Helping EVERY student to become a math THINKER

Marian Small

Oct 2017

What do you think matters?

- What is our overarching goal in the math curriculum?
- Is it to create people who THINK mathematically or people who can DO math?

You can do math

- A DO: How many pencils long is your desk?

You can think math

- A THINK: Which description of the table length makes more sense to you? Why?

You can think math

- Either 16 pencils or 50 erasers OR
- Either 50 pencils OR 16 erasers

You can do math or think math

- A DO: How much is 14 x 23?
- A THINK: How do you know that 14 x 23 is a fair bit more than 200?

You can do math or think math

- A DO: Solve $2x + 8 = 4x - 10$
- A THINK: How do you know that the solution to $2x + 8 = 4x + 10$ cannot be more than 1?

You can do math

- A DO: What is 40 – 8?

You can think math

- A THINK: WITHOUT getting an answer, why do you think that 40 – 8 HAS TO be more than 311 – 295?

You can do math

- What is 10% of 72?

You can think math..

- A THINK: Do you think that 10% is a lot or do you not?

So why don’t kids succeed in math?

- Is it possible that a focus on thinking, rather than doing, or at least a remix of the blend, changes who is successful?

There is a long tradition…

- When students struggle, we tend to show them what to do.
- We think having them think is too hard.

- So when do they learn to think?

There is a long tradition…

- We only assign the straightforward questions from a text or other resource for strugglers.

There is a long tradition…

- So how do they learn to deal with anything complex?

There is a long tradition…

- We show them only one way to do things, not alternatives, to not make it hard.

Here is what it could look like

- Suppose we decide struggling kids should only meet the standard algorithm for subtraction.

Consider this question

- 200 – 85.

It can look like:

- 200
- <u>– 85</u>

It can look like:

- 1 9 10
  - ~~200~~
- <u>– 85</u>

Or kids could think

- $200 = 199 + 1$
- $\underline{-85} \quad \underline{-85}$

Is it possible….

- the problem for some students is the narrow rut in which we are forcing students to operate?

So what might we do?

- Strategy 1:
- Use more open-ended questions where students can make more decisions about where to go.

For example…

- Which two numbers do you think are more alike:
  10 and 15 or
  15 and 20?

For example…

- The answer when you do a subtraction is 40.
- What might you have subtracted?

For example…

- _____ is 3 times as much as _____.

For example…

- You have $35. It is a BIG percent of the cost of a jacket you want to buy.
- How much might the jacket cost? About what percent is the $35?

For example…

- WITHOUT calculating, do you think that 35% of 700 is easier to estimate or that 99% of 1052 is easier to estimate? Why?

You try

- Open up one of these questions to make it more discussable, more accessible and richer:

Choose

- 1. I had 5 apples. I got 4 more. How many do I have now?

Choose

- 2. 28 kids brought in $15 each for photos. How much money did we collect?

Choose

- 3. I paid $22 on a 20% off sale for a present for my Mom. How much money did I save?

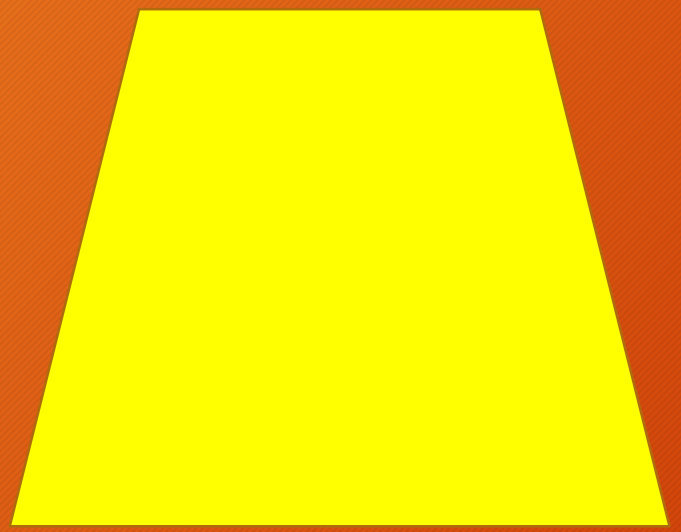
So what might we do?

- Strategy 2:
- Encourage divergence rather than convergence; foster creativity

It might be…

- Draw or describe a shape that you think is more like the yellow shape than the white one. Tell why.

It might be…



It might be

- Think of a way to use a picture to show what division means.

It might be

- Choose a number.
- Represent it three or four ways to show three or four different things about your number.

It might be

- Draw a shape with one side of 4 cm. Figure out the perimeter.

You try

- Make a divergent question about classifying quadrilaterals: square, rectangle, trapezoid, rhomus, parallelogram,…

So what might we do?

- Strategy 3: Ask questions and focus assessment of learning on ideas and not just answers

For example..

- Instead of ONLY: What pairs of numbers add to 10?

For example..

- I might ask: If you add a big number to a little number, will your answer be closer to the big number or closer to the little one? How do you know?

For example..

- Instead of: What are the factors of 45?

I might ask…

- You get to choose how many square tiles to take.
- You have to make lots of rectangles using ALL the tiles.
- What’s a good number to take? Why?

Instead of…

- What is 60% of $76?

I might ask…

- You pay the same amount when you buy a book at 20% off and a game at 40% off.
- Which cost more to start with?

You try

- Turn this into a focus on ideas:
- Surface area and volume of rectangular prisms

So what might we do?

- Strategy 4: Don’t make the solving of problems about negotiating a ton of text

What has happened

- In the interest of having real-life problems, we have made math text-heavy.

What has happened

- It is not wrong, but it gets in the way for too many kids.

So you might …

- Clarify for students what a problem is really saying.

For example

- If the problem were:
- You add two numbers and you also subtract them.
- The sum is 12 more than the difference.
- What could the numbers be?…
- I might…

So I say

- Pick two numbers.
- Add them.
- Subtract them.
- Is the add answer 12 more than the subtract?
- Try again if not.
- Look for more if it is.

For example

- I might present more problems visually.

What will happen next?
How sure are you?

HEADS	TAILS
𝍸 ||	

For example

- I might use videos.

For example

- https://gfletchy.com/piles-of-tiles/

So what might we do?

- Strategy 5: Allow for explanations that are oral or pictorial and not written

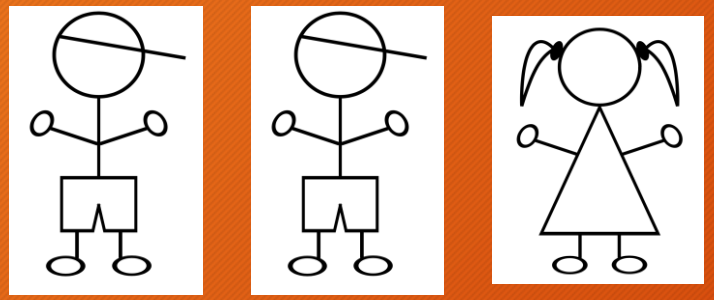
For example…

- Why are multiples of 8 always also multiples of 4.?

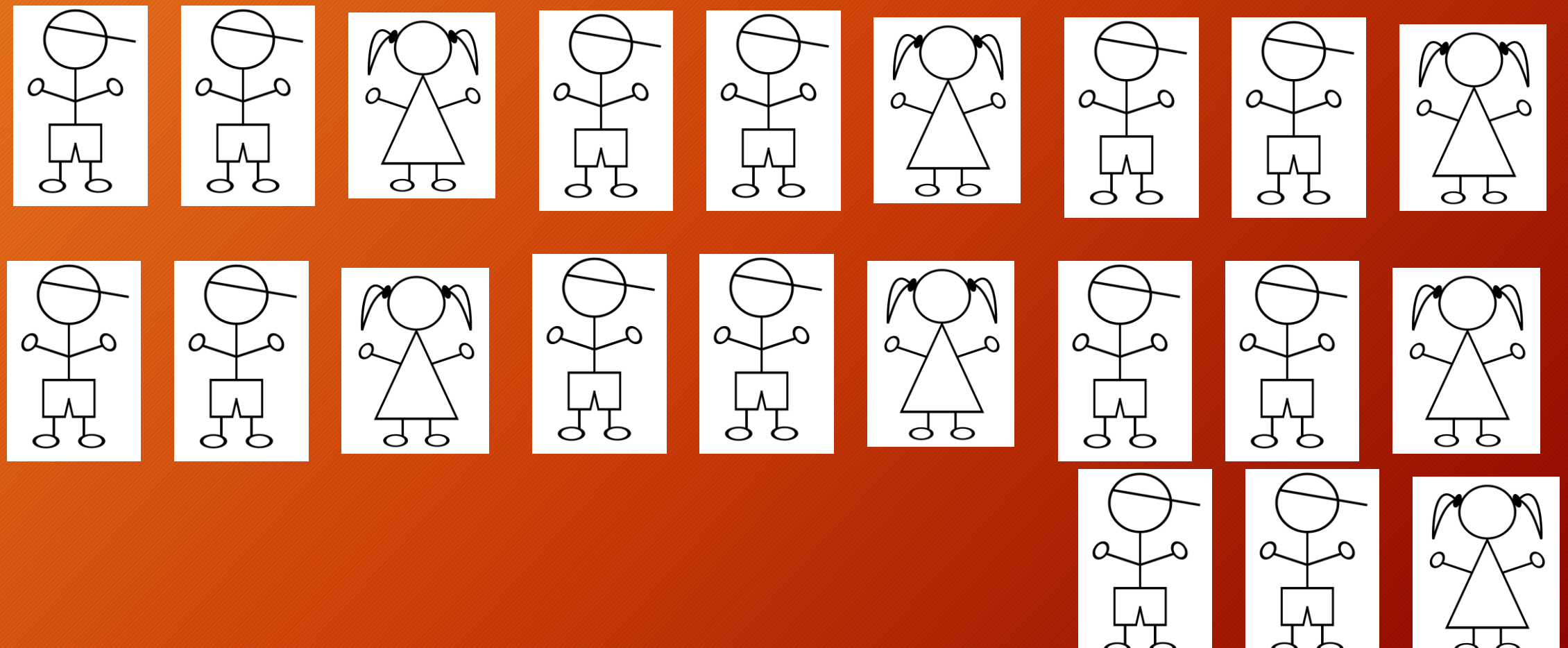
For example…

- There are twice as many boys as girls in the restaurant.
- There are 21 people.
- How many are boys?

I might show



I might show



For example…

- How can I grab each of these numbers of counters if the only available items are bags of 3 or bags of 7 that you cannot open?

For example…

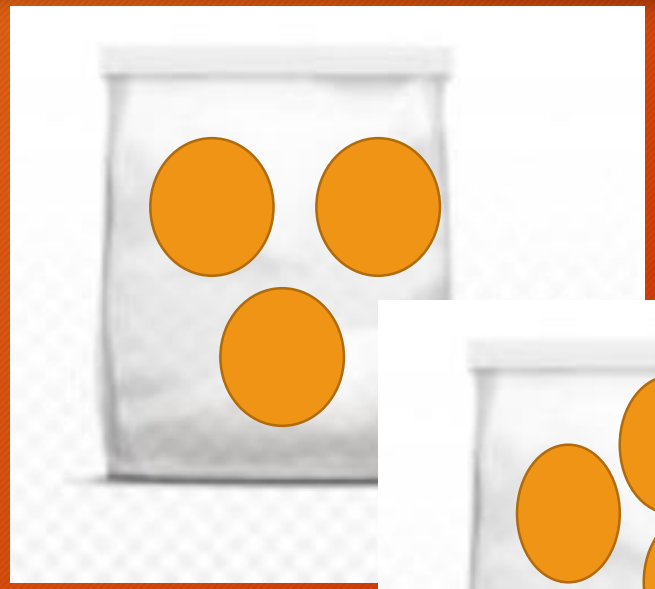
- 20
- 21
- 22

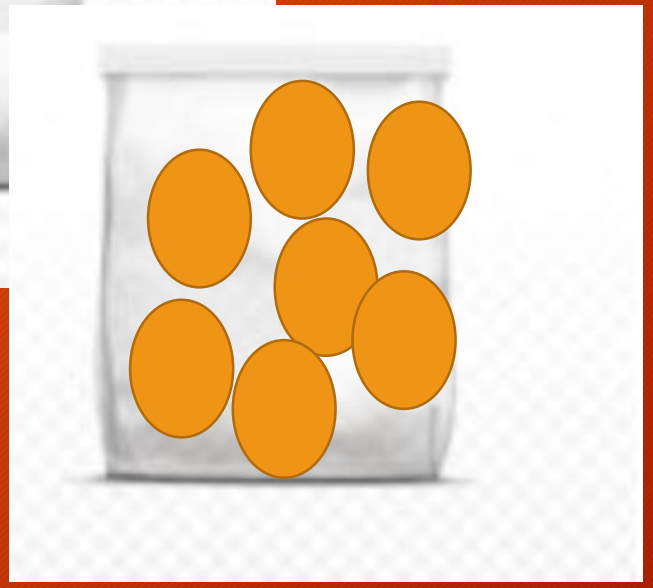
23

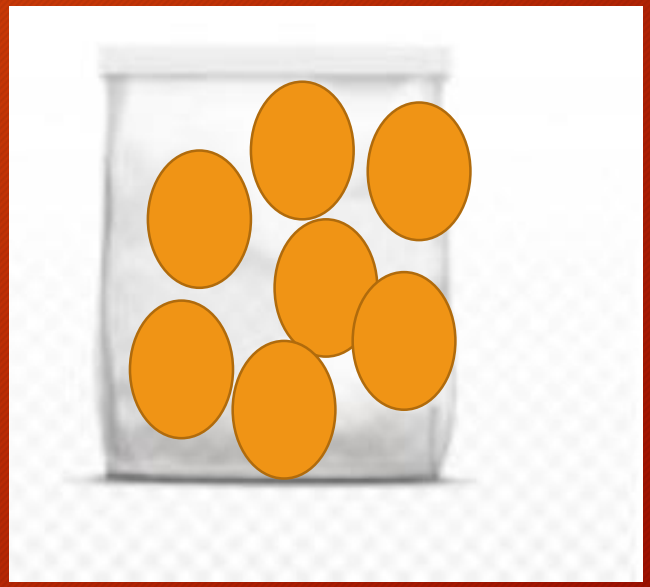
24

25

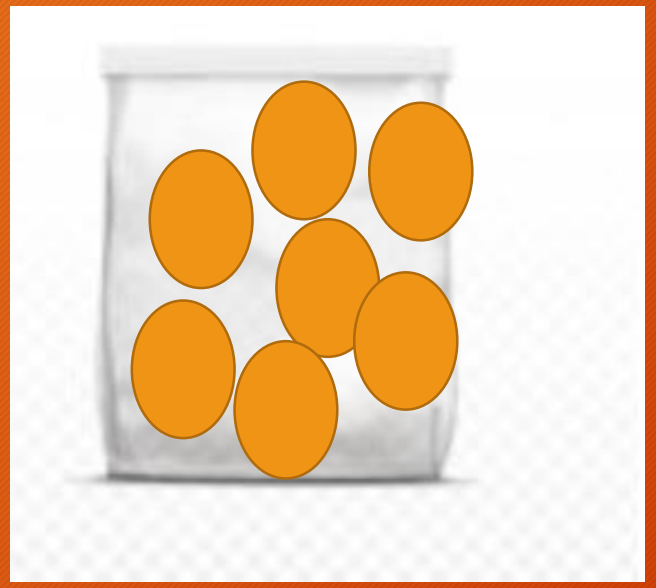
I might show 20

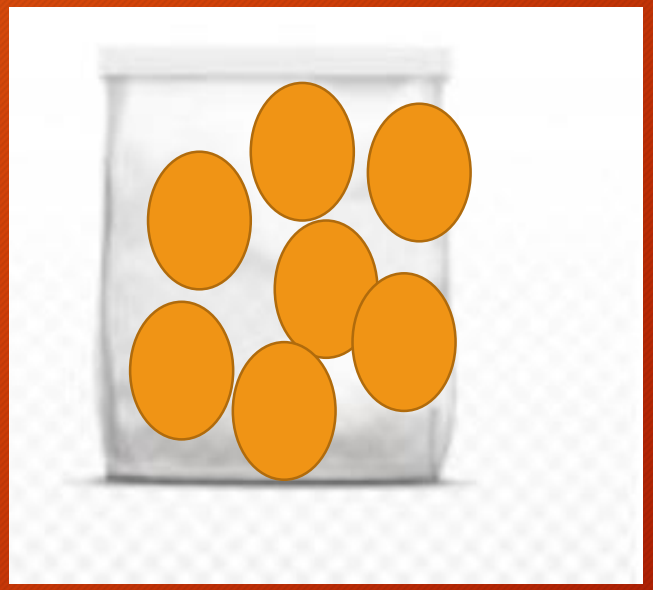


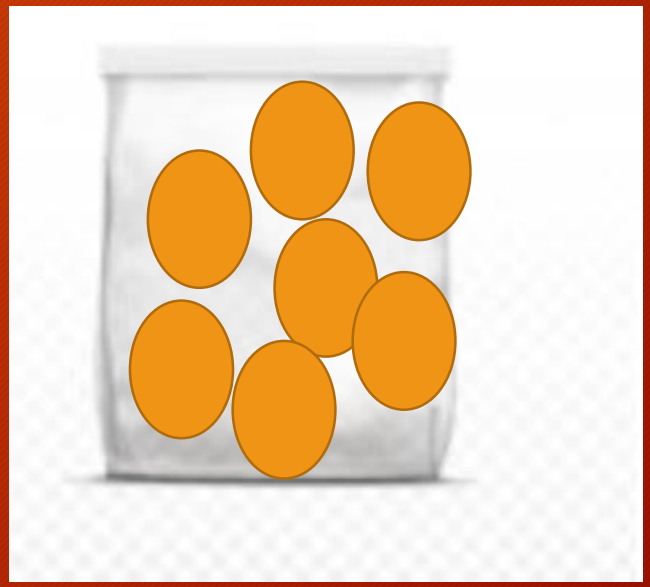




I might show 21







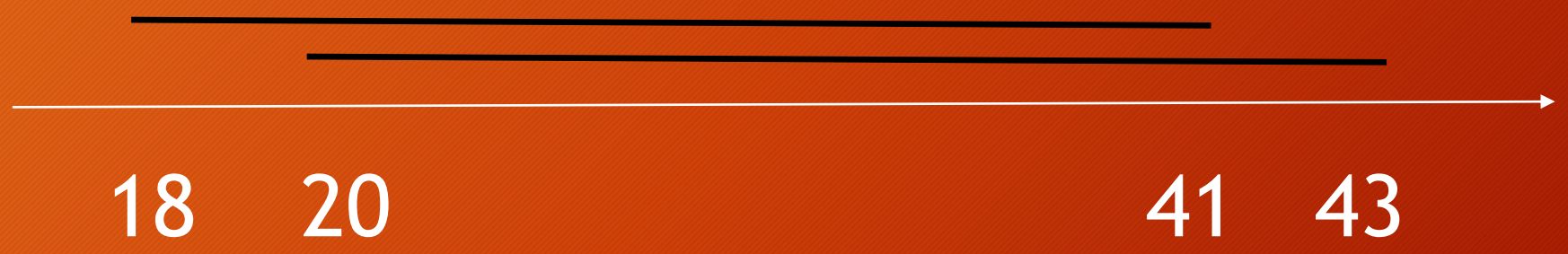
I might show 22

I might show 22

Your turn

- What picture helps me see why 41 – 18 HAS TO BE the same amount as 43 – 20?

Maybe

- 

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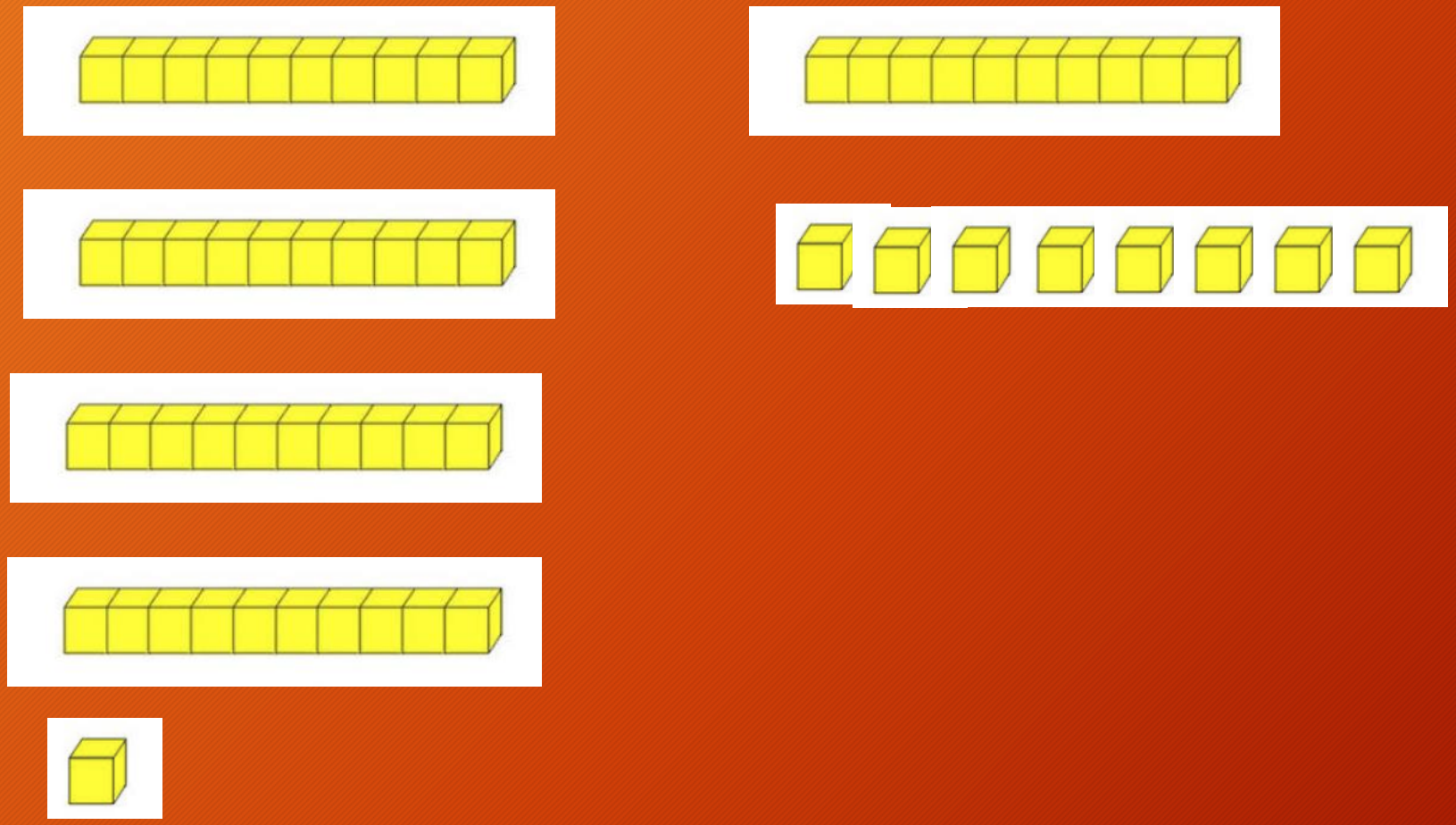

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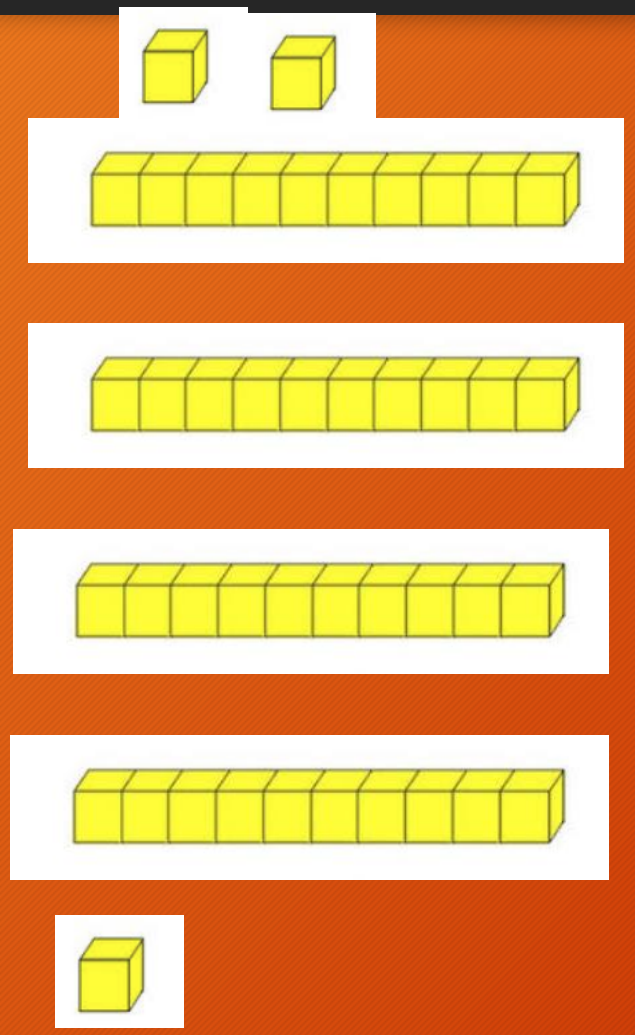

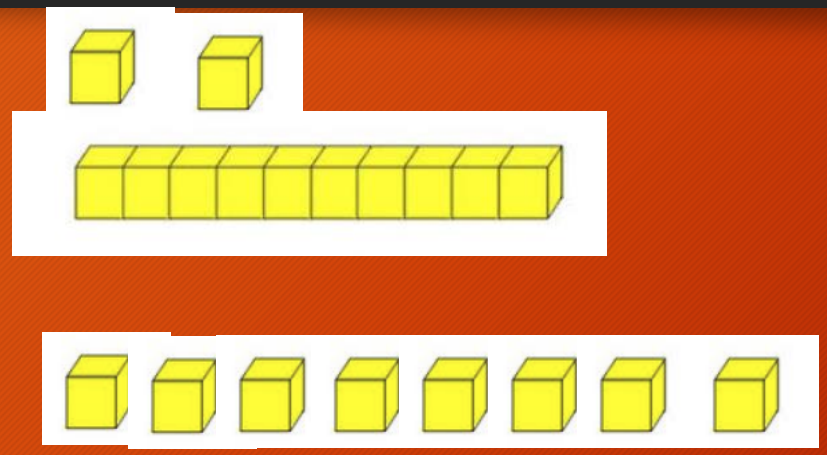

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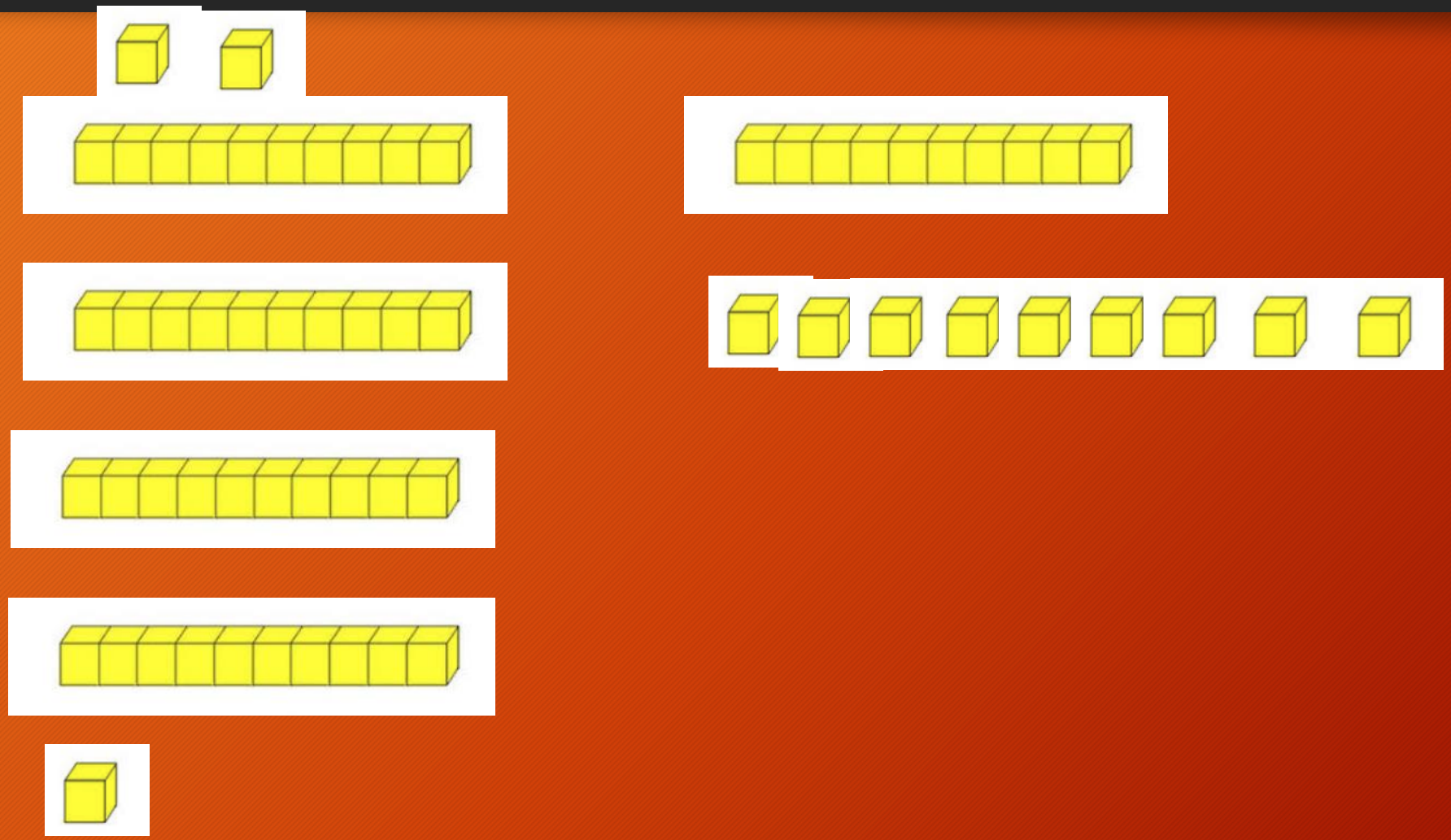

So you might..

- Strategy 7: Stop pressing for efficiency.

Is it important…

- that a 9 year old or 10 year old or even 13 year old use efficient strategies? Why?

So what is the story?

- The story is really what we believe math is.
- Is it answers or thinking we think math is about?

So what is the story?

- Is it convergence or divergence we think math is about?

So what is the story?

- Is it skills or ideas or at least in what proportion?

So what is the story?

- What about the conventions?

So what is the story?

- Is it essential to simplify 4/8 to ½?

So what is the story?

- Is it that kids answer the particular question I chose to pose or is it that they show good mathematical thinking in their attempt?

So what is the story?

- I can’t tell you what to believe.
- I can tell you there are choices.

So what is the story?

- Those choices affect the success of individual students in a math class.

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