

a) 1, 1, 2, 3, 5, 8, ...	b) 2, 4, 8, 16, ...
c) -1, 1, 3, 5, 7, ...	d) 100, 99, 98, 97, ...

Which one doesn't belong?

Strategies to Support Our Middle School Mathematicians

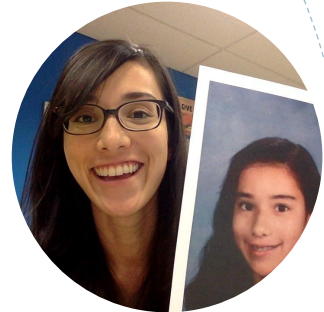
MS Parent Coffee
October 25, 2021
10 - 11:30 am



Chris Raymaakers
MS Deputy Principal



Scott Riley
MS Instructional Coach



Melissa Trainor
MS Math Specialist
Grade 8 Math

Today's Facilitators

Roadmap for Today's Session

Introductions &
Math Review Updates

2. The What, Why, How
of Number Sense

MS Math Pathways
Working Group

1

3

5

2

4

1. How to help our
children see
themselves as
mathematicians?

3. The Value in
Productive
Struggle



Strategies for Supporting Our Middle School Mathematicians

What?	Why?	How?
1. See Themselves as Mathematicians	Power of Self-Efficacy	Broaden definition of math and have your children share their math story.
2. Number Sense	Predictive of Success in Higher-level Math	Number Talks, Strings, Puzzles, Games, Questions
3. Productive Struggle	Boosts Problem-Solving	Embrace confusion. Foster the mindset that math is figure-out-able.



**CONTRIBUTING PRODUCTIVELY
AND POSITIVELY**

COMMUNITY NORMS

As an SAS community member I agree to hold myself to a high standard of personal conduct in my interactions and communications with students, faculty, and parents. This means I will adhere to the SAS Statement of Community by:



**ASSUMING POSITIVE
INTENT**



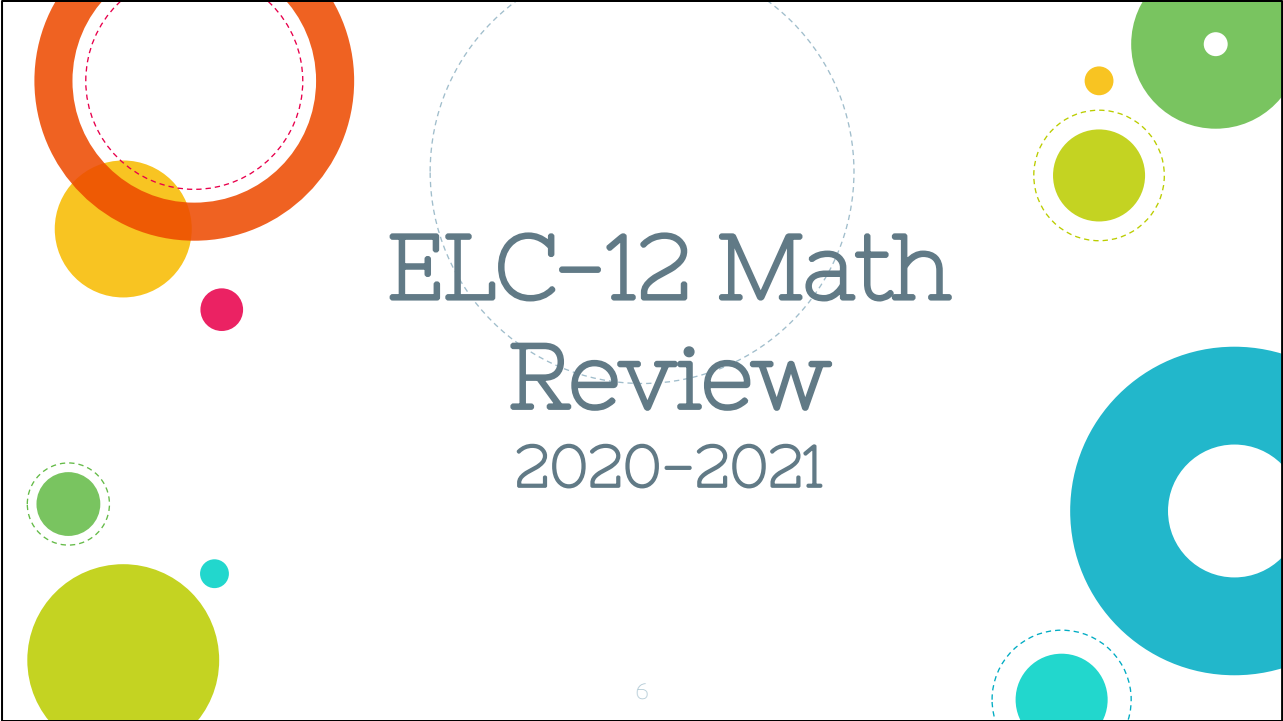
**REFRAINING FROM
DISCRIMINATION**
(religious, ethnic, racial, sexual, or gender)



**SHARING ACCURATE
INFORMATION**



**GOING TO THE
SOURCE**



ELC-12 Math Review 2020-2021

ELC – 12 Math Review

**WASC
ACCREDITATION
REPORT 2020**

**MEASUREMENT OF
ACADEMIC PROGRESS
ACHIEVEMENT DATA**
2014–20

**MATH AP
EXAM SCORES**
2016–20

AIMSWEB
2018–20

**K-12 FACULTY
FOCUS GROUPS**
n=37

**K-12 FACULTY
BELIEFS SURVEY**
n=37

**K-12 FACULTY
CURRICULUM AND
INSTRUCTION AUDIT**
n=37

**CLASSROOM
OBSERVATIONS**
n=46

**MIDDLE SCHOOL
COUNSELOR
FOCUS GROUP**
n=6

**HIGH SCHOOL
PERSONAL ACADEMIC
COUNSELOR
FOCUS GROUP**
n=5

**HIGH SCHOOL
PERSONAL ACADEMIC
COUNSELOR
FOCUS GROUP**
n=5

**6
PARENT**
FOCUS GROUPS ON
VARIOUS TOPICS
n=245
(APPROXIMATE)

**ALUMNI
FOCUS GROUP**
n=10

**2
HIGH SCHOOL
FOCUS GROUPS**
n=25

**MIDDLE
SCHOOL
FOCUS GROUP**

**5
ELEMENTARY
SCHOOL
FOCUS GROUPS**
n=34

<https://www.sas.edu.sg/math-curriculum-review>

ELC – 12 Math Review

Overall Strengths	Overall Areas for Growth
<ul style="list-style-type: none">• Strong commitment from all stakeholders to excellence in mathematics• Overall strong performance in student achievement data• Collaborative and dedicated faculty committed to student learning• High access to curriculum resources and professional learning• Evidence of rigor and challenge for students	<ul style="list-style-type: none">• Alignment across courses• Consistent high quality teaching• Interventions in the classroom and with learning support teachers• Extension of learning in and outside the classroom• Understand of requirements for courses• Student wellness• Parent engagement

ELC – 12 Math Review

Recommendation
Develop and share a schoolwide math philosophy of teaching and learning
Revise courses to ensure the curriculum and assessment is focused on depth, rather than breadth
Professional learning for faculty on consistent, high-impact mathematics teaching

ELC – 12 Math Review

Recommendation
Professional learning and systems for classroom intervention
Professional learning and further offerings for extension
Examine pathway/tracking options in middle school



What is your math story?

11

We, as educators and parents, can't move them towards seeing themselves as mathematicians unless we understand the story that has brought them to this moment.



Zoom Chat

What is your math story?

- What was math like for you in middle school?
 - How did you learn it?
 - How did you feel about it?
 - How did it develop your understanding of what math is?





1

Seeing Themselves as Mathematicians A Critical First Step



Strategies for Supporting Our Middle School Mathematicians

What?	Why?	How?
1. See Themselves as Mathematicians	Power of Self-Efficacy	Broaden definition of math and have your children share their math story.



Zoom Chat

What is math?

Why is math
important?

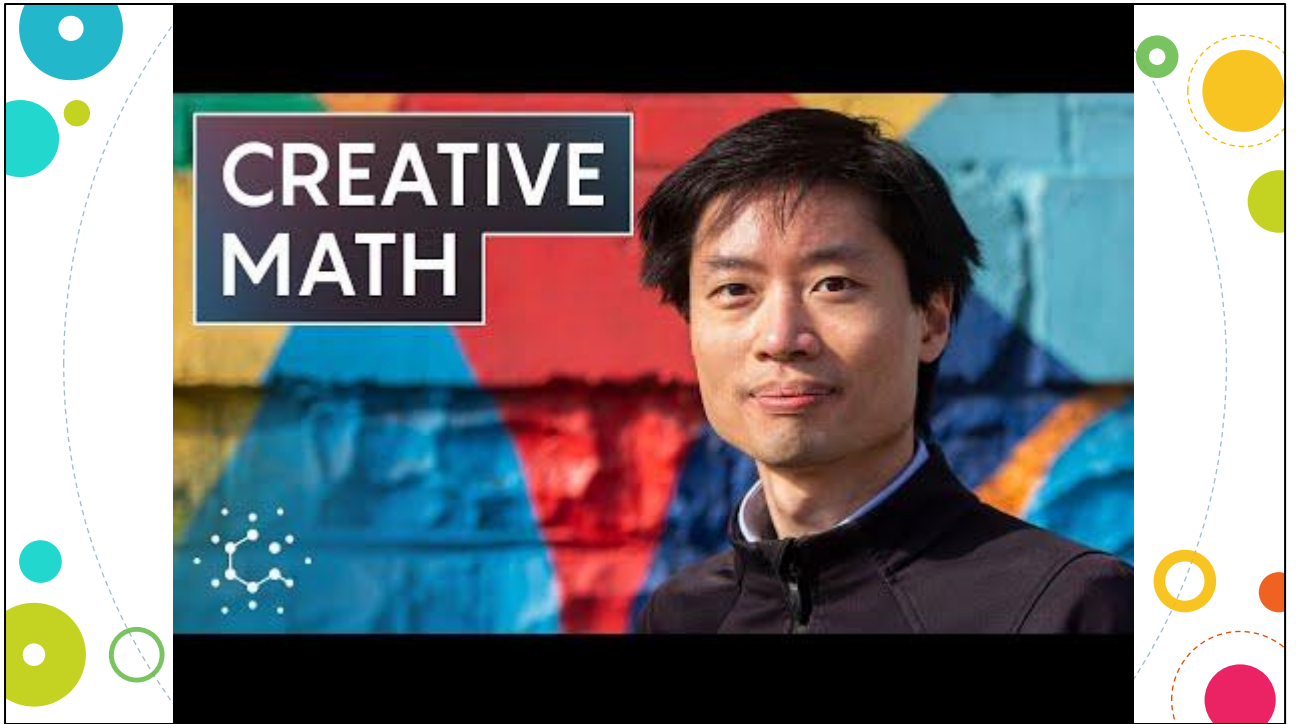
WHAT IS MATHEMATICS?



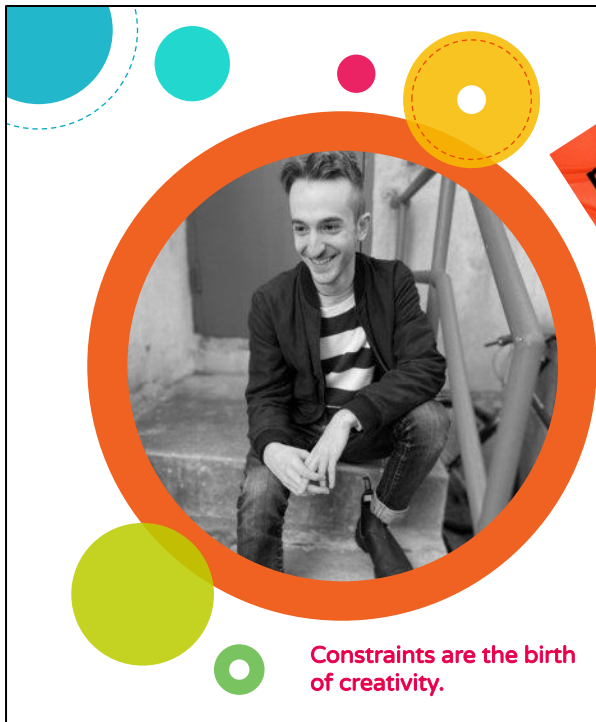
By Alec Wilkinson
March 2, 2021

- Mathematics is the craft of creating new knowledge from old, using deductive logic and abstraction.
- The theory of formal patterns.
- The science that draws necessary conclusions. Symbolic logic.
- The study of structures.
- The account we give of the timeless architecture of the cosmos.
- The poetry of logical ideas.
- A science involving things you can't see, whose presence is confined to the imagination.
- The study of ideas that can be handled as if they were real things.
- A field in which the properties and interactions of idealized objects are examined.
- Conjectures, questions, intelligent guesses, and heuristic arguments about what is probably true.
- The longest continuous human thought.
- Laboriously constructed intuition.
- The thing that scientific ideas, as they grow toward perfection, become.
- An ideal reality.
- What mathematicians do, the way musicians do music.

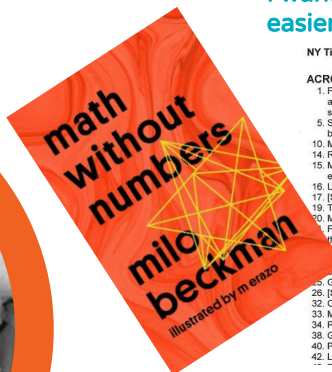
<https://www.newyorker.com/culture/culture-desk/what-is-mathematics>



Only show up to 0:36



**Constraints are the birth
of creativity.**



**I wanted to strip out digits to make it
easier to describe the beauty of math.**

NY Times, Tue, Apr 17, 2012 Milo Beckman / Will Shortz

ACROSS

1. Furniture on which a guest might sleep
5. Some 24-hr. breakfast places
10. Magician's word
14. Resting at night
15. Military academy enrollee
16. Leave out
17. (See note)
19. Toothpaste flavor
20. Marsh plant
21. Founding owner of the Pittsburgh Steelers
25. Wonderful connections
26. (See note)
32. Oriental, e.g.
33. Mount in Exodus
34. Pair of
38. Group of voters
40. Pair of
42. Lash



Milo Beckman has been addicted to math since a young age. Born in Manhattan in 1995, he began taking math classes at Stuyvesant High School at age eight, was captain of the New York City Math Team by age thirteen, and enrolled at Harvard University at the age of fifteen. His diverse projects and independent research have been featured in the *New York Times*, *FiveThirtyEight*, *Good Morning America*, *Salon*, the *Huffington Post*, the *Chronicle of Higher Education*, *Business Insider*, the *Boston Globe*, *Gothamist*, the *Economist*, and others. He worked for three tech companies, two banks, and a US Senator before retiring at age nineteen to teach math in New York, China, and Brazil, and to work on this book.

<https://www.amazon.com/Math-Without-Numbers-Milo-Beckman/dp/1524745545>

The Purposes of Middle School Mathematics

Catalyzing Change in Middle School Mathematics

Initiating Critical Conversations



NATIONAL COUNCIL OF
TEACHERS OF MATHEMATICS

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Key Recommendation:

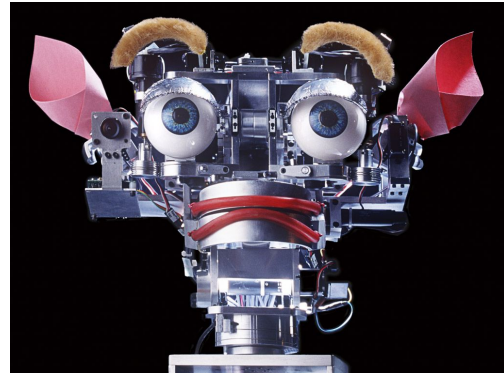
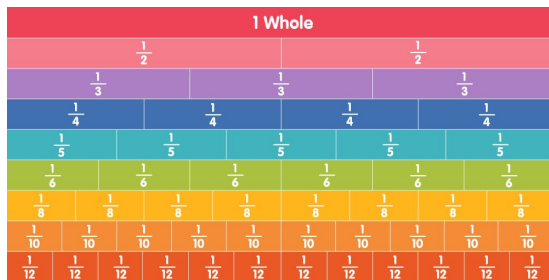
Broaden the Purposes of Learning Mathematics

Each and every student should develop deep mathematical understanding, understand and critique the world through mathematics, and experience wonder, joy, and beauty of mathematics, which all contribute to a **positive mathematical identity**.

Goal: An ultimate goal of a high-quality middle school mathematics program is for each and every student to develop confidence in themselves as **knowers, doers, and sense makers of mathematics**.

Broadening the purposes of mathematics allows children to cast the net wider in seeing themselves as mathematicians

[Catalyzing Change - Key Recommendations for ES, MS, HS](#)



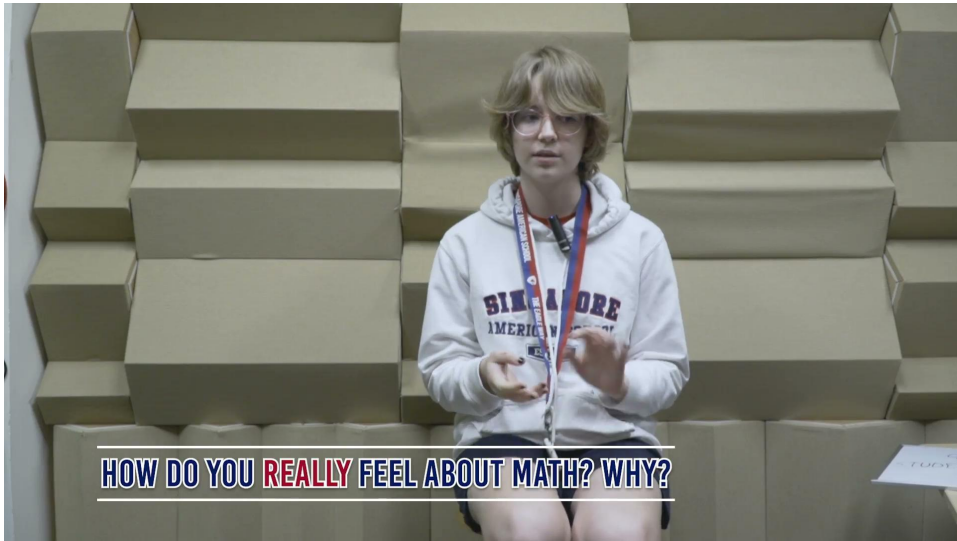
Kismet, the Social Robot



What is your math story?

22

We, as educators and parents, can't move them towards seeing themselves as mathematicians unless we understand the story that has brought them to this moment.





2

Number Sense

Most Important Mathematical Concept
in 21st Century K-12 Education



Strategies for Supporting Our Middle School Mathematicians

What?	Why?	How?
1. See Themselves as Mathematicians	Power of Self-Efficacy	Broaden definition of math and have your children share their math story.
2. Number Sense	Predictive of Success in Higher-level Math	Number Talks, Strings, Puzzles, Wondering, Questioning



“

If you are a parent of a child in the K-12 system, there is today just one thing you should ensure your offspring has mastered in the math class by the time they graduate: number sense.

-Keith Devlin
Math Professor at Stanford University

26

Math Guy on NPR

- [Number Sense: the most important mathematical concept in 21st Century K-12 education](#)
- [All The Mathematical Methods I Learned In My University Math Degree Became Obsolete In My Lifetime](#)

“

Foster Number Sense.

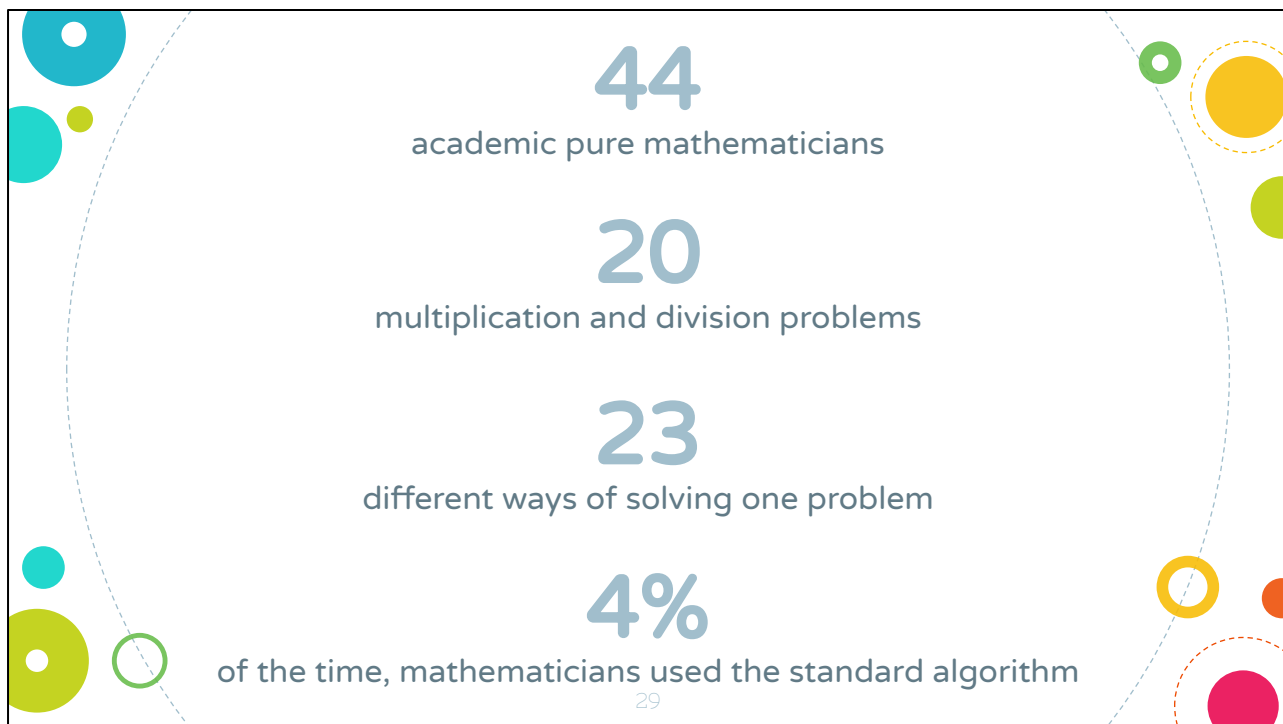
-High School Math Teachers



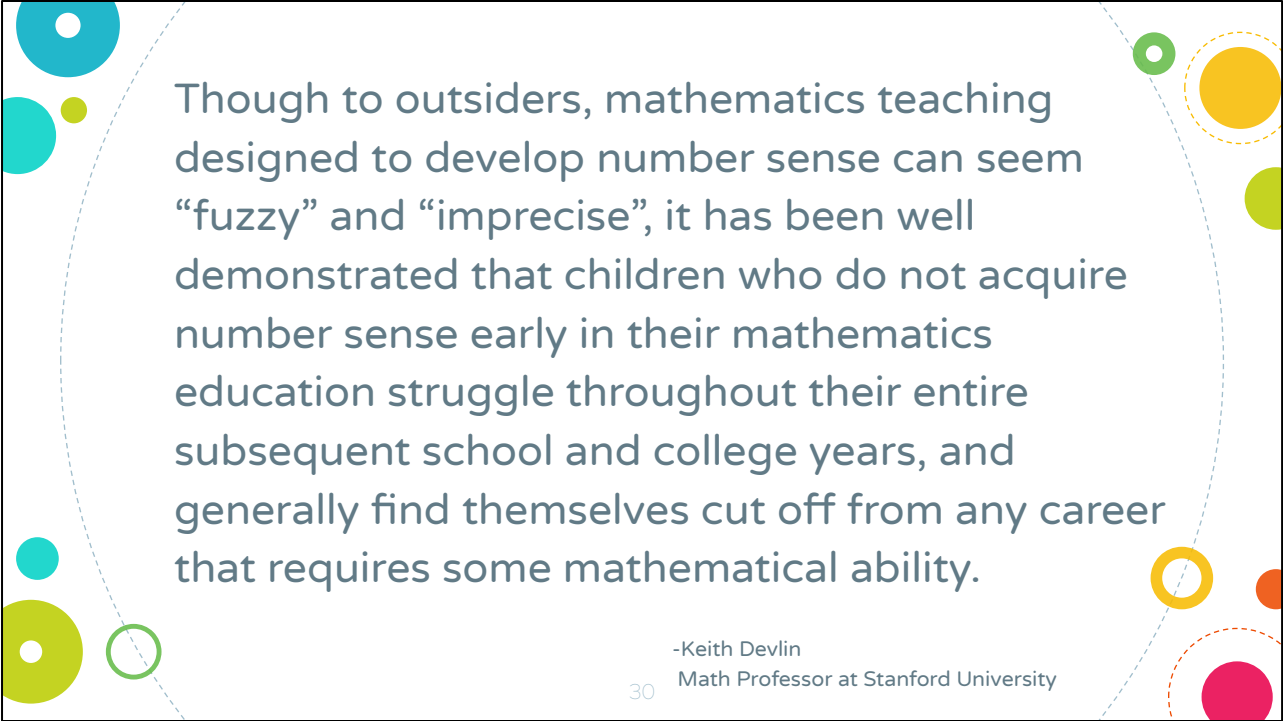


<https://www.youcubed.org/resources/what-is-number-sense/>
[Fluency without Fear by Jo Boaler, Stanford University Professor of Mathematics](#)

Which method is best? And is best the same in every context?

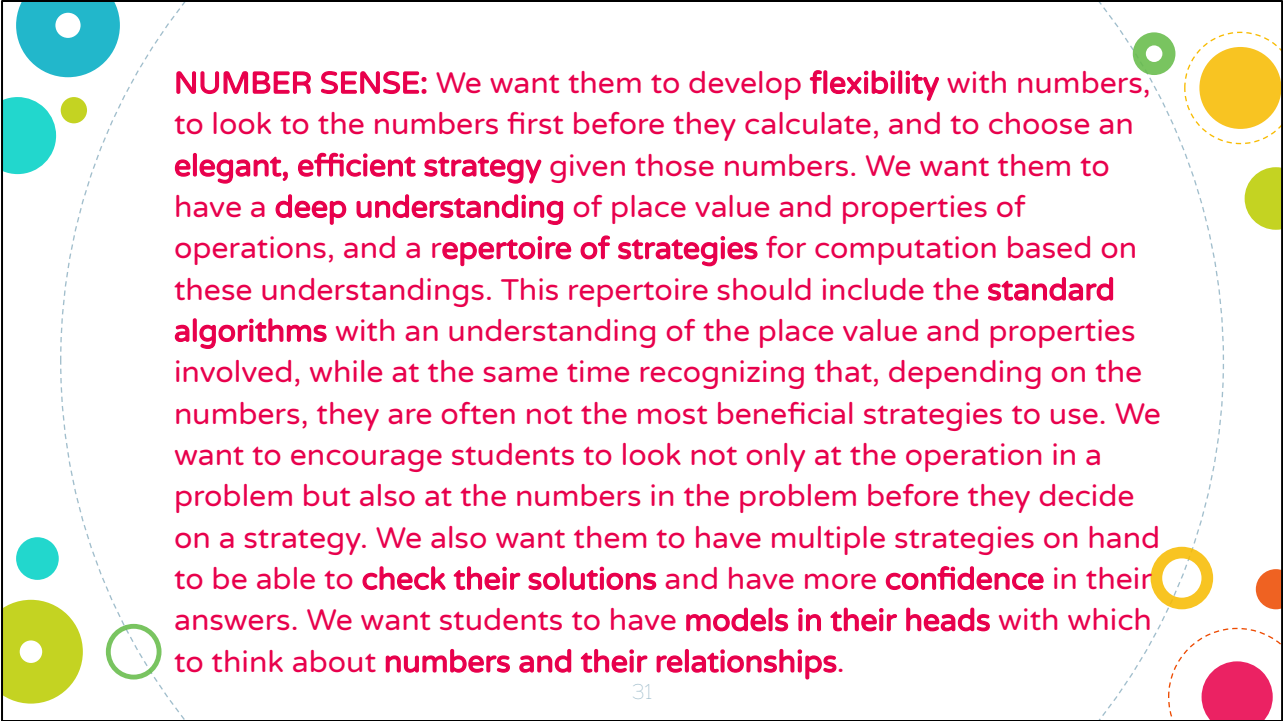


https://www.researchgate.net/publication/258333787_Computational_Estimation_Strategies_of_Professional_Mathematicians



Though to outsiders, mathematics teaching designed to develop number sense can seem “fuzzy” and “imprecise”, it has been well demonstrated that children who do not acquire number sense early in their mathematics education struggle throughout their entire subsequent school and college years, and generally find themselves cut off from any career that requires some mathematical ability.

-Keith Devlin
Math Professor at Stanford University



NUMBER SENSE: We want them to develop **flexibility** with numbers, to look to the numbers first before they calculate, and to choose an **elegant, efficient strategy** given those numbers. We want them to have a **deep understanding** of place value and properties of operations, and a **repertoire of strategies** for computation based on these understandings. This repertoire should include the **standard algorithms** with an understanding of the place value and properties involved, while at the same time recognizing that, depending on the numbers, they are often not the most beneficial strategies to use. We want to encourage students to look not only at the operation in a problem but also at the numbers in the problem before they decide on a strategy. We also want them to have multiple strategies on hand to be able to **check their solutions** and have more **confidence** in their answers. We want students to have **models in their heads** with which to think about **numbers and their relationships**.



How might we foster stronger **number** **sense?**

32

Number Sense: It's messy, it's PLAYFUL, it's not just step 1, 2, 3 of a recipe, it's hard to teach, it's hard to program a computer system to do it. This is WHY it is worthwhile.

Artificial Intelligence Thought Experiment: Chinese Room



TIP #1

Encourage your child to be **playful** with numbers and to go for **quantity** with their strategies.

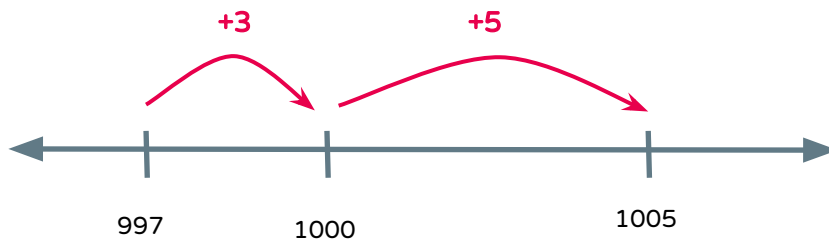
Number Talks

$$1005 - 997$$

$$\begin{array}{r} \overset{0}{\cancel{1}}\overset{9}{0}\overset{9}{0}5 \\ - 997 \\ \hline 8 \end{array}$$

Number Talks

$$1005 - 997$$



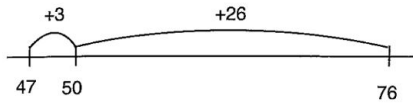
Number Talks

$$1005 - 997$$
$$= 1008 - 1000$$

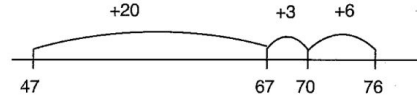


47 + 29 Represented Five Ways

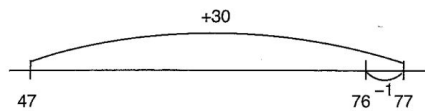
Strategy 1



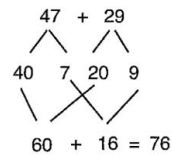
Strategy 2



Strategy 3



Strategy 4

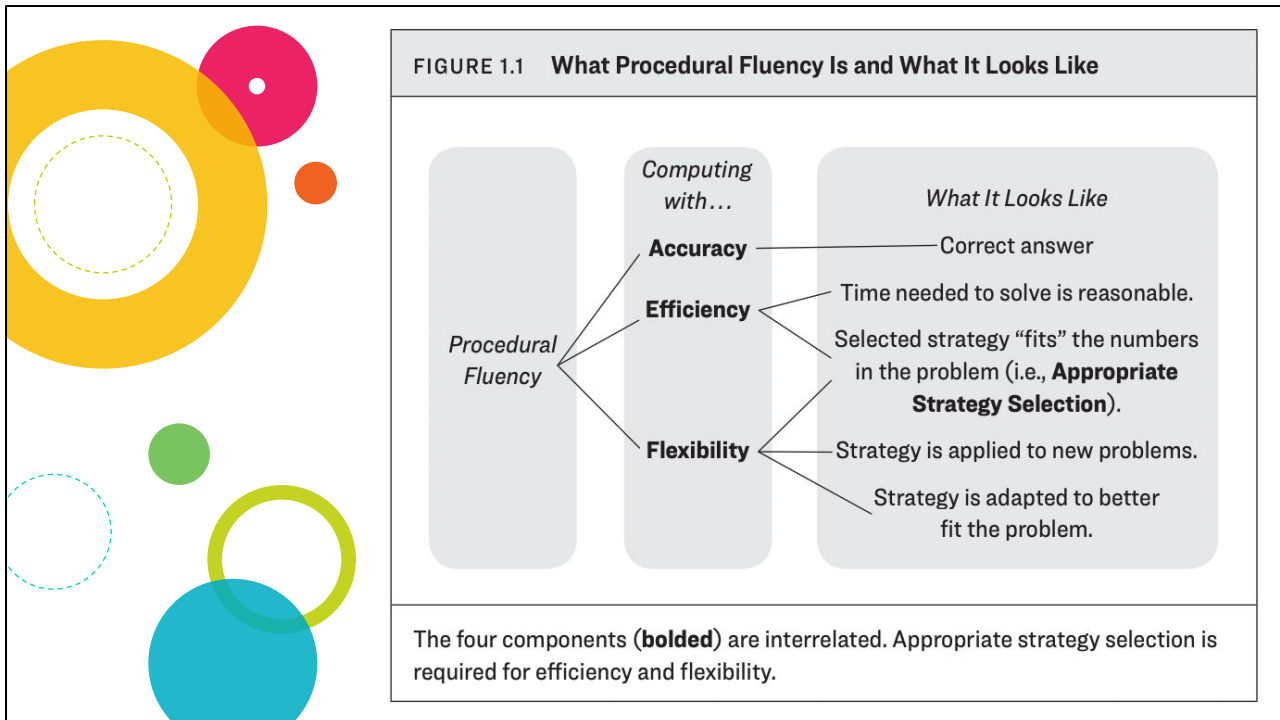


Strategy 5

40, 60, 67, 76

[Number Line Workouts by Pam Harris](#)

https://docs.google.com/document/d/1RzceYzKCN0tSpk0wXYA4FHRodogGyrmbjahNy8D_Kjc/edit?usp=sharing



Build [procedural fluency](#) from conceptual understanding. Effective teaching of mathematics builds fluency with procedures on a foundation of conceptual understanding so that students, over time, become skillful in using procedures flexibly as they solve contextual and mathematical problems.



TIP #2

Math is **figure-out-able**!
Encourage your child to
actively spot the **patterns**
and make **predictions**.
Discourage memorizing
without understanding.

$$176 \div 8 =$$

This problem has fewer entry points compared to the next number string.



TIP #2

Math is **figure-out-able**!
Encourage your child to
actively spot the **patterns**
and make **predictions**.
Discourage memorizing
without understanding.

Number Strings

$$160 \div 8 =$$

Solve one by one. Use the previous problem to help make connections with the problem that follows. Actively look for patterns and connections.



TIP #2

Math is **figure-out-able**!
Encourage your child to
actively spot the **patterns**
and make **predictions**.
Discourage memorizing
without understanding.

Number Strings

$$160 \div 8 = 20$$

$$168 \div 8 = 21$$

$$176 \div 8 = 22$$

$$152 \div 8 = 19$$

$$144 \div 8 = 18$$

$$240 \div 8 = 30$$

$$232 \div 8 = 29$$

Solve one by one. Use the previous problem to help make connections with the problem that follows. Actively look for patterns and connections.



TIP #3

Answer their
question with a
question.

- What do you know?
- What do you want to know?
- What have you tried?
- What could you do next?
- Can you explain what you were thinking?
- How do you know?
- What makes you think that?
- What math do you need to know to solve this problem?
- How could you represent the problem with a visual representation (picture)?
- Is there another way you can model or solve this problem? How?
- What questions do you have after having tried to solve this problem?
- Is your answer reasonable? Why or why not?
- What do you notice about...? What would happen if...
- What patterns do you notice...?
- What intimidates you about this problem? What if you made that part a bit simpler?
- Are there any other problems you've solved that are similar to this one?



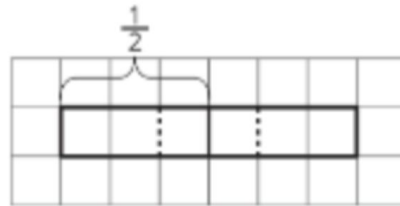
TIP #3

Answer their
question with a
question.

What intimidates you about this problem?

What if you made that part a bit simpler?

Problem 1: Use the tape diagram to represent and find the value of $\frac{1}{2} \div \frac{1}{3} =$



Problem above is from [Grade 6 Illustrative Math Unit 4: Dividing Fractions Lesson 5](#)

Great questions for parents and tutors to discuss with children -> Math Reasoning Inventory: 1) [Whole Number Interview Questions](#) 2) [Fractions Interview Questions](#) 3) [Decimal Interview Questions](#)



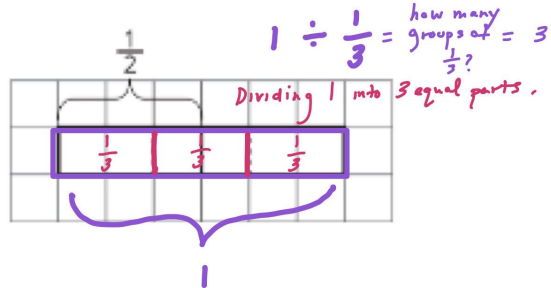
TIP #3

Answer their
question with a
question.

What intimidates you about this problem?

What if you made that part a bit simpler?

Problem 1: Use the tape diagram to represent and find the value of $\frac{1}{2} \div \frac{1}{3} =$





TIP #4

Encourage them to **mathematize** and share their **reasoning** with you. Play games like **Which One Doesn't Belong?** or do **Open Middle** tasks.

36	99
9	123

121	16
9	73

$\frac{1}{4}$	40%
$\frac{3}{2}$	$\frac{1}{6}$

Using the digits 1 to 9 at most one time each, place a digit in each box to make two different pairs of fractions that have a question of $\frac{2}{3}$.

$$\frac{\square}{\square} \div \frac{\square}{\square} = \frac{2}{3}$$

<https://wodb.ca/>

<https://www.openmiddle.com/>



TIP #4

Encourage them to **mathematize** and share their **reasoning** with you. Play games like **Which One Doesn't Belong?** or do **Open Middle** tasks.

What does it mean to distribute?
What is distributive? What is not?
True or False? Convince me.

1. $(3 + 4)^2 = 3^2 + 4^2$

2. $5(3 + 4) = 5(3) + 5(4)$

3. $11(x - 7) = 11x - 77$

4. $a(bc) = ab \cdot ac$

5. $\sqrt{a + b} = \sqrt{a} + \sqrt{b}$

6. $(3x)^4 = 3^4 \cdot x^4$



TIP #5

Guesstimate often with any stats you see in the news and have **fun!** Or play games like **Would You Rather...?**

How much, by weight, does the average American eat per year?

How many liters of water does it take to fill up an Olympic-sized swimming pool?

Would you rather....

Drive a car at a rate of 40 kilometers per hour

OR

Drive a car at a rate of 15 meters per second?



When helping students with math (and anything else)



- Ask questions instead of giving answers
- Teach into the process instead of the product
- Focus on the mathematician instead of the math
- Reflect on the learning instead of the results



Breakout Room 1

- Helping my child at home on math is/is like....
- What strategies have worked?
- What new strategies might you consider?
- What new thinking about math might reframe how you help your child?

A decorative graphic featuring a large, light blue dashed circle in the upper center containing the number '3'. Surrounding this are several other circles in orange, yellow, green, and blue, some solid and some dashed. A large blue 'C' shape is on the right side. The background is white.

3

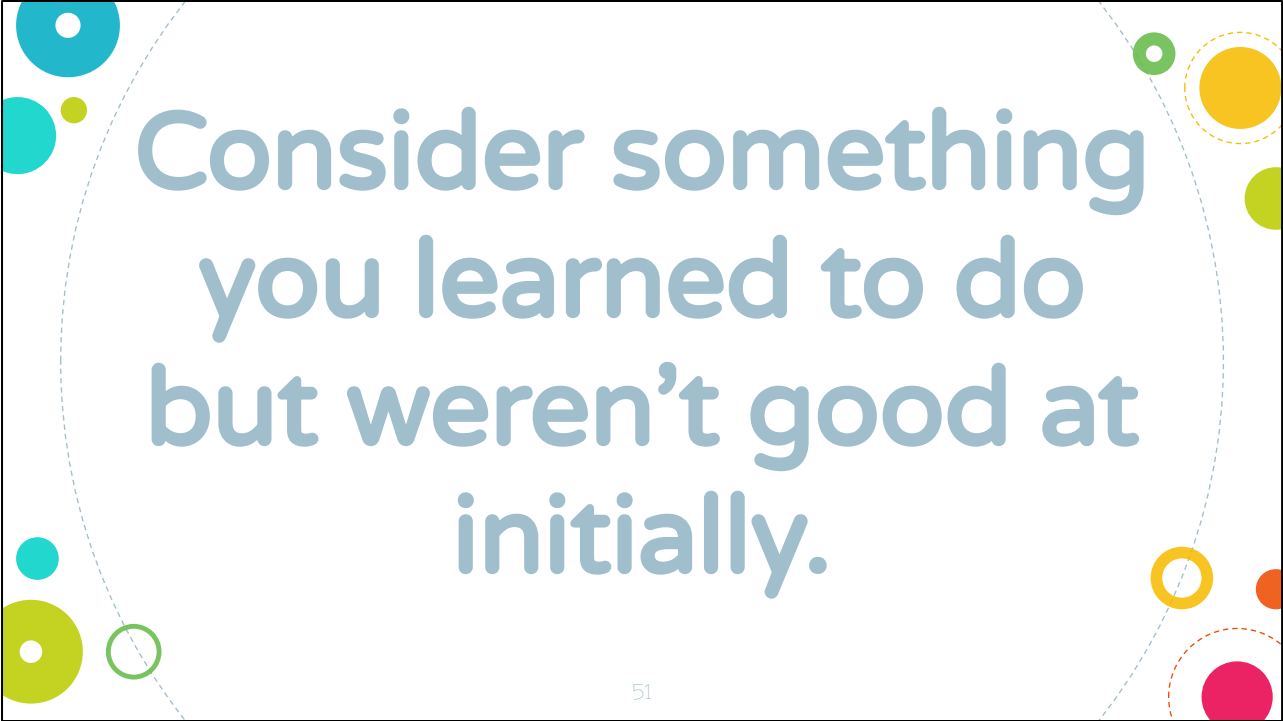
Productive Struggle

How Productive Struggle Sets Brains on Fire



Strategies for Supporting Our Middle School Mathematicians

What?	Why?	How?
1. See Themselves as Mathematicians	Power of Self-Efficacy	Broaden definition of math and have your children share their math story.
2. Number Sense	Predictive of Success in Higher-level Math	Number Talks, Strings, Puzzles, Wondering, Questioning
3. Productive Struggle	Boosts Problem-Solving	Embrace confusion. Foster the mindset that math is figure-out-able.



Consider something
you learned to do
but weren't good at
initially.



How did you get better?

struggle: none
feedback: none
reward: none



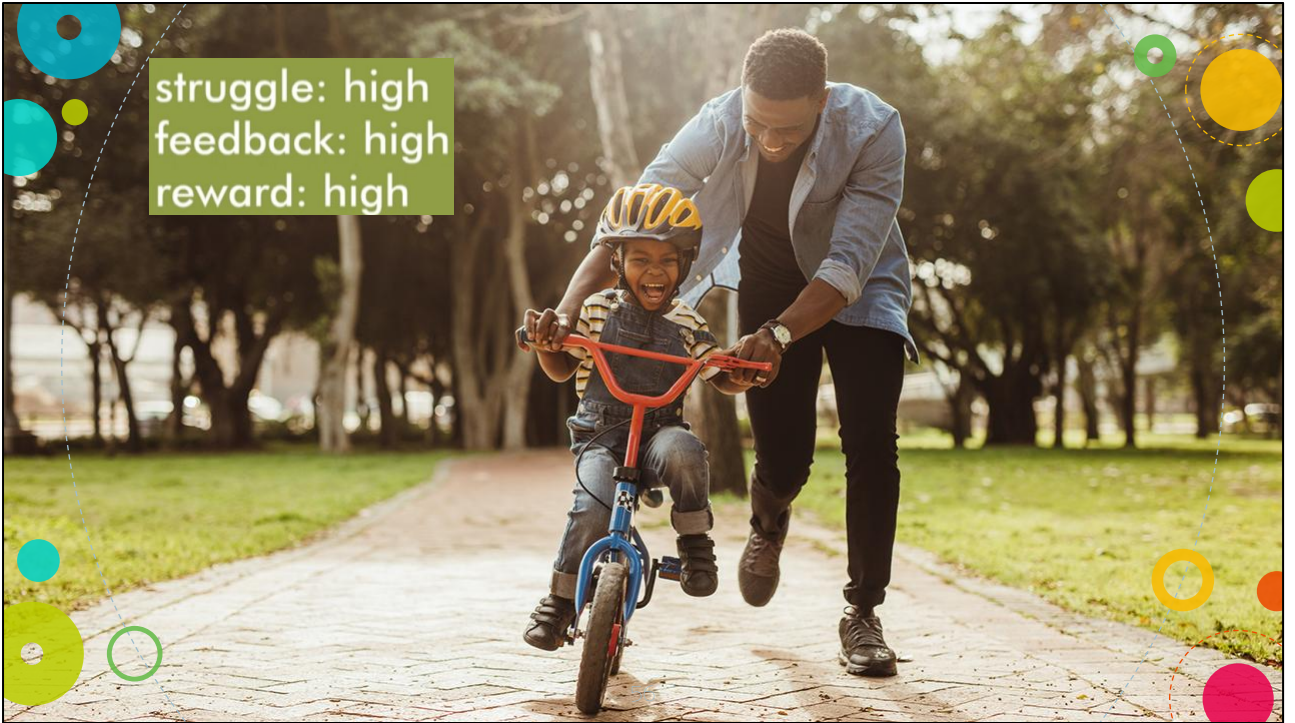


struggle: low
feedback: low
reward: high



struggle: medium
feedback: high
reward: medium

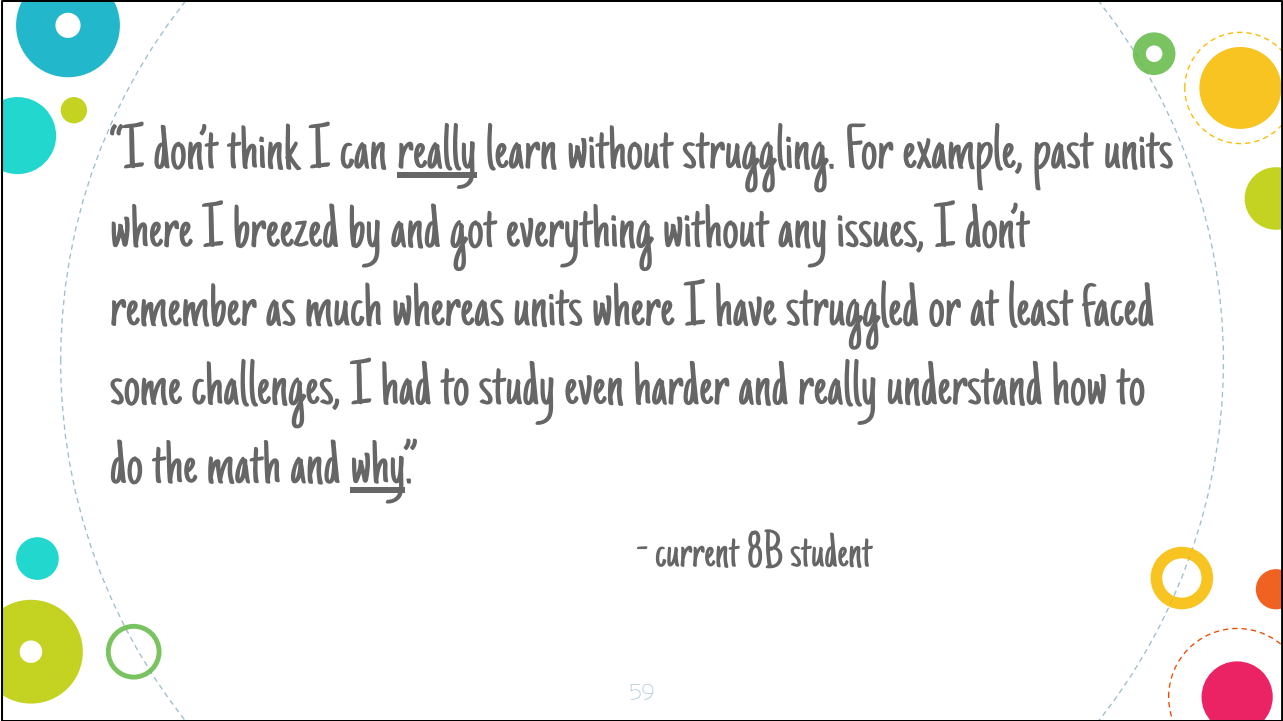
struggle: high
feedback: high
reward: high



struggle: high
feedback: high
reward: high







"I don't think I can really learn without struggling. For example, past units where I breezed by and got everything without any issues, I don't remember as much whereas units where I have struggled or at least faced some challenges, I had to study even harder and really understand how to do the math and why."

- current 8B student



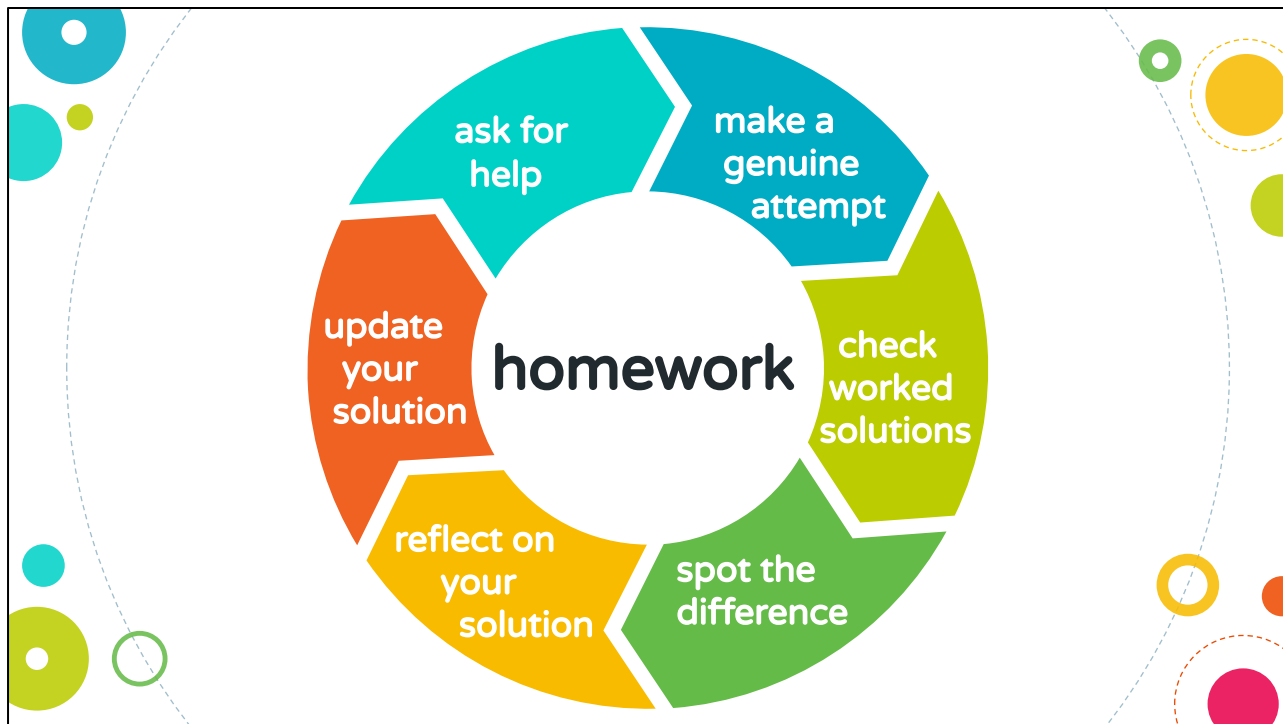
What's something
you persevered
with?



The first step in a
good problem is
feeling confused.

61

We need to normalize the feeling of confusion and perplexity.





Breakout Room 2

- In what area(s) does your child naturally embrace struggle, persevere, and foster his/her own growth? How might you make explicit connections with that and math?
- What might you say or do when helping your child foster productive struggle?



4

MS Math Pathways

Working Group

MS Math Pathways Working group

Recommendation
Professional learning and systems for classroom intervention
Professional learning and further offerings for extension
Examine pathway/tracking options in middle school



MS Math Pathways Working group

- Dig into math research and data around math pathways
- Advocate for interests of all middle school students
- Inform the eventual recommendation for middle school math pathways
- Attend four morning meetings:
 - Thursday, November 18
 - Monday, December 6
 - Thursday, January 27
 - Thursday, March 17

Thanks!



bit.ly/msmathcoffee