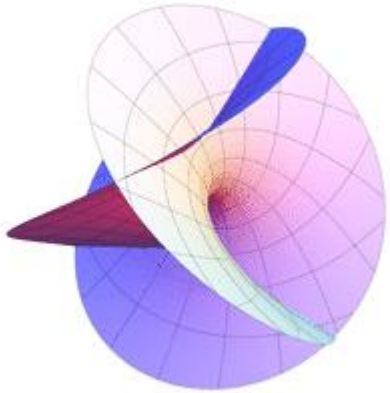
Understanding Georgia's K-12 Mathematics Standards



Georgia Department of Education

Mathematics Team

January 2023

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YOUR GADOE MATHEMATICS TEAM IS HERE TO SERVE YOU!

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Important Websites

Georgia Mathematics Program Updates:
www.gadoe.org/mathematics

Professional Learning Communities:
https://community.gadoe.org

Curriculum Resources:
www.georgiastandards.org

Professional Learning Conferences:
www.gadoe.org/mathcon

Learning Outcomes

- Overview of Georgia's K-12 Mathematics Standards
- Implementation Plan for 2023-2024

Important Details

As you engage with the new standards:

- Use the progressions, age appropriateness guardrails, decomposition of the standards through learning objectives or expectations, and evidence of student learning in all grade levels.
- Explore the embedded ways to help students master the fundamentals in numeracy development in K-5.
- Build relevant pathways through the big ideas to engage students based on a foundation of part-whole reasoning and flexible thinking.

Important Details

As you engage with students:

- Communicate flexibility in strategy selection or approach to solving mathematical problems.
- Promote the use of mathematical reasoning and sense-making through research-based, effective mathematics teaching practices in all grade levels and courses.
- Make mathematics learning fun and engaging while helping learners see the connection between mathematics and real-life phenomena.

Georgia's K-12 Mathematics Standards
Mathematics Big Ideas and Learning Progressions, K-12

<table>
<tr><th>K</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>HS Algebra: Concepts & Connections</th><th>HS Geometry: Concepts & Connections</th><th>HS Advanced Algebra: Concepts & Connections</th></tr>
<tr><td colspan="12">Mathematical Modeling (MM)</td></tr>
<tr><td colspan="12">Mathematical Practices (MP)</td></tr>
<tr><td colspan="12">Data & Statistical Reasoning (DSR)</td></tr>
<tr><td colspan="12">Numerical Reasoning (NR)</td></tr>
<tr><td colspan="12">Patterning & Algebraic Reasoning (PAR)</td></tr>
<tr><td colspan="12">Geometric & Spatial Reasoning (GSR)</td></tr>
<tr><td colspan="6">Measurement & Data Reasoning (MDR)</td><td colspan="6"></td></tr>
<tr><td colspan="8"></td><td colspan="4">Functional & Graphical Reasoning (FGR)</td></tr>
<tr><td colspan="7"></td><td colspan="2">Probability Reasoning (PR)</td><td colspan="2"></td><td colspan="2">Probabilistic Reasoning (PR)</td></tr>
</table>

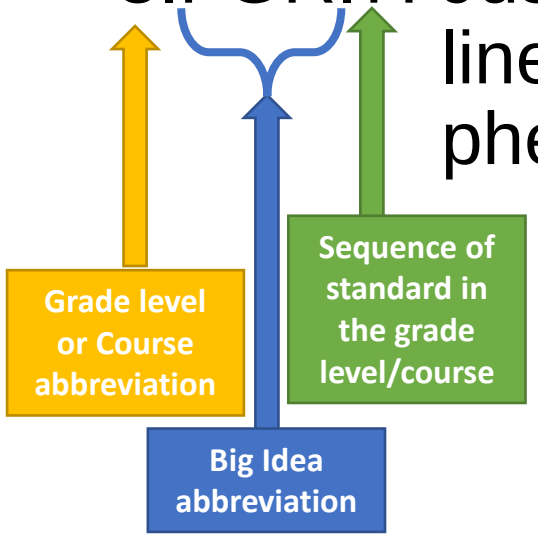
*The Big Ideas extend to High School 4th course options beyond Advanced Algebra: Concepts and Connections. These Big Ideas can be found within each course standards document.

Georgia's K-12 Mathematics Standards

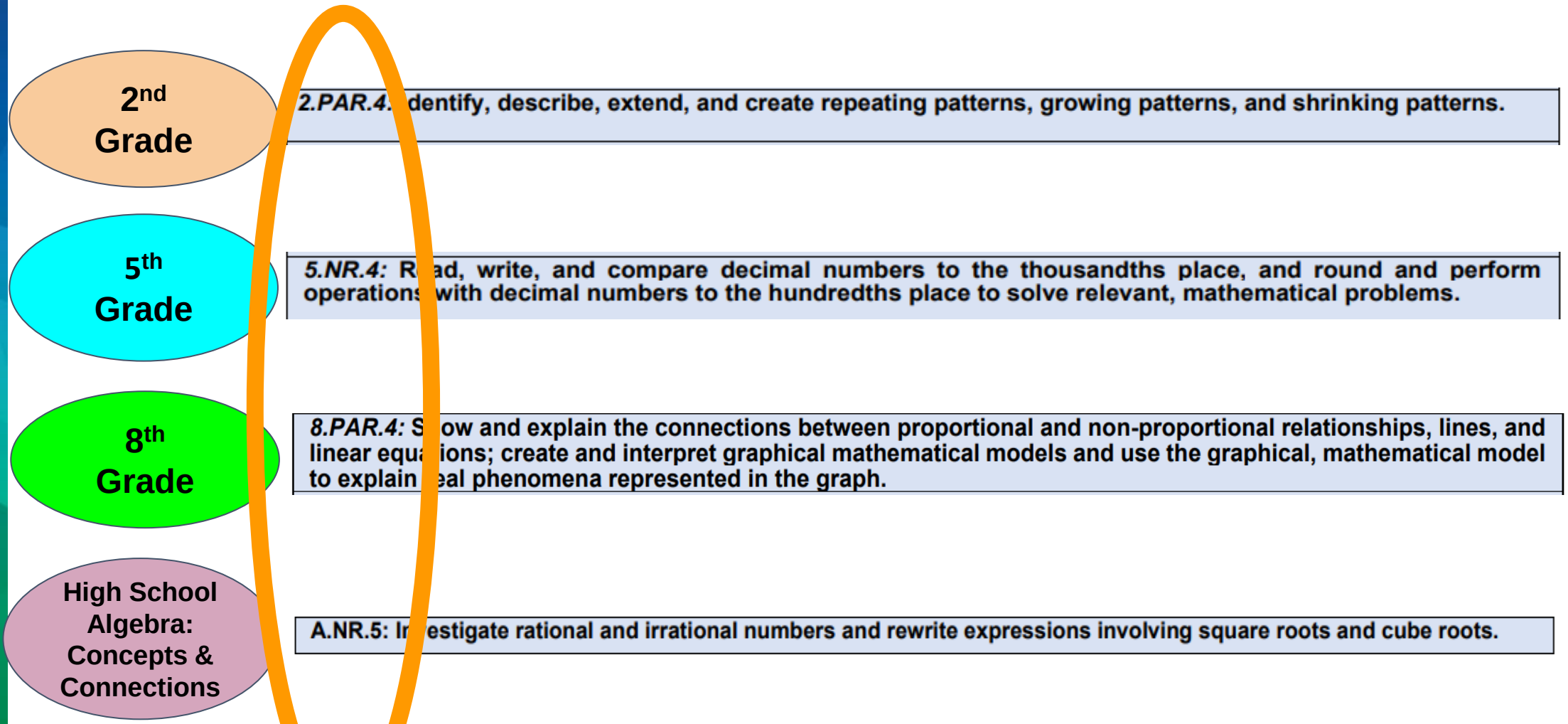
COURSE STANDARDS
A.MP: Display perseverance and patience in problem solving. Demonstrate skills and strategies needed to succeed in mathematics, including critical thinking, reasoning, and effective collaboration and expression. Seek help and apply feedback. Set and monitor goals.
A.MM.1: Apply mathematics to real-life situations; model real-life phenomena using mathematics.
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.
A.GSR.3: Solve problems involving distance, midpoint, slope, area, and perimeter to model and explain real-life phenomena.
A.PAR.4: Create, analyze, and solve linear inequalities in two variables and systems of linear inequalities to model real-life phenomena.
A.NR.5: Investigate rational and irrational numbers and rewrite expressions involving square roots and cube roots.
A.PAR.6: Build quadratic expressions and equations to represent and model real-life phenomena; solve quadratic equations in mathematically applicable situations.
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.
A.PAR.8: Create and analyze exponential expressions and equations to represent and model real-life phenomena; solve exponential equations in mathematically applicable situations.
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.
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.

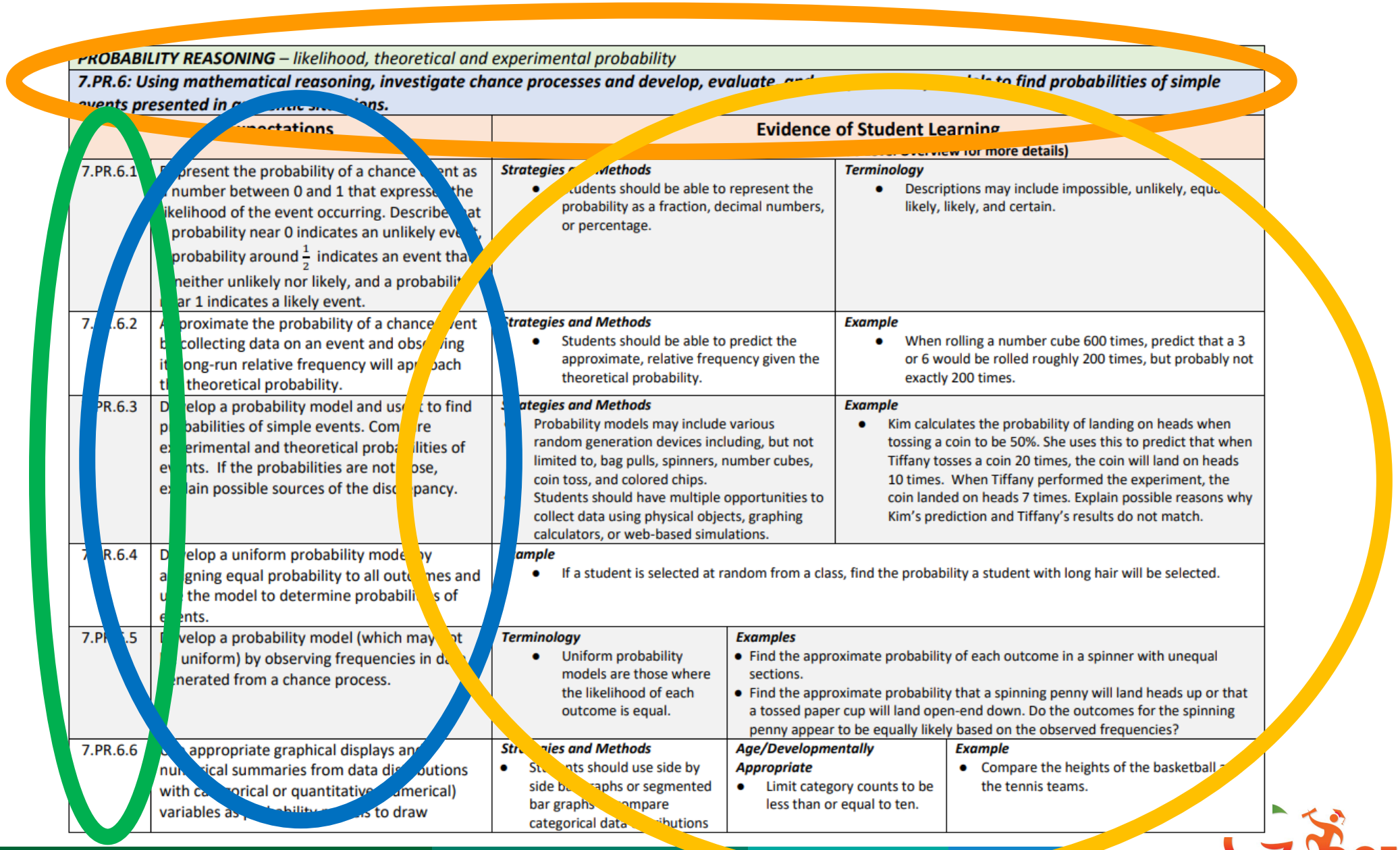
Coding/ Naming Convention

8.FGR.7: Justify and use various strategies to solve systems of linear equations to model and explain realistic phenomena.



Understanding the Standards Coding





PROBABILITY REASONING *– likelihood, theoretical and experimental probability*

7.PR.6: Using mathematical reasoning, investigate chance processes and develop, evaluate and ***to find probabilities of simple events presented in*** ***.***

Expectations		Evidence of Student Learning			
		(See Overview for more details)			
7.PR.6.1	Represent the probability of a chance event as a number between 0 and 1 that expresses the likelihood of the event occurring. Describe that a probability near 0 indicates an unlikely event, a probability around $\frac{1}{2}$ indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event.	***Strategies and Methods*** • Students should be able to represent the probability as a fraction, decimal numbers, or percentage.	***Terminology*** • Descriptions may include impossible, unlikely, equally likely, likely, and certain.		
7.PR.6.2	Approximate the probability of a chance event by collecting data on an event and observing its long-run relative frequency will approach the theoretical probability.	***Strategies and Methods*** • Students should be able to predict the approximate, relative frequency given the theoretical probability.	***Example*** • When rolling a number cube 600 times, predict that a 3 or 6 would be rolled roughly 200 times, but probably not exactly 200 times.		
7.PR.6.3	Develop a probability model and use it to find probabilities of simple events. Compare experimental and theoretical probabilities of events. If the probabilities are not close, explain possible sources of the discrepancy.	***Strategies and Methods*** Probability models may include various random generation devices including, but not limited to, bag pulls, spinners, number cubes, coin toss, and colored chips. Students should have multiple opportunities to collect data using physical objects, graphing calculators, or web-based simulations.	***Example*** • Kim calculates the probability of landing on heads when tossing a coin to be 50%. She uses this to predict that when Tiffany tosses a coin 20 times, the coin will land on heads 10 times. When Tiffany performed the experiment, the coin landed on heads 7 times. Explain possible reasons why Kim's prediction and Tiffany's results do not match.		
7.PR.6.4	Develop a uniform probability model by assigning equal probability to all outcomes and use the model to determine probabilities of events.	***Example*** • If a student is selected at random from a class, find the probability a student with long hair will be selected.			
7.PR.6.5	Develop a probability model (which may not be uniform) by observing frequencies in data generated from a chance process.	***Terminology*** • Uniform probability models are those where the likelihood of each outcome is equal.	***Examples*** • Find the approximate probability of each outcome in a spinner with unequal sections. • Find the approximate probability that a spinning penny will land heads up or that a tossed paper cup will land open-end down. Do the outcomes for the spinning penny appear to be equally likely based on the observed frequencies?		
7.PR.6.6	Use appropriate graphical displays and numerical summaries from data distributions with categorical or quantitative (numerical) variables as appropriate to draw	***Strategies and Methods*** • Students should use side by side bar graphs or segmented bar graphs to compare categorical data distributions	***Age/Developmentally Appropriate*** • Limit category counts to be less than or equal to ten.	***Example*** • Compare the heights of the basketball to the tennis teams.	

Competency-Based/Clustering Instructional Approach

GRADE 5

Semester 1
Unit 1: Investigating Volume of Solid Figures (2 - 3 weeks)
Big Ideas: Geometric & Spatial Reasoning and Numerical Reasoning
Standards Addressed in this Unit: ***5.GSR.8: Examine properties of polygons and rectangular prisms, classify polygons by their properties, and discover volume of right rectangular prisms.*** ***5.NR.5: Write, [illegible] and evaluate numerical expressions with [illegible] problems.***
Suggested Clusters of Concepts (Learning Objectives)
5.GSR.8.3 Investigate volume of right rectangular prisms by packing them with unit cubes without gaps or overlaps. Then, determine the total volume to solve problems.
5.GSR.8.4 Discover and explain how the volume of a right rectangular prism can be found by multiplying the area of the base times the height to solve real-life, mathematical problems.
5.NR.5.1 Write, [illegible] to simple numerical expressions involving whole [illegible] without grouping symbols to represent real-life situations.

Mathematical Practices (5.MP.1- 8) should be evidenced at some point throughout each unit depending on the tasks that are explored. It is important to note that MPs 1, 3 and 6 should support the learning in every lesson.

- For instructional purposes, the learning objectives are not intended to be taught as an isolated checklist, but rather as a cluster within the standard.
- Ultimately, students must show mastery of the overall standard/key competency for the grade level.

Instructional Resources and Supports for Georgia's K-12 Mathematics Standards

ESSENTIAL INSTRUCTIONAL GUIDANCE

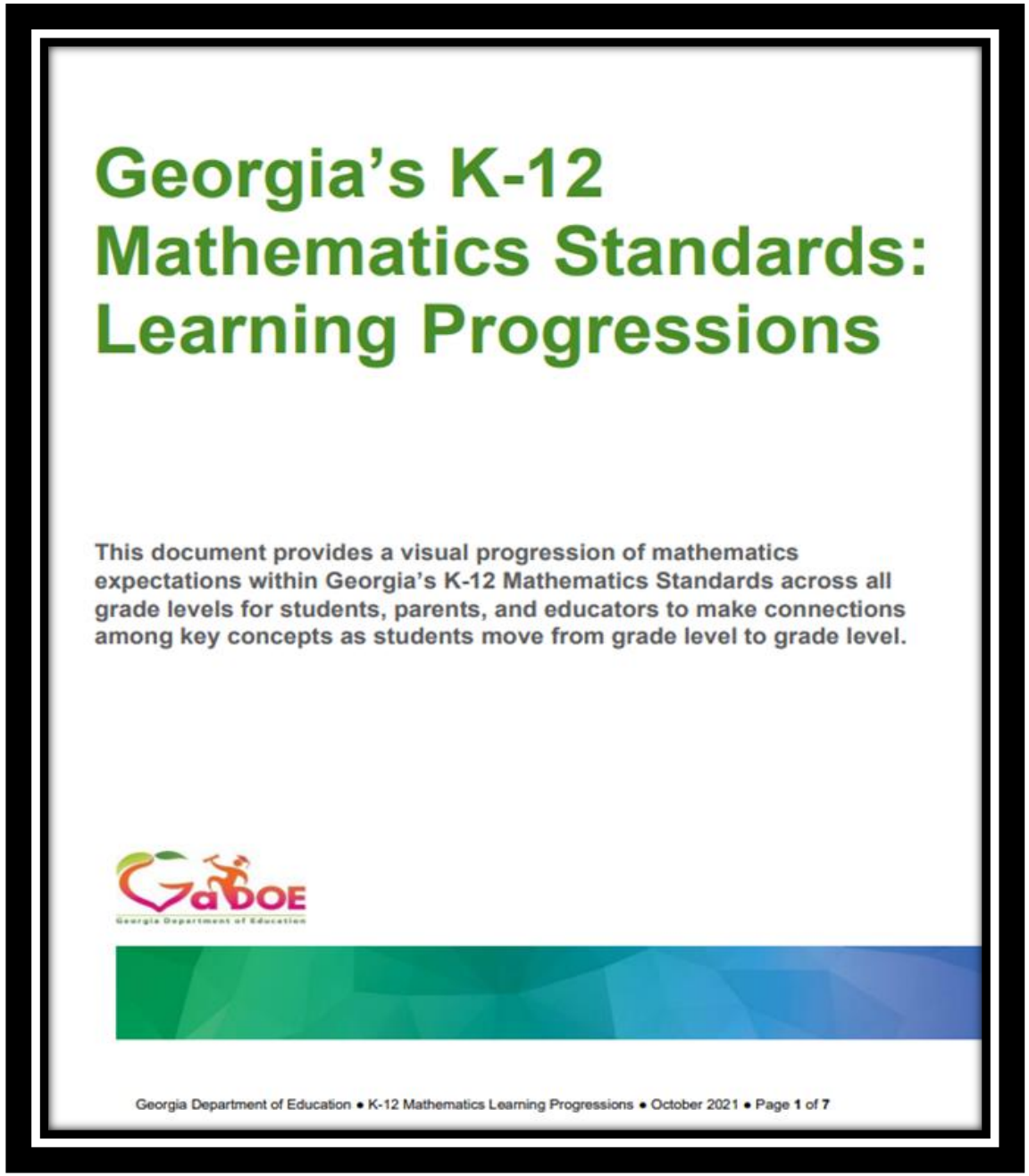
- Mathematical Practices
- Mathematical Modeling
- Framework for Statistical Reasoning
- Computational Strategies for Whole Numbers

Instructional Resources

KEY HIGHLIGHTS

- Mathematical Modeling Continuum
- Statistical Reasoning, Mathematical Practices, and Mathematical Modeling embedded throughout
- Interdisciplinary Connections and Support for all grade levels
- Capstone Units included for all grade levels and courses
- New enhanced courses added for middle and high school

  (providing open access to pathways that allow for AP Statistics, AP Calculus, and advanced college Calculus options for any interest student aligned to assessment and accountability requirements)


Georgia's K-12 Mathematics Standards: Learning Progressions
This document provides a visual progression of mathematics expectations within Georgia's K-12 Mathematics Standards across all grade levels for students, parents, and educators to make connections among key concepts as students move from grade level to grade level.
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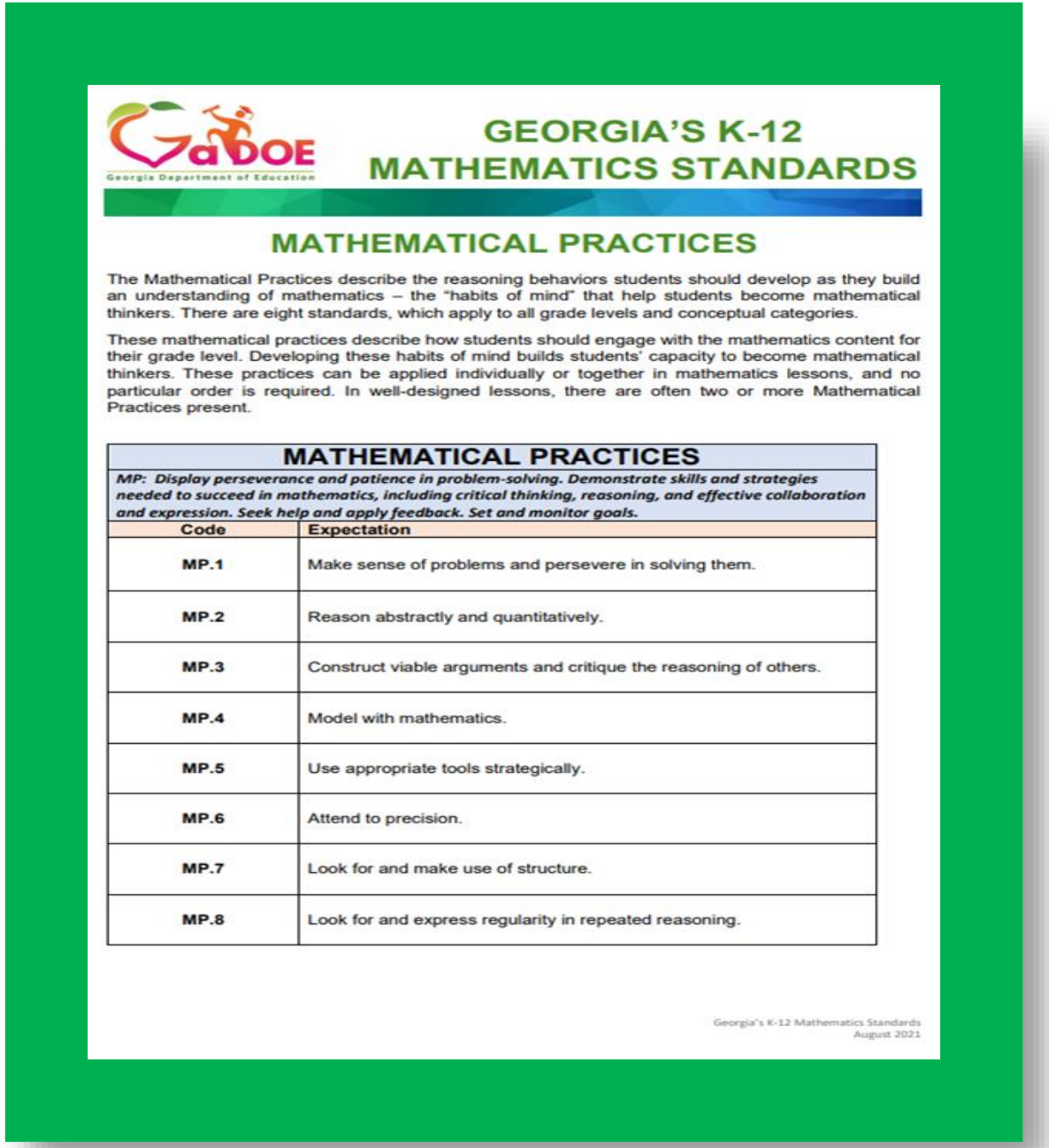
Georgia Department of Education • K-12 Mathematics Learning Progressions • October 2021 • Page 1 of 7



GEORGIA'S K-12 MATHEMATICS STANDARDS

MATHEMATICAL PRACTICES

The Mathematical Practices describe the reasoning behaviors students should develop as they build an understanding of mathematics – the "habits of mind" that help students become mathematical thinkers. There are eight standards, which apply to all grade levels and conceptual categories.

These mathematical practices describe how students should engage with the mathematics content for their grade level. Developing these habits of mind builds students' capacity to become mathematical thinkers. These practices can be applied individually or together in mathematics lessons, and no particular order is required. In well-designed lessons, there are often two or more Mathematical Practices present.

MATHEMATICAL PRACTICES	
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.	
Code	**Expectation**
MP.1	Make sense of problems and persevere in solving them.
MP.2	Reason abstractly and quantitatively.
MP.3	Construct viable arguments and critique the reasoning of others.
MP.4	Model with mathematics.
MP.5	Use appropriate tools strategically.
MP.6	Attend to precision.
MP.7	Look for and make use of structure.
MP.8	Look for and express regularity in repeated reasoning.

Georgia's K-12 Mathematics Standards
August 2021

8 Mathematical Practices (K-12 Habits of Mind for Mathematics)

COMPUTATIONAL STRATEGIES FOR WHOLE NUMBERS

Mathematics Place-Value Strategies and US Traditional Algorithms

Specific mathematics strategies for teaching and learning are not mandated by the Georgia Department of Education or assessed on state or federally mandated tests. Students may 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-makes sense to them. It is critical that teachers and parents remain partners to help each child grow to become a mathematically literate citizen. These standards preserve and affirm local control and flexibility.

In mathematics, the emphasis is on the reasoning and thinking about the quantities within mathematical contexts. Algorithms, tape diagrams (bar models), and number line representations are a few examples of ways that students communicate their strategic thinking in a written form.

Addition Example: 1573 + 796

US Traditional Algorithm:

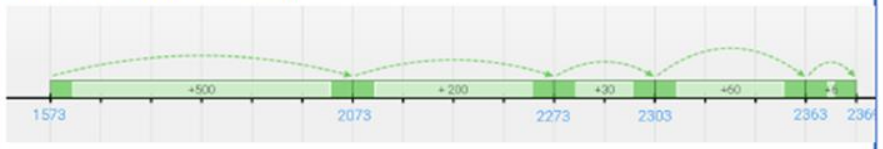
$$\begin{array}{r} {\scriptstyle 1\ \ 1\ \ \ \ } \\ 1\ 5\ 7\ 3 \\ +\ \ 7\ 9\ 6 \\ \hline 2\ 3\ 6\ 9 \end{array}$$

Description:
As students make sense of and use addition strategies and algorithms, it is important for them to be given the flexibility to use a part-whole strategy such as place value partitioning, adding on in parts, estimation and compensation, and friendly numbers to communicate their thinking using a written recording of that strategy that is most comfortable for and makes sense to them. Students should be able to demonstrate a deep understanding of the relationship between the quantities presented in the mathematics number sentence and to attend to precision in their explanations. Flexibility in thinking is key!

Place Value Algorithm:

$$\begin{array}{r} 1\ 5\ 7\ 3 \\ +\ \ \ 7\ 9\ 6 \\ \hline \ \ \ \ \ \ 9 \\ +\ \ \ 1\ 6\ 0 \\ +\ 1\ 2\ 0\ 0 \\ +\ 1\ 0\ 0\ 0 \\ \hline 2\ 3\ 6\ 9 \end{array}$$

Number Line Representation:



It is important to note that the examples of strategies provided in the tables are not all inclusive. Students may 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 makes sense to them.

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Mathematical Modeling Framework (K-12)

MATHEMATICAL MODELING

Teaching students to model with mathematics is engaging, builds confidence and competence, and gives students the opportunity to collaborate and make sense of the world around them, the main reason for doing mathematics. For these reasons, mathematical modeling should be incorporated at every level of a student's education. This is important not only to develop a deep understanding of mathematics itself, but more importantly to give students the tools they need to make sense of the world around them. Students who engage in mathematical modeling will not only be prepared for their chosen career but will also learn to make informed daily life decisions based on data and the models they create.

The diagram below is a mathematical modeling framework depicting a cycle of how students can engage in mathematical modeling when solving a realistic problem or task.

A Mathematical Modeling Framework

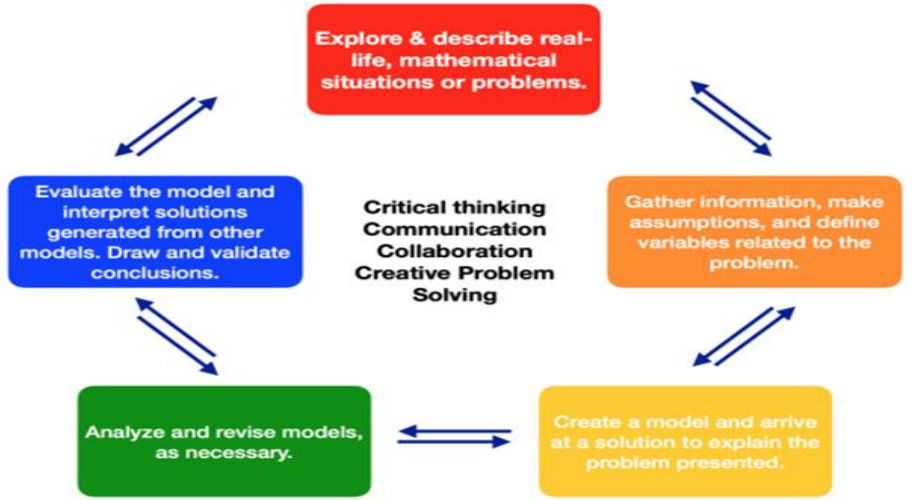


Image adapted from: Suh, Matson, Seshaiyer, 2017

Framework for Statistical Reasoning (K-12)

Framework for Statistical Reasoning

Statistical reasoning is important for learners to engage as citizens and professionals in a world that continues to change and evolve. Humans are naturally curious beings and statistics is a language that can be used to better answer questions about personal choices and/or make sense of naturally occurring phenomena. Statistics is a way to ask questions, explore, and make sense of the world around us.

The Framework for Statistical Reasoning should be used in all grade levels and courses to guide learners through the sense-making process, ultimately leading to the goal of statistical literacy in all grade levels and courses. Reasoning with statistics provides a context that necessitates the learning and application of a variety of mathematical concepts.

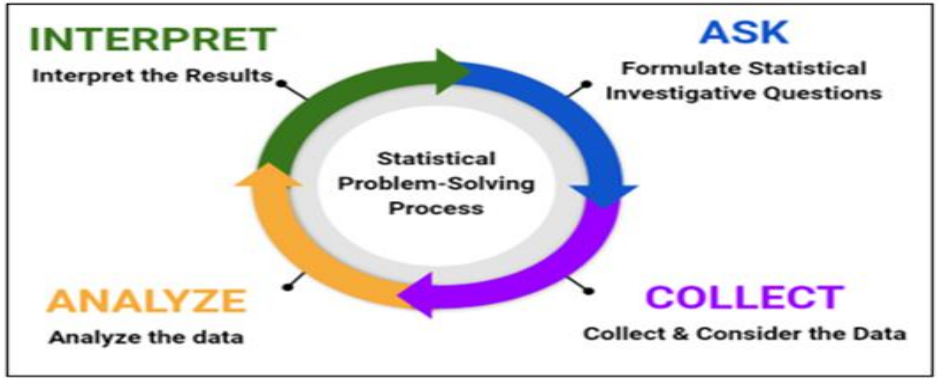


Figure 1: Georgia Framework for Statistical Reasoning

The following four-step statistical problem-solving process can be used throughout each grade level and course to help learners develop a solid foundation in statistical reasoning and literacy:

I. **Formulate Statistical Investigative Questions**
Ask questions that anticipate variability.

II. **Collect & Consider the Data**
Ensure that data collection designs acknowledge variability.

III. **Analyze the Data**
Make sense of data and communicate what the data mean using pictures (graphs) and words. Give an accounting of variability, as appropriate.

IV. **Interpret the Results**
Answer statistical investigative questions based on the collected data.

EXPLORE & DESCRIBE REAL-LIFE, MATHEMATICAL SITUATIONS OR PROBLEMS.

ASK

Formulate Statistical Investigative Questions

Gather information, make assumptions, and define variables related to the problem.

COLLECT

Collect & Consider the Data

Create a model and arrive at a solution to explain the problem presented.

ANALYZE

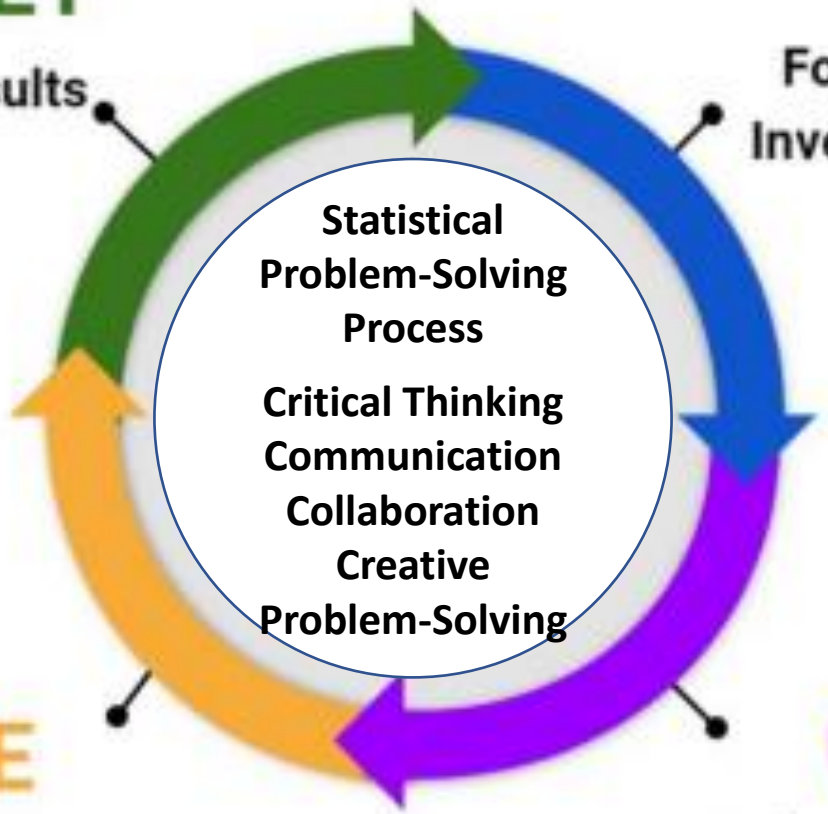
Analyze the data

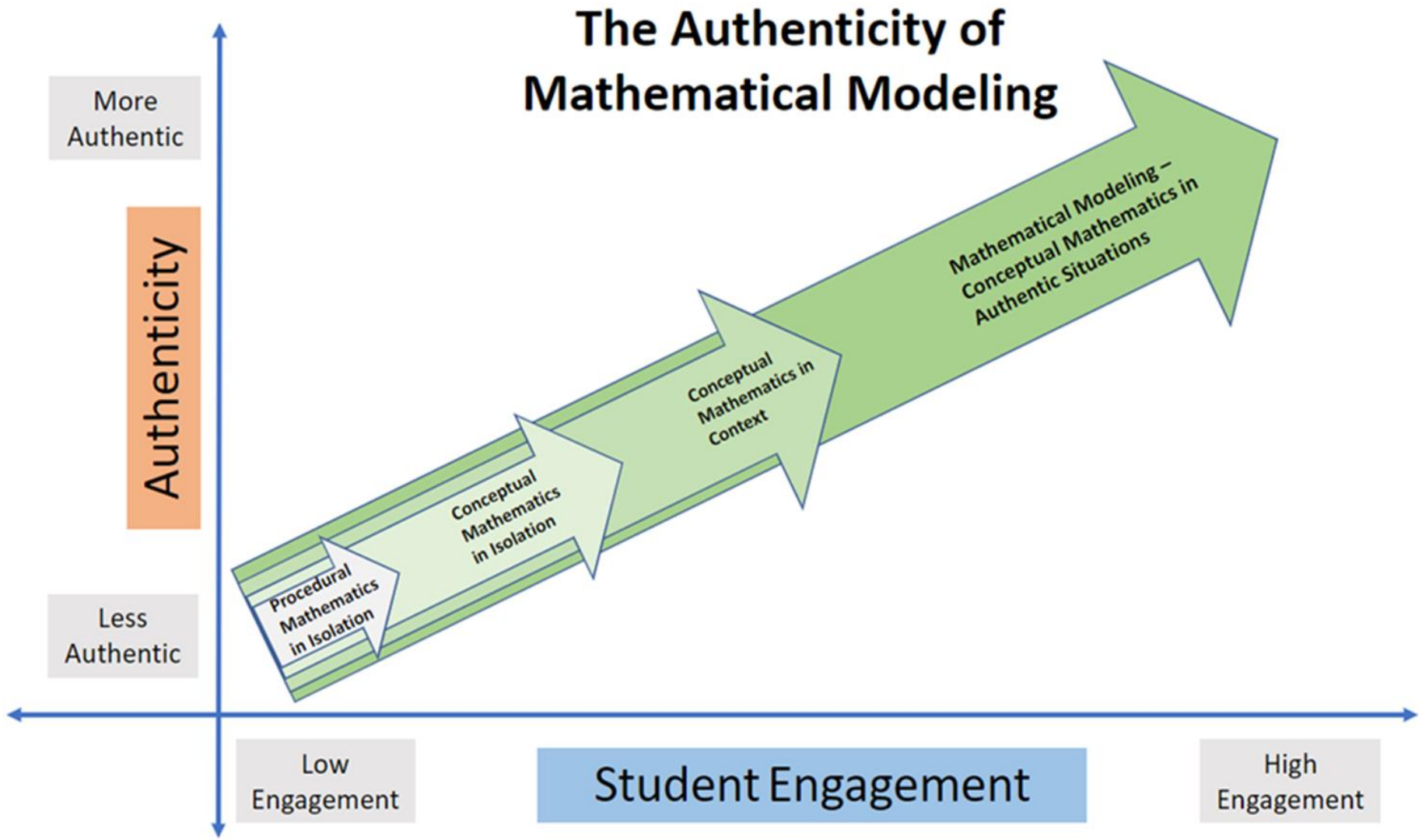
Analyze and revise models, as necessary.

INTERPRET

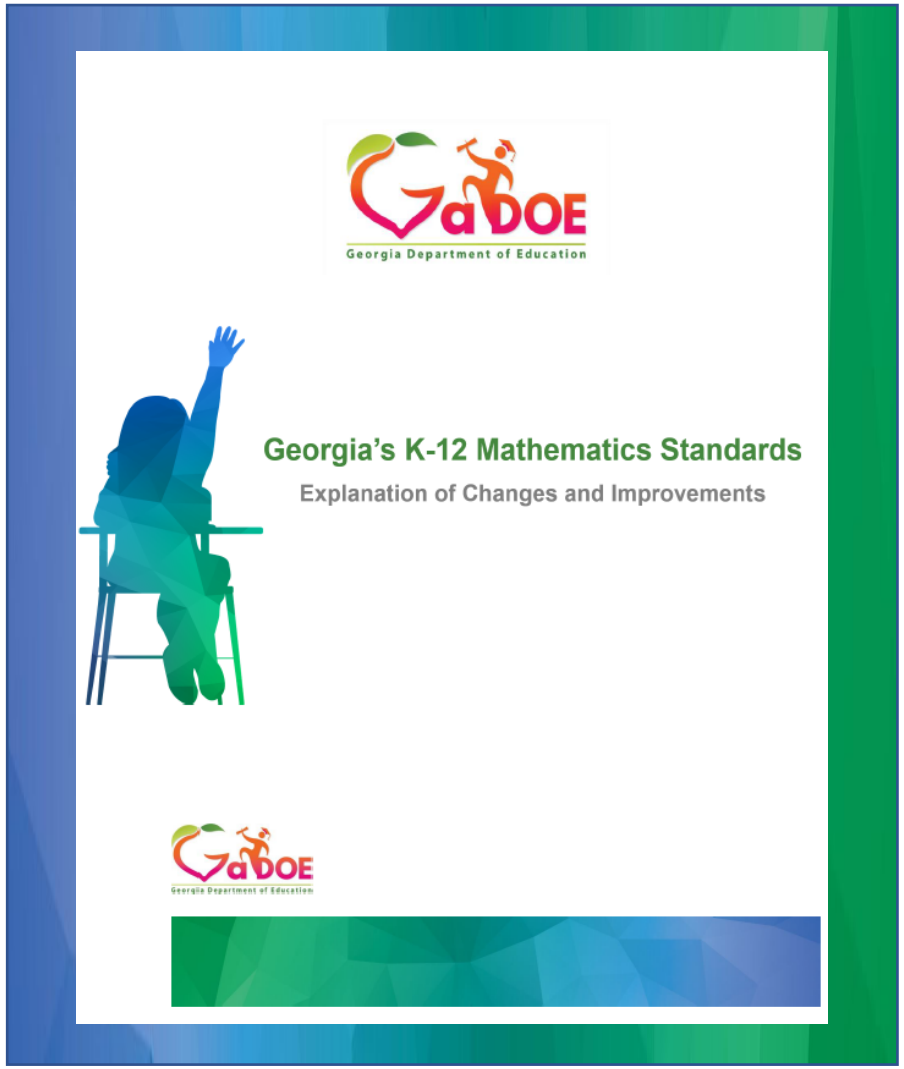
Interpret the Results

Evaluate the model and interpret solutions generated from other models. Draw and validate conclusions.

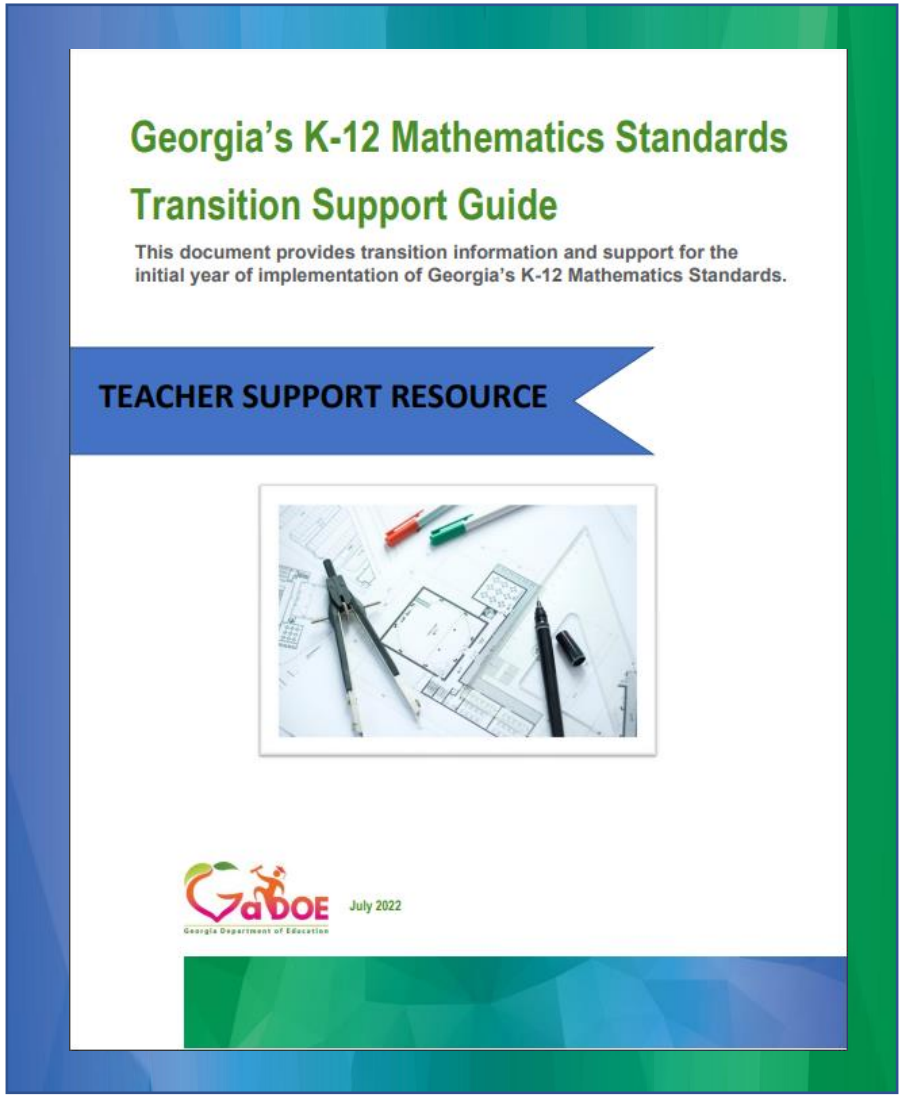



The Authenticity of Mathematical Modeling
More Authentic
Authenticity
Less Authentic
Procedural Mathematics in Isolation
Conceptual Mathematics in Isolation
Conceptual Mathematics in Context
Mathematical Modeling – Conceptual Mathematics in Authentic Situations
Low Engagement
Student Engagement
High Engagement

Explanation of Changes



Transition Document



Instructional Resources

Available Now!

The following resources are available for all grade levels and courses aligned to Georgia's K-12 Mathematics Standards:

- Explanation of Changes and Improvements
- K-12 Progressions
- Curriculum Maps
- Guidance for Acceleration and Support
- Transitions Resource
- Machine Readable Standards in SuitCASE
- Comprehensive Grade-Level or Course Overviews
- K-12 Interactive Instructional Frameworks Units
- Digital Learning Plans
- K-12 Mathematics Glossary
- Supports for Numeracy Development
- K-12 Mathematical Practices
- Mathematical Modeling Framework
- Framework for Statistical Reasoning
- Mathematical Modeling Continuum
- Supports for Learner Variability
- Instructional Support Guide for Multi-lingual Learners

Instructional Resources

The following resources will be available soon for all grade levels and courses aligned to Georgia's K-12 Mathematics Standards:

- Professional Learning Videos *(each standard and other key topics)*
- Newly Aligned State Assessments and Resources
- K-12 Parent Letters, in Multiple Languages
- Whole Child Mathematics Supports Resource Toolkit
- K-12 Interactive Instructional Frameworks Units

New K-12 Mathematics Glossary

Georgia's K-12 Mathematics Standards

K-12 Mathematics Glossary

How to Use this Glossary

Get Started

Richard Woods, Georgia's School Superintendent | Georgia Department of Education | *Educating Georgia's Future*

GaDOE Georgia Department of Education

Georgia's New K-12 Mathematics Standards Curriculum Maps

IMPLEMENTATION 2023-2024 SCHOOL YEAR

Georgia Department of Education

Georgia's New K-12 Mathematics Standards Grade Level and Course Overviews

IMPLEMENTATION 2023-2024 SCHOOL YEAR

- K-12 Mathematical Practices
- K-12 Mathematical Modeling Framework
- K-12 Statistical Reasoning Framework
- Whole Child Supports for Learner Variability

ELEMENTARY (K-5)

- KINDERGARTEN
- FIRST GRADE
- SECOND GRADE
- THIRD GRADE
- FOURTH GRADE
- FIFTH GRADE

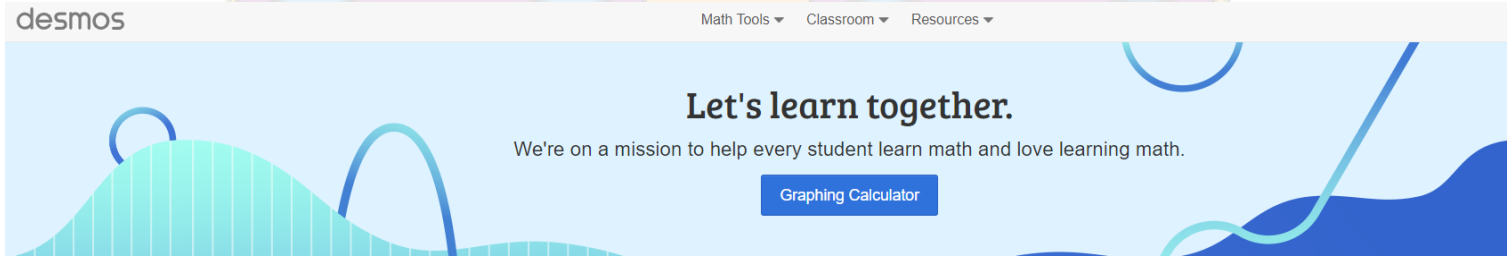
MIDDLE (6-8)

- SIXTH GRADE
- SEVENTH GRADE
- EIGHTH GRADE
- ENHANCED ALGEBRA: CONCEPTS & CONNECTIONS

HIGH (9-12)

- ALGEBRA: CONCEPTS & CONNECTIONS
- GEOMETRY: CONCEPTS & CONNECTIONS
- ADVANCED ALGEBRA: CONCEPTS & CONNECTIONS
- ENHANCED ADVANCED ALGEBRA & PRECALCULUS: CONCEPTS & CONNECTIONS
- HIGH SCHOOL FOURTH COURSE OPTIONS

New State Assessment Calculator Policy Georgia



New for Spring 2023 & beyond

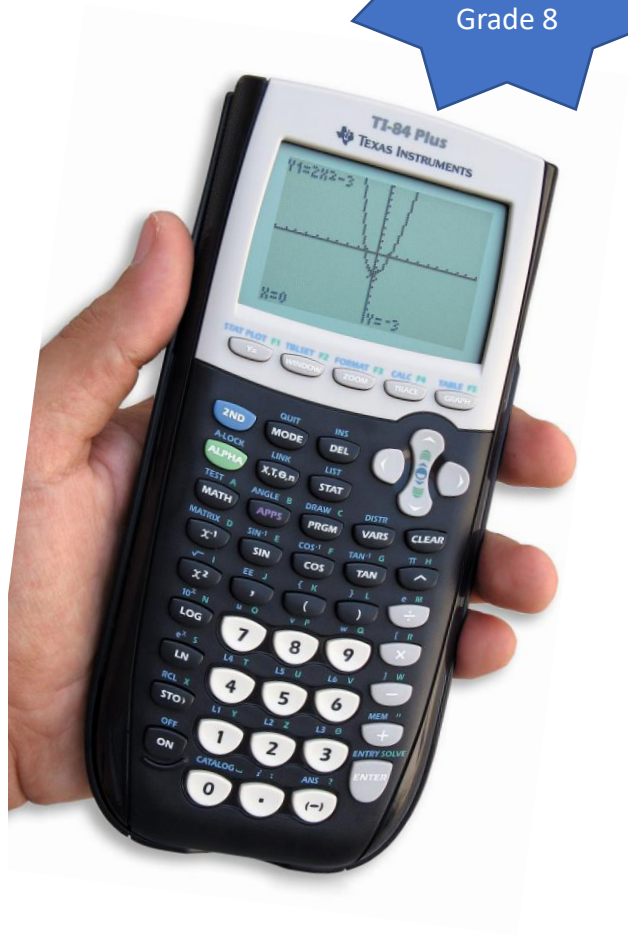
Scientific new for Grade 6

NEW CALCULATOR POLICY

- Allowable Calculators – End of Grade
  - Grades 3-5 – No Calculators Allowed
  - Grades 6-7 – Scientific or basic four-function calculator with square root and percentage functions allowed
  - Grade 8 – Graphing calculator or Scientific
  - HS Physical Science (Grade 8 only) – Scientific or basic calculator with square root and percentage functions allowed
- Allowable Calculators – End of Course
  - Coordinate Algebra – Graphing calculator or Scientific
  - Algebra I – Graphing calculator or Scientific

All grades 6 – high school test takers should receive training in the use of the online Desmos Calculator embedded in the practice tests or at https://www.desmos.com/testing/Georgia.

Graphing new for Grade 8



Personalized Mathematics Pathways: Opportunities for ALL Georgia Students

- Open access and opportunities for all pathways for all students
- Prepares students for any path they choose aligned with their unique college and career goals
- Includes secondary courses for support and enhancement
- Multiple entry points with on-ramps and off-ramps for learners
- Enhanced mathematics learning options for all learners

Personalized Mathematics Pathways Information

Mathematics Graduation Requirements for High School

First Three Required Courses

Algebra: Concepts & Connections *(or the equivalent)*

OR

Enhanced Algebra: Concepts & Connections*

Geometry: Concepts & Connections *(or the equivalent)*

Advanced Algebra: Concepts & Connections *(or the equivalent)*

OR

Enhanced Advanced Algebra and AP Precalculus: Concepts & Connections

4th Core Mathematics Course

**This course is an equivalent course to high school Algebra: Concepts and Connections for eligible Grade 8 students.*

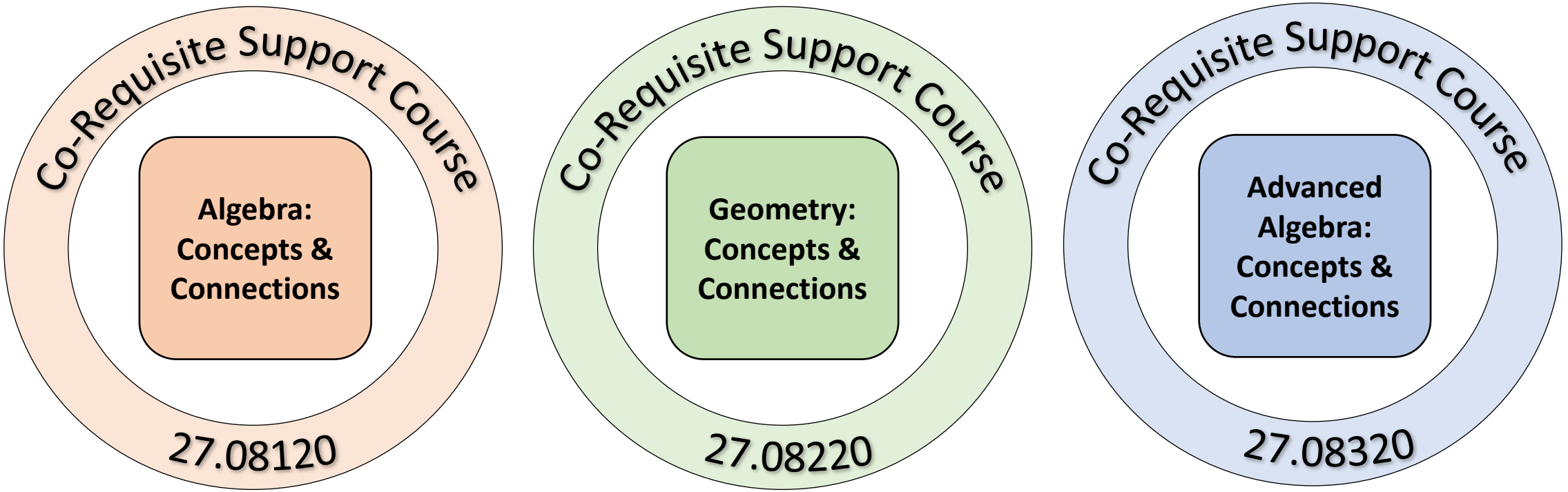
4th Mathematics Course Options

- AP Statistics
- Statistical Reasoning
- Computer Science Courses*
- Precalculus
  - Linear Algebra with Computer Science Applications
  - Calculus
    - History of Mathematics (elective credit ONLY)
    - Multivariable Calculus
    - Differential Equations
    - Engineering Calculus
  - AP Calculus AB
  - AP Calculus BC
- Advanced Finite Mathematics
- Advanced Mathematical Decision Making
- Mathematics of Industry and Government
- Mathematics Capstone Course
- Advanced Financial Algebra
- Approved Dual Enrollment Courses

Fourth mathematics course options may be taken simultaneously once the prerequisite for each course is satisfied.

- **Multiple options for 4th core mathematics courses**
- **Co-Requisite Support courses offered, as needed**

Co-Requisite Support Courses



- The co-requisite support courses are offered for students, as needed, based on local school or district selection criteria.
- The co-requisite support courses are not stand-alone courses; these courses assist students as they work to earn the required core course credit.
- Co-Requisite support courses may be taken in conjunction with the core mathematics courses they are paired
- These co-requisite support courses provide teachers with additional time to implement wraparound interventions and supports for students in real time as the students are learning the standards in the core course required for graduation.

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Acceleration in Mathematics using Gifted Services Model

- Acceleration at every grade level, K-12, with the gifted services model
- Alignment with the gifted model and definition of acceleration
- Alignment with the federal expectations of assessment and accountability
- New enhanced mathematics courses that are open-access for students interested in pursuing higher levels of mathematics

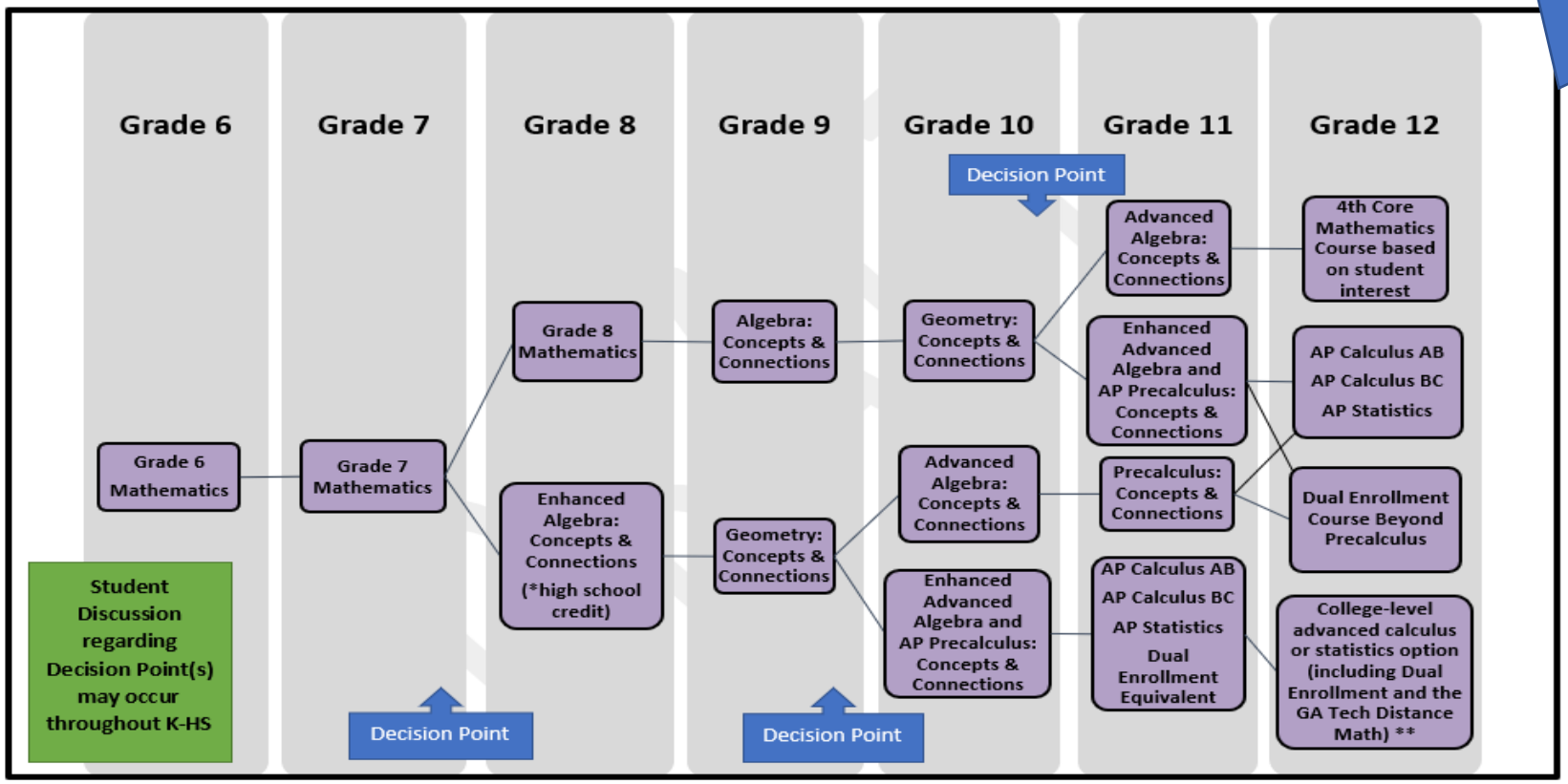
Personalized Pathways for Students interested in Advanced Calculus Options in High School

Open Access for **ANY** interested student

NOTE:
Local Districts have the flexibility to create additional pathways that support student success based on the needs in their individual districts.

Personalized, Student-Centered Decision Points

Georgia's K-12 Mathematics Standards
Open Access Pathways for Middle and High School



Open Access Secondary Mathematics Pathways

***AP Calculus BC is required for the Georgia Tech Distance Mathematics Program.*

Offering a holistic education to each and every child in our state.

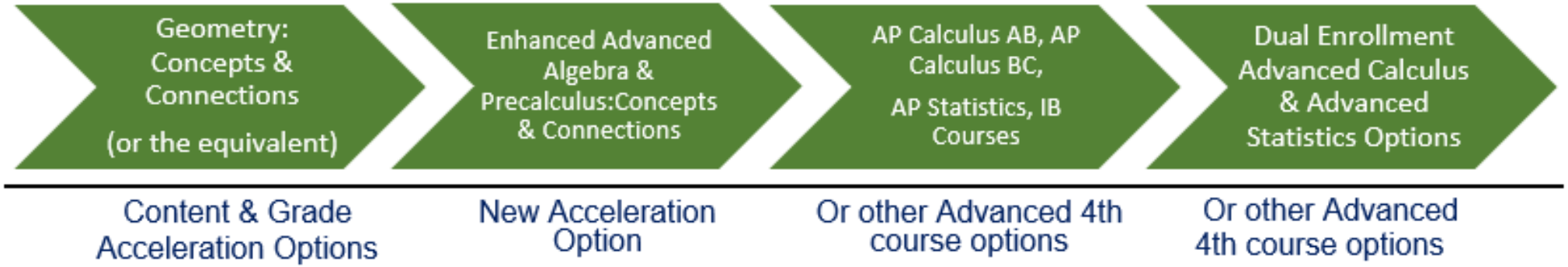
NEW

High School Enhanced Course

A new course blending option has been made available for advanced learners that includes Enhanced Advanced Algebra and Precalculus: Concepts and Connections starting in 2023-2024. All learners should have the opportunity to enroll in support courses and advanced placement mathematics courses at the high school level based on their course-taking patterns at the middle school level. All options should be made available for all students.

High School Acceleration

(Local districts may add additional options, as needed.)



***Local school districts maintain the flexibility to offer courses that best meet the needs of students in their school communities.**

New Staying on Course Guidance

- The University System of Georgia and the Georgia Department of Education have partnered to revise the Staying on Course document to align with the new courses implemented as a result of the newly adopted standards.

New Course Numbers (available in SuitCASE)

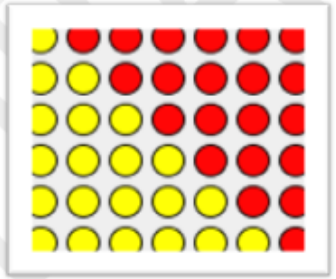
New Instructional Units

Grade 7

Unit 1:

Making Relevant Connections within the Number System

Students will build upon understandings of rational numbers to ultimately formalize rules for basic arithmetic operations (addition, subtraction, multiplication, and division) with rational numbers.



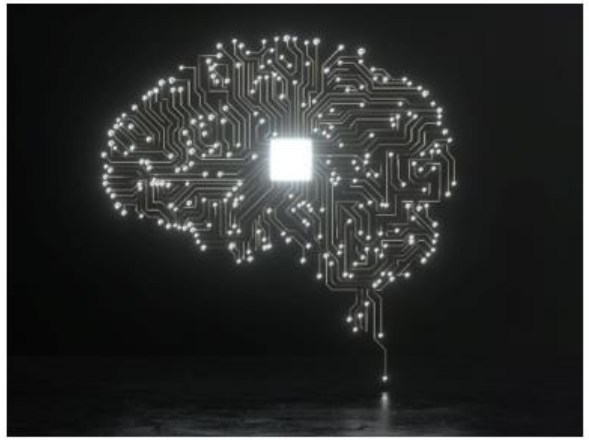
MATHEMATICS

Model Interdisciplinary PBL

Interdisciplinary Model Unit

Unit 5: Probability on the Farm

In this unit, students will explore probability and selective breeding. Students will develop probability models that allow them to predict the possible outcomes of crosses in a selective breeding program.



Instructional Design

Engage

Real World Hook/ Introduction

How will you engage the students?

What is the real world “hook” that will intrigue their interest?

Explore

Student Engagement through Process Based Thinking

What will students be asked to do in each step of process-based thinking? What will students write and/or draw in journals for each step?

How will students connect new information to what they already know?

In what ways will the student engagement allow for open-ended exploration and inquiry?

Apply

Student Presentation

How will students share their findings?

What form of presentation will they use?

Which community partners might provide feedback?

Reflect

Student Reflection

How will students summarize their efforts in this unit and pose questions that will lead to the next one?

Instructional Design

- **Engage**

(Includes an evidence-based instructional strategy and learning task that can be used as an introduction that mentally engages students to capture their interest, provides an opportunity to communicate what they know, and allows them to connect what they know to new ideas)

  - **Includes suggestions for Synchronous, Asynchronous, Unplugged/ Offline learning.**

- **Explore**

(Includes an evidence-based instructional strategy and learning task that allows students to engage in hands-on activities to explore the new concept/big idea at a deep level)

  - **Includes suggestions for Synchronous, Asynchronous, Unplugged/ Offline learning.**

- **Apply**

(Includes an evidence-based instructional strategy and learning task that allows students to apply what they have learned in a new situation to develop a deeper understanding of the big idea)

  - **Includes suggestions for Synchronous, Asynchronous, Unplugged/ Offline learning.**

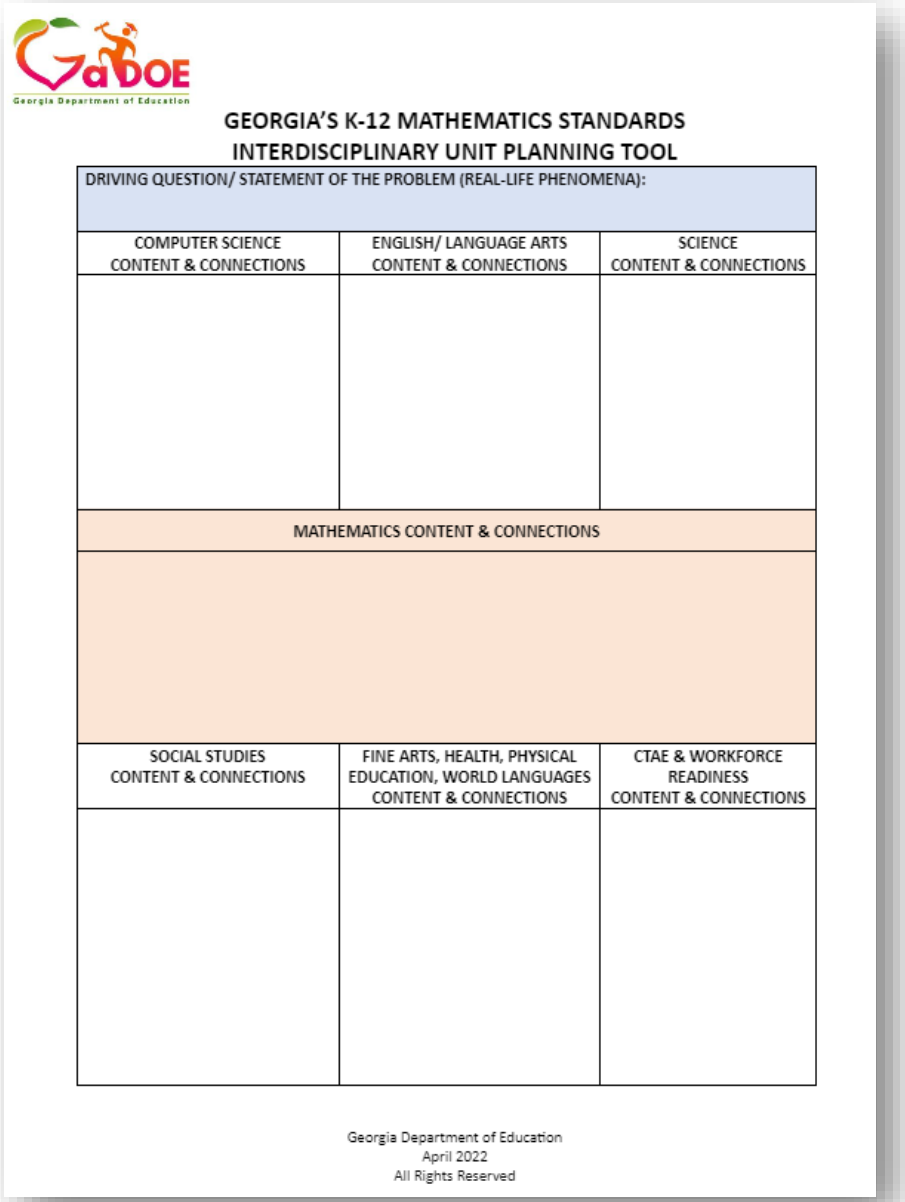
- **Reflect**

(Includes an evidence-based instructional strategy and learning task that allows students the opportunity to review and reflect on their own learning and new understandings)

  - **Includes suggestions for Synchronous, Asynchronous, Unplugged/ Offline learning.**

Customized for School Community and Needs

All content areas connected to the mathematics standards to provide inspiration for teachers to implement interdisciplinary instruction.



GEORGIA'S K-12 MATHEMATICS STANDARDS
INTERDISCIPLINARY UNIT PLANNING TOOL

DRIVING QUESTION/ STATEMENT OF THE PROBLEM (REAL-LIFE PHENOMENA):		
COMPUTER SCIENCE CONTENT & CONNECTIONS	ENGLISH/ LANGUAGE ARTS CONTENT & CONNECTIONS	SCIENCE CONTENT & CONNECTIONS
MATHEMATICS CONTENT & CONNECTIONS		
SOCIAL STUDIES CONTENT & CONNECTIONS	FINE ARTS, HEALTH, PHYSICAL EDUCATION, WORLD LANGUAGES CONTENT & CONNECTIONS	CTAE & WORKFORCE READINESS CONTENT & CONNECTIONS

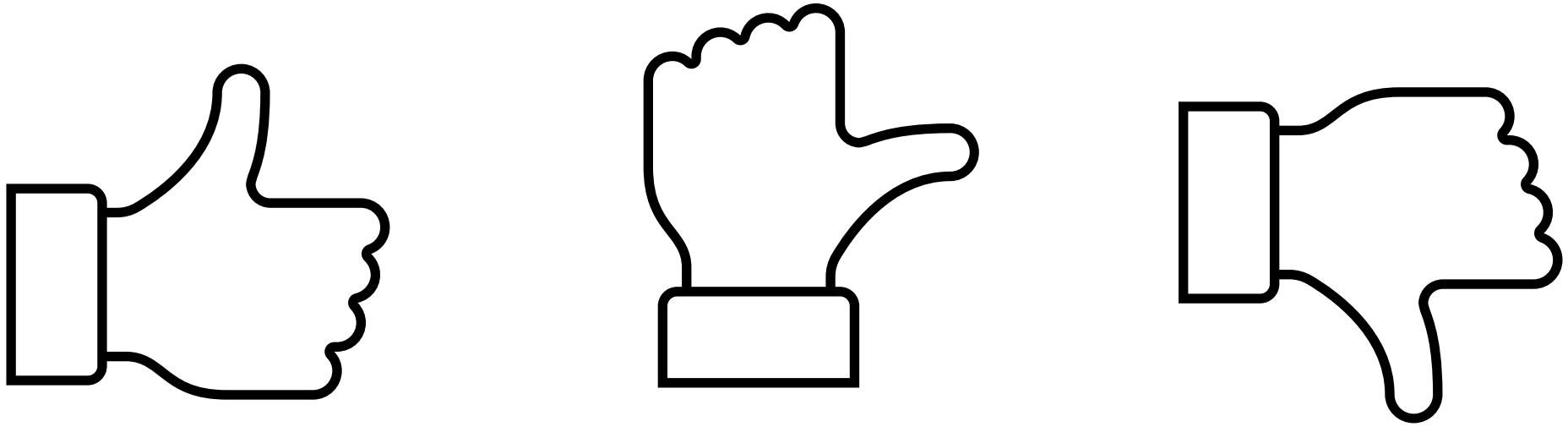
Interdisciplinary approaches to teaching and learning

Strong connections with mathematical modeling

Student Learning Supports

Addressing Learning Variability

Always, Sometimes, Never



Always, Sometimes, Never

All students have needs that are academic and non-academic.

All students are general education students.

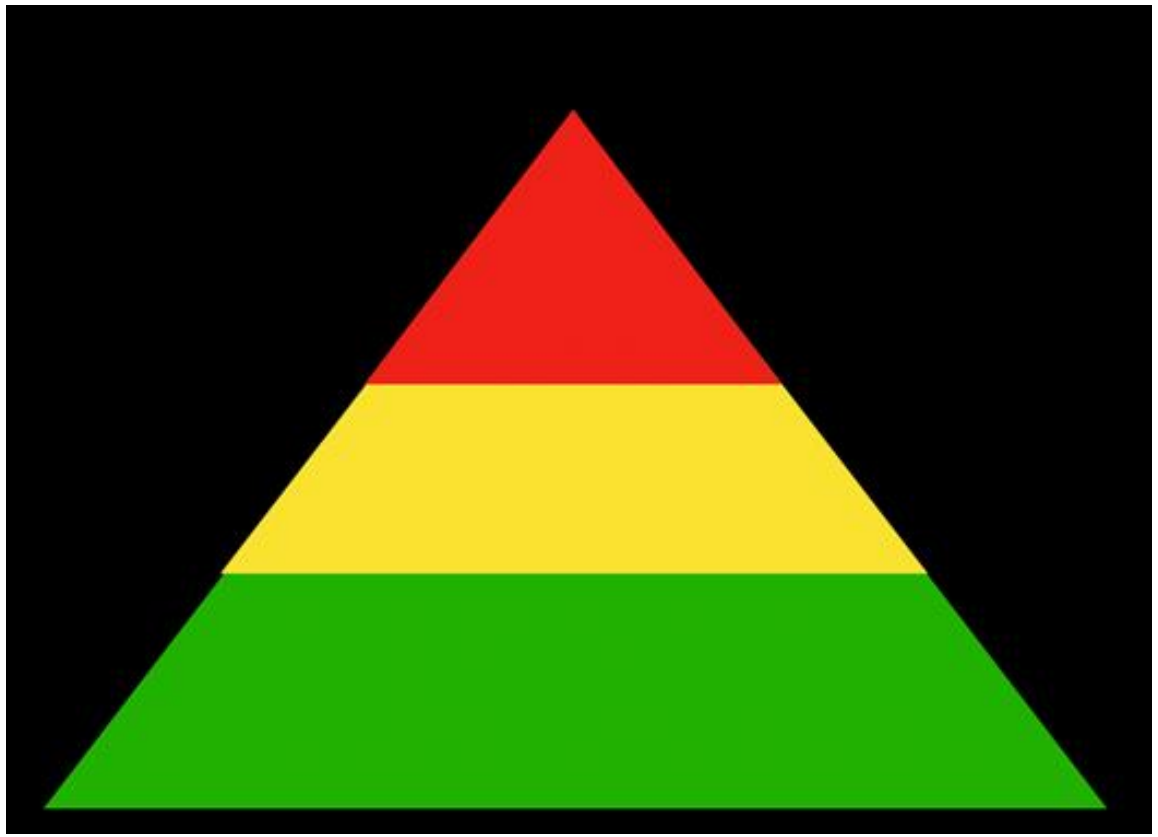
At some point during their K-12 career, all students will need some supports.

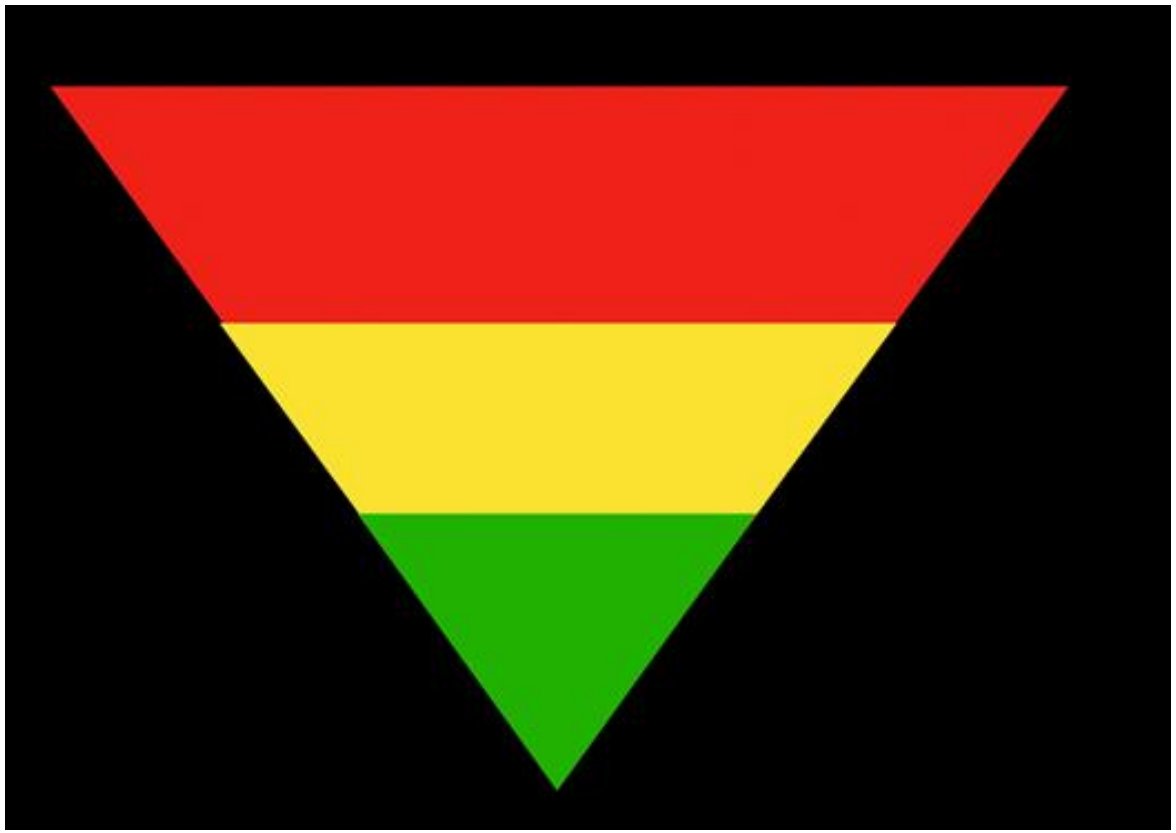
What We Know About Learners

- ✓All students have needs that are academic and non-academic.
- ✓All students are general education students FIRST.
  - ✓Yes…students with disabilities are general education students.
  - ✓Yes…students identified as gifted or advanced are general education students.
  - ✓Yes…multi-lingual learners are general education students.

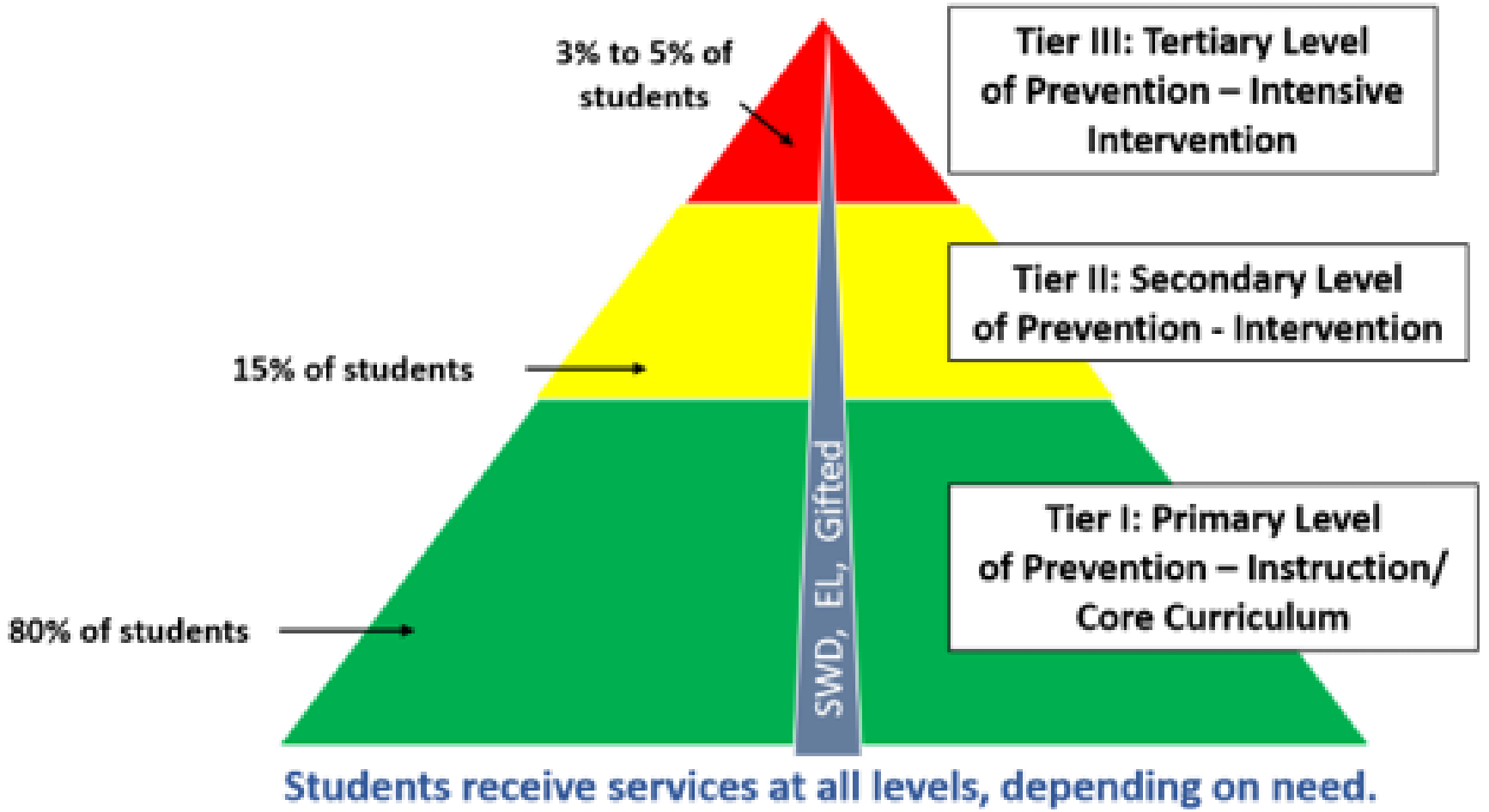
Georgia's System of Continuous Improvement

What do you notice?
What do you wonder?





Services Provided to Students




GROUP
A

ESSENTIAL INSTRUCTIONAL GUIDANCE

- Mathematical Practices
- Mathematical Modeling
- Framework for Statistical Reasoning
- Computational Strategies for Whole Numbers

MATHEMATICAL PRACTICES

The Mathematical Practices describe the reasoning behaviors students should develop as they build an understanding of mathematics – the "habits of mind" that help students become mathematical thinkers. There are eight standards, which apply to all grade levels and conceptual categories.

These mathematical practices describe how students should engage with the mathematics content for their grade level. Developing these habits of mind builds students' capacity to become mathematical thinkers. These practices can be applied individually or together in mathematics lessons, and no particular order is required. In well-designed lessons, there are often two or more Standards for Mathematical Practice present.

MATHEMATICAL PRACTICES	
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.	
Code	**Expectation**
MP.1	Make sense of problems and persevere in solving them.
MP.2	Reason abstractly and quantitatively.
MP.3	Construct viable arguments and critique the reasoning of others.
MP.4	Model with mathematics.
MP.5	Use appropriate tools strategically.
MP.6	Attend to precision.
MP.7	Look for and make use of structure.
MP.8	Look for and express regularity in repeated reasoning.

GEORGIA'S K-12 MATHEMATICS STANDARDS

FRAMEWORK FOR STATISTICAL REASONING

Statistical reasoning is important for learners to engage as citizens and professionals in a world that continues to change and evolve. Humans are naturally curious beings and statistics is a language that can be used to better answer questions about personal choices and/or make sense of naturally occurring phenomena. Statistics is a way to ask questions, explore, and make sense of the world around us.

The Framework for Statistical Reasoning should be used in all grade levels and courses to guide learners through the sense-making process, ultimately leading to the goal of statistical literacy in all grade levels and courses. Reasoning with statistics provides a context that necessitates the learning and application of a variety of mathematical concepts.

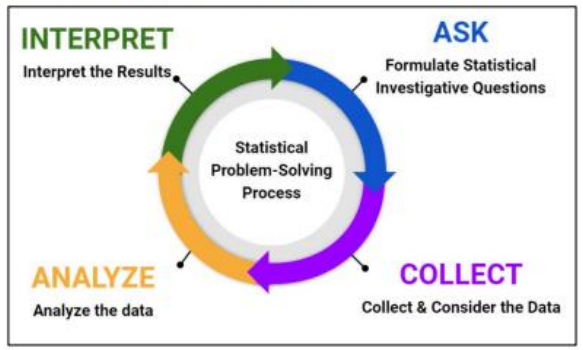


FIGURE 1: GEORGIA FRAMEWORK FOR STATISTICAL REASONING

The following four-step statistical problem-solving process can be used throughout each grade level and course to help learners develop a solid foundation in statistical reasoning and literacy:

I. **Formulate Statistical Investigative Questions**
Ask questions that anticipate variability.

II. **Collect & Consider the Data**
Ensure that data collection designs acknowledge variability.

III. **Analyze the Data**
Make sense of data and communicate what the data mean using pictures (graphs) and words. Give an accounting of variability, as appropriate.

IV. **Interpret the Results**
Answer statistical investigative questions based on the collected data.

A Mathematical Modeling Framework

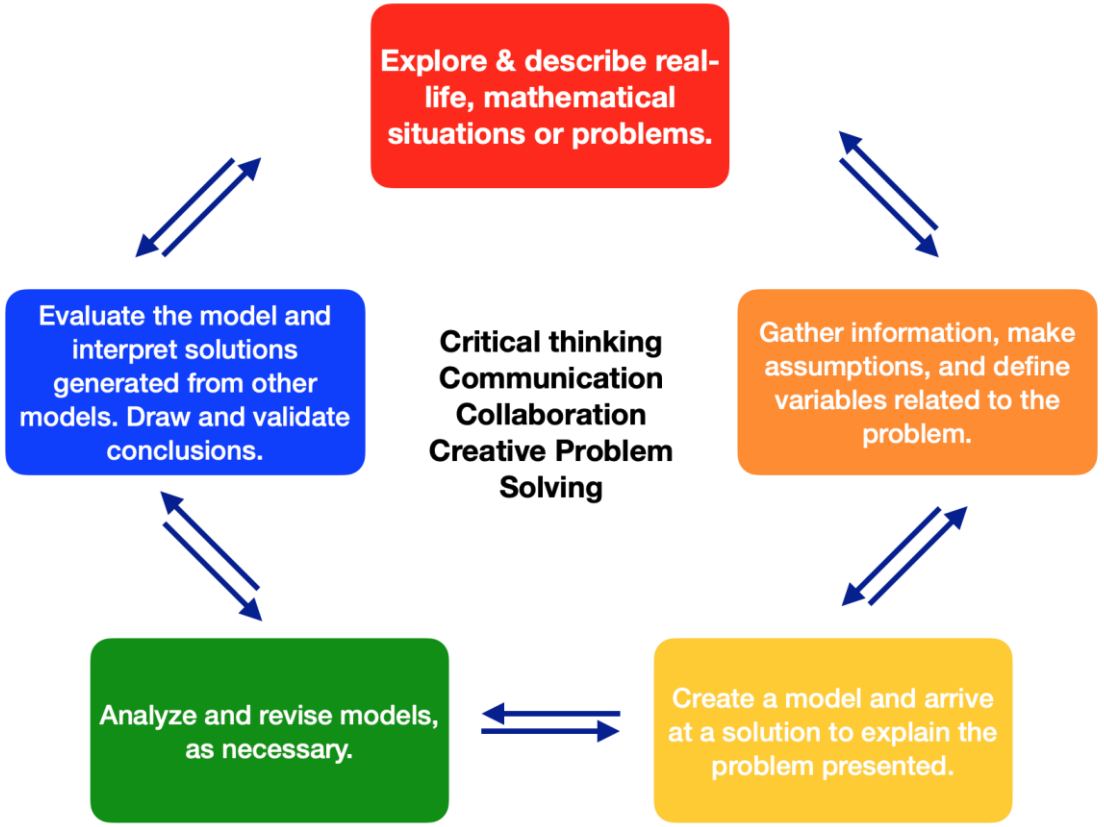
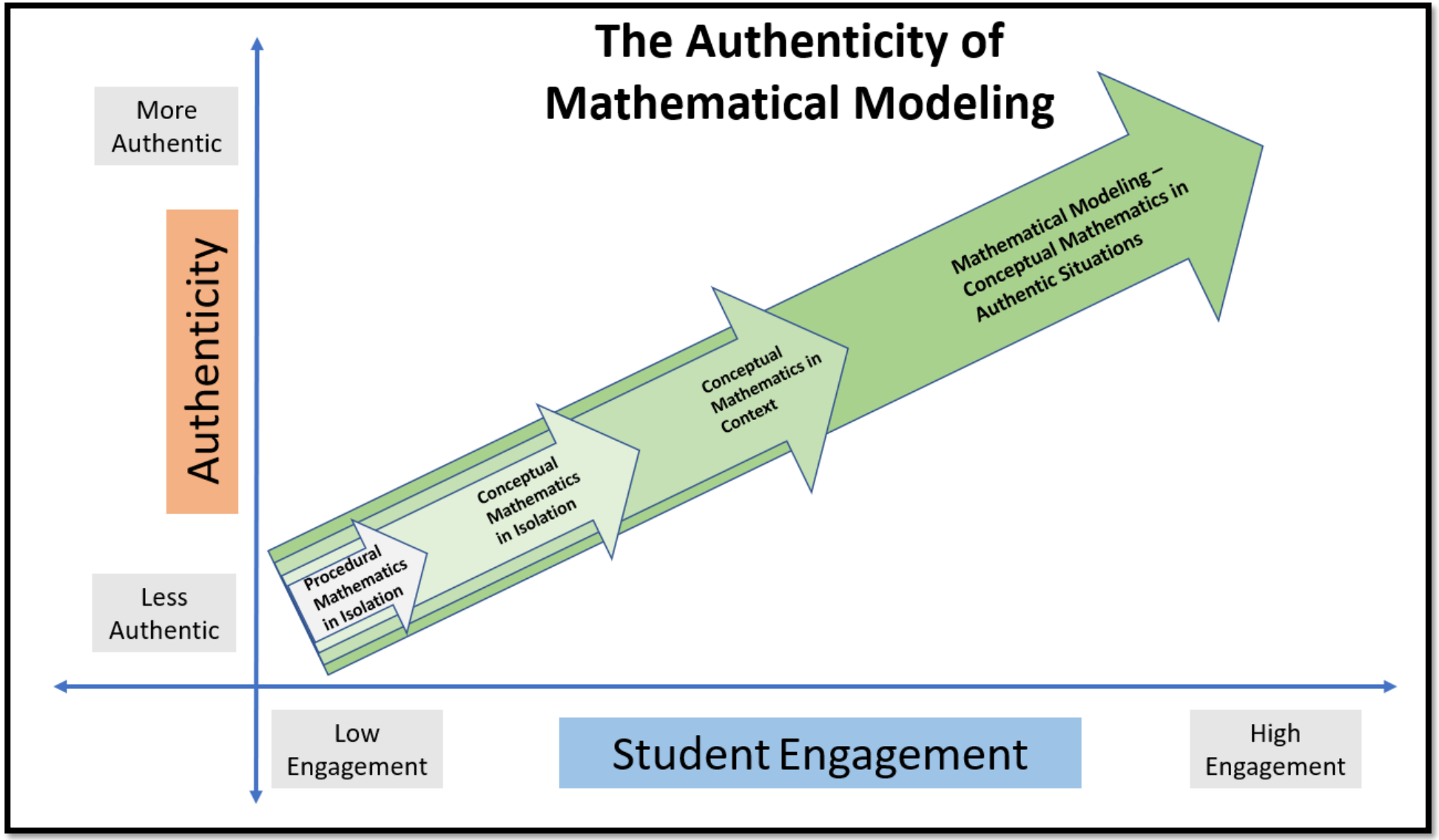


Image adapted from: Suh, Matson, Seshaiyer, 2017


The Authenticity of Mathematical Modeling
More Authentic
Authenticity
Less Authentic
Procedural Mathematics in Isolation
Conceptual Mathematics in Isolation
Conceptual Mathematics in Context
Mathematical Modeling – Conceptual Mathematics in Authentic Situations
Low Engagement
Student Engagement
High Engagement

Addressing Learner Variability

Supports for Learner Variability

Supporting the Learning

- intervention activities specific to the learning experiences
- teacher actions from the Georgia Mathematics Strategy Toolkits tailored to the learning experiences

Extending the Learning

- extension activities specific to the learning experiences
- instructional strategies that support students who are labeled gifted or demonstrated a solid understanding of the mathematical concepts within the learning experiences

Language Supports

- teacher actions from the English Language Proficiency for English (as a 2nd language) Learners section of the Mathematics Strategy Toolkit tailored to the learning experiences
- strategies and resources included in the Mathematics Resources to Support English Learners provide specific evidence-based practices that indicate the benefits of hands-on, relevant learning experiences in the mathematics classroom

Collective Teacher Efficacy

Belief you can make a difference

X

Evidence you are making a difference

=

Effect size of 1.57*

John Hattie, Visible Learning https://visible-learning.org/2018/03/collective-teacher-efficacy-hattie/

Georgia Mathematics Strategy Toolkits to Address Learner Variability

Georgia Numeracy Project
Numeracy Intervention Resource

Enter Here

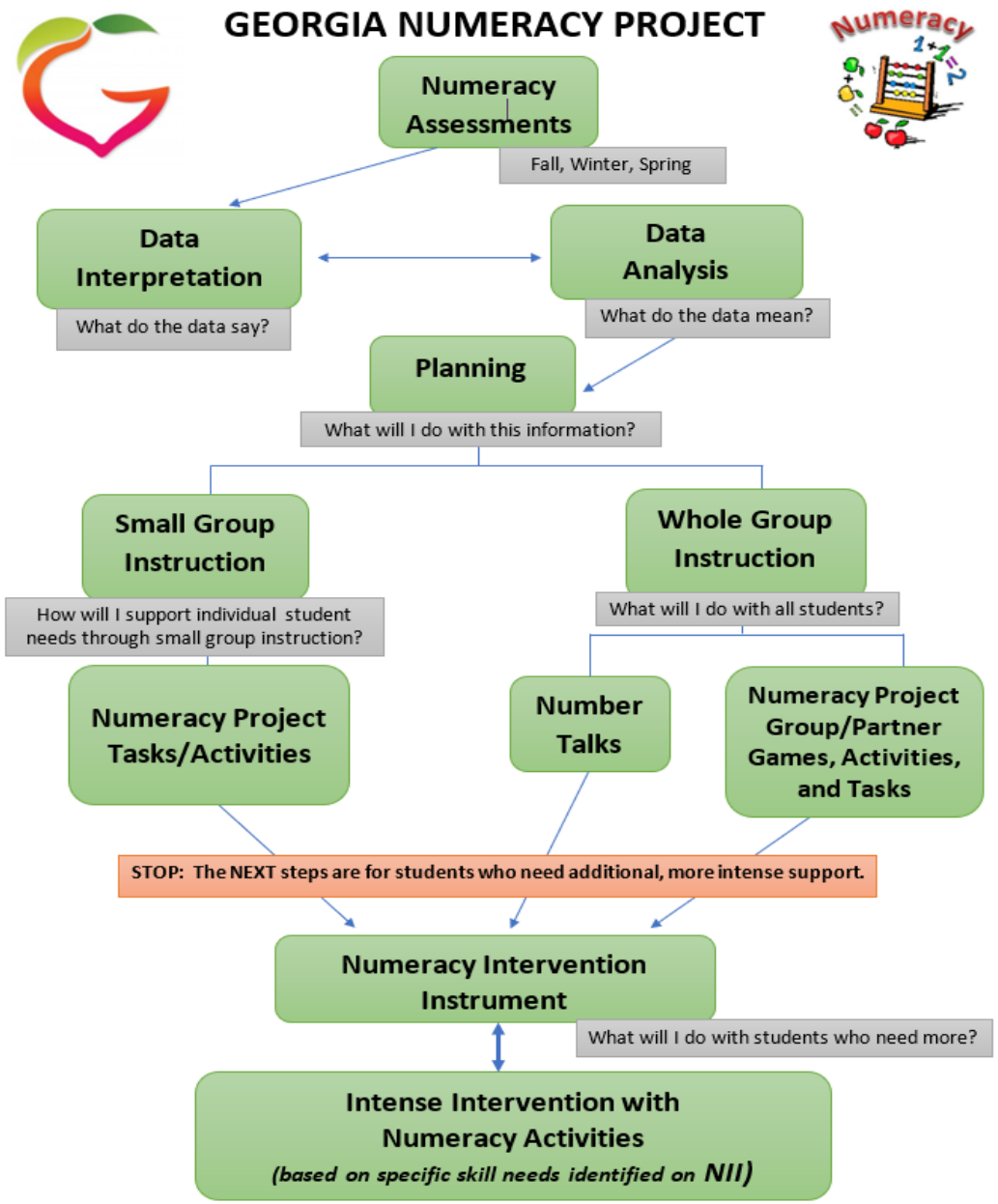
Parallel Resources

Georgia Early Numeracy Project

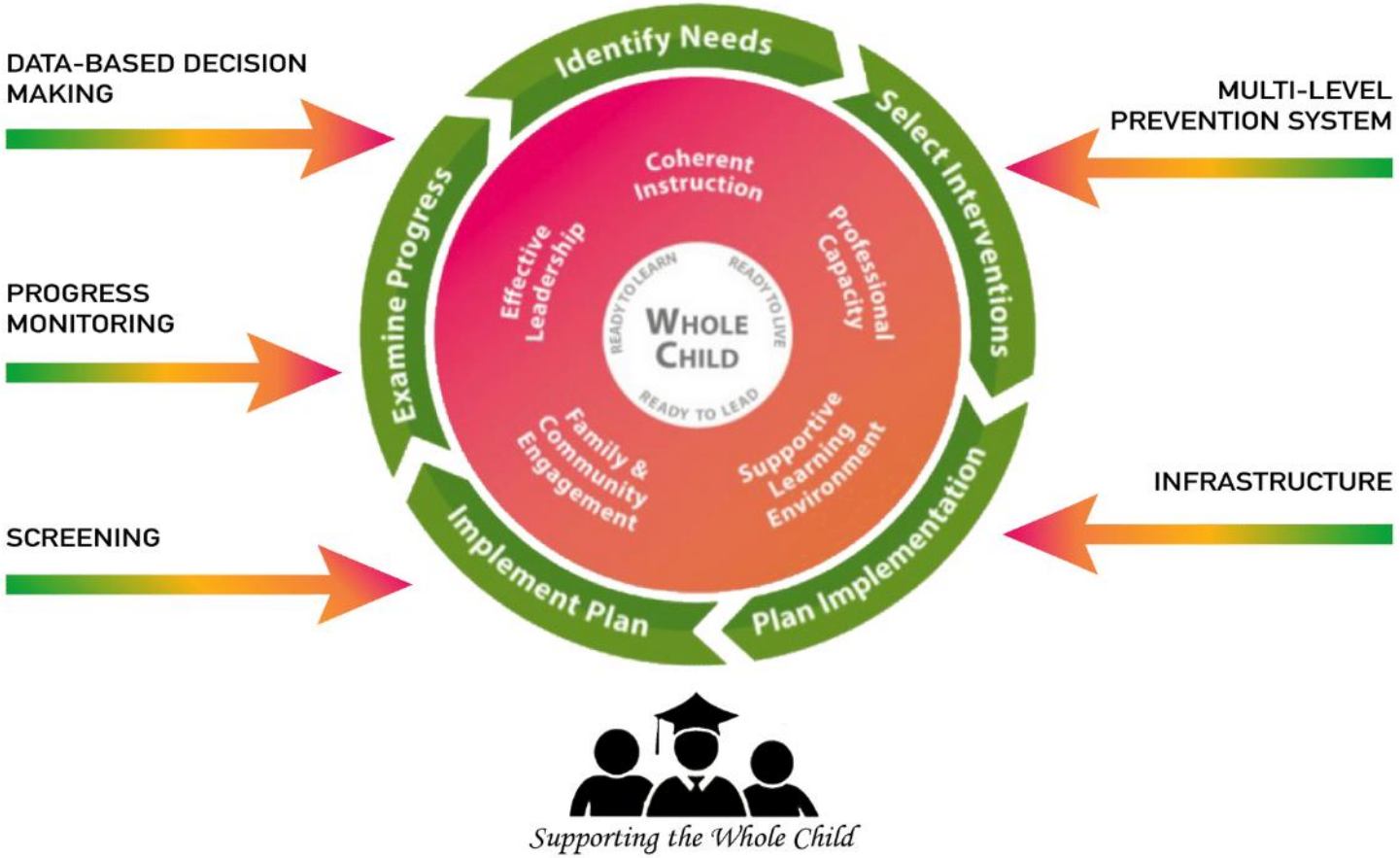
K - 7 Resource

8 - HS Resource

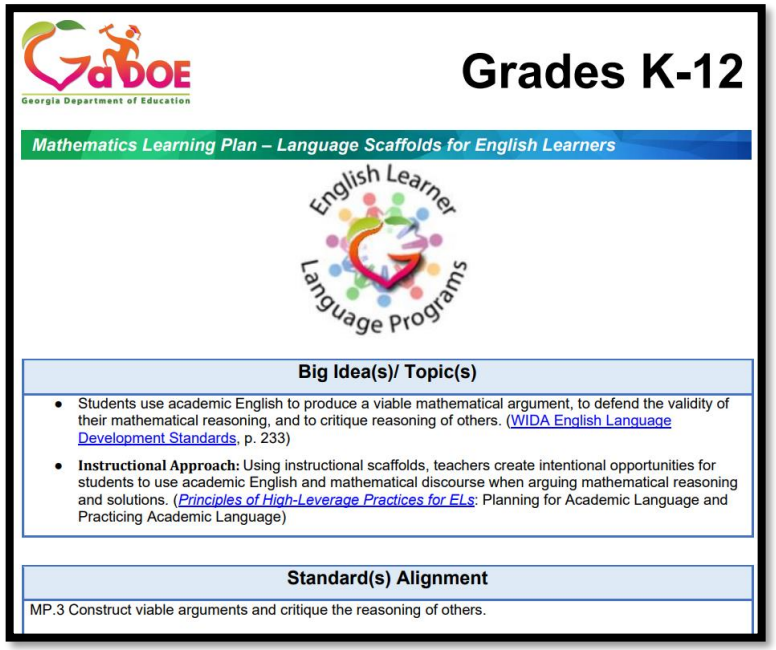
Georgia Secondary Numeracy Project

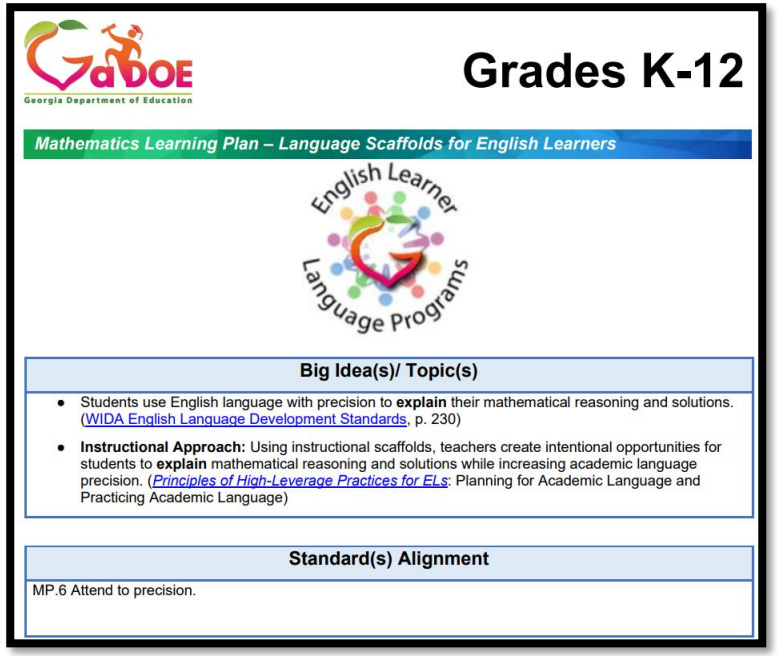

GEORGIA NUMERACY PROJECT
Numeracy
Numeracy Assessments
Fall, Winter, Spring
Data Interpretation
What do the data say?
Data Analysis
What do the data mean?
Planning
What will I do with this information?
Small Group Instruction
How will I support individual student needs through small group instruction?
Numeracy Project Tasks/Activities
Whole Group Instruction
What will I do with all students?
Number Talks
Numeracy Project Group/Partner Games, Activities, and Tasks
STOP: The NEXT steps are for students who need additional, more intense support.
Numeracy Intervention Instrument
What will I do with students who need more?
Intense Intervention with Numeracy Activities
(based on specific skill needs identified on NII)

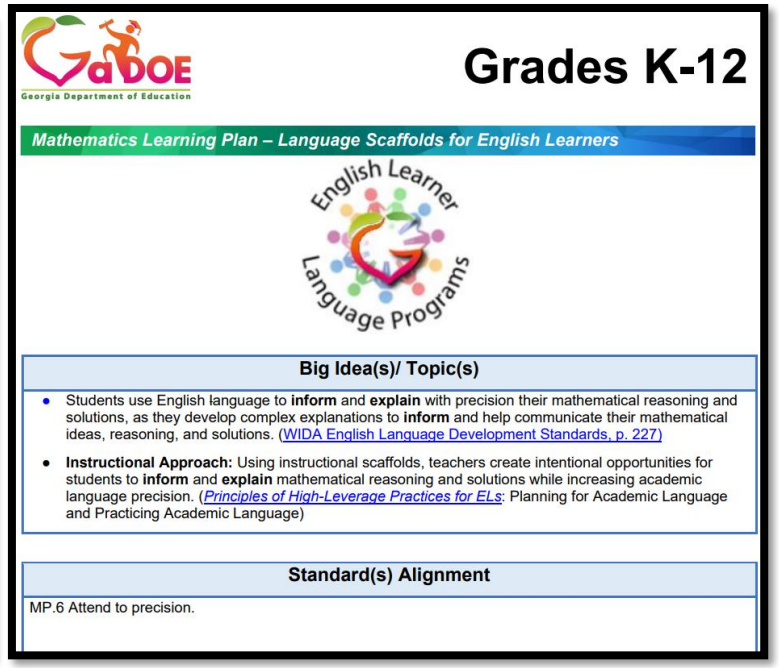
Alignment to Essential Components of Georgia's Tiered System of Supports for Students



Supporting Multilingual Learners





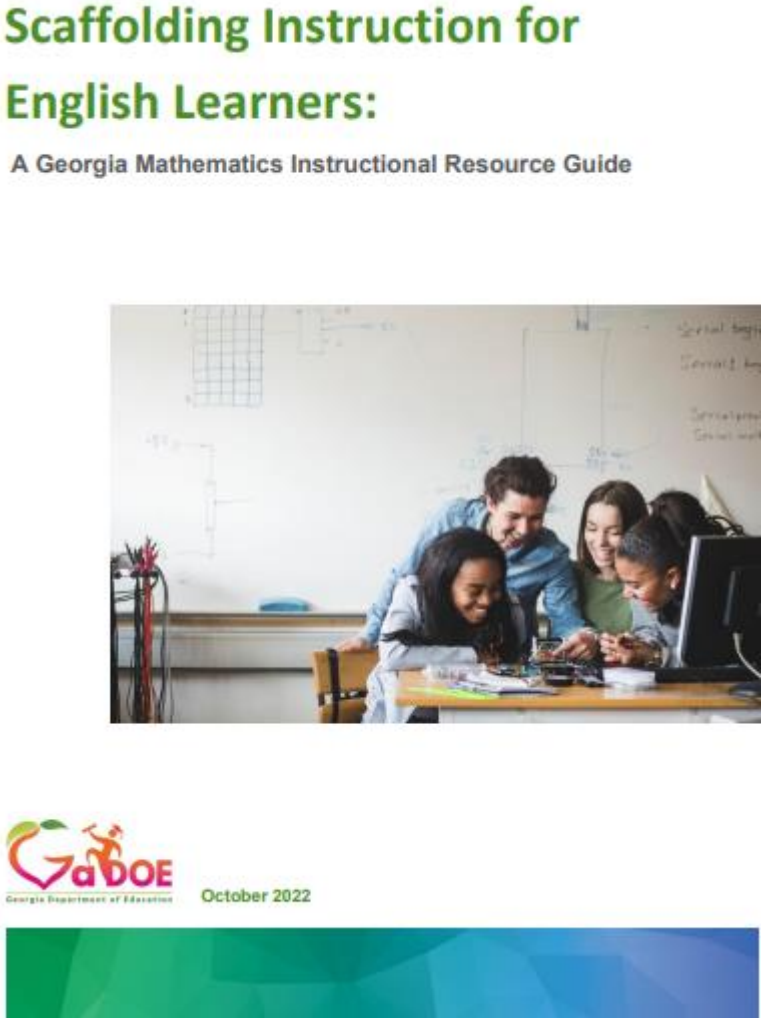


K-12 Digital Learning Plans

www.gpb.org/education/learn/k-12-learning-plans/math

NEW

Support for Multilingual Learners



Supporting Students with Disabilities

Specially Designed Instruction

- Specially designed instruction is implemented by general education or special education teacher
- **Based on needs** arising from the student's identified disability
- It's "special".

Georgia Mathematics Strategy Toolkits to Address Learner Variability

Introduction

"If the goal in mathematics teaching and learning is to support student success with mathematical proficiency, then we must be explicit about using instructional routines that focus on student engagement in activities that support reasoning and sense making, communication with and about mathematical ideas, making meaningful connections, building procedural fluency from conceptual understanding…"

- Thinking about Instructional Routines in Mathematics Teaching and Learning

Within this toolkit, educators will find observations of student behavior for each of the 14 identified areas for addressing learner variability. Aligned to each observation of student behavior, are evidence-based, research-based strategies intended to strengthen students' ability in mathematics. Support resources are provided to assist educators with implementing the strategies.

- Behavior
- Cognitive Processing
  - Attention
  - Conceptual
  - Memory
  - Reasoning
- Executive Functioning
- Instructional Climate and Student Mindsets
- Language Processing
- Language Proficiency
- Mathematics Calculation
- Other Exceptionalities
- Problem-Solving
- Visual-Spatial Processing

Looking for more evidence-based, researched based practices for mathematics? Please visit gadoe.org/mathematics.

Cognitive Processing: Memory

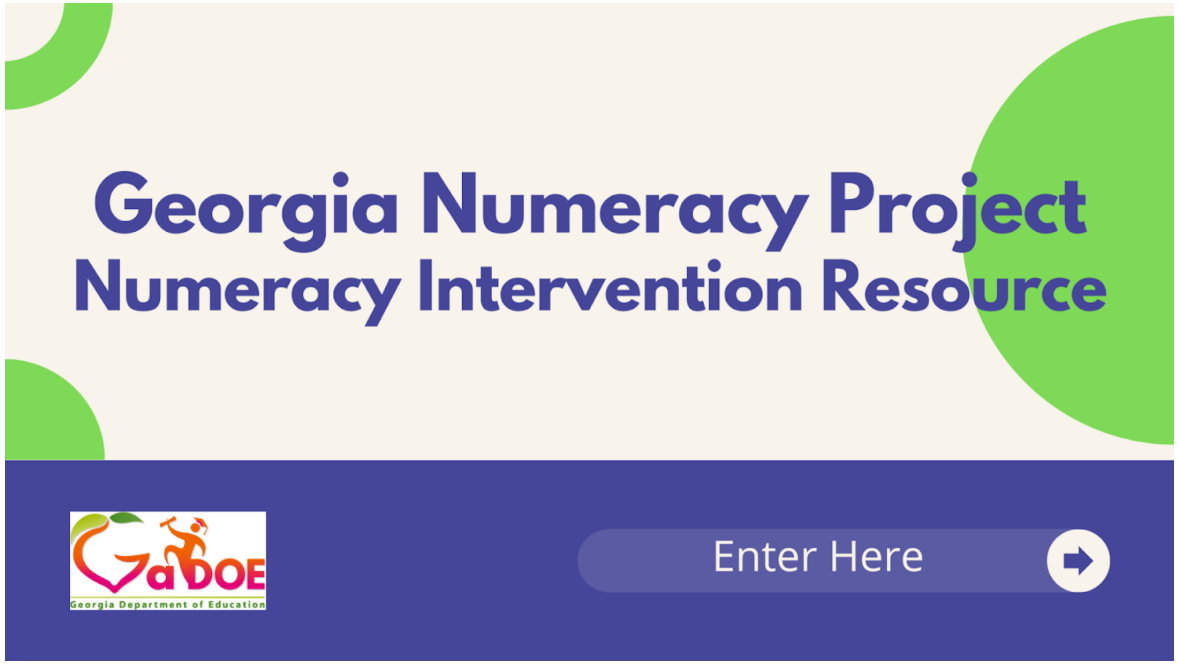
Mathematics Connection: Using rote memory to recall facts or remember the steps of an algorithm does not yield long-term learning. Students should have opportunities to use conceptual learning strategies that will lead to committing the basic computational facts to memory.

Student Learning Expectations: Students should have opportunities to use knowledge from their memories to perform calculations and procedures, identify geometric figures, and demonstrate basic graphing skills by using visual-spatial and numerical representations to make sense of real-life, mathematical problems to help with sustaining long-term memory.

Memory			
Observations	**Teacher Actions**	**Student Actions**	**Support Resources**
Observations reveal difficulty recalling key vocabulary terms consistently, such as: number names, the difference between area and perimeter, etc.	The teacher will facilitate meaningful discourse that allows students to repeat accurate math vocabulary while engaging in rich tasks. (EMTP 4)	The student will demonstrate precise communication of mathematical ideas using clear academic-language and accurate vocabulary. (MP.6)	Counting Cup Lesson This video shows how teachers explicitly use and reinforce vocabulary terms with manipulatives. GA Frameworks Task on Perimeter and Area This GA frameworks task allows students to demonstrate their knowledge and distinguish between concepts.
Observations reveal difficulty recalling prior mathematics skills or concepts previously taught.	The teacher will pose purposeful questions to assess student prior knowledge and elicit student thinking to address concepts needing review. (EMTP 5)	The student will use math models to build conceptual understanding of the previous skills and apply them to current content. (MP.4)	GA Frameworks Video: MGSEK.CC.4 This video is part of the GA Frameworks video series. Here, the teacher demonstrates questioning skills that connect previous learning to new knowledge. Addition and Subtraction Progression Video This video provides the teacher with knowledge of the sequencing of skills.

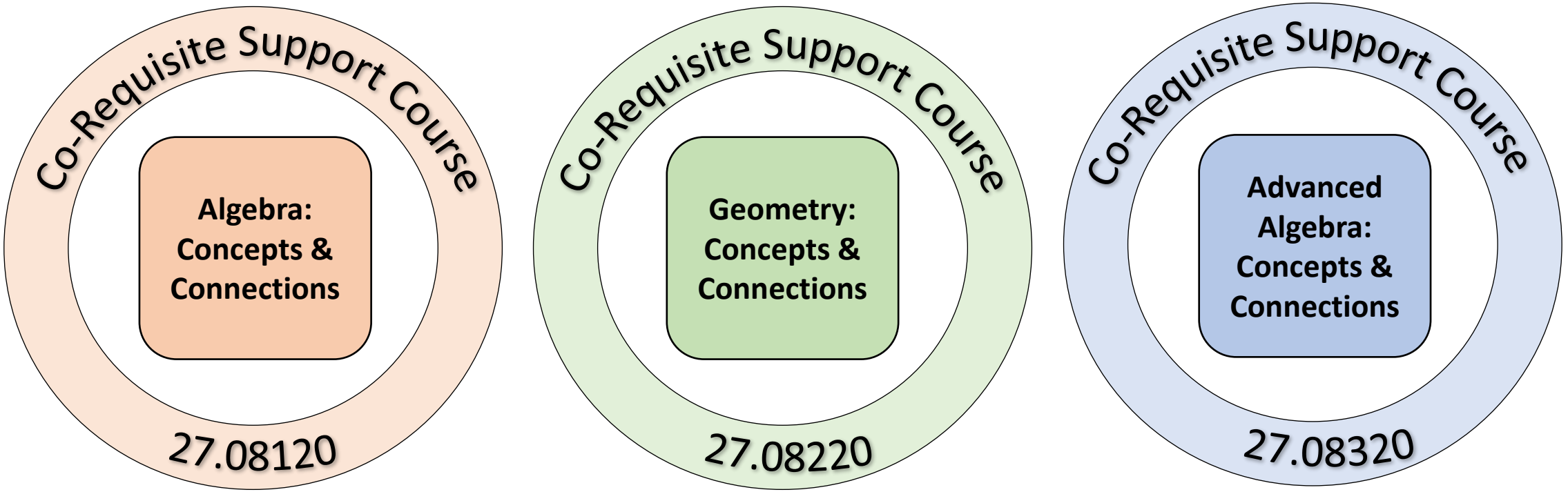
Developing Meaningful IEP Goals

- ✓Follow the appropriate administration protocol
- ✓Expose the strengths and the needs
- ✓Identify skills using the Numeracy Intervention Instrument and use the skills to formulate Individual Education Program goals
- ✓Implement the numeracy tasks and activities to address identified goal



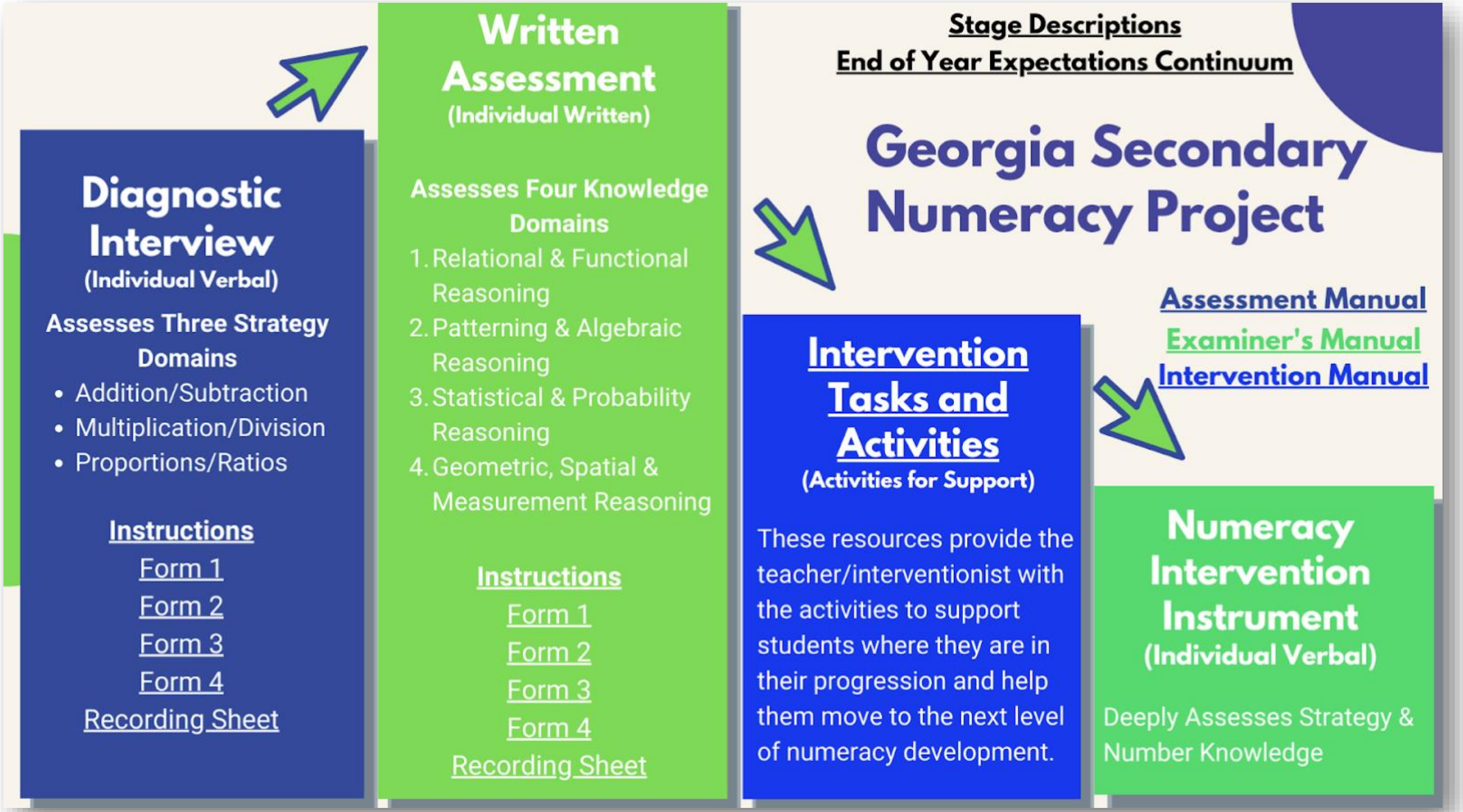
High School Co-Requisite Support Courses

Co-Requisite Support Courses



- The co-requisite support courses are offered for students, as needed, based on local school or district selection criteria.
- The co-requisite support courses are not stand-alone courses; these courses assist students as they work to earn the required core course credit.
- Co-Requisite support courses may be taken in conjunction with the core mathematics courses they are paired
- These co-requisite support courses provide teachers with additional time to implement wraparound interventions and supports for students in real time as the students are learning the standards in the core course required for graduation.

GaDOE
Georgia Department of Education


Stage Descriptions
End of Year Expectations Continuum
Georgia Secondary Numeracy Project
Diagnostic Interview
(Individual Verbal)
Assesses Three Strategy Domains
• Addition/Subtraction
• Multiplication/Division
• Proportions/Ratios
Instructions
Form 1
Form 2
Form 3
Form 4
Recording Sheet
Written Assessment
(Individual Written)
Assesses Four Knowledge Domains
1. Relational & Functional Reasoning
2. Patterning & Algebraic Reasoning
3. Statistical & Probability Reasoning
4. Geometric, Spatial & Measurement Reasoning
Instructions
Form 1
Form 2
Form 3
Form 4
Recording Sheet
Intervention Tasks and Activities
(Activities for Support)
These resources provide the teacher/interventionist with the activities to support students where they are in their progression and help them move to the next level of numeracy development.
Assessment Manual
Examiner's Manual
Intervention Manual
Numeracy Intervention Instrument
(Individual Verbal)
Deeply Assesses Strategy & Number Knowledge

Embedded Supports

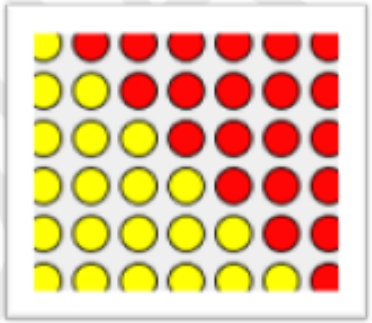
Sample Unit - Structures

Grade 7

Unit 1:

Making Relevant Connections within the Number System

Students will build upon understandings of rational numbers to ultimately formalize rules for basic arithmetic operations (addition, subtraction, multiplication, and division) with rational numbers.



MATHEMATICS

Standard(s) Alignment

- **7.NR.1: 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).**
  - **7.NR.1.1**: Show that a number and its opposite have a sum of 0 (are additive inverses). Describe situations in which opposite quantities combine to make 0.
  - **7.NR.1.2**: Show and explain p + q as the number located a distance |q| from p, in the positive or negative direction, depending on whether q is positive or negative. Interpret sums of rational numbers by describing applicable situations.
  - **7.NR.1.5**: Apply properties of operations, including part-whole reasoning, as strategies to add and subtract rational numbers.

Mathematical Practice(s)

7.MP.1 Make sense of problems and persevere in solving them.
7.MP.2 Reason abstractly and quantitatively.
7.MP.3 Construct viable arguments and critique the reasoning of others.
7.MP.4 Model with mathematics.
7.MP.5 Use appropriate tools strategically.
7.MP.6 Attend to precision.
7.MP.7 Look for and make use of structure

Common Misconceptions

Visual representations may be helpful as students begin this work. If they do not have a visual to illustrate what is happening when they are adding and subtracting integers, they may get lost in the symbols and will not know how to combine the absolute value of the integers.

- Students want to subtract by just taking the counter off instead of bringing in a zero pair.
- Students do not always understand the value of a zero pair and how the value stays the same no matter how many zero pairs you bring.
- Ask students to create their own stories for integer operations and to answer the following three prompts:
  - Where did you start?
  - How far did you go?
  - Where are you now?

Teacher Notes: To combat the misconceptions students have when computing with integers, there are several tools that will aid in developing an understanding of operations with integers. Beginning with a bead string number line will help reinforce the quantity of the integers. The bead string can be created using pony beads and a pipe cleaner or string. Use a black bead to represent zero, white beads for each positive number and red beads for each negative number.

Diagnostic Assessment

Students will have an opportunity to demonstrate understanding of finding sums of two integers using a visual representation. They will be asked to justify how to determine the sum of two integers with different signs.

1. Using your knowledge of the commutative property, determine if (-7) + 4 is equivalent to 4 + (-7)? Show the sum using a visual representation to justify your answer.

Solution: Models can vary

2. Explain how you can determine the sign of the sum of two integers if one is positive and the other is negative.

Solution: Answer can vary

Sample: If I am using counters to find the sum, I can create zero pairs. The number of counters that has the greatest value when I count them is going to be the sign of the sum.

Sample: To find the sum of a positive and a negative integer, take the absolute value of each integer and then subtract these values.

Student Learning Supports

This section provides suggested strategies to support learners before, during and/or after the learning experiences outlined within the instructional design. Teachers should use frequent formative assessment information to determine which students need additional support. For more information on supporting the learning, extending the learning and language supports, please review the information under Instructional Support Strategies within the Comprehensive Grade Level Overview.

Establish mathematics goals to focus learning.

- **Supporting the Learning:** Make explicit connections between current and prior lessons or units to integers.

Implement tasks that promote reasoning and problem solving.

- **Extending the Learning:** Make a game to practice the skills and concepts experienced today. Make a list of materials you will need. Think about rules for the game. Be prepared to explain to your teacher how the game works.

Use and connect mathematical representations.

- **Supporting the Learning:** Provide copies of notes, two color counters, number lines and utilize color coding to organize information to connect mathematical representations.
- **Supporting the Learning**: Have students to verbalize their thinking as they create the zero pairs and model the situations. Use think, pair, share as a strategy so students are able to hear and see one another's thinking and process.
- **Supporting the Learning:** Encourage students to identify zero pairs and how they represent them using the rekenrek or bring in other models to support the understanding of the concept.

Facilitate meaningful mathematical discourse.

- **Language Supports:** Provide multiple opportunities for structured peer interactions or conversations (pairs or triads) to negotiate meaning using charts, graphic organizers, a word bank and/or sentence frames.
- **Language Supports:** Explicitly model and teach etiquette when conducting mathematical debates and how to justify answers.
- **Language Supports:** Utilize Mathematical Language Routines to support students in formulating their explanations.

Pose purposeful questions.

- **Supporting the Learning:** Pose purposeful questions to assess prior knowledge and elicit student thinking to address concepts needing review.
- **Language Supports:** The teacher will model how to construct an effective question in math by utilizing 8 Ways to Pose Better Math Questions in Math.

Build procedural fluency from conceptual understanding.

- **Extending the Learning:** Students can work together to develop formal rules and properties and provide justifications for why those rules and properties are applicable.

Support productive struggle in learning mathematics.

- **Supporting the Learning:** To combat the misconceptions students have when computing with integers, there are several tools that will aid in developing an understanding of operations with integers. Beginning with a bead string number line will help reinforce the quantity of the integers. The bead string can be created using pony beads and a pipe cleaner or string. Use a black bead to represent zero, white beads for each positive number and red beads for each negative number.
- **Supporting the Learning:** A modified rekenrek can help align zero pairs when adding and subtracting integers. A traditional rekenrek has two rows of 10 beads. Each row has five red beads and five white beads. They're useful when students are developing the ideas of unitizing, quantity of numbers and number strategies for addition and subtraction of whole numbers. The modified rekenrek for use with integers has two rows of ten beads. One row has ten white beads and the second row has ten red beads. It can be constructed using red and white pony beads, two pipe cleaners and cardboard or tag board.

Additional Resources

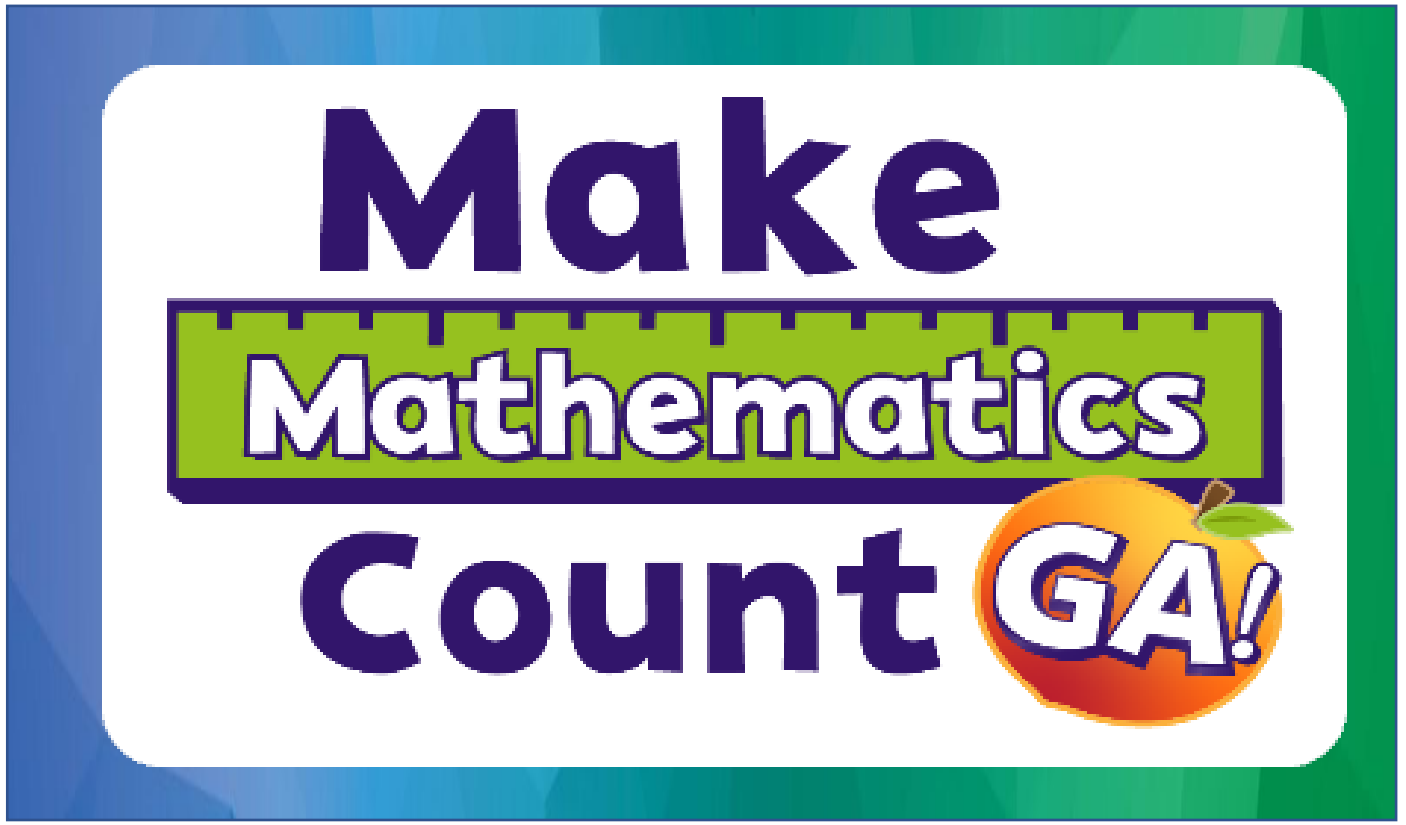
Georgia Home Classroom

Let's Learn GA!

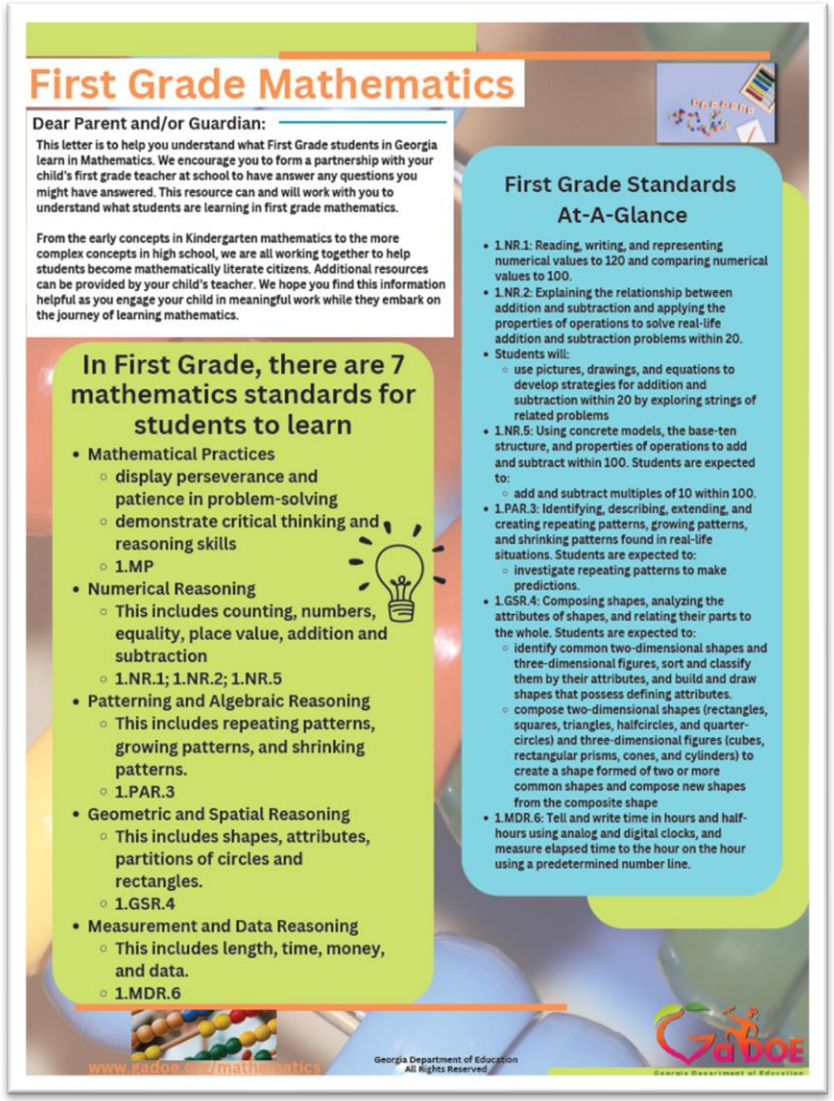
https://www.gpb.org/education/learn/lets-learn-ga/instructional-support/mathematics

Resources for Parents

- Make Mathematics Count, GA! Parent Videos and Resources



Resources for Parents




Mathematizing a Student's Journey
Getting Ready Guides
BATTLESHIP
Myths of Early Math
HIDATO
10
Make Mathematics Count
SCHOOL
Elementary School
Middle School
Math Learning Center Apps
youcubed
OPEN MIDDLE
Play Now!
1300+ Resources for Students to Have Fun with Mathematics!
Transition to High School!
GEORGIA MATHEMATICS
High School
73
GEORGIA VIRTUAL
High School Mathematics Graduation Guidance
Post-Secondary Opportunities
WEB SUDOKU
GTCA
CollegeBoard
100
Dual Enrollment
GAfutures
Explore. Plan. Succeed.
Make Mathematics Count
STEAM

Mathematics Professional Learning

Professional Learning Opportunities Resources for Teachers and Leaders

www.gadoe.org/mathematics

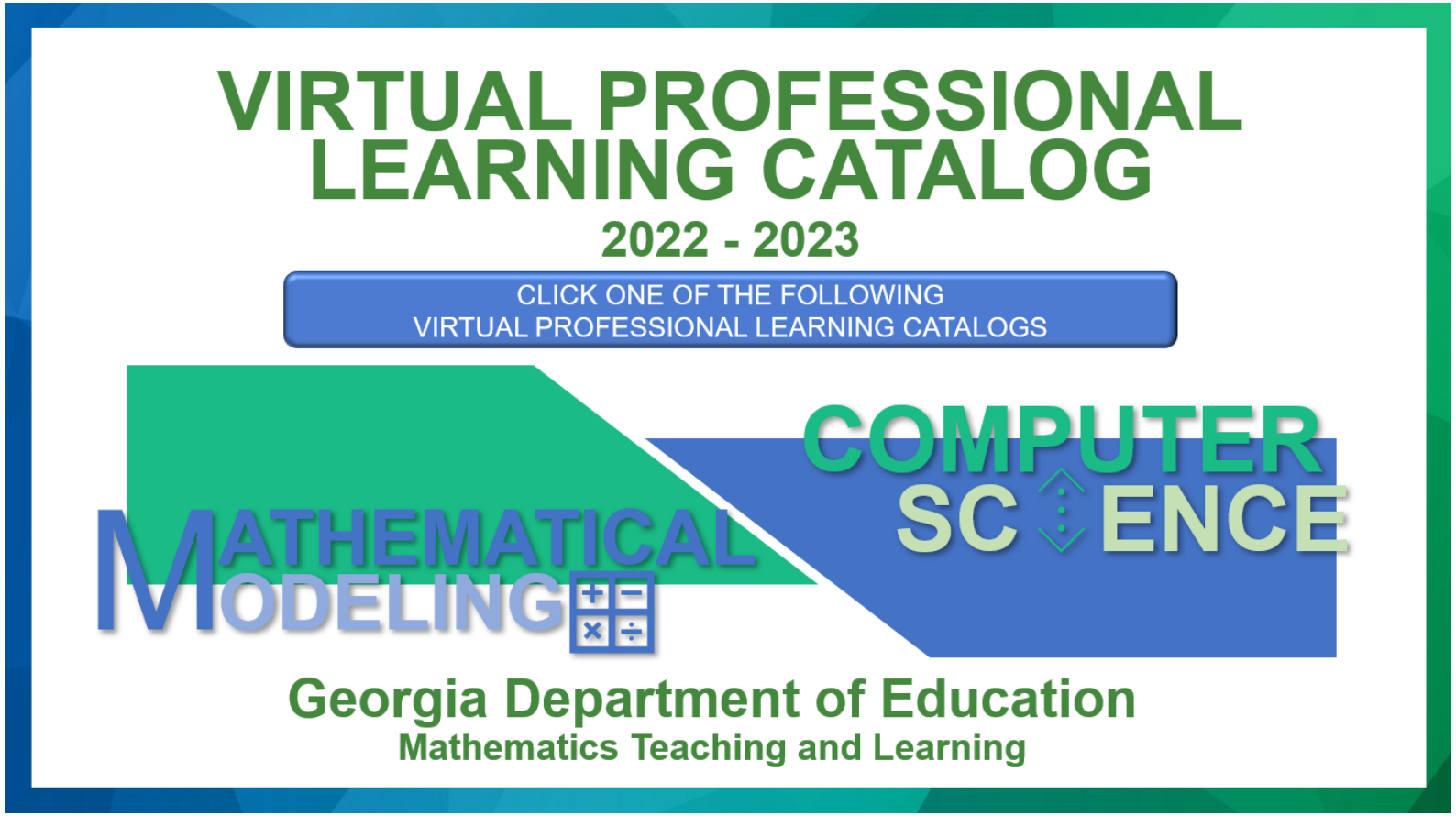
Mathematics PL Series
(on the Road to RESAs)

Mathematics Professional Learning Series with RESA

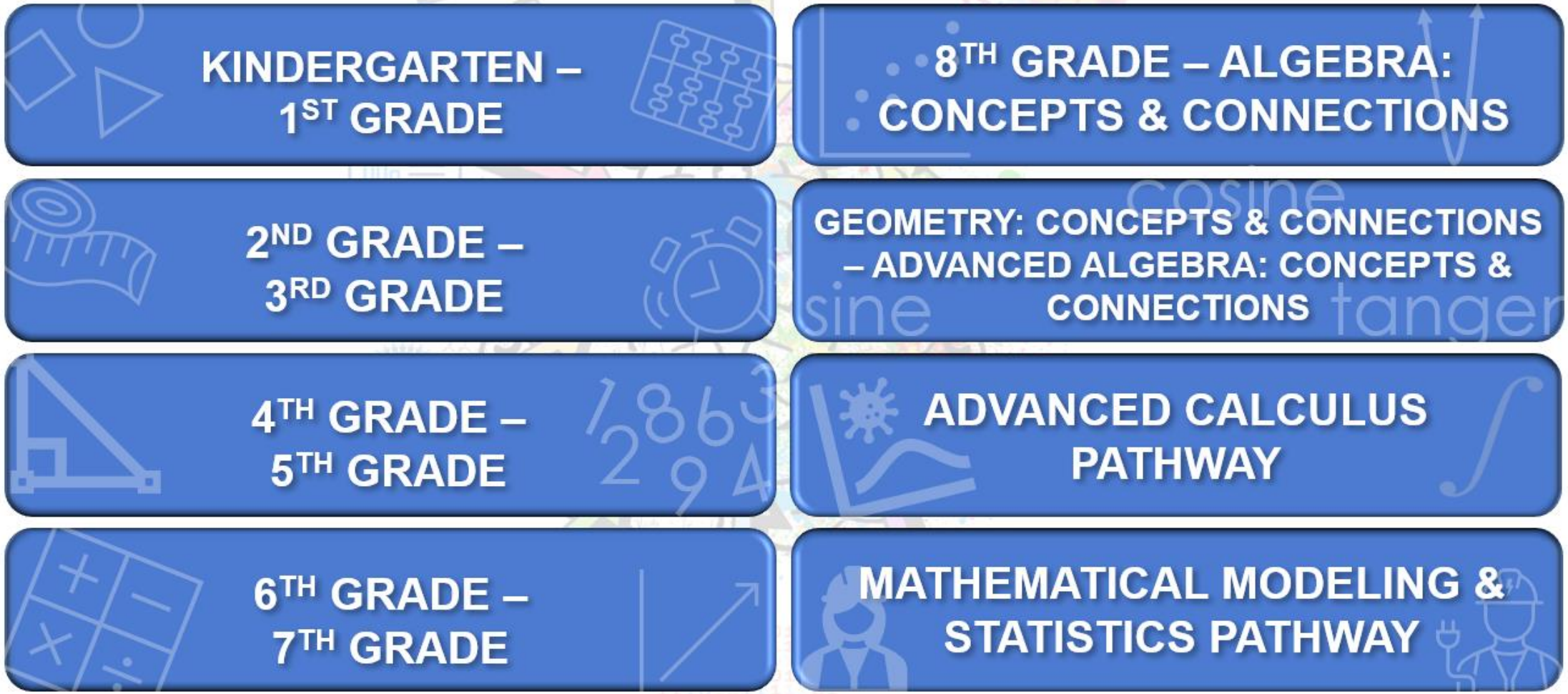
(Register on each individual RESA website.)

Mathematics Virtual Specialists PL

Saturday morning sessions at 9:00 AM on select dates
(First Date Recordings Available from October 22, 2022)



Grade Bands/ Course Pathways



GA MathCON

SAVE THE DATE

July 11 – 13, 2023

Professional Learning Videos

COMING SOON!

QUESTIONS????

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