

Bringing Wonder into Math Class Through Inquiry based Learning



Jonathon Butler



@jdbutler13



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About Me



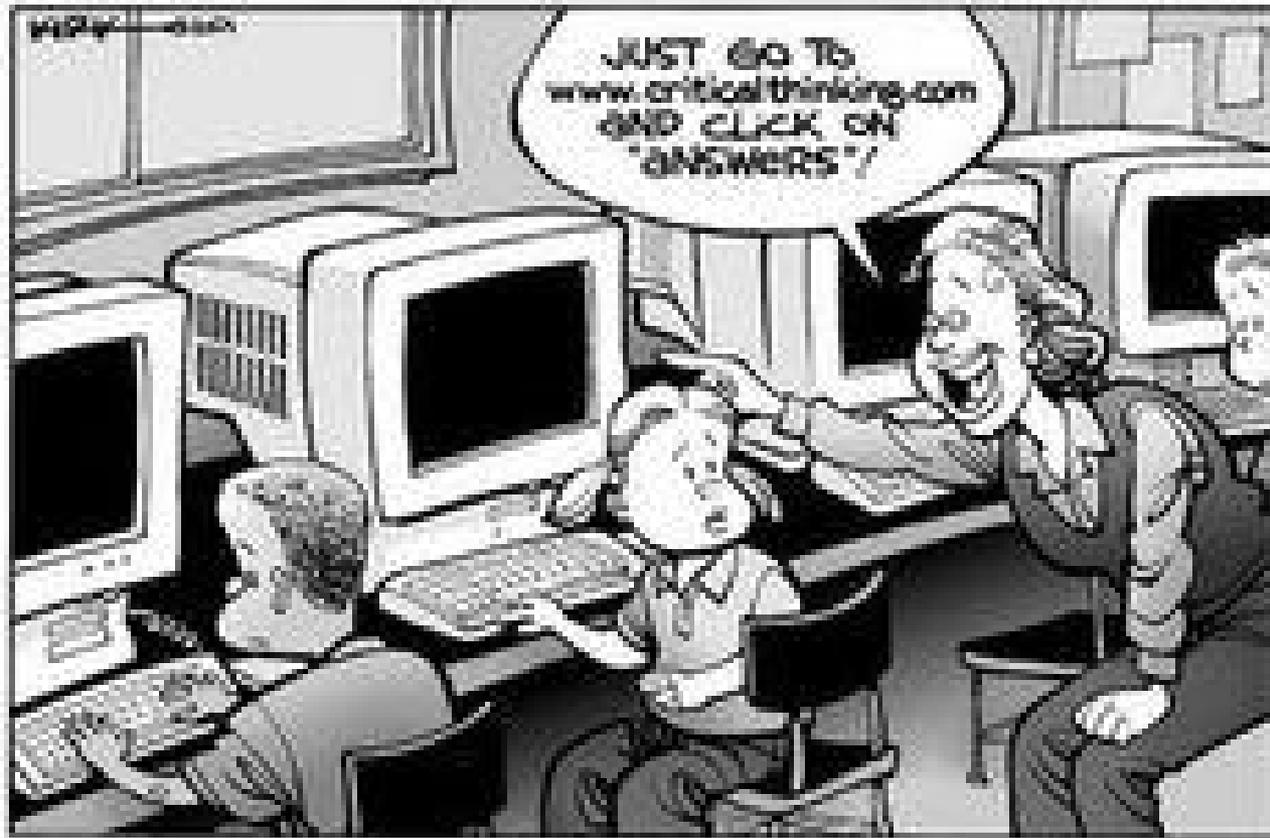
Jonathon Butler is a passionate teacher always looking to engage students and teachers of all levels. His areas of focus include literacy, mathematics, game-based learning, Inquiry, STEAM and highlighting Global Competencies so that they are tangible and real for all students. He is a Literacy Resource teacher, supporting teachers in TCDSB, but has also teaches an AQ Certification course at York University on creating an inquiry based classroom.



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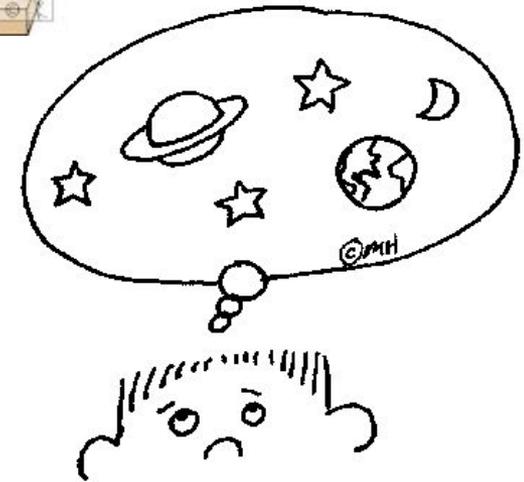


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Faith the Doorway to Education



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Faith the Doorway to Education

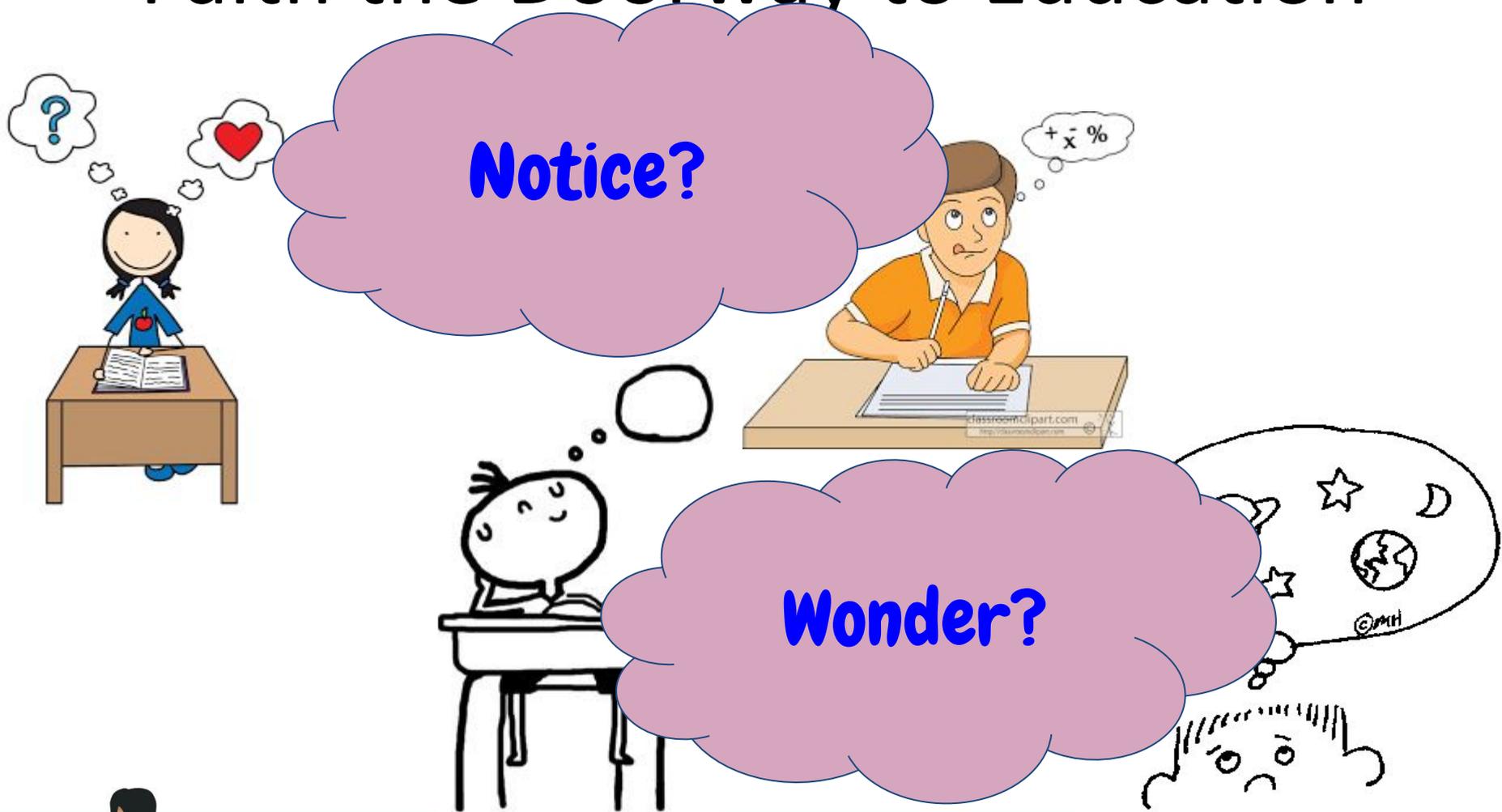


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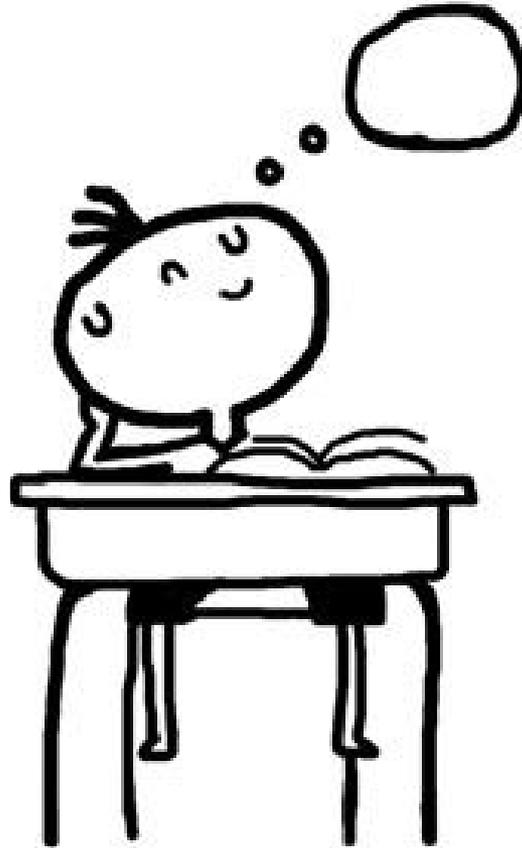


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What do our students need to be successful in the future?



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Differentiated & Personalized



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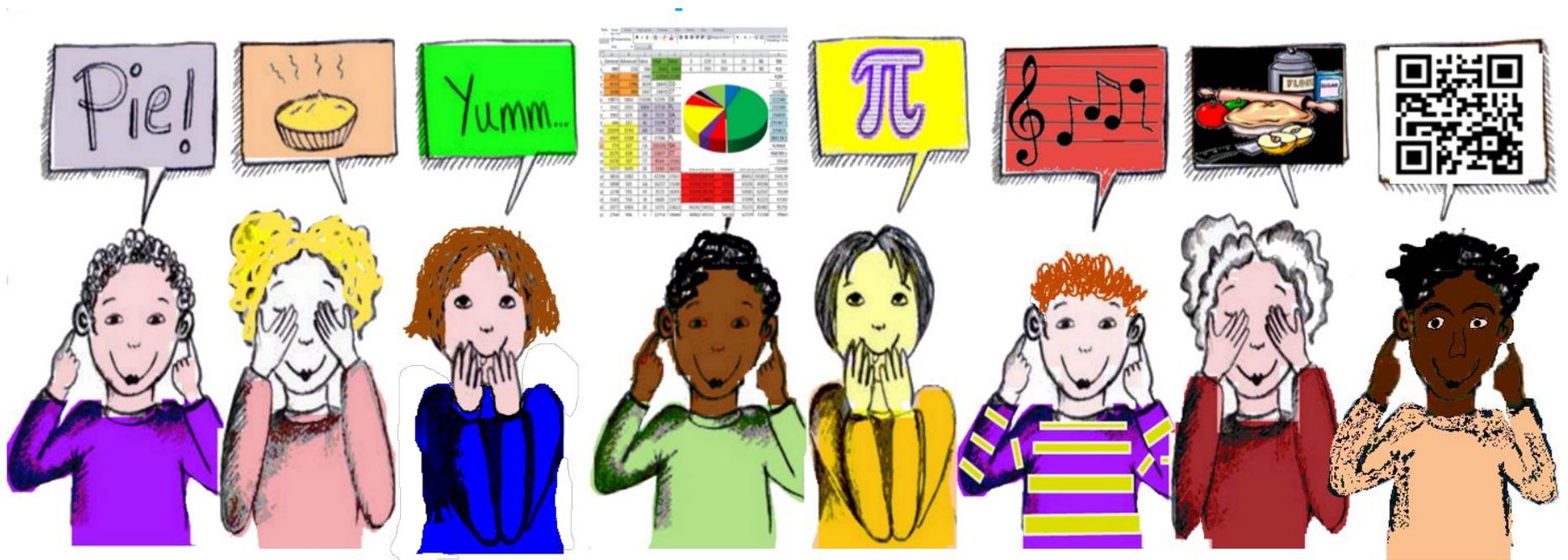
**What is the first thing that
comes to mind when I say...**



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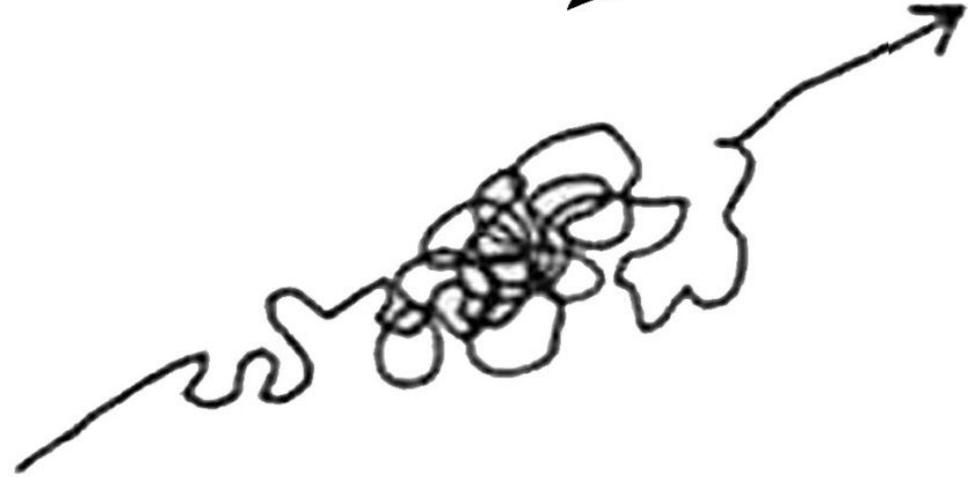
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Success



what people think
it looks like

Success



what it really
looks like



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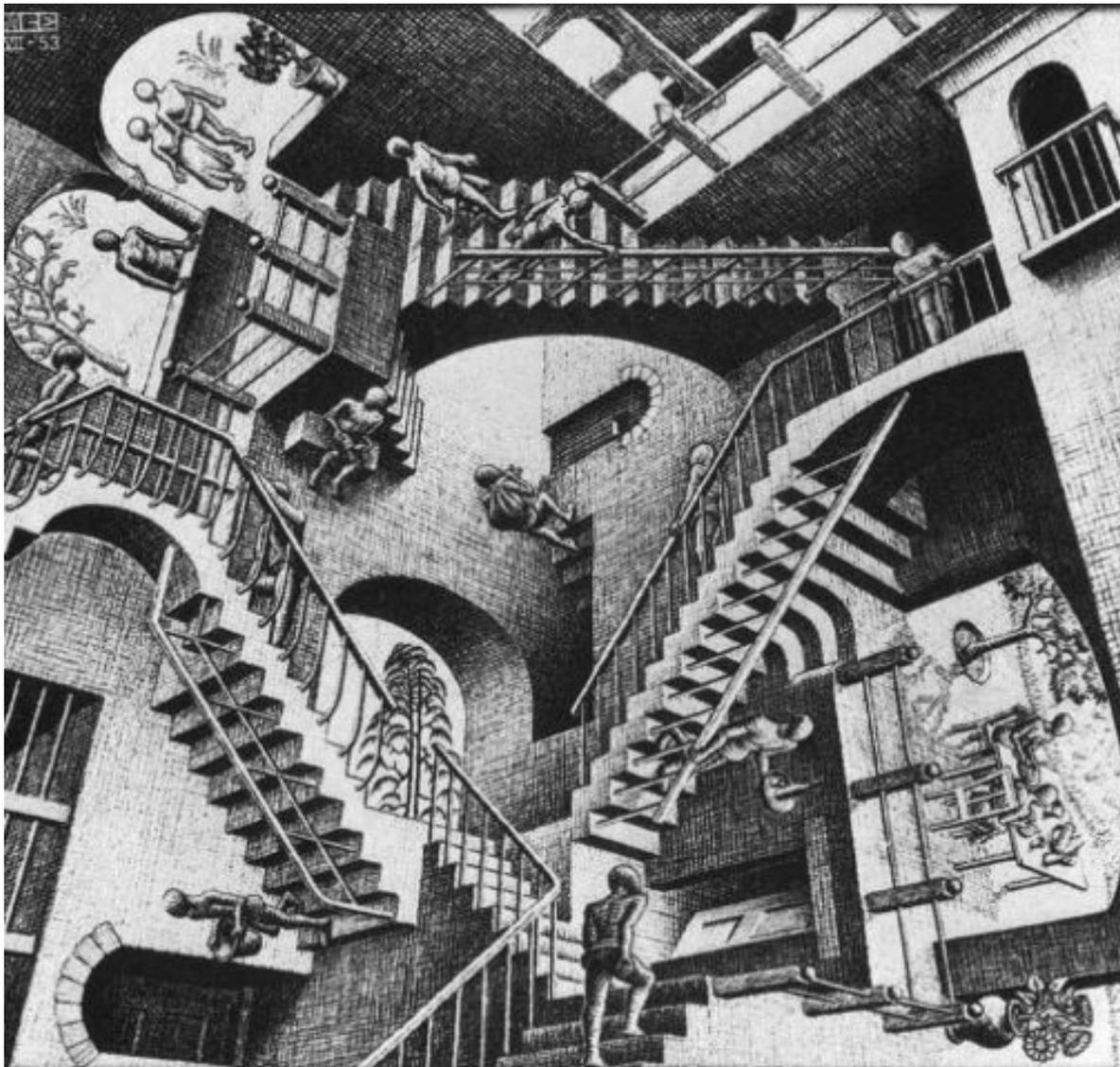
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MATH Mondays!

Broaden the Landscape & Deeper Understanding

2 x 3



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**More important they have tools
and strategies to apply to any
question than the correct
answer to the question of the
day**



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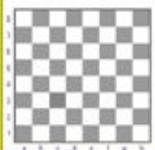
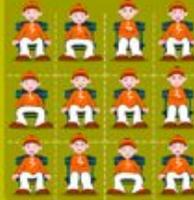
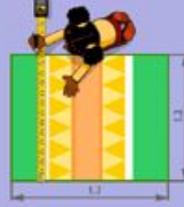
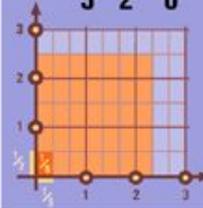
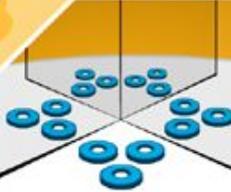
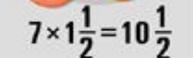
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Broaden the Landscape & Deeper Understanding

Natural Math®

MULTIPLICATION MODELS

ARRAY	AREA	SYMMETRY
<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> $8 \times 8 = 64$  </div> <div style="text-align: center;">  $3 \times 4 = 12$ </div> </div> <p style="font-size: small;">Multiply: rows \times columns Handy for: positive whole numbers Activities: counter arrays; chairs; floor tiles; graph paper coloring</p>	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  $1.7 \times 1.3 = 2.21$ </div> <div style="text-align: center;"> $\frac{7}{3} \times \frac{5}{2} = \frac{35}{6}$  </div> </div> <p style="font-size: small;">Multiply: side \times side Handy for: positive whole numbers; positive fractions Activities: floor, wall and rectangular object measuring</p>	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  $2 \times 3 = 6$ </div> <div style="text-align: center;">  $5 \times 3 = 15$ </div> </div> <p style="font-size: small;">Multiply: regions \times objects in each region Handy for: positive whole numbers Activities: mirror book; paper folding; finding symmetry in nature</p>
SETS, PER EACH	COMBINATIONS	SKIP COUNTING
<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  $3 \times 8 = 24$ </div> <div style="text-align: center;">  $7 \times 1\frac{1}{2} = 10\frac{1}{2}$ </div> </div> <p style="font-size: small;">Multiply: sets \times items in each set Handy for: positive whole numbers of sets; whole numbers or fractions in each Activities: set making; natural "per each" hunt (eyes, legs, wheels)</p>	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  $2 \times 4 = 8$ </div> <div style="text-align: center;">  $3 \times 3 = 9$ </div> </div> <p style="font-size: small;">Multiply: types \times types Handy for: positive whole numbers Activities: making all possible combinations; arranging combination trees and tables</p>	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  $6 \times 2 = 12$ </div> <div style="text-align: center;">  $7 \times 5 = 35$ </div> </div> <p style="font-size: small;">Multiply: skips \times skip size Handy for: whole numbers, especially twos, fives, tens, hundreds, thousands; some fractions Activities: skipping on stairs or tiles; counting money</p>



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FOLDING AND SPLITTING

$2 \times 2 \times 2 = 8$

$2 \times 5 = 10$

Multiply: splits \times parts per split
 Handy for: positive whole numbers
 Activities: cutting; sharing; folding

REPEATED ADDITION

$3 \times 23 = 69$

$4 \times 15 = 60$

Multiply: repetitions \times repeated number
 Handy for: whole numbers and fractions; positive whole repetitions
 Activities: computation

NUMBER LINE

$6 \times \frac{1}{2} = -3$

$7 \times 0.3 = 2.1$

Multiply: steps \times step size
 Handy for: whole steps; whole or fractional sizes
 Activities: measuring length or temperature

FRACTAL

$5 \times 5 = 25$

$2 \times 2 \times 2 \times 2 \times 2 = 32$

Multiply: iterations \times iterations
 Handy for: positive whole numbers
 Activities: drawing or tracing repeating patterns (hands, branches, shapes)

SCALE AND STRETCHING

$3 \times 10 = 30$

$4 \times 2.5 = 10$

Multiply: scaling factor \times size
 Handy for: positive whole scaling factors; positive whole or fractional sizes
 Activities: shadow projections; drawing software and photocopy stretching; magnifying glass

TIME AND MONEY

$3 \times -2 = -6$

$-2 \times -4.20 = 8.40$

Multiply: time \times money
 Handy for: whole numbers and fractions, especially hundredth for money
 Activities: computing speedings or earnings

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Overview:



What is Inquiry



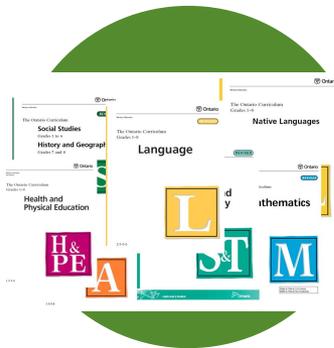
Why? Benefits?



Competencies/
Models



Provocations



Curriculum



Assessment



Closing



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Deanna McLennan Ph.D

@McLennan1977

Follow



When we stop defaulting to the ways we were taught as children, #math begins to appear in the most magical of places.

#mindset #inspiration



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What is Inquiry based Learning

“Inquiry-based learning is more than asking a student what he or she wants to know. It’s about triggering curiosity”

[-https://www.edutopia.org/blog/what-heck-inquiry-based-learning-heather-wolpert-gawron](https://www.edutopia.org/blog/what-heck-inquiry-based-learning-heather-wolpert-gawron)

“Inquiry ... requires more than simply answering questions or getting a right answer. It espouses investigation, exploration, search, quest, research, pursuit, and study. It is enhanced by involvement with a community of learners, each learning from the other in social interaction.”

(Kuklthau, Maniotes & Caspari, 2007, p. 2)



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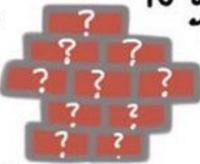
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Why? Benefits

10 Reasons to use Inquiry-based Learning

@Trev_Mackenzie

@sylviaaduckworth

- 1 Nurture student passions & talents 
- 2 Empower student voice & honour student choice 
- 3 Increase motivation and engagement 
- 4 Foster curiosity and a love for learning 
- 5 Teach grit, perseverance, growth mindset & self-regulation 
- 6 Make research meaningful & develop strong research skills 
- 7 Deepen understanding to go beyond memorizing facts and content 
- 8 Fortify the importance of asking good questions 
- 9 Enable students to take ownership over their own learning and to reach their goals 
- 10 Solve the problems of tomorrow in the classrooms of today 



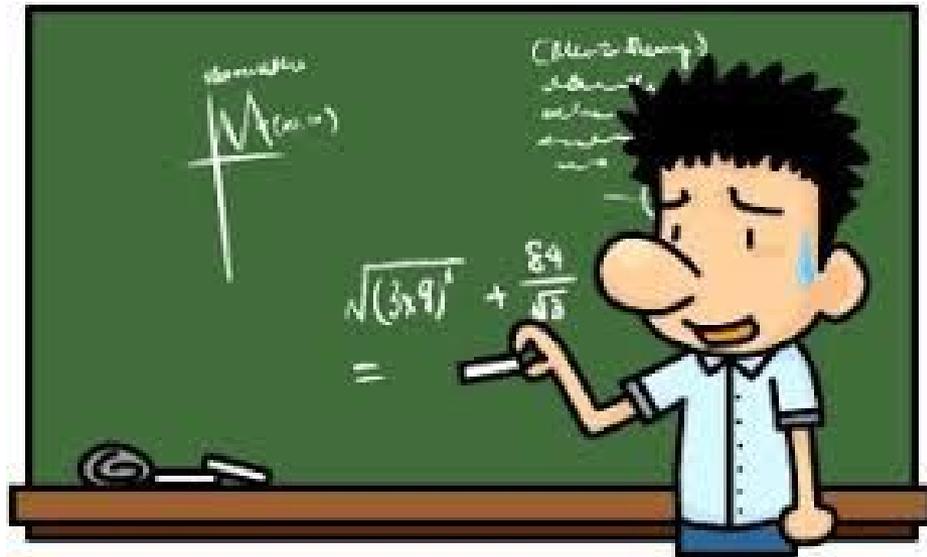
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Dealing with Parents

- REAL WORLD Application
- The EQAO battle
- The data by people smarter than us (Ministry push)
- It has been around forever
- “Content is the variable, skills must be the constant”
- Root it in the curriculum



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Competencies & Models

- **Student centered (Choice & Voice) Autonomy**
 - Not always free, but multiple entry points that resonate with students
- **Real World Problem Solving & Critical Thinking**
 - Whose world???
- **Purposeful & Applicable outside the 4 wall of your class**
 - Audience & Solving a need

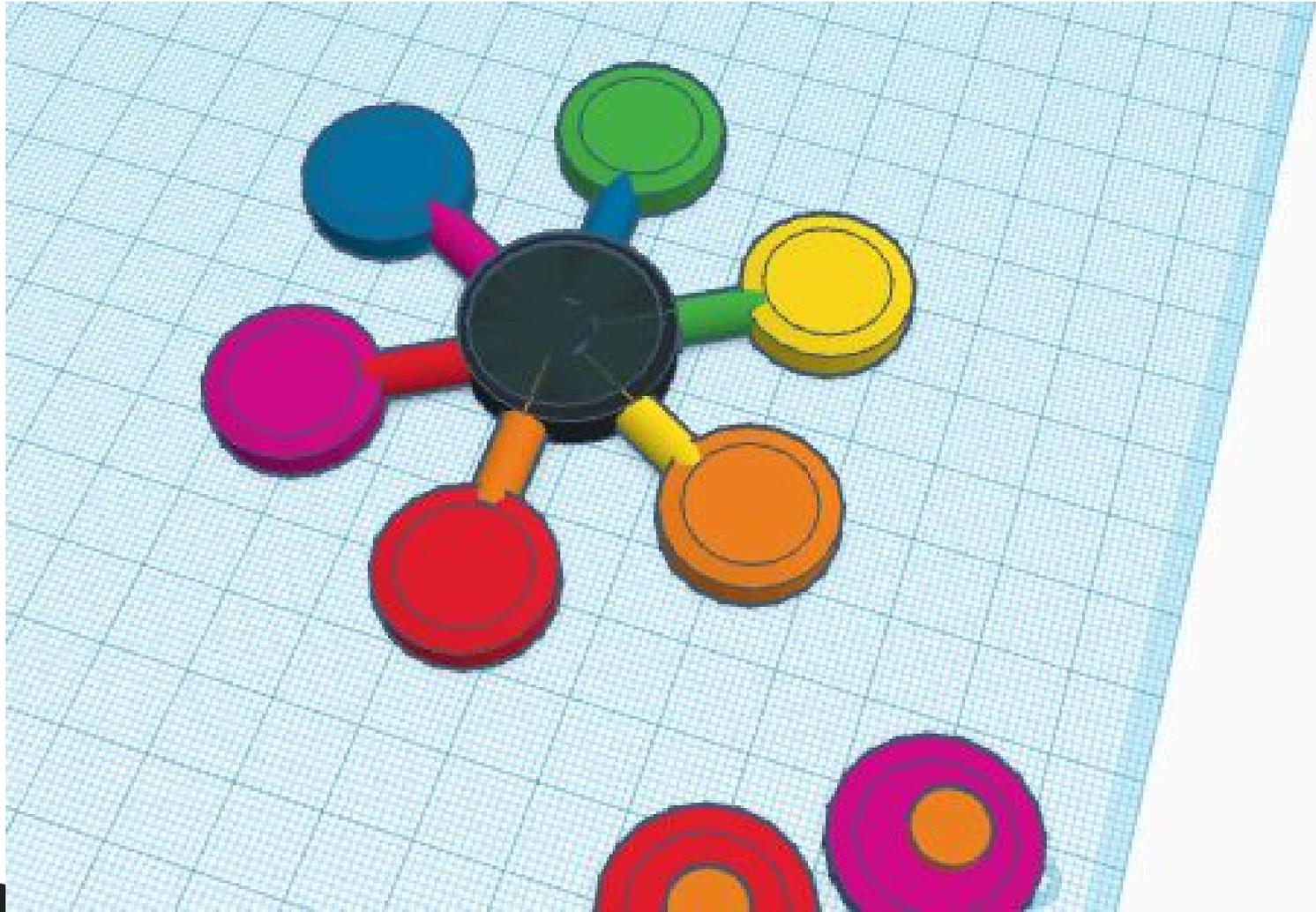


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Logan's Play Speech Vs Logan's Spinner



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Competencies & Models

- **Student centered (Choice & Voice)**
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- **Real World Problem Solving & Critical Thinking**
 - Whose world???
- **Purposeful & Applicable outside the 4 wall of your class**
 - Audience & Solving a need
- **Collaborative**
 - Knowledge is interdependent
- **Knowledge Construction & Creativity**
 - Merges Prior Knowledge with Knowledge Construction
 - Don't cover the curriculum, allow children to uncover it
- **Skilled Communication**
 - Multiple modalities of expression and communication
- **Self Regulation**
 - Work is based on a process or cycle of inspiration, asking questions, searching, revision and feedback and improving not on the final answer

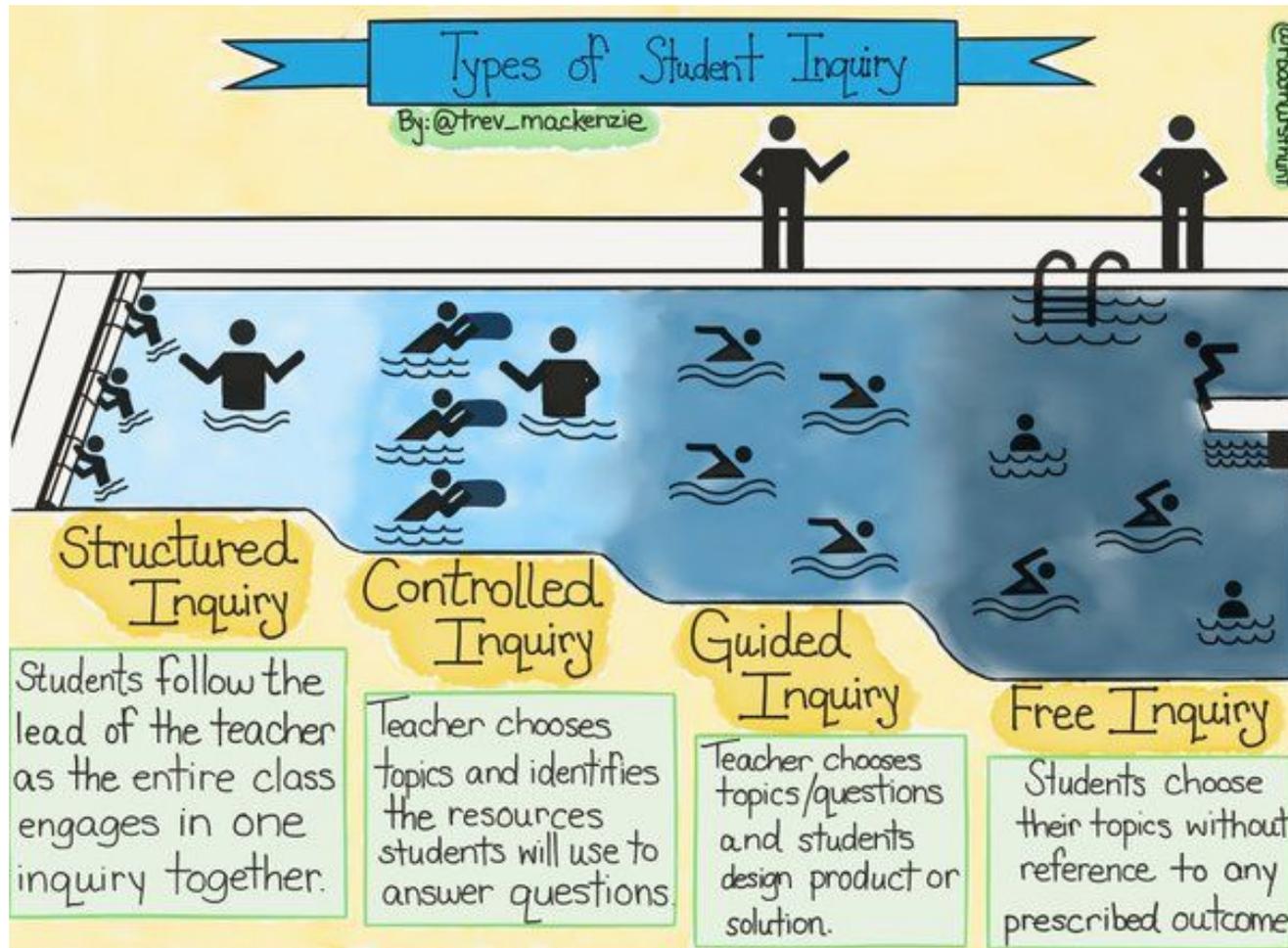


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Competencies & Models



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Provocations

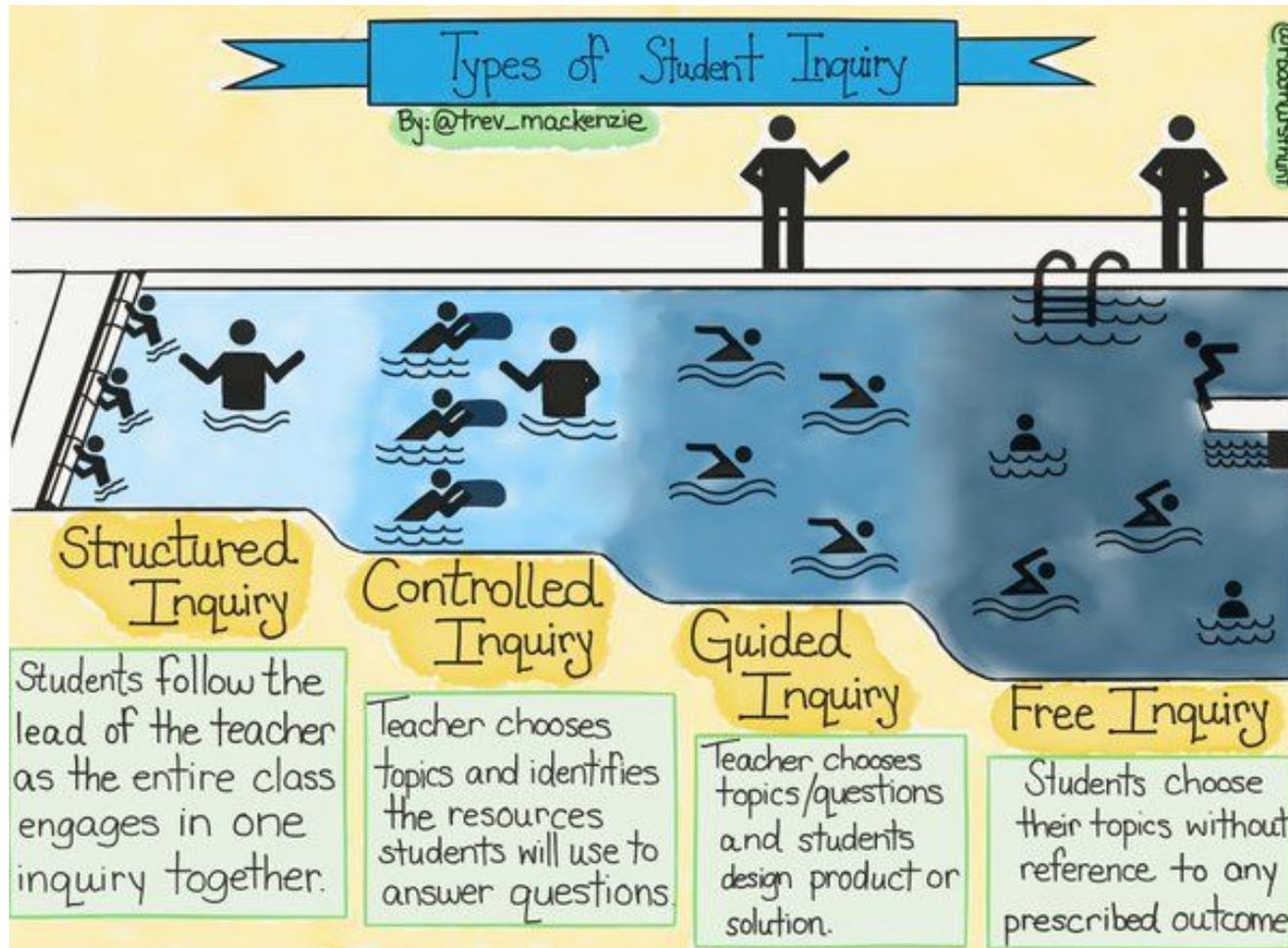


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Competencies & Models



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Nutrition Facts

Serving Size 1 cup (30g)
Servings Per Container about 13

	Cereal with	
Amount Per Serving	Dry	1/2 cup Skim Milk
Calories	120	160
Calories from Fat	10	15
% Daily Value**		
Total Fat 1g*	1%	2%
Saturated Fat 0g	0%	2%
Trans Fat 0g		
Cholesterol 0mg	0%	1%
Sodium 160mg	7%	9%
Potassium 110mg	3%	9%
Total Carbohydrate 24g	8%	10%
Dietary Fiber 3g	12%	12%
Sugars 6g		
Protein 3g		
Vitamin A	25%	30%
Vitamin C	25%	25%
Calcium	10%	25%
Iron	50%	50%
Vitamin D	10%	25%
Vitamin E	20%	20%
Vitamin B12	10%	25%
Thiamine	15%	20%
Riboflavin	15%	25%
Niacin	20%	20%
Vitamin B6	20%	20%
Folate	25%	25%
Zinc	25%	25%

*Amount in cereal
**Percent Daily Values are based on a 2,000 calorie diet.
Your daily values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Potassium		3,500mg	3,500mg
Total Carbohydrate		300g	300g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

Curriculum

How can we tread backwards for our students who might need a “structured/controlled/guided inquiry” questions?



Nutrition Facts

Serving Size: 1/4 Cup Dry (45g)
Servings Per Package: TBD

Amount Per Serving	1/4 Cup Dry Cereal	With 1/2 Cup Skim Milk
Calories	170	210
Calories from Fat	0	0
% Daily Value*		
Total Fat 0g	0%	1%
Saturated Fat 0g	0%	1%
Trans Fat 0g		
Polyunsaturated Fat 0g		
Monounsaturated Fat 0g		
Cholesterol 0mg	0%	1%
Sodium 0mg	0%	3%
Potassium 65mg	2%	8%
Total Carbohydrate 37g	12%	14%
Dietary Fiber 1g	5%	5%
Sugars 13g		
Other Carbohydrate 23g		
Protein 4g		
Vitamin A	0%	6%
Vitamin C	0%	2%
Calcium	10%	25%
Iron	60%	60%
Thiamin	25%	30%
Riboflavin	15%	25%
Niacin	25%	25%
Vitamin B6	20%	20%
Folate (Folic Acid)	100%	100%
Phosphorus	6%	20%

* Percent Daily Values are based on a 2,000 calorie diet.
Your daily values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Saturated Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Potassium		3,500mg	3,500mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

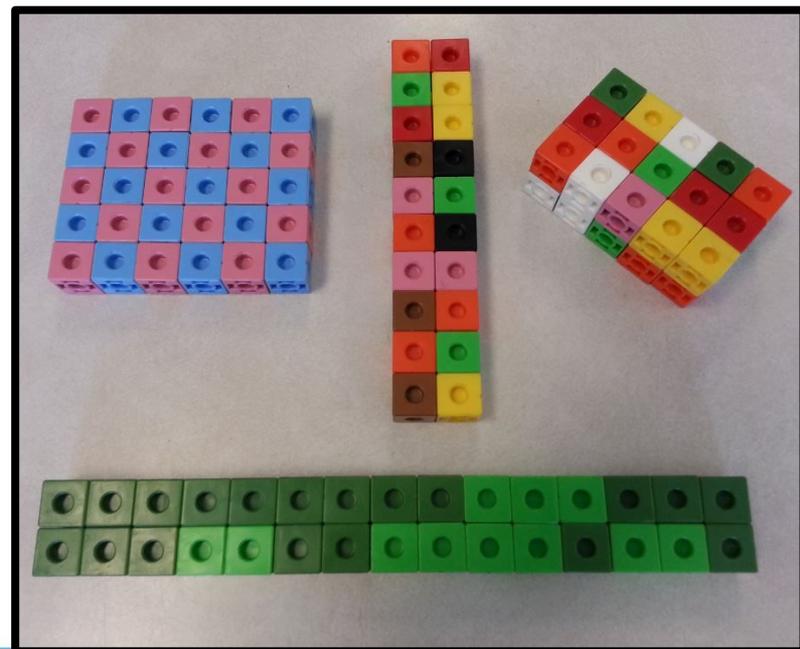
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Provocation Sources:

- <http://www.wouldyourathermath.com/>
- <http://www.101qs.com/index.php>
- <http://wonderopolis.org/>
- <http://www.wodb.ca/>
- www.Google.com

Which One
Doesn't Belong



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Triangulation of Data

- Peer/ Self assessment
- Journals
- Apps (Seesaw, Sesame, Classdojo)
- Google Drive & Rename

2. Observations

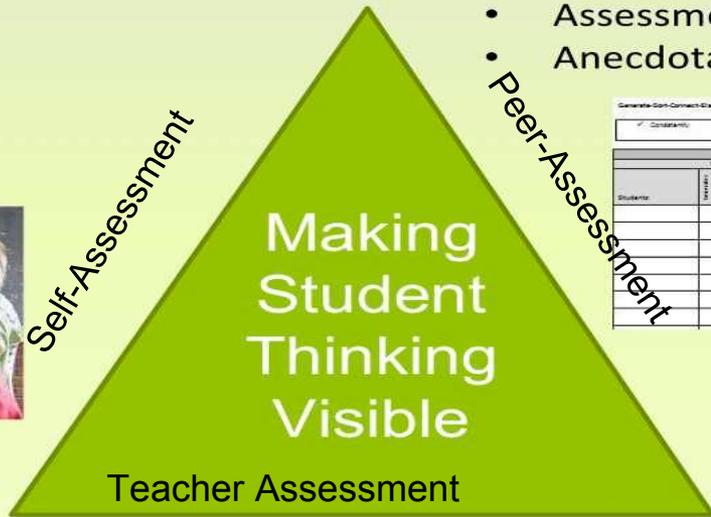
- Assessment checklists
- Anecdotal notes

Generate Self-Connect-Elaborate Assessment Tracking Form						
Generate Self-Connect-Elaborate						Teacher:
Consistent						
Generate Self-Connect-Elaborate						
Students	Identify the Problem	Identify the Solution	Identify the Strategy	Identify the Skill	Identify the Strategy	Notes



Self-Assessment

Peer-Assessment



Making Student Thinking Visible

Teacher Assessment

1. Conversations:

- Between peers
- With the teacher
- Student lead conference
- Meta-cognitive Exit Cards



3. Products

- Students work
- Student thinking recorded
- Variety of thinking routines explored
- Web 2.0/blogs/videos
- Portfolios



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Achievement Chart

ACHIEVEMENT CHART – LANGUAGE, GRADES 1–8

Categories	Level 1	Level 2	Level 3	Level 4
Knowledge and Understanding – Subject-specific content acquired in each grade (knowledge), and the comprehension of its meaning and significance (understanding)				
	The student:			
Knowledge of content (e.g., forms of text; strategies associated with reading, writing, speaking, and listening; elements of style; terminology; conventions)	demonstrates limited knowledge of content	demonstrates some knowledge of content	demonstrates considerable knowledge of content	demonstrates thorough knowledge of content
Understanding of content (e.g., concepts; ideas; opinions; relationships among facts, ideas, concepts, themes)	demonstrates limited understanding of content	demonstrates some understanding of content	demonstrates considerable understanding of content	demonstrates thorough understanding of content
Thinking – The use of critical and creative thinking skills and/or processes				
	The student:			
Use of planning skills (e.g., generating ideas, gathering information, focusing research, organizing information)	uses planning skills with limited effectiveness	uses planning skills with some effectiveness	uses planning skills with considerable effectiveness	uses planning skills with a high degree of effectiveness
Use of processing skills (e.g., making inferences, interpreting, analysing, detecting bias, synthesizing, evaluating, forming conclusions)	uses processing skills with limited effectiveness	uses processing skills with some effectiveness	uses processing skills with considerable effectiveness	uses processing skills with a high degree of effectiveness
Use of critical/creative thinking processes (e.g., reading process, writing process, oral discourse, research, critical/creative analysis, critical literacy, metacognition, invention)	uses critical/creative thinking processes with limited effectiveness	uses critical/creative thinking processes with some effectiveness	uses critical/creative thinking processes with considerable effectiveness	uses critical/creative thinking processes with a high degree of effectiveness

Achievement Chart Categories

Knowledge & Understanding—subject specific content acquired in each grade/course and the comprehension of its meaning

Thinking—use of critical and creative thinking skills and processes

Communication—conveying of meaning through various forms

Application—use of knowledge and skills to make connections within and between various contexts



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Assessment for/as/of Learning

Assessment		
For Learning	As Learning	Of Learning
<ul style="list-style-type: none"> •By teachers •to determine <u>what to do next</u> instructionally (strategies, differentiation) •To provide <u>descriptive feedback</u> to students (what they are doing well, what needs improvement and how to improve) 	<ul style="list-style-type: none"> •By student •to determine what to do next in my learning (e.g. strategy, focus) •To provide descriptive feedback to peers and self (peer and self assessment) •Goal is to become reflective, self-monitoring learner 	<ul style="list-style-type: none"> •By teacher •to determine student's level of achievement of overall expectations at a given point in time •As evidence to support professional judgment
		GS p. 31



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Where Does it Fit?

HOW DOES IT FIT INTO THE BEFORE, DURING AND AFTER MODEL?



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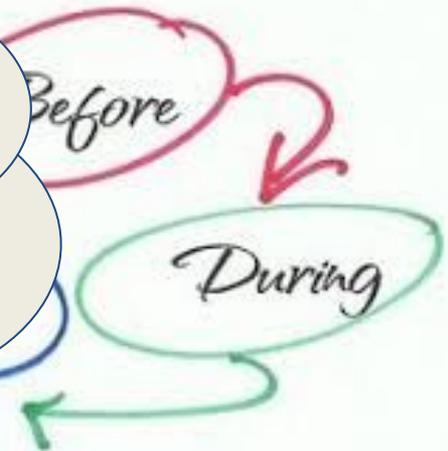
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Where Does it Fit?

HOW DOES IT FIT INTO THE BEFORE, DURING AND AFTER MODEL?

Share your thoughts?
You know your class
best?



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Planning

	Primary	Junior	Intermediate
GSS:	Describe, sort, classify, and compare Two-dimensional shapes and three-dimensional figures, and describe the location and movement of objects through investigation (Kinder)	Identify and describe the location of an object, using the cardinal directions, and translate two- dimensional shapes (Grade 5)	Represent transformations using the Cartesian coordinate plane, and make connections between transformations and the real world (Grade 6)



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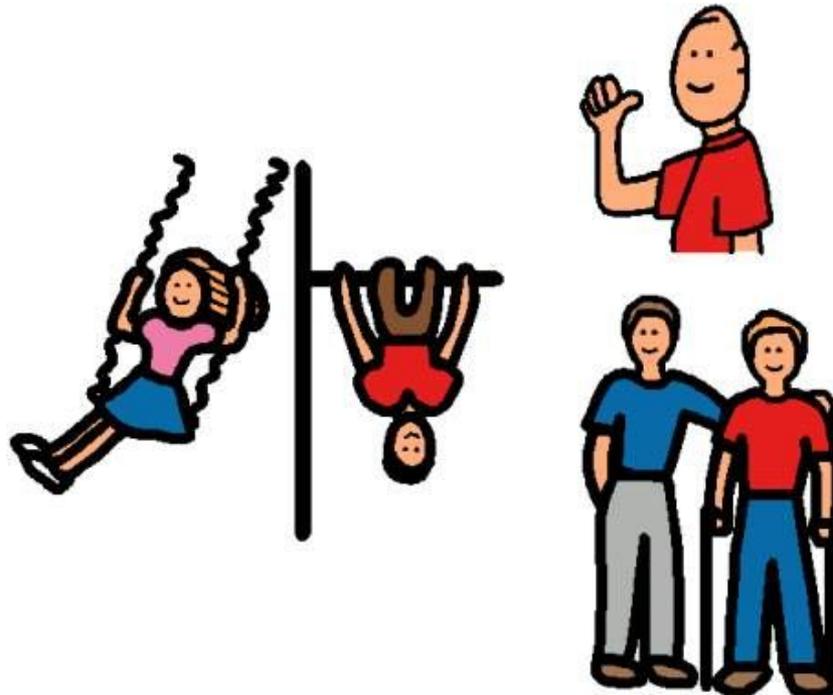
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Problem:

A friend who a physical impairment is having trouble moving around the yard at recess. How can you help him?

-Students can build maps, identify routes, efficiency, etc

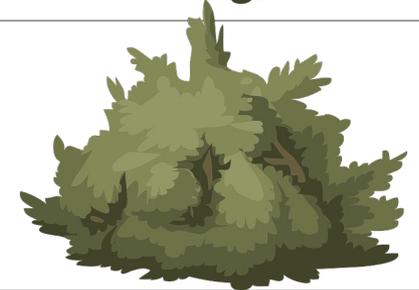
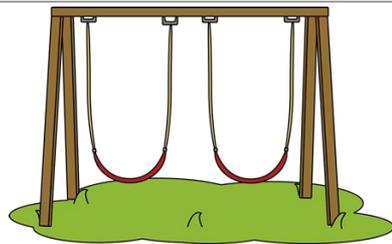
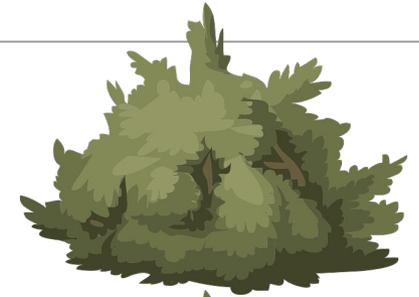
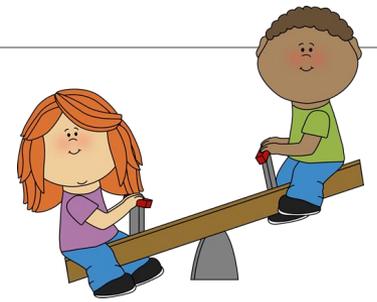


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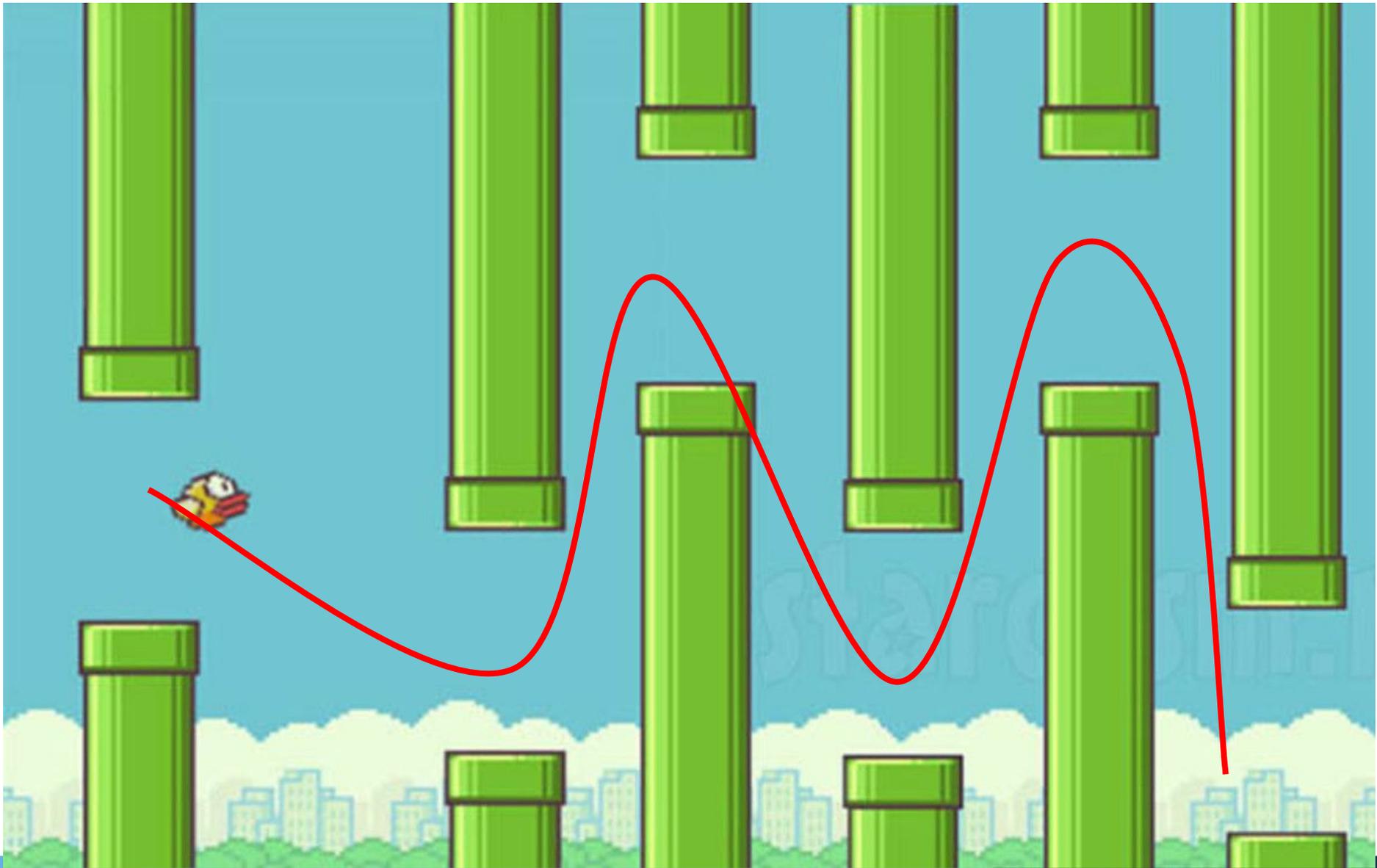
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Next Steps

- Books:
 - Dive into Inquiry (Trevor Mackenzie)
 - IQ series book (Jill Colyer & Jennifer Watts)
 - Natural Curiosity
- www.Google.com
- <http://www.101qs.com/index.php>
- <http://wonderopolis.org/>
- <http://www.wouldyourathermath.com/>
- <http://www.wodb.ca/index.html>



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Thank you



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Sources:

Kuklthau, C.C., Maniotes, L.K., & Caspari, A.K. (2007). Guided inquiry: Learning in the 21st century. Westport, CT & London: Libraries Unlimited.



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