Effective Math Instruction

DAY 1

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Introduce yourself.

Describe your role as an educator.

Describe the mathematics you support.

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Schedule for Today

8:00-8:25	- Introductions - Trajectories in mathematics
8:25-9:15	- Critical math content - Evidence-based practices
9:15-9:25	BREAK
9:25-10:25	- Evidence-based practice: Systematic instruction
10:25-11:30	- Evidence-based practice: Fluency with facts - Evidence-based practice: Multiple representations
11:30-1:00	LUNCH
1:00-2:15	- Evidence-based practice: Fluency with computation - Multiple representations: Whole numbers
2:15-2:25	BREAK
2:25-4:00	- Multiple representations: Rational numbers - Multiple representations: Pre-algebra - Multiple representations: Geometry

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Schedule for Tomorrow

8:00-9:30	- Language of mathematics
9:30-9:40	BREAK
9:40-10:15	- Evidence-based practice: Word-problem solving
10:15-10:30	- Word-problem solving: Ineffective strategies
10:30-11:00	- Word-problem solving: Attack strategies
11:00-11:30	- Word-problem solving: Total problems
11:30-1:00	LUNCH
1:00-2:15	- Word-problem solving: Difference problems - Word-problem solving: Change problems - Word-problem solving: Equal groups problems - Word-problem solving: Comparison problems
2:15-2:25	BREAK
2:25-4:00	- Word-problem solving: Ratios/Proportions problems - Word-problem solving: Multi-step problems - Wrap-up

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Trajectories in Mathematics

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Effective Mathematics Practices
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Mathematical Trajectories

Critical Content

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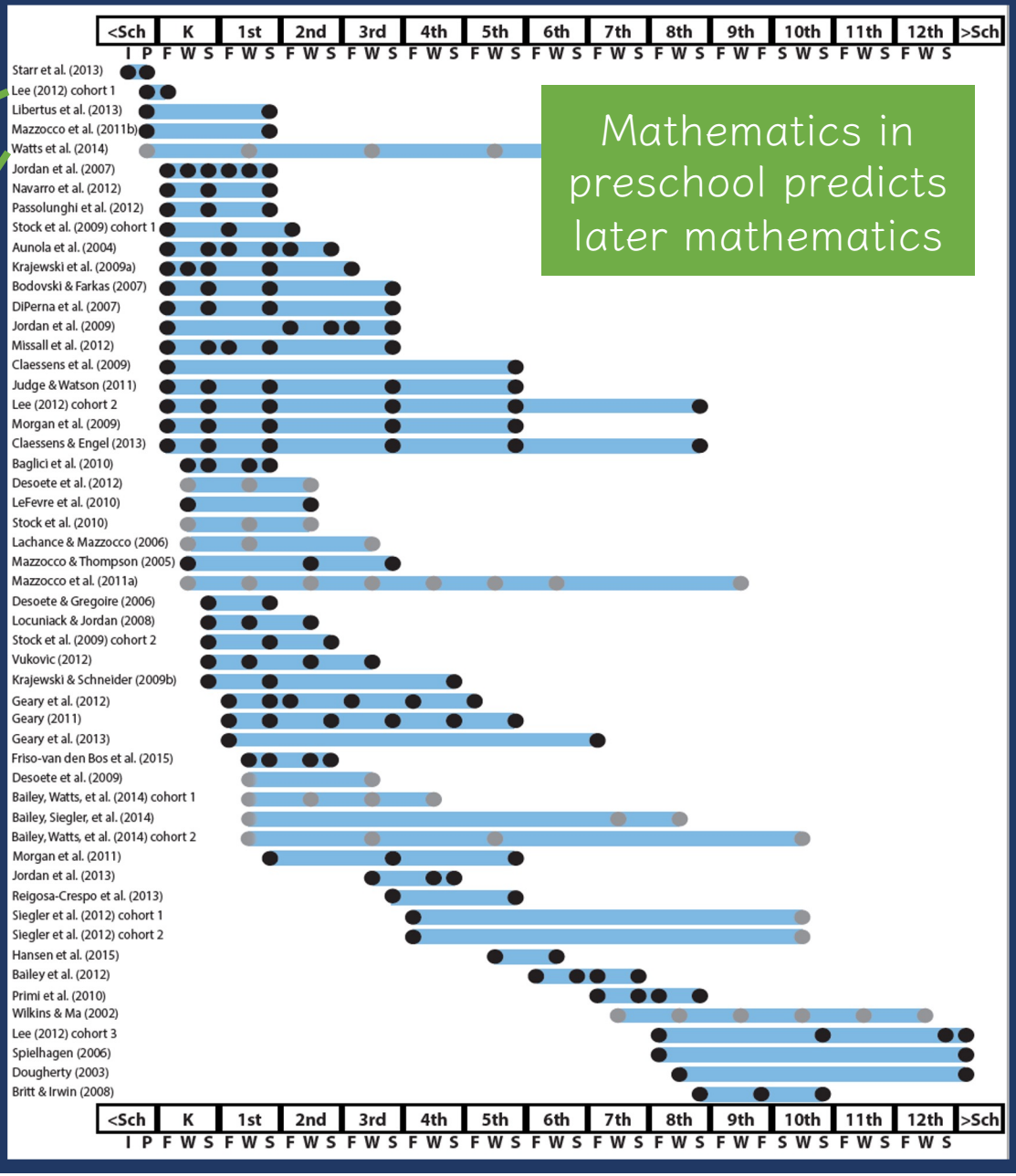
Broad math in preK predicted K broad math

Broad math in preK predicted grade 10 broad math



Mathematics in preschool predicts later mathematics

http://www.greatertexasfoundation.org/trajectories-of-mathematics-performance/

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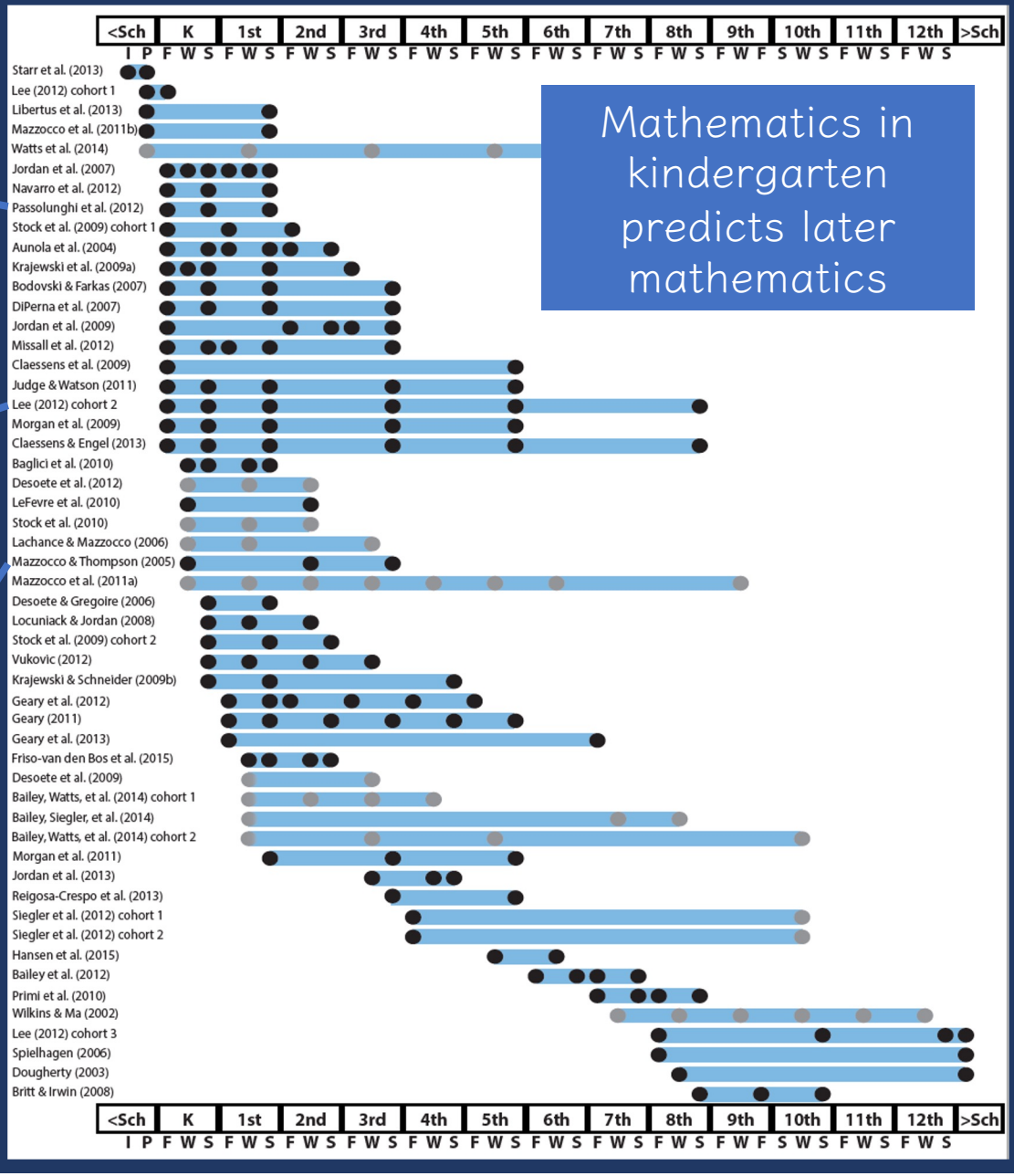
Counting in K predicted grade 1 broad math

Broad math in K predicted grade 8 broad math

K math accurately predicted math performance below 10th percentile in grades 2 and 3 with 84% correct classification



Mathematics in kindergarten predicts later mathematics

http://www.greatertexasfoundation.org/trajectories-of-mathematics-performance/

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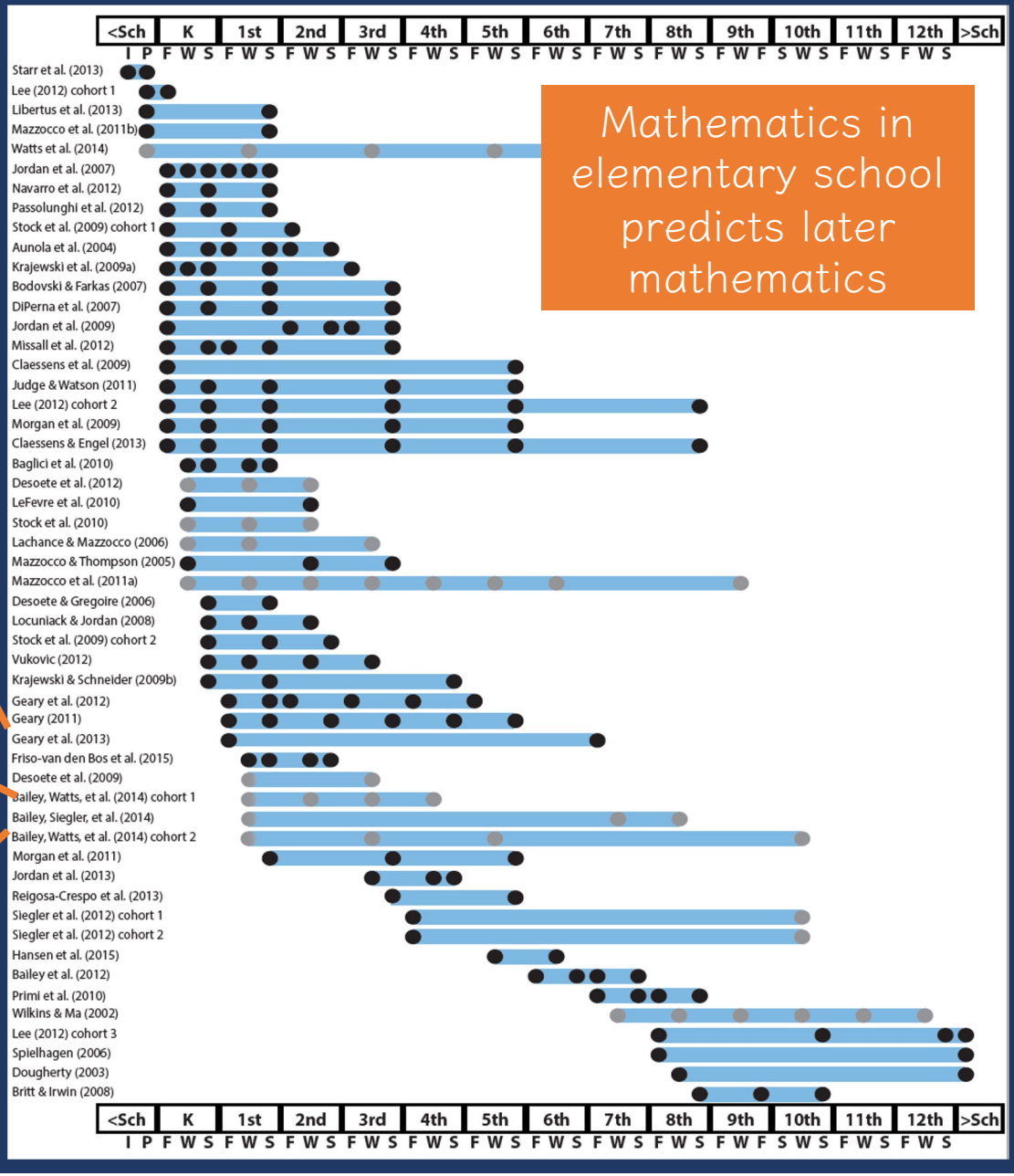
Addition influenced arithmetic with increasing importance from grades 1 to 5

Grade 1 arithmetic predicted arithmetic at grades 2, 3, and 4

Grade 1 broad math predicted broad math at grades 3, 5, and 10



Mathematics in elementary school predicts later mathematics

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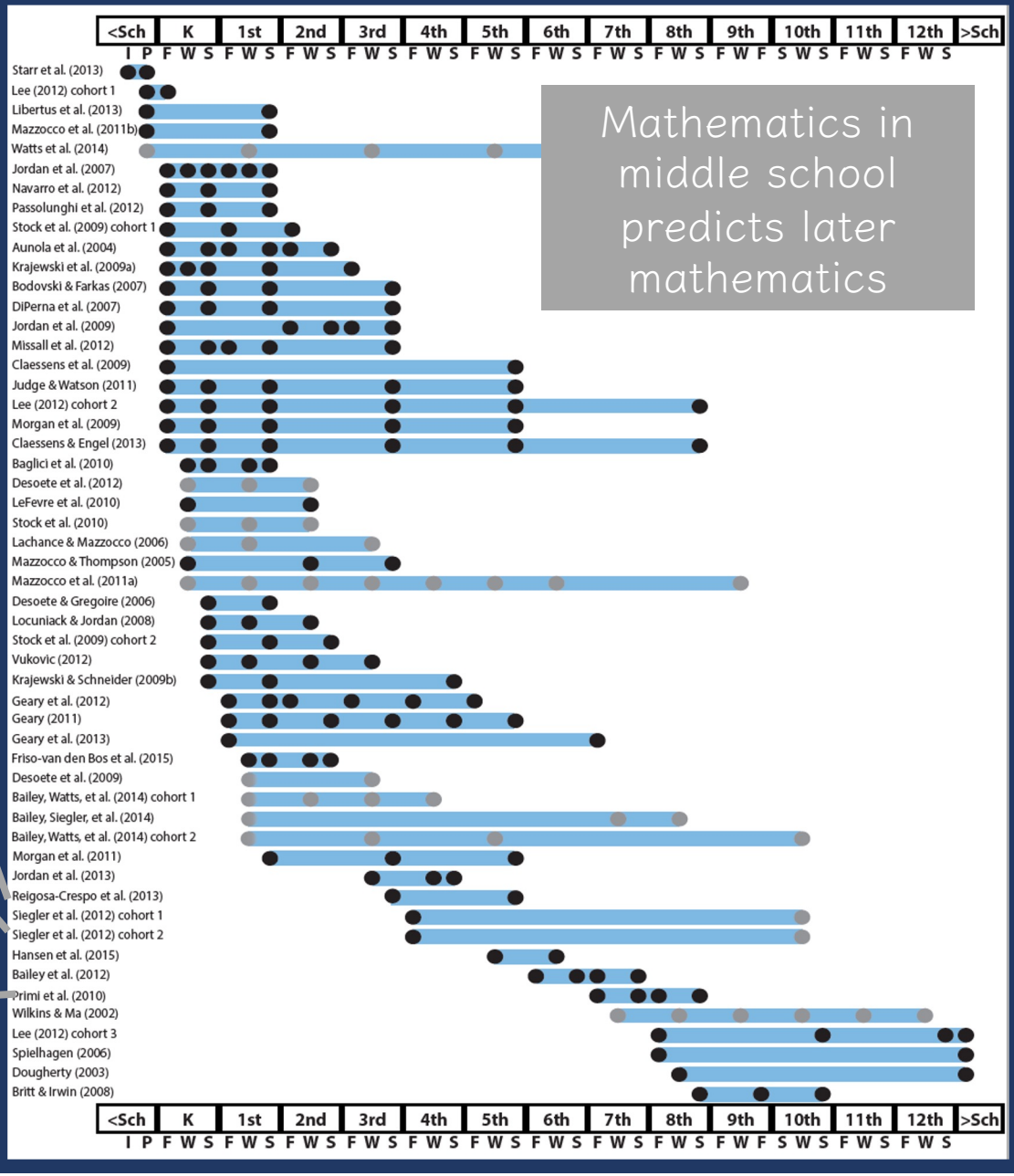
Counting and comparison in grades 2 or 4 predicted broad math 1 year later

Fractions at 10-12 years old predicted broad math 5 years later

Broad math in grade 7 predicted broad math in grade 8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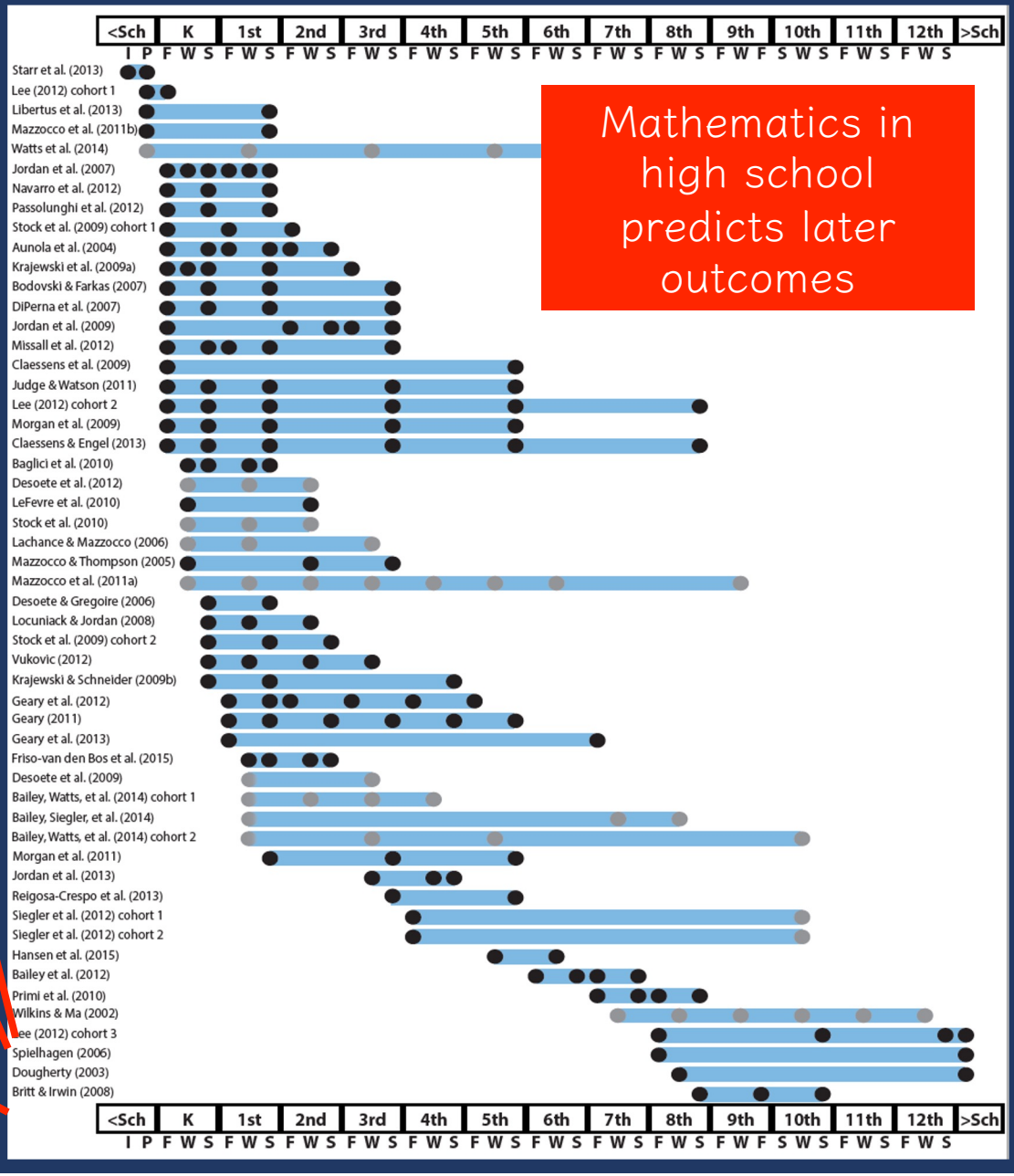
Broad math in grade 8 predicted completion of 4-year college degree

Students who took algebra in grades 8 took more advanced math courses and enrolled in 4-year colleges more often than students who took algebra in grade 9

Numeracy measured in adolescence impacted hourly earnings 7 to 15 years later



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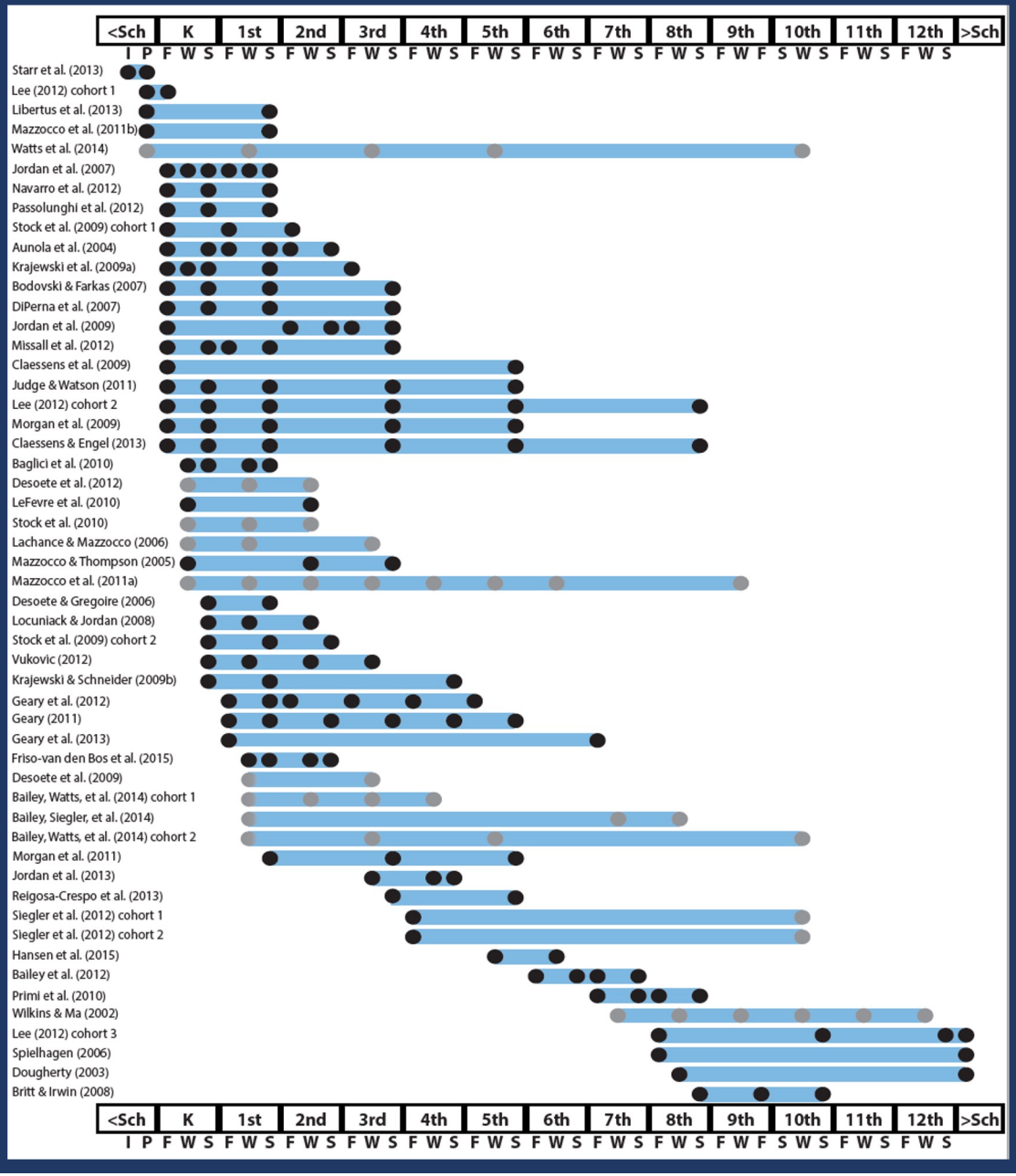
Mathematics in preschool predicts later mathematics

Mathematics in kindergarten predicts later mathematics

Mathematics in elementary school predicts later mathematics

Mathematics in middle school predicts later mathematics

Mathematics in high school predicts later outcomes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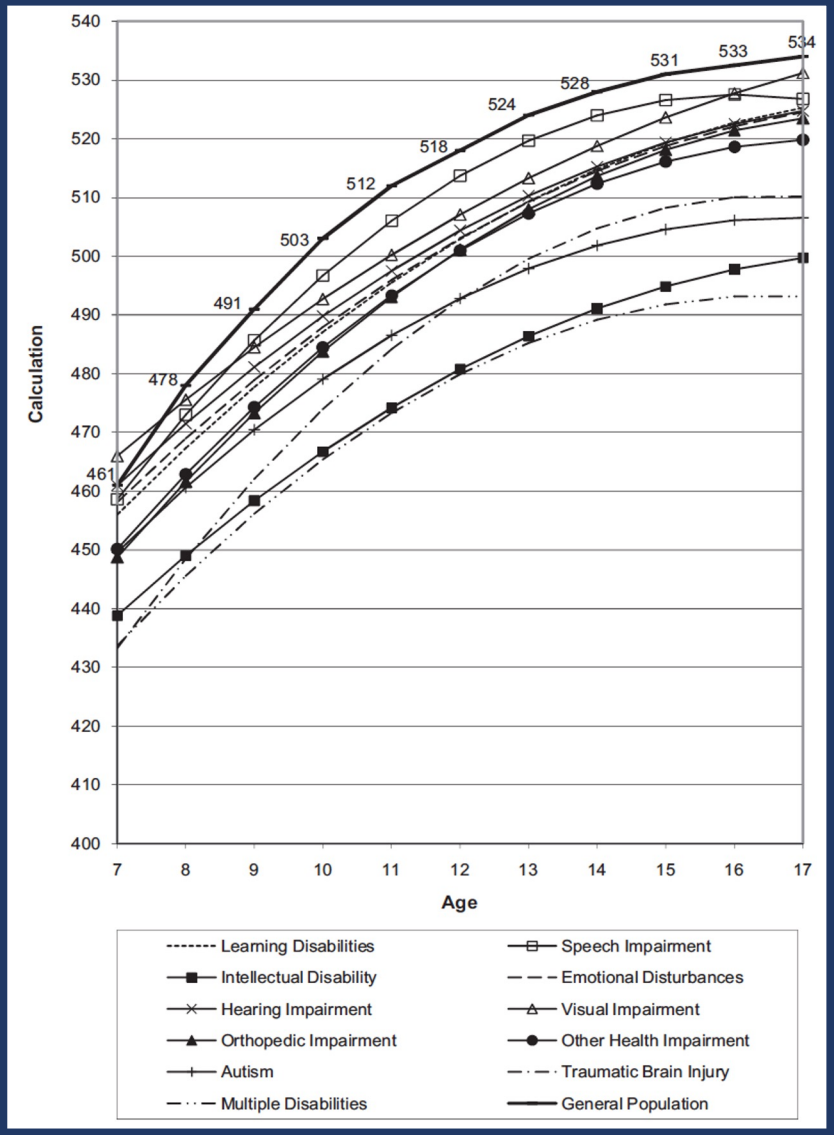
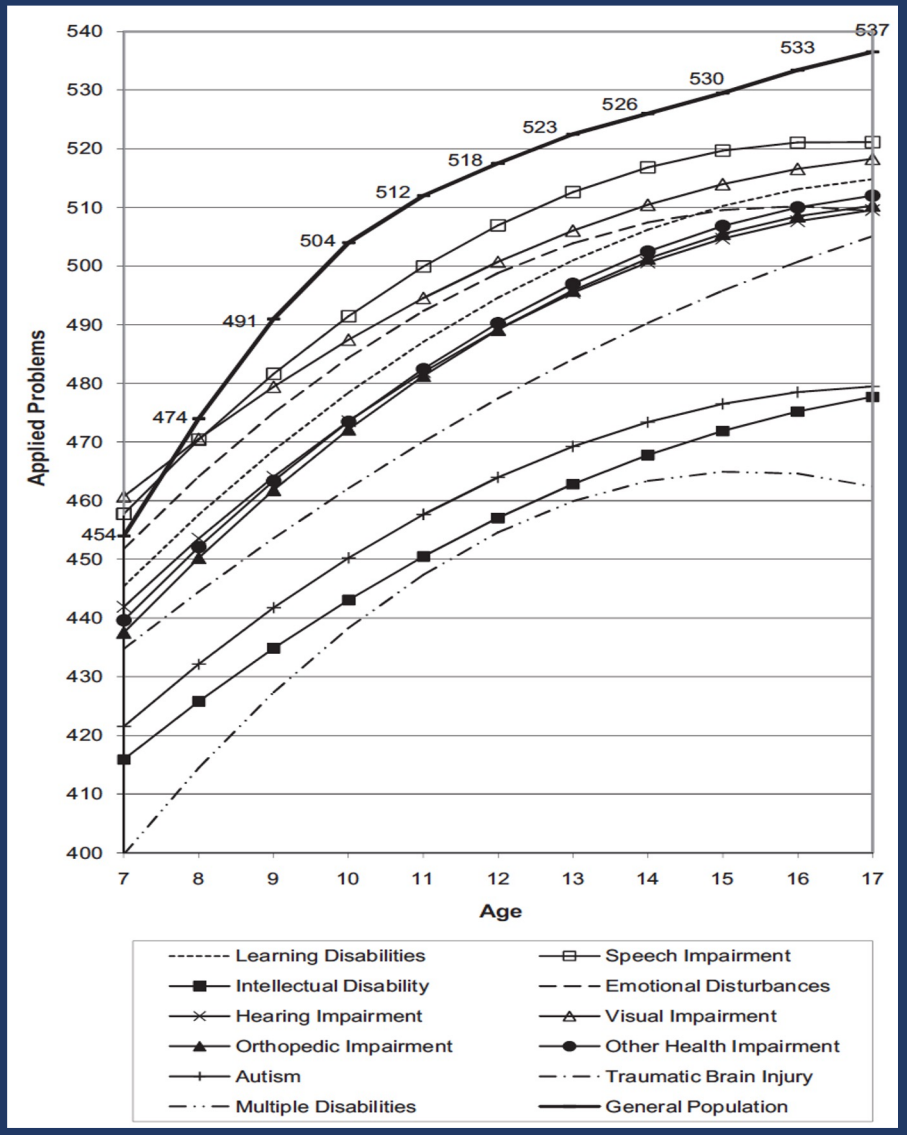


Computation



Problem Solving

Wei, Lenz, & Blackorby (2013)

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Provide examples of how you see earlier math skills relating to later math skills.

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Critical Mathematics Content

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Mathematical Trajectories

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continuum of mathematics learning

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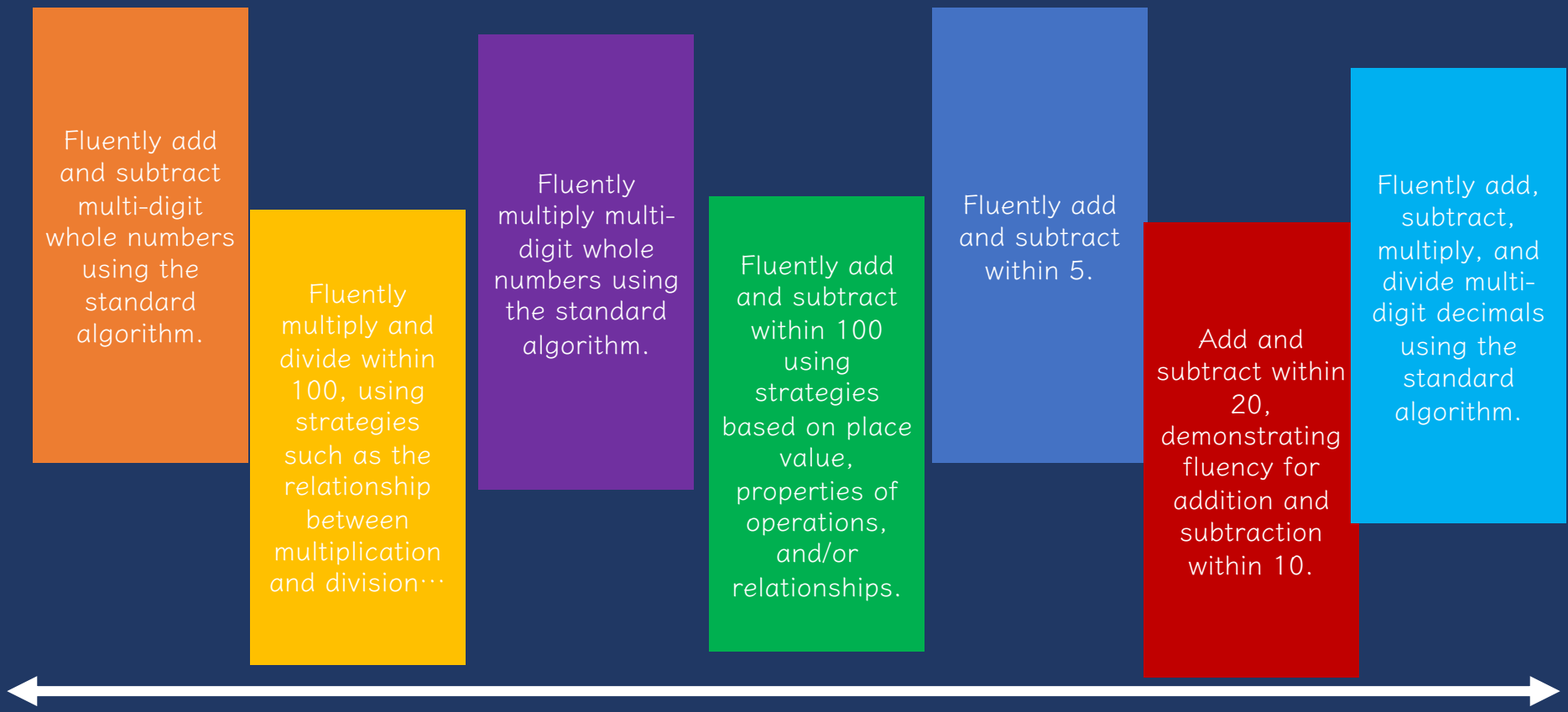

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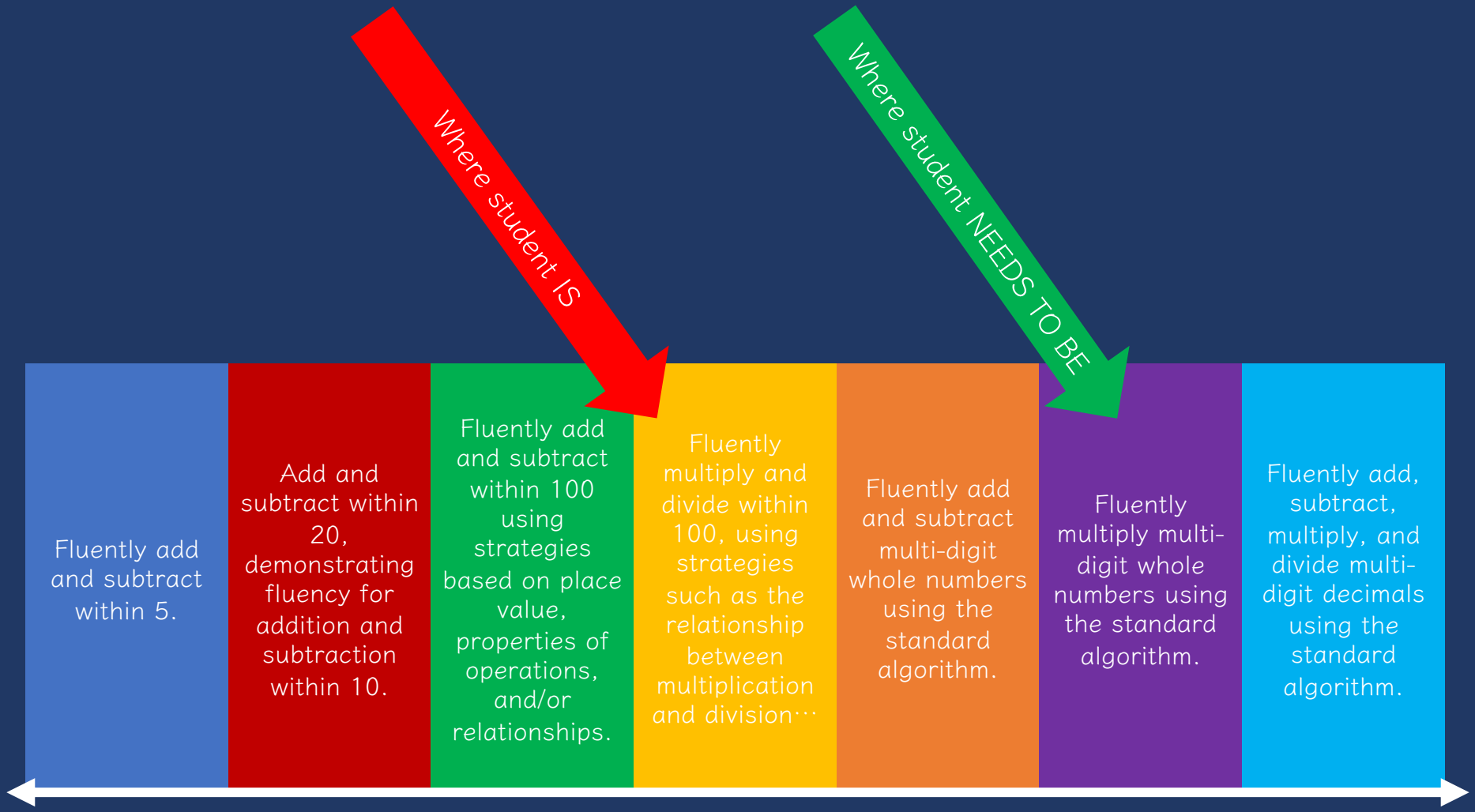

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Recognize that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the place to its right and 1/10 of what it represents in the place to its left.

Understand that the two digits of a two-digit number represent amounts of tens and ones.

Understand that the three digits of a three-digit number represent amounts of hundreds, tens, and ones.

Recognize that in a multi-digit number, a digit in one place represents ten times what it represents in the place to its right…

Compose and decompose numbers from 11 to 19 into ten ones and some further ones…

Use place value understanding to round whole numbers to the nearest 10 or 100.

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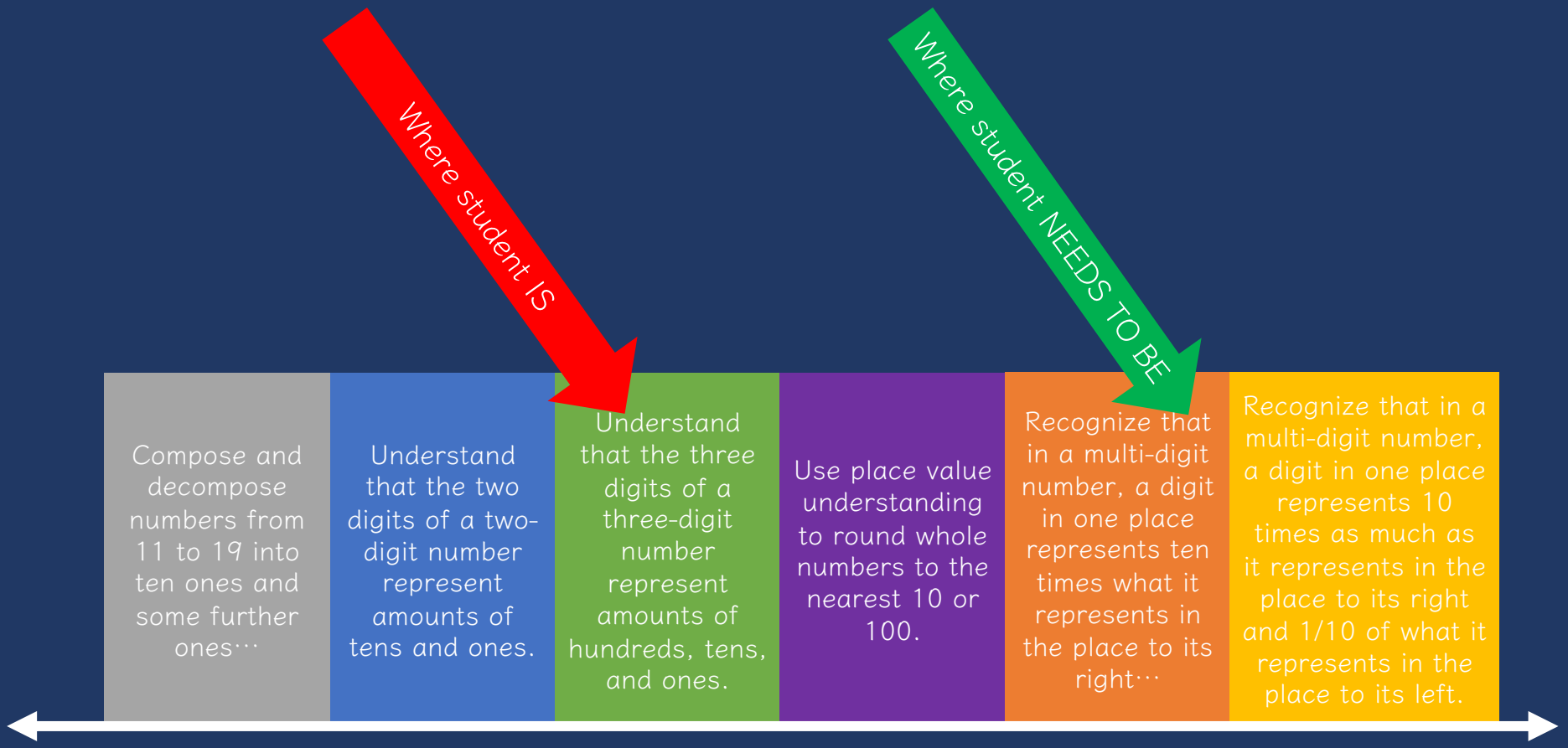

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Interpret and compute quotients of fractions, and solve word problems involving division of fractions by fractions…

Solve multi-step word problems posed with whole numbers and having whole-number answers using the four operations…

Solve word problems that call for addition of three whole numbers whose sum is less than or equal to 20…

Solve real-world and mathematical problems involving the four operations with rational numbers.

Solve real-world and mathematical problems leading to two linear equations in two variables.

Use multiplication and division within 100 to solve word problems…

Solve addition and subtraction word problems, and add and subtract within 10…

Use addition and subtraction within 100 to solve one- and two-step word problems…

Solve word problems involving addition and subtraction of fractions referring to the same whole, including cases of unlike denominators…

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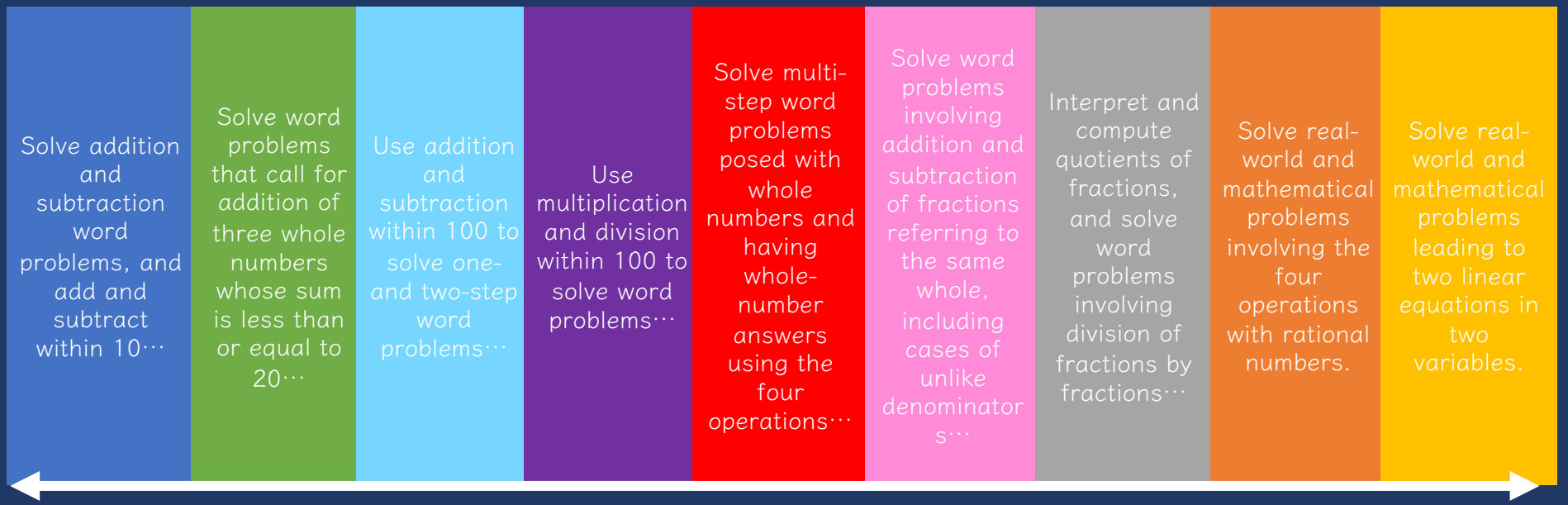

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Kindergarten	Grade 1	Grade 2	Grade 3
Comparing and Ordering Numbers			
(2) Number and operations. The student applies mathematical process standards to understand how to represent and compare whole numbers, the relative position and magnitude of whole numbers, and relationships within the numeration system. The student is expected to:	(2) Number and operations. The student applies mathematical process standards to represent and compare whole numbers, the relative position and magnitude of whole numbers, and relationships within the numeration system related to place value. The student is expected to:	(2) Number and operations. The student applies mathematical process standards to understand how to represent and compare whole numbers, the relative position and magnitude of whole numbers, and relationships within the numeration system related to place value. The student is expected to:	(2) Number and operations. The student applies mathematical process standards to represent and compare whole numbers and understand relationships related to place value. The student is expected to:
(G) compare sets of objects up to at least 20 in each set using comparative language.	(E) use place value to compare whole numbers up to 120 using comparative language.	(D) use place value to compare and order whole numbers up to 1,200 using comparative language, numbers, and symbols (>, <, or =).	(D) compare and order whole numbers up to 100,000 and represent comparisons using the symbols >, <, or =.
(H) use comparative language to describe two numbers up to 20 presented as written numerals.			
	(F) order whole numbers up to 120 using place value and open number lines.		
	(G) represent the comparison of two numbers to 100 using the symbols >, <, or =.		

https://www.texasgateway.org/resource/vertical-alignment-charts-revised-mathematics-teks

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An important subset of the major work in grades K–8 is the progression that leads toward middle school algebra.

K	1	2	3	4	5	6	7	8
Know number names and the count sequence Count to tell the number of objects Compare numbers Understand addition as putting together and adding to, and understand subtraction as taking apart and taking from Work with numbers 11-19 to gain foundations for place value	Represent and solve problems involving addition and subtraction Understand and apply properties of operations and the relationship between addition and subtraction Add and subtract within 20 Work with addition and subtraction equations Extend the counting sequence Understand place value Use place value understanding and properties of operations to add and subtract Measure lengths indirectly and by iterating length units	Represent and solve problems involving addition and subtraction Add and subtract within 20 Understand place value Use place value understanding and properties of operations to add and subtract Measure and estimate lengths in standard units Relate addition and subtraction to length	Represent & solve problems involving multiplication and division Understand properties of multiplication and the relationship between multiplication and division Multiply & divide within 100 Solve problems involving the four operations, and identify & explain patterns in arithmetic Develop understanding of fractions as numbers Solve problems involving measurement and estimation of intervals of time, liquid volumes, & masses of objects Geometric measurement: understand concepts of area and relate area to multiplication and to addition	Use the four operations with whole numbers to solve problems Generalize place value understanding for multi-digit whole numbers Use place value understanding and properties of operations to perform multidigit arithmetic Extend understanding of fraction equivalence and ordering Build fractions from unit fractions by applying and extending previous understandings of operations Understand decimal notation for fractions, and compare decimal fractions	Understand the place value system Perform operations with multi-digit whole numbers and decimals to hundredths Use equivalent fractions as a strategy to add and subtract fractions Apply and extend previous understandings of multiplication and division to multiply and divide fractions Geometric measurement: understand concepts of volume and relate volume to multiplication and to addition Graph points in the coordinate plane to solve real-world and mathematical problems*	Apply and extend previous understandings of multiplication and division to divide fractions by fractions Apply and extend previous understandings of numbers to the system of rational numbers Understand ratio concepts and use ratio reasoning to solve problems Apply and extend previous understandings of arithmetic to algebraic expressions Reason about and solve one-variable equations and inequalities Represent and analyze quantitative relationships between dependent and independent variables	Apply and extend previous understanding of operations with fractions to add, subtract, multiply, and divide rational numbers Analyze proportional relationships and use them to solve real-world and mathematical problems Use properties of operations to generate equivalent expressions Solve real-life and mathematical problems using numerical and algebraic expressions and equations	Work with radical and integer exponents Understand the connections between proportional relationships, lines, and linear equations** Analyze and solve linear equations and pairs of simultaneous linear equations Define, evaluate, and compare functions Use functions to model relationships between quantities

* Indicates a cluster that is well thought of as a part of a student's progress to algebra, but that is currently not designated as major by the assessment consortia in their draft materials. Apart from the one asterisked exception, the clusters listed here are a subset of those designated as major in the assessment consortia's draft documents.
** Depends on similarity ideas from geometry to show that slope can be defined and then used to show that a linear equation has a graph which is a straight line and conversely.

https://achievethecore.org/category/774/mathematics-focus-by-grade-level

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Table A.3. Grades 6–8 Curriculum Focal Points and Connections Compared with the Expectations of the Content Standards in *Principles and Standards for School Mathematics*

Grade 6 · Grade 7 · Grade 8 · Outside grades 6–8 · Not identified at any level, pre-K–8

Curriculum Focal Points and Connections	Expectations of the Content Standards
Grade 6 Curriculum Focal Points	
***Number and Operations:* Developing an understanding of and fluency with multiplication and division of fractions and decimals** Students use the meanings of fractions, multiplication and division, and the inverse relationship between multiplication and division to make sense of procedures for multiplying and dividing fractions and explain why they work. They use the relationship between decimals and fractions, as well as the relationship between finite decimals and whole numbers (i.e., a finite decimal multiplied by an appropriate power of 10 is a whole number), to understand and explain the procedures for multiplying and dividing decimals. Students use common procedures to multiply and divide fractions and decimals efficiently and accurately. They multiply and divide fractions and decimals to solve problems, including multistep problems and problems involving measurement.	***Number and Operations, Grades 6–8***
	Work flexibly with fractions, decimals, and percents to solve problems
	Compare and order fractions, decimals, and percents efficiently and find their approximate locations on a number line
	Develop meaning for percents greater than 100 and less than 1
	Understand and use ratios and proportions to represent quantitative relationships
	Develop an understanding of large numbers [identified in Grades 4 and 5 Curriculum Focal Points] and recognize and appropriately use exponential, scientific, and calculator notation
	Use factors, multiples, prime factorization, and relatively prime numbers to solve problems
	Develop meaning for integers and represent and compare quantities with them
	Understand the meaning and effects of arithmetic operations with fractions, decimals, and integers
	Use the associative and commutative properties of addition and multiplication and the distributive property of multiplication over addition to simplify computations with integers, fractions, and decimals
	Understand and use the inverse relationships of addition and subtraction, multiplication and division, and squaring and finding square roots to simplify computations and solve problems
	Select appropriate methods and tools for computing with fractions and decimals from among mental computation, estimation, calculators or computers, and paper and pencil, depending on the situation, and apply the selected methods
***Number and Operations:* Connecting ratio and rate to multiplication and division** Students use simple reasoning about multiplication and division to solve ratio and rate problems (e.g., "If 5 items cost $3.75 and all items are the same price, then I can find the cost of 12 items by first dividing $3.75 by 5 to find out how much one item costs and then multiplying the cost of a single item by 12"). By viewing equivalent ratios and rates as deriving from, and extending, pairs of rows (or columns) in the multiplication table, and by analyzing simple drawings that indicate the relative sizes of quantities, students extend whole number multiplication and division to ratios and rates. Thus, they expand the repertoire of problems that they can solve by using multiplication and division, and they build on their understanding of fractions to understand ratios. Students solve a wide variety of problems involving ratios and rates.	
***Algebra:* Writing, interpreting, and using mathematical expressions and equations** Students write mathematical expressions and equations that correspond to given situations, they evaluate expressions, and they use expressions and formulas to solve problems. They understand that variables represent numbers whose exact values are not yet specified, and they use variables appropriately. Students understand that expressions in different forms can be equivalent, and they can rewrite an expression to represent a quantity in a different way (e.g., to make it more compact or to feature different information). Students know that the solutions of an equation are the values of the variables that	

https://www.nctm.org/curriculumfocalpoints/

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What is the critical math content for your students?

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Evidence-Based Practices

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Evidence-Based Practices

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Instructional Platform

INSTRUCTIONAL DELIVERY

Explicit instruction

Precise language

Multiple representations

INSTRUCTIONAL STRATEGIES

Fluency building

Problem solving instruction

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evidence-based practice

A practice that has shown **consistent and positive** results

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An intervention (i.e., packaged program) that has shown **consistent and positive** results

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A method or strategy that has shown **consistent and positive** results

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A method or strategy that has shown a **positive** result

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Assessment data to show results

Improvement from before intervention

Improvement compared to no treatment students

Replication

Multiple researchers

Multiple students

Multiple times

Setting and students similar to your own

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How do you locate and identify evidence-based practices?

Which evidence-based practices do you plan to use?

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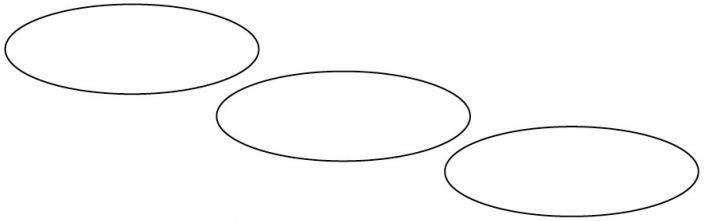
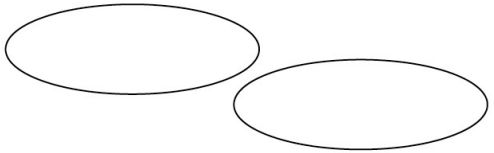
Instructional Delivery



Instructional Strategies



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Instructional Platform

INSTRUCTIONAL DELIVERY

Explicit instruction

Precise language

Multiple representations

INSTRUCTIONAL STRATEGIES

Fluency building

Problem solving instruction

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Explicit Instruction

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Explicit Instruction

MODELING	PRACTICE

SUPPORTS

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Instructional Platform

INSTRUCTIONAL DELIVERY

Explicit instruction

INSTRUCTIONAL STRATEGIES

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MODELING

Step-by-step explanation

Planned examples

PRACTICE

Guided practice

Independent practice

SUPPORTS

Ask high-level and low-level questions

Eliciting frequent responses

Providing affirmative and corrective feedback

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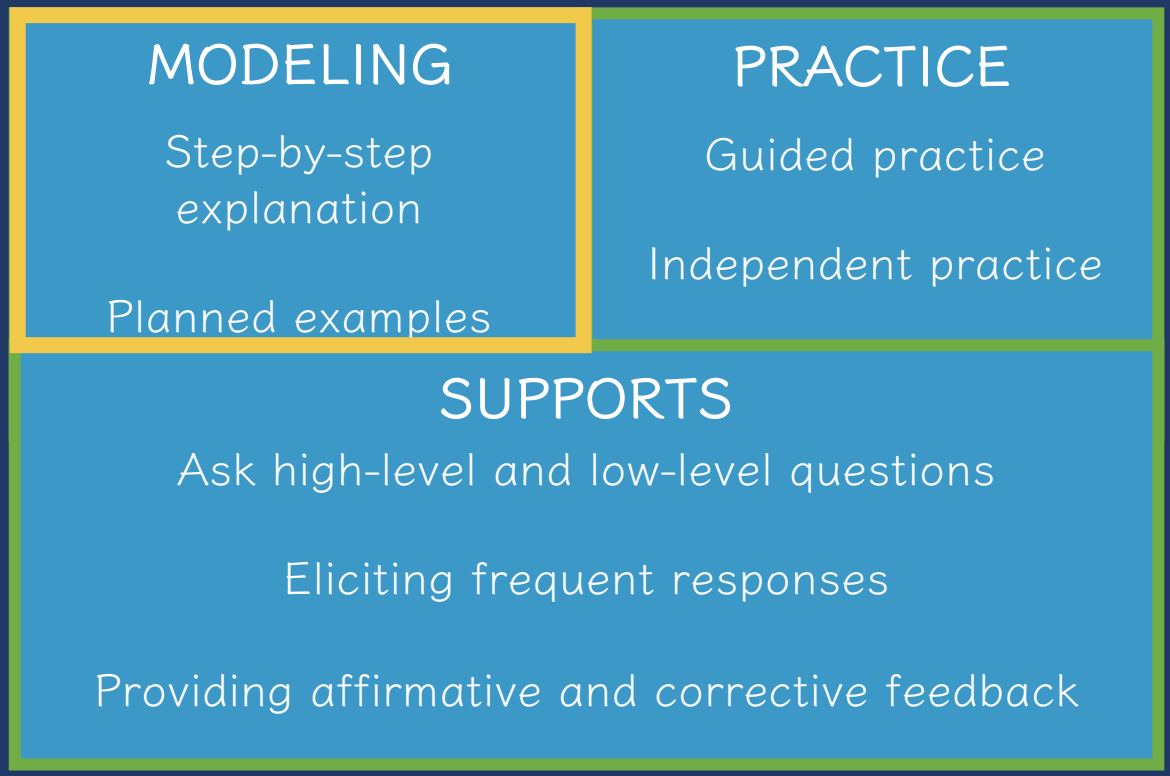
Modeling is a dialogue between the teacher and students.



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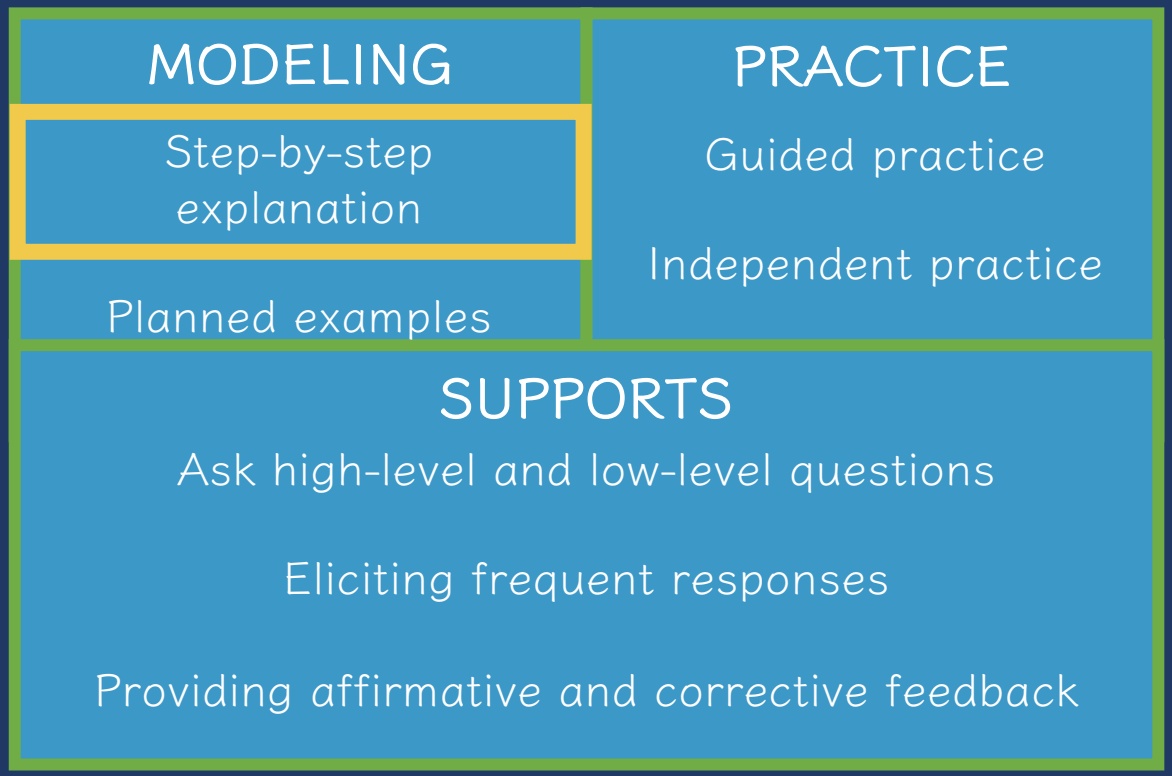
Modeling includes a step-by-step explanation of how to do a math problem.

A teacher may do 1 modeled problem or several.



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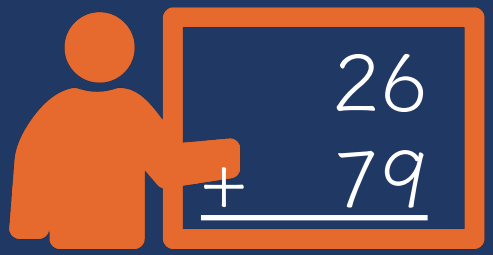

"Today, we are learning about addition. This is important because sometimes you have different amounts – like money – and you want to know how much money you have altogether."

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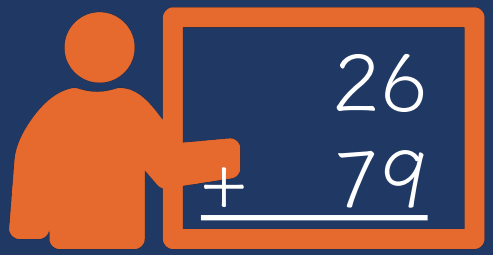

"Let's solve this problem. What's the problem?"

"26 plus 79."

"To solve 26 plus 79, first decide about the operation. Should we add, subtract, multiply, or divide?"

"Add."

"How did you know we want to add?"

"There's a plus sign."

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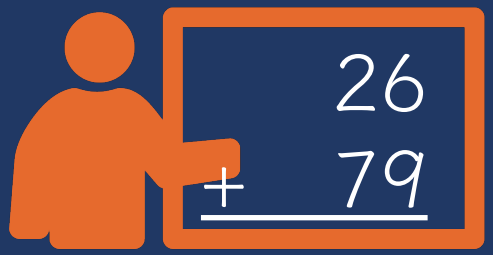

"The plus sign tells us we want to add. To add, let's use the partial sums strategy. What strategy?"

"Partial sums."

"With the partial sums strategy, we start adding in the greatest place value. What's the greatest place value in this problem?"

"The tens."

"So, let's add the tens. What's 20 plus 70?"

"90."

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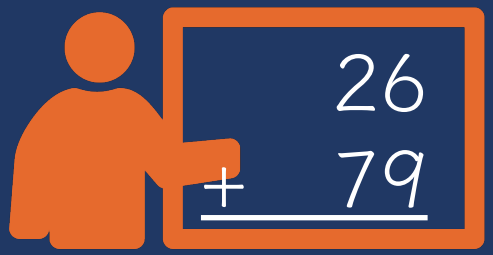

"20 plus 70 equals 90. Let's write 90 right here below the equal line. What will we write?"

"90."

"90 is the partial sum when you add the tens. What does 90 represent?"

"It's the partial sum of adding 20 plus 70."

"Now, let's add the ones. What should we add?"

"6 plus 9."

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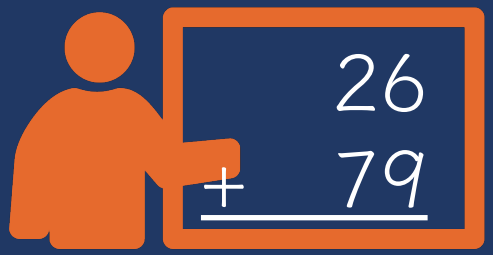

"6 plus 9 equals what?"

"15."

"Let's write 15 below the 90. Where do we write the 15?"

"Below the 90."

"15 is the partial sum when you add the ones. Now, let's add the partial sums together. What will we add?"

"90 plus 15."

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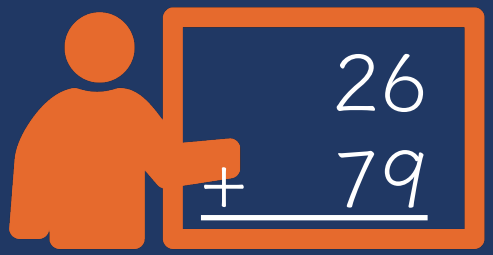

"What's 90 plus 15?"

"How did you add those numbers?"

"So, when you add 26 plus 79, the sum is 105. Who can share how we solved this problem?"

"105."

"I added 90 plus 10 then added 5 more."

"We used the partial sums strategy. We added the tens then added the ones. Then we added the partial sums."

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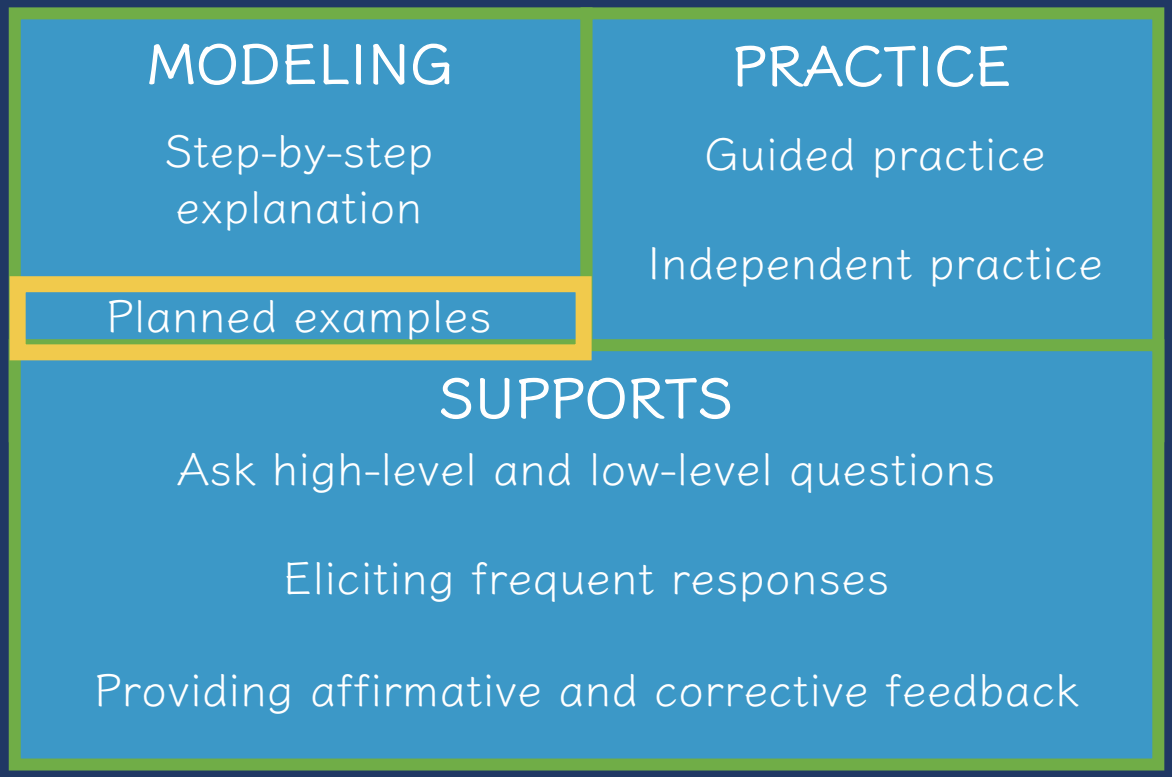
Modeling needs to include planned examples.

These examples should be sequenced so easier skills lead to more difficult skills.



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MODELING

Step-by-step explanation

Planned examples

PRACTICE

Guided practice

Independent practice

SUPPORTS

Ask high-level and low-level questions

Eliciting frequent responses

Providing affirmative and corrective feedback

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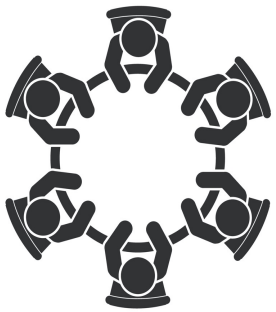
Explicit Instruction

Problem	Step-by-Step Explanation



Select a math problem.

Work with a partner to outline a step-by-step explanation.

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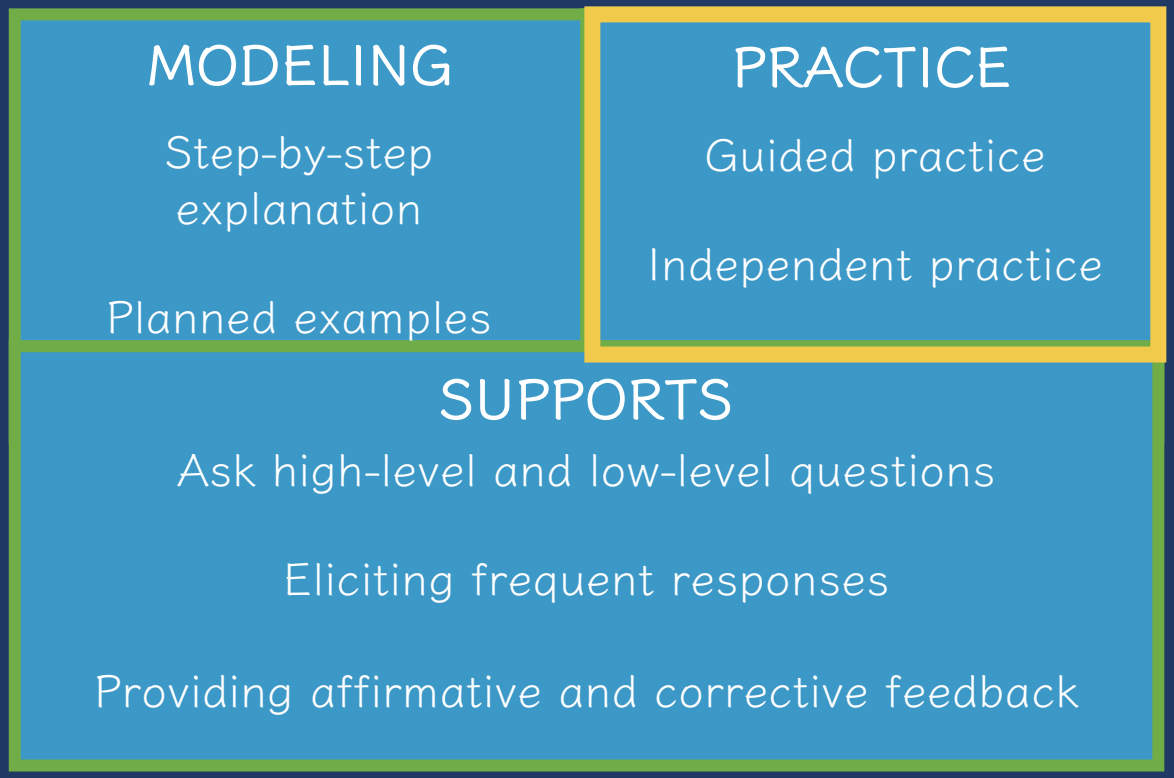

Practice continues as a dialogue between the teacher and students.

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MODELING

Step-by-step explanation

Planned examples

PRACTICE

Guided practice

Independent practice

SUPPORTS

Ask high-level and low-level questions

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Providing affirmative and corrective feedback

Guided practice is practice in which the teacher and students practice problems together.

"Let's work on a problem together."

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MODELING

Step-by-step explanation

Planned examples

PRACTICE

Guided practice

Independent practice

SUPPORTS

Ask high-level and low-level questions

Eliciting frequent responses

Providing affirmative and corrective feedback

Independent practice is practice in which the students practice independently with teacher support.

"Now, you'll practice a problem on your own. Use your attack strategy!"

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MODELING

Step-by-step explanation

Planned examples

PRACTICE

Guided practice

Independent practice

SUPPORTS

Ask high-level and low-level questions

Eliciting frequent responses

Providing affirmative and corrective feedback

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Explicit Instruction

Problem

Practice Opportunities

High-Level Questions

Low-Level Questions

Affirmative Feedback

Corrective Feedback

Describe how you would engage students in practice.

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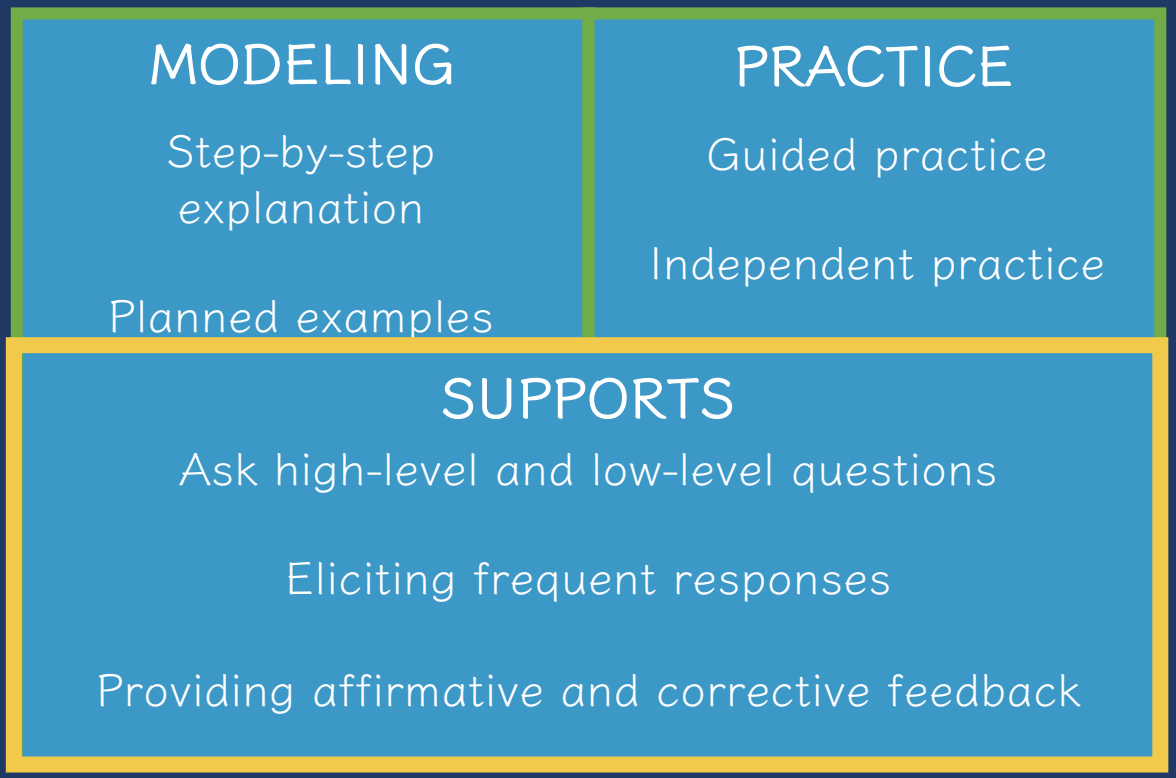

These **Supports** should be used in both **Modeling** and **Practice.**

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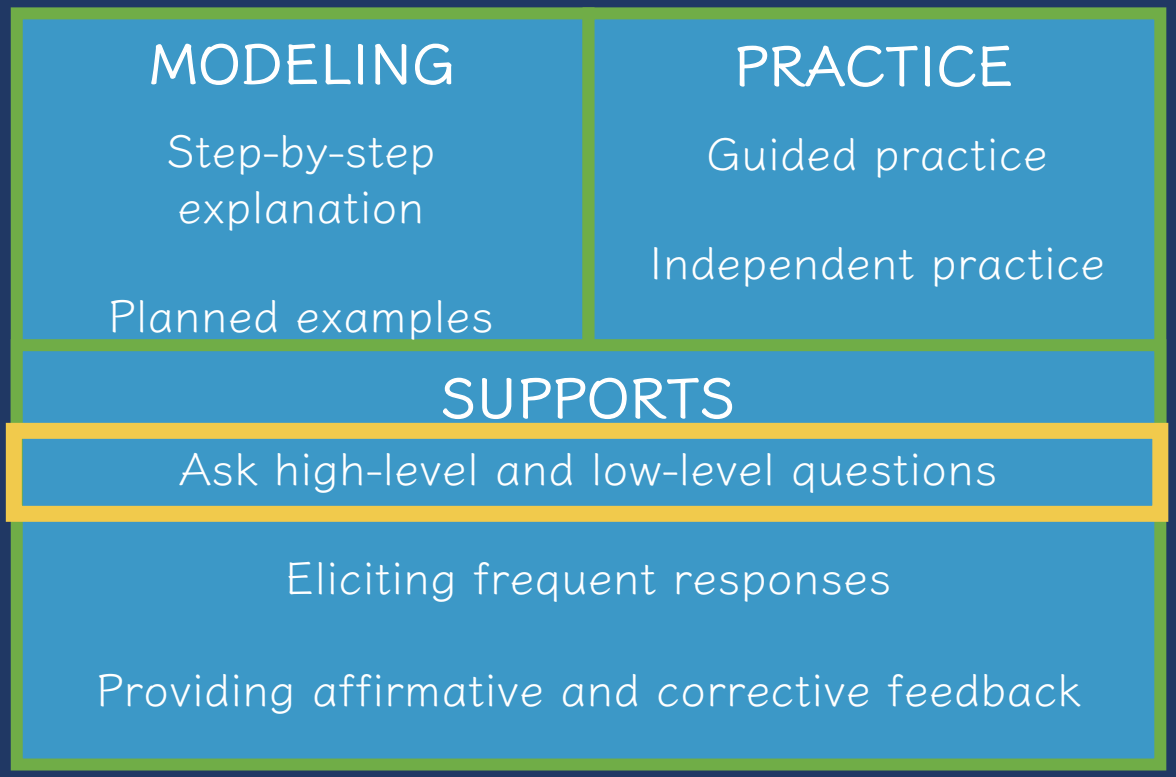

During **Modeling** and **Practice**, it is essential to engage students and check for understanding.

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MODELING

Step-by-step explanation

Planned examples

PRACTICE

Guided practice

Independent practice

SUPPORTS

Ask high-level and low-level questions

Eliciting frequent responses

Providing affirmative and corrective feedback

"What is 7 times 9?"

"63."

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MODELING

Step-by-step explanation

Planned examples

PRACTICE

Guided practice

Independent practice

SUPPORTS

Ask high-level and low-level questions

Eliciting frequent responses

Providing affirmative and corrective feedback

"Why do you use zero pairs?"

"Because a positive 1 and a negative 1 equal 0. I use the zero pair to help me subtract."

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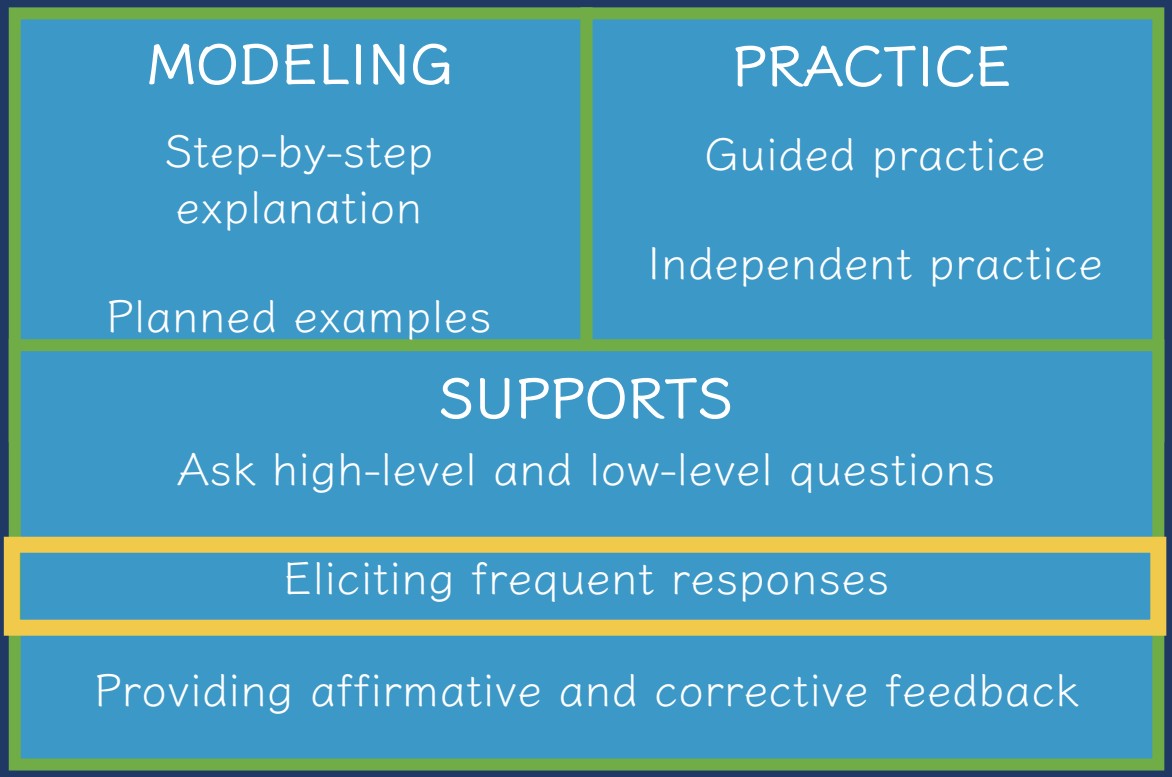

During **Modeling** and **Practice**, students should frequently respond. The frequent responses keeps student attention and keeps student learning active.

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MODELING

Step-by-step explanation

Planned examples

PRACTICE

Guided practice

Independent practice

SUPPORTS

Ask high-level and low-level questions

Eliciting frequent responses

Providing affirmative and corrective feedback

- Oral
- Written
- With manipulatives
- With drawings
- With gestures

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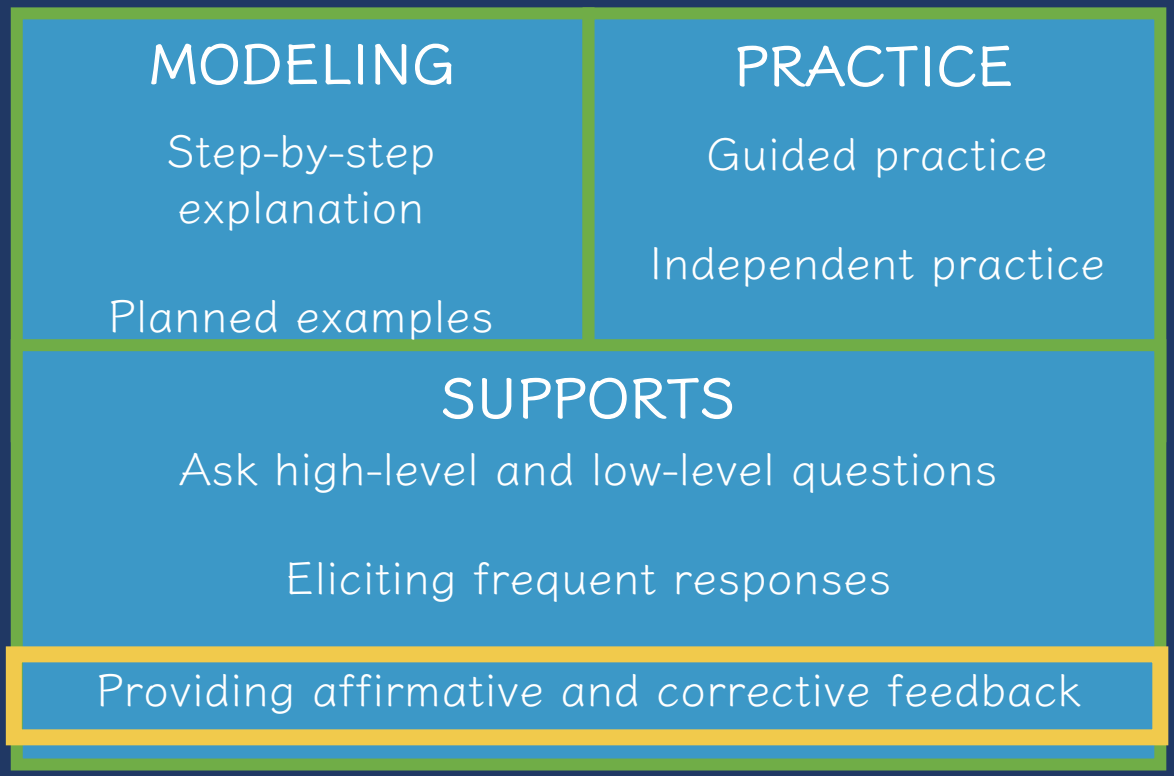

During **Modeling** and **Practice**, students should receive immediate feedback on their responses.

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MODELING

Step-by-step explanation

Planned examples

PRACTICE

Guided practice

Independent practice

SUPPORTS

Ask high-level and low-level questions

Eliciting frequent responses

Providing affirmative and corrective feedback

"Nice work using your word problem attack strategy."

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MODELING

Step-by-step explanation

Planned examples

PRACTICE

Guided practice

Independent practice

SUPPORTS

Ask high-level and low-level questions

Eliciting frequent responses

Providing affirmative and corrective feedback

"Let's look at that again. Tell me how you added in the hundreds column."

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MODELING

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Planned examples

PRACTICE

Guided practice

Independent practice

SUPPORTS

Ask high-level and low-level questions

Eliciting frequent responses

Providing affirmative and corrective feedback

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Explicit Instruction

Problem

Practice Opportunities

High-Level Questions

Low-Level Questions

Affirmative Feedback

Corrective Feedback

Provide several of your questions.

Provide examples of your feedback.

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MODELING

Step-by-step explanation

Planned examples

PRACTICE

Guided practice

Independent practice

SUPPORTS

Ask high-level and low-level questions

Eliciting frequent responses

Providing affirmative and corrective feedback

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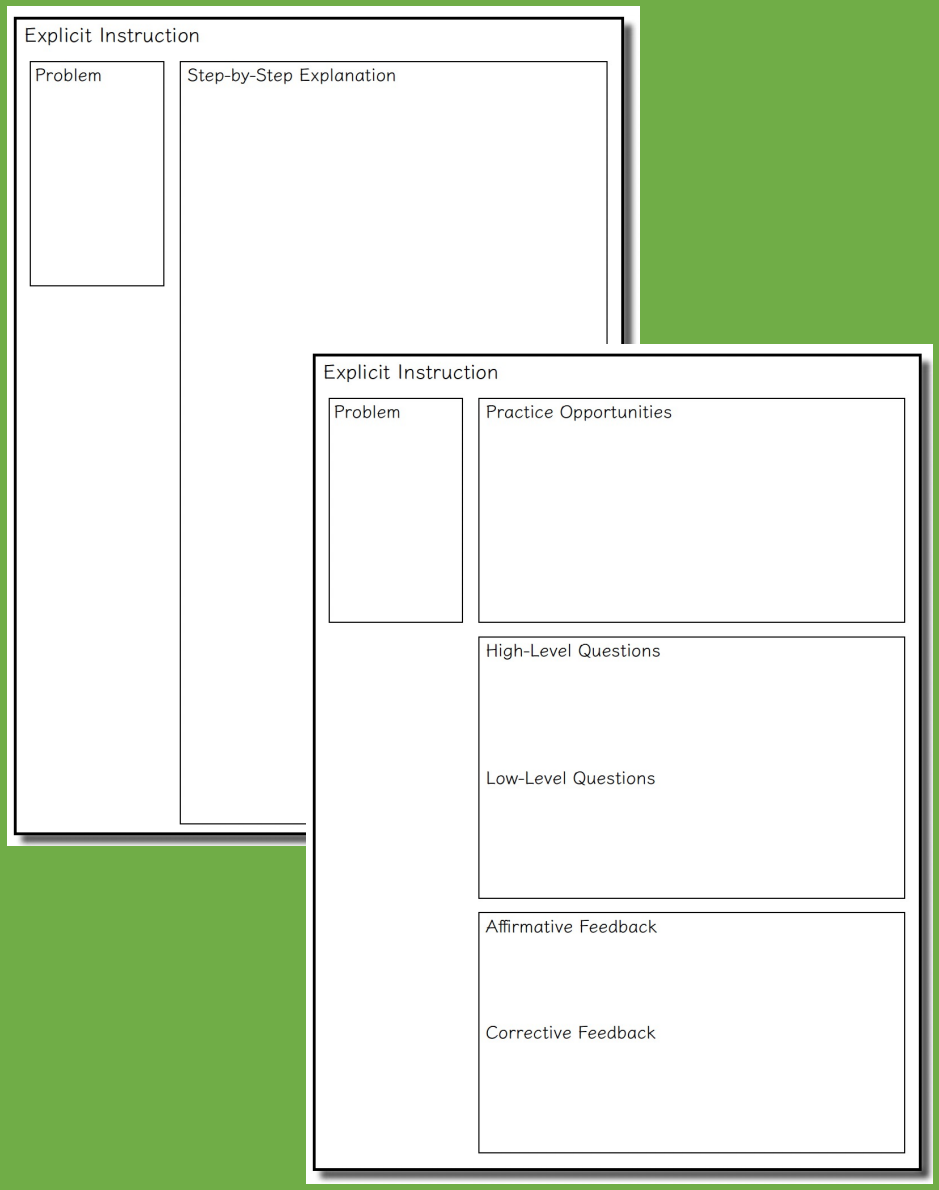

Find a partner.

Share your explicit instruction.

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Building Fluency

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Fluency

Addition

Subtraction

Multiplication

Division

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Instructional Platform

INSTRUCTIONAL DELIVERY

Explicit instruction

Precise language

Multiple representations

INSTRUCTIONAL STRATEGIES

Fluency building

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Building Fluency

Fluency is doing mathematics *easily and accurately.*

Fluency in mathematics *makes mathematics easier.*

Fluency provides less stress on working memory.

Fluency helps students build confidence with mathematics.

With fluency, it is important to emphasize both *conceptual learning and procedural learning.*

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Addition	Subtraction
Multiplication	Division

Counting

Comparing numbers

Counting coins

Telling time

Identifying equivalent fractions

Knowing multiples

Identifying shapes

Knowing formulas

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Multiple Representations

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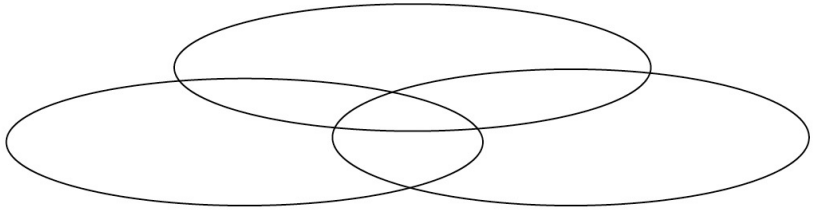
Multiple Representations



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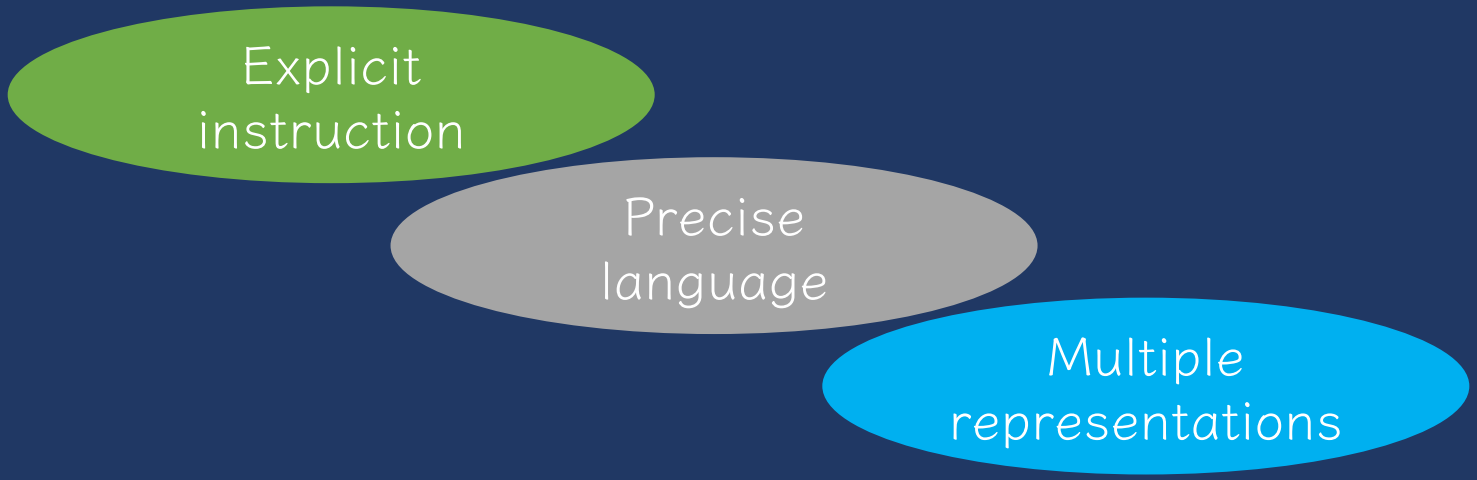
Instructional Platform

INSTRUCTIONAL DELIVERY



INSTRUCTIONAL STRATEGIES

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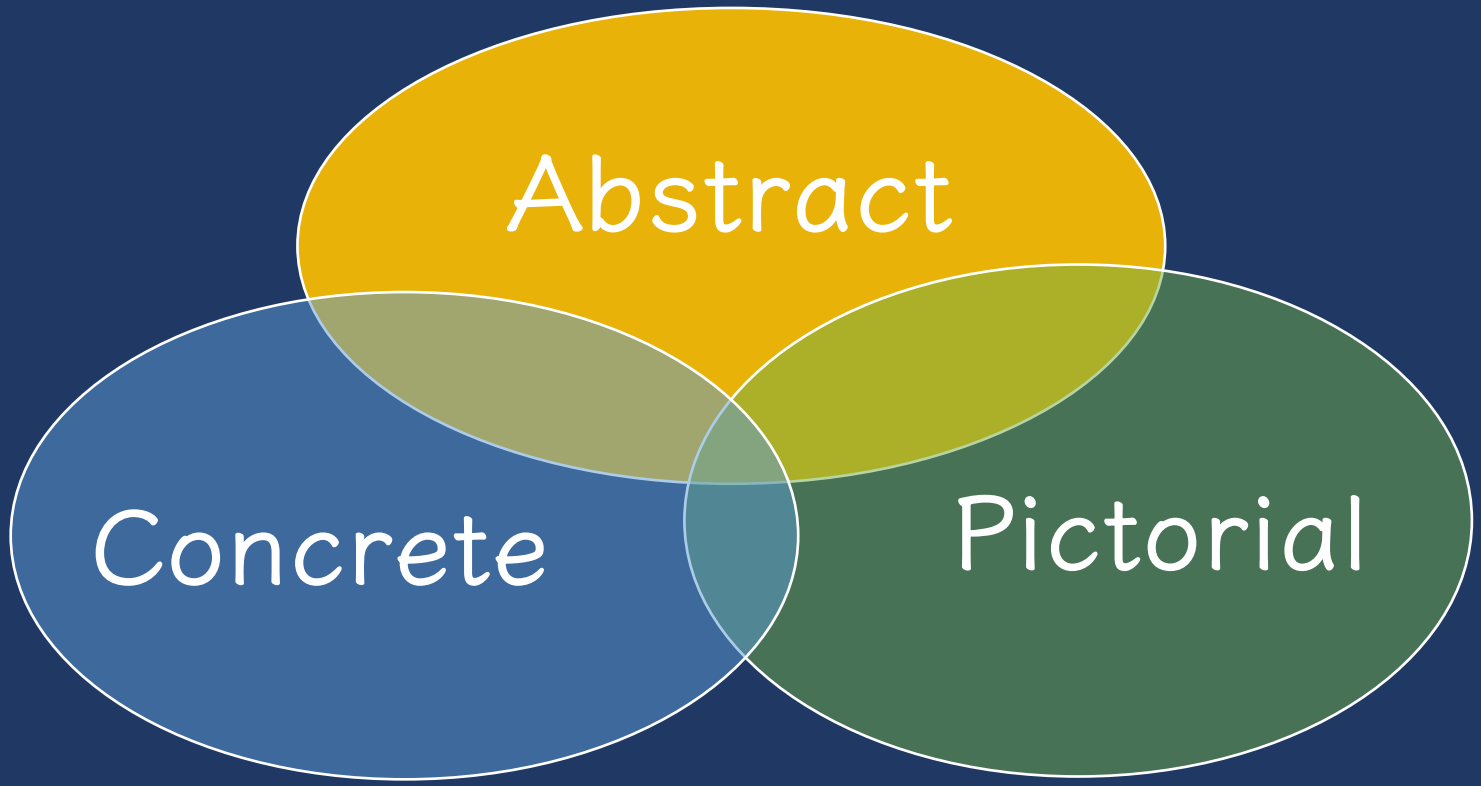
Multiple Representations



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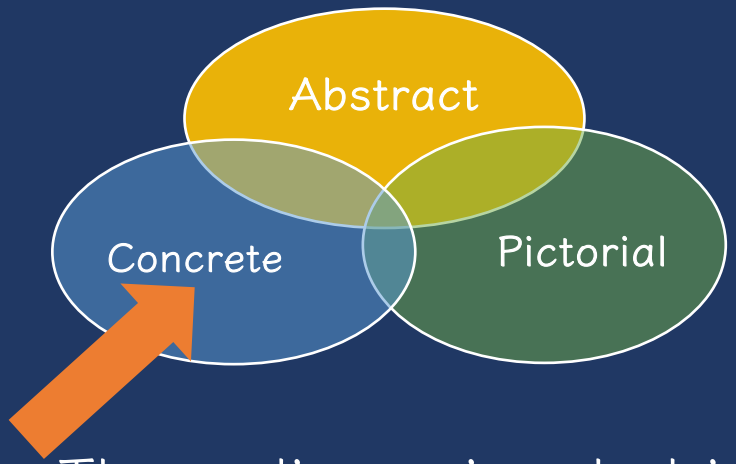
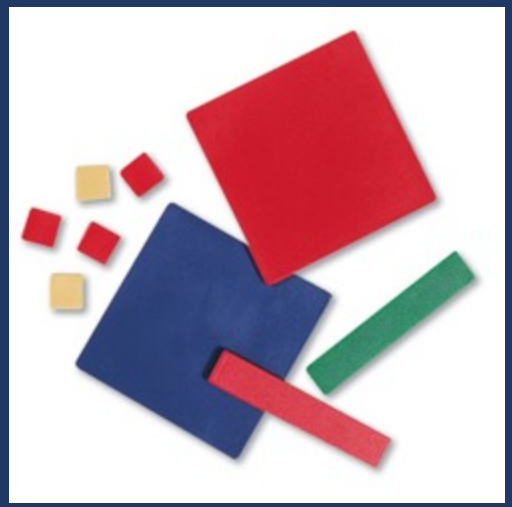
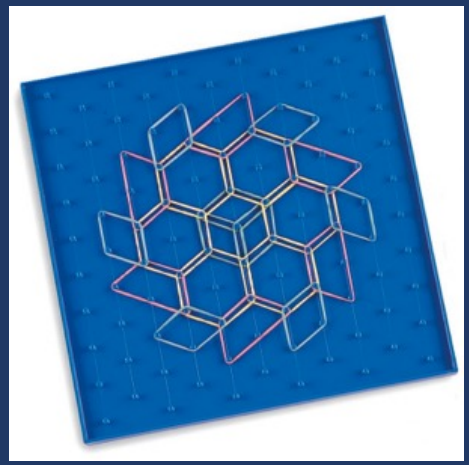


Three-dimensional objects





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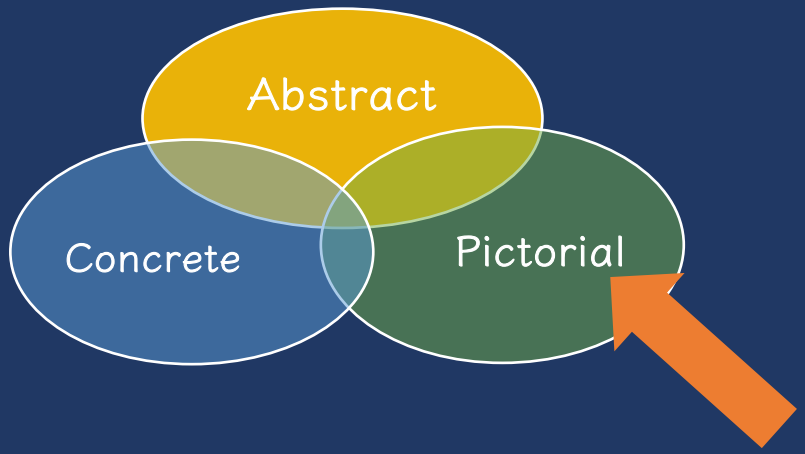
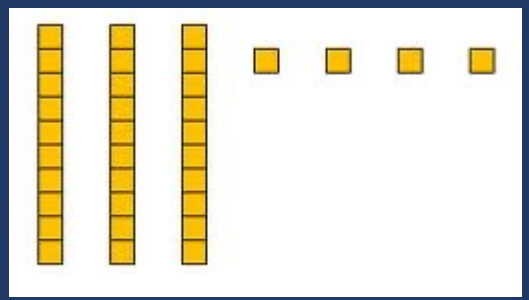
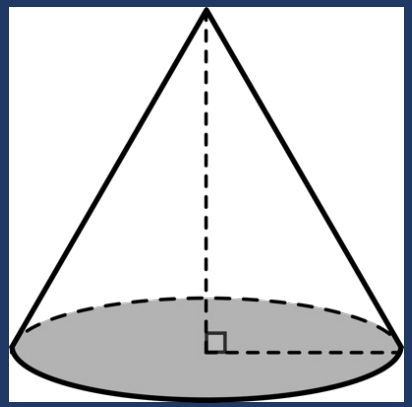
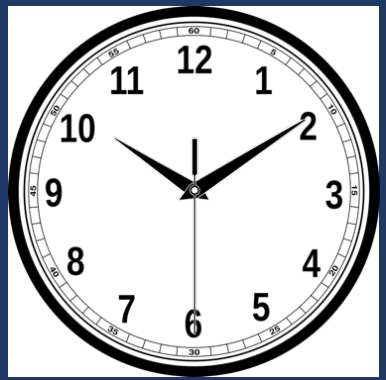


Two-dimensional images







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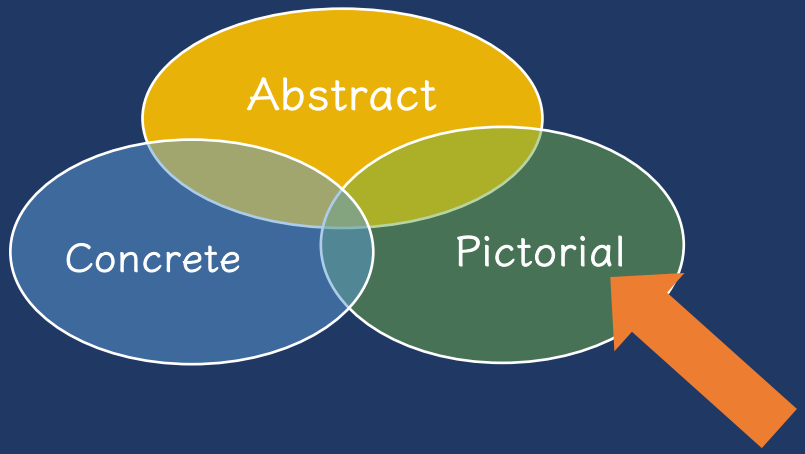
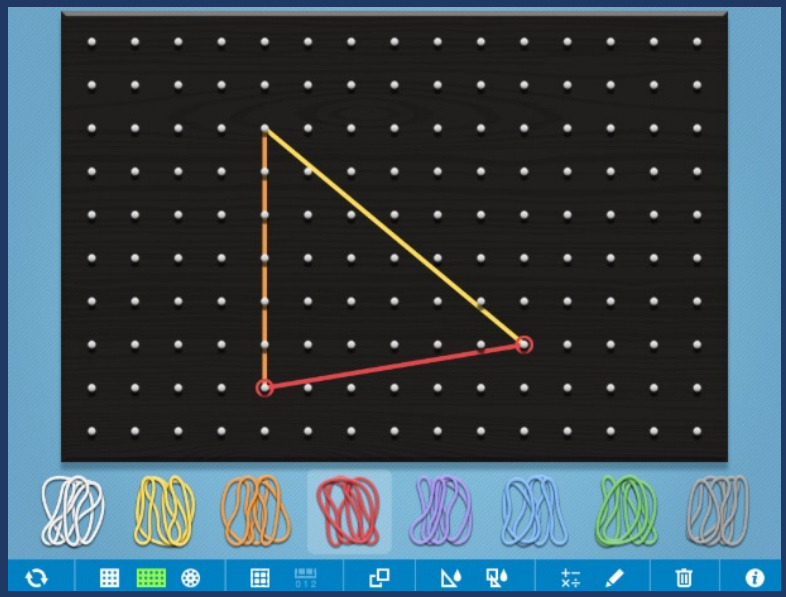
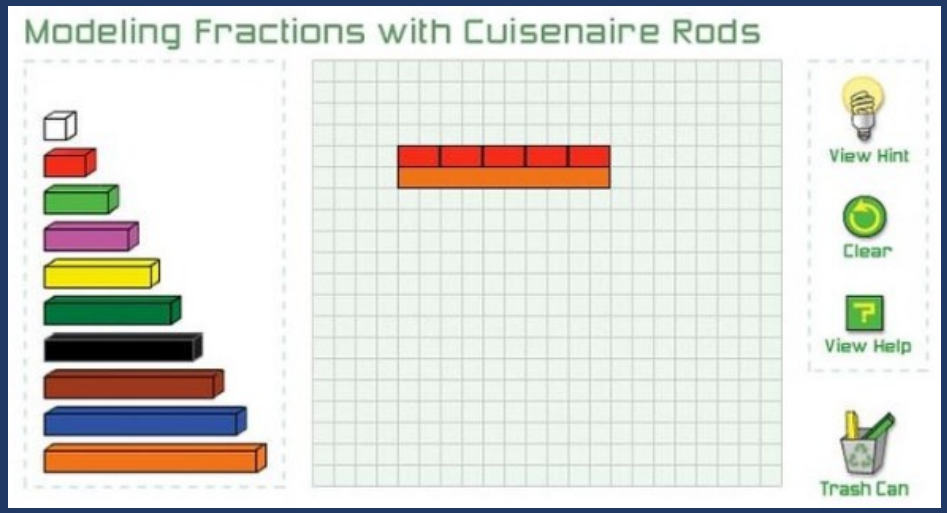
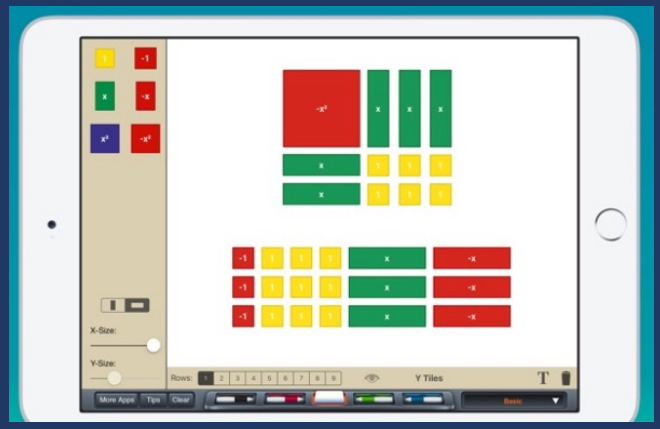


Two-dimensional images







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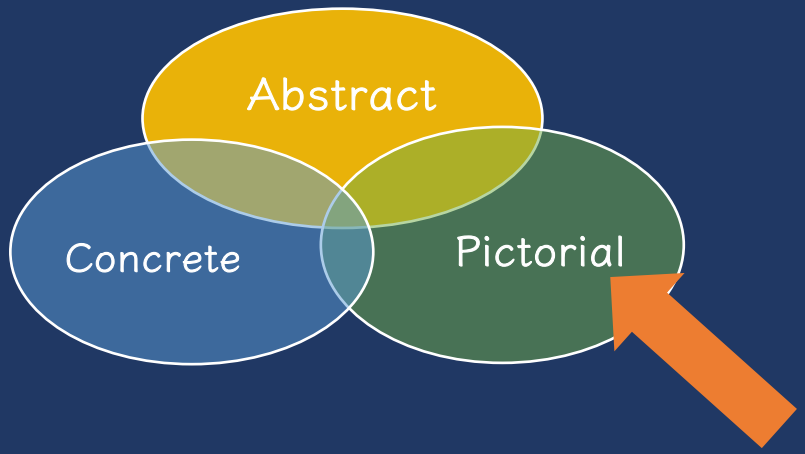
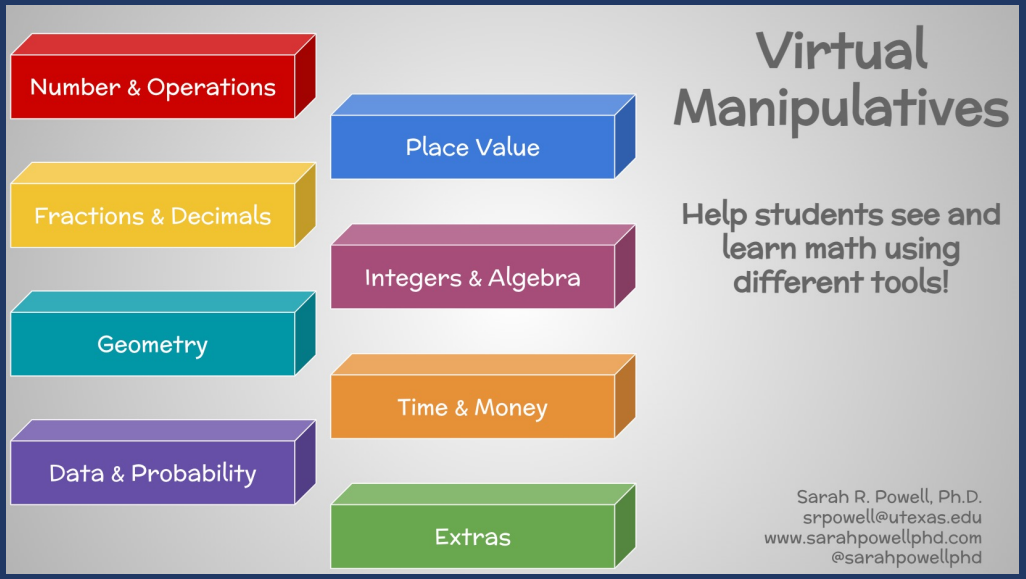
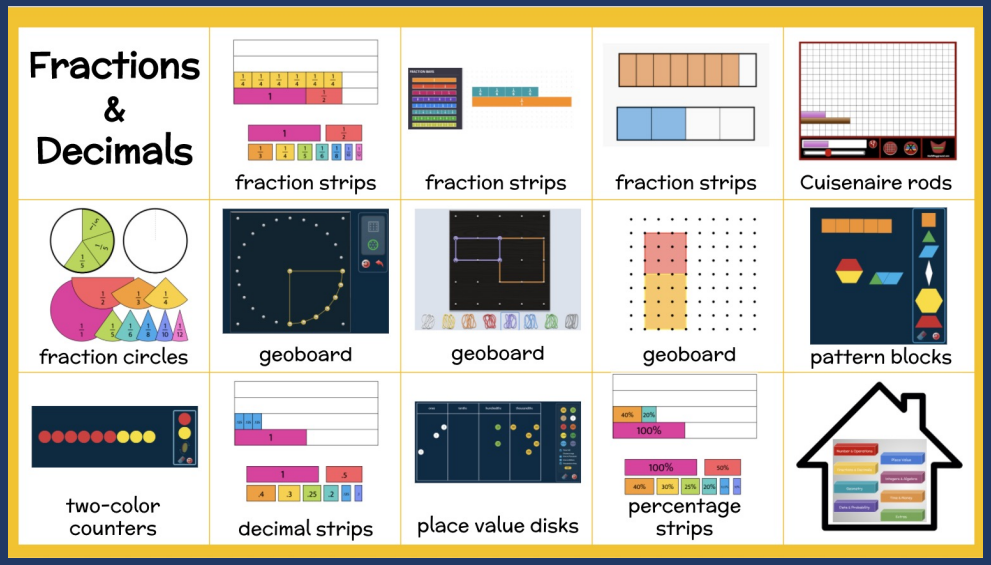


Two-dimensional images





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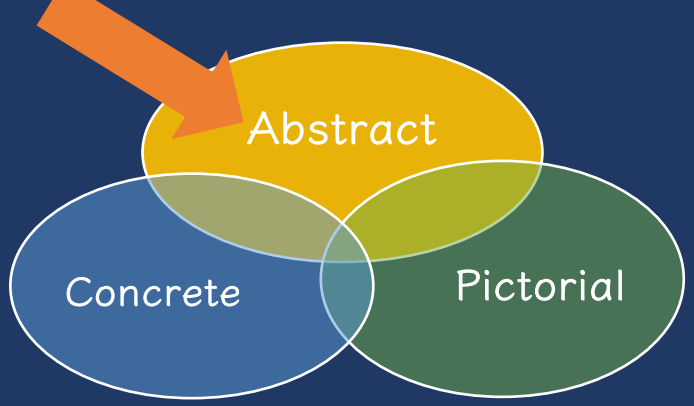

Numerals and symbols and words

$2 + 8 = 10$

34 = 3 tens and 4 ones

$x - 6 = 8$

$$\begin{array}{r} 4{,}179 \\ +\quad 569 \\ \hline \end{array}$$

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Explore 3 virtual manipulatives.

Share with a partner.

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Building Fluency with Mathematics Facts

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Addition

100 addition facts

Single-digit addends sum to a single- or double-digit number

$$\begin{array}{rl} 5 & \text{(addend)} \\ +\ 4 & \text{(addend)} \\ \hline 9 & \text{(sum)} \end{array}$$

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Total

Addition

Count one set, count another set, put sets together, count sum

$$2 + 3 = 5$$

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Change

Addition

Start with a set, add the other set, count sum

$$2 + 3 = 5$$

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Total

Addition

Parts put together into a total

Karly saw 4 cardinals and 5 blue jays. How many birds did Karly see?

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Change

Addition

An amount that **increases** or decreases

Premila had $4. Then they earned $5 for cleaning their room. How much money does Premila have now?

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$3 + 9 = __$

Addition

If you have brown *eyes*:

What's a Total story to show addition?

If you don't have brown *eyes*:

What's a Change/Join story to show addition?

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Subtraction

100 subtraction facts

Subtrahend and difference are single-digit numbers and minuend is single- or double-digit number

$$\begin{array}{rl} 16 & \text{(minuend)} \\ -\ \ 8 & \text{(subtrahend)} \\ \hline 8 & \text{(difference)} \end{array}$$

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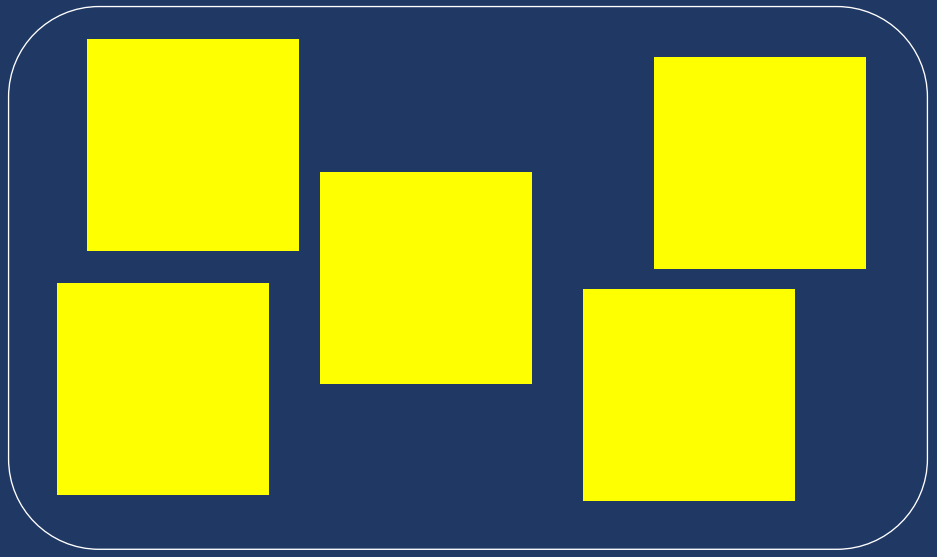
Change

Subtraction

Start with a set, take away from that set, count difference



$$5 - 3 = 2$$

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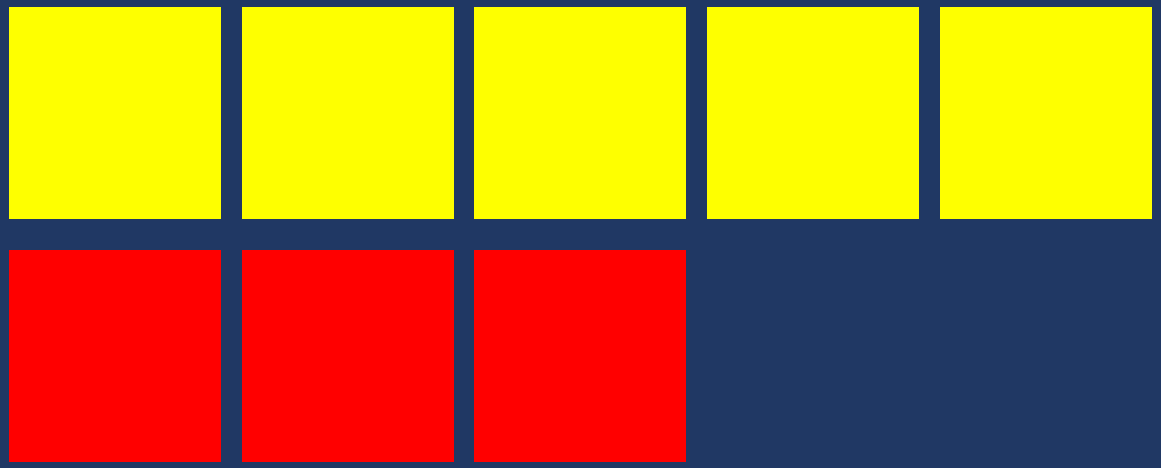
Difference

Subtraction

Compare two sets, count difference



$$5 - 3 = 2$$

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Change

Subtraction

An amount that increases or **decreases**

Bronwyn had 9 cookies. Then they ate 2 of the cookies. How many cookies does Bronwyn have now?

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Difference

Subtraction

Greater and lesser amounts compared for a difference

Rachel has 9 apples. Jodie has 2 apples. How many more apples does Rachel have? (How many fewer does Jodie have?)

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$9 - 5 = __$

Subtraction

If you would chose beaches:

What's a Change/Separate story to show addition?

If you would chose mountains:

What's a Difference story to show addition?

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Multiplication

100 multiplication facts

Multiplication of single-digit factors results in a single- or double-digit product

$$\begin{array}{rl} 2 & \text{(factor)} \\ \times\ 3 & \text{(factor)} \\ \hline 6 & \text{(product)} \end{array}$$

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Equal Groups

Multiplication

Show the groups, show the amount for each group, count product

$$3 \times 2 = 6$$

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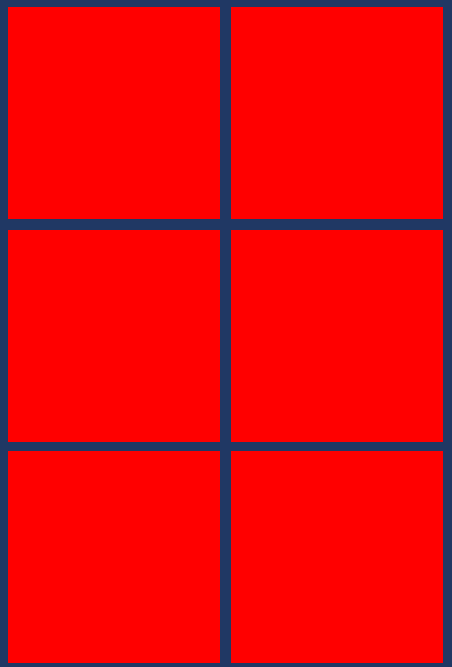
Equal Groups

Multiplication

Show the groups, show the amount for each group, count product



$$3 \times 2 = 6$$

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Comparison

Multiplication

Show a set, then multiply the set

$$3 \times 2 = 6$$

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Equal Groups

Multiplication

Groups multiplied by number in each group for a product

Rhiannon has 2 boxes of crayons. There are 12 crayons in each box. How many crayons does Rhiannon have altogether?

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Comparison

Multiplication

Set multiplied by a number of times for a product

Vivienne picked 12 apples. Jessica picked 2 times as many apples as Vivienne. How many apples did Jessica pick?

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$2 \times 5 = __$

Multiplication

If you wear glasses:

What's an Equal Groups story to show addition?

If you don't wear glasses:

What's a Comparison story to show addition?

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Division

90 division facts

Divisor and quotient are single-digit numbers and dividend is single- or double-digit number

8	÷	4	=	2
(dividend)		(divisor)		(quotient)

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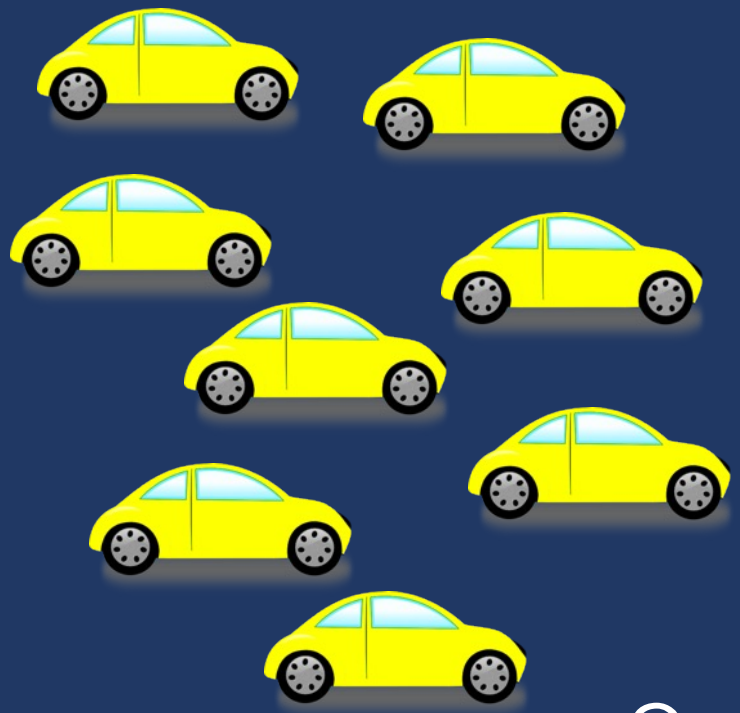
Equal Groups (Partitive Division)

Division

Show the dividend, divide equally among divisor, count quotient



$$8 \div 2 = 4$$

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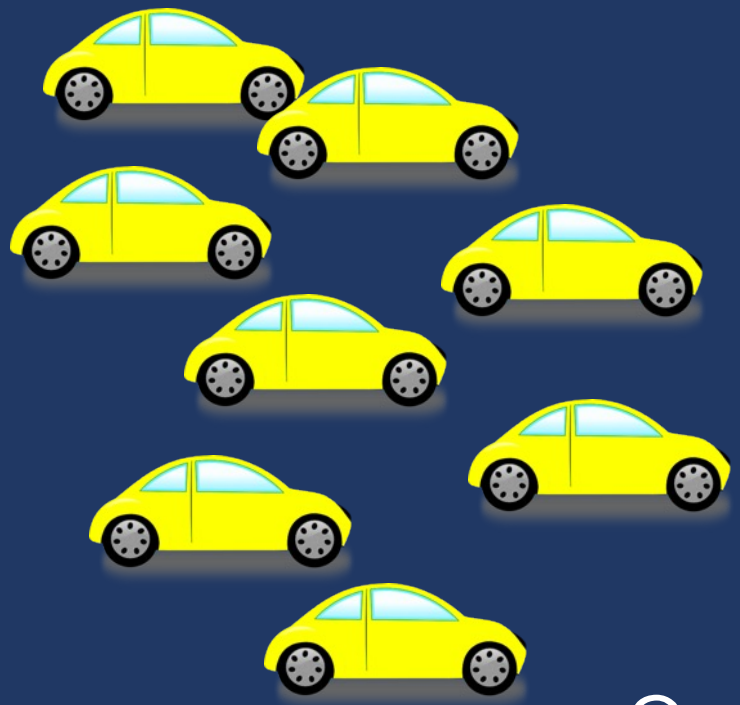
Equal Groups (Quotative Division)

Division

Show the dividend, make groups of the divisor, count groups



$$8 \div 2 = 4$$

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Equal Groups

Groups multiplied by number in each group for a product

Stefanie has 12 apples. She wants to share them equally among her 2 friends. How many apples will each friend receive?

Nicole has 12 apples. She put them into bags with 6 apples each. How many bags did Nicole use?

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$12 \div 4 = __$

Division

If you watch *Stranger Things*:

What's a Partitive story to show addition?

If you watch *Ted Lasso*:

What's a Quotative story to show addition?

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Addition	Subtraction
Multiplication	Division

Build fluency with math facts.

- Addition: single-digit addends
- Subtraction: single-digit subtrahend
- Multiplication: single-digit factors
- Division: single-digit divisor

$$\begin{array}{r} 5 \\ +\ 8 \\ \hline \end{array} \qquad \begin{array}{r} 9 \\ -\ 4 \\ \hline \end{array} \qquad \begin{array}{r} 6 \\ \times\ 7 \\ \hline \end{array} \qquad \begin{array}{r} 56 \\ \div\ 8 \\ \hline \end{array}$$

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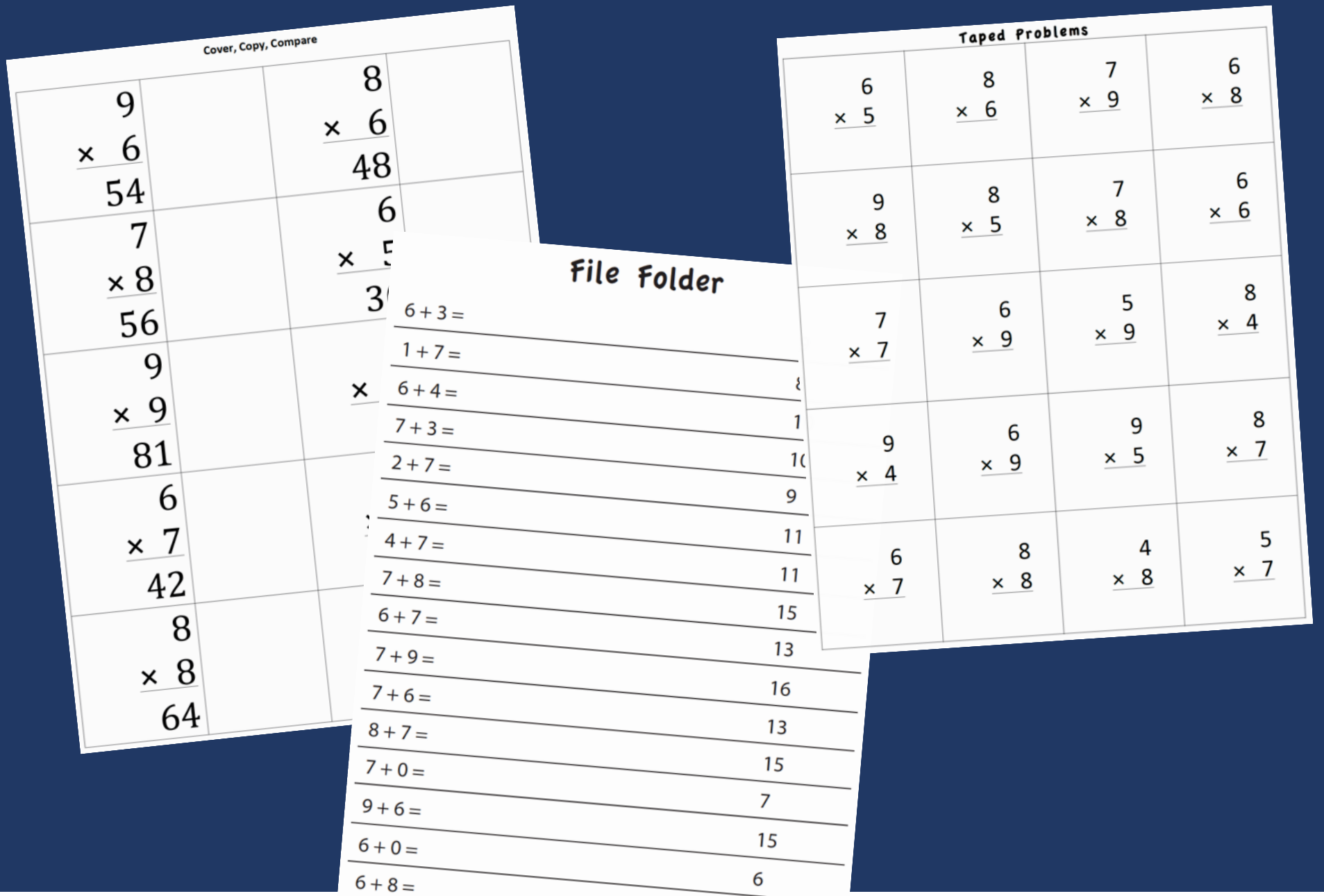

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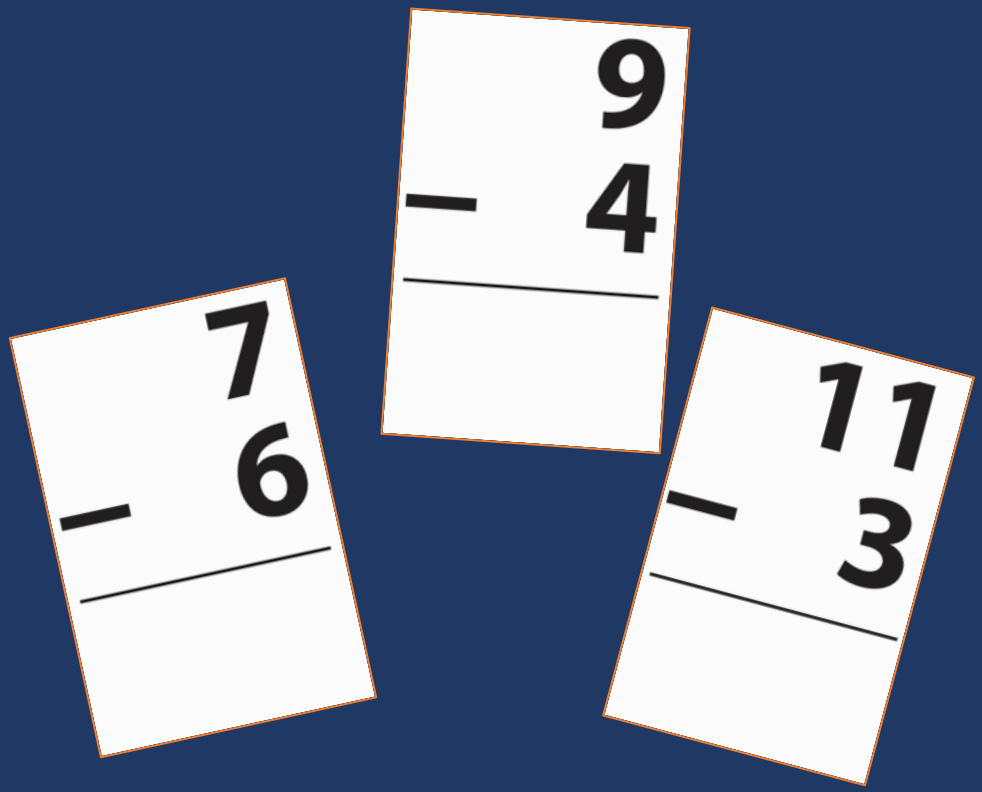

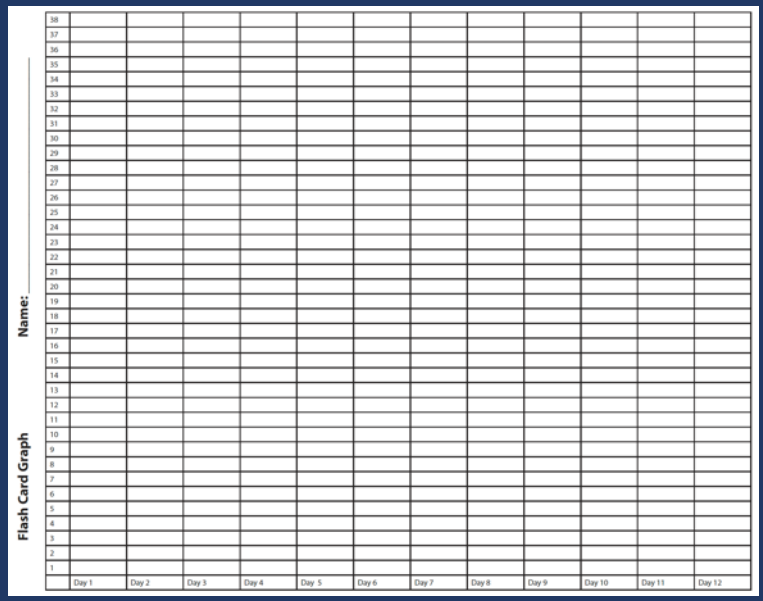

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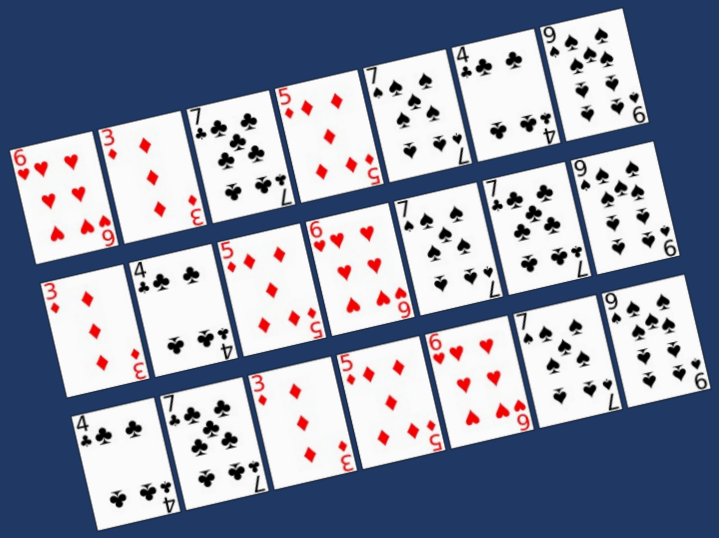

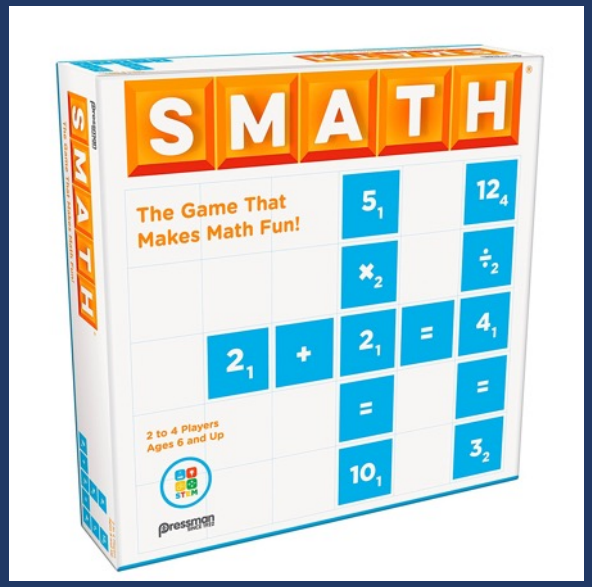

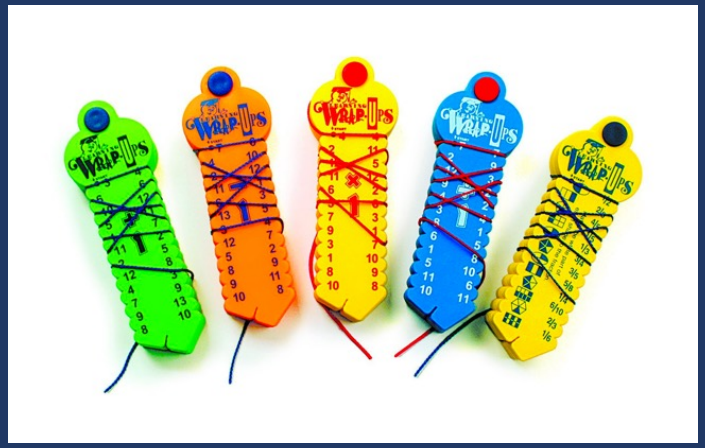

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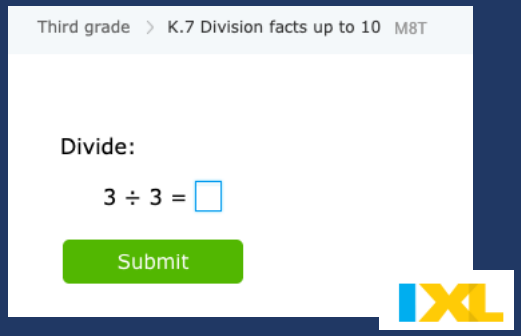

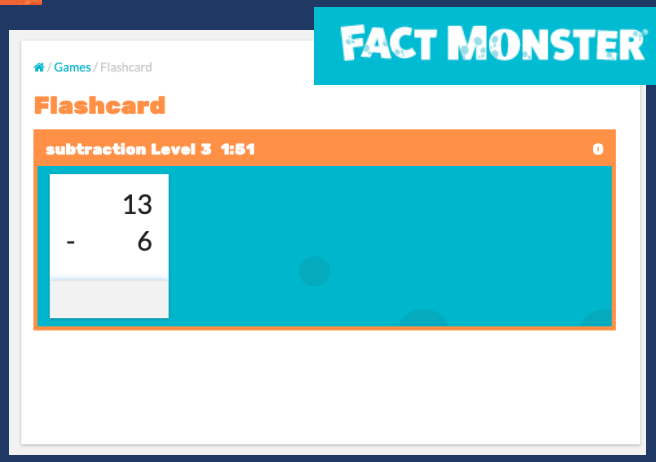

DAILY and BRIEF

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Addition	Subtraction
Multiplication	Division

What are five ways you help students build fact fluency?

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Addition	Subtraction
Multiplication	Division

Build fluency with whole-number computation

$$\begin{array}{r} 15 \\ +\ 28 \\ \hline \end{array}$$

$$\begin{array}{r} 23 \\ \times\ 9 \\ \hline \end{array}$$

$$\begin{array}{r} 1009 \\ -\ 724 \\ \hline \end{array}$$

$$\begin{array}{r} 7250 \\ \div\ 15 \\ \hline \end{array}$$

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Addition	Subtraction
Multiplication	Division

Build fluency with rational-number computation

$$\begin{array}{r} 1.4 \\ +\ 3.9 \\ \hline \end{array}$$

$$\frac{2}{3} \times \frac{3}{4}$$

$$\frac{9}{4} - \frac{3}{8}$$

$$\begin{array}{r} 7.892 \\ \div\ 0.14 \\ \hline \end{array}$$

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Addition	Subtraction
Multiplication	Division

Build fluency with integer computation

$$\begin{array}{r} 1.4 \\ +\ -3.9 \\ \hline \end{array}$$

$$\begin{array}{r} 6 \\ \times\ -12 \\ \hline \end{array}$$

$-14 - (-7) =$

$-135 \div 2 =$

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Building Fluency with Computation

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Addition and Subtraction Computation

227 + 185 =	232 – 164 =

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Partial Sums

A.

$$\begin{array}{r} 74 \\ +\ 18 \\ \hline 80 \\ +12 \\ \hline 92 \end{array}$$

B.

$$\begin{array}{r} 725 \\ +\ 365 \\ \hline 1{,}000 \\ 80 \\ +\ 10 \\ \hline 1{,}090 \end{array}$$

$$\begin{array}{r} 227 \\ +\ 185 \\ \hline \end{array}$$

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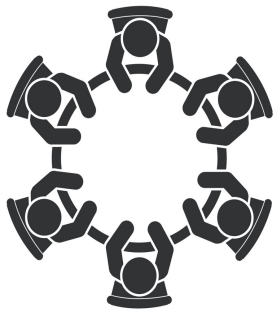
Opposite Change

A.

$$74 \xrightarrow{-4} 70$$
$$+\ 18 \xrightarrow{+4} +22$$
$$92$$

B.

$$725 \xrightarrow{+5} 730$$
$$+\ 365 \xrightarrow{-5} +360$$
$$1{,}090$$



$$227$$
$$+\ 185$$

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Addition and Subtraction Computation

227 + 185 =	232 – 164 =

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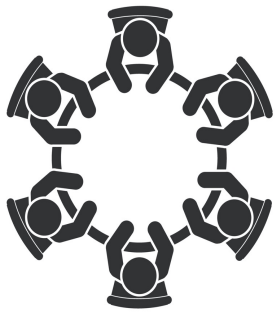
Partial Differences

A.

$$\begin{array}{r} 62 \\ -\ 17 \\ \hline +50 \\ -\ 5 \\ \hline 45 \end{array}$$

B.

$$\begin{array}{r} 305 \\ -\ 96 \\ \hline +300 \\ -90 \\ -1 \\ \hline 209 \end{array}$$



$$\begin{array}{r} 232 \\ -\ 164 \\ \hline \end{array}$$

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Same Change

A.

$$\begin{array}{r} 62 \xrightarrow{+3} 65 \\ -\ 17 \xrightarrow{+3} -20 \\ \hline 45 \end{array}$$

B.

$$\begin{array}{r} 305 \xrightarrow{+4} 309 \\ -\ 96 \xrightarrow{+4} -100 \\ \hline 209 \end{array}$$

$$\begin{array}{r} 232 \\ -\ 164 \\ \hline \end{array}$$

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Add Up

A.

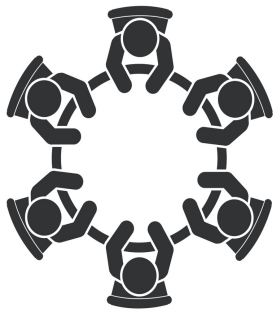
$$\begin{array}{r} 62 \\ -\ 17 \\ \hline \end{array}$$

$$\begin{array}{r} 17 \\ 20 \\ 60 \\ 62 \\ \hline \end{array} \qquad \begin{array}{r} 3 \\ 40 \\ +\ 2 \\ \hline 45 \end{array}$$

B.

$$\begin{array}{r} 305 \\ -\ 96 \\ \hline \end{array}$$

$$\begin{array}{r} 96 \\ 100 \\ 300 \\ 305 \\ \hline \end{array} \qquad \begin{array}{r} 4 \\ 200 \\ +\ 5 \\ \hline 209 \end{array}$$



$$\begin{array}{r} 232 \\ -\ 164 \\ \hline \end{array}$$

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Multiplication and Division Computation

13 x 7 =	135 ÷ 5 =
13 x 47 =	804 ÷ 12 =

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Partial Products

A.

$$\begin{array}{r} 24 \\ \times\ 43 \\ \hline 800 \\ 160 \\ 60 \\ +\ 12 \\ \hline 1{,}032 \end{array}$$

B.

$$\begin{array}{r} 132 \\ \times\ 53 \\ \hline 5000 \\ 1500 \\ 100 \\ 300 \\ 90 \\ +\ 6 \\ \hline 6996 \end{array}$$

$$\begin{array}{r} 13 \\ \times\ 47 \\ \hline \end{array}$$

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Area (Array)

A.

$$\begin{array}{r} 24 \\ \times\ 43 \\ \hline \end{array}$$

	20	4	
	800	160	40
	60	12	3

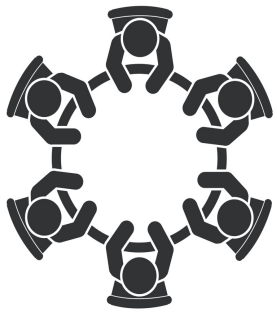
$$\begin{array}{r} {\scriptstyle 1\ 1} \\ 800 \\ 160 \\ 60 \\ +\ 12 \\ \hline 1{,}032 \end{array}$$

B.

$$\begin{array}{r} 132 \\ \times\ 53 \\ \hline \end{array}$$

	100	30	2	
	5000	1500	100	50
	300	90	6	3

$$\begin{array}{r} 5000 \\ 1500 \\ 100 \\ 300 \\ 90 \\ +\ 6 \\ \hline 6996 \end{array}$$



$$\begin{array}{r} 13 \\ \times\ 47 \\ \hline \end{array}$$

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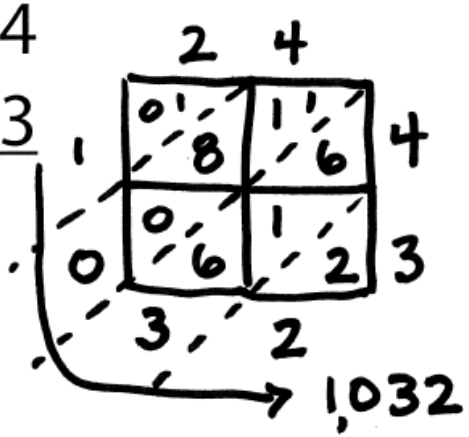
Lattice

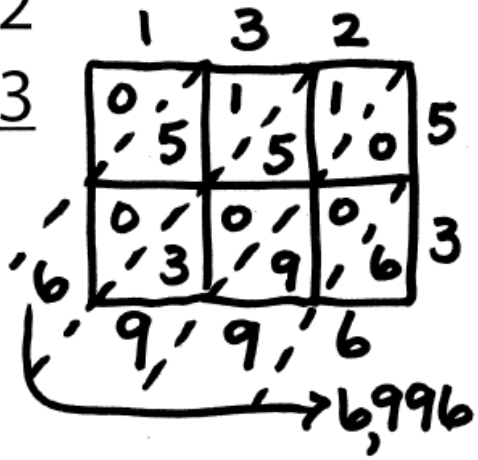
A.

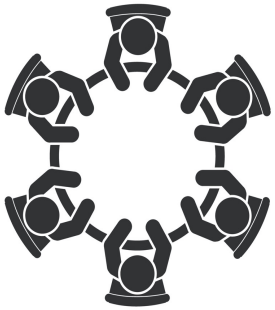
$$\begin{array}{r} 24 \\ \times\ 43 \\ \hline \end{array}$$



B.

$$\begin{array}{r} 132 \\ \times\ 53 \\ \hline \end{array}$$





$$\begin{array}{r} 13 \\ \times\ 47 \\ \hline \end{array}$$

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Multiplication and Division Computation

13 x 7 =	135 ÷ 5 =
13 x 47 =	804 ÷ 12 =

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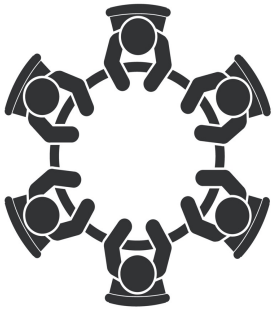
Partial Quotients

A.

$$
\begin{array}{r|l}
12\overline{)158} & \\
-120 & 10 \\
\hline
38 & \\
-36 & +3 \\
\hline
2 & 13\ \text{R}2
\end{array}
$$

B.

$$
\begin{array}{r|l}
34\overline{)570} & \\
-680 & 20 \\
\hline
290 & \\
-170 & 5 \\
\hline
120 & \\
102 & +3 \\
\hline
18 & 28\ \text{R}\ 18
\end{array}
$$



$$
\begin{array}{r}
804 \\
\div\ \ 12 \\
\hline
\end{array}
$$

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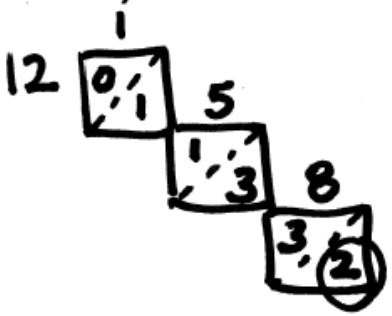
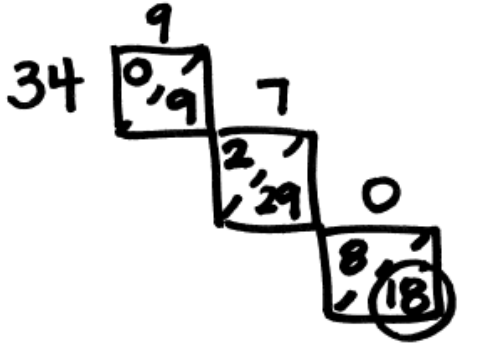
Lattice

A. $12\overline{)158}$ = 13 R2



B. $34\overline{)970}$ = 28 R 18



$$804 \div 12$$

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Division as Fractions

A. $12\overline{)158}$

$\frac{100}{12}$ $8\frac{4}{12}$

$\frac{50}{12}$ $4\frac{2}{12}$

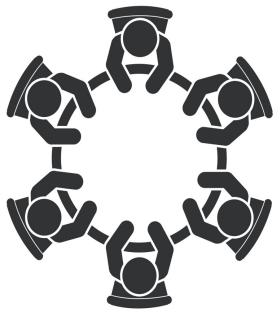
$\frac{8}{12} + \frac{8}{12} = 12\frac{14}{12} = 13\frac{2}{12}$

B. $34\overline{)970}$

$\frac{900}{34}$ $26\frac{16}{34}$

$\frac{70}{34}$ $+2\ \frac{2}{34}$

$\frac{0}{34}$ $= 28\frac{18}{34}$



$$\begin{array}{r} 804 \\ \div\ \ 12 \\ \hline \end{array}$$

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Multiple Representations: Fractions

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Fraction Concepts

Fraction	Length	Area	Set
$\frac{2}{3}$			
$\frac{1}{4}$			
$1\frac{1}{2}$			
$\frac{3}{7}$			

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LENGTH

AREA

SET

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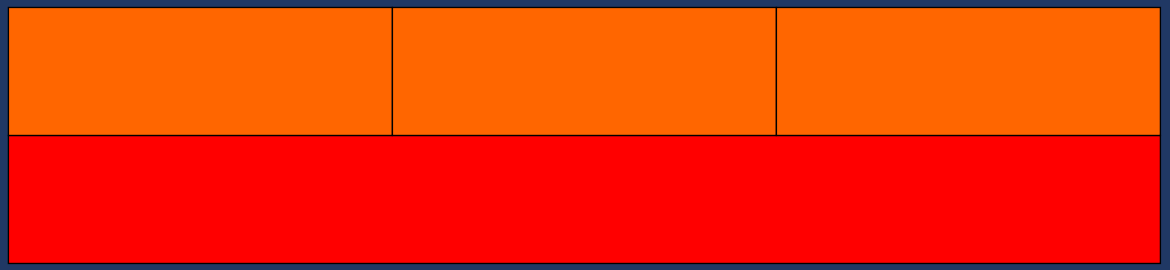
LENGTH

Fractions are appropriated by length

$\frac{2}{3}$



Fraction tiles/bars

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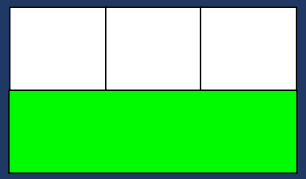
LENGTH

Fractions are appropriated by length

$\frac{2}{3}$



Cuisenaire rods

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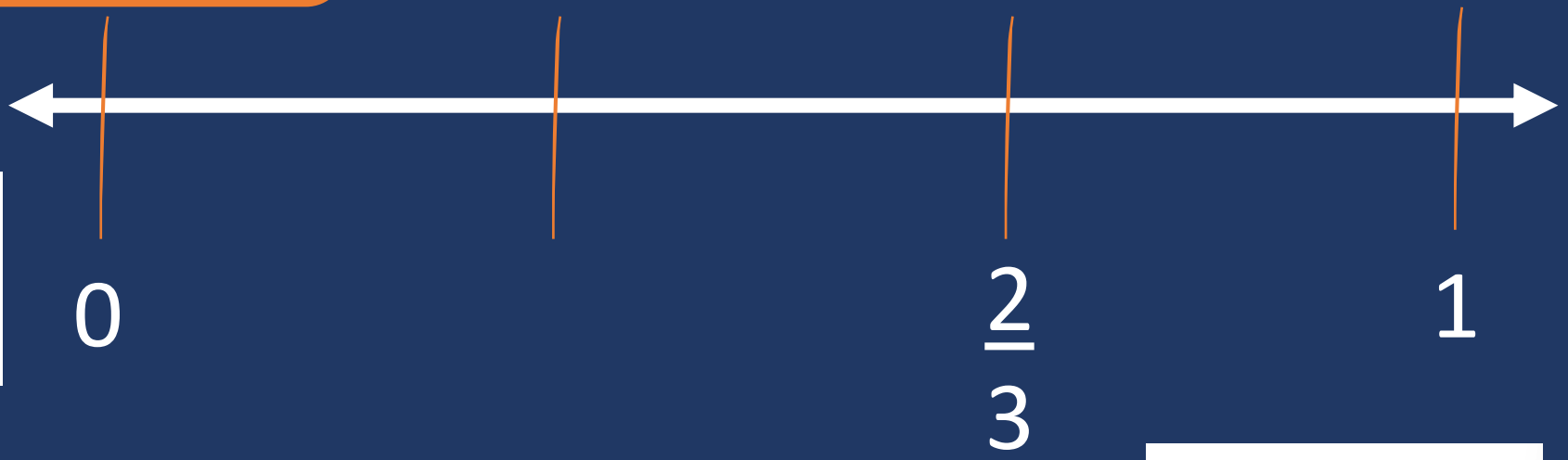
LENGTH

Fractions are appropriated by length

$\frac{2}{3}$



Number line

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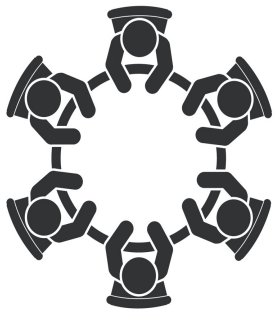
Fraction Concepts

Fraction	Length	Area	Set
$\frac{2}{3}$			
$\frac{1}{4}$			
$1\frac{1}{2}$			
$\frac{3}{7}$			



Show fractions with the length model.

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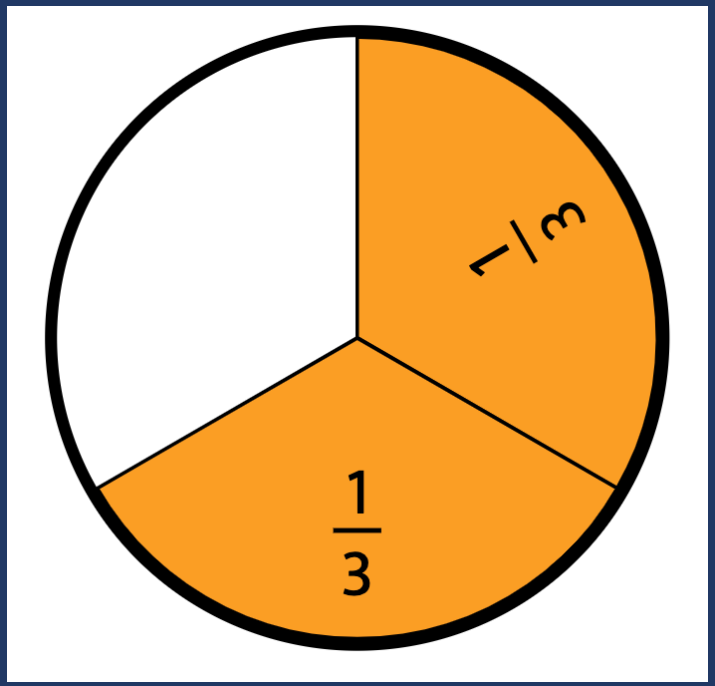
AREA

Shapes divided into equal sections

$\frac{2}{3}$



Fraction circles

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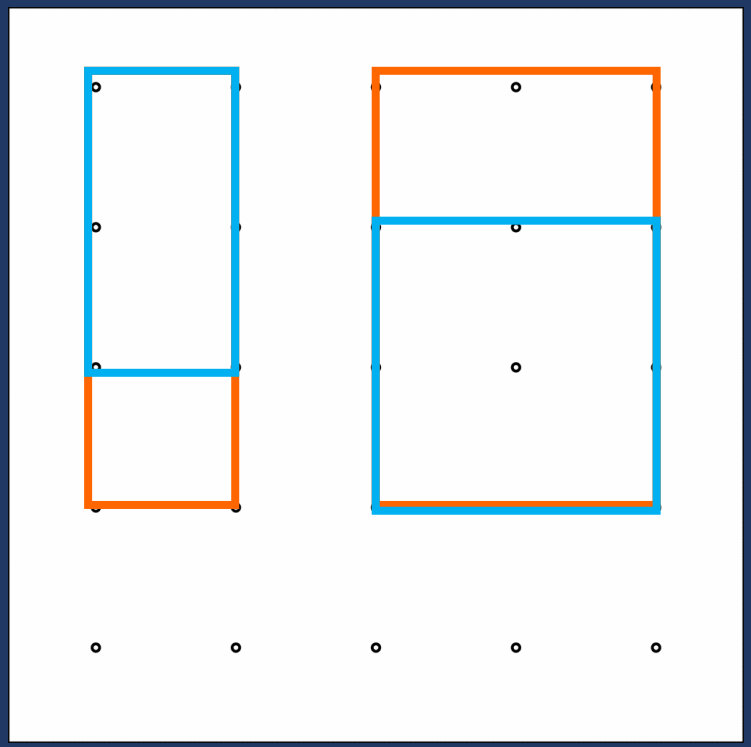
AREA

Shapes divided into equal sections

$\frac{2}{3}$



Geoboards

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AREA

Shapes divided into equal sections

$\frac{2}{3}$

Pattern blocks

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AREA

Shapes divided into equal sections

$\frac{2}{3}$

Legos

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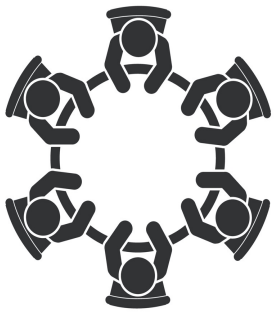
Fraction Concepts

Fraction	Length	Area	Set
$\frac{2}{3}$			
$\frac{1}{4}$			
$1\frac{1}{2}$			
$\frac{3}{7}$			



Show fractions with the area model.

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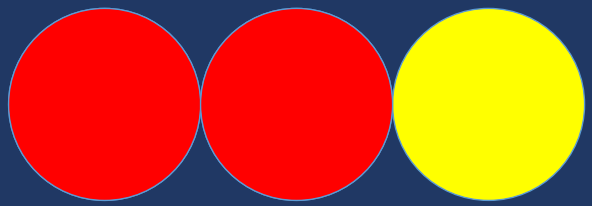
SET

Individual shapes match the fraction

$\frac{2}{3}$



Two-color counters

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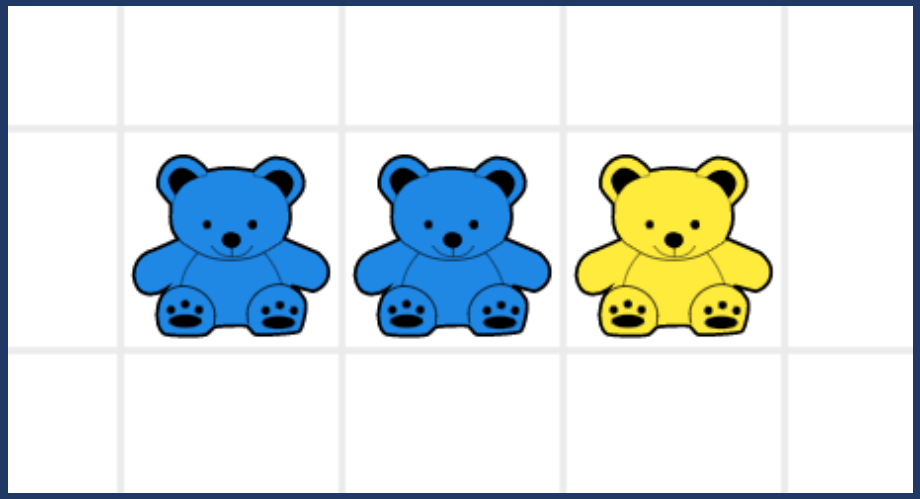
SET

Individual shapes match the fraction

$\frac{2}{3}$



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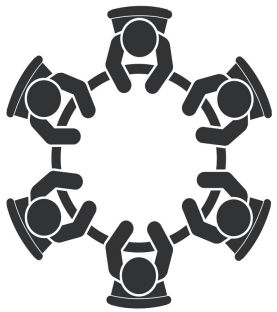
Fraction Concepts

Fraction	Length	Area	Set
$\frac{2}{3}$			
$\frac{1}{4}$			
$1\frac{1}{2}$			
$\frac{3}{7}$			



Show fractions with the set model.

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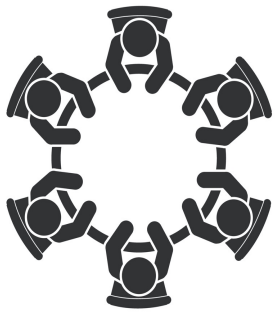
Fraction Concepts

Fraction	Length	Area	Set
$\frac{2}{3}$			
$\frac{1}{4}$			
$1\frac{1}{2}$			
$\frac{3}{7}$			



Select a grade-level fractions task. Use representations to model the task.

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Multiple Representations: Pre-Algebra

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Integers

Addition and Subtraction

Problem	Representation
3 + (-5)	
-2 + 6	
3 + (-1)	
-3 – 4	
2 – 5	
-2 – (-6)	
-3 – 2	

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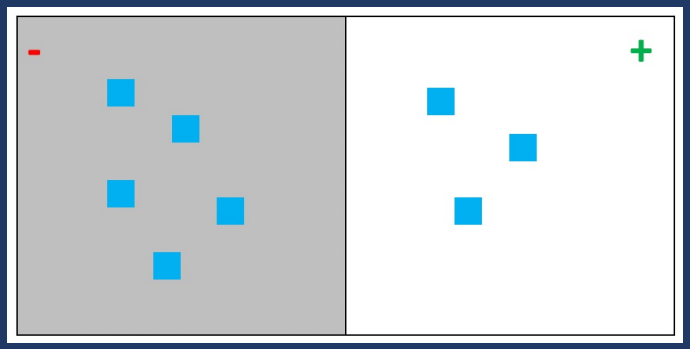
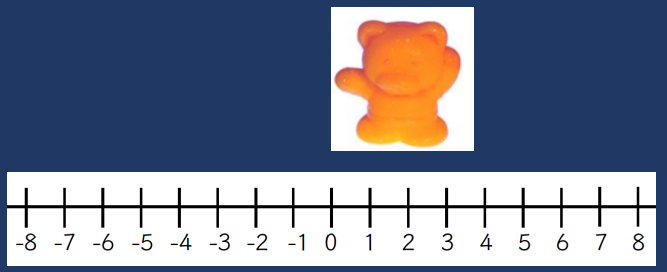
Ways to Teach Addition and Subtraction

MAT and CUBES



TWO-COLOR COUNTERS

NUMBER LINE



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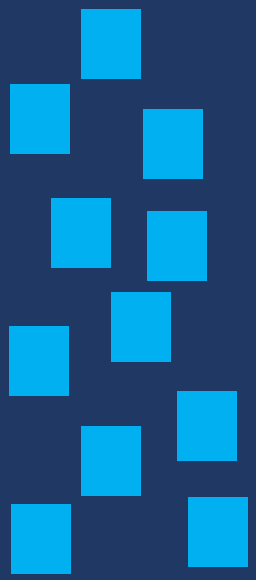
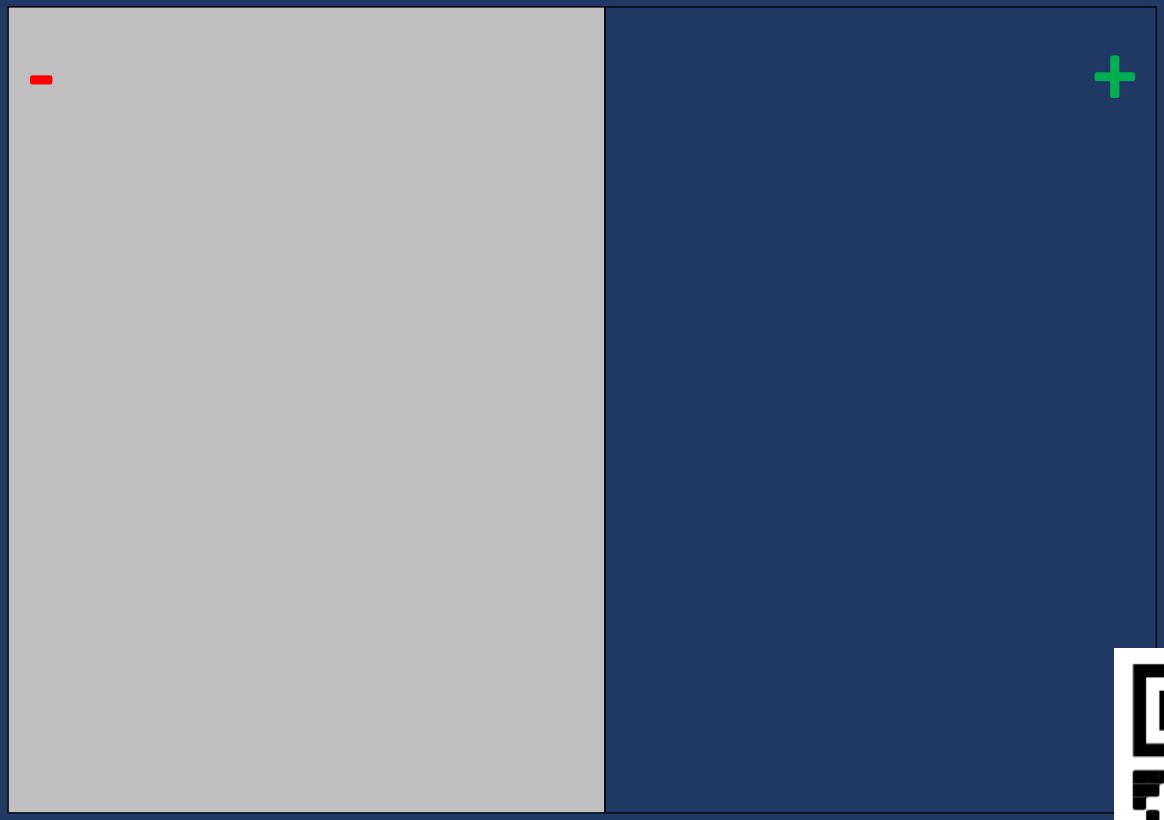
3 + (-5)





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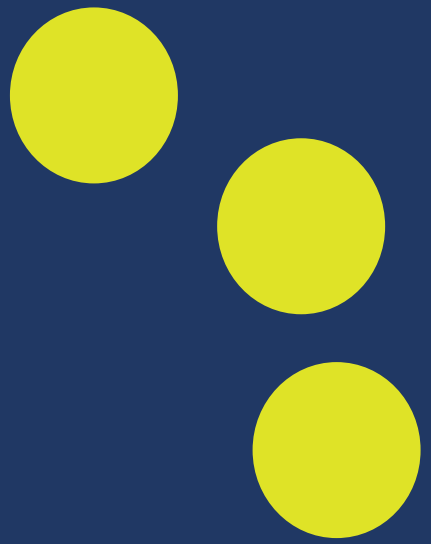
3 + (-5)



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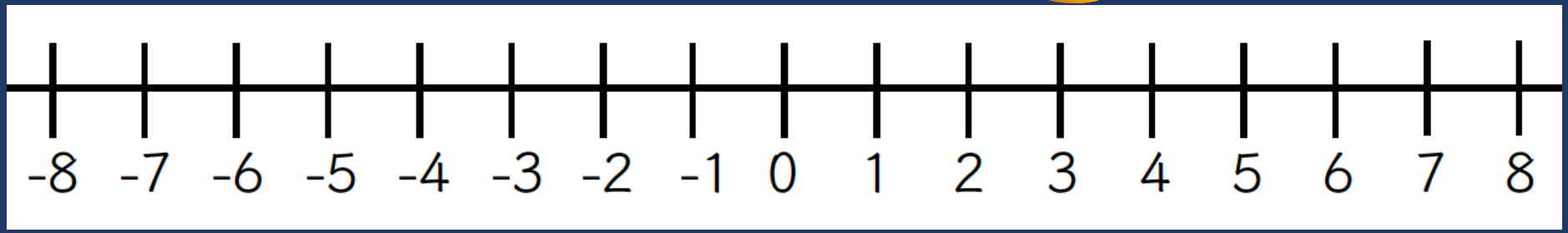
$3 + (-5)$



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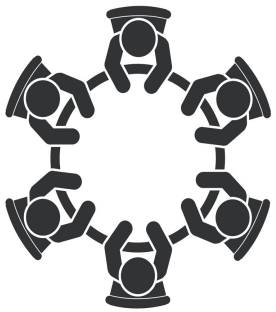
Integers

Addition and Subtraction

Problem	Representation
3 + (-5)	
-2 + 6	
3 + (-1)	
-3 – 4	
2 – 5	
-2 – (-6)	
-3 – 2	



Use representations to model the addition problems.

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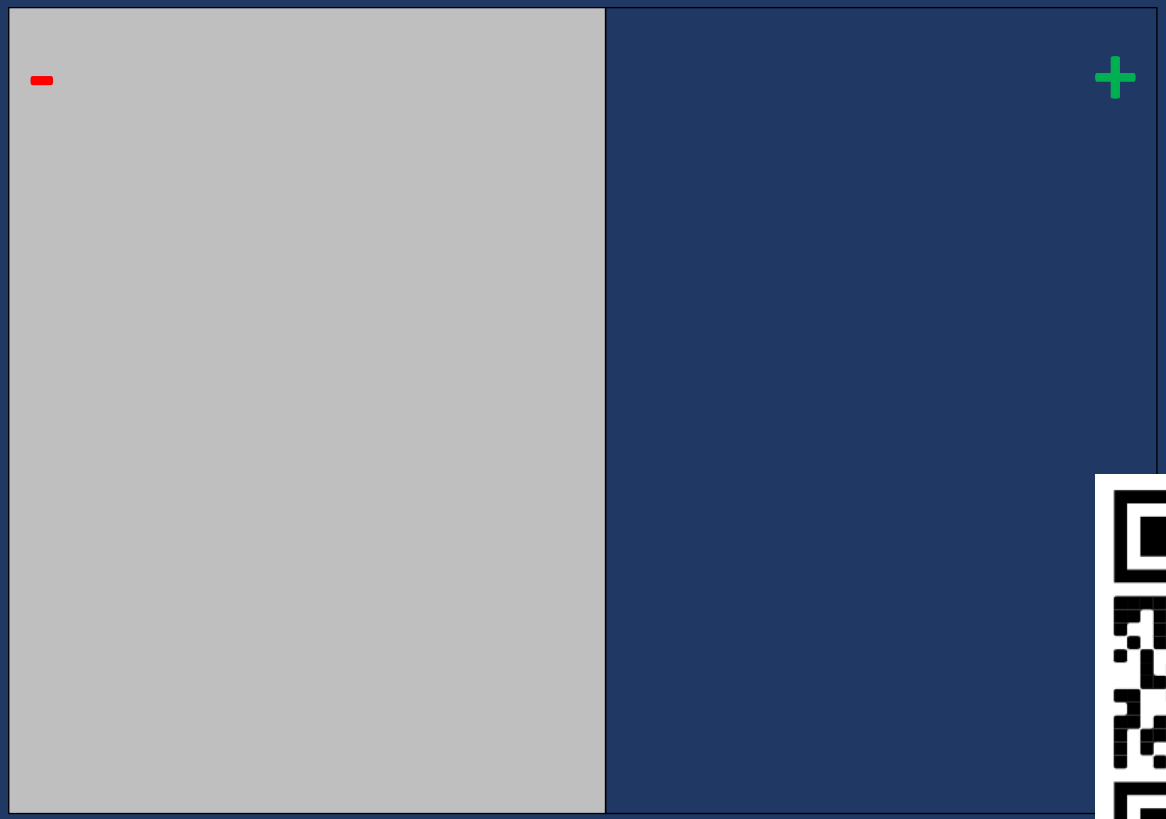
-3 – 4



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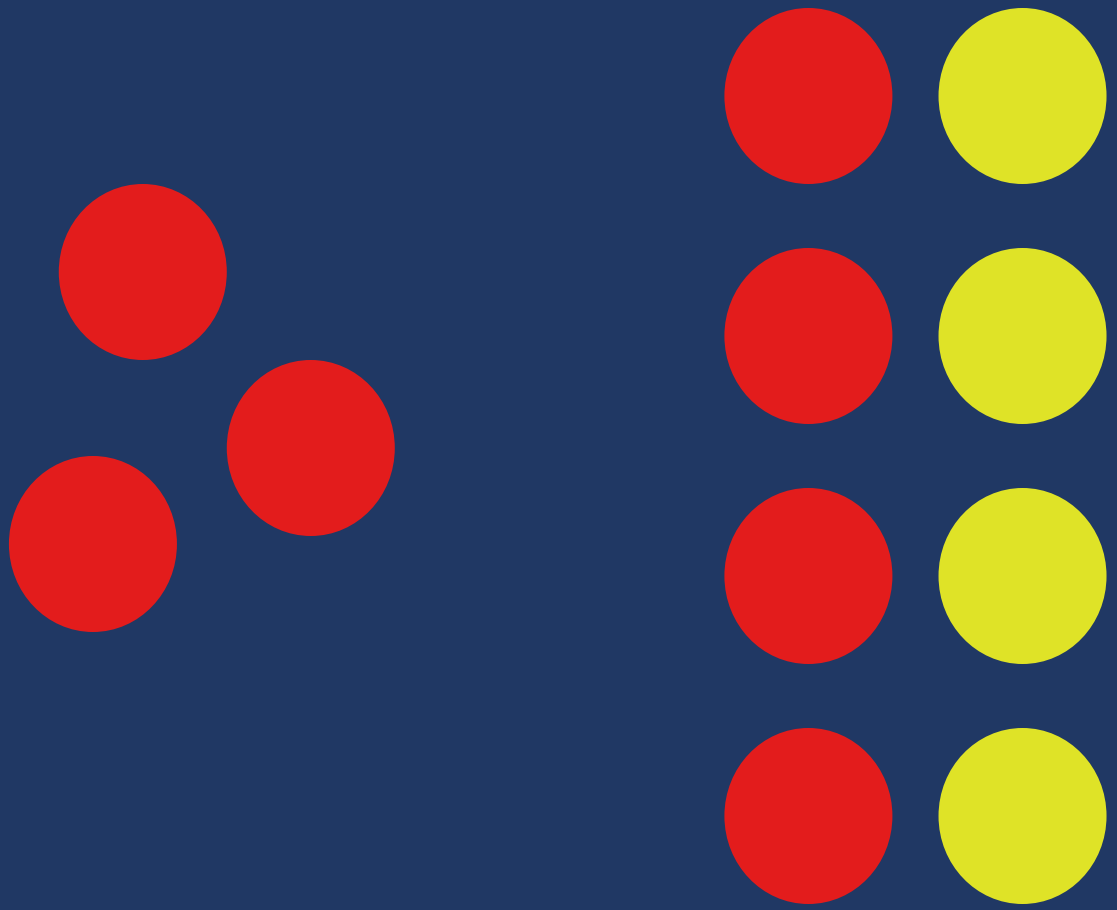
-3 – 4



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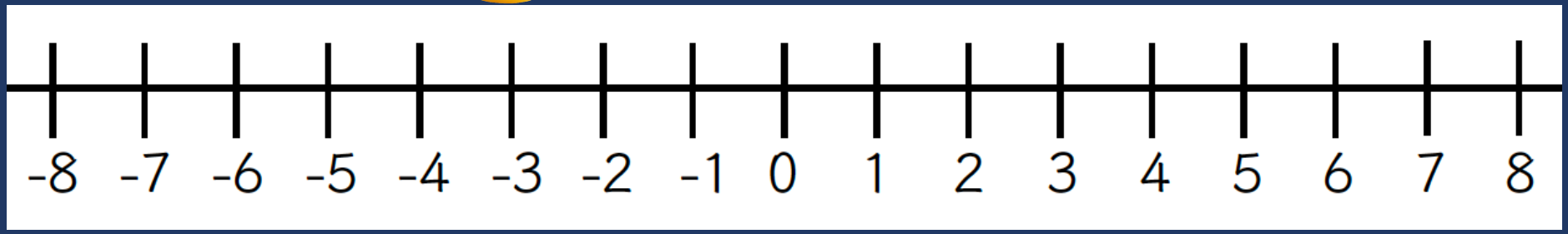
-3 – 4



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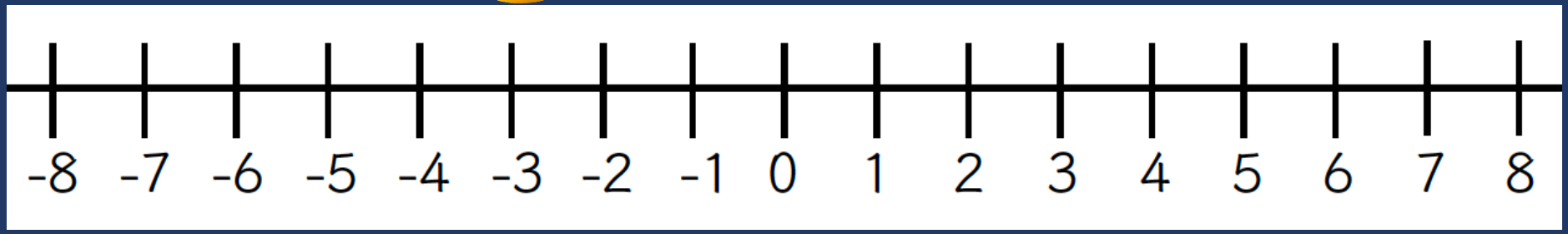
-3 – 4



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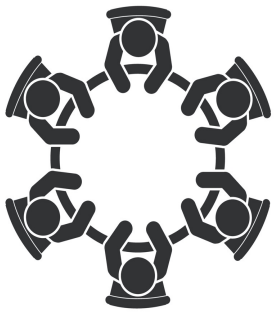
Integers

Addition and Subtraction

Problem	Representation
3 + (-5)	
-2 + 6	
3 + (-1)	
-3 – 4	
2 – 5	
-2 – (-6)	
-3 – 2	



Use representations to model the subtraction problems.

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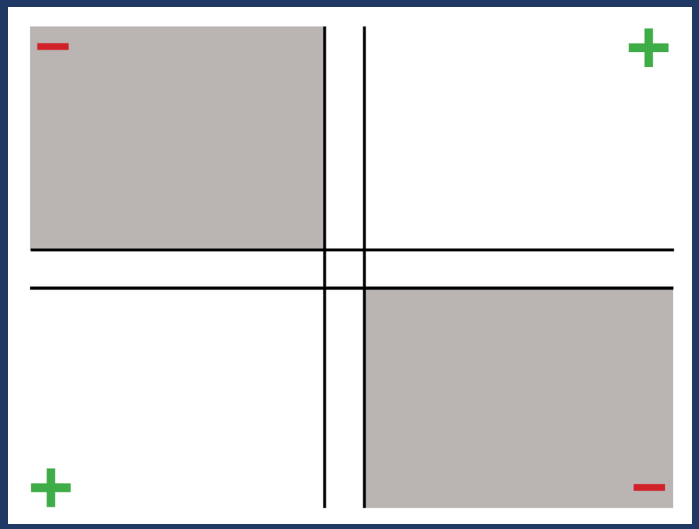
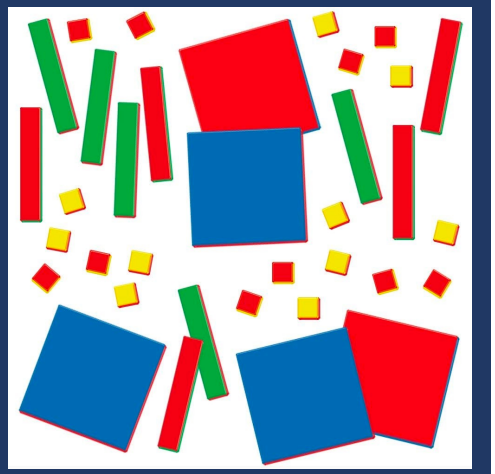
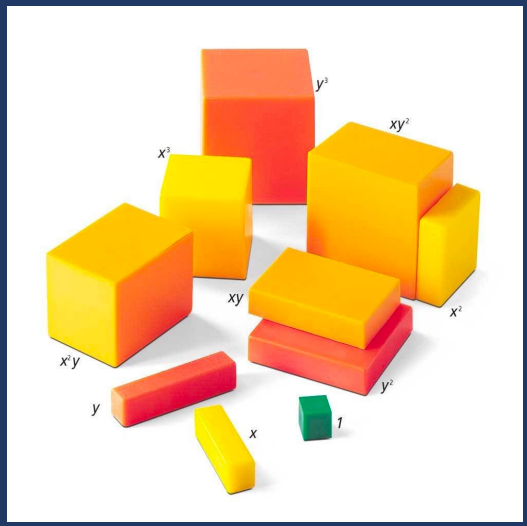
Ways to Teach Multiplication and Division

MAT and CUBES



ALGEBRA TILES/ALGEBLOCKS





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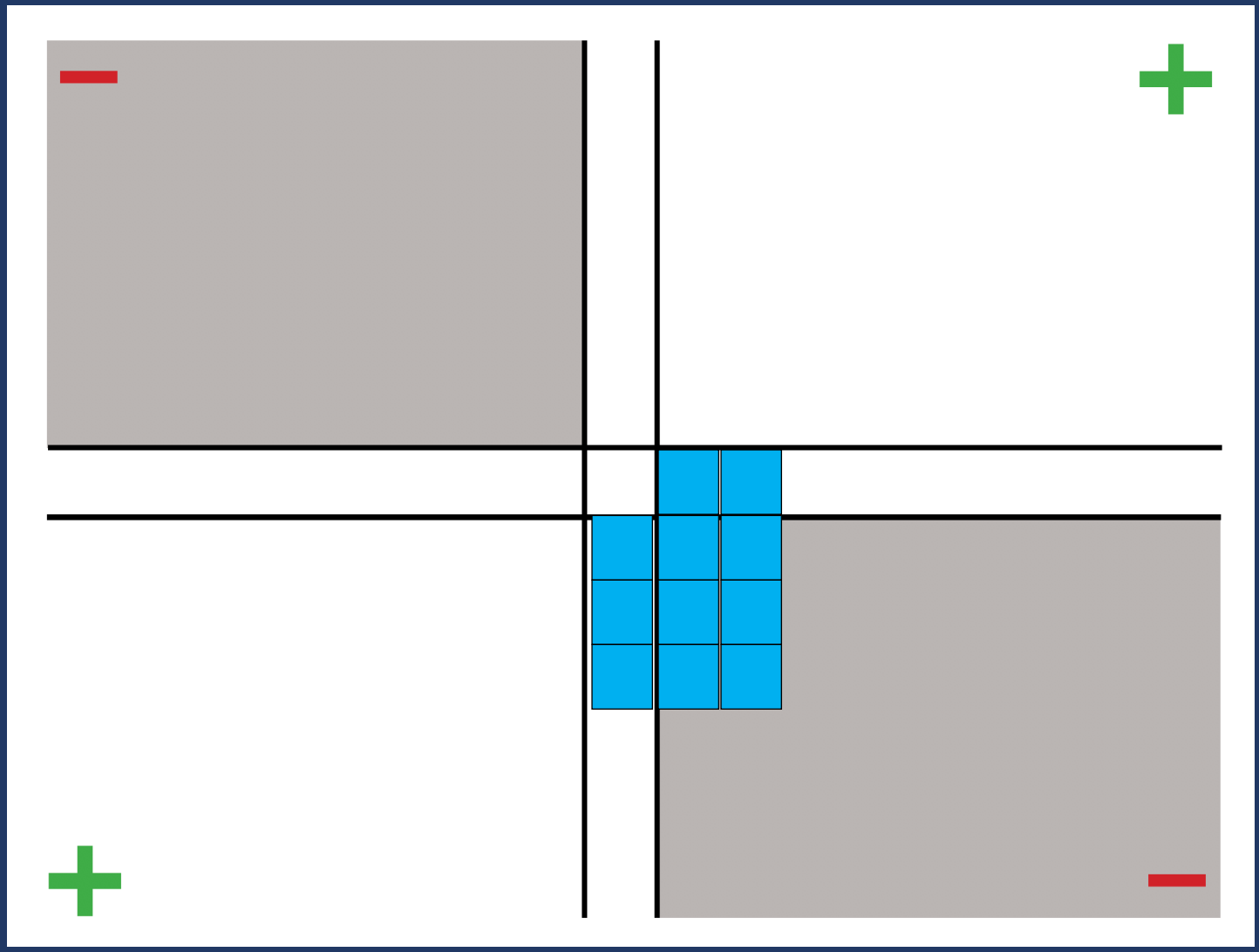
(2)(-3)



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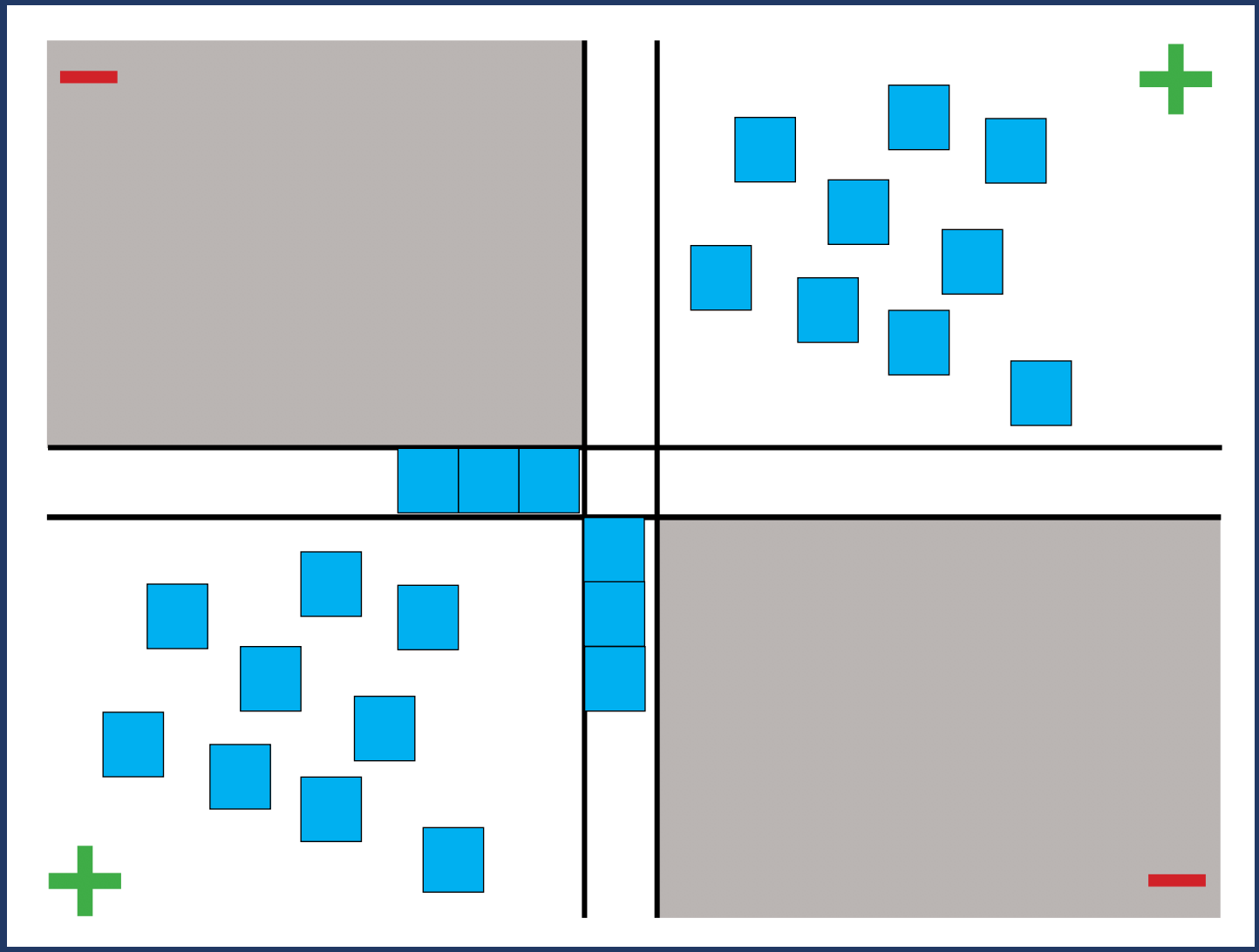
$9 \div (-3)$



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Solving Equations

With Cups/Plates and Counters

Problem	Representations
$x + 2 = 5$	
$x + 2 = 5$	
$4 + x = 6$	
$5 = x - 3$	
$-2 = x + 3$	

With Algebra Tiles

Problem	Representations
$x + 2 = 5$	
$4 + x = 6$ $x + 3 = 7$	
$y - 4 = 2$	
$5 = x - 3$ $y - 2 = 5$	

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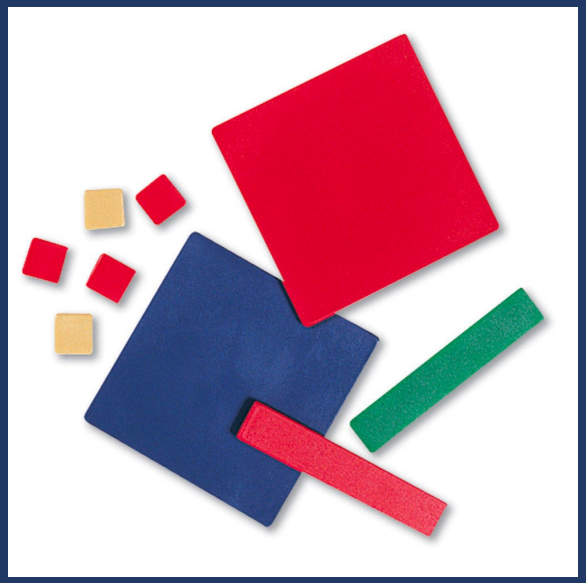
cups/plates and counters

algebra tiles



Algeblocks

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zero pairs

-1 and 1 equal 0

properties of equality

If you do something to one side of the equal sign, you do the same thing to the other side.

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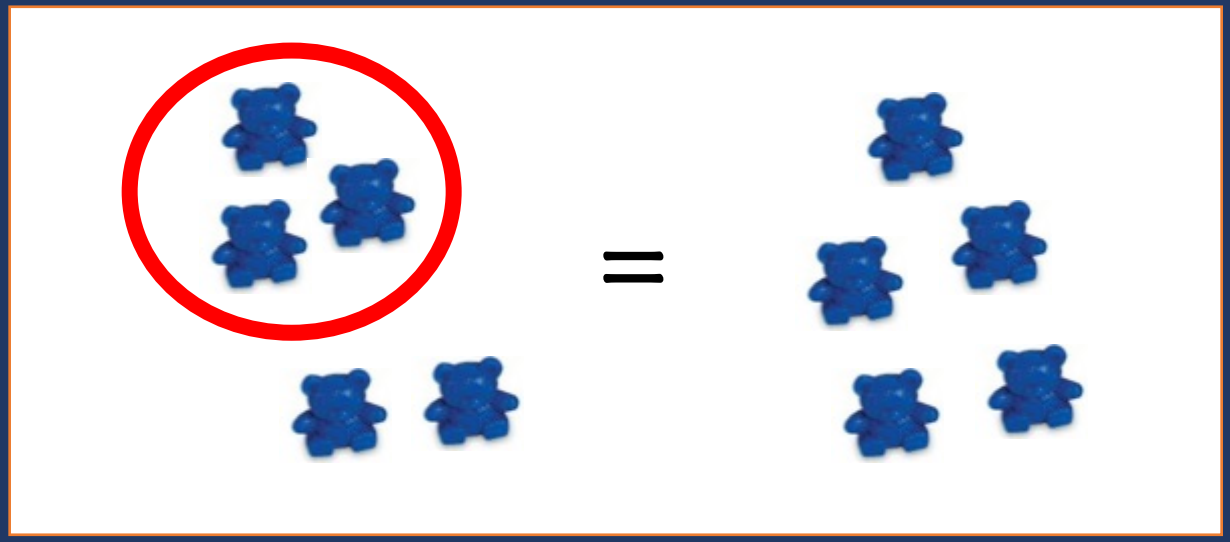
cups/plates and counters

$x + 2 = 5$



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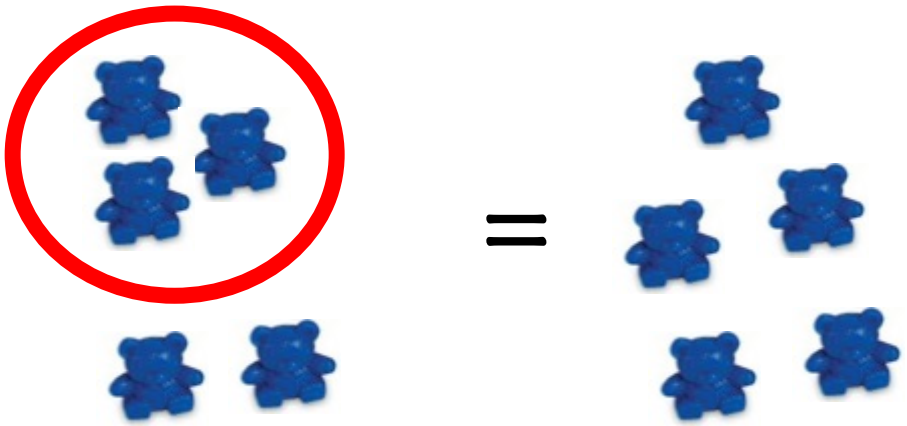
cups/plates and counters

$x + 2 = 5$



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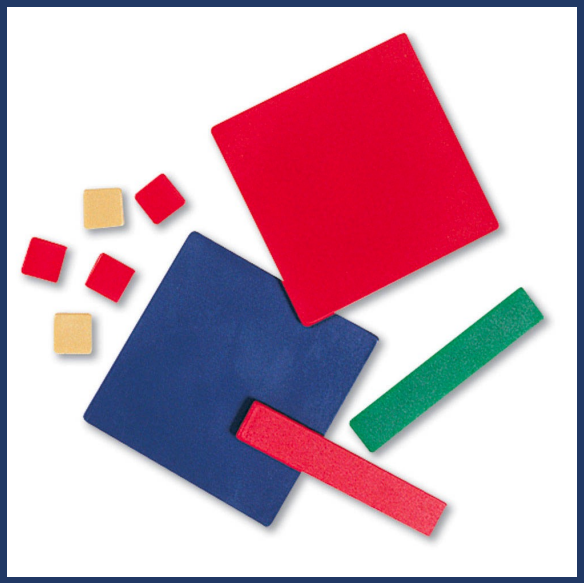
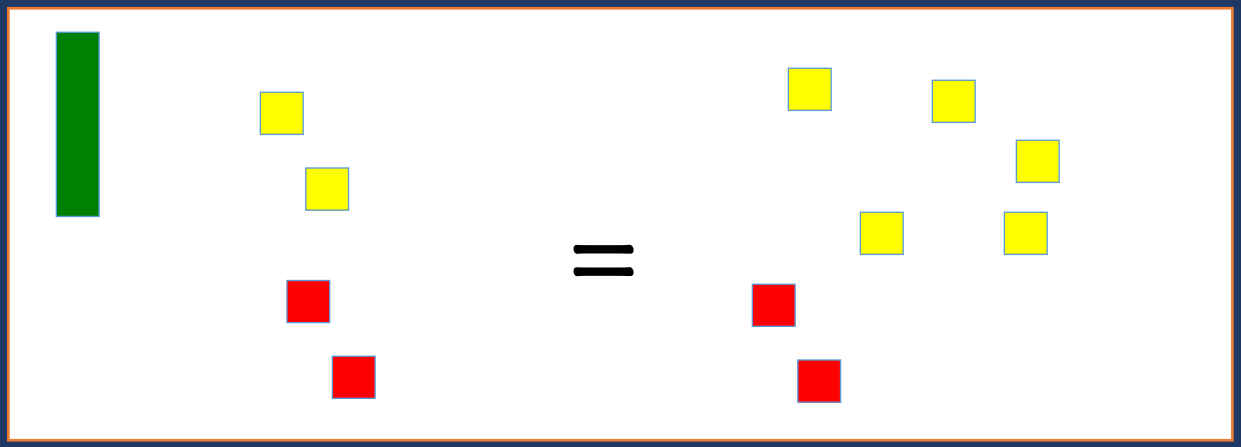
algebra tiles

$x + 2 = 5$





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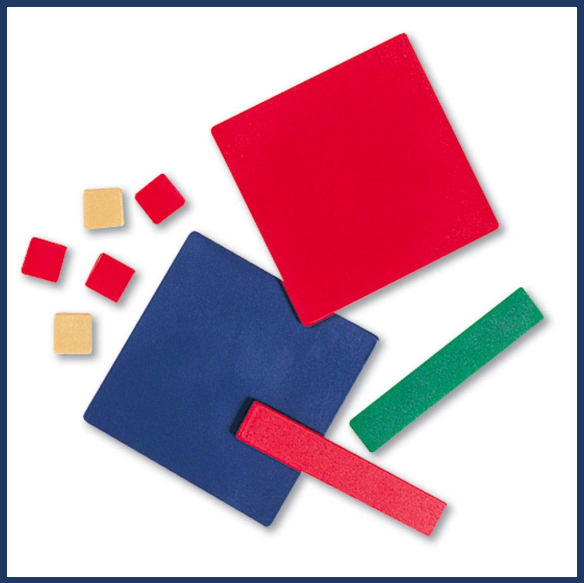
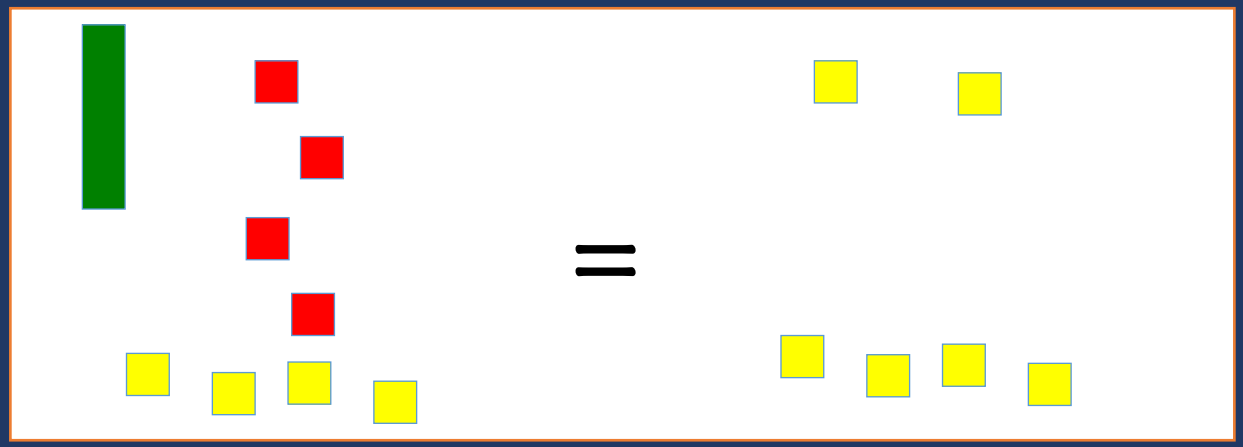
algebra tiles

$y - 4 = 2$

$x + 2 = 5$





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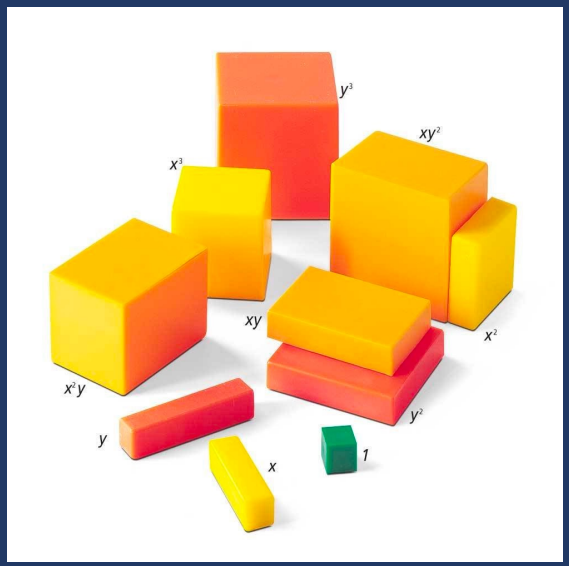
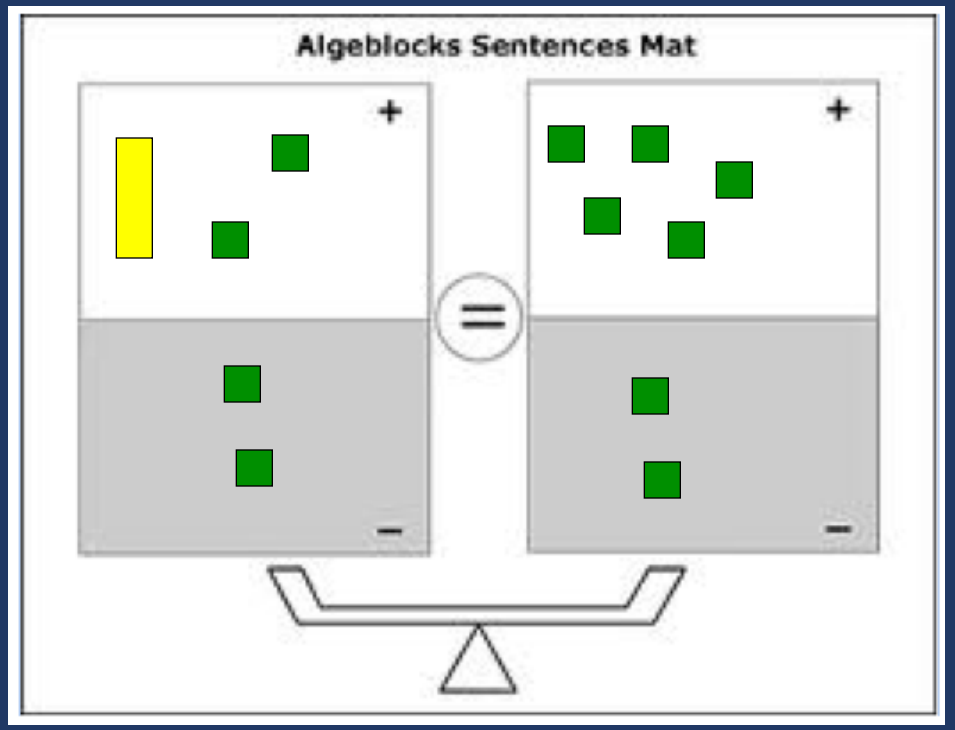
Algeblocks

$x + 2 = 5$





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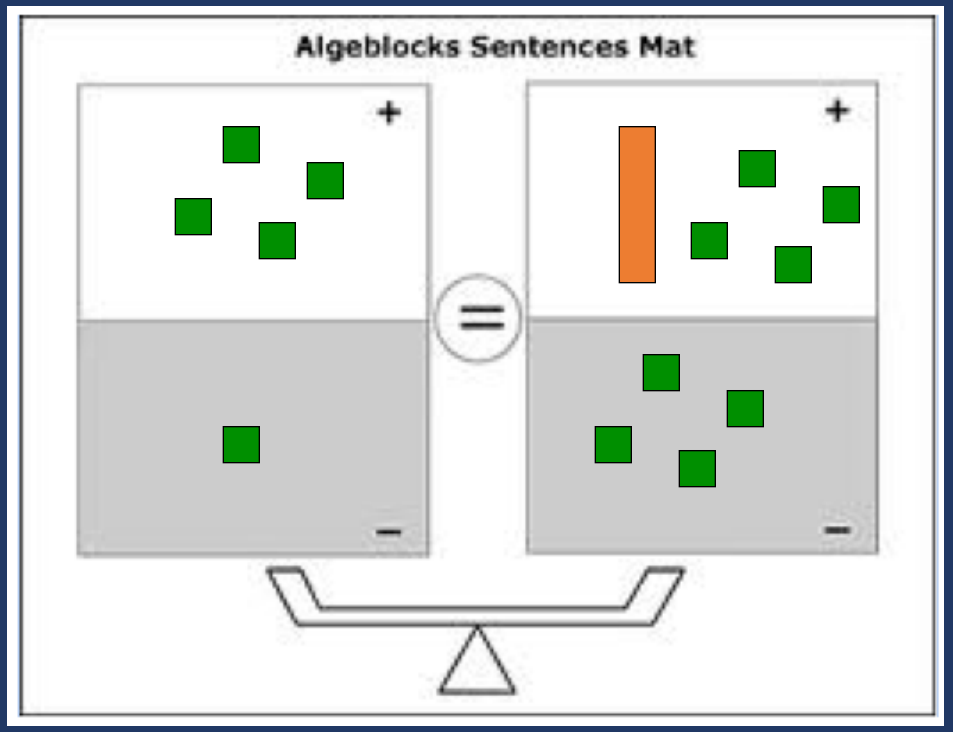
Algeblocks

$-1 = y - 4$



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Solving Equations

With Cups/Plates and Counters

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With Algebra Tiles

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$5 = x - 3$ $y - 2 = 5$	

Use representations to solve the problems.

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Solving Equations

With Algeblocks

Problem	Representations
$x + 2 = 5$	
$4 + x = 6$	
$-2 = x + 3$	
$-1 = y - 4$	
$2x + 2 = 6$	
$x + 4 = 3x$	
$2(x + 3) = x + 4$	
$2x - 4 = 1 + 3x$	
$3y - 5 = -y - 1$	
$1 - x = x + 1$	

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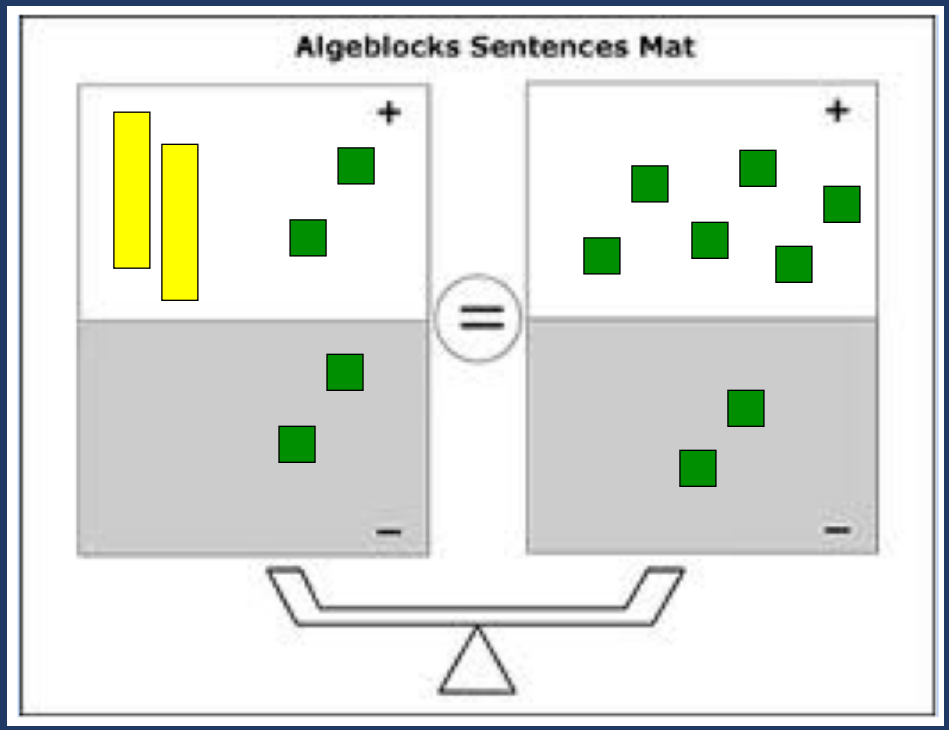
Algeblocks

$$2x + 2 = 6$$



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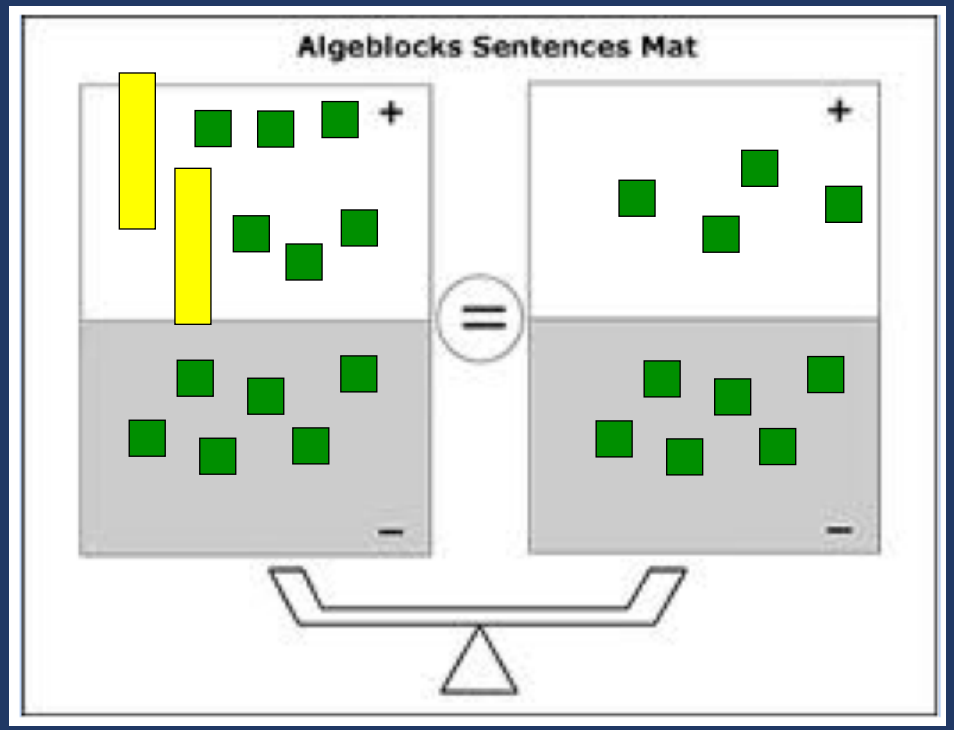
Algeblocks

$$2(x+3)=4$$



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Solving Equations

With Algeblocks

Problem	Representations
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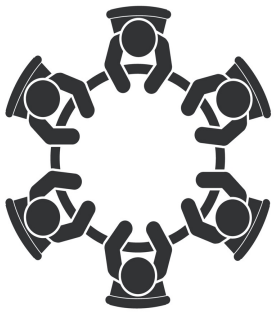
$4 + x = 6$	
$-2 = x + 3$	
$-1 = y - 4$	
$2x + 2 = 6$	
$x + 4 = 3x$	
$2(x + 3) = x + 4$	
$2x - 4 = 1 + 3x$	
$3y - 5 = -y - 1$	
$1 - x = x + 1$	



Use representations to solve the problems.

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Multiple Representations: Geometry

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Geometry

Select a grade-level geometry task. Use representations to model the task.

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Schedule for Today

8:00-8:25	- Introductions - Trajectories in mathematics
8:25-9:15	- Critical math content - Evidence-based practices
9:15-9:25	BREAK
9:25-10:25	- Evidence-based practice: Systematic instruction
10:25-11:30	- Evidence-based practice: Fluency with facts - Evidence-based practice: Multiple representations
11:30-1:00	LUNCH
1:00-2:15	- Evidence-based practice: Fluency with computation - Multiple representations: Whole numbers
2:15-2:25	BREAK
2:25-4:00	- Multiple representations: Rational numbers - Multiple representations: Pre-algebra - Multiple representations: Geometry

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Schedule for Tomorrow

8:00-9:30	- Language of mathematics
9:30-9:40	BREAK
9:40-10:15	- Evidence-based practice: Word-problem solving
10:15-10:30	- Word-problem solving: Ineffective strategies
10:30-11:00	- Word-problem solving: Attack strategies
11:00-11:30	- Word-problem solving: Total problems
11:30-1:00	LUNCH
1:00-2:15	- Word-problem solving: Difference problems - Word-problem solving: Change problems - Word-problem solving: Equal groups problems - Word-problem solving: Comparison problems
2:15-2:25	BREAK
2:25-4:00	- Word-problem solving: Ratios/Proportions problems - Word-problem solving: Multi-step problems - Wrap-up

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https://intensiveintervention.org/intensive-intervention-math-course

National Center on
INTENSIVE INTERVENTION
at American Institutes for Research

Intensive Intervention | Tools Charts | Implementation Support | Intervention Materials

Intensive Intervention in Mathematics Course Content

NCII, through a collaboration with the University of Connecticut, developed a set of course content focused on developing educators' skills in designing and delivering intensive mathematics instruction. This content is designed to support faculty and professional development providers with instructing pre-service and in-service educators who are developing and/or refining their implementation of intensive mathematics intervention.

Intensive instruction was recently identified as a high-leverage practice in special education, and DBI is a research based approach to delivering intensive instruction across content areas (NCII, 2013). This course provides learners with an opportunity to extend their understanding of intensive instruction through in-depth exposure to DBI in mathematics, complete with exemplars from actual classroom teachers.

NCII, through a collaboration with the University of Connecticut and the National Center on Leadership in Intensive Intervention and with support from the CEEDAR Center, developed course content focused on enhancing educators' skills in intensive mathematics intervention. The course includes eight modules that can support faculty and professional development providers with instructing pre-service and in-service educators who are learning to implement intensive mathematics intervention through data-based individualization (DBI). The content in this course complements concepts covered in the Features of Explicit Instruction Course and so we suggest that users complete both courses.

MODULE 4: INTENSIVE MATHEMATICS INTERVENTION: INSTRUCTIONAL DELIVERY

MODULE 5: INTENSIVE MATHEMATICS INTERVENTION: INSTRUCTIONAL STRATEGIES

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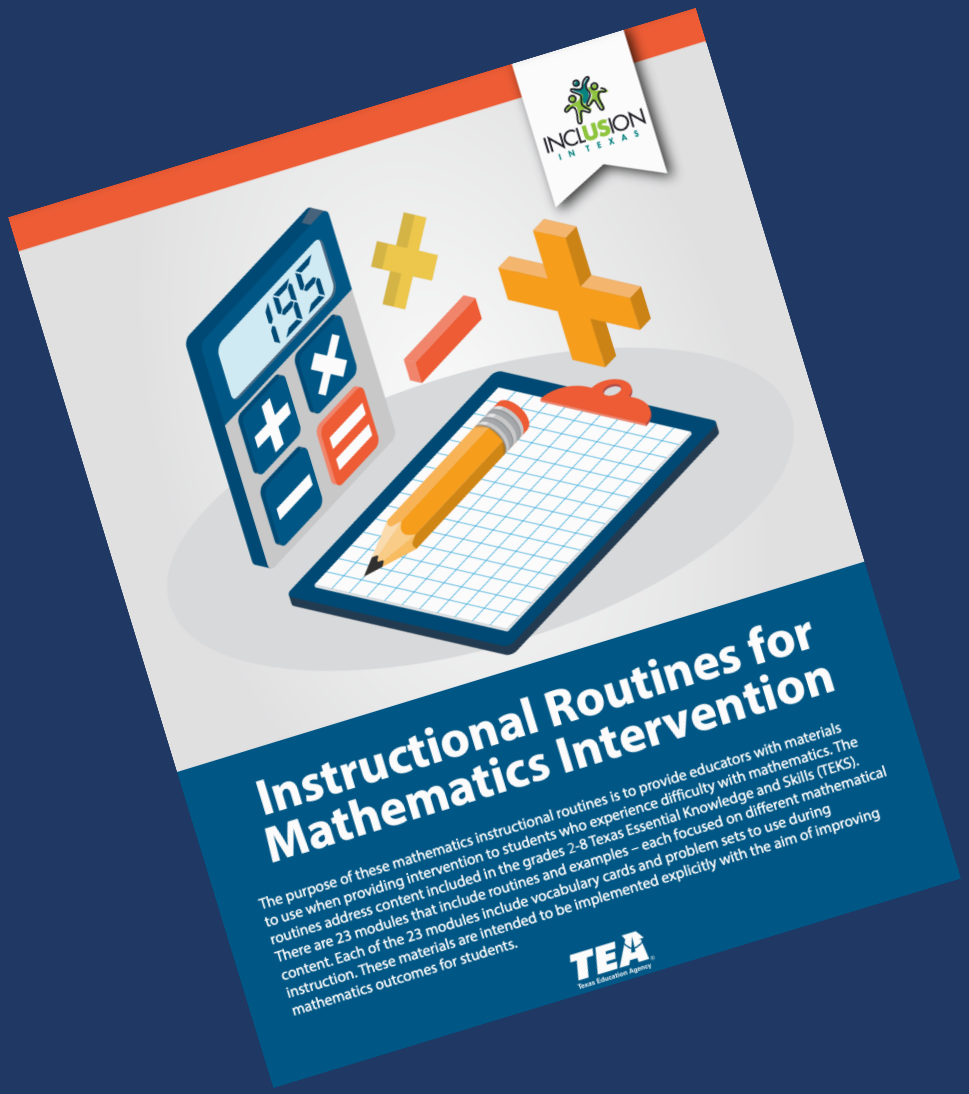

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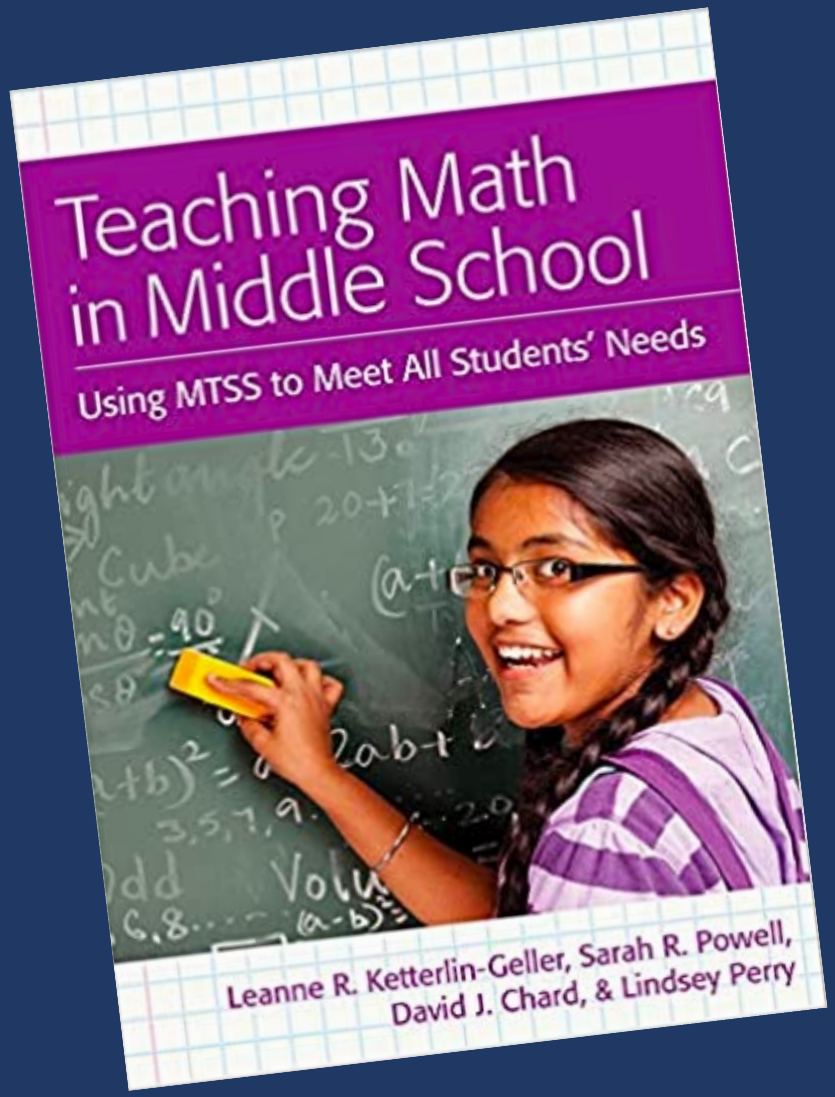

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