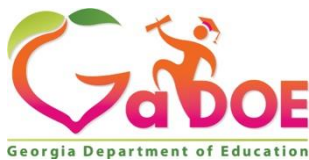
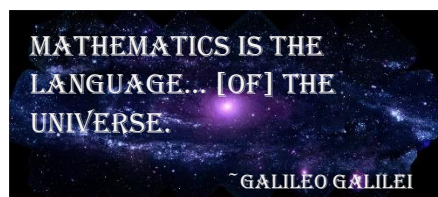


Georgia's K-12 Mathematics Standards

Explanation of Changes and Improvements





“Ensuring that each learner is a prepared, numerate citizen ready to enter the future workforce with the critical thinking and reasoning skills necessary for success in both the local and global workforces.”

This document contains an explanation of Georgia’s 2021 K-12 Mathematics Standards. The standards are organized into big ideas, grade level/course competencies/standards, and learning objectives. The grade level/course key competencies represent the standard expectation of learning for students in each grade level/course. The competencies/standards are each followed by more detailed learning objectives that further explain the expectations for learning in the specific grade level/course.

New instructional supports are included, such as clarification of language and expectations, as well as detailed examples. These have been provided for teaching professionals and stakeholders through the Evidence of Student Learning Column that accompanies each learning objective.

Table of Contents

Goals of Mathematics Education.....	3
Rationale for Changes and Improvements	3
Georgia’s K-12 Mathematics Standards Big Ideas	4
Standards Structure and Coding	5
KINDERGARTEN	6
1 st GRADE	11
2 nd GRADE	17
3 rd GRADE	22
4 th GRADE	28
5 th GRADE	34
6 th GRADE	40
7 th GRADE	46
8 th GRADE	50
ALGEBRA: CONCEPTS & CONNECTIONS.....	56
GEOMETRY: CONCEPTS & CONNECTIONS	64
ADVANCED ALGEBRA: CONCEPTS & CONNECTIONS	72
PRECALCULUS	78

Goals of Mathematics Education

Each and every student in Georgia should be provided with opportunities to:

- become confident in using mathematics to analyze and solve problems both in school and in real-life situations as they recognize that mathematics permeates the world around us.
- develop the knowledge and skills, including academic language, symbols and notation of mathematics, and attitudes necessary to pursue further studies in mathematics.
- develop abstract, logical, and critical thinking and the ability to reflect critically upon their work and the work of others.
- develop a critical appreciation of the use of information and communication technology in mathematics.
- appreciate the international dimension of mathematics and its multicultural and historical perspectives.

Rationale for Changes and Improvements

- I. Focus on strategic mathematical thinking and reasoning.
 - Cognitive flexibility is a core skill for workforce success. All students must experience the trajectory of reasoning to develop flexibility in their thinking.
 - Jobs of the future will require an advanced level of mathematical reasoning and application, as well as data analysis and statistical reasoning and comprehension.
- II. Align mathematics to industry and workforce needs and 21st century skills by:
 - Incorporating mathematical practices into the content standards
 - Emphasizing mathematical modeling K-12
 - Increasing the presence of statistical reasoning K-12 to prepare all learners for life after high school

How to Use this Document

The standards for each grade level/course are explained in multiple parts. Each explanation begins with a brief overview of the standard, followed by a description of how the concepts are addressed in the Georgia Standards of Excellence. Improvements and changes in Georgia's K-12 Mathematics Standards complete the statement with a detailed explanation of the standard expectations and intent.

Georgia's K-12 Mathematics Standards Big Ideas

The image below illustrates the big ideas for Georgia's K-12 Mathematics Standards. For each big idea in Kindergarten through Grade 12, the grade levels/courses where it is addressed is indicated. Most of the big ideas span multiple grade levels/courses, supporting the progression of mathematics and the coherence across grade levels/courses.

Mathematics Big Ideas, K-HS

K	1	2	3	4	5	6	7	8	HS Algebra: Concepts & Connections	HS Geometry: Concepts & Connections	HS Advanced Algebra: Concepts & Connections
Mathematical Modeling (MM)											
Mathematical Practices (MP)											
Data & Statistical Reasoning (DSR)											
Numerical Reasoning (NR)											
Patterning & Algebraic Reasoning (PAR)											
Geometric & Spatial Reasoning (GSR)											
Measurement & Data Reasoning (MDR)											
								Functional & Graphical Reasoning (FGR)			
						Probability Reasoning (PR)		Probabilistic Reasoning (PR)			

*The Big Ideas extend from Kindergarten through Advanced Algebra: Concepts & Connections and into the High School 4th course options beyond Advanced Algebra: Concepts and Connections. The specific big ideas for the fourth courses can be found within each course standards document for [Georgia's K-12 Mathematics Standards](#) (adopted August 26, 2021).

The standards are for ALL students:

All students including students with disabilities, EL students and students labeled gifted must be challenged to excel within the general curriculum and be prepared for success in their post-school lives, including college and/or careers.

Each student is expected to meet the high academic standards and demonstrate the level of mathematical reasoning needed to fully develop their conceptual understanding and procedural fluency; therefore, their instruction must incorporate supports and accommodations.

Promoting a culture of high expectations for all students is a fundamental goal of Georgia's K-12 Mathematics Standards.

Standards Structure and Coding

The grade-level/course key competencies represent the standard expectation of learning for students in each grade level/course. Students should be provided with learning opportunities which allows for progression towards mastery of the course standards. The competencies/standards are each followed by more detailed learning objectives that further explain the expectations for learning in the specific grade level/course.

Georgia's K-12 Mathematics Standards - 2021
Kindergarten

NUMERICAL REASONING – counting, money, place value, numbers to 20, addition, subtraction and fluency
K.NR.1: Demonstrate and explain the relationship between numbers and quantities up to 20; connect counting to cardinality (the last number counted represents the total quantity in a set).

Expectations		Evidence of Student Learning (not all inclusive; see Grade Level Overview for more details)		
K.NR.1.1	Count up to 20 objects in a variety of structured arrangements and up to 10 objects in a scattered arrangement.	Fundamentals - This learning objective builds on the Pre-K Georgia Early Learning and Development Standard, CD-MA2.4b: Counts at least 10 objects using one-to-one correspondence. - Students should count objects using one-to-one correspondence saying the number names in the standard order and communicate quantities for authentic purposes. "Authentic purposes" refers to experiences students have in their everyday lives. - The overall goal is for students to be able to count up to 20 objects arranged in a line, a rectangle, or a circle, or up to 10 objects in a scattered arrangement.	Relevance and Application Students should be able to count to answer "how many?" questions with up to 20 objects arranged in a variety of ways (a line, a rectangular array, or a circle), or up to 10 objects arranged in a scattered configuration.	Strategies and Methods Dot cards, five-frames, ten-frames, rekenreks, dominoes, beads, rocks, counting bears, and playing cards are some tools that can be used for subitizing.
K.NR.1.2	When counting objects, explain that the last number counted represents the total quantity in a set (cardinality), regardless of the arrangement and order.	Fundamentals - This learning objective builds on the Pre-K Georgia Early Learning and Development Standards, CD-MA1.4e: Quickly recognizes and names how many items are in a set of up to four items, and CD-MA2.4e: With adult guidance and when counting, understands and can respond with the last number counted to represent quantity (cardinality). - Students should know that the last number counted represents the total quantity in a set (cardinality), when counting objects regardless of the arrangement and order. - Students should instantly see how many objects are in a group without counting (subitizing).	Relevance and Application Students should be able to count to answer "how many?" questions with up to 20 objects arranged in a variety of ways (a line, a rectangular array, or a circle), or up to 10 objects arranged in a scattered configuration.	Strategies and Methods Dot cards, five-frames, ten-frames, and rekenreks can be used for subitizing.
K.NR.1.3	Given a number from 1-20, identify the number that is one more or one less.	Fundamentals - This learning objective builds on the Pre-K Georgia Early Learning and Development Standard, CD-MA1.4d: Describes sets as having more, less, same as/equal. and CD-MA1.4f: Tells numbers that come before and after a given number up to 10. - Students should be able to understand that each successive number name refers to a quantity that is one larger and the previous number name is one less.	Relevance and Application Students should be able to count to answer "how many?" questions with up to 20 objects arranged in a variety of ways (a line, a rectangular array, or a circle), or up to 10 objects arranged in a scattered configuration.	Strategies and Methods Dot cards, five-frames, ten-frames, and rekenreks can be used for subitizing.
K.NR.1.4	Identify pennies, nickels, and dimes and know their name and value.	Fundamentals Students should be able to identify and represent coins by name and value.	Strategies and Methods - Students can use different types of coin manipulatives to extend their understanding of counting by ones. - Coins as manipulatives could be used for counting by ones.	Developmentally Appropriate Student is able to count five nickels. Students are not expected to find the value.

Learning objectives/expectations
– "breaks down" the standard in an instructional progression

Evidence of Student Learning
– instructional supports

Standard Coding Example

Grade Level	Big Idea	Standard	Learning Objective/Exception
1	NR	1	3
Kindergarten	Numerical Reasoning	Demonstrate and explain the relationship between numbers and quantities up to 20; connect counting to cardinality (the last number counted represents the total quantity in a set).	Given a number from 1-20, identify the number that is one more or one less.

Georgia's K-12 Mathematics Standards

KINDERGARTEN

KINDERGARTEN STANDARDS AND EXPECTATIONS		Explanation of Changes and Improvements
New standard code	Language of the New Standard	Brief Explanation of Changes (with relevant GSE standard codes)
K.MP	<i>Display perseverance and patience in problem-solving. Demonstrate skills and strategies needed to succeed in mathematics, including critical thinking, reasoning, and effective collaboration and expression. Seek help and apply feedback. Set and monitor goals.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations K.MP.1, K.MP.2, K.MP.3, K.MP.4, K.MP.5, K.MP.6, K.MP.7, K.MP.8)</i>	This standard describes the eight habits of mind in which all students should engage to ensure a deep understanding of mathematics and focus on developing reasoning and building mathematical communication. These eight mathematical practices engage students in learning the kindergarten mathematics content in a meaningful way that allows students to relate concepts and skills to other concepts and skills, making sense of the mathematics along the way. Kindergarten students engage in these eight practices as they build proficiency with numerals to represent specific quantities and create models to represent real-life problems involving the joining and separating sets. They choose appropriate tools to solve problems, use mathematically precise vocabulary to describe quantities, shapes, data, and measurements. Kindergarten students look for patterns and structures and notice repetitive actions as they study shapes and patterns, as they explore the count sequence, interpret data, and compare sets. In addition to building mathematical proficiency, engaging in these practices often results in an appreciation for and increased value of mathematics as a subject worthy of study. (GSE Reference: SMP1, SMP2, SMP3, SMP4, SMP5, SMP6, SMP7, SMP8)
K.NR.1	<i>Demonstrate and explain the relationship between numbers and quantities up to 20; connect counting to cardinality (the last number counted represents the total quantity in a set).</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations K.NR.1.1, K.NR.1.2, K.NR.1.3, and K.NR.1.4)</i>	This standard focuses on counting quantities up to 20 and building the concept of cardinality of number. In the GSE, students use counting to tell the number of objects in a set and use pennies as manipulatives to count.

		Improvements in Georgia's K-12 Mathematics Standards include a focus on students using real objects to count quantities. In addition, students will use pennies, nickels and dimes as counters and know their names and value. The guiding principle for this change was to build a progression of the study of money that begins in kindergarten, and purposefully builds from grade level to grade level. Pennies, nickels, and dimes connect nicely to benchmark numbers (5 and 10) that students are introduced to in kindergarten. (GSE Reference: MGSEK.CC.4, MGSEK.CC.4a, MGSEK.CC.4b, MGSEK.CC.4c, MGSEK.CC.5, MGSEK.CC.5a, MGSEK.CC.5b, MGSEK.CC.5c)
K.NR.2	<i>Use count sequences within 100 to count forward and backward in sequence.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations K.NR.2.1 and K.NR.2.2)</i>	This standard focuses on learning number names and the count sequence to 100. In the GSE, students count to 100 by tens and ones, count forward from a given number and write numbers from 0 to 20. Improvements in Georgia's K-12 Mathematics Standards include a shift to develop students' reasoning and patterns within the count sequence to also count backward from 20. The guiding principle for this change is to better align the expectations for Kindergarten with the Early Georgia Numeracy Project expectations. (GSE Reference: MGSEK.CC.1, MGSEK.CC.2)
K.NR.3	<i>Use place value understanding to compose and decompose numbers from 11–19.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations K.NR.3.1)</i>	This standard sets the stage for building a deep understanding of the base-ten number system by composing and decomposing the numbers 11-19. In the GSE, students compose and decompose numbers from 11-19 and record these compositions and decompositions as one ten and 1, 2, 3, 4, 5, 6, 7, 8, or 9 ones. Improvements in Georgia's K-12 Mathematics Standards include an explicit focus on fostering student reasoning about their number composition/ decomposition. (GSE Reference: MGSEK.NBT.1)

K.NR.4	Identify, write, represent, and compare numbers up to 20. <i>(A further breakdown of this standard can be found in learning objectives/expectations K.NR.4.1 and K.NR.4.2)</i>	This standard focuses on writing, representing, and comparing numbers to 20. In the GSE, students write numbers to represent quantities and compare numbers. Improvements in Georgia's K-12 Mathematics Standards include a focus on fostering students' numerical reasoning to represent and write numbers to 20. Students should focus on comparing sets of objects, using words, not symbols, and connecting the numerals to those sets. (GSE Reference MGSEK.CC.3, MGSEK.CC.6, MGSEK.CC.7)
K.NR.5	Explain the concepts of addition, subtraction, and equality and use these concepts to solve real-life problems within 10. <i>(A further breakdown of this standard can be found in learning objectives/expectations K.NR.5.1, K.NR.5.2, K.NR.5.3, and K.NR.5.4)</i>	This standard develops the concepts of addition, subtraction, and equality through the process of solving problems. In the GSE, students relate addition to "putting together" and "adding to," and relate subtraction to "taking apart" and "taking from." This is taught by engaging students in all problem types for addition and subtraction. In Georgia's K-12 Mathematics Standards, improvements include an emphasis on real-life problems to show the relevance of mathematics. In addition, there has been a reduction of the problem types for kindergarten. The problem types have been reduced to: <i>Join: Result Unknown, Separate: Result Unknown, Part Part-Whole: Whole Unknown, and Part Part-Whole: Both Parts Unknown.</i> (GSE Reference: MGSEK.OA.1, MGSEK.OA.2, MGSEK.OA.3, MGSEK.OA.4, MGSEK.OA.5)
K.PAR.6	Explain, extend, and create repeating patterns with a repetition, not exceeding 4 and describe patterns involving the passage of time. <i>(A further breakdown of this standard can be found in learning objectives/expectations K.NR.6.1 and K.NR.6.2)</i>	This standard develops foundational understandings of algebra through the study of repeating patterns. In the GSE, students discuss patterns within the context of the count sequence, decomposing shapes or numbers 11-19, and through the development of understanding addition and subtraction. In Georgia's K-12 Mathematics Standards, improvements include the study of patterns to provide opportunities for students to

		make connections. These connections help to build a foundational understanding of algebra as it relates to addition and subtraction strategies, the count sequence, and geometric understandings. (GSE Reference: <i>*The concept of patterning is embedded with the following standards.*</i> MGSEK.CC.1, MGSEK.CC.2, MGSEK.OA.1, MGSEK.OA.2, MGSEK.OA.3, MGSEK.OA.4, MGSEK.G.2, MGSEK.G.4)
K.MDR.7	<i>Observe, describe, and compare the physical and measurable attributes of objects and analyze graphical displays of data.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations K.MDR.7.1, K.MDR.7.2, and K.MDR.7.3)</i>	This standard focuses on describing and directly comparing measurable attributes of objects and students asking and answering statistical questions about their world. In the GSE, students describe and compare measurable attributes. They also classify objects and count the objects in each category. Improvements in Georgia's K-12 Mathematics Standards include a focus on student reasoning about the measurable attributes to compare two objects and reasoning about classifying and sorting objects into categories and explain how they sorted. The framework for statistical reasoning was added to create a richer, more meaningful experience with data for kindergarten students. The focus of statistical reasoning includes opportunities for students to ask and answer statistical investigative questions that matter to them and a study of categorical data. (GSE Reference: MGSEK.MD.1, MGSEK.MD.2, MGSEK.MD.3)

K.GSR.8	Identify, describe, and compare basic shapes encountered in the environment, and form two-dimensional shapes and three-dimensional figures. <i>(A further breakdown of this standard can be found in learning objectives/expectations K.GSR.8.1, K.GSR.8.2, K.GSR.8.3, and K.GSR.8.4)</i>	This standard describes how students investigate two- and three-dimensional shapes in the world around them. In the GSE, students investigate common shapes, describe shapes in their environment, analyze and compare two- and three-dimensional shapes, and compose larger shapes from simple shapes. In Georgia's K-12 Mathematics Standards, improvements include a focus on reasoning about shapes and describing the shapes they see in the world around them. In Georgia's K-12 Mathematics Standards, students continue to use this reasoning to sort, compare, analyze, and classify shapes and compose shapes from two or more basic shapes. Hexagons and octagons have been added as shapes for investigation in kindergarten. (GSE Reference: MGSEK.G.1, MGSEK.G.2, MGSEK.G.3, MGSEK.G.4, MGSEK.G.5, MGSEK.G.6)
Kindergarten Mathematical Modeling	In Kindergarten, students apply mathematics to real-life situations and model real-life phenomena using: • <i>relationship between numbers and quantities up to 20,</i> • <i>counting and cardinality,</i> • <i>count sequences within 100,</i> • <i>place value understanding to compose and decompose numbers 11-19,</i> • <i>numbers up to 20,</i> • <i>addition and subtractions within 10,</i> • <i>repeating patterns and time intervals,</i> • <i>physical and measurable attributes and analysis of graphical displays of data, and</i> • <i>two- and three- dimensional shapes.</i>	Students explain contextual, mathematical problems using a mathematical model and create mathematical models to explain phenomena that exist in the natural sciences, social sciences, liberal arts, fine and performing arts, and/or humanities contexts. Using abstract and quantitative reasoning, students make decisions about information and data from a contextual situation. Students use various mathematical representations and structures with this information to represent and solve real-life problems.
Kindergarten Data & Statistical Reasoning	As students engage with K.MDR.7, students create statistical investigative questions that can be answered by collecting, analyzing, and interpreting data with up to 10 data points.	Students develop statistical investigative questions, collect, and organize their data with guidance. In Kindergarten, students use friendly language to explain their data and answer the overall question. Students display their data using objects and pictures. In later grades, students will represent data in pictographs and bar graphs. Limit category counts to be less than or equal to ten.

Georgia's K-12 Mathematics Standards

1st GRADE

GRADE 1 STANDARDS AND EXPECTATIONS		Explanation of Changes and Improvements
New standard code	Language of the New Standard	Brief Explanation of Changes (with relevant GSE standard codes)
1.MP	<i>Display perseverance and patience in problem-solving. Demonstrate skills and strategies needed to succeed in mathematics, including critical thinking, reasoning, and effective collaboration, and expression. Seek help and apply feedback. Set and monitor goals.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 1.MP.1, 1.MP.2, 1.MP.3, 1.MP.4, 1.MP.5, 1.MP.6, 1.MP.7, and 1.MP.8)</i>	This standard describes the eight habits of mind in which all students should engage to ensure a deep understanding of mathematics and focus on developing reasoning and building mathematical communication. These eight mathematical practices engage students in learning the first-grade mathematics content in a meaningful way that allows students to relate concepts and skills to other concepts and skills, making sense of the mathematics along the way. First grade students engage in these eight practices as they build proficiency with problem-solving across all big ideas. They make connections between numbers and the specific quantities they represent. They create models to represent real-life problems involving addition and subtraction, choose appropriate tools to solve problems, and use mathematically precise vocabulary as they discuss patterns, quantities, shapes, data, and measurements. First grade students search for patterns and structures and notice repetitive actions in geometry, as they extend the count sequence, collect, and interpret data, and compute to solve problems. In addition to building mathematical proficiency, engaging in these practices often results in an appreciation for and increased value of mathematics as a subject worthy of study. (GSE Reference: SMP1, SMP2, SMP3, SMP4, SMP5, SMP6, SMP7, SMP8)

1.NR.1	<i>Extend the count sequence to 120. Read, write, and represent numerical values to 120 and compare numerical values to 100.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 1.NR.1.1, 1.NR.1.2, and 1.NR.1.3)</i>	This standard focuses on reading and writing numerical values to 120, learning the count sequence to 120 and comparing numerical values to 120. This standard extends the work done in kindergarten where students learn the count sequence to 100 and write numerical values to 20. In the GSE, students count to 120, read and write numerals within the range of 0-120 and represent a number of objects with a written numeral. In Georgia's K-12 Mathematics Standards, improvements include a focus on numerical reasoning about the patterns of the count sequence to count forward and backward from any number less than 120. Additionally, students will reason about the place value structure to make sense of the idea of tens and ones and compare and order whole numbers to 100. Combining these ideas into one larger competency provides students with the opportunity to learn and understand these as connected concepts and skills. (GSE Reference: MGSE1.NBT.1, 1.NBT.2, MGSE1.NBT.2a, MGSE1.NBT.2b, MGSE1.NBT.2b, MGSE1.NBT.3)
1.NR.2	<i>Explain the relationship between addition and subtraction and apply the properties of operations to solve real-life addition and subtraction problems within 20.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 1.NR.2.1, 1.NR.2.2, 1.NR.2.3, 1.NR.2.4, 1.NR.2.5, 1.NR.2.6, and 1.NR.2.7)</i>	This standard focuses on understanding the relationship between addition and subtraction and using addition and subtraction strategies to solve problems within 20. In the GSE, students solve addition and subtraction problems within 100 using a variety of strategies. Improvements in Georgia's K-12 Mathematics Standards include student choice of strategies. These strategies may be student created and may be based on the context of the problem and/or the numbers used. This is a foundational exploration into the properties of addition and subtraction and sets the stage for students to use these properties throughout the rest of their mathematical learning journey. Students may solve problems in a variety of ways and have the flexibility to choose a mathematical strategy that allows them to make sense of and strategically solve

		problems using efficient methods that are most comfortable for and make sense to them. (GSE Reference: MGSE1.OA.1, MGSE1.OA.2, MGSE1.OA.3, MGSE1.OA.4, MGSE1.OA.5, MGSE1.OA.6, MGSE1.OA.6a, MGSE1.OA.6b, MGSE1.OA.7, MGSE1.OA.8)
1.PAR.3	<i>Identify, describe, extend, and create repeating patterns, growing patterns, and shrinking patterns found in real-life situations.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 1.PAR.3.1 and 1.PAR.3.2)</i>	This standard focuses on identifying, describing, extending, and creating repeating and growing patterns. This extends the work done in kindergarten with repeating patterns and continues to build foundational algebraic understandings through the exploration of and reasoning about these patterns. In the GSE, patterns are embedded in several standards including those involving counting, place value, and the use of part-whole strategies to add and subtract. In Georgia's K-12 Mathematics Standards, the study of repeating and growing patterns is explicitly stated to ensure that students develop foundational algebraic understandings, such as, identify, describe, extend, and create patterns based on repeated addition and subtraction. As students develop these foundational algebraic understandings, they should have opportunities to connect them to other mathematical concepts and skills. (GSE Reference: <i>*The concept of patterning is embedded with the following standards.*</i> MGSE1.OA.3, MGSE1.OA.4, MGSE1.OA.5, MGSE1.OA.6, MGSE1.OA.7, MGSE1.OA.8, MGSE1.NBT.1, MGSE1.NBT.2, MGSE1.NBT.5, MGSE1.NBT.6)

1.GSR.4	Compose shapes, analyze the attributes of shapes, and relate their parts to the whole. <i>(A further breakdown of this standard can be found in learning objectives/expectations 1.GSR.4.1, 1.GSR.4.2, and 1.GSR.4.3)</i>	This standard focuses on identifying, sorting, and classifying two- and three-dimensional shapes, composing shapes, and relating parts of circles and rectangles to the whole. In the GSE, the geometry focus is on reasoning with shapes and their attributes and building a foundation for fraction understanding by composing and decomposing shapes into two and four equal shares. In Georgia's K-12 Mathematics Standards, the improvements include building students' capacity to reason deeply about the shapes they sort and classify, the composed shapes they create, and the shapes they partition to build a stronger foundation in geometry and fractions. (GSE Reference: MGSE1.G.1, MGSE1.G.2, MGSE1.G.3)
1.NR.5	Use concrete models, the base ten structure, and properties of operations to add and subtract within 100. <i>(A further breakdown of this standard can be found in learning objectives/expectations 1.NR.5.1, 1.NR.5.2, and 1.NR.5.3)</i>	This standard extends the understandings of the base ten structure developed in kindergarten and defines how students use addition and subtraction properties to add and subtract within 100 to solve problems. In the GSE, using strategies and the properties of operations are the focus of adding and subtracting within 100. In Georgia's K-12 Mathematics Standards, the focus has shifted to reasoning. Students may choose from a variety of strategies that they, themselves, develop and share their reasoning for the strategy used. Strategies will vary based on the level of student understanding, the context of the problem presented and/or the numbers involved. Also, students may solve problems in a variety of ways and have the flexibility to choose a mathematical strategy that allows them to make sense of and strategically solve problems using efficient methods that are most comfortable for and make sense to them. (GSE Reference: MGSE1.NBT.4, MGSE1.NBT.5, MGSE1.NBT.6)

1.MDR.6	<i>Use appropriate tools to measure, order, and compare intervals of length and time, as well as denominations of money to solve real-life, mathematical problems and analyze graphical displays of data to answer relevant questions.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 1.MDR.6.1, 1.MDR.6.2, 1.MDR.6.3, and 1.MDR.6.4)</i>	This standard defines how students use tools to measure, order, and compare length and time, gain an understanding of U.S. coins, and use the framework for statistical reasoning to ask and answer questions based on data. In the GSE, the focus of measurement is on length and writing and telling time in hours and half-hours. The focus of money is on connecting the value of dimes to ten pennies. Students learn about categorical data with up to three categories. In Georgia's K-12 Mathematics Standards, improvements include the beginning of a progression of the study of time to include elapsed time to the nearest hour using a number line clock. This concept connects with students' work with using a number line to add and subtract and provides students an opportunity to reason about addition and subtraction through the context of time. Quarters are also introduced in first grade to build on the introduction of pennies, nickels, and dimes in kindergarten. The framework for statistical reasoning was added to create a richer, more meaningful experience with data for first grade students. The focus of statistical reasoning includes a study of categorical data while engaging students in opportunities to ask and answer statistical investigative questions that matter to them. (GSE Reference: MGSE1.MD.1, MGSE1.MD.2, MGSE1.MD.3, MGSE1.MD.4, MGSE3.MD.1)
1st Grade Mathematical Modeling	<i>In 1st grade, students apply mathematics to real-life situations and model real-life phenomena using:</i> • <i>the count sequence to 100,</i> • <i>values to 120,</i> • <i>addition and subtraction within 20,</i> • <i>repeating, growing, and shrinking patterns using operations and shapes,</i> • <i>composition of shapes and attributes of shapes,</i> • <i>additions and subtraction within 100,</i> • <i>intervals of length and time, and</i> • <i>denominations of money.</i>	Students explain contextual, mathematical problems using a mathematical model and create mathematical models to explain phenomena that exist in the natural sciences, social sciences, liberal arts, fine and performing arts, and/or humanities contexts. Using abstract and quantitative reasoning, students make decisions about information and data from a contextual situation. Students use various mathematical representations and structures with this

		information to represent and solve real-life problems.
1st Grade Data & Statistical Reasoning	<i>As students engage with 1.MDR.6, students create a statistical investigative question that can be answered using data involving numerical values within 20. Students collect, analyze, and interpret categorical data presented as picture graphs and bar graphs (with single-unit scales) with up to three categories from actual situations to answer the question posed.</i>	Students formulate a statistical investigative question to explore a realistic situation in their classroom. Students organize the data collected, represent the data on a table, and ask questions about the data generated. This expectation is limited to data with up to three categories presented in tables and charts. Students use tally marks and numerical values within 20 to organize and represent data. Students summarize the number of tally marks in each category. Students analyze and interpret categorical data on a provided pictograph or bar graph to answer the formulated statistical investigative question. On a picture graph, one symbol stands for a value of 1 at this grade level. Students gather data from a variety of sources to answer the statistical investigative question posed.

Georgia's K-12 Mathematics Standards

2nd GRADE

GRADE 2 STANDARDS AND EXPECTATIONS		Explanation of Changes and Improvements
New standard code	Language of the New Standard	Brief Explanation of Changes (with relevant GSE standard codes)
2.MP	<i>Display perseverance and patience in problem-solving. Demonstrate skills and strategies needed to succeed in mathematics, including critical thinking, reasoning, and effective collaboration and expression. Seek help and apply feedback. Set and monitor goals.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 2.MP.1, 2.MP.2, 2.MP.3, 2.MP.4, 2.MP.5, 2.MP.6, 2.MP.7, and 2.MP.8)</i>	This standard describes the eight habits of mind in which all students should engage to ensure a deep understanding of mathematics and focus on developing reasoning and building mathematical communication. These eight mathematical practices engage students in learning the second-grade mathematics content in a meaningful way that allows students to relate concepts and skills to other concepts and skills, making sense of the mathematics along the way. Second grade students engage in these eight practices as they build proficiency with problem-solving across all big ideas. They make connections between larger numbers and the specific quantities they represent. They create models to represent real-life problems involving addition and subtraction of numbers to 1,000, choose appropriate tools to solve problems, and use mathematically precise vocabulary as they discuss patterns, quantities, shapes, data, and measurement. Second grade students look for patterns and structures and notice repetitive actions as they count, compute, measure, collect and interpret data, and study shapes. In addition to building mathematical proficiency, engaging in these practices often results in an appreciation for and increased value of mathematics as a subject worthy of study. (GSE Reference: SMP1, SMP2, SMP3, SMP4, SMP5, SMP6, SMP7, SMP8)

2.NR.1	<i>Using the place value structure, explore the count sequences to represent, read, write, and compare numerical values to 1000 and describe basic place-value relationships and structures.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 2.NR.1.1, 2.NR.1.2, and 2.NR.1.3)</i>	This standard focuses on building on the count sequence developed in previous grades to represent, read, write, compare, and describe place value relationships for numerical values to 1000. In the GSE, students explore count sequences to 1000 and the place value structure as separate ideas. In Georgia's K-12 Mathematics Standards, improvements include combining these ideas into a larger competency, allowing for more opportunities for students to make connections between these mathematical ideas through reasoning and problem-solving. (GSE Reference: MGSE2.NBT.1, MGSE2.NBT.2, MGSE2.NBT.3, MGSE2.NBT.4)
2.NR.2	<i>Apply multiple part-whole strategies, properties of operations and place value understanding to solve real-life, mathematical problems involving addition and subtraction within 1,000.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 2.NR.2.1, 2.NR.2.2, 2.NR.2.3, and 2.NR.2.4)</i>	This standard focuses on applying part-whole strategies to solve problems and build a deeper understanding of addition and subtraction within 1,000. In the GSE, students use strategies to solve addition and subtraction problems within 1,000. In Georgia's K-12 Mathematics Standards, improvements include a focus on developing numerical reasoning to build a deeper understanding of addition and subtraction and extend the use of the strategies developed in previous grades to apply to larger numbers. Students may solve problems in a variety of ways and have the flexibility to choose a mathematical strategy that allows them to make sense of and strategically solve problems using efficient methods that are most comfortable for and make sense to them. (GSE Reference: MGSE2.OA.1, MGSE2.OA.2, MGSE2.NBT.5, MGSE2.NBT.6, MGSE2.NBT.7, MGSE2.NBT.8, MGSE2.NBT.9)

2.NR.3	<i>Work with equal groups to gain foundations for multiplication through real-life, mathematical problems.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 2.NR.3.1 and 2.NR.3.2)</i>	This standard introduces the idea of equal groups as a foundation for developing the concepts of even and odd numbers and multiplication. In the GSE, students find the solution to multiplication problems using equal addends. In Georgia's K-12 Mathematics Standards, improvements include using numerical reasoning to find the solution to multiplication problems through repeated addition when solving real-life problems, representing those contextual problems mathematically, and explaining the reasoning behind the representations created as it relates to the context. Students use equal groups to represent and solve multiplication problems up to 5 x 5. (GSE Reference: MGSE2.OA.3, MGSE2.OA.4, MGSE2.MD.5)
2.PAR.4	<i>Identify, describe, extend, and create repeating patterns, growing patterns, and shrinking patterns.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 2.PAR.4.1 and 2.PAR.4.2)</i>	This standard focuses on identifying, describing, and creating patterns, including patterns that result from a repeated operation (i.e., addition and subtraction), as well as growing and shrinking patterns. In the GSE, patterns are embedded in several standards including counting and skip counting, place value, the use of part-whole strategies to add and subtract, and partitioning rectangles into rows and columns. In Georgia's K-12 Mathematics Standards, improvements include the addition of the study of repeating and growing patterns to ensure that students develop these foundational algebraic understandings and have the opportunities to connect them to other mathematical concepts and skills. (GSE Reference: <i>*The concept of patterning is embedded with the following standards.*</i> MGSE2.OA.1, MGSE2.OA.2, MGSE2.OA.3, MGSE2.OA.4, MGSE2.NBT.1, MGSE2.NBT.2, MGSE2.NBT.5, MGSE2.NBT.6, MGSE2.NBT.7, MGSE2.NBT.8, MGSE2.NBT.9, MGSE2.G.2)

2.MDR.5	<i>Estimate and measure the lengths of objects and distance to solve problems found in real-life using standard units of measurement, including inches, feet, and yards and analyze graphical displays of data to answer relevant questions.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 2.MDR.5.1, 2.MDR.5.2, 2.MDR.5.3, 2.MDR.5.4, and 2.MDR.5.5)</i>	This standard builds on measurement ideas presented in previous grades. In the GSE, students measure objects, compare measurements, and connect measurement to addition and subtraction. Students study categorical data and represent and interpret this data using bar and picture graphs. Numerical data is also introduced through measurement by representing measurements on a line plot. In Georgia's K-12 Mathematics Standards, improvements include a shift in focus to using measurement reasoning to solve problems involving standard measurements. Additionally, students develop the idea of standard measurement units such as inches, feet, and yards, measure lengths and distances with these units appropriately, and use statistical reasoning to solve real-life problems involving data. The focus of statistical reasoning has also been improved to engage students in a richer experience to include a study of categorical data while engaging students in the framework for statistical reasoning to ask and answer statistical investigative questions that matter to them. (GSE Reference: MGSE2.MD.1, MGSE2.MD.3, MGSE2.MD.4, MGSE2.MD.6, MGSE2.MD.10)
2.MDR.6	<i>Solve real-life problems involving time and money.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 2.MDR.6.1 and 2.MDR.6.2)</i>	This standard focuses on problem-solving involving time and money. In the GSE, second grade students solve problems with money and focus on telling time to the nearest five minutes. In Georgia's K-12 Mathematics Standards, improvements include a shift to reasoning about coin and bill values to solve real-life problems. In addition, the study of time progression, which begins in first grade, continues to include reasoning to solve problems involving elapsed time to the hour or half hour on the hour or half hour using a number line. (GSE Reference: MGSE2.MD.7, MGSE2.MD.8, MGSE3.MD.1)

2.GSR.7	<i>Draw and partition shapes and other objects with specific attributes, and conduct observations of everyday items and structures to identify how shapes exist in the world.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 2.GSR.7.1, 2.GSR.7.2, 2.GSR.7.3, and 2.GSR.7.4)</i>	This standard focuses on drawing shapes with specific attributes, identifying shapes that exist in the real world, and partitioning shapes to build a foundational understanding of fractions. In the GSE, students recognize and draw shapes with specific attributes, partition circles and rectangles into fractional parts and describe those parts using the words halves, thirds, and quarters. In Georgia's K-12 Mathematics Standards, improvements include a shift in focus to develop student reasoning about shapes and their attributes, as students sort and classify shapes based on their choice of attributes in addition to attributes that may be provided. Additional improvements include the introduction of the idea of symmetry, as well as reason about the fractional parts of partitioned shapes. (GSE Reference: MGSE2.G.1, MGSE2.G.3, MGSE4.G.3)
2nd Grade Mathematical Modeling	<i>In 2nd grade, students apply mathematics to real-life situations and model real-life phenomena using:</i> <i>• the place value structure to explore the count sequence,</i> <i>• addition and subtraction within 1,000,</i> <i>• equal groups of quantities,</i> <i>• repeating, growing, and shrinking patterns with the use of repeated addition and subtraction,</i> <i>• lengths of objects using standard units and distance,</i> <i>• elapsed time to the hour or half hour and money, and</i> <i>• partition of shapes and other objects with specific attributes.</i>	Students explain contextual, mathematical problems using a mathematical model and create mathematical models to explain phenomena that exist in the natural sciences, social sciences, liberal arts, fine and performing arts, and/or humanities contexts. Using abstract and quantitative reasoning, students make decisions about information and data from a contextual situation. Students use various mathematical representations and structures with this information to represent and solve real-life problems.
2nd Grade Data & Statistical Reasoning	<i>As students engage with 2.MDR.6, students create statistical investigative questions that can be answered using data. Students collect, analyze, and interpret categorical data presented as picture graphs and bar graphs (with single-unit scales) with up to four categories from real situations to answer questions.</i>	Students formulate a statistical investigative question to explore an authentic situation in their classroom. Students collect data through the use of surveys and scientific observations and organize data using tables and tally marks. Students work with pictographs and bar graphs representing a data set with no more than four categories. Students solve simple join, separate, and compare problems using information presented.

Georgia's K-12 Mathematics Standards

3rd GRADE

GRADE 3 STANDARDS AND EXPECTATIONS		Explanation of Changes and Improvements
New standard code	Language of the New Standard	Brief Explanation of Changes (with relevant GSE standard codes)
3.MP	<i>Display perseverance and patience in problem-solving. Demonstrate skills and strategies needed to succeed in mathematics, including critical thinking, reasoning, and effective collaboration and expression. Seek help and apply feedback. Set and monitor goals.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 3.MP.1, 3.MP.2, 3.MP.3, 3.MP.4, 3.MP.5, 3.MP.6, 3.MP.7, and 3.MP.8)</i>	This standard describes the eight habits of mind in which all students should engage to ensure a deep understanding of mathematics and focus on developing reasoning and building mathematical communication. These eight mathematical practices engage students in learning the third-grade mathematics content in a meaningful way that allows students to relate concepts and skills to other concepts and skills, making sense of the mathematics along the way. Third grade students engage in these eight practices as they build proficiency with problem-solving across all big ideas. They make connections between numbers and the specific quantities they represent (including fractions). They create logical representations of problems while considering appropriate units (i.e., square units for area problems), create models to represent real-life problems involving addition, subtraction, multiplication and division, area, and perimeter. Third grade students choose appropriate tools to solve problems, use mathematically precise vocabulary as they discuss patterns, quantities, shapes, data, and measurement. They look for patterns and structures, and notice repetitive actions in geometry, counting, computation, data, and measurement, and using these to look for more efficient methods. In addition to building mathematical proficiency, engaging in these practices often results in an appreciation for and increased value of mathematics as a subject worthy of study. (GSE Reference: SMP1, SMP2, SMP3, SMP4, SMP5, SMP6, SMP7, SMP8)

3.NR.1	<i>Use place value reasoning to represent, read, write, and compare numerical values up to 10,000 and round whole numbers up to 1,000.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 3.NR.1.1, 3.NR.1.2, and 3.NR.1.3)</i>	This standard focuses on reasoning about place value to represent, read, write, and compare numbers to 10,000 and round numbers to 1,000. In the GSE, students round numbers to 1,000. In Georgia's K-12 Mathematics Standards, improvements include the addition of reading, writing, and comparing numbers. In addition, there is an emphasis on reasoning about place value and magnitude of number within real-life situations to round numbers. (GSE Reference: MGSE3.NBT.1)
3.PAR.2	<i>Use part-whole strategies to represent and solve real-life problems involving addition and subtraction with whole numbers up to 10,000.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 3.PAR.2.1, and 3.PAR.2.2)</i>	This standard focuses on building part-whole strategies to represent and solve real-life problems involving addition and subtraction. In the GSE, students solve addition and subtraction problems to 1,000 using strategies based on place value, the properties of operations, and/or the relationship between addition and subtraction. In Georgia's K-12 Mathematic Standards, improvements include a focus on reasoning and using efficient strategies to solve real-life problems involving addition and subtraction within 10,000. Students may solve problems in a variety of ways and have the flexibility to choose a mathematical strategy that allows them to make sense of and strategically solve problems using efficient methods that are most comfortable for and make sense to them. (GSE Reference: MGSE3.NBT.2)
3.PAR.3	<i>Use part-whole strategies to solve real-life, mathematical problems involving multiplication and division with whole numbers within 100.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 3.PAR.3.1, 3.PAR.3.2, 3.PAR.3.3, 3.PAR.3.4, 3.PAR.3.5, 3.PAR.3.6, and 3.PAR.3.7)</i>	This standard focuses on investigating the patterns in multiplication to develop strategies for solving real-life problems involving multiplication and division within 100. In the GSE, students apply properties to multiply and divide within 100, interpret quotients and products as equal groups problems, and identify and explain the patterns in multiplication.

		In Georgia's K-12 Mathematics Standards, improvements include a focus on reasoning about the patterns of multiplication, solving real-life problems by reasoning about multiplication and by developing strategies based on the patterns discovered. Students build connections between facts using the patterns they learn and build fluency with multiplication facts as they do so. Students may solve problems in a variety of ways and have the flexibility to choose a mathematical strategy that allows them to make sense of and strategically solve problems using efficient methods that are most comfortable for and make sense to them. (GSE Reference: MGSE.3.OA.1, MGSE.3.OA.2, MGSE.3.OA.3, MGSE.3.OA.4, MGSE.3.OA.5, MGSE.3.OA.6, MGSE.3.OA.7, MGSE.3.OA.8, MGSE.3.OA.9, MGSE.3.NBT.3)
3.NR.4	<i>Represent fractions with denominators of 2, 3, 4, 6 and 8 in multiple ways within a framework using visual models.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 3.NR.4.1, 3.NR.4.2, 3.NR.4.3, and 3.NR.4.4)</i>	This standard describes how students use visual models to represent fractions using fraction notation with denominators of 2, 3, 4, 6, and 8. In the GSE, students use fraction notation, build an understanding of a fraction as a number on a number line, represent non-unit fractions, compare fractions, and explain equivalent fractions. In Georgia's K-12 Mathematics Standards, the study of fractions has been streamlined to focus on reasoning to compare unit fractions, represent fractions (including fractions greater than one in multiple ways), and using numerical reasoning to recognize and generate equivalent fractions. Comparing non-unit fractions has been moved to fourth grade. (GSE Reference: MGSE3.NF.1, MGSE3.NF.2, MGSE3.NF.2a, MGSE3.NF.2b, MGSE3.NF.3, MGSE3.NF.3a, MGSE3.NF.3b, MGSE3.NF.3c, MGSE3.NF.3d)

3.MDR.5	<i>Solve real-life, mathematical problems involving length, liquid volume, mass, and time and analyze graphical displays of data to answer relevant questions.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 3.MDR.5.1, 3.MDR.5.2, 3.MDR.5.3, 3.MDR.5.4, and 3.MDR.5.5)</i>	This standard focuses on solving real-life problems involving measurement of length, volume, and mass using customary units and the measurement of time. Additionally, students use the framework for statistical reasoning to ask and answer questions based on data. In the GSE, students measure mass, volume, and time. They create and interpret scaled picture graphs and bar graphs to represent categorical data, and line plots to represent numerical data to a quarter of a unit. The improvements with Georgia's K-12 Mathematics Standards include a focus on the relevance of measurement in real-life as they solve meaningful problems. Students reason about the relative sizes of measurement units within the customary system. The focus of statistical reasoning has also been improved to engage students in a richer experience to include a study of categorical and numerical data while engaging students in the framework for statistical reasoning to ask and answer statistical investigative questions that matter to them. (GSE Reference: MGSE3.MD.1, MGSE3.MD.2, MGSE3.MD.3, MGSE3.MD.4)
3.GSR.6	<i>Identify the attributes of polygons, including parallel segments, perpendicular segments, right angles, and symmetry.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 3.GSR.6.1, 3.GSR.6.2, and 3.GSR.6.3)</i>	This standard focuses on identifying attributes of polygons which include parallel and perpendicular line segments, right angles, and symmetry. In the GSE, students make sense of shared attributes of shapes in different categories and partition shapes into parts with equal areas. In Georgia's K-12 Mathematics Standards, improvements include a shift to reasoning about polygons, with a focus on quadrilaterals, to determine similarities and differences between those polygons. Attributes include, but are not limited to parallel segments, perpendicular segments, right angles, and symmetry. These should be used to describe, compare, and contrast shapes. (GSE Reference: MGSE3.G.1)

3.GSR.7	Identify area as a measurable attribute of rectangles and determine the area of a rectangle presented in real-life, mathematical problems. <i>(A further breakdown of this standard can be found in learning objectives/expectations 3.GSR.7.1, 3.GSR.7.2, and 3.GSR.7.3)</i>	This standard focuses on making sense of area as a measurable attribute of rectangles and solving real-life problems involving area. In the GSE, students determine areas of rectangles in a variety of ways and relate area to multiplication. In Georgia's K-12 Mathematics Standards, the study of area has been streamlined to focus on reasoning to help students make the connection between area and multiplication through the process of solving real-life contextual problems. (GSE Reference: MGSE3.MD.5, MGSE3.MD.6, MGSE3.MD.7, MGSE3.MD.7a, MGSE3.MD.7b, MGSE3.MD.7c)
3.GSR.8	Determine the perimeter of a polygon presented in real-life, mathematical problems. <i>(A further breakdown of this standard can be found in learning objectives/expectations 3.GSR.8.1 and 3.GSR.8.2)</i>	This standard focuses on making sense of perimeter as it relates to polygons and investigating how perimeter is related to area. In the GSE, students solve real-life perimeter problems and look for relationships between area and perimeter. In Georgia's K-12 Mathematics Standards, improvements place more emphasis on reasoning about real-life problems to find the perimeter of a figure, how the dimensions of a rectangular affect the perimeter and area of the rectangular figure, and the connections between these two ideas to build deeper understandings. (GSE Reference: MGSE3.MD.8)
3rd Grade Mathematical Modeling	In 3rd grade, students apply mathematics to real-life situations and model real-life phenomena using: • <i>place value understanding of numbers to 10,000, and round up to 1,000,</i> • <i>addition and subtraction within 10,000,</i> • <i>part-whole strategies for multiplying and dividing multi-digit whole numbers,</i> • <i>multiplication and division of whole numbers within 100,</i> • <i>representing fractions in different ways,</i> • <i>mathematical problems involving length, liquid volume, mass, and time and analyze graphical displays of data to answer relevant questions analysis of graphical displays of data,</i> • <i>attributes of polygons, and</i>	Students explain contextual, mathematical problems using a mathematical model and create mathematical models to explain phenomena that exist in the natural sciences, social sciences, liberal arts, fine and performing arts, and/or humanities contexts. Using abstract and quantitative reasoning, students make decisions about information and data from a contextual situation. Students use various mathematical representations and structures with this information to represent and solve real-life problems.

	• <i>area of rectangles and perimeter of polygons.</i>	
3rd Grade Data & Statistical Reasoning	<i>As students engage with 3.MDR.5, students create statistical investigative questions that can be answered using data. Students collect, analyze, and interpret numerical and categorical data involving whole number values obtained from real situations to answer questions.</i>	Students formulate a statistical investigative question to explore a real situation in their classroom. Students collect and analyze both numerical data and categorical data. Students solve problems involving the reading of bar graphs, pictographs, and dot plots, as well as measurements in ounces and pounds. Students gather data from a variety of sources to answer the statistical investigative question posed. Students explore data sets for categorical data which include several categories and determine the scales of the pictographs, bar graphs, and dot plots based on the data collected. Students create and analyze pictographs where one symbol may stand for a value greater than 1 which allows students to apply their understanding of single digit multiplication and division facts. Students use a ruler that is marked at halves and fourths only to create an evenly spaced number line for the dot plot.

Georgia's K-12 Mathematics Standards

4th GRADE

GRADE 4 STANDARDS AND EXPECTATIONS		Explanation of Changes and Improvements
New standard code	Language of the New Standard	Brief Explanation of Changes (with relevant GSE standard codes)
4.MP	<i>Display perseverance and patience in problem-solving. Demonstrate skills and strategies needed to succeed in mathematics, including critical thinking, reasoning, and effective collaboration and expression. Seek help and apply feedback. Set and monitor goals.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 4.MP.1, 4.MP.2, 4.MP.3, 4.MP.4, 4.MP.5, 4.MP.6, 4.MP.7, and 4.MP.8)</i>	This standard describes the eight habits of mind in which all students should engage to ensure a deep understanding of mathematics and focus on developing reasoning and building mathematical communication. These eight mathematical practices engage students in learning the fourth-grade mathematics content in a meaningful way that allows students to relate concepts and skills to other concepts and skills, making sense of the mathematics along the way. Fourth grade students engage in these eight practices as they build proficiency with problem-solving across all big ideas. They continue to build their understandings of numbers representing specific quantities (including fractions and decimal numbers). Fourth grade students create logical representations of problems while considering appropriate units (i.e., square units for area) and create models to represent real-life problems involving addition, subtraction, multiplication, and division, evaluating solutions in the context of the situation. They choose appropriate tools to solve problems, use mathematically precise vocabulary as they discuss patterns, quantities, shapes, data, and measurements, look for patterns and structures, and notice repetitive actions in geometry, counting, computation, data and measurement, and using these to look for more efficient methods. In addition to building mathematical proficiency, engaging in these practices often results in an appreciation for and increased value of mathematics as a subject worthy of study. (GSE Reference: SMP1, SMP2, SMP3, SMP4, SMP5, SMP6, SMP7, SMP8)

4.NR.1	<i>Recognize patterns within the base ten place value system with quantities presented in real-life situations to compare and round multi-digit whole numbers through the hundred-thousands place.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 4.NR.1.1, 4.NR.1.2, 4.NR.1.3, and 4.NR.1.4)</i>	This standard focuses on determining the patterns within the base-ten system and using place value reasoning to compare and round multi-digit whole numbers. In the GSE, students learn that the value of a digit in one place represents ten times what it represents in the place to its right. They read and write multi-digit whole numbers in multiple forms and compare and round whole numbers. In Georgia's K-12 Mathematics Standards, improvements include a focus on students using numerical reasoning to build a deeper understanding of the patterns within the base-ten system and compare and round whole numbers. (GSE Reference: MGSE4.NBT.1, MGSE4.NBT.2, MGSE4.NBT.3)
4.NR.2	<i>Using part-whole strategies, solve problems involving addition and subtraction through the hundred-thousands place, as well as multiplication and division of multi-digit whole numbers presented in real-life, mathematical situations.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 4.NR.2.1, 4.NR.2.2, 4.NR.2.3, 4.NR.2.4, and 4.NR.2.5)</i>	This standard focuses on real-life problem-solving involving multi-digit whole numbers using the four operations. In the GSE, students solve problems with multi-digit whole numbers using all four operations. Students also learn to use the standard algorithm to solve addition and subtraction problems. In Georgia's K-12 Mathematics Standards, the improvements include a focus on solving contextual problems to build fluency with the four operations. Students may solve problems in a variety of ways and have the flexibility to choose a mathematical strategy that allows them to make sense of and strategically solve problems using efficient methods that are most comfortable for and make sense to them. (GSE Reference: MGSE4.OA.1, MGSE4.OA.2, MGSE4.OA.3, MGSE4.NBT.4, MGSE4.NBT.5, MGSE4.NBT.6)
4.PAR.3	<i>Generate and analyze patterns, including those involving shapes, input/output diagrams, factors, multiples, prime numbers, and composite numbers.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations</i>	This standard focuses on generating patterns involving numbers and shapes that follow a provided rule. In the GSE, students learn about factors, multiples, composite, and prime numbers, and investigate patterns that follow a given rule.

	4.PAR.3.1, 4.PAR.3.2, 4.PAR.3.3, and 4.PAR.3.4)	Improvements in Georgia's K-12 Mathematics Standards, include a focus on investigating these patterns, factors, multiples, composite numbers, and prime numbers together in order to allow for the opportunity for deeper connections to be made between these ideas. Students investigate and analyze these patterns using tables and charts. (GSE Reference: MGSE4.OA.4, MGSE4.OA.5)
4.NR.4	<i>Solve real-life problems involving addition, subtraction, equivalence, and comparison of fractions with denominators of 2, 3, 4, 5, 6, 8, 10, 12, and 100 using part-whole strategies and visual models.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 4.NRR.4.1, 4.NR.4.2, 4.NR.4.3, 4.NR.4.4, 4.NR.4.5, and 4.NR.4.6)</i>	This standard builds upon the foundational understandings of fractions developed in grades one through three. In the GSE, students learn about fraction addition, subtraction, and equivalence. They are also introduced to the idea of multiplication of a fraction by a whole number and a whole number by a fraction. Improvements made in Georgia's K-12 Mathematics Standards include a more streamlined study of fractions involving a deeper exploration into addition and subtraction. As students engage in this standard, they extend their understanding of fraction equivalence and learn how to add, subtract, and compare fractions with denominators of 2, 3, 4, 5, 6, 8, 10, 12, and 100. Multiplying fractions by whole numbers and whole numbers by fractions concepts have been moved to fifth grade, standard 5.NR.3. (GSE Reference: MGSE4.NF.1, MGSE4.NF.2, MGSE4.NF.3, MGSE4.NF.3a, MGSE4.NF.3b, MGSE4.NF.3c, MGSE4.NF.3d)
4.NR.5	<i>Solve real-life problems involving addition, equivalence, comparison of fractions with denominators of 10 and 100, and comparison of decimal numbers as tenths and hundredths using part-whole strategies and visual models.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 4.NR.5.1, 4.NR.5.2, and 4.NR.5.3)</i>	This standard builds a foundational understanding of decimal fractions involving tenths and hundredths, decimal numbers involving tenths and hundredths, and using numerical reasoning to add and compare these numbers. In the GSE, students are introduced to decimal fractions and decimal numbers and compare two decimal numbers by reasoning about their size. Improvements made in Georgia's K-12 Mathematics Standards include a focus on using real-life contexts and a focus on reasoning and sense-making to connect

		these new ideas to previously learned mathematics content. Students solve contextual problems involving the addition of two fractions with denominators of 10 and 100. Students represent, read, and write fractions with denominators of 10 or 100 using decimal notation and compare decimal numbers to the hundredths place. (GSE Reference: MGSE3.NF.3d, MGSE4.NF.5, MGSE4.NF.6, MGSE4.NF.7)
4.MDR.6	<i>Measure time and objects that exist in the world to solve real-life, mathematical problems and analyze graphical displays of data to answer relevant questions.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 4.MDR.6.1, 4.MDR.6.2, and 4.MDR.6.3)</i>	This standard focuses on measuring time and objects and using measurement units to solve real-life problems. Measurement units should include measurements of liquid volume, length, distance, and mass within the metric system. In the GSE, students focus on measurement equivalents, solve problems involving measurement units, make line plots to display data in fractions of a unit, and solving problems involving addition and subtraction of fractions using information presented in line plots. In Georgia's K-12 Mathematics Standards improvements included a shift in the focus of measurement to using reasoning about equivalence when measuring with different units within the same measurement system. Additionally, students reason about the relative sizes of measurement units within the metric system. The focus of statistical reasoning has also been improved to engage students in a richer experience to include a study of categorical and numerical data while engaging students in the framework for statistical reasoning to ask and answer statistical investigative questions that matter to them. Students create dot plots to display a distribution of numerical measurement data. (GSE Reference: MGSE4.MD.1, MGSE4.MD.2, MGSE4.MD.4)

4.GSR.7	<i>Investigate the concepts of angles and angle measurement to estimate and measure angles.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 4.GSR.7.1 and 4.GSR.7.2)</i>	This standard introduces students to the concept of angles and angle measurement. In the GSE, students learn how angles are formed, measure angles with a protractor, and decompose angles to recognize that angle measure is additive. In Georgia's K-12 Mathematics Standards, improvements have streamlined the study of angles in fourth grade to remove recognizing that angle measure is additive and focus on using geometric and spatial reasoning to relate angle measure to the 360 degrees in a circle. (GSE Reference: MGSE4.MD.5, MGSE4.MD.5a, MGSE4.MD.6)
4.GSR.8	<i>Identify and draw geometric objects, classify polygons based on properties, and solve problems involving area and perimeter of rectangular figures.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 4.GSR.8.1, 4.GSR.8.2, and 4.GSR.8.3)</i>	This standard is focuses on using geometric properties to identify, draw, and classify geometric shapes, and solve problems involving area and perimeter of rectangular figures. In the GSE, students classify shapes based on lines and angles within those shapes, identify lines of symmetry and apply area and perimeter formulas to solve real-world problems. Improvements in Georgia's K-12 Mathematics Standards include developing a deeper understanding of properties of shapes to include lines of symmetry, angle types, parallel and/or perpendicular line segments as a means of shape classification and using reasoning to solve problems involving area and perimeter. (GSE Reference: MGSE4.MD.3, MGSE4.MD.8, MGSE4.G.1, MGSE4.G.2, MGSE4.G.3)
4th Grade Mathematical Modeling	<i>In 4th grade, students apply mathematics to real-life situations and model real-life phenomena using:</i> <i>• patterns within the base-ten system,</i> <i>• part-whole strategies for adding and subtracting decimals,</i> <i>• part-whole strategies for multiplying and dividing multi-digit whole numbers,</i> <i>• patterns involving factors, multiples, and prime and composite numbers,</i> <i>• add and subtraction and comparison of simple fractions and decimal fractions,</i> <i>• measure of time and objects</i> <i>• analysis of graphical displays of data,</i>	Students explain contextual, mathematical problems using a mathematical model and create mathematical models to explain phenomena that exist in the natural sciences, social sciences, liberal arts, fine and performing arts, and/or humanities contexts. Using abstract and quantitative reasoning, students make decisions about information and data from a contextual situation. Students use various mathematical representations and structures with this

	• <i>investigation of angles,</i> • <i>geometric concepts such as polygons and area and perimeter of rectangular prisms.</i>	information to represent and solve real-life problems.
4th Grade Data & Statistical Reasoning	<i>As students engage with 4.MDR.6, students create statistical investigative questions that can be answered using data. Students collect, analyze, and interpret data from real situations to answer questions using dot plots displaying numerical data to the nearest 1/8 of a unit.</i>	Students generate a statistical investigative question based on things they notice and wonder about an everyday situation. Based on the statistical investigative question, they should create a plan that determines the appropriate population to survey and how to collect that data. Students determine the difference between representations for categorical data and numerical data presented. Students measure objects found in everyday life to collect data and use rulers to measure to the nearest 1/8. Students record observations they notice about the shape of the distribution using informal language such as spread out and/or grouped.

Georgia's K-12 Mathematics Standards

5th GRADE

GRADE 5 STANDARDS AND EXPECTATIONS		Explanation of Changes and Improvements
New standard code	Language of the New Standard	Brief Explanation of Changes (with relevant GSE standard codes)
5.MP	<i>Display perseverance and patience in problem-solving. Demonstrate skills and strategies needed to succeed in mathematics, including critical thinking, reasoning, and effective collaboration and expression. Seek help and apply feedback. Set and monitor goals.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 5.MP.1, 5.MP.2, 5.MP.3, 5.MP.5, 5.MP.5, 5.MP.6, 5.MP.7, 5.MP.8)</i>	This standard describes the eight habits of mind in which all students should engage to ensure a deep understanding of mathematics and focus on developing reasoning and building mathematical communication. These eight mathematical practices engage students in learning the fifth-grade mathematics content in a meaningful way that allows students to relate new concepts and skills to other concepts and skills, making sense of the mathematics along the way. Fifth grade students engage in these eight practices as they build proficiency with problem-solving across all big ideas. They continue to make connections with regards to numbers representing specific quantities (including fractions and decimal numbers). Fifth grade students create logical representations of problems while considering appropriate units, create models to represent real-life problems involving addition, subtraction, multiplication, and division, and choose appropriate tools to solve problems. Students in fifth grade continue to use mathematically precise vocabulary as they discuss patterns, quantities, shapes, measurements, and data. They look for patterns and structures, and notice repetitive actions in geometry, counting, computation, data, and measurement and use these to look for more efficient methods. In addition to building mathematical proficiency, engaging in these practices often results in an appreciation for and increased value of mathematics as a subject worthy of study. (GSE Reference: SMP1, SMP2, SMP3, SMP4, SMP5, SMP6, SMP7, SMP8)

5.NR.1	<i>Use place value understanding to solve real-life, mathematical problems.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 5.NR.1.1, 5.NR.1.2)</i>	This standard focuses on making sense of patterns in the base-ten place value system and using these patterns to solve real-life problems. In the GSE, students recognize and explain that a digit in one place represents ten times as much as it represents in the place to its right and one-tenth of what it represents in the place to its left. Students also explain the patterns of zeros in numbers multiplied or divided by a power of ten. Improvements in Georgia's K-12 Mathematics Standards include a shift to using these patterns in place value to solve real-life, mathematical problems and using numerical reasoning to develop deeper understandings of these concepts. (GSE Reference: MGSE5.NBT.1, MGSE5.NBT.2)
5.NR.2	<i>Multiply and divide multi-digit whole numbers to solve relevant, mathematical problems.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 5.NR.2.1, 5.NR.2.2)</i>	This standard focuses on solving relevant problems involving multiplication and division of whole numbers. In the GSE, students use the standard algorithm to multiply, and they divide using multiple strategies. Improvements in Georgia's K-12 Mathematics Standards include a focus on solving relevant contextual problems to build fluency with multi-digit multiplication and division. In addition, students solve problems in different ways and have the flexibility to choose a mathematical strategy that allows them to make sense of and strategically solve problems using efficient methods that are most comfortable for and make sense to them. (GSE Reference: MGSE5.NBT.5, MGSE5.NBT.6)
5.NR.3	<i>Describe fractions and perform operations with fractions to solve relevant, mathematical problems using part-whole strategies and visual models.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 5.NR.3.1, 5.NR.3.2, 5.NR.3.3, 5.NR.3.4, 5.NR.5.3.5, 5.NR.3.6)</i>	This standard focuses on developing part-whole strategies and visual models to solve relevant problems involving fractions. In the GSE, students solve addition, subtraction, multiplication, and division problems involving fractions with unlike denominators. Students also compare fractions.

		Improvements in Georgia's K-12 Mathematics Standards include a focus on relevant contexts for problems and using numerical reasoning to make sense of and solve problems involving fractions. This includes an introduction to multiplying fractions by whole numbers and whole numbers by fractions. In the GSE, this topic is addressed in fourth grade mathematics. In Georgia's K-12 Mathematics Standards, students also divide unit fractions by whole numbers and whole numbers by unit fractions. The concept of multiplying fractions and mixed numbers, which is addressed in GSE 5th grade mathematics, is addressed in 6th grade in Georgia's K-12 Mathematics Standards. (GSE Reference: MGSE4.NF.4, MGSE5.NF.1, MGSE5.NF.2, MGSE5.NF.3, MGSE5.NF.4, MGSE5.NF.5, MGSE5.NF.5b, MGSE5.NF.7, MGSE5.NF.7a, MGSE5.NF.7b, MGSE5.NF.7c)
5.NR.4	<i>Read, write, and compare decimal numbers to the thousandths place, and round and perform operations with decimal numbers to the hundredths place to solve relevant, mathematical problems.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 5.NR.4.1, 5.NR.4.2, 5.NR.4.3, 5.NR.4.4)</i>	This standard focuses on building a deeper understanding of decimal numbers to the thousandths place, reading, writing, and rounding decimal numbers, and solving relevant problems involving the addition and subtraction of decimal numbers. In the GSE, students learn to read, write, compare, round, and solve addition, subtraction, multiplication, and division problems involving decimal numbers to the thousandths place. Improvements in Georgia's K-12 Mathematics Standards include a focus on addition and subtraction of decimal numbers using numerical reasoning and efficient strategies. The multiplication and division of decimal number concepts, which is addressed in the GSE 5th grade mathematics standards, is covered in Georgia's K-12 Mathematics Standards, Grade 6 Mathematics. (GSE Reference: MGSE5.NBT.3, MGSE5.NBT.3a, MGSE5.NBT.3b, MGSE5.NBT.4, MGSE5.NBT.7)

5.NR.5	Write, interpret, and evaluate numerical expressions within authentic problems. <i>(A further breakdown of this standard can be found in learning objective/expectation 5.NR.5.1)</i>	This standard focuses on writing, interpreting, and evaluating numerical expressions within authentic problems. In the GSE, the focus is often on students learning the order of operations. In Georgia's K-12 Mathematics Standards, improvements include clarity within the standards document detailing the intent and appropriate parameters for this standard. In addition, there is an explicit emphasis on student reasoning and using authentic contexts. (GSE Reference: MGSE5.OA.1, MGSE5.OA.2)
5.PAR.6	Solve relevant problems by creating and analyzing numerical patterns using the given rule(s). <i>(A further breakdown of this standard can be found in learning objectives/expectations 5.PAR.6.1, 5.PAR.6.2)</i>	This standard focuses on solving relevant problems by creating and analyzing numerical patterns using given rules and representing these patterns by plotting coordinates in the first quadrant of the coordinate plane. In the GSE, students generate two numerical patterns using a given rule and complete a function table to identify relationships between corresponding terms. Students use these terms to create ordered pairs to graph on the coordinate plane. Improvements made in Georgia's K-12 Mathematics Standards include the grouping of the study of patterns and graphing in the coordinate plane within the same big idea of Patterning and Algebraic Reasoning. In addition, the focus here is to use relevant contexts to provide students opportunities to use reasoning to interpret the coordinate values from the provided context. (GSE Reference: MGSE5.OA.3, MGSE5.G.1, MGSE5.G.2)
5.MDR.7	Solve problems involving customary measurements, metric measurements, and time and analyze graphical displays of data to answer relevant questions. <i>(A further breakdown of this standard can be found in learning objectives/expectations 5.MDR.7.1, 5.MDR.7.2, 5.MDR.7.3, 5.MDR.7.4)</i>	This standard focuses on problem-solving involving customary and metric measurements, and time, to solve problems and to analyze data to answer relevant questions. In the GSE, students use measurement conversions to solve problems and make line plots using fractions of a unit to connect operations with fractions to data.

		In Georgia's K-12 Mathematics Standards, improvements include a focus on using measurement reasoning to solve relevant measurement problems that may or may not involve conversions. The focus of statistical reasoning has also been improved to engage students in a richer experience to include a study of categorical and numerical data. Students engaging in the framework for statistical reasoning ask and answer statistical investigative questions that matter to them. Students in fifth grade will explore categorical and numerical data and gain a conceptual understanding of mean and distribution, which is addressed in sixth grade in the GSE. (GSE Reference: MGSE5.MD.1, MGSE5.MD.2, MGSE6.SP.3)
5.GSR.8	<i>Examine properties of polygons and rectangular prisms, classify polygons by their properties, and discover volume of right rectangular prisms.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 5.GSR.8.1, 5.GSR.8.2, 5.GSR.8.3, and 5.GSR.8.4)</i>	This standard focuses on exploring the properties of polygons and rectangular prisms, classifying polygons based on their properties, and solving authentic problems involving volume of rectangular prisms. In the GSE, students classify polygons in a hierarchy based on properties. In Georgia's K-12 Mathematics Standards, improvements include the removal of classifying polygons in a hierarchy and a focus on using geometric and spatial reasoning over memorization of geometric terms. (GSE Reference: MGSE5.MD.3, MGSE5.MD.3a, MGSE5.MD.3b, MGSE5.MD.4, MGSE5.MD.5, MGSE5.G.3, MGSE5.MD.5a, MGSE5.MD.5b,)
5th Grade Mathematical Modeling	<i>In 5th grade, students apply mathematics to real-life situations and model real-life phenomena using:</i> <i>• the four operations with whole numbers and addition and subtraction of decimals and fractions,</i> <i>• numerical expressions, numerical patterns, and ordered pairs in the first quadrant of the coordinate plane,</i> <i>• customary and metric measurements,</i> <i>• analysis of graphical displays of data, and</i> <i>• polygons and volume of right rectangular prisms.</i>	Students explain contextual, mathematical problems using a mathematical model and create mathematical models to explain phenomena that exist in the natural sciences, social sciences, liberal arts, fine and performing arts, and/or humanities contexts. Using abstract and quantitative reasoning, students make decisions about information and data from a contextual situation. Students use various mathematical representations and structures with this information to represent and solve real-life problems.

5th Grade Data & Statistical Reasoning	<i>As students engage with 5.MDR.7, students create statistical investigative questions that can be answered by using quantitative (numerical) and categorical data. Students determine strategies for gathering data to answer questions. Students collect, analyze, and interpret data presented on dot plots and bar graphs from real situations to answer questions about the data distribution, spread, and center.</i>	Students generate questions about things they notice and wonder from an authentic situation. Based on the posed question(s), students create a plan that determines the appropriate population to survey and how to collect that data. Students collect and analyze both numerical data and categorical data from a variety of sources. Students create dot plots (line plots) with measurements in fractions of a unit ($\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$). Students begin developing the concept of measures of center, which they will continue to explore in sixth grade. The mean formula is not an expectation in fifth grade. Instead, students explore the concept of mean visually and conceptually.
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Georgia's K-12 Mathematics Standards

6th GRADE

GRADE 6 STANDARDS AND EXPECTATIONS		Explanation of Changes and Improvements
New standard code	Language of the New Standard	Brief Explanation of Changes (with relevant GSE standard codes)
6.MP	<i>Display perseverance and patience in problem-solving. Demonstrate skills and strategies needed to succeed in mathematics, including critical thinking, reasoning, and effective collaboration and expression. Seek help and apply feedback. Set and monitor goals.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 6.MP.1, 6.MP.2, 6.MP.3, 6.MP.4, 6.MP.5, 6.MP.6, 6.MP.7, and 6.MP.8)</i>	This standard describes students blending their knowledge of mathematics content with their ability to apply that knowledge to solve problems, communicate mathematical ideas, justify solutions, model mathematical concepts to solve real-world problems, and reason to make sense of mathematics. Students repeatedly analyze the mathematics practices to build a deeper understanding of skills and concepts. In sixth grade, students represent a wide variety of real-life contexts through the use of real numbers and variables in mathematical expressions, equations, and inequalities. Students construct arguments using verbal or written explanations accompanied by expressions, equations, inequalities, models, and graphs, tables, and other data displays (i.e., box plots, dot plots, etc.). Students in sixth grade may decide to represent similar data sets using dot plots with the same scale to visually compare the center and variability of the data. Additionally, students might use physical objects or applets to construct nets and calculate the surface area of three-dimensional figures. (GSE Reference: SMP 1, SMP 2, SMP 3, SMP 4, SMP 5, SMP 6, SMP 7, SMP 8)

6.NR.1	<i>Solve relevant, mathematical problems involving operations with whole numbers, fractions, and decimal numbers.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 6.NR.1.1, 6.NR.1.2, and 6.NR.1.3)</i>	This standard illustrates the culmination of strategies and procedures developed involving all four operations with whole numbers and extended to decimals and fractions. In the GSE, the focus of understanding rests upon the division of fractions and multi-digit whole numbers. When working with decimals, students work to apply all four operations fluently. With the improvements in Georgia's K-12 Mathematics Standards, students continue to generalize strategies and procedures applied to whole numbers from 5th grade as they use all four operations with decimals and fractions, in addition to whole numbers. (GSE Reference: MGSE5.NF.4, MGSE5.NF.6, MGSE5.NBT.7, MGSE5.NF.1, MGSE5.NF.6, MGSE6.NS.1, MGSE6.NS.2, MGSE6.NS.3)
6.NR.2	<i>Apply operations with whole numbers, fractions and decimals within relevant applications.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 6.NR.2.1, 6.NR.2.2, 6.NR.2.3, 6.NR.2.4, 6.NR.2.5, and 6.NR.2.6)</i>	This standard focuses on emphasizing the relevancy of statistical reasoning through the application of the statistical investigative process. In the GSE, students study measures of center (mean and median) and variability (range and interquartile range), analyze data displayed using dot plots, histograms, and box plots and draw inferences about the data. Students conclude a data distribution may not have a definite center and that the different measures of center produce different values. Students discover that the mean or median for the same data set affects how the data is interpreted. In Georgia's K-12 Mathematics Standards, improvements include engaging students in the statistical investigative process. Students formulate a statistical investigative question, and collect, model, and analyze data distributions for variability to answer the questions and solve problems within relevant statistical applications. Students apply their understanding of absolute value in the context of mean absolute deviation as they describe variability of data. In addition,

		students summarize data sets and display distributions on various graphical displays. (GSE Reference: MGSE5.NBT.7, MGSE6.SP.1, MGSE6.SP.2, MGSE6.SP.3, MGSE6.SP.4, MGSE6.SP.5, MGSE9-12.S.ID.2)
6.NR.3	<i>Solve a variety of problems involving whole numbers and their opposites; model rational numbers on a number line to describe problems presented in relevant, mathematical situations.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 6.NR.3.1, 6.NR.3.2, 6.NR.3.3, 6.NR.3.4, 6.NR.3.5, and 6.NR.3.6)</i>	This standard sets the stage for work with the system of rational numbers, including negative rational numbers. In the GSE, students focus on the order and absolute value of rational numbers and the location of points in all four quadrants of the coordinate plane. Changes in Georgia's K-12 Mathematics Standards separates the work with rational numbers on the coordinate grid into the Patterning and Algebraic Reasoning Big Idea with standard 6.PAR.8. Students use numerical reasoning to explain the relationships of rational numbers and their opposites in expressions and on number lines. In addition, students compare rational numbers using equality and inequality symbols and distinguish comparisons of absolute value from statements about order. (GSE Reference: MGSE6.NS.5, MGSE6.NS.6a, MGSE6.NS.7, MGSE6.NS.7a, MGSE6.NS.7b, MGSE6.NS.7c, MGSE6.NS.7d)
6.NR.4	<i>Solve a variety of contextual problems involving ratios, unit rates, equivalent ratios, percentages, and conversions within measurement systems using proportional reasoning.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 6.NR.4.1, 6.NR.4.2, 6.NR.4.3, 6.NR.4.4, 6.NR.4.5, 6.NR.4.6, and 6.NR.4.7)</i>	This standard focuses on the use of proportional reasoning to develop an understanding of ratios and rates. In the GSE, students use reasoning about multiplication and division to solve ratio and rate problems as they learn how ratios and rates are used in the real world. With improvements in Georgia's K-12 Mathematics Standards, students apply proportional reasoning to solve problems involving percentages and conversions with measurement systems. Additionally, students solve problems involving ratios and rates found in realistic situations. (GSE Reference: MGSE6.RP.1, MGSE6.RP.2, MGSE6.RP.3, MGSE6.RP.3a, MGSE6.RP.3b, MGSE6.RP.3c, MGSE6.RP.3d)

6.GSR.5	<i>Solve relevant problems involving area, surface area, and volume.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 6.GSR.5.1, 6.GSR.5.2, and 6.GSR.5.3)</i>	This standard focuses on area, surface area and volume. In the GSE, students deepen their understanding of volume and build understanding of area as they work with polygons on a coordinate grid. Students also use coordinates to find the distance between two points on a coordinate plane. In Georgia's K-12 Mathematics Standards, this concept is addressed within the Patterning and Algebraic Reasoning Big Idea with standard 6.PAR.8. Improvements in Georgia's K-12 Mathematics Standards include the use of the formula for volume of a rectangular prism as $\text{Volume} = (\text{area of the base}) \times (\text{height})$ to explicitly connect students' understanding of area of rectangles to volume of rectangular prisms. In addition, students build upon understanding developed in 5th grade and use geometric and spatial reasoning to solve problems involving polygons and three-dimensional figures composed of rectangular and triangular faces. (GSE Reference: MGSE6.G.1, MGSE6.G.2, MGSE6.G.3, MGSE6.G.4)
6.PAR.6	<i>Identify, write, evaluate, and interpret numerical and algebraic expressions as mathematical models to explain authentic situations.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 6.PAR.6.1, 6.PAR.6.2, 6.PAR.6.3, 6.PAR.6.4 and 6.PAR.6.5)</i>	This standard explores the use of numerical and algebraic expressions as mathematical models to explain real-life phenomena. In the GSE, students focus on the use of variables in mathematical expressions. Students write and evaluate numerical expressions and use expressions to solve problems. Students use properties of operations to make sense of problems and generate equivalent expressions. Improvements in Georgia's K-12 Mathematics Standards include emphasis on using a variety of strategies, such as, determine the greatest common factor and least common multiple when generating equivalent expressions. In addition, students explore the meanings of parts of an expression and evaluate numerical and algebraic expressions using a context. Students apply properties of operations to generate equivalent expressions.

		(GSE Reference: MGSE6.NS.4, MGSE6.NS.4a, MGSE6.NS.4b, MGSE6.EE.1, MGSE6.EE.2, MGSE6.EE.2a, MGSE6.EE.2b, MGSE6.EE.2c, MGSE6.EE.3)
6.PAR.7	<i>Write and solve one-step equations and inequalities as mathematical models to explain authentic, realistic situations.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 6.PAR.7.1, 6.PAR.7.2, 6.PAR.7.3 and 6.PAR.7.4)</i>	This standard focuses on solving one-step equations and inequalities, as well as recognizing and generating simple inequalities. In the GSE, students solve simple one-step equations and use equations to describe relationships between quantities. With improvements in Georgia's K-12 Mathematics Standards, students strengthen their understanding of equality and use various strategies to solve one-step equations involving positive variables and rational numbers. Additionally, students make sense of equations and inequalities within various contexts and explain the meaning of solutions based on the context. (GSE Reference: MGSE6.EE.5, MGSE6.EE.6, MGSE6.EE.7, MGSE6.EE.8)
6.PAR.8	<i>Graph rational numbers as points on the coordinate plane to represent and solve contextual, mathematical problems; draw polygons using the coordinates for their vertices and find the length of a side of a polygon.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 6.PAR.8.1, 6.PAR.8.2, 6.PAR.8.3, and 6.PAR.8.4)</i>	This standard describes working with rational numbers on the coordinate plane. In the GSE, students focus on the location of points in all four quadrants of the coordinate plane and the use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate. With improvements in the Georgia's K-12 Mathematics Standards, students use numerical and graphical reasoning to connect location of rational numbers on horizontal and vertical numbers to locations in all four quadrants of the coordinate plane. Additionally, students solve relevant problems involving the application of algebra through geometry as they work with polygons and find distance between points on the coordinate plane. (GSE Reference: MGSE6.NS.6, MGSE6.NS.6b, MGSE6.NS.6c, MGSE6.NS.8, GSE6.G.3)

6th Grade Mathematical Modeling	<i>In 6th grade, students apply mathematics to real-life situations and model real-life phenomena using:</i> <i>• various numbers including whole numbers, integers, and rational numbers,</i> <i>• numerical and algebraic expressions and one-step equations and inequalities,</i> <i>• ratios, rates, and percentages,</i> <i>• data and statistical concepts, such as measures of center and variability and</i> <i>• geometric concepts involving area, surface area and volume.</i>	Students explain contextual, mathematical problems using a mathematical model and create mathematical models to explain phenomena that exist in the natural sciences, social sciences, liberal arts, fine and performing arts, and/or humanities contexts. Using abstract and quantitative reasoning, students make decisions about information and data from a contextual situation. Students use various mathematical representations and structures with this information to represent and solve real-life problems.
6th Grade Data & Statistical Reasoning	<i>As students engage with standard 6.NR.2, students experience the 4 steps of the statistical problem-solving process. During the process, students formulate an investigative question, and collect, model, and analyze data distributions for variability to answer statistical questions and solve problems in context.</i>	Students use the statistical process to formulate and answer statistical investigative questions. As a result of an investigation, students summarize categorical and quantitative (numerical) data sets in relation to the context. Students extend their understanding of analyzing categorical data displayed on dot plots, histograms, and box plots. To develop solid statistical reasoning, students use quantitative measures of center and variability to draw conclusions about data sets and make predictions based on comparisons. Students explore the conceptual idea of mean absolute deviation (MAD) – not the formula. Students apply their understanding of absolute value (rather than use operations on negative integers) in the context of MAD. Students apply an understanding of the measures of center (mean, median) and measures of variability (interquartile range, range and mean absolute deviation) to determine quantitative measures of center and variability, draw conclusions about the data, compare different numerical data sets and make predictions using data gathered from realistic scenarios and simulations.

Georgia's K-12 Mathematics Standards

7th GRADE

GRADE 7 STANDARDS AND EXPECTATIONS		Explanation of Changes and Improvements
New standard code	Language of the New Standard	Brief Explanation of Changes (with relevant GSE standard codes)
7.MP	<i>Display perseverance and patience in problem-solving. Demonstrate skills and strategies needed to succeed in mathematics, including critical thinking, reasoning, and effective collaboration and expression. Seek help and apply feedback. Set and monitor goals.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 7.MP.1, 7.MP.2, 7.MP.3, 7.MP.4, 7.MP.5, 7.MP.6, 7.MP.7, and 7.MP.8)</i>	This standard describes students blending their knowledge of mathematics content with their ability to apply that knowledge to solve problems involving ratios and rates and discuss how they solved those problems. Students communicate mathematical ideas and construct arguments using verbal or written explanations accompanied by expressions, equations, inequalities, models, and graphs, tables, and other data displays (i.e., box plots, dot plots, etc.). Students justify solutions, model mathematical concepts to solve real-world problems, and reason to make sense of mathematics as they form expressions, equations, or inequalities from real world contexts and connect symbolic and graphical representations. Students repeatedly analyze these ideas to build a deeper understanding of the skills and concepts addressed in this grade level. (GSE Reference: SMP 1, SMP 2, SMP 3, SMP 4, SMP 5, SMP 6, SMP 7, SMP 8)
7.NR.1	<i>Solve relevant, mathematical problems, including multi-step problems, involving the four operations with rational numbers and quantities in any form (integers, percentages, fractions, and decimal numbers).</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 7.NR.1.1, 7.NR.1.2, 7.NR.1.3, 7.NR.1.4, 7.NR.1.5, 7.NR.1.6, 7.NR.1.7, 7.NR.1.8, 7.NR.1.9, 7.NR.1.10 and 7.NR.1.11)</i>	This standard focuses on solving multi-step problems involving addition, subtraction, multiplication, and/or division with rational numbers and quantities in any forms. In the GSE, students develop a deeper understanding of numbers, recognizing fractions, decimals and percents as different representations of rational numbers. Students extend addition, subtraction, multiplication, and division to all rational numbers and explain and interpret the rules for adding, subtracting, multiplying, and dividing with negative numbers. In Georgia's K-12 Mathematics Standards improvements include students using numerical reasoning to solve relevant,

		mathematical problems involving rational numbers. Students derive rules for adding, subtracting, multiplying and dividing integers by looking for and making use of structure. Students use numerical reasoning to convert rational numbers between forms when solving problems. (GSE Reference: MGSE7.NS.1, MGSE7.NS.1a, MGSE7.NS.1b, MGSE7.NS.1c, MGSE7.NS.1d, MGSE7.NS.2, MGSE7.NS.2a, MGSE7.NS.2b, MGSE7.NS.2c, MGSE7.NS.2d, MGSE7.NS.3, MGSE7.EE.3)
7.PAR.2	<i>Use properties of operations, generate equivalent expressions and interpret the expressions to explain relevant situations.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 7.PAR.2.1 and 7.PAR.2.2)</i>	This standard describes the further development of the understanding of algebraic expressions. In the GSE, students use properties of operations to generate equivalent expressions. They use arithmetic of rational numbers to formulate expressions. Improvements in Georgia's K-12 Mathematics Standards include an emphasis on relational thinking as students reason about the meaning of expressions and what makes them equivalent. Additionally, students generate equivalent expressions using properties of operations. Students also reason about the representations of numbers and expressions written in different forms. (GSE Reference: MGSE7.EE.1, MGSE7.EE.2)
7.PAR.3	<i>Represent authentic situations using equations and inequalities with variables; solve equations and inequalities symbolically, using the properties of equality.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 7.PAR.3.1 and 7.PAR.3.2)</i>	This standard describes solving equations and inequalities in specified forms. In the GSE, students use the arithmetic of rational numbers to write equations in one variable and use these equations and inequalities to solve problems. In the Georgia's K-12 Standards for Mathematics, improvements include a heavier emphasis on the use of equations and inequalities to solve problems in a meaningful context. In addition, students apply their understanding of operations with rational numbers and properties of equality to solve equations and inequalities.

		(GSE Reference: MGSE7.EE.4, MGSE7.EE.4a, MGSE7.EE.4b, MGSE7.EE.4c)
7.PAR.4	Recognize proportional relationships in relevant, mathematical problems; represent, solve, and explain these relationships with tables, graphs, and equations. <i>(A further breakdown of this standard can be found in learning objectives/expectations 7.PAR.4.1, 7.PAR.4.2, 7.PAR.4.3, 7.PAR.4.4, 7.PAR.4.5, 7.PAR.4.6, 7.PAR.4.7, 7.PAR.4.8, 7.PAR.4.9, 7.PAR.4.10, 7.PAR.4.11, and 7.PAR.4.12.)</i>	This standard emphasizes the building of proportional reasoning. In the GSE, students analyze proportions and proportional relationships. Students recognize and represent proportional relationships in equations and on graphs. Improvements in Georgia's K-12 Mathematics Standards include an emphasis on creating opportunities for students to compute unit rates of complex fractions and connect unit rate to the slope of a graph of proportional relationships. This understanding leads to comparing proportional relationships represented in different forms by interpreting the unit rate as the slope. Additionally, students analyze and use proportional relationships in multiple representations, including graphically, algebraically, tabularly and geometrically to solve problems. Students apply proportional reasoning in statistical contexts as they analyze data collected through random sampling. (GSE Reference: MGSE7.RP.1, MGSE7.RP.2, MGSE7.RP.2a, MGSE7.RP.2b, MGSE7.RP.2c, MGSE7.RP.2d, MGSE7.RP.3, MGSE7.G.1, MGSE7.SP.1, MGSE.7SP.2, MGSE8.EE.5, MGSE8.EE.6)
7.GSR.5	Solve practical problems involving angle measurement, circles, area of circles, surface area of prisms and cylinders, and volume of cylinders and prisms composed of cubes and right prisms. <i>(A further breakdown of this standard can be found in learning objectives/expectations 7.GSR.5.1, 7.GSR.5.2, 7.GSR.5.3, 7.GSR.5.4, 7.GSR.5.5, 7.GSR.5.6, 7.GSR.5.7, and 7.GSR.5.8.)</i>	This standard addresses geometric concepts such as, angles, area, circumference, volume, and surface area. In the GSE, students solve problems involving informal geometric constructions, scale drawings and work with two- and three- dimensional shapes. Improvements in Georgia's K-12 Mathematics Standards includes measuring angles using non-standard and standard tools. In addition, students solve equations to find the value of an unknown angle in a figure. Students build upon their knowledge of area of quadrilaterals and triangles to find the area of circles and their knowledge of volume and surface area to solve problems involving surface area and volume of right prisms and cylinders. Students apply geometric and spatial

		reasoning as they connect three-dimensional and two-dimensional figures through a study of cross sections. (GSE Reference: MGSE4.MD.6, MGSE7.G.3, MGSE7.G.4, MGSE7.G.5, MGSE7.G.6)
7.PR.6	<i>Using mathematical reasoning, investigate chance processes and develop, evaluate, and use probability models to find probabilities of simple events presented in authentic situations.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 7.PR.6.1, 7.PR.6.2, 7.PR.6.3, 7.PR.6.4, 7.PR.6.5, and 7.PR.6.6)</i>	This standard focuses on the investigation of simple probability. In the GSE, students connect their understanding of simple probability to make sense of compound probabilities. With improvements in Georgia's K-12 Mathematics Standards, the focus is shifted solely to simple probability. Additionally, students represent and approximate the probability of a chance event. Students develop probability models and use appropriate graphical displays and numerical summaries as probability models. (GSE Reference: MGSE7.SP.4, MGSE7.SP.5, MGSE7.SP.6, MGSE7.SP.7, MGSE7.SP.7a, MGSE7.SP.7b)
7th Grade Mathematical Modeling	<i>In 7th grade, students apply mathematics to real-life situations and model real-life phenomena using:</i> <i>• operations with rational numbers,</i> <i>• generating equivalent expressions and multi-step equations and inequalities,</i> <i>• proportional relationships and multi-step percent problems,</i> <i>• data and statistical concepts, such as random sampling and analyzing data of populations and probabilities and</i> <i>• geometric concepts involving geometric measures of angles, circles, right rectangular prisms and cylinders.</i>	Students explain contextual, mathematical problems using mathematical models and create mathematical models to explain phenomena that exist in the natural sciences, social sciences, liberal arts, fine and performing arts, and/or humanities contexts. Students make decisions about information and data from a contextual situation using abstract and quantitative reasoning. Students use various mathematical representations and structures to represent and solve real-life problems.
7th Grade Data & Statistical Reasoning	<i>As students engage with standards 7.PAR.4 and 7.PR.6, students experience the 4 steps of the statistical problem-solving process. Students create statistical investigative questions that can be answered using quantitative data, collect data through random sampling to make inferences about population distributions using data distributions, and interpret data to answer statistical investigative questions.</i>	Students create and answer statistical investigative questions about a population by collecting data from a representative sample, using random sampling techniques to collect the data. Students use sample data collected to draw inferences about the population. Students draw inferences using measures of central tendency and/or measures of variability from the data generated from random samples.

Georgia's K-12 Mathematics Standards

8th GRADE

GRADE 8 STANDARDS AND EXPECTATIONS		Explanation of Changes and Improvements
New standard code	Language of the New Standard	Brief Explanation of Changes (with relevant GSE standard codes)
8.MP	<i>Display perseverance and patience in problem-solving. Demonstrate skills and strategies needed to succeed in mathematics, including critical thinking, reasoning, and effective collaboration and expression. Seek help and apply feedback. Set and monitor goals.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 8.MP.1, 8.MP.2, 8.MP.3, 8.MP.4, 8.MP.5, 8.MP.6, 8.MP.7, and 8.MP.8)</i>	This standard focuses on students blending their knowledge of mathematics content with their ability to apply that knowledge to solve real-world problems through the application of algebraic and geometric concepts. Students represent a wide variety of real-life contexts using real numbers and variables in mathematical expressions, equations, and inequalities and communicate these mathematical ideas. Students examine patterns in tables and graphs to generate equations, describe relationships, and justify solutions. Students model mathematical concepts to solve real-world contexts and connect symbolic and graphical representations when solving systems of linear equations and comparing properties of functions provided in different forms. (GSE Reference: SMP 1, SMP 2, SMP 3, SMP 4, SMP 5, SMP 6, SMP 7, SMP 8)
8.NR.1	<i>Solve problems involving irrational numbers and rational approximations of irrational numbers to explain realistic applications.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 8.NR.1.1 and 8.NR.1.2)</i>	This standard focuses on extending students' understanding of rational numbers to help them develop an understanding of irrational numbers. In the GSE, students learn to distinguish between rational and irrational numbers by recognizing decimal equivalents. Students use rational approximations of irrational numbers to compare irrational numbers. Improvements in Georgia's K-12 Mathematics Standards include an emphasis on relational thinking as students reason about the relative size of rational numbers and close irrational numbers. Additionally, students use characteristics of rational numbers to distinguish between irrational and rational numbers. Students compare the size of irrational numbers using approximates of irrational numbers.

		(GSE Reference: MGSE8.NS.1, MGSE8.NS.2)
8.NR.2	<i>Solve problems involving radicals and integer exponents including relevant application situations; apply place value understanding with scientific notation and use scientific notation to explain real phenomena.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 8.NR.2.1, 8.NR.2.2, 8.NR.2.3, and 8.NR.2.4)</i>	This standard is all about the use of numerical reasoning to solve problems involving radicals, integer exponents and scientific notation. In the GSE, students focus on equations that require applying the properties of integer exponents, square and cube roots and scientific notation. With improvements in Georgia's K-12 Mathematics Standards, students analyze patterns associated with integer exponents and patterns of square and cube numbers. In addition, students use the magnitude of quantities to compare numbers written in scientific notation and extend this understanding to operations with scientific notation. (GSE Reference: MGSE8.EE.1, MGSE8.EE.2, MGSE8.EE.3, MGSE8.EE.4)
8.PAR.3	<i>Create and interpret expressions within relevant situations. Create, interpret, and solve linear equations and linear inequalities in one variable to model and explain real phenomena.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 8.PAR.3.1, 8.PAR.3.2, 8.PAR.3.3, 8.PAR.3.4, 8.PAR.3.5, and 8.PAR.3.6)</i>	This standard is all about linear expressions and equations. In the GSE, students connect previous understandings about proportional relationships to linear equations. In Georgia's K-12 Mathematics Standards, students engage in a deeper study of linear equations and inequalities. Students build upon their knowledge of parts of expressions to interpret expressions in context. Students use algebraic reasoning to create linear equations to model real-life phenomena and solve linear equations and inequalities, justifying their steps along the way. (GSE Reference: MGSE8.EE.7, MGSE8.EE.7a, MGSE8.EE.7b, MGSE9-12.A.SSE.1, MGSE9-12.A.SSE.1a, MGSE9-12.A.CED.1, MGSE9-12.A.REI.1, MGSE9-12.A.REI.3, MGSE9-12.A.CED.4)

8.PAR.4	Show and explain the connections between proportional and non-proportional relationships, lines, and linear equations; create and interpret graphical mathematical models and use the graphical, mathematical model to explain real phenomena represented in the graph. <i>(A further breakdown of this standard can be found in learning objectives/expectations 8.PAR.4.1, and 8.PAR.4.2)</i>	This standard connects students' understanding of proportional relationships to translates of linear relationships. In the GSE, students interpret the equation $y = mx + b$ to define linear functions as a graphed straight line. Students use this understanding to distinguish between linear and non-linear functions. In Georgia's K-12 Mathematics Standards, students explore $y = mx + b$ as a translation of $y = mx$ as they extend their knowledge of slope. Students use algebraic reasoning to demonstrate the understanding that the graph of an equation represents the set of all its solutions. Students continue to strengthen their knowledge of proportional relationships, using the idea that one variable is conditioned on another. (GSE Reference: MGSE8.EE.6, MGSE9-12.A.REI.10)
8.FGR.5	Describe the properties of functions to define, evaluate, and compare relationships, and use functions and graphs of functions to model and explain real phenomena. <i>(A further breakdown of this standard can be found in learning objectives/expectations 8.FGR.5.1, 8.FGR.5.2, 8.FGR.5.3, 8.FGR.5.4, 8.FGR.5.5, 8.FGR.5.6, 8.FGR.5.7, 8.FGR.5.8, and 8.FGR.5.9)</i>	This standard presents an introduction to linear functions. In the GSE, students define functions, compare properties of two functions, describe linear and nonlinear functions and define linear functions using equations. With improvements in Georgia's K-12 Mathematics Standards, students use their understanding of linear equations to define linear functions and explain the different properties of the function. Additionally, students write linear functions, determine the rate of change and initial value and explain the meaning of the rate of change and initial value in context. Students graph and analyze linear functions expressed in various algebraic forms. Students use the characteristics of linear functions to describe nonlinear functions. Students begin using formal function notation in the next course, Algebra: Concepts & Connections. (GSE Reference: MGSE8.F.1, MGSE8.F.2, MGSE8.F.3, MGSE8.F.4, MGSE8.F.5, MGSE9-12.F.IF.5, MGSE9-12.F.IF.7, MGSE9-12.F.IF.7a, MGSE9-12.F.IF.8)

8.FGR.6	<i>Solve practical, linear problems involving situations using bivariate quantitative data.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 8.FGR.6.1, 8.FGR.6.2, 8.FGR.6.3, and 8.FGR.6.4)</i>	This standard explores statistical reasoning concepts involving bivariate data. In the GSE, students explore bivariate data through the context of scatter plots and two-way tables. Changes within Georgia's K-12 Mathematics Standards shift the focus of bivariate data solely through the context of scatter plots. Students use patterning and algebraic reasoning to solve problems in the context of bivariate measurement data. Additionally, students use appropriate graphical displays from data distributions to draw inferences based on the meaning of predicted slope and intercepts of linear models in context. (GSE Reference: MGSE8.SP.2, MGSE8.SP.3)
8.FGR.7	<i>Justify and use various strategies to solve systems of linear equations to model and explain realistic phenomena.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 8.FGR.7.1, 8.FGR.7.2, 8.FGR.7.3, 8.FGR.7.4, and 8.FGR.7.5)</i>	This standard illustrates systems of linear equations. In the GSE, students solve problems involving systems of linear equations graphically, algebraically, and by inspection, depending upon the problem presented. In Georgia's K-12 Mathematics Standards, students interpret and solve relevant problems leading to two linear equations in two variables. Students graph a system of linear equations, approximate solutions of two linear equations and find exact solutions of systems of two linear equations algebraically. A significant change in Georgia's K-12 Mathematics Standards involves students creating and comparing equations of parallel and perpendicular lines. (GSE Reference: MGSE8.EE.8, MGSE8.EE.8a, MGSE8.EE.8b, MGSE8.EE.8c, MGSE9-12.G.GPE.5, MGSE9-12A.REI.6)

8.GSR.8	<i>Solve contextual, geometric problems involving the Pythagorean Theorem and the volume of geometric figures to explain real phenomena.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations 8.GSR.8.1, 8.GSR.8.2, 8.GSR.8.3, and 8.GSR.8.4)</i>	This standard focuses on solving real-life, geometric problems involving the Pythagorean Theorem and volume of geometric figures. In the GSE, the geometry focus is on transformations. Students describe the effects of transformations on figures in the coordinate plane and use these ideas to build their understanding of distance and angles. Students investigate angles created when a transversal cross parallel lines and investigate the angle-angle criterion for similarity of triangles. Students understand the Pythagorean Theorem and its converse and use it to find distances on the coordinate plane. The study of volume extends to cones, spheres, and cylinders. With changes in Georgia's K-12 Mathematics Standards, all concepts related to transformations and the investigation of angles created when a transversal crosses parallel lines are within Geometry: Concepts & Connections. In Georgia's K-12 Mathematics Standards, students use geometric and spatial reasoning to explain the Pythagorean Theorem and its converse. Students explore triangles with dimensions of rational or irrational numbers when applying the Pythagorean Theorem. And use the Pythagorean Theorem to find distance. As students explore relevant, geometric problems, they apply the formulas for the volumes of cones, cylinders, and spheres. (GSE Reference: MGSE8.G.6, MGSE8.G.7, MGSE8.G.8, MGSE8.G.9)
8th Grade Mathematical Modeling	<i>In 8th grade, students apply mathematics to real-life situations and model real-life phenomena using:</i> <i>• rational numbers, irrational numbers, integer exponents and scientific notation,</i> <i>• linear equations and inequalities,</i> <i>• linear functions</i> <i>• data and statistical concepts, such as patterns of bivariate data and</i> <i>• geometric concepts involving Pythagorean Theorem and volume of cones, cylinders and spheres.</i>	Students explain contextual, mathematical problems using a mathematical model and create mathematical models to explain phenomena that exist in the natural sciences, social sciences, liberal arts, fine and performing arts, and/or humanities contexts. Using abstract and quantitative reasoning, students make decisions about information and data from a contextual situation. Students use various mathematical representations and structures with this information to represent and solve real-life problems.

8th Grade Data & Statistical Reasoning	<i>As students engage with standard 8.FGR.6, students experience the 4 steps of the statistical problem-solving process. Create statistical investigative questions that can be answered using quantitative data. Collect, analyze, and interpret patterns of bivariate data and interpret linear models to answer statistical questions and solve real problems.</i>	Students use statistical reasoning to describe patterns of association, such as clustering, outliers, positive or negative association, linear association, and nonlinear association through the analysis of data presented in multiple ways. Students analyze the data distribution displayed graphically to answer the statistical investigative question generated from a real situation. Students solve practical, linear problems involving situations using bivariate quantitative data. A linear model shows the relationship between two variables in a data set, such as lines of best fit. Students should discover the line of best fit as the one that comes closest to most of the data points and shows the linear relationship between two variables in a data set.
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Georgia's K-12 Mathematics Standards

ALGEBRA: CONCEPTS & CONNECTIONS

ALGEBRA: CONCEPTS AND CONNECTIONS STANDARDS AND EXPECTATIONS		Explanation of Changes and Improvements
New standard code	Language of the New Standard	Brief Explanation of Changes (with relevant GSE standard codes)
A.MP	Display perseverance and patience in problem-solving. Demonstrate skills and strategies needed to succeed in mathematics, including critical thinking, reasoning, and effective collaboration and expression. Seek help and apply feedback. Set and monitor goals. <i>(A further breakdown of this standard can be found in the Essential Instructional Guidance documents: A.MP.1, A.MP.2, A.MP.3, A.MP.4, A.MP.5, A.MP.6, A.MP.7, and A.MP.8.)</i>	This standard describes students blending their knowledge of mathematics content with their ability to apply that knowledge to solve real-world problems through the application of algebraic and geometric concepts. Students represent a wide variety of real-life contexts using rational and irrational numbers and variables in mathematical expressions, equations, and inequalities and communicate these mathematical ideas. Students examine patterns in tables and graphs to generate linear, quadratic, and exponential equations, describe relationships and justify solutions. Students model mathematical concepts to solve problems from real-world contexts and connect symbolic and graphical representations when solving systems of linear inequalities and compare properties of functions provided in different forms. (GSE Reference: SMP 1, SMP 2, SMP 3, SMP 4, SMP 5, SMP 6, SMP 7, SMP 8)
A.MM.1	Apply mathematics to real-life situations; model real-life phenomena using mathematics. <i>(A further breakdown of this standard can be found in learning objectives/expectations A.MM.1.1, A.MM.1.2, A.MM.1.3, A.MM.1.4, and A.MM.1.5.)</i>	This standard illustrates critical thinking, communication, collaboration, and creative problem solving as students explore real-life, mathematical situations. Students gather information, make assumptions, and define variables related to the problem. Students create a model and arrive at a solution to explain the problem presented; they analyze and revise models, as necessary. Students evaluate the model and interpret solutions generated from other models. They draw and validate conclusions. This cycle continues as students develop a deeper understanding of the world around them. In Algebra: Concepts and Connections, students apply mathematics to real-life situations and model real-life phenomena using: • linear equations and inequalities

		- quadratic and exponential expressions and equations - linear, quadratic, and exponential functions - geometric concepts involving slope, distance, midpoint, area and perimeter - rational numbers, irrational numbers, square roots, and cube roots - data and statistical reasoning concepts involving univariate and bivariate data (GSE Reference: <i>Modeling with mathematics aligns to multiple standards, including MGSE9-12.N.Q.1, MGSE9-12.N.Q.2, MGSE9-12.N.Q.3</i>)
A.FGR.2	Construct and interpret arithmetic sequences as functions, algebraically and graphically, to model and explain real-life phenomena. Use formal notation to represent linear functions and the key characteristics of graphs of linear functions, and informally compare linear and non-linear functions using parent graphs. <i>(A further breakdown of this standard can be found in learning objectives/expectations A.FGR.2.1, A.FGR.2.2, A.FGR.2.3, A.FGR.2.4, and A.FGR.2.5.)</i>	This standard describes functional and graphical reasoning as it applies to function notation, modeling linear functions, and linear versus nonlinear comparisons. In the GSE, several function families are combined into a single standard for high school courses. The focus is on understanding the concept of a function and how to use proper notation for functions, as well as understanding functions in terms of a context and analyzing functions using multiple interpretations. Improvements in Georgia's K-12 Mathematics Standards describe big ideas and learning expectations of each function family separately. Students extend their understanding of linear functions to model and explain contextual situations, building and interpreting arithmetic sequences as functions presented graphically and algebraically. Students use formal notation to build and evaluate linear functions as well as to describe key characteristics of their graphs. Students strengthen their understanding of linear functions as they use a variety of tools, including graphing calculators and interactive graphing technologies, to compare the graphs of various parent functions (linear, quadratic, exponential, absolute value, square root, and cube root parent curve); students can discuss their similarities and differences. (GSE Reference: MGSE9-12.F.IF.1, MGSE9-12.F.IF.2, MGSE9-12.F.IF.3,

		F.IF.5, MGSE9-12.F.IF.7, MGSE9-12.F.BF.1a, MGSE9-12.F.LE.1, MGSE9-12.F.LE.3)
A.GSR.3	Solve problems involving distance, midpoint, slope, area, and perimeter to model and explain real-life phenomena. <i>(A further breakdown of this standard can be found in learning objectives/expectations A.GSR.3.1 and A.GSR.3.2.)</i>	This standard illustrates geometric and spatial reasoning through the solving of contextual problems involving distance, midpoint, slope, area, and perimeter. In the GSE, expectations center around students being able to prove simple geometric theorems. Students explore geometric theorems using coordinates with algebraic justifications. With improvements in Georgia's K-12 Mathematics Standards, the emphasis is on <i>applying</i> conceptual knowledge to solve problems in context. Students focus their attention on geometric and algebraic reasoning to apply the distance formula, midpoint formula, and slope of line segments to solve real-world problems. (GSE Reference: MGSE9-12.GPE.4, MGSE9-12.GPE.5, MGSE9-12.GPE.7)
A.PAR.4	Create, analyze, and solve linear inequalities in two variables and systems of linear inequalities to model real-life phenomena. <i>(A further breakdown of this standard can be found in learning objectives/expectations A.PAR.4.1, A.PAR.4.2, and A.PAR.4.3.)</i>	This standard focuses on patterning and algebraic reasoning as it relates to linear inequalities and systems of linear inequalities. In the GSE, students reason about solving and relating equations and inequalities in one variables and systems of equations and inequalities with two or more variables. Students create equations and inequalities from different situations. Students use the equations and inequalities to solve problems and relate solutions to the context of problems and to graphical representations. Georgia's K-12 Mathematics Standards place value on students being able to flexibly solve inequalities and systems of inequalities. Therefore, the emphasis is not on any one specific strategy, but rather being able to conceptualize the problem at hand and choose the most appropriate strategy for solving that problem. Additionally, students apply knowledge of linear inequalities and systems of linear equations developed in previous grades. Students solve linear inequalities as well as solve problems modeled by systems of linear inequalities. Working with linear inequalities that represent real-world

		situations provides context for understanding constraints and other characteristics of the models. (GSE Reference: MGSE9-12.REI.11, MGSE9-12.REI.12, MGSE9-12.A.CED.2, MGSE9-12.A.CED.3, MGSE9-12.F.LE.5)
A.NR.5	Investigate rational and irrational numbers and rewrite expressions involving square roots and cube roots. <i>(A further breakdown of this standard can be found in learning objectives/expectations A.NR.5.1 and A.NR.5.2.)</i>	This standard focuses on numerical reasoning as it relates to rational and irrational numbers, square roots and cube roots. In the GSE, students create the meaning of fractional exponents and are able to rewrite radical and exponential expressions. Students connect the properties of closure for addition and multiplication of integers to rational and irrational computation. With improvements in Georgia's K-12 Mathematics Standards, students develop a conceptual understanding of the sums and products of rational and irrational numbers through exploration and investigation of problems that require addition, subtraction, or multiplication of radicals (limited to square and cube roots). This conceptual understanding enhances numerical reasoning skills and students can now show and explain that the sum or product of rational numbers is rational, the sum of a rational number and an irrational number is irrational, and the product of a nonzero rational number and an irrational number is irrational. (GSE Reference: MGSE9-12.N.RN.2, MGSE9-12.N.RN.3)
A.PAR.6	Build quadratic expressions and equations to represent and model real-life phenomena; solve quadratic equations in mathematically applicable situations. <i>(A further breakdown of this standard can be found in learning objectives/expectations A.PAR.6.1, A.PAR.6.2, A.PAR.6.3, and A.PAR.6.4.)</i>	This standard focuses on patterning and algebraic reasoning as students gain a richer understanding of the world around them by exploring a variety of real-world contexts that can be modeled by quadratic expressions and/or equations. In the GSE, several function families are combined into a single standard for high school courses. Students recognize expressions as being built out of basic operations and complicated expressions are built up out of simpler ones. Students model with equations and inequalities, including describe numeric patterns, represent the relationship between two variables, and interpret solutions as reasonable or not in the context from which they arose.

		Improvements in Georgia's K-12 Mathematics Standards describes big ideas and learning expectations of each function family separately. Students solve quadratic equations fluently (flexibly, accurately, efficiently) by inspection, taking square roots, factoring, completing the square, and applying the quadratic formula, as appropriate to the initial form of the equation. The emphasis is not on any one specific strategy, but rather being able to conceptualize the problem at hand and choosing the most appropriate strategy for solving that problem. This involves students performing operations with polynomials to solve quadratics. (GSE Reference: MGSE9-12.A.SSE.1, MGSE9-12.A.SSE.1a, MGSE9-12.A.SSE.1b, MGSE9-12.A.SSE.2, MGSE9-12.A.SSE.3, MGSE9-12.A.SSE.3a, MGSE9-12.A.SSE.3b, MGSE9-12.A.APR.1, MGSE9-12.A.CED.1, MGSE9-12.A.CED.3, MGSE9-12.A.REI.4, MGSE9-12.A.REI.4b MGSE9-12.F.LE.5)
A.FGR.7	Construct and interpret quadratic functions from data points to model and explain real-life phenomena; describe key characteristics of the graph of a quadratic function to explain a mathematically applicable situation for which the graph serves as a model. <i>(A further breakdown of this standard can be found in learning objectives/expectations A.FGR.7.1, A.FGR.7.2, A.FGR.7.3, A.FGR.7.4, A.FGR.7.5, A.FGR.7.6, A.FGR.7.7, A.FGR.7.8, and A.FGR.7.9.)</i>	This standard illustrates functional and graphical reasoning as it relates to quadratic functions. In the GSE, several function families are combined into a single standard for high school courses. Students understand the meaning of a function to be a correlation between one element of the domain or set of input values and one element of the range or set of output values. Students use function notation efficiently and flexibly, including use in contexts, sequences, and recursively defined functions. Students explore average rate of change for any function and look at key values when interpreting functions. Improvements with Georgia's K-12 Mathematics Standards describes big ideas and learning expectations of each function family separately. Students extend their understanding of function notation, as it relates to linear functions, to build, evaluate, and interpret quadratic functions using formal notation to describe and better understand the world around them. Additionally, students sketch graphs to show key features of quadratic functions as well as use interactive technology tools to

		make greater sense of graphs of quadratic functions. Students estimate, calculate, and interpret the average rate of change of quadratic functions to solve contextual problems. Students compare characteristics of quadratic functions and linear functions, including average rates of change, to enhance their understanding of each function. (GSE Reference: MGSE9-12.F.IF.1, MGSE9-12.F.IF.2, MGSE9-12.F.IF.4, MGSE9-12.F.IF.5, MGSE9-12.F.IF.6, MGSE9-12.F.IF.7, MGSE9-12.F.IF.7a, MGSE9-12.F.IF.8, MGSE9-12.F.IF.8a, MGSE9-12.F.IF.9, MGSE9-12.A.CED.2, MGSE9-12.F.BF.1, MGSE9-12.F.BF.3, MGSE9-12.A.REI.4a)
A.PAR.8	Create and analyze exponential expressions and equations to represent and model real-life phenomena; solve exponential equations in mathematically applicable situations. <i>(A further breakdown of this standard can be found in learning objectives/expectations A.PAR.8.1, A.PAR.8.2, A.PAR.8.3, and A.PAR.8.4.)</i>	This standard illustrates patterning and algebraic reasoning as students represent and model real-life phenomena with exponential expressions and equations. In the GSE, several function families are combined into a single standard for high school courses. This is an important shift to note for teachers. Students develop the understanding that complex expressions are built from simpler expressions. Students model with equations and inequalities through describing numeric patterns, representing the relationship between two variables and interpreting solutions as reasonable or not in the context from which they evolved. Improvements in Georgia's K-12 Mathematics Standards describes big ideas and learning expectations of each function family separately. Students interpret exponential expressions and understand each component as it relates to the context it represents. Additionally, students create equations in one and two variables to solve contextual problems. Students develop a natural understanding of constraints as they continue to explore, solve problems, and model real-life scenarios. (GSE Reference: MGSE9-12.A.SSE.1, MGSE9-12.A.SSE.1a, MGSE9-12.A.SSE.1b, MGSE9-12.A.CED.1, MGSE9-12.A.CED.2, MGSE9-12.A.CED.3, MGSE9-12.F.IF.7e, MGSE9-12.F.LE.5)

A.FGR.9	Construct and analyze the graph of an exponential function to explain a mathematically applicable situation for which the graph serves as a model; compare exponential with linear and quadratic functions. <i>(A further breakdown of this standard can be found in learning objectives/expectations A.FGR.9.1, A.FGR.9.2, A.FGR.9.3, A.FGR.9.4, and A.FGR.9.5.)</i>	This standard focuses on functional and graphical reasoning as it relates to exponential functions. In the GSE, several function families are combined into a single standard for high school courses. Students generalize knowledge of linear functions to explore exponential functions. Students connect the effects on graphs of exponential functions to related geometric transformations. Improvements in Georgia's K-12 Mathematics Standards describes big ideas and learning expectations of each function family separately. Students apply their understanding of function notation, as it relates to linear and quadratic functions, to exponential functions. In addition, students graph and analyze key characteristics of simple exponential functions based on contextual situations; they identify the effect of transformations to the functions and compare linear, quadratic, and exponential functions to reinforce their understanding of the world around them. (GSE Reference: MGSE9-12.F.IF.1, MGSE9-12.F.IF.2, MGSE9-12.F.IF.7, MGSE9-12.F.IF.7a, MGSE9-12.F.IF.9, MGSE9-12.F.BF.1a, MGSE9-12.F.BF.2, MGSE9-12.F.BF.3, MGSE9-12.F.LE.1, MGSE9-12.F.LE.1a, MGSE9-12.F.LE.1b, MGSE9-12.F.LE.1c, MGSE9-12.F.LE.2)
A.DSR.10	Collect, analyze, and interpret univariate quantitative data to answer statistical investigative questions that compare groups to solve real-life problems; Represent bivariate data on a scatter plot and fit a function to the data to answer statistical questions and solve real-life problems. <i>(A further breakdown of this standard can be found in learning objectives/expectations A.DSR.10.1, A.DSR.10.2, A.DSR.10.3, A.DSR.10.4, A.DSR.10.5, A.DSR.10.6, and A.DSR.10.7.)</i>	This standard describes data and statistical reasoning as it relates to univariate data and single quantitative data, as well as bivariate data. In the GSE, students develop and understanding of univariate and bivariate data both numerically and graphically. In Georgia's K-12 Mathematics Standards, students ask statistical investigative questions about the world around them, collect and consider data to answer questions, analyze data, interpret results and perhaps ask more questions and/or collect more data. Additionally, students build on understandings developed in previous grades to compare and represent center and variability of two or more distributions by hand and using technology. Students develop a more conceptual understanding of statistical and data

		reasoning concepts as they continue to work with real-life contexts. This allows students to apply their understanding with greater flexibility rather than rely on formulas and procedures. (GSE Reference: MGSE9-12.S.ID.2, MGSE9-12.S.ID.3, MGSE9-12.S.ID.6, MGSE9-12.S.ID.6a, MGSE9-12.S.ID.7, MGSE9-12.S.ID.8, MGSE9-12.S.ID.9, MGSE9-12.F.IF.6)
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Georgia's K-12 Mathematics Standards

GEOMETRY: CONCEPTS & CONNECTIONS

GEOMETRY STANDARDS AND EXPECTATIONS		Explanation of Changes and Improvements
New standard code	Language of the New Standard	Brief Explanation of Changes (with relevant GSE standard codes)
G.MP	<i>Display perseverance and patience in problem-solving. Demonstrate skills and strategies needed to succeed in mathematics, including critical thinking, reasoning, and effective collaboration and expression. Seek help and apply feedback. Set and monitor goals.</i> <i>(A further breakdown of this standard can be found in the Essential Instructional Guidance documents: G.MP.1, G.MP.2, G.MP.3, G.MP.4, G.MP.5, G.MP.6, G.MP.7, and G.MP.8.)</i>	This standard illustrates students blending their knowledge of mathematics content with their ability to apply that knowledge to solve real-world problems through the application of algebraic and geometric concepts. Students make sense of problems involving geometry, trigonometry, algebra, probability, and statistics in real-world contexts. Students continue to enhance their critical thinking and reasoning skills as they analyze and apply a deep understanding of polynomial expressions, proofs, constructions, rigid motions and transformations, similarity, congruence, circles, right triangle trigonometry, geometric measurement, and conditional probability. (GSE Reference: SMP 1, SMP 2, SMP 3, SMP 4, SMP 5, SMP 6, SMP 7, SMP 8)
G.MM.1	<i>Apply mathematics to real-life situations; model real-life phenomena using mathematics.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations G.MM.1.1, G.MM.1.2, G.MM.1.3, and G.MM.1.4.)</i>	This standard illustrates critical thinking, communication, collaboration, and creative problem solving as students explore real-life, mathematical situations. Students gather information, make assumptions, and define variables related to the problem. Students create a model and arrive at a solution to explain the problem presented; they analyze and revise models, as necessary. Students evaluate the model and interpret solutions generated from other models. They draw and validate conclusions. This cycle continues as students develop a deeper understanding of the world around them. In Geometry: Concepts and Connections, students apply mathematics to real-life situations and model real-life phenomena using: • polynomial expressions • transformations in the plane • symmetries and congruence • dilations • geometric concepts involving lines and angles

		• similar triangles, right triangles, sine and cosine • radian measure and special right triangles • geometric concepts involving circles • relationships between two-dimensional and three-dimensional objects (GSE Reference: MGSE9-12.G.MG.3)
G.PAR.2	<i>Interpret the structure of polynomial expressions and perform operations with polynomials within a geometric framework.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations G.PAR.2.1, G.PAR.2.2, and G.PAR.2.3.)</i>	This standard explores patterning and algebraic reasoning as it relates to polynomial expressions. In the GSE, students explore operations with polynomials in Coordinate Algebra and/or Geometry. In Geometry: Concepts & Connections, students apply patterning and algebraic reasoning skills to represent a quantity in terms of its given geometric context. Students use algebraic reasoning to add, subtract, and multiply single variable polynomials to solve geometric problems. In previous Georgia's K-12 Mathematics Standards courses, students explore operations with polynomials in the context of quadratic functions. Students perform operations with polynomials and prove that polynomials form a system analogous to the integers in that they are closed under these operations. (GSE Reference: MGSE9-12.A.APR.1)
G.GSR.3	<i>Experiment with transformations in the plane to develop precise definitions for translations, rotations, and reflections and use these to describe symmetries and congruence to model and explain real-life phenomena.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations G.GSR.3.1, G.GSR.3.2, G.GSR.3.3, and G.GSR.3.4.)</i>	This standard discusses geometric and spatial reasoning, specifically as it relates to congruence. In the GSE, the study of transformations begins in 8th Grade. Students further develop the big idea of transformations in the plane in GSE Coordinate Algebra and/or GSE Geometry. Understanding congruence in terms of rigid motions is addressed in both GSE Analytic Geometry and GSE Geometry. With changes in Georgia's K-12 Mathematics Standards, students explore transformations of geometric figures for the first time in Geometry: Concepts & Connections. Students are expected to use precise definitions and symbolic notations

		to solve problems. Additionally, students describe symmetries and congruence to model and explain real-life problems. Students experimentally verify congruence properties, use geometric reasoning to develop common understandings (i.e., definitions), and describe rigid motions to draw transformed figures and make predictions about the effects on given figures. In Georgia's K-12 Mathematics Standards, rotations are limited to those centered about the origin and in increments of 90 degrees, clockwise and counterclockwise. (GSE Reference: MGSE8.G.1, MGSE8.G.2, MGSE9-12.G.CO.2, MGSE9-12.G.CO.3, MGSE9-12.G.CO.4, MGSE9-12.G.CO.5, MGSE9-12.G.CO.6, MGSE9-12.G.CO.7, MGSE9-12.G.CO.8)
G.GSR.4	<i>Establish facts between angle relations and generate valid arguments to defend facts established. Prove theorems and solve geometric problems involving lines and angles to model and explain real-life phenomena.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations G.GSR.4.1, G.GSR.4.2, G.GSR.4.3, G.GSR.4.4, and G.GSR.4.5.)</i>	This standard explores geometric and spatial reasoning, specifically as it applies to geometric foundations, constructions, and proof. In the GSE, students use informal arguments to establish facts about the angle sum and exterior angle of triangles in 8th grade. In Geometry and Analytic Geometry, students prove geometric theorems using geometric characteristics and algebraically. In Georgia's K-12 Mathematics Standards, students develop and use precise definitions and symbolic notation to solve realistic real-world problems. Students prove and apply simple geometric theorems algebraically. They make formal geometric constructions with a variety of tools and methods, including dynamic geometric software. Students reason geometrically to discover the angle relationships between angles formed when two lines are cut by a transversal. (GSE Reference: MGSE8.G.5, MGSE9-12.G.GO.1, MGSE9-12.G.CO.9, MGSE9-12.G.CO.11, MGSE9-12.G.CO.12, MGSE9-12.GPE.4)

G.GSR.5	<i>Describe dilations in terms of center and scale factor and use these terms to describe properties of dilations; use the precise definition of a dilation to describe similarity and establish the criterion for triangles to be similar; use these terms, definitions, and criterion to prove similarity, model, and explain real-life phenomena.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations G.GSR.5.1, G.GSR.5.2, G.GSR.5.3, and G.GSR.5.4.)</i>	This standard explores geometric and spatial reasoning, specifically as it applies to similarity. In the GSE, students build on their informal experiences with dilation in middle school and define similarity in terms of similarity transformations. Students use similarity to prove various theorems and solve problems. These concepts are mostly addressed in the Analytic Geometry and Geometry courses. Improvements in Georgia's K-12 Mathematics Standards include an emphasis on strengthening reasoning and problem-solving skills through application of geometric concepts in real-life situations. Geometry: Concepts & Connections presents the first opportunity for students to explore dilation of geometric figures. In addition, students verify, experimentally, the properties of dilations and identify dilations as reduction or enlargement depending on scale factor. They describe properties of dilations such as center, scale factor, angle measure, parallelism, and collinearity, informally and with function notation. Students use the properties of similarity transformations to establish criterion for two triangles to be similar. They also use similarity criteria for triangles to solve problems and to prove relationships in geometric figures. Lastly, students construct formal proofs to justify and apply theorems about triangles. In Georgia's K-12 Mathematics Standards, dilations should be limited to those centered at the origin. (GSE Reference: MGSE9-12.G.SRT.1, MGSE9-12.G.SRT.2, MGSE9-12.G.SRT.3, MGSE9-12.G.SRT.4, MGSE9-12.G.SRT.5)
G.GSR.6	<i>Examine side ratios of similar triangles; use the relationship between right triangles to develop an understanding of sine and cosine to solve geometric problems and to model and explain real-life phenomena.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations G.GSR.6.1, G.GSR.6.2, and G.GSR.6.3.)</i>	This standard explores geometric and spatial reasoning as it applies to right triangle trigonometry. In the GSE, students explore properties of triangles in earlier grades; the other concepts are mostly addressed in the Analytic Geometry and Geometry courses. Students extend their work with similar triangles to look at the special case of similar right triangles.

		With changes in Georgia's K-12 Mathematics Standards, students have limited experience with the properties of triangles. Students apply their understanding of similarity that was developed in G.GSR.5 to establish sine, cosine, and tangent ratios and solve problems involving right triangles. In seventh grade, students write and solve equations using supplementary, complementary, vertical, and adjacent angles. In Geometry: Concepts & Connections, students deepen their understanding of angles as they explain and use the relationship between the sine and cosine of complementary angles. Students continue to develop their geometric and spatial reasoning skills as they use trigonometric ratios and the Pythagorean Theorem to solve for sides and angles of right triangles in applied problems. (GSE Reference: MGSE9-12.G.SRT.6, MGSE9-12.G.SRT.7, MGSE9-12.G.SRT.8)
G.GSR.7	Explore the concept of a radian measure and special right triangles. <i>(A further breakdown of this standard can be found in learning objectives/expectations G.GSR.7.1, G.GSR.7.2, and G.GSR.7.3.)</i>	This standard explores geometric and spatial reasoning as it applies to trigonometry and the unit circle. In the GSE, students discover another way to measure angles and use radian measures. Students model different angles and rotations to discover positive and negative angles. And students explore special right triangles. These are concepts that are mostly explored in the Precalculus course. Improvements in Georgia's K-12 Mathematics Standards include the introduction of radian measure earlier in the progression of learning. Students make sense of the conceptual meaning of a radian through exploration with visual tools, both hands-on and using technology. They explore and discover experimentally the relationship between radian measure and degree measure and can fluently convert between the two. Additionally, students use special right triangles on the unit circle to determine values of sine, cosine, and tangent and use reflections of triangles to determine reference angles and identify coordinate values in all four quadrants of the coordinate plane.

		(GSE Reference: MGSE9-12.F.TF.1, MGSE9-12.G.TF.2, MGSE9-12.G.TF.3)
G.GSR.8	<i>Examine and apply theorems involving circles; describe and derive arc length and area of a sector; and model and explain real-life situations involving circles.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations G.GSR.8.1, G.GSR.8.2, and G.GSR.8.3.)</i>	This standard explores geometric and spatial reasoning as it applies to circles. In the GSE, students build on their knowledge of properties for angles, lines, and segments and relate to circles to form conjectures. Through their justifications, students establish the conjectures as theorems. These concepts are mostly addressed in the Analytic Geometry and Geometry courses. Improvements in the Georgia's K-12 Mathematics Standards include an emphasis on reasoning and problem solving in real life contexts. Students identify and apply angle relationships, derive the formula for the area of a sector, and solve contextual problems involving applications of arc length and sector area . In addition, students apply their conceptual understanding of the characteristics of circles to write, describe, and graph the equation of circles in standard form. As students convert equations of circles in general form to standard form, the leading coefficient of the quadratic terms should be limited to 1. (GSE Reference: MGSE9-12.G.C.1, MGSE9-12.G.C.2, MGSE9-12.G.C.3, MGSE9-12.G.C.4, MGSE9-12.G.C.5, MGSE9-12.G.GPE.1)
G.GSR.9	<i>Develop informal arguments for geometric formulas using dissection arguments, limit arguments, and Cavalieri's principle; solve realistic problems involving volume; explore and visualize relationships between two-dimensional and three-dimensional objects to model and explain real-life phenomena.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations G.GSR.9.1, G.GSR.9.2, and G.GSR.9.3.)</i>	This standard explores geometric and spatial reasoning as it applies to equations and measurement. In the GSE, students discuss why formulas for geometric figures learned in middle school work. These concepts are mostly addressed in the Analytic Geometry and Geometry courses. Improvements in the Georgia's K-12 Mathematics Standards include an emphasis on conceptual understanding and problem solving in realistic contexts. Students verify, experimentally, the formulas for the volume of a cylinder, pyramid, sphere, prism and cone; emphasize volume as the product of the area of the base and the height for both prisms and cylinders. Additionally, students use and explain Cavalieri's Principle to

		show that the volume of an oblique solid can be found using right solids. Students find the volume of solids and composite solids to explain real-life phenomena. Students choose the appropriate geometric solid to approximate volumes of irregular objects, and choose the appropriate geometric figure or solid to approximate density of irregular objects in a geometric situation. (GSE Reference: MGSE9-12.G.GMD.1, MGSE9-12.G.GMD.2, GSE912.G.GMD.3, MGSE912.G.GMD.4, MGSE9-12.G.MG.1, MGSE9-12.G.MG.2)
G.PR.10	<i>Solve problems involving the probability of compound events to make informed decisions; interpret expected value and measures of variability to analyze probability distributions.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations G.PR.10.1, G.PR.10.2, G.PR.10.3, G.PR.10.4, G.PR.10.5, G.PR.10.6, G.PR.10.7, and G.PR.10.8.)</i>	This standard describes probabilistic reasoning as students make sense of data to make informed decisions about the world around them. In the GSE Analytic Geometry and GSE Geometry courses, students developed an understanding of independence and conditional probability to interpret data and make decisions. However, the standards did not always follow a natural progression and there may have been holes in the learning progression between courses. In Georgia's K-12 Mathematics Standards, students describe categories of events as subsets of a sample space. Students apply the Addition Rule and Multiplication Rule conceptually and interpret answers in the context of the problems they are exploring. Students demonstrate a conceptual understanding and application of combinations and permutations to solve simple problems involving selection and arrangements of objects in a line, including those involving repetition and restriction. Students investigate questions such as those involving false positives or false negatives from screening tests. Students develop and interpret a probability distribution using theoretical and empirical (observed) probabilities and calculate and interpret the expected value. Students compare the payoff values and make informed decision based on expected value and measures of variability. Georgia's K-12 Mathematics Standards more clearly and intentionally define how

		students should be able to work with and understand data. As such, permutations, combinations, expected value, and payoff values are relatively new for this course. (GSE Reference: MGSE9-12.S.CP.1, MGSE9-12.S.CP.2, MGSE9-12.S.CP.3, MGSE9-12.S.CP.5, MGSE9-12.S.CP.7, MGSE9-12.S.CP.8, MGSE9-12.S.CP.9, MGSE9-12.MD.1, MGSE9-12.MD.2, MGSE9-12.MD.3, MGSE9-12.MD.4, MGSE9-12.MD.5, MGSE9-12.MD.5a, MGSE9-12.MD.5b)
G.DSR.11	<i>Examine real-life situations presented in a two-way frequency table to calculate probabilities, to model categorical data, and to explain real-life phenomena.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations G.DSR.11.1 and G.DSR.11.2.)</i>	This standard is all about data and statistical reasoning, specifically with categorical data in two-way frequency tables as well as probabilistic reasoning as it relates to conditional probability. In GSE, students begin their exploration of two-ways in 8th grade. In the Geometry course, students learn to interpret categorical and quantitative data using scatter plots and to generate a function of best fit (linear, quadratic, and exponential models). With changes in Georgia's K-12 Mathematics Standards, students are introduced to two-ways in Geometry: Concepts & Connections. Students construct and interpret information presented in a two-way frequency table to calculate probabilities and draw informed conclusions about real-world problems. (GSE Reference: MGSE8.SP.4, MGSE8.4a, MGSE9-12.S.CP.4)

Georgia's K-12 Mathematics Standards

ADVANCED ALGEBRA: CONCEPTS & CONNECTIONS

ADVANCED ALGEBRA STANDARDS AND EXPECTATIONS		Explanation of Changes and Improvements
New standard code	Language of the New Standard	Brief Explanation of Changes (with relevant GSE standard codes)
AA.MP	<i>Display perseverance and patience in problem-solving. Demonstrate skills and strategies needed to succeed in mathematics, including critical thinking, reasoning, and effective collaboration and expression. Seek help and apply feedback. Set and monitor goals.</i> <i>(A further breakdown of this standard can be found in the Essential Instructional Guidance documents: AA.MP.1, AA.MP.2, AA.MP.3, AA.MP.4, AA.MP.5, AA.MP.6, AA.MP.7, and AA.MP.8.)</i>	This standard focuses on students integrating their knowledge of mathematics content with their ability to apply that knowledge to solve real-world problems through the application of algebraic and geometric concepts. Students use quantitative reasoning to create coherent representations of problems and flexibly use different properties of operations. Students interpret mathematical results in the context of the situation and reflect on whether the results make sense. Students use these patterns to create equivalent expressions, factor and solve equations, and compose functions, and transform figures. (GSE Reference: SMP 1, SMP 2, SMP 3, SMP 4, SMP 5, SMP 6, SMP 7, SMP 8)
AA.MM.1	<i>Apply mathematics to real-life situations; model real-life phenomena using mathematics.</i> <i>(A further breakdown of this standard can be found in learning objectives/ expectations AA.MM.1.1, AA.MM.1.2, AA.MM.1.3, and AA.MM.1.4.)</i>	This standard focuses on critical thinking, inquiry, collaboration, and creative problem solving as students explore real-life, mathematical situations. Students gather information, make assumptions, and define variables related to the problem. Students create a model and arrive at a solution to explain the problem presented; they analyze and revise models, as necessary. Students evaluate the model and interpret solutions generated from other models. They draw and validate conclusions. This cycle continues as students develop a deeper understanding of the work around them. In Advanced Algebra: Concepts and Connections, students apply mathematics to real-life situations and model real-life phenomena using: • descriptive and inferential statistics • exponential and logarithmic expressions, equations, and functions

		• radical expressions, equations, and functions • polynomial expressions, equations, and functions • rational functions • systems of equations • matrices • the unit circle (GSE Reference: <i>Modeling with mathematics aligns to multiple standards, including MGSE9-12.F.IF.4, MGSE9-12.F.BF.1)</i>
AA.DSR.2	<i>Communicate descriptive and inferential statistics by collecting, critiquing, analyzing, and interpreting real-world data.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations AA.DSR.2.1, AA.DSR.2.2, AA.DSR.2.3, AA.DSR.2.4, AA.DSR.2.5, AA.DSR.2.6, AA.DSR.2.7, and AA.DSR.2.8.)</i>	This standard centers on the development data and statistical reasoning as students communicate about descriptive and inferential statistics. In the GSE, students summarize, represent, and interpret data on a single count or measurement variable. Students understand and evaluate random processes underlying statistical experiments. They also make inferences and justify conclusions from sample surveys, experiments, and observational studies. In Georgia’s K-12 Mathematics Standards, students strengthen their understanding of measures of variability with explorations of standard deviation. Students recognize the purposes of and differences among different types of studies and different types of data sources. Students build upon their understanding of statistical investigative questions and data collection and learn to recognize biases and describe its potential effects, as well as critically consider ethics and privacy issues related to data collection. Students explore representative samples from a population to make inferences about the population. Students understand how to use z-scores to compare samples with differing units; they use technology to calculate standard deviation when necessary to determine the z-score. (GSE Reference: MGSE9-12S.ID.2, MGSE9-12S.ID.4, MGSE9-12S.IC.1, MGSE9-12S.IC.2, MGSE9-12S.IC.3, MGSE9-12S.IC.4, MGSE9-12S.IC.5, MGSE9-12S.IC.6)

AA.FGR.3	Explore and analyze structures and patterns for exponential and logarithmic functions and use exponential and logarithmic expressions, equations, and functions to model real-life phenomena. <i>(A further breakdown of this standard can be found in learning objectives/expectations AA.FGR.3.1, AA.FGR.3.2, AA.FGR.3.3, AA.FGR.3.4, AA.FGR.3.5, AA.FGR.3.6, and AA.FGR.3.7.)</i>	This standard focuses on functional and graphical reasoning as it relates specifically to real-life situations that can be modeled with exponential and logarithmic functions. In the GSE, students build and interpret functions using different representations, including those modeled by square root, cube root, piecewise-defined, polynomial, rational, exponential and logarithmic functions. Students analyze and graph functions and show key features. They also write functions in different but equivalent forms. Students work with transformations of functions as well as the concept of even and odd functions. In Georgia's K-12 Mathematics Standards, students work with exponential and logarithmic expressions, equations, and functions to model real-life phenomena. Transformation of functions is a standard in <i>Algebra: Concepts & Connections</i> (A.FGR.7.2 and A.FGR.9.3) and the topics of piecewise-defined functions and even and odd functions are introduced in <i>Precalculus</i> (PC.FGR.3). There is a strong emphasis on exploring real-life situations and solving practical problems modeled by exponential and logarithmic expressions, equations, and functions. (GSE Reference: MGSE9-12.A.CED.1, MGSE9-12.A.CED.2, MGSE9-12F.BF.1, MGSE9-12.F.BF.1b, MGSE9-12F.BF.4, MGSE9-12.F.LE.2, MGSE9-12F.LE.4, MGSE9-12.F.LE.5, MGSE9-12.F.IF.4, MGSE9-12F.IF.7e, MGSE9-12.F.IF.8, MGSE9-12.F.IF.9, MGSE9-12.N.RN.1, MGSE9-12.N.RN.2)
AA.FGR.4	Explore and analyze structures and patterns for radical functions and use radical expressions, equations, and functions to model real-life phenomena. <i>(A further breakdown of this standard can be found in learning objectives/expectations AA.FGR.4.1, AA.FGR.4.2, AA.FGR.4.3, AA.FGR.4.4, and AA.FGR.4.5.)</i>	This standard focuses on functional and graphical reasoning as it relates specifically to real-life situations that can be modeled with radical expressions, equations, and functions. In the GSE, students extend the properties of exponents to rational exponents, analyze functions using different representations, including square root, cube root, piece-wise defined, polynomial, rational, exponential and logarithmic functions. In Georgia's K-12 Mathematics Standards, students work with radical expressions, equations, and functions. Creating,

		analyzing, and solving radical equations in two or more variables is new with Georgia's K-12 Standards for Mathematics. Cube root and piecewise-defined functions are introduced in Precalculus. Students explore rational and radical equations separately, or together, whatever makes sense in that contextual problem, although the intent is to address rational and radical separately. (GSE Reference: MGSE9-12.A.REI.2, MGSE9-12.N.RN.1, MGSE9-12.N.RN.2, MGSE9-12.A.SSE.1, MGSE9-12.A.SSE.2, MGSE9-12.A.SSE.3, MGSE9-12.F.IF.7, MGSE9-12.F.IF.8, MGSE9-12.F.IF.9, MGSE9-12.F.IF.4, MGSE9-12.A.REI.4b)
AA.FGR.5	<i>Extend exploration of quadratic solutions to include real and non-real numbers and explore how these numbers behave under familiar operations and within real-world situations; create polynomial expressions, solve polynomial equations, graph polynomial functions, and model real-world phenomena.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations AA.FGR.5.1, AA.FGR.5.2, AA.FGR.5.3, AA.FGR.5.4, AA.FGR.5.5, AA.FGR.5.6, AA.FGR.5.7, AA.FGR.5.8, AA.FGR.5.9, AA.FGR.5.10, and AA.FGR.5.11.)</i>	This standard focuses on functional and graphical reasoning as it relates to polynomial functions, with a strong foundational basis in quadratic equations and functions. In the GSE, students perform arithmetic operations on polynomials, understand the relationship between zeros and factors of polynomials, use polynomial identities to solve problems, and rewrite rational expression. Within these topics, students study the concepts of the Remainder Theorem, finite geometric series and The Binomial Theorem. In Georgia's K-12 Mathematics Standards, students build on what they learned in previous courses about quadratic solutions to include real and non-real numbers. They work with polynomial expressions, equations, and functions to model and make sense of real-world problems. The concepts of the Remainder Theorem and finite geometric series are introduced in Precalculus. (GSE Reference: MGSE9-12.A.APR.1, MGSE9-12.A.APR.2, MGSE9-12.A.APR.3, MGSE9-12.A.APR.4, MGSE9-12.N.CN.1, MGSE9-12.N.CN.2, MGSE9-12.N.CN.3, MGSE9-12.N.CN.7, MGSE9-12.N.CN.8, MGSE9-12.N.CN.9, MGSE9-12.A.SSE.1, MGSE9-12.A.SSE.2, MGSE9-12.A.SSE.3, MGSE9-12.A.CED.1, MGSE9-12.A.CED.2, MGSE9-12.A.CED.3, MGSE9-12.A.CED.4, MGSE9-12.A.REI.4, MGSE9-12.F.IF.4, MGSE9-12.F.IF.7, MGSE9-12.F.IF.8, MGSE9-12.F.IF.9, MGSE9-12.F.BF.3.)

AA.PAR.6	Represent data with matrices, perform mathematical operations, and solve systems of linear equations leading to real-world linear programming applications. <i>(A further breakdown of this standard can be found in learning objectives/expectations AA.PAR.6.1, AA.PAR.6.2, AA.PAR.6.3, and AA.FGR.6.4.)</i>	This standard centers on patterning and algebraic reasoning as it applies to linear algebra and matrices. In the GSE, students perform operations on matrices and use matrices in applications, including to solve systems of equations. In Georgia's K-12 Mathematics Standards, students learn to represent data and solve systems of linear equations problems using a matrix representation. Students utilize linear programming to represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret data points as solutions or non-solutions under the established constraints in real-world problems. (GSE Reference: MGSE9-12.N.VM.6, MGSE9-12.N.VM.7, MGSE9-12.N.VM.8, MGSE9-12.N.VM.9, MGSE9-12.N.VM.10, MGSE9-12.N.VM.11, MGSE9-12.N.VM.12, MGSE9-12.A.REI.7, MGSE9-12.A.REI.8)
AA.GSR.7	Develop an introductory understanding of the unit circle; solve trigonometric equations using the unit circle. <i>(A further breakdown of this standard can be found in learning objectives/expectations AA.GSR.7.1 and AA.GSR.7.2.)</i>	This standard focuses on trigonometry and the unit circle. In the GSE, students extend the domain of trigonometric functions using the unit circle, model periodic phenomena with trigonometric functions, prove and apply trigonometric identities, and apply trigonometry to general triangles. In Georgia's K-12 Mathematics Standards, students define sine, cosine, and tangent in terms of x, y, and r using the unit circle centered at the origin of the coordinate plane. Students apply an understanding of the angle measures and coordinates of the unit circle to solve contextual problems involving trigonometric equations. In Georgia's K-12 Mathematics Standards, students begin developing a conceptual understanding of radians and the unit circle in Geometry: Concepts & Connections (G.GSR.7). (GSE Reference: MGSE9-12F.TF.1, MGSE9-12F.TF.2, MGSE9-12F.TF.3, GSE9-12F.TF.4)

AA.FGR.8	Analyze the behaviors of rational functions to model applicable, mathematical problems. <i>(A further breakdown of this standard can be found in learning objectives/expectations AA.FGR.8.1, AA.FGR.8.2, AA.FGR.8.3, and AA.FGR.8.4.)</i>	This standard focuses on rational functions. In GSE, students are introduced to rational functions. Students use factoring to simplify rational functions and perform operations, specifically multiply and divide with rational functions. And combine rational functions using addition and subtraction. Students graph rational functions and identify key features and characteristics of the function, including end behavior. Students solve simple rational equations. In Georgia's K-12 Mathematics Standards, students write simple rational expressions, perform operations with rational expressions, graph rational functions and solve simple rational equations in one variable to model and solve real-life problems. (GSE Reference: MGSE9-12.A.APR.6, MGSE9-12.A.APR.7, MGSE9-12.A.REI.2, MGSE9-12.F.IF.4, MGSE9-12.F.IF.7d, MGSE9-12.F.IF.8, MGSE9-12.F.IF.9)
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Georgia's K-12 Mathematics Standards

PRECALCULUS

PRECALCULUS STANDARDS AND EXPECTATIONS		Explanation of Changes and Improvements
New standard code	Language of the New Standard	Brief Explanation of Changes (with relevant GSE standard codes)
PC.MP	<i>Display perseverance and patience in problem-solving. Demonstrate skills and strategies needed to succeed in mathematics, including critical thinking, reasoning, and effective collaboration and expression. Seek help and apply feedback. Set and monitor goals.</i> <i>(A further breakdown of this standard can be found in learning objectives/ expectations PC.MP.1, PC.MP.2, PC.MP.3, PC.MP.4, PC.MP.5, PC.MP.6, PC.MP.7, and PC.MP.8.)</i>	This standard focuses on students integrating their knowledge of mathematics content with their ability to apply that knowledge to solve real-world problems through the application of algebraic and geometric concepts. Students examine problems by explaining to themselves the meaning of a problem and looking for entry points to its solution. Students seek to make sense of quantities and their relationships in problem situations. They analyze relationships mathematically to draw conclusions and interpret mathematical results in the context of the situation. (GSE Reference: SMP 1, SMP 2, SMP 3, SMP 4, SMP 5, SMP 6, SMP 7, SMP 8)
PC.MM.1	<i>Apply mathematics to real-life situations; model real-life phenomena using mathematics.</i> <i>(A further breakdown of this standard can be found in learning objectives/ expectations PC.MM.1.1, PC.MM.1.2, PC.MM.1.3, and PC.MM.1.4.)</i>	This standard centers on critical thinking, communication, collaboration, and creative problem solving as students explore real-life, mathematical situations. Students gather information, make assumptions, and define variables related to the problem. Students create a model and arrive at a solution to explain the problem presented; they analyze and revise models, as necessary. Students evaluate the model and interpret solutions generated from other models. They draw and validate conclusions. This cycle continues as students develop a deeper understanding of the work around them. In Precalculus: Concepts and Connections, students apply mathematics to real-life situations and model real-life phenomena using: • piecewise-defined functions • rational functions • trigonometric expressions, equations and functions • conic sections • polar plane • vectors • parametric equations • sequences and series

		(GSE Reference: <i>Modeling with mathematics aligns to multiple standards, including MGSE9-12.F.TF.5, MGSE9-12.F.TF.7</i>)
PC.FGR.2	Analyze the behaviors of rational and piecewise functions to model contextual mathematical problems. <i>(A further breakdown of this standard can be found in learning objectives/expectations PC.FGR.2.1, PC.FGR.2.2, PC.FGR.2.3, PC.FGR.2.4, PC.FGR.2.5, PC.FGR.2.6, PC.FGR.2.7, PC.FGR.2.8, and PC.FGR.2.9.)</i>	This standard focuses on functional and graphical reasoning as it applies to rational and piecewise functions. In the GSE, students graph piecewise-defined functions, including step functions and absolute value functions in Advanced Algebra/Algebra II. Students identify key characteristics of the functions. With improvements in Georgia's K-12 Mathematics Standards, students are formally introduced to piecewise-defined functions in Precalculus. Students analyze piecewise-defined and rational functions using different representations. They graph piecewise-defined and rational functions, describe key characteristics of both the algebraic form and the graph, and represent the limit of a function. Students divide polynomials, solve simple rational equations, and perform partial fraction decomposition of rational functions. students begin exploring real-life situations that can be modeled with rational functions in Advanced Algebra: Concepts & Connections. (GSE Reference: MGSE9-12.F.IF.4, MGSE9-12.F.IF.7, MGSE9-12.F.BF.4, , MGSE9-12.A.REI.2)
PC.FGR.3	Utilize trigonometric expressions to solve problems and model periodic phenomena with trigonometric functions. <i>(A further breakdown of this standard can be found in learning objectives/expectations PC.FGR.3.1, PC.FGR.3.2, PC.FGR.3.3, PC.FGR.3.4, PC.FGR.3.5, PC.FGR.3.6, PC.FGR.3.7, and PC.FGR.3.8.)</i>	This standard focuses on functional and graphical reasoning as it applies to trigonometric relationships, functions, and their inverses. In the GSE, students understand radian measures of an angle as length of an arc. Students explore the unit circle and define sine and cosine functions. With improvements in Georgia's K-12 Mathematics Standards, students construct equations for real-life contexts such as pendulum motion, tides, predator-prey models, and sound waves. Students build upon their exploration of radian measure in Geometry: Concepts & Connections and Advanced Algebra: Concepts & Connections to define and analyze trigonometric relationships to make sense of real-life problems. Students also analyze trigonometric functions and their inverses, with and without technology.

		(GSE Reference: MGSE9-12.F.BF.3, MGSE9-12.F.TF.1, MGSE9-12.F.TF.2, MGSE9-12.F.TF.3, MGSE9-12.F.TF.5, MGSE9-12.F.TF.6, MGSE9-12.F.TF.8, MGSE9-12.F.IF.7e)
PC.AGR.4	<i>Manipulate, prove, and apply trigonometric identities and equations to solve contextual mathematical problems.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations PC.AGR.4.1, PC.AGR.4.2, PC.AGR.4.3, PC.AGR.4.4, and PC.AGR.4.5.)</i>	This standard focuses on algebraic and geometric reasoning, centered on trigonometric identities and equations and solving general triangles. In the GSE, students model periodic phenomena with trigonometric functions, prove and apply trigonometric identities, and apply trigonometry to general triangles. In Georgia's K-12 Mathematics Standards, students verify trigonometric identities and solve trigonometric equations arising in modeling contexts. Students also apply trigonometry to right triangles to prove and apply the Law of Sines and Law of Cosines to find unknown measurements in right and non-right triangles as well as to determine the area of an oblique triangle. (GSE Reference: MGSE9-12.F.TF.5, MGSE9-12.F.TF.6, MGSE9-12.F.TF.7, MGSE9-12.F.TF.8, MGSE9-12.F.TF.9, MGSE9-12.G.SRT.9, MGSE9-12.G.SRT.10, MGSE9-12.G.SRT.11)
PC.GSR.5	<i>Analyze the behaviors of conic sections and polar equations to model contextual mathematical problems.</i> <i>(A further breakdown of this standard can be found in learning objectives/expectations PC.GSR.5.1, PC.GSR.5.2, PC.GSR.5.3, PC.GSR.5.4, and PC.GSR.5.5.)</i>	This standard focuses geometric and spatial reasoning centered on conic sections and polar equations. In the GSE, students translate between the geometric description and the equation for a conic section. In Georgia's K-12 Mathematics Standards, improvements include students extending trigonometry to the polar plane and classifying polar equations and applying their understanding to contextual situations. Students graph equations in the polar coordinate plane. Students explore conic sections using different representations, such as graphs and equations. (GSE Reference: MGSE9-12.G.GPE.2, MGSE9-12.G.GPE.3)

PC.AGR.6	Represent and model vector quantities to solve problems in contextual situations. <i>(A further breakdown of this standard can be found in learning objectives/expectations PC.AGR.6.1, PC.AGR.6.2, PC.AGR.6.3, PC.AGR.6.4, PC.AGR.6.5, and PC.AGR.6.6.)</i>	This standard focuses on algebraic and graphical reasoning centered on vectors and parametric equations. In the GSE, students represent and model with vector quantities, perform operations on vectors, and perform operations on matrices and use matrices in applications. With improvements in Georgia's K-12 Mathematics Standards, students build upon their experience from Advanced Algebra: Concepts & Connections with matrices and vectors to perform operations with vectors in context. Students solve real-life problems such as those involving velocity, force, and other quantities. In this course, students also model situations with parametric equations, such as movement along a curve in the Cartesian Plane and projectile motion. (GSE Reference: MGSE9-12.N.VM.1, MGSE9-12.N.VM.2, MGSE9-12.N.VM.3, MGSE9-12.N.VM.4, MGSE9-12.N.VM.5, MGSE9-12.N.VM.6, MGSE9-12.N.VM.7, MGSE9-12.N.VM.8, MGSE9-12.N.VM.9, MGSE9-12.N.VM.10, MGSE9-12.N.VM.11, MGSE9-12.N.VM.12)
PC.PAR.7	Demonstrate how sequences and series apply to mathematical models in real-life situations. <i>(A further breakdown of this standard can be found in learning objectives/expectations PC.PAR.7.1, PC.PAR.7.2, PC.PAR.7.3, PC.PAR.7.4, PC.PAR.7.5, PC.PAR.7.6, and PC.PAR.7.7.)</i>	This standard focuses on patterning and algebraic reasoning as it relates to sequences and series. In the GSE, sequences and series are addressed in Advanced Algebra/Algebra II. With changes in Georgia's K-12 Mathematics Standards, students analyze sequences and series using multiple representations, including graphically, numerically, and symbolically. Students determine the limit of a sequence if it exists. Students can also describe the behavior of a series in terms of the limit of its partial sums. Students can derive and use the sum formula of finite and infinite geometric series to solve contextual problems. (GSE Reference: MGSE9-12.A.SSE.4, MGSE9-12.S.MD.1, MGSE9-12.S.MD.2, MGSE9-12.S.MD.3, MGSE9-12.S.MD.4, MGSE9-12.S.MD.5, MGSE9-12.S.MD.6, MGSE9-12.S.MD.7)