Welcome to the Math Research-Based Topics!

Strong Foundations Framework Grant Learning Opportunity

July 2022

Recap: Strong Foundations Framework Grant Learning Opportunities

We have many ways to learn more about this grant!

1. **District Panel:** Sign up for our last District Panel to hear from districts already engaging in this work.
   - Date: 8/18; Registration: Here

2. **RLA Research-Based Topics:** Sign up for the August research topic session for RLA (register here).

3. **TEA Consultation [Optional]:** District leaders may sign up for one 30-minute session with TEA here to help determine what application decision may be best based on local context.

Purpose of Session

- Allow LEAs interested in the Strong Foundations Framework Grant to learn more about research topics in math
- Allow LEAs to get a ***short sample*** of the collective learning series and “step back” their district would take to dig deeper into the research

Recap: Collective Learning Series in Strong Foundations Framework Grant

*LEAs will contract with an **approved provider** to go through the following steps, with the flexibility to customize for their local context*

Build a Roadmap

- Build a math/literacy committee
- Plan framework development process
- Create and norm on decision making process

Communications Plan

- Determine who are the larger stakeholder groups
- Develop customized communication plan for each group
- Set up systems of coaching for stakeholders throughout process

Collective Learning

- Develop collective learning scope and sequence focused on research in math and/or literacy
- Complete collective learning with committee
- Stamp key collective learning take-aways

Develop Framework

- Based on learning, draft vision and framework
- Collect feedback and iterate upon the draft with the committee
- Vote on final framework

Implement Framework

Use final framework to assess existing district resources and supports including:

- curriculum and instructional materials
- professional learning focus and design
- coaching structures and tools

What are the essential best practices in mathematics instruction?

Math Research-based Instructional Strategies (RBIS)

1 Balance Conceptual & Procedural	2 Depth of key concepts	3 Coherence of Key Concepts	4 Productive Struggle	5 Assessment Practices
Pursue **rigor by balancing conceptual understanding, procedural skill** and **fluency.** Apply this balanced understanding to mathematical **applications** as required by the standards in the TEKS.	Focus on math content that **aligns to and meets the rigor of the TEKS** for each grade level, **while concentrating time and effort** on going deep on the **most important topics** for the grade level.	**Connect concepts within and across grades** along a strategic progression of learning so that new understandings are built on previous foundations. Mathematics tells a **continuous, connected story**.	Students engage in productive problem solving, engaging in **multiple opportunities for practice, discussion, representations, and writing** that requires them to explain and revise their thinking.	Leverage HQIM **embedded assessments** to drive instruction.

RBIS Background Information

TEA developed a set of Research-based Instructional Strategies → RBIS → Arby's

Session Norms & Parking Lot

- Be fully present
- Use technology appropriately
- Disagree with ideas, not people
- Have fun!

Got questions?

Please drop them in the chat.

What are the RBIS?

RBIS are…	RBIS are NOT…
• A set of research-based practices that highlights misconceptions common in the field • Topics that require conceptual or philosophical shifts in approach to instruction • A set of practices that are supported by research and should be present in classrooms, regardless of instructional materials • A set of practices that relate directly to the design of instructional materials AND/OR the approach required to implement them well	• Topics that are commonly agreed upon (e.g., materials should be aligned to the standards) • Topics not related to curriculum and instructional materials (e.g., classroom management best practices)

RBIS in Context

[Effective Schools Framework HQIM In Context Image]

Why is it important to look towards the research?

Research tells us there are clear **best practices in instruction** by content and associated topics such as assessment and supporting special populations. Because these practices directly connect to **improving students' academic achievement and experience**, they should inform school, district, and state-wide **visions for instruction** and increase use of **high-quality instructional materials (HQIM).** The RBIS also demonstrate **why HQIM is important** and what is required to **implement HQIM** well.

RBIS 1: Balance Conceptual & Procedural

What are the essential best practices in mathematics instruction?

Math Research-Based Instructional Strategies (RBIS)

1 Balance Conceptual & Procedural

Pursue **rigor by balancing conceptual understanding, procedural skill** and **fluency.** Apply this balanced understanding to mathematical **applications** as required by the standards in the TEKS.

2 Depth of key concepts

Focus on math content that **aligns to and meets the rigor of the TEKS** for each grade level, **while concentrating time and effort** on going deep on the **most important topics** for the grade level.

3 Coherence of Key Concepts

Connect concepts within and across grades along a strategic progression of learning so that new understandings are built on previous foundations. Mathematics tells a **continuous, connected story**.

4 Productive Struggle

Students engage in productive problem solving, engaging in **multiple opportunities for practice, discussion, representations, and writing** that requires them to explain and revise their thinking.

5 Assessment Practices

Leverage HQIM **embedded assessments** to drive instruction.

Do the Math

Work independently to complete the following…

1. Simplify the expression.
2. Script out how you would explain how to solve this problem to a student.
3. Begin to reflect on how you have seen this skill taught in TX classrooms.

$$1\frac{3}{4} \div \frac{1}{2}$$

TEA

PISA Results & Trends

U.S. 15-year-old students' average score **below** OECD average

Average Score Higher than U.S. Average			
Singapore	564	Austria	497
Hong Kong (China)	548	New Zealand	495
Macau (China)	544	*Vietnam*	495
Chinese Taipei	542	*Russian Federation*	494
Japan		Sweden	494
B-S-J-G (China)	531	Australia	494
Korea, Republic of	524	France	493
Switzerland	521	United Kingdom	492
Estonia	520	Czech Republic	492
Canada	516	Portugal	492
Netherlands	512	**OECD Average**	**490**
Denmark	511	Italy	490
Finland	511	Iceland	488
Slovenia	510	Spain	486
Belgium	507	Luxembourg	486
Germany	506	Latvia	482
Poland	504	*Malta*	479
Ireland	504	*Lithuania*	478
Norway	502	**United States**	**470**

Note: *Italics* indicate non-OECD countries and education systems.

Key Points

- U.S. student performance on the **curriculum-based** assessment was notably stronger than it was on the assessment that required students to **apply their understandings** to novel, real-world problems.

- When students had to **apply their learning to new contexts**, the relative ranking of U.S. students, in comparison to other countries, declined.

- **Reflect:** What connections are you making between the results of these two studies and how students perform in math around the state?

Back to Division of Fraction

Compare the following responses. What do you notice?

$$1\frac{3}{4} \div \frac{1}{2}$$

Response 1: "I would convert $1\frac{3}{4}$ to fourths, which would give me $\frac{7}{4}$. Then to divide by $\frac{1}{2}$, I would invert $\frac{1}{2}$ and multiply. So, I would multiply $\frac{7}{4}$ by 2 and I would get $\frac{14}{4}$, and then I would divide 14 by 4 to get it back to my mixed number, $3\frac{2}{4}$ and then I would reduce that into $3\frac{1}{2}$.

Response 2: "This question is asking us how many halves there are in $1\frac{3}{4}$. So, to divide $1\frac{3}{4}$ by $\frac{1}{2}$ we multiply $1\frac{3}{4}$ by the reciprocal of $\frac{1}{2}$ (which is $\frac{2}{1}$) and we get $3\frac{1}{2}$.

TEA

Ma, L. (1999). *Knowing and Teaching Elementary Mathematics.* University of California, Berkeley.

Division of Fraction

CONCEPTUAL

Response 2: "This question is asking us how many halves there are in $1\frac{3}{4}$.

So, to divide $1\frac{3}{4}$ by $\frac{1}{2}$ we multiply $1\frac{3}{4}$ by the reciprocal of $\frac{1}{2}$ (which is $\frac{2}{1}$) and we get $3\frac{1}{2}$."

PROCEDURAL

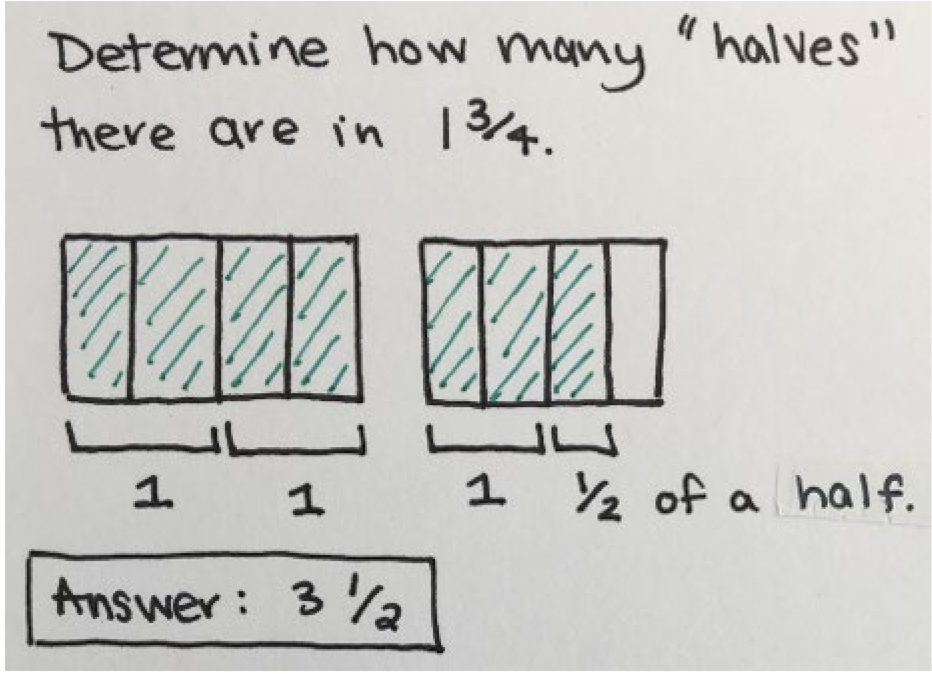
$$1\frac{3}{4} \div \frac{1}{2}$$

Ma, L. (1999). *Knowing and Teaching Elementary Mathematics.* University of California, Berkeley.

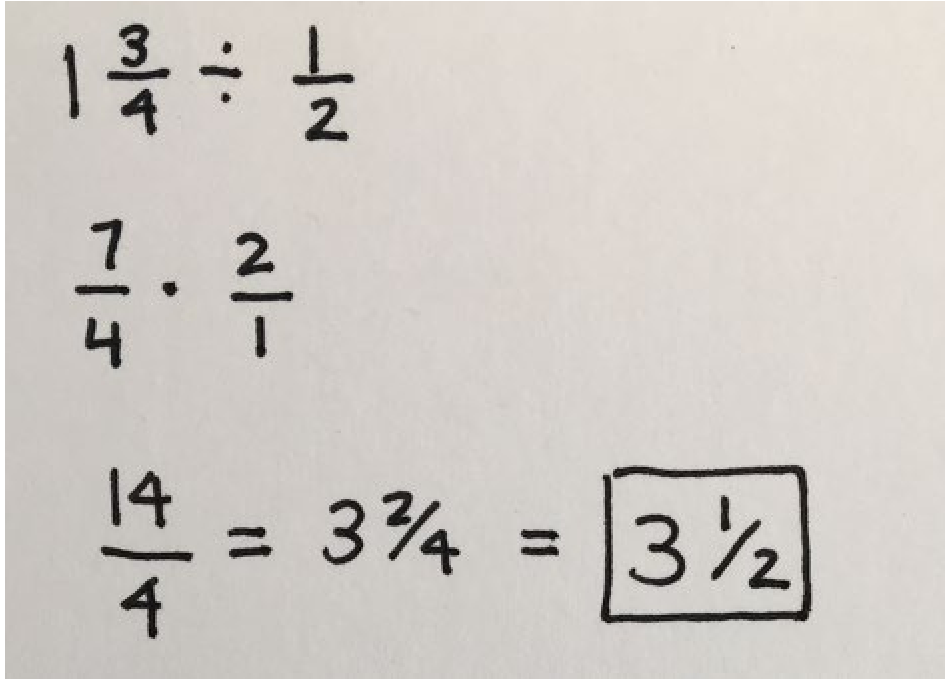
Division of Fractions – A Balanced Approach

$$1\frac{3}{4} \div \frac{1}{2}$$

Conceptual

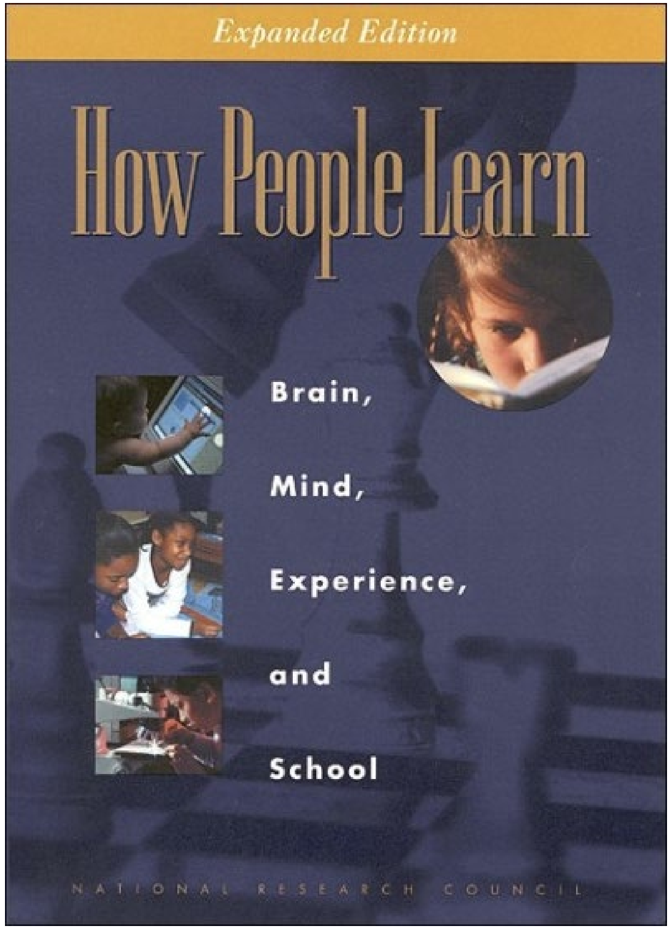


Procedural



The Science of Learning: Three Key Findings

- Engage Preconceptions
- Understanding Requires Factual Knowledge and Conceptual Frameworks
- A Metacognitive Approach Enables Self-Monitoring



National Research Council, *How People Learn: Brain, Mind, Experience and School.* National Academy Press, 2000..

TEA

Procedural Skill & Fluency allows for Automaticity

- Students can carry out procedures flexibly, accurately, efficiently, and appropriately.
- Student mastery of key fluency allows for the automaticity that helps to access and manipulate more advanced concepts.

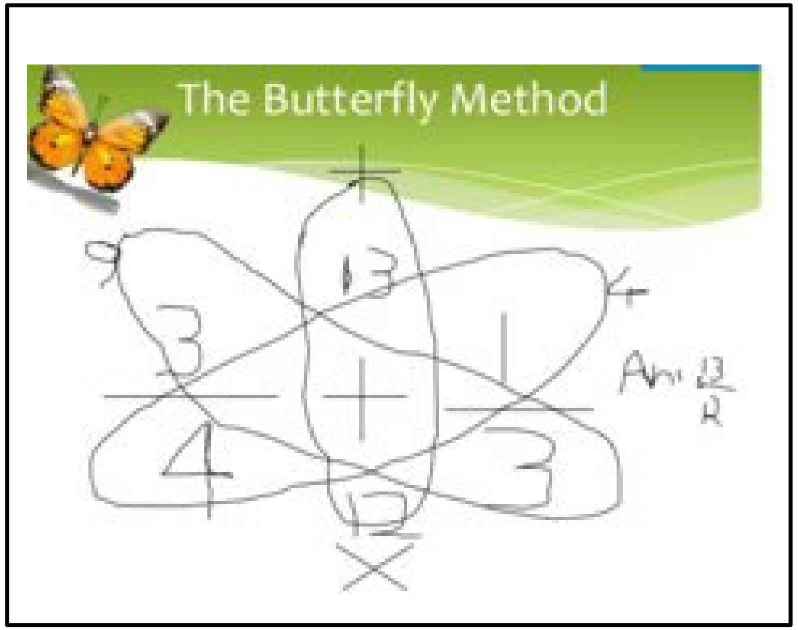
$$9x - 28 = -1$$

$$\underline{\quad +28 \quad +28}$$

$$\frac{9x}{9} = \frac{27}{9}$$

$$x = 3$$

Tricks versus Procedural Understanding



$$\frac{3}{4} + \frac{3}{5} + \frac{1}{3} =$$

Key Idea: Tricks are **context dependent**. When students have a balanced procedural and conceptual understanding, they can apply a consistent framework to all contexts; **the rules of math do not change**.

Key Points: Trick versus Procedural Understanding

- The ability to apply a "trick" is not the same as true procedural fluency.
- When students are introduced to tricks, it removes all elements of balance of procedural and conceptual understanding.
- When students do not have conceptual understanding, they are not set up to apply their learning and they have fluency with a trick, not a procedure that can be applied in different contexts.

Balance Conceptual and Procedural Instruction

Misconception:	RBIS Approach:
Balancing conceptual, procedural, and application means there should be equal time spent on each component of rigor.	Conceptual understanding is often the primary focus and comes before procedural fluency and application, but each of these components of rigor are intertwined in quality tasks.
Procedural fluency is fact practice.	The TEKS define procedural fluency as “skill in carrying out procedures flexibly, accurately, efficiently, and appropriately.” Fact practice is important, but there is more to procedural fluency than memorizing math facts.
Students need to master math facts before they can engage in conceptual problem-solving.	Students can engage in rich, conceptually-based tasks while continuing to develop their procedural fluency.

RBIS 2 & 3 : Depth and Coherence of Key Concepts

Do The Math

- Order the following elementary level math problems to illustrate the correct grade level progression. Justify your reasoning.

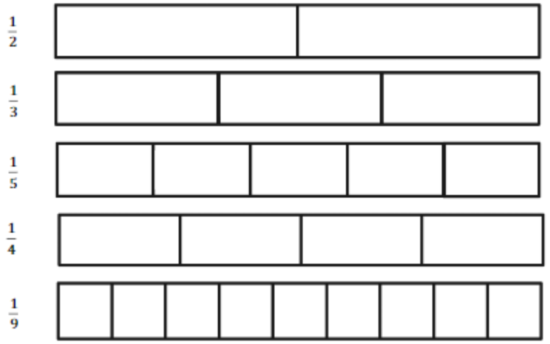
A

1. For the following problems, draw a picture using the rectangular fraction model and write the answer. Simplify your answer, if possible.

   a. $\frac{1}{3} - \frac{1}{4} =$ b. $\frac{2}{3} - \frac{1}{2} =$

B

1. Each fraction strip is 1 whole. All the fraction strips are equal in length. Color 1 fractional unit in each strip. Then, answer the questions below.



2. Circle *less than* or *greater than*. Whisper the complete sentence.

   a. $\frac{1}{2}$ is less than / greater than $\frac{1}{3}$
   b. $\frac{1}{9}$ is less than / greater than $\frac{1}{2}$
   c. $\frac{1}{4}$ is less than / greater than $\frac{1}{2}$
   d. $\frac{1}{4}$ is less than / greater than $\frac{1}{9}$
   e. $\frac{1}{5}$ is less than / greater than $\frac{1}{3}$
   f. $\frac{1}{5}$ is less than / greater than $\frac{1}{4}$
   g. $\frac{1}{2}$ is less than / greater than $\frac{1}{5}$
   h. 6 fifths is less than / greater than 3 thirds

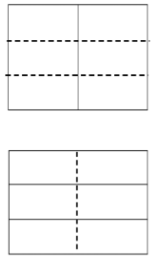
C

1. Draw an area model for each pair of fractions, and use it to compare the two fractions by writing >, <, or = on the line. The first two have been partially done for you. Each rectangle represents 1.

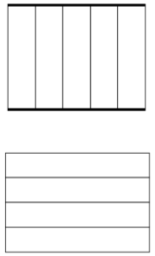
   a. $\frac{1}{2}$ ____<____ $\frac{2}{3}$

   $\frac{1\times3}{2\times3} = \frac{3}{6}$

   $\frac{2\times2}{3\times2} = \frac{4}{6}$



   b. $\frac{4}{5}$ ________ $\frac{3}{4}$



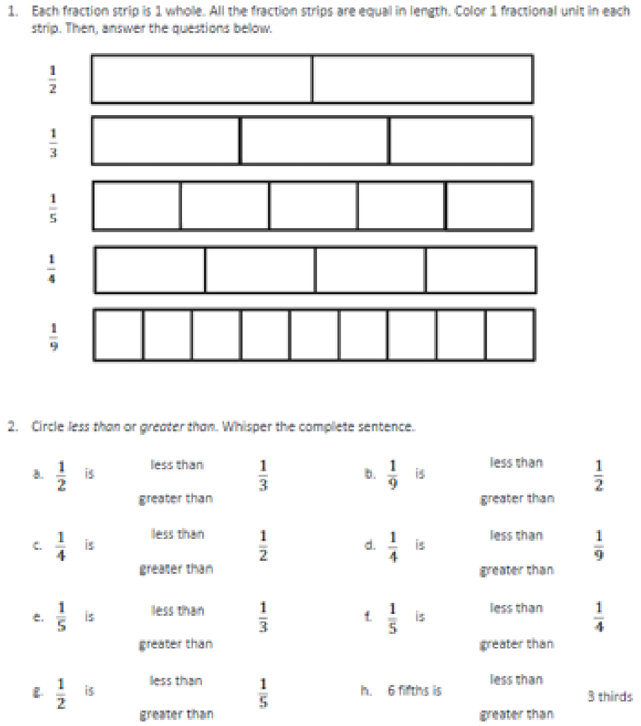
   c. $\frac{3}{5}$ ________ $\frac{4}{7}$

   d. $\frac{3}{7}$ ________ $\frac{2}{6}$

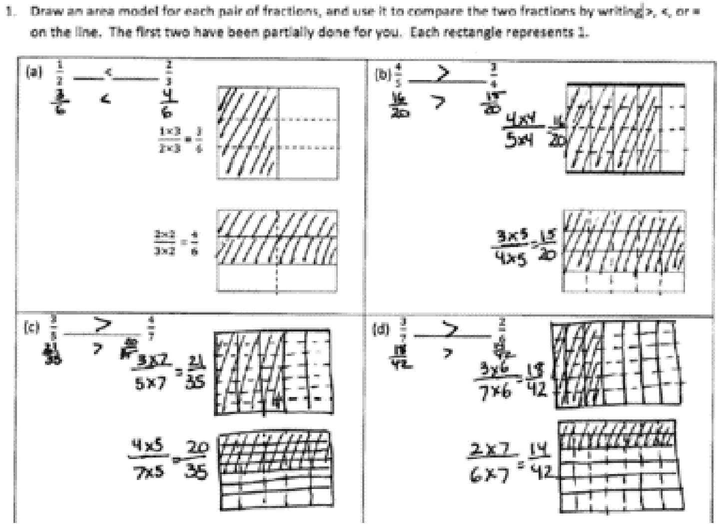
Depth and Coherence of Key Concepts Examples

How do these examples tell a connected, coherent story about the progression of the skills students must build around fractions?

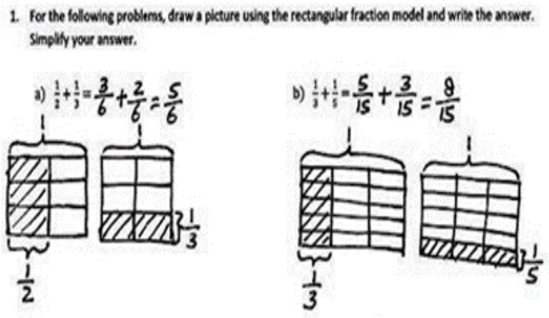
B 3rd Grade



C 4th Grade



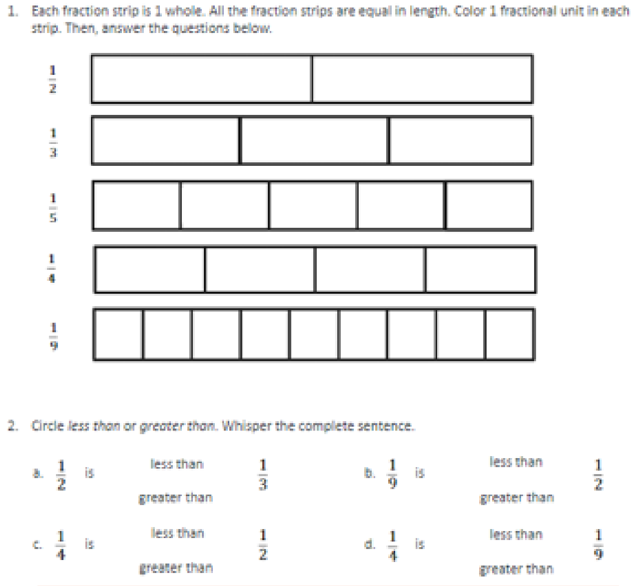
A 5th Grade



Eureka Math TEKS Edition. Grade 3, Module 5, Lesson 11
Eureka Math TEKS Edition. Grade 4, Module 5, Lesson 14
Eureka Math TEKS Edition. Grade 5, Module 3, Lesson 3

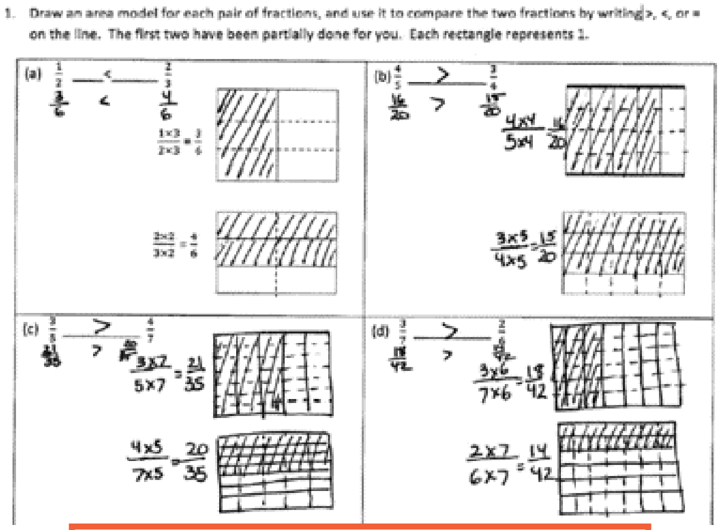
Depth & Coherence of Key Concepts Examples

B 3rd Grade



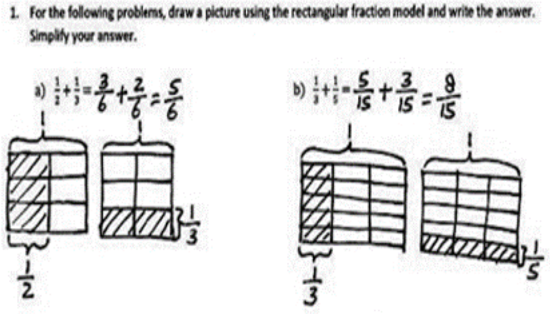
Students compare unit fractions by looking at their size. 3.3H

C 4th Grade



Students begin to compare fractions with different numerators and denominators. 4.3D

A 5th Grade



Students represent and solve addition and subtraction of fractions with unequal denominators. 5.3H

What are the essential best practices in mathematics instruction?

Math Research-Based Instructional Strategies (RBIS)

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Pursue **rigor by balancing conceptu al understanding, procedural skill and fluency**, and **application** as required by the standards in the TEKS.	Focus on math content that **aligns to and meets the rigor of the TEKS** for each grade level, **while concentrating time and effort** on going deep on the **most important topics** for the grade level.	**Connect concepts wi thin and across grades** along a strategic progression of learning so that new understandings are built on previous foundations. Mathematics tells a **continuous, connected story**.	Students engage in productive problem solving, engaging in **multiple opportunities for practice, discussion, representations, and writing** that requires them to explain and revise their thinking.	Leverage HQIM **embedded assessments** to drive instruction.

TEA

Depth of Key Concepts

2

Depth of Key Concepts

Focus on math content that **aligns to and meets the rigor of the TEKS** for each grade level, **while concentrating time and effort** on going deep on the most **most important topics** for the grade level.

Meet rigor of the TEKS	Prepare students to identify appropriate concepts to tackle real-world, relevant tasks through an alignment to the TEKS and a balance of conceptual and procedural fluency.
Concentrate time and effort	Utilize high-quality instructional materials to ensure that the majority of class time is spent going deep on the most important topics for the grade level or course.
Most important topics	Identify the focal points that build coherence across grade levels and provide a foundation for strong mathematics understanding of algebra and beyond.

Depth of Key Concepts - Task 1

Solve. What skills are students demonstrating when completing this task?

Equivalent Fractions (only numerators missing)

Grade 3 Fractions Worksheet

Complete the equivalent fractions.

1. $\frac{2}{5} = \frac{\_\_}{30}$
2. $\frac{\_\_}{2} = \frac{6}{12}$
3. $\frac{2}{3} = \frac{\_\_}{27}$
4. $\frac{1}{2} = \frac{\_\_}{18}$
5. $\frac{\_\_}{3} = \frac{12}{18}$
6. $\frac{4}{5} = \frac{\_\_}{25}$

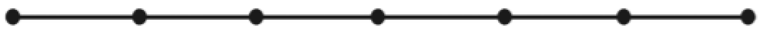
TEA

Depth of Key Concepts - Task 2

Solve. What skills are students demonstrating when completing this task?

1. Jerry put 7 equally spaced hooks on a straight wire so students could hang up their coats. The whole length is from the first hook to the last hook.

   a. On the picture below, label the fraction of the wire's length where each hook is located.



   b. At what fraction is Betsy's coat if she hangs it at the halfway point?

   c. Write a fraction that is equivalent to your answer for Part (b).

2. Jerry used the picture below to show his son how to find a fraction equal to $\frac{2}{3}$. Explain what Jerry might have said and done using words, pictures, and numbers.

TEA

Depth of Key Concepts Comparison

Equivalent Fractions (only numerators missing)

Grade 3 Fractions Worksheet

Complete the equivalent fractions.

1. $\frac{2}{5} = \frac{\ \ }{30}$
2. $\frac{\ \ }{2} = \frac{6}{12}$
3. $\frac{2}{3} = \frac{\ \ }{27}$
4. $\frac{1}{2} = \frac{\ \ }{18}$
5. $\frac{\ \ }{3} = \frac{12}{18}$
6. $\frac{4}{5} = \frac{\ \ }{25}$

3(3)(F) The student is expected to represent equivalent fractions with denominators of 2, 3, 4, 6, and 8 using a variety of objects and pictorial models, including number lines.

1. Jerry put 7 equally spaced hooks on a straight wire so students could hang up their coats. The whole length is from the first hook to the last hook.

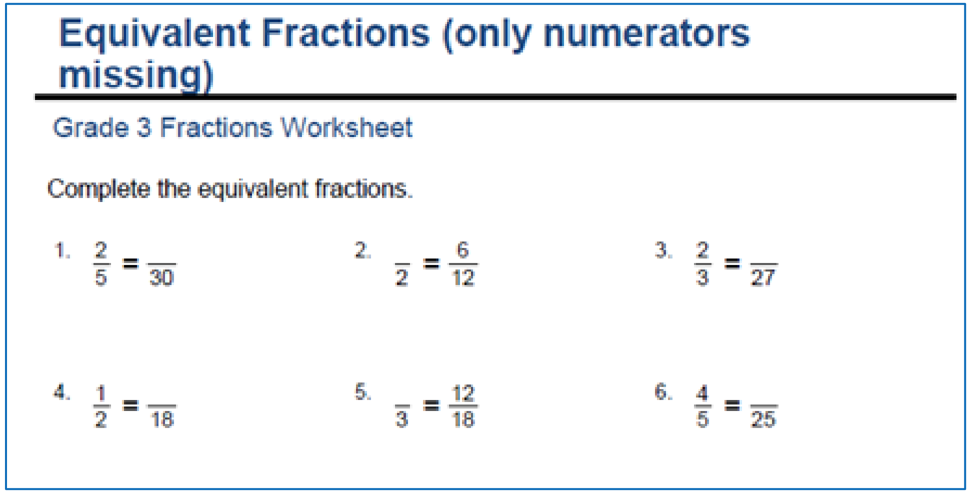
   a. On the picture below, label the fraction of the wire's length where each hook is located.

   b. At what fraction is Betsy's coat if she hangs it at the halfway point?

   c. Write a fraction that is equivalent to your answer for Part (b).

2. Jerry used the picture below to show his son how to find a fraction equal to $\frac{2}{3}$. Explain what Jerry might have said and done using words, pictures, and numbers.

Depth of Key Concepts Comparison



Equivalent Fractions (only numerators missing)

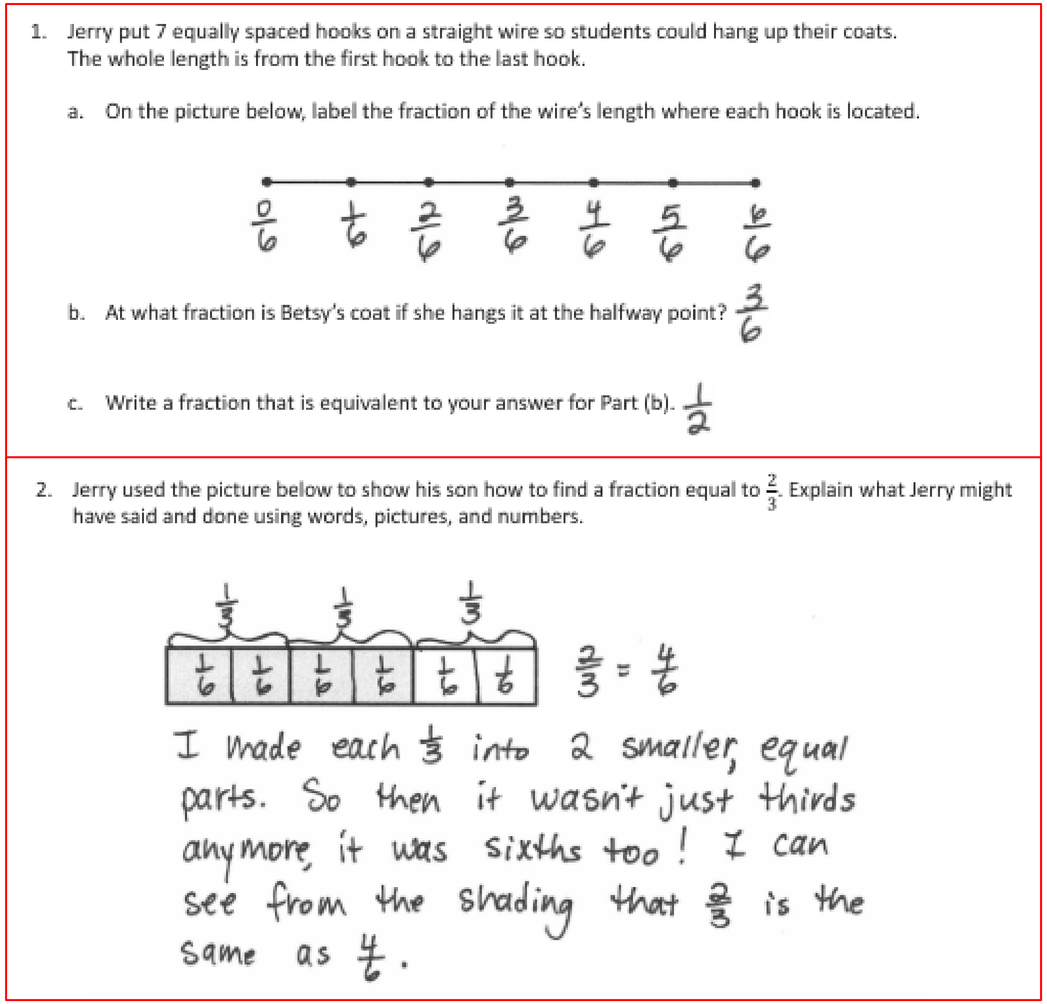
Grade 3 Fractions Worksheet

Complete the equivalent fractions.

1. $\frac{2}{5} = \frac{\_\_}{30}$
2. $\frac{\_\_}{2} = \frac{6}{12}$
3. $\frac{2}{3} = \frac{\_\_}{27}$
4. $\frac{1}{2} = \frac{\_\_}{18}$
5. $\frac{\_\_}{3} = \frac{12}{18}$
6. $\frac{4}{5} = \frac{\_\_}{25}$

- Grade 3 students should be using a **<u>variety of objects, models, or the number line</u>** to develop their understanding of fraction equivalence.

- Students should be demonstrating that they can recognize and generate simple equivalent fractions on a number line or area model and **<u>explaining</u>** why they are equivalent.



1. Jerry put 7 equally spaced hooks on a straight wire so students could hang up their coats. The whole length is from the first hook to the last hook.

   a. On the picture below, label the fraction of the wire's length where each hook is located.

   $\frac{0}{6}$ $\frac{1}{6}$ $\frac{2}{6}$ $\frac{3}{6}$ $\frac{4}{6}$ $\frac{5}{6}$ $\frac{6}{6}$

   b. At what fraction is Betsy's coat if she hangs it at the halfway point? $\frac{3}{6}$

   c. Write a fraction that is equivalent to your answer for Part (b). $\frac{1}{2}$

2. Jerry used the picture below to show his son how to find a fraction equal to $\frac{2}{3}$. Explain what Jerry might have said and done using words, pictures, and numbers.

   $\frac{1}{3}$ $\frac{1}{3}$ $\frac{1}{3}$

   $\frac{1}{6}$ $\frac{1}{6}$ $\frac{1}{6}$ $\frac{1}{6}$ $\frac{1}{6}$ $\frac{1}{6}$ $\frac{2}{3} = \frac{4}{6}$

   I made each $\frac{1}{3}$ into 2 smaller, equal parts. So then it wasn't just thirds anymore, it was sixths too! I can see from the shading that $\frac{2}{3}$ is the same as $\frac{4}{6}$.

RBIS 3: Coherence of Key Concepts

Coherence of Key Concepts

3

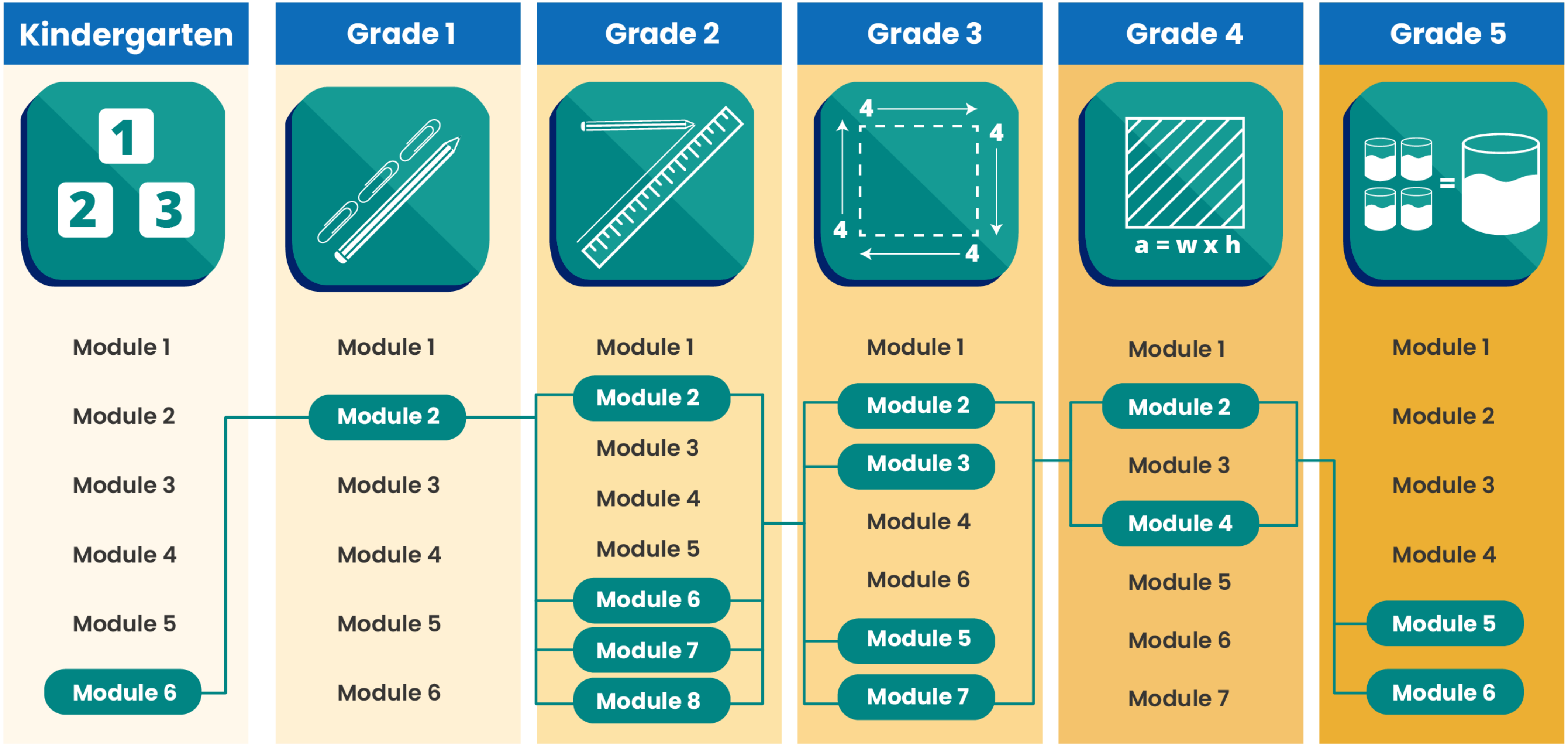
Coherence of Key Concepts

Connect concepts wit hin and across grades along a strategic progression of learning so that new understandings are built on previous foundations. Mathematics tells a **continuous, connected story**.

Within grade levels	Build new ideas on the foundation of what students have learned during the current school year in previous and future lessons and units.
Across grade levels	Build upon key concepts in previous and current grade levels as foundational knowledge that could serve as gatekeepers for new ideas in the next grade level and future math courses.
Continuous, connected story	Mathematics concepts and skills create an ongoing, coherent learning experience throughout a students' educational journey.

Coherence of Key Concepts

Over time, students develop knowledge of key mathematical concepts. Concepts connect within and across grades along a strategic learning progression.



Coherence of Key Concepts

Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
		Module 2 Addition and Subtraction of Length Units	**Module 2** Place Value and Problem Solving with Units of Measure		
Module 3 Comparison of Length, Weight, Capacity, and Numbers to 10	**Module 3** Ordering and Comparing Length Measurements as Numbers	**Module 6** Foundations of Multiplication, Division, and Area	**Module 4** Multiplication and Area	**Module 2** Unit Conversion and Problem Solving with Metric Measurement	**Module 5** Addition and Multiplication with Volume and Area
		Module 7 Problem Solving with Length, Money, and Data	**Module 6** Financial Literacy and Data	**Module 4** Angle Measure and Plane Figures	**Module 6** Problem Solving with the Coordinate Plane and Data
		Module 8 Time, Shapes, and Fracions as Equal Parts of Shapes	**Module 7** Geometry and Measurement Word Problems		

Example: Coherence in Geometry and Measurement

Beginning with "Length, Weight, Capacity, and Numbers to 10" in kindergarten and progressing all the way up to "Problem Solving with the Coordinate Plane and Data" in grade 5, Eureka Math TEKS Edition builds coherence in the foundations of geometry and measurement.

Texas Education Agency

Coherence of Key Concepts: Grades 6-8

Grade 6	Grade 7	Grade 8
Representing Linear Relationships		
(6) Expressions, equations, and relationships. The student applies mathematical process standards to use multiple representations to describe algebraic relationships. The student is expected to:	(7) Expressions, equations, and relationships. The student applies mathematical process standards to represent linear relationships using multiple representations. The student is expected to:	(5) Proportionality. The student applies mathematical
	(A) represent linear relationships using verbal descriptions, tables, graphs, and equations that simplify to ... = *mx* + *b*.	
(B) wr... repre... betw... deper... table.		(I) write an equation in the form *y* = *mx* + *b* to model a linear relationship between two quantities using verbal, numerical, tabular, and graphical representations.
(C) re... situat... descr... and e... *kx* or		(F) distinguish between proportional and non-proportional situations using tables, graphs, and equations in the form *y* = *kx* or *y* = *mx* + *b*, where *b* ≠ 0.
		(H) identify examples of proportional and non-proportional functions that arise from mathematical and real-world problems.

(I) Write an equation in the form y = mx + b to model a linear relationship between two quantities using verbal, numerical, tabular, and graphical representations

(B) write an equation that represents the relationship between independent and dependent quantities from a table

Grade 8

Module 2: Linear Relationships
Topic 1: From Proportions to Linear Relationships
Topic 2: Linear Relationships

Grade 7

Module 1: Thinking Proportionally
Topic 3: Proportionality

Module 3: Reasoning Algebraically
Topic 4: Multiple Representations of Equations

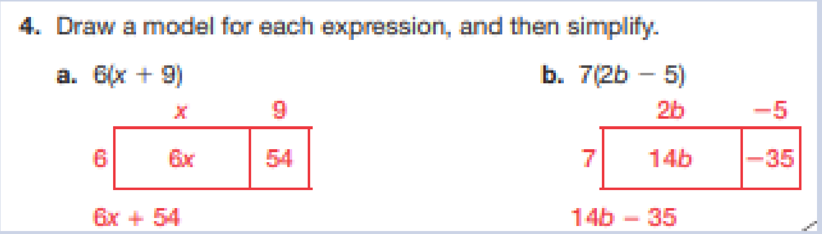
Grade 6

Module 4: Determining Unknown Quantities
Topic 3: Graphing Quantitative Relationships

TEXAS MATH SOLUTION

Examples of Building Coherence Across Grade Levels with HQIM

Order the following math problems to illustrate the correct grade level progression. Justify your reasoning.



4. Draw a model for each expression, and then simplify.

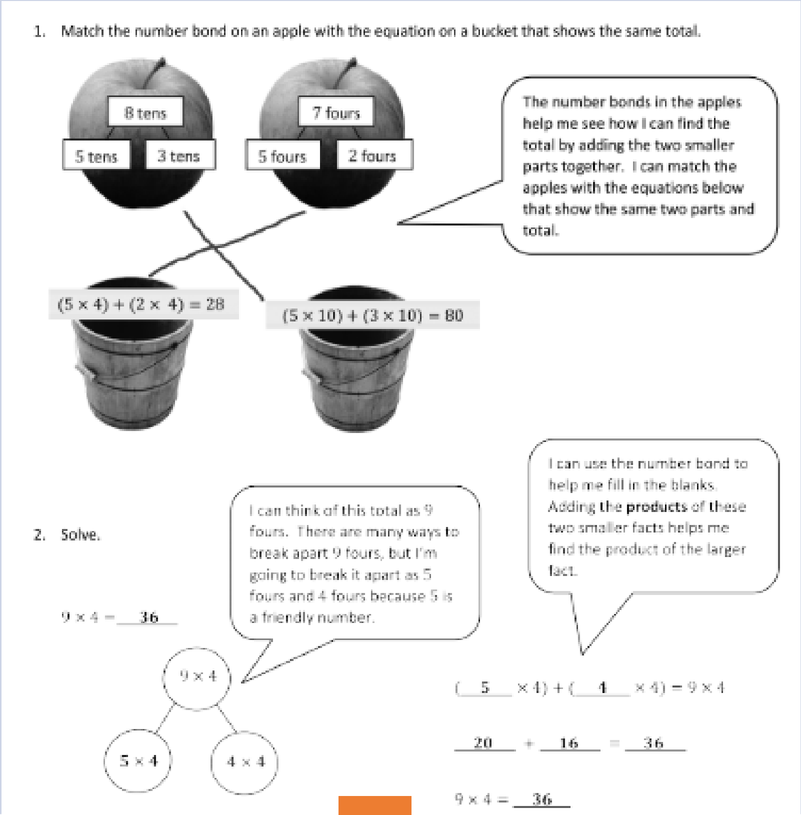
a. $6(x + 9)$

$6x + 54$

b. $7(2b - 5)$

$14b - 35$

A



1. Match the number bond on an apple with the equation on a bucket that shows the same total.

2. Solve.

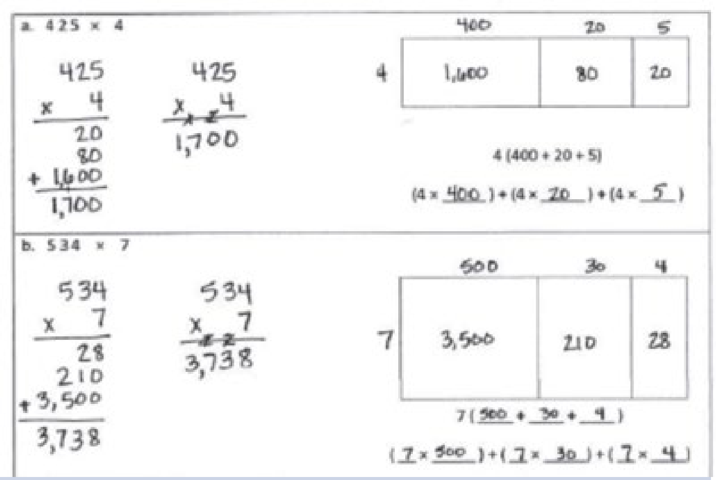
$9 \times 4 =$ 36

(5 × 4) + (4 × 4) = 9 × 4

20 + 16 = 36

9 × 4 = 36

B

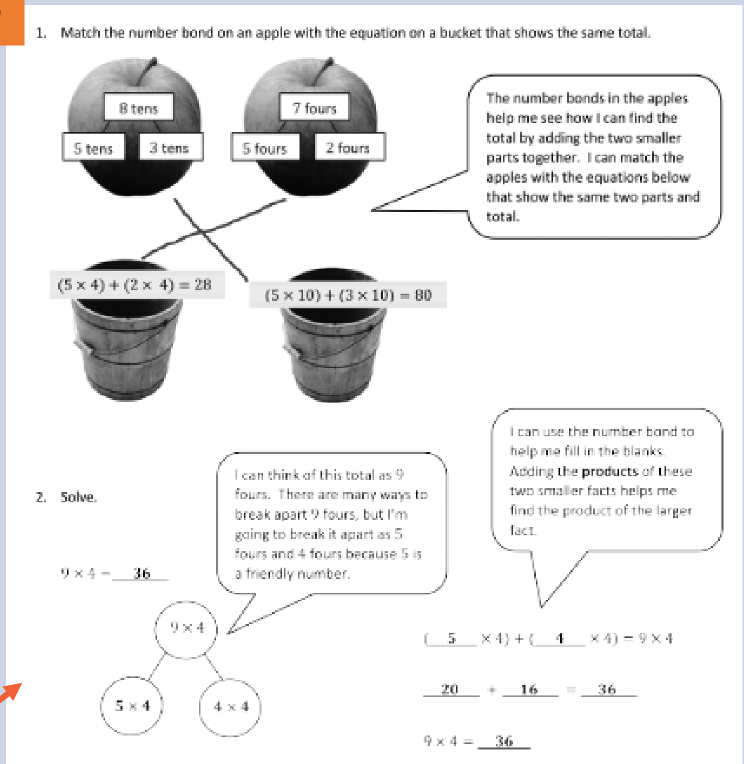


C

Examples of Building Coherence Across Grade Levels with HQIM

Grade 3	Grade 4	Grade 6

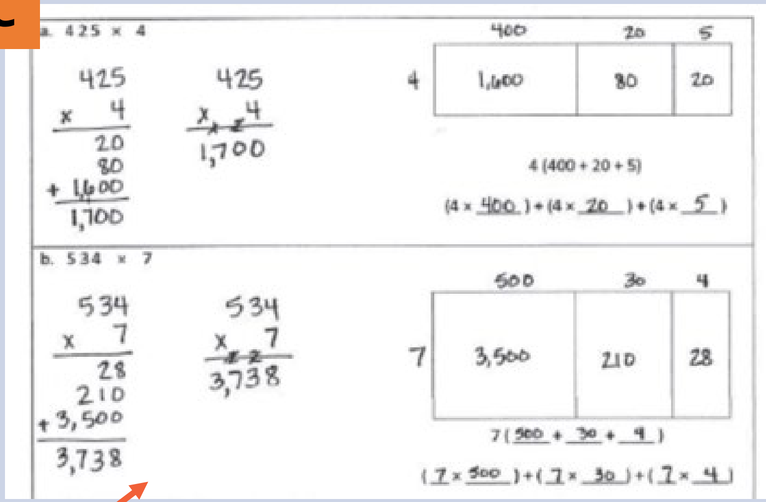
B



Eureka Math TEKS Edition Module 1, Lesson 18

Students apply the distributive property to decompose units. 3.4G

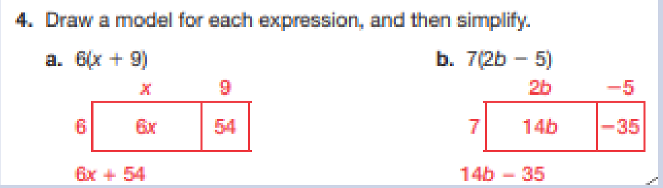
C



Eureka Math TEKS Edition Module 3, Lesson 11

Students represent the product of 2 two-digit numbers using area models. 4.4C/4.4D

A



Carnegie Learning Texas Math Solution 6-12Module 1

Students generate equivalent expressions using the distributive property. 6.7D

Types of Coherence

Within HQIM
Teachers and selected materials utilize consistent vocabulary terms and tools year-to-year from elementary to secondary levels to support all learners, including emergent bilingual students.

Year-to-Year

Grade level content builds year-to-year. Teachers regularly connect or ask students to connect what they have learned from previous years.

"In third grade you learned how to add and subtract fractions with the same denominator, this year we will learn how to add and subtract fractions with different denominators. Let's start with what we know..."

Unit-to-Unit

Units are sequenced to build on each other over the course of the school year. Students and teacher regularly connect and build on what they know from previous units.

"Last unit we studied linear expressions between two quantities, this unit we will begin to discuss what happens when there is not a constant rate of change."

Day-to-Day

Teachers and students make connections and build on what they know from previous lessons.

"Over the past few days we have been studying complex fractions, their meaning, and comparing numbers, yesterday we used modeling to ... today we will continue to model ..."

TEA

RBIS 4: Productive Struggle

What are the essential best practices in mathematics instruction?

Math Research-Based Instructional Strategies (RBIS)

1 Balance Conceptual & Procedural

Pursue **rigor by balancing conceptu al understanding, procedural skill and fluency**, and **application** as required by the standards in the TEKS.

2 Depth of Key Concepts

Focus on math content that **aligns to and meets the rigor of the TEKS** for each grade level, **while concentrating time and effort** on going deep on the **most important topics** for the grade level.

3 Coherence of Key Concepts

Connect concepts wi thin and across grades along a strategic progression of learning so that new understandings are built on previous foundations. Mathematics tells a **continuous, connected story**.

4 Productive Struggle

Students engage in productive problem solving, engaging in **multiple opportunities for practice, discussion, representations, and writing** that requires them to explain and revise their thinking.

5 Assessment Practices

Leverage HQIM **embedded assessments** to drive instruction.

Defining productive struggle

4

Productive Struggle

Students engage in productive problem solving, including **multiple opportunities for practice, discussion, representations, and writing** that requires them to explain and revise their thinking.

"…students **expend effort to make sense of mathematics**, to figure something out that is not immediately apparent…The struggle we have in mind comes from **solving problems that are within reach and grappling with key mathematical ideas** that are comprehendible but not yet well formed (Hiebert et al., 1996)."

"…productive struggle comprises **the work that students do to make sense of a situation and determine a course of action when a solution strategy is not stated**, implied, or immediately obvious. From an equity perspective, this implies that each and **every student must have the opportunity to struggle** with challenging mathematics and to receive support that encourages their persistence without removing the challenge." (NCTM publications 2007, 2017)

Defining productive struggle

4

Productive Struggle

Student engage in productive problem solving, including **multiple opportunities for practice, discussion, representations, and writing** that requires them to explain and revise their thinking.

Maintains Rigor	Provides students time to collaboratively problem solve using different representations and then asking them to explain their thinking
Sets up all students to Engage	Tasks should have multiple entry points so that students can use different solution paths to solve and make connections
Develops Independent Problem Solvers	Acknowledging when students' effort supports their thinking and mathematical understanding, thus developing their capacity to persevere in the face of challenging content

Observing productive struggle…

4

Productive Struggle

Students engage in productive problem solving, including **multiple opportunities for practice, discussion, representations, and writing** that requires them to explain and revise their thinking.

- **Observe and Reflect:** Watch the following instructional video. Is this an example of productive struggle? Using language from the RBIS, explain why or why not.

"Natalie has 30 jellybeans. Her mom gives her 23 more jellybeans. How many jellybeans does Natalie have?"

Productive Struggle is NOT

- students just showing their work on paper
- something to give only when students are at a certain age or grade level
- asking all students how they got an answer
- just for students who have the wrong answer.
- giving students challenging work or work above grade level.
- something that could harm a student's development

5 Types of Common Teacher Responses to Struggle

	Example	Impact on Student Learning
1. Telling 2. Directed Guidance	*"Not quite. Instead, draw 23 cubes…"*	More likely to lower the demands of the task and remove struggle.
3. Unfocused or Vague Direction	*"Read the problem again and check your work…"*	More likely to provide general suggestions that are not helpful to the particular task.
4. Probing Guidance 5. Affordance	*"Can you tell me how your picture shows how you solved the problem…"*	More likely to maintain the demands of the task and support productive struggle

Warshauer, Hiroko Kawaguchi. "Productive Struggle in Middle School Mathematics Classrooms." Journal of Mathematics Teacher Education 17, no.4 (2015): 375-399. [p. 387]

Strategies to Support Productive Struggle

Strategy	What it looks like
Question	"Teachers ask questions that help students focus on their thinking and identify the source of their struggle, then encourage students to build on their thinking or look at other ways to approach the problem."
Encourage	"Teachers encourage students to reflect on their work and support student struggle in their effort and not just in getting the correct answers."
Give Time	"Teachers give time and support for students to manage their struggles through adversity and failure by not stepping in too soon or too much, thereby taking the intellectual work away from the students."
Acknowledge	"Teachers acknowledge that struggle is an important part of learning and doing mathematics."

Probing Guidance

Affordance

What examples of these have you observed today?

TEA

Dos and Don'ts of Productive Struggle

DO…	Rationale
Give your students **time** to engage in productive struggle.	*You know your students, and you prepared your lesson to meet their needs. Trust that they can accomplish what you prepared for them.*
Ask questions when students are stuck.	*What have you done before that might be useful now? What seems important in the problem? How is this the same or different as what you've seen before?*
Encourage students to solve problems in different ways.	*Students need to feel comfortable trying different strategies. Celebrate creativity by encouraging students to share their thinking with the class.*
Praise students' effort on both successful and unsuccessful **attempts**.	*These actions send the message to students that you value risk-taking and trying out ideas. Have students reflect on what they learned from their unsuccessful efforts and how those efforts helped them decide what method(s) to try next.* ***Math is not just about getting the right answer.***

The Struggle is Real (and Productive) Mike Linskey, Great Minds: Eureka Math Blog https://gm.greatminds.org/math/blog/eureka/the-struggle-is-real-and-productive

STAAR redesign reflects RBIS best practices

Changes are coming to help improve alignment

- Classroom practices that over-use multiple choice questions, rely on only short reading passages, and limit student writing can get small, short-term gains on STAAR, but evidence has shown they don't lead to high performance or long-term student mastery
- Strong instructional practices lead to increased student understanding and stronger performance on STAAR
- **It is possible for the state summative assessment to be designed so that it better aligns with strong instructional practices, while still accurately measuring student mastery**

For math specifically, many of the changes will be in new item types to allow for students to respond in new ways

These new question types allow students to respond to questions in a way that they'll see in their classrooms and high-quality instructional materials

The following new question types may be included in the specified Mathematics tests starting in Spring 2023

*Question Type	Question Type Description	STAAR Math Test Titles
Equation editor	Student can write responses in the form of fractions, expressions, equations, or inequalities.	Grades 3-8 EOC
Text Entry	Student responds by typing a brief string of text such as a number, word, or phrase.	Grades 3-8 EOC
Graphing	Student selects, points, draws lines, drags bar graphs, and perform other functions to independently create different types of graphs.	Grades 3-8 EOC
Number line	Student selects a point, an open or closed circle, and a direction arrow to demonstrate a solution set on a number line.	Grades 6-8 EOC
Inline choice	Student selects the correct answer(s) from one or more drop-down menu(s).	Grades 3-8 EOC
Hot spot	Student responds by selecting one or more specific areas of a graphic.	Grades 3-8 EOC
Fraction model	Student represents a fraction by dividing an object into the correct number of sections to indicate the denominator and clicking to shade the appropriate number of sections to indicate the numerator.	Grades 3-5
Drag and drop	Student evaluates a given number of options (words, numbers, symbols, etc.) and chooses which response(s) to drag to a given area (a diagram, map, chart, etc.).	Grades 3-8 EOC
Match table grid	Student matches statements or objects to different categories presented in a table grid.	Grades 6-8 EOC
Multiselect	Student can select more than one correct answer from a set of possible answers.	Grades 3-8 EOC

Max possible points per question

- 2 points (yellow: Match table grid, Multiselect)
- 1 or 2 points dependent upon question (grey: all other question types)

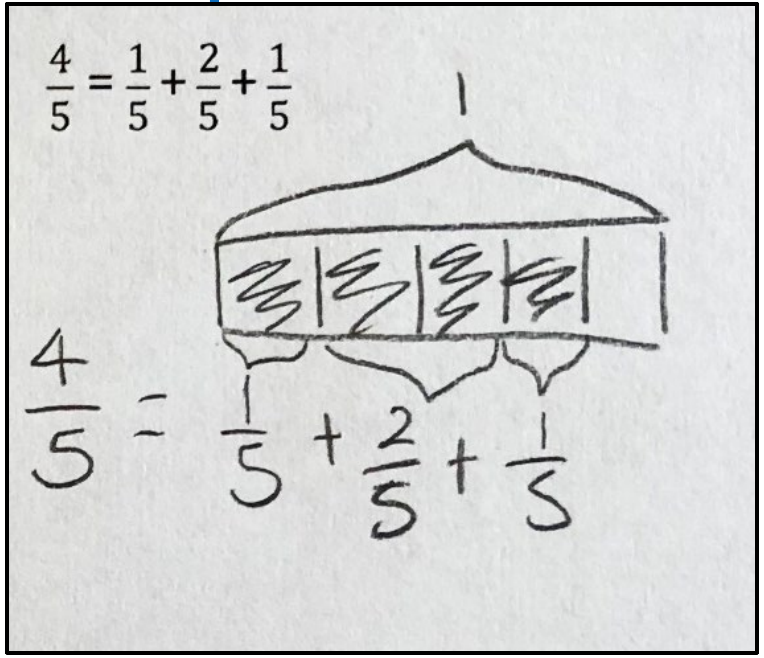
*Not all new question types will appear on every test every year

In the classroom, students are asked to engage with content in multiple ways to gain and express understanding (I)

Grade 4 Math TEKS

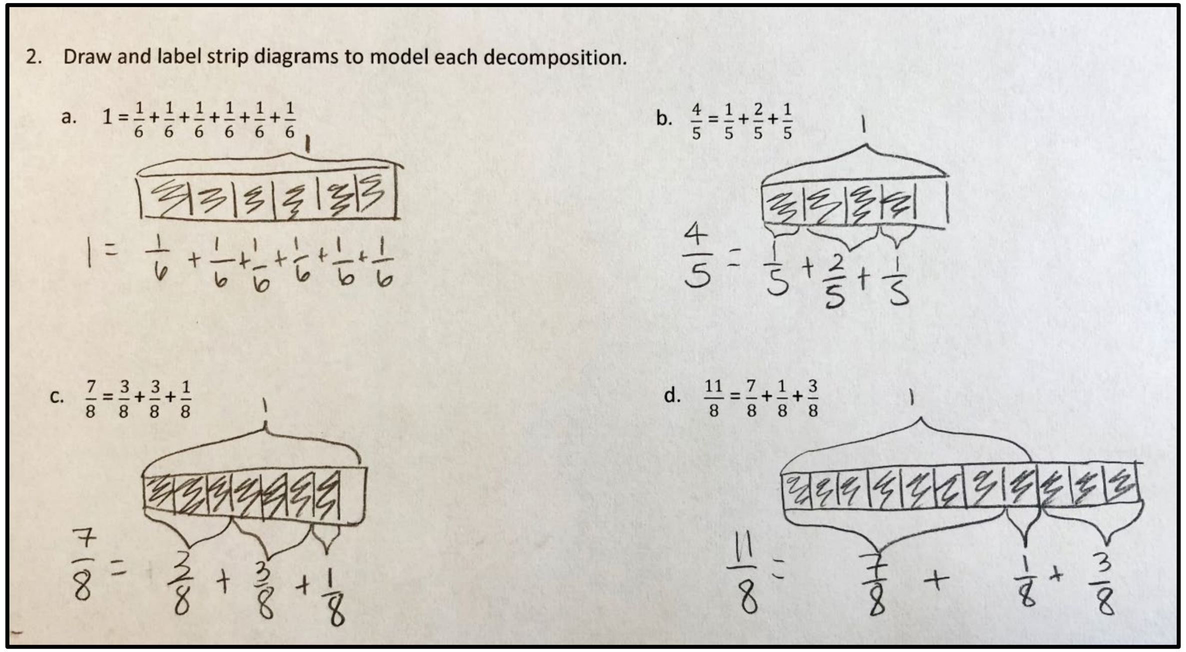
- 4.3A: represent a fraction a/b as a sum of fractions 1/b, where a and b are whole numbers and b > 0, including when a > b
- 4.3B: decompose a fraction in more than one way into a sum of fractions with the same denominator using concrete and pictorial models and recording results with symbolic representations.

Example: "Draw and label a strip diagram to model the decomposition"



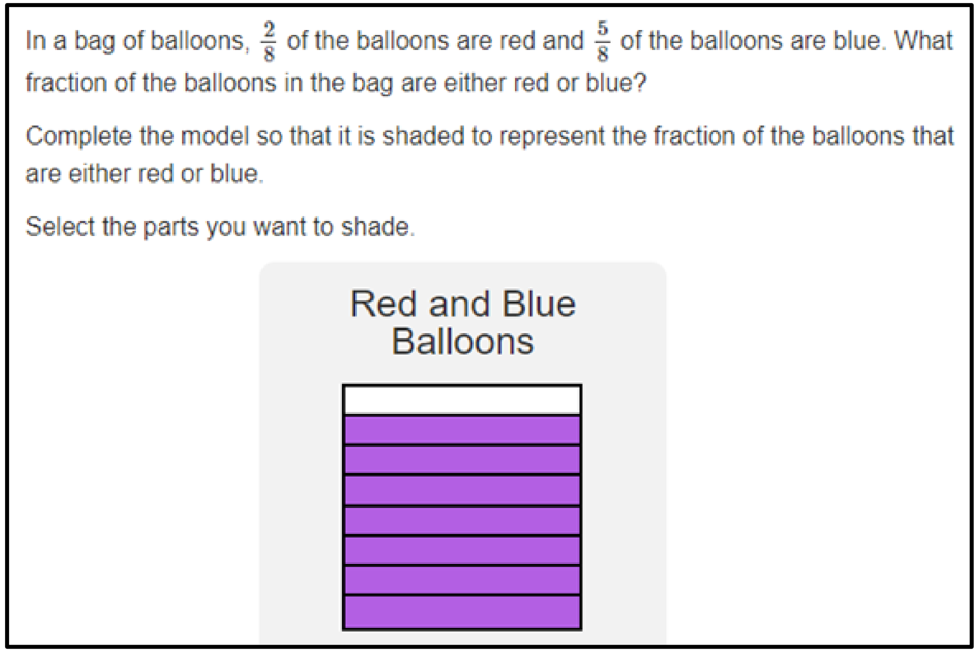
New STAAR question types are more like the kind teachers ask in class (I)

Math, Grade 4 Lesson



In this lesson, students are using shaded fraction models to show their understanding of adding fractions

Potential new STAAR question



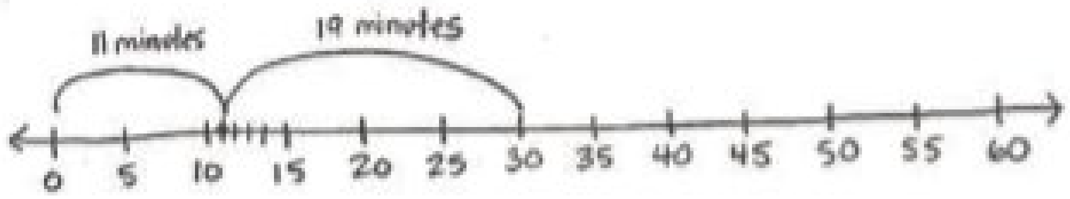
This potential new STAAR question asks students to shade in a fraction model to represent the addition of two fractions

In the 3rd grade classroom, students are asked to engage with time

Grade 3 Math TEKS

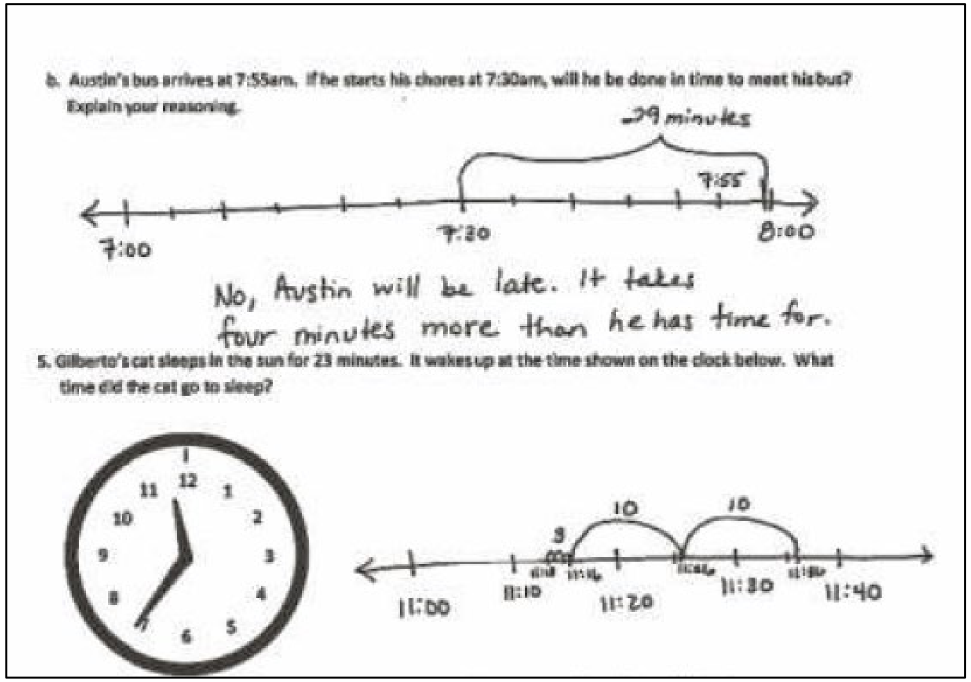
- 3.7A determine the solutions to problems involving addition and subtraction of time intervals in minutes using pictorial models or tools such as a 15-minute event plus a 30-minute event equals 45 minutes

Example: "Draw and use a number line to solve problems"



New STAAR question types are more like the kind teachers ask in class

Eureka Math TEKS, Grade 3 Module 2



b. Austin's bus arrives at 7:55am. If he starts his chores at 7:30am, will he be done in time to meet his bus? Explain your reasoning.

5. Gilberto's cat sleeps in the sun for 23 minutes. It wakes up at the time shown on the clock below. What time did the cat go to sleep?

In this lesson, students are using number lines to show their understanding of elapsed time

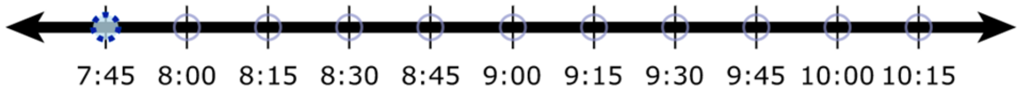
Potential new STAAR question

Miguel decided to watch a show on television:

- It took him 15 minutes to choose a show to watch.
- After choosing a show, he watched the show for 1 hour.

If Miguel started choosing a show at 7:45, at what time did he stop watching the show?

Select **ONE** location on the number line to plot the point.



This potential new STAAR question asks students to use a number line and solve for the end time

TEA

Reflection

How does the research on how student learn in math support student success on STAAR?

Breakout Rooms – Reflect and Debrief

Directions:

1	From what we went over today, does your LEA have a vision or framework aligned to research?
2	How does this math research support the needs of all learners in your LEA?
3	Where do you see strengths or gaps in your instructional practices for math?

Next Steps

- **District Panels [Optional]:** Sign up for District Panels to hear from districts already engaging in this work
  - Date: 8/18; Registration: Here
- **Research Overview Series [Optional]:** Sign up for overview of research topics series aligned with STAAR Redesign to see if your district may want to explore further
  - Date: 8/19 (Math) and 8/25 (RLA)
- **TEA Consultation [Optional]:** District leaders may sign up for one 30-minute session with TEA here to help determine what application decision may be best based on local context
- **Apply to grant [Required]**
  - Open: June 22nd, 2022; Closing: July 29th ***and*** August 26th