

Promoting Mathematical Literacy: What Our Students Need to Know, Why They Struggle, and How We Can Help!



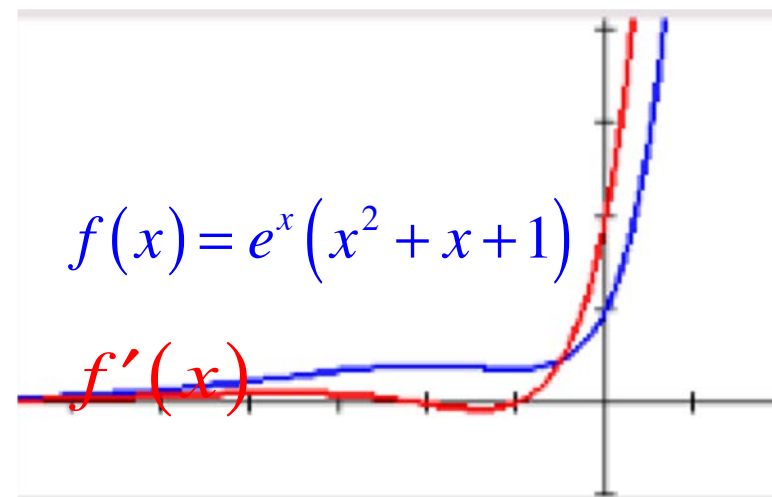
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Promoting Mathematical Literacy: What our students need to know, why they struggle, and how we can help!

Agenda:

- Welcome and Warm Up
- Mathematical Literacy
 - A. What our students need to know
 - B. Why they struggle
 - C. How we can help
- Closing and Reflections



Presentation PDF –
link at the end!

WARM UP:

REFLECT ON THIS
PICTURE...

What do you notice?
What do you wonder?
What do you think?

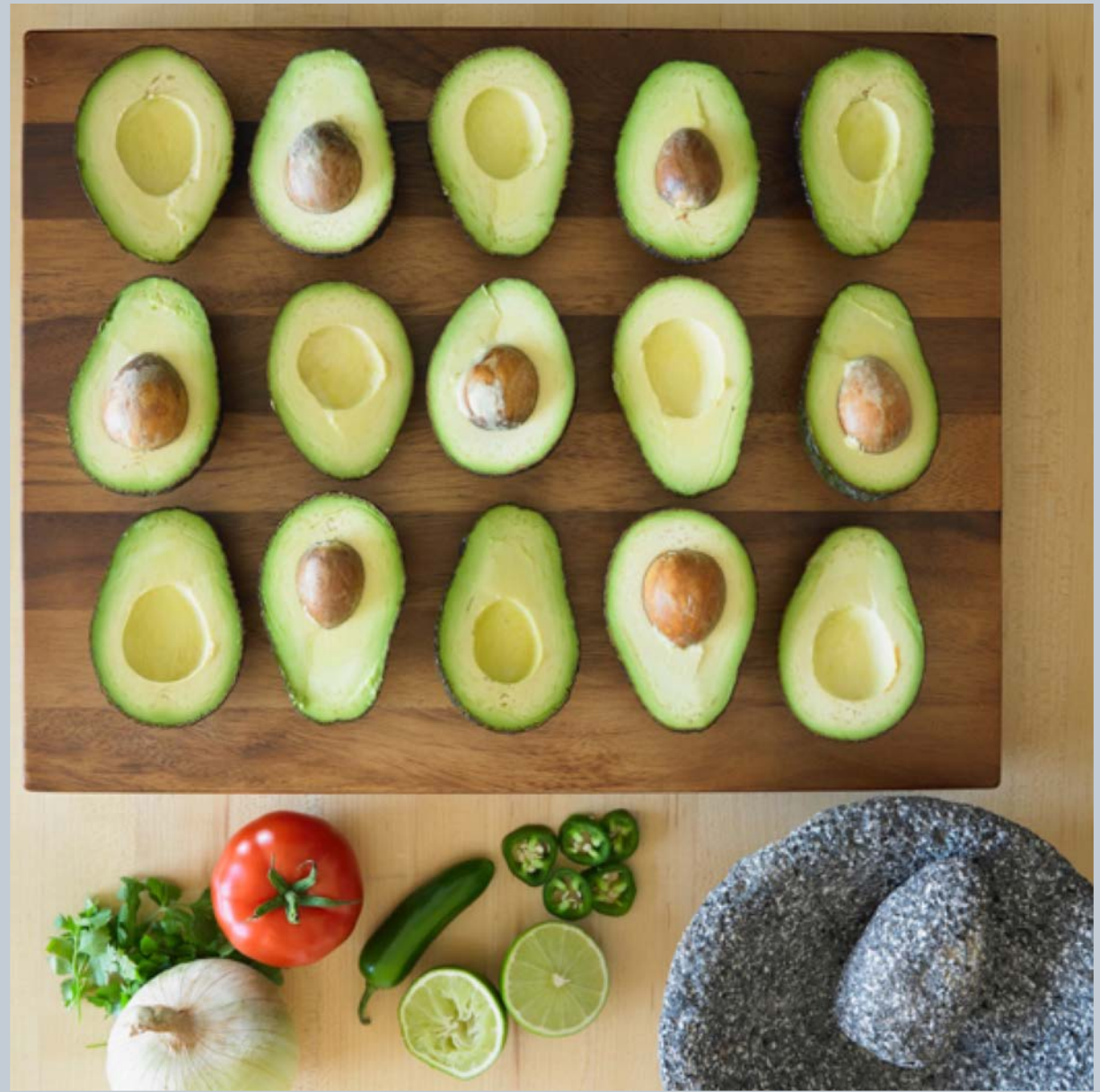


WARM UP:

HOW MANY?

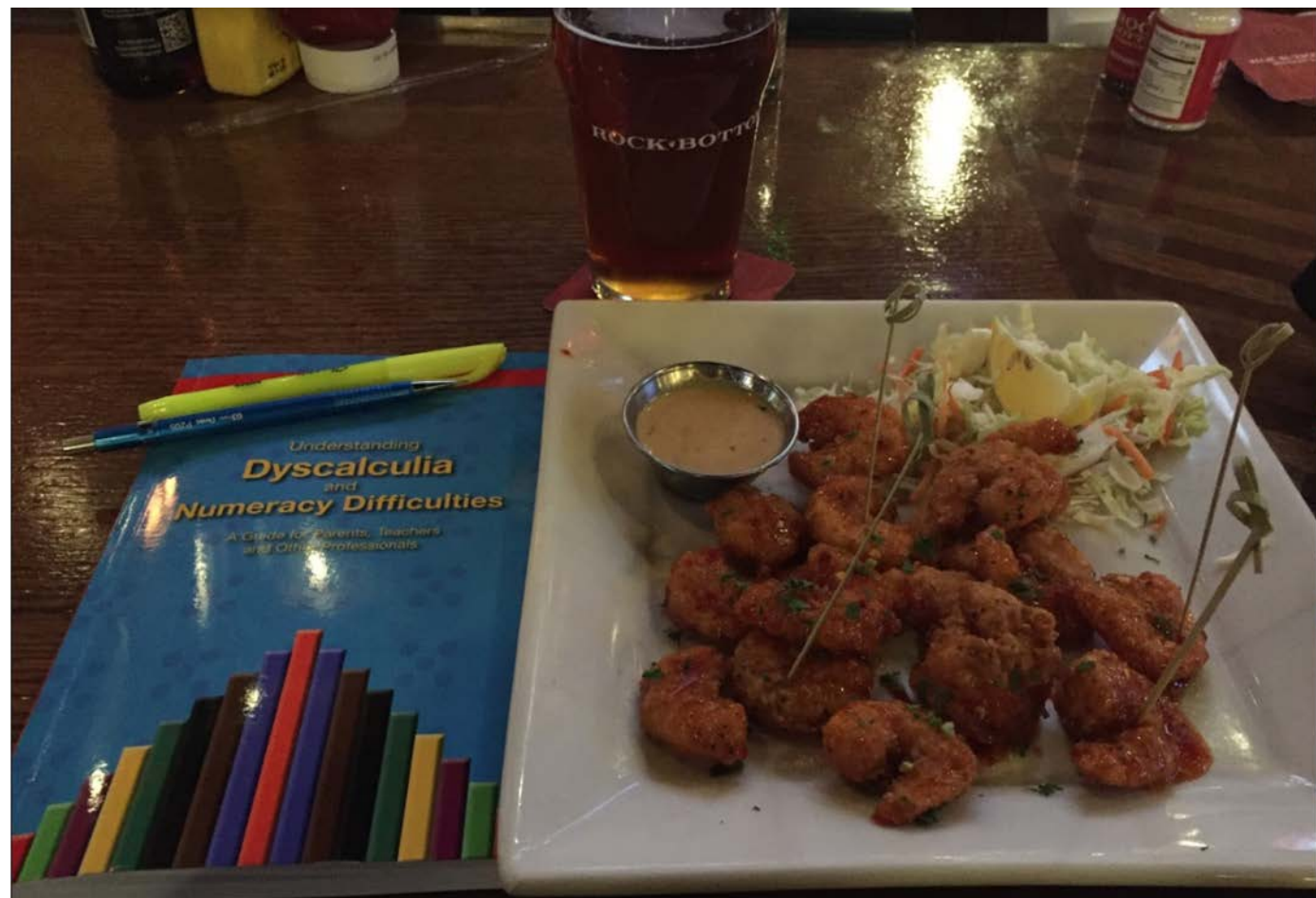
How Many?

Christopher Danielson



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How Many?



REFLECTIONS:

TURN TO A NEIGHBOR
OR YOUR JOURNAL...

1. How did each activity make you feel?
2. What did you learn?
3. Are you relieved that these were our first tasks together?



Geometric Beasts by: Kerby Rosanes

REFLECTIONS:

WHAT IF I HAD ASKED:

Please prove the following trigonometric identity:

$$\tan x + \cot x = \sec x \cdot \csc x$$

Will this change our conversation? With our students?

Proof:

$$\tan x + \cot x = \sec x \cdot \csc x$$

$$\frac{\sin x}{\cos x} + \frac{\cos x}{\sin x} = \sec x \cdot \csc x$$

$$\left[\frac{\sin x}{\sin x} \right] \cdot \frac{\sin x}{\cos x} + \left[\frac{\cos x}{\cos x} \right] \cdot \frac{\cos x}{\sin x} = \sec x \cdot \csc x$$

$$\frac{\sin^2 x + \cos^2 x}{\sin x \cdot \cos x} = \sec x \cdot \csc x$$

$$\frac{1}{\sin x \cdot \cos x} = \sec x \cdot \csc x$$

$$\frac{1}{\sin x} \cdot \frac{1}{\cos x} = \sec x \cdot \csc x$$

$$\csc x \cdot \sec x = \sec x \cdot \csc x$$

$$\sec x \cdot \csc x = \sec x \cdot \csc x$$

QED

Three Goals for us today...

1. We will do Maths.
2. We will challenge our perspectives and messages regarding *who* can do maths.
3. You will leave here knowing how funny I am.

Cause I am – funny. Just sayin.

Our Biases, Our Insecurities:

The Cocktail Party...

“What do you do for a living?”



Our Biases, Our Insecurities:

The Airport Bar...

Lady at the end of bar:

“I am very good at math and I can do it in my head.”



Mathematical Literacy:

- “Mathematical Literacy provides learners with an awareness and understanding of the role that mathematics plays in the modern world.”
- “It enables learners to develop the ability and confidence to think numerically and spatially in order to interpret and critically analyze everyday situations and to solve problems.”
 - South Africa – Department of Education

Honoring our Differences...

- Mathematics is for all.
- Mathematics is developmental.
- It requires work, patience, and determination.
- What ***we*** say matters – it matters deeply.



Kerby Rosanes:
Geometric Beasts

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Our Story Begins...Questions - Visual Spatial

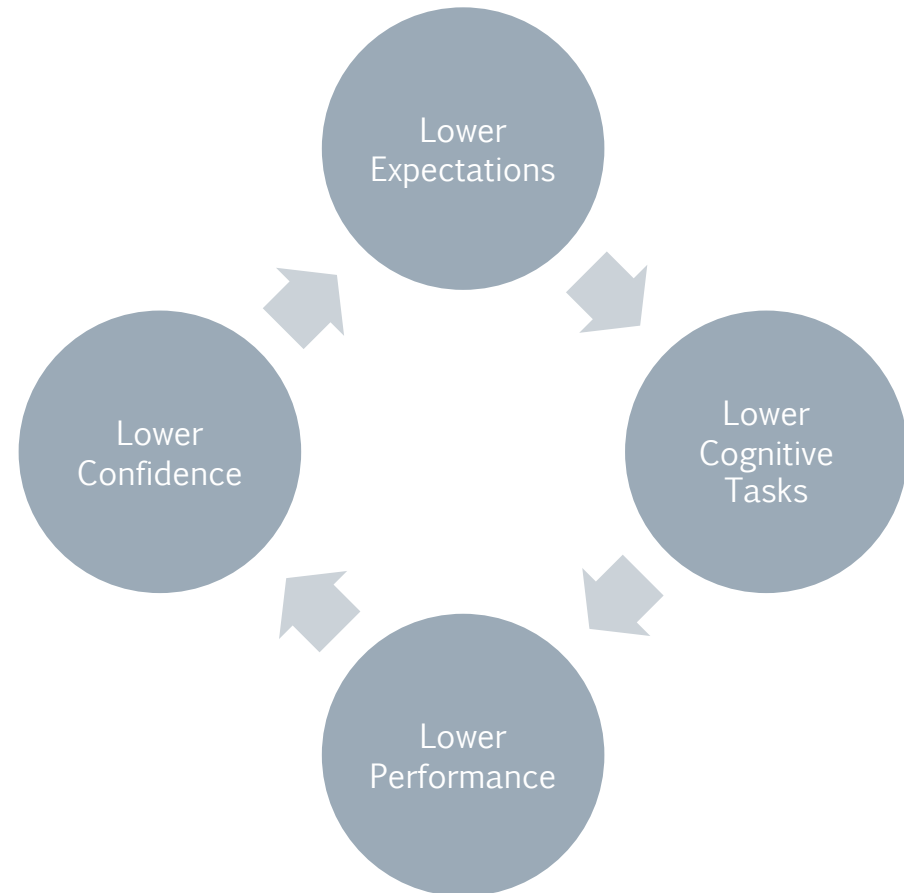


The Take Away: Ask Better Questions!

- › Valuing student thinking is paramount.
- › Mathematical content matters!
- › Integrity of the discipline is essential!
- › How we access it with our students is critical!

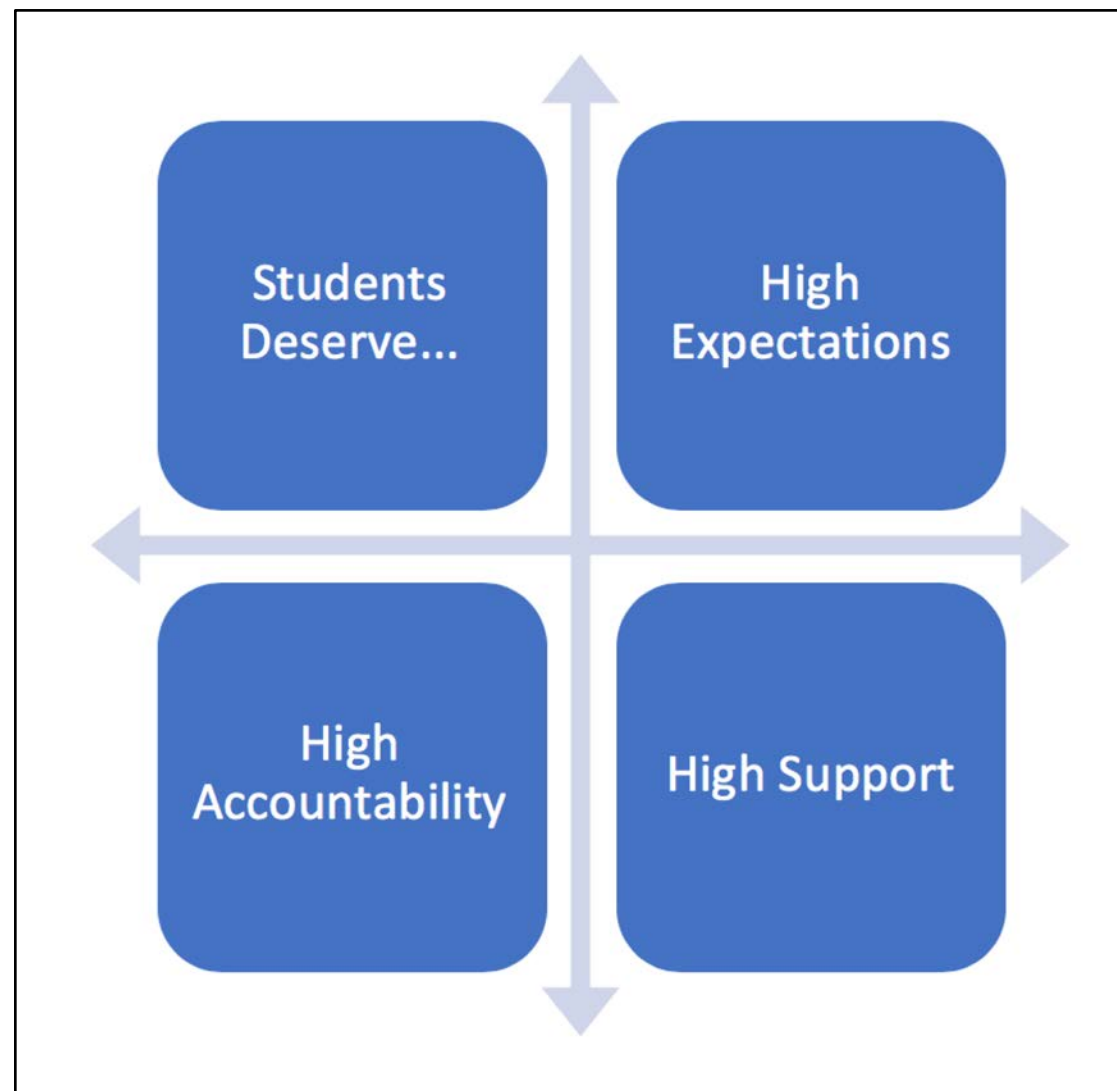
The Pygmalion Effect: Andrew Gael NCTM 2018

- › Our beliefs affect our actions towards others and their corresponding actions.



Denver Academy:

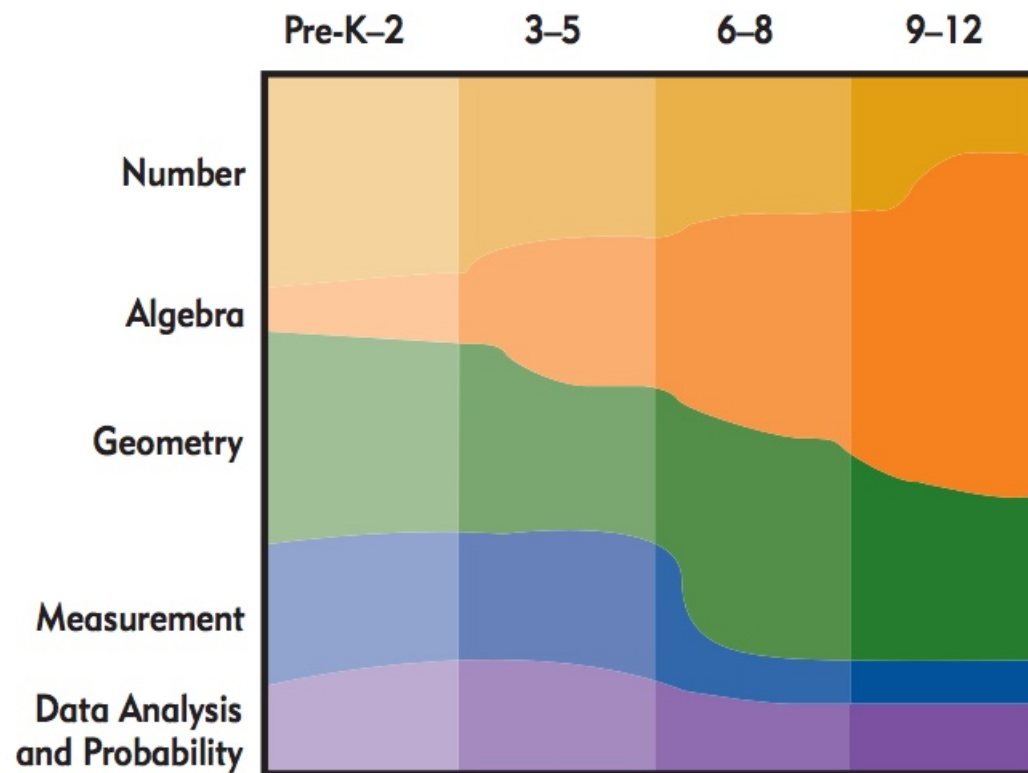
› We work to honor all learners...



A. What do our students need to know?

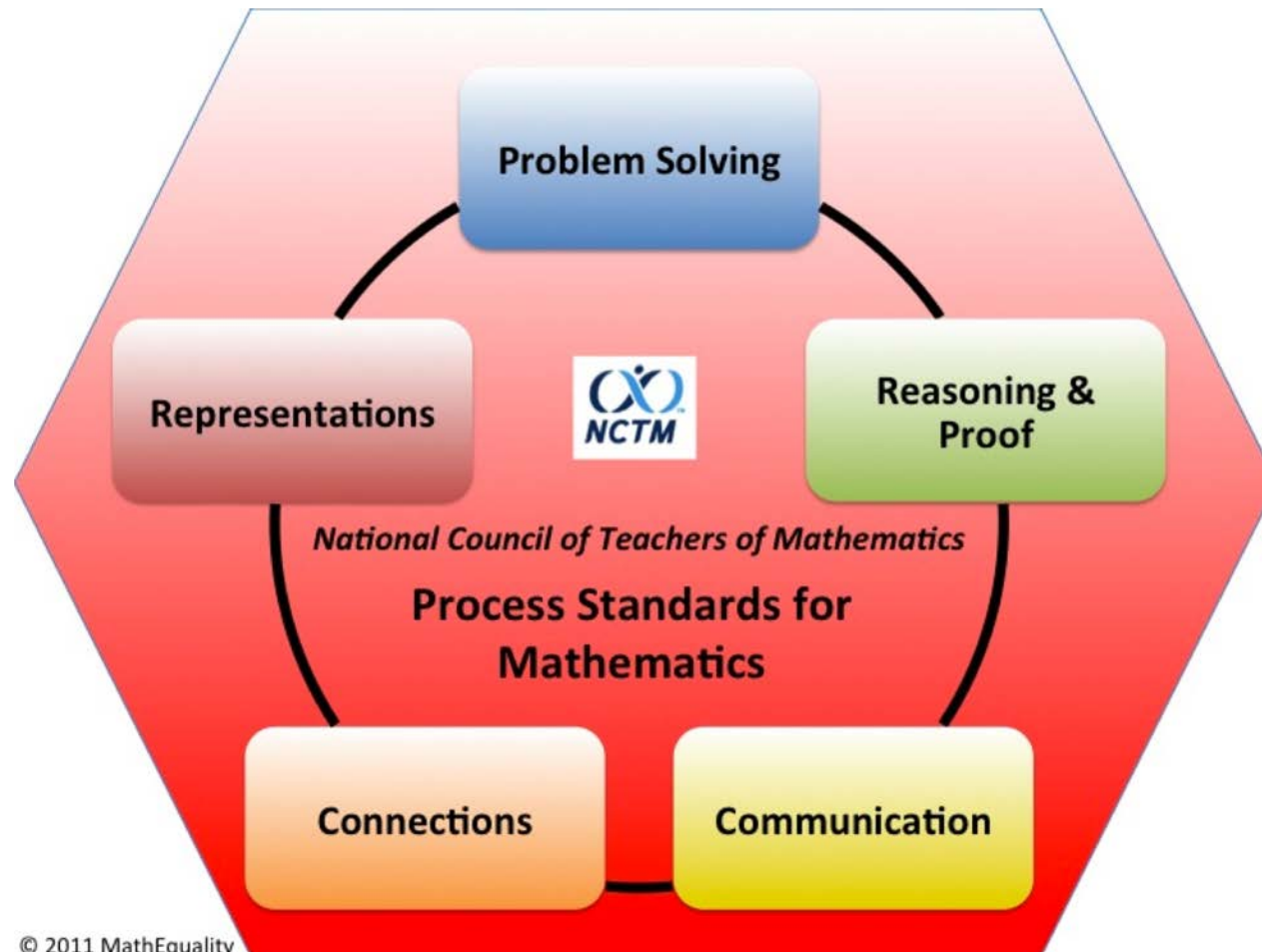
- Content Standards – NCTM – **What do our kids know?**
 - Numbers and Operations, Algebra, Geometry, Measurement, Data Analysis and Probability
- Processing Standards – NCTM – **What can our kids do?**
 - Problem Solving, Reasoning and Proof, Communication, Connections, Representations
- Quantitative Literacy – **How can our kids function?**
 - Being able to successfully navigate in the world mathematically

NCTM Content Standards



*The Content Standards
should receive different emphases
across the grade bands.*

NCTM Processing Standards



Quantitative Literacy

- › Small Bottle – How many?
- › Big Bottle – How many?
- › What do you call the big bottle?



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Does that number make sense?



- › Pam Adams, my wife, is amazing!
- › 18 “true” marathons...plus one!



Boston
2018

New York
2018



Numeracy...

- › “The ability to make sense of numbers and to use them effectively in real life situations.”

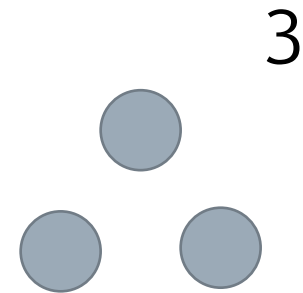
Understanding Dyscalculia and Numeracy Difficulties – Patricia Babbie & Jane Emerson, p. 35

- › As students continue to struggle, the temptation is “to concentrate even harder on a narrow range of activities.”

Mathematics for Dyslexics and Dyscalculics - A Teaching Handbook – Steve Chinn & Richard Ashcroft, p. 269

Early Numerical Development

- › Ability to assess numerical quantity is a profound challenge for students with dyscalculia.
- › Difficulty in linking the representation of numerical quantity to the symbols.



Early Numerical Development

› The “Distance Effect”

› Compare: 3 to 5

Compare: 2 to 8

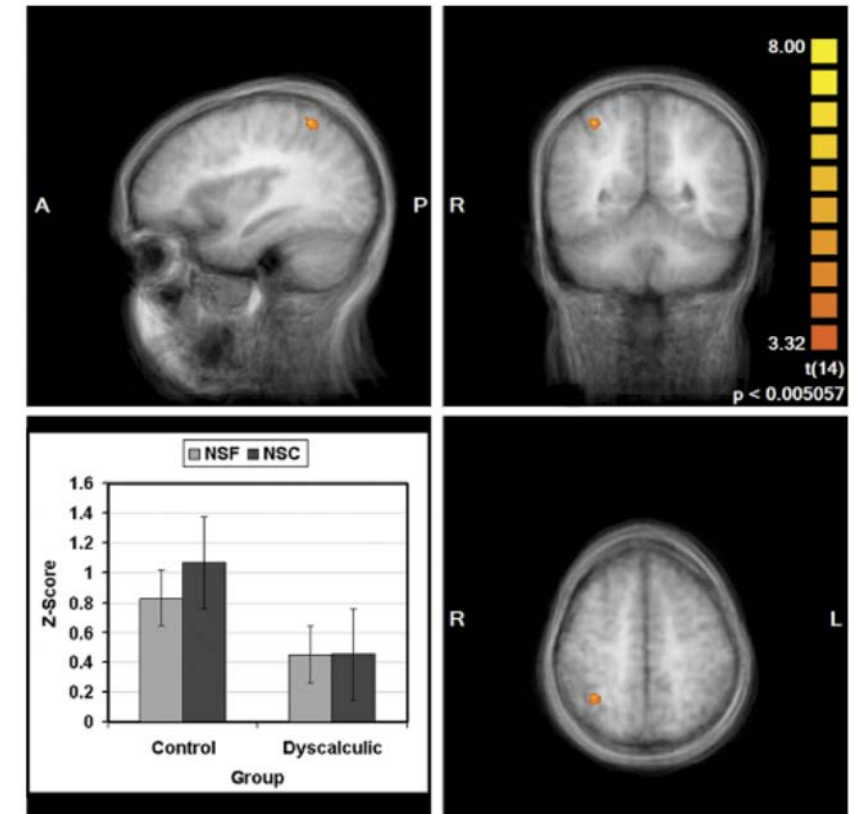
› “Numerosity comparison becomes increasingly difficult as the numerical distance between the comparators is decreased.”

Price, G. R., Holloway, I., Räsänen, P., Vesterinen, M., & Ansari, D. (2007). Impaired parietal magnitude processing in developmental dyscalculia. *Current Biology*, 17(24), R1042–R1043.
<https://doi.org/10.1016/j.cub.2007.10.013>

Research – The Distance Effect

“The the interaction in the brain was characterized by: a stronger distance effect in the control group than in the DD group

suggesting a lack of modulation of parietal numerical processing mechanisms in response to increasing numerical task demands in DD children.”



Price, G. R., Holloway, I., Räsänen, P., Vesterinen, M., & Ansari, D. (2007). Impaired parietal magnitude processing in developmental dyscalculia. *Current Biology*, 17(24), R1042–R1043.
<https://doi.org/10.1016/j.cub.2007.10.013>

Additional Research...

› Two groups: Dyscalculia and non-Dyscalculia.

Congruent Pair: 3 5 Incongruent Pair: 5 3

Students were asked about the two numbers:

Congruent Pair: Physically larger – not big difference.

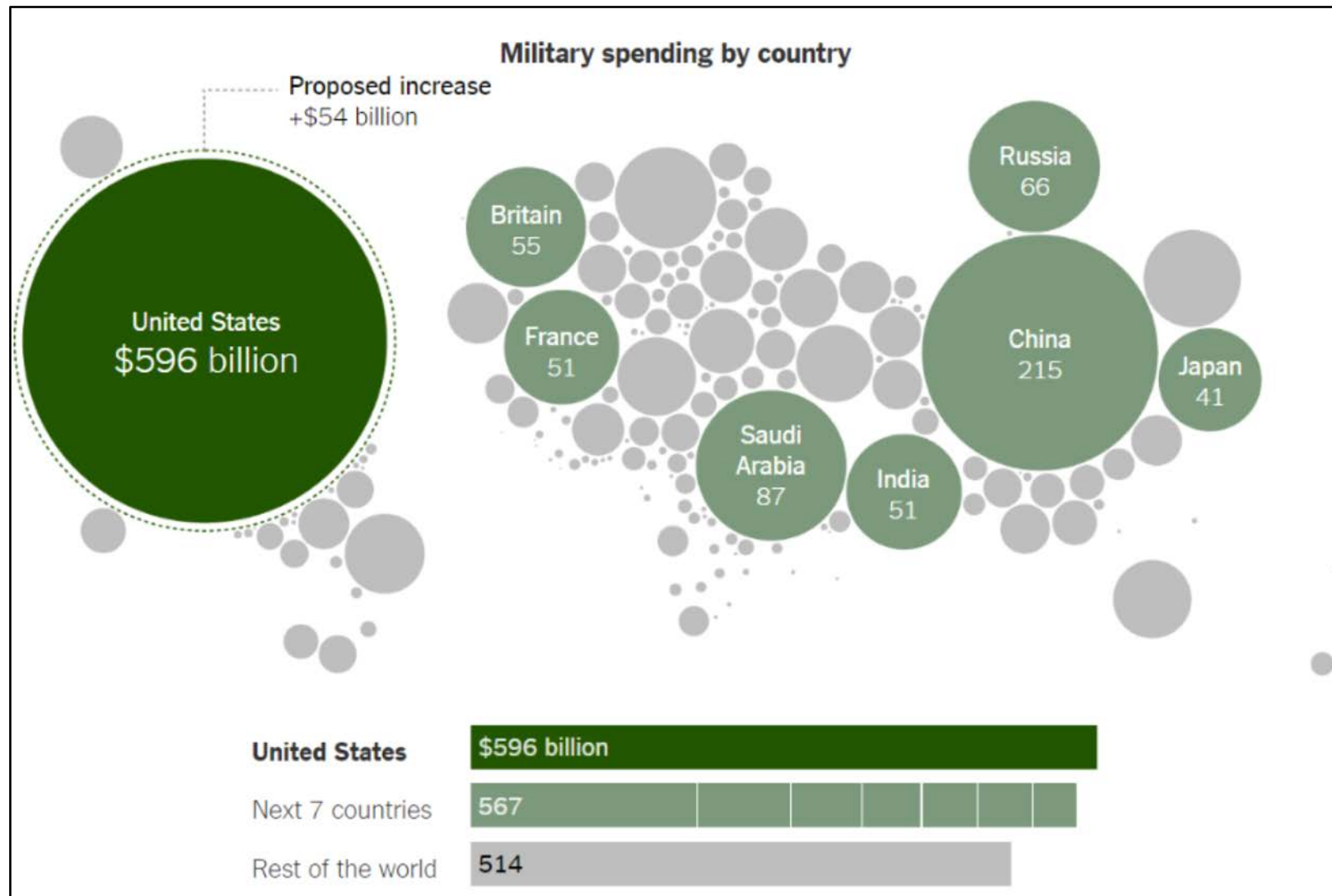
Incongruent Pair: Numerically larger – big difference

Price, G. R., Holloway, I., Räsänen, P., Vesterinen, M., & Ansari, D. (2007). Impaired parietal magnitude processing in developmental dyscalculia. *Current Biology*, 17(24), R1042-R1043.
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Supporting Numerical Development!

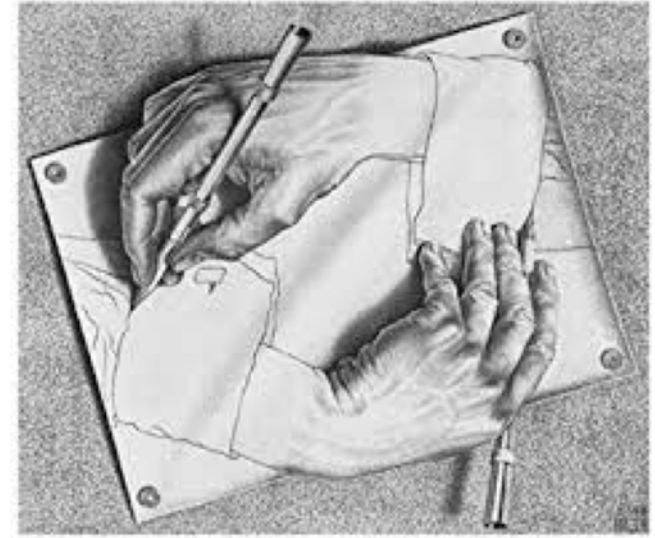
- › We can and should maintain high expectations with high levels of support.
- › What's Going On in This Graph? New York Times
- › Annie Fetter – The Math Forum
- › Notice and Wonder...

What's Going On in This Graph? 2.13.19



We can all do Maths...

- Growth Mindset – Carol Dweck
- Mathematical Mindsets – Jo Boaler
- GRIT: The Power of Passion and Perseverance – Angela Duckworth
- Productive Struggle - NCTM



M.C. Escher

B. Why do our students struggle?

1. Mathematics as a Language and Discipline is Complex
2. Social and Emotional Considerations
3. Environmental Influences
4. Learning Profiles – Maths Learning Difficulties

1. Mathematics as a Language and Discipline

3.

▪ **Conceptual Understanding:**

- Understanding Why

1

▪ **Procedural Fluency:**

- Understanding How

4

▪ **Automaticity & Developmental Progress:**

- Sophisticated and Precise Mathematics

$$\pi \approx 3.141592653...$$

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Our Story Develops...Fluid Reasoning.



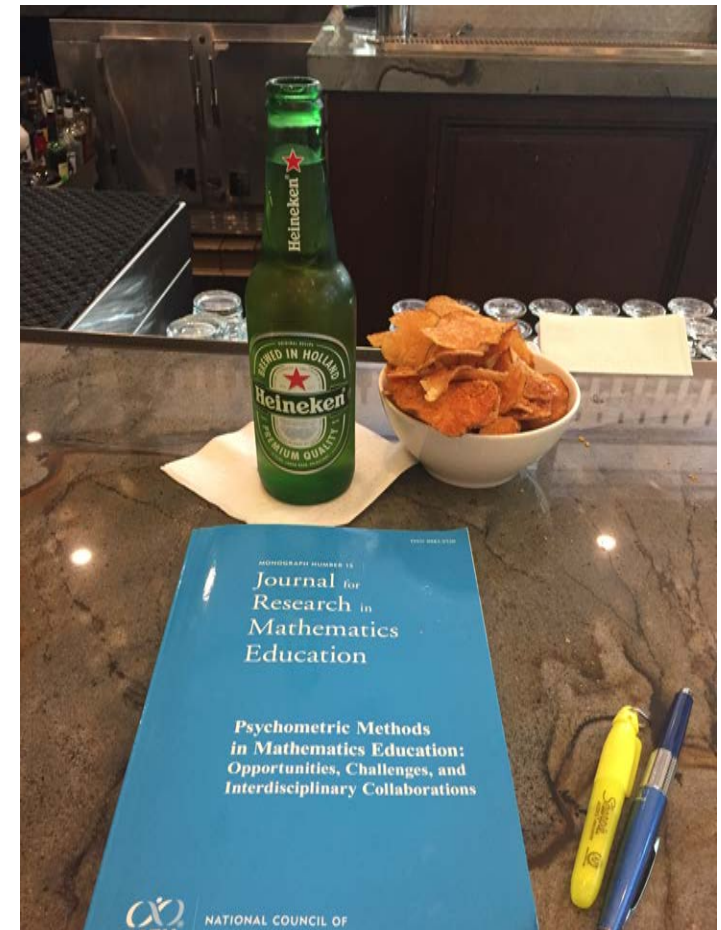
Sturgis[®]
MOTORCYCLE RALLY™

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My Problem?

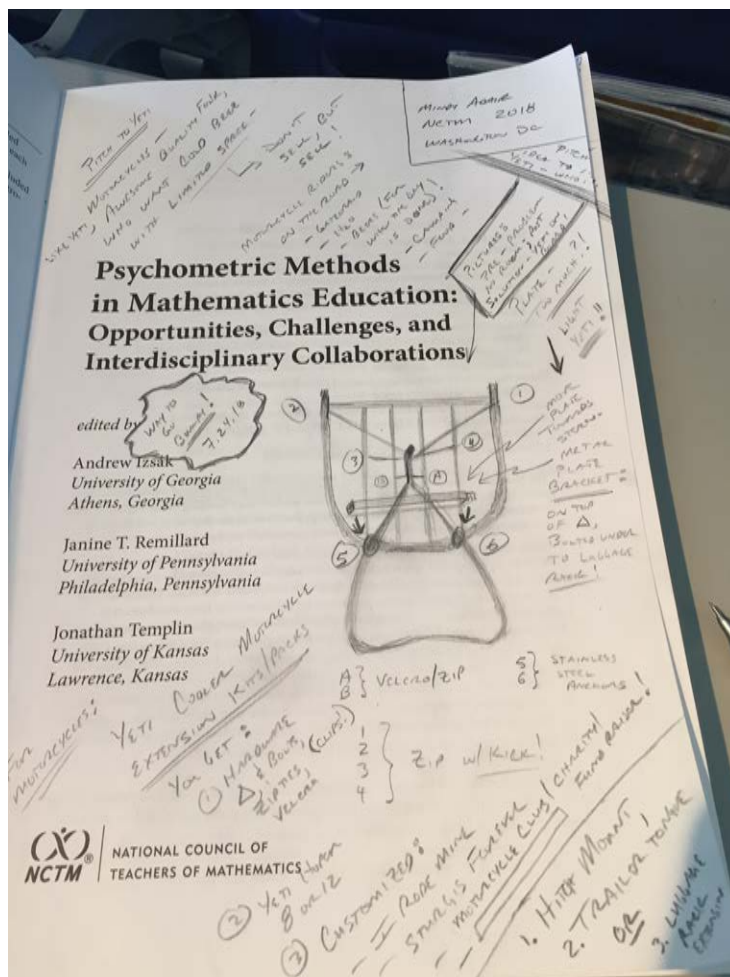


My Yeti needs a place to ride!



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Design Failure!



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Problem solving takes time, energy, and effort!



The Take Away: Tackle Problems!



My dad helped me to think, he helped me to do, he helped me to believe.

Do we help our students believe they can do maths?

2. Social and Emotional Considerations

3.

- **Mindset – Growth or Fixed:**

- I can, I will, I want to...

1

- **Confidence, Insecurities, Anxiety:**

- Yet, not yet.

4

- **Motivation, Interest, Work Attitude:**

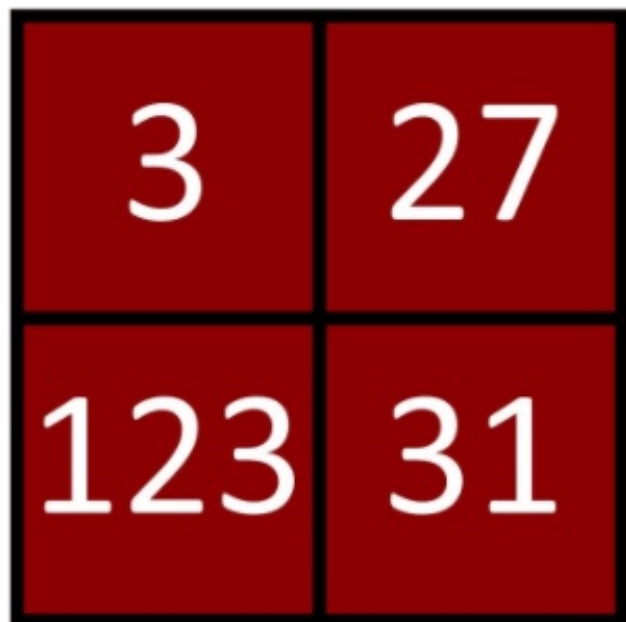
- Character Building

Mathematical Tasks...Low Floor High Ceiling

- › Which One Doesn't Belong – Mary Bourassa
- › Youcubed – Jo Boaler
- › Visual Patterns – Fawn Nguyen
- › Estimation 180 – Andrew Stadel

Doing Mathematics is Empowering!

Which One Doesn't Belong:



Mary Bourassa <http://wodb.ca/>
and Christopher Danielson

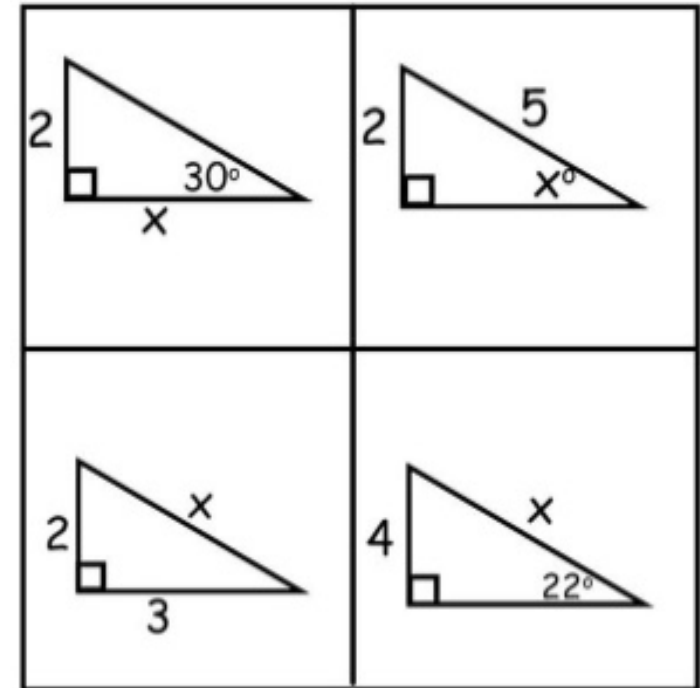
“Do math and you can do anything!” - NCTM

Which One Doesn't Belong:

A.

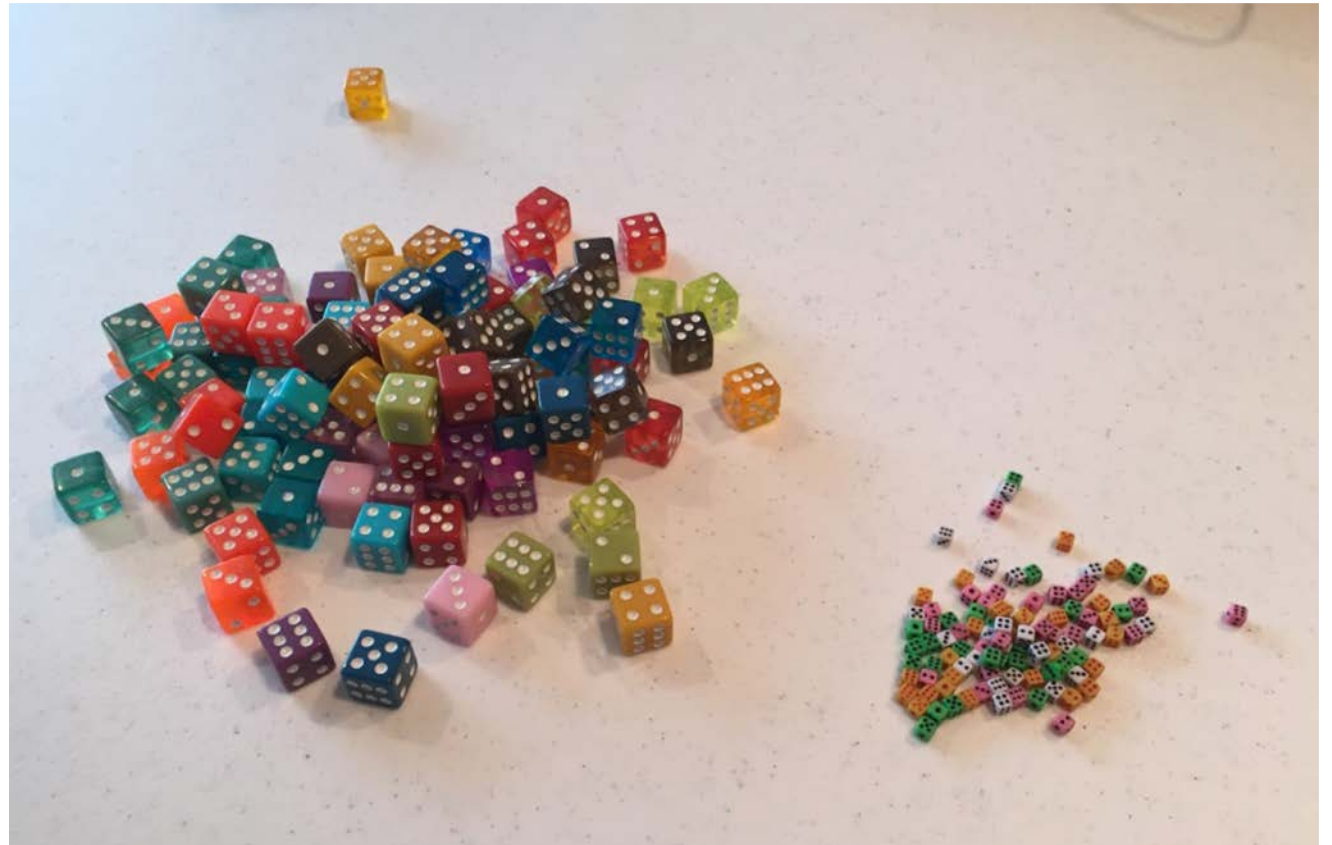


B.



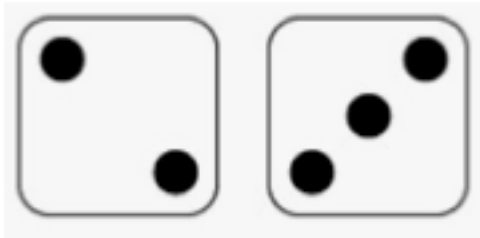
Let's compare...

- › How many big?
- › How many little?
- › What is the scale difference?



Let's Bowl! Rolling Number Cubes...

› Roll #1:



› Roll #2:



Maths Tasks 2019 Mindy Adair, Ph.D. 1

Bowling: Roll two dice. Those are your seed numbers. Use any mathematical operation to get the numbers 1 – 10 using only those two numbers. When (if) you get stuck – you get a second roll.

Scoring. After you have exhausted the second roll options – **count up the number left** (total of the pins) **and that is your score for that frame. Low score wins.**

Name: _____

1	2	3	4	5	6	7	8	9	10	Total
6	2									
2										

Roll #1
3, 2

Roll #2
4, 2

<p>Frame 1 equations</p> <p>$3 + 2 = 5$ $2^3 = 8$</p> <p>$3 - 2 = 1$</p> <p>$3 * 2 = 6$</p> <p>$3^2 = 9$</p> <p>$\sqrt{3^2} = \sqrt{9} = 3$</p>	<p>$4 - 2 = 2$</p> <p>$\sqrt{4} * 2 = 2 * 2 = 4$</p> <p>2 LEFT</p>
<p>Frame 2 equations</p>	

Presented by Dr. Barbara Dougherty at Math on the “Planes” - Denver, CO 2.23.18

Four Fours!

Four Fours:

Make all the numbers from 1 to 20 using exactly four fours and any mathematical operation. You must use four fours. To extend the problem – expand to the numbers from 1 to 100. Students can expand to 100.

Taken from: Jo Boaler [Mathematical Mindsets](#) page 80.

Four 4's Problem



1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16
17	18	19	20

Mathematical Anxiety...

- › Unnecessary Pressure
- › Timed Expectations
- › Public Situations
- › Lack of Confidence



Recent Research...

- › Dr. Jo Boaler & Tanya LaMar – Stanford
- › “Valuing Difference and Growth: A Youcubed Perspective on Special Education” – 2019
- Difference in Maths Learning
- Maths Anxiety Affects Achievement

- › Dr. Sian L. Beilock – President at Barnard College
- › “Math Performance in Stressful Situations” – 2008
- Situation Induced Pressure
- Depleted Cognitive Resources

3. Environmental Influences

3.

- **Parents and Teachers:**

- Attitudes and Content Knowledge

1

- **Curriculum - Coherent Scope and Sequence:**

- Precise, Sophisticated, & Accurate Language; Pace

4

- **Resources – Materials and Technology:**

- “Easy to Use and Useful!” – Fred Davis - 1989

Dr. Wendy Mogel

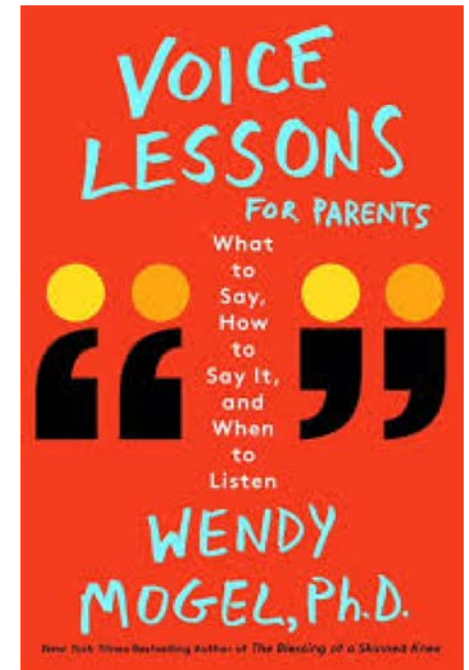


› Keynote Speaker at our 2019 Symposium

“Children will lead you on an incredible journey. If they trust you. If you make the time, and if you are willing to follow.”

-Dr. Wendy Mogel

Relationships with students:
How do we make them feel in
the moment? Down the line?



Field Terms of the Spoken Word

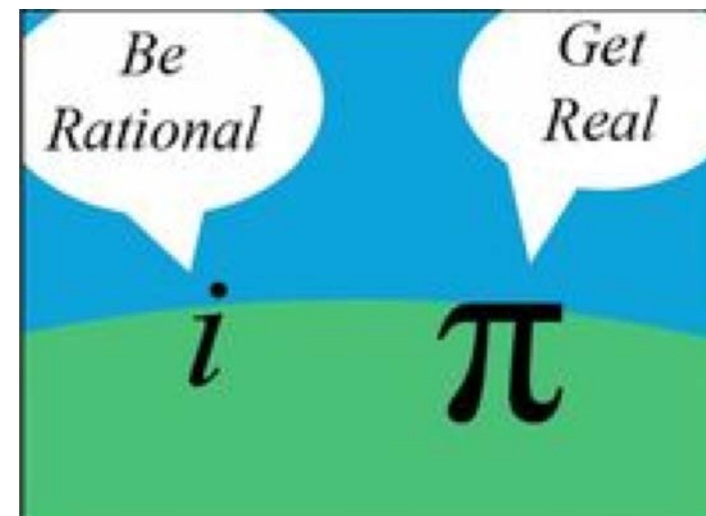
Pitch is the register of your voice	Volume is a formidable tool that is frequently abused.
Tempo is the rate of speech.	Pausing signals a transition to a new point or gives your child the chance to absorb and idea.
Tone is the emotional quality of your voice.	Cadence is the rhythm of your speech.
Lexicon is the vocabulary you use with your child.	Facial expressions should match your voice & words.

Wendy Mogel. *Voice Lessons: What to Say, How to Say It, and When to Listen*. New York: Scribner. (pages 32)

What we say matters...deeply!

› What do you say to your students/kids regarding mathematics that is:

- ☐ Discouraging...
- ☐ Encouraging...



Promoting Curiosity and Mathematical Thinking!

PLEASE DON'T SAY...

- › It is easy, let me show you.
- › I am just not a math person.
- › You are so smart!

HOW ABOUT...

- › What do you notice, wonder, think?
- › Help me understand your thinking.
- › I am proud of your effort.

Our Story Continues...Working Memory.

- › Our First Trip...Honesty!
- › Situational Awareness...



Our Second Trip...

Learning to observe...



DC Metro

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Motivate

Plan

Execute



Review

Modify

Have a Drink

Adapt

Additional
Support



DC Metro

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TO THE MALL

STATION → MT. VERNON
7th


YELLOW TO HUNTINGTON
GREEN TO BRANCIT

OFF AT L'ENFANT PLAZA

TRANSFER

BLUE TO FRANCONIA
ORANGE TO VIENNA
SILVER TO WIEITL

OFF AT SMITHSONIAN



MARRIOTT

BACK TO HOTEL

STATION → SMITHSONIAN

BLUE TO LARGO TOWN
SILVER TO LARGO TOWN
ORANGE TO NEW CARROLTON

OFF AT L'ENFANT PLAZA

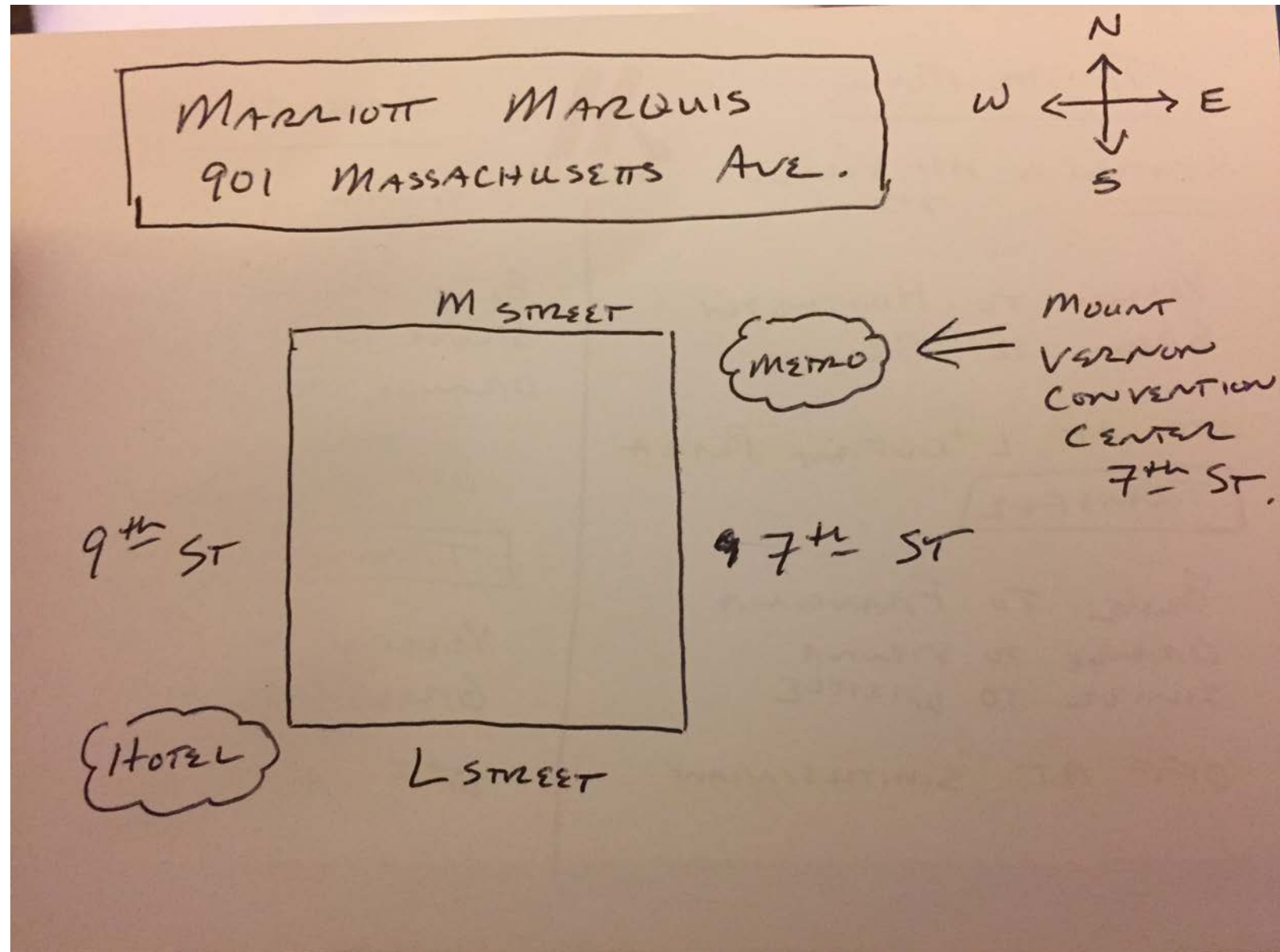
TRANSFER

YELLOW TO FORT TOTTEN
GREEN TO GREENBELT

OFF AT MT. VERNON
7th

DC Metro

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Take Away: Provide Resources!

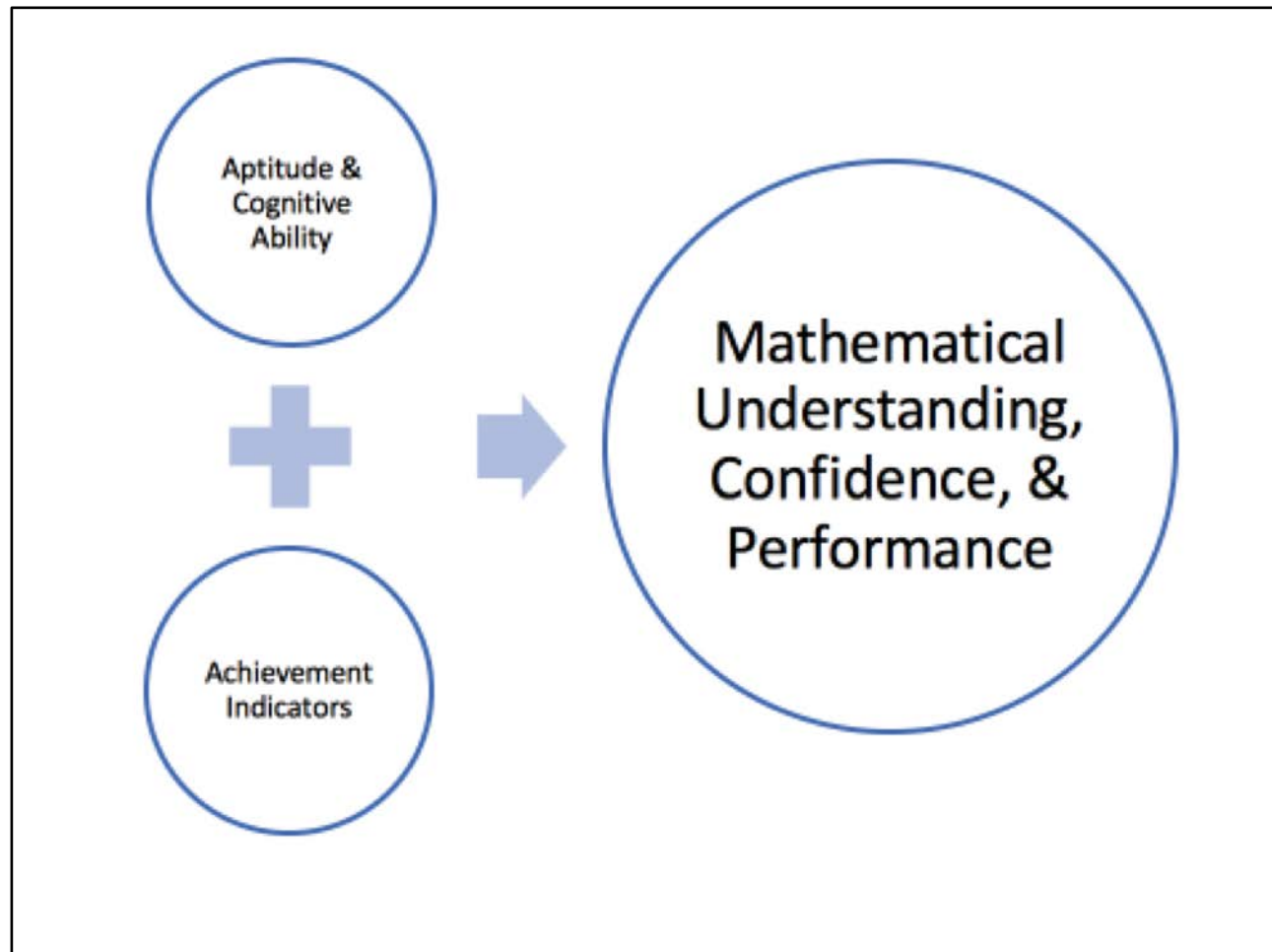
- › Fred Davis – 1989:
Technology Acceptance
Model:
- › “Easy to Use & Useful”

My mom helps me to process,
value relationships, and care.

Do we help our students know
that we care?



What is the nature of the struggle?



Struggles with Maths...Collect Data.

ACHIEVEMENT TESTS

Measure of what one has learned.

- › **ACT**
- › IOWA Test of Basic Skills
- › SAT II (subject mastery)
- › ISEE (Independent School Entrance Exam)
- › WIAT – III (The Wechsler Individual Achievement Test)
- › KTEA – III (Kaufman Test of Educational Achievement)

APTITUDE-COGNITIVE ABILITY

Attempts to predict one's ability to learn new skills and/or cognitive ability.

- › SAT (Scholastic Aptitude Test)
- › PSAT (Preliminary Scholastic Aptitude Test)
- › **WISC-V (Wechsler Intelligence Scale)**
- › Woodcock-Johnson Tests of Cognitive Ability
- › Stanford-Binet Test of Cognitive Ability

B. Review - Why do our students struggle?

1. Mathematics as a Language and Discipline is Complex
2. Social and Emotional Considerations
3. Environmental Influences
4. **Learning Profiles – Maths Learning Difficulties**

4. Maths Learning Difficulties

3.

- **Dyscalculia:**

- Difficulty with Number Concepts and Facts

1

- **Dysgraphia:**

- Difficulty with Written Language, Handwriting

4

- **Dyspraxia:**

- Difficulty with Fine and Gross Motor Skills

What is Dyscalculia?

The definition below comes from the American Psychiatric Association (2013):

“Developmental Dyscalculia (DD) is a specific learning disorder that is characterized by impairments in learning basic arithmetic facts, processing numerical magnitude and performing accurate and fluent calculations.

These difficulties must be quantifiably below what is expected for an individual's chronological age, and must not be caused by poor educational or daily activities or by intellectual impairments.”

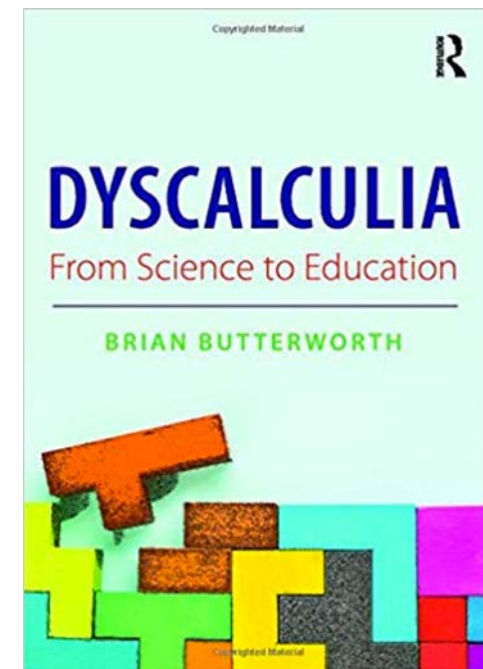
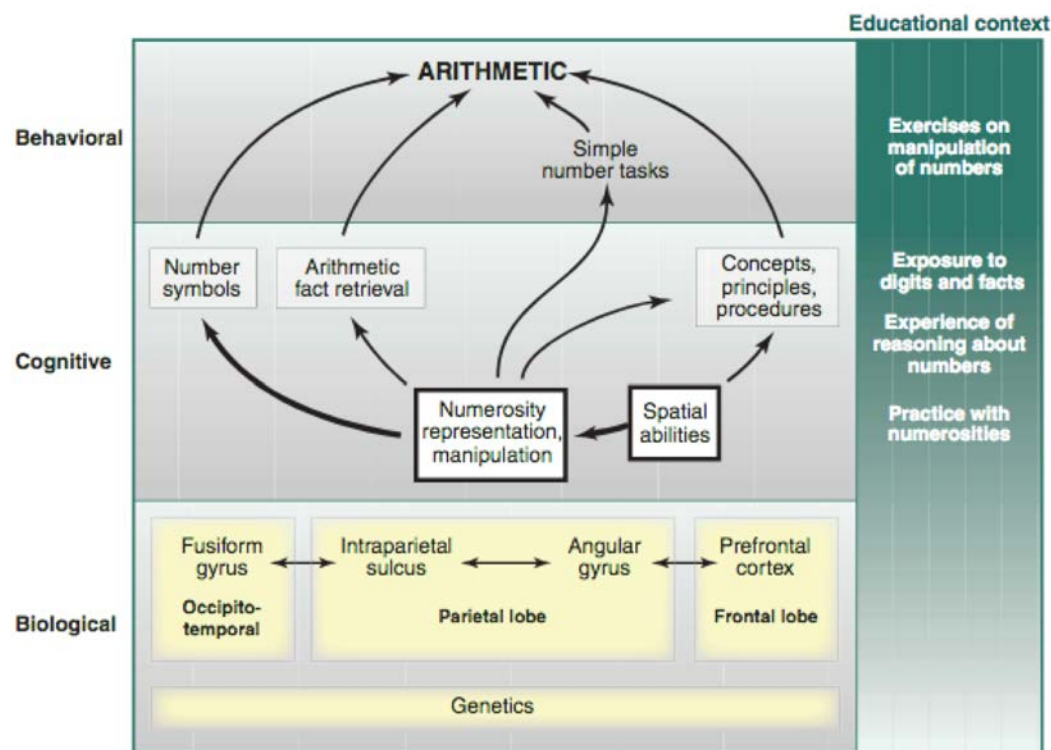
Maths Learning Difficulties - Dyscalculia

- Difficulty with number concepts and facts.

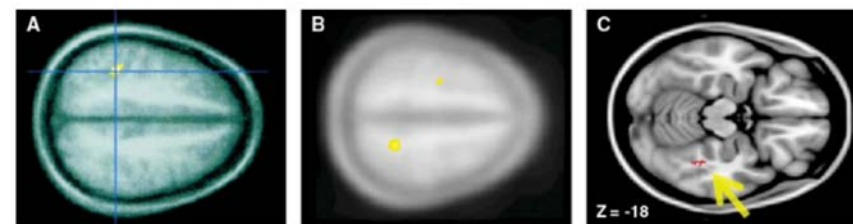
Dyscalculia	Indicators	Support
Unique Presentations for students	Trouble recognizing numbers and symbols	Avoid “Learned Helplessness” and passive learning
Visual Spatial Component	Lack of Fluidity with numbers (number sense)	Attend to memory and attention - review
Language of Math	Trouble with counting, estimating, patterns, rules, measurements	Metacognition – reflect on thinking & learning. Direct Instruction.

Dyscalculia and the Brain

- › Arithmetic Skills Affected
- › Brain region responsible – Left Parietal Lobe
- › Differences in Numerical Processing



Butterworth, 2019

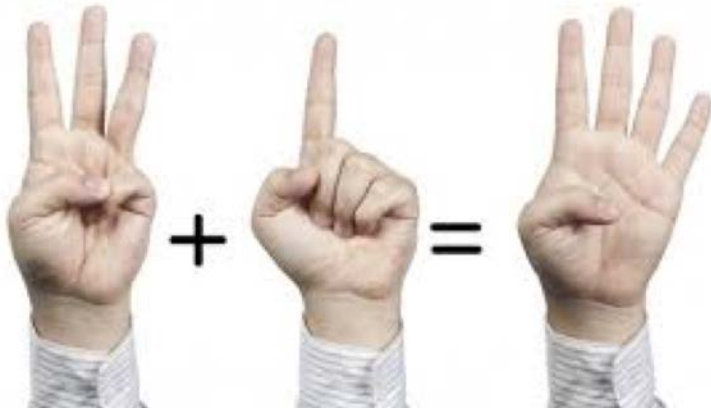


Dyscalculia: From Brain to Education, Brian Butterworth, 2011

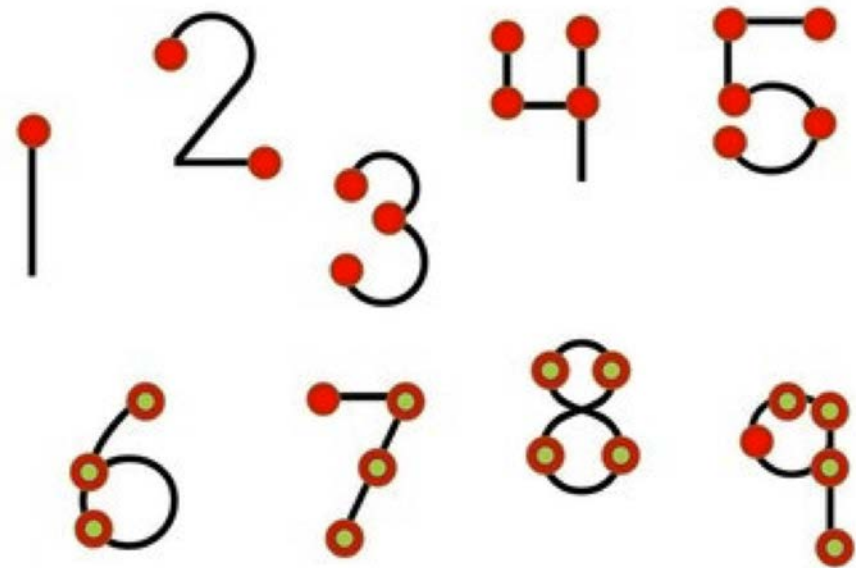
Maths Learning Difficulties - **Dyscalculia**

- Difficulty with number concepts and facts.

Use of Fingers



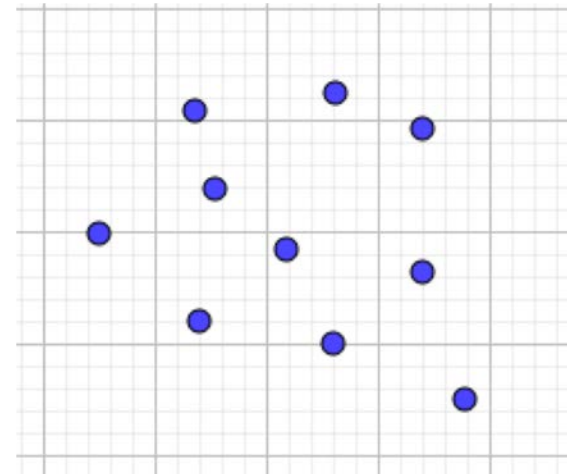
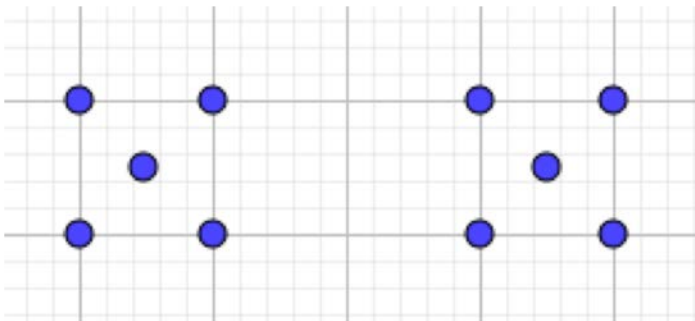
Touch Points (Math)



Maths Learning Difficulties - Dyscalculia

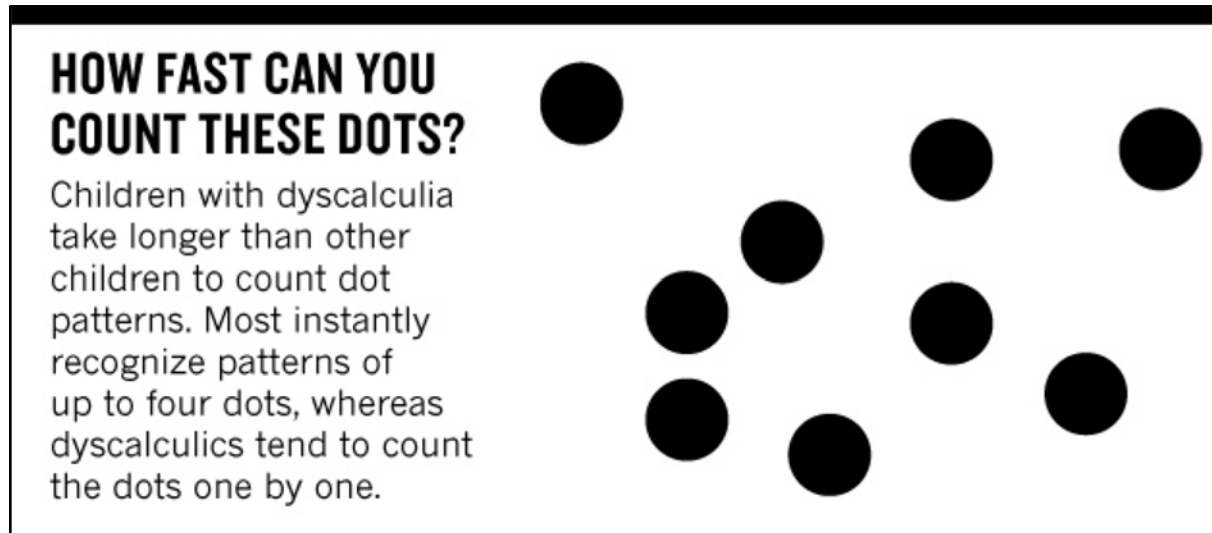
- Developing a conceptual understanding of a number.
- Creating a structured approach that supports learning.

“Using consistent and recognizable patterns for objects enhances the ability to recognize quantity, for example ten.” – Chinn, 2017



Maths Learning Difficulties - Dyscalculia

- Difficulty with number concepts and facts.
 - › Subitizing “is the ability to ‘see’ a small amount of objects and know how many there are without counting.”

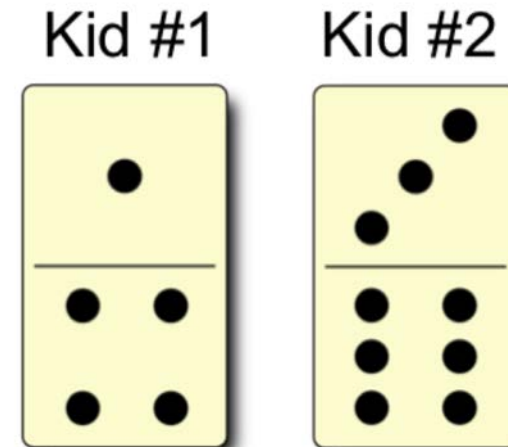


Maths Learning Difficulties - Dyscalculia

- Difficulty with number concepts and facts.

Low Floor High Ceiling Tasks – Dominos games:

- › Sorting by order
- › Addition – Subtraction
- › Multiplication
- › Fractions



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Math Facts...

- › Matter!
- › Should be reviewed.
- › Assistive Technology...

Name: _____ Date: _____

Cute Lion

10+0	5+5	9+1	6+4	3+7	4+6	8+2	9+1	9+1	8+2	4+6	4+6	9+1	9+1	9+1	10+0	4+6	4+6	8+2
1+9	2+8	8+2	7+3	0+1	9+1	3+0	8+2	0+3	6+4	3+0	9+1	1+1	8+2	0+1	3+7	2+8	6+4	0+10
2+8	10+0	8+2	1+1	0+1	2+1	2+0	2+0	0+2	1+1	0+3	1+1	3+0	1+1	3+0	0+1	0+10	9+1	0+10
8+2	2+8	0+3	1+0	1+0	1+2	0+3	0+2	1+2	2+1	2+1	2+0	2+0	2+0	0+1	1+0	1+0	3+7	1+9
3+7	7+3	5+5	0+2	0+2	2+2	6+0	1+3	2+2	2+3	4+2	2+3	6+0	1+3	0+3	0+3	2+8	0+10	1+9
1+9	2+8	1+2	0+2	0+3	2+2	0+2	1+3	0+4	3+3	1+5	4+2	1+0	0+5	0+1	0+3	0+3	9+1	5+5
8+2	6+4	4+6	3+0	0+2	3+3	1+2	0+5	1+2	0+3	2+0	0+4	0+3	2+4	3+0	0+2	8+2	7+3	3+7
0+10	9+1	1+1	2+0	1+1	1+5	1+4	2+4	0+0	1+2	0+0	3+3	0+4	0+4	1+0	0+2	2+0	7+3	7+3
1+9	0+10	8+2	3+0	0+1	2+4	5+1	0+0	0+0	0+0	0+0	0+0	6+0	5+1	1+1	2+0	7+3	6+4	10+0
10+0	4+6	2+0	1+1	2+0	3+2	2+4	0+0	0+0	0+0	0+0	0+0	0+4	3+1	1+0	2+1	2+1	4+6	9+1
2+8	3+7	6+4	2+0	2+1	0+1	2+1	2+1	3+0	3+0	2+0	1+1	1+2	0+1	1+1	2+0	1+9	8+2	4+6
2+8	2+8	0+3	3+0	1+2	0+3	0+2	2+0	0+2	1+0	0+2	1+0	1+2	0+1	0+2	1+1	3+0	10+0	3+7
8+2	3+7	4+6	0+2	10+0	0+1	8+2	0+4	2+2	2+2	3+1	2+4	7+3	0+1	6+4	0+1	0+10	0+10	8+2
0+1	3+7	4+6	4+6	7+3	1+9	1+3	4+2	6+0	0+0	3+3	2+4	5+1	1+9	3+7	1+9	9+1	5+5	8+2
6+0	1+9	1+9	3+7	9+1	9+1	5+1	2+4	0+0	0+0	0+0	1+4	5+0	1+9	0+10	4+6	6+4	8+2	1+9
6+0	4+5	6+2	8+0	3+1	0+4	5+0	4+1	0+0	0+0	0+0	4+2	6+1	7+1	4+4	4+5	3+4	4+4	2+7
0+4	2+3	1+4	5+1	1+5	2+6	3+3	4+2	2+4	0+0	4+2	0+6	8+1	2+6	9+0	2+5	2+7	0+8	1+7
2+7	4+5	1+6	4+5	7+1	2+6	4+2	5+0	0+6	3+2	0+5	1+3	1+4	3+6	3+6	6+1	7+0	3+5	3+4
5+2	3+4	0+8	4+4	9+0	7+1	1+6	7+2	1+7	8+0	5+2	0+7	3+5	7+1	6+2	4+4	9+0	2+7	6+2
1+6	7+1	7+1	0+8	2+7	2+6	2+7	7+1	6+2	6+2	3+4	3+6	3+4	3+4	0+8	7+1	1+8	3+4	1+6

Key:

0	Tan
1,2,3	Brown
4,5,6	Orange
7,8,9	Green
10	Blue

www.coloringsquared.com

Math Automaticity

› Continue to work on mathematical facts.

› Don't get stuck!

Name:

Date:

Cute Lion

4+6	6+4	7+3	8+2	9+1	4+6	0+10	3+7	5+5	1+9	5+5	2+8	5+5	10+0	7+3	7+3	4+6	5+5	4+6
5+5	1+9	2+8	6+4	3+0	1+9	1+0	7+3	3+0	4+6	0+3	4+6	1+0	5+5	1+0	5+5	8+2	10+0	0+10
7+3	8+2	1+9	1+0	0+3	0+1	1+1	1+0	1+2	2+1	1+1	0+2	3+0	2+0	1+1	0+3	8+2	5+5	8+2
9+1	10+0	1+0	0+1	2+0	1+0	2+1	1+1	1+1	1+1	2+0	0+3	2+0	1+2	0+3	1+0	1+1	6+4	1+9
3+7	4+6	6+4	2+0	0+2	0+6	0+6	4+2	0+6	2+4	4+0	4+2	2+4	5+1	1+1	1+2	8+2	10+0	10+0
10+0	8+2	1+1	1+0	3+0	4+1	1+0	5+0	3+2	1+4	2+2	4+2	3+0	1+5	2+1	3+0	3+0	3+7	2+8
0+10	10+0	4+6	1+1	1+2	2+2	1+2	1+4	0+3	2+0	1+1	3+3	2+0	6+0	0+1	2+0	9+1	8+2	9+1
3+7	7+3	0+3	3+0	3+0	1+5	1+4	4+0	0+0	1+2	0+0	0+4	4+0	5+1	3+0	2+1	1+2	3+7	8+2
1+9	2+8	4+6	0+3	2+1	4+0	0+5	0+0	0+0	0+0	0+0	0+0	5+1	3+2	1+2	1+2	3+7	10+0	10+0
7+3	10+0	2+0	1+2	1+1	2+2	0+5	0+0	0+0	0+0	0+0	0+0	4+2	0+6	3+0	1+1	3+0	4+6	1+9
8+2	5+5	8+2	2+0	0+2	0+2	0+3	1+0	2+0	1+1	0+1	2+0	2+1	2+1	0+2	2+1	1+9	1+9	3+7
6+4	5+5	2+1	1+1	1+2	1+1	1+1	2+0	0+1	2+1	1+2	1+1	0+3	0+3	0+1	3+0	0+2	0+10	2+8
9+1	0+10	2+8	1+1	10+0	2+1	3+7	2+2	1+4	4+0	6+0	6+0	2+8	1+0	10+0	0+3	9+1	5+5	1+9
0+2	4+6	9+1	6+4	2+8	10+0	3+2	4+0	2+4	0+0	0+4	5+1	6+0	1+9	3+7	9+1	7+3	1+9	10+0
1+4	7+3	8+2	9+1	8+2	7+3	3+2	2+3	0+0	0+0	0+0	1+5	4+0	8+2	10+0	5+5	7+3	10+0	1+9
5+1	2+5	2+6	7+1	5+1	0+6	1+4	1+5	0+0	0+0	0+0	1+3	3+4	1+8	0+8	0+8	6+2	2+6	0+7
4+2	0+5	0+5	3+1	4+2	3+4	5+1	3+2	5+1	0+0	2+2	3+3	2+5	8+1	4+4	0+7	3+5	7+2	6+2
5+2	3+4	1+6	2+6	3+6	3+5	1+3	4+0	0+4	0+6	2+2	0+5	5+1	1+6	0+8	3+6	1+8	4+4	3+6
6+2	4+4	8+1	0+7	3+6	1+7	1+7	2+6	7+0	5+2	3+4	7+0	0+9	3+4	4+5	6+2	8+1	2+5	8+1
2+7	2+6	6+1	4+4	8+1	0+7	0+8	1+8	7+2	7+1	0+7	7+0	1+8	2+6	0+7	6+1	3+5	7+2	5+2

Maths Learning Difficulties - Dysgraphia

- Difficulty with written language, handwriting.

Dysgraphia	Indicators	Support
This can impact the written language	Trouble organizing thoughts and putting them into writing	Access to class notes
It can affect both information and motor processing	Unreadable handwriting, slow and labored writing	Oral assessments
This can impact handwriting	Odd spacing of words and letters, poor punctuation skills	Extended time, typing assignments

Maths Learning Difficulties - Dyspraxia

- Difficulty with fine and gross motor skills.

Dyspraxia	Indicators	Support
Can affect a person's conception of how his/her body moves in space	Trouble grasping a pencil	Speech to text technology
Can have physical awkwardness	Slow and messy handwriting	Practice and Repetition
May avoid situations (games/athletics) that draw attention	Trouble throwing a ball, using buttons	Larger print, more space, keyboarding

Maths Learning Difficulties – Dyspraxia and Dysgraphia

› Support

- Occupational therapy to help with balance and coordination
- Perceptual motor training – hear, see, move
- Assistive technology **** Should never do the math!**
 - An app that lets you dictate reminders rather than type
 - MyScript math app



Mind the Gap...



- › How can we help students who struggle with Maths?
- › We must decide what we think the issues are...
- › Collect Data!
 - Observations
 - Student Reflections
 - Educational Evaluations

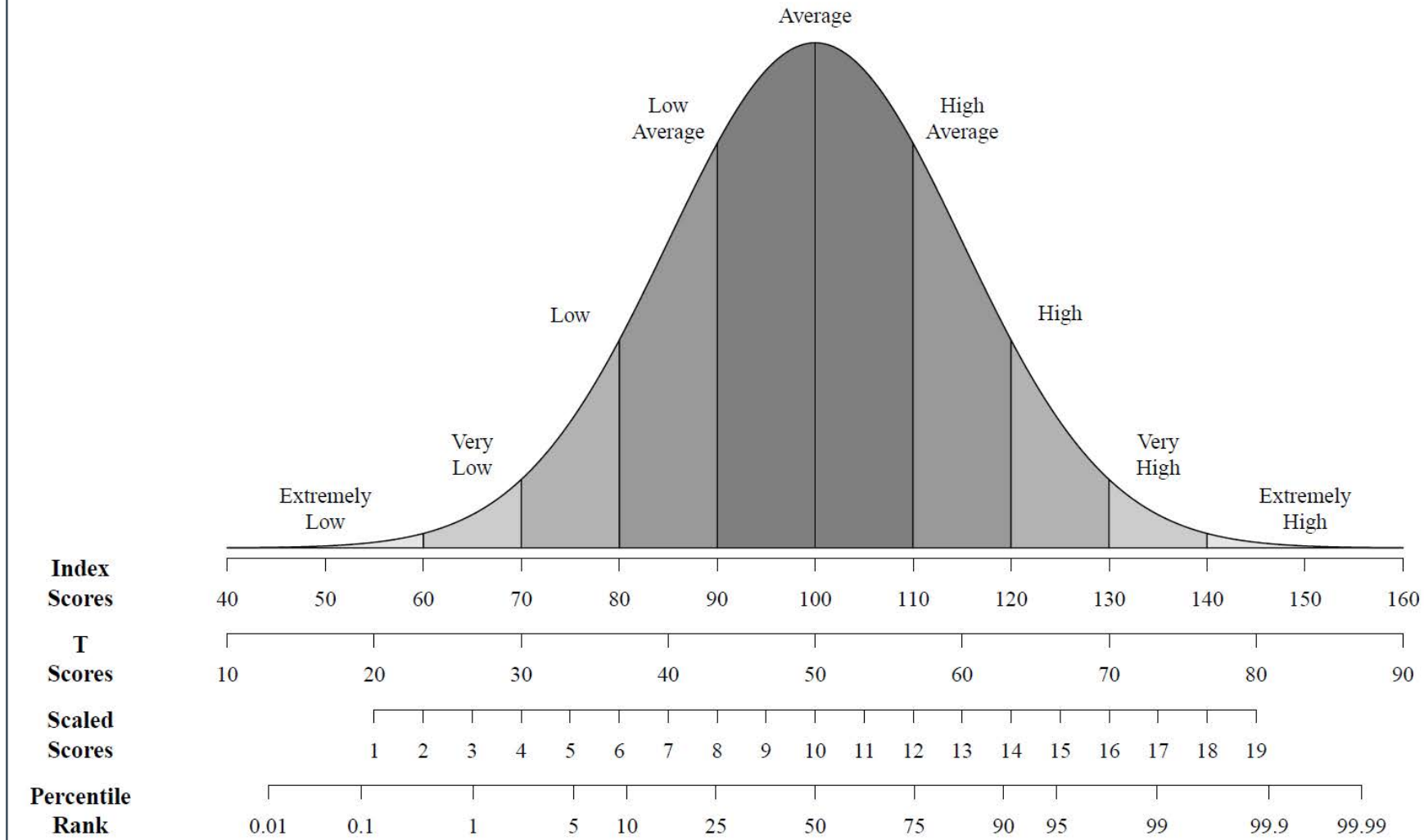
WISC-V: Wechsler Intelligence Scale for Children

Full Scale				
Verbal Comprehension	Visual Spatial	Fluid Reasoning	Working Memory	Processing Speed
Similarities	Block Design	Matrix Reasoning	Digit Span	Coding
Vocabulary	Visual Puzzles	Figure Weights	Picture Span	Symbol Search
Information		Picture Concepts	Letter-Number Sequencing	Cancellation
Comprehension		Arithmetic		

Image taken from [Intelligent Testing with the WISC-V](#), Kaufman, p. 3

****Sample Test Items taken from: Preparation Workbook for the WISC-V Test (2015)**

Standard Scores



Maths Challenges...Learning Profiles

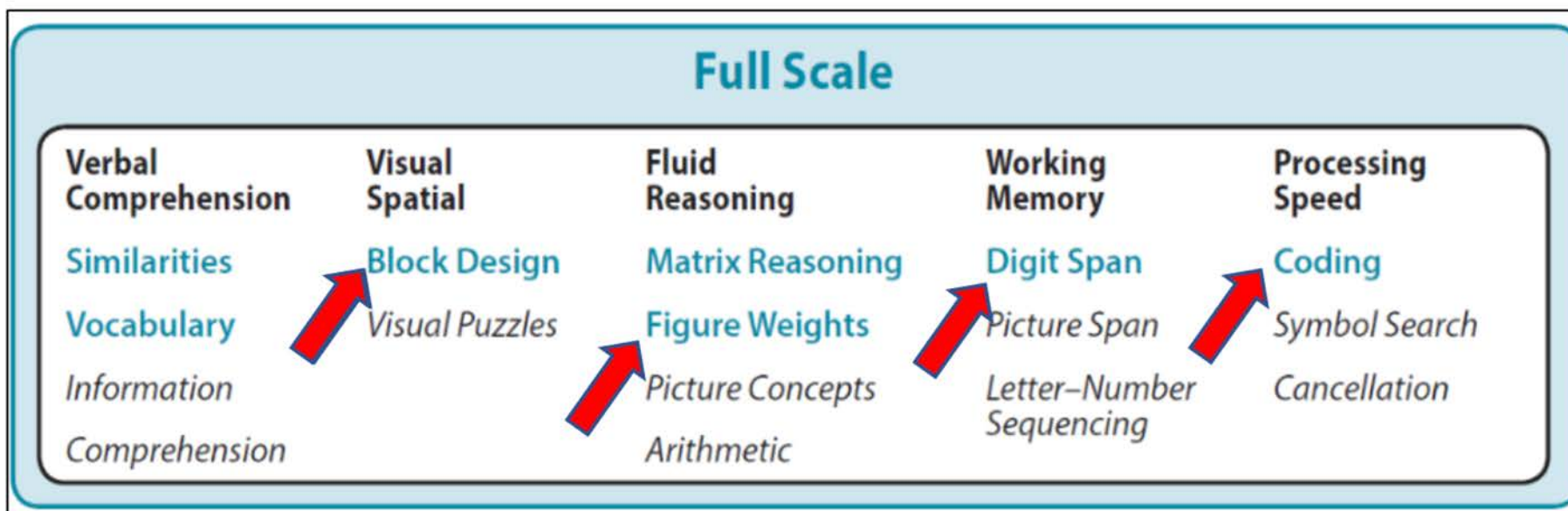


Figure taken from: (Alan S. Kaufman, 2016, p. 3)

Special thanks to my colleagues at Denver Academy: Cynthia Richardson & Philippe Ernewein – who are extraordinarily knowledgeable in this arena.

Visual Spatial Index (VSI)

Definition:

“The ability to perceive patterns and solve problems in the mind’s eye by manipulating visual imagery.” (Flanagan, 2017, p. 37)

Subtest:

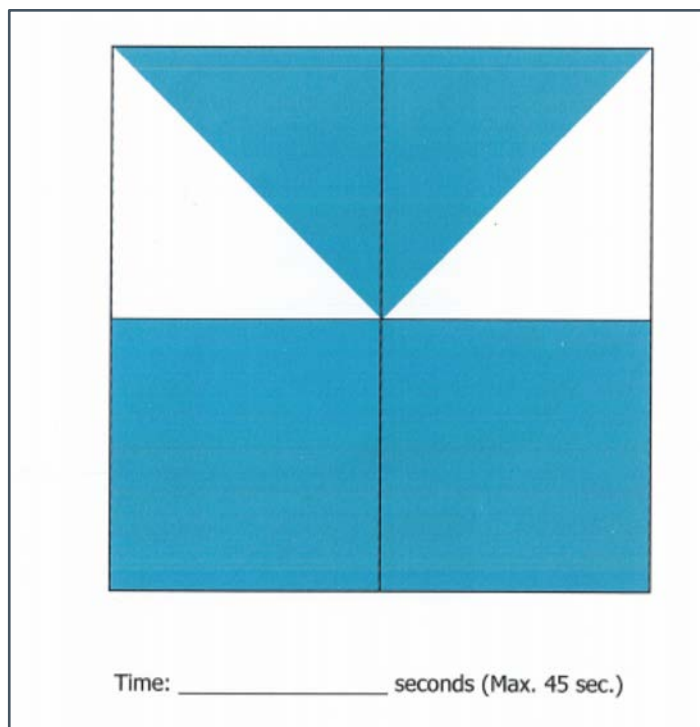
Block Design

Impact on Mathematics:

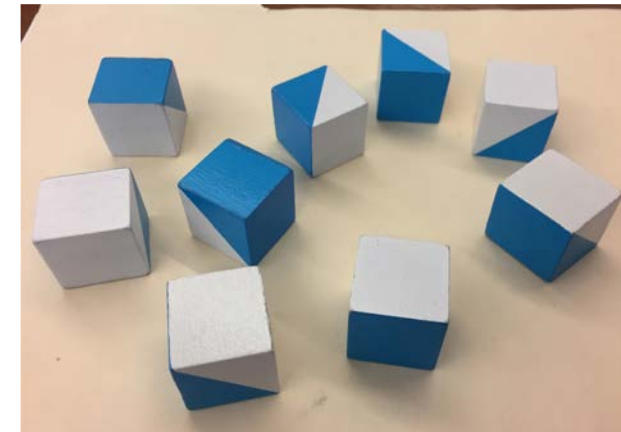
*Problem Solving and Mathematical Thinking;
Decision Making with Multiple Steps

Block Design

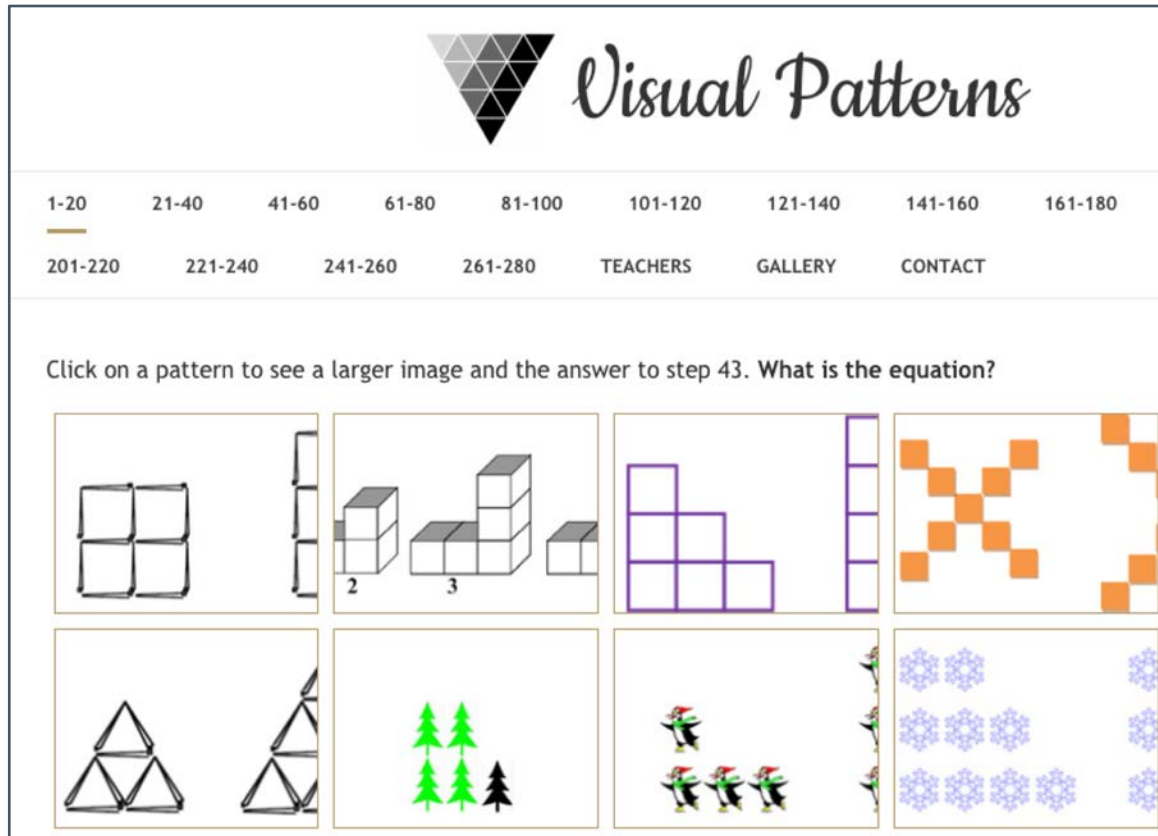
- › Shown 2-D image,
- › Build 3-D model in specific time.



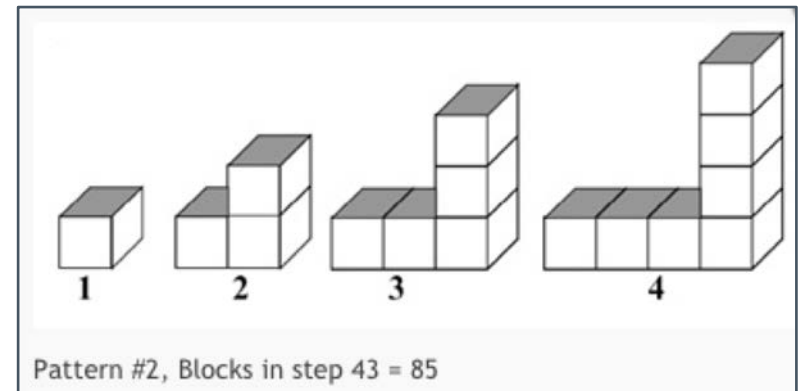
Sample test items taken from:
Preparation Workbook for the WISC-V Test (Publishing, 2015)



Support: Visual Patterns – Fawn Nguyen



- › Sketch the next three images.
- › How many blocks are there in step 43?



Fluid Reasoning Index (FRI)

Definition:

“The ability to use logic to solve unfamiliar problems.”
(Flanagan, 2017, p. 35)

Subtest:

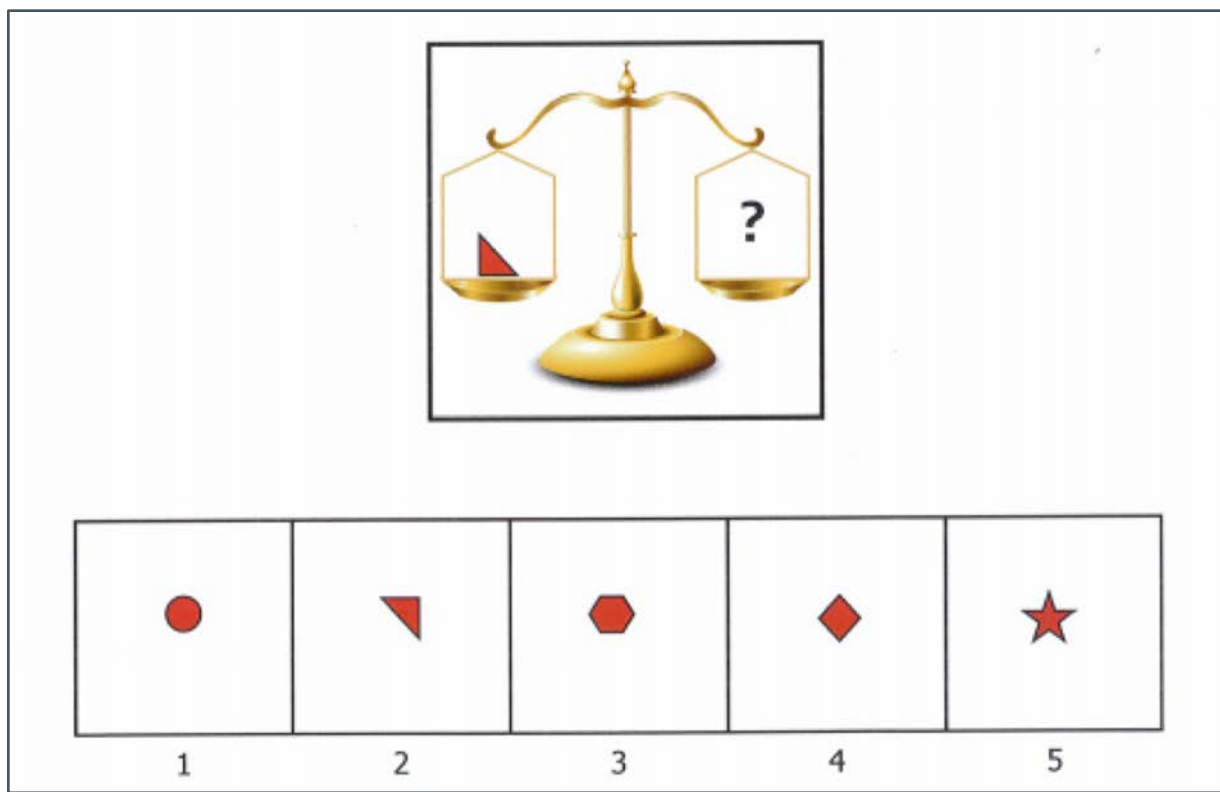
Figure Weights

Impact on Mathematics:

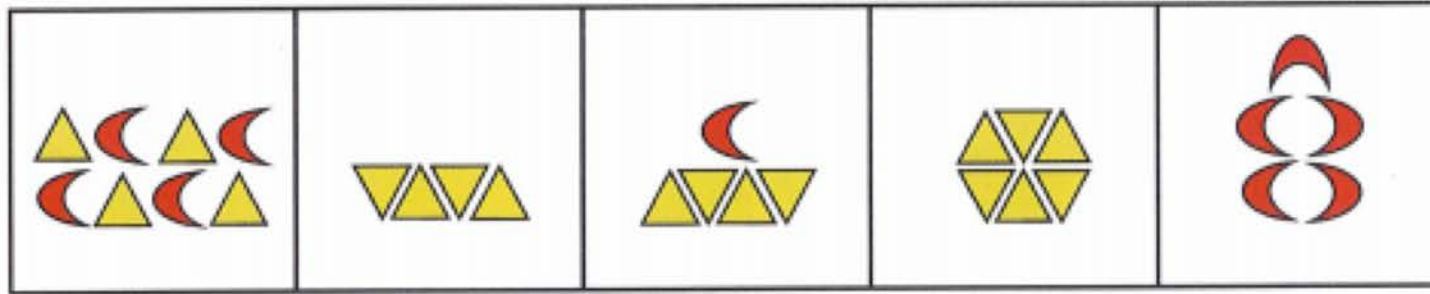
*Understanding Mathematical Concepts and Relationships;
Algebra; Deductive and Quantitative Reasoning

Figure Weights

› Given a specific time limit – determine:



Sample test items taken from:
*Preparation Workbook for the WISC-
V Test (Publishing, 2015)*



1

2

3

4

5

Support: Estimation 180 – Andrew Stadel

WHAT DO YOU THINK?

[HTTP://WWW.ESTIMATION180.COM/](http://www.estimate180.com/)

- › How many small vases will it take to fill the large vase?
- › How would you test your guess?



π

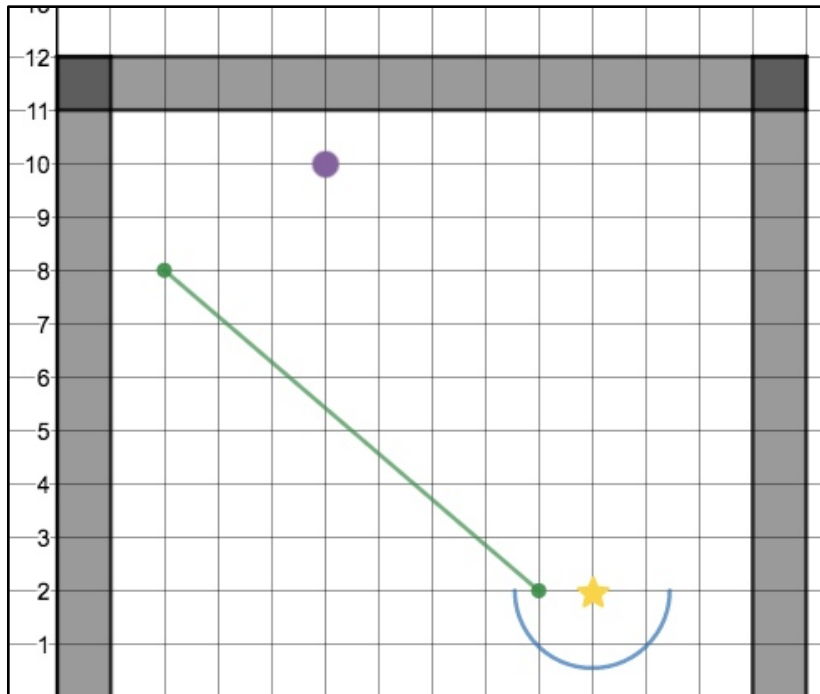
Estimation 180

Answer:

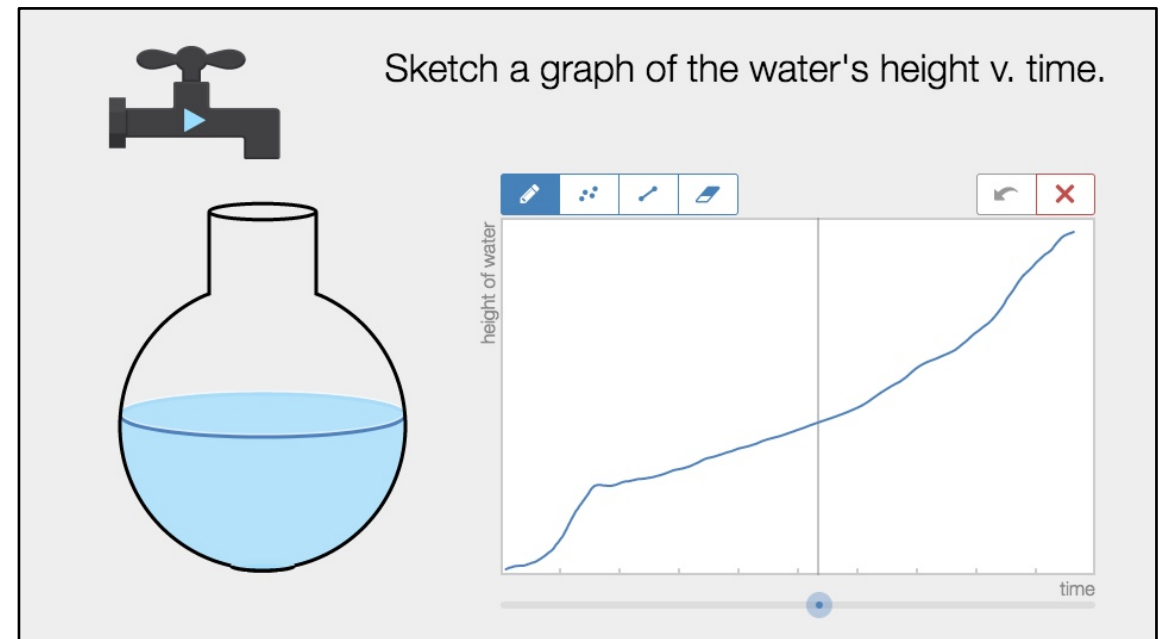


Desmos Activities – Dan Meyer and team

› Marble Slide



› Water Line



Working Memory Index (WMI)

Definition:

“The ability to maintain and manipulate information in short term memory in order to solve multistep problems.” (Flanagan, 2017, p. 37)

Subtest:

Digit Span

Impact on Mathematics:

*Numeracy, representation, and one-to-one correspondence; procedural fluency with multistep problems.

Digit Span

› Three Parts:

- Digit Span Forward: 2-3-6-8 Ans: 2-3-6-8
- Digit Span Backward: 2-1-8-3 Ans: 3-8-1-2
- Digit Span Sequence: 5-3-9-2 Ans: 2-3-5-9

Digit Span – Let's Try It!

› Three Parts:

#1 Digit Span **Forward**:

#2 Digit Span **Backward**:

#3 Digit Span **Sequence**:

π

Digit Span – How did you do?

› Three Parts:

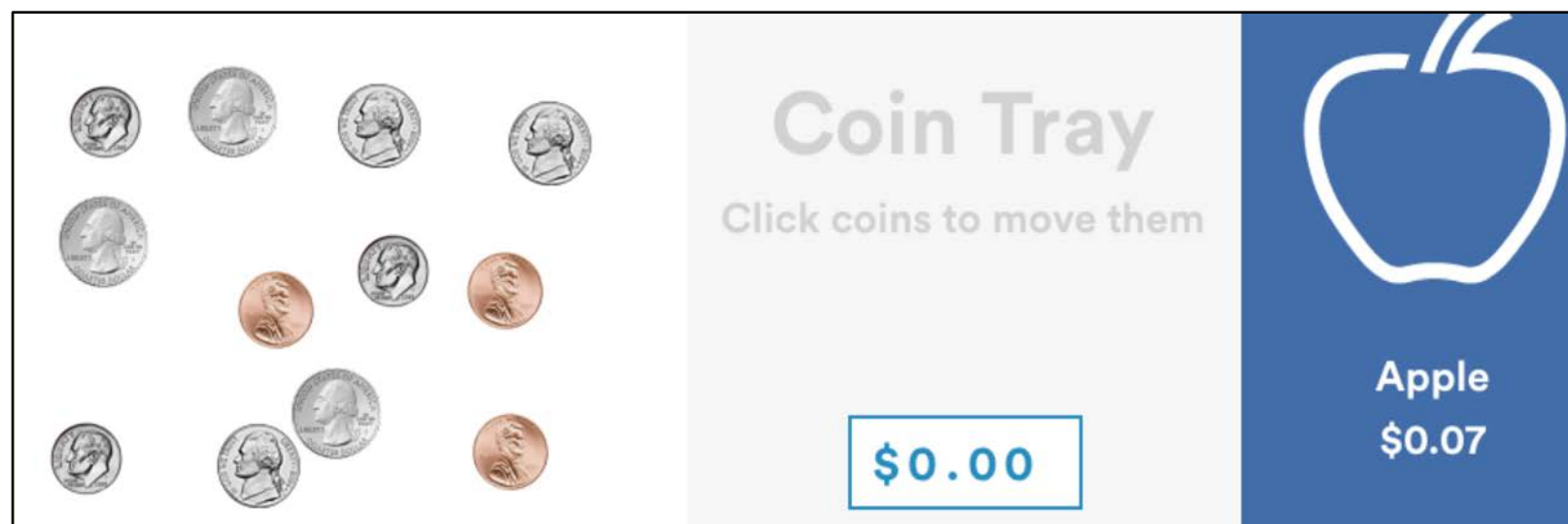
#1 Digit Span Forward: 1-4-2-8-6-9 Ans: 1-4-2-8-6-9

#2 Digit Span Backward: 4-2-8-9-3-5 Ans: 5-3-9-8-2-4

#3 Digit Span Sequence: 3-9-0-1-7-2-6 Ans: 0-1-2-3-6-7-9

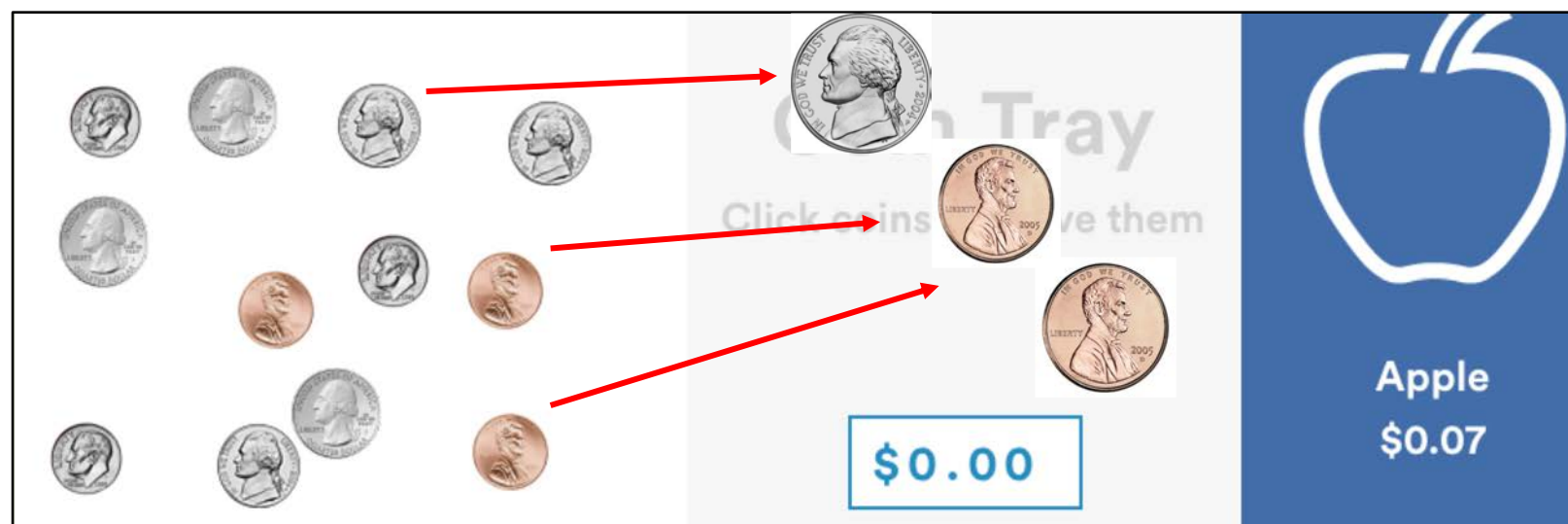
What would it feel like?

- › Simulation: From Understood.org
- › <https://u.org/1qOLNXk>



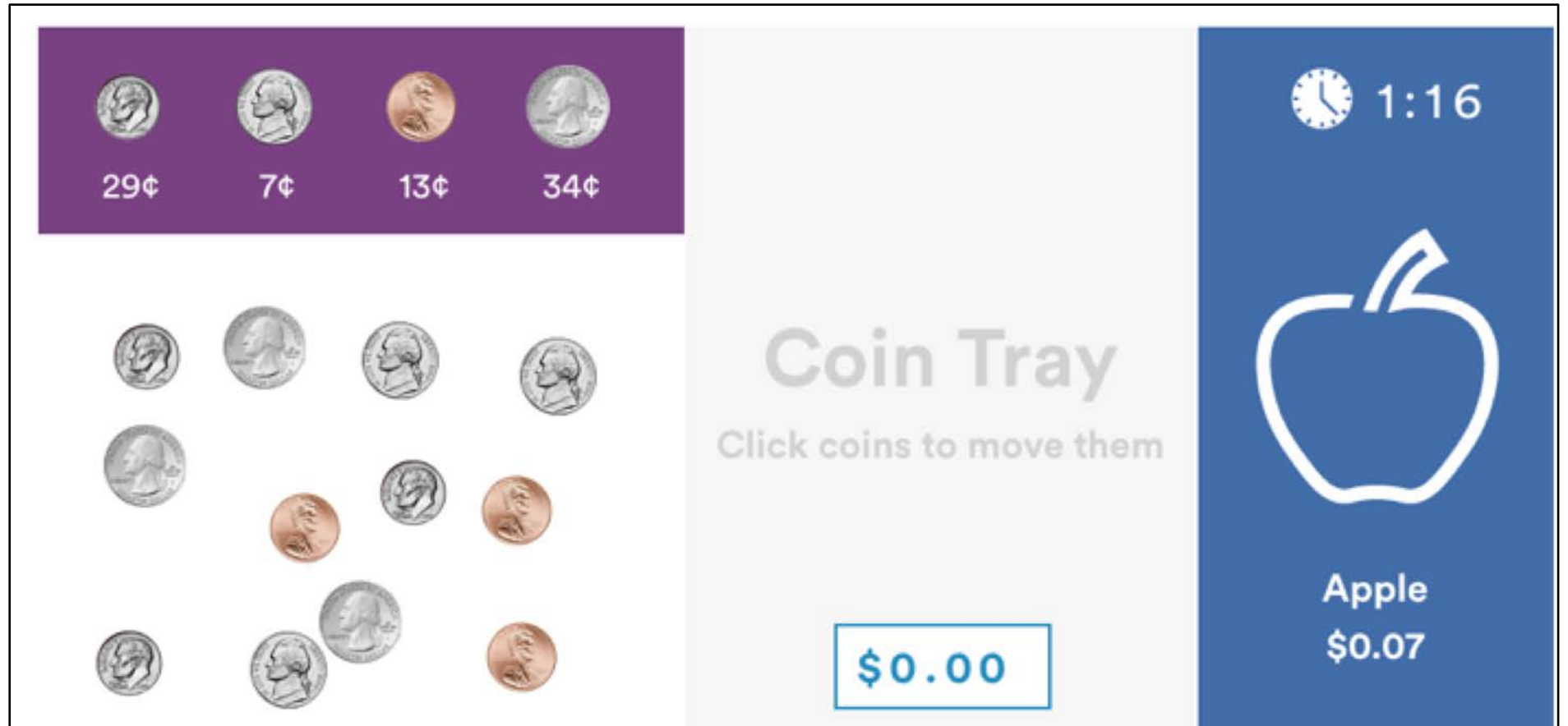
Support and Information: Understood.org

- › Simulation:
- › <https://u.org/1qOLNXk>



π

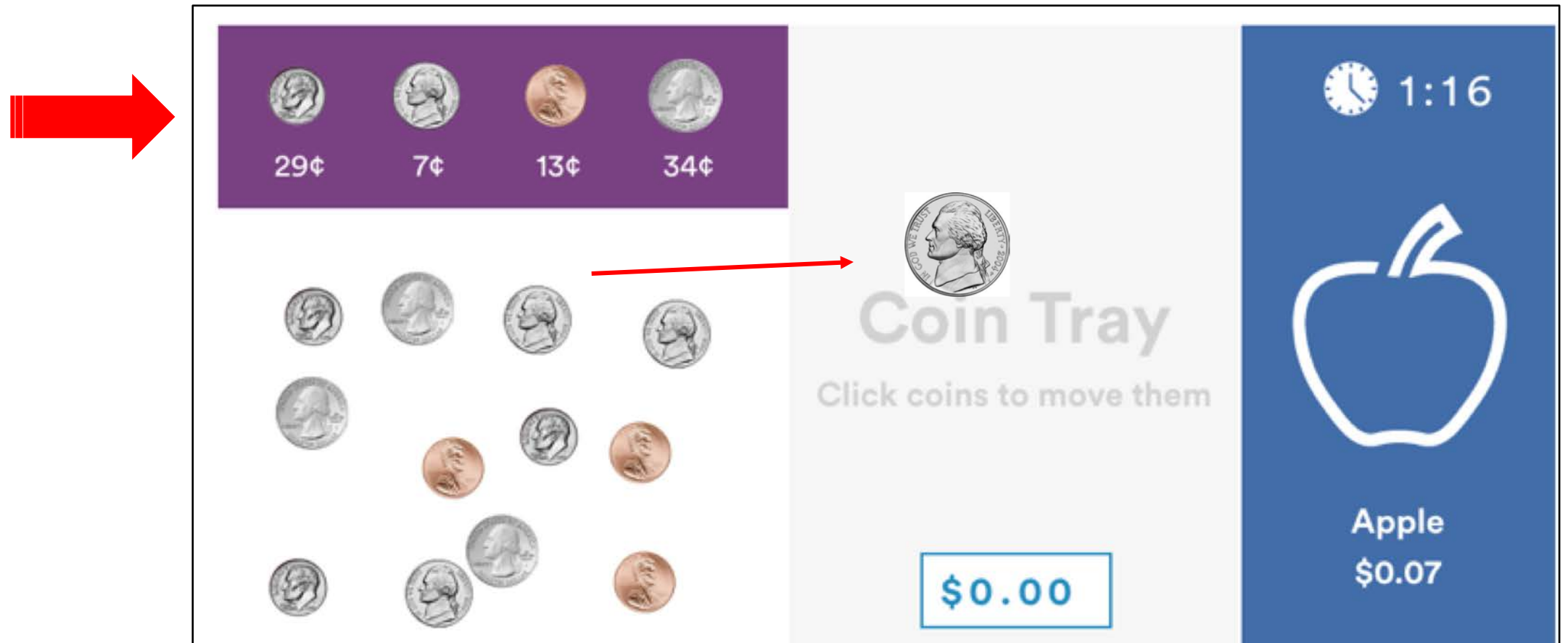
Problem #1:



The screenshot displays a mobile application interface for a 'Coin Tray'. It is divided into three main vertical sections. The leftmost section is a purple header bar containing four coin icons with their respective values: 29¢, 7¢, 13¢, and 34¢. Below this header is a large white area representing the coin tray, filled with various US coins (quarters, dimes, and pennies) scattered randomly. The middle section is a light gray area with the title 'Coin Tray' in large, bold, gray font, followed by the instruction 'Click coins to move them' in a smaller gray font. At the bottom of this section is a blue-outlined box containing the text '\$0.00'. The rightmost section is a dark blue vertical bar. At the top, it shows a clock icon and the time '1:16'. In the center is a large white outline of an apple. At the bottom, it displays the text 'Apple' and '\$0.07'.

π

Problem #1: Solution



π

Problem #2:



The interface is divided into three main sections. The top-left section is a purple bar containing four coin icons with their respective values: 29¢, 7¢, 13¢, and 34¢. The bottom-left section is a white area labeled 'Coin Tray' with the instruction 'Click coins to move them', containing a collection of loose coins. The bottom-right section is a blue bar containing a clock icon with a 0:10 timer, a milk carton icon, and the text 'Milk \$0.83'. A blue box at the bottom center displays '\$0.00'.

29¢ 7¢ 13¢ 34¢

Coin Tray
Click coins to move them

\$0.00

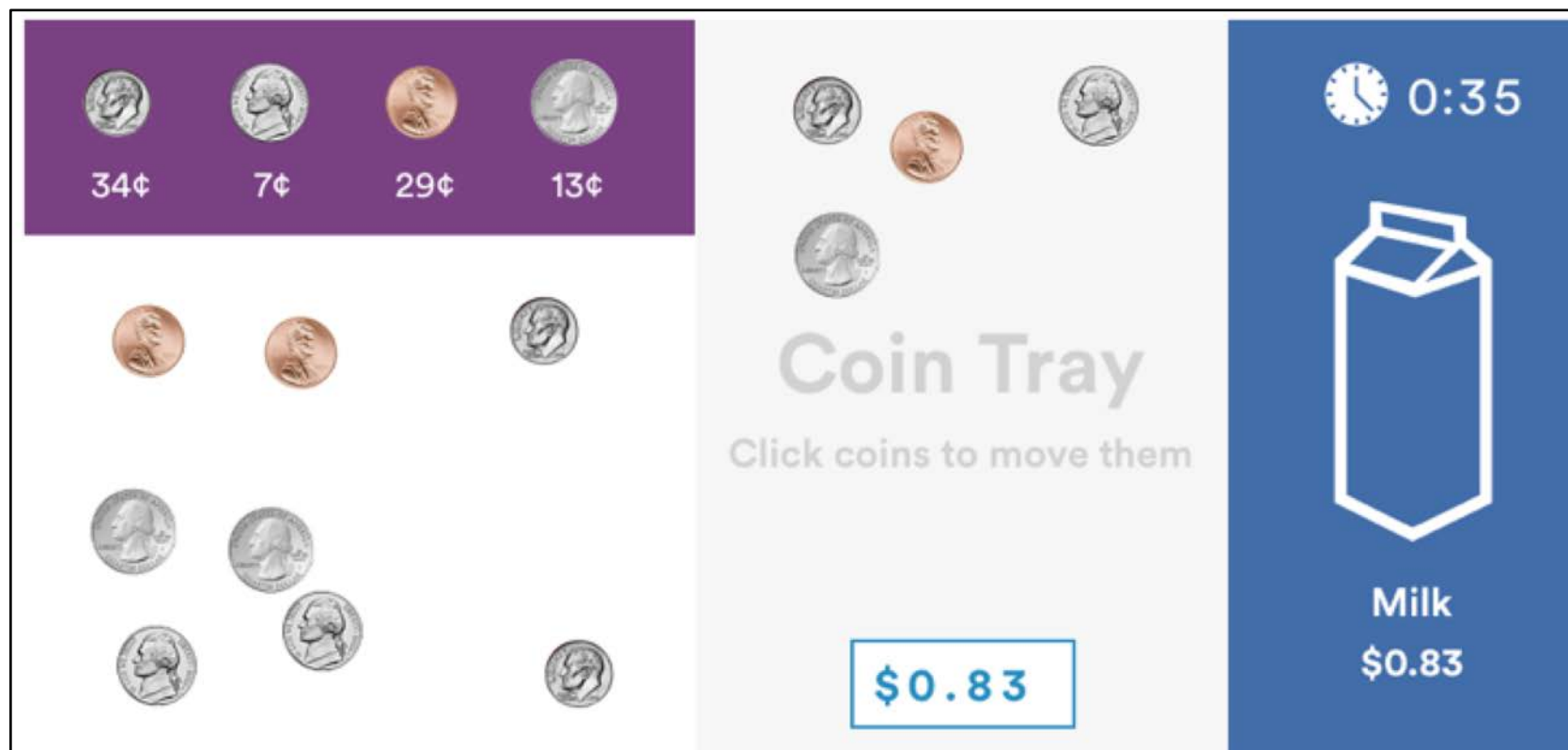
0:10

Milk
\$0.83

Problem #2: Solution

Dime = 34¢
Nickle = 7¢
Penny = 29¢
Quarter = 13¢

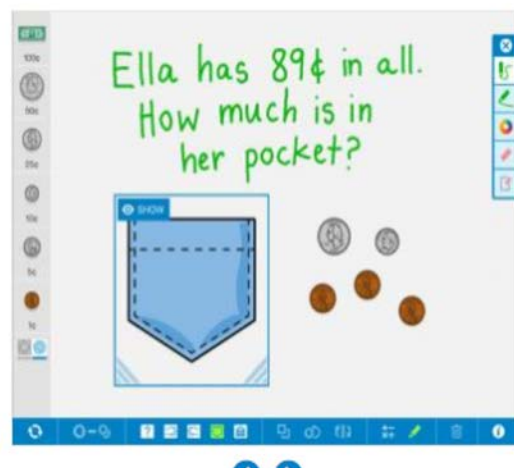
Total = 83¢



Support and Information:

- › The Math Learning Center – Free Apps

Money Pieces for iPad, Chrome, and Web



Number Line for iPad, Web, and More



Processing Speed Index (PSI)

Definition:

This is about output – performance. How efficiently one is able to produce.

“The ability to fluently deploy the focus of one’s attention to process information quickly.” (Flanagan, 2017, p. 39)

Subtest:

Coding

Impact on Mathematics:

*Numeracy, representation, and one-to-one correspondence; procedural fluency with multistep problems.

Coding

- › 120 seconds (not 1 minute 20 seconds).
- › Score one point for correct items.

A	B	C	D	E	F	G	H	I
○	△	∃	⊙	=	⊥	:	>	⊖

Practice Items:

D	B

Sample test items taken from:
Preparation Workbook for the WISC-V Test (Publishing, 2015)

KEY								
A	B	C	D	E	F	G	H	I
○	△	☾	⊙	=	⊥	:	>	⊖

Practice Items:

D	B

C	E	D	I	A	F	H	E	D	I	B	A	H	B	E	D	F	I	A	C

A	G	B	I	C	D	E	D	C	H	A	F	E	G	I	A	H	F	I	D

B	F	A	H	B	I	D	G	F	E	A	B	H	G	C	E	H	D	A	E

D	I	G	E	H	A	F	D	E	H	G	I	A	B	C	I	E	B	C	D

F	A	I	E	G	F	C	H	I	G	B	F	D	E	A	I	G	E	B	H

I	B	G	E	A	D	E	I	G	B	C	F	A	H	G	D	I	A	B	F

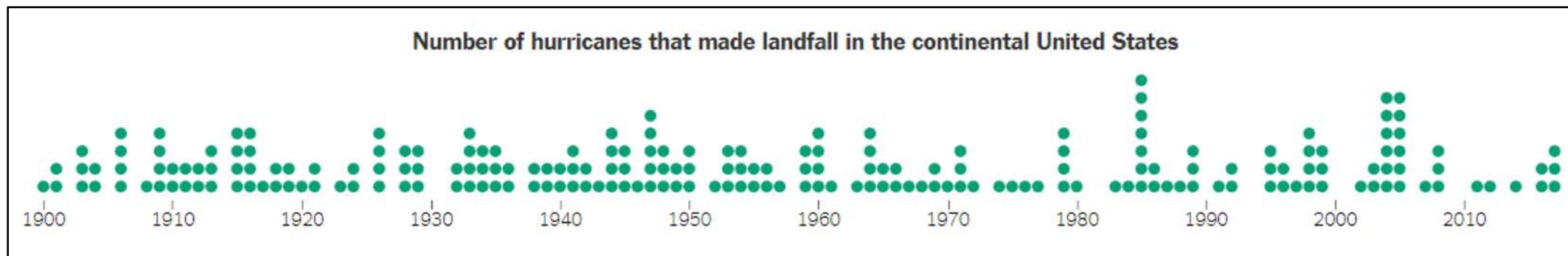
Time (Max. 120 sec.)

Total Correct

% Correct
_____/120 x 100= _____

Support: Annie Fetter – New York Times

- › What's Going On in This Graph?
- › <https://www.nytimes.com/column/whats-going-on-in-this-graph>

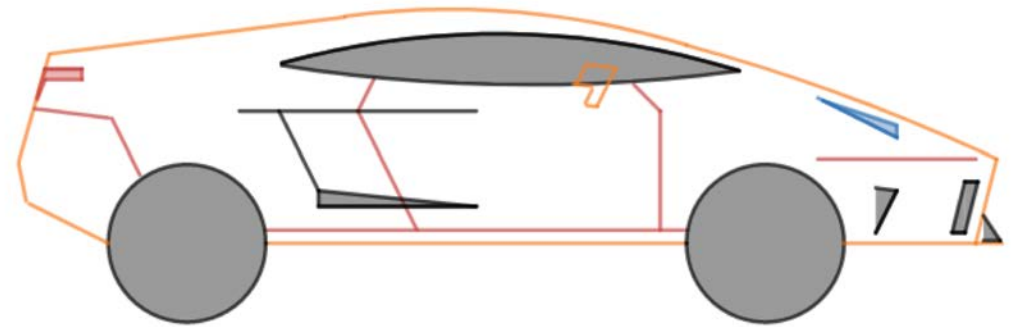


C. How can we help?

- Embrace Mathematics
- Share a Positive Attitude and Know that Challenge is Critical
- Promote Curiosity
- Think Mathematically
- Ask Questions “What do you notice, wonder, think?”

Student Story...Processing Speed – Output.

- › Engage students at a high academic level by attending to mathematical precision, language, and ideas.
- › Students can be mathematically creative.



Desmos Math Art Project
– by Zach Weiland

Mathematical Tasks...

LOW FLOOR HIGH CEILING

- › Accessible
- › Interesting and Engaging
- › About the Process
- › Mathematical Thinking

FOUR 4's Puzzle

Numbers from 1 - 20; 1 - 100

$$\frac{4 + 4}{4 + 4} = \frac{8}{8} = 1$$

$$4 \cdot 4 + \sqrt{4} + \sqrt{4} = 20$$

Taken from Jo Boaler
Mathematical Mindsets page 80.

Additional Resources: (See handout)

- › Understood
 - Parent organization with helpful resources
 - <https://www.understood.org/en>
- › Rocky Mountain Branch – International Dyslexia Association
 - <http://idarmb.org/>
- › NCTM – Illuminations
 - <https://illuminations.nctm.org/>
- › Dyscalculia
 - <http://www.dyscalculia.org/>

Mathematical Thinking and Questions...

SELECT AN ITEM...



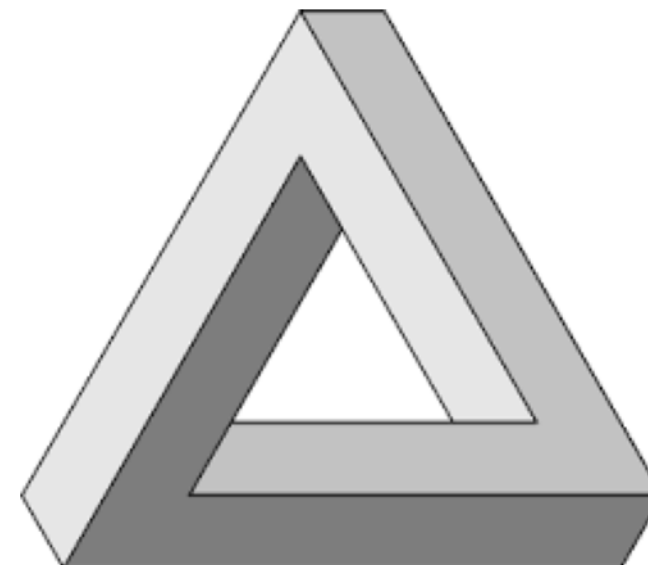
- › What do you notice?
- › What do you wonder?
- › What do you think?



Closing and Reflection...

PLEASE CONSIDER THE
FOLLOWING:

1. As a learner I would like to
be viewed as? (3 words)
2. Math is...



$$P_{ni} \left(x_{ni} = \frac{1}{B_n}, D_i \right) = \frac{e^{(B_n - D_i)}}{1 - e^{(B_n - D_i)}}$$

Presentation & Handouts:

<https://bit.ly/2OhzlgU>

Thank you! Questions?

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