

HOW TO IMPLEMENT ENGAGING PROBLEM SOLVING IN YOUR MATH CLASSROOM

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Using the digits 1 to 9 at most one time each, place a digit in each box to make the product as close to 7,000 as possible.

×

Source: Paolo Tolomeo on openmiddle.com

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3

Name: _____ Date: _____

MULTIPLICATION PRACTICE

$\begin{array}{r} 66 \\ \times 23 \\ \hline \end{array}$	$\begin{array}{r} 49 \\ \times 72 \\ \hline \end{array}$	$\begin{array}{r} 52 \\ \times 44 \\ \hline \end{array}$	$\begin{array}{r} 26 \\ \times 35 \\ \hline \end{array}$	$\begin{array}{r} 18 \\ \times 87 \\ \hline \end{array}$	$\begin{array}{r} 63 \\ \times 55 \\ \hline \end{array}$
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4

STUDENTING BEHAVIOR

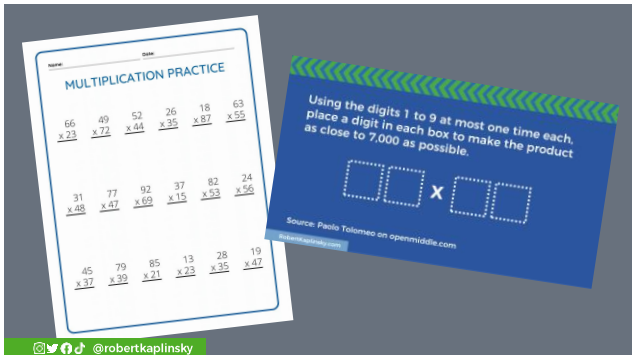
- slacking – not attempting to work at all
- stalling – doing legitimate off-task behavior
- faking – pretending to do the task but in reality, doing nothing
- mimicking – mindlessly repeating what they have in their notes
- trying it on their own – attempting to work through a problem

• thinking - what you do when you don't know what to do

Source: Dr. Darien Allan via Peter Liljedahl's *Building Thinking Classrooms*

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The image shows a stack of worksheets. The top worksheet is titled 'MULTIPLICATION PRACTICE' and contains several multiplication problems. Below it is a blue card with the same problem-solving challenge as slide 3: 'Using the digits 1 to 9 at most one time each, place a digit in each box to make the product as close to 7,000 as possible.' The card also features the source information and social media handles.

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DISCUSSION TIME

- Why was our engagement and thinking when working on the multiplication problem different than it would have been with a worksheet?

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7



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CHECKPOINTS

- HOW DO WE GET STUDENTS THINKING?
- HOW DO WE DO IT WITH REAL WORLD PROBLEMS?
- HOW DO WE DO IT WITH OPEN MIDDLE PROBLEMS?

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9



10

- 1/2 cup butter
- 1/2 cup white sugar
- 1/3 cup packed brown sugar
- 1/2 cup peanut butter
- 1/2 teaspoon vanilla extract

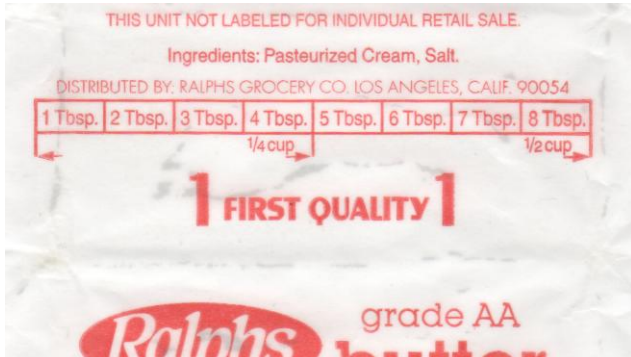
11



12



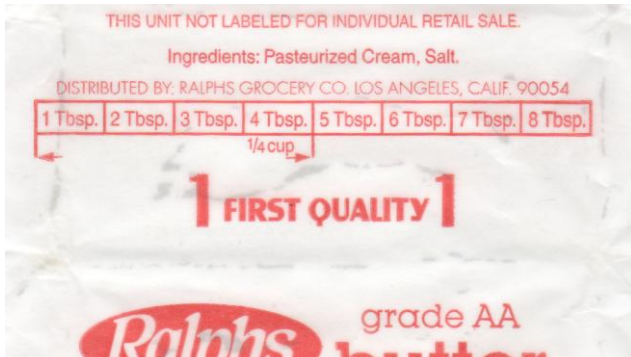
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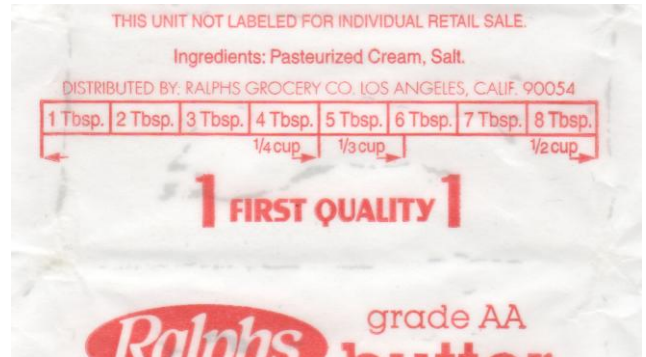
14

- 1/3 cup butter
- 1/3 cup white sugar
- 3 tablespoons and 1-3/4 teaspoons packed brown sugar
- 1/3 cup peanut butter
- 1/4 teaspoon vanilla extract

15



16



20

TOPICS

- IGNORANCE IS BLISS
- WORKSHEET-IFY
- 5 PRACTICES
- BUILDING THINKING CLASSROOMS
- WHAT I'M STILL WORKING ON

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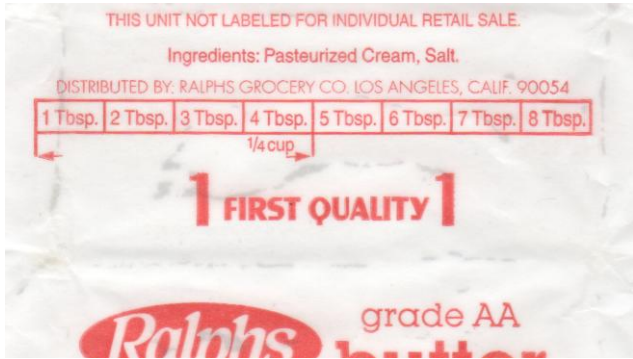
21

20. Baking

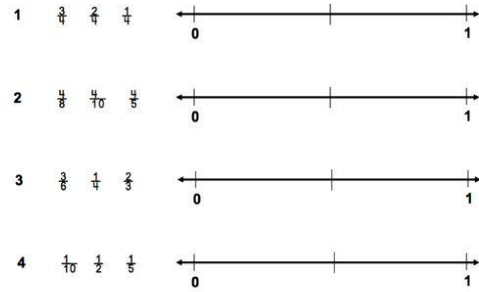
A stick of butter has 1/2 cup of butter. How much of a stick do you need for 1/3 of a cup of butter?



22



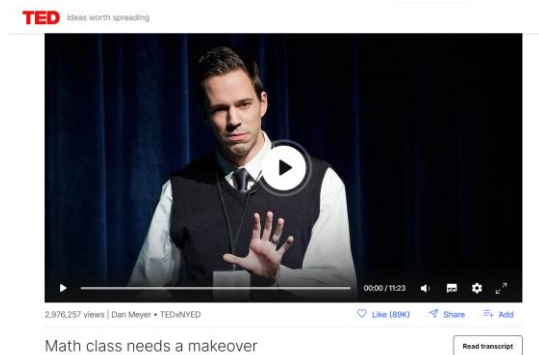
23



24



25



26



27



28

Cutting Butter Activity

Name: _____

Period: _____

1. Copy the image of the stick of butter and circle where $\frac{1}{4}$ cup is:

2. If half a stick is $\frac{1}{4}$ cup of butter, how much is $\frac{1}{2}$ cup of butter?

3. Estimate where you think you should cut the stick for $\frac{1}{3}$ cup of butter. How do you know?

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	Before using the problem	Working on the problem
Worksheet	Made a worksheet	Guided students with the worksheet

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TOPICS

- IGNORANCE IS BLISS
- WORKSHEET-IFY
- 5 PRACTICES
- BUILDING THINKING CLASSROOMS
- WHAT I'M STILL WORKING ON

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- Predictable
- Powerful
- Repeatable

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5 PRACTICES

1. Anticipating
2. Monitoring
3. Selecting
4. Sequencing
5. Connecting

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ANTICIPATING

- Count 16 tablespoons and divide by 3.
- Use two sticks to make a whole cup and:
 - Slice the whole cup into thirds.
 - Break each tablespoon into thirds and collect them.
 - Make groups of five tablespoons and split the 16th.
- Take two thirds of one stick.
- One third is marked as less than one fourth.
- 15 tablespoons were distributed but not the 16th.

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MONITORING

- Use a student strategy tracker
- Keep track of who is using what
- Nudge people as needed

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Strategy	Student Name(s) and Notes	Order

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SELECTING, SEQUENCING, & CONNECTING

- Pick useful student work
- Order it to tell a story
- Ask questions to make connections

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Strategy	Student Name(s) and Notes	Order
Count 16 tablespoons and divide by 3.		
Use two sticks to make a whole cup and slice the whole cup into thirds.		3
Use two sticks to make a whole cup and break each tablespoon into thirds and collect them.		1
Use two sticks to make a whole cup and make groups of five tablespoons and split the 16 th .		2

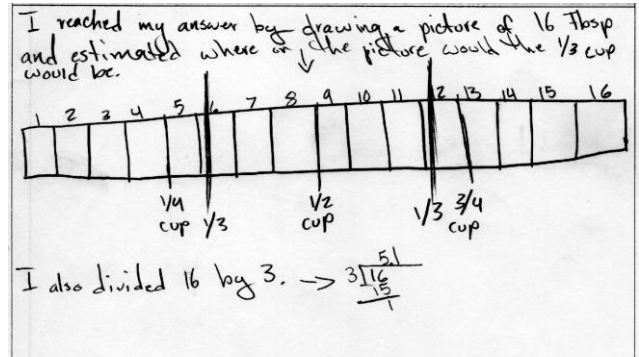
41

TAKEAWAYS

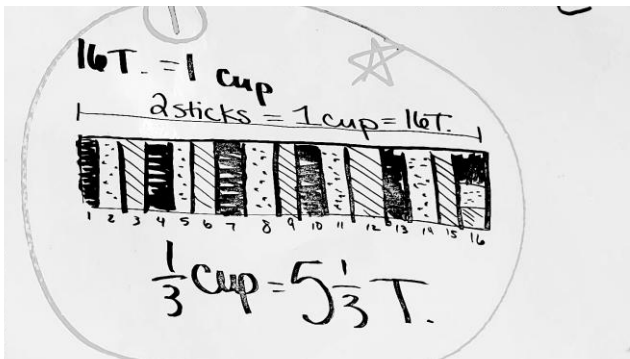
- No more crime scene investigation
- Getting the answer is the middle, not the end.
- Sometimes I fake student work

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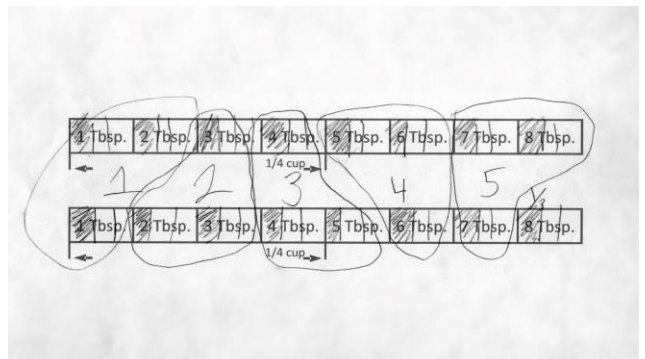
42



43



44



45

TAKEAWAYS

- No more crime scene investigation
- Getting the answer is the middle, not the end.
- Sometimes I fake student work
- Everyone getting the problem wrong is an opportunity, not a failure.

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	Before using the problem	Working on the problem	Facilitating the conversation
Worksheet	Made a worksheet	Guided students with the worksheet	Shared answers
5 Practices	Anticipated	Monitored	Selected Sequenced Connected

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TOPICS

- ✓ **IGNORANCE IS BLISS**
- ✓ **WORKSHEET-IFY**
- ✓ **5 PRACTICES**
- **BUILDING THINKING CLASSROOMS**
- **WHAT I'M STILL WORKING ON**

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THE FOURTEEN PRACTICES

1. What types of tasks we use
2. How we form collaborative groups
3. **Where students work**
4. **How we arrange the furniture**
5. How we answer student questions
6. **When, where, and how tasks are given**
7. What homework looks like
8. **How we foster student autonomy**
9. **How we use hints and extensions**
10. **How we consolidate a lesson**
11. How students take notes
12. What we choose to evaluate
13. How we use formative assessment
14. How we grade

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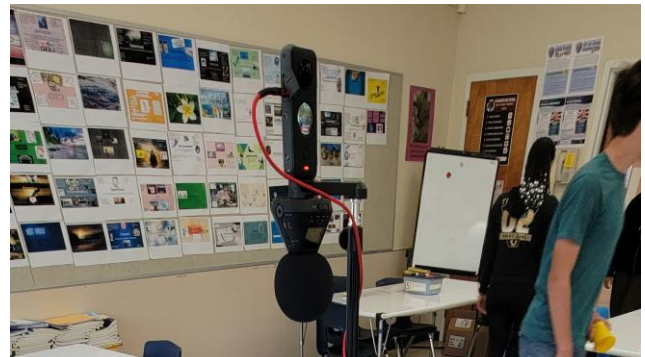
360 Degree Video Practice
Robert Kaplinsky

Move device to explore video

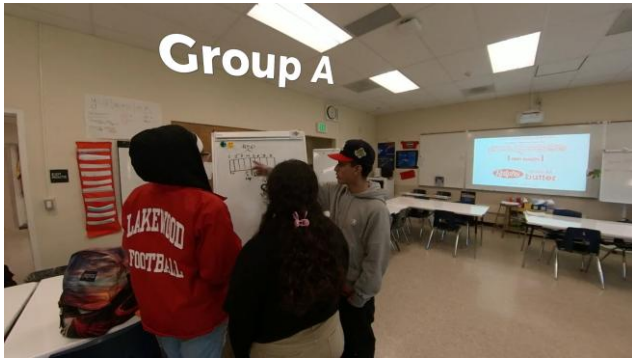
Rotate

0:00 / 1:25

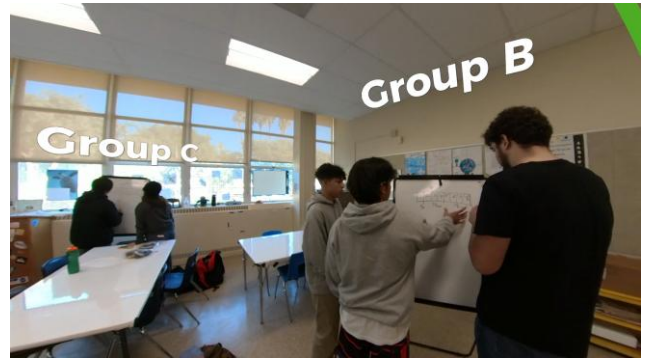
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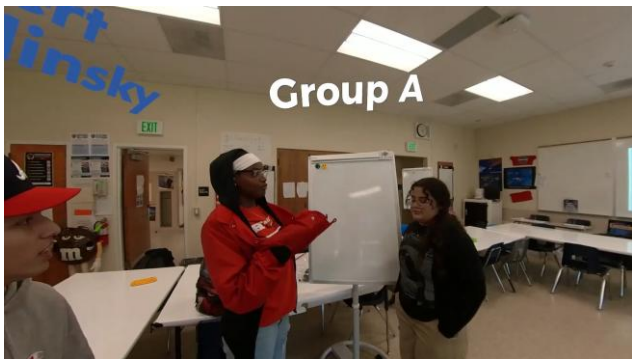
53



54



55



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DISCUSSION TIME

- How do you think having groups of three students sharing vertical whiteboards scattered around the room impacted the way they interacted?

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DISCUSSION TIME

- What was the teacher's role in facilitating group conversations and helping them when they got stuck?

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DISCUSSION TIME

- Why was Group C walking to check out what other groups were doing a really good sign?

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DISCUSSION TIME

- What do you notice and wonder about the way this conversation took place?

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TAKEAWAYS

- Small changes make huge differences
- Giving up control is not bad
- Students are more comfortable

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	Before using the problem	Showing the problem with students	Facilitating the conversation	
Worksheet	Made a worksheet	Guided students with the worksheet	Shared answers	
5 Practices	Anticipated	Showed it to students	Selected Sequenced Connected	
BTC	Defronted VNPS			

Merged with BTC

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TOPICS

- IGNORANCE IS BLISS
- WORKSHEET-IFY
- 5 PRACTICES
- BUILDING THINKING CLASSROOMS
- WHAT I'M STILL WORKING ON

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WHAT I'M STILL WORKING ON

- How much wait time do I give?
- What do conversations look like?
- Who should do the explaining?
- How do I ensure all students are participating?

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TOPICS

- IGNORANCE IS BLISS
- WORKSHEET-IFY
- 5 PRACTICES
- BUILDING THINKING CLASSROOMS
- WHAT I'M STILL WORKING ON

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DISCUSSION TIME

- What parts of this reinforced what you've already been working to implement?
- What parts most challenged your beliefs and/or experiences?

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CHECKPOINTS

- HOW DO WE GET STUDENTS THINKING?
- HOW DO WE DO IT WITH REAL WORLD PROBLEMS?
- HOW DO WE DO IT WITH OPEN MIDDLE PROBLEMS?

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Source: Dan Meyer

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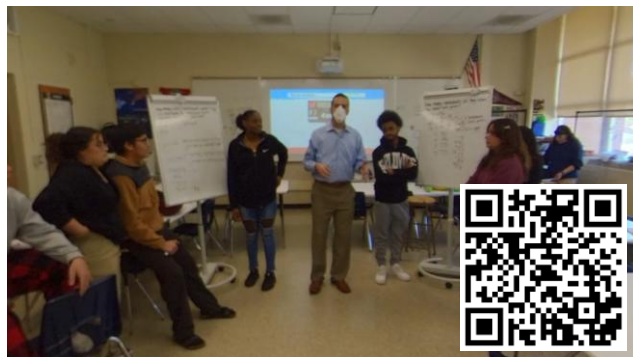


Source: Dan Meyer

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79



80



81

GAMEHQ
 Scores Top 25
Final
 **Indiana 20** (4-6, 0-6 Big Ten)
 **(7) Wisconsin 83** (9-1, 5-1 Big Ten)
 Check-in 117 Alerts
 12:00 PM ET, November 13, 2010
 Camp Randall Stadium, MADISON, WI
 1 2 3 4 T

82



83



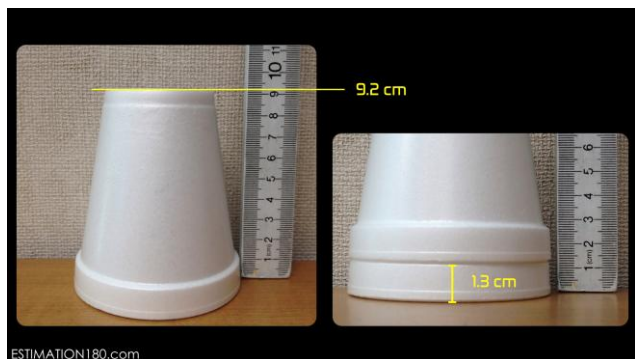
85

NOTICE AND WONDER

- What do you notice about the video?
- What do you wonder about the video?

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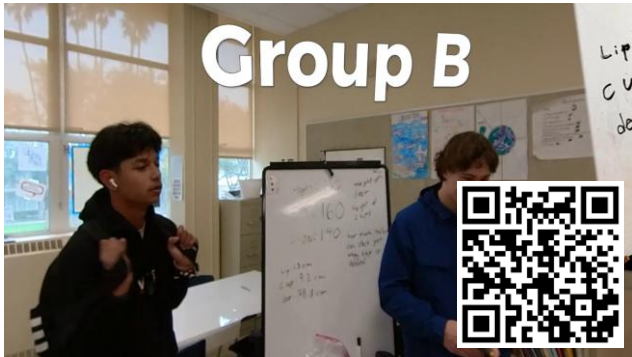
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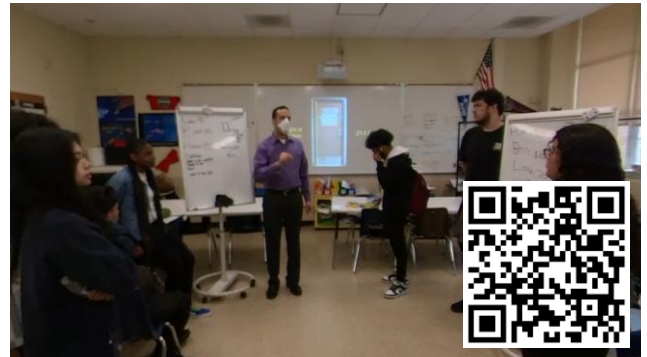
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88



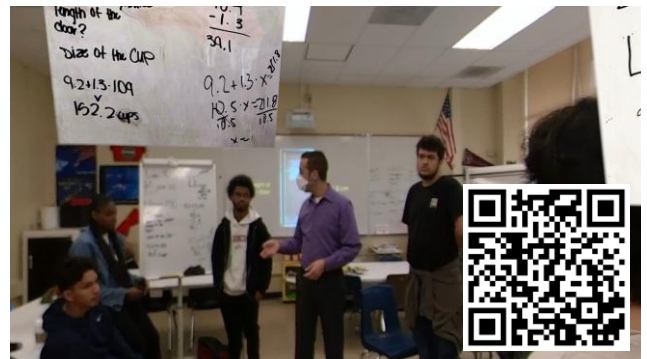
89



90



91



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CHECKPOINTS

- HOW DO WE GET STUDENTS THINKING?
- HOW DO WE DO IT WITH REAL WORLD PROBLEMS?
- HOW DO WE DO IT WITH OPEN MIDDLE PROBLEMS?

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Using the digits 0 to 9 at most one time each, place a digit in each box to create a true equation with the greatest possible product.

$$\square\square \times \square\square = \square\square\square$$

Source: openmiddle.com

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DISCUSSION TIME

- Share with your neighbor(s) how you each solved the problem.
- What other correct and incorrect strategies might students use?

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PARTS OF A MATH PROBLEM

- Beginning
- Middle
- End

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Correct

-
-
-
-
-

Concerns

-
-
-
-
-

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109



110

Correct

- Guess and check without conceptual understanding

Concerns

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111

Using the digits 0 to 9 at most one time each, place a digit in each box to create a true equation with the greatest possible product.

$$\boxed{3} \boxed{8} \times \boxed{6} \boxed{8} = \boxed{}$$

Source: openmiddle.com
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112

Correct

- Guess and check **without** conceptual understanding
- Guess and check **with** conceptual understanding

Concerns

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113

Using the digits 0 to 9 at most one time each, place a digit in each box to create a true equation with the greatest possible product.

$$\boxed{} \boxed{} \times \boxed{} \boxed{} = 9 \boxed{} \boxed{}$$

Source: openmiddle.com
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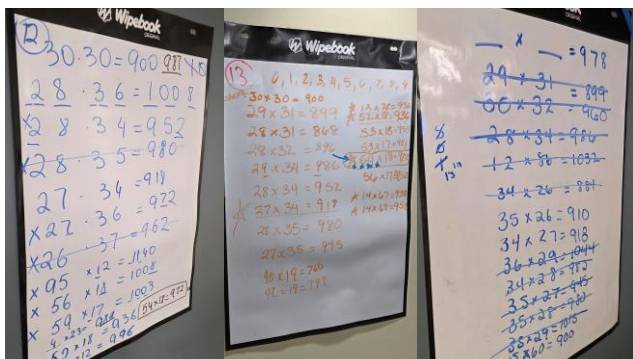
114

Using the digits 0 to 9 at most one time each, place a digit in each box to create a true equation with the greatest possible product.

$$\boxed{0} \boxed{8} \times \boxed{} \boxed{5} = \boxed{} \boxed{8}$$

Source: openmiddle.com
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116

Correct


- Guess and check **without** conceptual understanding
- Guess and check **with** conceptual understanding
- Division

Concerns

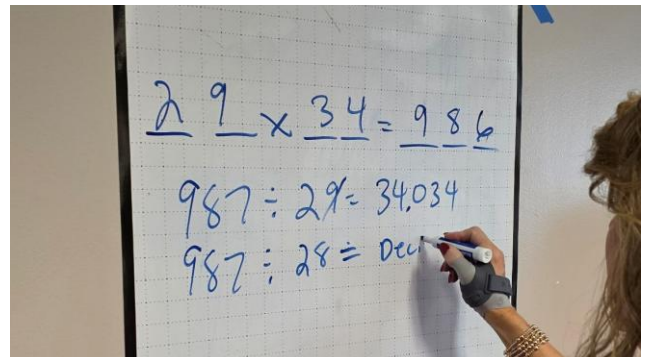
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$987 \div 53$
 $987 \div 52$
 $987 \div 51$
 $987 \div 50$
 $987 \div 49$

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118



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$\frac{972}{54} = 18$
 $\frac{432}{19} = 23$
 $\frac{432}{16} = 27$


$\frac{435}{27} = 16.1$
 $\frac{436}{27} = 16.148$
 $\frac{438}{15} = 29.2$
 $\frac{438}{16} = 27.3$

120

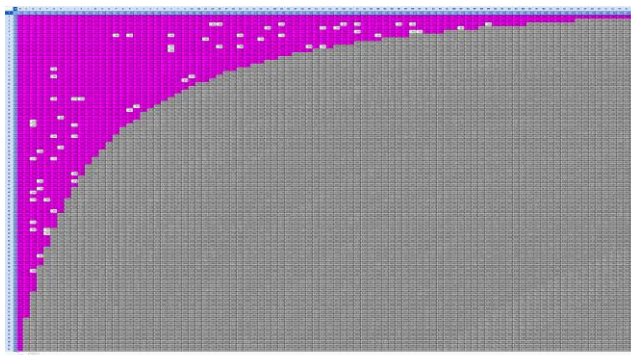
Correct

- Guess and check without conceptual understanding
- Guess and check with conceptual understanding
- Division
- Giant times table

Concerns


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121



122

930
 936
 938
 952
 972

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Correct	Concerns
<ul style="list-style-type: none"> • Guess and check <i>without</i> conceptual understanding • Guess and check <i>with</i> conceptual understanding • Division • Giant times table • Prime factorization 	

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125

Using the digits 0 to 9 at most one time each, place a digit in each box to create a true equation with the greatest possible product.

$$\boxed{2} \boxed{1} \times \boxed{4} \boxed{7} = \boxed{9} \boxed{8} \boxed{7}$$

Source: openmiddle.com
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Using the digits 0 to 9 at most one time each, place a digit in each box to create a true equation with the greatest possible product.

$$\boxed{3} \boxed{4} \times \boxed{2} \boxed{9} = \boxed{9} \boxed{8} \boxed{6}$$

Source: openmiddle.com
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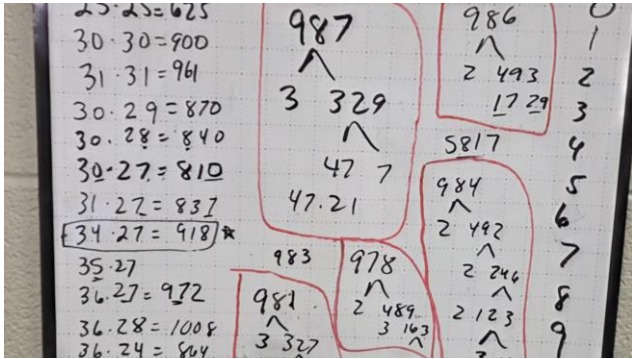
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Using the digits 0 to 9 at most one time each, place a digit in each box to create a true equation with the greatest possible product.

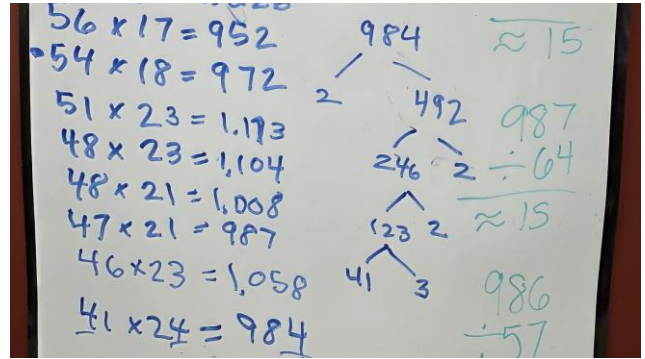
$$\boxed{1} \boxed{7} \times \boxed{5} \boxed{8} = \boxed{9} \boxed{8} \boxed{6}$$

Source: openmiddle.com
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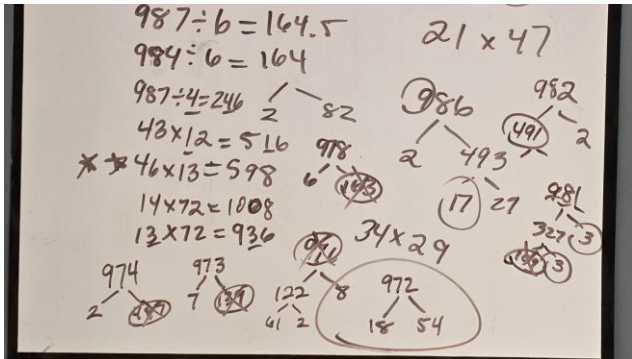
129



130



131



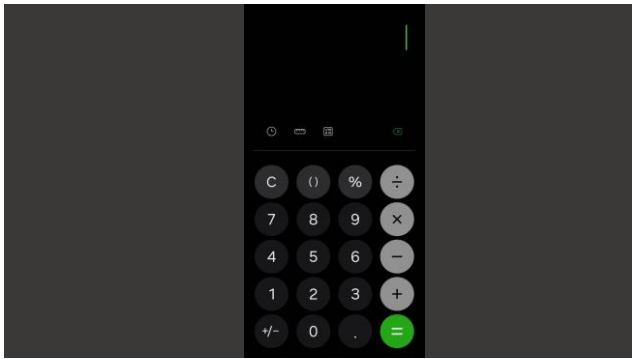
132

Correct Concerns

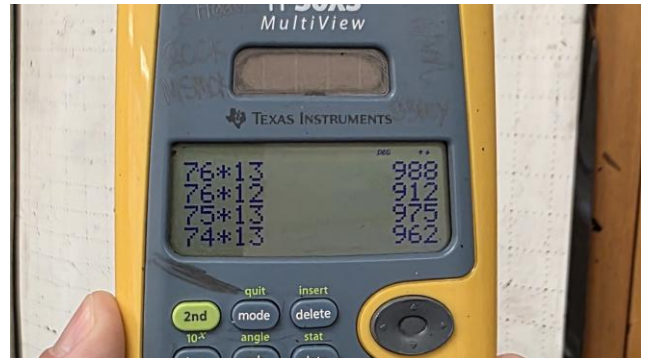
- Guess and check without conceptual understanding
- Guess and check with conceptual understanding
- Division
- Giant times table
- Prime factorization
- Strategic brute force with calculator

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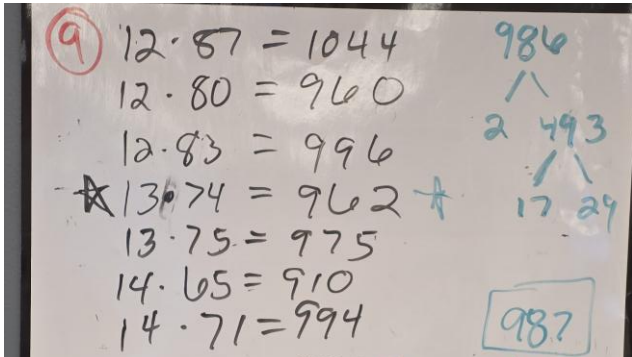
133



134



135



136

Correct

- Guess and check without conceptual understanding
- Guess and check with conceptual understanding
- Division
- Giant times table
- Prime factorization
- Strategic brute force with calculator
- Brute force with coding

Concerns

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results = []

```

for a in range(10, 100): # factor 1 (10 to 99)
  for b in range(10, 100): # factor 2 (10 to 99)
    product = a * b # multiply them
    if product < 1000: # keep 999 or less
      results.append((a, b, product))
    
```

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	A	B	C
1	Factor	Factor	Product
2	10	10	100
3	10	11	110
4	10	12	120
5	10	13	130
6	10	14	140
7	10	15	150
8	10	16	160
9	10	17	170
10	10	18	180
11	10	19	190
12	10	20	200
13	10	21	210
14	10	22	220
15	10	23	230
16	10	24	240
17	10	25	250
18	10	26	260
19	10	27	270
20	10	28	280
21	10	29	290
22	10	30	300
23	10	31	310
24	10	32	320
25	10	33	330
26	10	34	340
27	10	35	350

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	A	B	C
1	Factor	Factor	Product
2	27	37	999
3	37	27	999
4	12	83	996
5	83	12	996
6	14	71	994
7	71	14	994
8	16	62	992
9	31	32	992
10	32	31	992
11	62	16	992
12	10	99	990
13	11	90	990
14	15	66	990
15	18	55	990
16	22	45	990
17	30	33	990
18	33	30	990
19	45	22	990
20	55	18	990
21	66	15	990
22	90	11	990
23	99	10	990
24	23	43	989
25	43	23	989
26	13	76	988
27	76	13	988

140

	A	B	C
1	Factor	Factor	Product
2	27	37	999
3	37	27	999
4	12	83	996
5	83	12	996
6	14	71	994
7	71	14	994
8	16	62	992
9	31	32	992
10	32	31	992
11	62	16	992
12	10	99	990
13	11	90	990
14	15	66	990
15	18	55	990
16	22	45	990
17	30	33	990
18	33	30	990
19	45	22	990
20	55	18	990
21	66	15	990
22	90	11	990
23	99	10	990
24	23	43	989
25	43	23	989
26	13	76	988
27	76	13	988

141

Correct

- Guess and check without conceptual understanding
- Guess and check with conceptual understanding
- Division
- Giant times table
- Prime factorization
- Strategic brute force with calculator
- Brute force with coding

Concerns

- Math issues
 - Students struggle with two-digit multiplication

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Correct

- Guess and check without conceptual understanding
- Guess and check with conceptual understanding
- Division
- Giant times table
- Prime factorization
- Strategic brute force with calculator
- Brute force with coding

Concerns

- Math issues
 - Students struggle with two-digit multiplication
 - Students lack place value conceptual understanding

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Using the digits 0 to 9 at most one time each, place a digit in each box to create a true equation with the greatest possible product.

$$\boxed{9} \boxed{8} \times \boxed{7} \boxed{6} = \boxed{}$$

Source: openmiddle.com

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Correct

- Guess and check without conceptual understanding
- Guess and check with conceptual understanding
- Division
- Giant times table
- Prime factorization
- Strategic brute force with calculator
- Brute force with coding

Concerns

- Math issues
 - Students struggle with two-digit multiplication
 - Students lack place value conceptual understanding
 - Students don't understand what a true equation is

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146

Using the digits 0 to 9 at most one time each, place a digit in each box to create a true equation with the greatest possible product.

$$\boxed{6} \boxed{5} \times \boxed{4} \boxed{3} = \boxed{9} \boxed{8} \boxed{7}$$

Source: openmiddle.com

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Correct

- Guess and check without conceptual understanding
- Guess and check with conceptual understanding
- Division
- Giant times table
- Prime factorization
- Strategic brute force with calculator
- Brute force with coding

Concerns

- Math issues
 - Students struggle with two-digit multiplication
 - Students lack place value conceptual understanding
 - Students don't understand what a true equation is
- Open Middle issues
 - Students use a digit more than once.

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MaTh KiNg !%\$
 nice, the biggest answers my class were 980 and 996

Melissa Marks Miss. Shaw
 $12 \times 83 = 996$ $12 \times 83 = 996$

claire and Oscar lose
 we did $11 \times 11 = 121$ and a solution of $83 \times 12 = 996$

149

Correct

- Guess and check without conceptual understanding
- Guess and check with conceptual understanding
- Division
- Giant times table
- Prime factorization
- Strategic brute force with calculator
- Brute force with coding

Concerns

- Math issues
 - Students struggle with two-digit multiplication
 - Students lack place value conceptual understanding
 - Students don't understand what a true equation is
- Open Middle issues
 - Students use a digit more than once.
 - Students use more than three digits in the product

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Johnny Guzman
 there is one greater $97 \times 86 + 8342$ or $98 \times 76 + 8342$

MaTh KiNg !%\$
 Also a bigger product will be $96 \times 87 = 8352$

rocco burns ybreak
 $96 \times 87 = 8,352$ and a higher product. $78 \times 96 = 7488$

Cordova

151

Correct

- Guess and check without conceptual understanding
- Guess and check with conceptual understanding
- Division
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“The greatest possible product found so far is 62×15 which equals 930 but there may be one even greater. Let us know in the comments what you find.”

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Eric
 We found a higher product. $78 \times 12 = 936$

Amy Smith
 My student and I found $18 \times 54 = 972$ oh yea! We loved this one!

J. Kellams
 We found $74 \times 13 = 962$

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DISCUSSION TIME

- Which strategy (other than the one you used) did you like most?
- How does spending time anticipating both correct and incorrect strategies impact your ability to facilitate the lesson?

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When the cook tastes the soup, that's formative;
when the guests taste the soup, that's summative.

BOB STAKE

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more understanding \neq correct answer

less understanding \neq incorrect answer


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

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

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

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Why???

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$$3 \overline{) 4 \frac{1}{3}} \\ \underline{-3} \\ 1$$

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162



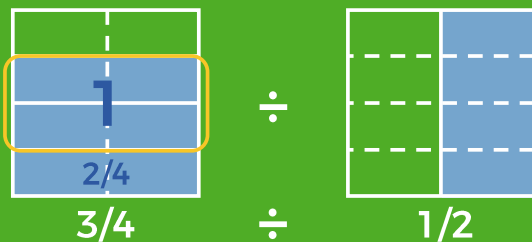
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$$\frac{3}{4} \div \frac{1}{2} \\ \frac{3}{4} \times \frac{2}{1} = \frac{6}{4} \\ \frac{3}{2} = 1 \frac{1}{2}$$

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more understanding \neq correct answer
less understanding \neq incorrect answer

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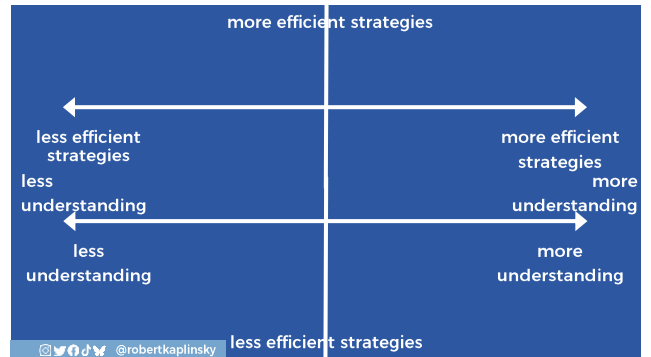
171

DOUBLE-DOUBLE [®]	Double Meat & Double Cheese	265
CHEESEBURGER	175	SM 99 MED 110 LG 129 X-LG 149
HAMBURGER	150	COKE Classic or Diet
FRENCH FRIES	105	SEVEN-UP
SHAKES	155	ROOT BEER
	Chocolate Strawberry Vanilla	DR PEPPER
		LEMONADE
		ICED TEA
		MILK 70
		COFFEE 70

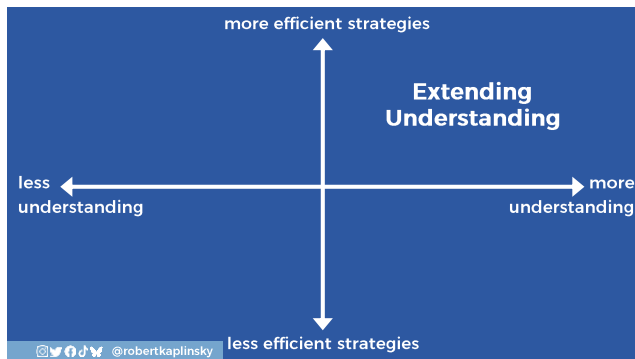
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174



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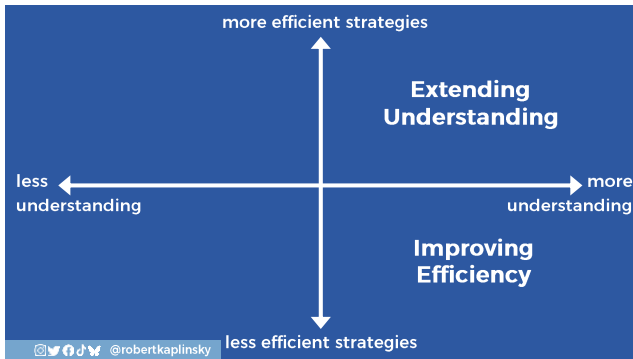
Correct	Concerns
<ul style="list-style-type: none"> • Guess and check <i>without</i> conceptual understanding → • Guess and check <i>with</i> conceptual understanding • Division • Giant times table → • Prime factorization • Strategic brute force with calculator → • Brute force with coding 	<ul style="list-style-type: none"> • Math issues <ul style="list-style-type: none"> • Students struggle with two-digit multiplication • Students lack place value conceptual understanding • Students don't understand what a true equation is • Open Middle issues <ul style="list-style-type: none"> • Students use a digit more than once. • Students use more than three digits in the product

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A PROMPT YOU MIGHT USE

“These are great strategies. What other ways might we solve this so we can add more tools for future problems?”

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181

Correct

- Guess and check *without* conceptual understanding
- Guess and check *with* conceptual understanding
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Footer: @robertkaplinsky

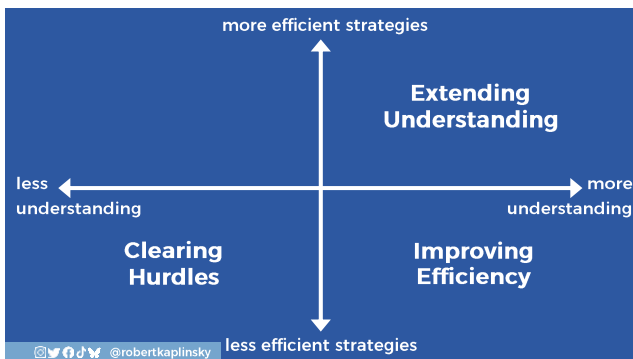
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A PROMPT YOU MIGHT USE

“Our strategy worked, but is there a more efficient way to think about this problem?”

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Correct

- Guess and check without conceptual understanding
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Concerns

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 - Students struggle with two-digit multiplication
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MY FAVORITE NO

- Pick a math error
- Share it with the class
- Ask “What in this problem am I happy to see?”
- Ask “Where’s the mistake?”

Source: Leah Alcalá

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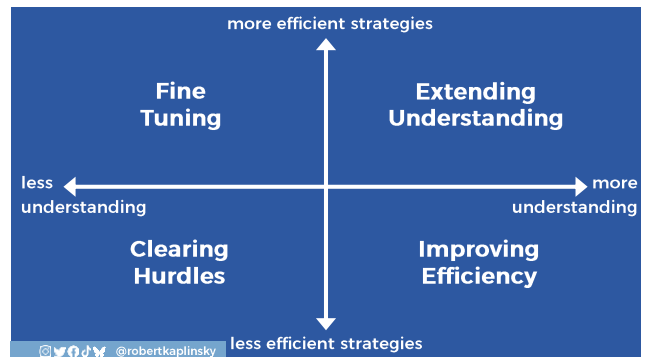
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A PROMPT YOU MIGHT USE

“Just like in a video game, everyone makes mistakes at first. What matters is learning from them so we do not repeat them and can go farther next time. Which mistake feels most useful to learn from?”

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A PROMPT YOU MIGHT USE


"What about this problem makes this strategy work?"

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DISCUSSION TIME

- How can students get correct answers yet still have less understanding?
- How does viewing students' work through the quadrant structure make it easier to handle most outcomes?

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TOPICS

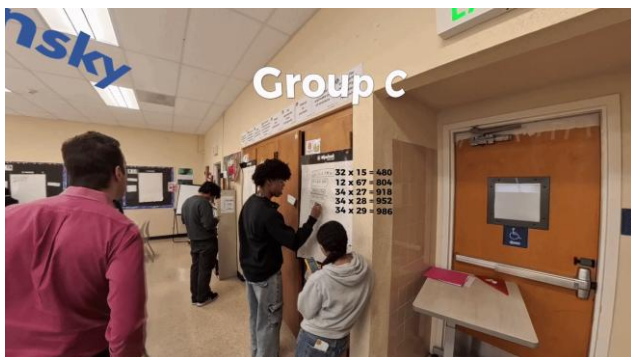
- HOW SHOULD WE MEASURE A LESSON'S SUCCESS?
- WHAT'S AN EXAMPLE WE CAN EXPLORE?
- WHAT ARE OUR FACILITATING OPTIONS?
- WHAT DOES THIS LOOK LIKE IN ACTION?
- CONCLUSION

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DISCUSSION TIME


- What's something you already believed that was reinforced after watching the videos?
- What's something that was different than you expected after watching the videos?

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Using the digits 1 to 9 at most one time each, place a digit in each box to make the greatest possible sum.

$$\boxed{9} \boxed{8} + \boxed{8} \boxed{6} =$$


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203

Using the digits 1 to 9 at most one time each, place a digit in each box to make the least possible difference.

$$\boxed{}\boxed{} - \boxed{}\boxed{}$$

Source: openmiddle.com


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What advice would you give yourself if you were trying this problem again for the first time?

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CHECKPOINTS

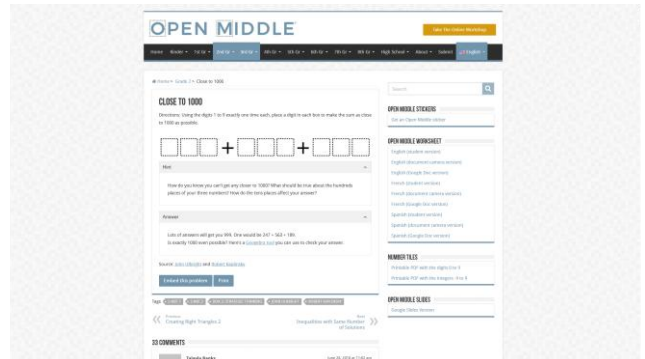
- ✓ HOW DO WE GET STUDENTS THINKING?
- ✓ HOW DO WE DO IT WITH REAL WORLD PROBLEMS?
- ✓ HOW DO WE DO IT WITH OPEN MIDDLE PROBLEMS?

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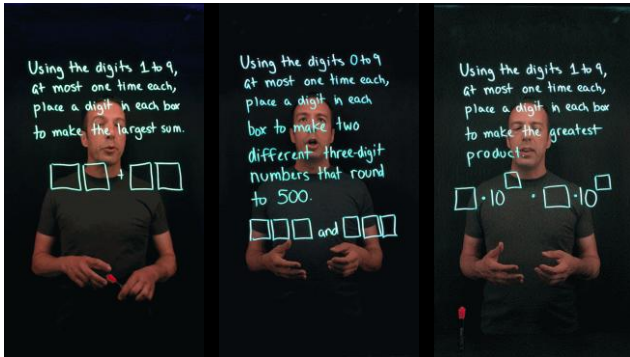
How long would you like access?	Standard	Extended
4-6 weeks	\$49.00	\$59.00
12-18 months	\$99.00	\$109.00

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link.robertkaplinsky.com/openmiddle

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**HOW TO IMPLEMENT ENGAGING
PROBLEM SOLVING IN YOUR
MATH CLASSROOM**

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[@robertkaplinsky](https://www.instagram.com/robertkaplinsky)



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