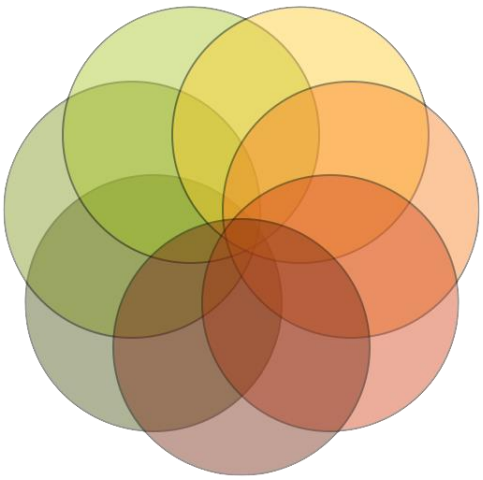
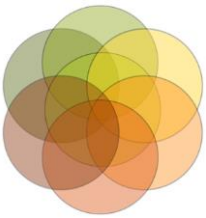


# Oklahoma Academic Standards for Mathematics

## Third DRAFT

## September, 2015



# Acknowledgements

The Oklahoma Academic Standards for Mathematics 2015 is the result of the contributions of many mathematics teachers and mathematics educators from across the state. We believe this document reflects a balanced synthesis of the work of all members of the Oklahoma Academic Standards for Mathematics Writing Committee.

## Oklahoma Academic Standards for Mathematics Writing Committee

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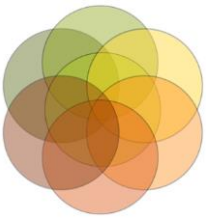


# Introduction

The Oklahoma Academic Standards for Mathematics 2015 specify what students should know and be able to do as learners of mathematics at the end of each grade level or course. Students are held responsible for learning standards listed at earlier grade levels as well as their current grade level. Following each of the standards are **Sample Problems or Classroom Activities (Forthcoming)** that clarify the standards and provide possibilities for their implementation.

**Comment [CY1]:** Just curious, does this have implications for assessment or does it simply point out an expectation that learned material persists?

Throughout this document, the standards are written to allow time for study of additional material at every grade level. The order of the standards at any grade level is not meant to imply a sequence of topics and should be considered flexible for the organization of any course. The document provides standards for PK-7, Pre-Algebra, Algebra I, Geometry, Algebra II with Algebra I as the pre-requisite for both Geometry and Algebra II.

## Development of the Oklahoma Academic Standards for Mathematics

The Oklahoma Academic Standards for Mathematics writing team drew on the work of the National Council of Teachers of Mathematics (NCTM) standards documents; the National Research Council's report *Adding It Up*, the Oklahoma Priority Academic Standards (PASS), and other states' standards documents and curriculum framework guides (e.g., Minnesota, Virginia, and Massachusetts). Please see the reference list at the end of this document for a more complete list of all resources consulted.

## Vision and Guiding Principles

These standards envision all students in Oklahoma will become mathematically proficient and literate through a strong mathematics program that emphasizes and engages them in problem solving, communicating, reasoning and proof, making connections, and using representations. Mathematically proficient and literate students can confidently and effectively use mathematics concepts, computation skills, and numbers to problem-solve, reason and analyze information. Developing mathematical proficiency and literacy for Oklahoma students depends in large part on a clear, comprehensive, coherent, and developmentally appropriate set of standards to guide curricular decisions. The understanding and implementation of these standards throughout PK-12 mathematics experience for students is based on the following guiding principles:

**Guiding Principle 1:** Excellence in mathematics education requires equity--high expectations and strong support for all students.

All students must have opportunities to study—and support to learn—mathematics. Equity does not mean that every student should receive identical instruction; instead, it demands that reasonable and appropriate accommodations be made as needed to promote access and attainment for all students.

**Guiding Principle 2:** Mathematical ideas should be explored in ways that stimulate curiosity, create enjoyment of mathematics, and develop depth of understanding.

Students need to understand mathematics deeply and use it effectively. To achieve mathematical understanding, students should be actively engaged in doing meaningful mathematics, discussing mathematical ideas, and applying mathematics in interesting, thought provoking situations. Student understanding is further developed through ongoing reflection about cognitively demanding and worthwhile tasks.

**Comment [CY2]:** Does this mean, for example, relevant to their lives?

Tasks should challenge and engage students in mathematics in multiple ways. Short- and long-term investigations that connect procedures and skills with conceptual understanding are integral components of an effective mathematics program. Activities should build upon curiosity and prior knowledge, and enable students to solve progressively deeper, broader, and more sophisticated problems. Mathematical tasks reflecting significant mathematics should generate active classroom talk, promote the development of conjectures, and lead to an understanding of the necessity for mathematical reasoning.

**Guiding Principle 3:** An effective mathematics program focuses on problem solving.

Mathematical problem solving is the hallmark of an effective mathematics program. Skill in mathematical problem solving requires practice with a variety of mathematical problems as well as a firm grasp of mathematical techniques and their underlying principles. Students who possess a deeper knowledge of mathematics can then use mathematics in a flexible way to attack various problems and devise different ways of solving any particular problem. Mathematical problem solving calls for reflective thinking, persistence, learning from the ideas of others, and going back over one's own work with a critical eye. Success in solving mathematical problems helps to create an abiding interest in mathematics.

**Comment [CY3]:** I wonder if "reflective thinking" already includes "going back over ones' work with a critical eye," or if the second phrase I've cited could be stated differently as to make it more distinct from reflective thinking.

**Guiding Principle 4:** Technology is essential in teaching and learning mathematics.

Technology enhances the mathematics curriculum in many ways. Technology enables students to communicate ideas within the classroom or to search for needed information. It can be especially helpful in assisting students with special needs in regular and special classrooms, at home, and in the community. Technology changes what mathematics is to be learned and when and how it is learned. Tools such as measuring instruments, manipulatives (such as base ten blocks and fraction pieces), scientific and graphing calculators, and computers with appropriate software, if properly used, contribute to a rich learning environment for developing and applying mathematical concepts. Appropriate use of calculators is essential; calculators should not be used as a replacement for basic understanding and skills. Although the use of a graphing calculator can help middle and secondary students to visualize properties of functions and their graphs, graphing calculators should be used to enhance their understanding and skills rather than replace them.

## Standards Overview

The Oklahoma Academic Standards for Mathematics are developed around both content and process strands. The four main content strands, Algebraic Reasoning and Algebra, Number and Operations,

Geometry and Measurement, and Data and Probability organize the content standards throughout PK-7 and Pre-Algebra. The standards for Algebra I, Algebra II, and Geometry are fundamentally organized around these strands as well. The process standards are defined as the Mathematical Actions and Processes and are comprise of the skills and abilities students should develop and be engaged in developing throughout their PK-12 mathematics education. Among these are the ability to problem solve and communicate and reason about mathematics which will help students be ready for the mathematics expectations of college and the skills desired by many employers. The process and content standards work in concert to create clear, concise and rigorous mathematics standards and expectations for Oklahoma students with the aim of helping them be college and career ready. Both content and process strands are described below.

**Algebraic Reasoning and Algebra Strand:** All students should be able to reason algebraically and learn algebra. This strand provides focus for the PK-7 and Pre-Algebra standards around the notion that algebra is more than moving symbols around. It is about understanding patterns, relations and functions, representing and analyzing mathematical situations and structures using algebraic symbols, using mathematical models to represent and understanding quantitative relationships, and analyzing change in various contexts. Understanding change is fundamental to algebraic reasoning and understanding the concept of function with depth. It is also fundamental to understanding many real-world problems and ideas presented in the news.

**Number and Operations Strand:** A focus on number and operations is the cornerstone of a strong mathematics program. Developing students' fluency with number and operations throughout their PK-12 mathematics experience requires a balance and connection between conceptual understanding and computational proficiency. This strand provides focus on the importance of students' understanding of numbers, ways of representing numbers, relationships among numbers, relationships among number systems, and meanings of operations and how they relate to one another. Further, it requires that students should be able to compute fluently and make reasonable estimates.

**Geometry and Measurement Strand:** All students should gain experience using a variety of visual and coordinate representations to analyze problems and solve mathematics and learn how to use appropriate units and tools for measuring. This strand provides focus for the PK-7 and Geometry standards around the notion that geometry and measurement help students understand and represent ideas and solve problems they will encounter in their daily lives. A focus on geometry should enable students to analyze characteristics of two- and three-dimensional objects, develop arguments based on geometric relationships, describe spatial relationships using coordinate geometry and other representational systems, apply transformations and symmetry to analyze mathematical situations, and utilize visualization, spatial reasoning and geometric modeling to solve problems. A focus on measurement should enable students to understand measureable attributes of objects and the units, systems, and processes of measurement, and apply appropriate techniques, tools, and formulas to determine measurements.

**Data and Probability Strand:** An increased emphasis on understanding data should span all grade levels. ~~The idea that m~~Making sense of data and probability has become a part of our daily lives, ~~provides~~ supporting ~~for~~ the importance of this strand throughout a students' Pk-12 mathematics experience. A focus on data and probability should enable all students to formulate questions that can be addressed with data, and collect, organize, and display relevant data to answer them, select and use appropriate statistical methods to analyze data, develop and evaluate inferences and predictions that are based on data, and

**Comment [CY4]:** I think this was meant to say "comprised of."

**Comment [CY5]:** I think this was meant to say "understand"

**Comment [CY6]:** The double use of understanding is a little confusing here. Perhaps the second "understanding" could be removed?

**Comment [CY7]:** Just a suggested change to make this sentence read easier.

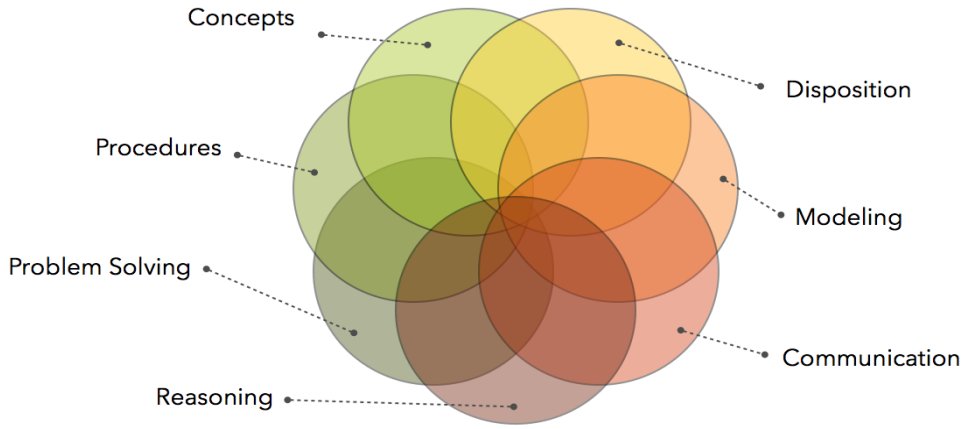
understand and apply basic concepts of probability. The study of data is also an opportunity to apply the basic skills of computing with numbers while the study of probability provides application and use of fractions in daily life.

**Comment [CY8]:** This statement is quite a mouthful, and might be chopped up into smaller pieces.

Perhaps:

"A focus on data and probability should enable all students to formulate questions that can be addressed with data, **and to** collect, organize, and display relevant data to answer them. **Students should** select and use appropriate statistical methods to analyze data, develop and evaluate inferences and predictions that are based on data, and understand and apply basic concepts of probability.

# Mathematical Actions & Processes




*Throughout their Pk-12 education experience, mathematically literate students will:*

**Develop a Deep and Flexible *Conceptual* Understanding**

Demonstrate a deep and flexible conceptual understanding of mathematical concepts, operations, and relations while making mathematical and real-world connections.

**Develop Accurate and Appropriate *Procedural* Fluency**

Pursue efficient procedures for various computations and repeated processes based on a strong sense of numbers. They will develop a sophisticated understanding of the development and application of algorithms and procedures.

**Develop Strategies for *Problem Solving***

Analyze the parts of complex mathematical tasks and identify entry points to begin the search for a solution. They will select from a variety of problem solving strategies and use corresponding multiple representations (verbal, physical, symbolic, pictorial, graphical, tabular) when appropriate. They will pursue

**Comment [CY9]:** These are crucial, of course, and I would make a humble suggestion that they be given short abbreviated names like CU, PF, PS, MR, D, CMG, CM or *something* along these lines, so perhaps throughout the standards they can be indicated with these acronyms in their colored circles?

See my general comments as well.

**Comment [CY10]:** Notice that this is not parallel with the first statement, which has no subject. So either both sentences start with "They will…" or both simply start with the verb.

**Comment [CY11]:** Again, and throughout.

solutions to various tasks from real-world situations and applications that are often interdisciplinary in nature. They will find methods to verify their answers in context and will always question the reasonableness of solutions.

**Develop Mathematical *Reasoning***

Explore and communicate a variety of reasoning strategies to think through problems. They will apply their logic to critique the thinking and strategies of others to develop and evaluate mathematical arguments, including making arguments and counterarguments and making connections to other contexts.

**Develop a Productive Mathematical *Disposition***

Hold the belief that mathematics is sensible, useful and worthwhile. They will develop the habit of looking for and making use of patterns and mathematical structures. They will persevere and become resilient, effective problem solvers.

**Develop the Ability to Make Conjectures, *Model*, and Generalize**

Make predictions and conjectures and draw conclusions throughout the problem solving process based on patterns and the repeated structures in mathematics. They will create, identify, and extend patterns as a strategy for solving and making sense of problems.

**Comment [CY12]:** I would prefer to see something about real-world applications if this is the modeling Action/Process.

**Develop the Ability to *Communicate* Mathematically**

Develop the ability to communicate mathematically. They will discuss, write, read, interpret and translate ideas and concepts mathematically. As they progress, students' ability to communicate mathematically will include their increased use of mathematical language and terms and analysis of mathematical definitions.

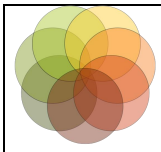
# Oklahoma Academic Standards for Mathematics
# Pre-Kindergarten

The Pre-kindergarten standards place emphasis on developing the concept of number by counting; recognizing numerals, 0-9; sorting and grouping sets of objects; recognizing and describing simple repeating patterns; and recognizing shapes and sizes of figures and objects. Students will investigate the attributes of objects and sort and organize them based on those attributes.

Problem solving has been integrated throughout the content strands. The development of problem solving skills should be a major goal of the mathematics program at every grade level. Experience with the process of problem solving will need to be integrated early and continuously into each student's mathematics education. Students must be helped to develop a wide range of skills and strategies for solving a variety of problem types.

While learning mathematics, students should be actively engaged, using concrete materials and appropriate technologies such as calculators and computers. However, facility in the use of technology should not be regarded as a substitute for a student's understanding of quantitative concepts and relationships or for proficiency and fluency with basic computations.

Mathematics has its own language, and the acquisition of specialized vocabulary and language patterns is crucial to a student's understanding, appreciation of, and disposition for the subject. Students should be encouraged to correctly use the concepts, skills, symbols, and vocabulary identified in the following set of standards.



# Algebraic Reasoning and Algebra

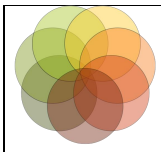
**PK.A.1 Apply mathematical actions and processes to recognize, create, complete, and extend patterns.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **PK.A.1.1** Sort and group up to 5 objects into a set and explain verbally what the objects have in common (e.g., color, size, shape).<br><br>**PK.A.1.2** Recognize, duplicate, extend, and create repeating patterns in various formats (e.g., manipulatives, sound, movement). |

**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY13]:** Compare with P.K.N.2.1, which identifies number of objects up to 10.



# Number and Operations

**PK.N.1 Apply mathematical actions and processes to know number names and count in sequence.**

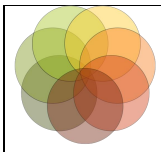
| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Solving Diverse Problems<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **PK.N.1.1** Count aloud in sequence to 20.<br><br>**PK.N.1.2** Recognize and name written numerals 0-9.<br><br>**PK.N.1.3** Recognize that zero represents the count of no objects. |

**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY14]:** With one-to-one correspondence and understanding of value or simply sequence?

**Comment [CY15]:** Since they count objects up to 10 do they recognize "10" as well?



# Number and Operations

**PK.N.2 Apply mathematical actions and processes to count to tell the number of objects.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Solving Diverse Problems<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **PK.N.2.1** Identify the number of objects, up to 10, in a horizontal row or column.<br><br>**PK.N.2.2** Use of one-to-one correspondence in counting objects and matching groups of objects.<br><br>**PK.N.2.3** Understand that the last numeral spoken, when counting aloud, tells how many total objects are in a set.<br><br>**PK.N.2.4** Count up to 5 items in a scattered configuration; not in a horizontal row or column. |

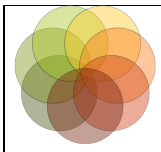
**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY16]:** Compare with PK.A.1.1, which only goes up to 5 objects.

**Comment [CY17]:** Should this be "Use…" not "Use of…" ?

**Comment [CY18]:** Up to how many? 10? Or just the general concept? The students count to 20 in (PK.N.1.1)



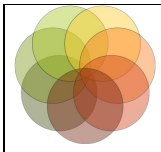
# Number and Operations

**PK.N.3 Apply mathematical actions and processes to compare numbers.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Solving Diverse Problems<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **PK.N.3.1** Compare two sets of 1-5 objects using comparative language such as “same,” “more,” or “fewer”. |

**Sample Problems or Classroom Activities**

FORTHCOMING



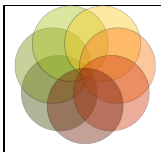
# Geometry and Measurement

**PK.GM.1 Apply mathematical actions and processes to analyze common shapes.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Solving Diverse Problems<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **PK.GM.1.1** Identify common shapes by pointing to the shape when given the name (e.g., circle, square, rectangle and triangle). |

**Sample Problems or Classroom Activities**

FORTHCOMING



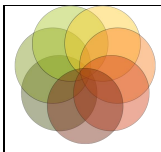
# Geometry and Measurement

**PK.GM.2 Apply mathematical actions and processes to describe and compare measureable attributes.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Solving Diverse Problems<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **PK.GM.2.1** Identify measurable attributes of objects. Describe them using age appropriate vocabulary (e.g., little, big, long, short, tall, heavy, and light).<br><br>**PK.GM.2.2** Directly compare two objects with a common measurable attribute using words such as longer/ shorter (horizontal); heavier/ lighter; or taller/ shorter (vertical).<br><br>**PK.GM.2.3** Sort objects into sets by one or more attributes. |

**Sample Problems or Classroom Activities**

FORTHCOMING



# Data and Probability

**PK.DP.1 Apply mathematical actions and processes to collect and organize data.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **PK.D.1.1** Collect and organize information about objects and events in the environment. |

**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY19]:** Examples will help here as this is very broad.

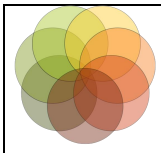
# Oklahoma Academic Standards for Mathematics
# Kindergarten

The kindergarten standards are divided into four strands: Algebraic Reasoning and Algebra, Number and Operations, Geometry and Measurement, and Data and Probability. The Algebraic Reasoning and Algebra strand lays the foundation for recognizing, creating, completing and extending patterns. The Number and Operations strand emphasizes the development of number by counting; subitizing, combining, sorting, and comparing sets of objects. Students will begin to understand the relationship between quantities and whole numbers. Laying the foundation for fractions begins by distributing sets of objects equally (fair shares) into smaller groups. Students will also begin to recognize value of coins. The Geometry and Measurement strand focuses on students recognizing and identifying simple two- and three-dimensional shapes, sorting objects by measureable attributes, and recognizing time concepts such as today, tomorrow, morning, etc.

Problem solving has been integrated throughout the content strands. The development of problem solving skills should be a major goal of the mathematics program at every grade level. Experience with the process of problem solving will need to be integrated early and continuously into each student's mathematics education. Students must be helped to develop a wide range of skills and strategies for solving a variety of problem types.

While learning mathematics, students should be actively engaged, using concrete materials and appropriate technologies such as calculators and computers. However, facility in the use of technology should not be regarded as a substitute for a student's understanding of quantitative concepts and relationships or for proficiency and fluency with basic computations.

Mathematics has its own language, and the acquisition of specialized vocabulary and language patterns is crucial to a student's understanding, appreciation of, and disposition for the subject. Students should be encouraged to correctly use the concepts, skills, symbols, and vocabulary identified in the following set of standards.



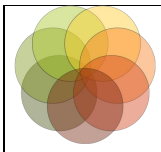
# Algebraic Reasoning and Algebra

**K.A.1 Apply mathematical actions and processes to recognize, create, complete, and extend patterns.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **K.A.1.1** Sort and group up to 10 objects into a set and explain verbally what the objects have in common (e.g., color, size, shape).<br><br>**K.A.1.2** Recognize, create, complete, and extend repeating, shrinking and growing patterns using shape, color, size, quantity, sounds and movements. |

**Sample Problems or Classroom Activities**

FORTHCOMING



# Algebraic Reasoning and Algebra

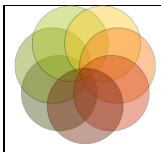
**K.A.2 Apply mathematical actions and processes standards to use objects and pictures to develop fluency with addition and subtraction (up to 10) to represent and solve real-world and mathematical problems.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **K.A.2.1** Compose and decompose numbers up to 10 with objects and pictures to develop the concept of fluidity of numbers and lay the foundation for addition and subtraction (e.g., making ten, number bonds). |

**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY20]:** While I can certainly infer the intention of this word in this context, it may need more clarification somewhere. The concept of "multiple representations of numbers"…? Not sure of the exact language.



# Number and Operations

**K.N.1 Apply mathematical actions and processes to understand the relationship between quantities and whole numbers.**

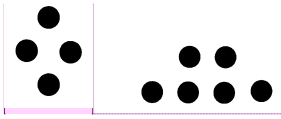
| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **K.N.1.1** Count aloud in sequence to 100.<br><br>**K.N.1.2** Recognize that a number can be used to represent how many objects are in a set up to 10.<br><br>**K.N.1.3** Use ordinal numbers to represent the position of an object in a sequence up to 10.<br><br>**K.N.1.4** Recognize without counting (subitizing*) the quantity of a small group of objects in organized and random arrangements up to 10 (e.g. dot patterns).<br><br>**K.N.1.5** Count forward, with and without objects, from any given number up to 10.<br><br>**K.N.1.6** Read, write and represent whole numbers from 0 to at least 10. Representations may include numerals, pictures, real objects and picture graphs, spoken words, and manipulatives.<br><br>**K.N.1.7** Find a number that is 1 more or 1 less than a given number up to 10.<br><br>**K.N.1.8** Compare and order whole numbers, with and without objects, from 0 to 10 (e.g., more than, less than, equal to).<br><br>*Subitizing is defined as instantly recognizing the quantity of a set without having to count. "Subitizing" is not a vocabulary word, not for student discussion at this age. |

**Comment [CY21]:** Compare with PK.N.2.1—how is this different or an extension?

## Sample Problems or Classroom Activities

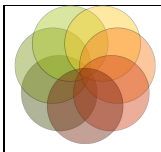
*Example for KN1.4*

Dot Plate Flash-Hold up a dot plate for only 3 seconds. Ask children, “How many did you see?” “How did you see it?”

Dot Pattern Cards 

Comment [CY22]: Are these separate cards?

FORTHCOMING



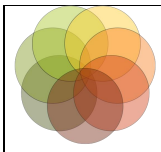
# Number and Operations

**K.N.2 Apply mathematical actions and processes to understand the relationship between whole numbers and fractions through fair share.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **K.N.2.1** Distribute equally a set of objects into at least two smaller equal sets. |

**Sample Problems or Classroom Activities**

FORTHCOMING



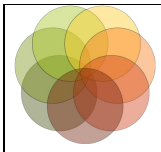
# Number and Operations

**K.N.3 Apply mathematical actions and processes to identify coins in order to recognize the need for monetary transactions.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **K.N.3.1** Identify U.S. coins by name, including pennies, nickels, dimes, and quarters. |

**Sample Problems or Classroom Activities**

FORTHCOMING



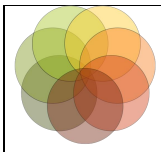
# Geometry and Measurement

**K.GM.1 Apply mathematical actions and processes to recognize and sort basic two- and three-dimensional shapes; use them to model real-world objects.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **K.GM.1.1** Recognize basic two- and three-dimensional shapes such as squares, circles, triangles, rectangles, trapezoids, hexagons, cubes, cones, cylinders and spheres.<br><br>**K.GM.1.2** Identify attributes of two-dimensional shapes using informal and formal geometric language interchangeably (e.g., a square has 4 corners).<br><br>**K.GM.1.3** Use smaller shapes to form a larger shape when there is an outline to follow (e.g., create a larger square using 4 small squares). |

**Sample Problems or Classroom Activities**

FORTHCOMING



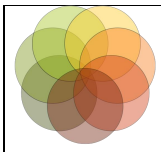
# Geometry and Measurement

**K.GM.2 Apply mathematical actions and processes to compare and order objects according to location and measurable attributes.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **K.GM.2.1** Use words to compare objects according to length, size, weight and position.<br><br>**K.GM.2.2** Order up to 6 objects using measurable attributes, such as length and weight.<br><br>**K.GM.2.3** Sort objects into sets by more than one attribute. |

**Sample Problems or Classroom Activities**

FORTHCOMING



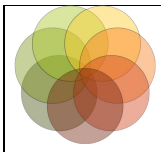
# Geometry and Measurement

**K.GM.3 Apply mathematical actions and processes to tell time.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **K.GM.3.1** Develop an awareness of simple time concepts within his/her daily life (e.g. yesterday, today, tomorrow; morning, afternoon, night). |

**Sample Problems or Classroom Activities**

FORTHCOMING



# Data and Probability

**K.DP.1 Apply mathematical actions and processes to collect and organize data to make it useful for interpreting information.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **K.DP.1.1** Collect and analyze information about objects and events in the environment.<br><br>**K.DP.1.2** Use data to create real-object, picture graphs and Venn diagrams.<br><br>**K.DP.1.3** Draw conclusions from real-object and picture graphs. |

**Sample Problems or Classroom Activities**

FORTHCOMING

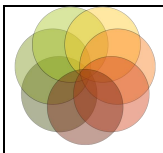
# Oklahoma Academic Standards for Mathematics
# 1st Grade

The first-grade standards are divided into four strands; Number and Operations, Algebraic Reasoning and Algebra, Geometry and Measurement, Data and Probability. The Number and Operations strand places emphasis on the number sequence to 100, quantifying, sorting, and comparing quantities of sets up to 100. Students' understanding of number expands to include explanation of thinking strategies used to solve addition and subtraction problems up to 20. Fractional concepts will be expanded by partitioning regular polygons into equal pieces. The Algebraic Reasoning and Algebra strand emphasizes recognizing and describing simple repeating and growing patterns. The Geometry and Measurement strand emphasizes identifying characteristics of two and three dimensional shapes to develop general ideas about the properties of geometric figures. Students will develop ideas understanding the use of measuring tools. Students will use measuring tools to measure the length of objects in order to reinforce the continuous nature of linear measurement. The Data and Probability strand emphasizes collecting, organizing and interpreting data.

Problem solving has been integrated throughout the content strands. The development of problem solving skills should be a major goal of the mathematics program at every grade level. Experience with the process of problem solving will need to be integrated early and continuously into each student's mathematics education. Students must be helped to develop a wide range of skills and strategies for solving a variety of problem types.

While learning mathematics, students should be actively engaged, using concrete materials and appropriate technologies such as calculators and computers. However, facility in the use of technology should not be regarded as a substitute for a student's understanding of quantitative concepts and relationships or for proficiency and fluency with basic computations.

Mathematics has its own language, and the acquisition of specialized vocabulary and language patterns is crucial to a student's understanding, appreciation of, and disposition for the subject. Students should be encouraged to correctly use the concepts, skills, symbols, and vocabulary identified in the following set of standards.



# Algebraic Reasoning and Algebra

**1.A.1 Apply mathematical actions and processes to recognize, create, complete, and extend patterns.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **1.A.1.1** Recognize and create repeating, shrinking and growing patterns with objects, numbers, or geometric shapes in a variety of contexts (e.g., addition charts, skip counting, calendars, hundreds charts, number lines, real world situations such as art and architecture). |

**Sample Problems or Classroom Activities**

Examples for 1.A.1.1

*Pattern Strips: Students work to extend patterns from simple materials such as buttons, colored blocks, connecting cubes toothpicks, etc.*
*Same Pattern, Different Stuff: Have students make a pattern with one set of materials given a pattern strip showing a different set. Mix up the pattern strips and have students find strips that have the same patterns.*
*Predict Down the LINE: Provide students with a pattern to extend. Before they extend the pattern have them predict what element will be in the $10^{th}$ place, $7^{th}$ place, etc.*
*Change the Charts, Change the Patterns: Have students make number charts with fewer than ten numbers in a row. Color skip-counting patterns. Discuss which numbers make diagonal patterns? Which numbers make column patterns? Which numbers skip count by?*

FORTHCOMING

# Algebraic Reasoning and Algebra

**1.A.2 Apply mathematical actions and processes standards to use number sentences to develop fluency with addition and subtraction (up to 20) to represent and solve real-world and mathematical problems; create real-world situations corresponding to number sentences.**

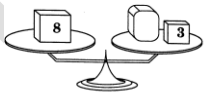
| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **1.A.2.1** Represent and create real-world situations involving basic addition and subtraction, using objects and number sentences. (e.g., making ten, compatible numbers, number bonds). |

**Comment [CY23]:** My small concern here is how students understand addition and subtraction. Addition defined as "grouping objects together and finding the total" is fine as a basic interpretation, but I would like to **explicitly** see several interpretations of subtraction: take-away, missing addend, compare, etc. Such interpretations become more and more important as students continue, including when they study integers much later (e.g., take-away is only one and perhaps not even the best model for integer subtraction)

## Sample Problems or Classroom Activities

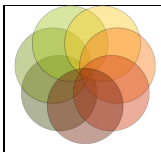
**Example for 1. A.2.1**

*A student can see a stack of 7 cubes and know that a stack of 4 cubes and 3 cubes has the same number of cubes and create a pictorial model of the relationship.*




*Balance Tasks*

MORE FORTHCOMING



# Number and Operations

**1.N.1 Apply mathematical actions and processes to count, compare and represent whole numbers up to 100, with an emphasis on groups of tens and ones.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **1.N.1.1** Recognize numbers to 20 without counting (subitizing*) the quantity of structured arrangements (e.g., ten frames, arrays, dot patterns).<br><br>**1.N.1.2** Use concrete models to describe whole numbers between 10 and 100 in terms of tens and ones.<br><br>**1.N.1.3** Read, write and represent whole numbers up to 100. Representations may include numerals, addition and subtraction, pictures, tally marks, number lines and manipulatives, such as bundles of sticks and base 10 blocks.<br><br>**1.N.1.4** Count forward, with and without objects, from any given number up to 100 by 1s, 2s, 5s and/or 10s.<br><br>**1.N.1.5** Find a number that is 10 more or 10 less than a given number.<br><br>**1.N.1.6** Compare and order whole numbers up to 100.<br><br>**1.N.1.7** Create and use knowledge of number relationships to locate the position of a given whole number on an open number line up to 20.<br><br>**1.N.1.8** Use objects to model and use words to describe the relative size of numbers, such as more than, less than, and equal to. Explore equivalence through the use of balance scales.<br><br>*Subitizing is defined as instantly recognizing the |

**Comment [CY24]:** Very important, and I would want to make sure that the understanding that we bundle ten 1's together to make a "ten" is developed, as well as the fact that while the symbol "10" can mean 10 separate units, it can also mean "1 ten and 0 ones/units"

**Comment [CY25]:** Yes, see my comment above.

| | |
|---|---|
| | quantity of a set without having to count. "subitizing" is not a vocabulary word, not for student discussion at this age. |
| **Sample Problems or Classroom Activities**<br><br>FORTHCOMING | |

# Number and Operations

**1.N.2 Apply mathematical actions and processes to solve addition and subtraction problems up to 20 in real-world and mathematical contexts.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **1.N.2.1** Model and explain strategies used to solve addition and subtraction problems up to 20 using a variety of strategies (e.g., spoken words, objects, pictorial models, number lines, number sentences, compose and decompose numbers, making 10, doubles plus one, part part-whole).<br><br>**1.N.2.2** Apply basic fact strategies to add and subtract within 20 (e.g., making ten, decomposing a number leading to a ten, doubles plus one).<br><br>**1.N.2.3** Determine if equations involving addition and subtraction are true.<br><br>**1.N.2.4** Demonstrate fluency with basic addition facts and related subtraction facts up to 20. |

**Comment [CY26]:** Just to clarify for myself, 1.A.2.1 essentially deals with the **concepts** of addition and subtraction, while this standard is more about strategies for solving problems—yes?

## Sample Problems or Classroom Activities

**Example for 1.N2.1**

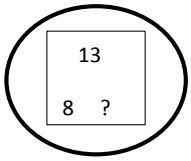
*a. Dot Card Activities—Choose 2 dot cards that equal to any given number up to 20.*

*--Students use dot cards to find different combinations that total given number.*

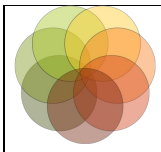
*b. Math Squares (need to add)*

*c. Two Ways (need to add)*

*d. Missing Number cards:*



MORE FORTHCOMING



# Number and Operations

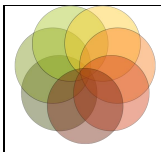
**1.N.3 Apply mathematical actions and processes to explore the foundational ideas of fractions.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **1.N.3.1** Partition a regular polygon using physical models into equal pieces (e.g., halves, thirds, fourths). |

**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY27]:** Do students use these words here? Do they use the symbols?



# Number and Operations

**1.N.4 Apply mathematical actions and processes to identify coins, their values, and the relationships among them in order to recognize the need for monetary transactions.**

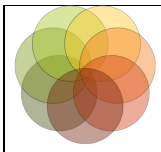
| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **1.N.4.1** Identify U.S. coins, including pennies, nickels, dimes, and quarters, and their value.<br><br>**1.N.4.2** Write a number with the cent symbol to describe the value of a coin.<br><br>**1.N.4.3** Use relationships to count by ones, fives, and tens to determine the value of a collection of pennies, nickels, and/or dimes up to 100¢. |

**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY28]:** Specify perhaps "their value **in cents**."

**Comment [CY29]:** Seems important to me, as $1.00=100¢ is not developed yet. Or was this not the intention?



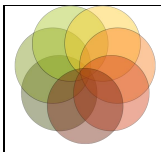
# Geometry and Measurement

**1.GM.1 Apply mathematical actions and processes standards to analyze attributes of two- and three - dimensional shapes to create new shapes.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **1.GM.1.1** Use smaller shapes to form a larger shape (compose) two- dimensional shapes such as triangles, squares, rectangles, and circles, -and three-dimensional shapes such as rectangular prisms and cylinders. |

**Sample Problems or Classroom Activities**

FORTHCOMING



# Geometry and Measurement

**1.GM.2 Apply mathematical actions and processes to select and use units to describe length and time.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **1.GM.2.1** Use nonstandard and standard measuring tools to measure the length of objects to reinforce the continuous nature of linear measurement.<br><br>**1.GM.2.2** Illustrate that the length of an object is the number of same-size units of length that, when laid end-to-end with no gaps or overlaps, reach from one end of the object to the other.<br><br>**1.GM.2.3** Measure the same object/distance with units of two different lengths and describe how and why the measurements differ.<br><br>**1.GM.2.4** Describe a length to the nearest whole unit using a number and a unit (e.g., foot, inch, centimeter). |

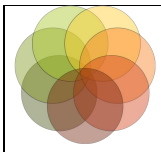
## Sample Problems or Classroom Activities

**Example for 1.GM2.1:**

*a. Giant Footprints—Use footprints to measure given objects*

*b. Changing Units—Have students measure a length with a specified unit. Then provide them with a different unit that is twice as long or half as long as the original unit. Their task is to predict the measure of the same length using the new unit. Students should write down their predictions and explanations of how they were made. Discuss.*

FORTHCOMING



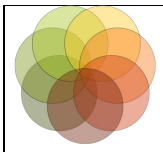
# Geometry and Measurement

**1.GM.3 Apply mathematical actions and processes to tell time.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **1.GM.3.1** Tell time to the hour and half-hour (analog and digital). |

**Sample Problems or Classroom Activities**

FORTHCOMING



# Data and Probability

**1.D.1 Apply mathematical actions and processes to organize data to make it useful for interpreting information and solving problems.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **1.D.1.1** Collect, sort, and organize data in up to three categories using models/representations (e.g., tally marks, tables).<br><br>**1.D.1.2** Use data to create picture and bar-type graphs, to demonstrate one to one correspondence.<br><br>**1.D.1.3** Draw conclusions from picture and bar-type graphs. |

## Sample Problems or Classroom Activities

**Example for 1.D.1.1:**

Attribute Sort (need to add)
The First Loops—Give children *2 large loops of yarn or string. Direct them to put all the red pieces inside one string and all triangles inside the other. Let the children try to resolve the difficulty of what to do with the red triangle pieces.*

**Example for 1.D1.2:**

*Favorite Food—Have children find out another class's favorite fruit. Graph the results using pictures to make a pictograph.*

MORE FORTHCOMING

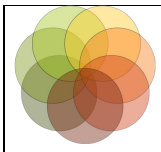
# Oklahoma Academic Standards for Mathematics
# 2nd Grade

The second-grade standards are divided into four strands: Algebraic Reasoning and Algebra, Number and Operations, Geometry and Measurement, and Data and Probability. The Algebraic Reasoning and Algebra strand provides opportunities for students to work with a variety of patterns and will develop a strong understanding of the equal sign and variables through the use of concrete materials. The Number and Operations strand emphasizes the study of number, ways of representing numbers, relationships among numbers, and the number system. Students will be asked to demonstrate fluency with basic addition and related subtraction facts. Place value will play an important role in developing, modeling and using addition and subtraction with multi-digit numbers. The Geometry and Measurement Strand provides opportunities for students to describe and analyze the characteristics and properties of 2-D and 3-D objects. Students will focus on measurable attributes of objects and the units and processes of measurement. The Data and Probability Strand places an emphasis on formulating questions and gathering data, sorting and classifying objects according to attributes, describing data and making inferences and predictions based on the data gathered.

Problem solving has been integrated throughout the content strands. The development of problem solving skills should be a major goal of the mathematics program at every grade level. Experience with the process of problem solving will need to be integrated early and continuously into each student's mathematics education. Students must be helped to develop a wide range of skills and strategies for solving a variety of problem types.

While learning mathematics, students should be actively engaged, using concrete materials and appropriate technologies such as calculators and computers. However, facility in the use of technology should not be regarded as a substitute for a student's understanding of quantitative concepts and relationships or for proficiency and fluency with basic computations.

Mathematics has its own language, and the acquisition of specialized vocabulary and language patterns is crucial to a student's understanding, appreciation of, and disposition for the subject. Students should be encouraged to correctly use the concepts, skills, symbols, and vocabulary identified in the following set of standards.



# Algebraic Reasoning and Algebra

**2.A.1 Apply mathematical actions and processes to recognize, create, describe, and use patterns and rules to solve real-world and mathematical problems.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **2.A.1.1** Create, describe, complete, and extend repeating, growing, and shrinking patterns involving numbers in a variety of contexts (e.g., repeated addition or subtraction, skip counting, arrays of objects).<br><br>**2.A.1.2** Recognize and describe repeating patterns involving geometric shapes in a variety of contexts. |

**Sample Problems or Classroom Activities**

FORTHCOMING

# Algebraic Reasoning and Algebra

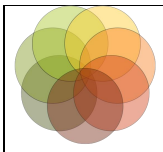
**2.A.2 Apply mathematical actions and processes to use number sentences involving addition, subtraction and unknowns to represent and solve real-world and mathematical problems; create real-world situations corresponding to number sentences.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **2.A.2.1** Use objects and number lines and create real-world situations to represent number sentences.<br><br>**2.A.2.2** Use number sense and properties (commutative and identity) of addition and subtraction to find values for the unknowns that make the number sentences true. (Introduction to properties, but not mastery of vocabulary). |

**Comment [CY30]:** Very important to develop number line throughout the grades.

**Sample Problems or Classroom Activities**

FORTHCOMING



# Number and Operations

**2.N.1 Apply mathematical actions and processes to compare and represent whole numbers up to 1000 with an emphasis on place value and equality.**

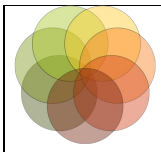
| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **2.N.1.1** Read, write, discuss, and represent whole numbers up to 1000. Representations may include numerals, words, pictures, tally marks, number lines and manipulatives.<br><br>**2.N.1.2** Create -and use knowledge of number relationships to locate the position of a given whole number on an open number line up to 100.<br><br>**2.N.1.3** Use place value to describe whole numbers between 10 and 1000 in terms of hundreds, tens and ones. Know that 100 is 10 tens, and 1000 is 10 hundreds.<br><br>**2.N.1.4** Find 10 more or 10 less than a given three-digit number. Find 100 more or 100 less than a given three-digit number.<br><br>**2.N.1.5** Recognize when to round numbers to the nearest 10 and 100. Emphasis on understanding how to round instead of memorizing the rules for rounding.<br><br>**2.N.1.6** Use place value to compare and order whole numbers up to 1000 using comparative language, numbers, and symbols (e.g., 425 > 276, 73 < 107, page 351 comes after 350, 753 is between 700 and 800). |

**Comment [CY31]:** This is what I was referring to in 1st Grade, I would like to see a standard that says "know that 10 is '10 ones'" somewhere.

**Comment [CY32]:** I think in a later grade a similar standard appears and makes reference to rounding and estimating in application problems, which is great. I would love to see something similar here, as otherwise rounding and estimating becomes a disconnected skill that seems to not have much use.

**Sample Problems or Classroom Activities**

FORTHCOMING



# Number and Operations

**2.N.2 Apply mathematical actions and processes to add and subtract one- and two-digit numbers in real-world and mathematical problems.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **2.N.2.1** Use the relationship between addition and subtraction to generate basic facts (e.g., making tens, fact families, doubles plus or minus one, counting on, counting back, commutative and associative properties).<br><br>**2.N.2.2** Demonstrate fluency with basic addition facts and related subtraction facts up to 20.<br><br>**2.N.2.3** Use strategies to estimate sums and differences up to 100 [e.g., compose, decompose and regroup numbers, use knowledge of 10 to estimate quantities and sums (two numbers less than 10 cannot add up to more than 20)].<br><br>**2.N.2.4** Use strategies and algorithms based on knowledge of place value and equality to add and subtract two-digit numbers (e.g., mental strategies, standard algorithm, decomposition, expanded notation, partial sums and differences).<br><br>**2.N.2.5** Solve real-world and mathematical addition and subtraction problems involving whole numbers up to 2 digits.<br><br>**2.N.2.6** Use concrete models and structured arrangements, such as repeated addition, arrays and ten frames to develop understanding of multiplication. |

**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY33]:** How do these differ from/relate to standard below from 1st Grade? What is the expectation, given this is a standard in 1st Grade?

**1.N.2.4** Demonstrate fluency with basic addition facts and related subtraction facts up to 20.

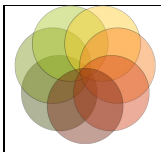
**Comment [CY34]:** YES!

**Comment [CY35]:** Really love how several standards are very flexible with "strategies **AND** algorithms"…

**Comment [CY36]:** Just a thought, but students are expected to count up to and represent numbers to 1000, so why only adding & subtracting 2-digit numbers?

**Comment [CY37]:** Is the definition/understanding of multiplication as "repeated addition" here? Do they use multiplication notation? Are they to know any facts? E.g. are they expected to know 5 × 4 = 4 +4 +4 +4 =20? This might be developed more, or else simply wait until Grade 3?

Or perhaps the standard is only meant to "lay the foundation" for multiplication?



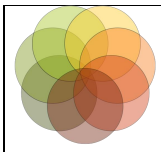
# Number and Operations

**2.N.3 Apply mathematical actions and processes to explore the foundational ideas of fractions.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **2.N.3.1** Identify the parts of a set and/or area that represent fractions for halves, thirds and fourths.<br><br>**2.N.3.2** Construct equal sized portions through fair sharing including length and set area models for halves, thirds, and fourths. |

**Sample Problems or Classroom Activities**

FORTHCOMING



# Number and Operations

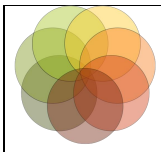
**2.N.4 Apply mathematical actions and processes to determine the value of coins in order to solve monetary transactions.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **2.N.4.1** Determine the value of a collection(s) of coins up to one dollar (e.g., given 2 dimes and 1 quarter, recognize you have 45¢; person 1 has 15¢ and person 2 has 25¢, together they have 40¢). Limited to: whole numbers.<br><br>**2.N.4.2** Select a combination of coins to represent a given amount of money up to one dollar. |

**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY38]:** Earlier grades do not specify "up to one dollar."



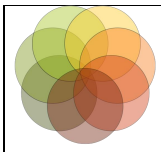
# Geometry and Measurement

**2.GM.1 Apply mathematical actions and processes standards to analyze attributes of two- and three-dimensional figures develop generalizations about their properties.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **2.GM.1.1** Describe, compare, and classify two- and three-dimensional figures according to their geometric attributes including developing appropriate vocabulary for faces, and the number of sides, edges and vertices.<br><br>**2.GM.1.2** Identify and name basic two- and three-dimensional shapes, such as squares, circles, triangles, rectangles, trapezoids, hexagons, cubes, rectangular prisms, cones, cylinders and spheres (architecture, technology, art). |

**Sample Problems or Classroom Activities**

FORTHCOMING



# Geometry and Measurement

**2.GM.2 Apply mathematical actions and processes to understand length as a measurable attribute; use tools to measure length.**

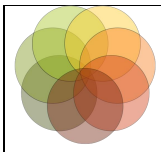
| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Solving Diverse Problems<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **2.GM.2.1** Explain the relationship between the size of the unit of measurement and the number of units needed to measure the length of an object.<br><br>**2.GM.2.2** Explain the relationship between length and the numbers on a ruler by using a ruler to measure lengths to the nearest inch and centimeter. |

## Sample Problems or Classroom Activities

**Example for 2.GM.2.1:**

*To help students understand that it takes more centimeters to measure the length of a table than it does meters because centimeters are smaller than meters, students can be engaged in an activity where some groups measure a table, for example, in meters while other groups measure the same table in centimeters. Each group can present their results and the class can discuss the difference in findings. Following the group discussion, students should be asked to write about why it required fewer meters than centimeters to measure the length of the table when meters are longer than centimeters. This relationship seems proportionally counterintuitive for many students so they may need several concrete experiences measuring with several units to fully understand and be able to explain with confidence that the smaller the unit, the more will be needed to measure the length of any object.*

MORE FORTHCOMING



# Geometry and Measurement

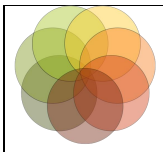
**2.GM.3 Apply mathematical actions and processes to tell time.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **2.GM.3.1** Tell time to 5 minutes. Read and write time to the quarter-hour and distinguish between a.m. and p.m. (analog and digital). |

**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY39]:** Curious as to why they would tell time to 5 minutes but write times only to quarter hours.



# Data and Probability

**2.D.1 Apply mathematical actions and processes to organize data to make it useful for interpreting information and solving problems.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **2.D.1.1** Explain that the length of a bar in a bar graph or the number of objects in a picture graph represents the number of data points for a given category.<br><br>**2.D.1.2** Organize a collection of data with up to four categories using pictographs and bar graphs with intervals of 1s, 2s, 5s or 10s.<br><br>**2.D.1.3** Write and solve one-step word problems involving addition or subtraction using data represented within pictographs and bar graphs with intervals of one.<br><br>**2.D.1.4** Draw conclusions and make predictions from information in a graph. |

**Sample Problems or Classroom Activities**

FORTHCOMING

# Oklahoma Academic Standards for Mathematics
# 3rd Grade

The third grade standards are divided into four strands, Number and Operations, Algebraic Reasoning and Algebra, Geometry and Measurement, and Data and Probability. The Number and Operation strand continues to develop number sense with respect to larger numbers including multiplication and division. Students begin to understand numbers are related in a variety of ways such as 46 is more than 30, 4 less than, 50 and can be made up of 30 and 16. Students will demonstrate fluency with addition and subtraction facts up to 20. Multiplication involves counting groups of like size and determining how many there are in all. Division and fraction concepts are developed through "fair sharing". Students will understand and apply place value, as well as build on the foundation of fractions by reading, writing, recognizing in different contexts, ordering and comparing fractions with like denominators. Students will investigate and describe the identity and commutative properties for addition and multiplication. The Algebraic Reasoning and Algebra strand has students searching for patterns in a variety of contexts. Students will recognize, extend and generalize with both words and symbols. Students will express mathematical relationships using equations and model problem situations with objects. The Geometry and Measurement strand involves recognizing and comparing attributes and making meaningful measurements. Students will use standard units (U.S. Customary and metric) to measure temperature, length, liquid volume, and weight and identify relevant properties of shapes and lines, and find the perimeter of polygons. The Data and Probability strand emphasizes the formulating of questions that can be addressed with data. Students will collect, organize, and display relevant data to answer the questions. Students will develop inferences and predictions based on data. Students will understand that the occurrence of an event can be characterized along a continuum from impossible to certain.

Problem solving has been integrated throughout the content strands. The development of problem solving skills should be a major goal of the mathematics program at every grade level. Experience with the process of problem solving will need to be integrated early and continuously into each student's mathematics education. Students must be helped to develop a wide range of skills and strategies for solving a variety of problem types.

While learning mathematics, students should be actively engaged, using concrete materials and appropriate technologies such as calculators and computers. However, facility in the use of technology should not be regarded as a substitute for a student's understanding of quantitative concepts and relationships or for proficiency and fluency with basic computations.

Mathematics has its own language, and the acquisition of specialized vocabulary and language patterns is crucial to a student's understanding, appreciation of, and disposition for the subject. Students should be encouraged to correctly use the concepts, skills, symbols, and vocabulary identified in the following set of standards.

**Comment [CY40]:** Isn't this a 2nd Grade Standard? Maybe even a 1st Grade standard?

**Comment [CY41]:** Want to make sure this is connected to area model later. In my opinion, it is one of the most important models for an operation in all of mathematics.

**Comment [CY42]:** Is this alluding to a relationship between P.V. and fractions?

# Algebraic Reasoning and Algebra

**3.A.1 Apply mathematical actions and processes to use single-operation input-output rules to represent patterns and relationships and to solve real-world and mathematical problems.**

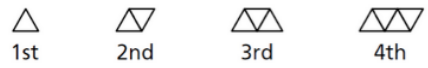
| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **3.A.1.1** Create, describe, and extend patterns involving addition, subtraction or multiplication to solve problems in a variety of contexts (e.g., skip counting, arrays of objects, function machine, hundreds chart).<br><br>**3.A.1.2** Describe the rule (single operation) for a pattern from an input/output table or function machine involving addition, subtraction or multiplication.<br><br>**3.A.1.3** Construct and explore models of growing patterns and construct the next steps. |

**Comment [CY43]:** I have a later concern that can begin to be addressed here (I think it appears in 4th or 5th Grade). The main concern is that the pattern of " × 10" when we move to the left along the positions in the base10 number system and "÷ 10" when we move to the right along the places in the base-10 number system must be developed. It is crucial for later development of relationship between 1/10, 1/100 etc. and their representations as 0.1, 0.01, etc.

I'm not sure if 3rd Grade is where to start investigating this pattern, but I thought I'd put this comment here to develop awareness of it.

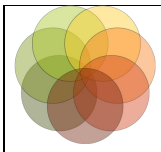
## Sample Problems or Classroom Activities

**Example for 3.A.1.3**




*What is the next stage?*
*How many triangles will there be in the 10th stage?*
*Do you notice any patterns?*

MORE FORTHCOMING



# Algebraic Reasoning and Algebra

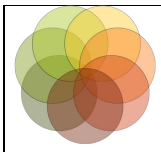
**3.A.2 Apply mathematical actions and processes to use number sentences involving multiplication and unknowns to represent and solve real-world and mathematical problems; create real-world situations corresponding to number sentences.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **3.A.2.1** Find unknowns represented by symbols in arithmetic problems by solving open sentences (equations) and other problems involving addition, subtraction, and multiplication. Create real-world situations to represent number sentences.<br><br>**3.A.2.2** Recognize, represent and apply the number properties (commutative and identity properties of addition and multiplication) using models and manipulatives. (Introduction to properties, but not mastery of vocabulary). |

**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY44]:** See comment below on standard **3.N.2.7**, but I believe that distributive property must be explicitly included here…



# Number and Operations

**3.N.1 Apply mathematical actions and processes to compare and represent whole numbers up to 10,000 with an emphasis on place value and equality.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **3.N.1.1** Read, write, discuss, and represent whole numbers up to 10,000. Representations may include numerals, expressions with operations, words, pictures, number lines, and manipulatives.<br><br>**3.N.1.2** Use place value to describe whole numbers between 1000 and 10,000 in terms of ten thousands, thousands, hundreds, tens and one, including expanded form.<br><br>**3.N.1.3** Find 1,000 more or 1,000 less than a given four- or five-digit number. Find 100 more or 100 less than a given four- or five-digit number.<br><br>**3.N.1.4** Recognize when to round numbers to the nearest 10,000, 1000, 100 and 10 and/or use compatible numbers to estimate sums and differences. Emphasis on understanding why and how to round rather than memorization of the rules for rounding.<br><br>**3.N.1.5** Use place value to compare and order whole numbers up to 10,000, using comparative language, numbers, and symbols (e.g., 15,023 < 25,156; 2345 is between 2000 and 3000). |

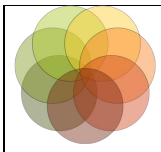
**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY45]:** I didn't see expanded form in earlier grades. I raise this because one of the primary reasons to represent numbers in expanded form is to explore why algorithms work the way they do—that is, we can add like base-10 groupings and regroup as needed. May want to consider how expanded form relates to algorithms and whether it should appear earlier, when number concepts are being built.

**Comment [CY46]:** Love it.

But notice sentence structure is different than other standards. (Sentence fragment, actually.)



# Number and Operations

**3.N.2 Apply mathematical actions and processes to add and subtract multi-digit whole numbers; represent multiplication and division in various ways; solve real-world and mathematical problems.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **3.N.2.1** Represent multiplication facts by using a variety of approaches, such as repeated addition, equal-sized groups, arrays, area models, equal jumps on a number line and skip counting.<br><br>**3.N.2.2** Demonstrate fluency in addition, subtraction, and multiplication (10 x 10) facts up to 100.<br><br>**3.N.2.3** Use strategies and algorithms based on knowledge of place value and equality to add and subtract multi-digit numbers(e.g., mental strategies, standard algorithm, decomposition, expanded notation, partial sums and differences).<br><br>**3.N.2.4** Use addition and subtraction to solve real-world and mathematical problems involving whole numbers. Use various strategies, including the relationship between addition and subtraction, the use of technology, and the context of the problem to assess the reasonableness of results.<br><br>**3.N.2.5** Represent division facts by using a variety of approaches, such as repeated subtraction, equal sharing and forming equal groups.<br><br>**3.N.2.6** Recognize the relationship between multiplication and division to model and solve real world problems (e.g. partitioning, missing factors, arrays).<br><br>**3.N.2.7** Use strategies and algorithms based on knowledge of place value, equality and properties of addition and multiplication to multiply a two- |

**Comment [CY47]:** See later comments in 3.G.

**Comment [CY48]:** Is this needed given the phrase "up to 100" immediately after?

**Comment [CY49]:** Ah! Here it is… I had forgotten this comes about. But my earlier comment remains: could/should this be done earlier?

**Comment [CY50]:** Just curious: As division models have many, many names(!), which of these are different? For example, is repeated subtraction the same as forming equal groups, at least in context? For example, if asked to find out how many groups of 5 can be made from 45 the answer is found by forming equal groups of 5 until running out of objects, but repeatedly subtracting 5 gives the same process and answer, does it not?

In my experience, the three main division types are: fair-sharing (partitive), repeated subtraction (quotitive or measurement), and missing factor (i.e. $28 \div 7 = \square$ is same as $\square \times 7 = 28$.)

| | |
|---|---|
| | digit number by a one-digit number (e.g., mental strategies, partial products, standard algorithm, and commutative, associative, and distributive properties). |
| **Sample Problems or Classroom Activities**<br><br>FORTHCOMING | |

**Comment [CY51]:** See my comment for 3.A.2.2, but note that partial products (and really the standard algorithm, which is also based on digit-by-digit multiplication) relies on understanding the distributive property, that is, that finding 3 × 14 is the same as finding 3 × 10 and adding 3 × 4 to the result.

In my opinion, the most important model for showing this is area model (with base-10 blocks).

**Comment [CY52]:** So here distributive property appears, but it really should appear in 3.A.2.2.

# Number and Operations

**3.N.3 Apply mathematical actions and processes to understand meanings and uses of fractions in real-world and mathematical situations.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **3.N.3.1** Read and write fractions with words and symbols.<br><br>**3.N.3.2** Construct fractions using set, area and length models.<br><br>**3.N.3.3** Order and compare fractions, including unit fractions and equivalent fractions with like denominators by using models, reasoning about their size and an understanding of the concept of numerator and denominator. |

**Sample Problems or Classroom Activities**

FORTHCOMING

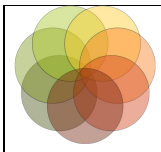


**Comment [CY53]:** It may be important to specify which interpretation of fraction is being introduced first. I see that Susan Lamon's text is a reference; thus, we know there are many, many interpretations of fractions. Later, ratio and unit rate will make use of fractions, but these should be reserved until then and I would want to ensure that here.

Also, some attention to proper language might want to be addressed here, e.g., that we say "one-third" and "five eights" not "1 **over** 3" and "3 **over** 5", as this emphasizes the seemingly disconnected nature of the numbers in the fraction symbol. Not sure exactly how to include that here; this may be a PD for teachers issue?

**Comment [CY54]:** See later comments in 3.G

**Comment [CY55]:** Should this be included?



# Number and Operations

**3.N.4 Apply mathematical actions and processes to determine the value of coins in order to solve monetary transactions.**

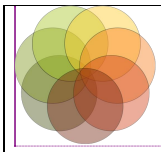
| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **3.N.4.1** Use addition to determine the value of a collection of coins or bills up to $20. (e.g. 45¢ + 30¢= 75¢, $11 + $9=$20 ). Limited to: whole numbers.<br><br>**3.N.4.2** Select the fewest amount of coins for a given amount of money up to one dollar. |

**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY56]:** Should this be "number"? "Amount" sounds like it should be reserved for continuous quantities.

Also, the difference between this and the standard in 2nd Grade is that they find the **fewest** number, correct?



# Geometry and Measurement

**3.GM.1 Apply mathematical actions and processes to use geometric attributes to describe and create shapes in various contexts.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **3.GM.1.1** Identify points, lines, line segments, rays, angles, endpoints, and parallel and perpendicular lines in various contexts and use them (parallel and perpendicular) to describe and create shapes such as right triangles, rectangles, parallelograms, and trapezoids. |

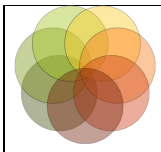
**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY57]:** My major concern here is that the concept of area as "counting the number of non-overlapping unit squares in an object" is not introduced, yet the area model for multiplication is cited earlier as well as area models for fractions (which is less of an issue). This is a fairly large logical gap in my opinion, as otherwise how do teachers describe multiplication as resulting in area and make use of the model? The term *area* would perhaps need to be avoided, and viewing the area model as non-overlapping unit squares in arrays would need to be the standard perspective. The writing team may need to reconsider shifting area of a rectangle (at the least) to 3rd Grade. There is room for it, I believe, if the focus on lines and angles in 3.GM.1.1 is delayed. Also, note that the measurement standards here are still mainly focused on linear measure, something started as far back as 1st Grade. (Perhaps the concept of area is meant to be introduced in those Number and Operation standards, but that isn't made clear.)

**Comment [CY58]:** I'm not an expert in the developmental stages of Geometry understanding, but this seems like a lot for third graders—lots of sophisticated language and concepts.

Also, do students measure angles? Otherwise, what is the definition of a right angle, and hence a right triangle? It seems to me the only recourse would be to accept a square as an axiomatic object and use the corner of a square as a right angle? Not sure.



# Geometry and Measurement

**3.GM.2 Apply mathematical actions and processes to understand perimeter as a measurable attribute of real-world and mathematical objects. Use various tools to measure distances.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **3.GM.2.1** Choose an appropriate measurement instrument (e.g., ruler, yard/meter stick, measuring tape) and measure the length of objects to the nearest whole or half unit.<br><br>**3.GM.2.2** Establish personal benchmarks for metric units and estimate the measures of a variety of objects (e.g., mass: the mass of a raisin is about 1 gram, length: the width of a finger is about 1 centimeter).<br><br>**3.GM.2.3** Find the perimeter of a polygon.<br><br>**3.GM.2.4** Use an analog thermometer to determine temperature to the nearest degree in Fahrenheit and Celsius. |

**Sample Problems or Classroom Activities**

FORTHCOMING

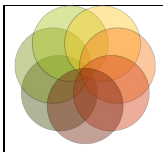
# Geometry and Measurement

**3.GM.3 Apply mathematical actions and processes to tell time.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **3.GM.3.1** Read and write time to the nearest 5-minute (analog and digital).<br><br>**3.GM.3.2** Determine the solutions to problems involving addition and subtraction of time intervals of 5-minutes using pictorial models or tools up to one hour (e.g.15-minute event plus a 30-minute event equals 45 minutes). |

**Sample Problems or Classroom Activities**

FORTHCOMING



# Data and Probability

**3.D.1 Apply mathematical actions and processes to organize data to make it useful for interpreting information and solving problems.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **3.D.1.1** Summarize and construct a data set with multiple categories using a frequency table, line plot, dot plot*, pictograph, and/or bar graph with scaled intervals.<br><br>**3.D.1.2** Solve one- and two-step problems using categorical data represented with a frequency table, dot plot, pictograph, and/or bar graph with scaled intervals.<br><br>*Dot plot is a type of graphic display using filled in circles (dots) and a simple scale to compare the counts (frequency) within categories or groups. Dots are stacked in a column. Column heights represent count. |

**Sample Problems or Classroom Activities**

FORTHCOMING

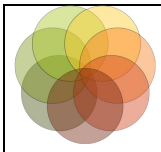
# Oklahoma Academic Standards for Mathematics
# 4th Grade

The fourth-grade standards are divided into four strands, Number and Operations, Algebraic Reasoning and Algebra, Geometry and Measurement, and Data and Probability. The Number and Operation strand emphasizes multiplication and division with whole numbers and solving problems involving addition and subtraction of fractions by finding common multiples and factors using concrete or pictorial models. Students will be fluent in the basic multiplication and division facts as they become proficient in multiplying larger numbers. The Algebraic Reasoning and Algebra strand involves students identifying creating, describing, and extending a wide variety of patterns involving numbers and/or geometric shapes. Students will identify rules for a variety of patterns. The Geometry and Measurement strand focuses on students identifying, classifying, and constructing triangles and quadrilaterals. Students will predict, identify, and describe slides, flips, turns and lines of symmetry. Concrete materials and two-dimensional representations will be used to solve problems involving area, patterns, and equivalence of fractions and decimals. Students will establish personal benchmarks for measurement, choose appropriate measurement tools and solve problems involving measurements in a variety of situations. The Data and Probability strand emphasizes representation of data using tables, bar graphs, timelines, and Venn Diagrams. Students will develop inferences and predictions based on data. Students will identify the occurrence of an event happening as likely, not likely, most likely, and equally likely based on the mathematics involved.

Problem solving has been integrated throughout the content strands. The development of problem solving skills should be a major goal of the mathematics program at every grade level. Experience with the process of problem solving will need to be integrated early and continuously into each student's mathematics education. Students must be helped to develop a wide range of skills and strategies for solving a variety of problem types.

While learning mathematics, students should be actively engaged, using concrete materials and appropriate technologies such as calculators and computers. However, facility in the use of technology should not be regarded as a substitute for a student's understanding of quantitative concepts and relationships or for proficiency and fluency with basic computations.

Mathematics has its own language, and the acquisition of specialized vocabulary and language patterns is crucial to a student's understanding, appreciation of, and disposition for the subject. Students should be encouraged to correctly use the concepts, skills, symbols, and vocabulary identified in the following set of standards.



# Algebraic Reasoning and Algebra

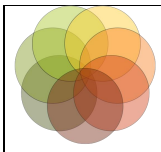
**4.A.1 Apply mathematical actions and processes to use single-operation input-output rules, tables and charts to represent patterns and relationships and to solve real-world and mathematical problems.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **4.A.1.1** Create, describe, and extend a wide variety of patterns involving numbers, using tables, charts and/or rules (e.g., determine the rule from a table or "function machine", extend number patterns). Record the inputs and outputs in a chart or table.<br><br>**4.A.1.2** Describe the rule for a pattern from an input/output table or function machine involving addition, subtraction, multiplication, or division.<br><br>**4.A.1.3** Create, describe, and extend a wide variety of patterns involving geometric shapes and define the rule of the pattern. |

**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY59]:** See comment in 3rd Grade, RE: ×10 and ÷10 pattern in place value.



# Algebraic Reasoning and Algebra

**4.A.2 Apply mathematical actions and processes to use multiplication and division with unknowns to create number sentences representing a given problem situation using a number sentence.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **4.A.2.1** Use number sense, properties of multiplication (commutative, identity, and associative) and the relationship between multiplication and division to find values for the unknowns represented by letters and symbols that make number sentences true. (Introduction to properties, but not mastery of vocabulary).<br><br>**4.A.2.2** Solve for unknowns in one-step problems by solving open sentences (equations) and other problems involving addition, subtraction, multiplication, or division with whole numbers. Use real-world situations to represent number sentences. |

## Sample Problems or Classroom Activities

**Example for 4.A.2.1**

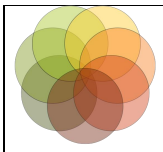
*4 × 12 = ☐ × 4*
*6 × ? = 6*
*2 × (3 × 4) = (2 × 3)× ☐*

**Example for 4.A.2.2**

*Find the value of the unknown in the following number sentences to make them true.*

*4 × y = 12*
*c + 9 = 17*

MORE FORTHCOMING



# Number and Operations

**4.N.1 Apply mathematical actions and processes to multiply multi-digit numbers and solve real-world and mathematical problems using arithmetic.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Solving Diverse Problems<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **4.N.1.1** Demonstrate fluency with multiplication and division facts up to 12 x 12.<br><br>**4.N.1.2** Use an understanding of place value to multiply or divide a number by 10, 100 and 1000.<br><br>**4.N.1.3** Multiply 3-digit by 1-digit or a 2-digit by 2-digit whole numbers, using efficient and generalizable procedures and strategies, based on knowledge of place value, including but not limited to standard algorithms.<br><br>**4.N.1.4** Estimate products of 3-digit by 1-digit or a 2-digit by 2-digit whole numbers by using rounding, benchmarks and place value to assess the reasonableness of results. Explore larger numbers using technology to investigate patterns.<br><br>**4.N.1.5** Solve multi-step real world and mathematical problems requiring the use of addition, subtraction and multiplication of multi-digit whole numbers. Use various strategies, including the relationship between operations, the use of appropriate technology, and the context of the problem to assess the reasonableness of results.<br><br>**4.N.1.6** Use strategies and algorithms based on knowledge of place value, equality and properties of operations to divide 3-digit dividends by 1-digit whole number divisors. (e.g., mental strategies, standard algorithms, partial quotients, the commutative, associative, and distributive properties and repeated subtraction). |

**Comment [CY60]:** Note: There is a symbol for the multiplication sign, found in the "Insert→ Symbol" menu: ×

**Comment [CY61]:** Yes, and I want to go further and establish the "to the left is 10× greater" pattern. Later, this pattern can be used for decimal understanding.

**Comment [CY62]:** Does this "a" need to be here? Sentence doesn't read right to me.

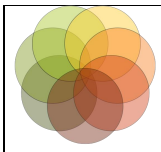
**Comment [CY63]:** Love this. Flexibility.

**Comment [CY64]:** Needed?

**Comment [CY65]:** What kind of patterns?

**Sample Problems or Classroom Activities**

FORTHCOMING



# Number and Operations

**4.N.2 Apply mathematical actions and processes to represent and compare fractions and decimals in real-world and mathematical situations; use place value to understand how decimals represent quantities.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **4.N.2.1** Represent equivalent fractions using fraction models (e.g., parts of a set, fraction circles, fraction strips, number lines and other manipulatives).<br><br>**4.N.2.2** Use benchmark fractions (0, ¼, 1/3, ½, 2/3, ¾, 1) to locate additional fractions on a number line. Use models to order and compare whole numbers and fractions less than and greater than one.<br><br>**4.N.2.3** Decompose a fraction in more than one way into a sum of fractions with the same denominator using concrete and pictorial models and recording results with symbolic representations (e.g., 3/4 = 1/4 + 1/4 + 1/4).<br><br>**4.N.2.4** Use fraction models to add and subtract fractions with like denominators in real world and mathematical situations.<br><br>**4.N.2.5** Represent tenths and hundredths with concrete models, making connections between fractions and decimals.<br><br>**4.N.2.6** Model, read and write decimals up to at least the hundredths place in a variety of context including money.<br><br>**4.N.2.7** Compare and order decimals and whole numbers using place value, a number line and models such as grids and base 10 blocks.<br><br>**4.N.2.8** Rename and compare benchmark fractions |

**Comment [CY66]:** I'd prefer area models in addition to these.

**Comment [CY67]:** May need to consider using "concrete models" or "concrete representations" or something, as opposed to simply "models," as now "model" will be used in the mathematical modeling sense due to Action and Process CMG.

**Comment [CY68]:** And here it is.

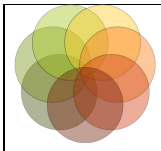
**Comment [CY69]:** Indeed, however, the connection between 1/10 and 1/100 and the decimal representation is that the × 10 and ÷ 10 pattern of the base-10 system persists to the right of the units digit, a new set of places indicated by a "decimal point," etc.

For instance, students mistake ½ as 0.2, or ¼ as 0.4, because 1/10 is 0.10, so why shouldn't that make sense? The big idea is that the pattern of ÷ 10 persisting to the right of the "unit", the number 1, would mean a new place value is introduced and represents the number of 1/10ths, etc. I hope my point is coming across clearly enough.

To summarize: Would love to see somewhere, here or in 3rd Grade, the establishment of the base-10 number system pattern of × 10 and ÷ 10.

| | |
|---|---|
| | (1/4, 1/3, ½, 2/3, ¾) and decimals (0.25, 0.50, 0.75) in real-world and mathematical situations; use place value to understand how decimals represent quantities, including money (e.g. half of a dollar is $0.50; ¼ is the same as 0.25). |
| **Sample Problems or Classroom Activities**<br><br>FORTHCOMING | |

**Comment [CY70]:** So this includes renaming in the sense of ¼ = 25/100, correct? This is discussed above in **4.N.2.1**. Should the process of multiplying numerator and denominator by the same non-zero number to obtain equivalent fractions be specified somewhere?



# Number and Operations

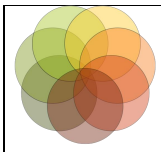
**4.N.3 Apply mathematical actions and processes to determine the value of coins in order to solve monetary transactions.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Solving Diverse Problems<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **4.N.3.1** Given a total cost (whole dollars and/or decimal) and amount paid (whole dollars and/or decimal), find the change required in a variety of ways. |

**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY71]:** Note that addition/subtraction of decimals is not mentioned above in the Number and Operation standards.



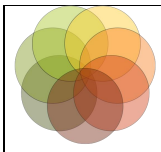
# Geometry and Measurement

**4.GM.1 Apply mathematical actions and processes to name, describe, classify and construct polygons.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **4.GM.1.1** Describe, classify and construct triangles, including equilateral, right, scalene, and isosceles triangles. Recognize triangles in various contexts.<br><br>**4.GM.1.2** Describe, classify and construct quadrilaterals, including squares, rectangles, trapezoids, rhombuses, parallelograms and kites. Recognize quadrilaterals in various contexts. |

**Sample Problems or Classroom Activities**

FORTHCOMING



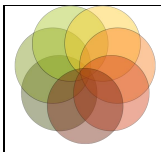
# Geometry and Measurement

**4.GM.2 Apply mathematical actions and processes to transformations and use symmetry to analyze mathematical situations.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **4.GM.2.1** Predict and describe the results of translation (sliding), reflection (flipping) and rotation (turning) 2-dimensional shapes.<br><br>**4.GM.2.2** Identify and describe the line(s) of symmetry in 2-dimensional shapes. |

**Sample Problems or Classroom Activities**

FORTHCOMING



# Geometry and Measurement

**4.GM.3 Apply mathematical actions and processes to understand angle and area as measurable attributes of real world and mathematical objects. Use various tools to measure angles and areas.**

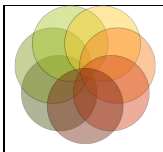
| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **4.GM.3.1** Measure angles in geometric figures and real world objects with a protractor or angle ruler.<br><br>**4.GM.3.2** Find the area of a two-dimensional figure by counting the total number of same size square units that cover a shape without gaps or overlaps.<br><br>**4.GM.3.3** Develop and use formulas to determine the area of rectangles. Justify why length and width are multiplied to find the area of a rectangle by breaking the rectangle into one unit by one unit squares and viewing these as grouped into rows and columns.<br><br>**4.GM.3.4** Find the area of polygons that can be decomposed into rectangles.<br><br>**4.GM.3.5** Choose an appropriate instrument (e.g., ruler, yard/meter stick, tape measure) and measure the length of an object to the nearest whole centimeter or quarter-inch.<br>**Clarification:** Anything smaller than a centimeter should be measured in millimeters.<br><br>**4.GM.3.6** Solve problems that deal with measurements of length, when to use liquid volumes, when to use mass, temperatures above zero and money using addition, subtraction, multiplication, or division as appropriate (customary and metric).<br><br>**Clarification:** Focus should be on why and when to use the tools in addition to how to use the tools.<br><br>**4.GM.3.7** Determine elapsed time. Solve problems |

**Comment [CY72]:** This standard is crucial for earlier 4th Grade standards (e.g. right triangles, rotations)

**Comment [CY73]:** As mentioned earlier, I strongly believe this belongs in 3rd Grade and should be developed in tandem with multiplication.

| | |
|---|---|
| | involving the conversion of one measure of time to another. |
| **Sample Problems or Classroom Activities**<br><br>FORTHCOMING | |

**Comment [CY74]:** Specific examples of expectations would be helpful here. E.g. 150 minutes is 2.5 hours?



# Data and Probability

**4.D.1 Apply mathematical actions and processes to solve problems by collecting, organizing, displaying, and interpreting data.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **4.D.1.1** Represent data on a frequency table or dot plot marked with whole numbers and fractions using appropriate titles, labels and units.<br><br>**4.D.1.2** Use tables, bar graphs, timelines and Venn diagrams to display data sets. The data may include benchmark fractions or decimals (1/4, 1/3, ½, 2/3, ¾, 0.25, 0.50, 0.75).<br><br>**4.D.1.3** Solve one- and two-step problems using data in whole number, decimal, and and/or fraction form in a frequency table and dot plot. |

**Sample Problems or Classroom Activities**

FORTHCOMING

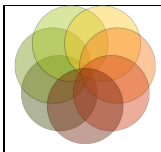
# Oklahoma Academic Standards for Mathematics
# 5th Grade

The fifth-grade standards place emphasis on number sense with whole numbers, fractions, and decimals. This focus involves three main ideas: whole number division, the notion of decimal and their connections with fractions, and addition and subtraction of fractions. Students will develop proficiency in the use of fractions and decimals to solve problems. Solving real-world and mathematical problems is a common theme across the number and operation strand. Additionally, students will work with many foundational algebraic ideas, including exploring patterns of change using patterns, tables, graphs and rules along with evaluating expressions and solving equations involving variables when values of the variables are given. Students will describe, classify, and draw representations of three-dimensional figures. They will also determine the area of triangles and quadrilaterals. Finally, students will display and interpret data including finding the mean, median and range of a set of numbers.

Problem solving has been integrated throughout the content strands. The development of problem solving skills should be a major goal of the mathematics program at every grade level. Experience with the process of problem solving will need to be integrated early and continuously into each student's mathematics education. Students must be helped to develop a wide range of skills and strategies for solving a variety of problem types.

While learning mathematics, students should be actively engaged, using concrete materials and appropriate technologies such as calculators and computers. However, facility in the use of technology should not be regarded as a substitute for a student's understanding of quantitative concepts and relationships or for proficiency and fluency with basic computations.

Mathematics has its own language, and the acquisition of specialized vocabulary and language patterns is crucial to a student's understanding, appreciation of, and disposition for the subject. Students should be encouraged to correctly use the concepts, skills, symbols, and vocabulary identified in the following set of standards.



# Algebraic Reasoning and Algebra

**5.A.1 Apply mathematical actions and processes to create and use tables, graphs and rules to describe patterns to solve real-world and mathematical problems.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **5.A.1.1** Create and use rules and tables to describe patterns of change and make predictions and generalizations about real-world and mathematical problems.<br><br>**5.A.1.2** Use a rule or table to represent ordered pairs of positive integers and graph these ordered pairs on a coordinate system. |

**Comment [CY75]:** Important for 6th grade later.

**Sample Problems or Classroom Activities**

FORTHCOMING

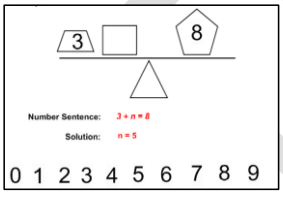
# Algebraic Reasoning and Algebra

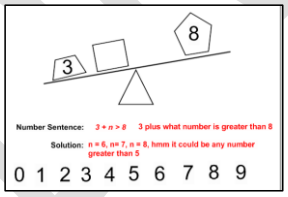
**5.A.2 Apply mathematical actions and processes to understand and interpret expressions, equations, and inequalities involving variables and whole numbers, and use them to represent and solve real-world and mathematical problems.**

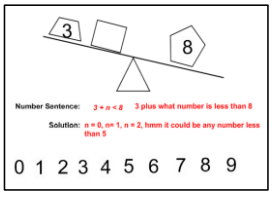
| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **5.A.2.1** Generate equivalent numerical expressions and ~~to~~ solve problems involving whole numbers by applying the commutative, associative, and distributive properties and order of operations (no exponents).<br><br>**5.A.2.2** Determine whether an equation or inequality involving a variable is true or false for a given value of the variable.<br><br>**5.A.2.3** Evaluate expressions and solve equations involving variables when values for the variables are given. |

## Sample Problems or Classroom Activities

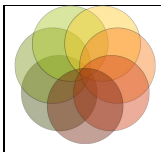
**Example for 5.A.2.2**




MORE FORTHCOMING



# Number and Operations

**5.N.1 Apply mathematical actions and processes to divide multi-digit numbers and solve real-world and mathematical problems using arithmetic.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **5.N.1.1** Estimate solutions to division problems in order to assess the reasonableness of results.<br><br>**5.N.1.2** Divide multi-digit numbers, using efficient and generalizable procedures, based on knowledge of place value, including standard algorithms. Recognize that quotients can be represented in a variety of ways, including a whole number with a remainder, a fraction or mixed number, or a decimal and consider the context in which a problem is situated to select and interpret the most useful form of the quotient for the solution.<br><br>**5.N.1.3** Solve real-world and mathematical problems requiring addition, subtraction, multiplication and division of multi-digit whole numbers. Use various strategies, including the inverse relationships between operations, the use of technology, and the context of the problem to assess the reasonableness of results. |

**Sample Problems or Classroom Activities**

FORTHCOMING

# Number and Operations

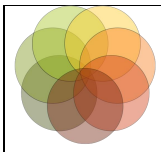
**5.N.2 Apply mathematical actions and processes to read, write, represent and compare fractions and decimals; recognize and write equivalent fractions; convert between fractions and decimals; use fractions and decimals in real-world and mathematical situations.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **5.N.2.1** Represent decimal fractions (e.g. 1/10, 1/100) using a variety of models (e.g, 10 by 10 grids, rational number wheel, base-ten blocks, meter stick) and make connections between fractions and decimals (e.g., the visual for 1/10 is the same as for 0.1).<br><br>**5.N.2.2** Model, read and write decimals using place value to describe decimal numbers from at least millions to thousandths.<br><br>**5.N.2.3** Compare and order fractions and decimals, including mixed numbers and improper fractions, and locate on a number line.<br><br>**5.N.2.4** Recognize and generate equivalent decimals, fractions, mixed numbers and improper fractions in various contexts. |

**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY76]:** How does this differ from the 4th Grade standard? What is the "visual" for 0.1? The symbol 0.1 has no intrinsic meaning unless we see it as extending the base-10 place value system in a natural way to the right of the ones place by using the ÷ 10 pattern.



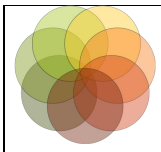
# Numbers and Operations

**5.N.3 Apply mathematical actions and processes to add and subtract fractions with like and unlike denominators, mixed numbers and decimals to solve real-world and mathematical problems.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **5.N.3.1** Estimate sums and differences of fractions and decimals to assess the reasonableness of the results.<br><br>**5.N.3.2** ~~Using~~ Use the meanings of fractions, meanings of whole number addition and subtraction, and inverse relationships to model addition and subtraction of fractions and decimals using a variety of representations (e.g., fraction strips, area models, number lines, Cuisenaire rods).<br><br>**5.N.3.3** Add and subtract fractions and decimals, using efficient and generalizable procedures, including but not limited to standard algorithms in order to solve real world and mathematical problems including those involving money, measurement, geometry, and data.<br><br>**5.N.3.4** Find 0.1 more than a number and 0.1 less than a number. Find 0.01 more than a number and 0.01 less than a number. Find 0.001 more than a number and 0.001 less than a number. |

**Sample Problems or Classroom Activities**

FORTHCOMING



# Geometry and Measurement

**5.GM.1 Apply mathematical actions and processes to describe, classify, and draw representations of three-dimensional figures.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **5.GM.1.1** Describe and classify three-dimensional figures including cubes, rectangular prisms and pyramids by the number of edges, faces or vertices as well as the shapes of faces.<br><br>**5.GM.1.2** Recognize and draw a net for a three-dimensional figure (e.g., cubes, rectangular prisms, pyramids). |

**Sample Problems or Classroom Activities**

FORTHCOMING

# Geometry and Measurement

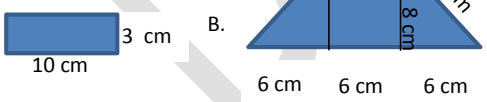
**5.GM.2 Apply mathematical actions and processes to determine the area of triangles and parallelograms.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **5.GM.2.1** Develop and use formulas to determine the area of triangles and parallelograms.<br><br>**5.GM.2.2** Find the area of polygons that can be decomposed into triangles. |

## Sample Problems or Classroom Activities

**Example for 5.GM.2.2**

*Find the area of the following polygons by decomposing each into non-overlapping triangles.*



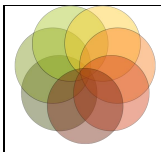

B.




MORE FORTHCOMING

**Comment [CY77]:** I'm not sure why we would do that for the first figure, as it is already a rectangle, and we know how to find the area of a rectangle by multiplication.

However, decomposing a rectangle into triangles can help arrive at the area formula for (right) triangles, of course.



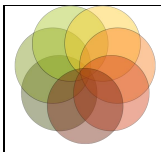
# Geometry and Measurement

**5.GM.3 Apply mathematical actions and processes to understand angle and length as measurable attributes of real world and mathematical objects. Use various tools to measure angles and lengths.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **5.GM.3.1** Measure and compare angles according to size. Classify angles as acute, right, and obtuse.<br><br>**5.GM.3.2** Choose an appropriate instrument (e.g., ruler, yard/meter stick, tape measure) and measure the length of an object to the nearest whole centimeter or 1/16-inch. |

**Sample Problems or Classroom Activities**

FORTHCOMING



# Data and Probability

**5.D.1 Apply mathematical actions and processes to display and interpret data and determine mean, median, mode, and range.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **5.D.1.1** Know and use the definitions of the mean, median, mode, and range of a set of data. Understand that the mean is a "leveling out" of data.<br><br>**5.D.1.2** Using appropriate tools, create and analyze line graphs and double-bar graphs by applying understanding of whole numbers, fractions and decimals. |

**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY78]:** While I can infer the meaning of this statement, it may need clarification.

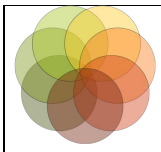
# Oklahoma Academic Standards for Mathematics
# 6th Grade

The sixth-grade standards transition from an emphasis on whole number arithmetic in the elementary grades to an increased emphasis on algebra and geometry with some data analysis and probability. Students will read, write, represent, compare, and explore the connections between fractions, decimals, percents, and ratios. They will write positive integers as a product of factors. Students will develop mathematical proficiency with multiplication and division of fractions and solve real-world problems. Solving real-world and mathematical problems is a common theme across the number and operation strand. As a part of the algebra strand, students will recognize and represent relationships between varying quantities as well as solve real-world and mathematical problems using patterns, tables, graphs and rules. Students will model, write, solve, and graph one-step equations with one variable using number sense, the properties of operations and the properties of equality. Students will develop formulas and use them to calculate the area of quadrilaterals and be able to explain why a particular formula is used and why it works. They will begin to explore and use relationships between angles in geometric figures and choose appropriate units of measurements to solve real-world and mathematical problems. Students will display and interpret data and use probabilities to solve real-world and mathematical problems.

Problem solving has been integrated throughout the content strands. The development of problem solving skills should be a major goal of the mathematics program at every grade level. Experience with the process of problem solving will need to be integrated early and continuously into each student's mathematics education. Students must be helped to develop a wide range of skills and strategies for solving a variety of problem types.

While learning mathematics, students should be actively engaged, using concrete materials and appropriate technologies such as calculators and computers. However, facility in the use of technology should not be regarded as a substitute for a student's understanding of quantitative concepts and relationships or for proficiency and fluency with basic computations.

Mathematics has its own language, and the acquisition of specialized vocabulary and language patterns is crucial to a student's understanding, appreciation of, and disposition for the subject. Students should be encouraged to correctly use the concepts, skills, symbols, and vocabulary identified in the following set of standards.



# Algebraic Reasoning and Algebra

**6.A.1 Apply mathematical actions and processes to recognize and represent relationships between varying quantities; translate from one representation to another; use patterns, tables, graphs and rules to solve real-world and mathematical problems.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **6.A.1.1** Represent the relationship between two varying quantities with function rules, graphs and tables; translate between any two of these representations.<br><br>**6.A.1.2** Use variables in various contexts including whether an equation or inequality involving a variable is true or false for a given value of the variable. |

**Sample Problems or Classroom Activities**

**Example for 6.A.1.3** - *Using table below, recognize and graph on the x-y coordinate plane the points (2, 3) and (1, 2).*

| *x* | *y* |
|---|---|
| *2* | *3* |
| *1* | *2* |

*Use y = 2x or y = x + 2 (limit to one operation) to generate a table and then graph.*

MORE FORTHCOMING

# Algebraic Reasoning and Algebra

**6.A.2 Apply mathematical actions and processes to use properties of arithmetic to generate equivalent numerical expressions and evaluate expressions involving positive rational numbers.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **6.A.2.1** Generate equivalent expressions and ~~to~~ solve problems involving positive rational numbers by applying the commutative, associative, and distributive properties and order of operations. |

**Comment [CY79]:** Are exponents now included here?

## Sample Problems or Classroom Activities

**Example for 6.A.2.1**

Include exponents

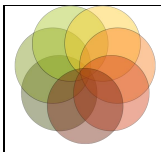
Which expression has 120 for the answer?

- A. (2 x 6) x (2 x 6)
- B. (2 x 2 x 2) x 3 x 5
- C. 6 x 6
- D. 6 x 5 x 3

Evaluate $4 + 5(45 - 15) + 6^2$.

- A. 30
- B. 46
- C. 190
- D. 306

MORE FORTHCOMING



# Algebraic Reasoning and Algebra

**6.A.3 Apply mathematical actions and processes to understand and interpret equations and inequalities involving variables and positive rational numbers. Use equations and inequalities to represent real-world and mathematical problems; use the idea of maintaining equality to solve equations. Interpret solutions in the original context.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **6.A.3.1** Represent real-world or mathematical situations using equations and inequalities involving variables and positive rational numbers.<br><br>**6.A.3.2** Solve and graph one-step equations (e.g., 1/3x = 9) involving positive rational numbers using number sense, properties of operations and equality. Interpret a solution in the original context and assess the reasonableness of results. |

**Sample Problems or Classroom Activities**

**Resource note for 6.A.3.2:** *Use a balance to model an equation and show how subtracting a number from one side requires subtracting the same amount from the other side. Hands on equations and balance tasks can help students move from the concrete to the pictorial to the abstract.*

*The app "SolveMe Mobiles" for tablet and the Balance Task app found on the NCTM Illuminations website will be helpful for students working to understand solving equations.*

MORE FORTHCOMING

# Number and Operations

**6.N.1 Apply mathematical actions and processes to read, write, represent and compare integers and positive rational numbers expressed as fractions, decimals, percents and ratios; write positive integers as products of factors; use these representations in real-world and mathematical situations.**

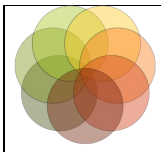
| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **6.N.1.1** Locate integers and rational numbers on a number line and understand the concept of opposites.<br><br>**6.N.1.2** Plot coordinates in all four quadrants. Be able to identify each quadrant, the origin, the x-axis, and the y-axis.<br><br>**6.N.1.3** Compare positive rational numbers represented in various forms using the symbols <, >, and =.<br><br>**6.N.1.4** Explain that a percent represents parts out of 100 and ratios to 100 (e.g., 75% corresponds to the ratio 75 to 100 which is equivalent to a ratio of 3 to 4).<br><br>**6.N.1.5** Determine equivalencies among fractions, decimals and percents. Select among these representations to solve problems.<br><br>**6.N.1.6** Factor whole numbers and express a whole number as a product of prime factors with exponents.<br><br>**6.N.1.7** Determine ~~the~~ greatest common factors and least common multiples. Use common factors and multiples to calculate with fractions and find equivalent fractions. |

**Comment [CY80]:** Introduced in 6.N.2.3.

**Comment [CY81]:** Haven't students found equivalent fractions already? E.g. earlier they were responsible for representing ¼ as 0.25—they did this by renaming ¼ as 25/100 I assumed.

**Sample Problems or Classroom Activities**

FORTHCOMING



# Number and Operations

**6.N.2 Apply mathematical actions and processes to understand the concept of ratio and its relationship to fractions and percents and to the multiplication and division of whole numbers. Use ratios to solve real-world and mathematical problems.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **6.N.2.1** Identify and use ratios to compare quantities. Recognize that comparing quantities using ratios is not the same as comparing quantities using subtraction.<br><br>**6.N.2.2** Determine the unit rate for ratios of quantities with different units.<br><br>**6.N.2.3** Apply the relationship between ratios, equivalent fractions and percents to solve problems in various contexts, including those involving mixture and concentrations.<br><br>**6.N.2.4** Use reasoning about multiplication and division to solve ratio and rate problems. |

**Comment [CY82]:** This was a little unclear to me. Does this mean they see that multiplicative comparing is different from additive comparing? Some clarification may be needed.

**Comment [CY83]:** Does this include problems involving say concentrations of chemicals in solution? E.g. problems that result in $x+y=100$ and $.10x+.25y = .20$? Just curious, as these are systems of linear equations which do not appear in generality until Pre-Algebra or Algebra I.

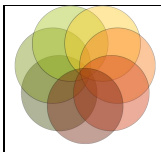
**Sample Problems or Classroom Activities**

**Example for 6.N.2.2**

*Determine the unit rate for each of the following situations:*

*20 miles every 5 hours* *(Answer: 4 miles per hour)*
*12 cans of soda for $6* *(Answer: 2 cans per $1)*

MORE FORTHCOMING



# Number and Operations

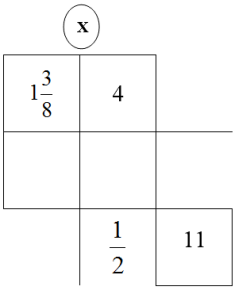
**6.N.3 Apply mathematical actions and processes to multiply and divide decimals, fractions with like and unlike denominators, and mixed numbers; solve real-world and mathematical with positive rational numbers.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **6.N.3.1** Estimate solutions to problems with whole numbers, decimals, fractions, and mixed numbers and use the estimates to assess the reasonableness of results in the context of the problem.<br><br>**6.N.3.2** ~~Using~~ Use the meanings of fractions, meanings of whole number multiplication and division, and inverse relationships to model multiplication and division of fractions and decimals using a variety of representations (e.g., fraction strips, area models, number lines, Cuisenaire rods).<br><br>**6.N.3.3** Multiply and divide fractions and decimals, using efficient and generalizable procedures, including but not limited to standard algorithms.<br><br>**6.N.3.4** Solve real-world and mathematical problems including those involving money, measurement, geometry, and data requiring arithmetic with decimals, fractions and mixed numbers. |

## Sample Problems or Classroom Activities

**Examples for 6.N.3.3**

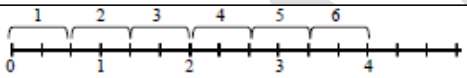
***Example 1.*** *Solve the following multiplication 2-way. For each row or column the first two numbers are multiplied to produce the last number.*



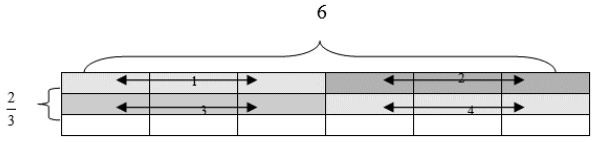

***Teacher Note:*** *This problem is self-checking, encourages students to use their number sense to decide where to start, encourages mental arithmetic, and helps students see the reciprocal relationship between multiplication and division.*

***Example 2.*** *Solve the multiplication problem* $6 \times \frac{2}{3}$ *using at least 3 different strategies. Explain your thinking process for each.*

***Possible solutions:***




After drawing a number line and marking it off in thirds, I made 6 hops of $\frac{2}{3}$ and ended on 4. Thus, my answer is 4.

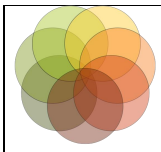



I drew a 1 by 6 array and then cut my side of 1 into 3 equal parts. Then I shaded $\frac{2}{3}$ of each of my 6 columns. I found that I had 4 wholes shaded. Therefore, $6 \times \frac{2}{3} = 4$.

I know that $\frac{1}{3}$ of 6 is 2. So, $\frac{2}{3}$ of 6 is double that – 4.



MORE FORTHCOMING



# Geometry and Measurement

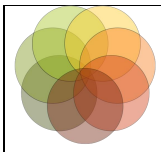
**6.GM.1 Apply mathematical actions and processes to calculate perimeter and area of two- dimensional figures to solve real-world and mathematical problems.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **6.GM.1.1** Develop and use formulas for the area of quadrilaterals (e.g., squares, rectangles, rhombi, parallelograms, trapezoids) using a variety of methods including but not limited to the standard algorithm.<br><br>**6.GM.1.2** Find the perimeter of polygons to solve real-world and mathematical problems. |

**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY84]:** Does this mean standard formulas?



# Geometry and Measurement

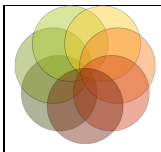
**6.GM.2 Apply mathematical actions and processes to understand and use relationships between angles in geometric figures.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **6.GM.2.1** Solve problems using the relationships between the angles (e.g. vertical, complementary, and supplementary) formed by intersecting lines.<br><br>**6.GM.2.2** Determine missing angle measures in a triangle using the fact that the sum of the interior angles of a triangle is 180˚. |

**Comment [CY85]:** Do students also experience/understand reasoning for *why* the interior angle sum of a triangle is 180\deg ?

**Sample Problems or Classroom Activities**

FORTHCOMING



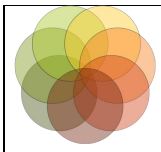
# Geometry and Measurement

**6.GM.3 Apply mathematical actions and processes to choose appropriate units of measurement and use ratios to convert within measurement systems to solve real-world and mathematical problems.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **6.GM.3.1** Solve problems in various contexts involving conversion of weights, capacities, geometric measurements and times within the same measurement systems using appropriate units. |

**Sample Problems or Classroom Activities**

FORTHCOMING



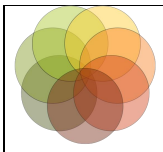
# Data and Probability

**6.D.1 Apply mathematical actions and processes to display and interpret data, including box and whisker plots.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **6.D.1.1** For a given set of data, explain and defend which measure of central tendency (mean, median, and mode) would provide the most descriptive information.<br><br>**6.D.1.2** Create and analyze box and whisker plots exploring how each segment contains ¼ of the data. |

**Sample Problems or Classroom Activities**

FORTHCOMING



# Data and Probability

**6.D.2 Apply mathematical actions and processes to use probability to solve real-world and mathematical problems: represent probabilities using fractions, decimals, and percents.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **6.D.2.1** Determine the sample space (set of possible outcomes) for a given experiment and determine which members of the sample space are related to certain events. Sample space may be determined by the use of tree diagrams, tables or pictorial representations.<br><br>**6.D.2.2** Identify dependent and independent events.<br><br>**6.D.2.3** Model situations in which the probabilities are known, compare the resulting relative frequencies with the known probabilities; know that there may be differences. |

## Sample Problems or Classroom Activities

**Example 6.D.2.2**

*Repeatedly draw colored chips with replacement from a bag with an unknown mixture of chips, record relative frequencies, and use the results to make predictions about the contents of the bag.*



MORE FORTHCOMING

# Oklahoma Academic Standards for Mathematics
# 7th Grade

The seventh-grade standards continue the transition from an emphasis placed on whole number arithmetic in the elementary grades to an increased emphasis on algebra and geometry with some data analysis and probability. Students who complete seventh grade are prepared to study pre-algebra in eighth grade. Topics in grade seven include integer concepts and computation, proportional reasoning, and two-step linear equations. Students will apply the properties of real numbers to solve both equations and inequalities. Students will display and interpret meaningful data in a variety of ways. They will also begin to use proportional reasoning to draw conclusions and make predictions about relative frequencies of outcomes based on probability.

Problem solving has been integrated throughout the content strands. The development of problem solving skills should be a major goal of the mathematics program at every grade level. Experience with the process of problem solving will need to be integrated early and continuously into each student's mathematics education. Students must be helped to develop a wide range of skills and strategies for solving a variety of problem types.

While learning mathematics, students should be actively engaged, using concrete materials and appropriate technologies such as calculators and computers. However, facility in the use of technology should not be regarded as a substitute for a student's understanding of quantitative concepts and relationships or for proficiency and fluency with basic computations.

Mathematics has its own language, and the acquisition of specialized vocabulary and language patterns is crucial to a student's understanding, appreciation of, and disposition for the subject. Students should be encouraged to correctly use the concepts, skills, symbols, and vocabulary identified in the following set of standards.

# Algebraic Reasoning and Algebra

**7.A.1 Apply mathematical actions and processes to understand the concept of proportionality in real-world and mathematical situations, and distinguish between proportional and other relationships.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **7.A.1.1** Recognize that a relationship between two variables, *x* and *y,* is proportional if it can be expressed in the form $\frac{y}{x}=k$ or $y=kx$. Distinguish proportional relationships from other relationships, including inversely proportional relationships ($xy=k$ or $y=\frac{k}{x}$).<br><br>**7.A.1.2** Recognize that the graph of a proportional relationship is a line through the origin whose slope is the unit rate (constant of proportionality). Know how to use graphing technology to examine what happens to a line when the unit rate is changed. |

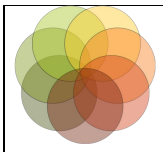
**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY86]:** How do they do this? Using which representations?

**Comment [CY87]:** That lies on a line, or is part of a line.

**Comment [CY88]:** When is slope of a line defined? How is it defined?



# Algebraic Reasoning and Algebra

**7.A.2 Apply mathematical actions and processes to recognize proportional relationships in real-world and mathematical situations; represent these and other relationships with tables, verbal descriptions, symbols and graphs; solve problems involving proportional relationships and explain results in the original context.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **7.A.2.1** Represent proportional relationships with tables, verbal descriptions, symbols, equations and graphs; translate from one representation to another. Determine the unit rate (constant of proportionality or slope) given any of these representations.<br><br>**7.A.2.2** Solve multi-step problems involving proportional relationships in numerous contexts.<br><br>**7.A.2.3** Use knowledge of proportions to assess the reasonableness of solutions.<br><br>**7.A.2.4** Represent real-world or mathematical situations using equations and inequalities involving variables and positive and negative rational numbers. |

**Comment [CY89]:** These two standards could be combined: "and assess the reasonableness of solutions…"

**Comment [CY90]:** Operations yet?

**Sample Problems or Classroom Activities**

FORTHCOMING

# Algebraic Reasoning and Algebra

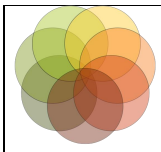
**7.A.3 Apply mathematical actions and processes to use number sense, the properties of operations, and algebraic reasoning to identify, simplify, and solve simple linear equations and inequalities.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **7.A.3.1** Write and solve two-step linear equations with one variable using number sense, the properties of operations, and the properties of equality.<br><br>**7.A.3.2** Model, write, solve, and graph one-step linear inequalities with one variable. |

**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY91]:** Why two-step above but only one-step here?



# Algebraic Reasoning and Algebra

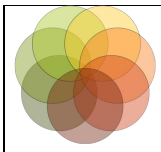
**7.A.4 Apply mathematical actions and processes to use ratios to solve real-world and mathematical problems.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **7.A.4.1** Use reasoning about multiplication and division to solve ratio and rate problems.<br><br>**7.A.4.2** Use proportional reasoning to solve problems involving ratios in various contexts.<br><br>**7.A.4.3** Use knowledge of proportions to assess the reasonableness of solutions. |

**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY92]:** Duplicate standards? See 7.A.2.2 and 7.A.2.3



# Algebraic Reasoning and Algebra

**7.A.5 Apply mathematical actions and processes to use order of operations and algebraic properties to generate equivalent numerical and algebraic expressions containing positive and negative rational numbers and grouping symbols; evaluate such expressions.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **7.A.5.1** Use properties of algebra to generate equivalent numerical and algebraic expressions containing positive and negative rational numbers, grouping symbols and whole number exponents. Properties of algebra include associative, commutative and distributive laws.<br><br>**7.A.5.2** Apply understanding of order of operations and grouping symbols when using calculators and other technologies. |

**Sample Problems or Classroom Activities**

FORTHCOMING

# Algebraic Reasoning and Algebra

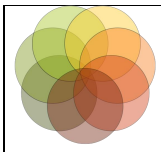
**7.A.6 Apply mathematical actions and processes to represent real-world and mathematical situations using equations with variables. Solve equations algebraically, using the properties of equality. Interpret solutions in the original context.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **7.A.6.1** Represent relationships in various contexts with equations involving variables and positive and negative rational numbers.<br><br>**7.A.6.2** Use properties of operations and equality to solve for the value of a variable and interpret solutions in the original context.<br><br>**7.A.6.3**. Solve equations resulting from proportional relationships in various contexts. |

**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY93]:** Is this only two-step as well? See standard 7.A.3.1



# Number and Operations

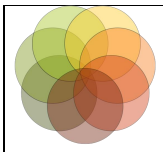
**7.N.1 Apply mathematical actions and processes to read, write, represent and compare positive and negative rational numbers, expressed as integers, fractions and decimals.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **7.N.1.1** Know that every rational number can be written as the ratio of two integers or as a terminating or repeating decimal. Recognize that π is not rational, but that it can be approximated by rational numbers such as $\frac{22}{7}$ and 3.14.<br><br>**7.N.1.2** Compare and order positive and negative rational numbers expressed in various forms using the symbols <, >, =, ≤, and ≥.<br><br>**7.N.1.3** Recognize and generate equivalent representations of positive and negative rational numbers, including equivalent fractions. |

**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY94]:** Does this include changing from decimal representation to fraction representation? If so, translating from repeating decimal to fraction is often done with a process like "Set $N = 0.454545\ldots$, so $100N = 45.4545\ldots$ so $99N = 45$, so that… etc. If so, note that this is a more than just a two-step equation in one unknown.



# Number and Operations

**7.N.2 Apply mathematical actions and processes to calculate with positive and negative rational numbers, and rational numbers with natural number exponents, to solve real-world and mathematical problems.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **7.N.2.1** Use real-world contexts and the inverse relationship between addition and subtraction to explain why the procedures of arithmetic with negative rational numbers make sense.<br><br>**7.N.2.2** Model addition, subtraction, multiplication and division of positive and negative integers using a variety of representations (e.g., two-color counters, number lines).<br><br>**7.N.2.3** Add, subtract, multiply and divide positive and negative rational numbers including integers, fractions and terminating decimals; use efficient and generalizable procedures including but not limited to standard algorithms.<br><br>**7.N.2.4** Raise integers to whole number exponents.<br><br>**7.N.2.5** Solve real-world and mathematical problems involving calculations with positive and negative rational numbers and positive integer exponents.<br><br>**7.N.2.6** Demonstrate an understanding of the relationship between the absolute value of a rational number and distance on a number line. Use the symbol for absolute value.<br><br>**7.N.2.7** Calculate the percent of a number and determine what percent one number is of another number to solve problems in various contexts (e.g., sales tax, markup, discount, percent error, tip).<br><br>**7.N.2.8** Use proportional reasoning to solve |

**Comment [CY95]:** Could this be rational numbers in general, or is that later grades?

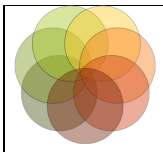
**Comment [CY96]:** Are these not included as problems in "**7.A.2.2** Solve multi-step problems involving proportional relationships in numerous contexts. "?

| | |
|---|---|
| | problems involving ratios in various contexts. |

**Sample Problems or Classroom Activities**

FORTHCOMING

Comment [CY97]: Is this a duplicate of 7.A.4.2?



# Geometry and Measurement

**7.GM.1 Apply mathematical actions and processes to analyze the effect of change of scale, translations and reflections on the attributes of two-dimensional figures.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **7.GM.1.1** Describe the properties of similarity, compare geometric figures for similarity, and determine scale factors.<br><br>**7.GM.1.2** Apply scale factors, length ratios and area ratios to determine side lengths and areas of similar geometric figures limited to triangles and rectangles.<br><br>**7.GM.1.3** Use proportions and ratios to solve problems involving scale drawings and conversions of measurement units. |

**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY98]:** How is similarity defined?

# Geometry and Measurement

**7.GM.2 Apply mathematical actions and processes to use reasoning with proportions and ratios to determine measurements, justify formulas, and solve real-world and mathematical problems involving circles and related geometric figures.**

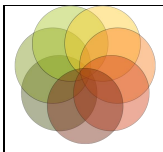
| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **7.GM.2.1** Demonstrate an understanding of the proportional relationship between the diameter and circumference of a circle and that the unit rate (constant of proportionality) is $\pi$ and can be approximated by rational numbers such as $\frac{22}{7}$ and 3.14.<br><br>**7.GM.2.2** Calculate the circumference and area of circles to solve problems in various contexts, as approximate values and in terms of $\pi$. |

**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY99]:** The last part of this is already in the Number and Operations standards.

**Comment [CY100]:** I feel like this could be restated as "in terms of π and using approximations for π."



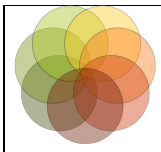
# Geometry and Measurement

**7.GM.3 Apply mathematical actions and processes to develop and understand the concept of surface area and volume of rectangular prisms.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **7.GM.3.1** Using a variety of tools and strategies, develop the concept that surface area of a rectangular prism can be found by wrapping the figure with same-sized square units without gaps or overlap. Use appropriate measurements such as $cm^2$.<br><br>**7.GM.3.2** Using a variety of tools and strategies, develop the concept that the volume of a rectangular prism ~~s~~ can be found by counting the total number of same-sized cubic units that fill ~~a~~ the shape without gaps or overlaps. Use appropriate measurements such as $cm^3$. |

**Sample Problems or Classroom Activities**

FORTHCOMING



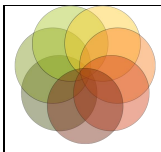
# Data and Probability

**7.D.1 Apply mathematical actions and processes to display and interpret data in a variety of ways, including circle graphs and histograms.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **7.D.1.1** Design simple experiments, collect data and calculate measures of central tendency (mean, median, and mode) and spread (range). Use these quantities to draw conclusions about the data collected and make predictions.<br><br>**7.D.1.2** Use reasoning with proportions to display and interpret data in circle graphs (pie charts) and histograms. Choose the appropriate data display and know how to create the display using a spreadsheet or other graphing technology. |

**Sample Problems or Classroom Activities**

FORTHCOMING



# Data and Probability

**7.D.2 Apply mathematical actions and processes to calculate probabilities and reason about probabilities using proportions to solve real-world and mathematical problems.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **7.D.2.1** Determine the theoretical probability of an event using the ratio between the size of the event and the size of the sample space; represent probabilities as percents, fractions and decimals between 0 and 1 inclusive. Understand that probabilities measure likelihood.<br><br>**7.D.2.2** Use proportional reasoning to draw conclusions about and predict relative frequencies of outcomes based on probabilities. |

**Sample Problems or Classroom Activities**

FORTHCOMING

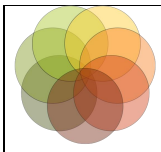
# Oklahoma Academic Standards for Mathematics
# Pre-Algebra

The Pre-Algebra standards prepare students for success in Algebra I. The Pre-Algebra standards are divided into four strands: Number and Operations, Algebraic Reasoning and Algebra, Geometry and Measurement, and Data and Probability. In Number and Operations, irrational numbers will be introduced. In Algebraic Reasoning and Algebra, students will use their computation skills with rational numbers to solve multi-step linear equations, extend solving to include two step linear inequalities, and begin working with functions. Students will recognize and interpret linear functions in real-world and mathematical situations and represent relations and functions in multiple ways including tables, graphs, and rules. In the Geometry and Measurement strand, students will apply the Pythagorean Theorem, as well as calculate the surface area and volume of rectangular prisms and right cylinders. In Data and Probability, students will explain effects of outliers on measures of central tendency, interpret data using scatterplots, and calculate experimental probabilities.

Problem solving has been integrated throughout the content strands. The development of problem solving skills should be a major goal of the mathematics program at every grade level. Experience with the process of problem solving will need to be integrated early and continuously into each student's mathematics education. Students must be helped to develop a wide range of skills and strategies for solving a variety of problem types.

While learning mathematics, students should be actively engaged, using concrete materials and appropriate technologies such as calculators and computers. However, facility in the use of technology should not be regarded as a substitute for a student's understanding of quantitative concepts and relationships or for proficiency and fluency with basic computations.

Mathematics has its own language, and the acquisition of specialized vocabulary and language patterns is crucial to a student's understanding, appreciation of, and disposition for the subject. Students should be encouraged to correctly use the concepts, skills, symbols, and vocabulary identified in the following set of standards.



# Algebraic Reasoning and Algebra

**PA.A.1 Apply mathematical actions and processes to understand the concept of function in real-world and mathematical situations, and distinguish between linear and nonlinear functions.**

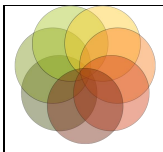
| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **PA.A.1.1** Recognize that a function is a relationship between an independent variable and a dependent variable in which the value of the independent variable determines the value of the dependent variable. Use functional notation, such as $f(x)$, to represent such relationships.<br><br>**PA.A.1.2** Use linear functions to represent relationships in which changing the input variable by some amount leads to a change in the output variable that is a product of a constant and that amount.<br><br>**PA.A.1.3** Identify a function as linear if it can be expressed in the form $f(x)=mx+b$ or if its graph is a straight line. |

**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY101]:** Appropriate to discuss range here? At least in an informal sense, "the possible/allowable inputs"

**Comment [CY102]:** This could probably be worded a little more clearly.



# Algebraic Reasoning and Algebra

**PA.A.2 Apply mathematical actions and processes to recognize linear functions in real-world and mathematical situations; represent linear functions and other functions with tables, verbal descriptions, symbols and graphs; solve problems involving these functions and explain results in the original context.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Solving Diverse Problems<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **PA.A.2.1** Represent linear functions with tables, verbal descriptions, symbols, equations and graphs; translate from one representation to another.<br><br>**PA.A.2.2** Identify, describe, and analyze linear relationships between two variables (e.g., as the value of x increases on a table, do the values of y increase or decrease or stay the same, identify a positive rate of change on a graph and compare it to a negative rate of change).<br><br>**PA.A.2.3** Identify graphical properties of linear functions including slopes and intercepts. Know that the slope equals the rate of change, and that the y-intercept is zero when the function represents a proportional relationship.<br><br>**PA.A.2.4** Predict the effect on the graph of a linear equation when the slope or y-intercept changes (e.g., make predictions from graphs, identify the slope or y-intercept in the equation y = mx + b and relate to a graph). Use appropriate tools to examine these effects. |

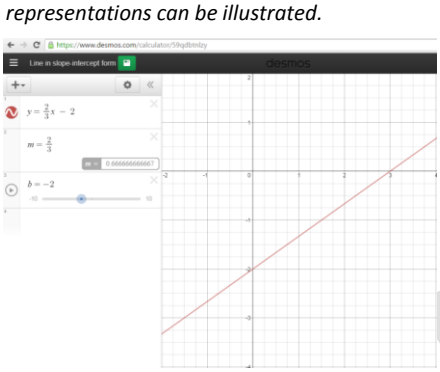
**Comment [CY103]:** Nice standard.

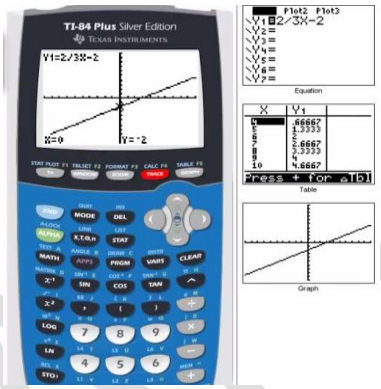
## Sample Problems or Classroom Activities

**Example for PA.A.2.4**

*One example solved in two ways – Desmos and graphing calculator.*

*Desmos:* $m = \frac{2}{3}$*; b = - 2; Teacher Note: students can drag the line to different locations to see the changes in slope and y-intercept; they can also change the values for m and/or b on the left for specific examples. Multiple representations can be illustrated.*





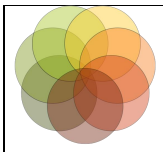




TI 84+: m = 2/3; b = - 2;

***Teacher Note:*** *students can change use graph of table to find the values for slope and/or y-intercept. They can also enter additional equations to see the effect on m and/or b.*

MORE FORTHCOMING



# Algebraic Reasoning and Algebra

**PA.A.3 Apply mathematical actions and processes to generate equivalent numerical and algebraic expressions and use algebraic properties to evaluate expressions.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Solving Diverse Problems<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **PA.A.3.1** Evaluate algebraic expressions using a variety of methods.<br><br>**PA.A.3.2** Justify steps in generating equivalent expressions by identifying the properties used, including the properties of operation and equality. Properties include the associative, commutative and distributive laws, and the order of operations, including grouping symbols. |

**Sample Problems or Classroom Activities**

FORTHCOMING

# Algebraic Reasoning and Algebra

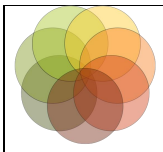
**PA.A.4 Apply mathematical actions and processes to represent real-world and mathematical problems using equations and inequalities involving linear expressions. Solve and graph equations and inequalities algebraically and graphically. Interpret solutions in the original context.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Solving Diverse Problems<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **PA.A.4.1** Model, write, and solve multi-step linear equations with one variable to solve mathematical and real-world problems. Interpret solutions in the original context.<br><br>**PA.A.4.2** Express linear equations in slope-intercept form. Graph and interpret linear equations on an x-y coordinate plane.<br><br>**PA.A.4.3** Model, write, and solve one- and two-step linear inequalities with one variable using the properties of inequality. Graph the solutions on a number line.<br><br>**PA.A.4.4** Represent real-world situations using equations and inequalities involving one variable. |

**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY104]:** Wonder if this should be **functions**, as $4 = 3x - 5$ is technically a linear equation.



# Number and Operations

**PA.N.1 Apply mathematical actions and processes to read, write, compare, classify and represent real numbers, and use them to solve problems in various contexts.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Solving Diverse Problems<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **PA.N.1.1** Develop and apply the properties of positive and negative integer exponents to generate equivalent numerical expressions, including $\mathbf{a}^0 = 1$, **a** not equal to zero.<br><br>**PA.N.1.2** Express approximations of very large and very small numbers using scientific notation; understand how scientific calculators display numbers in scientific notation. Multiply and divide numbers expressed in scientific notation, express the answer in scientific notation, using the correct number of significant digits when physical measurements are involved.<br><br>**PA.N.1.3** Classify real numbers as rational or irrational. Recognize that when a square root of a positive integer is not an integer, then it is irrational. Recognize that the sum of a rational number and an irrational number is irrational, and the product of a non-zero rational number and an irrational number is irrational.<br><br>**PA.N.1.4** Compare real numbers; locate real numbers on a number line. Identify the square root of a perfect square to 400 or, if it is not a perfect square root, locate it as a real number between two consecutive positive integers.<br><br>**PA.N.1.5** Express approximations of very large and very small numbers using scientific notation; understand how calculators display numbers in scientific notation. Multiply and divide numbers expressed in scientific notation, express the answer in scientific notation, using the correct number of significant digits when physical measurements are |

**Comment [CY105]:** Is this where students raise fractions to exponents? I don't believe I've seen it yet.

**Comment [CY106]:** Nice, though we should be aware that this really can be classified as a science standard. For example, a mathematician would divide $3.46 \times 10^5$ by $2.0 \times 10^4$ and not necessarily care about significant digits, just viewing it as an operation between two numbers. Sig digits come into play with estimation due to experimental error—this will need to be fleshed out; otherwise it is simply taught as a procedure.

**Comment [CY107]:** Is the definition of rational number one that can be written as $p/q$ for $p$ and $q$ integers ($q \neq 0$) or is it that they can be represented by terminating or repeating decimals?

**Comment [CY108]:** Is this only recognize, or is there reasoning and proving involved? Deep concepts.

| | |
|---|---|
| | involved. |
| **Sample Problems or Classroom Activities**<br><br>FORTHCOMING | |

Comment [CY109]: Repeated standard? Check PA.N.1.2

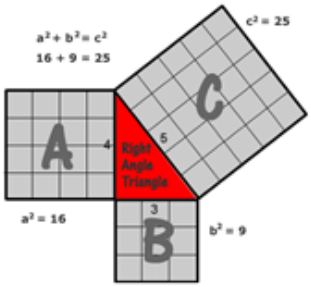
# Geometry and Measurement

**PA.GM.1 Apply mathematical actions and processes to solve problems involving right triangles using the Pythagorean Theorem.**

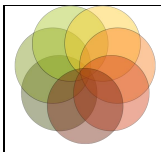
| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Solving Diverse Problems<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **PA.GM.1.1** Informally justify the Pythagorean Theorem using measurements, diagrams or dynamic software and use the Pythagorean Theorem to solve problems involving right triangles.<br><br>**PA.GM.1.2** Determine the distance between two points on a horizontal or vertical line in a coordinate system. Use the Pythagorean Theorem to find the distance between any two points in a coordinate system. |

**Sample Problems or Classroom Activities**

**Example for PA.GM.1.1**




MORE FORTHCOMING



# Geometry and Measurement

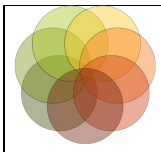
**PA.GM.2 Apply mathematical actions and processes to solve problems involving parallel and perpendicular lines on a coordinate system.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Solving Diverse Problems<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **PA.GM.2.1** Use the relationships between the slopes of parallel lines and between the slopes of perpendicular lines graphically and algebraically to determine whether sets of lines are parallel, perpendicular, or neither. Dynamic graphing software may be used to examine these relationships. |

**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY110]:** Is there justification of this relationship? Of the one for parallel lines?



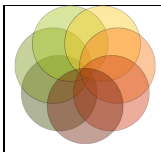
# Geometry and Measurement

**PA.GM.3 Apply mathematical actions and processes to calculate surface area and volume of three-dimensional figures.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Solving Diverse Problems<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **PA.GM.3.1** Calculate the surface area of a rectangular prism using decomposition or nets. Use appropriate measurements such as $cm^2$.<br><br>**PA.GM.3.2** Calculate the surface area of a cylinder, as approximate values and in terms of $\pi$, using decomposition or nets. Use appropriate measurements such as $cm^2$.<br><br>**PA.GM.3.3** Develop and use the formulas $V = \ell wh$ and $V = Bh$ to determine the volume of rectangular prisms. Justify why base area (B) and height (h) are multiplied to find the volume of a rectangular prism by breaking the prism into layers of rectangles. Use appropriate measurements such as $cm^3$.<br><br>**PA.GM.3.4** Develop and use the formulas $V = \pi r^2 h$ and $V = Bh$ to determine the volume of right cylinders, as approximate values and in terms of $\pi$. Justify why base area B and height h are multiplied to find the volume of a right cylinder by breaking the cylinder into layers of circles with radius (r). Use appropriate measurements such as $cm^3$. |

**Sample Problems or Classroom Activities**

FORTHCOMING



# Data and Probability

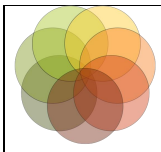
**PA.D.1 Apply mathematical actions and processes to display and interpret data in a variety of ways, including using scatterplots and approximate lines of best fit. Use lines of best fit to draw conclusions about data.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Solving Diverse Problems<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **PA.D.1.1** Describe the impact that inserting or deleting a data point has on the mean and the median of a data set. Know how to create data displays using a spreadsheet and use a calculator to examine this impact.<br><br>**PA.D.1.2** Explain how outliers affect measures of central tendency.<br><br>**PA.D.1.3** Collect, display and interpret data using scatterplots. Use the shape of the scatterplot to informally estimate a line of best fit and determine an equation for the line. Use appropriate titles, labels and units. Know how to use graphing technology to display scatterplots and corresponding lines of best fit.<br><br>**PA.D.1.4** Use a line of best fit to estimate rate of change and to make predictions about values not in the original data set and assess the reasonableness of predictions using scatterplots by interpreting them in the original context. |

**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY111]:** Fits well with linear functions emphasis of PA.



# Data and Probability

**PA.D.2 Apply mathematical actions and processes to calculate experimental probabilities and reason about probabilities to solve real-world and mathematical problems.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Solving Diverse Problems<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **PA.D.2.1** Calculate experimental probabilities and represent them as percents, fractions and decimals between 0 and 1 inclusive. Use experimental probabilities to make predictions when actual probabilities are unknown. |

**Sample Problems or Classroom Activities**

FORTHCOMING

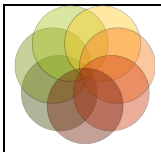
# Oklahoma Academic Standards for Mathematics
# Algebra I

The Algebra I standards are divided into four strands: Number and Operations, Algebra, Functions, and Data and Probability. The Algebra strand extends the foundation in linear relationships and proportionality from PreAlgebra to allow students to use linear equations and inequalities as well as systems of linear equations and inequalities to represent and solve mathematical and real world problems. Students will not only graph and interpret linear equations but also write linear equations and recognize linear and nonlinear graphs generated from arithmetic and geometric sequences. Work with expressions will be expanded to include absolute value, rational, radical, and polynomials. In the Function strand, students will distinguish between linear and nonlinear functions and evaluate linear and nonlinear functions. The Data and Probability strand's focus is applying counting procedures, using Venn diagrams, analyzing data with regression lines to make predications and interpreting graphs as discrete or continuous. Students will apply probability concepts to real world situations to make informed decisions. The Algebra I course should be taught in such a way as to help students transition from the concrete to the abstract and to make connections with practical applications to attach meaning to the abstract concepts of algebra.

Problem solving has been integrated throughout the content strands. The development of problem solving skills should be a major goal of the mathematics program at every grade level. Experience with the process of problem solving will need to be integrated early and continuously into each student's mathematics education. Students must be helped to develop a wide range of skills and strategies for solving a variety of problem types.

While learning mathematics, students should be actively engaged, using concrete materials and appropriate technologies such as calculators and computers. However, facility in the use of technology should not be regarded as a substitute for a student's understanding of quantitative concepts and relationships or for proficiency and fluency with basic computations.

Mathematics has its own language, and the acquisition of specialized vocabulary and language patterns is crucial to a student's understanding, appreciation of, and disposition for the subject. Students should be encouraged to correctly use the concepts, skills, symbols, and vocabulary identified in the following set of standards.



# Number and Operations

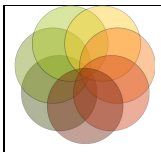
**A1.N.1 Apply mathematical actions and processes to extend the understanding of number and operations to include square roots and cubic roots.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **A1.N.1.1** Write square roots and cube roots of monomial algebraic expressions in simplest radical form.<br><br>**A1.N.1.2** Add, subtract, multiply, and simplify square roots of monomial algebraic expressions and divide square roots of whole numbers. |

**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY112]:** Do students learn rational exponents here?



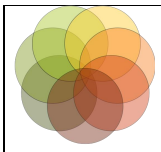
# Algebra

**A1.A.1 Apply mathematical actions and processes to represent and solve mathematical and real world problems using linear equations (including absolute value equations) and systems of equations; interpret solutions in the original context.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **A1.A.1.1** Use knowledge of solving multi-step equations to represent and solve mathematical and real-world problems (e.g., angle measures, geometric formulas, science, or statistics) and interpret the solutions in the original context.<br><br>**A1.A.1.2** Solve absolute value equations and interpret the solutions in the original context.<br><br>**A1.A.1.3** Solve systems of linear equations with a maximum of two variables by graphing (graphing calculator optional), substitution, and elimination and interpret the solutions in the original context. |

**Sample Problems or Classroom Activities**

FORTHCOMING



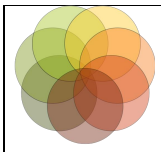
# Algebra

**A1.A.2 Apply mathematical actions and processes to represent and solve real-world and mathematical problems using linear inequalities (including compound inequalities); interpret solutions in the original context.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **A1.A.2.1** Represent relationships in various contexts with linear inequalities and solve the resulting inequalities, graph, and interpret the solutions on a coordinate plane.<br><br>**A1.A.2.2** Represent relationships in various contexts with compound and absolute value inequalities and solve the resulting inequalities, graph, and interpret the solutions on a number line.<br><br>**A1.A.2.3** Solve systems of linear inequalities with a maximum of two variables, graph, and interpret the solutions on a coordinate plane. |

**Sample Problems or Classroom Activities**

FORTHCOMING



# Algebra

**A1.A.3 Apply mathematical actions and processes to generate equivalent algebraic expressions and use algebraic properties to evaluate expressions and arithmetic and geometric sequences.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **A1.A.3.1** Solve literal equations involving several variables for one variable in terms of the others.<br><br>**A1.A.3.2** Simplify polynomial expressions by adding, subtracting, or multiplying.<br><br>**A1.A.3.3** Factor common monomial factors from polynomial expressions and factor quadratic expressions with a leading coefficient of 1.<br><br>**A1.A.3.4** Evaluate linear, absolute value, rational, and radical expressions. Include applying a nonstandard operation such as $a \odot b = 2a + 5$.<br><br>**A1.A.3.5** Recognize that arithmetic sequences are linear using equations, tables, graphs and verbal descriptions. Using the pattern, find the next term.<br><br>**A1.A.3.6** Recognize that geometric sequences are exponential using equations, tables, graphs and verbal descriptions. Given the formula $f(x) = a(r)^x$ ,find the next term. |

**Comment [CY113]:** Has "exponential" been defined yet? Is this the first course where exponential functions are studied?

**Sample Problems or Classroom Activities**

FORTHCOMING

# Algebra

**A1.A.4 Apply mathematical actions and processes to analyze mathematical change involving linear equations in in real world and mathematical problems.**

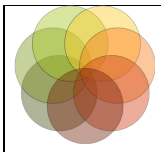
| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **A1.A.4.1** Calculate the slope of a line using a graph, an equation, two points, or a set of data points and interpret the slope and x- and y- intercepts in real world and mathematical problems.<br><br>**A1.A.4.2** Use the slope to differentiate between lines that are parallel, perpendicular, horizontal, or vertical.<br><br>**A1.A.4.3** Express linear equations in slope-intercept, point-slope, and standard forms and convert between these forms. Given sufficient information (slope and y-intercept, slope and one-point on the line, two points on the line, x-intercept and y-intercept, or a set of data points), write the equation of a line.<br><br>**A1.A.4.4** Relate a graph to a situation described qualitatively (e.g., faster change, slower change). |

**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY114]:** Students have worked with slope since 7th Grade, I think. But is this the first time they've really used these specific skills?

**Comment [CY115]:** I believe students have done this in in Pre-Algebra, standard **PA.GM.2.1?**



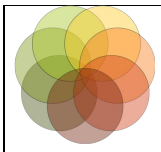
# Function

**A1.F.1 Apply mathematical actions and processes to understand functions as descriptions of covariation (how related quantities vary together) in real world and mathematical problems.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **A1.F.1.1** Distinguish between relations and functions using the vertical line test and the definition of a function.<br><br>**A1.F.1.2** Identify the dependent and independent variables as well as the domain and range given a function, equation, or graph. Identify restrictions on the domain and range in real world contexts.<br><br>**A1.F.1.3** Write linear functions in terms of real world context using function notation.<br><br>**A1.F.1.4** Given a graph modeling a real world situation, read and interpret the linear piecewise function (excluding step functions). |

**Sample Problems or Classroom Activities**

FORTHCOMING



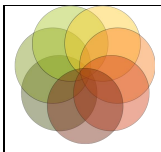
# Function

**A1.F.2 Apply mathematical actions and processes to understand that families of functions are characterized by the rate of change.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **A1.F.2.1** Distinguish between linear and nonlinear data (including exponential) through tables, graphs, equations, and real-world contexts.<br><br>**A1.F.2.2** Recognize the graphs of the functions $f(x) = x$ and $f(x) = \|x\|$ and predict the effects of transformations algebraically and graphically on the graphs using various methods and tools which may include graphing calculators. |

**Sample Problems or Classroom Activities**

FORTHCOMING



# Function

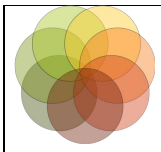
**A1.F.3 Apply mathematical actions and processes to represent functions can in multiple ways and use to interpret real world and mathematical problems.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **A1.F.3.1** Identify matching linear equations, graphs, tables, and real-world situations.<br><br>**A1.F.3.2** Use function notation and evaluate a function (including nonlinear) at a given point in its domain algebraically and graphically and interpret the results in terms of real world and mathematical problems.<br><br>**A1.F.3.3** Add, subtract, and multiply functions using function notation. |

**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY116]:** Does this mean students recognize the same function represented in different ways? I.e., they match an equation with a graph, etc? Wasn't exactly clear to me.



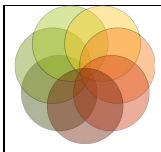
# Data and Probability

**A1.D.1 Apply mathematical actions and processes to display and analyze data.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **A1.D.1.1** Describe a data set using data displays, describe and compare data sets using summary statistics, including measures of central tendency, location, and spread. Measures of central tendency and location include mean, median, mode, and percentile. Measures of spread include standard deviation and range. Know how to use calculators, spreadsheets, or other appropriate technology to display data and calculate summary statistics.<br><br>**A1.D.1.2** Collect data and use scatterplots to analyze patterns and describe linear relationships between two variables. Using graphing technology, determine regression lines and correlation coefficients; use regression lines to make predictions and correlation coefficients to assess the reliability of those predictions.<br><br>**A1.D.1.3** Interpret graphs as being discrete or continuous. |

**Sample Problems or Classroom Activities**

FORTHCOMING



# Data and Probability

**A1.D.2 Apply mathematical actions and processes to calculate probabilities and apply probability concepts.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **A1.D.2.1** Select and apply counting procedures, such as the multiplication and addition principles and tree diagrams, to determine the size of a sample space (the number of possible outcomes) and to calculate probabilities.<br><br>**A1.D.2.2** Describe the concepts of intersections, unions, and complements using Venn diagrams to evaluate probabilities. Understand the relationships between these concepts and the words AND, OR, NOT.<br><br>**A1.D.2.3** Calculate experimental probabilities by performing simulations or experiments involving a probability model and using relative frequencies of outcomes.<br><br>**A1.D.2.4** Apply probability concepts to real-world situations to make informed decisions. |

**Sample Problems or Classroom Activities**

**Example for A1.D.2.2**

*Braums is testing out two new ice cream flavors, Pumpkin and Cotton Candy. A poll conducted by Braums showed that 32 customers liked Pumpkin, 58 customers liked Cotton Candy, 12 liked both flavors, and 22 liked neither flavor. What is the **probability** that one of those customers selected at random would like Cotton Candy?*

MORE FORTHCOMING

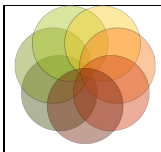
# Oklahoma Academic Standards for Mathematics
# Geometry

The Geometry course following Algebra I allows students to extend their knowledge of geometry through investigations of properties, lines, congruent and similar polygons, circles, three-dimensional objects, transformations, and right triangle trigonometry. This course emphasizes the use of logical reasoning skills in order to develop and justify mathematical arguments. Students apply the algebraic skills from Algebra I and spatial reasoning in order to solve real world and mathematical problems. Learning appropriate vocabulary is important to develop and apply ~~the~~ geometric concepts. In addition, the course emphasizes the use of appropriate units with problems involving measurements. Calculators, computers, graphing utilities, dynamic geometry software, and other appropriate technology tools can be used to assist in teaching and learning.

Problem solving has been integrated throughout the content strands. The development of problem solving skills should be a major goal of the mathematics program at every grade level. Experience with the process of problem solving will need to be integrated early and continuously into each student's mathematics education. Students must be helped to develop a wide range of skills and strategies for solving a variety of problem types.

While learning mathematics, students should be actively engaged, using concrete materials and appropriate technologies such as calculators and computers. However, facility in the use of technology should not be regarded as a substitute for a student's understanding of quantitative concepts and relationships or for proficiency and fluency with basic computations.

Mathematics has its own language, and the acquisition of specialized vocabulary and language patterns is crucial to a student's understanding, appreciation of, disposition for the subject. Students should be encouraged to correctly use the concepts, skills, symbols, and vocabulary identified in the following set of standards.



# Geometry (Reasoning and Logic)

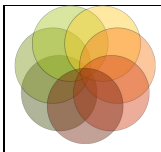
**G.RL.1 Apply mathematical actions and processes to use appropriate tools and logic to evaluate mathematical arguments.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **G.RL.1.1** Understand the roles of axioms, postulates, definitions, undefined terms and theorems in logical arguments.<br><br>**G.RL.1.2** Analyze and draw conclusions based on a set of conditions. Recognize the logical relationships between an "if…then" statement and its inverse, converse and contrapositive.<br><br>**G.RL.1.3** Assess the validity of a logical argument and give counterexamples to disprove a statement. |

**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY117]:** A little note here: this standard is different in the Vertical Alignment Chart. "Axioms" is missing.



# Geometry (Line, Angle and Polygon Relationships)

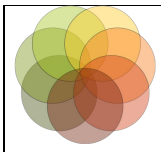
**G.2D.1 Apply mathematical actions and processes to discover, evaluate and analyze the relationships between lines, angles and polygons to solve real world and mathematical problems; express proofs in a form that clearly justifies the reasoning, such as two-column proofs, paragraph proofs, flow charts or illustrations.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **G.2D.1.1** Know and apply properties of parallel and perpendicular lines, including properties of angles formed by a transversal, to solve problems and determine if two lines are parallel, and logically justify results using algebraic and deductive proofs.<br><br>**G.2D.1.2** Know and apply properties of angles, including corresponding, exterior, interior, vertical, complementary and supplementary angles, to solve algebraic and geometric problems, discover unknowns, and logically justify results.<br><br>**G.2D.1.3** Apply theorems involving the interior and exterior angle sums of polygons and use them to solve real world and mathematical problems using algebraic reasoning and proofs.<br><br>**G.2D.1.4** Apply the properties of special quadrilaterals (square, rectangle, trapezoid, isosceles trapezoid, rhombus, kite, parallelogram) and use them to solve real world and mathematical problems involving angle measures and segment lengths using algebraic reasoning and proofs.<br><br>**G.2D.1.5** Use coordinate geometry to represent and analyze line segments and polygons, including determining lengths, midpoints, and slopes of line segments.<br><br>**G.2D.1.6** Apply the properties of polygons to solve real world and mathematical problems involving perimeter and area (e.g., triangles, special quadrilaterals, regular polygons – up to 12 sided |

| | |
|---|---|
| | figures, composite figures) and identify types of symmetry.<br><br>**G.2D.1.7** Apply the properties of congruent or similar polygons to solve real world and mathematical problems using algebraic and logical reasoning.<br><br>**G.2D.1.8** Construct logical arguments to prove triangle congruence (SSS, SAS, ASA, AAS and HL) and triangle similarity (AA~, SSS~, SAS~).<br><br>**G.2D.1.9** Use numeric, graphic and algebraic representations of transformations in two dimensions, such as reflections, translations, dilations, and rotations about the origin by multiples of 90˚, to solve problems involving figures on a coordinate plane. |
| **Sample Problems or Classroom Activities**<br><br>FORTHCOMING | |

**Comment [CY118]:** I am curious as to how "congruent" is defined, as typically in the past we have simply said "same size, same shape" or something similar to that, or else we have defined it as two shapes being able to be placed in a correspondence of sides and vertices such that corresponding parts are congruent, etc.

**Comment [CY119]:** The definition of congruence above dictates how such proofs go. E.g., for SSS, how would a student prove that knowing SSS congruent, he/she could argue that all corresponding angles would also be congruent? What is the expectation here?



# Geometry (3-Dimensional Shapes)

**G.3D.1 Apply mathematical actions and processes to solve real world and mathematical problems involving 3-dimensional figures.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **G.3D.1.1** Solve real world and mathematical problems using the surface area and volume of prisms, cylinders, pyramids, cones, spheres, and composites of these figures. Use nets, measuring devices, or formulas as appropriate<br><br>**G.3D.1.2** Use ratios of similar 3-dimensional figures to solve for unknown values such as angles, side lengths, perimeter or circumference of a face, area of a face, and volume.<br><br>**G.3D.1.3** Apply the fact that dilations can be conveyed by the effect of a scale factor k on length, area and volume, multiplied by k, $k^2$ and $k^3$, respectively. |

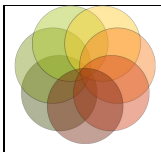
**Sample Problems or Classroom Activities**

FORTHCOMING



**Comment [CY120]:** I'm unsure what this is trying to say here. Is it stating that a dilation is a transformation that multiplies all lengths by a factor of *k*, or equivalently, all areas by $k^2$, etc.?

Or is it defining a dilation in terms of a scale factor *k*, and then noting the effects on lengths, areas, and volumes? I think some clarification is in order.



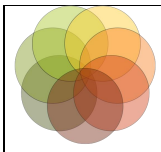
# Geometry (Circles)

**G.C.1 Apply mathematical actions and processes to solve real world and mathematical problems using the properties of circles.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **G.C.1.1** Apply the properties of circles to solve problems involving circumference and area, as approximate values and in terms of $\pi$, using algebraic and logical reasoning.<br><br>**G.C.1.2 A**pply the properties of circles and relationships among angles, arcs, and distances in a circle to solve problems using algebraic and logical reasoning.<br><br>**G.C.1.3** Recognize and write the radius *r*, center (h,k), and standard form of the equation of a circle $(x - h)^2 + (y - k)^2 = r^2$ with and without graphs.<br><br>**G.C.1.4** Apply the distance and midpoint formula, where appropriate, to develop the equation of a circle in standard form. |

**Sample Problems or Classroom Activities**

FORTHCOMING



# Geometry (Right Triangle Geometry)

**G.RT.1 Apply mathematical actions and processes to develop and verify mathematical relationships of right triangles and trigonometric ratios to solve real world and mathematical problems.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **G.RT1.1** Apply the distance formula and~~,~~ the Pythagorean Theorem~~,~~ and its converse to solve real world and mathematical problems, ~~as~~ with approximate and exact values, using algebraic and logical reasoning (include Pythagorean Triples).<br><br>**G.RT.1.2** Verify and apply properties of right triangles, including properties of 45-45-90 and 30-60-90 triangles, to solve problems using algebraic and logical reasoning.<br><br>**G.RT.1.3** Use the definition of the trigonometric functions to determine the sine, cosine and tangent ratio of an acute angle in a right triangle.<br><br>**G.RT.1.4** Apply the trigonometric functions as ratios (sine, cosine and tangent) to find side lengths in right triangles in real world and mathematical problems.<br><br>**G.RT.1.5** Apply inverse trigonometric functions to solve problems to find acute angle measures in right triangles in real world and mathematical problems. |

**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY121]:** This must include the use of technology then?

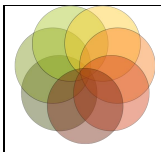
# Oklahoma Academic Standards for Mathematics
# Algebra II

The standards for Algebra II are divided into four strands: Number and Operations, Algebra, Functions, and Data and Probability. The Number and Operation strand extends the understanding of number and operations to include expressions with rational exponents, complex numbers, and matrices. The Algebra strand emphasizes the representation and solving of real world and mathematical situations using linear, quadratic, and exponential equations as well as systems of equations. The Function strand explores various functions including quadratic, exponential, logarithmic, rational, polynomial, and radical and introduces the role of ~~inverses~~inverse functions~~.~~ The Data and Probability strand's focus is the displaying and analysis of data including the application of the normal curve and linear and non-linear regression models. Graphing calculators, dynamic software, and other appropriate technology tools can be used to assist in teaching and learning.

Problem solving has been integrated throughout the content strands. The development of problem solving skills should be a major goal of the mathematics program at every grade level. Experience with the process of problem solving will need to be integrated early and continuously into each student's mathematics education. Students must be helped to develop a wide range of skills and strategies for solving a variety of problem types.

While learning mathematics, students should be actively engaged, using concrete materials and appropriate technologies such as calculators and computers. However, facility in the use of technology should not be regarded as a substitute for a student's understanding of quantitative concepts and relationships or for proficiency and fluency with basic computations.

Mathematics has its own language, and the acquisition of specialized vocabulary and language patterns is crucial to a student's understanding, appreciation of, and disposition for the subject. Students should be encouraged to correctly use the concepts, skills, symbols, and vocabulary identified in the following set of standards.



# Number and Operations

**A2.N.1 Apply mathematical actions and processes to extend the understanding of number and operations to include complex numbers, matrices and expressions written with rational exponents.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **A2.N.1.1** Find the value of $i^n$ for any whole number n.<br><br>**A2.N.1.2** Simply, add, subtract, multiply, and divide complex numbers.<br><br>**A2.N.1.3** Identify the order (dimension) of a matrix, add and subtract matrices of appropriate dimensions, and multiply a matrix by a scalar to create new matrices.<br><br>**A2.N.1.4** Add, subtract, multiply, divide and simplify radical expressions and expressions containing rational exponents. |

**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY122]:** I assume this is meant to be "simplify", not simply.

**Comment [CY123]:** Reading through the remainder of the A2 standards, I was left to wonder why this standard was included as it didn't seem to have a later application or purpose.

# Algebra

**A2.A.1 Apply mathematical actions and processes to represent, model and solve mathematical and real-world problems using nonlinear equations and systems of linear equations; interpret the solutions in the original context.**

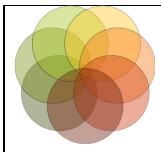
| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **A2.A.1.1** Represent and model real world or mathematical problems using quadratic equations and solve using various methods including graphing (including graphing calculator or other appropriate technology), factoring, completing the square, and the quadratic formula. Find complex roots when they exist.<br><br>**A2.A.1.2** Represent and model real world or mathematical problems using exponential equations, such as compound interest, depreciation, and population growth, and solve these equations graphically (including graphing calculator or other appropriate technology) or algebraically.<br><br>**A2.A.1.3** Solve rational equations with only one variable and limited to three or less denominators. Check for extraneous solutions.<br><br>**A2.A.1.4** Find and interpret the meaning of zeros of polynomials from a graphical perspective.<br><br>**A2.A.1.5** Solve radical equations (square root only) with one variable and only one radical on either one or both sides of the equal sign. Check for extraneous solutions.<br><br>**A2.A.1.6** Solve common and natural logarithmic equations using the properties of logs.<br><br>**A2.A.1.7** Use graphing calculators or other appropriate technology to explore and solve real world and mathematical problems that can be |

**Comment [CY124]:** I would prefer "Find non-real roots when appropriate."

**Comment [CY125]:** I assume $e^x$ is introduced here? How is $e$ introduced and defined?

| | |
|---|---|
| | modeled using arithmetic or finite geometric sequences or series given the nth terms and sum formulas.<br><br>**A2.A.1.8** Represent and model real world or mathematical problems using systems of linear equations with a maximum of three variables and solve using various methods, which may include substitution, elimination, and graphing (may include graphing calculators or other appropriate technology).<br><br>**A2.A.1.9** Solve systems of equations containing one linear equation and one quadratic equation using tools, which may include graphing calculators or other appropriate technology.<br><br>**A2.A.1.10** Assess the reasonableness of a solution in its given context and compare the solution to appropriate graphical or numerical estimates; interpret a solution in the context of the domain. |
| **Sample Problems or Classroom Activities**<br><br>FORTHCOMING | |

**Comment [CY126]:** This would possibly be a place to use matrices, but I don't believe that is the intention here?



# Algebra

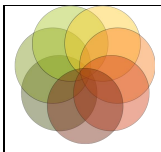
**A2.A.2 Apply mathematical actions and processes to represent and analyze mathematical situations and structures using algebraic symbols using various strategies to write equivalent forms of expressions.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **A2.A.2.1** Factor polynomial expressions including but not limited to trinomials, differences of squares, sum and difference of cubes, and factoring by grouping using a variety of tools and strategies.<br><br>**A2.A.2.2** Add, subtract, multiply, divide, and simplify polynomial and rational expressions.<br><br>**A2.A.2.3** Recognize that a quadratic equation has different equivalent representations ($f(x) = ax^2 + bx + c$, $f(x) = a(x-h)^2 + k$, or in factored form) and identify the representation that is most appropriate for the situation (solving or graphing) .<br><br>**A2.A.2.4** Rewrite expressions involving radicals and rational exponents using the properties of exponents. |

**Comment [CY127]:** Function?

**Sample Problems or Classroom Activities**

FORTHCOMING

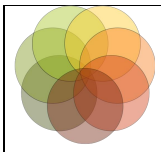


# Function

**A2.F.1 Apply mathematical actions and processes to understand functions as descriptions of covariation (how related quantities vary together).**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **A2.F.1.1** Use algebraic, interval, and set notations to specify the domain and range of functions of various types and evaluate a function at a given point in its domain.<br><br>**A2.F.1.2** Recognize the graphs of exponential, radical (square root and cube root only), quadratic, and logarithmic functions. Predict the effects of transformations algebraically and graphically on the graphs, using various methods and tools, which may include graphing calculators or other appropriate technology [e.g., f(x)+c, f(x+c), f(cx), and cf(x), where c is a positive or negative constant].<br><br>**A2.F.1.3** Graph a quadratic function. Identify the x- and y- intercepts, maximum or minimum value, axis of symmetry, and vertex using various methods and tools which may include a graphing calculator or appropriate technology.<br><br>**A2.F.1.4** Graph exponential and logarithmic functions. Identify asymptotes and x- and y-intercepts using various methods and tools which may include graphing calculators or other appropriate technology. Recognize exponential decay and growth graphically and algebraically.<br><br>**A2.F.1.5** Identify the domain, range, intercepts, zeros, relative maxima, relative minima, and intervals of increase and decrease given the graph of a polynomial function~~s~~.<br><br>**A2.F.1.6** Graph a rational function and identify the x- and y- intercepts and~~,~~ vertical and horizontal asymptotes, using various methods and tools which |

| | |
|---|---|
| | may include a graphing calculator or other appropriate technology. (Excluding slant asymptotes and holes.)<br><br>**A2.F.1.7** Graph a radical function (square root and cube root only) and identify the x- and y- intercepts using various methods and tools which may include a graphing calculator or other appropriate technology.<br><br>**A2.F.1.8** Graph piecewise functions with no more than three branches. Given a graph, analyze piecewise functions. |
| **Sample Problems or Classroom Activities**<br><br>FORTHCOMING | |



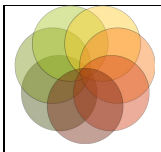
# Function

**A2.F.2 Apply mathematical actions and processes to understand functions can be combined algebraically and by composition and in some cases will have an inverse.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **A2.F.2.1** Add, subtract, multiply, and divide functions using function notation and recognize domain restrictions.<br><br>**A2.F.2.2** Combine functions by composition and recognize that $f(x)$ and $g(x)$ are inverse functions if $f(g(x))=g(f(x))=x$.<br><br>**A2.F.2.3** Find and graph the inverse of a function, if it exists, and know the graphs are reflected in the line $y=x$.<br><br>**A2.F.2.4** Apply the inverse relationship between exponential and logarithmic functions to convert from one form to another. |

**Sample Problems or Classroom Activities**

FORTHCOMING



# Data and Probability

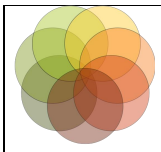
**A2.D.1 Apply mathematical actions and processes to display and analyze data.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **A2.D.1.1** Use the mean and standard deviation of a data set to fit it to a normal distribution (bell-shaped curve) and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate.<br><br>**A2.D.1.2** Collect data and use scatterplots to analyze patterns and describe linear, exponential or quadratic relationships between two variables. Using graphing calculators or other appropriate technology, determine regression equation and correlation coefficients; use regression equations to make predictions and correlation coefficients to assess the reliability of those predictions.<br><br>**A2.D.1.3** Based upon the real world context, recognize whether a discrete or continuous graphical representation is appropriate and then create the graph. |

**Sample Problems or Classroom Activities**

FORTHCOMING

**Comment [CY128]:** Somewhat concerning here is that the foundation for understanding how the area under the standard normal distribution tells you population percentages may not have been fully developed, so it will need to be developed here. It appears that the last time a histogram (probably the easiest entry-point) has been explicitly mentioned is in 7th Grade



# Data and Probability

**A2.D.2 Apply mathematical actions and processes to analyze statistical thinking to draw inferences, make predictions, and justify conclusions.**

| Mathematical Actions and Processes | Mathematical Benchmark |
|---|---|
| Develop a Deep and Flexible Conceptual Understanding<br>Develop Accurate and Appropriate Procedural Fluency<br>Develop Strategies for Problem Solving<br>Develop Mathematical Reasoning<br>Develop a Productive Mathematical Disposition<br>Develop the Ability to Make Conjectures, Model, and Generalize<br>Develop the Ability to Communicate Mathematically | **A2.D.2.1** Evaluate reports based on data published in the media by identifying the source of the data, the design of the study, and the way the data are analyzed and displayed. Given spreadsheets, tables, or graphs, recognize and analyze distortions in data displays. Show how graphs and data can be distorted to support different points of view.<br><br>**A2.D.2.2** Identify and explain misleading uses of data. Recognize when arguments based on data confuse correlation and causation. |

**Sample Problems or Classroom Activities**



FORTHCOMING

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# Appendix A

# Mathematical Actions and Processes Expanded

FORTHCOMING

# Appendix B

## Support Materials and Resources

FORTHCOMING

# Appendix C – Vertical Alignment Charts

| Number and Operation (N) | | |
|---|---|---|
| **Pre-K** | **Kindergarten** | **First** |
| **PK.N.1 Apply mathematical actions and processes to know number names and count in sequence.**<br>**PK.N.1.1** Count aloud in sequence to 20.<br>**PK.N.1.2** Recognize and name written numerals 0-9.<br>**PK.N.1.3** Recognize that zero represents the count of no objects.<br><br>**PK.N.2 Apply mathematical actions and processes to counting to tell the number of objects.**<br>**PK.N.2.1** Identify the number of objects, up to 10, in a horizontal row or column.<br>**PK.N.2.2** Use one-to-one correspondence in counting objects and matching groups of objects.<br>**PK.N.2.3** Understand the last numeral spoken, when counting aloud, tells how many total objects are in a set.<br>**PK.N.2.4** Count up to 5 items in a scattered configuration; not in a horizontal row or column.<br><br>**PK.N.3 Apply mathematical actions and processes to compare numbers.**<br>**PK.N.3.1** Compare two sets of 1-5 objects using comparative language such as “same,” “more,” or “fewer”. | **K.N.1 Apply mathematical actions and processes to understand the relationship between quantities and whole numbers.**<br>**K.N.1.1** Count aloud in sequence to 100.<br>**K.N.1.2** Recognize that a number can be used to represent how many objects are in a set up to 10.<br>**K.N.1.3** Use ordinal numbers to represent the position of an object in a sequence up to 10.<br>**K.N.1.4** Recognize without counting (subitizing*) the quantity of a small group of objects in organized and random arrangements up to 10 (e.g. dot patterns).<br>**K.N.1.5** Count forward, with and without objects, from any given number up to 10.<br>**K.N.1.6** Read, write and represent whole numbers from 0 to at least 10. Representations may include numerals, pictures, real objects and picture graphs, spoken words, and manipulatives.<br>**K.N.1.7** Find a number that is 1 more or 1 less than a given number up to 10.<br>**K.N.1.8** Compare and order whole numbers, with and without objects, from 0 to 10 (e.g., more than, less than, equal to).<br><br>*Subitizing is defined as instantly recognizing the quantity of a set without having to count. “Subitizing” is not a vocabulary word, not for student discussion at this age. | **1.N.1 Apply mathematical actions and processes to count, compare and represent whole numbers up to 100, with an emphasis on groups of tens and ones.**<br>**1.N.1.1** Recognize numbers to 20 without counting (subitizing*) the quantity of structured arrangements (e.g. ten frames, arrays, dot patterns).<br>**1.N.1.2** Use concrete models to describe whole numbers between 10 and 100 in terms of tens and ones.<br>**1.N.1.3** Read, write and represent whole numbers up to 100. Representations may include numerals, addition and subtraction, pictures, tally marks, number lines and manipulatives, such as bundles of sticks and base 10 blocks.<br>**1.N.1.4** Count forward, with and without objects, from any given number up to 100 by 1s, 2s, 5s and/or 10s.<br>**1.N.1.5** Find a number that is 10 more or 10 less than a given number.<br>**1.N.1.6** Compare and order whole numbers up to 100.<br>**1.N.1.7** Create and use knowledge of number relationships to locate the position of a given whole number on an open number line up to 20.<br>**1.N.1.8** Use objects to model and use words to describe the relative size of numbers, such as more than, less than, and equal to. Explore |

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| | **K.N.2 Apply mathematical actions and processes to understand the relationship between whole numbers and fractions through fair share.**<br>**K.N.2.1** Distribute equally a set of objects into at least two smaller equal sets.<br><br>**K.N.3 Apply mathematical actions and processes to identify coins in order to recognize the need for monetary transactions.**<br>**K.N.3.1** Identify U.S. coins by name, including pennies, nickels, dimes, and quarters. | equivalence through the use of balance scales.<br><br>*Subitizing is defined as instantly recognizing the quantity of a set without having to count. "subitizing" is not a vocabulary word, not for student discussion at this age.<br><br>**1.N.2 Apply mathematical actions and processes to solve addition and subtraction problems up to 20 in real-world and mathematical contexts.**<br>**1.N.2.1** Model and explain strategies used to solve addition and subtraction problems up to 20 using a variety of strategies (e.g. spoken words, objects, pictorial models, number lines, number sentences, compose and decompose numbers, making 10, doubles plus one, part part- whole).<br>**1.N.2.2** Apply basic fact strategies to add and subtract within 20 (e.g., making ten, decomposing a number leading to a ten, doubles plus one).<br>**1.N.2.3** Determine if equations involving addition and subtraction are true.<br>**1.N.2.4** Demonstrate fluency with basic addition facts and related subtraction facts up to 20.<br><br>**1.N.3 Apply mathematical actions and processes to explore the foundational ideas of fractions.**<br>**1.N.3.1** Partition a regular polygon using physical models into equal pieces (e.g., halves, thirds, fourths).<br><br>**1.N.4 Apply mathematical actions and processes to identify coins, their values, and the relationships among them in order to recognize the need for monetary transactions.**<br>**1.N.4.1** Identify U.S. coins, including pennies, nickels, dimes, and quarters, and their value.<br>**1.N.4.2** Write a number with the cent symbol to |

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| | | describe the value of a coin.<br>**1.N.4.3** Use relationships to count by ones, fives, and tens to determine the value of a collection of pennies, nickels, and/or dimes. |
| **Algebra Reasoning and Algebra (A)** | | |
| **Pre-K** | **Kindergarten** | **First** |
| **PK.A.1 Apply mathematical actions and processes to recognize, create, and extend patterns.**<br>**PK.A.1.1** Sort and group up to 5 objects into a set and explain verbally what the objects have in common (e.g., color, size, shape).<br>**PK.A.1.2** Recognize, duplicate, extend, and create repeating patterns in various formats (e.g., manipulatives, sound, movement). | **K.A.1 Apply mathematical actions and processes to recognize, create, complete, and extend patterns.**<br>**K.A.1.1** Sort and group up to 10 objects into a set and explain verbally what the objects have in common (e.g., color, size, shape).<br>**K.A.1.2** Recognize, create, complete, and extend repeating, shrinking and growing patterns using shape, color, size, quantity, sounds and movements.<br><br>**K.A.2 Apply mathematical actions and processes standards to use objects and pictures to develop fluency with addition and subtraction (up to 10) to represent and solve real-world and mathematical problems.**<br>**K.A.2.1** Compose and decompose numbers up to 10 with objects and pictures to develop the concept of fluidity of numbers and lay the foundation for addition and subtraction (e.g., making ten, number bonds). | **1.A.1 Apply mathematical actions and processes to identify, create, complete, and extend patterns.**<br>**1.A.1.1** Recognize and create repeating, shrinking and growing patterns with objects, numbers, or geometric shapes in a variety of contexts (e.g., addition charts, skip counting, calendars, hundreds charts, number lines, real world situations such as art and architecture).<br><br>**1.A.2 Apply mathematical actions and processes standards to use number sentences to develop fluency with addition and subtraction (up to 20) to represent and solve real-world and mathematical problems; create real-world situations corresponding to number sentences.**<br>**1.A.2.1** Represent and create real-world situations involving basic addition and subtraction, using objects and number sentences. (e.g., making ten, compatible numbers, number bonds). |
| **Geometry and Measurement (GM)** | | |
| **Pre-K** | **Kindergarten** | **First** |
| **PK.GM.1 Apply mathematical actions and processes to analyze common shapes.**<br>**PK.GM.1.1** Identify common shapes by pointing to the shape when given the name (e.g., circle, square, rectangle and triangle).<br><br>**PK.GM.2 Apply mathematical actions and** | **K.GM.1 Apply mathematical actions and processes to recognize and sort basic two- and three -dimensional shapes; use them to model real-world objects.**<br>**K.GM.1.1** Recognize basic two- and three-dimensional shapes such as squares, circles, triangles, rectangles, trapezoids, hexagons, cubes, | **1.GM.1 Apply mathematical actions and processes standards to analyze attributes of two- and three -dimensional shapes to create new shapes.**<br>**1.GM.1.1** Use smaller shapes to form a larger shape (compose) two- dimensional shapes such as triangles, squares, rectangles, and circles, and |

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| **processes to describe and compare measureable attributes.**<br>**PK.GM.2.1** Identify measurable attributes of objects. Describe them using age appropriate vocabulary (e.g., little, big, long, short, tall, heavy, and light).<br>**PK.GM.2.2** Directly compare two objects with a common measurable attribute using words such as longer/ shorter (horizontal); heavier/ lighter; or taller/ shorter (vertical).<br>**PK.GM.2.3** Sort objects into sets by one or more attributes. | cones, cylinders and spheres.<br>**K.GM.1.2** Identify attributes of two-dimensional shapes using informal and formal geometric language interchangeably (e.g., a square has 4 corners).<br>**K.GM.1.3** Use smaller shapes to form a larger shape when there is an outline to follow (e.g., create a larger square using 4 small squares).<br><br>**K.GM.2 Apply mathematical actions and processes to compare and order objects according to location and measurable attributes.**<br>**K.GM.2.1** Use words to compare objects according to length, size, weight and position.<br>**K.GM.2.2** Order up to 6 objects using measurable attributes, such as length and weight.<br>**K.GM.2.3** Sort objects into sets by more than one attribute.<br><br>**K.GM.3 Apply mathematical actions and processes to tell time.**<br>**K.GM.3.1** Develop an awareness of simple time concepts within his/her daily life (e.g. yesterday, today, tomorrow; morning, afternoon, night). | three-dimensional shapes such as rectangular prisms and cylinders.<br><br>**1.GM.2 Apply mathematical actions and processes to select and use units to describe length.**<br>**1.GM.2.1** Use nonstandard and standard measuring tools to measure the length of objects to reinforce the continuous nature of linear measurement.<br>Clarification: According to Clements and Sarama learning trajectories 6 year olds start end-to-end measurement.<br>**1.GM.2.2** Illustrate that the length of an object is the number of same-size units of length that, when laid end-to-end with no gaps or overlaps, reach from one end of the object to the other.<br>**1.GM.2.3** Measure the same object/distance with units of two different lengths and describe how and why the measurements differ.<br>**1.GM.2.4** Describe a length to the nearest whole unit using a number and a unit (e.g., foot, inch, centimeter).<br><br>**1.GM.3 Apply mathematical actions and processes to tell time.**<br>**1.GM.3.1** Tell time to the hour and half-hour (analog and digital). |
| **Data and Probability (DP)** | | |
| **Pre-K** | **Kindergarten** | **First** |
| **PK.D.1 Apply mathematical actions and processes to collect and organize data.**<br>**PK.D.1.1** Collect and organize information about objects and events in the environment. | **K.D.1 Apply mathematical actions and processes to collect and organize data to make it useful for interpreting information.**<br>**K.D.1.1** Collect and analyze information about objects and events in the environment.<br>**K.D.1.2** Use data to create real-object, picture | **1.D.1 Apply mathematical actions and processes to organize data to make it useful for interpreting information and solving problems.**<br>**1.D.1.1** Collect, sort, and organize data in up to three categories using models/representations (e.g., tally marks, tables). |

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| | graphs, and Venn diagrams.<br>**K.D.1.3** Draw conclusions from real-object and picture graphs. | **1.D.1.2** Use data to create picture and bar-type graphs, to demonstrate one to one correspondence.<br>**1.D.1.3** Draw conclusions from picture and bar-type graphs. |
| **Number and Operations (N)** | | |
| **Second** | **Third** | **Fourth** |
| **2.N.1 Apply mathematical actions and processes to compare and represent whole numbers up to 1000 with an emphasis on place value and equality.**<br>**2.N.1.1** Read, write, discuss, and represent whole numbers up to 1000. Representations may include numerals, words, pictures, tally marks, number lines and manipulatives.<br>**2.N.1.2** Create and use knowledge of number relationships to locate the position of a given whole number on an open number line up to 100.<br>**2.N.1.3** Use place value to describe whole numbers between 10 and 1000 in terms of hundreds, tens and ones. Know that 100 is 10 tens, and 1000 is 10 hundreds.<br>**2.N.1.4** Find 10 more or 10 less than a given three-digit number. Find 100 more or 100 less than a given three-digit number.<br>**2.N.1.5** Recognize when to round numbers to the nearest 10 and 100.<br>Clarification statement: Emphasis on understanding why and how to round vs. memorizing a rule.<br>**2.N.1.6** Use place value to compare and order whole numbers up to 1000 using comparative language, numbers, and symbols (e.g., 425 > 276, 73 < 107, page 351 comes after 350, 753 is between 700 and 800). | **3.N.1 Apply mathematical actions and processes to compare and represent whole numbers up to 10,000 with an emphasis on place value and equality.**<br>**3.N.1.1** Read, write, discuss, and represent whole numbers up to 10,000. Representations may include numerals, expressions with operations, words, pictures, number lines, and manipulatives.<br>**3.N.1.2** Use place value to describe whole numbers between 1000 and 10,000 in terms of ten thousands, thousands, hundreds, tens and one, including expanded form.<br>**3.N.1.3** Find 1,000 more or 1,000 less than a given four- or five-digit number. Find 100 more or 100 less than a given four- or five-digit number.<br>**3.N.1.4** Recognize when to round numbers to the nearest 10,000, 1000, 100 and 10 and/or use compatible numbers to estimate sums and differences.<br>Clarification statement: Emphasis on understanding why and how to round vs. memorizing a rule.<br>**3.N.1.5** Use place value to compare and order whole numbers up to 10,000, using comparative language, numbers, and symbols (e.g. 15,023 < 25,156; 2345 is between 2000 and 3000).<br><br>**3.N.2 Apply mathematical actions and processes to add and subtract multi-digit whole numbers;** | **4.N.1 Apply mathematical actions and processes to multiply multi-digit numbers and solve real-world and mathematical problems using arithmetic.**<br>**4.N.1.1** Demonstrate fluency with multiplication and division facts up to 12 x 12.<br>**4.N.1.2** Use an understanding of place value to multiply or divide a number by 10, 100 and 1000.<br>**4.N.1.3** Multiply 3-digit by 1-digit or a 2-digit by 2-digit whole numbers, using efficient and generalizable procedures and strategies, based on knowledge of place value, including but not limited to standard algorithms.<br>**4.N.1.4** Estimate products of 3-digit by 1-digit or a 2-digit by 2-digit whole numbers by using rounding, benchmarks and place value to assess the reasonableness of results. Explore larger numbers using technology to investigate patterns.<br>**4.N.1.5** Solve multi-step real world and mathematical problems requiring the use of addition, subtraction and multiplication of multi-digit whole numbers. Use various strategies, including the relationship between operations, the use of appropriate technology, and the context of the problem to assess the reasonableness of results.<br>**4.N.1.6** Use strategies and algorithms based on knowledge of place value, equality and properties of operations to divide 3-digit dividend by 1-digit |

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| **2.N.2 Apply mathematical actions and processes to add and subtract one- and two-digit numbers in real-world and mathematical problems.**<br>**2.N.2.1** Use the relationship between addition and subtraction to generate basic facts (e.g., making tens, fact families, doubles plus or minus one, counting on, counting back, commutative and associative properties).<br>**2.N.2.2** Demonstrate fluency with basic addition facts and related subtraction facts up to 20.<br>**2.N.2.3** Use strategies to estimate sums and differences up to 100 [e.g., compose, decompose and regroup numbers, use knowledge of 10 to estimate quantities and sums (two numbers less than 10 cannot add up to more than 20)].<br>**2.N.2.4** Use strategies and algorithms based on knowledge of place value and equality to add and subtract two-digit numbers (e.g., mental strategies, standard algorithm, decomposition, expanded notation, partial sums and differences).<br>**2.N.2.5** Solve real-world and mathematical addition and subtraction problems involving whole numbers up to 2 digits.<br>**2.N.2.6** Use concrete models and structured arrangements, such as repeated addition, arrays and ten frames to develop understanding of multiplication.<br><br>**2.N.3 Apply mathematical actions and processes to explore the foundational ideas of fractions**.<br>**2.N.3.1** Identify the parts of a set and/or area that represent fractions for halves, thirds and fourths.<br>**2.N.3.2** Construct equal sized portions through fair sharing including length and set area models for halves, thirds, and fourths. | **represent multiplication and division in various ways; solve real-world and mathematical problems.**<br>**3.N.2.1** Represent multiplication facts by using a variety of approaches, such as repeated addition, equal-sized groups, arrays, area models, equal jumps on a number line and skip counting.<br>**3.N.2.2** Demonstrate fluency in addition, subtraction, and multiplication (10 x 10) facts up to 100.<br>**3.N.2.3** Use strategies and algorithms based on knowledge of place value and equality to add and subtract multi-digit numbers(e.g., mental strategies, standard algorithm, decomposition, expanded notation, partial sums and differences).<br>**3.N.2.4** Use addition and subtraction to solve real-world and mathematical problems involving whole numbers. Use various strategies, including the relationship between addition and subtraction, the use of technology, and the context of the problem to assess the reasonableness of results.<br>**3.N.2.5** Represent division facts by using a variety of approaches, such as repeated subtraction, equal sharing and forming equal groups.<br>**3.N.2.6** Recognize the relationship between multiplication and division to model and solve real world problems (e.g. partitioning, missing factors, arrays).<br>**3.N.2.7** Use strategies and algorithms based on knowledge of place value, equality and properties of addition and multiplication to multiply a two-digit number by a one-digit number (e.g., mental strategies, partial products, standard algorithm, and commutative, associative, and distributive properties).<br><br>**3.N.3. Apply mathematical actions and processes** | whole number divisors. (e.g., mental strategies, standard algorithms, partial quotients, the commutative, associative, and distributive properties and repeated subtraction).<br><br>**4.N.2 Apply mathematical actions and processes to represent and compare fractions and decimals in real-world and mathematical situations; use place value to understand how decimals represent quantities.**<br>**4.N.2.1** Represent equivalent fractions using fraction models (e.g. parts of a set, fraction circles, fraction strips, number lines and other manipulatives).<br>**4.N.2.2** Use benchmark fractions (0, ¼, 1/3, ½, 2/3, ¾, 1) to locate additional fractions on a number line. Use models to order and compare whole numbers and fractions less than and greater than one.<br>**4.N.2.3** Decompose a fraction in more than one way into a sum of fractions with the same denominator using concrete and pictorial models and recording results with symbolic representations (e.g. 3/4 = 1/4 + 1/4 + 1/4).<br>**4.N.2.4** Use fraction models to add and subtract fractions with like denominators in real world and mathematical situations.<br>**4.N.2.5** Represent tenths and hundredths with concrete models, making connections between fractions and decimals.<br>**4.N.2.6** Model, read and write decimals up to at least the hundredths place in a variety of context including money.<br>**4.N.2.7** Compare and order decimals and whole numbers using place value, a number line and models such as grids and base 10 blocks.<br>**4.N.2.8** Rename and compare benchmark fractions |

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| **2.N.4 Apply mathematical actions and processes to determine the value of coins in order to solve monetary transactions.**<br>**2.N.4.1** Determine the value of a collection(s) of coins up to one dollar (e.g., given 2 dimes and 1 quarter, recognize you have 45¢; person 1 has 15¢ and person 2 has 25¢, together they have 40¢). Limited to: whole numbers.<br>**2.N.4.2** Select a combination of coins to represent a given amount of money up to one dollar. | **to understand meanings and uses of fractions in real-world and mathematical situations.**<br>**3.N.3.1** Read and write fractions with words and symbols.<br>**3.N.3.2** Construct fractions using set, area and length models.<br>**3.N.3.3** Order and compare, including unit fractions and equivalent fractions with like denominators by using models, reasoning about their size and an understanding of the concept of numerator and denominator.<br><br>**3.N.4 Apply mathematical actions and processes to determine the value of coins in order to solve monetary transactions.**<br>**3.N.4.1** Use addition to determine the value of a collection of coins or bills up to $20. (e.g. 45¢ + 30¢= 75¢, $11 + $9=$20 ). Limited to: whole numbers<br>**3.N.4.2** Select the fewest amount of coins for a given amount of money up to one dollar. | (1/4, 1/3, ½, 2/3, ¾) and decimals (0.25, 0.50, 0.75) in real-world and mathematical situations; use place value to understand how decimals represent quantities, including money (e.g. half of a dollar is $0.50; ¼ is the same as 0.25).<br><br>**4.N.3 Apply mathematical actions and processes to determine the value of coins in order to solve monetary transactions.**<br>4.N.3.1 Given a total cost (whole dollars and/or decimal) and amount paid (whole dollars and/or decimal), find the change required in a variety of ways. |
| **Algebraic Reasoning and Algebra (A)** | | |
| **Second** | **Third** | **Fourth** |
| **2.A.1 Apply mathematical actions and processes to identify, create, describe, extend and use patterns and rules to solve real-world and mathematical problems.**<br>**2.A.1.1** Create, describe, complete, and extend repeating, growing, and shrinking patterns involving numbers in a variety of contexts (e.g., repeated addition or subtraction, skip counting, arrays of objects).<br>**2.A.1.2** Recognize and describe repeating patterns involving geometric shapes in a variety of contexts. | **3.A.1 Apply mathematical actions and processes to use single-operation input-output rules to represent patterns and relationships and to solve real-world and mathematical problems.**<br>**3.A.1.1** Create, describe, and extend patterns involving addition, subtraction or multiplication to solve problems in a variety of contexts (e.g., skip counting, arrays of objects, function machine, hundreds chart).<br>**3.A.1.2** Describe the rule (single operation) for a pattern from an input/output table or function machine involving addition, subtraction or multiplication. | **4.A.1 Apply mathematical actions and processes to use single-operation input-output rules, tables and charts to represent patterns and relationships and to solve real-world and mathematical problems.**<br>**4.A.1.1** Create, describe, and extend a wide variety of patterns involving numbers, using tables, charts and/or rules (e.g., determine the rule from a table or "function machine", extend number patterns). Record the inputs and outputs in a chart or table.<br>**4.A.1.2** Describe the rule for a pattern from a input/output table or function machine involving addition, subtraction, multiplication, or division. |

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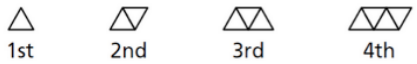
| **2.A.2 Apply mathematical actions and processes to use number sentences involving addition, subtraction and unknowns to represent and solve real-world and mathematical problems; create real-world situations corresponding to number sentences.**<br>**2.A.2.1** Use objects and number lines and create real-world situations to represent number sentences.<br>**2.A.2.2** Use number sense and properties (commutative and identity) of addition and subtraction to find values for the unknowns that make the number sentences true. (Introduction to properties, but not mastery of vocabulary). | **3.A.1.3** Construct and explore models of growing patterns and construct the next steps.<br>  <br><br>**3.A.2 Apply mathematical actions and processes to use number sentences involving multiplication and unknowns to represent and solve real-world and mathematical problems; create real-world situations corresponding to number sentences.**<br>**3.A.2.1** Find unknowns represented by symbols in arithmetic problems by solving open sentences (equations) and other problems involving addition, subtraction, and multiplication. Create real-world situations to represent number sentences.<br>**3.A.2.2** Recognize, represent and apply the number properties (commutative and identity properties of addition and multiplication) using models and manipulatives. (Introduction to properties, but not mastery of vocabulary). | **4.A.1.3** Create, describe, and extend a wide variety of patterns involving geometric shapes and define the rule of the pattern.<br><br>**4.A.2 Apply mathematical actions and processes to use multiplication and division with unknowns to create number sentences representing a given problem situation using a number sentence.**<br>**4.A.2.1** Use number sense, properties of multiplication (commutative, identity, and associative) and the relationship between multiplication and division to find values for the unknowns represented by letters and symbols that make number sentences true. (Introduction to properties, but not mastery of vocabulary).<br>**4.A.2.2** Solve for unknowns in one-step problems by solving open sentences (equations) and other problems involving addition, subtraction, multiplication, or division with whole numbers. Use real-world situations to represent number sentences. |
| **Geometry and Measurement (GM)** | | |
| **Second** | **Third** | **Fourth** |
| **2.GM.1 Apply mathematical actions and processes standards to analyze attributes of two- and three-dimensional figures develop generalizations about their properties.**<br>**2.GM.1.1** Describe, compare, and classify two- and three-dimensional figures according to their geometric attributes including developing appropriate vocabulary for faces, and the number of sides, edges and vertices.<br>**2.GM.1.2** Identify and name basic two- and three-dimensional shapes, such as squares, circles, triangles, rectangles, trapezoids, hexagons, cubes, rectangular prisms, cones, cylinders and spheres | **3.GM.1 Apply mathematical actions and processes to use geometric attributes to describe and create shapes in various contexts.**<br>**3.GM.1.1** Identify points, lines, line segments, rays, angles, endpoints, and parallel and perpendicular lines in various contexts and use them (parallel and perpendicular) to describe and create shapes such as right triangles, rectangles, parallelograms, and trapezoids.<br><br>**3.GM.2 Apply mathematical actions and processes to understand perimeter as a measurable attribute of real-world and** | **4.GM.1 Apply mathematical actions and processes to name, describe, classify and construct polygons.**<br>**4.GM.1.1** Describe, classify and construct triangles, including equilateral, right, scalene, and isosceles triangles. Recognize triangles in various contexts.<br>**4.GM.1.2** Describe, classify and construct quadrilaterals, including squares, rectangles, trapezoids, rhombuses, parallelograms and kites. Recognize quadrilaterals in various contexts.<br><br>**4.GM.2 Apply mathematical actions and** |

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| (architecture, technology, art).<br><br>**2.GM.2 Apply mathematical actions and processes to understand length as a measurable attribute; use tools to measure length.**<br>**2.GM.2.1** Explain the relationship between the size of the unit of measurement and the number of units needed to measure the length of an object.<br>**2.GM.2.2** Explain the relationship between length and the numbers on a ruler by using a ruler to measure lengths to the nearest inch and centimeter.<br><br>**2.GM.3 Apply mathematical actions and processes to tell time.**<br>**2.GM.3.1** Tell time to 5 minutes. Read and write time to the quarter-hour and distinguish between a.m. and p.m. (analog and digital). | **mathematical objects. Use various tools to measure distances.**<br>**3.GM.2.1** Choose an appropriate measurement instrument (e.g., ruler, yard/meter, measuring tape) and measure the length of objects to the nearest whole or half unit.<br>**3.GM.2.2** Establish personal benchmarks for metric units and estimate the measures of a variety of objects (e.g., mass: the mass of a raisin is about 1 gram, length: the width of a finger is about 1 centimeter).<br>**3.GM.2.3** Find the perimeter of a polygon.<br>**3.GM.2.4** Use an analog thermometer to determine temperature to the nearest degree in Fahrenheit and Celsius.<br><br>**3.GM.3 Apply mathematical actions and processes to tell time**.<br>**3.GM.3.1** Read and write time to the nearest 5-minute (analog and digital).<br>**3.GM.3.2** Determine the solutions to problems involving addition and subtraction of time intervals of 5-minutes using pictorial models or tools up to one hour (e.g.15-minute event plus a 30-minute event equals 45 minutes). | **processes to transformations and use symmetry to analyze mathematical situations.**<br>**4.GM.2.1** Predict and describe the results of translation (sliding), reflection (flipping) and rotation (turning) 2-dimensional shapes.<br>Clarification: NCTM used flip, turn and slide, formal transformations will be introduced in later grades.<br>**4.GM.2.2** Identify and describe the line(s) of symmetry in 2-dimensional shapes.<br><br>**4.GM.3 Apply mathematical actions and processes to understand angle and area as measurable attributes of real world and mathematical objects. Use various tools to measure angles and areas.**<br>**4.GM.3.1** Measure angles in geometric figures and real world objects with a protractor or angle ruler.<br>**4.GM.3.2** Find the area of a two-dimensional figure by counting the total number of same size square units that cover a shape without gaps or overlaps.<br>**4.GM.3.3** Develop and use formulas to determine the area of rectangles. Justify why length and width are multiplied to find the area of a rectangle by breaking the rectangle into one unit by one unit squares and viewing these as grouped into rows and columns.<br>**4.GM.3.4** Find the area of polygons that can be decomposed into rectangles.<br>**4.GM.3.5** Choose an appropriate instrument (e.g., ruler, yard/meter stick, tape measure) and measure the length of an object to the nearest whole centimeter or quarter-inch.<br>Clarification: Anything smaller than a centimeter should be measured in millimeters.<br>**4.GM.3.6** Solve problems that deal with |

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| | | measurements of length, when to use liquid volumes, when to use mass, temperatures above zero and money using addition, subtraction, multiplication, or division as appropriate (customary and metric).<br>Clarification: Focus should be on why and when to use the tools in addition to how to use the tools.<br>**4.GM.3.7** Determine elapsed time. Solve problems involving the conversion of one measure of time to another. |

## Data and Probability (DP)

| Second | Third | Fourth |
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| **2.D.1 Apply mathematical actions and processes to organize data to make it useful for interpreting information and solving problems.**<br>**2.D.1.1** Explain that the length of a bar in a bar graph or the number of objects in a picture graph represents the number of data points for a given category.<br>**2.D.1.2** Organize a collection of data with up to four categories using pictographs and bar graphs with intervals of 1s, 2s, 5s or 10s.<br>**2.D.1.3** Write and solve one-step word problems involving addition or subtraction using data represented within pictographs and bar graphs with intervals of one.<br>**2.D.1.4** Draw conclusions and make predictions from information in a graph. | **3.D.1 Apply mathematical actions and processes to organize data to make it useful for interpreting information and solving problems.**<br>**3.D.1.1** Summarize and construct a data set with multiple categories using a frequency table, line plot, dot plot*, pictograph, and/or bar graph with scaled intervals.<br>**3.D.1.2** Solve one- and two-step problems using categorical data represented with a frequency table, dot plot, pictograph, and/or bar graph with scaled intervals.<br><br>*Dot plot is a type of graphic display using filled in circles (dots) and a simple scale to compare the counts (frequency) within categories or groups. Dots are stacked in a column. Column heights represent count. | **4.D.1 Apply mathematical actions and processes to solve problems by collecting, organizing, displaying, and interpreting data.**<br>**4.D.1.1** Represent data on a frequency table or dot plot marked with whole numbers and fractions using appropriate titles, labels and units.<br>**4.D.1.2** Use tables, bar graphs, timelines and Venn diagrams to display data sets. The data may include benchmark fractions or decimals (1/4, 1/3, ½, 2/3, ¾, 0.25, 0.50, 0.75).<br>**4.D.1.3** Solve one- and two-step problems using data in whole number, decimal, and/or fraction form in a frequency table and dot plot. |

## Number and Operations (N)

| Fifth | Sixth | Seventh | Pre-Algebra |
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| **5.N.1 Apply mathematical actions and processes to divide multi-digit numbers and solve real-world and mathematical problems using arithmetic.** | **6.N.1 Apply mathematical actions and processes to read, write, represent and compare integers and positive rational numbers expressed as fractions, decimals, percents and** | **7.N.1 Apply mathematical actions and processes to read, write, represent and compare positive and negative rational numbers, expressed as integers, fractions and** | **PA.N.1 Apply mathematical actions and processes to read, write, compare, classify and represent real numbers, and use them to solve problems in various contexts.** |

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| **5.N.1.1** Estimate solutions to division problems in order to assess the reasonableness of results.<br>**5.N.1.2** Divide multi-digit numbers, using efficient and generalizable procedures, based on knowledge of place value, including standard algorithms. Recognize that quotients can be represented in a variety of ways, including a whole number with a remainder, a fraction or mixed number, or a decimal and consider the context in which a problem is situated to select and interpret the most useful form of the quotient for the solution.<br>**5.N.1.3** Solve real-world and mathematical problems requiring addition, subtraction, multiplication and division of multi-digit whole numbers. Use various strategies, including the inverse relationships between operations, the use of technology, and the context of the problem to assess the reasonableness of results.<br><br>**5.N.2 Apply mathematical actions and processes to read, write, represent and compare fractions and decimals; recognize and write equivalent fractions; convert between fractions and decimals; use fractions and decimals in real-world and mathematical situations.**<br>**5.N.2.1** Represent decimal fractions (e.g. 1/10, 1/100) using a variety of | **ratios; write positive integers as products of factors; use these representations in real-world and mathematical situations.**<br>**6.N.1.1** Locate integers and rational numbers on a number line and understand the concept of opposites.<br>**6.N.1.2** Plot coordinates in all four quadrants. Be able to identify each quadrant, the origin, the x-axis, and the y-axis.<br>**6.N.1.3** Compare positive rational numbers represented in various forms using the symbols <, >, and =.<br>**6.N.1.4** Explain that a percent represents parts out of 100 and ratios to 100 (e.g., 75% corresponds to the ratio 75 to 100 which is equivalent to a ratio of 3 to 4).<br>**6.N.1.5** Determine equivalencies among fractions, decimals and percents. Select among these representations to solve problems.<br>**6.N.1.6** Factor whole numbers and express a whole number as a product of prime factors with exponents.<br>**6.N.1.7** Determine the greatest common factors and least common multiples. Use common factors and multiples to calculate with fractions and find equivalent fractions.<br><br>**6.N.2 Apply mathematical actions and processes to understand the concept of ratio and its relationship to fractions and percents and to the multiplication and division of whole** | **decimals.**<br>**7.N.1.1** Know that every rational number can be written as the ratio of two integers or as a terminating or repeating decimal.<br>**7.N.1.2** Compare and order positive and negative rational numbers expressed in various forms using the symbols <, >, =, ≤, and ≥.<br>**7.N.1.3** Recognize and generate equivalent representations of positive and negative rational numbers, including equivalent fractions.<br><br>**7.N.2 Apply mathematical actions and processes to calculate with positive and negative rational numbers, and rational numbers with natural number exponents, to solve real-world and mathematical problems.**<br>**7.N.2.1** Use real-world contexts and the inverse relationship between addition and subtraction to explain why the procedures of arithmetic with negative rational numbers make sense.<br>**7.N.2.2** Model addition, subtraction, multiplication and division of positive and negative integers using a variety of representations (e.g., two-color counters, number lines).<br>**7.N.2.3** Add, subtract, multiply and divide positive and negative rational numbers including integers, fractions and terminating decimals; use | **PA.N.1.1** Develop and apply the properties of positive and negative integer exponents to generate equivalent numerical expressions, including $a^0 = 1$.<br>**PA.N.1.2** Express approximations of very large and very small numbers using scientific notation; understand how scientific calculators display numbers in scientific notation. Multiply and divide numbers expressed in scientific notation, express the answer in scientific notation, using the correct number of significant digits when physical measurements are involved.<br>**PA.N.1.3** Classify real numbers as rational or irrational. Recognize that when a square root of a positive integer is not an integer, then it is irrational. Recognize that the sum of a rational number and an irrational number is irrational, and the product of a non-zero rational number and an irrational number is irrational.<br>**PA.N.1.4** Compare real numbers; locate real numbers on a number line. Identify the square root of a perfect square to 400 or, if it is not a perfect square root, locate it as a real number between two consecutive positive integers.<br>**PA.N.1.5** Express approximations of very large and very small numbers using scientific notation; understand how calculators display numbers in scientific notation. Multiply and |

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| models (e.g, 10 by 10 grids, rational number wheel, base-ten blocks, meter stick) and make connections between fractions and decimals (e.g., the visual for 1/10 is the same as for 0.1).<br>**5.N.2.2** Model, read and write decimals using place value to describe decimal numbers from at least millions to thousandths.<br>**5.N.2.3** Compare and order fractions and decimals, including mixed numbers and improper fractions, and locate on a number line.<br>**5.N.2.4** Recognize and generate equivalent decimals, fractions, mixed numbers and improper fractions in various contexts.<br><br>**5.N.3 Apply mathematical actions and processes to add and subtract fractions with like and unlike denominators, mixed numbers and decimals to solve real-world and mathematical problems.**<br>**5.N.3.1** Estimate sums and differences of fractions and decimals to assess the reasonableness of the results.<br>**5.N.3.2** Using the meanings of fractions, meanings of whole number addition and subtraction, and inverse relationships to model addition and subtraction of fractions and decimals using a variety of representations (e.g., fraction strips, area models, number lines, Cuisenaire rods). | **numbers. Use ratios to solve real-world and mathematical problems.**<br>**6.N.2.1** Identify and use ratios to compare quantities. Recognize that comparing quantities using ratios is not the same as comparing quantities using subtraction.<br>**6.N.2.2** Determine the unit rate for ratios of quantities with different units.<br>**6.N.2.3** Apply the relationship between ratios, equivalent fractions and percents to solve problems in various contexts, including those involving mixture and concentrations.<br>**6.N.2.4** Use reasoning about multiplication and division to solve ratio and rate problems.<br><br>**6.N.3 Apply mathematical actions and processes to multiply and divide decimals, fractions with like and unlike denominators, and mixed numbers; solve real-world and mathematical with positive rational numbers.**<br>**6.N.3.1** Estimate solutions to problems with whole numbers, decimals, fractions, and mixed numbers and use the estimates to assess the reasonableness of results in the context of the problem.<br>**6.N.3.2** Using the meanings of fractions, meanings of whole number multiplication and division, and inverse relationships to model | efficient and generalizable procedures including but not limited to standard algorithms.<br>**7.N.2.4** Raise integers to whole number exponents.<br>**7.N.2.5** Solve real-world and mathematical problems involving calculations with positive and negative rational numbers and positive integer exponents.<br>**7.N.2.6** Demonstrate an understanding of the relationship between the absolute value of a rational number and distance on a number line. Use the symbol for absolute value.<br>**7.N.2.7** Calculate the percent of a number and determine what percent one number is of another number to solve problems in various contexts (e.g., sales tax, markup, discount, percent error, tip).<br>**7.N.2.8** Use proportional reasoning to solve problems involving ratios in various contexts. | divide numbers expressed in scientific notation, express the answer in scientific notation, using the correct number of significant digits when physical measurements are involved. |

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| **5.N.3.3** Add and subtract fractions and decimals, using efficient and generalizable procedures, including but not limited to standard algorithms in order to solve real world and mathematical problems including those involving money, measurement, geometry, and data.<br>**5.N.3.4** Find 0.1 more than a number and 0.1 less than a number. Find 0.01 more than a number and 0.01 less than a number. Find 0.001 more than a number and 0.001 less than a number. | multiplication and division of fractions and decimals using a variety of representations (e.g., fraction strips, area models, number lines, Cuisenaire rods).<br>**6.N.3.3** Multiply and divide fractions and decimals, using efficient and generalizable procedures, including but not limited to standard algorithms.<br>**6.N.3.4** Solve real-world and mathematical problems including those involving money, measurement, geometry, and data requiring arithmetic with decimals, fractions and mixed numbers. | | |
| **Algebraic Reasoning and Algebra (A)** | | | |
| **Fifth** | **Sixth** | **Seventh** | **Pre-Algebra** |
| **5.A.1 Apply mathematical actions and processes to create and use tables, graphs and rules to describe patterns to solve real-world and mathematical problems.**<br>**5.A.1.1** Create and use rules and tables to describe patterns of change and make predictions and generalizations about real-world and mathematical problems.<br>**5.A.1.2** Use a rule or table to represent ordered pairs of positive integers and graph these ordered pairs on a coordinate system.<br><br>**5.A.2 Apply mathematical actions and processes to understand and interpret expressions, equations,** | **6.A.1 Apply mathematical actions and processes to recognize and represent relationships between varying quantities; translate from one representation to another; use patterns, tables, graphs and rules to solve real-world and mathematical problems.**<br>**6.A.1.1** Represent the relationship between two varying quantities with function rules, graphs and tables; translate between any two of these representations.<br>**6.A.1.2** Use variables in various contexts including whether an equation or inequality involving a variable is true or false for a given value of the variable. | **7.A.1 Apply the mathematical actions and processes to understand the concept of proportionality in real-world and mathematical situations, and distinguish between proportional and other relationships.**<br>**7.A.1.1** Recognize that a relationship between two variables, *x* and *y,* is proportional if it can be expressed in the form $\frac{y}{x}=k$ or $y=kx$. Distinguish proportional relationships from other relationships, including inversely proportional relationships ( $xy=k$ or $y=\frac{k}{x}$).<br>**7.A.1.2** Recognize that the graph of | **PA.A.1 Apply mathematical actions and processes to understand the concept of function in real-world and mathematical situations, and distinguish between linear and nonlinear functions.**<br>**PA.A.1.1** Recognize that a function is a relationship between an independent variable and a dependent variable in which the value of the independent variable determines the value of the dependent variable. Use functional notation, such as *f*(*x*), to represent such relationships.<br>**PA.A.1.2** Use linear functions to represent relationships in which changing the input variable by some |

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| **and inequalities involving variables and whole numbers, and use them to represent and solve real-world and mathematical problems.**<br>**5.A.2.1** Generate equivalent numerical expressions and to solve problems involving whole numbers by applying the commutative, associative, and distributive properties and order of operations (no exponents).<br>**5.A.2.2** Determine whether an equation or inequality involving a variable is true or false for a given value of the variable.<br>**5.A.2.3** Evaluate expressions and solve equations involving variables when values for the variables are given. | **6.A.2 Apply mathematical actions and processes to use properties of arithmetic to generate equivalent numerical expressions and evaluate expressions involving positive rational numbers.**<br>**6.A.2.1** Generate equivalent expressions and to solve problems involving positive rational numbers by applying the commutative, associative, and distributive properties and order of operations.<br><br>**6.A.3 Apply mathematical actions and processes to understand and interpret equations and inequalities involving variables and positive rational numbers. Use equations and inequalities to represent real-world and mathematical problems; use the idea of maintaining equality to solve equations. Interpret solutions in the original context.**<br>**6.A.3.1** Represent real-world or mathematical situations using equations and inequalities involving variables and positive rational numbers.<br>**6.A.3.2** Solve and graph one-step equations (e.g., 1/3x = 9) involving positive rational numbers using number sense, properties of operations and equality. Interpret a solution in the original context and assess the reasonableness of results. | a proportional relationship is a line through the origin whose slope is the unit rate (constant of proportionality). Know how to use graphing technology to examine what happens to a line when the unit rate is changed.<br><br>**7.A.2 Apply mathematical actions and processes to recognize proportional relationships in real-world and mathematical situations; represent these and other relationships with tables, verbal descriptions, symbols and graphs; solve problems involving proportional relationships and explain results in the original context.**<br>**7.A.2.1** Represent proportional relationships with tables, verbal descriptions, symbols, equations and graphs; translate from one representation to another. Determine the unit rate (constant of proportionality or slope) given any of these representations.<br>**7.A.2.2** Solve multi-step problems involving proportional relationships in numerous contexts.<br>**7.A.2.3** Use knowledge of proportions to assess the reasonableness of solutions.<br>**7.A.2.4** Represent real-world or mathematical situations using equations and inequalities involving variables and positive and negative | amount leads to a change in the output variable that is a product of a constant and that amount.<br>**PA.A.1.3** Identify a function as linear if it can be expressed in the form $f(x)=mx+b$ or if its graph is a straight line.<br><br>**PA.A.2 Apply mathematical actions and processes to recognize linear functions in real-world and mathematical situations; represent linear functions and other functions with tables, verbal descriptions, symbols and graphs; solve problems involving these functions and explain results in the original context.**<br>**PA.A.2.1** Represent linear functions with tables, verbal descriptions, symbols, equations and graphs; translate from one representation to another.<br>**PA.A.2.2** Identify, describe, and analyze linear relationships between two variables (e.g., as the value of x increases on a table, do the values of y increase or decrease, identify a positive rate of change on a graph and compare it to a negative rate of change).<br>**PA.A.2.3** Identify graphical properties of linear functions including slopes and intercepts. Know that the slope equals the rate of change, and that the y-intercept is zero when the function represents a proportional |

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| | | rational numbers.<br><br>**7.A.3 Apply mathematical actions and processes to use number sense, the properties of operations, and algebraic reasoning to identify, simplify, and solve simple linear equations and inequalities.**<br>**7.A.3.1** Write and solve two-step linear equations with one variable using number sense, the properties of operations, and the properties of equality.<br>**7.A.3.2** Model, write, solve, and graph one-step linear inequalities with one variable.<br><br>**7.A.4 Apply mathematical actions and processes to use ratios to solve real-world and mathematical problems.**<br>**7.A.4.1** Use reasoning about multiplication and division to solve ratio and rate problems.<br>**7.A.4.2** Use proportional reasoning to solve problems involving ratios in various contexts.<br>**7.A.4.3** Use knowledge of proportions to assess the reasonableness of solutions.<br><br>**7.A.5 Apply mathematical actions and processes to use order of operations and algebraic properties to generate equivalent numerical and algebraic expressions containing positive and negative rational** | relationship.<br>**PA.A.2.4** Predict the effect on the graph of a linear equation when the slope or y-intercept changes (e.g., make predictions from graphs, identify the slope or y-intercept in the equation y = mx + b and relate to a graph). Use appropriate tools to examine these effects.<br><br>**PA.A.3 Apply mathematical actions and processes to generate equivalent numerical and algebraic expressions and use algebraic properties to evaluate expressions.**<br>**PA.A.3.1** Evaluate algebraic expressions using a variety of methods.<br>**PA.A.3.2** Justify steps in generating equivalent expressions by identifying the properties used, including the properties of operation and equality. Properties include the associative, commutative and distributive laws, and the order of operations, including grouping symbols.<br><br>**PA.A.4 Apply mathematical actions and processes to represent real-world and mathematical problems using equations and inequalities involving linear expressions. Solve and graph equations and inequalities symbolically and graphically. Interpret solutions in the original context.**<br>**PA.A.4.1** Model, write, and solve |

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| | | **numbers and grouping symbols; evaluate such expressions.**<br>**7.A.5.1** Use properties of algebra to generate equivalent numerical and algebraic expressions containing positive and negative rational numbers, grouping symbols and whole number exponents. Properties of algebra include associative, commutative and distributive laws.<br>**7.A.5.2** Apply understanding of order of operations and grouping symbols when using calculators and other technologies.<br><br>**7.A.6 Apply mathematical actions and processes to represent real-world and mathematical situations using equations with variables. Solve equations algebraically, using the properties of equality. Interpret solutions in the original context.**<br>**7.A.6.1** Represent relationships in various contexts with equations involving variables and positive and negative rational numbers.<br>**7.A.6.2** Use properties of operations and equality to solve for the value of a variable and interpret solutions in the original context.<br>**7.A.6.3**. Solve equations resulting from proportional relationships in various contexts. | multi-step linear equations with one variable to solve mathematical and real-world problems. Interpret solutions in the original context.<br>**PA.A.4.2** Express linear equations in slope-intercept form. Graph and interpret linear equations on an x-y coordinate plane.<br>**PA.A.4.3** Model, write, and solve one- and two-step linear inequalities with one variable using the properties of inequality. Graph the solutions on a number line.<br>**PA.A.4.4** Represent real-world situations using equations and inequalities involving one variable. |

| Geometry and Measurement (GM) | | | |
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| **Fifth** | **Sixth** | **Seventh** | **Pre-Algebra** |
| **5.GM.1 Apply mathematical actions and processes to describe, classify, and draw representations of three-dimensional figures.**<br>**5.GM.1.1** Describe and classify three-dimensional figures including cubes, rectangular prisms and pyramids by the number of edges, faces or vertices as well as the shapes of faces.<br>**5.GM.1.2** Recognize and draw a net for a three-dimensional figure (e.g., cubes, rectangular prisms, pyramids).<br><br>**5.GM.2 Apply mathematical actions and processes to determine the area of triangles and parallelograms.**<br>**5.GM.2.1** Develop and use formulas to determine the area of triangles and parallelograms.<br>**5.GM.2.2** Find the area of polygons that can be decomposed into triangles.<br><br>**5.GM.3. Apply mathematical actions and processes to understand angle and length as measurable attributes of real world and mathematical objects. Use various tools to measure angles and lengths.**<br>**5.GM.3.1** Measure and compare angles according to size. Classify angles as acute, right, and obtuse.<br>**5.GM.3.2** Choose an appropriate | **6.GM.1 Apply mathematical actions and processes to calculate perimeter and area of two- dimensional figures to solve real-world and mathematical problems.**<br>**6.GM.1.1** Develop and use formulas for the area of quadrilaterals (e.g., squares, rectangles, rhombi, parallelograms, trapezoids) using a variety of methods including but not limited to the standard algorithm.<br>**6.GM.1.2** Find the perimeter of polygons to solve real-world and mathematical problems.<br><br>**6.GM.2 Apply mathematical actions and processes to understand and use relationships between angles in geometric figures.**<br>**6.GM.2.1** Solve problems using the relationships between the angles (e.g. vertical, complementary, and supplementary) formed by intersecting lines.<br>**6.GM.2.2** Determine missing angle measures in a triangle using the fact that the sum of the interior angles of a triangle is 180˚.<br><br>**6.GM.3 Apply mathematical actions and processes to choose appropriate units of measurement and use ratios to convert within measurement systems to solve real-world and mathematical problems.**<br>**6.GM.3.1** Solve problems in various | **7.GM.1 Apply mathematical actions and processes to analyze the effect of change of scale, translations and reflections on the attributes of two-dimensional figures.**<br>**7.GM.1.1** Describe the properties of similarity, compare geometric figures for similarity, and determine scale factors.<br>**7.GM.1.2** Apply scale factors, length ratios and area ratios to determine side lengths and areas of similar geometric figures limited to triangles and rectangles.<br>**7.GM.1.3** Use proportions and ratios to solve problems involving scale drawings.<br><br>**7.GM.2 Apply mathematical actions and processes to use reasoning with proportions and ratios to determine measurements, justify formulas, and solve real-world and mathematical problems involving circles and related geometric figures.**<br>**7.GM.2.1** Demonstrate an understanding of the proportional relationship between the diameter and circumference of a circle and that the unit rate (constant of proportionality) is $\pi$ and can be approximated by rational numbers such as $\frac{22}{7}$ and 3.14.<br>**7.GM.2.2** Calculate the | **PA.GM.1 Apply mathematical actions and processes to solve problems involving right triangles using the Pythagorean Theorem.**<br>**PA.GM.1.1** Informally justify the Pythagorean Theorem using measurements, diagrams or dynamic software and use the Pythagorean Theorem to solve problems involving right triangles.<br>**PA.GM.1.2** Determine the distance between two points on a horizontal or vertical line in a coordinate system. Use the Pythagorean Theorem to find the distance between any two points in a coordinate system.<br><br>**PA.GM.2 Apply mathematical actions and processes to solve problems involving parallel and perpendicular lines on a coordinate system.**<br>**PA.GM.2.1** Use the relationships between the slopes of parallel lines and between the slopes of perpendicular lines graphically and algebraically to determine whether sets of lines are parallel, perpendicular, or neither. Dynamic graphing software may be used to examine these relationships.<br><br>**PA.GM.3 Apply mathematical actions and processes to calculate** |

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| instrument (e.g., ruler, yard/meter stick, tape measure) and measure the length of an object to the nearest whole centimeter or 1/16-inch. | contexts involving conversion of weights, capacities, geometric measurements and times within the same measurement systems using appropriate units. | circumference and area of circles to solve problems in various contexts, as approximate values and in terms of $\pi$ .<br><br>**7.GM.3 Apply mathematical actions and processes to develop and understand the concept of surface area and volume of rectangular prisms.**<br>**7.GM.3.1** Using a variety of tools and strategies, develop the concept that surface area of a rectangular prism can be found by wrapping the figure with same-sized square units without gaps or overlap. Use appropriate measurements such as $cm^2$.<br>**7.GM.3.2** Using a variety of tools and strategies, develop the concept that the volume rectangular prisms can be found by counting the total number of same-sized cubic units that fill a shape without gaps or overlaps. Use appropriate measurements such as $cm^3$. | **surface area and volume of three-dimensional figures.**<br>**PA.GM.3.1** Calculate the surface area of a rectangular prism using decomposition or nets. Use appropriate measurements such as $cm^2$.<br>**PA.GM.3.2** Calculate the surface area of a cylinder, as approximate values and in terms of $\pi$, using decomposition or nets. Use appropriate measurements such as $cm^2$.<br>**PA.GM.3.3** Develop and use the formulas V = ℓwh and V = Bh to determine the volume of rectangular prisms. Justify why base area (B) and height (h) are multiplied to find the volume of a rectangular prism by breaking the prism into layers of rectangles. Use appropriate measurements such as $cm^3$.<br>**PA.GM.3.4** Develop and use the formulas $V = \pi r^2 h$ and V = Bh to determine the volume of right cylinders, as approximate values and in terms of $\pi$. Justify why base area B and height h are multiplied to find the volume of a right cylinder by breaking the cylinder into layers of circles with radius (r). Use appropriate measurements such as $cm^3$. |
| **Data and Probability (DP)** | | | |
| **Fifth** | **Sixth** | **Seventh** | **Pre-Algebra** |
| **5.D.1 Apply mathematical actions** | **6.D.1 Apply mathematical actions** | **7.D.1 Apply mathematical actions** | **PA.D.1 Apply mathematical actions** |

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| **and processes to display and interpret data and determine mean, median, mode, and range.**<br>**5.D.1.1** Know and use the definitions of the mean, median, mode and range of a set of data. Understand that the mean is a "leveling out" of data.<br>**5.D.1.2** Using appropriate tools, create and analyze line graphs and double-bar graphs by applying understanding of whole numbers, fractions and decimals. | **and processes to display and interpret data, including box and whisker plots.**<br>**6.D.1.1** For a given set of data, explain and defend which measure of central tendency (mean, median, and mode) would provide the most descriptive information.<br>**6.D.1.2** Create and analyze box and whisker plots exploring how each segment contains ¼ of the data.<br><br>**6.D.2 Apply mathematical actions and processes to use probability to solve real-world and mathematical problems: represent probabilities using fractions, decimals, and percents.**<br>**6.D.2.1** Determine the sample space (set of possible outcomes) for a given experiment and determine which members of the sample space are related to certain events. Sample space may be determined by the use of tree diagrams, tables or pictorial representations.<br>**6.D.2.2** Identify dependent and independent events.<br>**6.D.2.3** Model situations in which the probabilities are known, compare the resulting relative frequencies with the known probabilities; know that there may be differences. | **and processes to display and interpret data in a variety of ways, including circle graphs and histograms.**<br>**7.D.1.1** Design simple experiments, collect data and calculate measures of central tendency (mean, median, and mode) and spread (range). Use these quantities to draw conclusions about the data collected and make predictions.<br>**7.D.1.2** Use reasoning with proportions to display and interpret data in circle graphs (pie charts) and histograms. Choose the appropriate data display and know how to create the display using a spreadsheet or other graphing technology.<br><br>**7.D.2 Apply mathematical actions and processes to calculate probabilities and reason about probabilities using proportions to solve real-world and mathematical problems.**<br>**7.D.2.1** Determine the theoretical probability of an event using the ratio between the size of the event and the size of the sample space; represent probabilities as percents, fractions and decimals between 0 and 1 inclusive. Understand that probabilities measure likelihood.<br>**7.D.2.2** Use proportional reasoning to draw conclusions about and predict relative frequencies of outcomes based on probabilities. | **and processes to display and interpret data in a variety of ways, including using scatterplots and approximate lines of best fit. Use lines of best fit to draw conclusions about data.**<br>**PA.D.1.1** Describe the impact that inserting or deleting a data point has on the mean and the median of a data set. Know how to create data displays using a spreadsheet and use a calculator to examine this impact.<br>**PA.D.1.2** Explain how outliers affect measures of central tendency.<br>**PA.D.1.3** Collect, display and interpret data using scatterplots. Use the shape of the scatterplot to informally estimate a line of best fit and determine an equation for the line. Use appropriate titles, labels and units. Know how to use graphing technology to display scatterplots and corresponding lines of best fit.<br>**PA.D.1.4** Use a line of best fit to estimate rate of change and to make predictions about values not in the original data set and assess the reasonableness of predictions using scatterplots by interpreting them in the original context.<br><br>**PA.D.2 Apply mathematical actions and processes to calculate experimental probabilities and reason about probabilities to solve real-world and mathematical problems.** |

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| | | | **PA.D.2.1** Calculate experimental probabilities and represent them as percents, fractions and decimals between 0 and 1 inclusive. Use experimental probabilities to make predictions when actual probabilities are unknown. |

## Algebra I & II Number and Operations (N) and Geometry Reasoning and Logic (RL)

| Algebra | Geometry | Algebra II |
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| **A1.N.1 Apply mathematical actions and processes to extend the understanding of number and operations to include square roots and cubic roots.**<br>**A1.N.1.1** Write square roots and cube roots of monomial algebraic expressions in simplest radical form.<br>**A1.N.1.2** Add, subtract, multiply, and simplify square roots of monomial algebraic expressions and divide square roots of whole numbers. | <u>Reasoning and Logic</u><br>**G.RL.1 Apply mathematical actions and processes to use appropriate tools and logic to evaluate mathematical arguments.**<br>**G.RL.1.1** Understand the roles of undefined terms, definitions, postulates, and theorems in logical arguments.<br>**G.RL.1.2** Analyze and draw conclusions based on a set of conditions. Recognize the logical relationships between an "if…then" statement and its inverse, converse and contrapositive.<br>**G.RL.1.3** Assess the validity of a logical argument and give counterexamples to disprove a statement. | **A2.N.1 Apply mathematical actions and processes to extend the understanding of number and operations to include complex numbers, matrices and expressions written with rational exponents.**<br>**A2.N.1.1** Find the value of $i^n$ for any whole number n.<br>**A2.N.1.2** Simply, add, subtract, multiply, and divide complex numbers.<br>**A2.N.1.3** Identify the order (dimension) of a matrix, add and subtract matrices of appropriate dimensions, and multiply a matrix by a scalar to create new matrices.<br>**A2.N.1.4** Add, subtract, multiply, divide and simplify radical expressions and expressions containing rational exponents. |

## Algebra I & II Algebraic Reasoning and Algebra (A) and Geometry 2 & 3 Dimensional Shapes (2D & 3D)

| Algebra | Geometry | Algebra II |
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| **A1.A.1 Apply mathematical actions and processes to represent and solve mathematical and real world problems using linear equations (including absolute value equations) and systems of equations; interpret solutions in the original context.**<br>**A1.A.1.1** Use knowledge of solving multi-step equations to represent and solve mathematical and real-world problems (e.g., angle measures, geometric formulas, science, or statistics) and | <u>Line, Angle and Polygon Relationships</u><br>**G.2D.1 Apply mathematical actions and processes to discover, evaluate and analyze the relationships between lines, angles and polygons to solve real world and mathematical problems; express proofs in a form that clearly justifies the reasoning, such as two-column proofs, paragraph proofs, flow charts or illustrations.**<br>**G.2D.1.1** Apply the properties of parallel and perpendicular lines, including properties of angles | **A2.A.1 Apply mathematical actions and processes to represent, model and solve mathematical and real-world problems using nonlinear equations and systems of linear equations; interpret the solutions in the original context.**<br>**A2.A.1.1** Represent and model real world or mathematical problems using quadratic equations and solve using various methods including graphing (including graphing calculator or other |

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| interpret the solutions in the original context.<br>**A1.A.1.2** Solve absolute value equations and interpret the solutions in the original context.<br>**A1.A.1.3** Solve systems of linear equations with a maximum of two variables by graphing (graphing calculator optional), substitution, and elimination and interpret the solutions in the original context.<br><br>**A1.A.2 Apply mathematical actions and processes to represent and solve real-world and mathematical problems using linear inequalities (including compound inequalities); interpret solutions in the original context.**<br>**A1.A.2.1** Represent relationships in various contexts with linear inequalities and solve the resulting inequalities, graph, and interpret the solutions on a coordinate plane.<br>**A1.A.2.2** Represent relationships in various contexts with compound and absolute value inequalities and solve the resulting inequalities, graph, and interpret the solutions on a number line.<br>**A1.A.2.3** Solve systems of linear inequalities with a maximum of two variables, graph, and interpret the solutions on a coordinate plane.<br><br>**A1.A.3 Apply mathematical actions and processes to generate equivalent algebraic expressions and use algebraic properties to evaluate expressions and arithmetic and geometric sequences.**<br>**A1.A.3.1** Solve literal equations involving several variables for one variable in terms of the others.<br>**A1.A.3.2** Simplify polynomial expressions by adding, subtracting, or multiplying.<br>**A1.A.3.3** Factor common monomial factors from polynomial expressions and factor quadratic expressions with a leading coefficient of 1. | formed by a transversal, to solve real world and mathematical problems and determine if two lines are parallel, using algebraic reasoning and proofs.<br>**G.2D.1.2** Apply the properties of angles, including corresponding, exterior, interior, vertical, complementary, and supplementary angles to solve real world and mathematical problems using algebraic reasoning and proofs.<br>**G.2D.1.3** Apply theorems involving the interior and exterior angle sums of polygons and use them to solve real world and mathematical problems using algebraic reasoning and proofs.<br>**G.2D.1.4** Apply the properties of special quadrilaterals (square, rectangle, trapezoid, isosceles trapezoid, rhombus, kite, parallelogram) and use them to solve real world and mathematical problems involving angle measures and segment lengths using algebraic reasoning and proofs.<br>**G.2D.1.5** Use coordinate geometry to represent and analyze line segments and polygons, including determining lengths, midpoints, and slopes of line segments.<br>**G.2D.1.6** Apply the properties of polygons to solve real world and mathematical problems involving perimeter and area (e.g., triangles, special quadrilaterals, regular polygons – up to 12 sided figures, composite figures) and identify types of symmetry.<br>**G.2D.1.7** Apply the properties of congruent or similar polygons to solve real world and mathematical problems using algebraic and logical reasoning.<br>**G.2D.1.8** Construct logical arguments to prove triangle congruence (SSS, SAS, ASA, AAS and HL) and triangle similarity (AA~, SSS~, SAS~).<br>**G.2D.1.9** Use numeric, graphic and algebraic | appropriate technology), factoring, completing the square, and the quadratic formula. Find complex roots when they exist.<br>**A2.A.1.2** Represent and model real world or mathematical problems using exponential equations, such as compound interest, depreciation, and population growth, and solve these equations graphically (including graphing calculator or other appropriate technology) or algebraically.<br>**A2.A.1.3** Solve rational equations with only one variable and limited to three or less denominators. Check for extraneous solutions.<br>**A2.A.1.4** Find and interpret the meaning of zeros **of** polynomials from a graphical perspective.<br>**A2.A.1.5** Solve radical equations (square root only) with one variable and only one radical on either one or both sides of the equal sign. Check for extraneous solutions.<br>**A2.A.1.6** Solve common and natural logarithmic equations using the properties of logs.<br>**A2.A.1.7** Use graphing calculators or other appropriate technology to explore and solve real world and mathematical problems that can be modeled using arithmetic or finite geometric sequences or series given the nth terms and sum formulas.<br>**A2.A.1.8** Represent and model real world or mathematical problems using systems of linear equations with a maximum of three variables and solve using various methods which may include substitution, elimination, and graphing (may include graphing calculators or other appropriate technology).<br>**A2.A.1.9** Solve systems of equations containing one linear equation and one quadratic equation using tools which may include graphing calculators |

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| **A1.A.3.4** Evaluate linear, absolute value, rational, and radical expressions. Include applying a nonstandard operation such as $a \odot b = 2a + 5$.<br>**A1.A.3.5** Recognize that arithmetic sequences are linear using equations, tables, graphs and verbal descriptions. Using the pattern, find the next term.<br>**A1.A.3.6** Recognize that geometric sequences are exponential using equations, tables, graphs and verbal descriptions. Given the formula $f(x) =$ a$(r)^x$ ,find the next term.<br><br>**A1.A.4 Apply mathematical actions and processes to analyze mathematical change involving linear equations in in real world and mathematical problems.**<br>**A1.A.4.1** Calculate the slope of a line using a graph, an equation, two points, or a set of data points and interpret the slope and x- and y-intercepts in real world and mathematical problems.<br>**A1.A.4.2** Use the slope to differentiate between lines that are parallel, perpendicular, horizontal, or vertical.<br>**A1.A.4.3** Express linear equations in slope-intercept, point-slope, and standard forms and convert between these forms. Given sufficient information (slope and y-intercept, slope and one-point on the line, two points on the line, x-intercept and y-intercept, or a set of data points), write the equation of a line.<br>**A1.A.4.4** Relate a graph to a situation described qualitatively (e.g., faster change, slower change). | representations of transformations in two dimensions, such as reflections, translations, dilations, and rotations about the origin by multiples of 90˚, to solve problems involving figures on a coordinate plane.<br><br>**<u>3-Dimensional Shapes</u>**<br>**G.3D.1 Apply mathematical actions and processes to solve real world and mathematical problems involving 3-dimensional figures.**<br>**G.3D.1.1** Solve real world and mathematical problems using the surface area and volume of prisms, cylinders, pyramids, cones, spheres, and composites of these figures. Use nets, measuring devices, or formulas as appropriate.<br>**G.3D.1.2** Use ratios of similar 3-dimensional figures to solve for unknown values such as angles, side lengths, perimeter or circumference of a face, area of a face, and volume.<br>**G.3D.1.3** Apply the fact that dilations can be conveyed by the effect of a scale factor k on length, area and volume, multiplied by k, $k^2$ and $k^3$, respectively. | or other appropriate technology.<br>**A2.A.1.10** Assess the reasonableness of a solution in its given context and compare the solution to appropriate graphical or numerical estimates; interpret a solution in the context of the domain.<br><br>**A2.A.2 Apply mathematical actions and processes to represent and analyze mathematical situations and structures using algebraic symbols using various strategies to write equivalent forms of expressions.**<br>**A2.A.2.1** Factor polynomial expressions including but not limited to trinomials, differences of squares, sum and difference of cubes, and factoring by grouping using a variety of tools and strategies.<br>**A2.A.2.2** Add, subtract, multiply, divide, and simplify polynomial and rational expressions.<br>**A2.A.2.3** Recognize that a quadratic equation has different equivalent representations ( $f(x) = ax^2 + bx + c$, $f(x) = a(x - h)^2 + k$ , or in factored form) and identify the representation that is most appropriate for the situation (solving or graphing) .<br>**A2.A.2.4** Rewrite expressions involving radicals and rational exponents using the properties of exponents. |

| Algebra I & II Function (F) and Geometry Circles (C) | | |
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| **Algebra** | **Geometry** | **Algebra II** |
| **A1.F.1 Apply mathematical actions and processes to understand functions as descriptions of covariation (how related quantities vary together) in real world and mathematical problems.**<br>**A1.F.1.1** Distinguish between relations and functions using the vertical line test and the definition of a function.<br>**A1.F.1.2** Identify the dependent and independent variables as well as the domain and range given a function, equation, or graph. Identify restrictions on the domain and range in real world contexts.<br>A1.F.1.3 Write linear functions in terms of real world context using function notation.<br>A1.F.1.4 Given a graph modeling a real world situation, read and interpret the linear piecewise function (excluding step functions).<br><br>**A1.F.2 Apply mathematical actions and processes to understand that families of functions are characterized by the rate of change.**<br>**A1.F.2.1** Distinguish between linear and nonlinear data (including exponential) through tables, graphs, equations, and real-world contexts.<br>**A1.F.2.2** Recognize the graph of the functions $f(x) = x$ and $f(x) = \|x\|$ and predict the effects of transformations algebraically and graphically on the graph using various methods and tools which may include graphing calculators.<br><br>**A1.F.3 Apply mathematical actions and processes to represent functions can in multiple ways and use to interpret real world and mathematical** | <u>Circles</u><br>**G.C.1 Apply mathematical actions and processes to solve real world and mathematical problems using the properties of circles.**<br>**G.C.1.1** Apply the properties of circles to solve problems involving circumference and area, as approximate values and in terms of $\pi$, using algebraic and logical reasoning.<br>**G.C.1.2 A**pply the properties of circles and relationships among angles, arcs, and distances in a circle to solve problems using algebraic and logical reasoning.<br>**G.C.1.3** Recognize and write the radius *r*, center (h,k), and standard form of the equation of a circle $(x - h)^2 + (y - k)^2 = r^2$ with and without graphs.<br>**G.C.1.4** Apply the distance and midpoint formula, where appropriate, to develop the equation of a circle in standard form. | **A2.F.1 Apply mathematical actions and processes to understand functions as descriptions of covariation (how related quantities vary together).**<br>**A2.F.1.1** Use algebraic, interval, and set notations to specify the domain and range of functions of various types and evaluate a function at a given point in its domain.<br>**A2.F.1.2** Recognize the graphs of exponential, radical (square root and cube root only), quadratic, and logarithmic functions. Predict the effects of transformations algebraically and graphically on the graphs, using various methods and tools which may include graphing calculators or other appropriate technology [e.g., f(x)+c, f(x+c), f(cx), and cf(x), where c is a positive or negative constant].<br>**A2.F.1.3** Graph a quadratic function. Identify the x- and y- intercepts, maximum or minimum value, axis of symmetry, and vertex using various methods and tools which may include a graphing calculator or appropriate technology.<br>**A2.F.1.4** Graph exponential and logarithmic functions. Identify asymptotes and x- and y-intercepts using various methods and tools which may include graphing calculators or other appropriate technology. Recognize exponential decay and growth graphically and algebraically.<br>**A2.F.1.5** Identify the domain, range, intercepts, zeros, relative maxima, relative minima, and intervals of increase and decrease given the graph of a polynomial functions.<br>**A2.F.1.6** Graph a rational function and identify the x- and y- intercepts, vertical and horizontal |

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| **problems.**<br>**A1.F.3.1** Identify matching linear equations, graphs, tables, and real-world situations.<br>**A1.F.3.2** Use function notation and evaluate a function (including nonlinear) at a given point in its domain algebraically and graphically and interpret the results in terms of real world and mathematical problems.<br>**A1.F.3.3** Add, subtract, and multiply functions using function notation. | | asymptotes, using various methods and tools which may include a graphing calculator or other appropriate technology. (Excluding slant asymptotes and holes.)<br>**A2.F.1.7** Graph a radical function (square root and cube root only) and identify the x- and y-intercepts using various methods and tools which may include a graphing calculator or other appropriate technology.<br>**A2.F.1.8** Graph piecewise functions with no more than three branches. Given a graph, analyze piecewise functions.<br><br>**A2.F.2 Apply mathematical actions and processes to understand functions can be combined algebraically and by composition and in some cases will have an inverse.**<br>**A2.F.2.1** Add, subtract, multiply, and divide functions using function notation and recognize domain restrictions.<br>**A2.F.2.2** Combine functions by composition and recognize that f(x) and g(x) are inverse functions if f(g(x))=g(f(x))=x.<br>**A2.F.2.3** Find and graph the inverse of a function, if it exists, and know the graphs are reflected in the line y=x.<br>**A2.F.2.4** Apply the inverse relationship between exponential and logarithmic functions to convert from one form to another. |
| **Algebra I & II Data and Probability (DP) and Geometry Right Triangle Trigonometry (RT)** | | |
| **Algebra** | **Geometry** | **Algebra II** |
| **A1.D.1 Apply mathematical actions and processes to display and analyze data**.<br>**A1.D.1.1** Describe a data set using data displays, describe and compare data sets using summary statistics, including measures of central tendency, | **Right Triangle Trigonometry**<br>**G.RT.1 Apply mathematical actions and processes to develop and verify mathematical relationships of right triangles and trigonometric ratios to solve real world and mathematical problems.** | **A2.D.1 Apply mathematical actions and processes to display and analyze data.**<br>**A2.D.1.1** Use the mean and standard deviation of a data set to fit it to a normal distribution (bell-shaped curve) and to estimate population |

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| location, and spread. Measures of central tendency and location include mean, median, mode, and percentile. Measures of spread include standard deviation and range. Know how to use calculators, spreadsheets, or other appropriate technology to display data and calculate summary statistics.<br>**A1.D.1.2** Collect data and use scatterplots to analyze patterns and describe linear relationships between two variables. Using graphing technology, determine regression lines and correlation coefficients; use regression lines to make predictions and correlation coefficients to assess the reliability of those predictions.<br>**A1.D.1.3** Interpret graphs as being discrete or continuous.<br><br>**A1.D.2 Apply mathematical actions and processes to calculate probabilities and apply probability concepts.**<br>**A1.D.2.1** Select and apply counting procedures, such as the multiplication and addition principles and tree diagrams, to determine the size of a sample space (the number of possible outcomes) and to calculate probabilities.<br>**A1.D.2.2** Describe the concepts of intersections, unions, and complements using Venn diagrams to evaluate probabilities. Understand the relationships between these concepts and the words AND, OR, NOT.<br>**A1.D.2.3** Calculate experimental probabilities by performing simulations or experiments involving a probability model and using relative frequencies of outcomes.<br>**A1.D.2.4** Apply probability concepts to real-world situations to make informed decisions. | **G.RT.1.1** Apply the distance formula, the Pythagorean Theorem, and its converse to solve real world and mathematical problems, as approximate and exact values, using algebraic and logical reasoning (include Pythagorean Triples).<br>**G.RT.1.2** Verify and apply properties of right triangles, including properties of 45-45-90 and 30-60-90 triangles, to solve problems using algebraic and logical reasoning.<br>**G.RT.1.3** Use the definition of the trigonometric functions to determine the sine, cosine and tangent ratio of an acute angle in a right triangle.<br>**G.RT.1.4** Apply the trigonometric functions as ratios (sine, cosine and tangent) to find side lengths in right triangles in real world and mathematical problems. | percentages. Recognize that there are data sets for which such a procedure is not appropriate.<br>**A2.D.1.2** Collect data and use scatterplots to analyze patterns and describe linear, exponential or quadratic relationships between two variables. Using graphing calculators or other appropriate technology, determine regression equation and correlation coefficients; use regression equations to make predictions and correlation coefficients to assess the reliability of those predictions.<br>**A2.D.1.3** Based upon the real world context, recognize whether a discrete or continuous graphical representation is appropriate and then create the graph.<br><br>**A2.D.2 Apply mathematical actions and processes to analyze statistical thinking to draw inferences, make predictions, and justify conclusions.**<br>**A2.D.2.1** Evaluate reports based on data published in the media by identifying the source of the data, the design of the study, and the way the data are analyzed and displayed. Given spreadsheets, tables, or graphs, recognize and analyze distortions in data displays. Show how graphs and data can be distorted to support different points of view.<br>**A2.D.2.2** Identify and explain misleading uses of data. Recognize when arguments based on data confuse correlation and causation. |