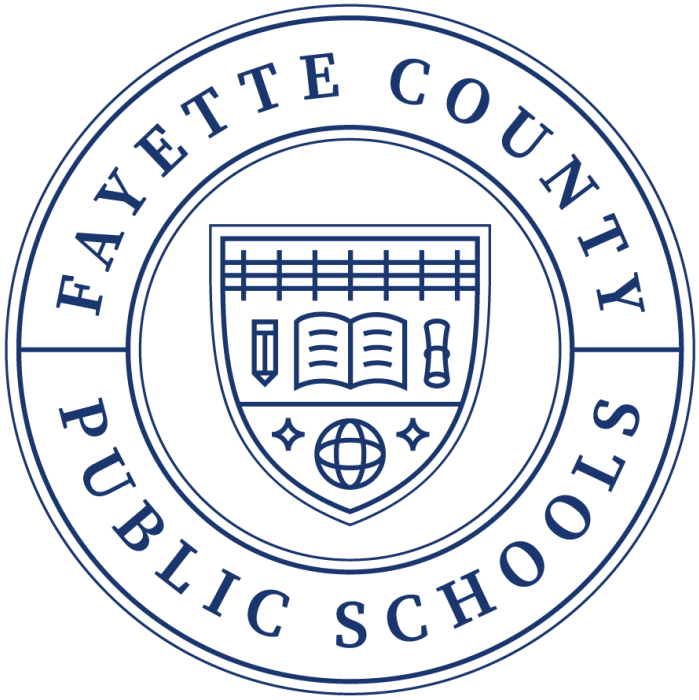
FCPS
P-12 Mathematics Guidance Document



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District-Adopted Tier 1 Resources

Resource	Components	Implementation	Progress Monitoring
iReady Mathematics Classroom	K-5	Tier 1, Whole Group	School-based Common Assessments FCPS Common Unit Assessments
enVision Mathematics	6-Algebra II	Tier 1, Whole Group	School-based Common Assessments FCPS Common Unit Assessments

Family and Community Engagement

Parent involvement is a critical factor in math student achievement. We encourage continuous communication with parents and families about our mathematics teaching and learning, and we value their support of mathematics.

Family Learning Guides

See below for Math-specific learning guides by grade level:

Kindergarten 1st grade 2nd grade 3rd grade 4th grade 5th grade 6th grade

7th grade 8th grade Algebra 1 Geometry

Section 1: Introduction

Purpose

The FCPS Math Guidance Document is based on current research in mathematics content and best instructional practices. The content in the FCPS Math Guidance Document reflects the skills, processes, and knowledge students in Fayette County Public Schools need to know to be competent, knowledgeable, and confident in their understanding of mathematics and in their ability to apply this understanding in future learning experiences. The Kentucky Academic Standards and *Principles to Actions: Ensuring Mathematical Success for All* were the foundational resources used to guide the development and content of this document.

Core Mathematics Beliefs

Fayette County Public Schools believes that learning mathematics involves a balance of standards-based instruction and applying the Math Practice Standards. This includes students' ability to model mathematical situations appropriately and construct their own learning involving a variety of skills, processes, and understandings.

Student-centered classrooms use a balanced approach to teaching mathematics, including

- Emphasizing conceptual understanding and fluency
- Building upon prior knowledge
- Promoting inquiry, problem-solving, reasoning, and self-monitoring
- Formulating, representing, and solving various mathematical problems
- Applying 21st Century Skills (i.e., collaboration, creative thinking, flexibility)
- Engaging in student discourse through intentional high-level questioning
- Using active monitoring and providing feedback to move learning forward

Learner Rights

In Fayette County Schools, we are committed to equity for all students through timely, deliberate, and unified action to remedy opportunity gaps, eliminate exclusionary practices and systems, and create a barrier-free learning environment. Embedding Culturally Responsive Teaching ensures each child receives a high-quality education designed to maximize potential that reflects and stretches their abilities, interests, and mindsets. FCPS Math Educators must be committed to serving the math learning needs of students from various social, economic, academic, cultural, linguistic, and developmental backgrounds. These components include a call to provide ALL students with the following:

- Equitable access to math resources and facilities.
- Instruction in all areas of mathematics, including Math Practice Standards, tailored to their needs.
- A math curriculum that is rigorous and relevant.
- Educators who are culturally sensitive and respectful.
- Interactions with staff and other students that are positive and encouraging in a growth mindset atmosphere.
- Varied assessments allow each student to demonstrate learning in math.

Section 2: Tier 1 Math Practices

Planning For Tier I Instruction

1. Plan for Standards-based Whole Group Instruction

- Use FCPS Math Unit Frameworks to identify essential standards for each unit
- Determine how students will be assessed to demonstrate proficiency and or mastery of standards
- Design formative assessment to determine learning/mastery
- Deconstruct standards to ensure student learning aligns with the depth of the grade-level standard
- Search for high-quality instructional resources that align with standards instruction (for more, see the Kentucky Department of Education's Model Curriculum Framework
- Implement High-Yield instructional strategies
- Design lessons using the Instructional Design Models (IDM)
    - Sample Graphic (page 6)
    - Instructional Design Model Guidance Document

2. Ensure Teacher Clarity

- Deconstruct Mathematics Standards to ensure that student learning aligns with the depth of the grade-level standard
- Develop learning progressions, learning intentions, and success criteria for Kentucky Academic Mathematics Standards
- Integrate essential and supporting standards within mathematics, integrating math practices
- Integrate relevant reading and writing standards
- Include students in the visible learning process through co-constructing success criteria
- Develop feedback that will move the learning forward, and utilize feedback to inform teaching

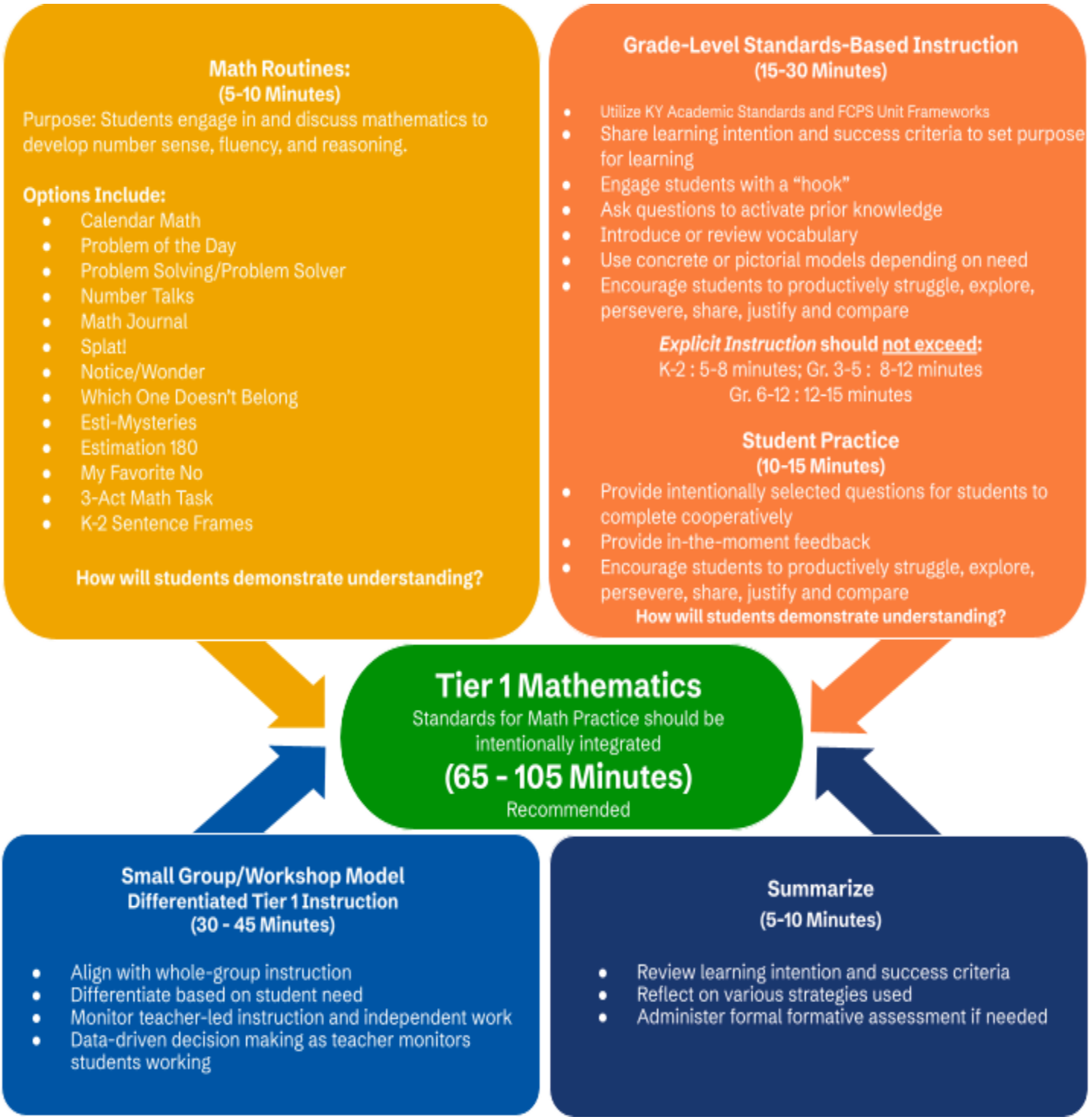
3. Plan for Differentiated Small Group Instruction

- Use Teacher-led Small Groups to differentiate for student needs, including:
    - Use of data to inform instruction
    - Selecting resources to align with concrete, representational, and abstract thinking
    - Scaffolding
    - Students explain their thinking by showing their work
    - Real-world integration
- Create and manage independent math stations (centers) during small-group instruction

4. Integrate the Standards for Mathematical Practice

5. Embed Culturally Responsive Teaching Practices throughout the mathematics block

Instructional Design Model Sample Graphic



Standards For Mathematical Practice

These research-based practices are founded on critical "processes and proficiencies" with longstanding importance in mathematics education. Additional support in engaging the Standards for Mathematical Practice and implementing can be found in the links based on resources from Mathleadership.com, MathSpecialists.org; Georgia Department of Education, and NCTM *Principles to Action*.

1. Make sense of problems and persevere in solving them.
• Identify a problem and make a plan • Explain to themselves the meaning of a problem • Use a variety of appropriate strategies to solve problems • Explain relationships between equations, verbal descriptions, tables, and graphs • Draw diagrams of important features and relationships • Monitor and evaluate their progress and change course if necessary • Check their answers to problems using a different method • Justify their process and outcome
2. Reason abstracting and quantitatively.
• Make sense of numbers and their relationships to problems • Use reasoning to represent how to solve a problem versus computation alone • Know and flexibly use different properties of operations • Use different objects to represent a problem
3. Construct viable arguments and critique the reasoning of others.
• Understand and use situations to construct arguments • Make predictions and use data to support and validate their predictions
4. Model with mathematics.
• Apply the mathematics they know to solve everyday problems • Use tools like tables and graphs to express the solution • Analyze solutions to draw conclusions • Interpret results in the context of the situation
5. Use appropriate tools strategically.
• Consider available tools and resources when solving a mathematical problem • Use estimation to detect possible errors • Use grade-appropriate and technological tools to explore and deepen their understanding of concepts
6. Attend to precision.
• Communicate precisely with others • Use clear definitions in discussions with others • State the meaning of the symbols they choose • Specify units of measure and label axes • Calculate accurately and efficiently
7. Look for and make use of structure.
• Look to find a pattern or structure • Check for the accuracy of the pattern and revise as necessary • See that complex problems can be broken down to make solving easier
8. Look for and express regularity in repeated reasoning.
• Continually evaluate the reasonableness of intermediate results

Technology Strategies

An effective math classroom integrates technology as an essential resource (NCTM, 2014). Below are some universal and content-specific educational technology tools that support and advance mathematical sense-making, reasoning, problem-solving, and communication.

Calculators:

- Research shows that calculator use does not contribute to negative skill development but enhances understanding of math concepts (Ronau et al. 2001, 2021).
- Students should be taught when to use a calculator and when mental computing is more effective or appropriate.
- Calculators should be used
    - to enhance learning opportunities.
    - when the computations become so cumbersome that they hinder learning higher-level concepts.

Sampling of Technology Platforms	
Desmos	Online software with several calculators for student use
Desmos Classroom	Allows for student engagement, voice, and differentiation while providing real-time feedback in synchronous or asynchronous settings
Flip	Microsoft app, where educators create safe, online groups for students to express their ideas asynchronously in short videos, text, and audio messages.
Illuminations	NCTM's digital activities, including manipulatives, applets, and games
MILC	The Math Instructional Learning Community (MILC) is a platform for secondary math teachers focusing on pedagogy, content knowledge, and instructional units of study.
MyViewBoard	An interactive whiteboard app is available on each Interactive Flat Panel in FCPS classrooms. Participate mode allows multiple students to work out problems at once
Pear Assessment	Math teachers can access the Pear Assessment platform, housing Common Unit Assessments and other assessments, by logging into Pear Assessment through Clever.
Polypad	Free interactive digital manipulatives

Balanced Assessment System

To meet the needs of all learners, teachers should use a variety of data to guide instructional decisions regularly.

Data Analysis and Decision-Making

- Balanced Assessment Infographic
- Data-Informed Decision Flowchart
- Systematic Problem-Solving Process
- Five Key Strategies for Effective Formative Assessment: NCTM Research Brief
- Ongoing Classroom Formative Assessments
- Data Protocol Interim Assessments

Acceleration

The FCPS Acceleration Model aims to accelerate learning for all students by increasing their academic confidence by previewing grade-level math content and reinforcing state standards in mathematics cyclically. One of the most critical factors in accelerating student learning during the academic year is access to quality, standards-aligned Tier 1 instruction. According to The New Teacher Project (TNTP) (2018), well-intentioned approaches that pull students out of grade-level instruction to reteach previous grade-level content reinforce low expectations and create vicious cycles of underachievement. Instead, teachers need to provide students with exposure to grade-level expectations scaffolded with just-in-time support necessary for them to engage with the content. To do this, teachers should prioritize prerequisite math skills for the current grade-level standards required for students to be successful.

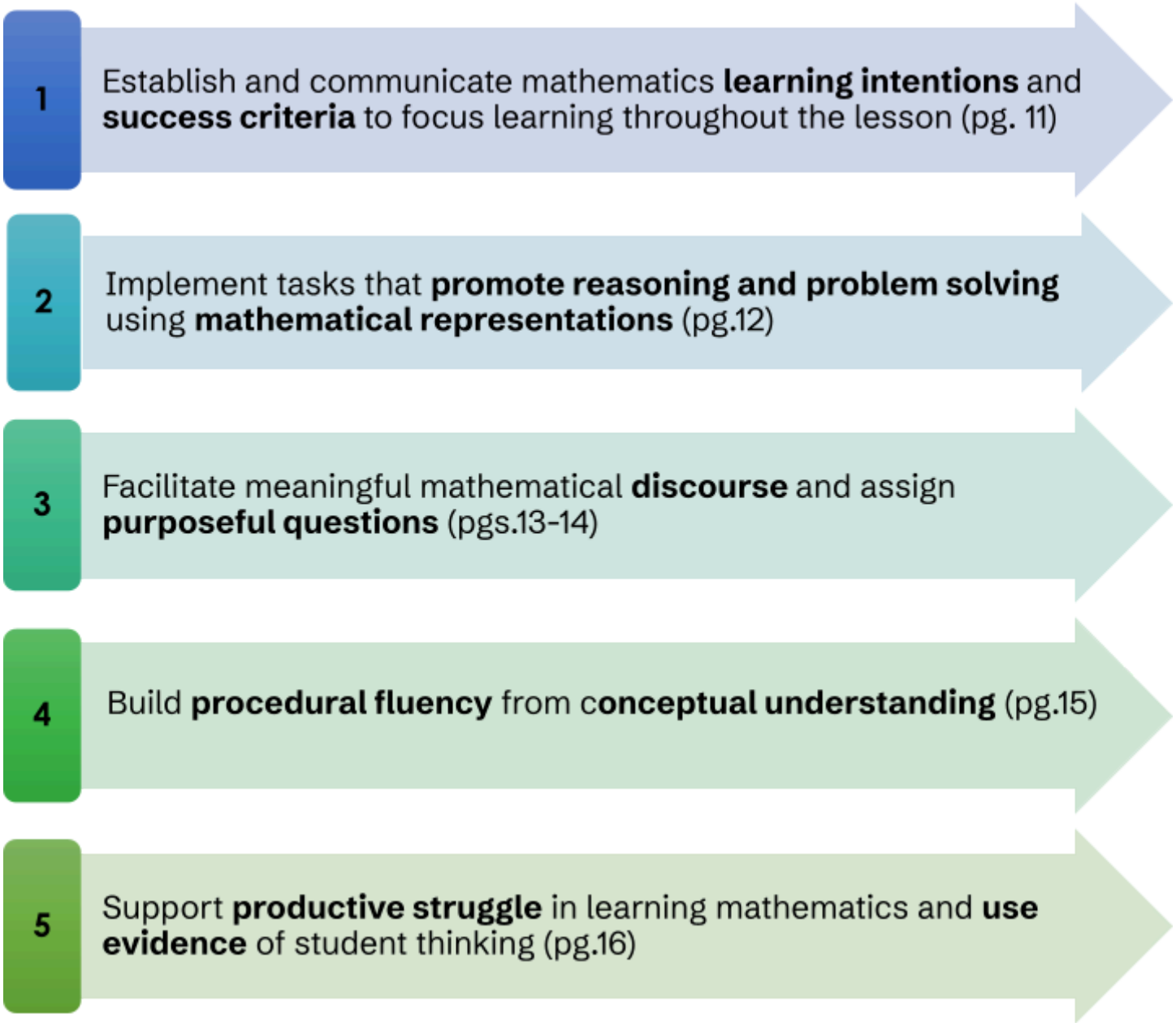
Goals:

1. All students have access to grade-appropriate assignments focused on essential math standards.
2. All students have access to high-quality math instruction that addresses gaps identified through pre-assessment within grade-appropriate assignments focused on essential standards.
3. All students are demonstrating mastery of grade-level math standards.

FCPS Mathematical Teaching Strategies

The teaching of mathematics is complex and requires teachers to deeply understand the mathematical knowledge they teach (Ball, 2008). It is essential for teachers to have a clear view of how student learning of mathematics develops and progresses across grades and in ways that effectively develop mathematics learning for all students (Daro, 2011).

The five FCPS Mathematical Teaching Strategies listed below are adapted from *Principles to Actions: Ensuring Mathematical Success for All* (NCTM, 2014), which lists teaching practices that encourage effective teaching and learning.



1. Establish and communicate Mathematics Learning Intentions to Focus Learning throughout the lesson

Effective teaching of mathematics:

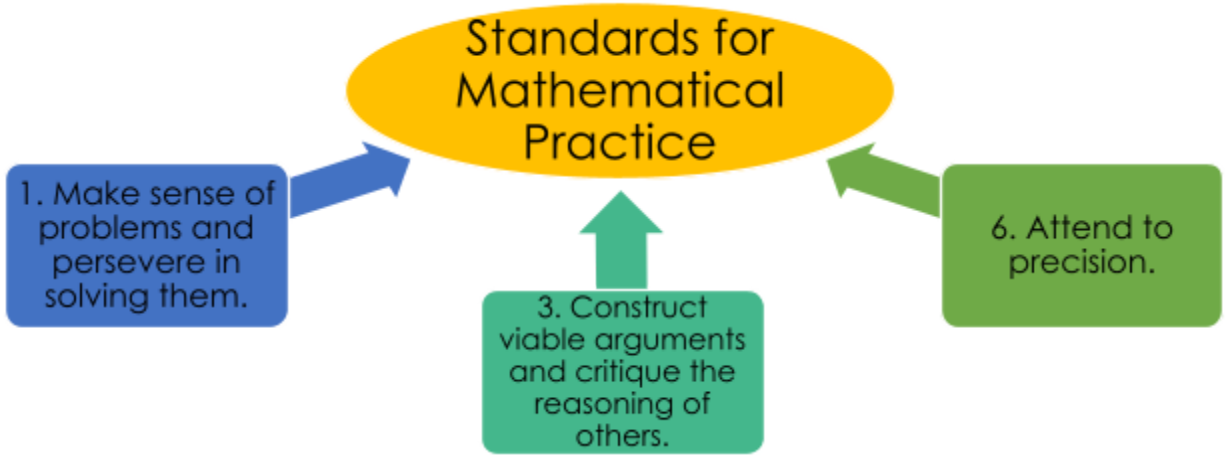
- deconstructs standards to understand the knowledge, skills, and dispositions students should acquire
- establishes clear learning intentions for the mathematics that students are learning
- aligns success criteria with the learning progression and provides clarity on the expected appearance of student exemplars within an instructional unit
- uses the success criteria to guide teachers' instructional decisions as well as students' monitoring of their own progress

Teacher Actions	Student Actions
Establish clear learning intentions that articulate the mathematics students learn as a result of instruction in a lesson, over a series of lessons, or throughout a unit.	Engage in discussions of the mathematical purpose of the learning intention related to their current work in the mathematical classroom (What are we learning? Why are we learning it?)
Identify how learning intentions fit within a mathematics learning progression.	Use the learning intention to stay focused on their progress in improving their understanding of mathematics content and proficiency in using mathematical practices.
Discuss and refer to a lesson's mathematical learning intention and success criteria during instruction to ensure students understand how the current work contributes to their learning.	Connect their current work with the mathematics they studied previously and see where it is going.
Use the mathematics learning intentions to guide lesson planning and reflection and to make in-the-moment decisions during instruction.	Assess and monitor the mathematics learning intentions.

Fig. 1: *Math Goals* NCTM, 2014, p.16

Important Instructional Considerations:

- Communicate what students will understand based on instruction
- Identify mathematical practices that students are learning to use more proficiently
- Should not just be a reiteration of standards, but should be linked to the curriculum and learning



2. Implement tasks that promote reasoning and problem-solving using mathematical representations

Effective teaching of mathematics:

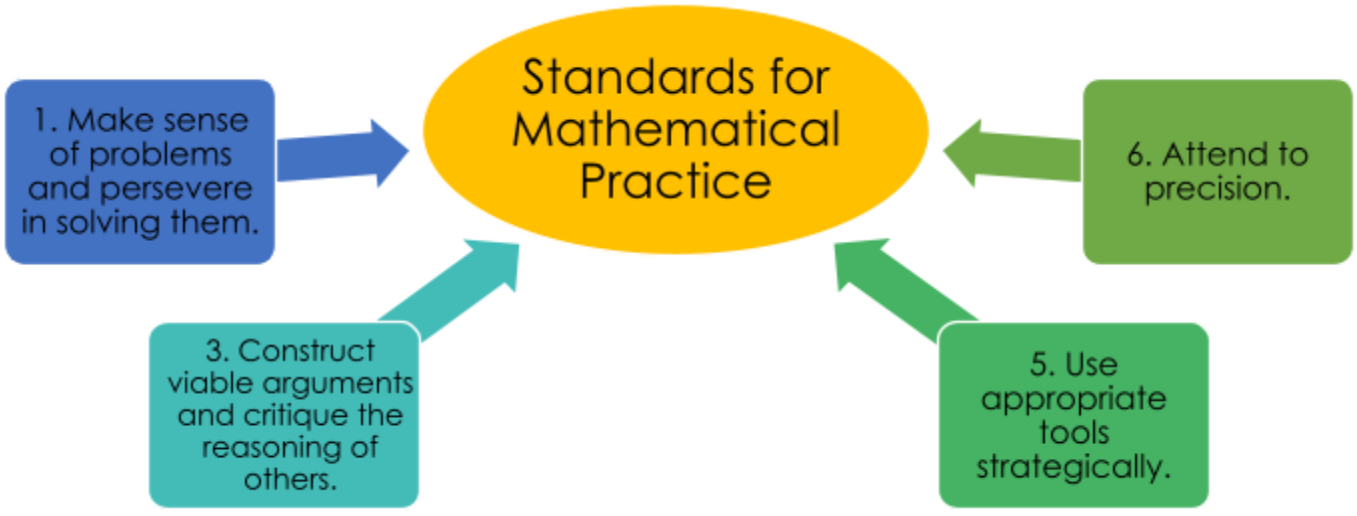
- engages students in solving and discussing tasks that promote mathematical reasoning and problem-solving
- allows for multiple entry points and varied solution strategies
- engages students in making connections among mathematical representations to deepen their understanding of math concepts and procedures, and as tools for problem-solving

Teacher Actions	Student Actions
Motivate students' learning of mathematics through opportunities for exploring and solving problems that build on and extend their current mathematical understanding.	Persevere in exploring and reasoning through tasks.
Select tasks that provide multiple entry points using varied tools and representations.	Take responsibility for making sense of tasks by drawing on and connecting with their prior understanding and ideas.
Pose tasks regularly that require a high level of cognitive demand. Support students in exploring tasks without taking over student thinking.	Use tools and representations as needed to support their thinking and problem-solving.
Encourage students to use varied approaches and strategies to understand and solve tasks.	Accept and expect that their classmates will use a variety of solution approaches and that they will discuss and justify their strategies to one another.
Design ways to elicit and assess students' abilities to use representations meaningfully.	Connect mathematical ideas and concepts to real-world situations.

Fig. 2: *Tasks* NCTM, 2014, pgs. 24 and 29

Important Instructional Considerations:

- Provide rich, open-ended tasks that allow for multiple solutions
- Model and use visual supports
- Help students see the connection between the different representations



3. Facilitate meaningful mathematical discourse and assign purposeful questions

Effective teaching of mathematics:

- facilitates discourse among students to build a shared understanding of mathematical ideas by analyzing and comparing student approaches and arguments

Teacher Actions	Student Actions
Use varied representations to engage students in purposeful sharing of mathematical ideas, reasoning, and approaches.	Present and explain ideas, reasoning, and representations to one another in pairs, small groups, and whole-class discourse.
Scaffold student approaches and solution strategies for whole-class analysis and discussion.	Use examples to support or counterexamples to refute conclusions and solutions.
Facilitate discourse among students by having them justify and explain their reasoning for their answer and approach.	Seek to understand the approaches used by peers by asking clarifying questions, trying out others' strategies, and describing the approaches used by others. Listen to critique the reasoning of peers
Ensure progress toward mathematical goals by making explicit connections to student approaches and reasoning.	Identify how approaches to solving a task are the same and how they are different.
Ask questions that go beyond gathering information. The questions should probe students' thinking and require explanation and justification.	Think carefully about how to clearly present their responses to questions without rushing to respond quickly.

Fig. 3: *Discourse* NCTM, 2014, pgs. 35 and 41

Important Instructional Considerations

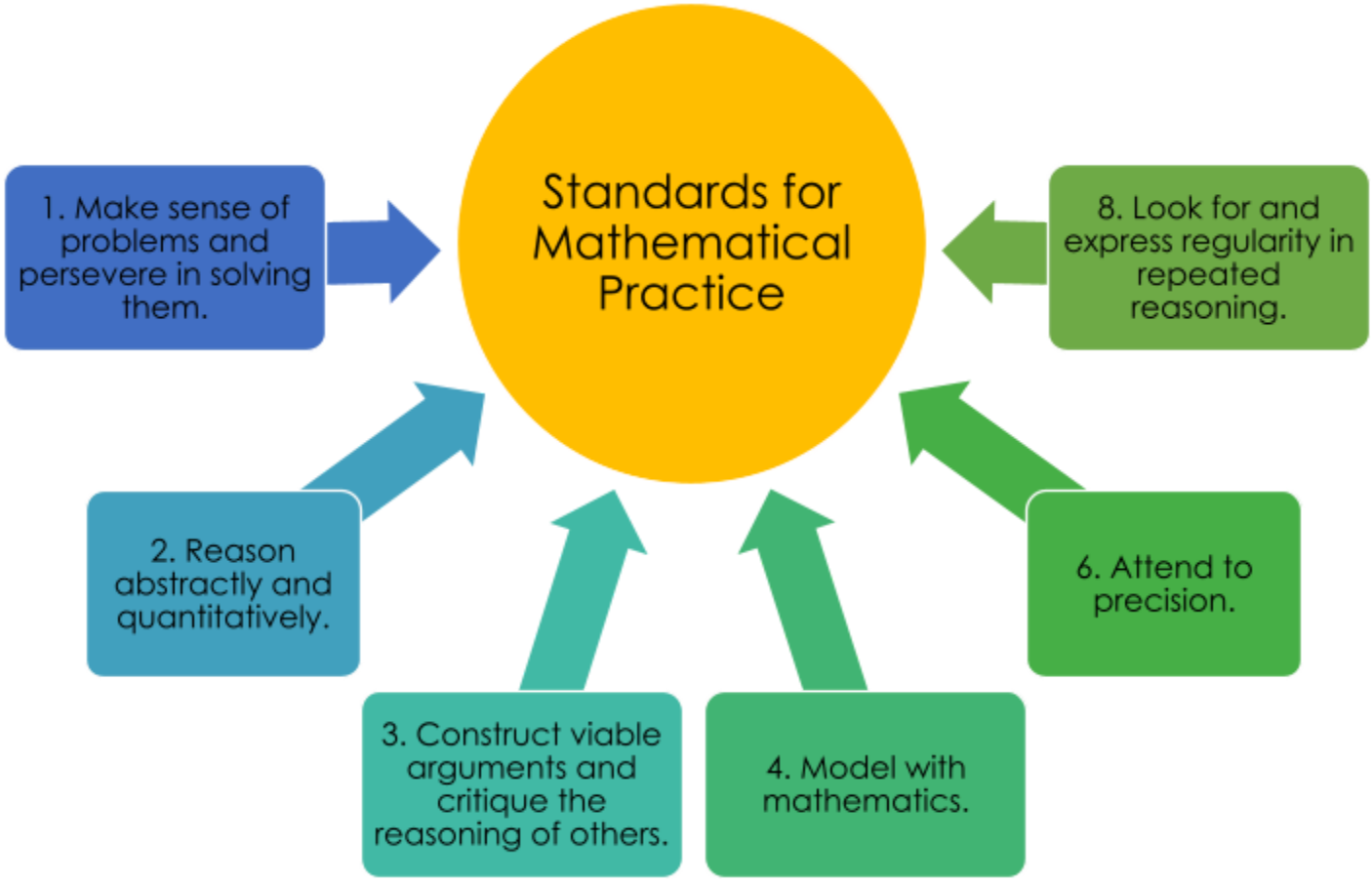
Teacher Role	• Students carry the conversation themselves. • Teacher only guides from the periphery of the conversation. • Teacher waits for the students to clarify the thinking of others.
Questioning	• Student-to-student talk is student-initiated. • Students ask questions and listen to responses. • Many questions ask why and call for justification. • Teacher questions may still guide discourse.
Explaining Mathematical Reasoning	• Teacher follows student explanations closely. • Teacher asks students to contrast strategies. • Students defend and justify their answers with little prompting from teacher.
Mathematical Representations	• Students follow and help shape the descriptions of others' math thinking through math representations and suggest edits to others' representations.
Building Student Responsibility within the Community	• Students believe that they are math leaders and can help shape the thinking of others. • They help shape others' math thinking and accept support from others.

Student Materials:

Depending on the lesson you are building, teachers and students must use representations, communication tools, justification, and responsive classroom techniques.

Provide students with a variety of manipulatives to promote understanding and sense-making of mathematics. (This is not a limited list, but suggestions of tools to have available.)

calculators	number line	base ten blocks	algebra tiles
dice	100s charts	measurement tools	pattern blocks
clocks	graph paper	five and ten frames	Cuisenaire rods
diagrams	number bonds	1 in. or cm tiles/cubes	attribute shapes
tangrams	linking cubes	two color counters	3D shapes
geoboards	fraction pieces	place value chips	money sets
rekenreks	counters	dry erase boards	pentominoes
spinners	dominoes	calculator diagrams	graphing mats



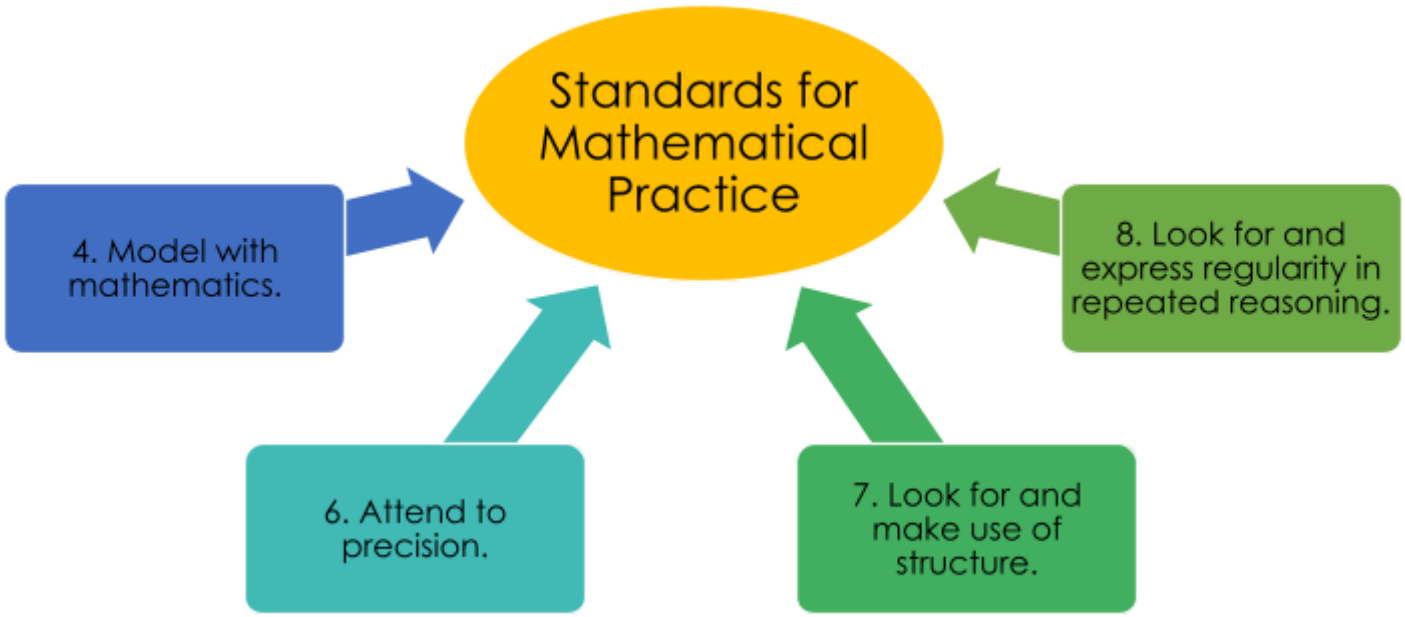
4. Build procedural fluency from conceptual understanding

Effective teaching of mathematics promotes students to be able to:

- Build fluency with procedures on a foundation of conceptual understanding
- Become skillful in flexibly using procedures as they solve contextual and mathematical problems

Teacher Actions	Student Actions
Acknowledge the importance of both conceptual understanding and procedural fluency.	Demonstrate the ability to choose flexibly among methods and strategies to solve problems.
Provide students with opportunities to use their reasoning strategies and problem-solving methods.	Demonstrate knowledge by practicing on a moderate number of carefully selected problems once they have a solid conceptual foundation and can explain the use of the strategy.
Ask students to discuss and explain why their procedures work to solve particular problems.	Access procedures that they can use with an understanding of a broad range of problems.
Connect student-generated strategies and methods to more efficient procedures as appropriate.	Know which procedure is appropriate and most productive in a given situation.
Use visual models to support students' understanding of general methods.	Are able to explain their approaches and can produce accurate answers efficiently.
Provide students with opportunities for continuous practice of procedures.	
Provide students with time to practice math facts.	

Fig. 4: *Fluency* NCTM, 2014, pg.47



5. Support productive struggle in learning mathematics and use evidence of student thinking

Effective teaching of mathematics:

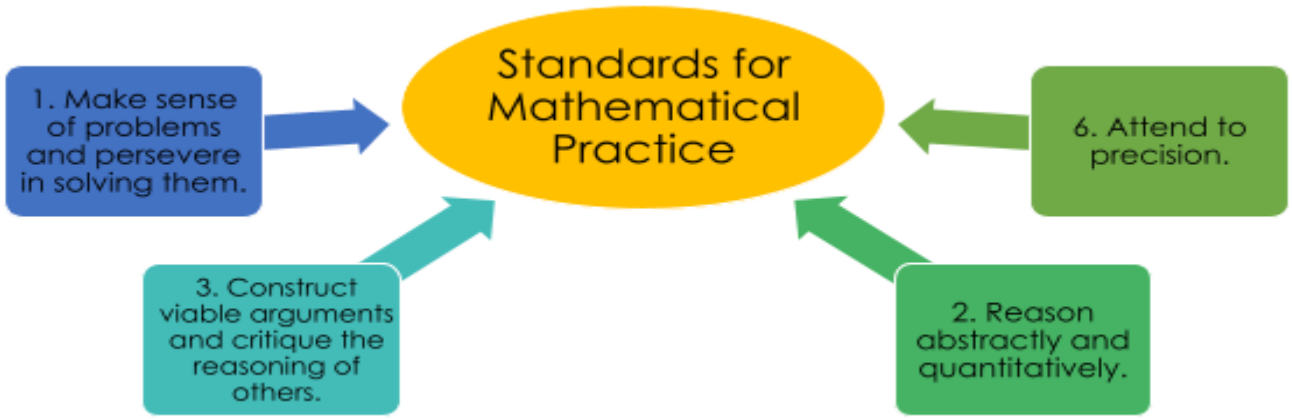
- Consistently provides students with opportunities and support to engage in productive struggle
- Opportunities for delving more deeply into understanding the mathematical ideas
- Able to apply their learning to new problem situations
- Uses evidence of student thinking to assess progress toward understanding
- Uses evidence to adjust instruction continually in ways that support and extend

Teacher Actions	Student Actions
Anticipate what students might struggle with during a lesson and be prepared to support them productively through the struggle.	Struggle sometimes with mathematics tasks, but know that breakthroughs often emerge from confusion and struggle.
Give students time to struggle with tasks and ask questions that scaffold students' thinking without stepping in to do the work for them.	Ask questions related to the sources of their struggles and help them progress in understanding and solving tasks.
Help students realize that confusion and errors are a natural part of learning by facilitating discussion on mistakes, misconceptions, and struggles.	Persevere in solving problems and realizing that it is acceptable to say, "I don't know how to proceed here," but it is not acceptable to give up.
Praise students for their efforts in making sense of mathematical ideas and their perseverance in reasoning through problems.	Help one another without telling their classmates the answer or how to solve the problem.
Elicit and gather evidence of student understanding at strategic points during instruction.	Reflect on mistakes and misconceptions to improve their mathematical understanding.
Make in-the-moment decisions on responding to students with questions and prompts that probe, scaffold, and extend.	Assess and monitor their progress toward mathematics learning goals and identify areas they need to improve.

Fig. 5: *Student Thinking* NCTM, 2014, pgs. 52 and 56

Important Instructional Considerations:

- Consider and discuss a growth mindset and the importance of mistakes for learning
- Students question and critique the reasoning of their peers
- Students reflect on their own understanding
- Students have access to tools that will support their thinking processes



Section 3: Special Considerations

MTSS

A Multi-Tiered System of Supports (MTSS) is a framework that provides schools with structures for designing a seamless continuum of instruction and aligning resources. MTSS is designed to prevent students from needing intensive intervention by ensuring all students have access to high-quality, evidence-based instructional practices implemented as designed. The comprehensive MTSS framework houses Response to Intervention (RTI), including academic and social behavior interventions and support, integrated school mental health, and social-emotional learning.

- FCPS MTSS Guidance Document
- FCPS Multi-Tiered System of Supports One Pager
- FCPS MTSS Framework Brief
- Math Intervention Strategies/Programs
- Intervention Models

English Learners and Dual Language Immersion

Teaching mathematics to Dual Language Immersion and English Learners requires careful attention to their unique linguistic and cultural needs. Instruction should incorporate culturally relevant examples, problems, and contexts and be differentiated to meet students' needs. Scaffolds and supports should be gradually released to foster independence. Below are some considerations for ensuring equitable access to grade-level mathematical concepts and skills for language learners.

Mathematics teachers must attend to all students, including those who speak a first language other than English or have related cultural differences, and ensure that all have access and opportunities to learn mathematics and to reveal what they know. Students who are not fluent in English can learn math at grade level or beyond while they are learning English when appropriate strategies are used (NCTM 2014, 63).

Input (Listening & Reading) Provide scaffolds for oral and written instruction and task completion	**Output (Speaking & Writing)** Provide scaffolds for oral and written student responses
• Simplify & clarify language. Use clear and concise explanations, avoiding excessive jargon or complex sentence structures. • Build background knowledge • Link instruction to prior experiences • Reinforce academic language • Provide visual supports (pictures, props, real-life examples) • Provide non-verbal supports (gestures & facial expressions) • Provide manipulatives and model how to use • Adapt the pace of instruction (frequent checks for understanding, wait time) • Provide reference materials in the home language	• Provide intentional opportunities for peer interaction, including academic conversations with peers and structured and intentional peer coaching • Provide differentiated sentence stems and/or sentence frames • Provide word banks as needed • Develop interactive word walls, anchor charts, and reference sheets • Provide written cues (acronyms, checklists, graphic organizers) • Give students choice in demonstrating learning (oral, written, pictures, numbers) • Provide extended time for task completion as needed

Student Voice

Student Voice is an opportunity for teachers to receive feedback from students related to their learning experiences. It provides formative evidence for teacher reflection to improve classroom culture and instructional practices. Feedback is a part of the adjustment of practice in the FCPS Instructional Playbook.

The following criteria represent student expectations for a mathematics classroom as collected in feedback sessions from Fayette County students:

real-world examples	engaging activities	hands-on learning	technology
differentiated assignments	immediate feedback	study guides and supports	guided instruction

Special Education

Students receiving special education services are provided mathematical accommodations according to their Individualized Education Program (IEP) or 504 Plan. Equity requires reasonable and appropriate accommodations to promote all students' access and attainment (NCTM 2000, 12). FCPS also provides resources to families to support IEPs.

Some things to consider and plan for as you work with students with an IEP:

- Students with a reading disability may need word problems read to them. The IEP will clarify if the student should be offered a text reader option before offering a human reader.
- Students with ADD/ADHD might need a timer and a goal of completing a certain number of problems before the timer goes off. They may also need directions given to them in multiple modalities (verbal, written, visual) and repeated/ rephrased, checking for understanding of the directions, especially when providing multi-step directions.
- Some students may need a choice of manipulatives, while others may need virtual manipulatives. Always make sure you have modeled how to use the manipulatives.
- Some students may receive a calculator as an accommodation on their IEP. Always make sure you have modeled how to use the calculator.

Gifted and Talented

The Fayette County Public Schools (FCPS) Gifted Education program aims to provide high-quality, differentiated instruction supported by a challenging and rigorous curriculum (Product, Process, Content, Learning Environment). Specifically, the Gifted and Talented (GT) program is designed to meet all students' needs and interests, demonstrating math potential. Services provided to gifted math students include, but are not limited to subject acceleration, enrichment services, resource opportunities, grouping of students with like abilities, and independent study experiences, as discussed in the FCPS GT Overview for Families.

Students with exceptional mathematical promise must be engaged in enriching learning opportunities during and outside the school day to allow them to pursue their interests, develop their talent, and maintain their passion for mathematics. Opportunities must be open to a wide range of students who express a higher interest in mathematics, not just those identified through traditional assessments.

Section 4: Grade-Level Critical Skills

Developed by FCPS teachers and aligned with Advanced Ed Standards, these critical skills are essential learning for mastery of grade-level content. It should ***not*** be interpreted as a complete list of all topics to be taught. The tool is aligned with the *Articulating Expected Mastery of Skills and Standards* and *High Learning Expectations for Students*. The Mathematical Practices and standards-based content vocabulary are embedded. Printables are available on Navigator in both English and Spanish.

Kindergarten:

- Know number names and the count sequence. Count (forward) to 100 by 1's and 10's and count forward or backward from a given number within 30.
- Identify and write numbers 0 to 20.
- Count to tell the number of objects to 20. Count out objects to represent a number to 20.
- Compare numbers (greater than, less than, or equal to) another number within 10.
- Tell the next number that is one more (or one larger) and the number before that is one less (or one fewer), within numbers to 20.
- Understand addition as putting together and adding to. Understand subtraction as taking apart and taking from. **Required fluency:** Add and subtract within 5 using mental math.
- Work with numbers 11–19 to gain foundations for place value.
- Add to a given number to make 10 and record the answer with drawings and equations.
- Describe and compare measurable attributes.
- Classify objects and count the number of objects in categories.
- Identify, describe, create, compare, and compose 2D and 3D shapes (square, circle, rectangle, triangle, hexagon, cube, cone, cylinder, and sphere).

1st Grade:

- Count forward to and backward from 120, starting at any given number.
- Read, write, and represent any given numeral between 0 and 120.
- Compare numbers (greater than, less than, or equal to) to another number within 100.
- Represent and solve problems involving addition and subtraction.
- Understand and apply properties of operations and the relationship between addition and subtraction to add and subtract within 20. **Required fluency:** Add and subtract within 10.
- Work with addition and subtraction equations within 100, using different strategies, including models. Work with 3 types of addition and subtraction problems: result unknown, change unknown, and start unknown. Model add-to, take-from, put-together, take-apart.
- Understand that the position of each digit in a number impacts the quantity of a number.
- Use place value understanding and properties of operations to add and subtract.
- Measure lengths indirectly and by iterating length units. Order 3 objects by length.
- Tell and write time to the hour and half hour, using *both* analog and digital clocks.
- Recognize and understand patterns in a 0-99 chart and a hundreds chart.
- Reason with shapes & attributes (compare, compose, decompose, partition into equal parts).

2nd Grade:

- Count forwards and backward within 1000; skip count by 5s, 10s, and 100s.
- Read, model, and write numbers up to 1000 using base-ten numerals, number names, diagrams, number sentences, and expanded form.
- Explain the value of each digit in a 3-digit number, including zeros in the tens or one's place.
    - Understand the difference between place and value.
- Use place value understanding and operation properties to represent and solve addition and subtraction problems.
- **Required fluency:** Recall from memory all single-digit sums and differences within 20.
- **Required fluency:** Fluently add and subtract 2-digit numbers within 100.
- Measure and estimate lengths in standard units. Relate addition and subtraction to length.
- Count and solve word problems with pennies, nickels, dimes, quarters, bills, and symbols.
- Identify and represent fractional parts of a whole (halves, thirds, fourths).

3rd Grade:

- Represent and solve problems involving multiplication and division. Required fluency: Single-digit products and quotients from memory by the end of Grade 3.
- Understand the properties of multiplication *and the relationship* between multiplication and division. **Required fluency:** Multiply and divide within 100.
- Solve problems involving the four operations and identify and explain patterns in arithmetic.
- Use place value understanding and properties of operations to perform multi-digit arithmetic. Required fluency: Add and subtract within 1000.
- Develop an understanding of fractions as numbers (beginning with unit fractions).
- Represent fractions on a number line.
- Compare fractions of denominators 2, 3, 4, 6, and 8 using a visual fraction model with either the same numerators or the same denominators.
- Generate equivalent fractions of denominators 2, 3, 4, 6, and 8.
- Understand the concept of area. Relate area to multiplication and to addition using arrays.

4th Grade:

- Generalize and use place value understanding and properties of operations to perform multi-digit arithmetic. **Required fluency:** Add and subtract within 1,000,000.
- Use the four operations with whole numbers to solve multi-step word problems.
- Multiply 4x1 and 2x2 numbers and find quotients and remainders with up to 4-digit dividends and 1-digit divisors.
- *Extend* 3rd-grade understanding of fraction equivalence and ordering to include denominators of 5, 10, 12, and 100 using visual fraction models.
- Add and subtract proper fractions, improper fractions, and mixed numbers with like denominators using visual fraction models and equations. Build fractions from unit fractions.
- Multiply a fraction by a whole number using models and equations.
- Understand decimal notation. Compare two decimals to hundredths.
- Locate fractions and decimals on a number line.
- Solve problems involving measurement *and conversion* of measurements from a larger unit to a smaller unit (including ALL standard measures, ALL metric measures, money, and time).
- Understand concepts of angles and measure angles with a protractor.

5th Grade:

- Understand the place value system, including decimals to thousandths.
- Perform all four operations with multi-digit whole numbers, including the order of operations (including parentheses and brackets). Required fluency: Multi-digit multiplication (a 3—or 4-digit number multiplied by a 2—or 3-digit number).
- Add, subtract, multiply, and divide decimals to hundredths.
- Compare decimals to the thousandth place.
- Round decimals to the thousandth place.
- Add and subtract fractions and mixed numerals (including unlike denominators).
- Multiply fractions and mixed numerals. Divide fractions in limited cases (unit fractions divided by whole numbers and whole numbers divided by unit fractions).
- Find the area of a rectangle with fractional side lengths.
- Understand concepts of volume and relate volume to multiplication and addition.
- Graph points on the coordinate plane to solve real-world and mathematical problems.
- Classify two-dimensional figures into categories based on their properties.
- Generate 2 numerical patterns given two rules.

6th Grade:

- Extend understanding of fractions and decimals.
- Understand and use ratios, ratio reasoning, and unit rates.
- Solve algebraic expressions.
- Solve and interpret 1-step equations and 1-step inequalities.
- Construct, analyze, and interpret data in various graphical manners (number line, line plot, dot plot, histogram, box plot, distribution); compute mean, median, mode, and range.
- Find the area of complex 2-D figures (including composing or decomposing figures) and review the volume of 3-D figures with fractional side lengths.
- Represent and understand integers and position on both horizontal and vertical number lines, including ordering, comparing, and absolute value.
- Extend understanding of the coordinate plane to all four quadrants, including drawing polygons using coordinates.

7th Grade:

- Extend understanding of ratios; analyze and use proportional reasoning, including scale drawings.
- Represent proportional relationships with the constant of proportionality in tables, graphs, equations, and verbal descriptions.
- Solve and apply percent problems, including tax, gratuities, discounts, simple interest, and percent of change.
- Perform operations on rational numbers, including integers, fractions, and decimals.
- Determine and analyze probabilities by constructing sample space, conducting samples, and conducting experiments.
- Solve problems involving the area and circumference of circles and calculate the surface area and volume of 3-D figures.
- Solve equations for unknown angle measures, including complementary, supplementary, vertical, and adjacent angles.
- Use central tendency and variability to compare two sets of data.
- Solve and interpret multi-step equations and inequalities.

8th Grade:

- Work with irrational numbers, radicals, and integer exponents.
- Graph linear equations and extend understanding of slope as the rate of change.
- Solve multi-step equations, including those with variables on both sides, the distributive property, and combining like terms.
- Solve systems of two linear equations in two variables algebraically and estimate solutions graphically (both by hand and on a graphing calculator).
- Investigate and interpret patterns of association in bivariate data using scatter plots and lines of fit.
- Define, evaluate, and compare functions using tables, graphs, equations, and verbal descriptions.
- Understand and apply the Pythagorean Theorem.
- Work with transformations in a coordinate plane.
- Prove assumptions using parallel lines cut by a transversal.

Algebra 1:

- Solve multi-step equations and inequalities in one variable and represent the solution on a number line.
- Write and graph linear equations in two variables that model real-world situations.
- Solve systems of equations by multiple methods and interpret their solutions in context.
- Use function notation to perform arithmetic operations; find domain and range of functions.
- Perform arithmetic operations on polynomials.
- Use rational and irrational numbers in the appropriate context of a problem.
- Factor quadratic functions; Solve and graph quadratic equations using multiple methods.
- Summarize, represent, and interpret one or two variable data.

Geometry:

- Use logic and proof to reason mathematically; make conjectures about points, lines, angles, planes, polygons, and other geometric figures.
- Use various methods to prove that figures are congruent or similar.
- Classify polygons by their properties and use those properties to solve problems (parallel, perpendicular, angle relationships, triangles, etc.).
- Use coordinate geometry (midpoint, distance, circles, parabolas) to analyze figures and solve problems.
- Use properties of circles to solve problems with chords, secants, tangents, inscribed angles…
- Introduce basic trigonometry concepts, including the Pythagorean Theorem, sine, cosine, tangent, 45-45-90, and 30-60-90 triangles, and use trig ratios to solve real-world problems.
- Use surface area to analyze three-dimensional figures, including cross-sections and ratios of perimeter, area, and volume.

Algebra 2:

- Solve multistep linear equations and compound inequalities involving absolute value and graph the solution on a number line when applicable.
- Solve systems of equations and inequalities using multiple methods as appropriate.
- Solve and graph quadratic equations using real and complex numbers; use the discriminant to determine the number and types of solutions; find the domain and range.
- Factor, solve, and graph polynomial equations. Determine the type of zeros for a polynomial; use maximums, minimums, zeros, and intercepts to graph polynomials; find domain and range.
- Use operations on radical expressions and solve equations. Include rational and negative exponents, nth roots, and rationalizing denominators.
- Use logarithms to simplify expressions and solve equations.
- Perform operations on rational expressions and solve rational equations.
- Use the counting principle to find the number of ways an event can happen and the probability of that event.
- Find the nth term in an arithmetic or geometric sequence, and find the sum of a series.

Section 5: Professional Learning

Mathematics-Specific Professional Learning

The Office of Teaching and Learning provides professional learning to support teachers with literacy instruction. Support may be provided through learning sessions led by instructional specialists, coaching, modeling, or a combination of all three.

Section 6: Cross-Curricular Connections

Kentucky Interdisciplinary Literacy Practices

The Interdisciplinary Literacy Practices collectively and independently support KDE's vision. This vision aims to empower every Kentucky student with the academic, cognitive, metacognitive, technical, and employability skills needed for success beyond high school while fostering the ability to make positive contributions to their communities. These practices serve as a means for students to engage deeply with the content. Therefore, opportunities for students to apply these practices should be seamlessly integrated into their learning experiences. They are essential for accessing, processing, and effectively communicating information.

- Recognize that text is anything that communicates a message.
- Employ, develop, and refine schemas to understand and create text.
- View literacy experiences as transactional, interdisciplinary, and transformational.
- Utilize receptive and expressive language arts better to understand self, others, and the world.
- Apply strategic practices, with scaffolding, and then independently, to approach new tasks.
- Collaborate with others to create new meaning.
- Utilize digital resources to learn and share with others.
- Engage in specialized, discipline-specific literacy practices.
- Apply high-level cognitive processes to think deeply and critically about text.
- Develop a literacy identity that promotes lifelong learning.

Literacy Connections in Mathematics

Writing to Learn in Mathematics Instruction

- Occurs regularly in mathematics classes
- Provides opportunities for students to
    - think metacognitively and organize their own thoughts with the given information
    - share information with others for feedback and discussion
    - continuously revise their thinking as they gain a deeper understanding of the task
- Routines for Reasoning
- Data Talks
- I Notice, I Wonder
- Mathematical Language Routines
- Three-Act Tasks
- FCPS Close Reading and Writing Strategies for Mathematics

Science, Technology, Engineering, Mathematics (STEM)

- Science Connections to the Common Core State Standards for Mathematics
- Middle School Math Teams are offered for all students at all FCPS Middle Schools to increase enthusiasm for and enhance math achievement. Academic Challenge is promoted at the elementary school level.

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