

Sense-Making: Is it at the Core of Your Classrooms?

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There are 125 sheep and
5 dogs in a flock.
How old is the shepherd?

Robert Kaplinsky (@robertkaplinsky) recently gave this to 32 eighth grade students. What percentage do you think realized it was impossible to answer?

(<http://robertkaplinsky.com/how-old-is-the-shepherd/>
<https://www.youtube.com/watch?v=kibaFBgaPx4>)



How Old is the Shepherd?

75% gave numerical answers.

100% of his sixth graders gave numerical answers.

In the original research paper*, "...three out of four school children will produce a numerical answer to this problem."

* Reusser, 1986.

Sample Grade 3 Test Question

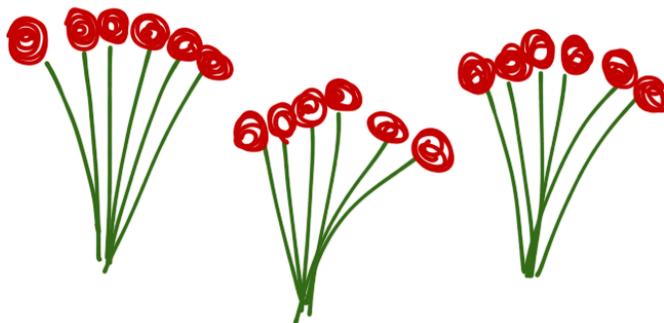
The corner deli sells roses in bunches of 6. If Dylan buys 3 bunches of roses, how many roses does he have?

- A. 6 18%
- B. 9 46%
- C. 18 31%
- D. 24 4%

Combined scores of the 160 third graders in a group of four low-performing schools I used to support.

Sample Test Question Revised

The corner deli sells roses in bunches of 6. Dylan bought 3 bunches. Draw a picture of the story.



Sample Grade 3 Test Question

Hot dog buns come in packages of 8. Michael buys 6 packages of hot dog buns. How many hot dog buns does Michael have in all?

- A. 14 43%
- B. 36 8%
- C. 48 40%
- D. 56 5%

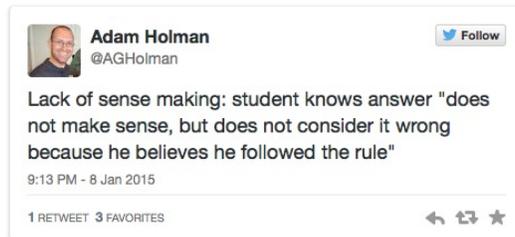
“Cracking the Math Code”

ADDITION	SUBTRACTION	MULTIPLICATION	DIVISION
Add	are not	By (dimension)	as much
Altogether	change	Double	cut up
And	decreased by	Each group	divided by
Both	difference	Multiplied by	each group has
How many	fewer	Of	half (or other
How much	have left	Product of	fractions)
In all	how many did not	Times	how many in each
Increased by	have	Triple	parts
Plus	how many more		quotient of
Sum	less than		Separated
Together	remain		Share something
Total	subtract		equally
	take away		split
	Taller/shorter		

(document from the web site of a large eastern metropolitan school district)



“The Steps Trump Thinking”



[Michelle's son] was struggling to “remember” $28/4$. When [she] asked him, “How do you think about $28/4$?” He replied, “Mom, you aren’t supposed to think about it, you are just supposed to do it!!”



Teacher Knows Best

$$\frac{3}{4} + \frac{5}{8} = \frac{8}{12}$$

Student Perceptions of Math and Sense Making

1. You aren't supposed to sense-make when doing math.
2. You are supposed to use rules and algorithms and accept whatever answer results.
3. You are supposed to do what your teacher said, even when it doesn't seem like a good idea.

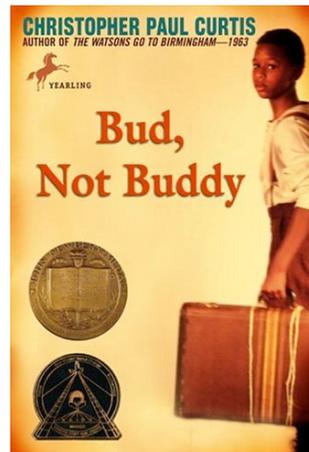
The Five Strands of Mathematical Proficiency

National Research Council, 2001, *Adding it up: Helping children learn mathematics*.

1. Conceptual understanding
2. Procedural fluency
3. Strategic competence
4. Adaptive reasoning
5. Productive disposition

“Productive disposition is the inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one’s own efficacy.”

Jekyll and Hyde?



Teaching Reading Like We Teach Math?

Characteristics of Strong ~~Readers~~ Mathematicians

- They are motivated to ~~read~~ tackle problems
- They are able to ~~read words~~ accurately and automatically. ~~recite facts~~
- They comprehend what they read.
- They are able to read with expression.
- They use a variety of strategies to tackle ~~words~~ problems they don't recognize.
- They use active problem solving strategies to search for information, to determine meaning, to make sense of words, to make connections.

Strategies – Unknown Words

- Sound it out
- Context clues
- Apply known patterns to a new situations

Strategies – Comprehension

- Predicting
- Estimating
- Hypothesizing
- Make a movie in your mind
- Storyboarding (beginning, middle, end)
- Story elements (character, setting, problem, solution)

Grade 3 English SOLs

The student will read and demonstrate comprehension of nonfiction texts.

- a) Use text structures, such as type, headings, and graphics, to predict and categorize information in both print and digital texts.
- b) Formulate questions that might be answered in the selection.
- c) Explain the author's purpose.
- d) Identify the main idea.
- e) Summarize supporting details.
- f) Draw conclusions and make simple inferences using textual information as support.
- g) Distinguish between cause and effect.
- h) Distinguish between fact and opinion.
- i) Use prior knowledge and build additional background knowledge as context for new learning.
- j) Identify new information gained from reading.
- k) Use reading strategies throughout the reading process to monitor comprehension.
- l) Read with fluency and accuracy.

The Teacher's Role in ELA and Math

Encouraging Sense Making

Q: What's one way to cultivate a classroom focused on *sense making* rather than *answer-getting*?

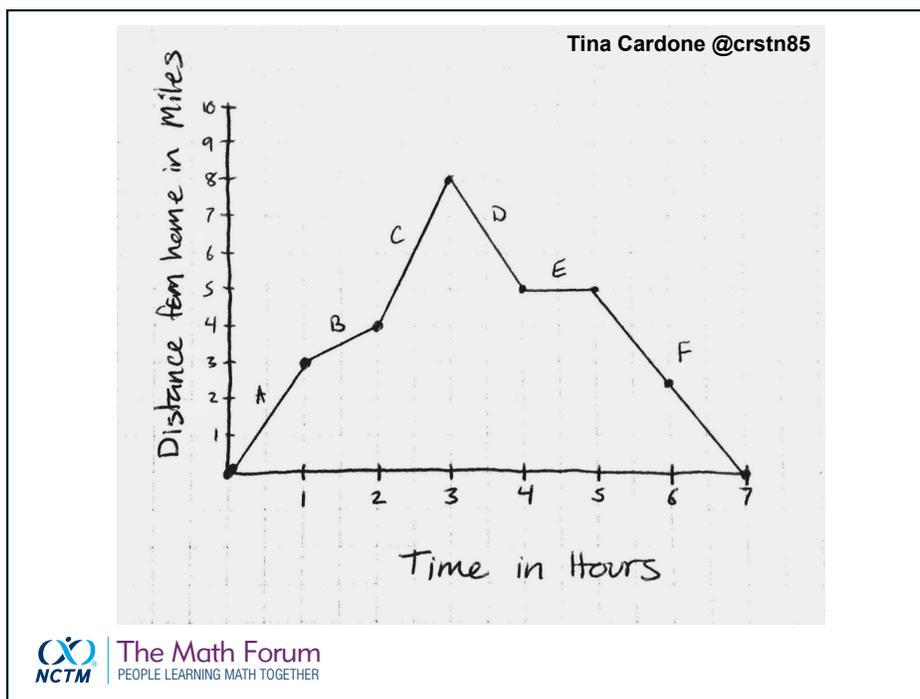
A: Get rid of the question. Literally.

Apple juice costs 50¢. The juice machine accepts quarters, dimes, and nickels.

Mr. Gavin has a ladder that is 100 centimeters tall.

Ms. Cornell has a ladder that is 2 meters tall.

To make a stained glass window, Robert used 16 pieces of glass. Seven of the pieces were red.



Encouraging Sense Making

Q: What's another way to cultivate a classroom focused on *sense making* rather than *answer-getting*?

A: Give them the answer.

Give the Answer

◆ Math Message Follow-Up

WHOLE-CLASS ACTIVITY

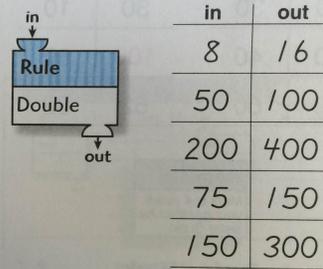
Draw or display a function machine and “What’s My Rule?” table. (See Advance Preparation.)

Ask children to imagine that the **function machine** works like this:

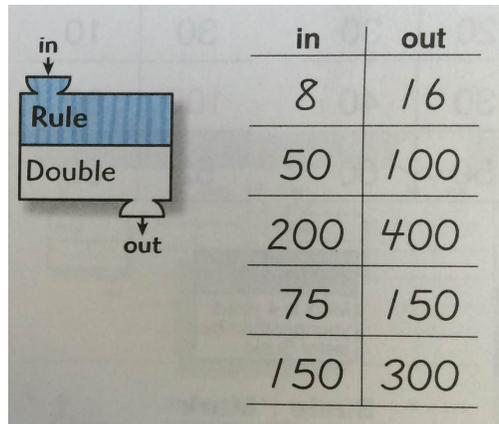
- A number (the **input**) is dropped into the machine,
- the machine changes the number according to a rule,
- and a new number (the **output**) comes out the other end.

The **rule** for the Math Message problem is “Double the number.” Write the word *Double* in the function machine.

Point out the “**What’s My Rule?**” table. Discuss the 8 in the *in* column and the 16 in the *out* column. Explain to children that numbers in the *in* column represent the numbers of bacteria now. Corresponding numbers in the *out* column represent the numbers of bacteria 20 minutes from now.



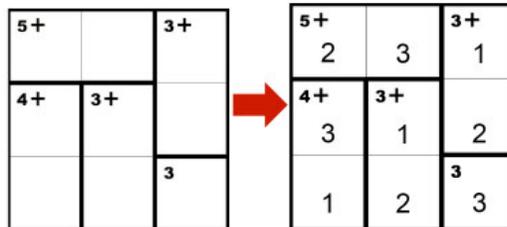
Give the Answer



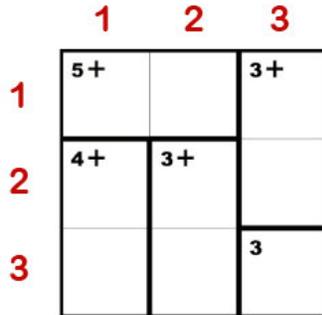
Anyone Play KenKen?

How to Play KenKen®

Your goal is to fill in the whole grid with numbers, making sure no number is repeated in any row or column.



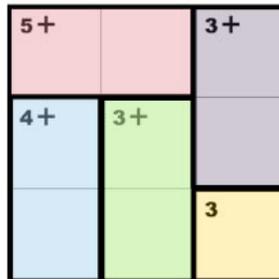
In a 3x3 puzzle, use the numbers 1 – 3.



In a 4x4 puzzle, use the numbers 1 – 4.
 In a 5x5, use the numbers 1 – 5, and so on.



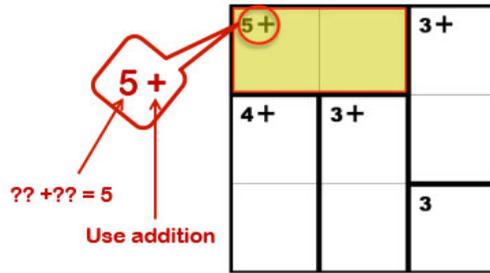
The heavily-outlined areas are called
 “cages.”



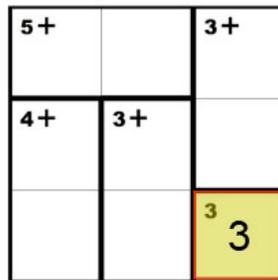
This puzzle has 5 cages.



In this cage, the math operation to use is **addition**, and the numbers must add up to **5**.
 Since this cage has 2 squares, the only possibilities are 2 and 3, in either order (2+3 or 3+2 = 5).



A cage with one square is a "Freebie"...
 just fill in the number you're given.



A number cannot be repeated within the same row or column.

5+		3+
4+	3+	
X	3	3

5+		3+
2	3	1
4+	3+	
3	1	2
		3
1	2	3

Encouraging Sense Making

Q: What's another way to cultivate a classroom focused on *sense making* rather than *answer-getting*?

A: Ask about ideas, not answers.

This can be really simple:

“Tell me something about number 7.”

instead of

“What's the answer to number 7?”

Teacher Questions

“Why?”

“How do you know?”

“How did you decide?”

“Tell me more about that.”

What sorts of questions do you ask in math?

Record yourself and find out!

Walk-Through Questions

“Tell me about what you’re working on.”

“Why are you doing it?”

“How do you know what to do?”

“How will you know when you’re done?”

**Are students doing sense-making or answer-getting?
Try to find out!**



Learning Progressions

Students can’t answer questions they didn’t ask.
How do we encourage them to be curious?

Teachers can’t implement things they can’t envision.
How do we encourage them to experiment?

Coaches and administrators can’t recognize things that might
seem foreign.

What conversations can you as a grade/school/district have?

What are the steps to getting where we want to go?



Learning Progressions

Max Ray-Riek's NCSM 2015 Ignite Talk

What We Talk About
When We Talk About Teaching



<https://www.youtube.com/watch?v=CxWpfVD182A>



Mingle Questions

- Why focus on sense making?
- What are some strategies you will use and/or encourage?
- How might you implement this with the goal to get all students thinking and sharing?
- How might you value students' ideas and build up their math confidence?
- How could it make core instruction more effective?
- What concerns do you have about implementing this?



Mingle Questions

- Stand up and move around.
- Find someone and introduce yourself.
- Ask them one question from the list.
- Listen to their answer.
- Move on to find another person.
- No back and forth, just ask one question and listen to the answer.
- When I raise my hand, finish your conversation and raise your hand.

Mingle Reflections

Three Things We Should Care About More

1. Math
2. The Whys
3. Students' Thinking and Ideas

Notes to Self