

Appendix C -- Vertical Alignment Charts

Number and Operations		
Pre-K	Kindergarten	First
<p>PK.N.1. Apply mathematical actions and processes to know number names and count in sequence PK.N.1.1 Count aloud in sequence to 30. PK.N.1.2 Recognize and name written numerals 0-9. PK.N.1.3 Recognize that zero represents the count of no objects.</p> <p>PK.N.2. Apply mathematical actions and processes to counting to tell the number of objects. PK.N.2.1 Identify the number of objects, up to 10, in a horizontal row. PK.N.2.2 Begin to make use of one-to-one correspondence in counting objects and matching groups of objects. PK.N.2.3 Understand the last numeral spoken, when counting aloud, tells how many total objects are in a set. PK.N.2.4 Count up to 5 items in a scattered configuration; not in a horizontal row.</p> <p>PK.N.3. Apply mathematical actions and processes to compare numbers. PK.N.3.1 Compare two sets of 1-5 objects using comparative language such as “more” or “less”.</p>	<p>K.N.1. Apply mathematical actions and processes to understand the relationship between quantities and whole numbers. K.N.1.1 Count aloud in sequence to 100. K.N.1.2 Recognize that a number can be used to represent how many objects are in a set or to represent the position of an object in a sequence up to 10. K.N.1.3 Recognize without counting (subitizing*) the quantity of a small group of objects in organized and random arrangements up to 10 (e.g. dot patterns). K.N.1.4 Count forward, with and without objects, from any given number up to 10. K.N.1.5 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. K.N.1.6 Find a number that is 1 more or 1 less than a given number. K.N.1.7 Compare and order whole numbers, with and without objects, from 0 to 10.</p> <p>*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.</p> <p>K.N.2. Apply mathematical actions and processes to understand the relationship between whole numbers and fractions through fair share. K.N.2.1 Distribute equally a set of objects into at least two smaller sets.</p>	<p>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. 1.N.1.1 Recognize without counting (subitizing*) the quantity of structured arrangements (e.g. ten frames, arrays, dot patterns). 1.N.1.2 Use concrete model to describe whole numbers between 10 and 100 in terms of tens and ones. 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. 1.N.1.4 Count forward, with and without objects, from any given number up to 100 by 1s, 2s, 5s and/or 10s. 1.N.1.5 Find a number that is 10 more or 10 less than a given number (e.g. Using a hundred chart, find the number that is 10 more than 27). 1.N.1.6 Compare and order whole numbers, with and without objects, including open number lines, up to 100. 1.N.1.7 Create an open number line and use knowledge of number relationships to locate the position of a given whole number on that open number line up to 20. 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.</p> <p>*Subitizing is defined as instantly recognizing the</p>

	<p>K.N.3. Apply mathematical actions and processes to identify coins in order to recognize the need for monetary transactions.</p> <p>K.N.3.1 Identify U.S. coins by name, including pennies, nickels, dimes, and quarters.</p>	<p>quantity of a set without having to count. “subitizing” is not a vocabulary word, not for student discussion at this age.</p> <p>1.N.2. Apply mathematical actions and processes to solve addition and subtraction problems up to 20 in real-world and mathematical contexts.</p> <p>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).</p> <p>1.N.2.2 Apply basic fact strategies to add and subtract within 20 including making ten, decomposing a number leading to a ten, doubles plus one.</p> <p>1.N.2.3 Determine if equations involving addition and subtraction are true.</p> <p>1.N.3. Apply mathematical actions and processes to explore the foundational ideas of fractions.</p> <p>1.N.3.1 Partition a regular polygon using physical models into equal pieces (e.g., halves, thirds, fourths).</p> <p>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.</p> <p>1.N.4.1 Identify U.S. coins, including pennies, nickels, dimes, and quarters, by value and describe the relationships among them.</p> <p>1.N.4.2 Write a number with the cent symbol to describe the value of a coin.</p> <p>1.N.4.3 Use relationships to count by ones, fives,</p>
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		and tens to determine the value of a collection of pennies, nickels, and/or dimes.
Algebraic Reasoning and Algebra		
Pre-K	Kindergarten	First
<p>PK.A.1. Apply mathematical actions and processes to recognize, create, and extend patterns.</p> <p>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).</p> <p>PK.A.1.2 Recognize, duplicate, extend, and create repeating patterns in various formats (e.g., manipulatives, sound, movement).</p>	<p>K.A.1. Apply mathematical actions and processes to recognize, create, complete, and extend patterns.</p> <p>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).</p> <p>K.A.1.2 Recognize, create, complete, and extend repeating, shrinking and growing patterns using shape, color, size, quantity, sounds and movements.</p> <p>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.</p> <p>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).</p>	<p>1.A.1. Apply mathematical actions and processes to identify, create, complete, and extend patterns.</p> <p>1.A.1.1 Create and extend repeating or growing patterns using objects, pictures, numbers and rules.</p> <p>1.A.1.2 Recognize, create, complete, and extend repeating, shrinking and growing patterns with 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).</p> <p>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.</p> <p>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).</p>
Geometry and Measurement		
Pre-K	Kindergarten	First
<p>PK.GM.1. Apply mathematical actions and processes to analyze, compare, create and compose shapes.</p> <p>PK.GM.1.1 Identify common shapes by pointing</p>	<p>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.</p>	<p>1.GM.1. Apply mathematical actions and processes standards to analyze attributes of two- and three -dimensional shapes to create new shapes.</p>

<p>to the shape when given the name (e.g., circle, square, rectangle and triangle).</p> <p>PK.GM.1.2 Use smaller shapes to form a larger shape when there is an outline to follow (create a larger square using 4 small squares).</p> <p>PK.G.M.2. Apply mathematical actions and processes to describe and compare measurable attributes.</p> <p>PK.GM.2.1 Identify measurable attributes of objects, such as length or weight. Describe them using age appropriate vocabulary (e.g., little, big, long, short, tall, heavy, and light).</p> <p>PK.GM.2.2 Directly compares two objects with a common measurable attribute using words such as longer/ shorter (horizontal); heavier/ lighter; or taller/ shorter (vertical).</p> <p>PK.GM.2.3 Compare 2 objects by size (e.g., tall/taller).</p> <p>PK.GM.2.4 Sort objects into sets by one or more attributes.</p>	<p>K.GM.1.1 Recognize basic two- and three-dimensional shapes such as squares, circles, triangles, rectangles, trapezoids, hexagons, cubes, cones, cylinders and spheres.</p> <p>K.GM.1.2 Identify attributes of two-dimensional shapes using informal and formal geometric language interchangeably.</p> <p>K.GM.2. Apply mathematical actions and processes to compare and order objects according to location and measurable attributes.</p> <p>K.GM.2.1 Use words to compare objects according to length, size, weight and position.</p> <p>K.GM.2.2 Order up to 6 objects using measurable attributes, such as length and weight (e.g. tall/taller/tallest).</p> <p>K.GM.2.3 Use smaller shapes to form a larger shape when there is a model or outline to follow (e.g. Create a larger square using 4 small squares).</p> <p>K.GM.3. Apply mathematical actions and processes to tell time.</p> <p>K.GM3.1 Develop an awareness of simple time concepts within his/her daily life (e.g. yesterday, today, tomorrow; morning, afternoon, night).</p>	<p>1.GM.1.1 Use smaller shapes to form a larger shape (compose and decompose) two-dimensional shapes such as triangles, squares, rectangles, and circles, and three-dimensional shapes such as rectangular prisms and cylinders.</p> <p>1.GM.2. Apply mathematical actions and processes to select and use units to describe length.</p> <p>1.GM.2.1 Use nonstandard and standard measuring tools to measure the length of objects to reinforce the continuous nature of linear measurement. Clarification: According to Clements and Sarama learning trajectories 6 year olds start end-to-end measurement.</p> <p>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.</p> <p>1.GM.2.3 Measure the same object/distance with units of two different lengths and describe how and why the measurements differ.</p> <p>1.GM.2.4 Describe a length to the nearest whole unit using a number and a unit.</p> <p>1.GM.3. Apply mathematical actions and processes to tell time.</p> <p>1.GM.3.1 Tell time to the hour and half-hour (analog and digital).</p>
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Data and Probability

Pre-K	Kindergarten	First
	<p>K.D.1. Apply mathematical actions and processes to collect and organize data to make it useful for interpreting information.</p> <p>K.D.1.1 Collect and analyze information about objects</p>	<p>1.D.1. Apply mathematical actions and processes to organize data to make it useful for interpreting information and solving problems.</p> <p>1.D.1.1 Collect, sort, and organize data in up to</p>

	<p>and events in the environment.</p> <p>K.D.1.2 Use data to create real-object, picture graphs, and Venn diagrams.</p> <p>K.D.1.3 Draw conclusions from real-object and picture graphs.</p>	<p>three categories using models/representations (e.g., tally marks, tables).</p> <p>1.D.1.2 Use data to create picture and bar-type graphs, to demonstrate one to one correspondence.</p> <p>1.D.1.3 Draw conclusions from picture and bar-type graphs.</p>
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Number and Operations

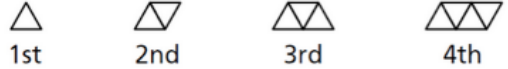
Second	Third	Fourth
<p>2.N.1. Apply mathematical actions and processes to compare and represent whole numbers up to 1000 with an emphasis on place value and equality.</p> <p>2.N.1.1 Read, write, discuss, and represent whole numbers up to 1000. Representations may include numerals, words, pictures, tally marks, number lines and manipulatives.</p> <p>2.N.1.2 Create an open number line and use knowledge of number relationships to locate the position of a given whole number on that open number line up to 100.</p> <p>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.</p> <p>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.</p> <p>2.N.1.5 Recognize when to round numbers to the nearest 10 and 100. Clarification statement: Emphasis on understanding why and how to round vs. memorizing a rule.</p> <p>2.N.1.6 Use place value to compare and order whole numbers up to 1000 using comparative</p>	<p>3.N.1. Apply mathematical actions and processes to compare and represent whole numbers up to 100,000 with an emphasis on place value and equality.</p> <p>3.N.1.1 Read, write, discuss, and represent whole numbers up to 100,000. Representations may include numerals, expressions with operations, words, pictures, number lines, and manipulatives.</p> <p>3.N.1.2 Use place value to describe whole numbers between 1000 and 100,000 in terms of ten thousands, thousands, hundreds, tens and one, including expanded form.</p> <p>3.N.1.3 Find 10,000 more or 10,000 less than a given five-digit number. Find 1000 more or 1000 less than a given four- or five-digit. Find 100 more or 100 less than a given four- or five-digit number.</p> <p>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. Clarification statement: Emphasis on understanding why and how to round vs. memorizing a rule.</p> <p>3.N.1.5 Use place value to compare and order whole numbers up to 100,000, using comparative language, numbers, and symbols (e.g. $15,023 < 25,156$; 2345 is between 2000 and 3000).</p>	<p>4.N.1 Apply mathematical actions and processes to multiply multi-digit numbers; solve real-world and mathematical problems using arithmetic.</p> <p>4.N.1.1 Demonstrate fluency with multiplication and division facts up to 12×12.</p> <p>4.N.1.2 Use an understanding of place value to multiply or divide a number by 10, 100 and 1000.</p> <p>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 standard algorithms.</p> <p>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.</p> <p>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.</p> <p>4.N.1.6 Use strategies and algorithms based on</p>

<p>language, numbers, and symbols (e.g., $425 > 276$, $73 < 107$, page 351 comes after 350, 753 is between 700 and 800).</p> <p>2.N.2. Apply mathematical actions and processes to add and subtract one- and two-digit numbers in real-world and mathematical problems.</p> <p>2.N.2.1 Use strategies to generate addition and subtraction facts including making tens, fact families, doubles plus or minus one, counting on, counting back, and the commutative and associative properties. Use the relationship between addition and subtraction to generate basic facts.</p> <p>2.N.2.2 Demonstrate fluency with basic addition facts and related subtraction facts up to 20.</p> <p>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]).</p> <p>2.N.2.4 Use mental strategies and algorithms based on knowledge of place value and equality to add and subtract two-digit numbers. Strategies may include decomposition, expanded notation, and partial sums and differences.</p> <p>2.N.2.5 Solve real-world and mathematical addition and subtraction problems involving whole numbers up to 2 digits.</p> <p>2.N.2.6 Use concrete models and structured arrangements, such as repeated addition, arrays and ten frames to develop</p>	<p>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 using arithmetic.</p> <p>3.N.2.1 Demonstrate fluency in addition and subtraction facts up to 100.</p> <p>3.N.2.2 Add and subtract multi-digit numbers, using efficient and generalizable procedures and strategies based on knowledge of place value, which may include standard algorithms.</p> <p>3.N.2.3 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.</p> <p>3.N.2.4 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.</p> <p>3.N.2.5 Represent division facts by using a variety of approaches, such as repeated subtraction, equal sharing and forming equal groups.</p> <p>3.N.2.6 Recognize the relationship between multiplication and division to model and solve real world problems (e.g. partitioning, missing factors, arrays).</p> <p>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. Strategies may include mental strategies, partial products, the standard algorithm, and the commutative, associative, and distributive properties.</p>	<p>knowledge of place value, equality and properties of operations to divide 3-digit by 1-digit whole numbers. Strategies may include mental strategies, partial quotients, the commutative, associative, and distributive properties and repeated subtraction.</p> <p>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.</p> <p>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).</p> <p>4.N.2.2 Use benchmark fractions to locate additional fractions on a number line. Use models to order and compare whole numbers and fractions less than and greater than one.</p> <p>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. $\frac{3}{4} = \frac{1}{4} + \frac{1}{4} + \frac{1}{4}$).</p> <p>4.N.2.4 Use fraction models to add and subtract fractions with like denominators in real world and mathematical situations. Develop a rule for addition and subtraction of fractions with like denominators.</p> <p>4.N.2.5 Represent tenths and hundredths with concrete models, making connections between fractions and decimals.</p> <p>4.N.2.6 Model, read and write decimals up to at least the hundredths place in a variety of context including money.</p>
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<p>understanding of multiplication.</p> <p>2.N.3. Apply mathematical actions and processes to explore the foundational ideas of fractions.</p> <p>2.N.3.1 Identify the parts of a set and/or area that represent fractions for halves, thirds and fourths.</p> <p>2.N.3.2 Construct equal sized portions through fair sharing including length and set area models for halves, thirds, and fourths.</p> <p>2.N.4. Apply mathematical actions and processes to determine the value of coins in order to solve monetary transactions.</p> <p>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.</p> <p>2.N.4.2 Select a combination of coins to represent a given amount of money up to one dollar.</p>	<p>3.N.3. Apply mathematical actions and processes to understand meanings and uses of fractions in real-world and mathematical situations.</p> <p>3.N.3.1 Read and write fractions with words and symbols.</p> <p>3.N.3.2 Construct fractions using set, area and length models.</p> <p>3.N.3.3 Order and compare, including equivalent unit fractions and fractions with like denominators by using models, reasoning about their size and an understanding of the concept of numerator and denominator.</p> <p>3.N.4. Apply mathematical actions and processes to determine the value of coins in order to solve monetary transactions.</p> <p>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</p> <p>3.N.4.2 Select the fewest amount of coins for a given amount of money up to one dollar.</p>	<p>Example 1: Using Base Ten Blocks</p> <p>Example 2: Use the cent symbol, dollar sign, and the decimal point to determine the value of a collection of coins.</p> <p>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.</p> <p>4.N.2.8 Rename and compare benchmark fractions and decimals 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; $\frac{1}{4}$ is the same as 0.25).</p> <p>4.N.3. Apply mathematical actions and processes to determine the value of coins in order to solve monetary transactions.</p> <p>4.N.3.1 Given a total cost and amount paid, find the change required in a variety of ways.</p>
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Algebraic Reasoning and Algebra

Second	Third	Fourth
<p>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.</p> <p>2.A.1.1 Recognize, create, describe, 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).</p>	<p>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.</p> <p>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).</p>	<p>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.</p> <p>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</p>

<p>2.A1.2 Recognize and describe repeating patterns involving geometric shapes in a variety of contexts.</p> <p>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.</p> <p>2.A.2.1 Use objects and number lines and create real-world situations to represent number sentences.</p> <p>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).</p>	<p>3.A.1.2 Describe the rule for a pattern from an input/output table or function machine involving addition, subtraction or multiplication.</p> <p>3.A.1.3 Construct and explore models of growing patterns and construct the next steps.</p> <div style="text-align: center;">  <p>1st 2nd 3rd 4th</p> </div> <p>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.</p> <p>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.</p> <p>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).</p>	<p>number patterns). Record the inputs and outputs in a chart or table.</p> <p>4.A1.2 Describe the rule for a pattern from a input/output table or function machine involving addition, subtraction, multiplication, or division.</p> <p>Assessment Boundary: Rules do not include explicit rules...</p> <p>4.A1.3 Create, describe, and extend a wide variety of patterns involving geometric shapes and define the rule of the pattern.</p> <p>4.A.2. Apply mathematical actions and processes to use multiplication, division with unknowns to create number sentences representing a given problem situation using a number sentence.</p> <p>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).</p> <p>4.A.2.2 Solve for unknowns in one-step arithmetic 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</p>
Geometry and Measurement		
Second	Third	Fourth
<p>2.GM.1. Apply mathematical actions and processes standards to analyze attributes of two- and three-dimensional figures develop generalizations about their properties.</p>	<p>3.GM.1. Apply mathematical actions and processes to use geometric attributes to describe and create shapes in various contexts.</p> <p>3.GM.1.1 Identify parallel and perpendicular lines in</p>	<p>4.GM.1. Apply mathematical actions and processes to name, describe, classify and construct polygons.</p> <p>4.GM.1.1 Describe, classify and construct</p>

<p>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.</p> <p>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).</p> <p>2.GM.2. Apply mathematical actions and processes to understand length as a measurable attribute; use tools to measure length.</p> <p>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. Example: It takes more centimeters to measure a table than it does meters because centimeters are smaller than meters.</p> <p>2.GM.2.2 Explain of the relationship between length and the numbers on a ruler by using a ruler to measure lengths to the nearest centimeter or inch.</p> <p>2.GM.3. Apply mathematical actions and processes to tell time.</p> <p>2.GM.3.1 Tell time to the quarter-hour and distinguish between a.m. and p.m. (analog and digital).</p>	<p>various contexts.</p> <p>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.</p> <p>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.</p> <p>3.GM2.2 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).</p> <p>3.GM.2.3 Find the perimeter of a polygon.</p> <p>3.GM.2.4 Use an analog thermometer to determine temperature to the nearest degree in Fahrenheit and Celsius.</p> <p>3.GM.3. Apply mathematical actions and processes to tell time.</p> <p>3.GM.3.1 Read and write time to the nearest minute (analog and digital).</p> <p>3.GM.3.2 Determine the solutions to problems involving addition and subtraction of time intervals in minutes using pictorial models or tools up to one hour (e.g.15-minute event plus a 30-minute event equals 45 minutes).</p>	<p>triangles, including equilateral, right, obtuse and acute triangles. Recognize triangles in various contexts.</p> <p>4.GM.1.2 Describe, classify and construct quadrilaterals, including squares, rectangles, trapezoids, rhombuses, parallelograms and kites. Recognize quadrilaterals in various contexts.</p> <p>4.GM.2. Apply mathematical actions and processes to transformations and use symmetry to analyze mathematical situations.</p> <p>4.GM.2.1 Predict and describe the results of sliding, flipping and turning 2-dimensional shapes. Clarification: NCTM used flip, turn and slide, formal transformations will be introduced in later grades.</p> <p>4.GM.2.2 Identify and describe the line(s) of symmetry in 2-dimensional shapes.</p> <p>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.</p> <p>4.GM.3.1 Measure angles in geometric figures and real world objects with a protractor or angle ruler.</p> <p>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.</p> <p>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</p>
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		<p>into rows and columns.</p> <p>4.GM.3.4 Find the area of polygons that can be decomposed into rectangles.</p> <p>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. Clarification: Anything smaller than a centimeter should be measured in millimeters. No need to “fraction” centimeters.</p> <p>4.GM.3.6 Solve problems that deal with measurements of length, intervals of time, when to use liquid volumes, when to use mass, temperatures above zero and money using addition, subtraction, multiplication, or division as appropriate. Clarification: Focus should be on why and when to use the tools in addition to how to use the tools.</p>
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Data and Probability

Second	Third	Fourth
<p>2.D1. Apply mathematical actions and processes to organize data to make it useful for interpreting information and solving problems.</p> <p>2.D1.1 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.</p> <p>2.D1.2 Organize a collection of data with up to four categories using pictographs and bar graphs with intervals of one or more.</p> <p>2.D1.3 Write and solve one-step word problems involving addition or subtraction using data represented within pictographs and bar graphs</p>	<p>3.D1. Apply mathematical actions and processes to organize data to make it useful for interpreting information and solving problems.</p> <p>3.D1.1 Summarize a data set with multiple categories using a frequency table, line plot, pictograph, and/or bar graph with scaled intervals.</p> <p>3.D1.2 Solve one- and two-step problems using categorical data represented with a frequency table, dot plot, pictograph, and/or bar graph with scaled intervals.</p>	<p>4.D1. Apply mathematical actions and processes to solve problems by collecting, organizing, displaying, and interpreting data.</p> <p>4.D1.1 Represent data on a frequency table or dot plot marked with whole numbers and fractions using appropriate titles, labels and units.</p> <p>4.D1.2 Use tables, bar graphs, timelines and Venn diagrams to display data sets. The data may include benchmark fractions or decimals.</p> <p>4.D1.3 Solve one- and two-step problems using data in whole number, decimal, and fraction form in a frequency table and dot plot.</p>

with intervals of one 2.D1.4 Draw conclusions and make predictions from information in a graph.		
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Number and Operations

Grade 5	Grade 6	Grade 7	Pre-Algebra
<p>5.N.1 Apply mathematical actions and processes to divide multi-digit numbers and solve real-world and mathematical problems using arithmetic.</p> <p>5.N.1.1 Estimate solutions to division problems in order to assess the reasonableness of results.</p> <p>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.</p> <p>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</p>	<p>6.N.1 Apply mathematical actions and processes to read, write, represent and compare 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.</p> <p>6.N.1.1 Locate positive rational numbers on a number line.</p> <p>6.N.1.2 Compare positive rational numbers represented in various forms using the symbols $<$, $>$, and $=$.</p> <p>6.N.1.3 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) and select among these representations to solve real-world or mathematical situations.</p> <p>6.N.1.4 Factor whole numbers; express a whole number as a product of prime factors with exponents.</p> <p>6.N.1.5 Determine greatest common factors and least common</p>	<p>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.</p> <p>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.</p> <p>7.N.1.2 Locate positive and negative rational numbers on a number line and understand the concept of opposites.</p> <p>7.N.1.3 Compare and order positive and negative rational numbers expressed in various forms using the symbols $<$, $>$, $=$, \leq, and \geq.</p> <p>7.N.2 Apply mathematical actions and processes to calculate with positive and negative rational numbers, and rational numbers with whole number exponents, to solve real-world and mathematical problems.</p> <p>7.N.2.1 Use real-world contexts and the inverse relationship between addition and</p>	<p>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.</p> <p>PA.N.1.1 Develop and apply the properties of positive and negative integer exponents to generate equivalent numerical expressions, including $a^0 = 1$.</p> <p>PA.N.1.2 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 involved.</p> <p>PA.N.1.3 Classify real numbers as rational or irrational. Recognize when a square root of a positive integer is not an</p>

<p>technology, and the context of the problem to assess the reasonableness of results.</p> <p>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.</p> <p>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).</p> <p>5.N.2.2 Model, read and write decimals using place value to describe decimal numbers from at least millions to thousandths.</p> <p>5.N.2.3 Compare and order fractions and decimals, including mixed numbers and improper fractions, and locate on a number line.</p> <p>5.N.2.4 Recognize and generate equivalent decimals, fractions, mixed numbers and improper fractions in various contexts.</p> <p>5.N.3 Apply mathematical actions and processes to add and subtract fractions, mixed numbers and</p>	<p>multiples. Use common factors and common multiples to calculate with fractions and find equivalent fractions.</p> <p>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.</p> <p>6.N.2.1 Identify and use ratios to compare quantities and use scaling up to solve problems.</p> <p>6.N.2.2 Determine the unit rate for ratios of quantities with different units.</p> <p>6.N.3 Apply mathematical actions and processes to multiply and divide decimals, fractions and mixed numbers; solve real-world and mathematical problems using arithmetic with positive rational numbers.</p> <p>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.</p> <p>6.N.3.2 Using the meanings of fractions, meanings of whole</p>	<p>subtraction to explain why the procedures of arithmetic with negative rational numbers make sense.</p> <p>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).</p> <p>7.N.2.3 Add, subtract, multiply and divide positive and negative rational numbers that are integers, fractions and terminating decimals; use efficient and generalizable procedures, including standard algorithms.</p> <p>7.N.2.4 Raise integers to whole number exponents.</p> <p>7.N.2.5 Solve real-world and mathematical problems involving calculations with positive and negative rational numbers and positive integer exponents.</p> <p>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.</p> <p>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).</p>	<p>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.</p> <p>PA.N.1.4 Compare real numbers; locate real numbers on a number line. Identify the square root of a perfect square to 169 or, if it is not a perfect square root, locate it as a real number between two consecutive positive integers.</p>
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<p>decimals to solve real-world and mathematical problems.</p> <p>5.N.3.1 Estimate sums and differences of fractions and decimals to assess the reasonableness of the results.</p> <p>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).</p> <p>5.N.3.3 Add and subtract fractions and decimals, using efficient and generalizable procedures, including standard algorithms in order to solve real world and mathematical problems including those involving money, measurement, geometry, and data.</p> <p>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.</p>	<p>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).</p> <p>6.N.3.3 Multiply and divide fractions and decimals, using efficient and generalizable procedures, including standard algorithms.</p> <p>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.</p>		
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Algebraic Reasoning and Algebra			
Grade 5	Grade 6	Grade 7	Pre-Algebra
<p>5.A.1 Apply mathematical actions and processes to create and use patterns, tables, graphs and rules</p>	<p>6.A.1 Apply mathematical actions and processes to recognize and represent relationships between</p>	<p>7.A.1 Apply mathematical actions and processes to create and use patterns, tables, graphs and rules to solve real-world and mathematical problems.</p> <p>7.A.1.1 Create and use rules, tables, spreadsheets</p>	<p>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.</p>

<p>to describe patterns to solve real-world and mathematical problems.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>5.A.2.1 Apply the commutative, associative, and distributive properties and order of operations</p>	<p>varying quantities; translate from one representation to another; use patterns, tables, graphs and rules to solve real-world and mathematical problems.</p> <p>6.A.1.1 Create and use rules, tables, and graphs to describe patterns of change and make predictions and generalizations about real-world and mathematical problems.</p> <p>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.</p> <p>6.A.1.3 Translate between any two of these representations.</p> <p>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.</p> <p>6.A.2.1 Apply the</p>	<p>and graphs to describe patterns of change and make predictions and generalizations about real-world and mathematical problems; translate between any two of these representations.</p> <p>7.A.2 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.</p> <p>7.A.2.1 Write and solve two-step linear equations with one variable using number sense, the properties of operations, and the properties of equality.</p> <p>7.A.2.2 Model, write, solve, and graph one-step linear inequalities with one variable.</p> <p>7.A.3 Apply mathematical actions and processes to use ratios to solve real-world and mathematical problems.</p> <p>7.A.3.1 Apply the relationship between ratios, equivalent fractions and percents to solve problems in various contexts, including those involving mixtures and concentrations.</p> <p>7.A.3.2 Use scaling up, scale factor, and unit rate reasoning to solve ratio and rate problems.</p> <p>7.A.4 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.</p> <p>7.A.4.1 Use properties of algebra to generate equivalent numerical and algebraic expressions containing rational numbers, grouping symbols and</p>	<p>PA.A.1.1 Identify 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.</p> <p>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 constant times that amount.</p> <p>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.</p> <p>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.</p> <p>PA.A.2.1 Represent linear functions with tables, verbal descriptions, symbols, equations and graphs; translate from one representation to another.</p> <p>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).</p> <p>PA.A.2.3 Identify graphical properties of linear functions including slopes and intercepts. Know</p>
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<p>to generate equivalent numerical expressions and to solve problems involving whole numbers.</p> <p>5.A.2.2 Determine whether an equation or inequality involving a variable is true or false for a given value of the variable.</p> <p>5.A.2.3 Evaluate expressions and solve equations involving variables when values for the variables are given.</p>	<p>associative, commutative and distributive properties and order of operations to generate equivalent expressions and to solve problems involving positive rational numbers.</p> <p>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.</p> <p>6.A.3.1 Represent real-world or mathematical situations using equations and inequalities involving variables and positive rational numbers.</p> <p>6.A.3.2 Solve equations involving positive rational numbers using number</p>	<p>whole number exponents. Properties of algebra include associative, commutative and distributive laws.</p> <p>7.A.4.2 Apply understanding of order of operations and grouping symbols when using calculators and other technologies.</p> <p>7.A.5 Apply mathematical actions and processes to represent real-world and mathematical situations using equations with variables. Solve equations symbolically, using the properties of equality. Also solve equations graphically and numerically. Interpret solutions in the original context.</p> <p>7.A.5.1 Represent relationships in various contexts with equations involving variables and positive and negative rational numbers. Use the properties of equality to solve for the value of a variable. Interpret the solution in the original context.</p> <p>7.A.5.2 Solve equations resulting from proportional relationships in various contexts.</p>	<p>that the slope equals the rate of change, and that the y-intercept is zero when the function represents a proportional relationship.</p> <p>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). Know how to use graphing technology to examine these effects.</p> <p>PA.A.2.5 Using data generated from an arithmetic sequence (e.g., tables, graphs, and verbal descriptions), write a linear function representing the data</p> <p>PA.A.3 Apply mathematical actions and processes to generate equivalent numerical and algebraic expressions and use algebraic properties to evaluate expressions.</p> <p>PA.A.3.1 Evaluate algebraic expressions using a variety of methods including modeling and substitution.</p> <p>PA.A.3.2 Justify steps in generating equivalent expressions by identifying the properties used, including the properties of algebra. Properties include the associative, commutative and distributive laws, and the order of operations, including grouping symbols.</p> <p>PA.A.4 Apply mathematical actions and processes to represent real-world and mathematical situations using equations and inequalities involving linear expressions. Solve and graph equations and inequalities symbolically and graphically. Interpret solutions in the original context.</p>
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	<p>sense, properties of arithmetic and the idea of maintaining equality on both sides of the equation. Interpret a solution in the original context and assess the reasonableness of results.</p> <p>6.A.3.3 Model, write, solve, and graph one-step equations with one variable using number sense, the properties of operations, and the properties of equality (e.g., $1/3x = 9$).</p>		<p>PA.A.4.1 Model, write, and solve multi-step linear equations with one variable using a variety of methods to solve application problems.</p> <p>PA.A.4.2 Graph and interpret the solution to one- and two-step linear equations on a number line with one variable and on a coordinate plane with two variables.</p> <p>PA.A.4.3 Solve multi-step equations in one variable. Graph the solution on a number line. Justify the steps by identifying the properties of equalities used.</p> <p>PA.A.4.4 Model, write, solve, and graph one- and two-step linear inequalities with one variable.</p> <p>PA.A.4.5 Express linear equations in slope-intercept, point-slope and standard forms, and convert between these forms. Given sufficient information, find an equation of a line.</p> <p>PA.A.4.6 Solve linear inequalities with one variable using properties of inequalities. Graph the solutions on a number line.</p> <p>PA.A.4.7 Use the relationship between square roots and squares of a number to solve problems.</p> <p>PA.A.4.8 Apply appropriate formulas to solve problems (e.g., $d=rt$, $l=prt$).</p> <p>PA.A.4.9 Represent and create real-world situations using equations and inequalities involving one variable.</p>
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Geometry and Measurement

Grade 5	Grade 6	Grade 7	Pre-Algebra
5.GM.1 Apply mathematical actions and processes to describe, classify, and draw	6.GM.1 Apply mathematical actions and processes to calculate perimeter and area of two- dimensional figures to solve real-	7.GM.1 Apply mathematical actions and processes to analyze the effect of change of scale, translations and	PA.GM.1 Apply mathematical actions and processes to solve problems involving right

<p>representations of three-dimensional figures.</p> <p>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 types of faces.</p> <p>5.GM.1.2 Recognize and draw a net for a three-dimensional figure (e.g., cubes, rectangular prisms, pyramids).</p> <p>5.GM.2 Apply mathematical actions and processes to determine the area of triangles and parallelograms.</p> <p>5.GM.2.1 Develop and use formulas to determine the area of triangles and parallelograms.</p> <p>5.GM.2.2 Find the area of polygons that can be decomposed into triangles.</p> <p>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.</p> <p>5.GM.3.1 Compare angles according to size. Classify angles as acute, right, and obtuse.</p>	<p>world and mathematical problems.</p> <p>6.GM.1.1 Develop and use formulas for the area of quadrilaterals (e.g., squares, rectangles, rhombi, parallelograms, trapezoids, kites) using a variety of methods including the formula.</p> <p>6.GM.2 Apply mathematical actions and processes to understand and use relationships between angles in geometric figures.</p> <p>6.GM.2.1 Solve problems using the relationships between the angles formed by intersecting lines, including vertical, supplementary, and complementary angles.</p> <p>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°. Use models of triangles to illustrate this fact.</p> <p>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.</p> <p>6.GM.3.1 Solve problems in various contexts involving conversion of weights, capacities, geometric measurements and times within measurement systems using appropriate units.</p>	<p>reflections on the attributes of two-dimensional figures.</p> <p>7.GM.1.1 Describe the properties of similarity, compare geometric figures for similarity, and determine scale factors.</p> <p>7.GM.1.2 Apply scale factors, length ratios and area ratios to determine side lengths and areas of similar geometric figures.</p> <p>7.GM.1.3 Use proportions and ratios to solve problems involving scale drawings and conversions of measurement units.</p> <p>7.GM.1.4 Graph and describe translations and reflections of figures on a coordinate grid and determine the coordinates of the vertices of the figure after the transformation.</p> <p>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.</p> <p>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 π and can be approximated by rational numbers such as $\frac{22}{7}$ and 3.14.</p> <p>7.GM.2.2 Calculate the circumference and area of circles to solve problems in</p>	<p>triangles using the Pythagorean Theorem.</p> <p>PA.GM.1.1 Informally justify the Pythagorean Theorem using measurements, diagrams and computer software and use the Pythagorean Theorem to solve problems involving right triangles.</p> <p>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.</p> <p>PA.GM.2 Apply mathematical actions and processes to solve problems involving parallel and perpendicular lines on a coordinate system.</p> <p>PA.GM.2.1 Understand and apply the relationships between the slopes of parallel lines and between the slopes of perpendicular lines. Dynamic graphing software may be used to examine these relationships.</p> <p>PA.GM.2.2 Given a line on a coordinate system and the coordinates of a point not on the line, find lines through that point that are parallel and perpendicular to the given line, symbolically and graphically.</p> <p>PA.GM.3 Apply mathematical</p>
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<p>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.</p>		<p>various contexts.</p> <p>7.GM.3 Apply mathematical actions and processes to develop and understand the concept of surface area and volume of three-dimensional figures.</p> <p>7.GM.3.1 Develop the concept that the volume of a three-dimensional figure can be found by counting the total number of same-sized cubic units that fill a shape without gaps or overlaps and that surface area of a three-dimensional figure can be found by wrapping the figure with same-sized cubic units without gaps or overlap.</p> <p>7.GM.3.2 Use various tools and strategies to measure the volume and surface area of rectangular prisms. Use cubic units to label volume measurements.</p>	<p>actions and processes to calculate surface area and volume of three-dimensional figures.</p> <p>PA.GM.3.1 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 unit cubes.</p> <p>PA.GM.3.2 Develop and use the formulas $V = Bh$ and $V = \pi r^2 h$ to determine the volume of right cylinders. Justify why base area B and height h are multiplied to find the volume of a right cylinder by breaking the cylinder into an infinite number of layers of circles with radius r.</p> <p>PA.GM.3.3 Calculate the surface area and volume of rectangular prisms and cylinders using appropriate units, such as cm^2 and cm^3. Justify the formulas used. Justification may involve decomposition, nets or other models.</p>
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Data and Probability

Grade 5	Grade 6	Grade 7	Pre-Algebra
<p>5.D.1 Apply mathematical actions and processes to display and interpret data; determine mean, median and</p>	<p>6.D.1 Apply mathematical actions and processes to display and interpret data, including box and whisker plots.</p> <p>6.D.1.1 For a given set of data, explain and</p>	<p>7.D.1 Apply mathematical actions and processes to display and interpret data in a variety of ways, including circle graphs and histograms.</p>	<p>PA.D.1 Apply mathematical actions and processes to display and interpret data in a variety of ways, including using</p>

<p>range.</p> <p>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.</p> <p>5.D.1.2 Create and analyze double-bar graphs and line graphs by applying understanding of whole numbers, fractions and decimals. Know how to create spreadsheet tables and graphs to display data.</p>	<p>defend which measure of central tendency (mean, median, and mode) would provide the most descriptive information.</p> <p>6.D.1.2 Create and analyze box and whisker plots exploring how each segment contains $\frac{1}{4}$ of the data.</p> <p>6.D.2 Apply mathematical actions and processes to use probabilities to solve real-world and mathematical problems: represent probabilities using fractions, decimals, and percents.</p> <p>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</p> <p>6.D.2.2 Perform experiments for situations in which the probabilities are known, compare the resulting relative frequencies with the known probabilities; know that there may be differences.</p>	<p>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.</p> <p>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.</p> <p>7.D.2 Apply mathematical actions and processes to calculate probabilities and reason about probabilities using proportions to solve real-world and mathematical problems.</p> <p>7.D.2.1 Determine the 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.</p> <p>7.D.2.2 Use proportional reasoning to draw conclusions about and predict relative frequencies of outcomes based on probabilities.</p>	<p>scatterplots and approximate lines of best fit. Use lines of best fit to draw conclusions about data.</p> <p>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.</p> <p>PA.D.1.2 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.</p> <p>PA.D.1.3 Use a line of best fit to make statements about approximate 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.</p> <p>PA.D.2 Apply mathematical actions and processes to calculate experimental probabilities and reason about</p>
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			<p>probabilities to solve real-world and mathematical problems.</p> <p>PA.D.2.1 Calculate experimental probabilities from experiments; represent them as percents, fractions and decimals between 0 and 1 inclusive. Use experimental probabilities to make predictions when actual probabilities are unknown.</p>
Number and Operations			
Algebra I		Algebra II	
<p>A1.N.1 Apply mathematical actions and processes to operate with irrational numbers in radical form.</p> <p>A1.N.1.1 Simplify radicals with or without variables.</p> <p>A1.N.1.2 Add, subtract, and multiply radicals with or without variables, and divide radicals without variables.</p>		<p>A2.N.1 Apply mathematical actions and processes to understand and interpret expressions written with rational exponents.</p> <p>A2.N.1.1 Convert from radical notation to rational exponent and vice versa.</p> <p>A2.N.1.2 Add, subtract, multiply, divide and simplify expressions containing rational exponents.</p> <p>A2.N.2 Apply mathematical actions and processes to understand and correctly represent complex numbers.</p> <p>A2.N.2.1 Simplify complex numbers</p> <p>A2.N.2.2 Add, subtract, multiply, divide complex numbers.</p> <p>A2.N.3 Apply mathematical actions and processes to represent, interpret, and manipulate data in matrix form.</p> <p>A2.N.3.1 Identify the order (dimension) of a matrix.</p> <p>A2.N.3.2 Add and subtract matrices.</p> <p>A2.N.3.3 Multiply a matrix by a scalar.</p>	
Algebraic Reasoning and Algebra			
Algebra I		Algebra II	
<p>A1.A.1 Apply mathematical actions and processes to represent real-world and mathematical situations using equations and inequalities involving linear expressions. Students will solve equations and inequalities symbolically and graphically and interpret solutions in the original context.</p>		<p>A2.A.1 Apply mathematical actions and processes to solve real-world and mathematical situations using equations and inequalities involving linear, quadratic, exponential, and nth root expressions and interpret the solutions in the original context.</p>	

A1.A.1.1 Solve equations symbolically and graphically.

A1.A.1.1a Solve real-world problems by using first-degree equations (i.e. using monomial or binomial expressions as angle measures with vertical, complementary, supplementary angles, geometric formulas, science, or statistics).

A1.A.1.1b Solve linear equations and absolute value equations by graphing, or using properties of equality.

A1.A.1.1c Solve systems of linear equations by graphing, substitution, and elimination.

A1.A.1.2 Solve inequalities symbolically and graphically.

A1.A.1.2a Match inequalities (with 1 or 2 variables) to a graph, table, or situation and vice versa.

A1.A.1.2b Solve linear inequalities and absolute value inequalities by graphing or using properties of inequalities.

A1.A.1.2c Solve systems of linear inequalities with two variables.

A1.A.1.2d Represent relationships in various contexts with inequalities involving the absolute value of a linear expression. Solve these inequalities and graph the solutions on a number line.

A1.A.2 Apply mathematical actions and processes to generate equivalent algebraic expressions and use algebraic properties to evaluate expressions with and without the use of technology.

A1.A.2.1 Solve literal equations involving several variables for one variable in terms of the others.

A1.A.2.2 Connect various representations of a linear equation (slope-intercept, point-slope, and standard forms) and manipulate to fit given context.

A1.A.2.3 Develop the equation of a line and graph linear relationships given the following: slope and y-intercept, slope and one-point on the line, two points on the line, x-intercept and y-intercept, a set of data points.

A1.A.2.4 Simplify and evaluate linear, absolute value, rational and radical expressions.

A1.A.2.5 Simplify polynomials by adding, subtracting or multiplying.

A1.A.2.6 Recognize, write and find the nth term of arithmetic sequences using proper notation.

A2.A.1.1 Solve quadratic equations using various methods including graphing, factoring, completing the square and the quadratic formula.

A2.A.1.2 Solve rational equations, consider domain restrictions and extraneous solutions.

A2.A.1.3 Solve equations that contain radical expressions, consider domain restrictions and extraneous solutions

A2.A.1.4 Solve polynomial equations using various methods and tools which may include factoring, polynomial division, and synthetic division.

A2.A.1.5 Solve common and natural logarithmic equations using a variety of methods and tools.

A2.A.1.6 Solve systems of linear equations and inequalities using various methods and tools which may include substitution, elimination, matrices, graphing, and graphing calculators.

A2.A.1.7 Solve systems of equations containing one linear equation and one quadratic equation to solve problems.

A2.A.1.8 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.

A2.A.2 Apply mathematical actions and processes to represent and analyze mathematical situations and structures using algebraic symbols. Students should be able to utilize flexible, accurate, efficient, and appropriate strategies to write equivalent forms of expressions and solve equations.

A2.A.2.1 Factor polynomial and quadratics expressions involving common factors, trinomials, and differences of squares, using a variety of tools and strategies.

A2.A.2.2 Generate equivalent algebraic expressions involving polynomials and radicals; use algebraic properties to evaluate expressions.

A2.A.2.3 Connect various representations of a parabolic equation (vertex, factored, and standard forms) and manipulate to fit given context.

A2.A.2.4 Recognize and solve problems that can be modeled using finite geometric sequences and series, such as home mortgage and other compound interest examples. Know how to use spreadsheets and calculators to explore geometric sequences and series in various contexts.

A2.A.2.5 Use the properties of logarithms to expand and condense

<p>A1.A.3 Apply mathematical actions and processes to analyze mathematical change in various contexts.</p> <p>A1.A.3.1 Calculate the slope of a line using a graph, an equation, two points or a set of data points.</p> <p>A1.A.3.2 Use the slope to differentiate between lines that are parallel, perpendicular, horizontal, or vertical.</p> <p>A1.A.3.3 Interpret the slope and intercepts within the context of everyday life (e.g., telephone charges base on base rate [y-intercept] plus rate per minute [slope]).</p> <p>A1.A.3.4 Relate a graph to a situation described qualitatively in terms of faster change or slower change.</p>	<p>logarithmic expressions.</p>
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Functions

Algebra I	Algebra II
<p>A1.F.1 Apply mathematical actions and processes to understand functions as descriptions of how related quantities vary together (covariation).</p> <p>A1.F.1.1 Distinguish between relations and functions using various methods including the vertical line test and the definition of a function.</p> <p>A1.F.1.2 Identify dependent and independent variables, domain and range in terms of valid input and output, and in terms of function graphs.</p> <p>A1.F.1.3 Write a linear function using function notation and explain its use in terms of a situational context.</p> <p>A1.F.1.4 Read and interpret linear piecewise graphs (for example, absolute values), excluding step functions.</p> <p>A1.F.2 Apply mathematical actions and processes to understand that families of functions are characterized by their type of rate of change.</p> <p>A1.F.2.1 Distinguish between linear and nonlinear data through tables, graphs, equations, and real-world situations.</p> <p>A1.F.2.2 Recognize the parent graph of the functions $f(x)=k$, $f(x)=x$, $f(x)=\text{abs}(x)$, and predict the effects of transformations symbolically and graphically on the parent graph using various methods and tools which may include graphing calculators.</p> <p>A1.F.3 Apply mathematical actions and processes to understand functions can be combined arithmetically and in some cases will have an inverse.</p>	<p>A2.F.1 Apply mathematical actions and processes to understand functions as descriptions of how related quantities vary together (covariation).</p> <p>A2.F.1.1 Use algebraic, interval, and set notations to specify the domain and range of functions of various types.</p> <p>A2.F.1.2 Graph a quadratic function and 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.</p> <p>A2.F.1.3 Model a situation that can be described by a quadratic function and use the model to answer questions about the situation.</p> <p>A2.F.1.4 Graph exponential and logarithmic functions and identify asymptotes and x- and y- intercepts using various methods and tools which may include graphing calculators. Recognize exponential decay and growth graphically and symbolically.</p> <p>A2.F.1.5 Model a situation that can be described by an exponential or logarithmic function and use the model to answer questions about the situation.</p> <p>A2.F.1.6 Graph a polynomial function and identify the x- and y- intercepts, relative maximums and relative minimums, using various methods and tools which may include a graphing calculator.</p> <p>A2.F.1.7 Model a situation that can be described by a polynomial function and use the model to answer questions about the situation.</p> <p>A2.F.1.8 Graph a rational function and identify the x- and y- intercepts,</p>

<p>A1.F.3.1 Add, subtract, and multiply polynomial functions.</p> <p>A1.F.4 Apply mathematical actions and processes to understand functions can be represented in multiple ways.</p> <p>A1.F.4.1 Evaluate a function using tables, equations and graphs and, when possible, interpret the results in terms of the situational context.</p> <p>A1.F.4.2 Identify matching linear equations, graphs, tables, and situations.</p>	<p>vertical and horizontal asymptotes, using various methods and tools which may include a graphing calculator.</p> <p>A2.F.1.9 Model a situation that can be described by a rational function and use the model to answer questions about the situation.</p> <p>A2.F.1.10 Graph a radical function and identify the x- and y- intercepts using various methods and tools which may include a graphing calculator.</p> <p>A2.F.1.11 Model a situation that can be described by a radical function and use the model to answer questions about the situation.</p> <p>A2.F.1.12 Read, interpret, and model piecewise graphs, including step functions.</p> <p>A2.F.2 Apply mathematical actions and processes to understand that families of functions are characterized by their type of rate of change.</p> <p>A2.F.2.1 Recognize the parent graphs of polynomial, exponential, radical, quadratic, and logarithmic functions and predict the effects of transformations symbolically and graphically on the parent graphs, using various methods and tools which may include graphing calculators [For example, $f(x)+c$, $f(x+c)$, $f(cx)$, and $cf(x)$, where c is a positive or negative constant.].</p> <p>A2.F.3 Apply mathematical actions and processes to understand functions can be combined arithmetically and by composition and in some cases will have an inverse.</p> <p>A2.F.3.1 Add, subtract, multiply, and divide functions using function notation and recognize domain restrictions.</p> <p>A2.F.3.2 Combine functions by composition and recognize that $f(x)$ and $g(x)$ are inverse functions if $f(g(x))=g(f(x))=x$.</p> <p>A2.F.3.3 Find and graph the inverse of a function, if it exists, and know the graphs are symmetric about the line $y=x$.</p> <p>A2.F.3.4 Apply the inverse relationship between exponential and logarithmic functions to convert from one form to another.</p>
Data and Probability	
Algebra I	Algebra II
<p>A1.D.1 Apply mathematical actions and processes to display and analyze data.</p> <p>A1.D.1.1 Describe a data set using data displays, describe and compare data</p>	<p>A2.D.1 Apply mathematical actions and processes to display and analyze data.</p> <p>A2.D.1.1 Use the mean and standard deviation of a data set to fit it to a</p>

sets using summary statistics, including measures of center, location and spread. Measures of center and location include mean, median, 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.

A1.D.1.2 Collect 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.

A1.D.1.3 Interpret graphs as being discrete or continuous based upon the context of the problem/situation.

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

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.

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, as used in computerized searches and spreadsheets.

A1.D.2.3 Calculate experimental probabilities by performing simulations or experiments involving a probability model and using relative frequencies of outcomes.

A1.D.2.4 Apply probability concepts to real-world situations to make informed decisions.

normal distribution (bell-shaped curve) and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate.

A2.D.1.2 Collect and use scatterplots to analyze patterns and describe linear, exponential or polynomial relationships between two variables. Using graphing technology, determine regression equation and correlation coefficients; use regression equations to make predictions and correlation coefficients to assess the reliability of those predictions.

A2.D.1.3 Based upon the context of the situation/problem recognize whether a discrete or continuous graphical representation is appropriate and then create the graph.

A2.D.2 Apply mathematical actions and processes to calculate probabilities and apply probability concepts.

A2.D.2.1 Understand and use simple probability formulas involving intersections, unions and complements of events.

A2.D.2.2 Apply probability concepts such as intersections, unions and complements of events, and conditional probability and independence, to calculate probabilities and solve problems.

A2.D.3 Apply mathematical actions and processes to analyze statistical thinking to draw inferences, make predictions and justify conclusions.

A2.D.3.1 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. Show how graphs and data can be distorted to support different points of view. Know how to use spreadsheet tables and graphs or graphing technology to recognize and analyze distortions in data displays.

A2.D.3.2 Identify and explain misleading uses of data; recognize when arguments based on data confuse correlation and causation.

Geometry

Logic and Reasoning

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

G.1.1 Understand the roles of axioms, postulates, definitions, undefined terms and theorems in logical arguments.

G.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.

G.1.3 Assess the validity of a logical argument and give counterexamples to disprove a statement.

G.1.4 Construct logical arguments and write proofs of theorems and other results in geometry, including proofs by contradiction. Express proofs in a form that clearly justifies the reasoning, such as two-column proofs, paragraph proofs, flow charts or illustrations.

2-D Line and Angle Relationships

G.2 Apply mathematical actions and process to discover and validate the relationships between lines and angles using theorems and postulates of parallel and perpendicular lines.

G.2.1 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.

G.2.2 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 using algebraic and deductive proofs.

2-D Shapes

G.3 Apply mathematical actions and process to develop and evaluate mathematical arguments about polygons and transformed shapes.

G.3.1 Discover the Interior and Exterior Angle Sum Theorems, and use them to solve problems and logically justify results.

G.3.2 Discover the properties of quadrilaterals and use them to solve problems involving angles and side lengths, and logically justify results.

G.3.3 Discover the properties of polygons and use them to solve problems involving perimeter and area, and logically justify results.

G.3.4 Know and apply properties of congruent and similar figures to solve problems and logically justify results.

G.3.5 Use numeric, graphic and symbolic 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 grid.

Circles

G.4 Apply mathematical actions and process to develop relationships and conduct investigations of circles involving lines and angles.

G.4.1 Discover and use the properties of circles to solve problems involving circumference and area, and logically justify results.

G.4.2 Discover and use properties of circles and relationships among angles, arcs, and distances in a circle to define them, solve problems and logically justify results.

G.4.3 Extend the distance formula to develop the equation for the graph of a circle with radius r and center (h, k) , $(x - h)^2 + (y - k)^2 = r^2$

Elementary Trigonometry

G.5 Apply mathematical actions and process to develop and verify mathematical relationships of right triangles and trigonometric ratios.

G.5.1 Apply the Pythagorean Theorem and its converse to solve problems and logically justify results, including Pythagorean Triples.

G.5.2 Explore and develop the distance formula based on the Pythagorean Theorem.

G.5.3 Discover, verify, and apply properties of right triangles, including properties of 45-45-90 and 30-60-90 triangles, to solve problems and logically justify results.

G.5.4 Understand how the properties of similar right triangles allow the trigonometric ratios to be defined, and determine the sine, cosine and tangent of an acute angle in a right triangle.

G.5.5 Apply the trigonometric ratios (sine, cosine and tangent) to solve problems, such as determining lengths in right triangles and in figures that can be decomposed into right triangles. Know how to use calculators or other appropriate technology to evaluate trigonometric ratios.

3-D Shapes

G.6 Apply mathematical actions and processes to develop and apply a variety of problem solving strategies to investigate 3-dimensional figures.

G.6.1 Compose and decompose two- and three-dimensional figures; use decomposition to determine the perimeter, area, surface area and volume of various figures.

G.6.2 Determine the surface area and volume of prisms, cylinders, pyramids, cones and spheres. Use measuring devices or formulas as appropriate.

G.6.3 Use ratios of similar 3-dimensional figures to determine unknown values, such as angles, side lengths, perimeter or circumference of a face, area of a face, and volume.

G.6.4 Understand and 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.