Practical Strategies for Building Language-Rich Classrooms

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General Introductory Thoughts!

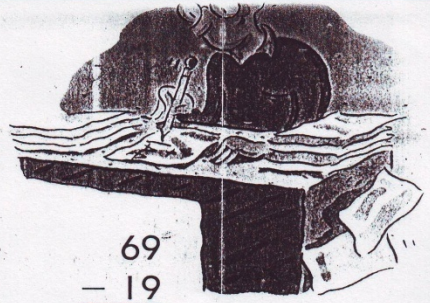
- Cell phones, I-phones, I-pads, etc.
- Hard – and don't let anyone tell you otherwise
- Rigor and differentiate
- PD vs. Collaborative structures and coaching
- Radical idea: You work for the kids!
- Ready??

So…the problem is:

If we continue to do what we've always done….

We'll continue to get what we've always gotten.

Practice Plus



Key Skill: Subtraction, page 225

Subtract.

1.	32 − 17	48 − 23	86 − 67	54 − 31	69 − 19	
2.	77 − 46	51 − 27	98 − 25	66 − 33	40 − 16	83 − 55
3.	53 − 26	31 − 8	74 − 26	95 − 48	57 − 19	21 − 10

Key Skill: Subtracting Money, page 23

Subtract.

1.	27¢ − 18¢	31¢ − 26¢	44¢ − 27¢	63¢ − 29¢	97¢ − 59¢	80¢ − 41¢
2.	49¢ − 22¢	74¢ − 59¢	89¢ − 39¢	56¢ − 37¢	65¢ − 48¢	92¢ − 15¢
3.	38¢ − 29¢	52¢ − 13¢	84¢ − 68¢	67¢ − 43¢	75¢ − 27¢	99¢ − 11¢

Just for fun:

$$\begin{array}{r} 95 \\ \underline{-\ 48} \end{array}$$

One seven-year-old student's viewpoint of life at 100

If I were 100 years old

If I were 100 years old,
I would go to a nursing
home. I would Stay
there until I was dead.
By the time I was 100,
I would Know Regrouping
With Sabtraction and
then I would die happy.

7. Add and subtract within 1000, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method. Understand that in adding or subtracting three-digit numbers, one adds or subtracts hundreds and hundreds, tens and tens, ones and ones; and sometimes it is necessary to compose or decompose tens or hundreds.

Ready, set…..

10.00

- 4.59

Find the difference:

Who did it the right way??

$$\begin{array}{r} {}^{9}\cancel{10}.{}^{91}\cancel{0}{}^{1}0 \\ -\ 4.\quad 5\ \ 9 \\ \hline \end{array}$$

How did you get 5.41 if you didn't do it this way?

Alg II L3 Exam Do not write on this exam. 25

I Perform the indicated operation and simplify.

1. $\frac{9x^7}{36x^{10}y^3}$

a) $\frac{3}{12x^3y^3}$ b) $\frac{x^7}{4x^{10}y^3}$ c) $4x^3y^3$ d) $\frac{1}{4}x^3y^3$ e) $\frac{1}{4x^3y^3}$

2. $\frac{x^2-x-12}{x^2+10x+21}$

a) $\frac{x-4}{x+7}$ b) $\frac{x+4}{x+7}$ c) $\frac{1-x-4}{1+10+x}$ d) $\frac{4}{7}$ e) $\frac{(x+12)(x-1)}{(x+3)(x+7)}$

3. $\frac{3x^4}{4a^2y^2} \cdot \frac{8a^6y^3}{6x^6}$

a) $\frac{a^2y^3x^{-2}}{y^2}$ b) $\frac{2a^4y}{2x^2}$ c) $\frac{a^4y}{x^2}$ d) $24a^8y^5$ e) $\frac{9x^{10}}{16a^8y^5}$

4. $\frac{x^2-3x-10}{x^2-4} \cdot \frac{x-2}{x-5}$

a) 0 b) $\frac{x+2}{x-2}$ c) 1 d) $\frac{x-5}{x-2}$ e) $\frac{x^3-3x^2+20}{x^3+20}$

5. $\frac{36x^2y^2}{15b^3z} \div \frac{\quad y^4}{5b^3z^3}$

a) $\frac{2z^2}{3b^2xy^2}$ b) $\frac{3b^2z^2}{6xy^2}$ c) $\frac{2b^3z^2}{xy^2}$ d) $\frac{2z^2}{b^2xy^2}$ e) $\frac{2}{x^2b^2}$

6. $\frac{x^2+4x+3}{x^2-y^2} \div \frac{x+3}{x-y}$

a) 0 b) $\frac{x+1}{x+y}$ c) $\frac{x+1}{x-y}$ d) $\frac{x-1}{x+y}$ e) $\frac{1}{y}$

7. $\frac{8x^2-3x+2}{x^3} + \frac{x^2+5x-4}{x^3}$

a) $\frac{9x^2+2x+2}{x^3}$ b) $\frac{8x^4+2x-2}{x^6}$ c) $\frac{9x^2+2x-2}{2x^3}$

d) $\frac{9x^2+2x-2}{x^3}$ e) $\frac{8x^2-8x-6}{x^3}$

8. $\frac{4y+3}{y-2} - \frac{y-2}{y-2}$

a) $\frac{3y+1}{y-2}$ b) $\frac{3y+5}{y-2}$ c) 0 d) $\frac{5y+5}{y-2}$ e) $\frac{5y+1}{y-2}$

9. $\frac{5x}{3} + \frac{4y}{5}$

a) 0 b) $25x+12y$ c) $\frac{37xy}{15}$ d) $\frac{5x+4y}{8}$ e) $\frac{25x+12y}{15}$

10. $\frac{4}{x} - \frac{5}{y}$ a) -1 b) $\frac{4x-5y}{xy}$ c) $\frac{5x+4y}{xy}$ d) $-\frac{1}{xy}$ e) $\frac{4y-5x}{xy}$

11. $\frac{18x^5+24x^4-36x^3}{6x^2}$ a) $3x^3+4x^2-6x$ b) $12x^3+18x^2-30x$ c) $3x^3+4x^2+6x$ d) $12x^2+18x-30$ e) $54x^7+144x^6-216x^5$

12. $x-5 \overline{)x^2-15x+50}$ a) $x-10$ b) $x+10$ c) $x+10\ \frac{5}{x-5}$ d) $x-10\ \frac{-5}{x-5}$ e) $x-45$

II Solve for x

13. $\frac{x}{3}+\frac{x}{4}=21$ a) 36 b) 3 c) 126 d) $\frac{3}{9}$ e) $82\frac{2}{3}$

14. $\frac{3}{x+1}=\frac{5}{x-3}$ a) [illegible] b) 1 c) -4 d) $\pm 3\sqrt{2}$ e) [illegible]

15. $\frac{3}{4x}+\frac{1}{10}=\frac{3}{5x}$ a) $-\frac{3}{2}$ b) $\frac{3}{2}$ c) $-\frac{2}{3}$ d) $\frac{2}{3}$ e) 0

III Simplify each of the following

16. 8^0 a) 1 b) 0 c) 2 d) 8 e) not possible

17. $2x^0$ a) 0 b) 2 c) 1 d) $2x$ e) 20

IV Write without negative exponents and simplify

18. $\frac{3xy^{-3}}{2a^{-2}b^3}$ a) $\frac{3xy^3}{2b^3a^2}$ b) $\frac{3a^2x}{2b^3y^3}$ c) $\frac{6a^2x}{3b^3y}$ d) $\frac{\frac{3x}{y^3}}{\frac{2b^3}{a^2}}$ e) none of these

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Algebra:

The intense study of the last three letters of the alphabet

So what have we gotten?

- Mountains of math anxiety
- Tons of mathematical illiteracy
- Mediocre test scores
- HS programs that barely work for more than half of the kids
- Gobs of remediation and intervention
- A slew of criticism

Not a pretty picture!

Versus:

- **Functions**
- **Models**
- **Statistics**
- **Sense-making**
- **Persevere solving problems**
- **Construct viable arguments and critique the reasoning of others**

If however…..

What we've always done is no longer acceptable, then…

We have no choice but to change some of what we do and some of how we do it.

So let’s turn to language

Language

I'm reminded of how important a command of language is to learning and how important an ongoing bombardment of language is to literacy every time I wander through my local Whole Foods. For almost 30 years, I have been the food shopper in whatever family I've been a part of. I love food shopping and I love observing other shoppers and the contents of their carts. Now that I've become the cook, as well as the shopper, and now that my local Whole Foods just happens to be in the rapidly gentrifying Logan Circle neighborhood of Washington, D.C., the food shopping experience is even more interesting. Do I want the fresh cilantro or just the organic parsley? Should I blacken the fresh Atlantic salmon with white pepper and cayenne or save time and money by just buying the store's blackened salmon filets?

But the real fun is listening in on the mother-child conversations as I wander up and down the aisles. Overwhelmingly we're talking about upper-middle-class, D.C. professionals in their late thirties and early forties with their later-in-life infants. "I think we're going to get the organic pasta today. Here's the rigatoni. No, maybe the penne is a better idea." They're not chatting on their cell phone. They're not talking to themselves. They're just babbling to this little toddler head in a Snugli. I've actually heard moms discussing aloud the choice between the Bigalow tea "that Daddy likes and that comes in rectangular boxes" and the Republic of Tea "that Mommy likes and that comes in these cool cylinders." I've listened in as "bulbs of fennel," "spears of asparagus," and "sprigs of broccoli" are comically announced and deposited into the cart. It's obvious how lucky these kids are. They are immersed, from a very early age, in a language-rich world of context-based vocabulary. They are being given a head start on learning and, based on the emerging brain research, strengthening neural connections that directly affect the capacity to learn.

Reactions?

Implications?

So how do we address these implications?

Some data. What do you see?

	40	4
	10	2
	30	4

Predict some additional data

	40	**4**
	10	**2**
	30	**4**

How close were you?

	40	4
	10	2
	30	4
	20	3

All the numbers – so?

	45	4
	25	3
	15	2
	40	4
	10	2
	30	4
	20	3

A lot more information (where are you?)

Roller Coaster	45	4
Ferris Wheel	25	3
Bumper Cars	15	2
Rocket Ride	40	4
Merry-go-Round	10	2
Water Slide	30	4
Fun House	20	3

Fill in the blanks

Ride	???	???
Roller Coaster	45	4
Ferris Wheel	25	3
Bumper Cars	15	2
Rocket Ride	40	4
Merry-go-Round	10	2
Water Slide	30	4
Fun House	20	3

At this point,

it's almost anticlimactic!

The amusement park

Ride	Time	Tickets
Roller Coaster	45	4
Ferris Wheel	25	3
Bumper Cars	15	2
Rocket Ride	40	4
Merry-go-Round	10	2
Water Slide	30	4
Fun House	20	3

The Amusement Park

The 4th and 2nd graders in your school are going on a trip to the Amusement Park. Each 4th grader is going to be a buddy to a 2nd grader.

Your buddy for the trip has never been to an amusement park before. Your buddy want to go on as many different rides as possible. However, there may not be enough time to go on every ride and you may not have enough tickets to go on every ride.

The bus will drop you off at 10:00 a.m. and pick you up at 1:00 p.m. Each student will get 20 tickets for rides.

Use the information in the chart to write a letter to your buddy and create a plan for a fun day at the amusement park for you and your buddy.

Why do you think I started with this task?

- Standards don't teach, teachers teach
- It's the translation of the words into tasks and instruction and assessments that really matter
- Processes are as important as content
- We need to give kids (and ourselves) a reason to care
- Difficult, unlikely, to do alone!!!

So let me set the table with context-setting perspectives:

Let's be clear:

We're being asked to do what has never been done before:

Make math work for nearly ALL kids and get nearly ALL kids ready for college.

There is no existence proof, no road map, and it's not widely believed to be possible.

Let's be even clearer:

Ergo, because there is no other way to serve a much broader proportion of students:

We're therefore being asked to teach in distinctly different ways.

Again, there is no existence proof, we don't agree on what "different" mean, nor how we bring it to scale.

Promises

These Standards are not intended to be new names for old ways of doing business. They are a call to take the next step. It is time for states to work together to build on lessons learned from two decades of standards based reforms. It is time to recognize that standards are not just promises to our children, but promises we intend to keep.

— CCSS (2010, p.5)

CCSSM Mathematical Practices

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.

Cannot be done without language and communication and all support language and communication!

CCSSM Mathematical Practices

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.

Join me in Teachers' Chat Room

- They forget
- They don't see it my way
- They approach it differently
- They don't follow directions
- They give ridiculous answers
- They don't remember the vocabulary

THEY THEY THEY BLAME BLAME BLAME

An achievement gap or an INSTRUCTION gap?

Well…..if…..

- They forget – so we need to more deliberately review;
- They see it differently – so we need to accommodate multiple representations;
- They approach it differently – so we need to elicit, value and celebrate alternative approaches;
- They give ridiculous answers – so we need to focus on number sense and estimation;
- They don't understand the vocabulary – so we need to build language rich classrooms;
- They ask why do we need to know this – so we need to embed the math in contexts.

So let’s get practical again:

Consider how we teach reading:
JANE WENT TO THE STORE.

- Who went to the store?
- Where did Jane go?
- Why do you think Jane went to the store?
- Do you think it made sense for Jane to go to the store?

Now consider mathematics:

TAKE OUT YOUR HOMEWORK.

#1 19

#2 37.5

#3 185

(No why? No how do you know? No who has a different answer?)

Strategy #1

Adapt from what we know about reading

(incorporate literal, inferential, and evaluative comprehension to develop stronger neural connections)

Number from 1 to 6

1. What is 6 x 7?
2. What number is 1000 less than 18,294?
3. About how much is 32¢ and 29¢?
4. What is 1/10 of 450?
5. Draw a picture of 1 2/3
6. About how much do I weight in kg?

Strategy #2

Incorporate on-going cumulative review into instruction every day and use questions to focus on language and communication.

Implementing Strategy #2

Almost no one masters something new after one or two lessons and one or two homework assignments. That is why one of the most effective strategies for fostering mastery and retention of critical skills is daily, cumulative review at the beginning of every lesson.

On the way to school:

- A fact of the day
- A term of the day
- A picture of the day
- An estimate of the day
- A skill of the day
- A measurement of the day
- A word problem of the day

Or in 2nd grade:

- How much bigger is 9 than 5?
- What number is the same as 5 tens and 7 ones?
- What number is 10 less than 83?
- Draw a four-sided figure and all of its diagonals.
- About how long is this pen in centimeters?

Good morning Boys and Girls Number from 1 to 5

1. What is the value of tan (π/4)?
2. Sketch the graph of $(x-3)^2 + (y+2)^2 = 16$
3. What are the equations of the asymptotes of $f(x) = (x-3)/(x-2)$?
4. If $\log_2 x = -4$, what is the value of x?
5. About how much do I weight in kg?

Let’s roll the videotape
Grade 3

3rd Grade

Today we're going to explore the mathematical ideas of multiplying, area, factors and products.

Warm-up

Ready?

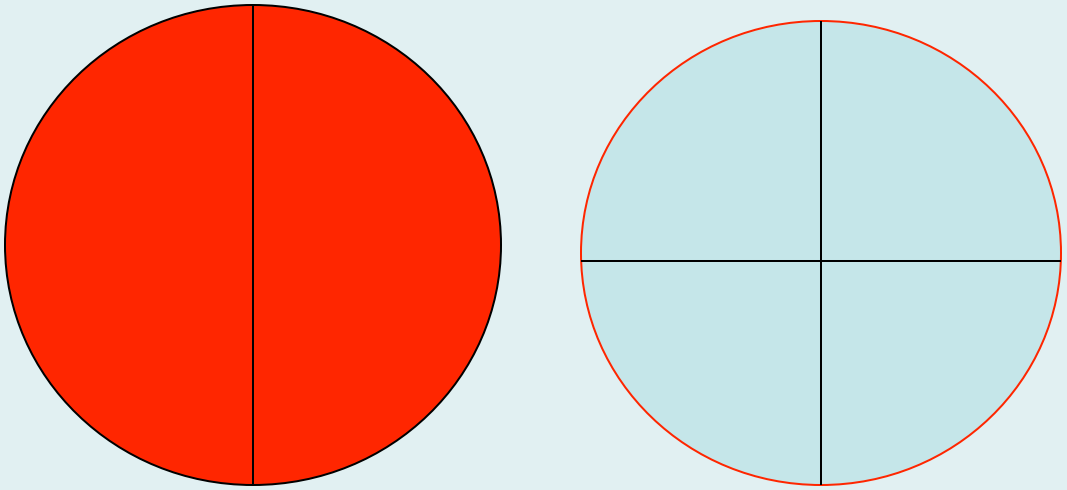
What is 3 + 7?

What is 5 + 9?

OK?

Convince me that 9 + 8 is 17

Tell me what you see.



Tell me what you see.

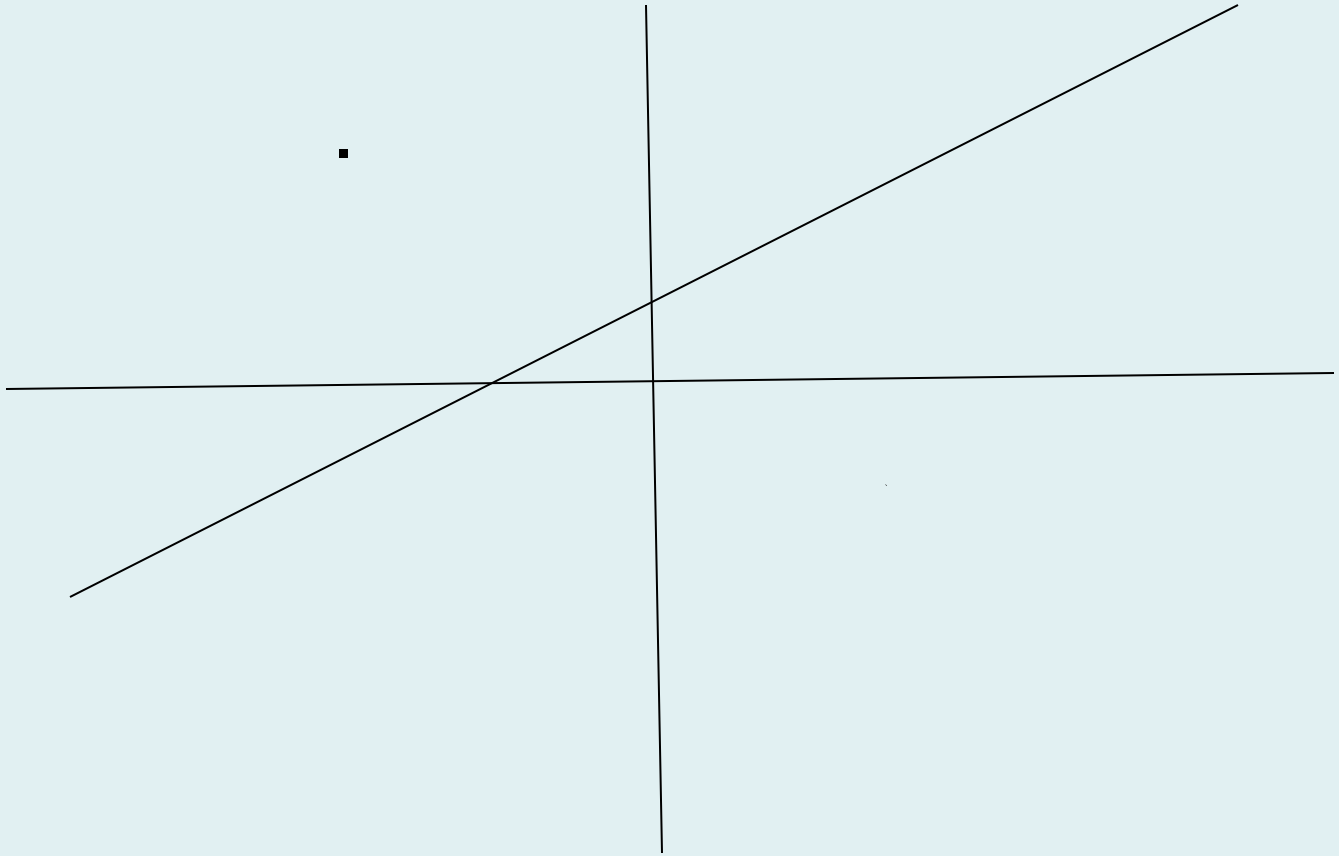
73

63

Tell me what you see.

2 1/4

Tell me what you see.



Tell me what you see.

$$f(x) = x^2 + 3x - 5$$

Strategy #3

Create a language rich classroom.

(Vocabulary, terms, answers, explanations)

Implementing Strategy #3

Like all languages, mathematics must be encountered orally and in writing. Like all vocabulary, mathematical terms must be used again and again in context and linked to more familiar words until they become internalized.

Area = covering

Perimeter = border

Cos = bucket

Circumference = a belt

Quotient = sharing

Mg = grain of sand

Cubic = S

Surface area = skin

Tan = sin/cos = y/x for all points on the unit circle

Area = covering **Quotient = sharing**

Perimeter = border **Mg = grain of sand**

Cos = bucket **Cubic = S**

Circumference = a belt **Surface area = skin**

Tan = sin/cos = y/x for all points on the unit circle

Let’s roll the videotape
Grade 6

Today we're going to explore some everyday mathematical situations.

Ready?

Some data:

You have $10.

Big Macs cost $1.59

Questions? So?

You choose:

3 + 4 = 10 - 3 = 2 x 4 = etc.

Vs.

SALE

Pencils 3¢

Pens 4¢

Limit of 2 of each!

My Store

SALE

Pencils 3¢

Pens 4¢

Erasers 5¢

Limit of 3 of each!

SO?

Your turn

Pencils 7¢

Pens 8 ¢

Erasers 9 ¢

Limit of 10 of each.

I just spent 83 ¢ (no tax) in this store.
What did I purchase?

Pencil	**7¢**	**0**		**1**	**3**	**3**	**2**	**1**	**0**	**8**	
Pen	**8¢**	**0**				**1**	**3**	**5**	**7**	**0**	
Eraser	**9¢**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**3**	
		83¢									

3. Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.

a. Make tables of equivalent ratios relating quantities with whole number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios.

b. Solve unit rate problems including those involving unit pricing and constant speed. *For example, if it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed?*

c. Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent.

d. Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.

Let's see what you know

Our trip to Florida.

Hours	1	2	3	5	____	X
Miles	60	____	_____	____	540	_____

What do you see?

What do you notice when you look:

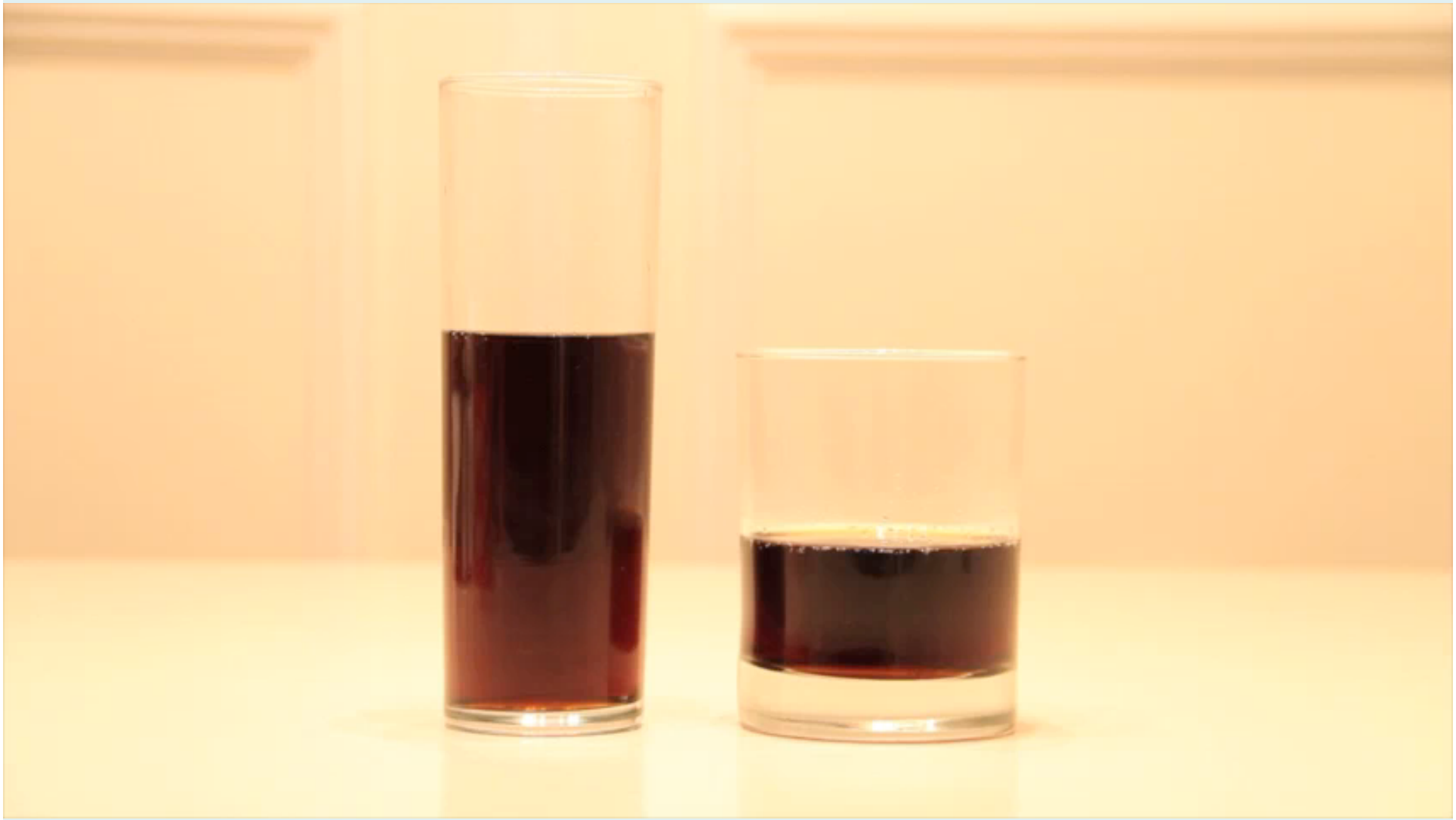
Left to right between columns?

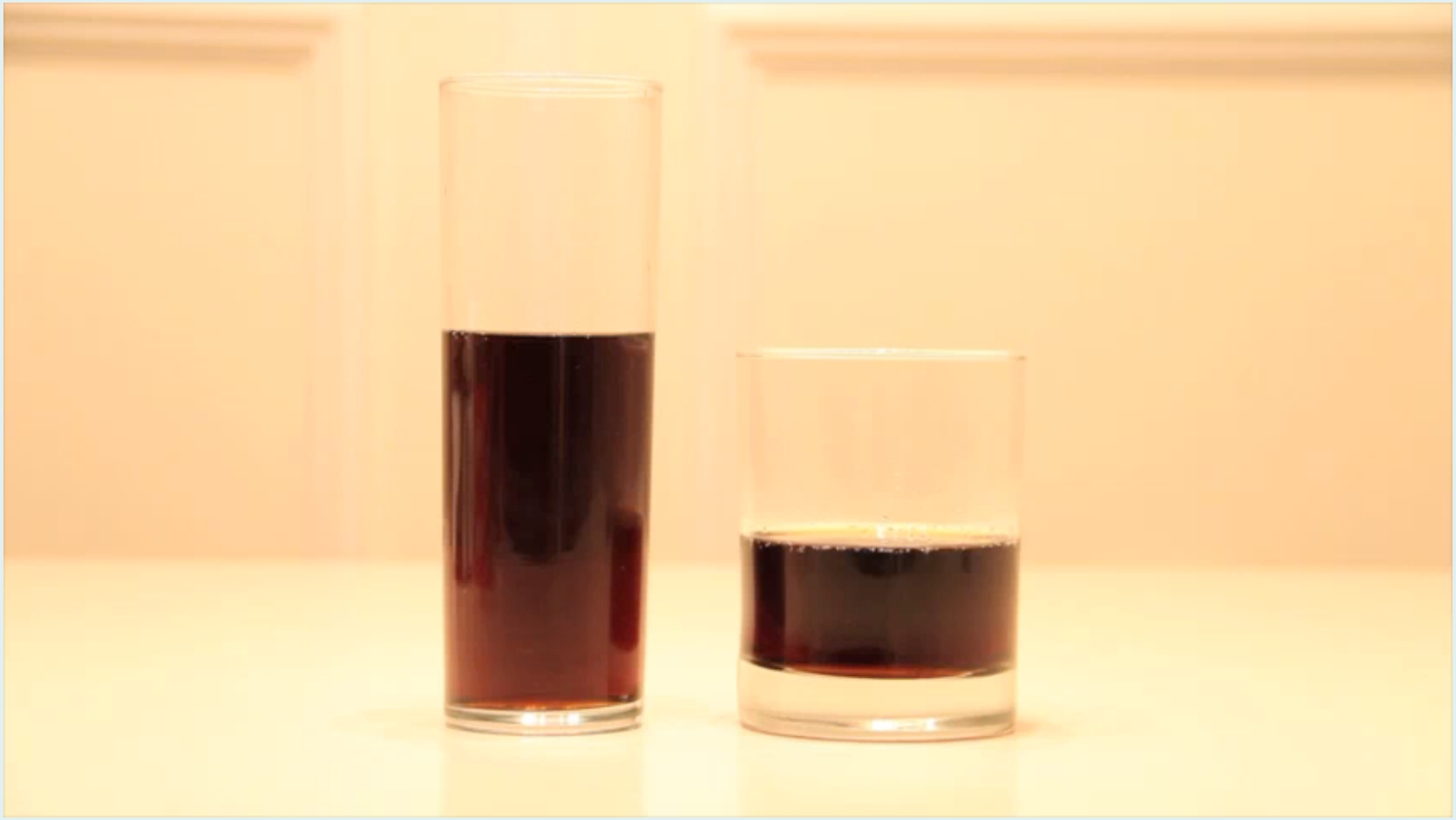
Top to bottom within columns?

Suppose you went 630 miles?

What is your guess? Share your guess with your neighbor and justify your guess.

What information is important here?
How would you get it?





Let’s roll the videotape
Grade 8

Today we're going to explore data rich situations using the questions:

What do you need to know?

What do you want to know?

FACT: Peter Dowdeswell of London, England holds the world record for pancake consumption!

Any questions that a normal reader of this sentence might have?

Why??

FACT: Peter Dowdeswell of London, England holds the world record for pancake consumption!

62
6” in diameter,
3/8” thick pancakes,
with butter and syrup
in 6 minutes 58.5 seconds!

Any questions you might have about this feat?

- About how high a stack? Show and explain
- Exactly how high?
- How fast?
- How much?
- Could it be, considering the size of the stomach?
- What's radius of single 3/8" thick pancake of same volume?
- Draw a graph of Peter's progress.

Comments?

Questions?

Last and most powerfully:

Make “why?”
“how do you know?”
“convince me”
“explain that please”
your classroom mantras

To recapitulate:

1. Incorporate on-going cumulative review
2. Parallel literal to inferential to evaluative comprehension used in reading
3. Create a language-rich classroom
4. Draw pictures/create mental images
5. Embed the math in contexts/problems

And always ask them "why?"

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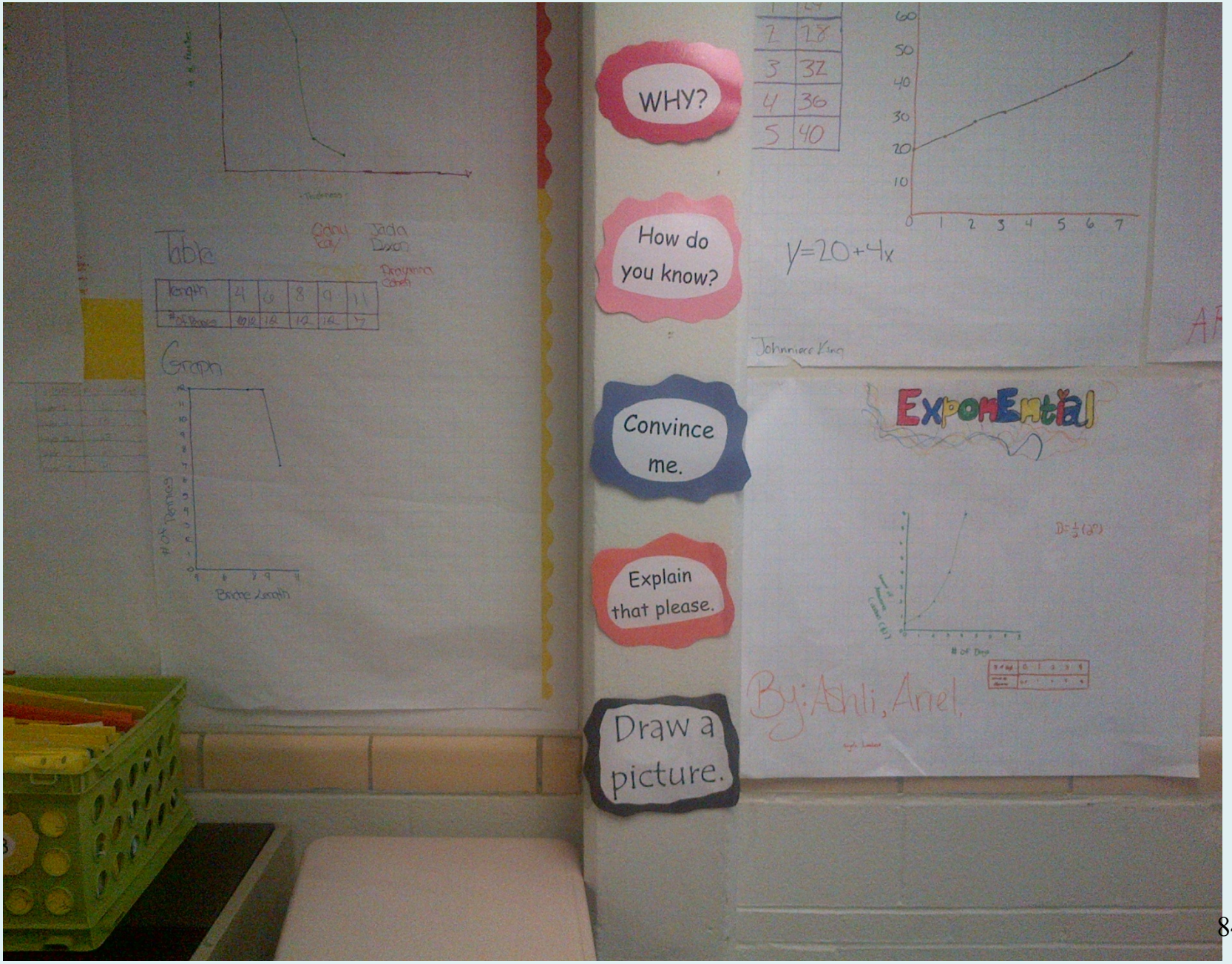
See also: "Accessible Math" by Heinemann


WHY?
How do you know?
Convince me.
Explain that please.
Draw a picture.
Table
Graph
Johnniece King
ExponEntial
By: Ashli, Ariel,

So what should we see in language-rich mathematics classrooms?

- An ongoing emphasis on the use and meaning of mathematical terms, including their definitions and their connections to real-world entities and/or pictures
- Student and teacher explanations that make frequent and precise use of mathematics terms, vocabulary, and notation
- An extensive use of word walls that capture the key terms and vocabulary with pictures when appropriate and in English as well as Spanish when appropriate

Processing Questions

- **What are the two most significant things you've heard in this presentation?**
- **What is the one most troubling or confusing thing you've heard in this presentation?**
- **What are the two next steps you would support and work on to make necessary changes?**

Next Steps

People won't do what they can't envision,

People can't do what they don't understand,

People can't do well what isn't practiced,

But practice without feedback results in little change, and

Work without collaboration is not sustaining.

Ergo: Our job, as professionals, at its core, is to help people envision, understand, practice, receive feedback and collaborate.

To collaborate, we need time and structures

- Structured and focused department meetings
- Before school breakfast sessions
- Common planning time – by grade and by department
- Pizza and beer/wine after school sessions
- Released time 1 p.m. to 4 p.m. sessions
- Hiring substitutes to release teachers for classroom visits
- Coach or principal teaching one or more classes to free up teacher to visit colleagues
- After school sessions with teacher who visited, teacher who was visited and the principal and/or coach to debrief
- Summer workshops
- Department seminars

To collaborate, we need strategies 1

Potential Strategies for developing professional learning communities:

- **Classroom visits – one teacher visits a colleague and the they debrief**
- **Demonstration classes by teachers or coaches with follow-up debriefing**
- **Co-teaching opportunities with one class or by joining two classes for a period**
- **Common readings assigned, with a discussion focus on:**
  - **To what degree are we already addressing the issue or issues raised in this article?**
  - **In what ways are we not addressing all or part of this issue?**
  - **What are the reasons that we are not addressing this issue?**
  - **What steps can we take to make improvements and narrow the gap between what we are currently doing and what we should be doing?**
- **Technology demonstrations (graphing calculators, SMART boards, document readers, etc.)**
- **Collaborative lesson development**

To collaborate, we need strategies 2

Potential Strategies for developing professional learning communities:

- **Video analysis of lessons**
- **Analysis of student work**
- **Development and review of common finals and unit assessments**
- **What's the data tell us sessions based on state and local assessments**
- **"What's not working" sessions**
- **Principal expectations for collaboration are clear and tangibly supported**
- **Policy analysis discussions, e.g. grading, placement, requirements, promotion, grouping practices, course options, etc.**

Next steps: Taking Risks

It all comes down to taking risks

While "nothing ventured, nothing gained" is an apt aphorism for so much of life, "nothing risked, nothing failed" is a much more apt descriptor of what we do in school.

Follow in the footsteps of the heroes about whom we so proudly teach, and TAKE SOME RISKS

Thank you!