

A top-down view of several children's hands gathered around a white grid paper on a wooden table. They are using small, light-colored beans to create patterns and shapes on the grid. One child is using a yellow pencil to point at a specific area. The scene illustrates a hands-on learning activity for mathematics.

# How can we teach students to be resilient problem solvers?

Using the New Three Rs and Positive Failure to transform our math culture





# Land Acknowledgement

- We recognize that we work, learn and play on the ancestral, traditional and unceded territories of the Kwantlen, Katzie, Matsqui and Semiahmoo First Peoples



# Why are we here today?



To enhance our math programs



To encourage student's love of math



To. build our students numeracy skills



To create a math culture that encourages risk taking and resilience



To utilize "The New Three Rs" to build problem solving skills



To plan for rich problem-solving skills



# Our Plan For The Sessions

---

Our own relationship with numeracy

---

Why numeracy matters

---

The New Three Rs

---

Positive Failure

---

Core Words for Learning



# Numeracy and You

Mary has ten dollars and Sam also has some money. Taking away 2 of Sam's dollars leaves him with as many as Mary has. How many dollars does Sam have?

$\frac{2}{5}$  of a number equals 12. What is the number?

Jane's savings are two thirds of Amy's savings. Together they save 450 dollars. How much money did Jane save?

The ratio of Simon's to Ramon's marbles is 3:5. Simon has 42 marbles. Simon buys 8 marbles more. Find the new ratio of Simon's to Ramon's marbles.

Sam has  $\frac{3}{7}$  the amount of marbles that Lisa has. Sam gives Lisa  $\frac{1}{6}$  of his marbles. What will be the new ratio between the number of marbles of Sam and Lisa?

If Amy gives 10 of her stamps to Robin, she will have four times as many stamps as Robin. If she gives 20 of her stamps to Robin, she will have three times as many stamps as Robin. How many stamps do they have in all?

- Pick one of the problems to solve using any strategy
- Do not use a calculator or your phone
- Solve the problems independently



# Math and You

---

Which problem did you choose to solve?

---

What did you notice about your problem solving strategy?

---

How did you feel about these problems?

---

What did you think about math as a student?

---

Has that changed now?

---

What is your favorite part of teaching math?

---

What do you look forward to when teaching math?

---

Does anything make you anxious when teaching math?



# Math in your classroom

---



What does your typical math block look like?



Who does most of the thinking during your math block?



How would your students describe math in your classroom?



What does problem solving look like in your classroom?



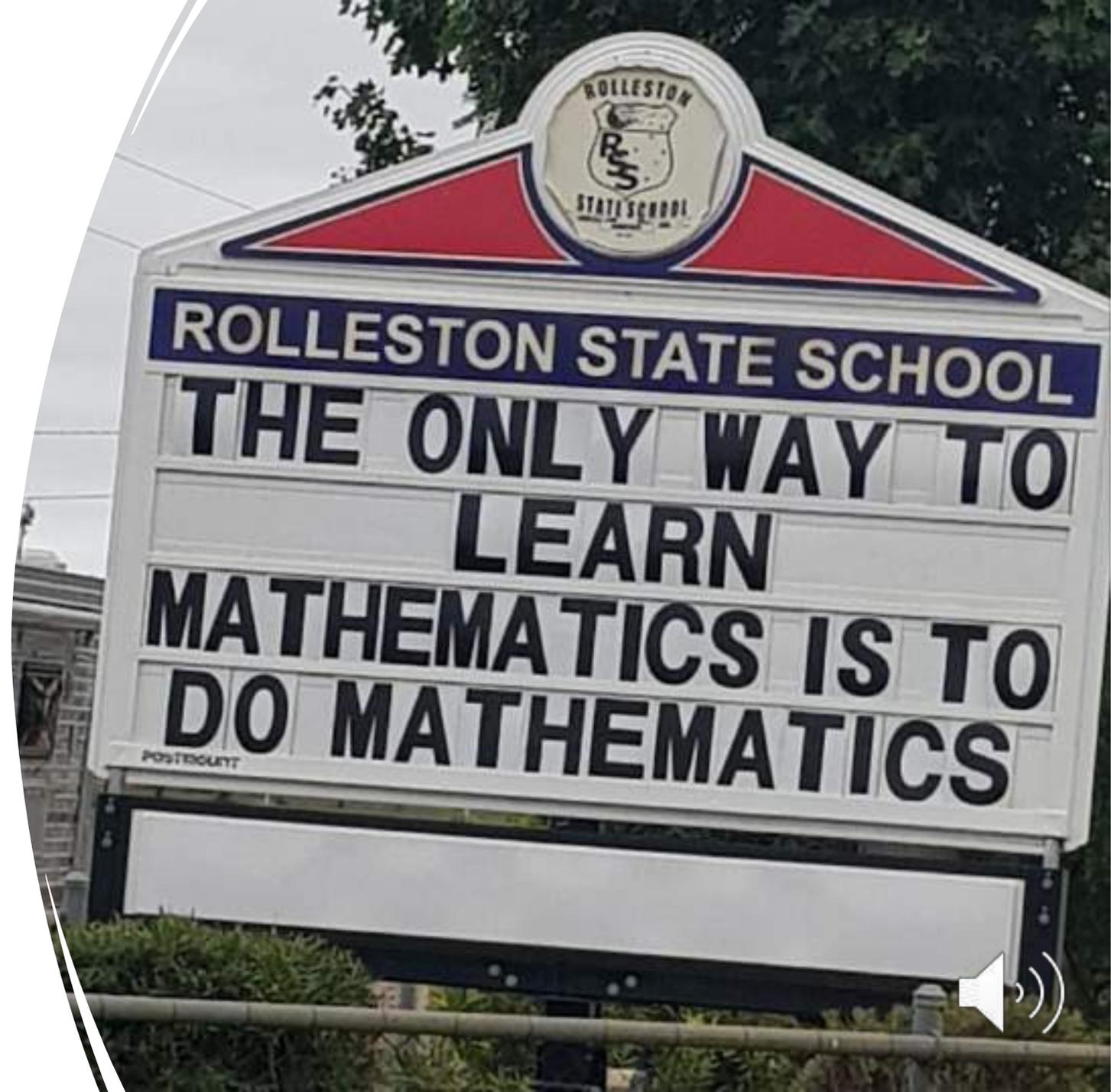
Do your students have the opportunity to be independent thinkers in math?



# Why Math Matters

---

- “Without numbers, we cannot send rockets roaming the solar system, nor could we build bridges, exchange goods, or pay our bills. In some sense, then, numbers are cultural inventions only comparable in importance to agriculture or the wheel. But they might have even deeper roots,” (Dehaene, 1997).
- Math is everywhere
- We use it every day for daily living activities
- A form of communication



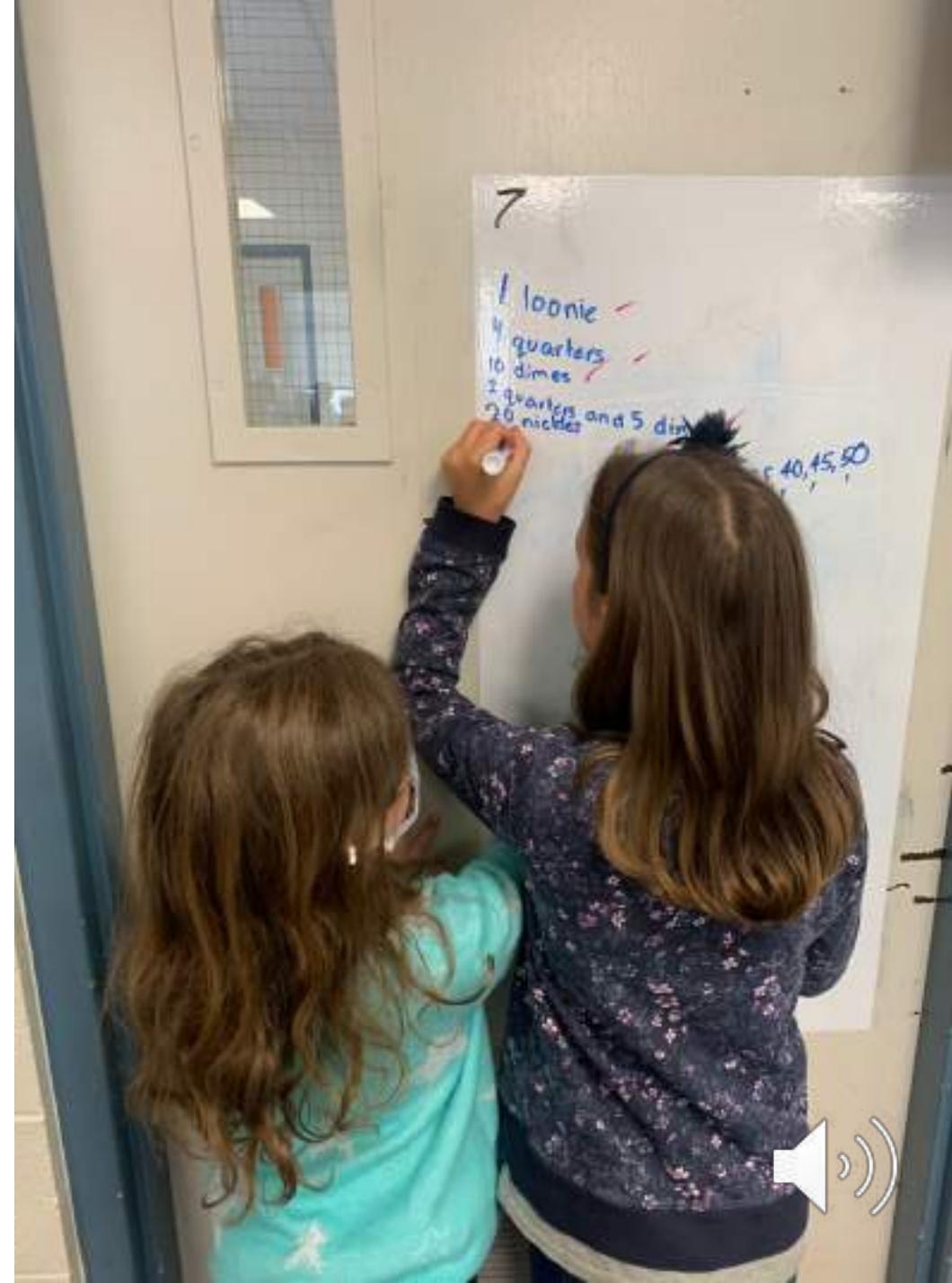
# Math Is A Sense!

- “Surprisingly deep down we are all born to be mathematicians.” (Woo, 2018)
- “Mathematics is a sense, just like sight and touch, it’s a sense that allows us to perceive realities that would otherwise be intangible to us. ” (Woo, 2018)
- Math is innately human
- Number sense is as much a part of our thinking and communication as language



# What Is Numeracy?

- “The ability to understand and work with numbers” (Merriam-Webster, 2016)
- Four parts
  - Handling information
  - Numbers and the number system
  - Operations and calculations
  - Shape, space and measurement
- (National Numeracy Network, 2022)



# Why Does Numeracy Matter?

---

- Essential life skill
- Basis for problem solving
- Teaches algorithmic and computational thinking



# The New Three Rs

- Skills that work in all curricular areas
  - Important for every student
  - Necessary for excellence
  - Applicable to all areas of life
- Based on the work of Robert Sternberg
    - Reasoning
    - Responsibility
    - Resilience



# Reasoning



## From Sternberg

Creative thinking to generate new and powerful ideas.

Critical and analytical thinking to ensure that the ideas (your own and those of others) are good ones.

Practical thinking to implement the ideas and persuade others of their value.

Wise thinking to ensure that the ideas help build a common good.

(Sternberg, 2008)



## What does this mean in our school?

Giving students opportunities to think

Teaching thinking skills and routines across the curriculum

Giving students the opportunity to practice thinking and explaining their thinking



## How does this connect to the curriculum?

Thinking Core Competency  
Curricular competencies in all subjects



## Resources to help develop Reasoning

Creating Cultures of Thinking  
Building Thinking Classrooms  
Making Thinking Visible  
Project Zero Thinking Routines



# Opportunities for Reasoning/ Thinking



How are we already encouraging students to think in math?



What can we add or change to encourage student thinking in math?



How can we support reluctant thinkers?



# Creating Opportunities To Encourage Student Reasoning / Thinking

---

- Building Thinking Classrooms
  - Change the type of task we do
  - Three Act Math Tasks
  - Open Ended Tasks
  - Open Middle Tasks
  - Rich Tasks
- Model thinking and discussion
- Teach language to explain your thinking



# Resilience



## From Sternberg

Willingness to defy the crowd in your thinking and actions—to take the road less traveled.

Willingness to surmount obstacles in trying to achieve your goals.

Passion in your pursuits—going for your goals with drive, motivation, and personal involvement.

Self-efficacy—belief in your ability to achieve your goals.

(Sternberg, 2008)



## What does this mean in our school?

Show students examples of people who have shown resilience in math and the sciences

Demonstrate resilience as a teacher



## How does this connect to the curriculum?

Personal Social Competency



## Resources to help develop Resilience

Julia Cook read aloud stories

Interviews with people who have shown resilience

Building Thinking Classrooms

Mathematical Mind Sets

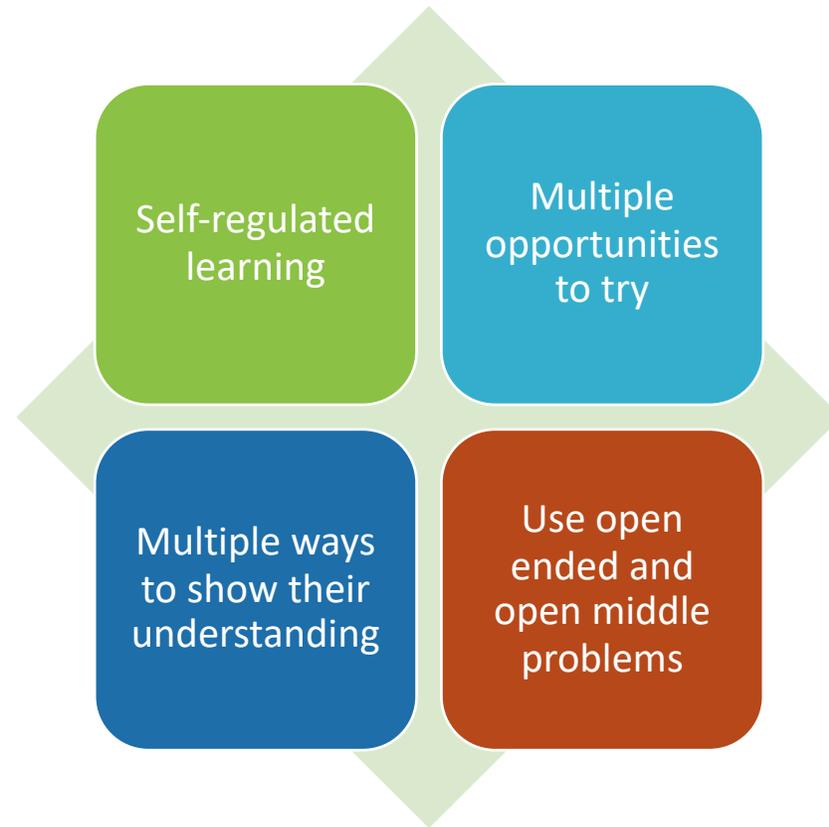


# Creating Opportunities to Build Resilience



# Creating Opportunities for Building Resilience

---



# Responsibility



## From Sternberg

Ethics—distinguishing right from wrong.

Wisdom—forging or following a path that represents a common good and balances your own interests with those of others.

Care—genuine understanding of and empathy for others' well-being that goes beyond an intellectual sense that you *should* care.

Right action—not only knowing the right thing to do, but doing it.

(Sternberg, 2008)



## What does this mean in our school?

Giving students opportunities to take responsibility



## How does this connect to the curriculum?

Personal Social Competency  
Thinking Competency



## Resources to help develop responsibility

Building Thinking Classrooms  
Julia Cook read aloud books



# Creating Opportunities for Taking Responsibility

---

- Hold students accountable for their work
- All students are encouraged to participate in math discussions and activities – no hiding behind your group
- Work in groups, pairs or trios
- Use check your understanding problems
- Use self-assessments
- Use self-reflections



# At Our School...

---

When do we ask our students to be responsible for their learning?

How are we teaching responsibility?

How are we modeling responsibility?

What do we do when students are not showing responsibility?

How are we involving families in teaching responsibility?



# Your thoughts

How do you see the New Three Rs fitting at our school?

Do they work with any of our existing models and structures?

Which one stands out to you?

Which one do you think our students are doing already?

Which one do you think our students need the most practice with?

How can we integrate them into our school culture?



# The New 3 Rs in Math



## Reasoning

Rich tasks

Opportunity for mathematical discussion

Creating your own problems

Performance tasks

Open middle tasks

Open ended tasks



## Responsibility

Check your understanding problems

Group work on boards

Math journals

Performance tasks



## Resilience

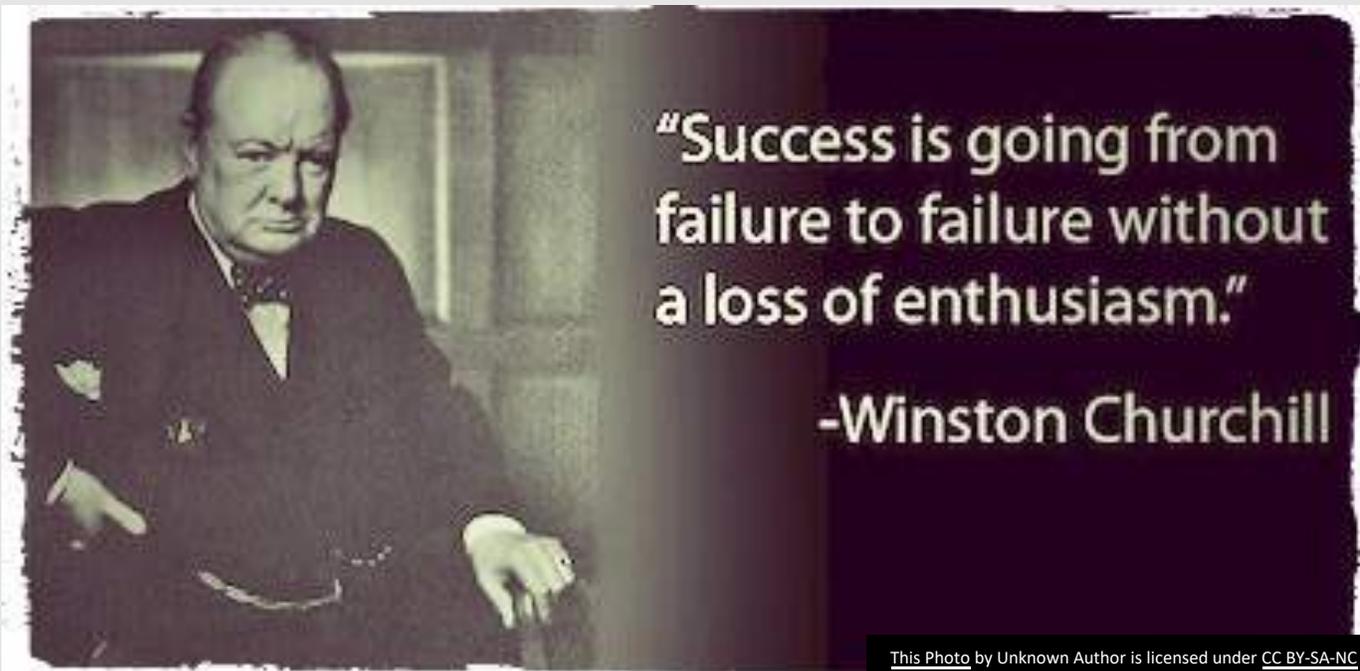
Group work on boards

Patient problem solving

Finding multiple ways to solve a problem



# How do we treat failure?



This Photo by Unknown Author is licensed under [CC BY-SA-NC](#)

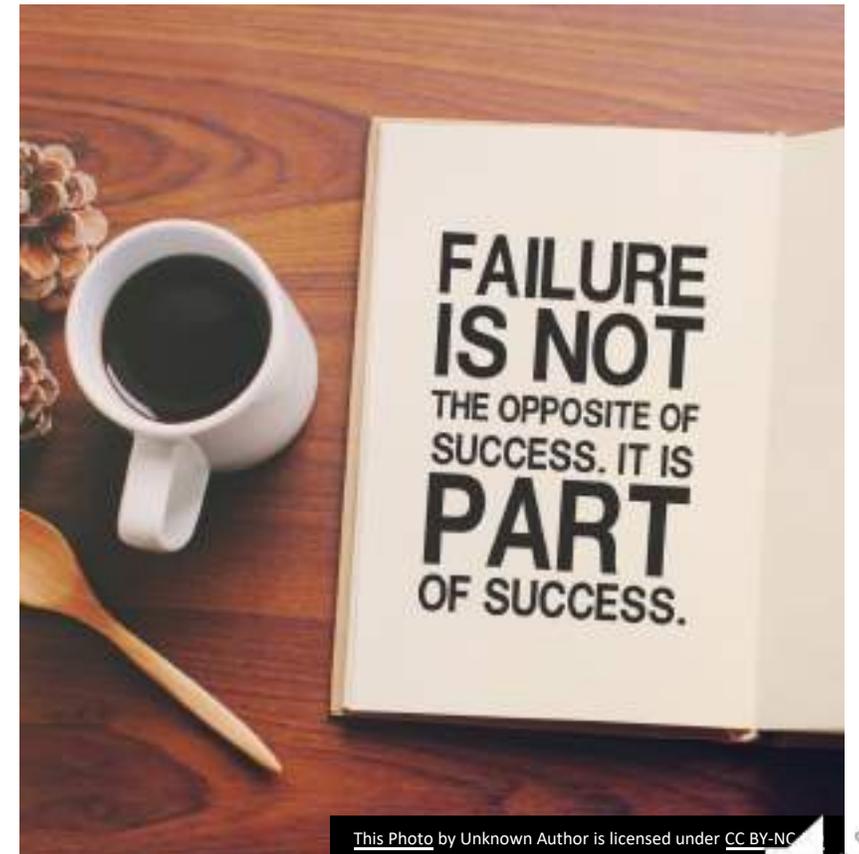
- “Unfortunately, schools tend to treat failure as almost exclusively negative. Think back to a time when you failed a test or a quiz or failed to complete an assignment. Do you remember that sinking feeling that there was nothing more you could do?” (Miller, 2015)
- How is failure treated in your classroom?
- Do your students get a chance to try again?
- Is there opportunity for growth?
- How is your assessment reflecting growth over time?



# Failure and Learning

---

- “If failure is the end of the road in some instances, it can be the beginning of an innovative journey in others.” (Miller, 2015)
- To learn we have to fail first
- Learning comes out of failure and correcting mistakes
- “But when treated as a necessary step toward innovation, failure can help students to , Promote and establish a growth mindset, Build resiliency and a life-long learning mentality, and Prepare for the real world” (Miller, 2015)



This Photo by Unknown Author is licensed under [CC BY-NC](#)



# Shifting our mindset

- “Fear of failure is one of the leading causes of anxiety for students.” (Miller, 2015)
- Failure is the first step to success and learning
- Necessary to build resilience
- Children have experienced failure in:
  - Playing video games
  - Sports games
  - Dance, gymnastics or skating competitions
  - Martial arts lessons
- We need to model failure and fixing our mistakes
- Sheltering students from failure does them a disservice
- Students need the opportunity to fail to help them learn to grow from their mistakes
- Failure is inevitable - we need to learn how to be resilient through it
- Opportunities for Intelligent Fast Failure



# Intelligent Fast Failure

- “Students who tried lots of ideas in a short period of time were going through a process of fast failure wherein each failed idea constituted knowledge acquisition,” (Tahirsyla, 2012)
- What is Intelligent Fast Failure?
  - Trying new ideas in quick succession
  - Limited investment of time or resources
  - Chances to fail and adapt your plan or strategy
- Pre-Requisites
  - We must overcome the fear of failure
  - We must see failure as part of learning and knowledge acquisition



# Inviting Chaos

- Sometimes we have to get out of the students way to let them learn
- Give them time to strategize and solve problems
- Time for students to create and apply their knowledge
- Time to think and discover

- Creating
- Havoc
- Accelerates
- Outrageous
- Success



# Opportunities For Failure in Math

- Rich tasks
- Open ended tasks
- Open middle tasks
- Group work
- Three Act Tasks



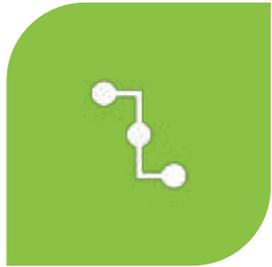
# Core Words For Learning

- Things to think about
  - What words would you use to describe learning in your classroom?
  - What are the big things you want your students to know or understand?
  - If your students remember one or two things about your time together what do you want them to be?
- Your task
  - List as many words as possible to describe learning in your classroom
  - Highlight the 2-4 that you feel are most important for you and your students



# My Core Words for Learning

---



CONNECTION



WONDER



THINKING

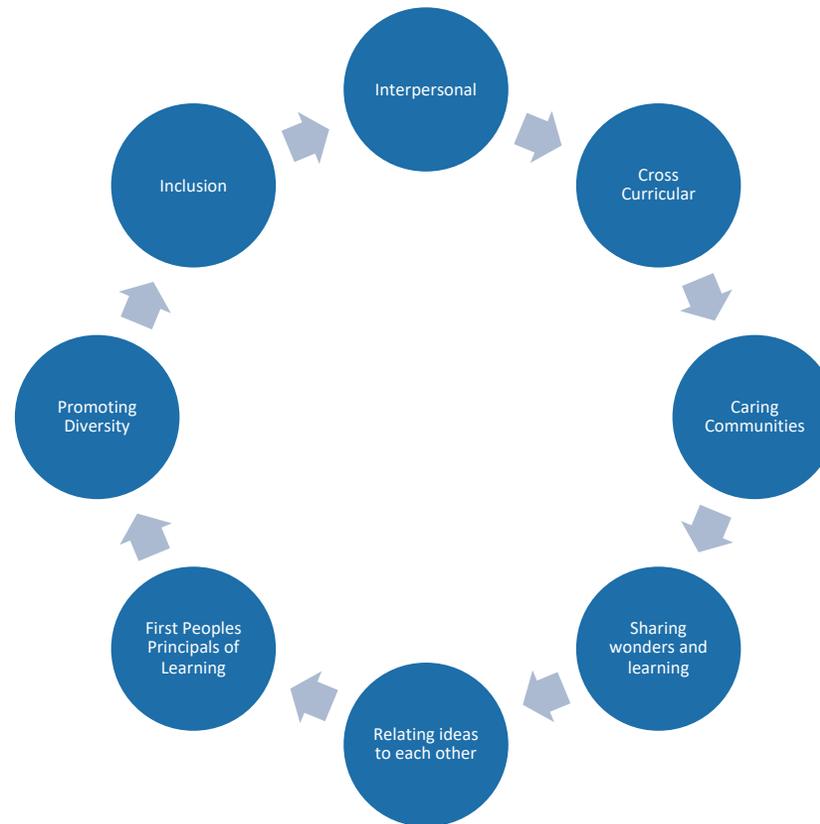


PLAY



# Connection

---



# Connection in Math

---

Small group  
work

Whole class  
work

Number  
Corner

Number Talks

Pairs, trios,  
quads

Whole class  
activities

Sharing  
between  
groups

Family math  
games /  
activities





# Wonder

---

- Wonder is the beginning. It is often uncomfortable. When we fail to find such moments, we become lost, disconnected, isolated. We cannot discover meaning on paths without wonder. (Liard, 2021)
- Sparks learning
- Initiates inquiry
- Self Regulated Learning
- Motivates sustained interest
- Supports Learning In Depth
- STEM and STEAM activities



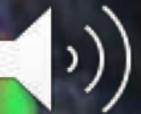
# Wonder in Math

- Hands on activities
- Using manipulatives
- Good questions
- Rich tasks
- Math talks / number talks
- Exploration activities
- Open ended tasks
- Open middle tasks



# Play

- Opportunities to explore and ideate
- Freely chosen and intrinsically motivated
- Many types of play support learning
- Allows for exploration
- Encourages resilience
- Motivates Learning
- Opportunities for creativity
- Maker Opportunities
- Art





# Play In Math

- Games
- Whole class activities
- Partner activities
- Family math games
- Open ended math
- Math escape rooms



# Creating Opportunities for Student Choice

## Offer opportunities for student choice

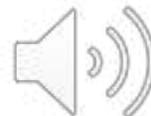
- Which of two or three problems to solve
- Student chooses which activity to start with
- Activity menus – all must be completed, student picks the order

## Challenge by choice philosophy

- Teacher picks 3-4 problems, student chooses which one to solve
- Offer problems at varying difficulties, students decide where they're at today could use :
  - salsa ( mild, medium, hot, extra hot)
  - ski runs ( green circle, blue square, single black diamond, double black diamond)
- Open middle problems

## Teacher picks the problem

- Student chooses the strategy



# Opportunities for choice in our classrooms



Where do students already get to make choices in math?



Where can we give students an opportunity to make a choice in math?



What activities are going to promote student choice?



What could you try to increase student choice?



# What Next?

---

What do you want to try?

---

What is one thing you can do this year to enhance student problem solving?

---

Which of these ideas makes you feel excited?

---

How do you think your students will respond to making the change?

---

What makes you apprehensive about the change?



# Innovating My Math Program

---

- Areas to focus on:
  - Student choice
  - Responsibility
  - Resilience
  - Thinking / Reasoning
  - Connection
  - Wonder
  - Play





# Teacher Resources

---

- Mindset Mathematics (Grade 2, Grade 3, Grade 4)
- Place Value in Intermediate
- Math Their Way
- Math Focus Grade 4
- Building Thinking Classrooms in Mathematics
- Math to The Max
- Maximizing Math
- Number Corner ( Grade 2, Grade 3, Grade 4)



# Bibliography

BC Ministry of Education. (2020). *Grade 4 Math Curriculum*. Retrieved from Building Student Success: <https://curriculum.gov.bc.ca/curriculum/mathematics/4/core>

British Columbia Ministry of Education. (2015). *Mathematics*. Retrieved from Building Student Success: <https://curriculum.gov.bc.ca/curriculum/mathematics>

Dehaene, S. (1997). *The Number Sense: How the Mind Creates Mathematics*. Oxford: Oxford University Press.

First Nations Education Steering Committee. (2007). *First People's Principles of Learning*. Retrieved from First Nations Education Steering Committee: <http://www.fnesc.ca/first-peoples-principles-of-learning/>

Liard, R. (2021, June 18). *Big Problems Small Wonder*. Retrieved from Ross Liard: <https://www.rosslaird.com/articles/mental-health/big-problems-small-wonder/>

Merriam-Webster. (2016). *Numeracy*. Retrieved from Webster's Dictionary: <https://www.merriam-webster.com/dictionary/numeracy>

Miller, A. K. (2015). *Freedom to Fail: How Do I Foster Risk-taking and Innovation in My Classroom*. ASCD Arias.

National Numeracy Network. (2022). *The Essentials of Numeracy*. Retrieved from National Numeracy Network: <https://www.nationalnumeracy.org.uk/what-numeracy/essentials-numeracy>

Sternberg, R. J. (2008). Excellence for All. *Educational Leadership*, 14-19.

Tahirsyla, A. S. (2012). Stimulating creativity and innovation through Intelligent Fast Failure. *Thinking Skills and Creativity*.

Woo, E. (2018, July 24). *Mathematics is the sense you never knew you had*. (E. Woo, Performer) TEDxSydney, Sydney, Australia.

