categories, for example, rhombuses, rectangles, and squares may share attributes, i.e. (having four sides); and shared attributes can define a larger category (e.g. quadrilaterals).

M.G.3.1.2	Partition shapes into parts with equal areas. Express the area of each part as a unit fraction of the whole, for example, partition a shape into 4 parts with equal area, and describe the area of each part as ¼ of the area of the shape.

GRADE 4 MATHEMATICS

The Archdiocese of Cincinnati has established the following mathematics standards to make clear to teachers, students, and parents what knowledge, understanding and skills students should acquire to satisfy the math requirements for Grade 4.

In Grade 4 math instructional time needs to focus on three critical areas.

1. **Developing an understanding and fluency with multi-digit multiplication and developing understanding of dividing to find quotients involving multi-digit dividends as part of effectively and efficiently performing multi-digit arithmetic.**
2. **Developing an understanding of fraction equivalence, addition, and subtraction of fractions with like denominators and multiplication of fractions by wholenumbers.**
3. **Understanding that geometric figures can be analyzed and classified based on their properties, such as having parallel sides, perpendicular sides, and particular angle measures.**

DOMAIN - OPERATION AND ALGEBRAIC THINKING - OA

Students extend their understanding of the place value system to count, read and write whole numbers up to 1,000,000 and decimals to two places. They order and compare whole numbers using the correct symbols for greater than and less than. They can use and describe models for multiplication in problem-solving situations using recall. Students can generate an understanding of algebraic rules and are able to write formulas and equations. They can recognize and apply the relationships among the four operations. Students extend the concept of fractions to mixed numbers, learning how fractions are related to whole numbers. Students extend their skills with decimals and how they relate to fractions.

DOMAIN – NUMBERS AND OPERATIONS IN BASE TEN - NBT

Students learn to multiply multi-digit numbers with fluency. They extend their understanding of the place value system and can apply it fluently. Students understand the special roles of 0 and 1 in multiplication and division. They can use models to represent division as an inverse of multiplication. Students determine the appropriateness of estimates versus exact answers.

DOMAIN – NUMBERS AND OPERATIONS – FRACTIONS - NF

Students learn to apply and extend previous understanding of numbers to the system of rational numbers. They explain why a fraction is equivalent to another fraction using visual fraction models. They can compare two fractions with different numerators and denominators by creating common denominators or numerators. They learn to apply and extend previous understandings of multiplication to multiply a fraction by a whole number. Students understand decimal notation for fractions and compare decimal fractions.

DOMAIN – MEASUREMENT AND DATA - MD

Students learn to solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit. Students learn how to apply the area and perimeter formulas for rectangles and how to construct a line plot to display a data set of measurements in fractions by using the given information. Students learn to measure angles and whole numbers using protractors.

DOMAIN – GEOMETRY - G

Students learn to draw and identify lines and angles and classify shapes by properties of their lines and angels. They identify, describe, and draw such concepts as acute angle and parallel lines. They describe shapes and objects, including special quadrilaterals such as rhombuses and trapezoids. Students identify congruent quadrilaterals and explain their reasoning using specific geometric terms. Students draw lines of symmetry for various polygons and they construct cubes and prisms developing their ability to work in three dimensions.

Primary Standards and Exiting Skills

The Archdiocese of Cincinnati stipulates the following exiting skills in Mathematics for Grade 4 students:

Domain: Operations and Algebraic Thinking

Anchor: Use the four operations with whole numbers to solve problems.

- ✓ Interpret a multiplication equation as a comparison.
- ✓ Represent verbal statements of multiplicative comparisons as multiplication equations.
- ✓ Using multiplication or division to solve word problems that involve multiplicative comparisons. Use drawings and equations to distinguish multiplicative from additive comparisons.
- ✓ Solve multistep word problems with whole numbers and whole number answers using the four operations, including problems with remainders.
- ✓ Represent these problems with equations using a letter for the unknown.
- ✓ Assess answers using mental computation and estimation strategies, including rounding.

Domain: Numbers and operations in base ten

Anchor: Generalize place value understanding for multi-digit whole numbers.

- ✓ Applying place value concepts, multiplication or division understand that in a multi-digit number the digit one place to the left represents 10 times what the place to the right represents.
- ✓ Read, write, and compare multi-digit whole numbers, less than or equal to 1,000,000, in standard, word, and expanded forms. Use the ≥, =,≤ to record comparison of two multi-digit numbers.

Domain: Number and Operations/Fractions

Anchor: Extend understanding of fraction equivalence and ordering limited to fractions with denominators 2, 3, 4, 5, 6, 8, 10, 12, and 100.

- ✓ Using visual fraction models, explain how number and size of parts differ even though fractions are the same. Recognize and generate equivalent fractions.
- ✓ Compare fractions by creating common denominators, numerators or using ½ as a benchmark fraction.
- ✓ Record results of comparison of fractions with ≥, =, ≤, and justify conclusion.

Anchor: Understand decimal notation for fractions and compare decimal fractions.

- ✓ Express equivalence of fractions with denominator 10 and denominator 100.
- ✓ Add two fractions with denominators 10 and 100.
- ✓ Use decimal notation for fractions with denominators 10 or 100.
- ✓ Using reasoning about size, compare two decimals to hundredths.
- ✓ Understand that comparisons only have value when both decimals refer to the same whole.
- ✓ Record and create visual models of comparisons with ≥, =, ≤, and justify conclusion.

Supporting Standards and Exiting Skills

Domain: Operations and Algebraic Thinking

Anchor: Gain familiarity with factors and multiples.

- ✓ Find factor pairs for whole numbers 1-100.
- ✓ Recognize that a whole number is a multiple of each of its factors.
- ✓ Determine if a whole number in the range of 1-100 is a multiple of a one-digit number.
- ✓ Determine if a whole number in the range of 1-100 is a prime composite number.

Anchor: Generate and analyze patterns.

- ✓ Generate number or shape patterns based on given rule.
- ✓ Identify features of a pattern that are not explicitly stated in the rule.
- ✓ Round multi-digit whole numbers to any place through 1,000,000.

Domain: Numbers and operations in base ten

Anchor: Use place value understanding and properties of operations to perform multi-digit arithmetic with whole numbers less than or equal to 1,000,000.

- ✓ Perform multi-digit arithmetic using whole numbers less than or equal to1,000,000 using place value understanding and properties of operations.
- ✓ Fluently add and subtract multi-digit whole numbers using standard algorithm.
- ✓ Multiply four-digit whole numbers by one-digit whole number and two two-digit whole numbers. Explain the calculations by using equations.
- ✓ Find whole number quotients and remainders with up to four-digit dividends. Explain calculation by equations, rectangular arrays and/or area models.

✓ **Domain: Number and Operations/Fractions**

Anchor: Build fractions from unit fractions by applying and extending previous understanding of operations on whole number limited to fractions with denominators 2, 3, 4, 5, 6, 8, 10, 12, and 100 (Fractions need not be simplified.)

- ✓ Understand that a fraction a/b with ≥ 1 is a sum of fractions 1/b.
- ✓ Understand the addition and subtraction of fractions.
- ✓ Decompose and record decomposition of fractions as an equation.
- ✓ Justify decomposition by using a visual fraction model.
- ✓ Add and subtract mixed numbers with common denominators.
- ✓ Solve word problems with addition and subtraction of fractions with same whole number and like denominators.
- ✓ Multiply fractions by whole numbers.
- ✓ Understand a/b as multiple of 1/b.

- ✓ Understanding multiple of a/b and multiplying fractions by whole number, create a visual model to recognize product.
- ✓ Solve word problems by multiplying fraction by whole number.

Domain: Measurement and Data

Anchor: Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit.

- ✓ Know relative sizes of measurement units within one system of units.
- ✓ Express measurements in larger unit in terms of smaller unit within one systemof measurement.
- ✓ Record measurement equivalent in a two-column table.
- ✓ Generate conversion table for feet and inches.
- ✓ Solve world problems involving time, volume, mass, and money. Include problems involving simple fractions, decimals, require expressions of measurement.
- ✓ Represent measurements using diagrams such as number line.
- ✓ Solve real world problems using area and perimeter formulas for rectangles.

Anchor: Represent and interpret data.

- ✓ Make a line plot to display data.
- ✓ Solve problems using addition and subtraction of fractions by using information online plots.

Anchor: Geometric measurement: understand concepts of angle and measurement angles.

- ✓ Understand angles as geometric shapes formed by two rays with same end pointand the concept of measuring angles.
- ✓ Understand angels as referenced to a circle with center as endpoint of rays and that an angle that turns 1/360 of a circle is called a “one-degree angle.”
- ✓ Understand that angle that turns ***n*** one-degree angles has a measurement of ***n*** degree.
- ✓ Use a protractor to measure whole number angles and sketch angles of specific measurements.
- ✓ Recognize angle measurement as an additive.
- ✓ Understand that an angle decomposed into non-overlapping parts the measurement of the whole angle is the sum of the angle parts.
- ✓ Solve real world problems using addition and subtraction to find angels on adiagram.

Domain: Geometry

Anchor: Draw and identify lines and angles and classify shapes by properties of their lines and angles.

- ✓ Draw and identify in two dimensional figures points, lines, line segments, rays, angles, perpendicular and parallel lines.
- ✓ Classify two dimensional figures based on lines and angles, including right angles.
- ✓ Recognize, identify, and draw lines of symmetry.

GRADE 4 – MATHEMATICS

OPERATIONS AND ALGEBRAIC THINKING - OA

ANCHOR STANDARD

M.OA.4.1 **Use the four operations with whole numbers to solve problems.**

STANDARD

M.OA.4.1.1 Interpret a multiplication equation as a comparison, for example, interpret 35 = 5 x 7 as a statement that 35 is 5 times as many as 7 and 7 times as many as 5.

M.OA.4.1.2 Represent verbal statements of multiplicative comparisons as multiplication equations.

M.OA.4.1.3 Multiply or divide to solve word problems involving multiplicative comparison, for example, by using drawings and equations with a symbol for the unknown number to represent the problem distinguishing multiplicative comparison from additive comparison.

M.OA.4.1.4 Solve multistep word problems posed with whole numbers and having whole – number answers using the four operations, including problems in which remainders must be interpreted.

M.OA.4.1.5 Represent these problems using equations with a letter standing for the unknown quantity.

M.OA.4.1.6 Assess the reasonableness of answers using mental computation and estimation strategies including rounding.

ANCHOR STANDARD

M.OA.4.2 **Gain familiarity with factors and multiples.**

STANDARD

M.OA.4.2.1 Find all factor pairs for a whole number in the range 1 – 100.

M.OA.4.2.2 Recognize that a whole number is a multiple of each of its factors.

M.OA.4.2.3 Determine whether a given whole number in the range 1 – 100 is a

multiple of a given one – digit number.

M.OA.4.2.4 Determine whether a given whole number in the range 1 – 100 is a prime composite.

ANCHOR STANDARD

M.OA.4.3 **Generate and analyze patterns.**

STANDARD

M. OA.4.3.1 Generate a number or shape pattern that follows a given rule.

M.OA.4.3.2 Identify apparent features of the pattern that was not explicit in the rule itself. For example, given the rule "Add 3" and thestarting number 1, generate terms in the resulting sequence and observe that the term appears to alternate between odd and even numbers.

NUMBERS AND OPERATIONS IN BASE TEN - NBT

ANCHOR STANDARD

M.NBT.4.1 **Generalize place value understanding for multi – digit whole numbers.**

STANDARD

M.NBT.4.1.1 Recognize that in a multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right by applying concepts of place value, multiplication, or division.

M.NBT.4.1.2 Read and write multi-digit whole numbers using standard form, word form and expanded from. Compare two multi-digit numbers based on meanings of the digits in each place, using ≥, =, and ≤ symbols to record the results of comparison. Grade 4 expectations in this domain are limited to whole numbers less than or equal to 1,000,000.

M.NBT.4.1.3 Use place value understanding to round multi-digit whole numbers to any place through 1,000,000.

ANCHOR STANDARD

M.NBT.4.2 **Use place value understanding and properties of operations to perform multi-digit arithmetic with whole numbers less than or equal to 1,000,000.**

STANDARD

M.NBT.4.2.1 Use place value understanding and properties of operations to perform multi-digit arithmetic with whole numbers less than or equal to 1,000,000.

M.NBT.4.2.2 Fluently add and subtract multi-digit whole numbers using a standard algorithm.

M.NBT.4.2.3 Multiply a whole number of up to four digits by a one-digit whole number, and multiply two two-digit numbers, using strategies based on place value and the properties of operations. Illustrate and explain the calculations by using equations.

M.NBT.4.2.4 Find whole-number quotients and remainders with up to fourdigits dividends and one=digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays and/or area models.

NUMBER AND OPERATIONS/FRACTIONS - NF

ANCHOR STANDARD

M.NF.4.1 **Extend understanding of fraction equivalence and ordering limited to fractions with denominators 2, 3, 4, 5, 6, 8, 10, 12 and 100.**

STANDARD

M.NF.4.1.1 Explain why a fraction a/b is equivalent to a fraction (n x a)/(n x b) by using visual fraction models, with attention to how the number and size of the parts differ even through the two fractions themselves are the same size. Use this principle to recognize and generate equivalent fractions.

M.NF.4.1.2 Compare two fractions with different numerators and different

	denominators, for examples, by creating common denominators a numerator, or by comparing to a benchmark fraction such as ½.
M.NF.4.1.3	Recognize that comparisons of two fractions are valued only when the two fractions refer to the same whole.
M.NF.4.1.4	Record the results of comparisons with symbols ≥, =, or ≤, and justify the conclusion, for example, by using a visual fraction model.
	ANCHOR STANDARD
M.NF.4.2	**Build fractions from unit fractions by applying and extending previous understanding of operations on whole number limited to fractions with denominators 2, 3, 4, 5, 6, 8, 10, 12 and 100 (Fractions need not be simplified.)**
	STANDARD
M.NF.4.2.1	Understand a fraction a/b with a ≥ 1 as a sum of fractions 1/b.
M.NF.4.2.2	Understand addition and subtraction of fractions as joining and separating parts referring to the same whole.
M.NF.4.2.3	Decompose a fraction into a sum of fractions with the same denominator in more than one way, recording each decomposition by an equation.
M.NF.4.2.4	Justify decompositions, for example, by using a visual fraction model. Examples: 3/8 = 1/8 + 1/8 + 1/8, 3/8 = 1/8 + 2/8, 2 1/8 = 1 + 1 + 1/8 = 8/8 + 8/8 + 1/8.
M.NF.4.2.5	Add and subtract mixed numbers with like denominators, for example, by replacing each mixed number with an equivalent fraction, and/or by using properties of operations and the relationship between addition and subtraction.
M.NF.4.2.6	Solve word problems involving addition and subtraction of fractions referring to the same whole and having like denominators. For example, by using visual fraction models and equations to represent the problem.

M.NF.4.2.7	Apply and extend previous understandings of multiplication to multiply a fraction by a whole number.
M.NF.4.2.8	Understand a fraction a/b as a multiple of 1/b.
M.NF.4.2.9	Understand a multiple of a/b and use this understanding to multiply a fraction by a whole number. For example, use a visual fraction model to express 3 x (2/5) as 6 x (1/5), recognizing this product as 6/5. (In general, *n* x (a/b) = (*n* x a)/b).
M.NF.4.2.10	Solve word problems involving multiplication of a fraction by a whole number, for example, by using visual fraction models and equations to represent the problem.
	ANCHOR STANDARD
M.NF.4.3.	**Understand decimal notation for fractions and compare decimal fractions.**
	STANDARD
M.NF.4.3.1	Express a fraction with denominator 10 as an equivalent fraction with denominator 100.
M.NF.4.3.2	Use this technique to add two fractions with respective denominator 10 and 100. For example, express 3/100, and add 3/10 + 4/100 = 34/100.
M.NF.4.3.3	Use decimal notation for fractions with denominators 10 or 100. For example, rewrite 0.62 as 62/100; describe a length as 0.62 meters; locate 0.62 on a number line diagram.
M.NF.4.3.4	Compare two decimals to hundredths by reasoning about their size.
M.NF.4.3.5	Recognize that comparisons are valued only when the two decimals refer to the same whole.
M.NF.4.3.6	Record the results of comparisons with symbols ≥, =, or ≤, and justify the conclusions. For example, by using a visual model.

MEASUREMENT AND DATA - MD

ANCHOR STANDARD

M.MD.4.1 **Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit.**

STANDARD

M.MD.4.1.1 Know relative sizes of measurement units within one system of units including kilometers, meters, centimeter, kilogram, gram, pound, ounce, liter, millimeter, hour, minute, second.

M.MD.4.1.2 Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit.

M.MD.4.1.3 Record measurement equivalents in a two-column table. For example know that 1 ft. is 12 times as long as 1 inch. Express the length of a 4 ft. snake as 48 inches.

M.MD.4.1.4 Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36) etc.

M.MD.4.1.5 Use the four operations to solve word problems involving distances intervals of time, liquid volumes, masses of objects, and money.

M.MD.4.1.6 Include problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit.

M.MD.4.1.7 Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.

M.MD.4.1.8 Apply the area and perimeter formulas for rectangles in real world and mathematical problems. For example, find the width of a rectangular room given the area of the flooring and the length, by viewing the area formula as a multiplication equation with an unknown factor.

ANCHOR STANDARD

M.MD.4.2 **Represent and interpret data.**

STANDARD

M.MD.4.2.1 Make a line plot to display a data set of measurements in fractions

	of a unit (½, ¼, ⅛).
M.MD.4.2.2	Solve problems involving addition and subtraction of fractions by using information presented in line plots. For example, from a line plot find and interpret the difference in length between the longest and shortest specimens in an insect collection.
	ANCHOR STANDARD
M.MD.4.3	**Geometric measurement: understand concepts of angle and measurement angles.**
	STANDARD
M.MD.4.3.1	Recognize angles as geometric shapes that are formed whenever two rays share a common endpoint and understand concepts of angle measurement.
M.MD.4.3.2	Understand an angle is measured with reference to a circle with its center at the common endpoint of the rays, by considering the fraction of the circular arc between the points where two rays intersect the circle.
M.MD.4.3.3	An angle that turns through 1/360 of a circle is called "one-degree angle" and can be used to measure angles.
M.MD.4.3.4	Understand an angle that turns through *n o*ne-degree angles is said to have an angle measurement of *n* degree.
M.MD.4.3.5	Measure angles in whole number degrees using a protractor. Sketch angles of specified measure.
M.MD. 4.3.6	Recognize angle measure as additive.
M.MD.4.3.7	When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts.
M.MD.4.3.8	Solve addition and subtraction problems to find unknown angles on a diagram in real world and mathematical problems. For example, by using an equation with a symbol for the unknown

angle measure.

GEOMETRY - G

ANCHOR STANDARD

M.G.4.1 **Draw and identify lines and angles and classify shapes by properties of their lines and angles.**

STANDARD

M.G.4.1.1 Draw points, lines, line segments, rays, angles (right, acute, and obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.

M.G.4.1.2 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. Recognize right triangles as a category and identify right triangles.

M.G.4.1.3 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 matching parts. Identify line-symmetric figures and draw lines of symmetry.

GRADE 5 MATHEMATICS

The Archdiocese of Cincinnati has established the following mathematics standards to make clear to teachers, students and parents what knowledge, understanding and skills students should acquire in order to satisfy the math requirements for Grade 5.

In Grade 5, math instructional time needs to focus on five critical areas.

1. **Developing fluency with addition and subtraction of fractions and developing understanding of the multiplication of fractions and of division of fractions in limited cases (unit fractions divided by whole numbers and whole numbers divided by unit fractions).**
2. **Extending division to 2-digit divisors, integrating decimal fractions into the place value system and developing understanding of operations with decimals to hundredths, and developing fluency with whole number and decimal operations.**
3. **Developing understanding of volume.**
4. **Modeling numerical relationships with the coordinate plane.**
5. **Classifying two-dimensional figures by properties.**

DOMAIN – OPERATION AND ALGEBRAIC THINKING - OA

Students develop, to a higher level, the fundamental concept of the order of operations which include exponents and parentheses, brackets or braces in numerical expression. Students at this level write simple algebraic expressions.

DOMAIN – NUMBERS AND OPERATIONS IN BASE TEN - NBT

Students develop an understanding of why division procedures work, based on the meaning of base-ten numerals and properties of operations. They develop fluency in computation and make reasonable estimates of their results. Students are able to understand and explain why the procedures for multiplying and dividing make sense.

DOMAIN – NUMBERS AND OPERATIONS – FRACTIONS - NF

Students apply their knowledge and understanding of fractions and fraction models to represent the addition and subtraction of fractions with unlike denominators as equivalent calculations with like denominators. They develop fluency in calculating sums and differences of fractions and can make reasonable estimates of them. Students also use the meaning of fractions, of multiplication and division and the relationship between multiplication and division to understand and explain why the procedures for multiplying and dividing fractions

make sense. Students also apply their understanding of models for decimals, decimal notation and properties of operations to add and subtract decimals hundredths. Students use the relationship between decimals and fractions, as well as the relationship between finite decimals and fractions and the relationship between finite decimals and whole numbers, to understand and explain why the procedures for multiplying and dividing finite decimals make sense. Students compute products and quotients of decimals to hundredths efficiently and accurately.

DOMAIN – MEASUREMENT AND DATA - MD

Students develop and use the formulas for calculating perimeters and area of triangles, parallelograms and trapezoids. They recognize volume as an attribute of three-dimensional space and understand that volume can be measured by finding the total number of same-size units of volume required to fill the space without gaps or overlaps. Students learn to construct and describe a graph, showing continuous data of a quantity that change over time. Students also analyze line graphs and double-bar graphs.

DOMAIN – GEOMETRY – G

Students develop the idea of linking an algebraic equation to a graph, by ordered pairs that fit in a linear equation,plotting as points in a grid and drawing the resulting straight line. Students also learn to generate two numerical patterns given two given rules. They draw angles, parallel and perpendicular lines, the radius and diameter of circles and other geometric shapes using ruler, compass, protractor and computer drawing programs. They analyze and compare the properties of two-dimensional figures and three-dimensional solids. Students can determine and define the surface area and volume of prisms by using appropriate units and selecting strategies and tools. They develop an understanding of reflectional and rotational symmetry while developing their ability to work in three dimensions.

Grade 5 Mathematics
Priority Standards and Exiting Skills

The Archdiocese of Cincinnati stipulates the following exiting skills in Mathematics for Grade 5 students:

Domain: Operations and Algebraic Thinking

Anchor: Write and interpret numerical expression.

- ✓ Use parentheses, brackets or braces in numerical expressions and evaluate expressions with these symbols.
- ✓ Write simple expressions that record calculations with numbers and interpret them without evaluating them.
- ✓ Using multi digit numbers, recognize that c x(a +b) or c x(a xb) is three times the product of the indicated sum or product.

Domain: Numbers and operations in base ten

Anchor: Understand the Place Value System.

- ✓ Recognize that in a multi-digit number, the number in one place represents 10 times as much as the number in the place to its right and 1/10 of the number to its left.
- ✓ Explain the patterns in the number of zeros of the product when multiplying a number by the powers of 10.
- ✓ Explain the patterns in the placement of the decimal point when a decimal is multiplied ***n*** divided by a power of 10.
- ✓ Use whole-number exponents to denote powers of 10.
- ✓ Read, write and compare decimals to thousandths using base-ten numerals, number names, and expanded form.
- ✓ Compare two decimals to thousandths based on the meaning of the digits in eachplace, using ≥, =, and ≤ symbols.
  - ✓ Round decimals to any place using place value understanding.

Anchor: Perform operations with multi-digit whole numbers and with decimals to hundredths.

- ✓ Fluently multiply multi-digit whole numbers using the standard algorithm.
- ✓ Find whole-number quotients of whole numbers with up to four-digit dividends and two-digit divisors using place value, properties of operations and/or relationship between multiplication and division.
- ✓ Illustrate and explain calculation by using equations, rectangular arrays, and/or area models.
- ✓ Add, subtract, multiply and divide decimals using models or drawings, and learned strategies, relating the strategy to a written method and explain reasoning.

Domain: Measurement and Data

Anchor: Geometric measurement: understand concepts of volume and relate volume to multiplications and to addition.

- ✓ Recognize and understand volume as an attribute of solid figures and concepts of volume measurement.
- ✓ Understand the meaning of "unit cube and its use in measuring volume.
- ✓ Unit cubes can be used to measure a solid figure if there are no gaps or overlaps.
- ✓ Measure volumes in unit cubes, cubic cm, cubic in., cubic ft. and improvised units.
- ✓ Solve real world and mathematical problems by relating volume to multiplication and division operations.
- ✓ Find volume by packing unit cubes in to a right rectangular prism. Show that the volume is the same as multiplying the height by the area of the base.
- ✓ Represent 3 whole-number products as volume.
- ✓ Apply the formulas V = 1 x W x b and V = b x b for rectangular prisms with whole number edge lengths in solving real problems and mathematical problems.
- ✓ Recognize volume as an additive.
- ✓ Find volumes of figures by adding the non- overlapping parts of two right rectangle prisms and apply the technique to solve real world problems.

Domain: Geometry

Anchor: Graph point s on the coordinate plane to solve real-world and mathematical problems.

- ✓ Use a pair of axes to define coordinate system with intersection coinciding with) on each line and its coordinates of ordered pairs.
- ✓ Understand the relation of the numbers to origin of the x axis or y axis. Know the names of both the axis and axes and coordinates.
- ✓ Graph real world and mathematical problems in the first quadrant of a coordinate plane and interpret the value of the points.

Domain: Number and Operations/Fractions

Anchor: Use equivalent fractions as a strategy to add and subtract fractions.

- ✓ Add and subtract fractions (including mixed numbers) with unlike denominators by replacing fractions with equivalent fractions to produce an equivalent sum or difference of fractions with like denominators.
- ✓ Solve word problems involving addition or subtraction of fractions of same whole including cases of unlike denominators.
- ✓ Mentally estimate and assess the reasonableness of answers using benchmark fractions and number sense of fractions.

Anchor: Apply and extend previous understandings of multiplication and division to multiply and divide fractions.

- ✓ Interpret a fraction as a division of the numerator by the denominator.
- ✓ Solve divisions of whole numbers that lead to mixed number answers.
- ✓ Use visual fraction models or equations to represent a problem.
- ✓ Apply and extend previous understandings of multiplication to multiply a fraction by a fraction or a whole number by a fraction.
- ✓ Using a sequence of operations, interpret the product of (a/b) x q into equal parts.
- ✓ Find area of a rectangle with fractional side lengths using tiles representing the fraction side lengths. Understand that the area is the same as multiplying the side lengths.
- ✓ Interpret multiplication as scaling (resizing).
- ✓ Without performing multiplication, compare the size of the product to the other factor.
- ✓ Explain that multiplying a number by a fraction greater than 1 results in a product greater than the number and when multiplying a number by a fraction less than1 results in a number less than the given number.
- ✓ Solve real world problems using multiplication of mixed numbers.
- ✓ Using previous understanding of division, divide unit fractions by whole numbers and whole numbers by unit fractions.
- ✓ Interpret and compute quotients by dividing a unit fraction by a non-zero whole number and a whole number by a unit fraction. Create story content to explain.
- ✓ Solve real world problems involving division of unit fractions by non-zero whole numbers and division of whole numbers by unit fractions.

Grade 5 Mathematics
Supporting Standards and Exiting Skills

Domain: Operations and Algebraic Thinking

Anchor: Analyze patterns and relationships.

- ✓ Given two rules, generate two numerical patters.
- ✓ Identify apparent relationships between corresponding terms.
- ✓ Form ordered pairs of corresponding terms from two patters and graph the pairs on a coordinate plane.

Domain: Measurement and Data

Anchor: Represent and interpret data.

- ✓ Make a line plot to display a data set of measurements in fractions of a unit.
- ✓ Using operations learned in this grade to solve problems involving information presented in line plots.

Domain: Geometry

Anchor: Classify two-dimensional figures based on their properties.

- ✓ Based on their properties, classify two-dimensional figures into a hierarchy.
- ✓ Illustrate and explain calculation by using equations, rectangular arrays, and/or area models.
- ✓ Add, subtract, multiply and divide decimals using models or drawings, and learned strategies, relating the strategy to a written method and explain reasoning.

GRADE 5 MATHEMATICS

OPERATIONS AND ALGEBRAIC THINKING - OA

	ANCHOR STANDARD
M.OA.5.1	**Write and interpret numerical expression.**
	STANDARD
M.OA.5.1.1	Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.
M.OA.5.1.2	Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them. For example, express the calculation "add 8 and 7, then multiply by 2" as 2 x (8 + 7).
M.OA.5.1.3	Recognize that 3 x (18,932 + 921) is three times as large as 18,932 + 921, without having to calculate the indicated sum or product.
	ANCHOR STANDARD
M.OA.5.2	**Analyze patterns and relationships.**
	STANDARD
M.OA.5.2.1	Generate two numerical patterns using two given rules.
M.OA.5.2.2	Identify apparent relationships between corresponding terms.
M.OA.5.2.3	Form ordered pairs consisting of corresponding terms from the two patterns and graph the ordered pairs on a coordinate plane. For example, given the rule "ADD3" and the number 0, and given the rule "ADD6" and the starting number 0, generate terms in the resulting sequences, and observe that the terms in one sequence are twice the corresponding terms in the other sequence. Explain informally why it is so.

NUMBER AND OPERATIONS IN BASE TEN - NBT

	ANCHOR STANDARD
M.NBT.5.1	**Understand the Place Value System.**
	STANDARD
M.NBT.5.1.1	Recognize that in a multi-digit number, a digit in one place represents 10 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.
M.NBT.5.1.2	Explain patterns in the number of zeros of the product when multiplying a number by powers of 10.
M.NBT.5.1.3	Explain patterns in the placement of the decimal point when a decimal is multiplied *n* divided by a power of 10.
M.NBT.5.1.4	Use whole-number exponents to denote powers of 10.
M.NBT.5.1.5	Read, write, and compare decimals to thousandths.
M.NBT.5.1.6	Read and write decimals to thousandths using base-ten numerals, number names, and expanded form. For example, 347.392 = 3 x 100 + 4 x 10 + 7 x 1 + 3 x (1/10) + 9 x (1/100) + 2 x (1/1000).
M.NBT.5.1.7	Compare two decimals to thousandths based on meanings of the digits in each place, using ≥, =, and ≤ symbols to record the results of comparisons.
M.NBT.5.1.8	Use place value understanding to round decimals to any place.
	ANCHOR STANDARD
M.NBT.5.2	**Perform operations with multi-digit whole numbers and with decimals to hundredths.**
	STANDARD
M.NBT.5.2.1	Fluently multiply multi-digit whole numbers using the standard algorithm.

M.NBT.5.2.2	Find whole-numbers quotients of whole numbers with up to four-digit dividends and two-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations rectangular arrays, and/or area models.
M.NBT.5.2.3	Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction, relate the strategy to a written method and explain the reasoning used.

NUMBERS AND OPERATIONS/FRACTIONS - NF

ANCHOR STANDARD

M.NF.5.1	**Use equivalent fractions as a strategy to add and subtract fractions.**

STANDARD

M.NF.5.1.1	Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators. For example, 2/3 + 5/4 = 8/12 + 15/12 = 23/12. In general, a/b + c/d = (ad + bc)/bd.
M.NF.5.1.2	Solve word problems involving addition and subtraction of fractions referring to the same whole, including cased of unlike denominators. For example, by using visual fraction models or equations to represent the problem.
M.NF.5.1.3	Use benchmark fractions and number sense of fractions to estimate mentally and assess the reasonableness of answers. For example, recognize an incorrect result 2/5 + 1/2 = 3/7, by observing that 3/7 ≤ 1/2.

ANCHOR STANDARD

M.NF.5.2	**Apply and extend previous understands of multiplication and division to multiply and divide fractions.**

	STANDARD
M.NF.5.2.1	Interpret a fraction as division of the numerator by the denominator (a/b = a÷ b).
M.NF.5.2.2	Solve word problems involving divisions of whole numbers leading to answers in the form of fractions a mixed number.
M.NF.5.2.3	By using visual fraction models or equations to represent the problem. For example, interpret ¾ as the result of dividing 3 by 4, noting that ¾ multiplied by 4 equals 3, and that when 3 wholes are shared equally among 4 people each person has a share of size ¾, If 9 people want to share a 50-pound sack of rice equally by weight how many pounds of rice should each person get? Between what two whole numbers where does your answer lie?
M.NF.5.2.4	Apply and extend previous understandings of multiplications to multiply a fraction or whole number by a fraction.
M.NF.5.2.5	Interpret the product (a/b) x q into b equal parts, equivalently, as the result of a sequence of operations a x q ÷ b. For example, using a visual fraction model to show (2/3) x 4 = 8/3, and create a story context for this equation. Do the same with (2/3) x (4/5) = 8/15.
M.NF.5.2.6	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 to find areas of rectangles, and represent fraction products as rectangular areas.
M.NF.5.2.7	Interpret multiplication as scaling (resizing).
M.NF.5.2.8	Compare the size of a product to the size of the other factor, without performing the indicated multiplication.
M.NF. 5.2.9	Explain why multiplying a given number by a fraction greater than 1 results in a product greater than the given number (recognizing multiplication by whole numbers greater than 1 as a familiar case).
M.NF.5.2.10	Explain why multiplying a given number by a fraction less than

	1 results in a product smaller than the given number; and relating the principle of fraction equivalence a/b = (n x a) / (n x b) to the effect of multiplying a/b by 1.
M.NF.5.2.11	Solve real world problems involving multiplication of fractions and mixed numbers. For example, by using visual fractions models or equations to represent the problem.
M.NF.5.2.12	Apply and extend previous understandings of division to divide fractions by whole numbers and whole numbers by unit fractions.
M.NF.5.2.13	Interpret division of a unit fraction by a non-zero whole number and compute such quotients. For example, create a story context for (1/3) ÷ 4 = 1/12 because (1/12) + 4 = 1/3.
M.NF.5.2.14	Interpret division of a whole number by a unit fraction, and compute such quotients. For example, create a story content ÷ (1/5) = 20 because 20 x (1/5) = 4.
M.NF.5.2.15	Solve real world problems involving division of unit fractions By non-zero whole numbers and division of whole numbers by unit fractions. For example, by using visual fraction models and equations to represent the problem. For example, how much chocolate will each person get if 3 people share 1/2 lb. of chocolate equally? How many 1/3 cup servings are in 2 cups of raisins?

MEASUREMENT AND DATA - MD

	ANCHOR STANDARD
M.MD.5.2	**Represent and interpret data.**
	STANDARD
M.MD.5.2.1	Make a line plot to display a data set of measurements in fractions of a unit, (1/2, 1/4, 1/8).
M.MD.5.2.2	Use operations on fractions for this grade to solve problems involving information presented in line plots. For example, give

	different measurements of liquid in identical beakers, find the amount of liquid each beaker would contain if the total amount in all the beakers were redistributed equally.
	ANCHOR STANDARD
M.MD.5.3	**Geometric measurement: understand concepts of volume and relate volume to multiplications and to addition.**
	STANDARD
M.MD.5.3.1	Recognize volume as an attribute of solid figures and understand concepts of volume measurement.
M.MD.5.3.2	A cube with side length 1 unit, called a "unit cube" is said to have "one cubic unit" of volume, and can be used to measure volume.
M.MD.5.3.3	A solid figure which can be packed without gaps or overlaps using *n* cubic units.
M.MD.5.3.4	Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft. and improvised units.
M.MD.5.3.5	Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume.
M.MD.5.3.6	Find the volume of a right rectangular prism with whole-Number side lengths by packing it with unit cubes.
M.MD.5.3.7	Show that the volume is the same as would be found by multiply the height by the area of the base.
M.MD. 5.3.8	Represent three whole – number products as volume. For example, to represent the associative property of multiplication.
M.MD.5.3.9	Apply the formulas V = 1 x W x b and V = b x b for rectangular prisms with whole – number edge lengths in the context of solving real world and mathematical problems.
M.MD.5.3.10	Recognize volume as additive.

M.MD.5.3.11	Find volumes of solid figures composed of two – non-overlapping right rectangular prisms by adding the volumes of the non-overlapping parts, applying this technique to solve real world problems.

GEOMETRY - G

ANCHOR STANDARD

M.G.5.1	**Graph points on the coordinate plane to solve real-world and mathematical problems.**
	STANDARD
M.G. 5.1.1	Use a pair of perpendicular number lines, called axes, to define a coordinate system with the intersection of the line (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates.
M.G. 5.1.2	Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond. For example, x – axis and x – coordinate, y – axis and y – coordinate.
M.G.5.1.3	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.

ANCHOR STANDARD

M.G.5.2	**Classify two-dimensional figures into categories based on their properties.**
	STANDARD
M.G.5.2.1	Classify two-dimensional figures in a hierarchy based on properties.

GRADE 6 MATHEMATICS

The Archdiocese of Cincinnati has established the following mathematics standards to make clear to teachers, students, and parents what knowledge, understanding and skills students should acquire to satisfy the math requirements for Grade 6.

In Grade 6, math instructional time needs to focus on five critical areas.
Connecting ratio and rate to whole number multiplication and division and using concepts of ratio and rate to solve problems.

1. **Completing understanding of division of fractions and extending the notion of number to the system of rational numbers, which includes negative numbers.**
2. **Writing, interpreting, and using expressions and equations.**
3. **Developing understanding of statistical problem solving.**
4. **Solving problems involving area, surface area, and volume.**

DOMAIN – RATIO AND PROPORTIONAL RELATIONSHIP - RP

Students use reasoning about multiplication and division to solve ratio and rate problems about quantities. By viewing equivalent ratios and rates as deriving from and extending pairs of rows or columns in the multiplication table and by analyzing simple drawings that indicate the relative size of quantities; students connect their understanding of multiplication and division with ratios and rates. Thus, students expand the scope of problems for which they can use multiplication and division to solve problems and they connect ratios and fractions. Students solve a wide variety of problems involving ratio and rates.

DOMAIN – THE NUMBER SYSTEM - NS

Students use the meaning of fractions, the meaning of multiplication and division and the relationship between multiplication and division to understand and explain why the procedures for dividing fractions make sense. Students use these operations to solve problems. Students extend their previous understanding of a number and the ordering of numbers to the full system of rational numbers, which includes negative rational numbers and, in particular, negative integers. Students reason about the order and absolute value of rational numbers and about the location of points in all four quadrants of the coordinate plane.

DOMAIN – EXPRESSIONS AND EQUATIONS - EE

Students understand the use of variables in mathematical expressions. They write expressions and equations that correspond to given situations, evaluate expressions and use expressions

and formulas to solve problems. Students understand that expressions in different forms can be equivalent and they use the properties of operations to rewrite expressions in equivalent forms. Students know that the solutions of an equation are the values of the variables that make the equation true. Students use properties of operations and the idea of maintaining the equality of both sides of an equation to solve simple one-step equations. Students construct and analyze tables, such as tables of quantities that are in equivalent ratios, and they use equations, such as 3x = y, to describe relationships between quantities.

DOMAIN – GEOMETRY - G

Students in Grade 6 build on their work in elementary school be reasoning about relationships among shapes to determine area, surface area and volume. They find areas of right triangles and special quadrilaterals by decomposing these shapes, rearranging, or removing pieces and relating the shapes to rectangles. Using these methods, students discuss, develop, and justify formulas for areas of triangles and parallelograms. Students find areas of polygons and surface areas of prisms and pyramids by decomposingthem into pieces whose area they can determine. Students reason about right rectangular prisms with fractional side lengths to extend formulas for the volume of a right rectangular prism to fractional side lengths.

DOMAIN – STATISTICS AND PROBABILITY - SP

Building on and reinforcing their understanding of a number, students begin to develop their ability to think statistically. Students recognize that a data distribution may not have a definite center and that different ways to measure center yield different values. The median measures center in the sense that it is the value that each data point would take on if the total of the data values were redistributed equally and in the sense that it is a balance point. Students recognize that a measure of variability (interquartile range or mean absolute deviation) can also be useful for summarizing data because two very different sets of data can have the same mean and median yet be distinguished by their variability. Students learn to describe and summarize numerical data sets, identifying clusters, peaks, gaps, and symmetry, considering the context in which the data was collected.

Grade 6 Mathematic
Priority Standards and Exiting Skills

The Archdiocese of Cincinnati stipulates the following exiting skills in Mathematics for Grade 6 students:

Domain: Ratio and Proportional Relationship

Anchor: Understand ration concepts and use ratio reasoning to solve problems.

- ✓ Understand the concept ofratio and use ratio language to describe a ratio relationship between two quantities.
- ✓ Understand the concept of a unit rate (a/b) associated with a ratio ($a:b$)with $b \neq 0$; use rate language in context of ratio relationship.
- ✓ Use ratio and rate reasoning to solve real-world and mathematical problems.
- ✓ Make and use tables to compare ratios, find missing values and plot pairs of values on coordinate planes.
- ✓ Solve unit rate problems including unit pricing and constant speed.
- ✓ Find a percent of a quantity as a rate per 100.
- ✓ Solve problems finding the whole given a part and a percent.
- ✓ Use ratio reasoning to convert measurement units.
- ✓ Appropriately manipulate and transform units when multiplying or dividing quantities.

Domain: The Number System

Anchor: Apply and extend previous understanding of multiplication and division to divide fractions by fractions.

- ✓ Interpret and compute quotients of fractions and solve world problems involving division of fractions by fractions.

Anchor: Compute fluently with multi-digit numbers and find common factors and multiples.

- ✓ Fluently divide multi-digit numbers using the standard algorithm.
- ✓ Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation.
- ✓ Find greatest common factor of two whole numbers less than or equal to 100.
- ✓ Find the least common multiple of two whole numbers less than or equal to 12.
- ✓ Express the sum if two whole numbers (1-100) with a common factor as a multiple of a sum of two whole numbers without a common factor. Use the distributive property.

Anchor: Apply and extend previous understands of numbers to the system of rational numbers.

- ✓ Understand that positive and negative numbers are used together to describe quantities having opposite directions of value.
- ✓ In real world contexts explain the meaning of 0 in each situation using positive and negative numbers representing quantities.
- ✓ Understand a rational number as a point on a number line.
- ✓ Extend number line diagrams and coordinate axes learned in previous grades to represent negative number points on the lines and in the plane with negative number coordinates.
- ✓ Recognize opposite signs of numbers indicate locations on opposite sides of 0 on the number line.
- ✓ Recognize that the opposite of the opposite of a number is the number itself and that 0 is its own opposite.
- ✓ Understand signs of numbers in ordered pairs indicate locations in quadrants of the coordinate plane.
- ✓ Recognize that when two ordered pairs differ only by signs, the location of the points are related by reflections across one or both axes.
- ✓ Find and position integers and other rational numbers on horizontal or vertical number line.
- ✓ Find and position pairs of integers and other rational numbers on coordinate plane.
- ✓ Understand ordering and absolute value of rational number.
- ✓ Interpret statements of inequality as the relative position of two numbers on the number line.
- ✓ In real world problems, write, interpret, and explain statement so of order for rational numbers.
- ✓ Understand that the absolute value of a rational number is its distance from 0 on the number line.
- ✓ In a real-world situation interpret absolute value as magnitude for positive or negative quantity.
- ✓ Distinguish comparisons of absolute value from statements about order.
- ✓ Solve real-world and mathematical problems by graphing on all four quadrants of the coordinate plane. Find the distance between points with the same first or second coordinate.

Domain: Expressions and Equations

Anchor: Apply and extend previous understandings of arithmetic to algebraic expressions.

- ✓ Write and evaluate numerical expressions involving whole-number exponents.
- ✓ Write, read, and evaluate expressions in which letters stand for numbers.
- ✓ Write expressions that record operations with numbers and with letters standing

for numbers.

- ✓ Identify an expression using mathematical terms; view one or more parts of an expression as a single entity.
- ✓ Including expressions that arise from formulas used in real-world problems, evaluate expressions at specific values of their variables.
- ✓ Perform arithmetic operations, including those with whole number exponents, in conventional order when there is no parenthesis to specify order.
- ✓ Apply properties of operations to generate equivalent expressions.
- ✓ Apply distributive property to an expression to create an equivalent expression.
- ✓ Apply properties of operations to produce equivalent expressions.
- ✓ Identify when two expressions are equivalent.

Anchor: Reason about and solve one-variable equations and inequalities.

- ✓ Understand that solving an equation or inequality requires answer which values from a set, if any, make the equation or inequality true.
- ✓ Use variables to represent numbers and write expressions when solving real world problems.
- ✓ Solve real-world and mathematical problems by writing and solving equations in which all numbers are nonnegative rational numbers.
- ✓ Solve real-world or mathematical problems writing an inequality to represent constraint or condition.
- ✓ Recognize that inequalities can have infinitely many solutions; represent such inequalities number line diagrams.

Domain: Statistics and Probability

Anchor: Develop understanding of statistical variability.

- ✓ Recognize that a statistical question anticipates variability in the data in the question and accounts for it in the answers.
- ✓ Design and use a plan to collect appropriate data to answer a statistical question.
- ✓ Select appropriate graphical methods and numerical measures to analyze data. Compare individual to individual and individual to group.
- ✓ Draw logical conclusions from data based on original question.
- ✓ Understand that set of data to answer statistical question has a distribution described by its center, spread and overall shape.
- ✓ Recognize that a measure of center for a numerical data set summarizes all its values within a single number, while a measure of variation describes how its values vary with a single number.

Grade 6 Mathematic
Supporting Standards and Exiting Skills

Domain: Geometry

Anchor: Solve real-world and mathematical problems involving area, surface area and volume.

- ✓ Solve real-world and mathematical problems by finding the area of various triangles, special quadrilaterals, and polygons by composing and decomposing the shapes.
- ✓ Find volume of right rectangle prism with fractional edge lengths by packing with appropriate unit fraction edge lengths and show the volume as that found by multiplying the edge lengths of the prism.
- ✓ Solve real-world and mathematical problems by using the formulas $V = l \cdot w \cdot h$ *and* $V = B \cdot h$ to find volume of right rectangle prism.
- ✓ Draw polygons on coordinate plane given coordinates for vertices.
- ✓ Solve real-world and mathematical problems by using coordinates to find the length of a side joining points with same first coordinate.
- ✓ Applying the following process, solve real-world and mathematical problems by Using nets made up of rectangles and triangles to represent three-dimensional figures to find the surface area of these figures.

Domain: Statistics and Probability

Anchor: Summarize and describe distributions.

- ✓ Display numerical data in plots on a number line, including dot plots, line plots, histograms, and box plots.
- ✓ Summarize numerical data sets in relation to their context.
- ✓ Report the number of observations.
- ✓ Describe the nature of the attribute under investigation, including how it was measured and its units of measurement.
- ✓ Find the quantitative measures of center (median and/or mean) for a numerical data set. Recognize that this value summarizes data set with a single value. Interpret mean as an equal or fair share. Find measures of variability and describe the shape, presence of clusters, gaps, peaks, and outliers in a distribution.
- ✓ Chose the measures of center and variability, based on shape and data distribution and context in which the data was gathered.

GRADE 6 MATHEMATICS

RATIO AND PROPORTIONAL RELATIONSHIP - RP

ANCHOR STANDARD

M.RP.6.1	**Understand ratio concepts and use ratio reasoning to solve problems.**

STANDARD

M.RP.6.1.1	Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.
M.RP.6.1.2	Understand the concept of a unit rate $^{aaaa}\diamond_{bbbb}$ associated with a ratio *a:b* with $b \neq 0$ *and* use rate language in the context of a ratio relationship.
M.RP.6.1.3	Use ratio and rate reasoning to solve real-world and mathematical problems.
M.RP.6.1.4	Make tables of equivalent ratios relating quantities with whole number measurements; find missing values in the tables; and plot the pairs of values on the coordinate plans. Use tables to compare ratios.
M.RP.6.1.5	Solve unit rate problems including those involving unit pricing and constant speed.
M.RP.6.1.6	Find a percent of a quantity as a rate per 100, e.g., 30% of a quantity means $^{30}\diamond_{100}$ times the quantity; solve problems involving finding the whole, given a part and the percent.
M.RP.6.1.7	Use ratio reasoning to convert measurement units; manipulate and Transform units appropriately when multiplying or diving quantities.

THE NUMBER SYSTEM - NS

ANCHOR STANDARD

M.NS.6.1	**Apply and extend previous understanding of multiplication and division to divide fractions by fractions.**

	STANDARD
M.NS.6.1.1	Interpret and compute quotients of fractions, and solve world problems involving division of fractions by fractions, e.g., by using visual fraction models and equations to represent the problem.
	ANCHOR STANDARD
M.NS.6.2	**Compute fluently with multi-digit numbers and find common factors and multiples.**
	STANDARD
M.NS.6.2.1	Fluently divide multi-digit numbers using the standard algorithm.
M.NS.6.2.2	Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation.
M.NS.6.2.3	Find the greatest common factor of two whole number less than or equal to 100 and the least common multiple of two whole numbers less than or equal to 12.
M.NS.6.2.4	Use the distributive property to express a sum of two whole numbers 1 – 100 with a common factor as a multiple of a sum of two whole numbers with no common factor. For example, express 36 + 8 as 4 (9 +2).
	ANCHOR STANDARD
M.NS.6.3	**Apply and extend previous understandings of numbers to the system of rational numbers.**
	STANDARD
M.NS.6.3.1	Understand that positive and negative numbers are used together to describe quantities having opposite directions of values, e.g., temperature above/below zero, elevation above/below sea level.
M.NS.6.3.2	Use positive and negative numbers to represent quantities in real world contexts, explaining the meaning of 0 in each situation.
M.NS.6.3.3	Understand a rational number as a point on the number line.

M.NS.6.3.4	Extend number line diagrams and coordinate axes familiar from previous grades to represent points on the line and in the plane with negative number coordinates.
M.NS.6.3.5	Recognize opposite signs of numbers as indicating locations on opposite sides of 0 on the number line.
M.NS.6.3.6	Recognize that the opposite of the opposite of a number is the number itself, e.g., - (-3) = 3, and that 0 is its own opposite.
M.NS.6.3.7	Understand signs of numbers in ordered pairs as indicating locations in quadrants of the coordinate plane.
M.NS.6.3.8	Recognize that when two ordered pairs differ only by signs, the locations of the points are related by reflections across one or both axes.
M.NS.6.3.9	Find and position integers and other rational numbers on a horizontal or vertical number line diagram.
M.NS.6.3.10	Find and position pairs of integers and other rational numbers on a coordinate plane.
M.NS.6.3.11	Understand ordering and absolute value of rational number.
M.NS.6.3.12	Interpret statements of inequality as statements about the relative position of two numbers on a number line diagram. For example, interpret -3° > -7° as a statement that -3°C is warmer than -7°C on a number line oriented from left to right.
M.NS.6.3.13	Write, interpret, and explain statements of order for rationale numbers in real-world contexts. For example, write -3°C > -7°C to express the fact that -3°C is warmer than -7°C.
M.NS.6.3.14	Understand the absolute value of a rational number as itsdistance form 0 on the number line.
M.NS.6.3.15	Interpret absolute value as magnitude for a positive or negative quantity in a real-world situation. For example, for an account balance of -30 dollars, write |-30| = 30 to describe the size of the debt in dollars.

M.NS.6.3.16	Distinguish comparisons of absolute value from statements about order. For example, recognize that an account balance less than - 30 dollars represents a debt greater than 30 dollars.
M.NS.6.3.17	Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate.

EXPRESSIONS AND EQUATIONS - EE

ANCHOR STANDARD

M.EE.6.1	**Apply and extend previous understandings of arithmetic to algebraic expressions.**
	STANDARD
M.EE.6.1.1	Write and evaluate numerical expressions involving whole-number exponents.
M.EE.6.1.2	Write, read, and evaluate expressions in which letters stand for numbers.
M.EE. 6.1.3	Write expressions that record operations with numbers and with letters standing for numbers. For example, express the calculation "Subtract y from 5" as 5 – y.
M.EE.6.1.4	Identify parts of an expression using mathematical terms (sums, term, product, factor, quotient, and coefficient); view one or more parts of an expression as a single entity. For example, describe the expression 2(8 + 7) as a product of two factors: view (8 + 7) as both a single entity and a sum of two terms.
M.EE.6.1.5	Evaluate expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems.
M.EE.6.1.6	Perform arithmetic operations, including those involving whole-number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations). For example, use the formulas V = s^3 and A = $6s^2$ to find the volume and surface area of a cube with sides of length 2 = ½.

M.EE.6.1.7	Apply the properties of operations to generate equivalent expressions. For example, apply the distributive property to the expression 3(2 + x) to produce the equivalent expression 6 + 3x.
M.EE.6.1.8	Apply the distributive property to the expression 24x + 18y to produce the equivalent expression 8(4x + 3y).
M.EE.6.1.9	Apply properties of operations to y + y + y to produce the equivalent expression 3y.
M.EE.6.1.10	Identify when two expressions are equivalent, i.e., when the two expressions name the same number regardless of which value is substituted into them. For example, expression y + y +y and 3y are equivalent because they name the same number regardless of which number y stands for.
	ANCHOR STANDARD
M.EE.6.2	**Reason about and solve one-variable equations and inequalities.**
	STANDARD
M.EE.6.2.1	Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true?
M.EE.6.2.2	Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.
M.EE.6.2.3	Solve real-world and mathematical problems by writing and solving equations of the form $x + p = q$ and $px = q$ for cases in which p, q and x are all nonnegative rational numbers.
M.EE.6.2.4	Write an inequality of the form x > c or x < c to represent a constraint or condition in a real-world or mathematical problem.
M.EE.6.2.5	Recognize that inequalities of the form x > c or x < c have infinitely many solutions; represent solutions of such inequalities on number line diagrams.

	ANCHOR STANDARD
M.EE.6.3	**Represent and analyze quantitative relationships between dependent and independent variables.**
	STANDARD
M.EE.6.3.1	Use variables to represent two quantities in a real-world problem that change in relationship to one another.
M.EE.6.3.2	Write an equation to express one quantity thought of as the dependent variable in terms of the other quantity, thought of as the independent variable.
M.EE.6.3.2	Analyze the relationship between the dependent and independent variables using graphs and tables and relate these to the equation. For examples, in a problem involving motion at constant speed, list and graph ordered pairs of distances and times, and write the equation d = rt to represent the relationship between distance and time.

GEOMETRY – G

	ANCHOR STANDARD
G.6.1	**Solve real-world mathematical problems involving area, surface area, and volume.**
	BENCHMARKDESCRIPTION
M.G.1.1	Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real world and mathematical problem.
M.G.6.1.2	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 would be found by multiplying the edge lengths of the prism.
M.G.6.1.3	Apply formulas $V = l \cdot w \cdot h$ and $V = B \cdot h$ to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems.

M.G.6.1.4	Draw polygons in the coordinate plane given coordinates for the vertices.
M.G.6.1.5	Use coordinates to find the length of a side joining points with the same first coordinate. Apply these techniques in the context of solving real-world and mathematical problems.
M.G.6.1.6	Represent three-dimensional figures using nets made up of rectangles and triangles and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problems.

STATISTICS AND PROBABILITY - SP

ANCHOR STANDARD

M.SP.6.1	**Develop understanding of statistical variability.**
M.SP.6.1.1	Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers. For example, "How old am I?" is not a statistical question, but "How old are the students in my school?" is a statistical question because of the variability in students' ages.
M.SP.6.1.2	Collect Date: Design and use a plan to collect appropriate data to answer a statistical question.
M.SP.6.1.3	Analyze Data: Select appropriate graphical methods and numerical measures to analyze data by displaying variability with a group. Compare individual to individual and compare individual to a group.
M.SP.6.1.4	Interpret Results: Draw logical conclusions from the data based on the original question.
M.SP.6.1.5	Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape.
M.SP.6.1.6	Recognize that a measure of center for a numerical data set summarizes all its values with a single number, white a measure of variation describes how its values vary with a single number.

	ANCHOR STANDARD
M.SP.6.2	**Summarize and describe distributions.**
	STANDARD
M.SP.6.2.1	Display numerical data in plots on a number line, including dot plots, line plots, histograms, and box plots.
M.SP.6.2.2	Summarize numerical data sets in relation to their context.
M.SP.6.2.3	Report the number of observations.
M.SP.6.2.4	Describe the nature of the attribute under investigation, including how it was measured and its units of measurement.
M.SP.6.2.5	Find the quantitative measures of center (median and/or mean) for a numerical data set and recognize that this value summarizes the data set with a single number. Interpret mean as an equal or fair share. Find measures of variability (range and interquartile range[G]) as well as informally describe the shape and the presence of clusters, gaps, peaks, and outliers in a distribution.
M.SP.6.2.6	Choose the measures of center and variability, based on theshape of the data distribution and the context in which the data was gathered.

GRADE 7 MATHEMATICS

The Archdiocese of Cincinnati has established the following mathematics standards to make clear to teachers, students, and parents what knowledge, understanding and skills students should acquire to satisfy the math requirements for Grade 7.

In Grade 7, math instructional time should focus on five critical areas.

1. **Develop understanding of and applying proportional relationships.**
2. **Developing understanding of operations with rational numbers and working with expressions and linear equations.**
3. **Solving problems involving scale drawings and informal geometric constructions and working with two- and three-dimensional shapes to solve problems involving area, surface area and volume.**
4. **Drawing inferences about populations based on samples.**
5. **Investigating chance.**

DOMAIN – RATIOS AND PROPORTIONAL RELATIONSHIP – RP

Students extend their understanding of ratios and develop understanding of proportionality to solve a wide variety of percent problems, including those involving discounts, interests, taxes, tips, and percent increase or decrease. Students solve problems about scale drawings by relating corresponding lengths between the objects or by using the fact that relationships of lengths within an object are preserved in similar objects. Students graph proportional relationships and understand the unit rate informally as a measure of the steepness of the related line called slope. They distinguish proportional relationships from other relationships.

DOMAIN – THE NUMBER SYSTEM - NS

Students develop a unified understanding of numbers, recognizing fractions, decimals (that have a finite or a repeating decimal representation) and percent's as different representations of rational numbers. Students extend addition, subtraction, multiplication, and division to all rational numbers, maintaining the properties of operations and the relationships between addition and subtraction, multiplication, and division. By applying these properties and by viewing negative numbers in terms of everyday contexts (i.e. amounts owed or temperatures below zero), students explain and interpret the rules for adding subtracting, multiplying, and dividing with negative numbers. The arithmetic of rational numbers is used as students formulate expressions and equations to solve problems.

DOMAIN – EXPRESSIONS AND EQUATIONS - EE

Students continue their understanding of the use of variables in mathematical expressions that were introduced in Grade 6. They continue to write expressions and equations and continue to use properties of operations to generate equivalent expressions. Students learn to solve multi- step, real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals) using tools strategically. Students also learn to use variables to represent quantities in a real-world or mathematical problem and construct simple equations and inequalities to solve problems by reasoning about the quantities.

DOMAIN – GEOMETRY - G

Students expand their knowledge from Grade 6, solving problems involving the area and circumference of a circle and surface area of three-dimensional objects. In preparation for work in congruence and similarity in Grade 8, they reason about relationships among two-dimensional figures using scale drawings and informal geometric constructions and they gain familiarity with the relationships between angles formed by intersecting lines. Students work with three- dimensional figures, relating them to two-dimensional figures by examining cross-sections. They solve real-world and mathematical problems involving area, surface areas and volume of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

DOMAIN – STATISTICS AND PROBABILITY - SP

Students build on their previous work with single data distributions to compare two data distributions and address questions about differences between populations. Students understand that statistics can be used to gain information about a population by examining a sample population. Students also understand they may use data from a random sample to draw inferences about a population with an unknown characteristic of interest. They also realize and understand how to draw informal comparative inferences about a population with an unknown characteristic of interest. They also realize and understand how to draw informal comparative inferences about two populations. They investigate chance processes and develop, use, and evaluate probability models.

Grade 7 Mathematic
Priority Standards and Exiting Skills

The Archdiocese of Cincinnati stipulates the following exiting skills in Mathematics for Grade 7 students:

Domain: Ratios and Proportional Relationship

Anchor: Analyze proportional relationships and use them to solve real-world and mathematical problems.

- ✓ Compute unit rates associated with ratios of fractions.
- ✓ Recognize and represent proportional relationship between quantities.
- ✓ Decide whether two quantities are in a proportional relationship.
- ✓ Identify the constant of proportionality in tables, graphs, equations diagrams and verbal descriptions.
- ✓ Represent proportional relationships by equations.
- ✓ Explain what a point on a graph of proportional relationship means in terms of the situation.
- ✓ Solve multistep ration and percent problems using proportional relationships.

Domain: The Number System

Anchor: Apply and extend previous understanding of operations with fractions to add, subtract, multiply and divide rational numbers.

- ✓ Represent addition and subtraction on a horizontal or vertical number line diagram.
- ✓ Describe situations in which opposite quantities combine to make 0.
- ✓ Understand $p + q$ as the number located a distance (q) from p in the positive or negative direction depending on whether q is positive or negative. Know and understand additive inverses and interpret sums of rational number in real world contexts.
- ✓ Using properties of operations, add, subtract, multiply and divide rational numbers.
- ✓ Understand that multiplication is extended from fractions to rational numbers by requiring that operations continue to satisfy the properties of operations. Interpret products of rational numbers by describing real-world contexts.
- ✓ Convert a rational number to a decimal using long division.
- ✓ Solve real-world and mathematical problems involving the four operations with rational numbers.

Domain: Expressions and Equations

Anchor: Use properties of operations to generate equivalent expressions.

- ✓ Apply properties of operations as strategies to add, subtract, fact, and expand linear expressions with rational coefficients.

- ✓ Understand that rewriting an expression in equivalent form can reveal and explain properties of the quantities represented and how they are related.

Anchor: Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

- ✓ Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form.
- ✓ Solve problems by applying operations in calculation with numbers of any form, converting between forms as appropriate and assess reasonableness of answers using mental computations and estimation strategies.
- ✓ Use variables to represent quantities in solving problems and construct simple equations and inequalities by reasoning about the quantities.
- ✓ Where *p, q,* and *r* are specific rational numbers, solve world problems which lead t equations of the form $px + q = r$ and $p(x + q) = r$.
- ✓ Using the sequence of operations used in each approach, compare and algebraic solution to an arithmetic solution.
- ✓ Solve real world problems leading to inequalities of the form $px + q \geq r$ or $px + q \leq r$ where p, q and r are rational numbers. Graph the solution and interpret it in context of the problem.

Grade 7 Mathematic
Supporting Standards and Exiting Skills

Domain: Geometry

Anchor: Draw, constructs, and describes geometrical figures and describes the relationship between them.

- ✓ Solve problems involving similar figures with right triangles, other triangles, and special quadrilaterals.
- ✓ Compute actual lengths and areas from a scale drawing and reproduce a scale drawing using a different scale.
- ✓ Represent proportional relationships within and between similar figures.
- ✓ Draw (freehand, with ruler, protractor, and technology) geometric figures with given conditions.
- ✓ Construct triangles from three measures of angles or sides, noting when conditions determine unique triangle, multiple triangles, or no triangle.
- ✓ Construct quadrilaterals with given conditions, noting types and properties of resulting quadrilaterals and if other quadrilaterals can be constructed with the sameconditions.
- ✓ Describe two-dimensional figures resulting from slicing three-dimensional figures.

Anchor: Solve real-life and mathematical problems involving angle measure, area, circles, surface area and volume.

- ✓ Explore and understand the relationships among the circumference, diameter, area, and radius of a circle.
- ✓ Using the formulas for area and circumference of a circle, solve real-world and mathematical problems.
- ✓ Write and solve simple equations in multi-step problems for an unknown angle in a figure by using facts about supplementary, complementary, vertical, and adjacent angles
- ✓ Solve real-world and mathematical problems involving area, volume, and surface area of two-and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

Domain: Statistics and Probability

Anchor: Use sampling to draw conclusions about a population.

- ✓ Understand that statistics can be used to gain information about a

population by examining a sample of the population.

- ✓ Differentiate between a sample and a population.
- ✓ Understand that conclusions and generalizations about a population are only valid if the sample is representative of the population.
- ✓ Develop an informal understanding of bias.

Anchor: Broaden understanding of statistical problem solving.

- ✓ Use random sampling to broaden understanding of statistical problem solving using the GAISE model.
- ✓ Recognize and formulate a statistical question as one that anticipates variability and can be answered with quantitative data. (GAISE Model Step 1)
- ✓ Design and use a plan to collect appropriate data to answer a statistical question. (GAISE Model Step 2)
- ✓ Select appropriate graphical methods and numerical measures to analyze data. (GAISE Model Step 3)
- ✓ Draw logical conclusions and make generalizations. (GAISE Model Step 4)

Anchor: Draw informal comparative inferences about two populations.

- ✓ Summarize and describe distributions representing one population and draw informal conclusions between two populations.
- ✓ Describe and analyze distributions by summarizing quantitative data sets in relation to their context, using mean absolute deviation (MAO) interpreting as a balance point.
- ✓ Assess the degree of visual overlap of two numerical data distributions by measuring the difference between the centers by expressing it as a multiple measure of variability.

Anchor: investigate chance processes and develop use and evaluate probability models.

- ✓ Understand that the probability of a chance event is a number between 0 and 1 expressing the likelihood of the event occurring. Larger numbers indicate greater likelihood.
- ✓ Probability near 0 indicates unlikely event.
- ✓ Probability around ½ indicates neither likely nor more likely.
- ✓ Probability near 1 is likely.
- ✓ Approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given probability.
- ✓ Develop a probability model to find probabilities of events. Compare probabilities fora model to observe frequencies; explain and sources of discrepancy.
- ✓ Develop a uniform probability model to determine probability of events.

- ✓ Develop a probability model (which may not be uniform) by observing frequencies of data generated by chance process.
- ✓ Using organized lists, tables, tree diagrams and simulations, find probability of compound events.
- ✓ Understand the probability of a compound vent is the faction of outcomes in the sample space, as it is in simple events.
- ✓ Using organized lists, tables, and tree diagrams, represent sample space for compound events.
- ✓ Design and use a simulation to generate frequencies for compound events.

GRADE 7 MATHEMATICS

RATIOS AND PROPORTIONAL RELATIONSHIP - RP

ANCHOR STANDARD

M.RP.7.1	**Analyze proportional relationships and use them to solve real- world and mathematical problems.**

STANDARD

M.RP.7.1.1	Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in line or different units.
M.RP.7.1.2	Recognize and represent proportional relationship between quantities.
M.RP.7.1.3	Decide whether two quantities are in a proportional relationship. For example, by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.
M.RP.7.1.4	Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.
M.RP.7.1.5	Represent proportional relationships by equations. For example, if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as $t = pn$.
M.RP.7.1.6	Explain what a point (x, y) on a graph of a proportional relationship means in terms of the situation, with special attention to the points $(0, 0)$ and $(1, r)$ where r is the unit rate.
M.RP.7.1.7	Use proportional relationships to solve multistep ratio and percent problems. Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.

THE NUMBER SYSTEM – NS

ANCHOR STANDARD

M.NS.7.1	**Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.**
	STANDARD
M.NS.7.1.1	Represent addition and subtraction on a horizontal or vertical number line diagram.
M.NS.7.1.2	Describe situations in which opposite quantities combine to make 0. For example, a hydrogen atom has 0 charge because its two constituents are oppositely charged.
M.NS.7.1.3	Understand $p + q$ as the number located a distance $\|q\|$ from p, in the positive or negative direction depending on whether q is positive or negative. Show that a number and its apposite have a sum of 0 (are additive inverses). Interpret sums of rational numbers by describing real-world contexts,
M.NS.7.1.4	Understand subtraction of rational numbers as adding the additive inverse, $p – q = p + (-q)$. Show that the distance between two rational numbers on the number line is the absolute value of their difference and apply this principle in real-world contexts.
M.NS.7.1.5	Apply properties of operations as strategies to add and subtract rational numbers.
M.NS.7.1.6	Understand that multiplication is extended from fractions to rational numbers by requiring that operations continue to satisfy the properties of operations, particularly the distributive property, leading to products such as (-1)(-1) = 1 and the rules for multiplying signed numbers. Interpret products of rational numbers by describing real-world contexts.
M.NS.7.1.7	Apply properties of operations as strategies to multiply and divide rational numbers.

M.NS.7.1.8	Convert a rational number to a decimal using long division; know that the decimal form of a rational number terminates in 0s or eventually repeats.
M.NS.7.1.9	Solve real-world and mathematical problems involving the four operations with rational numbers. Computations with rational numbers extend the rules for manipulating fractions to complex fractions.

EXPRESSIONS AND EQUATIONS - EE

ANCHOR STANDARD

M.EE.7.1 **Use properties of operations to generate equivalent expressions.**

STANDARD

M.EE.7.1.1	Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.
M.EE.7.1.2	In a problem context, understand that rewriting an expression in an equivalent form can reveal and explain properties of the quantities represented by the expression and can reveal how those quantities are related. For example, a discount of 15% (represented by p – 0.15)p, which is equivalent to 0.85p or finding 85% of the original price.

ANCHOR STANDARD

M.EE.7.2 **Solve real-life and mathematical problems using numerical and algebraic expressions and equations.**

STANDARD

M.EE.7.2.1	Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers if any form (whole numbers, fractions, and decimals), using tools strategically.
M.EE.7.2.2	Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computations and estimation strategies. For example, if a woman making $25 an

	hour gets a 10% raise, she will make an additional 1/10 of her salary an hour, or a raise of $2.50, for a new salary of $27.50 an hour.
M.EE.7.2.3	Use variable to represent quantities in a real-world or mathematical problem and construct simple equations and inequalities to solve problems by reasoning about the quantities.
M.EE.7.2.4	Solve word problems leading to equations of the form px + q = r and p(x + q) = r, where p, q and r are specific rational numbers. Solve equations of these forms fluently.
M.EE.7.2.5	Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach. For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?
M.EE.7.2.6	Solve world problems leading to inequalities of the form px + q ≥ r or px + q ≤ r, where p, q, and r are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem. For example, as a salesperson, you are paid $50 per week plus $3 per sale. This week you want your pay to be at least $100. Write an inequality for the number of sales you need to make and describe the solution.

GEOMETRY - G

	ANCHOR STANDARD
M.G.7.1	**Draw construct and describe geometrical figures and describe the relationship between them.**
	STANDARD
M.G.7.1.1	Solve problems involving similar figures with right triangles, other triangles, and special quadrilaterals.
M.G.7.1.2	Compute actual lengths and areas from a scale drawing and reproduce a scale drawing at a different scale.
M.G.7.1.3	Represent proportional relationships within and between similar figures.

M.G.7.1.4	Draw (freehand with ruler and protractor, and with technology) geometric figures with given conditions.
M.G.7.1.5	Focus on constructing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle.
M.G.7.1.6	Focus on constructing quadrilaterals with given conditions noticing types and properties of resulting quadrilaterals and whether it is possible to construct different quadrilaterals using the same conditions.
M.G.7.1.7	Describe the two-dimensional figures that result from slicing three- dimensional figures, as in plane sections of right rectangular prisms and right rectangular.
	ANCHOR STANDARD
M.G.7.2	**Solve real-life and mathematical problems involving angle measure, area, circles surface area, and volume.**
	STANDARD
M.G.7.2.1	Work with circles. Explore and understand the relationships among the circumference, diameter, area, and radius of a circle.
M.G.7.2.2	Know and use the formulas for the area and circumference of a circle and use them to solve real-world and mathematical problems.
M.G.7.2.3	Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure.
M.G.7.2.4	Solve real-world and mathematical problems involving area, volume, and surface area of two-and-three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

STATISTICS AND PROBABILITY - SP

	ANCHOR STANDARD
M.SP.7.1	**Use sampling to draw conclusions about a population.**
	STANDARD
M.SP.7.1.1	Understand that statistics can be used to gain information about population by examining a sample of the population.
M.SP.7.1.2	Differentiate between a sample and a population.
M.SP.7.1.3	Understand that conclusions and generalizations about a population are valid only if the sample is representative of that populations. Develop an informal understanding of bias.
	ANCHOR STANDARD
M.SP.7.2	**Broaden understanding of statistical problem solving.**
	STANDARD
M.SP.7.2.1	Use random sampling to broaden understanding of statistical problems solving by using GAISE model.
M.SP.7.2.2	Formulate Questions: Recognize and formulate a statistical question as one that anticipates variability and can be answered with quantitative data. For example, "How do the heights of seventh graders compare to the heights of eighth graders?" (GAISE Model Step 1)
M.SP.7.2.3	Collect Data: Design and use a plan to collect appropriate data to answer a statistical question (GAISE Model Step 2)
M.SP.7.2.4	Analyze Data: Select appropriate graphical methods and numerical measures to analyze data by displaying variability within a group, comparing individual to individual, and comparing individual to group (GAISE Model Step 3)
M.SP.7.2.5	Interpret Results: Draw logical conclusions and make generalizations. (GAISE Model Step 4)

ANCHOR STANDARD

M.SP.7.3 **Draw informal comparative inferences about two populations.**

STANDARD

M.SP.7.3.1 Summarize and describe distributions representing one population and draw informal comparisons between two populations.

M.SP.7.3.2 Describe and analyze distributions: Summarize quantitative data sets in relation to their context by using mean absolute deviation (MAO), interpreting as a balance point.

M.SP.7.3.3 Informally assess the degree of visual overlap of two numerical data distributions with roughly equal variabilities, measuring the difference between the centers by expressing it as a multiple of a measure of variability. For Example, the mean height of players on a basketball team is 10 cm. greater than the mean height of players on a soccer team, about twice the variability (MAD) on either team on a dot line (plot line, the separation between the two distributions of heights is noticeable.

ANCHOR STANDARD

M.SP.7.4 **Investigate chance processes and develop use and evaluate probability models.**

STANDARD

M.SP.7.4.1 Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood.

M.SP.7.4.2 A probability near 0 indicates an unlikely event.

M.SP.7.4.3 A probability around ½ indicates an event that is neither unlikely more likely.

M.SP.7.4.4 A probability near 1 indicates a likely event.

M.SP.7.4.5 Approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative

	frequency given probability. For example, when rolling a number cube 600 times, predict that a 3 or 6 would be rolled roughly 200 times, but probably not exactly 200 times.
M.SP.7.4.6	Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observe frequencies; if the agreement is not good, explain possible sources of the discrepancy.
M.SP.7.4.7	Develop a uniform probability model by assigning equal probability to all outcomes and use the model to determine probabilities of events. For example, if a student is selected at random from a class, find the probability that Jane will be selected and the probability that a girl will be selected.
M.SP.7.4.8	Develop a probability model (which may not be uniform) by observing frequencies in data generated from a chance process. For example, find the approximate probability that a spinning penny will land heads up or that a tossed paper cup will land open- end down. Do the outcomes for the spinning penny appear to be equally likely based on the observed frequencies?
M.SP.7.4.9	Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation.
M.SP.7.4.10	Understand that, just as with simple events, the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs.
M.SP.7.4.11	Represent sample space for compound events using methods such as organized lists, tables, and tree diagrams. For an event described in everyday language. For example, “rolling double sixes” identify the outcomes in the sample space which compose the event.
M.SP.7.4.12	Design and use a simulation to generate frequencies for compound events. For example, use random digits as a simulation tool to approximate the answer to the question: If 40% of donors have type A blood, what is the probability that it will take at least 4 donors to find one with type A blood?

GRADE 8 MATHEMATICS

The Archdiocese of Cincinnati has established the following mathematics standards to make clear to teaches, students and parents what knowledge, understanding and skills students should acquire in order to satisfy the math requirements for Grade 8.

In Grade 8, math instructional time should focus on four critical areas.

1. **Formulating and reasoning about expressions and equations, including modeling an association in bivariate data with linear equation and solving linear equations and systems of linear equations.**
2. **Grasping the concept of a function and using functions to describe quantitative relationships.**
3. **Analyzing two- and three-dimensional space and figures using distance, angles, similarity and congruence and understanding and applying the Pythagorean Theorem.**
4. **Working with irrational numbers, integer exponents, and scientific notation**

DOMAIN – THE NUMBER SYSTEM - NS

Students know that there are numbers that are not rational and approximate them by rational numbers. Students know that every number has a decimal expansion and understand that rational numbers show that the decimal expansion repeats eventually and convert a decimal expansion which repeats eventually into a rational number. Students learn to use rational approximations of irrational numbers to compare the size of irrational numbers and locate them approximately on a number line to diagram and estimate the value of expressions.

DOMAIN – EXPRESSIONS AND EQUATIONS - EE

Students know and apply the properties of integer exponents to generate equivalent numerical expressions. Students learn and use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Students evaluate square roots of small perfect squares and cube roots of small perfect cubes. They know that $\sqrt{2}$ is irrational. Students also know how to use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities and to express how many times as much one is than the other. Students learn to perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. They use scientific notation and choose units of appropriate size for measurements of very large or very small quantities. Students interpret scientific notation that
has been generated by technology. They understand the connections between proportional relationships, lines and linear equations. Students know how to graph proportional relationships as well as compare two different proportional relationships represented in

different ways. Students also analyze and solve linear equations in one variable as well as with rational number coefficients including solutions requiring expanding expressions using distributive property. They also learn to analyze and solve pairs of simultaneous linear equations.

DOMAIN – FUNCTIONS – F

Students define, evaluate and compare functions. They understand that functions are rules that assign to each input exactly one output. Students learn to compare properties of two functions each represented in a different way. Students learn to interpret the equation y = mx + b as defining a linear function, whose graph is a straight line. Students use functions to model relationships between quantities and construct a function to model a linear relationship between two quantities. Students determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. They describe qualitatively the functional relationship between two quantities by analyzing a graph.

DOMAIN – GEOMETRY - G

Students understand congruence and similarity using physical models, transparencies or geometry software. They learn to verify experimentally the properties of rotations, reflections and translations. Students understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections and translations. Students describe the effect of dilations, translations, rotations and reflections on two- dimensional figures using coordinates. Students also understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations and dilation. Students use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal and the angle-angle criterion for similarity of triangles. Students understand and can apply the Pythagorean Theorem. Students also can solve real-world and mathematical problems involving volume of cylinders, cones and spheres by knowing and applying the formulas.

DOMAIN – STATISTICS AND PROBABILITY - SP

Students construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Students know that straight lines are widely used to model relationships between two quantitative variables. Students also use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. Students understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table.

Grade 8 Mathematic
Priority Standards and Exiting Skills

The Archdiocese of Cincinnati stipulates the following exiting skills in Mathematics for Grade 8 students:

Domain: Expressions and Equations

Anchor: Work with radicals and integer exponents.

- ✓ Know and apply the properties of integer exponents to generate equivalent numerical expressions.
- ✓ Where *p* is a positive rational number, use square root and cube root symbols to represent solutions to equation of the form $x^2 = p$ and $x^3 = p$.
- ✓ Evaluate square roots and cube roots of small perfect squares. Know that $\sqrt{2}$ is irrational.
- ✓ Use single digit numbers time an integer power of 10 to estimate very large or very small quantities and to express how many times one is than the other.
- ✓ Perform operations with numbers expressed in scientific notation including problems where both decimal and scientific notation are used.
- ✓ Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities.

Anchor: Understand the connections between proportional relationships, lines, and linear equations.

- ✓ Graph proportional relationships, interpreting the unit rate as the slope of the graph.
- ✓ Compare two different proportional relationships represented in different ways.
- ✓ Use similar triangles to explain why the slope *m* is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation $y = mx$ for a line through the origin and the equation $y = mx + b$ for a line intercepting the vertical axis at *b*.

Anchor: Analyze and solve linear equations and pairs of simultaneous linear equations.

- ✓ Solve linear equations in one variable.
- ✓ Give examples of linear equations in one variable, with one solution, infinitely many solutions or no solutions. Show which solution is the case by transforming the equation into simpler forms until an equivalent equation of the form $x = a$, $a = a$, or $a = b$ results where *a* and *b* are different numbers.
- ✓ Solve linear equations with rational number coefficients including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

- ✓ Analyze and solve pairs of simultaneous linear equations.
- ✓ Understand solutions to a system or two variables algebraically.
- ✓ Estimate solutions by graphing the equations.
- ✓ Solve simple cases by inspection.
- ✓ Solve real-world and mathematical problems leading to two linear equations in two variables.

Domain: Functions

Anchor: Define, evaluate, and compare functions.

- ✓ Understand that a function is a rule that assigns to each input exactly one output.
- ✓ Understand 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 a different way.
- ✓ Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line.
- ✓ Give examples of functions that are not linear.

Anchor: Use functions to model relationships between quantities.

- ✓ Construct a function to model linear. Determine the rate of change and the initial value of the function from descriptions of a relationship or from two values. Include reading these from a graph or table.
- ✓ Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or table of values.
- ✓ Describe qualitatively the functional relationship between two quantities by analyzing a graph.
- ✓ Sketch a graph that exhibits the qualitative features of a function that has been described verbally.

Domain: Geometry

Anchor: Understand congruence and similarity using physical models, transparencies or geometry software.

- ✓ Using examples with and without coordinates, verify experimentally the properties of rotation, reflections and translations.
- ✓ Understand:
  - Lines are taken to lines and line segments are taken to line segments of the same length;
  - Angles are taken to angles of the same measure;
  - Parallel lines are taken to parallel lines.
- ✓ Understand that two-dimensional figure is congruent another if the second can be obtained by a sequence of rotations, reflections, and translations.
- ✓ Describe a sequence that exhibits the congruency between two-dimensional

figures including examples both with and without coordinates.

- ✓ Describe the effect of dilations, translations, rotations, and reflections on two=dimensional figures using coordinates.
- ✓ Understand that two-dimensional figure is similar another if the second can be obtained by a sequence of rotations, reflections, and translations.
- ✓ Describe a sequence that exhibits the similarity between two similar two-dimensional figures including examples both with and without coordinates.
- ✓ Use informal arguments to establish facts about the angle sum and exterior angle of triangle, about angles created when parallel lines are cut by a transversal and the angle- angle criterion for similarity of triangles.

Grade 8 Mathematic
Supporting Standards and Exiting Skills

Domain: The Number System

Anchor: Know that there are numbers that are not rational, and approximate them by rational numbers.

- ✓ Know that real numbers are either rational or irrational. Understand that every number has a decimal expansion and its characteristics.
- ✓ Use rational approximations of irrational numbers to compare the size, location on a number line and estimate the value of the expression.

Domain: Geometry

Anchor: Understand and apply the Pythagorean Theorem.

- ✓ Analyze and justify an informal proof of the Pythagorean Theorem and its converse.
- ✓ Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

Anchor: Solve real-world and mathematical problems involving volume of cylinders, cones and spheres.

- ✓ Know and use the formulas for the volumes of cones, cylinders and spheres to solve problems.

Domain: Statistics and Probability

Anchor: Investigate patterns of association in bivariate data.

- ✓ Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities.
- ✓ Describe patterns that indicate types of associations. (GAISE Model, Steps 3 and 4)
- ✓ Understand the use of straight lines to model relationships between two quantitative variables.
- ✓ Using equations of a linear model solve problems in the context of bivariate measurement data interpreting the slope and intercept.
- ✓ Understand that patterns of association can be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table.
- ✓ Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects.
- ✓ Describe possible association between two variables by using relative frequencies calculated for rows or columns.

GRADE 8 MATHEMATICS

THE NUMBER SYSTEM - NS

	ANCHOR STANDARD
M.NS.8.1	**Know that there are numbers that are not rational, and approximate them by rational numbers.**
	STANDARD
M.NS.8.1.1	Know that real numbers are either rational or irrational. Understand informally that every number has a decimal expansion which is repeating, terminating, or is non-repeating and non- terminating.
M.NS.8.1.2	Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions, e,g., $\square^2$. For example, by truncating the decimal expansion of $\sqrt{2}$, show that $\sqrt{2}$ is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.

EXPRESSIONS AND EQUATIONS - EE

	ANCHOR STANDARD
M.EE.8.1	**Work with radicals and integer exponents.**
	STANDARD
M.EE.8.1.1	Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, 3^2 x 3^{-5} = 3^{-3} = $1/3^3$ = 1/27.
M.EE.8.1.2	Use square root and cube root symbols to represent solutions to equations of the form $\square^2$ = *p* and $\square^3$ = *p,* where *p* is a positive rational number.
M.EE8.1.3	Evaluate square roots of small perfect squares and cube roots of Small perfect cubes. Know that $\sqrt{2}$ is irrational.
M.EE.8.1.4	Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities and to express how many times as much one is than the other. For example,

	estimate the population of the United States as 3 x 10^8; and the population of the world as 7 x 10^9; and determine that the world population is more than 20 times larger.
M.EE.8.1.5	Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used.
M.EE.8.1.6	Use scientific notation and choose units of appropriate size for measurements of vary large or very small quantities, e.g., use millimeters per year for seafloor spreading. Interpret scientific notation that has been generated by technology.
	ANCHOR STANDARD
M.EE.8.2	**Understand the connections between proportional relationships, lines, and linear equations.**
	STANDARD
M.EE.8.2.1	Graph proportional relationships, interpreting the unit rate as the slope of the graph.
M.EE.8.2.2	Compare two different proportional relationships represented in different ways. For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.
M.EE.8.2.3	Use similar triangles to explain why the slope m is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation $y = mx$ for a line through the origin and the equation $y = mx + b$ for a line intercepting the vertical axis at b.
	ANCHOR STANDARD
M.EE.8.3	**Analyze and solve linear equations and pairs of simultaneous linear equations.**
	STANDARD
M.EE.8.3.1	Solve linear equations in one variable.
M.EE.8.3.2	Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the

	given equation into simpler forms until an equivalent equation of the form $x = a$, $a = a$, or $a = b$ results (where a and b are different numbers.)
M.EE.8.3.3	Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.
M.EE.8.3.4	Analyze and solve pairs of simultaneous linear equations.
M.EE.8.3.5	Understand that solutions to a system or two variables algebraically.
M.EE.8.3.6	Estimate solutions by graphing the equations.
M.EE.8.3.7	Solve simple cases by inspection. For example, 3x + 2y = 5 and 3x + 2y = 6 have no solution because 3x + 2y cannot simultaneously be 5 and 6.
M.EE.8.3.8	Solve real-world and mathematical problems leading to two linear equations in two variables. For examples, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.

FUNCTIONS - F

ANCHOR STANDARD

M.F.8.1	**Define, evaluate, and compare functions.**
	STANDARD
M.F.8.1.1	Understand that a function is a rule that assigns to each input exactly one output.
M.F.8.1.2	Understand the graph of a function is the set of ordered pairs consisting of an input and the corresponding output.
M.F.8.1.3	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a linear function represented by a table of values and a linear function represented by a algebraic expression, determine which function has a greater rate of change.

M.F.8.1.4	Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line.
M.F.8.1.5	Give examples of functions that are not linear. For examples, the function $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points (1, 1), (2, 4) and (3, 9) which are not on a straight line.
	ANCHOR STANDARD
M.F.8.2	**Use functions to model relationships between quantities.**
	STANDARD
M.F.8.2.1	Construct a function to model a linear. Determine the rate of change and initial value of the function from a description of a relationship or from two (*x, y*) values including reading these from a table or from a graph.
M.F.8.2.2	Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.
M.F.8.2.3	Describe qualitatively the functional relationship between two quantities by analyzing a graph, e.g., where the function is increasing or decreasing, linear or nonlinear.
M.F.8.2.4	Sketch a graph that exhibits the qualitatively features of a function that has been described verbally.

GEOMETRY – G

	ANCHOR STANDARD
M.G.8.1	**Understand congruence and similarity using physical models, transparencies, or geometry software.**
	STANDARD
M.G.8.1.1	Verify experimentally the properties of rotations, reflections and translations include examples both with and without coordinates.
M.G.8.1.2	Lines are taken to lines, and line segments are taken to line

	segments of the same length.
M.G.8.1.3	Angles are taken to angles of the same measure.
M.G.8.1.4	Parallel lines are taken to parallel lines.
M.G.8.1.5	Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations.
M.G.8.1.6	Given two congruent figures, describe a sequence that exhibits the congruence between them. (Include examples both with and without coordinates.)
M.G.8.1.7	Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.
M.G.8.1.8	Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations.
M.G.8.1.9	Given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them. (Include examples both with and without coordinates.)
M.G.8.1.10	Use informal arguments to establish fats about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. For examples, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.
	ANCHOR STANDARD
M.G.8.2	**Understand and apply the Pythagorean Theorem.**
	STANDARD
M.G.8.2.1	Analyze and justify an informal proof of the Pythagorean Theorem and its converse.
M.G.8.2.2	Apply the Pythagorean Theorem to find the distance between

two points in a coordinate system.

ANCHOR STANDARD

M.G.8.3 **Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.**

STANDARD

M.G.8.3.1 Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.

STATISTICS AND PROBABILITY - SP

ANCHOR STANDARD

M.SP.8.1 **Investigate patterns of association in bivariate data.**

STANDARD

M.SP.8.1.1 Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities.

M.SP.8.1.2 Describe patterns such as clustering; outliers; positive, negative, or no association; and linear association and nonlinear association, (GAISE Model, steps 3 and 4).

M.SP.8.1.3 Understand that straight lines are widely used to model relationships between two quantitative variables.

M.SP.8.1.4 Use the equations of a linear model to solve problems in the context of bivariate measurement data interpreting the slop and intercept. For example, in a linear model for a biology experiment interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1/5 cm in mature plant height.

M.SP.8.1.5 Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table.

M.SP.8.1.6 Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects.

M.SP.8.1.7 Use relative frequencies calculated for rows or columns to describe possible association between the two variables. For

examples, collect data from students in class on whether or not they have a curfew on school nights, and whether they have assigned chores at home. Is there evidence that those who have a curfew also ten to have chores?

ALGEBRA I

The Archdiocese of Cincinnati has established the following mathematical standards to make clear to teachers, students and parents what knowledge, understanding and skills students should acquire in order to satisfy the math requirements for Algebra I.
(It is important to note that advanced math curriculum is only offered to Middle School/Junior High students who are ready for an advanced math course, and have successfully demonstrated knowledge of grade-level Ohio New Learning Standards. Acceptance to these classes is at the discretion of school administrators and math teachers.)

In Algebra I, math instructional time should focus on four critical areas.

1. **Determine the appropriate equivalent form of an expression for a given purpose.**
2. **Factor a quadratic expression so that the zeros of the function it defines can be identified.**
3. **Complete the square for a quadratic expression to identify the vertex and maximum or minimum value of the function it defines.**
4. **Rewrite exponential expressions by using properties of exponents.**

DOMAIN – SEE STRUCTURE IN EXPRESSION - SSE

Students develop an understanding of expressions as computations with numbers, variables, arithmetic operations and exponents. Students are also able to perform the operation of evaluating a function. The use of parentheses and the order of operations assure that each expression is unambiguous. Students will develop the skills required in reading an expression with comprehension, involving analysis of underlying structure and suggesting different but equivalent ways of writing the expression. Students will also learn algebraic manipulations are governed by the properties of operations and exponents and the conventions of algebraic notation.

DOMAIN – ARITHMETIC WITH POLYNOMIALS AND RATIONAL EXPRESSIONS - APR

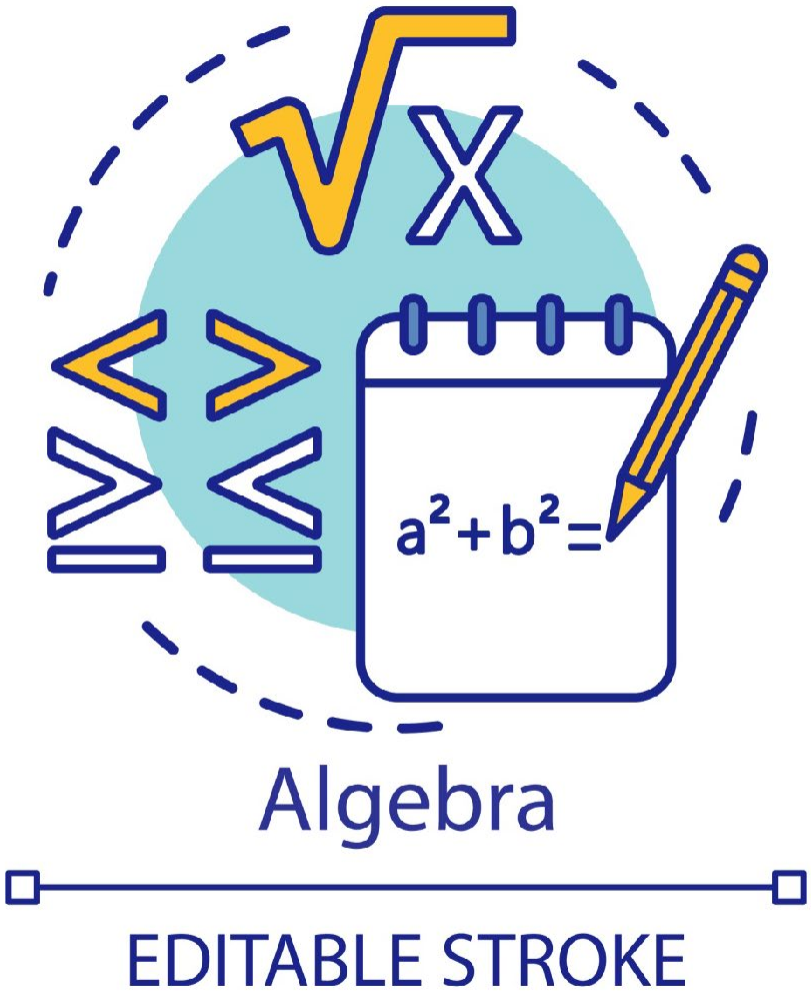
Students extend addition, subtraction, multiplication and division to polynomials, maintaining the properties and operations. The factoring of polynomials is used to solve problems and describe numerical relationships.

DOMAIN – CREATING EQUATIONS - CED

Students develop an understanding that an equation is a statement of equality between two expressions with unknown values. These values are the solution to the equation. Students extend their understanding of solutions of an equation in one variable, to solutions with two variables as ordered pairs which can be plotted on the coordinate plane. They continue their understanding that two or more equations and/or inequalities form a system. A solution for such a system must satisfy every equation and inequality in the system.

DOMAIN – REASONING WITH EQUATIONS AND INEQUALITIES - REI

Students extend their understanding and discover an equation can be solved by steps of simplification. They develop an understanding that some equations have no solutions in a given number system. Students use the same solution techniques to rearrange formulas, solving new equations and inequalities. Properties are applied to solve both equalities and inequalities extending to functions.



ALGEBRA I

SEE STRUCTURE IN EXPRESSION -SSE

ANCHOR STANDARD

A.SSE.9.1 **Interpret the structure of expressions.**

STANDARD

A.SSE.9.1.1 Interpret expressions that represent a quantity in terms of its context. For example, calculate mortgage payments.

A.SSE.9.1.2 Interpret parts of an expression, such as terms, factors, and coefficients.

A.SSE.9.1.3 Interpret complicated expressions by viewing one or more of their parts as a single entity.

A.SSE.9.1.4 Use the structure of an expression to identify ways to rewrite it. For example, to factor 3 x (x - 5) + 2(x - 5), students recognize that the "x - 5" is common to both expressions being added, so it simplifies to (3x + 2)(x -5); or see $xx^4 - yy^4$ as $(xx^2)^2 - (yy^2)^2$, thus recognizing it as a difference of squares that can be factored as $(xx^2 - yy^2)(xx^2 + yy^2)$.

ANCHOR STANDARD

A.SSE.9.2 **Write expressions in equivalent forms to solve problems.**

STANDARD

A.SSE.9.2.1 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

A.SSE.9.2.2 Factor a quadratic expression to reveal the zeros of the function it defines.

A.SSE.9.2.3 Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.

A.SSE.9.2.4	Use the properties of exponents to transform expressions for exponential functions. For example, 8^{tt} can be written as 2^{3tt}.
A.SSE.9.2.5	(+) Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems.

ARITHMETIC WITH POLYNOMIALS AND RATIONAL EXPRESSIONS - APR

ANCHOR STANDARD

A.APR.9.1 **Perform arithmetic operations on polynomials.**

STANDARD

A.APR.9.1.1	Understand that polynomials form a system analogous to the integers, namely that they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.
A.APR.9.1.2	Focus on polynomials expressions that simplify to forms that are linear or quadratic. (A1, M2)
A.APR.9.1.3	Extend to polynomial expressions beyond those expressions that simplify to forms that are linear or quadratic. (A2, M3)

ANCHOR STANDARD

A.APR.9.2 **Understand the relationship between zeros and factors of polynomials.**

STANDARD

A.APR.9.2.1	Understand and apply the Remainder Theorem: For a polynomial $p(x)$ and a number a, the remainder on division by $x – a$ is $p(a)$. In particular $p(a) = 0$ if and only if $(x – a)$ is a factor of $p(x)$.
A.APR.9.2.2	Identify zeros of polynomials, when factoring is reasonable, and use the zeros to construct a rough graph of the function defined by the polynomial.

A.APR.9.2.3 Prove polynomial identities and use them to describe numerical relationships. For example, the polynomial identity $(xx^2 + yy^2) = (xx^2 - yy^2) + (2xy)^2$ can be used to generate Pythagorean triples.

A.APR.9.2.4 (+) Know and apply the Binomial Theorem for the expression of $(x + y)^n$ in powers of x and y for a positive integer n, where x and y are any numbers. For example, by using coefficients determined by Pascal's Triangle. The Binomial Theorem can be proven by mathematical induction or by a combinatorial argument.

ANCHOR STANDARD

A.APR.9.3 Rewrite rational expressions.

STANDARD

A.APR.9.3.1 Rewrite simple rational expressions in different forms; write $\frac{aa(xx)}{bb(xx)}$ in the form $q(xx) + \frac{rr(xx)}{bb(xx)}$, where $a(xx)$, $bb(xx)$, $qq(xx)$, $aaaaaa\ rr(xx)$ are polynomials with the degree of $r(xx)$ less than the degree of $b(xx)$, using inspection, long division, or, for the more complicated examples, a computer algebra system.

A.APR.9.3.2 (+) Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division, by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.

CREATING EQUATIONS - CED

ANCHOR STANDARD

A.CED.9.1 Create equations that describe numbers or relationships.

STANDARD

A.CED.9.1.1 Create equations and inequalities in one variable and use them to solve problems. Include equations and inequalities arising from linear quadratic, simple rational and exponential functions.

A.CED.9.1.2 Focus on applying linear and simple exponential expressions. (A1, M1)

A.CED.9.1.3	Focus on applying simple quadratic expressions. (A1, M2)
A.CED.9.1.4	Extend to include more complicated function situations with the option to solve technology. (A2, M3)
A.CED.9.1.5	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
A.CED.9.1.6	Focus on applying linear and simple exponential expressions. (A1, M1)
A.CED.9.1.7	Focus on applying simple quadratic expressions. (A1, M2)
A.CED.9.1.8	Extend to include more complicated function.
A.CED.9.1.9	Represent constraints by equations or inequalities, and by systems of the equations and/or inequalities, and interpret solutions as viable a non-viable options in a modeling context. For example, represent inequalities describing nutritional cost constraints on combinations of different foods. (A1, M1)
A.CED.9.1.10	While functions will often be linear, exponential, or quadratic, the types of problems should draw from more complicated situations. (A2, M3)
A.CED.9.1.11	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
A.CED.9.1.12	Focus on formulas in which the variable of interest is linear or square. For example, rearrange Ohm's law V = IR to highlight resistance R, or rearrange the formula for the area of a circle. A = (πr^2 to highlight radius r. (A1)
A.CED.9.1.13	Focus on formulas in which the variable of interest is linear. For example, rearrange Ohm's law V = IR to highlight resistance R. (M1)
A.CED.9.1.14	Focus on formulas in which the variable of interest is linear or square. For example, rearrange the formulas for the area of a circle A = (π)r^2 to highlight radius r. (M2)

A.CED.9.1.15	While functions will often be linear, exponential, or quadratic, the types of problems should draw from more complicated situations. (A2, M3)

REASONING WITH EQUATIONS AND INEQUALITIES - REI

ANCHOR STANDARD

A.REI.9.1	**Solve equations and inequalities in one variable.**
	STANDARD
A.REI.9.1.1	Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution.
A.REI.9.1.2	Construct a variable argument to justify a solution method.
A.REI.9.1.3	Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

ANCHOR STANDARD

A.REI.9.2	**Solve equations and inequalities in one variable.**
	STANDARD
A.REI.9.2.1	Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
A.REI.9.2.2	Solve quadratic equations in one variable.
A.REI.9.2.3	Use the method on completing the square to transform any quadratic equation in xx into an equation of the form $(xx - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.
A.REI.9.2.4	Solve quadratic equations by inspections. For example, for $xx^2 = 49$, taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation.
A.REI.9.2.5	Recognize when the quadratic formula gives complex solutions and write them as a $\pm$ bi for real numbers a and b.