California Digital Learning Integration and Standards Guidance

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Standards Guidance for Mathematics

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The following is an extrcat from the California Digital Integration and Standards Guidance: California Digital Learning Integration and Standards Guidance(DOCX)

Introduction

The purpose of Chapters 5-9 is to present standards and instructional guidance to support the continuum of learning from TK/K through grade 10. These chapters prioritize critical areas of instructional focus by grade levels. Attention to these critical areas will ensure that students transition to the next grade level well prepared to learn new skills and concepts. This guidance serves as a companion resource to the *California Common Core State Standards: Mathematics* and the draft 2021 *Mathematics Framework*. The organization of the content and practice standards as "big ideas" raises the individual standards to a higher level of "big ideas" and highlights the importance of the content and the ways it is connected to other content and practices. The standards guidance is intended to support teachers as they implement math instruction in online, blended, or in-person learning environments.

California's goal for all students is that they learn mathematics as a meaningful subject of connected ideas. Teaching with meaning and connections requires a different organization of content and practice standards. The draft 2021 *Mathematics Framework* advocates for teaching to "big ideas" rather than organizing teaching around the small descriptions of mathematics set out in the standards. Mathematics professor Randy Charles defines a big idea as a "statement of an idea that is central to the learning of mathematics, one that links numerous mathematical understandings into a coherent whole" (Charles & Carmel, 2005, p.10). A "big idea" approach has been shown by research to engage students and increase achievement (Boaler et al., 2021; Cabana et al., 2014, Makar, 2018). The approach raises the individual standards to a higher level of "big ideas" that show teachers and students the importance of the content and the ways it is connected to other content and practices. As teachers orient their approach to big ideas and connections, they will find that there seems to be less content to teach and more time for students to explore ideas and learn deeply. The same content is actually taught and learned, but the organization of connections and big ideas allows for a more coherent approach in which students learn different, connected ideas together. The draft 2021 *Mathematics Framework* has organized Content Connections (CCs) of "Communicating stories with data," "Exploring changing quantities," "Taking wholes apart and putting parts together," and

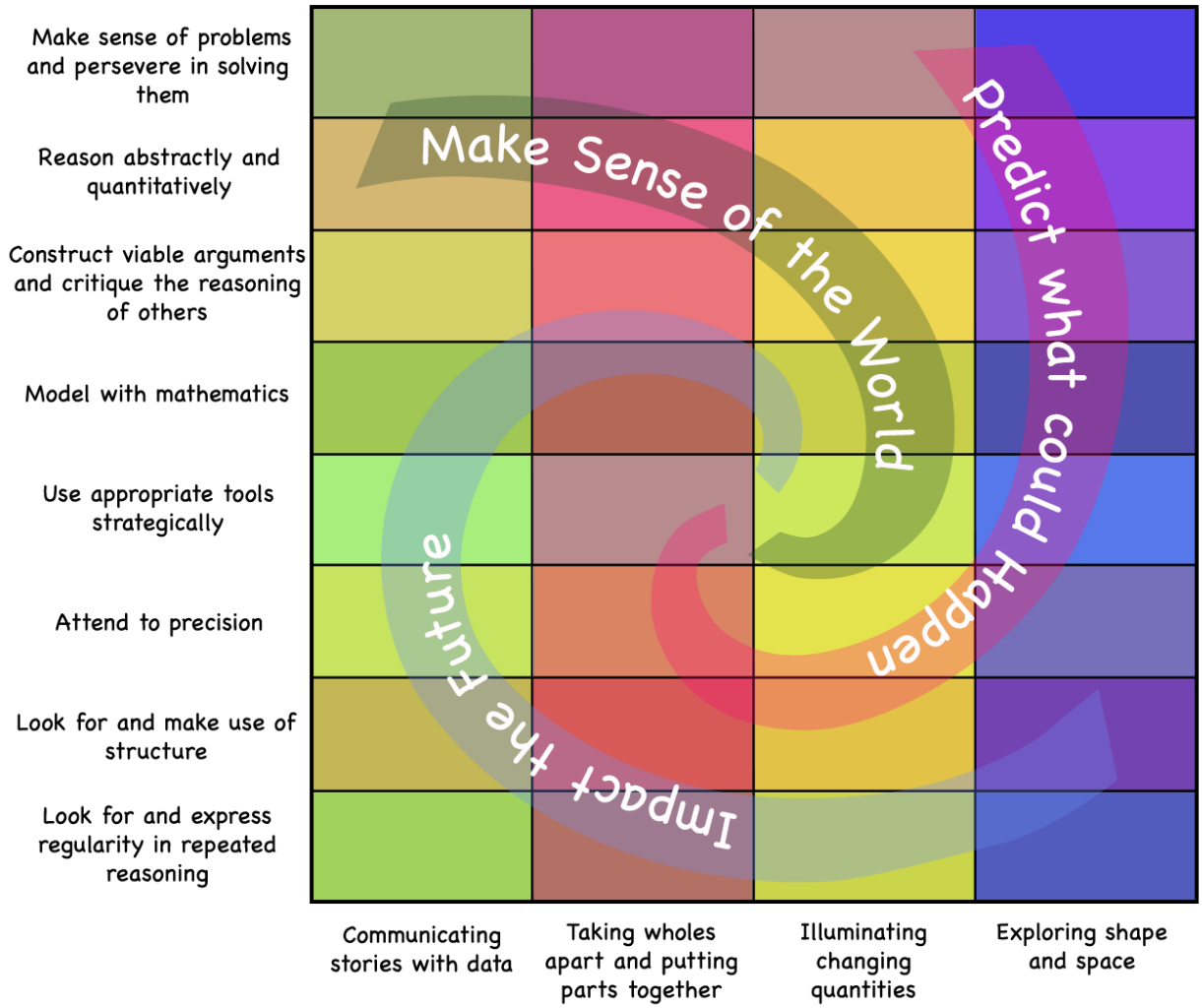
"Discovering shape and space," and this document organizes the big ideas under these broad content headings, which are explained in more detail below. Each grade band section (TK-2, 3-5, 6-8, 9-10) shows the progression of big ideas across the grades.

The draft 2021 *Mathematics Framework* includes a principle that mathematics learning in classrooms should always have a purpose and that rather than students working through questions without mathematical direction, they should work on an approach of "investigating and connecting." To do this, the Framework recommends "crosscutting drivers of investigation" that can guide investigations. The drivers are:

- **Making sense of the world** (understand and explain),
- **Predicting what could happen** (predict), and
- **Impacting the future** (affect).

Figure 5.1 shows these drivers and the ways they can be applied to any combination of content and mathematical practices.

Figure 5.1. The Drivers of Investigation, Content Connections, & Mathematical Practices from the draft 2021 *Mathematics Framework*.



Long description: Three Drivers of Investigation (DIs) provide the "why" of learning mathematics: Making Sense of the World (Understand and Explain); Predicting What Could Happen (Predict); Impacting the Future (Affect). The DIs overlay and pair with four categories of Content Connections (CCs), which provide the "how and what" mathematics (CA-CCSSM) is to be learned in an activity: Communicating stories with data; Exploring changing quantities; Taking wholes apart, putting parts together; Discovering shape and space. The DIs work with the Standards for Mathematical Practice to propel the learning of the ideas and actions framed in the CCs in ways that are coherent, focused, and rigorous. The Standards for Mathematical Practice are: Make sense of problems and persevere in solving them; Reason abstractly and quantitatively; Construct viable arguments and critique the reasoning of others; Model with mathematics; Use appropriate tools strategically; Attend to precision; Look for and make use of structure; Look for and express regularity in repeated reasoning.

Big Ideas and Network Maps

The *California Common Core State Standards: Mathematics* offer domains, cluster headings, and standards – with most textbook publishers translating the detailed standards into short, procedural questions. A problem with working through standards and associated questions is that teachers do not have time to go in depth on any of the standards, or even to teach them all. A different approach is to consider the big ideas, as set out in the introduction to this section, that bring in many different standards, that often go across the clusters and domains. As students work on rich tasks, they will encounter many of the standards but in a more connected and meaningful way. This document sets out this "big idea" approach to mathematics, with the goal of helping teachers and their students, both during a period of decreased learning time and moving forward.

To highlight mathematical connections, each grade has a network map which shows the big ideas as nodes. These represent important and foundational content, and an ideal approach to teaching mathematics, in person or online, starts with choosing rich tasks that focus on the big ideas.[1] As students explore and investigate with the big ideas, they will likely encounter many of the different content standards and see the connections between them.

The size of the node relates to the number of connections it has with other big ideas. The connections between big ideas are made when the two connected big ideas contain one or more of the same standards. The big idea colors in the nodes correspond to the table where the big ideas are correlated with full descriptions. The descriptions of each big idea are not taken from the standards or the clusters or domains; rather, they are new descriptions, as many of the ideas go across clusters and domains. For example, in grade 3 the big idea: Fractions of Shape & Time, brings together standards from the domains of Measurement and Data, Number and Operations in Base Ten, Fractions and Geometry. The new descriptions integrate well with the mathematical practices, as they describe mathematics as a subject of reasoning and communicating.

Progression of Big Ideas TK-10.

[1] https://www.youcubed.org/resource/k-8-curriculum/

Content connections	Communicating Stories with Data	Exploring Changing Quantities	Taking Wholes Apart, Putting Parts Together	Discovering shape and space
Grade Level	**Big Ideas**	**Big ideas**	**Big Ideas**	**Big Ideas**
TK	Measure & Order,	Measure & Order	Look for Patterns	See and use shapes
	Look for Patters	Count to 10	Create Patterns	Make and measure shapes
			See and use Shapes	Solids in shape
K	Sort & Describe Data	How Many?	Being flexible within 10	Shapes in the world
		Bigger or Equal	Place and position of numbers	Making shapes from parts
			Model with numbers	
1	Make sense of Data	Measuring with Objects	Tens and Ones	Equal parts inside shapes
	Measuring with Objects	Clocks & Time		
		Equal Expressions		
		Reasoning about Equality		
2	Represent Data	Dollars & Cents	Skip Counting to 100	Seeing Fractions in Shapes
	Measure & Compare Objects	Problem solving with measures	Number Strategies	Squares in Array
3	Represent Multivariable data	Addition and subtraction patterns	Square tiles	Unit fraction models
	Fractions of shape and time	Number flexibility to 100	Fractions as relationships	Analyze quadrilaterals

	Measuring		Unit fraction models	
4	Measuring and plotting	Number and shape patterns	Visual fraction models	Circles, fractions and decimals
	Rectangle Investigations	Factors & area models	Fraction flexibility	Shapes and symmetries
		Multi-digit numbers	Circles, fractions & decimals	Connected problem solving
5	Plotting patterns	Modeling	Seeing Division	Telling a data story
	Telling a data story	Telling a data story	Fraction connections	Layers of cubes
		Factors and groups	Powers and place value	
		Shapes on a plane		
		Fraction connections		
6	The shape of distributions	Patterns inside numbers	Model the world	Nets and Surface Area
	Variability in data	Fraction relationships	Nets and Surface Area	Distance and direction
		Generalizing with multiple representations		Graphing shapes
		Relationships between variables		
7	Visualize Populations	Proportional Relationships	Shapes in the world	Shapes in the world
	Populations and samples	Unit rates in the world	2-D and 3-D connections	2-D and 3-D connections

	Probability Models	Graphing relationships	Angle relationships	Scale drawings
		Scale Drawings		Angle relationships
8	Data explorations	Slopes and intercepts	Cylindrical investigations	Shape, number, and expressions
	Data graphs and tables	Linear equations	Pythagorean explorations	Pythagorean explorations
	Interpret scatterplots	Multiple representations of functions	Big and small numbers	Cylindrical investigations
		Interpret scatterplots		Transformational geometry
Integrated 1	Modeling with functions	Fraction relationships	Model the world	Nets & Surface Area
	Comparing models	Patterns inside numbers	Nets & Surface Area	Distance & direction
	Variability	Generalizing with multiple representations		Graphing shapes
	Correlation & causation	Relationships between variables		
Integrated 2	The shape of distributions	The shape of distributions	Functions in the world	Transformation & similarity
	Experimental models and functions	Equations to predict & model	Function representations	Circle relationships
	Probability modeling	Experimental models & functions	Polynomial identities	Trig functions
	Geospatial data	Transformation & similarity		

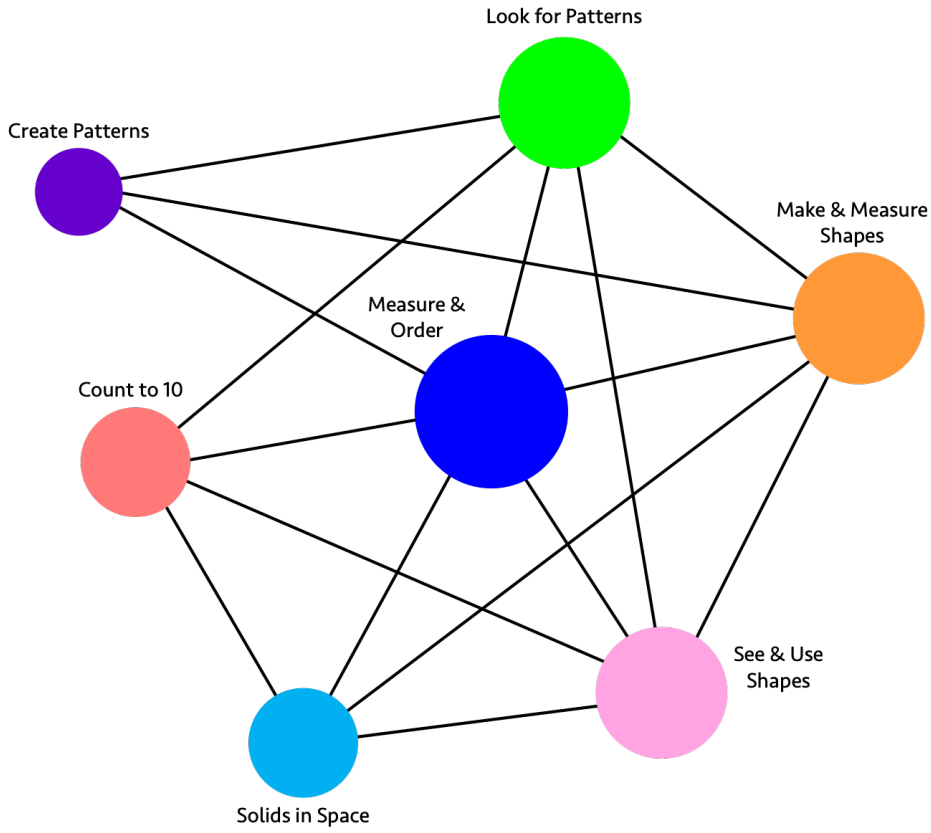
Algebra	Investigate data	Features of functions	Growth & decay	Investigate data
	Model with functions	Function investigations		Model with functions
		Systems of equations		
Geometry	Probability modeling	Points & slopes	Triangle congruence	Triangle congruence
	Fairness in data	Triangle congruence	Transformations	Congruence theorems
	Geospatial data	Triangle problems		Circle relationships
		Circle relationships		Transformations
		Trig explorations		Geometric models

Big Ideas TK-2

Grade Level	TK	K	1	2
Content Connections	Big Ideas	Big Ideas	Big Ideas	Big Ideas
Communicating Stories with Data	Measure & Order	Sort & Describe Data	Make sense of Data	Represent Data
	Look for Patterns		Measuring with Objects	Measure & Compare Objects
Exploring	Measure and	How Many?	Measuring with	Dollars and

Changing Quantities	Order		Objects	cents
	Count to 10	Bigger or Equal	Clocks and Time	Problem solving with measures
			Equal Expressions	
			Reasoning about Equality	
Taking Wholes Apart, Putting Parts Together	Create Patterns	Being flexible within 10	Tens and Ones	Skip Counting to 100
	Look for Patterns	Place and position of numbers		Number Strategies
	See and use Shapes	Model with numbers		
Discovering shape and space	See and use shapes	Shapes in the world	Equal parts inside shapes	Seeing fractions in shapes
	Make and measure shapes	Making shapes from parts		Squares in an array
	Solids in shape			

Grade TK Standards



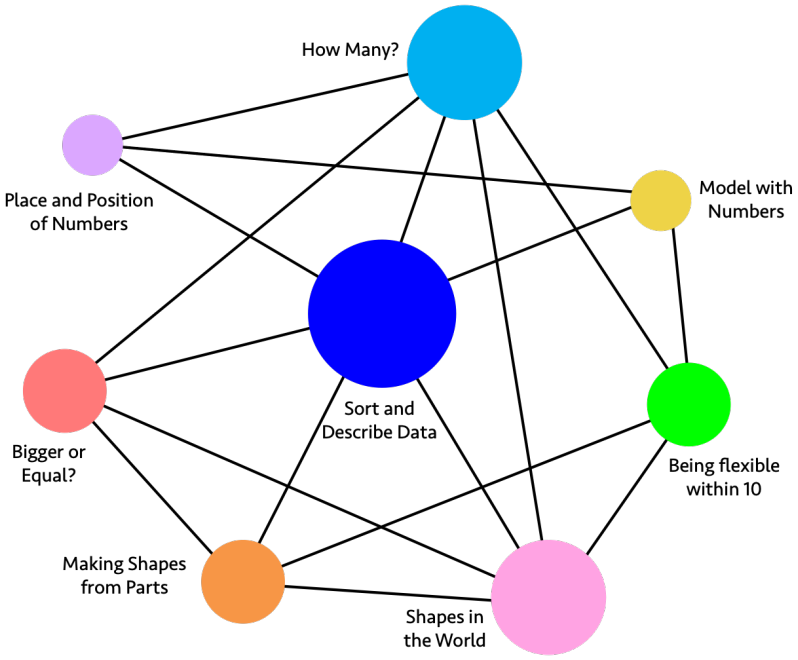
Content Connection	Big Idea	Standards
Communicating Stories with Data	Measure and Order	AF1.1, M1.1, M1.2, M1.3, NS2.1, NS2.3, NS1.3, G 1.1, G2.1 NS1.4, NS1.5, MR1.1, NS1.1, NS1.2: Compare, order, count, and measure objects in the world. Learn to work out the number of objects by grouping and recognize up to 4 objects without counting.
Communicating Stories with Data	Look for patterns	AF2.1, AF2.2: NS1.3, NS1.4, NS1.5, NS2.1, NS2.3, G1.1, M1.2: Recognize and duplicate patterns - understand the core unit in a repeating pattern. Notice size differences in similar shapes.

Exploring Changing Quantities	Measure and Order	AF1.1, M1.1, M1.2, M1.3, NS2.1, NS2.3, NS1.3, G 1.1, G2.1 NS1.4, NS1.5, MR1.1, NS1.1, NS1.2: Compare, order, count, and measure objects in the world. Learn to work out the number of objects by grouping and recognize up to 4 objects without counting.
Exploring Changing Quantities	Count to 10	NS1.4, MR1.1, AF1.1, NS2.2: Count up to 10 using one to one correspondence. Know that adding or taking away 1 makes the group larger or smaller by 1.
Taking Wholes Apart, Putting Parts Together	Create patterns	AF2.2, AF2.1, M1.2: (shape standards) Create patterns - using claps, signs, blocks, shapes. Use similar shapes to make a pattern and identify size differences in the patterns.
Taking Wholes Apart, Putting Parts Together	Look for patterns	AF2.1, AF2.2, NS1.3, NS1.4, NS1.5, NS2.1, NS2.3, G1.1, M1.2: Recognize and duplicate patterns - understand the core unit in a repeating pattern. Notice size differences in similar shapes.
Taking Wholes Apart, Putting Parts Together & Discovering Shape and Space	See and use shapes	G1.1, G1.2, NS2.3, NS1.4, MR1.1: Combine different shapes to create a picture or design & recognize individual shapes, identifying how many shapes there are.
Discovering Shape and Space	Make and measure shapes	G1.1, M1.1, M1.2, NS1.4: Create and measure different shapes. Identify size differences in similar shapes.
Discovering Shape and Space	Solids in space	G2.1, M1.1, MR1.1: Visualize shapes and solids (2-D and 3-D) in different positions, including nesting shapes, and learn to describe direction, distance, and location in space.

Content Connection	Big Idea	Standards

Communicating Stories with Data & Exploring Changing Quantities	Measure and Order	AF1.1, M1.1, M1.2, M1.3, NS2.1, NS2.3, NS1.3, G 1.1, G2.1 NS1.4, NS1.5, MR1.1, NS1.1, NS1.2: Compare, order, count, and measure objects in the world. Learn to work out the number of objects by grouping and recognize up to 4 objects without counting.
Communicating Stories with Data & Taking Wholes Apart, Putting Parts Together	Look for patterns	AF2.1, AF2.2: NS1.3, NS1.4, NS1.5, NS2.1, NS2.3, G1.1, M1.2: Recognize and duplicate patterns - understand the core unit in a repeating pattern. Notice size differences in similar shapes.
Exploring Changing Quantities	Count to 10	NS1.4, MR1.1, AF1.1, NS2.2: Count up to 10 using one to one correspondence. Know that adding or taking away 1 makes the group larger or smaller by 1.
Taking Wholes Apart, Putting Parts Together	Create patterns	AF2.2, AF2.1, M1.2: (shape standards) Create patterns - using claps, signs, blocks, shapes. Use similar shapes to make a pattern and identify size differences in the patterns.
Taking Wholes Apart, Putting Parts Together	See and use shapes	G1.1, G1.2, NS2.3, NS1.4, MR1.1: Combine different shapes to create a picture or design & recognize individual shapes, identifying how many shapes there are.
Discovering Shape and Space	Make and measure shapes	G1.1, M1.1, M1.2, NS1.4: Create and measure different shapes. Identify size differences in similar shapes.
Discovering Shape and Space	Solids in space	G2.1, M1.1, MR1.1: Visualize shapes and solids (2-D and 3-D) in different positions, including nesting shapes, and learn to describe direction, distance, and location in space.

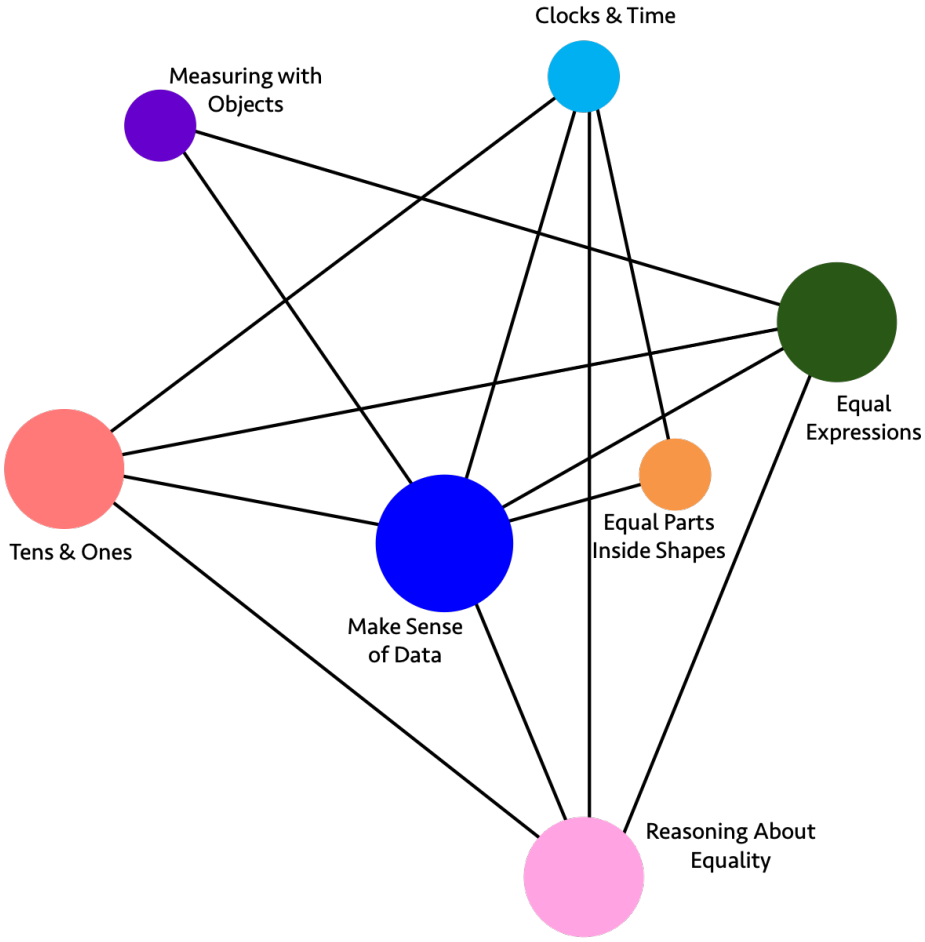
Grade K Standards



Content Connection	Big Idea	Standards
Communicating Stories with Data	Sort & Describe Data	MD.1, MD.2, MD.3, CC.4, CC.5, G.4: Sort, count, classify, compare, and describe objects using numbers for length, weight, or other attributes.
Exploring Changing Quantities	How Many?	CC.1, CC.2, CC.3, CC.4, CC.5, CC.6, CC.7, MD.3: Know number names and the count sequence to determine how many are in a group of objects arranged in a line, array, or circle. Fingers are important representations of numbers. Use words and drawings to make convincing arguments to justify work.
Exploring Changing Quantities	Bigger or Equal?	CC.4, CC.5, CC.6, MD.2, G.4: Identify a number of objects as greater than, less than, or equal to the number of objects in another group. Justify or prove your findings with number sentences and other representations.

Taking Wholes Apart, Putting Parts Together	Being Flexible within 10	OA.1, OA.2, OA.3, OA.4, OA.5, CC.6, G.6: Make 10, add and subtract within 10, compose and decompose within 10, (find 2 numbers to make 10). Fingers are important.
Taking Wholes Apart, Putting Parts Together	Place and position of numbers	CC.3, CC.5, NBT.1: Get to know numbers between 11 and 19 by name and expanded notation to become familiar with place value, for example: 14 = 10 + 4
Taking Wholes Apart, Putting Parts Together	Model with numbers	OA.1, OA.2, OA.5, NBT.1, MD.2: Add, subtract, and model abstract problems with fingers, other manipulatives, sounds, movement, words, and models.
Discovering Shape and Space	Shapes in the World	G.1, G.2, G.3, G.4, G.5, G.6, MD.1, MD.2, MD.3: Describe the physical world using shapes. Create 2-D and 3-D shapes, and analyze and compare them.
Discovering Shape and Space	Making shapes from parts	MD.1, MD.2, G.4, G.5, G.6 Compose larger shapes by combining known shapes. Explore similarities and differences of shapes using numbers and measurements.

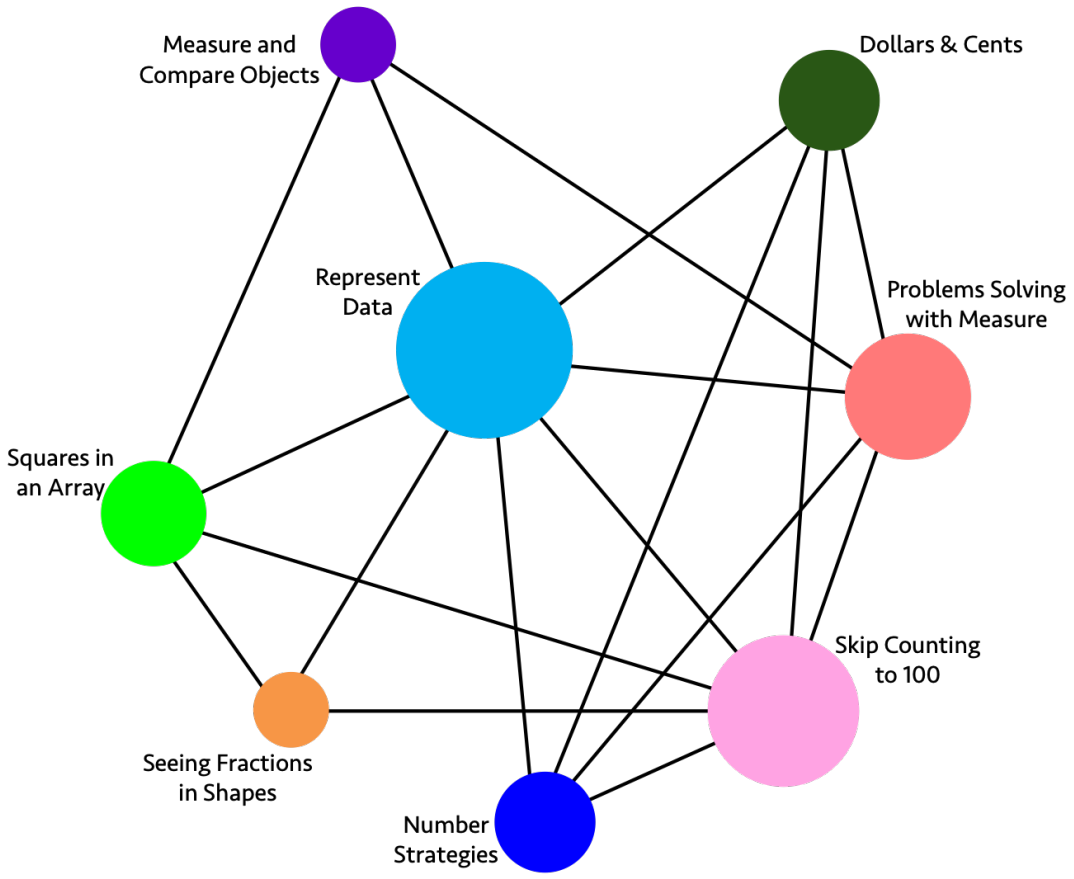
Grade 1 Standards



Content Connection	Big Idea	Standards
Communicating Stories with Data	Make Sense of Data	MD.2, MD.4, MD.3, MD.1, NBT.1, OA.1, OA.2, OA.3: Organize, order, represent, and interpret data with two or more categories; ask and answer questions about the total number of data points, how many are in each category, and how many more or less are in one category than in another.
Communicating Stories with Data & Exploring	Measuring with Objects	MD.1 MD.2, OA.5: Express the length of an object by units of measurement e.g., the stapler is 5 red Cuisenaire rods long, the red rod representing the unit

Changing Quantities		of measure. Understand that the measurement length of an object is the number of units used to measure.
Exploring Changing Quantities	Clocks & Time	MD.3, NBT.2, G.3: Read and express time on digital and analogue clocks using units of an hour or half hour.
Exploring Changing Quantities	Equal Expressions	OA.6, OA.7, OA.2, OA.1, OA.8, OA.5, OA.4, OA.3, NBT.4: Understand addition and subtraction, using various models such as connected cubes. Compose and decompose numbers to make equal expressions, knowing that equals means that both sides of an expression are the same, (and it is not simply the result of an operation).
Exploring Changing Quantities	Reasoning about Equality	OA.3, OA.6, OA.7, NBT.2, NBT.3, NBT.4: Justify reasoning about equal amounts, using flexible number strategies e.g., students use compensation strategies to justify number sentences such as 23 - 7 = 24 - 8.
Taking Wholes Apart, Putting Parts Together	Tens & Ones	NBT.4, NBT.3, NBT.1, NBT.2, NBT.6, NBT.5: Think of whole numbers between 10 and 100 in terms of tens and ones. Through activities that build number sense, students understand the order of the counting numbers and their relative magnitudes.
Discovering Shape and Space	Equal Parts inside Shapes	G.3, G.2, G.1, MD.3: Compose 2D shapes on a plane as well as in 3D space to create cubes, prisms, and cylinders and cones. Shapes can also be decomposed into equal shares, as in a circle broken into halves and quarters defines a clock face.

Grade 2 Standards



Content Connection	Big Idea	Standards
Communicating Stories with Data	Measure & Compare Objects	MD.1, MD.2, MD.3, MD.4, MD.6, MD.9: Determine the length of objects using standard units of measures and use appropriate tools to classify objects, interpreting and comparing linear measures on a number line.
Communicating Stories with Data	Represent Data	MD.7, MD.9, MD.10, G.2, G.3, NBT.2: Represent data by using line plots, picture graphs and bar graphs and interpret data in different data representations, including clock faces to the nearest 5 minutes.

Exploring Changing Quantities	Dollars & Cents	MD.8, MD.5, NBT.1, NBT.2, NBT.5, NBT.6, NBT.7: Understand the unit values of money and compute different values when combining dollars and cents.
Exploring Changing Quantities & Discovering Shape and Space	Problem Solving with Measure	NBT.7, NBT.1, MD.1, MD.2, MD.3, MD.4, MD.5, MD.6, MD.9, OA.1: Solve problems involving length measures using addition and subtraction.
Taking Wholes Apart, Putting Parts Together	Skip Counting to 100	NBT.1, NBT.3, NBT.7, OA.4, G.2: Use skip counting, counting bundles of 10 and expanded notation to understand the composition and place value of numbers up to 1,000. This includes ideas of counting in fives, tens, and multiples of hundreds, tens, and ones, as well as number relationships involving these units, including comparing.
Taking Wholes Apart, Putting Parts Together	Number Strategies	MD.5, NBT.5, NBT.6, NBT.7, OA.1, OA.2: Add and subtract 2-digit numbers, within 100, without using algorithms - instead encouraging different strategies and justification. Compare and contrast the different strategies using models, symbols, and drawings.
Discovering Shape and Space	Seeing Fractions in Shapes	G.1, G.2, G.3, MD.7: Divide circles and rectangles into equal shares and know them to be standard unit fractions. Identify and draw 2D and 3D shapes, recognizing faces and angles.
Discovering Shape and Space	Squares in an Array	OA.4, G.2, G.3, MD.6: Partition rectangles into rows and columns of unit squares to find the total number of square units in an array.

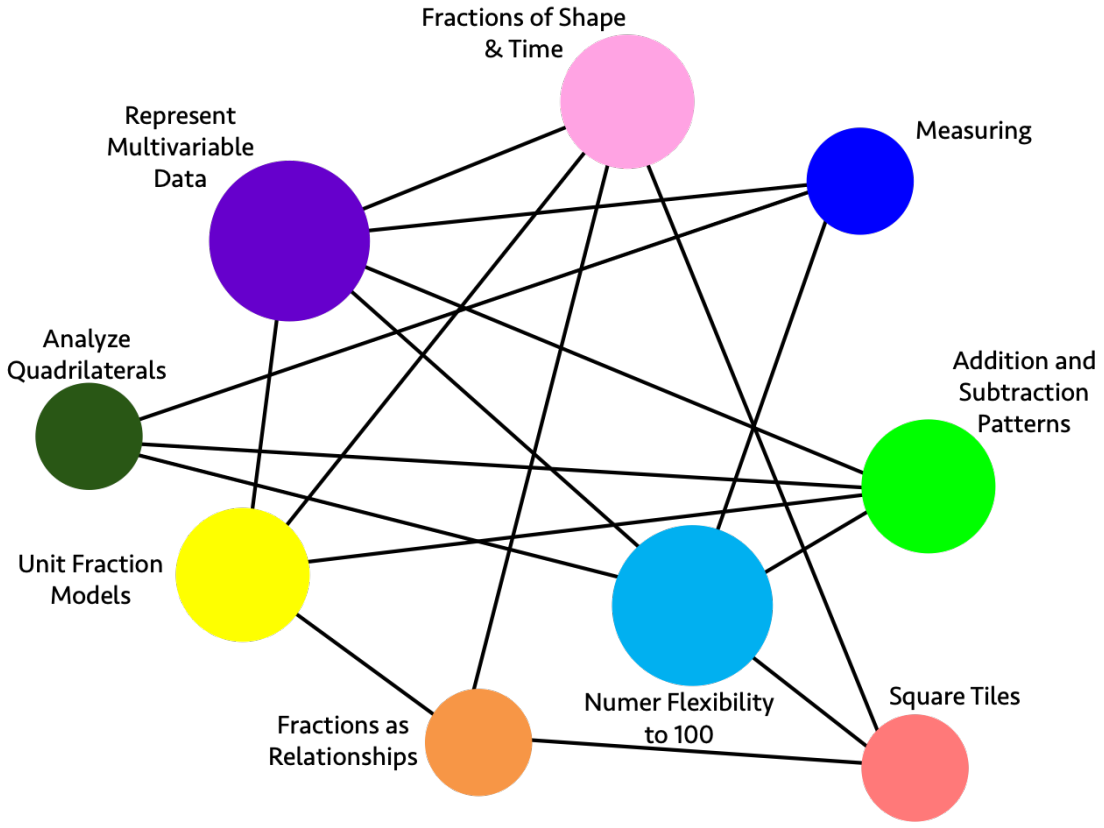
Grades 3 to 5

A Progression Chart of Big Ideas through Grades 3-5

Grade Level	3	4	5
Content Connections	Big Ideas	Big Ideas	Big Ideas
Communicating Stories with Data	Represent Multivariable data	Measuring and plotting	Plotting patterns
	Fractions of shape and time	Rectangle Investigations	Telling a data story
	Measuring		
Exploring Changing Quantities	Addition and subtraction patterns	Number and shape patterns	Telling a data story
	Number flexibility to 100	Factors & area models	Factors and groups
		Multi-digit numbers	Modeling
			Fraction connections
			Shapes on a plane
Taking Wholes Apart, Putting Parts Together	Square tiles	Fraction flexibility	Fraction connections
	Fractions as relationships	Visual fraction models	Seeing Division
	Unit fraction models	Circles, fractions and decimals	Powers and place value

Discovering shape and space	Unit fraction models	Circles, fractions and decimals	Telling a data story
	Analyze quadrilaterals	Shapes and symmetries	Layers of cubes
		Connected problem solving	

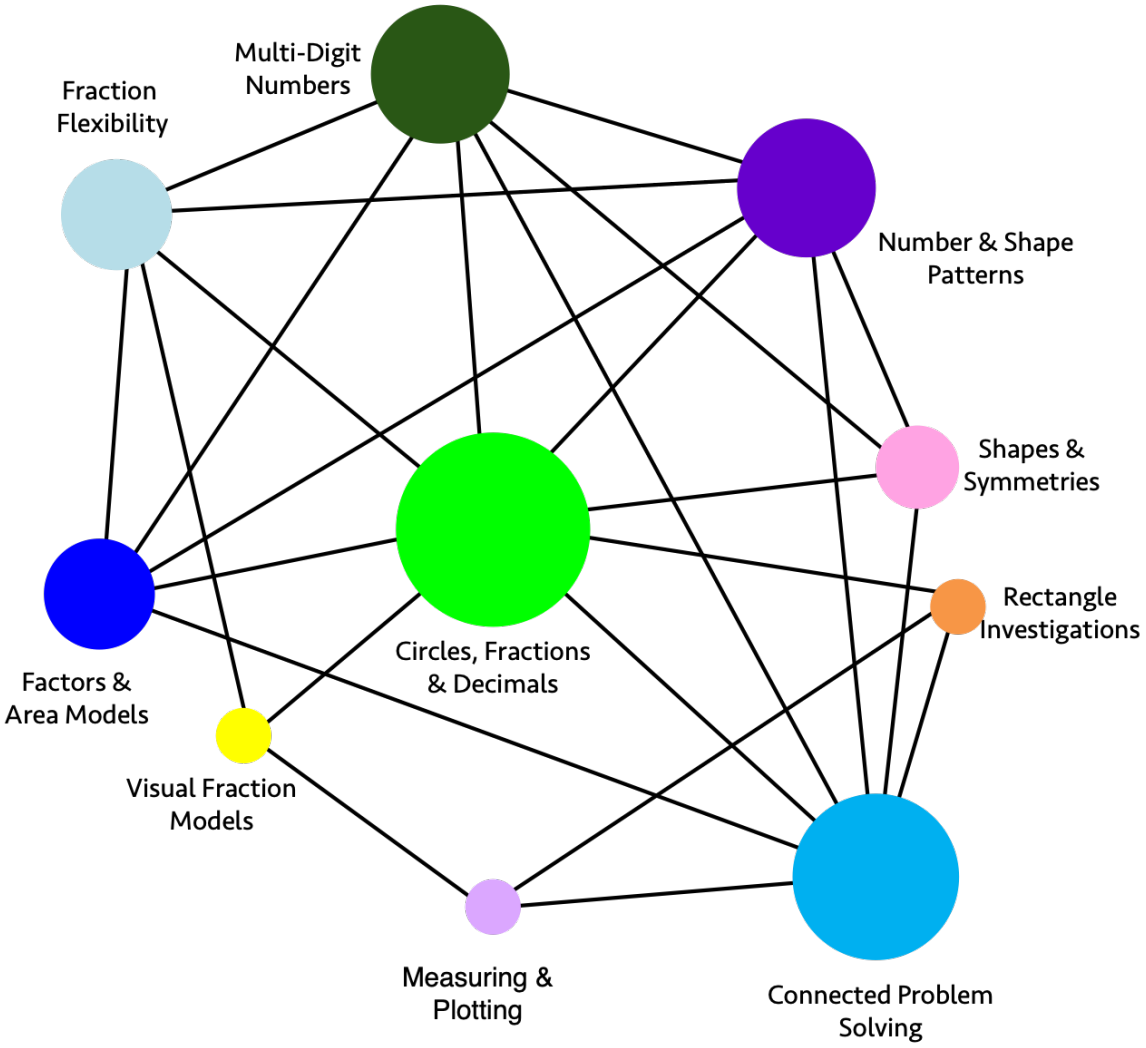
Grade 3 Standards



Content Connection	Big Idea	Standards
Communicating Stories with Data	Represent Multivariable Data	MD.3, MD.4, MD.1, MD.2, NBT.1: Collect data and organize data sets, including measurement data; read and create bar graphs and pictographs to scale. Consider data sets that include three or more categories (multivariable data) for example, when I interact with my puppy, I either call her name, pet her, or give her a treat.
Communicating Stories with Data & Taking Wholes Apart, Putting Parts Together & Discovering Shape and Space	Fractions of Shape & Time	MD.1, NF.1, NF.2, NF.3, G.2: Collect data by time of day, show time using a data visualization., Think about fractions of time and of shape and space, expressing the base unit as a unit fraction of the whole.
Communicating Stories with Data	Measuring	MD.2, MD.4, NBT.1: Measure volume and mass, incorporating linear measures to draw and represent objects in two-dimensional space. Compare the measured objects, using line plots to display measurement data. Use rounding where appropriate.
Exploring Changing Quantities	Addition and Subtraction Patterns	NBT.2, , OA.8, OA.9, MD.1: Add and subtract within 1000 - Using student generated strategies and models, such as base 10 blocks. e.g., use expanded notation to illustrate place value and justify results. Investigate patterns in addition and multiplication tables, and use operations, and color coding to generalize and justify findings.
Exploring Changing Quantities	Number Flexibility to 100	OA.1, OA,2, OA.3, OA.4, OA.5, OA.6, OA.7, OA.8, NBT.3, MD.7, NBT.1: Multiply and divide within 100 and justify answers using arrays and student generated visual representations. Encourage number sense and number flexibility - not “blind”

		memorization of number facts. Use estimation and rounding in number problems.
Taking Wholes Apart, Putting Parts Together	Square Tiles	MD.5, MD.6, MD.7, OA.7, NF.1: Use square tiles to measure the area of shapes, finding an area of n squared units, and learn that one square represents 1/nth of the total area.
Taking Wholes Apart, Putting Parts Together	Fractions as Relationships	NF.1, NF.3: Know that a fraction is a relationship between numerators and denominators – and it is important to consider the relationship in context. Understand why $\frac{1}{2} = \frac{2}{4} = \frac{3}{6}$.
Taking Wholes Apart, Putting Parts Together & Discovering Shape and Space	Unit Fraction Models	NF.2, NF.3, MD.1: Compare unit fractions using different visual models including linear models (e.g., number lines, tape measures, time, and clocks) and area models (e.g., shape diagrams encourage student justification with visual models).
Discovering Shape and Space	Analyze Quadrilaterals	MD.8, G.1, G.2, NBT.1, OA.8: Describe, analyze, and compare quadrilaterals. Explore the ways that area and perimeter change as side lengths change, by modeling real world problems. Use rounding strategies to approximate lengths where appropriate.

Grade 4 Standards

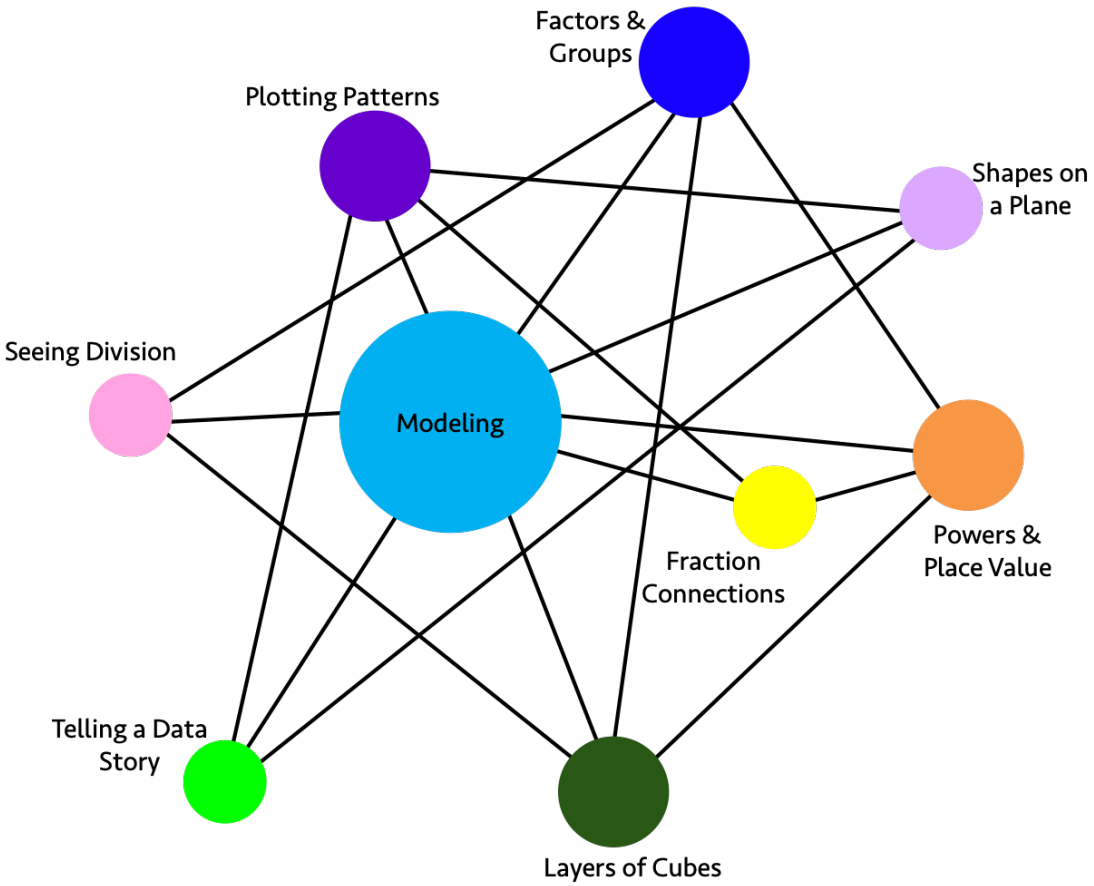


Content Connection	Big Idea	Standards
Communicating Stories with Data	Measuring & Plotting	MD.1, MD.4, NF.1, NF.2: Collect data consisting of distance, intervals of time, volume, mass, or money. Read, interpret, and create line plots that communicate data stories where the line plot measurements consist of fractional units of measure. For example, create a line plot showing classroom or home objects measured to the nearest quarter inch.

Communicating Stories with Data	Rectangle Investigations	MD1, MD2, MD3, MD5, MD6 Investigate rectangles in the world, measuring lengths and angles, collecting the data, and displaying it using data visualizations.
Exploring Changing Quantities	Number & Shape Patterns	OA.5, OA.1, OA.2, NBT.4: Generalize number and shape patterns that follow a given rule. Communicate understanding of how the pattern changes in words, symbols, and diagrams - working with multi-digit numbers.
Exploring Changing Quantities	Factors & Area Models	OA.1, OA.2, OA.4, NBT.5, NBT.6: Break numbers inside of 100 into factors. Illustrate whole number multiplication and division calculations as area models and rectangular arrays that illustrate factors.
Exploring Changing Quantities	Multi-Digit Numbers	NBT.1, NBT.2, NBT 3, NBT.4, OA.1: Read and write multi-digit whole numbers in expanded form and express each number component of the expanded form as a multiple of a power of ten.
Taking Wholes Apart, Putting Parts Together	Fraction Flexibility	NF.3, NF.1, NF.4, NF.5, OA.1: Understand that addition and subtraction of fractions as joining and separating parts that are referring to the same whole. Decompose fractions and mixed numbers into unit fractions and whole numbers and express mixed numbers as a sum of unit fractions.
Taking Wholes Apart, Putting Parts Together	Visual Fraction Models	NF.2, NF.1, NF.3, NF.5, NF.6, NF.7: Use different ways of seeing and visualizing fractions to compare fractions using student generated visual fraction models. Use >, < and = to compare fraction size, through linear and area models, and determine whether fractions are greater or less than benchmark numbers such as ½ and 1.
Taking Wholes Apart, Putting Parts Together & Discovering	Circles, Fractions & Decimals	NF.5, NF.6, NF.7, OA.1. MD2, MD5, MD7: Understand, compare, and visualize fractions expressed as decimals. Recognize fractions with denominators of 10 and 100, e.g., 25 cents can be written as 0.25 or 25/100. Connect a circle fraction model to the clock face. Example 3/10 + 4/100 = 30/100 + 4/100 = 34/100

Shape and Space		
Discovering Shape and Space	Shapes & Symmetries	MD.5, MD.6, MD.7, G.1, G.2, G.3, NBT.3, NBT.4, Draw and identify shapes, looking at the relationships between rays, lines, and angles. Explore symmetry through folding activities.
Discovering Shape and Space	Connected Problem Solving	OA.3, MD.1, MD.2, OA2, MD.3, NBT.3 place value, NBT.4, NBT.5, NBT.6, OA.2, OA.3, G.3: Solve problems with perimeter, area, volume, distance, and symmetry, using operations and measurement.

Grade 5 Standards



Content Connection	Big Idea	Standards
Communicating Stories with Data	Plotting Patterns	G.1, G.2, OA.3: MD.2, NF.7: Students generate and analyze patterns, plotting them on a line plot or coordinate plane, and use their graph to tell a story about the data. Some situations should include fraction and decimal measurements, such as a plant growing.
Communicating Stories with Data & Exploring Changing Quantities & Discovering Shape & Space	Telling a Data Story	G.1, G.2, OA.3: Understand a situation, graph the data to show patterns and relationships, and to help communicate the meaning of a real-world event.
Exploring Changing Quantities	Factors & Groups	OA.1, OA.2, MD.4, MD.5: Students use grouping symbols to express changing quantities and understand that a factor can represent the number of groups of the quantity.
Exploring Changing Quantities	Modeling	NBT.3, NBT.5, NBT.7, NF.1, NF.2, NF.3, NF.4, NF.5, NF.6, NF.7, MD.4, MD.5, OA.3: Set up a model and use whole, fraction, and decimal numbers and operations to solve a problem. Use concrete models and drawings and justify results.
Exploring Changing Quantities & Taking Wholes Apart, Putting Parts Together	Fraction connections	NF.1, NF.2, NF.3, NF.4, NF.5, NF.7, MD.2, NBT.3: Make and understand visual models, to show the effect of operations on fractions. Construct line plots from real data that include fractions of units.

Exploring Changing Quantities & Discovering Shape & Space	Shapes on a Plane	G.1, G.2, G.3, G4, OA.3, NF.4, NF.5, NF.6: Graph 2-D shapes on a coordinate plane, notice and wonder about the properties of shapes, parallel and perpendicular lines, right angles, and equal length sides. Use tables to organize the coordinates of the vertices of the figures and study the changing quantities of the coordinates.
Taking Wholes Apart, Putting Parts Together	Seeing Division	MD.3, MD.4, MD.5, NBT.4, NBT.6, NBT.7: Solve real problems that involve volume, area, and division, setting up models and creating visual representations. Some problems should include decimal numbers. Use rounding and estimation to check accuracy and justify results.
Taking Wholes Apart, Putting Parts Together	Powers and Place Value	NBT.3, NBT.2, NBT.1, OA.1, OA.2: Use whole number exponents to represent powers of 10. Use expanded notation to write decimal numbers to the thousandths place and connect decimal notation to fractional representations where the denominator can be expressed in powers of 10.
Discovering Shape and Space	Layers of Cubes	MD.5, MD.4, MD.3, OA.1, MD.1: Students recognize volume as an attribute of three-dimensional space. They understand that a 1-unit by 1-unit by 1-unit cube is the standard unit for measuring volume. They decompose three-dimensional shapes and find volumes of right rectangular prisms by viewing them as decomposed into layers of arrays of cubes.

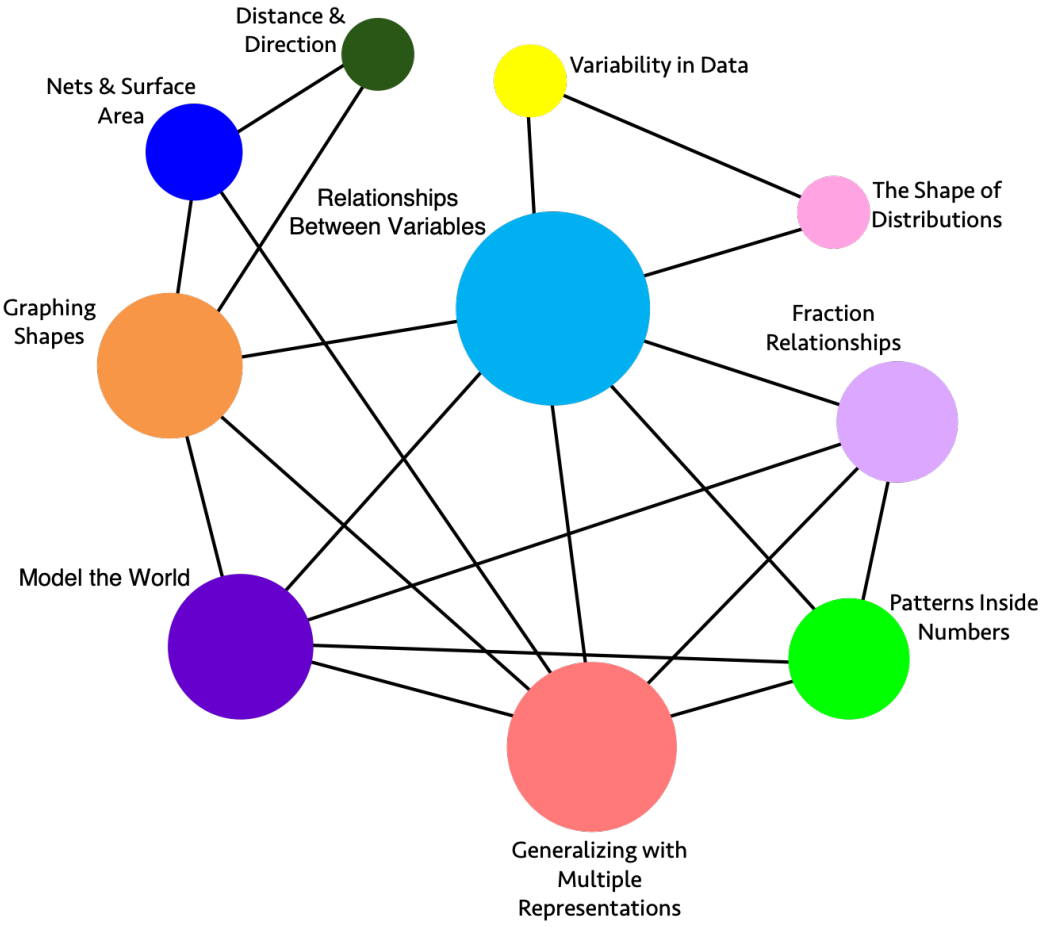
Grades Six to Eight

A Progression Chart of Big Ideas through Grades 6-8

Grade Level	6	7	8
Content Connections	Big Ideas	Big Ideas	Big Ideas
Communicating Stories with Data	Variability in data	Visualize Populations	Data explorations
	The shape of distributions	Populations and samples	Data graphs and tables
		Probability Models	Interpret scatterplots
Exploring Changing Quantities	Fraction relationships	Proportional Relationships	Multiple representations of functions
	Patterns inside numbers	Unit rates in the world	Linear equations
	Generalizing with multiple representations	Graphing relationships	Slopes and intercepts
	Relationships between variables	Scale Drawings	Interpret scatterplots
Taking Wholes Apart, Putting Parts Together	Model the world	Shapes in the world	Cylindrical investigations

	Nets and Surface Area	2-D and 3-D connections	Pythagorean explorations
		Angle relationships	Big and small numbers
Discovering shape and space	Nets and Surface Area	Shapes in the world	Shape, number, and expressions
	Distance and direction	2-D and 3-D connections	Pythagorean explorations
	Graphing shapes	Scale drawings	Cylindrical investigations
		Angle relationships	Transformational geometry

Grade 6 Standards

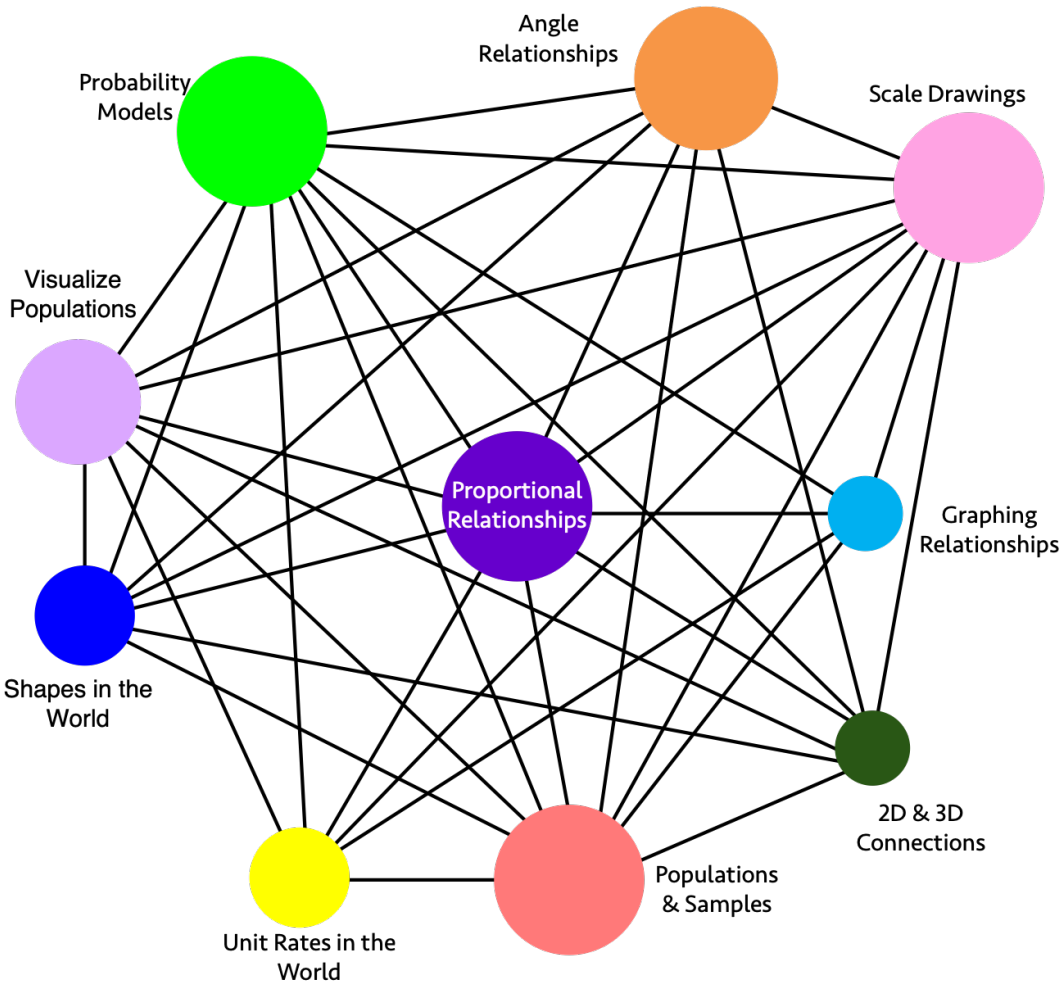


Content Connection	Big Idea	Standards
Communicating Stories with Data	Variability in Data	SP.1, SP.5, SP.4: Investigate real world data sources, ask questions of data, start to understand variability - within data sets and across different forms of data, consider different types of data, and represent data with different representations.
Communicating Stories with Data	The Shape of Distributions	SP.2, SP.3, SP.5: Consider the distribution of data sets - look at their shape and consider measures of center

		and variability to describe the data and the situation which is being investigated.
Exploring Changing Quantities	Fraction Relationships	NS.1, RP.1, RP.3: Understand fractions divided by fractions, thinking about them in different ways (e.g., how many 1/3 are inside 2/3?), considering the relationship between the numerator and denominator, using different strategies and visuals. Relate fractions to ratios and percentages.
Exploring Changing Quantities	Patterns inside Numbers	NS.4, RP.3: Consider how numbers are made up, exploring factors and multiples, visually and numerically.
Exploring Changing Quantities	Generalizing with Multiple Representations	EE.6, EE.2, EE.7, EE.3, EE.4, RP.1, RP.2, RP.3: Generalize from growth or decay patterns, leading to an understanding of variables. Understand that a variable can represent a changing quantity or an unknown number. Analyze a mathematical situation that can be seen and solved in different ways and that leads to multiple representations and equivalent expressions. Where appropriate in solving problems, use unit rates.
Exploring Changing Quantities	Relationships Between Variables	EE.9, EE.5, RP.1, RP.2, RP.3, NS.8, SP.1, SP.2: Use independent and dependent variables to represent how a situation changes over time, recognizing unit rates when it is a linear relationship. Illustrate the relationship using tables, 4 quadrant graphs and equations and understand the relationships between the different representations and what each one communicates.
Taking Wholes Apart, Putting Parts Together	Model the World	NS.3, NS.2, NS.8, RP.1, RP.2, RP.3: Solve and model real world problems. Add, subtract, multiply, and divide multi-digit numbers and decimals, in real-world and mathematical problems - with sense making and understanding, using visual models and algorithms.
Taking Wholes Apart, Putting Parts Together	Nets and Surface Area	EE.1, EE.2, G.4, G.1, G.2, G.3: Build and decompose 3-D figures using nets to find surface area. Represent

& Discovering Shape and Space		volume and area as expressions involving whole number exponents.
Discovering Shape and Space	Distance and Direction	NS.5, NS.6, NS.7, G.1, G.2, G.3, G.4: Students experience absolute value on numbers lines and relate it to distance, describing relationships such as order between numbers using inequality statements.
Discovering Shape and Space	Graphing Shapes	G.3, G.1, G.4, NS.8, EE.2: Use coordinates to represent the vertices of polygons and graph the shapes on the coordinate plane and determine side lengths, perimeter, and area.

Grade 7 Standards

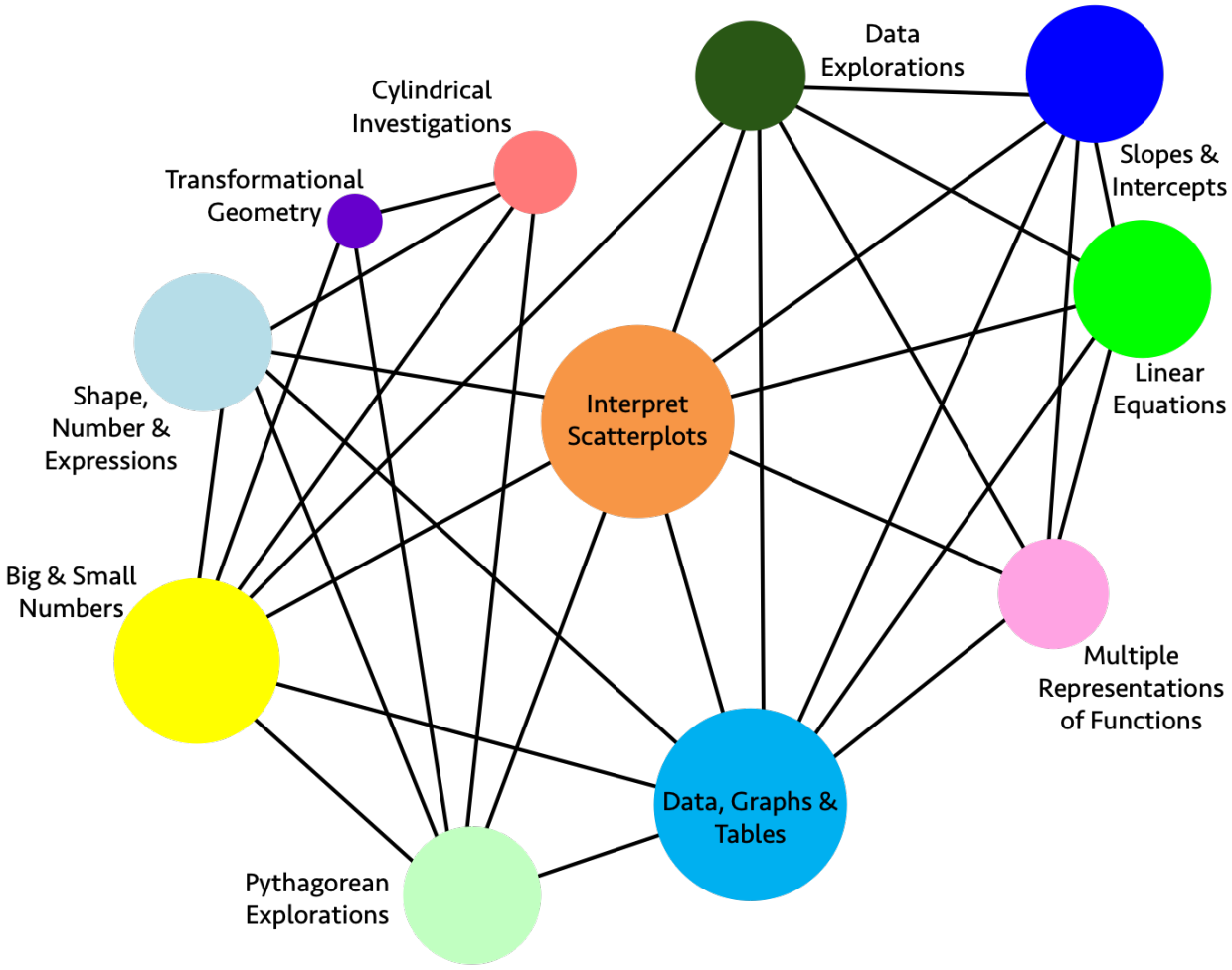


Content Connection	Big Idea	Standards
Communicating Stories with Data	Populations & Samples	SP.1, SP.2, RP.1, RP.2, RP.3, NS.1, NS.2, NS.3, EE.3: Study a population by taking random samples and determine if the samples accurately represent the population. • Analyze and critique reports by examining the sample and the claims made to the general population

		• Use classroom simulations and computer software to model repeated sampling, analyzing the variation in results.
Communicating Stories with Data	Visualize Populations	SP.3, SP.4, NS.1, NS.2, NS.3, EE.3: Draw comparative inferences about populations - consider what visual plots show, and use measures of center and variability • Students should toggle between the mathematical results and their meaningful interpretation with their given context, considering audiences, implications, etc.
Communicating Stories with Data	Probability Models	SP.5, SP.6, SP.7, SP.8, RP.1, RP.2, RP.3, NS.1, NS.2, NS.3, EE.3: Develop a probability model and use it to find probabilities of events and compound events, representing sample spaces and using lists, tables, and tree diagrams. • Compare observed probability and expected probability. • Explore potential bias and over-representation in real world data sets, and connect to dominating narratives and counter narratives used in public discourse.
Exploring Changing Quantities	Proportional Relationships	EE.2, EE.3, RP.1, RP.2, RP.3: Explore, understand & use proportional relationships: - using fractions, graphs & tables.
Exploring Changing Quantities	Unit Rates in the World	RP.1, RP.2, RP.3, EE1, EE.2, EE.3, EE.4: Solve real world problems using equations and inequalities, Recognize the unit rate within representations.
Exploring Changing Quantities	Graphing Relationships	EE.4, RP.1, RP.2, RP.3: Solve problems involving proportional relationships, that can lead to graphing using geometry software & making sense of solutions.
Exploring Changing Quantities &	Scale Drawings	G.1, EE.2, EE.3, EE.4, NS.2, NS.3, RP.1, RP.2, RP.3: Solve problems involving scale drawings and construct geometric figures using unit rates to accurately

Discovering Shape and Space		represent real world figures. (Use technology for drawing)
Taking Wholes Apart, Putting Parts Together & Discovering Shape and Space	Shapes in the World	G.1, G.2, G.3, G.4, G.5, G.6, NS.1, NS.2, NS.3: Solve real life problems involving triangles, quadrilaterals, polygons, cubes, right prisms, and circles using angle measures, area, surface area, and volume.
Taking Wholes Apart, Putting Parts Together & Discovering Shape and Space	2-D and 3-D Connections	G.1,G.2, G.3, NS.1, NS.2, NS.3: Draw and construct shapes, slice 3-D figures to see the 2-D shapes. Compare and classify the figures and shapes using area, surface area, volume, and geometric classifications for triangles, polygons, and angles. Make sure to measure with fractions and decimals, using technology for calculations.
Taking Wholes Apart, Putting Parts Together & Discovering Shape and Space	Angle Relationships	G.5, G.6, NS.1, NS.2, NS.3: Explore relationships between different angles, including complementary, supplementary, vertical, and adjacent, recognizing the relationships as the measures change. For example, angles A and B are complementary. As the measure of angle, A increases, the measure of angle B decreases.

Grade 8 Standards



Content Connection	Big Idea	Standards
Communicating Stories with Data & Exploring Changing Quantities	Interpret Scatterplots	SP.1, SP.2, SP.3, EE.2, EE.5, F.1, F.2, F.3: Construct and interpret data visualizations, including scatterplots for bivariate measurement data using two-way tables. Describe patterns noting whether the data appear in clusters, are linear or nonlinear, whether there are outliers, and if the association is negative or positive.

		Interpret the trend(s) in change of the data points over time.
Communicating Stories with Data	Data, Graphs & Tables	SP.3, SP.4, EE.2, EE.5, F.3, F.4, F.5: Construct graphs of relationships between two variables (bivariate data), displaying frequencies and relative frequencies in a two-way table. ● Use graphs with categorical data to help students describe events in their lives, looking at patterns in the graphs.
Communicating Stories with Data	Data Explorations	SP.1, SP.2, SP.3, SP.4, EE.4, EE.5, F.1, F.2, F.3, F.4, F.5: Conduct data explorations, such as the consideration of seafloor spreading, involving large data sets and numbers expressed in scientific notation, including integer exponents for large and small numbers using technology. ● Identify a large dataset and discuss the information it contains ● Identify what rows and columns represent in a spreadsheet
Exploring Changing Quantities	Linear Equations	EE.5, EE.7, EE.8, F.2, F.4, F.5: Analyze slope and intercepts and solve linear equations including pairs of simultaneous linear equations through graphing and tables and using technology.
Exploring Changing Quantities	Multiple Representations of Functions	EE.5, EE.6, EE.7: Move between different representations of linear functions (i.e., equation, graph, table, and context), sketch and analyze graphs, use similar triangles to visualize slope and rate of change with equations containing rational number coefficients.
Exploring Changing Quantities	Slopes & Intercepts	EE.5, SP.1, SP.2, SP.3: Construct graphs using bivariate data, comparing the meaning of parallel and non-parallel slopes with the same or different y-intercepts using technology.

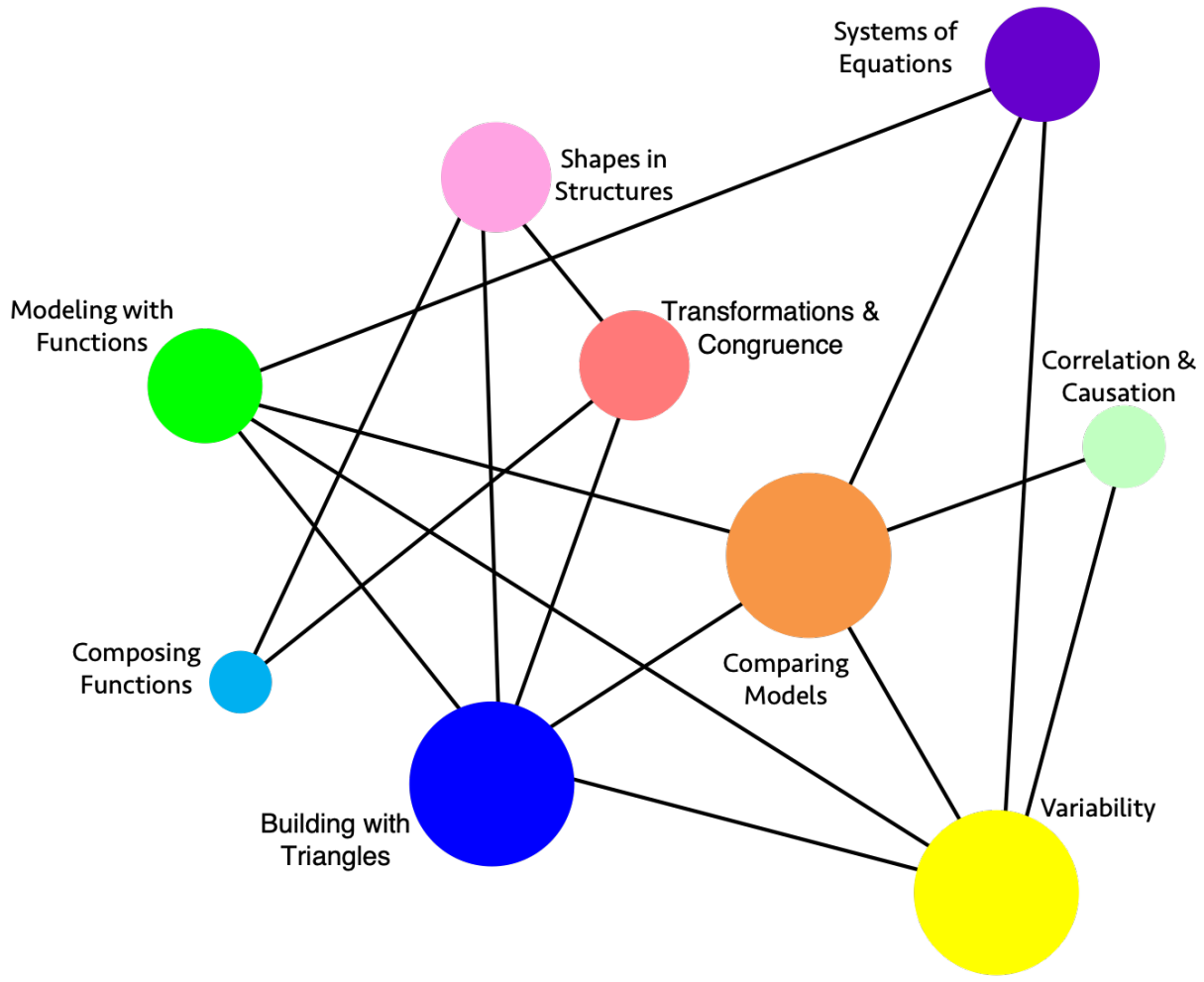
Taking Wholes Apart, Putting Parts Together & Discovering Shape and Space	Cylindrical Investigations	G.9, G.6, G.7, G.8, NS.1, NS.2: Solve real world problems with cylinders, cones, and spheres. Connect volume and surface area solutions to the structure of the figures themselves (e.g., why and how is the area of a circle formula used to find the volume of a cylinder?) Show visual proofs of these relationships, through modeling, building, and using computer software.
Taking Wholes Apart, Putting Parts Together & Discovering Shape and Space	Pythagorean Explorations	G.7, G.8, NS.1, NS.2, EE.1, EE.2: Conduct investigations in the coordinate plane with right triangles to show that the areas of the squares of each leg combine to create the square of the hypotenuse and name this as the Pythagorean theorem. Using technology use the Pythagorean theorem to solve real world problems that include irrational numbers.
Taking Wholes Apart, Putting Parts Together	Big & Small Numbers	EE.1, EE.2, EE.3, EE.4, NS.1, NS.2: Use scientific notation to investigate problems that include measurements of very large and very small numbers. Develop number sense with integer exponents e.g., $1/27 = ⅓^3 = 3^{-3}$
Discovering Shape and Space	Shape, Number & Expressions	G.9, G.6, G.7, G.8, EE.1, EE.2, NS.1, NS.2: Compare shapes containing circular measures, to prisms. Note that cubes and squares represent unit measures for volume and surface area. See and use the connections between integer exponents and area and volume.
Discovering Shape and Space	Transformational Geometry	G.1, G.2, G.3, G.4, G.5, G.6, G.7, G.8: Plot two dimensional figures on a coordinate plane, using geometry software, note similarity when dilations are performed and the corresponding angle measures maintain congruence. Perform translations, rotations and reflections and notice when shapes maintain congruence.

A Progression Chart of Big Ideas through Integrated 1 & 2

Grade Level	Integrated 1	Integrated 2
Content Connections	Big Ideas	Big Ideas
Communicating Stories with Data	Modeling with functions	The shape of distributions
	Comparing models	Geospatial data
	Variability	Probability modeling
	Correlation & causation	Experimental models and functions
Exploring Changing Quantities	Fraction relationships	The shape of distributions
	Patterns inside numbers	Equations to predict & model
	Generalizing with multiple representations	Experimental models & functions
	Relationships between variables	Transformation & similarity
Taking Wholes Apart, Putting Parts Together	Model the world	Functions in the world
	Nets & Surface Area	Polynomial identities
		Function representations

Discovering shape and space	Nets & Surface Area	Circle relationships
	Distance & direction	Trig functions
	Graphing shapes	Transformation & similarity

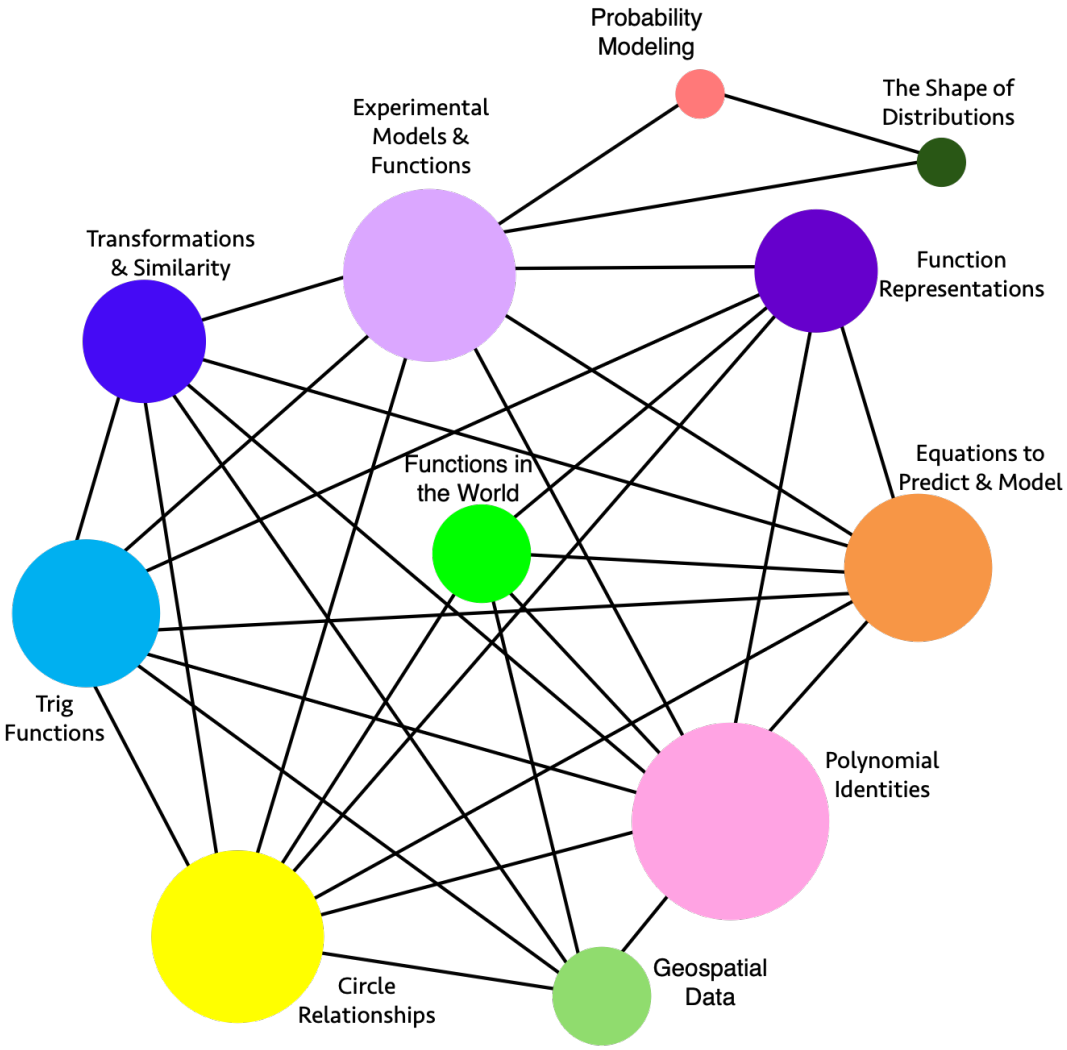
High School Integrated 1



Content Connection	Big Idea	Standards
Communicating Stories with Data & Exploring Changing Quantities	Modeling with Functions	N-Q.1, N-Q.2, N-Q.3, A-CED.2, F-BF.1 ,F-IF.1, F-IF.2, F-IF.4, F-LE.5, S-ID.7, A-CED.1, A-CED.2, A-CED.3, A-SSE.1: Build functions that model relationships between two quantities, including examples with inequalities; using units and different representations. Describe and interpret the relationships modeled using visuals, tables, and graphs.
Communicating Stories with Data & Exploring Changing Quantities	Comparing Models	F-LE.1, F-LE.2, F-LE.3, F-IF.4, F-BF.1, F-LE.5, S-ID.7, S-ID.8, A-CED.1, A-CED.2, A-CED.3, A-SSE.1: Construct, interpret and compare linear, quadratic, and exponential models of real data, and use them to describe and interpret the relationships between two variables, including inequalities. Interpret the slope and constant terms of linear models and use technology to compute and interpret the correlation coefficient of a linear fit.
Communicating Stories with Data & Exploring Changing Quantities	Variability	S-ID.5, S-ID.6, S-ID.7, S-ID.1, S-ID.2, S-ID.3, S-ID.4, A-SSE.1: Summarize, represent, and interpret data. For quantitative data use a scatter plot and describe how the variables are related. Summarize categorical data in two-way frequency tables and interpret the relative frequencies.
Communicating Stories with Data	Correlation & Causation	S-ID.9, S-ID.8, S-ID.7: Explore data that highlights the difference between correlation and causation. Understand and use correlation coefficients, where appropriate. (see resource section for classroom examples).
Exploring Changing Quantities & Taking Wholes Apart, Putting	Systems of Equations	A-REI.1, A-REI.3, A-REI.4, A-REI.5, A-REI.6, A-REI.7, A-REI.10, A-REI.11, A-REI.12, NQ.1, A-SEE.1: Students investigate real situations that include data for which systems of 1 or 2 equations or inequalities are helpful, paying attention to units. Investigations include linear, quadratic, and absolute value. Students use technology tools strategically to find their solutions

Parts Together		and approximate solutions, constructing viable arguments and interpreting the meaning of the results and communicating them in multidimensional ways.
Taking Wholes Apart, Putting Parts Together	Composing Functions	F-BF.3, F-BF.2, F-IF.3: Build and explore new functions that are made from existing functions and explore graphs of the related functions using technology. Recognize sequences are functions and are defined recursively.
Taking Wholes Apart, Putting Parts Together & Discovering Shape and Space	Shapes in Structures	G-CO.6, C-CO.7, C-CO.8, G-GPE.4, G-GPE.5, G.GPE.7, F.BF.3: Perform investigations that involve building triangles and quadrilaterals considering how the rigidity of triangles and non-rigidity of quadrilaterals influences the design of structures and devices. Study the changes in coordinates and express the changes algebraically.
Taking Wholes Apart, Putting Parts Together & Discovering Shape and Space	Building with Triangles	G-GPE.4, G-GPE.5, G-GPE.6, GPE.7, F-LE.1, F-LE.2, A-CED.2: Investigate with geometric figures, constructing figures in the plane, relating the distance formula to the Pythagorean Theorem, noticing how areas and perimeters of polygons change as the coordinates change. Build with triangles and quadrilaterals, noticing positions and movement, and creating equations that model the changing edges using technology.
Discovering Shape and Space	Transformations & Congruence	G-CO.1, G-CO.2, G-CO.3, G-CO.4, G-CO.5, G-CO.12, G-CO.13, G-GPE.4, G-GPE.5, G.GPE.7, F-BF.3: Explore congruence of triangles, including quadrilaterals built from triangles, through geometric constructions. Investigate transformations in the plane. Use geometry software to study transformations developing definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, and parallel lines. Express translations algebraically.

High School Integrated 2



Content Connection	Big Idea	Standards
Communicating Stories with Data	Probability Modeling	S.CP.1, S.CP.2, S.CP.3, S.CP.4, S.CP.5, S-IC.1, S-IC.2, S-IC.3, S.MD.6, S.MD.7: Explore and compare independent and conditional probabilities, interpreting the output in terms of the model. Construct and interpret two-way frequency tables of data as a sample space to determine if the events are independent and use the data to approximate conditional probabilities. Examples of topics include

		product and medical testing, player statistics in sports.
Communicating Stories with Data	The shape of distributions	S-IC.1, S-IC.2, S-IC.3, S-ID.1, S-ID.2, S-ID.3, S-MD.1 and S-MD.2: Consider the shape of data distributions to decide on ways to compare the center and spread of data. Use simulation models to generate data and decide if the model produces consistent results.
Communicating Stories with Data & Exploring Changing Quantities	Experimental Models & Functions	S-ID.1, S-ID.2, S-ID.3, S- ID.6, S-ID.7, S-IC.1, S-IC.2, S-IC.3, A-CED.1, A-REI.1, A-REI.4, F-IF.2, F-IF.3, F-IF.4, F-BF.1, F-LE.1, F-TF.2, A-APR.1: Conduct surveys, experiments, and observational studies - drawing conclusions and making inferences. Compare different data sources and what may be most appropriate for the situation. Create and interpret functions, that describe the relationships, interpreting slope and the constant term when linear models are used. Include quadratic and exponential models when appropriate and understand the meaning of outliers.
Communicating Stories with Data	Geospatial Data	G-MG.1, G-MG.2, G-MG.3, F-LE.6, G-GPE.4, G-GPE.6, G-SRT.5, G-CO.1, G-CO.2, G-CO.12, G-C.2, G-C.5: Explore geospatial data that represent either locations (e.g., maps) or objects (e.g., patterns of people's faces, road objects for driverless cars) and connect to geometric equations and properties of common shapes. Demonstrate how a computer can measure the distance between two points using geometry, and then account for constraints (e.g., distance and then roads for directions) and multiple points with triangulation. Model what shapes and geometric relationships are most appropriate for different situations.
Exploring Changing Quantities	Equations to Predict & Model	A-CED.1, A-CED.2, A-REI.4, A-REI.1, A-REI.2, A-REI.3, F.IF.4, F.IF.5, F.IF.6, F.BF.1, F.BF.3, A-APR.1: Model relationships that include creating equations or inequalities, including linear, quadratic, and absolute value. Use the equations or inequalities to

		make sense of the world, or to make predictions, understanding that solving equations is a process of reasoning. Make sense of the real situation, using multiple representations such as graphs, tables, and equations.
Exploring Changing Quantities & Discovering Shape and Space	Transformations & Similarity	G-SRT.1, G- SRT.2, G-SRT.3, , A-CED.2, G-GPE.4, F-BF.3, F-IF.4, A-APR.1: Explore similarity and congruence in terms of transformations, noticing the changes dilations have on figures and the effect of scale factors. Discover how coordinates can be used to describe translations, rotations and reflections and generalize findings to model the transformations using algebra.
Taking Wholes Apart, Putting Parts Together	Functions in the World	F-LE.3, F-LE.6, F-IF.9, N-RN.1, N-RN.2, A-SSE.1, A-SSE.2: Apply quadratic functions to the physical world such as motion of an object under the force of gravity. Produce equivalent forms of the functions to reveal zeros, max and min and intercepts. Investigate how functions increase and decrease and compare the rates of increase or decrease to linear and exponential functions.
Taking Wholes Apart, Putting Parts Together	Polynomial Identities	A-SSE.1, A-SSE.2, A-APR.1, A-APR.3, A-APR.4, G-GMD.2, G-MG.1, S-IC.1, S-MD.2: Prove polynomial identities and use them to describe numerical relationships, using a computer algebra system to rewrite polynomials. Use the binomial theorem to solve problems, appreciating the connections with Pascal's triangle
Taking Wholes Apart, Putting Parts Together	Functions Representations	F-IF.4, F-IF.5, F-IF.6, F-IF.7, F-IF.8, F-IF.9, N-RN.1, N-RN.2, F-LE.3, A-APR.1: Interpret functions representing real world applications in terms of the data understanding key features of graphs, tables, domain, and range. Compare properties of two functions each represented in different ways (algebraically,

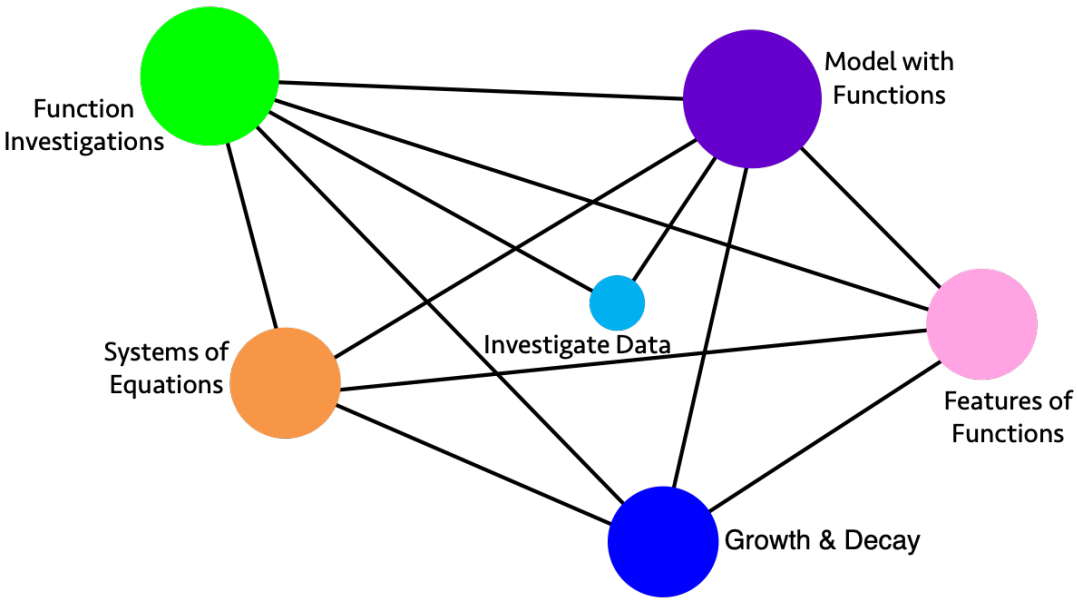
		graphically, numerically, in tables or by written/verbal descriptions.
Discovering Shape and Space	Circle Relationships	G-C.1, G-C.2, G-C.3, G-C.4, G-C.5, G-GPE.1, A-REI.7, A-APR.1, F-IF.9: Investigate the relationships of angles, radii, and chords in circles, including triangles and quadrilaterals that are inscribed and circumscribed. Explore arc lengths and areas of sectors using the coordinate plane. Relate the Pythagorean Theorem to the equation of the circle given the center and radius and solve simple systems where a line intersects the circle.
Discovering Shape and Space	Trig Functions	G-TF.2, G-GPE.1, G-GMD.2, G-MG.1, A-APR.1: Model periodic phenomena with trigonometric functions. Translate between geometric descriptions and the equation for a conic section. Visualize relationships between 2-D and 3-D objects.

A Progression Chart of Big Ideas through Algebra and Geometry

Grade Level	Algebra	Geometry
Content Connections	Big Ideas	Big Ideas
Communicating Stories with Data	Investigate data	Fairness in data
	Model with functions	Geospatial data
		Probability modeling
Exploring Changing Quantities	Function investigations	Trig explorations
	Systems of equations	Triangle congruence

	Features of functions	Triangle problems
		Circle relationships
		Points & slopes
Taking Wholes Apart, Putting Parts Together	Growth & decay	Triangle congruence
		Transformations
Discovering shape and space	Model with functions	Triangle congruence
	Investigate data	Transformations
		Congruence theorems
		Circle relationships
		Geometric models

High School Algebra



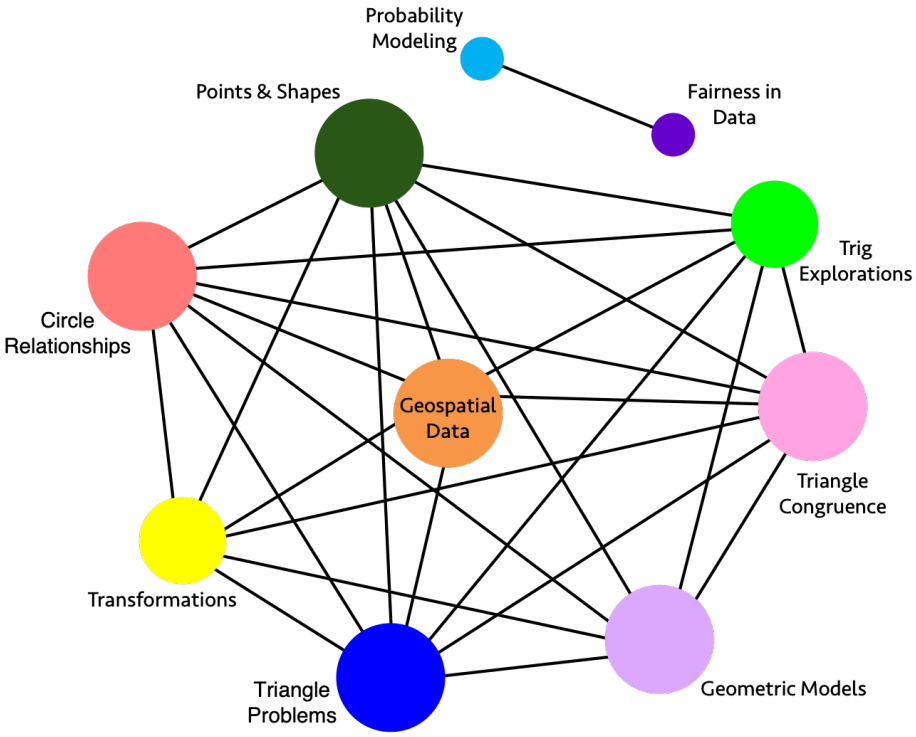
Content Connection	Big Idea	Standards
Communicating Stories with Data & Discovering Shape and Space	Investigate Data	S-ID.1, S-ID.2, S-ID.3, S-ID.6: Represent data from two or more data sets with plots, dot plots, histograms, and box plots, comparing and analyzing the center and spread, using technology, and interpreting the results. Interpret and compare data distributions using center (median, mean) and spread (interquartile range, standard deviation) through the use of technology. ● Students should have opportunities to explore and research a topic of interest and meaning to them, using the statistical methods, tools, and representations

		• Have students consider how different, competing interpretations can be made from different audiences, histories, and perspectives. • Allow students to develop follow-up questions to investigate, spurred by the original data set.
Communicating Stories with Data & Discovering Shape and Space	Model with Functions	F-IF.1, F-IF.2, F-IF.4, F-IF.5, F-IF.6, F-IF.7, F-IF.8, F-IF.9, F-BF.1, F-BF.2, F-BF.4, F-LE.1, F-LE.2, S-ID.5, S-ID.6, S-ID.7, S-ID.8, S-ID.9: Investigate data sets by table and graph and using technology; fit and interpret functions** to model the data between two quantities. Interpret information from the functions, noticing key features* and symmetries. Develop understanding of the meaning of the function and how it represents the data that it is modeling; recognizing possible associations and trends in the data - including consideration of the correlation coefficients of linear models. • Students can disaggregate data by different characteristics of interest (populations for example) and compare slopes to examine questions of fairness and bias among groups • Students should have opportunities to consider how to communicate relevant concerns to stakeholders and/or community members. • Students can identify both extreme values (true outliers) and data errors, and how the inclusion or exclusion of these observations may change the function that would most appropriately model the data. *intercepts, slope, increasing or decreasing, positive or negative ** functions include linear, quadratic and exponential
Exploring Changing	Systems of Equations	A-REI.1, A-REI.3, A-REI.4, A-REI.5, A-REI.6, A-REI.7, A-REI.10, A-REI.11, A-REI.12, NQ.1, A-SEE.1, F-LE.1, F-LE.2: Students investigate real situations that include

Quantities		data for which systems of 1 or 2 equations or inequalities are helpful, paying attention to units. Investigations include linear, quadratic, and absolute value. Students use technology tools strategically to find their solutions and approximate solutions, constructing viable arguments and interpreting the meaning of the results and communicating them in multidimensional ways.
Exploring Changing Quantities	Function investigations	F-IF.1, F-IF.2, F-IF.4, F-IF.5, F-IF.6, F-IF.7, F-IF.8, F-IF.9, F-BF.1, F-BF.2, F-BF.4, S-ID.5, S-ID.6, S-ID.7, S-ID.8, S-ID.9, F-LE.1, F-LE.2: Students investigate data sets by table and graph and using technology; such as earthquake data in the region of the school; they fit and interpret functions to model the data between two quantities and consider the meaning of inverse relationships. Students interpret information from the functions, noticing key features* and symmetries. Students develop understanding of the meaning of the function and how it represents the data that it is modeling; they recognize possible associations and trends in the data - including consideration of the correlation coefficients of linear models. (see above) *one to one correspondence, intercepts, slope, increasing or decreasing, positive or negative
Exploring Changing Quantities	Features of Functions	A-SSE.3, F-IF.3, F-IF.4, F-LE.1, F-LE.2, F-LE.6: Students investigate changing situations that are modeled by quadratic and exponential forms of expressions, and create equivalent expressions to reveal features* that help understand the meaning of the problem and situation being investigated. (driver of investigation 1, making sense of the world) Investigate patterns, such as the Fibonacci sequence and other mathematical patterns, that reveal recursive functions.

		*Factored form to reveal zeros of a quadratic function, standard form to reveal the y-intercept, vertex form to reveal a maximum or minimum.
Taking Wholes Apart, Putting Parts Together	Growth & Decay	F-LE.1, F-LE.2, F-LE.3, F-LE.5, F-LE.6, F-BF.1, F-BF.2, F-BF.3, F-BF.4, F-IF.4, F-IF.5, F-IF.9, NQ.1, A-SEE.1: Investigate situations that involve linear, quadratic, and exponential models and use these models to solve problems. Recognize linear functions grow by equal differences over equal intervals; exponential functions grow by equal factors over equal intervals, and functions grow or decay by a percentage rate per unit interval. Interpret the inverse of functions and model the inverse in graphs, tables, and equations.

High School Geometry



Content Connection	Big Idea	Standards
Communicating Stories with Data	Probability Modeling	S-CP.1, S-CP.2, S-CP.3, S-CP.4, S-CP.5, S-IC.1, S-IC.2, S-IC.3, S-MD.6, S-MD.7: Explore and compare independent and conditional probabilities, interpreting the output in terms of the model. Construct and interpret two-way frequency tables of data as a sample space to determine if the events are independent and use the data to approximate conditional probabilities. Examples of topics include product and medical testing, player statistics in sports.
Communicating Stories with Data	Fairness in Data	S-MD.6, S-MD.7: Determine fairness and make decisions based on evaluation of outcomes. Allow students to explore fairness by researching topics of interest, analyzing data from two-way tables. Provide opportunities for students to make meaningful inference and communicate their findings to community or other stakeholders.
Communicating Stories with Data	Geospatial Data	G-MG.1, G-MG.2, G-MG.3, F-LE.6, G-GPE.4, G-GPE.6, G-SRT.5, G-CO.1, G-CO.2, G-CO.12, G-C.2, G-C.5: Explore geospatial data that represent either locations (e.g., maps) or objects (e.g., patterns of people's faces, road objects for driverless cars) and connect to geometric equations and properties of common shapes. Demonstrate how a computer can measure the distance between two points using geometry, and then account for constraints (e.g., distance and then roads for directions) and multiple points with triangulation. Model what shapes and geometric relationships are most appropriate for different situations.
Exploring Changing Quantities	Trig Explorations	G-SRT.1, G-SRT.2, G-SRT.3, G-SRT.5, G-SRT.9, G-SRT.10, G-SRT.11, GPE.7. G-C.2, G-C.4: Investigate properties of right triangle similarity and congruence and the relationships between sine, cosine, and tangent; exploring the relationship

		between sine and cosine of complementary angles, and apply that knowledge to problem solving situations. Students recognize the role similarity plays in establishing trigonometric functions and they use trigonometric functions to investigate situations. Using dynamic geometric software students investigate similarity and trigonometric identities to derive the Laws of Sines and Cosines and use the laws to solve problems.
Exploring Changing Quantities & Taking Wholes Apart, Putting Parts Together & Discovering Shape and Space	Triangle Congruence	G-CO.1, G-CO.2, G-CO.7, G-CO.8, G-CO.9, G-CO.10, G-CO.11, G-CO.12, G-CO.13, G-SRT.5: Investigate triangles and their congruence over rigid transformations verifying findings using triangle congruence theorems (ASA, SSS, SAS, AAS, and HL) and other geometric properties including vertical angles, angles created by transversals across parallel lines and bisectors.
Exploring Changing Quantities	Triangle Problems	G-SRT.4, G-SRT.5, G-SRT.6, G-SRT.8, G-C.2, G-C.4, G-CO.12: Understand and use congruence and similarity when solving problems involving triangles, including trigonometric ratios. Use trigonometric ratios and the Pythagorean theorem to solve right triangles in applied problems using dynamic geometric software.
Exploring Changing Quantities & Discovering Shape and Space	Circle Relationships	G-C.1, G-C.2, G-C.3, G-C.4, G-CO.1, G-CO.12, G-CO.13, G-GPE.1: Investigate similarity in circles and relationships between angle measures and segments including inscribed angles, radii, chords, central angles, inscribed angles, circumscribed angles, and tangent lines using dynamic geometric software.
Exploring Changing Quantities	Points & Shapes	G-GPE.1, G-GPE.2, G-GPE.4, G-GPE.5, G-GPE.6, G-GPE.7, G-CO.1, G-CO.12, G-C.2, G-C.4: Solve problems involving geometric shapes in the

		coordinate plane using dynamic geometric software to apply the distance formula, Pythagorean Theorem, slope, and similarity rules in solving problems. ● Investigate equations of circles and how coefficients in the equations correspond to the location and radius of the circles. ● Find areas and perimeters of triangles and rectangles in the coordinate plane
Taking Wholes Apart, Putting Parts Together & Discovering Shape and Space	Transformations	G-CO.1, G-CO.3, G-CO.4, G-CO.5, G-CO.12: Understand rotations, reflections and translations of regular polygons, quadrilaterals, angels, circles, and line segments. Identify transformations, through investigation, that move a figure back onto itself, using that process to prove congruence.
Discovering Shape and Space	Geometric Models	G-GMD.1, G-GMD.3, G-GMD.4, G-GMD.5, G-MG.1, G-MG.12, G-MG.13, SRT.5, G-CO.12, G-C.2, G-C.4: Apply geometric concepts in modeling situations to solve design problems using dynamic geometric software ● Investigate 3-D shapes and their cross sections. ● Use volume, area, circumference, and perimeter formulas ● Understand and apply Cavalieri's principle. ● Investigate and apply scale factors for length, area, and volume.