

Using High Quality Tasks to Promote Meaningful Feedback

**Teaching Integrated Math and Science Project
University of Illinois at Chicago**



UIC



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Creating Communities and Cultivating Change

Using High Quality Tasks to Promote Meaningful Feedback

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TEACHING INTEGRATED MATH AND SCIENCE PROJECT

UNIVERSITY OF ILLINOIS AT CHICAGO

Using High Quality Tasks to Promote Meaningful Feedback

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University of Illinois at Chicago
Learning Sciences Research Institute

Math
Trailblazers

Workshop Goals

Participants will:

- ▶ Develop an understanding of the characteristics of high quality tasks.
- ▶ Engage in solving multiplication tasks to determine the cognitive demand.
- ▶ Analyze student work to identify the strategies and reasoning used.
- ▶ Identify strategies for providing meaningful feedback that moves learning forward.



Mathematics Teaching Practices

- ▶ Establish mathematics goals to focus learning.
- ▶ Implement tasks that promote reasoning and problem solving.
- ▶ Use and connect mathematical representations.
- ▶ Facilitate meaningful mathematical discourse.
- ▶ Pose purposeful questions.
- ▶ Build procedural fluency from conceptual understanding.
- ▶ Support productive struggle in learning mathematics.
- ▶ Elicit and use evidence of student thinking.



Supporting Productive Struggle...

- ▶ *Effective teaching of mathematics consistently provides students, individually and collectively, with **opportunities** and **supports** to engage in productive struggle as they grapple with mathematical ideas and relationships.*

NCTM Principles to Actions

Students' struggles are opportunities for diving more deeply into understanding the math instead of simply seeking correct solutions.

Feeling Good About Struggle



Standards for Mathematical Practice

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



Can I fill more or less than 8 small pots with four-tenths of a quart of soil?



High Quality Tasks...

per·se·ver·ance

/ˌpɜːsəˈvɪərəns/

noun

noun: perseverance



steadfastness in doing something despite difficulty or delay in achieving success.

"his **perseverance** with the technique illustrates his single-mindedness"

synonyms: persistence, tenacity, determination, staying power, indefatigability, steadfastness, purposefulness; patience, endurance, application, diligence, dedication, commitment, doggedness, assiduity, tirelessness, stamina; intransigence, obstinacy; *informal* stick-to-it-iveness; *formal* pertinacity

"in a competitive environment, perseverance is an invaluable asset"

A Classroom Culture that Allows Students to Persevere in Problem Solving...

- ✓ Embodies **problem-based** learning
- ✓ Allows **time** for students to reason mathematically
- ✓ Provides opportunities for students to **freely discuss** mathematical understandings
- ✓ Requires that students **explain** how they solve problems
- ✓ Lets students be **responsible** for their own learning
- ✓ Sets clear **expectations**
- ✓ Provides frequent formative assessment and **feedback**
- ✓ Teaches students to work like **real mathematicians**
- ✓ Creates a **flexible** and **dynamic** classroom environment
- ✓ Allows opportunities for further **exploration** of a topic



Shifting Paradigms:

Productive

An effective teacher provides students with appropriate challenge, encourages perseverance in solving problems, and supports productive struggle in learning mathematics.

The role of the teacher is to engage students in tasks that promote reasoning and problem-solving and facilitate discourse that moves students towards shared understanding of mathematics.

Unproductive

An effective teacher makes the mathematics easy for students by guiding them step-by-step through problem-solving to ensure that they are not frustrated or confused.

The role of the teacher is to tell students exactly what definitions, formulas, and rules they should know and demonstrate how to use this information to solve mathematics problems.

Shifting Paradigms

Productive

The role of the student is to be actively involved in making sense of mathematics tasks by using varied strategies and representations, justifying solutions, making connections to prior knowledge or familiar contexts and experiences, and considering the reasoning of others.

Unproductive

The role of the student is to memorize information that is presented and then use it to solve routine problems on homework, quizzes, and tests.

Creating a Positive Classroom Culture

Teachers can facilitate this by:

- ▶ **providing time for student exploration and inquiry, and allowing students to grapple with problems**
- ▶ carefully selecting problems to discuss, including problems where there are often misconceptions
- ▶ respectfully reacting to incorrect answers and communicating that these errors provide important learning opportunities

Creating a Community of Learners to Support Student Exploration and Inquiry

Mini candy bars come 10 in a package. Each bar is 2 inches long. How long will a train of 10 bars be if they are lined up end to end in a row with a $\frac{1}{4}$ inch space between them.



Adapted from Ms. Linares' 4th grade classroom, TeachingChannel.org

What Does it Look Like?

Supporting Productive Struggle in the Mathematics Classroom

What is the teacher doing?	What are students doing?

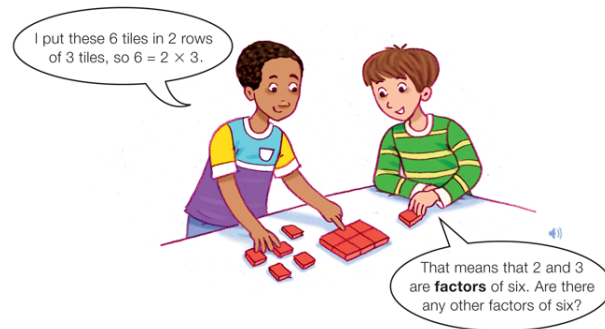
High Quality Tasks that Promote Inquiry and Engagement

- ▶ *Effective teaching of mathematics engages students in solving and discussing tasks that promote mathematical **reasoning and problem-solving** and allow multiple entry points and varied solution strategies.*

NCTM *Principles to Actions*

High Cognitive Tasks

Student learning is greatest in classrooms where the tasks consistently encourage **high-level student thinking and reasoning** and least in classrooms where the tasks are routinely **procedural** in nature.



Boaler & Staples '08; Hiebart & Wearne '93; Stein & Lane '96

Characteristics of High Quality Tasks

High Quality Tasks

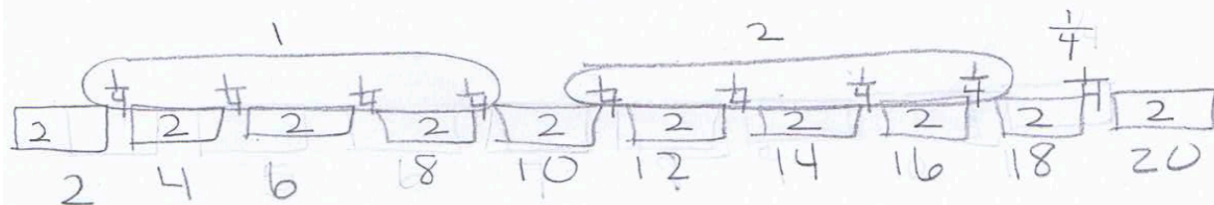
- ▶ Build mathematical proficiency
- ▶ Challenge and enrich student thinking
- ▶ Develop mathematical vocabulary related to the ideas and concepts
- ▶ Promote the ability to learn multiple ways of thinking about and representing mathematical ideas (pictures, diagrams, concrete models, numeric/symbolic)

Characteristics of High Quality Tasks

A great task:

- Revolves around an interesting problem
- Is directed at essential mathematical content
- Requires examination and perseverance – challenging students
- Begs for discussion – offering rich discourse on the mathematics
- Builds student understanding
- Warrants a summary look back – with opportunities for reflection and extension

Student 1
Mini Candy Bar Problem

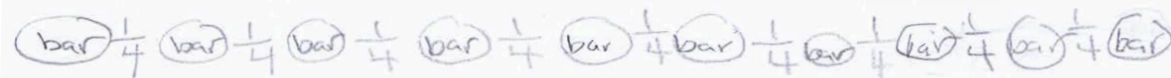


I drew 10 Candy bars in a row. I know each one is 2 inches long so I counted by two up to 20. The candy takes by two up to 20. There is $\frac{1}{4}$ inch between each bar. Four $\frac{1}{4}$ s make 1 whole so there are 2 wholes + $\frac{1}{4}$. That makes $2\frac{1}{4}$ inches in spaces. I added the bars and spaces.

$20 + 2\frac{1}{4} = 22\frac{1}{4}$ inches.

The train is $22\frac{1}{4}$ inches long.

Student 2
Mini Candy Bar Problem



My train has 10 bars and 9 spaces. I multiplied 10×2 because bars are 2 inches.

$10 \times 2 = 20$ inches

I multiplied $9 \times \frac{1}{4}$ for the spaces, that makes $\frac{9}{4}$.

$\frac{9}{4} = 2\frac{1}{4}$. Then I added

$20 + 2\frac{1}{4} = 22\frac{1}{4}$ inches

Mathematical Discourse

Facilitate meaningful mathematical discourse. *Effective teaching of mathematics facilitates discourse among students to **build shared understanding** of mathematical ideas by **analyzing** and **comparing** student approaches and arguments.*

Chris's answer makes sense.
21 hundredths divided by
3 hundredths is 7.



NCTM *Principles to Actions*

Four Principles of Productive Classroom Discussion

- ▶ Discussions should achieve a mathematical goal.
- ▶ Students need to know what and how to share.
- ▶ Teachers need to orient students to one another and to the mathematical ideas.
- ▶ Teachers must communicate that all students are sense makers and that their ideas are valued.

Kazemi & Hitz, 2014

Creating a Positive Classroom Culture

Teachers can facilitate this by:

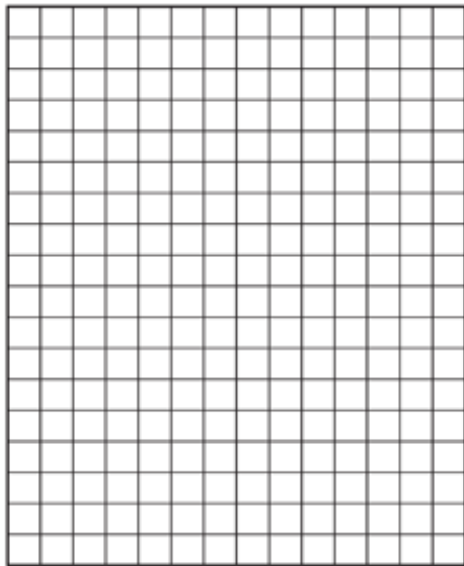
- ▶ providing time for student exploration and inquiry, and allowing students to grapple with problems
- ▶ carefully selecting problems to discuss, including problems where there are often misconceptions
- ▶ respectfully reacting to incorrect answers and communicating that these errors provide important learning opportunities

Is it a Great Task?

Name _____ Date _____ X

Counting Squares

1. How many small squares are in the large rectangle below? Show or tell how you found your answer.



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From the Fish Hatchery

SAB • Grade 4 • Unit 11 • Lesson 1 465



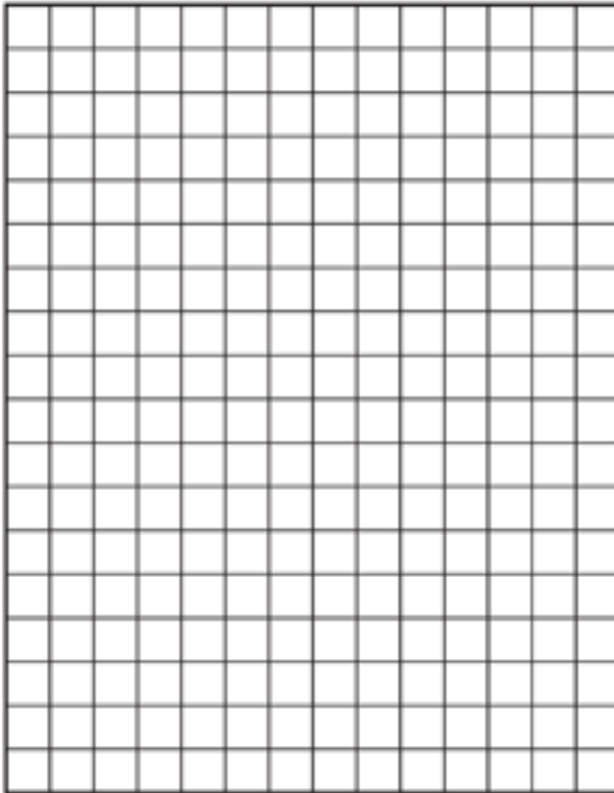
Math
Trailblazers

Counting Squares

Name _____ Date _____ X

Counting Squares

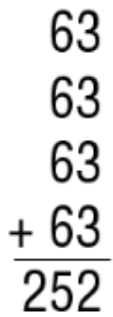
1. How many small squares are in the large rectangle below? Show or tell how you found your answer.



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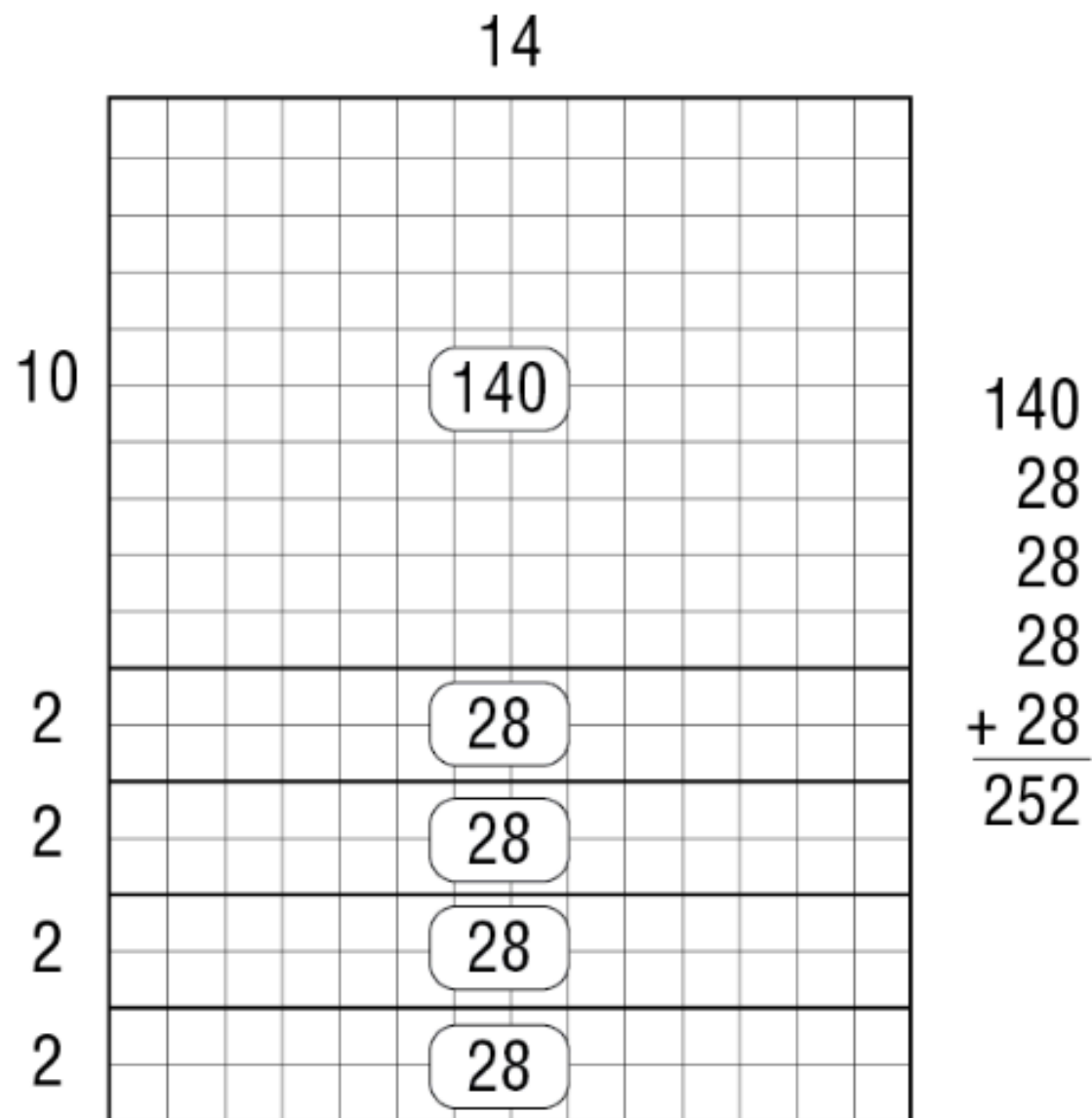


Math Trailblazers



Effective teaching of mathematics uses purposeful questions to assess and advance students' reasoning and sense making about important mathematical ideas and relationships.

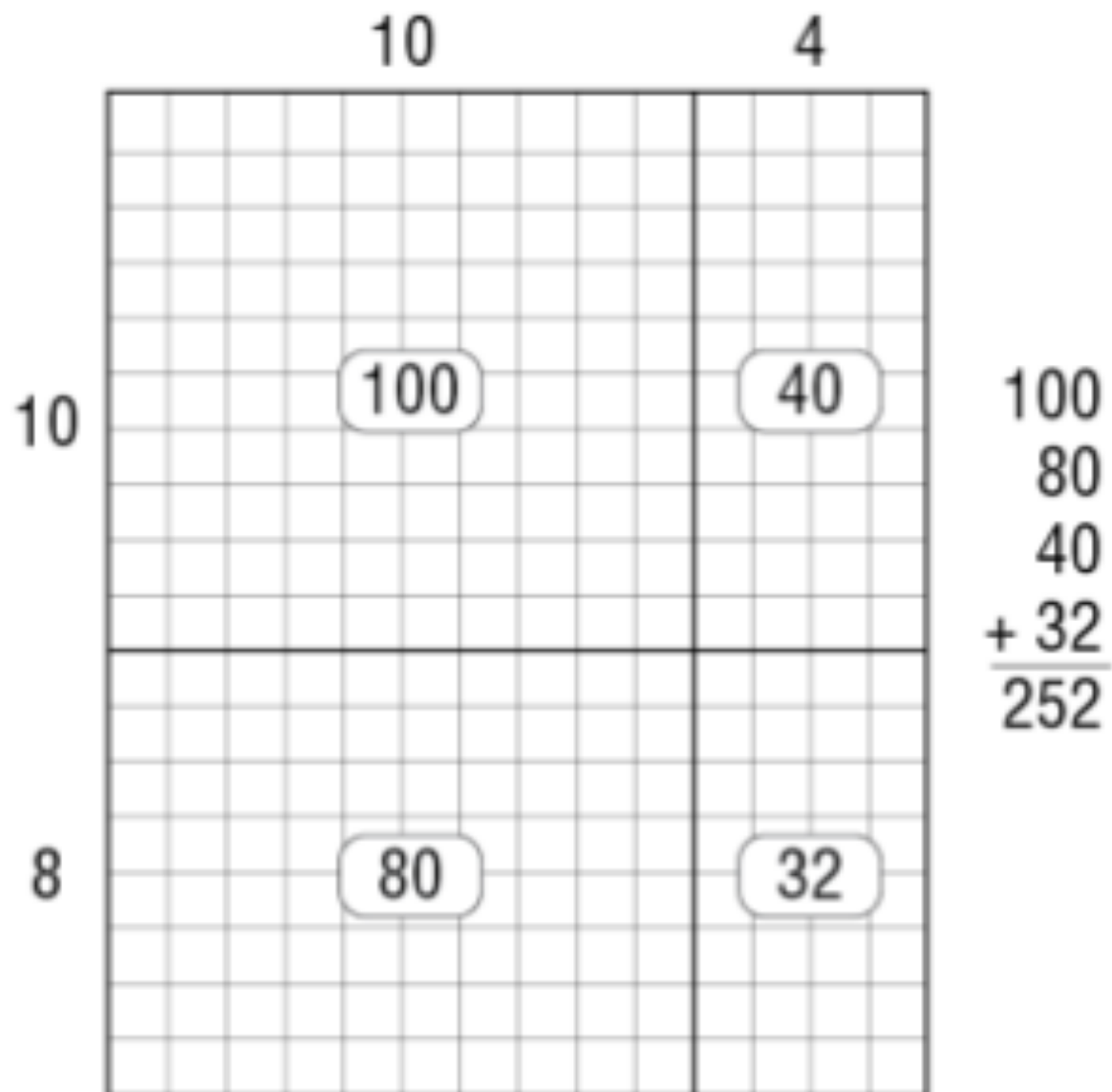
Shannon's Strategy



Nila's Strategy



$$\begin{array}{r} 14 \\ \times 18 \\ \hline 100 \\ 80 \\ 40 \\ + 32 \\ \hline 252 \end{array}$$



Four Principles of Productive Classroom Discussion

- ▶ Discussions should achieve a mathematical goal.
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- ▶ Teachers need to orient students to one another and to the mathematical ideas.
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Kazemi & Hitz, 2014

What Does it Look Like?

Supporting Productive Struggle in the Mathematics Classroom

What is the teacher doing?	What are students doing?



I do not know why I got this multiplication problem wrong:

$$\frac{1}{3} \times \frac{3}{4}$$

How did you solve it?



Elicit and use evidence of student thinking.

Effective teaching of mathematics uses evidence of student thinking to assess progress toward mathematical understanding and to adjust instruction continually in ways that support and extend.

NCTM *Principles to Actions*

Creating a Positive Classroom Culture

Teachers can facilitate this by:

- ▶ providing time for student exploration and inquiry, and allowing students to grapple with problems
- ▶ carefully selecting problems to discuss, including problems where there are often misconceptions
- ▶ respectfully reacting to incorrect answers and communicating that these errors provide important learning opportunities

Cornbread Fundraiser

The 5th graders want to raise money for their overnight camping trip by selling cornbread during the school district Chili Cook-Off contest. All the pans of cornbread are squares. A pan of cornbread costs \$12.00. The customers can buy any fractional part of a pan of cornbread and pay that fraction of \$12.00. For example $\frac{1}{2}$ of full pan costs $\frac{1}{2}$ of \$12.00

A Customer, Mrs. Farmer wants to buy cornbread. The pan is $\frac{1}{4}$ full. Mrs. Farmer wants to buy $\frac{1}{3}$ of the remaining Cornbread. What fraction of the whole pan does she want to buy? How much will she pay for her Purchase?



Meaningful Teacher Feedback

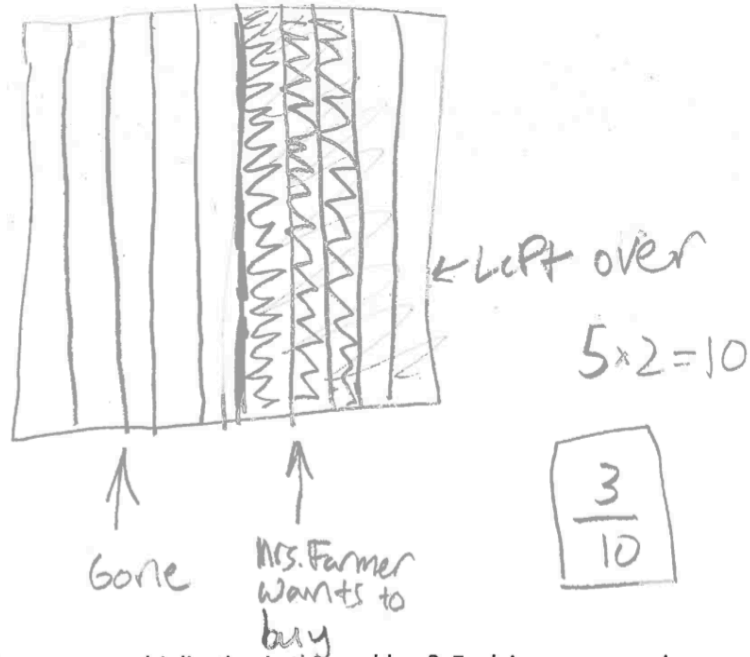
Where students are now

Where students need to be

Ways to close the gap

Exit Task—Cornbread Fundraiser

- A) Mr. Farmer walks up to buy cornbread and the pan was $\frac{1}{2}$ full. He wants to buy $\frac{3}{5}$ of the remaining cornbread. What fraction of the whole pan does he want to buy?

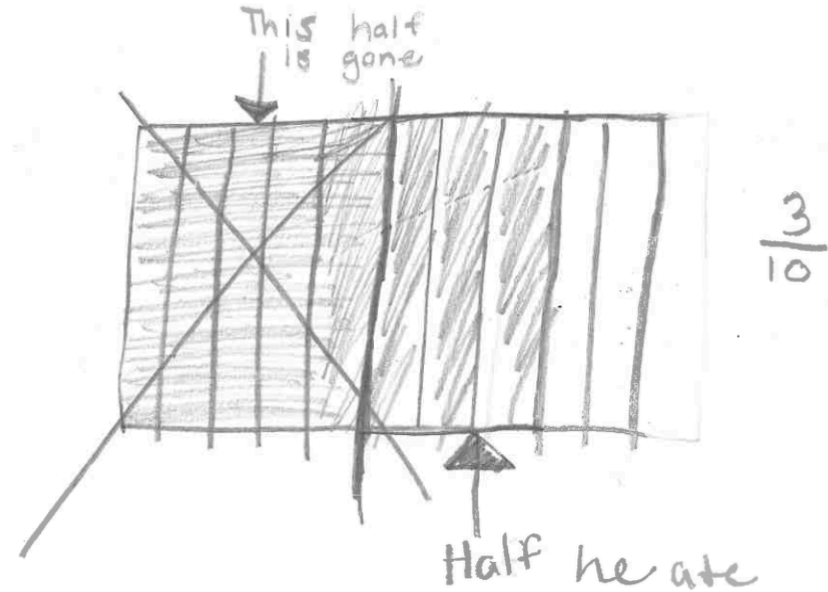


- B) Where do you see multiplication in this problem? Explain your reasoning.

Multiplication comes in when you are finding the denominator because there is 2 halves and five fifths in each so you do $5 \times 2 = 10$ and so then you have your denominator.

Exit Task—Cornbread Fundraiser

- A) Mr. Farmer walks up to buy cornbread and the pan was $\frac{1}{2}$ full. He wants to buy $\frac{3}{5}$ of the remaining cornbread. What fraction of the whole pan does he want to buy?

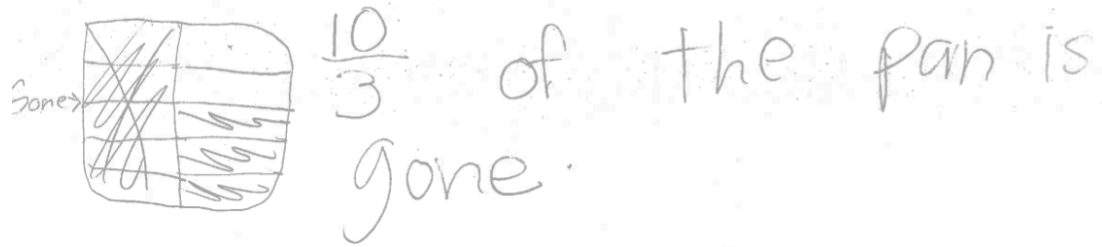


- B) Where do you see multiplication in this problem? Explain your reasoning.

I am not really sure because I don't know how to do that.

Exit Task—Cornbread Fundraiser

- A) Mr. Farmer walks up to buy cornbread and the pan was $\frac{1}{2}$ full. He wants to buy $\frac{3}{5}$ of the remaining cornbread. What fraction of the whole pan does he want to buy?

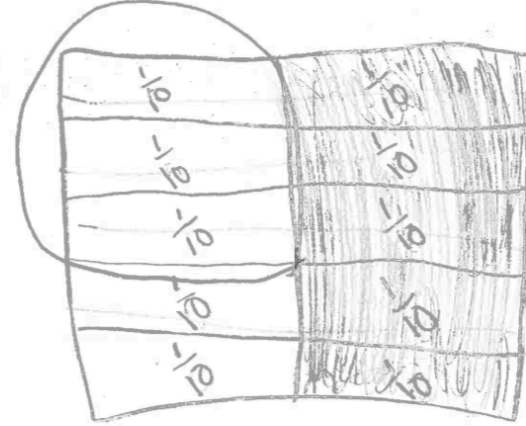


- B) Where do you see multiplication in this problem? Explain your reasoning.

Well I did not use multiplication. I just made a square and took it away. $\frac{10}{3}$ is the answer.

Exit Task—Cornbread Fundraiser

- A) Mr. Farmer walks up to buy cornbread and the pan was $\frac{1}{2}$ full. He wants to buy $\frac{3}{5}$ of the remaining cornbread. What fraction of the whole pan does he want to buy?



the shaded part is what was eaten.

the circled part is what she wants to buy.

* 5 of the 10ths is not shaded is what was not eaten

- B) Where do you see multiplication in this problem? Explain your reasoning.

He needs to buy $\frac{3}{10}$ which is half of $\frac{3}{5}$.

Supporting Productive Struggle in the Mathematics Classroom

What is the teacher doing?

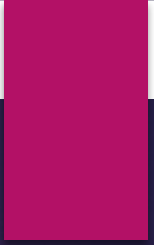
- Anticipating where students might struggle & being prepared to support
- Giving time to struggle
- Posing questions that scaffold and reengage student thinking without rescuing
- Providing feedback and facilitating discussions to deepen understanding
- Communicating that struggle and mistakes are a valuable part of learning
- Praising students for their effort and perseverance

What are students doing?

- Struggling at times but knowing that is part of learning
- Asking and answering questions to clarify thinking and understanding
- Realizing it is ok to ask for help but not to give up
- Supporting classmates by sharing strategies, justifying solutions, and critiquing reasoning

Positive Norms to Encourage in Math Class

- ▶ Everyone can learn math to the highest level.
- ▶ Mistakes are valuable—They make your brain grow.
- ▶ Failure and struggle do not mean that you can't do math—these are the most important parts of math and learning.
- ▶ Questions are really important.
- ▶ Math is about creativity and making sense.
- ▶ Math is about connections and communication.
- ▶ Depth is much more important than speed.
- ▶ Math class is about learning not performing.



Questions

Using High Quality Tasks to Promote Meaningful Feedback

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Thank you for attending!



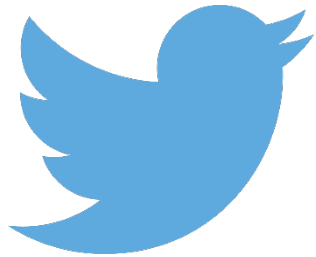
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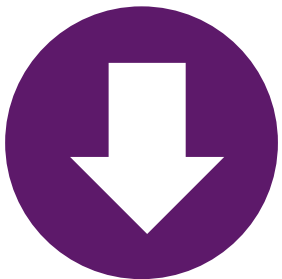


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