Promoting a Positive Math Identity

Module 1
The importance of math identity for math success

Classroom Practices to Promote a Positive Math Identity, Module 1 of 3

Note. These materials were produced for the Idaho State Department of Education and the Idaho Regional Mathematics Centers and were presented on August 13, 2019 at the Idaho Council of Teachers of Mathematics conference.

Training series progression

Module 1

The importance of math identity for math success

- Build knowledge of what math identity is and why it is important for math success

Module 2

Building the math environment (2 parts)

- Learn how to create a classroom environment that supports a positive math identity

Module 3

Kernels of practice

- Learn how to implement targeted activities that promote a positive math identity

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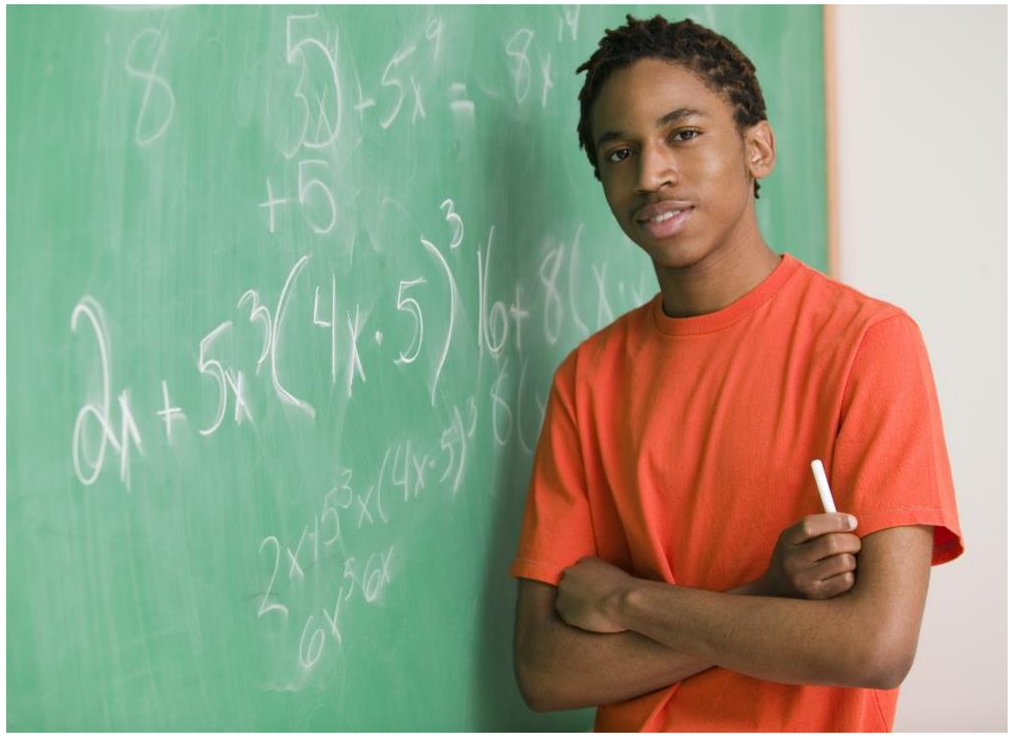
Module 1 learning objectives

By the end of this session, you will be able to:

- Reflect on your own math identity.
- Describe how math identity impacts students' engagement and learning.
- Recognize the role adults play in creating math environments that support the development of a positive math identity.
- Understand how math identity and the Standards for Math Practice support and build on each other.



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Activity

Take a few minutes to write your "math autobiography":

The last math course I took was _____.

When I think about doing math, I feel _____.

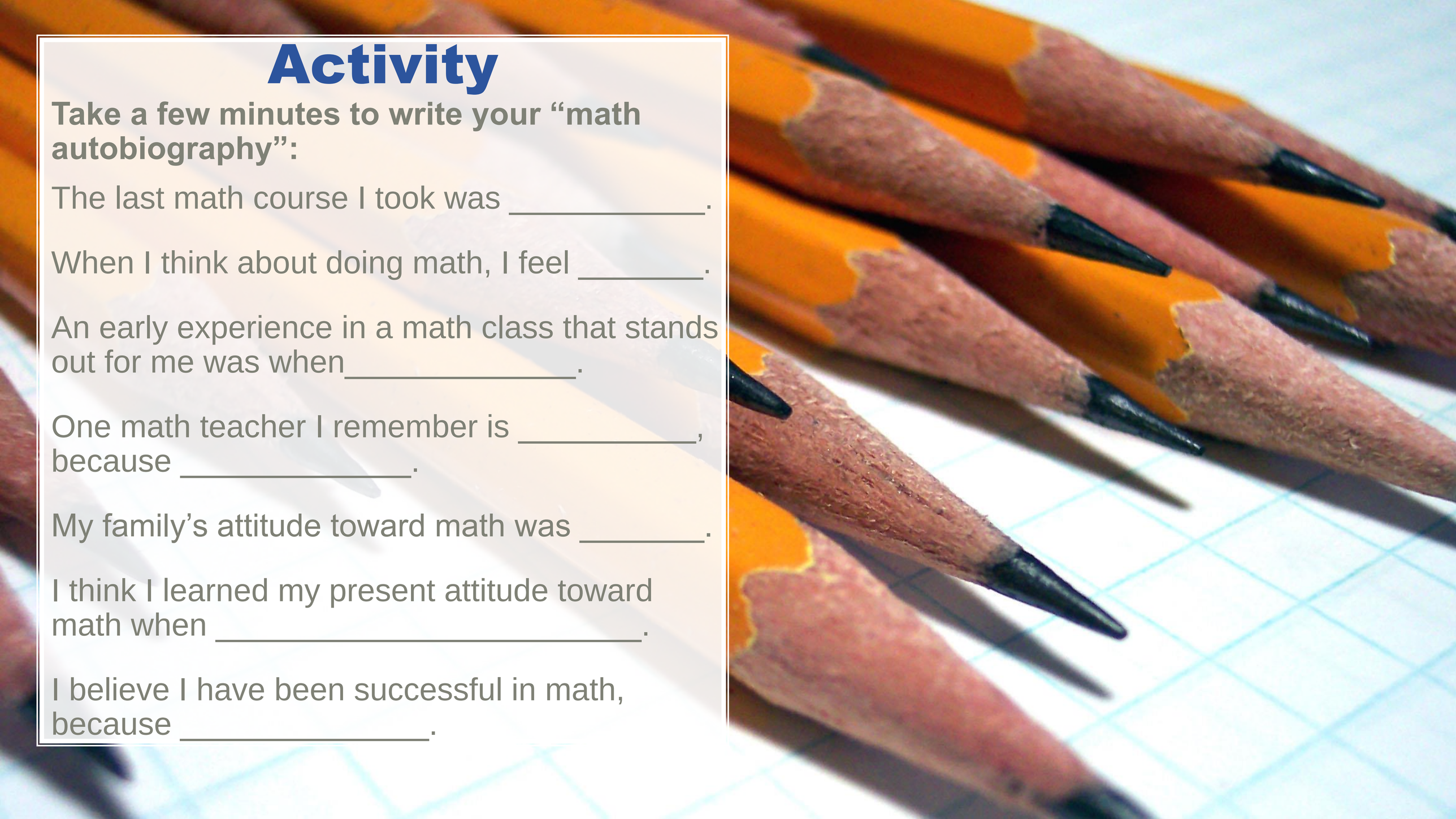
An early experience in a math class that stands out for me was when_____.

One math teacher I remember is _____, because _____.

My family's attitude toward math was _____.

I think I learned my present attitude toward math when _____.

I believe I have been successful in math, because _____.



Discussion

Would you describe your relationship to math as mostly positive, mostly negative, or somewhere in between? Why?

How do you think your experience with math as a young person shaped your "math life?"

In what ways, do you think, does your relationship to math influence or impact your work as a math teacher?

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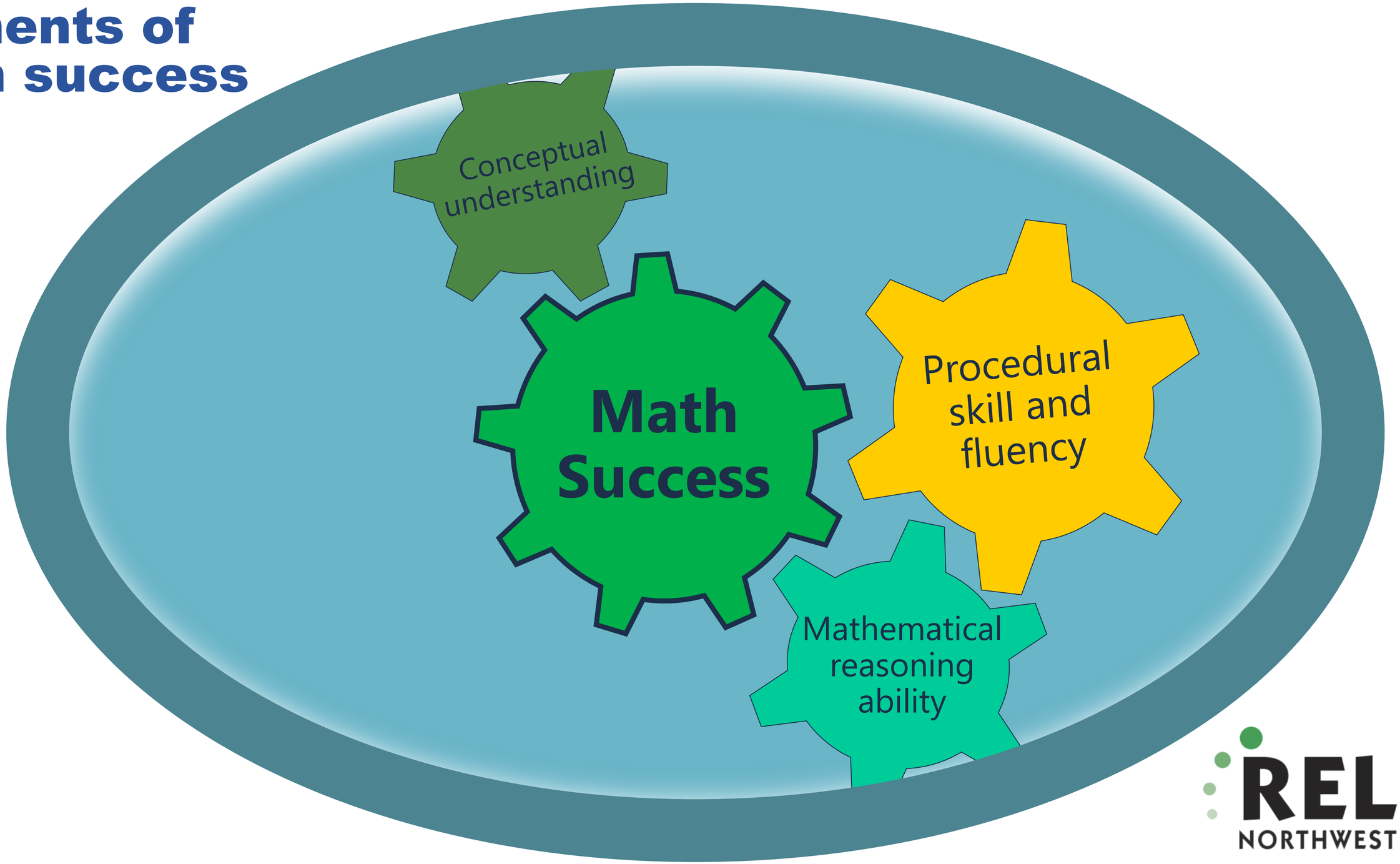
Elements of math success



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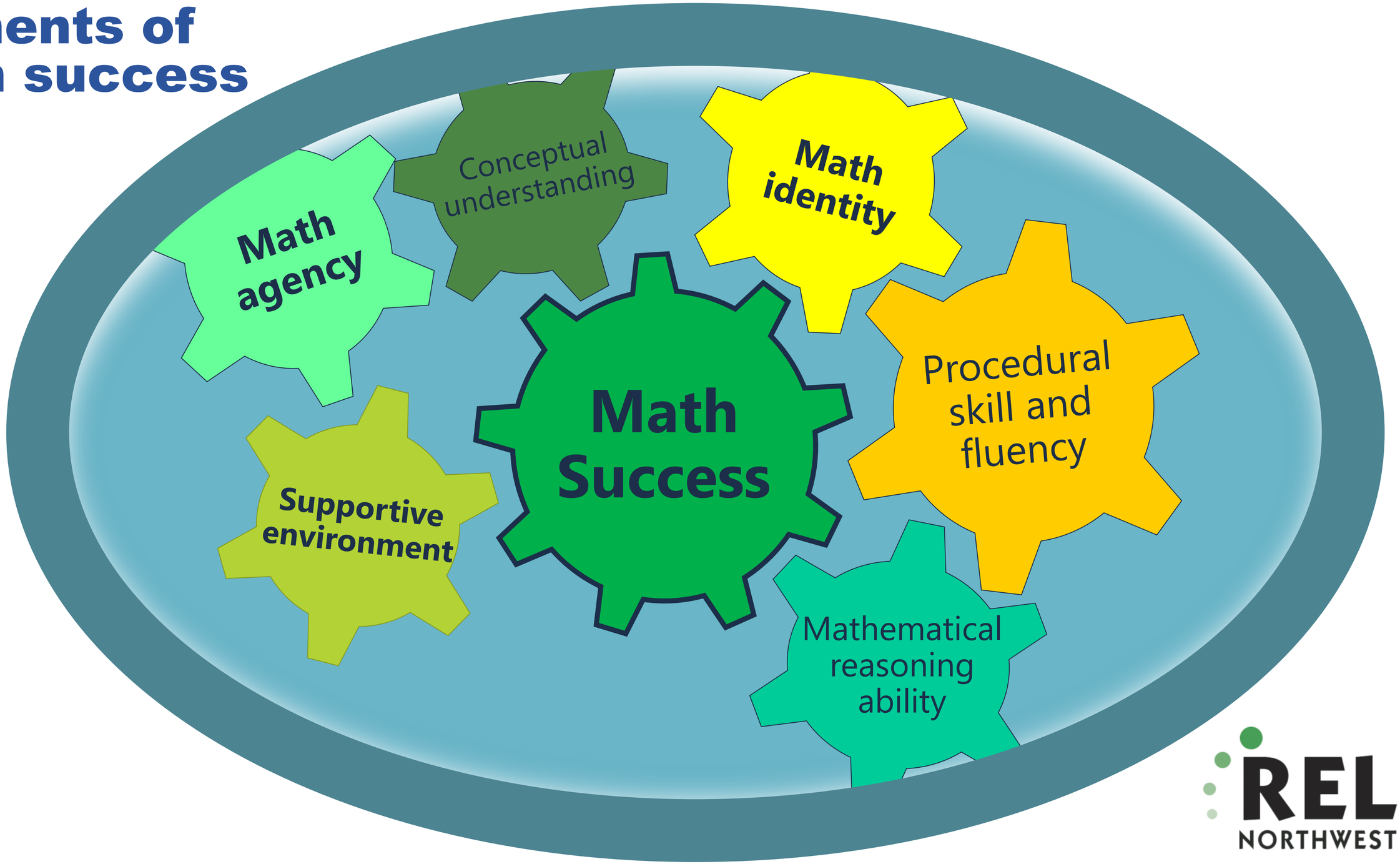

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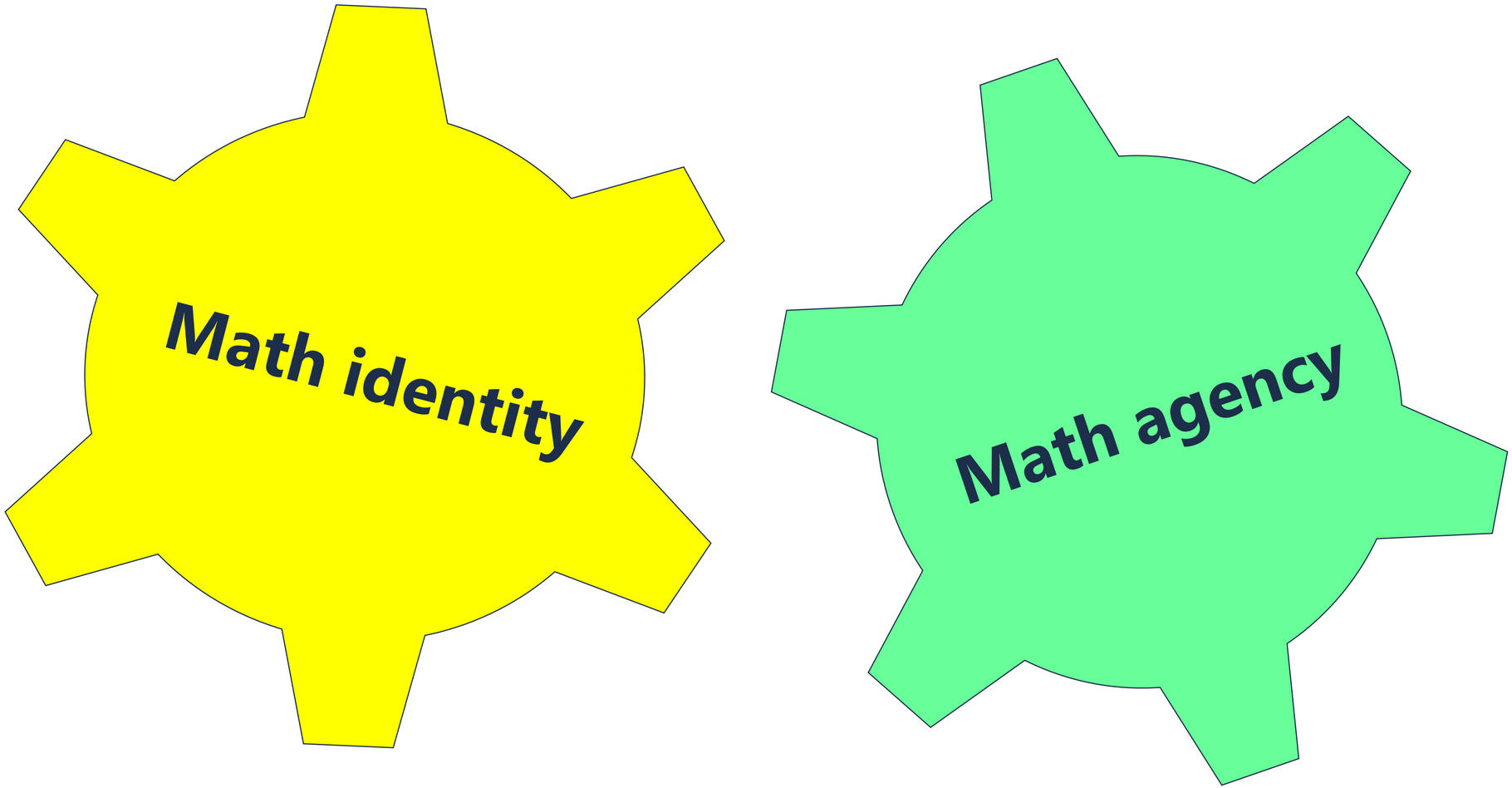

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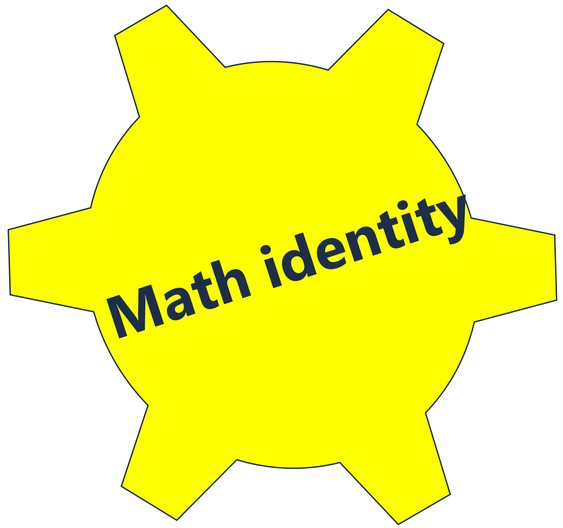
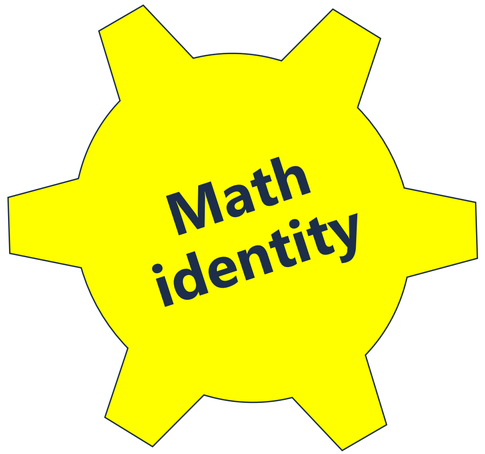


What is math identity?

- Beliefs about one's self as a math learner.
- Beliefs about how one is perceived by others as a math learner.
- Beliefs about math and the nature of math abilities.

Content source: Solomon, 2008



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What is math agency?

- Outward expression of math identity.

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Content source: Aguirre, Mayfield-Ingram, & Martin, 2013

Why should we care about identity and agency?

Connection with Standards for Math Practice

Standards for Mathematical Practice

1. Make sense of problems and persevere in solving them.
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Content source: Common Core State Standards Initiative, n.d.

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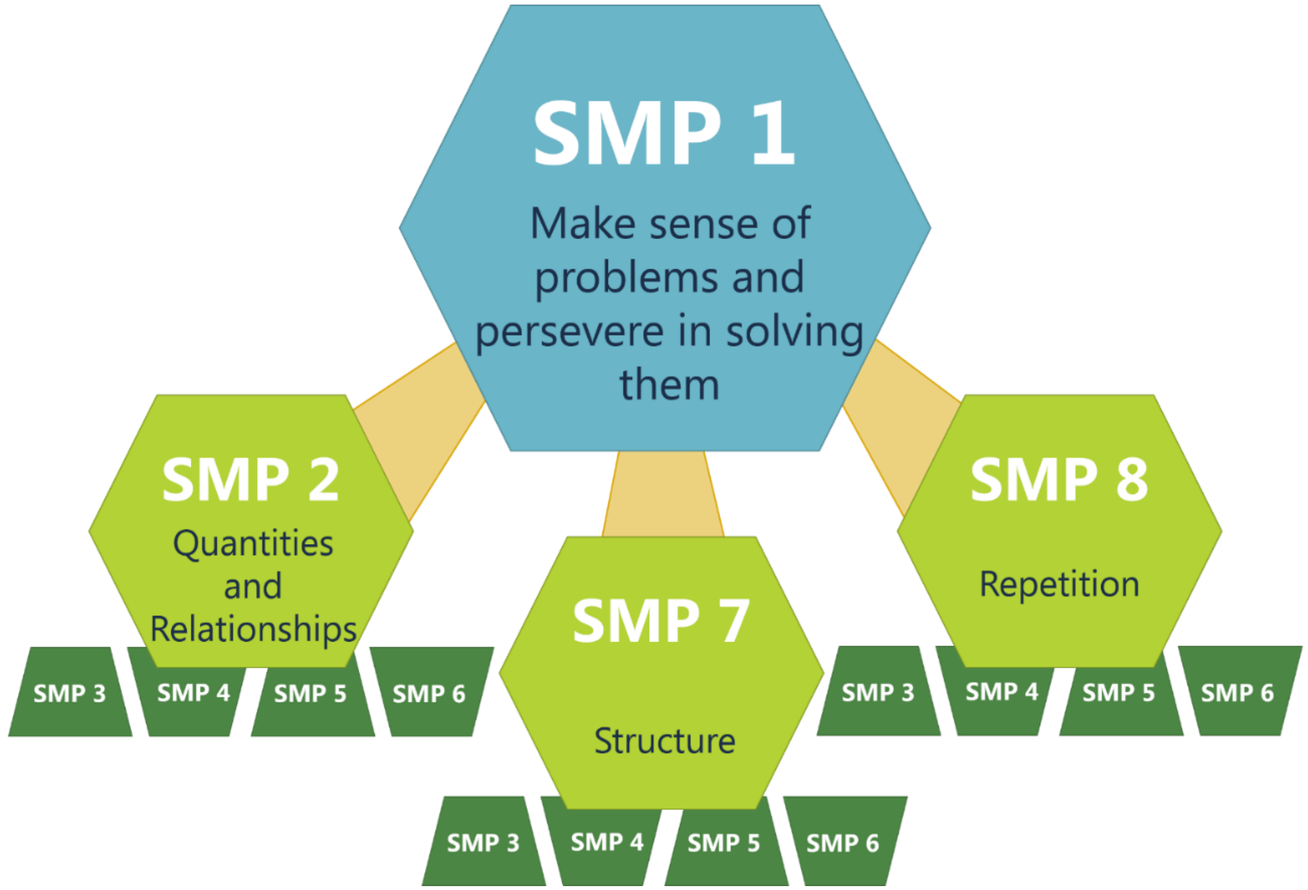

Content source: Common Core State Standards Initiative, n.d. ; Kelemanik, Lucenta, & Creighton, 2016

What's so special about math?

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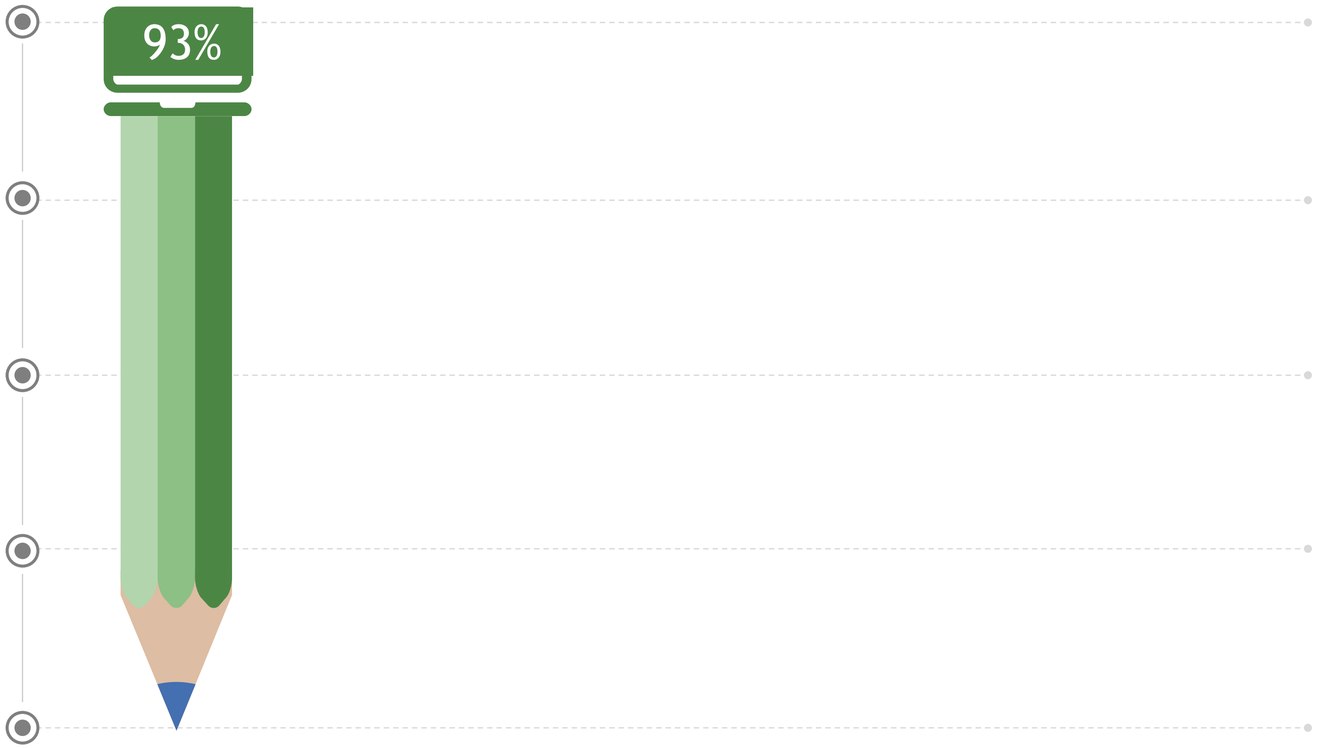
Prevalence of negativity about math

Amongst adults

- 93 percent report experiencing some level of math anxiety



Content source: Luttenberger, Wimmer, & Paechter, 2018

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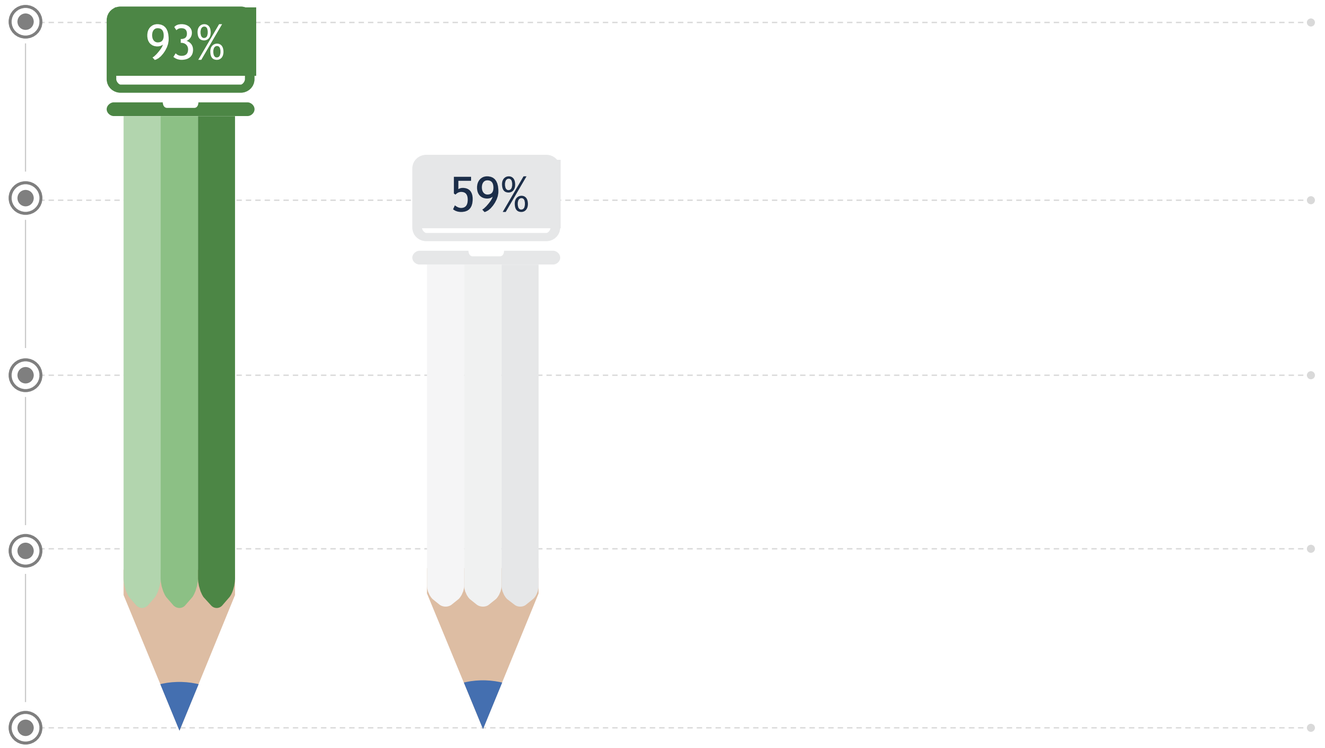
Amongst students taking PISA

- 59 percent report worrying math will be difficult



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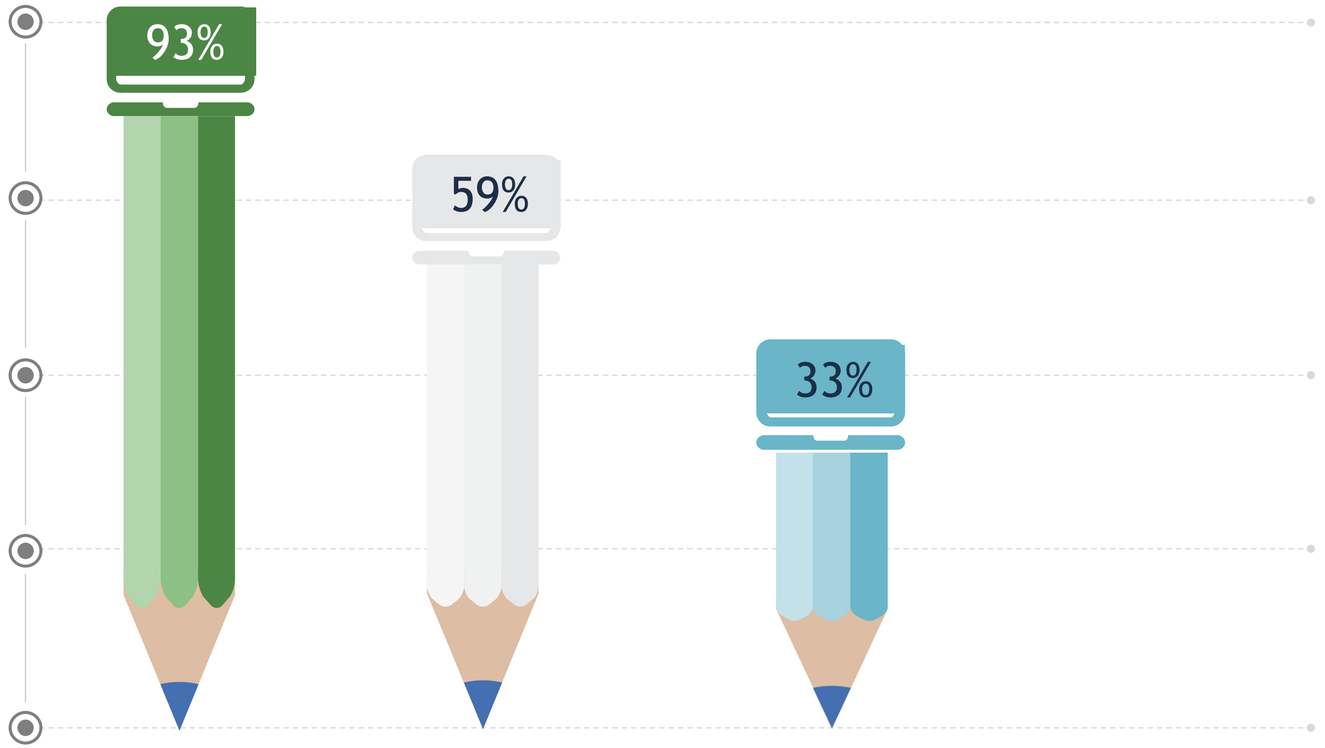

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Prevalence of negativity about math

Amongst adults

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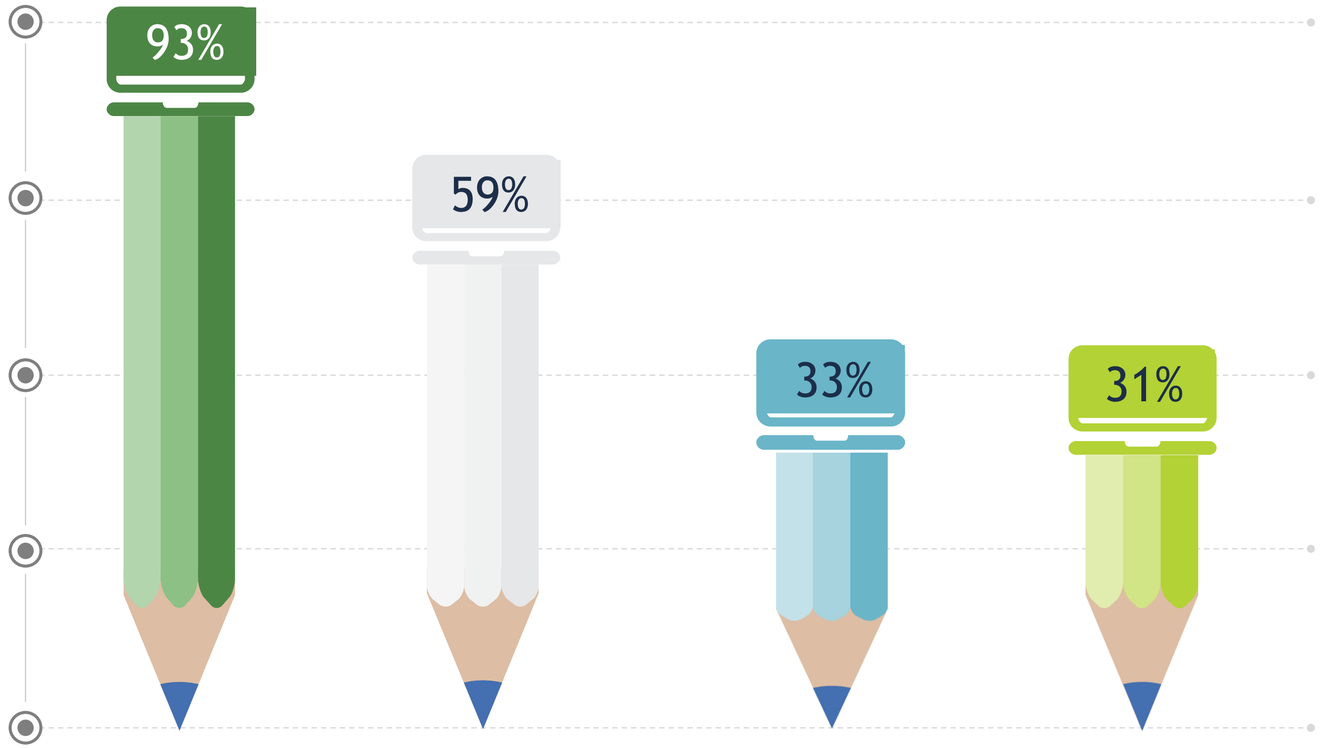
Amongst students taking PISA

- 59 percent report worrying math will be difficult
- 33 percent report they get very tense when completing math homework
- 31 percent state they get very nervous doing math problems



Content source: Luttenberger, Wimmer, & Paechter, 2018

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Negativity about math

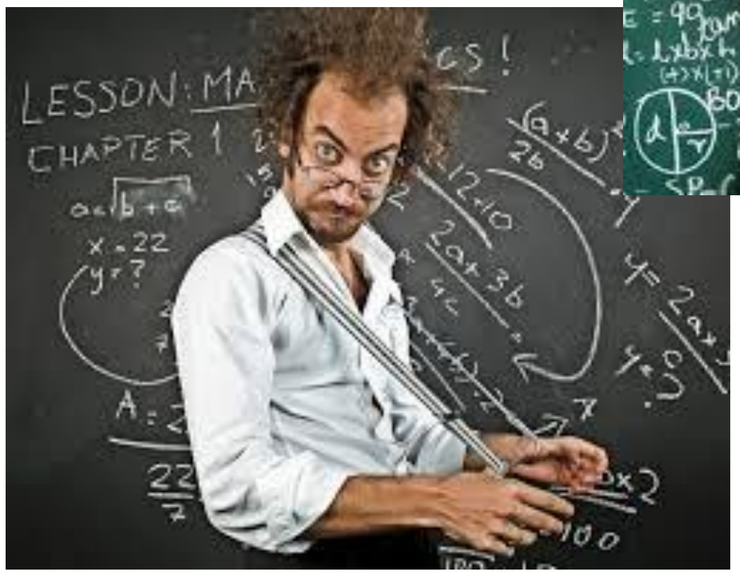
Math, more than other domains, carries baggage that can set students up to hold negative attitudes and beliefs.

~~I'm just not a letters person.~~

I'm just not a numbers person.

~~I'm so bad at reading.~~

Google image search for “Math Genius”



What do you notice about these images?

What cultural assumptions are reflected?

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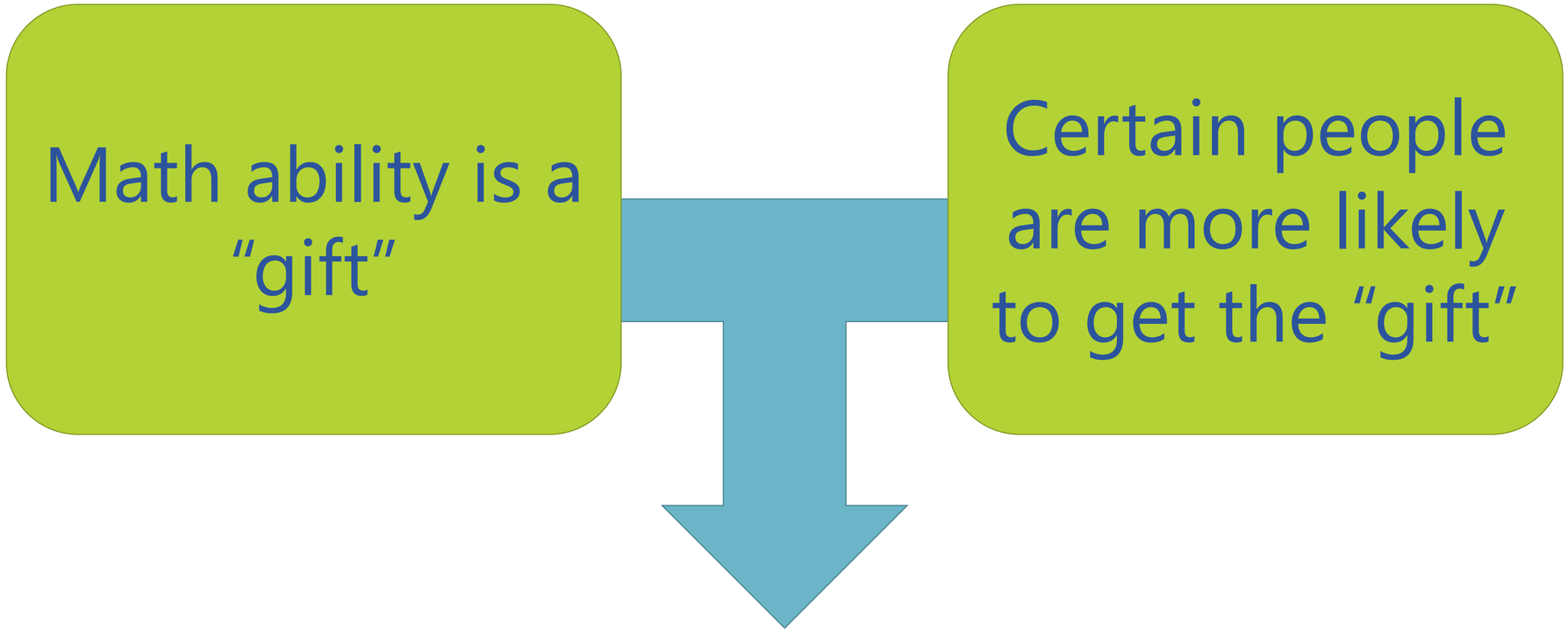
Stereotypes about math

Math ability is a "gift"

Certain people are more likely to get the "gift"

Content source: Chestnut, Lei, Leslie, & Cimpian, 2018

Stereotypes about math



Content source: Chestnut, Lei, Leslie, & Cimpian, 2018

Which groups does our society associate with brilliance?

Thanks, Mom and Dad, for All Your Support

By BILL MARSH JAN. 18, 2014

THE DISCONNECT BETWEEN PARENTS' WEB SEARCHES AND REALITY

Content source: Marsh, 2014

Girls and math

"Boys do not pursue mathematical activities at a higher rate than girls do because they are better at math. They do so, at least partially, because they ***think*** they are better."

Shelley Correll, Stanford sociologist

Content source: Correll, 2001

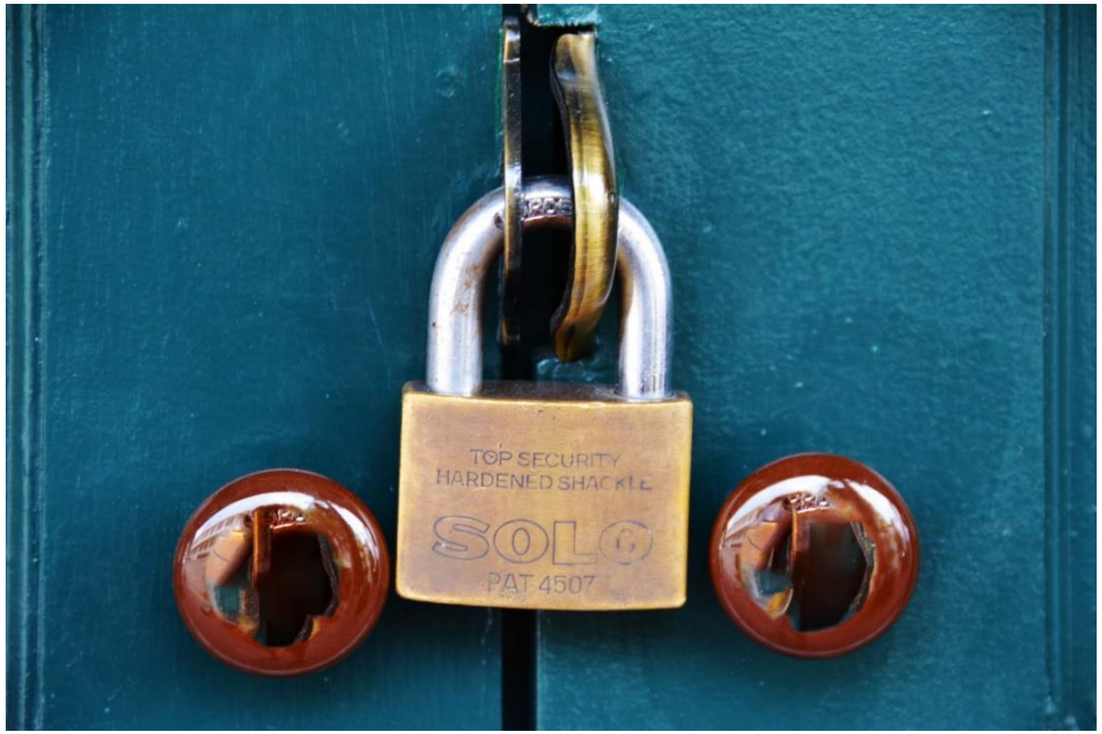
Stereotypes emerge early

- Children endorse the stereotype that math is for boys as early as second grade.
- Gender stereotypes emerge before differences in math achievement.

Content source: Bian, Leslie, & Cimpian, 2017

What's the harm?

- Math is a gateway and gatekeeper
  - Access to advanced courses
  - Entrance to college
  - Access to math-dependent careers
- Evident at a young age – early math skills are the strongest predictor of later academic outcomes



Content source: Douglas & Attewell, 2017; Duncan et al., 2007

What role do adults play?

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Adults' attitudes matter

- Children whose *parents* are anxious about math are more likely to:
  - Have math anxiety themselves
  - Show lower math achievement
- This is particularly true when math anxious parents provide frequent math homework help

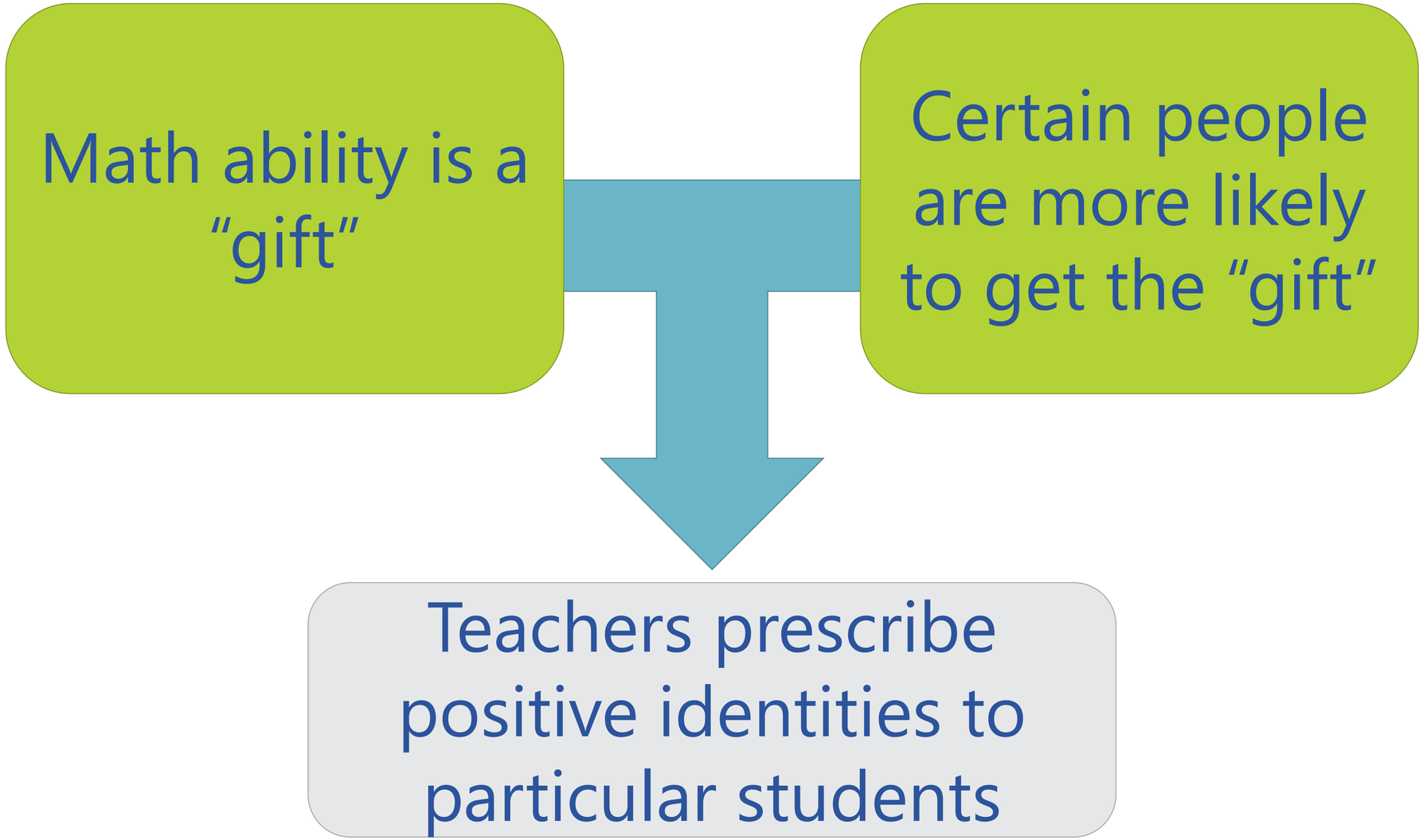
Content source: Casad, Hale, & Wachs, 2015; Maloney, Schaeffer, & Beilock,, 2013

Adults' attitudes matter

- Children whose *teachers* are anxious about math are more likely to:
  - Have math anxiety themselves
  - Endorse negative math stereotypes
  - Learn less in math
- Teachers with math anxiety spend less time teaching math and rely more on teaching skills and facts

Content source: Beilock, Gunderson, Ramirez, & Levine, 2010; Sloan, 2010

Adults' attitudes matter



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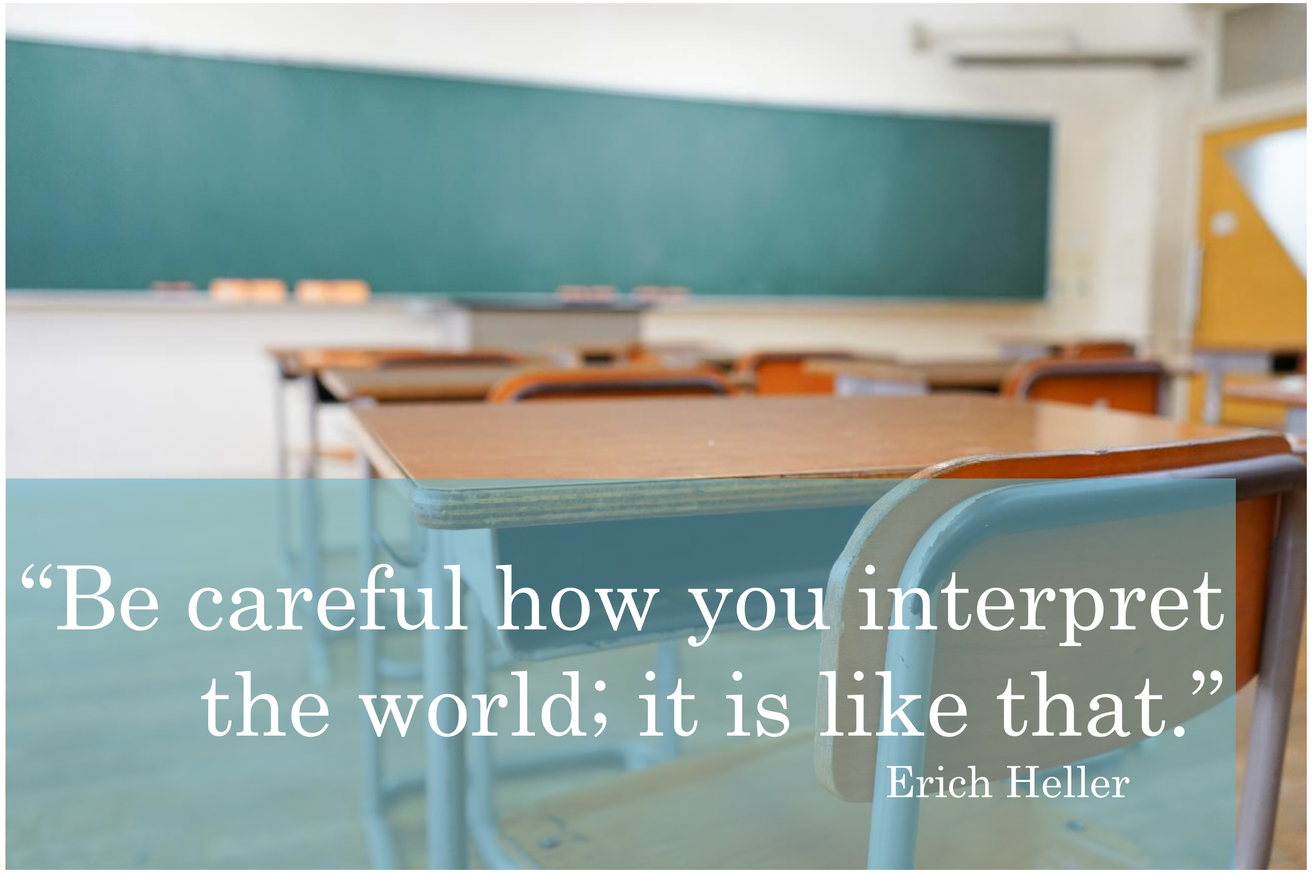

- Teacher expectations for student achievement in math influence future student outcomes
- Teachers' *implicit* attitudes are related to classroom achievement gaps

Content source: Jamil, Larsen, & Hamre, 2018; Van den Bergh, et al., 2010

Reflection

What factors do you consider – consciously or not – when you first encounter a student?

What influences a teacher's perceptions of a student's potential?

How do educators' perceptions of this potential influence their expectations and student performance?

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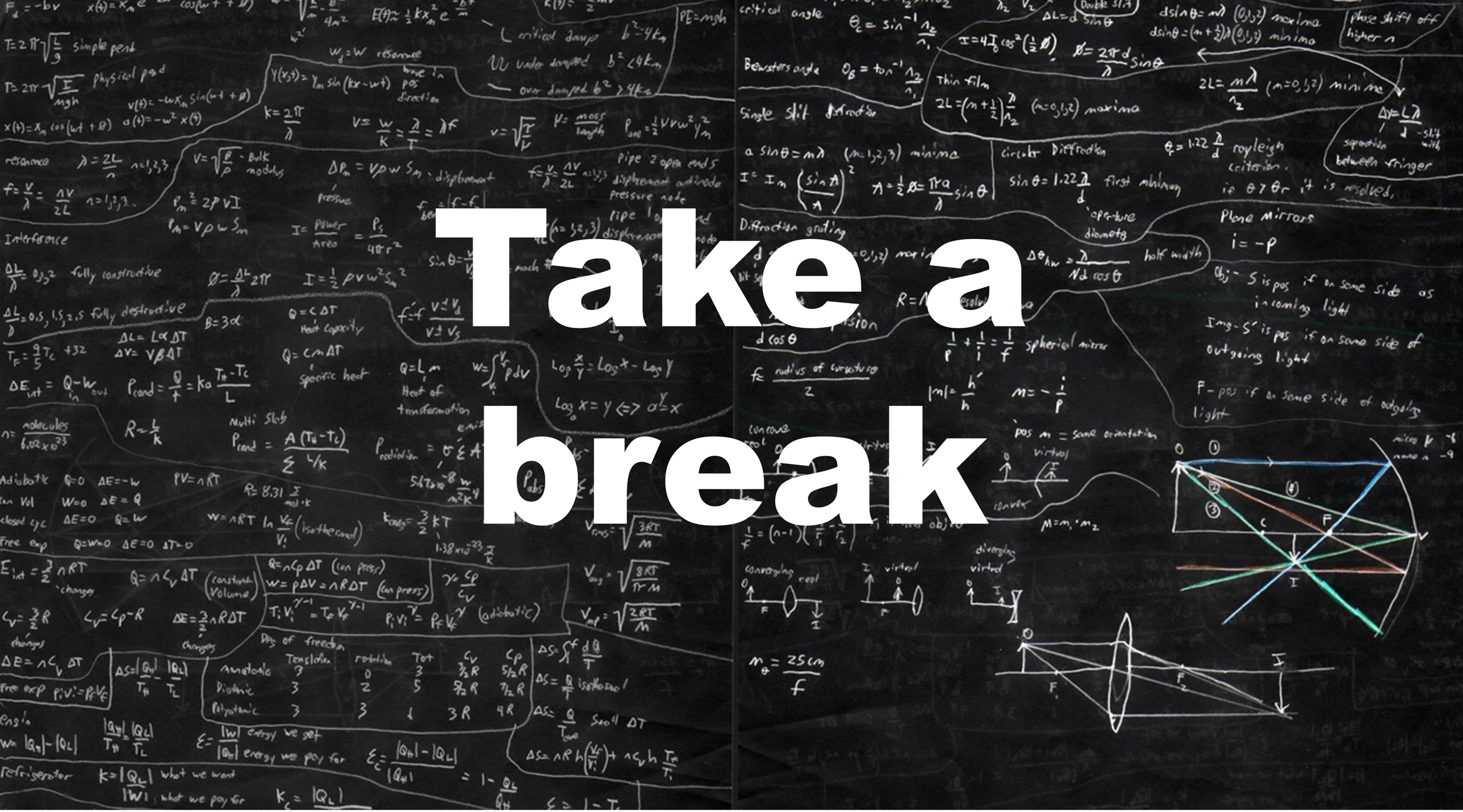
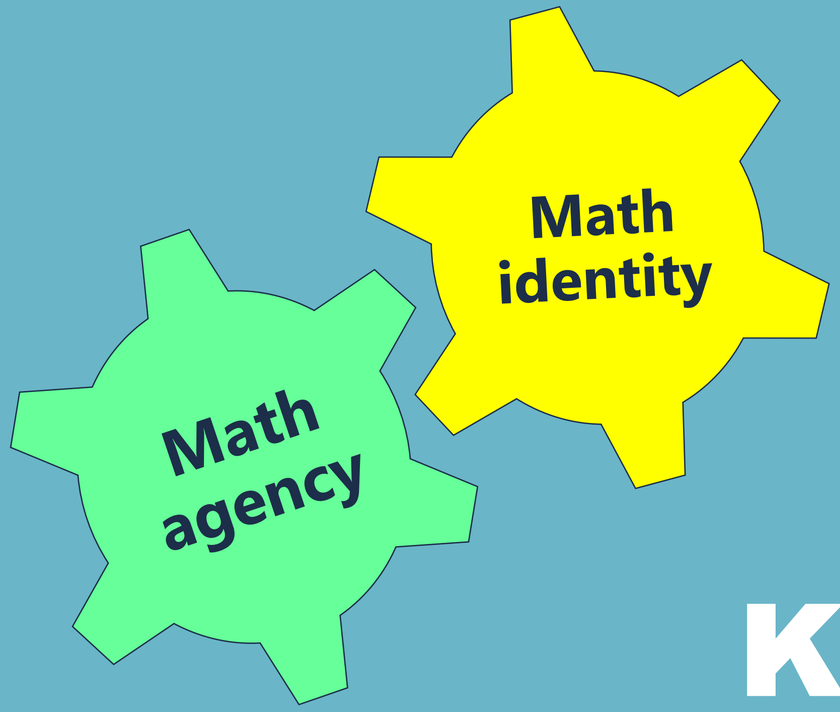
Take a break





Key aspects of math identity and agency

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Key aspects of math identity

Math anxiety

Math Identity

Sense of belonging

Growth mindset

Perceived utility

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What is belonging?

Feeling like an accepted, valued, and legitimate group member.

Belonging is a fundamental need

The need for social connections is innate and universal.

*It is a **need**, not a want.*

Vs.

Content source: Baumeister & Leary (1995)

Exclusion is painful

Psychological consequences

- Sadness, anger
- Decreased self-esteem
- Impaired self-regulation
- Poorer cognitive function

Physical consequences

- Brain science suggests social pain and physical pain are experienced in overlapping brain systems
- Loneliness poses the same health risks as smoking, drinking, and obesity

Content source: Baumeister & Leary, 1995

Belonging in school: So what?

Decreased:

- Substance abuse
- Early sexual initiation
- Violence
- Suicidal ideation
- Eating disorder development

Increased:

- Self-efficacy
- Motivation
- Attendance
- Persistence
- Achievement

Content source: Goodenow, 1993; Osterman, 2000

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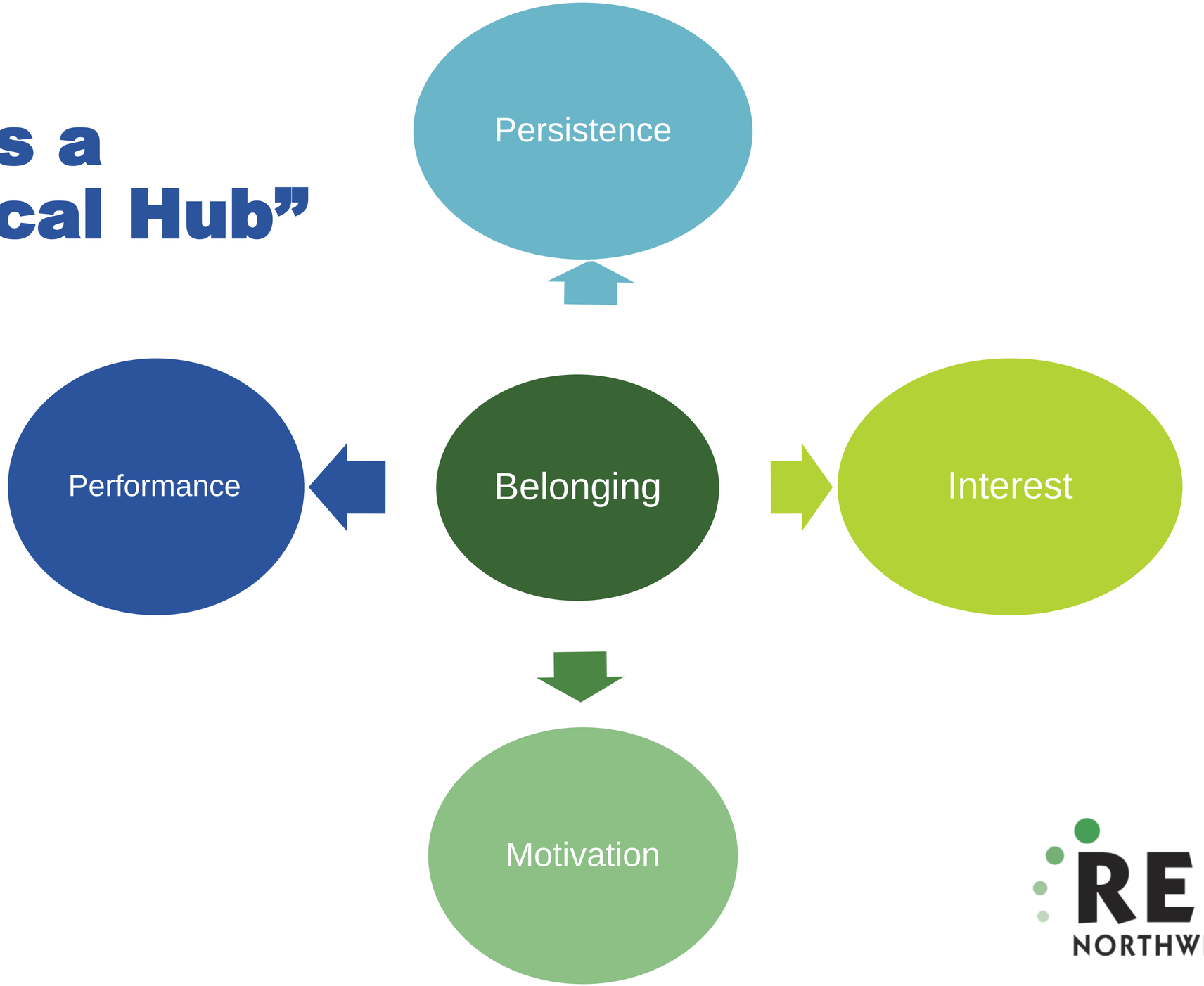
Belonging as a "Psychological Hub"



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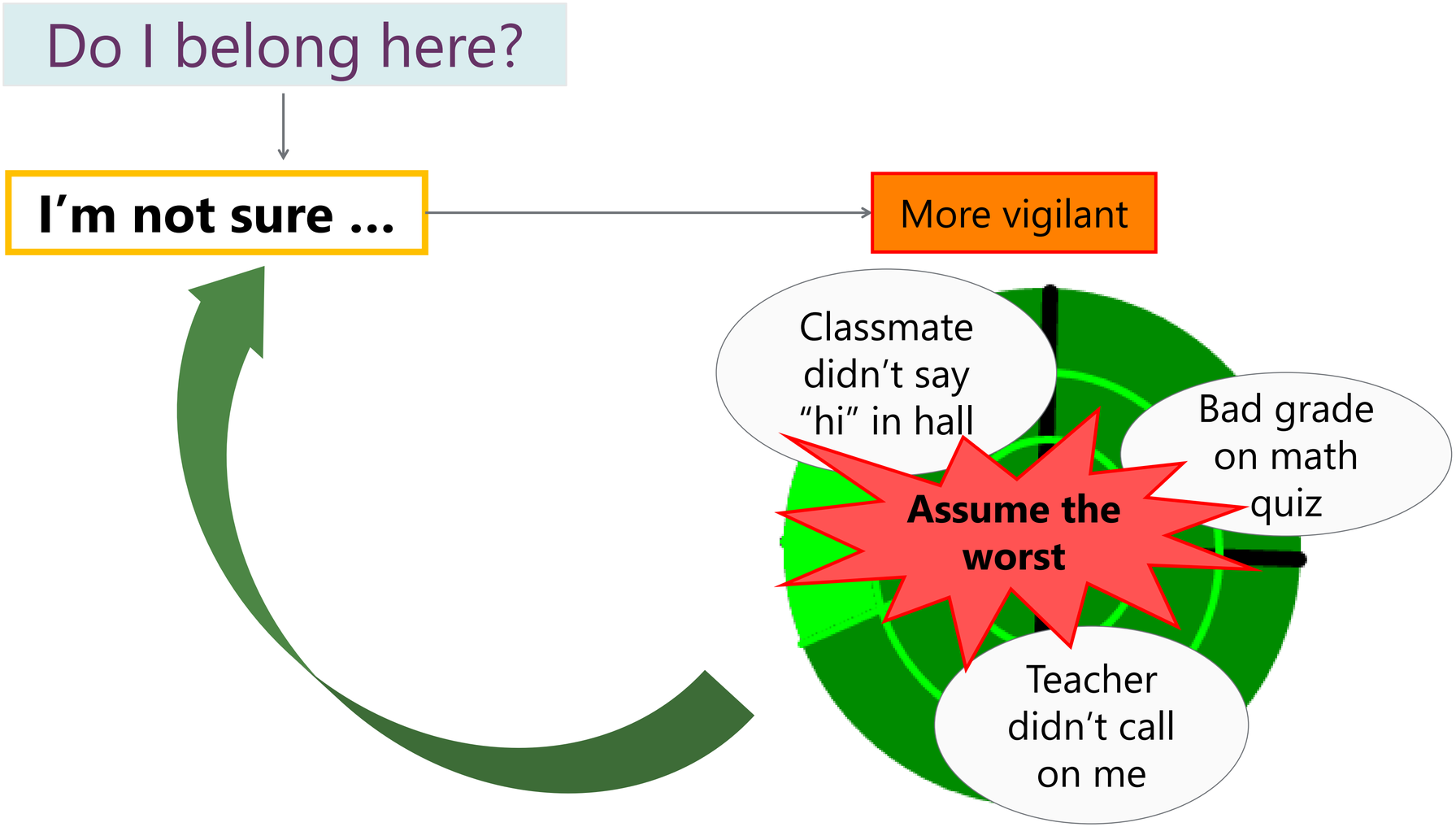
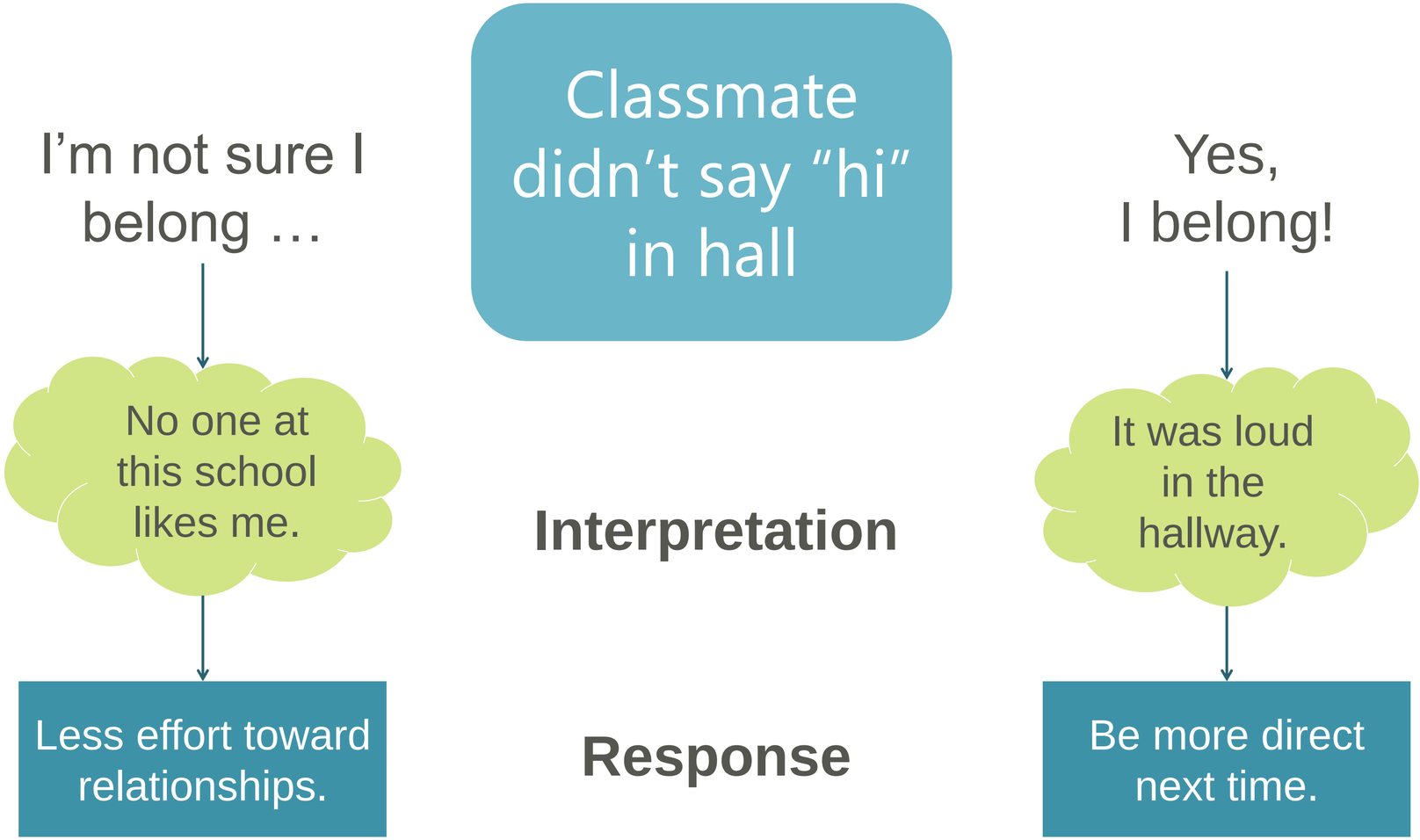
Lack of belonging saps concentration and focus



Content source: Walton & Cohen, 2007

Do I fit in socially?



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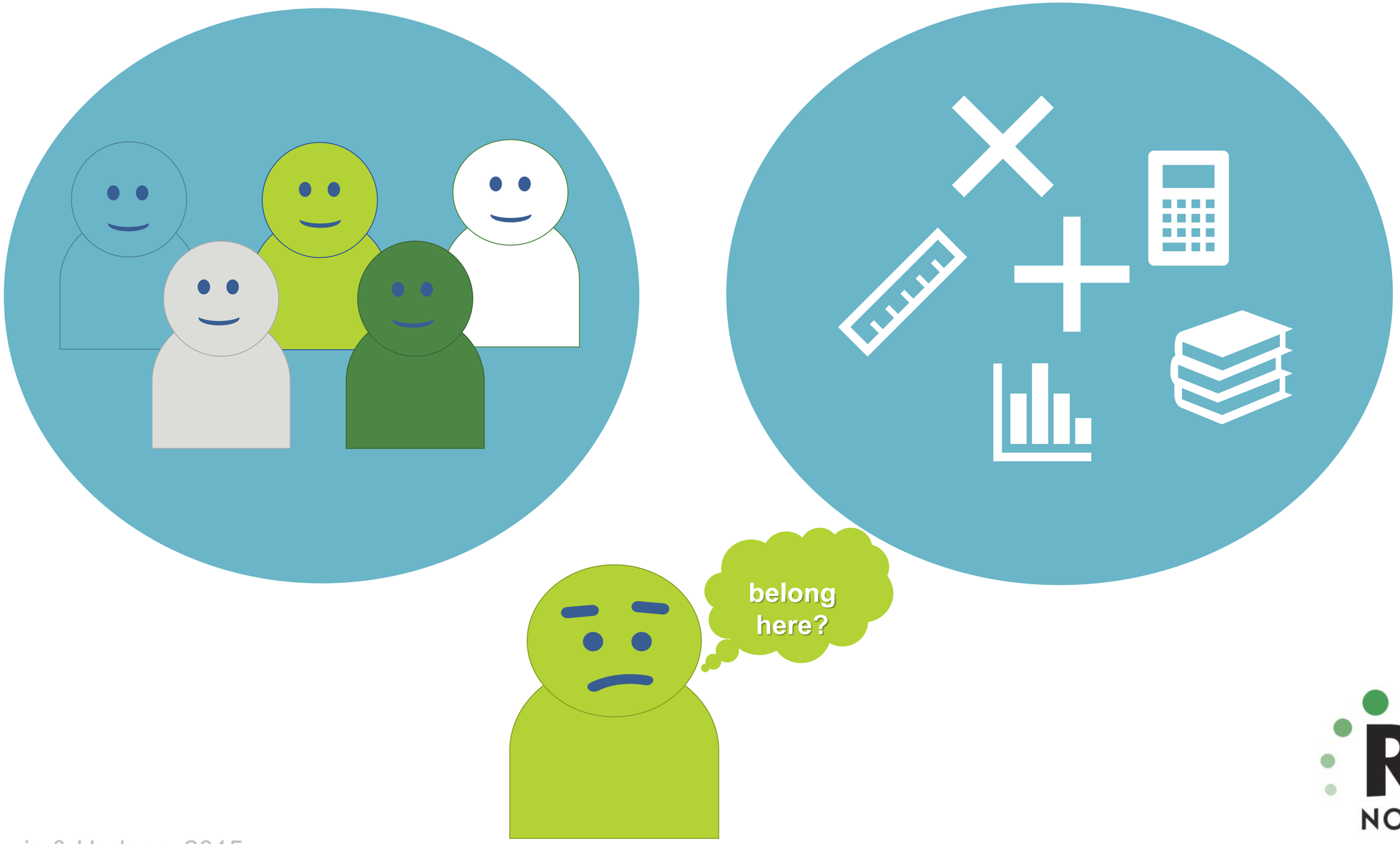
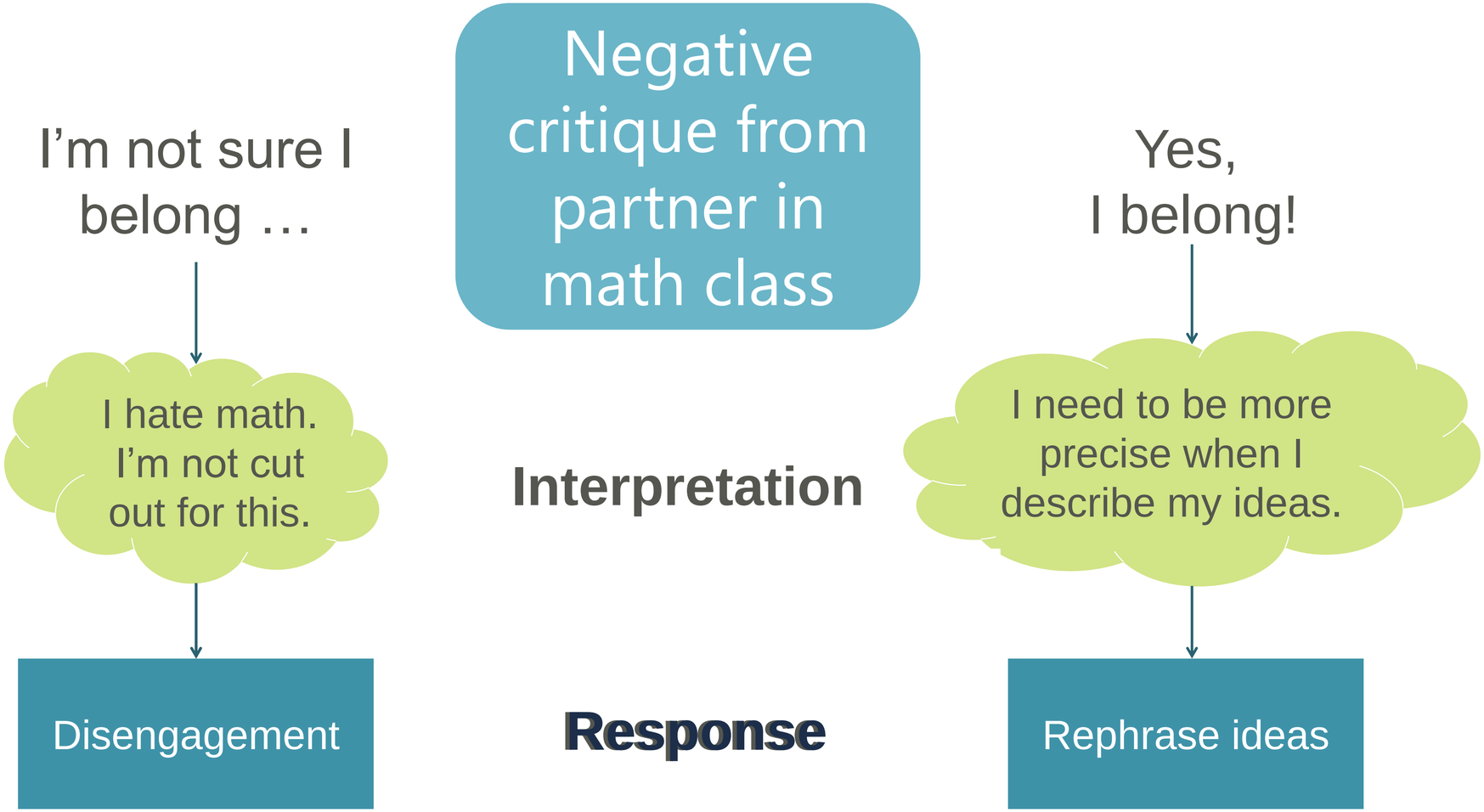
Belonging is multidimensional



Content source: Lewis & Hodges, 2015

Do I fit in intellectually?



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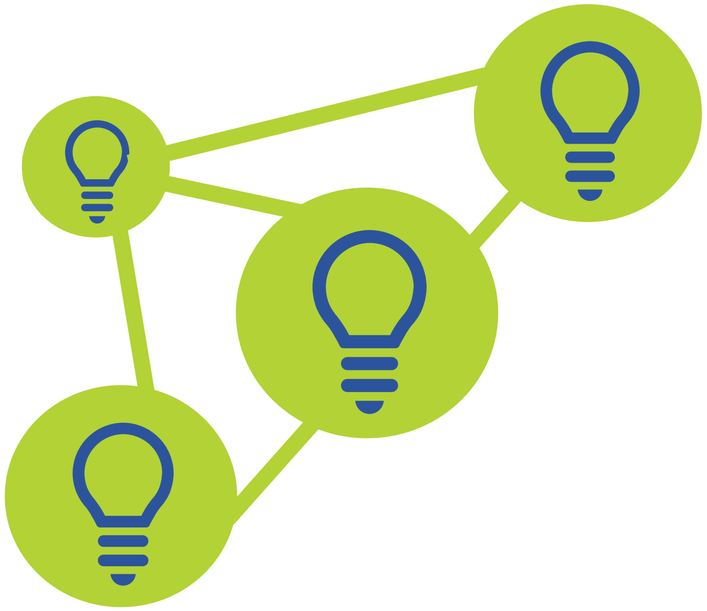
Olivia's Story

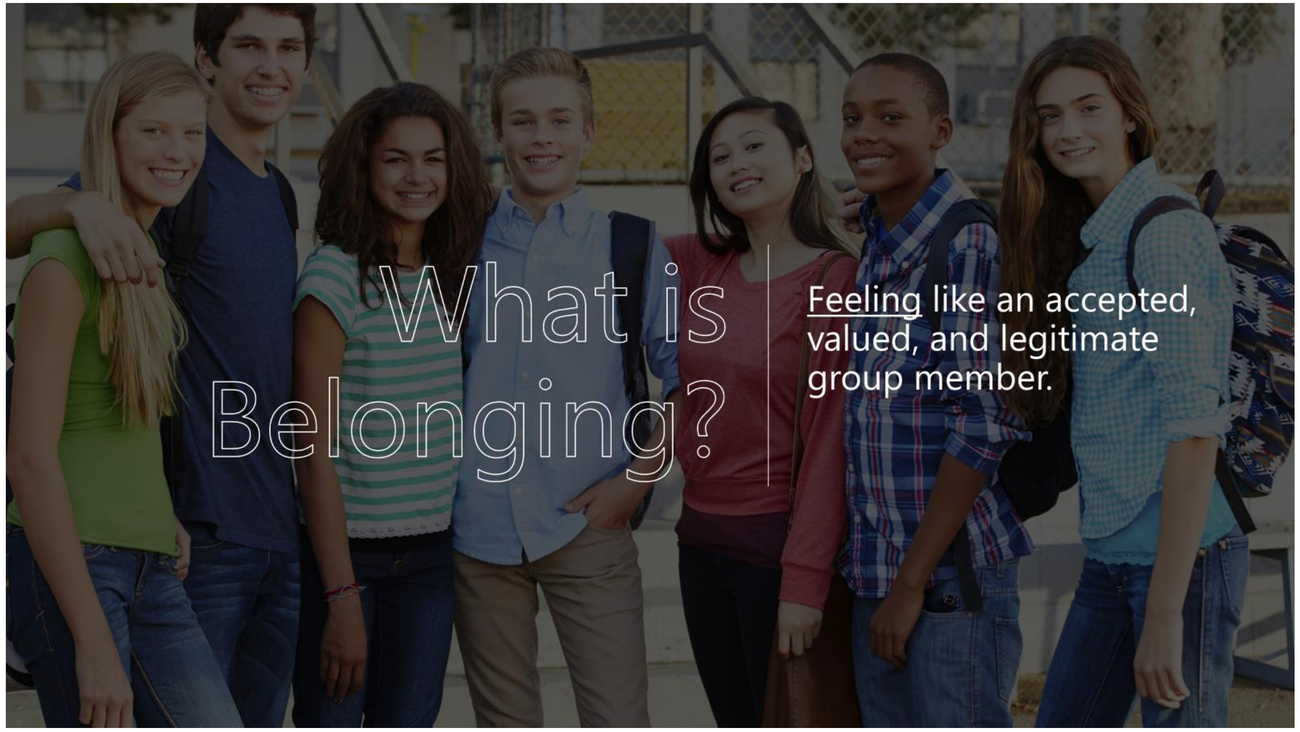
Olivia is an eighth-grade girl who enjoys school and considers herself to be smart. She lives in a small town and hopes to be the first person in her family to attend college. Olivia has always excelled in math and has mostly earned As, with an occasional B.

During seventh grade, Olivia's teacher identified her to enroll in an advanced math class, setting her up to take algebra in eighth grade. Olivia has found the work challenging and earned her first ever D on the first unit test.

Olivia's teacher asked her to stay after class to discuss her performance. When they spoke, her teacher said that maybe algebra was too hard for her. If her grades don't improve, her teacher will consider moving her into the regular eighth grade math class.



How does this aspect of math identity support and build on the SMPs?



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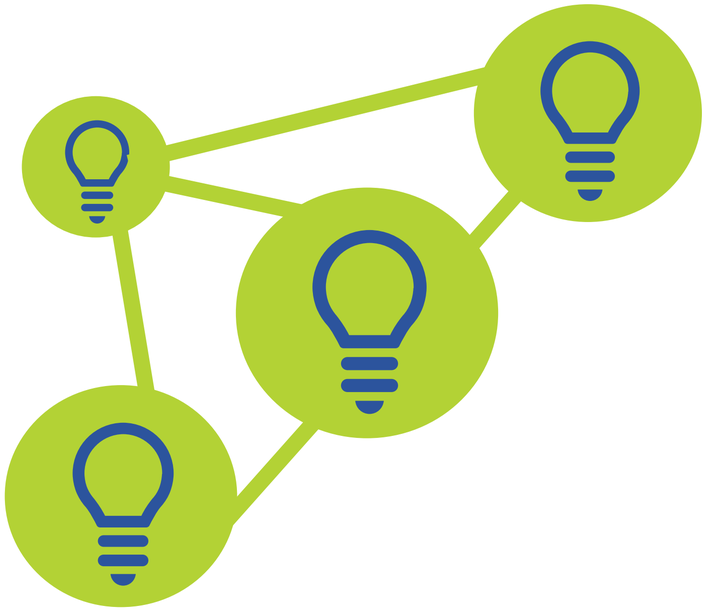

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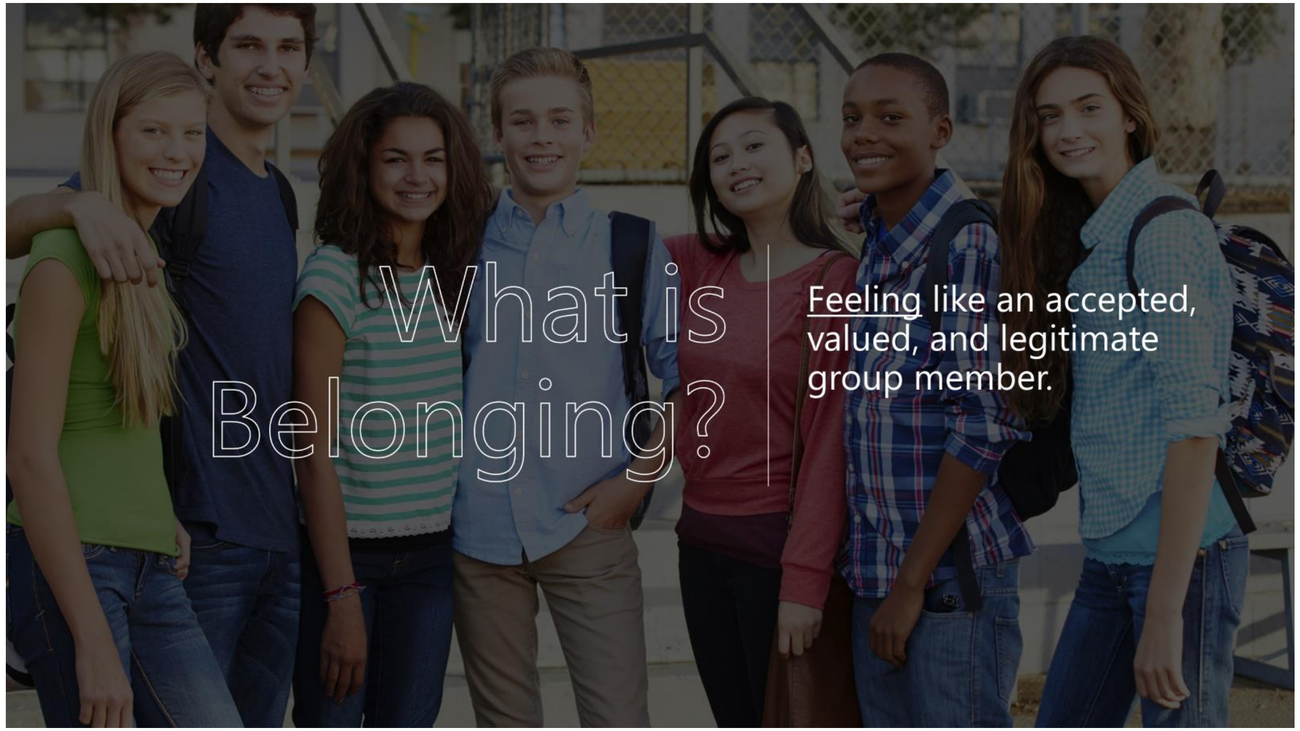

Content source: Common Core State Standards Initiative, n.d.

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What is a growth mindset?

The belief that intelligence and ability can be developed with effort, strategies, and support.

Content source: Blackwell, Trzesniewski, & Dweck, 2007

What are mindsets?

Fixed Mindset

Intelligence and ability are fixed qualities from birth that cannot be changed significantly.

Growth Mindset

Intelligence and ability can be developed with effort, strategies, and support.

Content source: Blackwell, Trzesniewski, & Dweck, 2007; Claro, Paunesku, & Dweck, 2016

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Mindsets are domain specific

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Growth mindset and math

Student mindset predicts math success

- Students with growth mindsets tend to have better math grades and test scores than students with fixed mindsets.

Content source: Blackwell, Trzesniewski, & Dweck, 2007; Claro, Paunesku, & Dweck, 2016

How does growth mindset impact math achievement?

When students have a growth mindset, they are MORE likely to:

- Believe that effort pays off. (“The harder you work at something, the better you will be at it.”)
- Set learning goals for themselves. (“The main reason I do my schoolwork is because I like to learn new things.”)
- Believe effort-based strategies will help them overcome failures. (“If I got a bad grade, I would work harder.”)

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When students have a growth mindset, they are LESS likely to:

- Attribute failures to things they cannot control (“The test was unfair.”)

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When students have a growth mindset, they are LESS likely to:

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In sum, the research suggests that students with growth mindsets are willing to put in effort even when they struggle or fail, and they stay focused on what they can learn. These behaviors result in better math performance over time.

Content source: Blackwell, Trzesniewski, & Dweck, 2007

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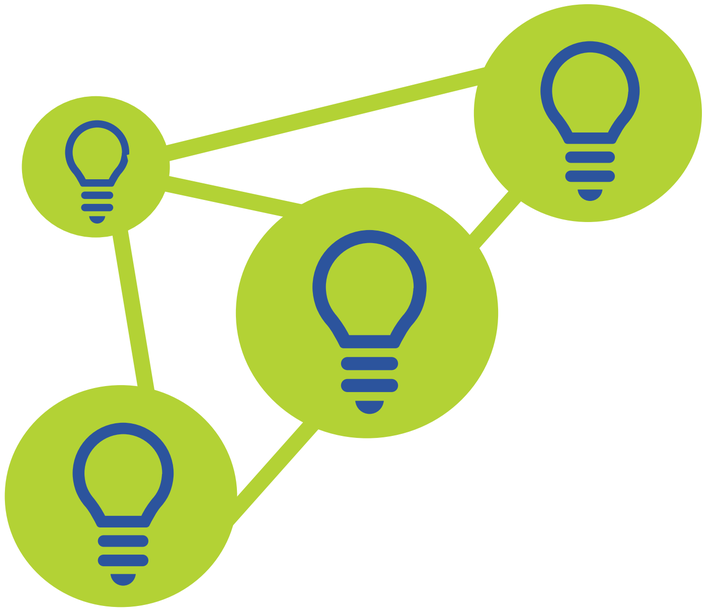

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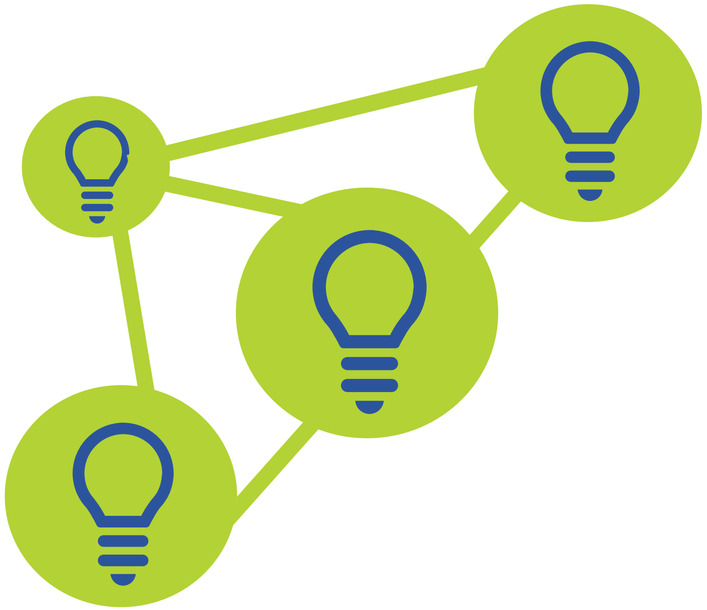

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What is perceived utility?

Belief that math is useful, worthwhile, and relevant to life outside of school, now and in the future.

Content source: Hulleman & Harackiewicz, 2009

Math – why bother?

“What I find difficult in school is to understand the concept of learning advanced math. When I grow up, the job I want to do will have nothing to do with radicals, algebra, imaginary numbers, and all this other complicated stuff. I understand why we learn basic math, but why all this extra stuff? My job will never require any of that. Yes, you might say, "Well you'll need it later in life", but I always have a calculator for that. In fact if you go to your local supermarket, they use a cash register with a built in calculator. Besides occurrences with money (and I'm sure I'm not going to have questions dealing with radicals), why are we taught this stuff?”

Letter to Dr. Math, from mathforum.org

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Content source: National Council of Teachers of Mathematics, Math Forum, 2005

Why does perceived utility matter?

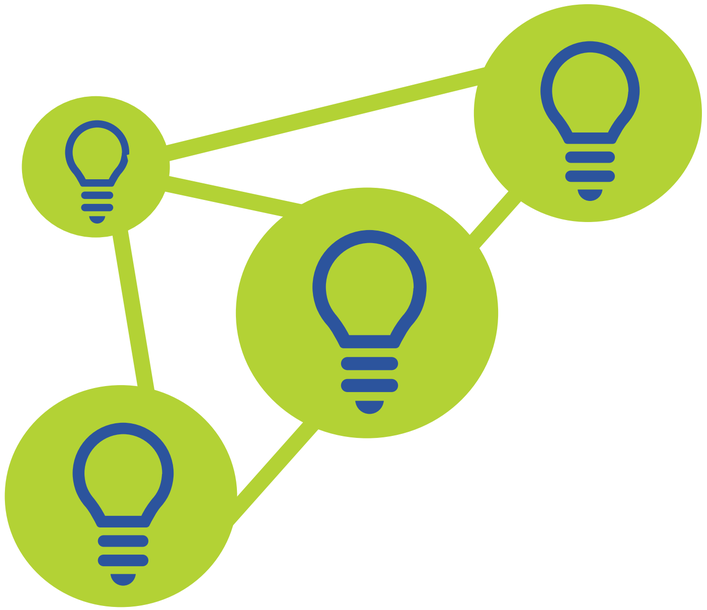
- Students are more motivated when they see the connections between what they are learning, how it relates to their own life and goals, and how it might be useful later on in life.

Image source: elpesce, 2013

Why does perceived utility matter?

- A simple classroom intervention was designed to help students identify the connections between math materials and their daily lives.
- Results from that intervention included:
  - Increased interest in the topic
  - Increased confidence
  - Better academic performance
- It was also effective to have parents help promote the utility of math.

Content source: Harackiewicz, Rozek, Hulleman, & Hyde, 2012; Hulleman & Harackiewicz, 2009



How does this aspect of math identity support and build on the SMPs?

Standards for Mathematical Practice

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Content source: Common Core State Standards Initiative, n.d.

REL NORTHWEST

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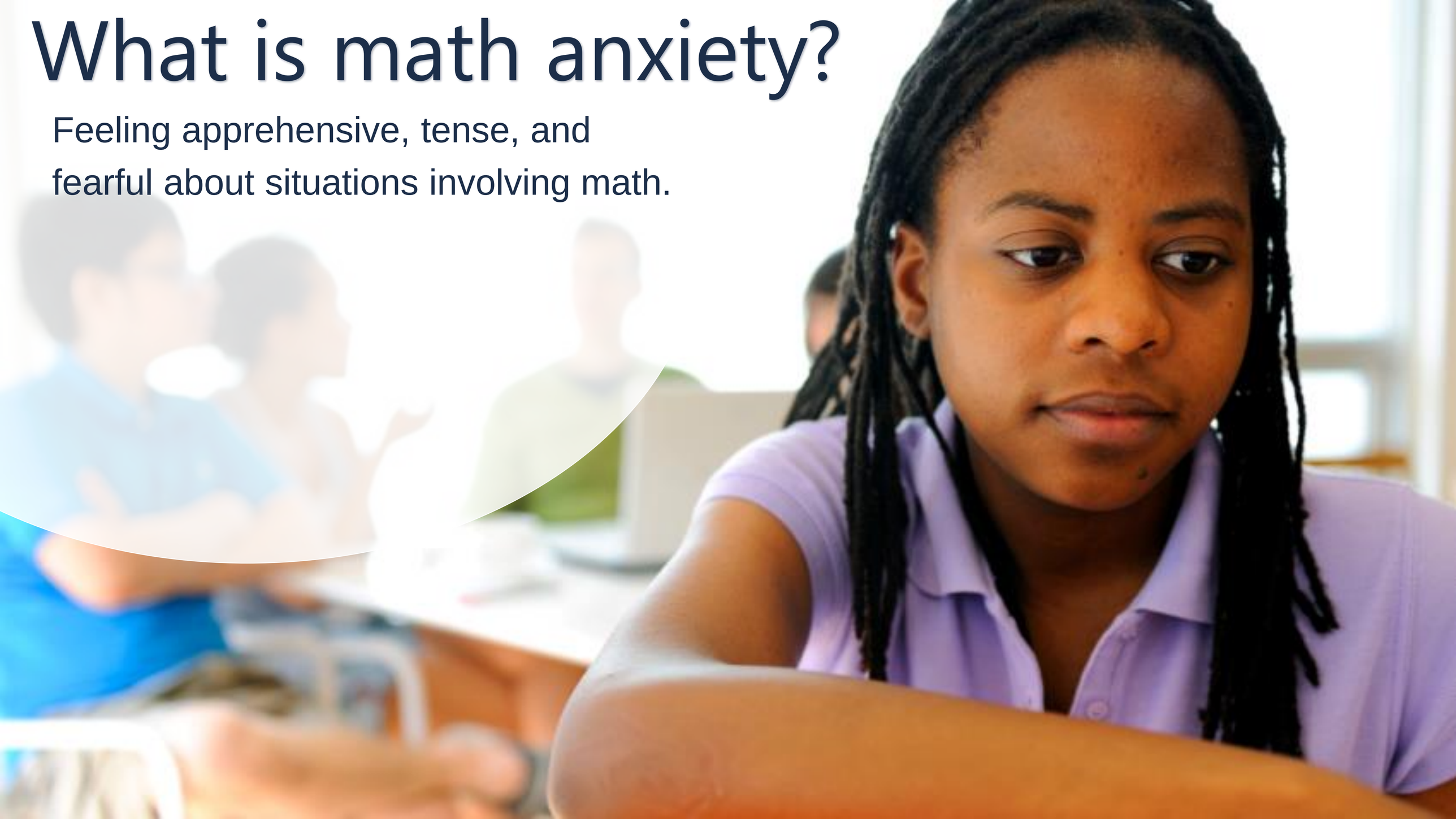
What is math anxiety?

Feeling apprehensive, tense, and fearful about situations involving math.

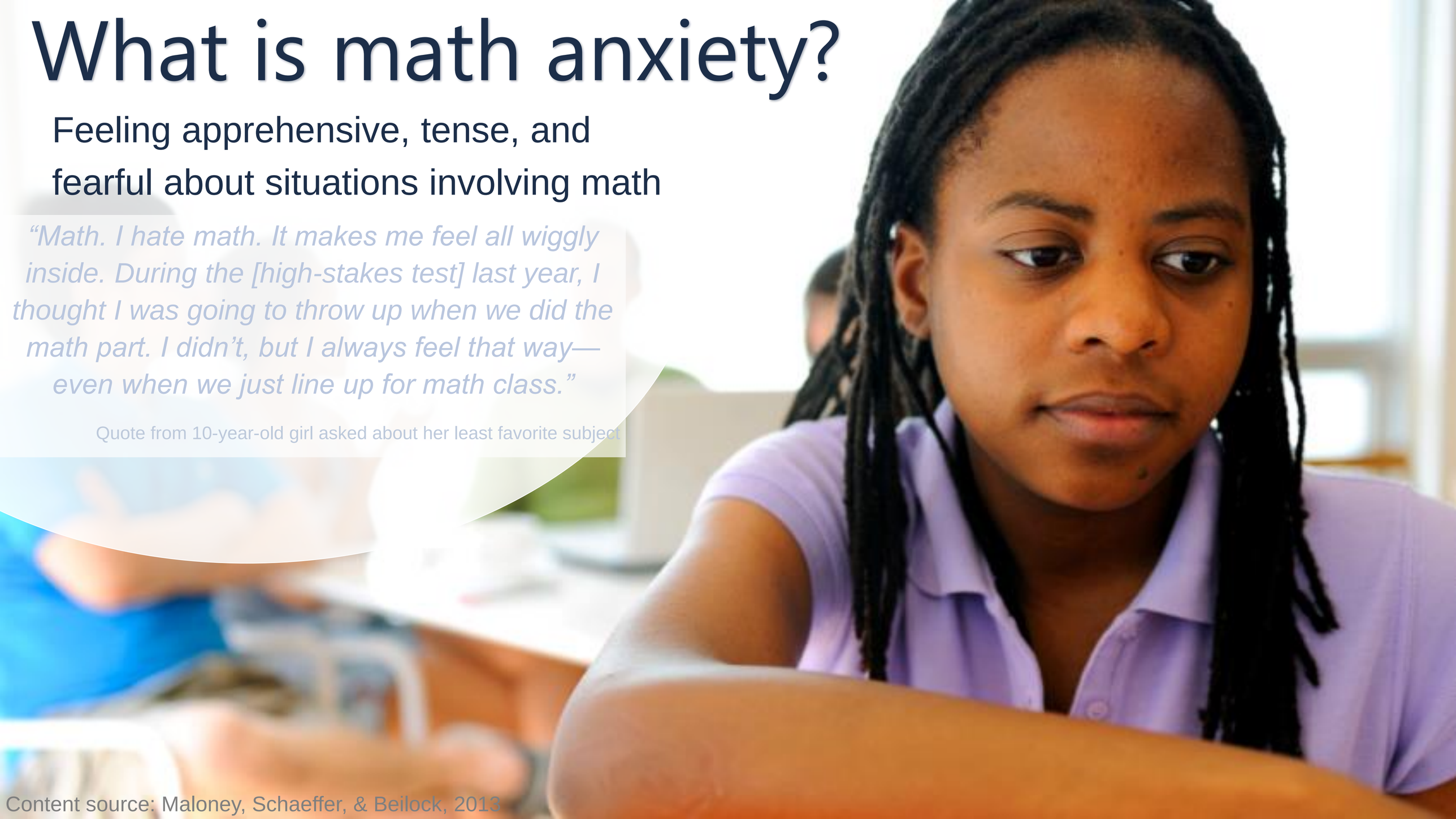


What is math anxiety?

Feeling apprehensive, tense, and fearful about situations involving math

“Math. I hate math. It makes me feel all wiggly inside. During the [high-stakes test] last year, I thought I was going to throw up when we did the math part. I didn’t, but I always feel that way—even when we just line up for math class.”

Quote from 10-year-old girl asked about her least favorite subject



Content source: Maloney, Schaeffer, & Beilock, 2013

What is math anxiety?

- Different from just “not liking math” or having poor math skills.
- It is a global phenomenon, and it is highly prevalent—even in very young children.
- It increases with age, particularly math test anxiety.

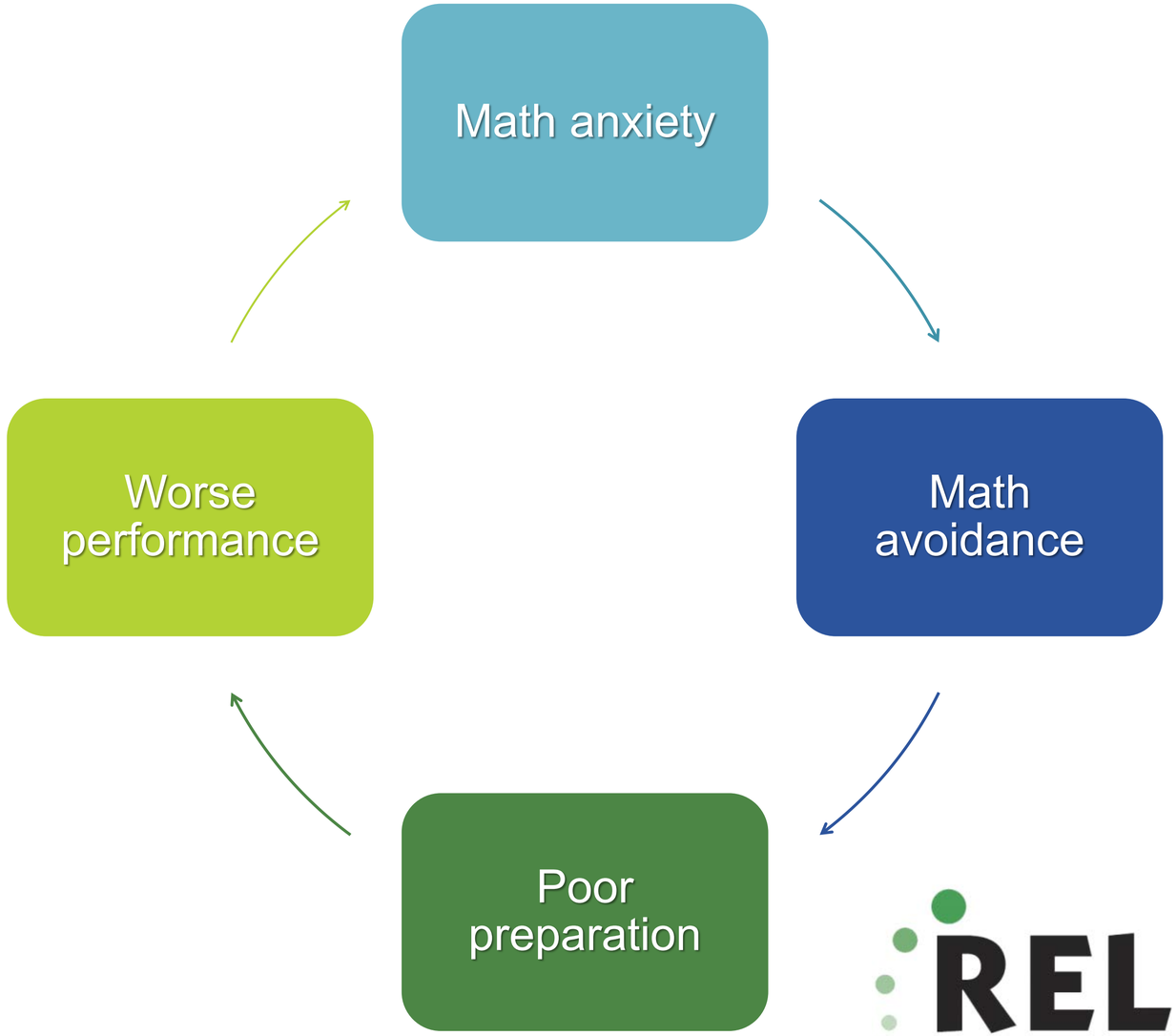
Content source: Ashcraft, 2002; Gierl & Bisanz, 1995

Implications of math anxiety

Compared with their less math-anxious peers, students with math anxiety perform worse in math from elementary school through college.

Content source: Ma & Xu, 2004

Reciprocal cycle

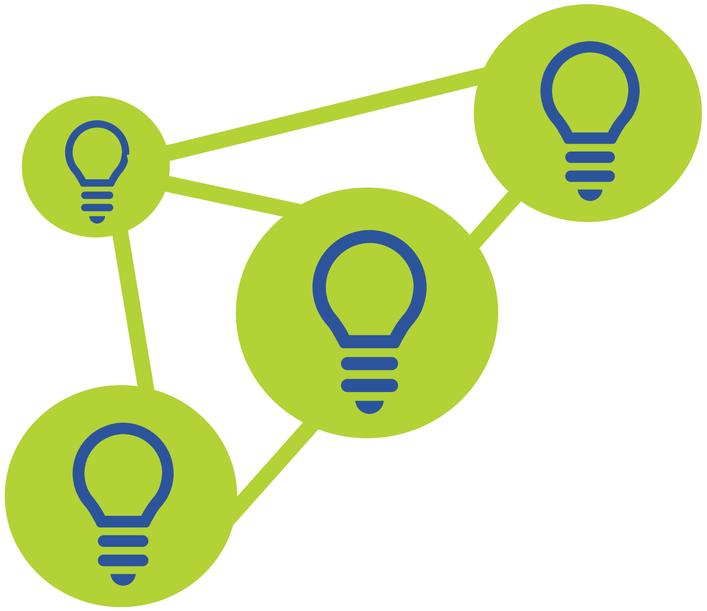


Content source: Ashcraft, 2002

Math anxiety robs performance

- Math anxiety disrupts **working memory**.
- Thus, math anxiety hurts performance by robbing the brain of cognitive capacity that could be spent on solving the math problems at hand.

Content source: Ashcraft & Kirk, 2001



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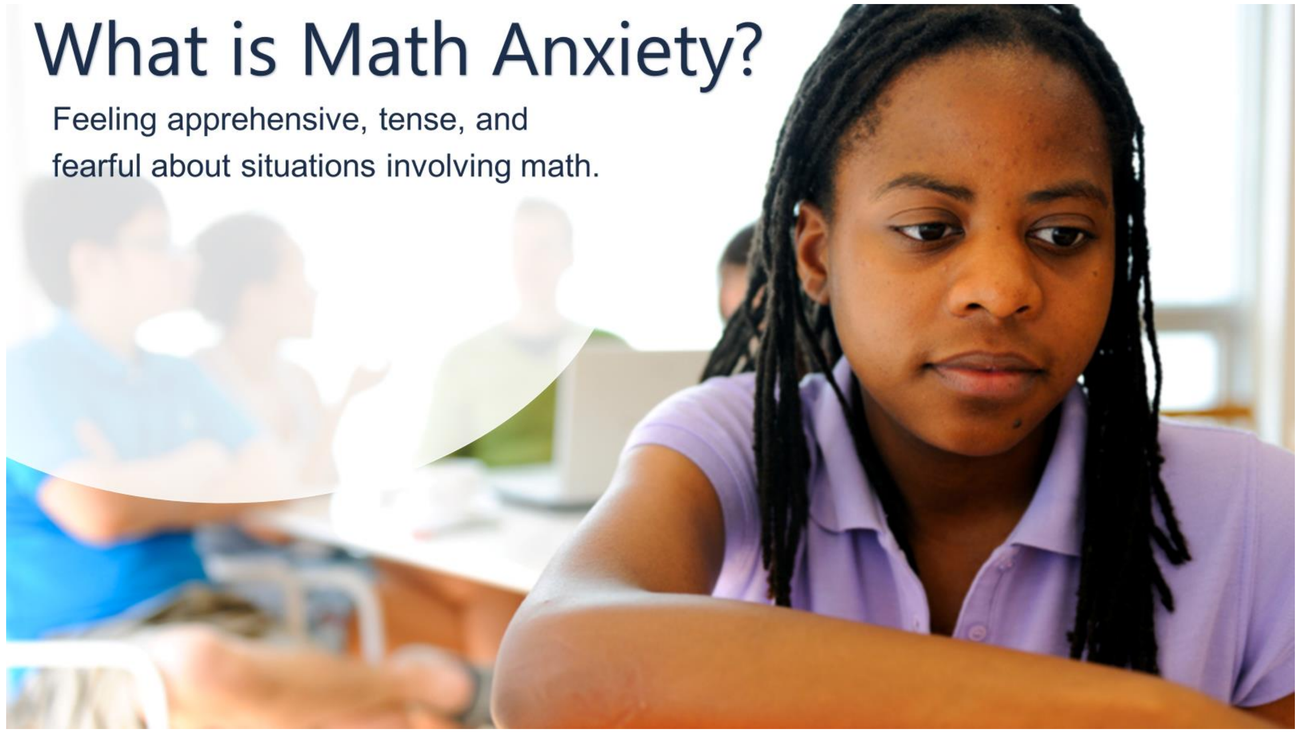

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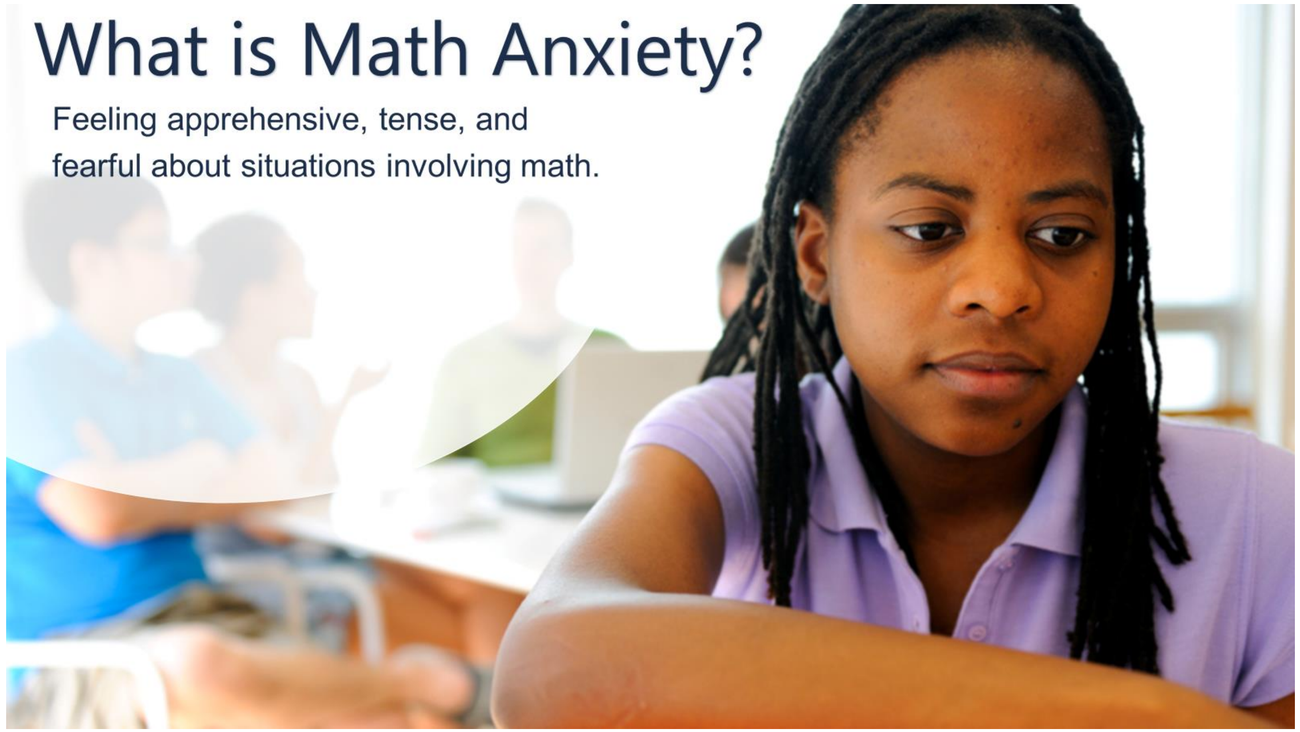

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Content source: Common Core State Standards Initiative, n.d.

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Tying it all together

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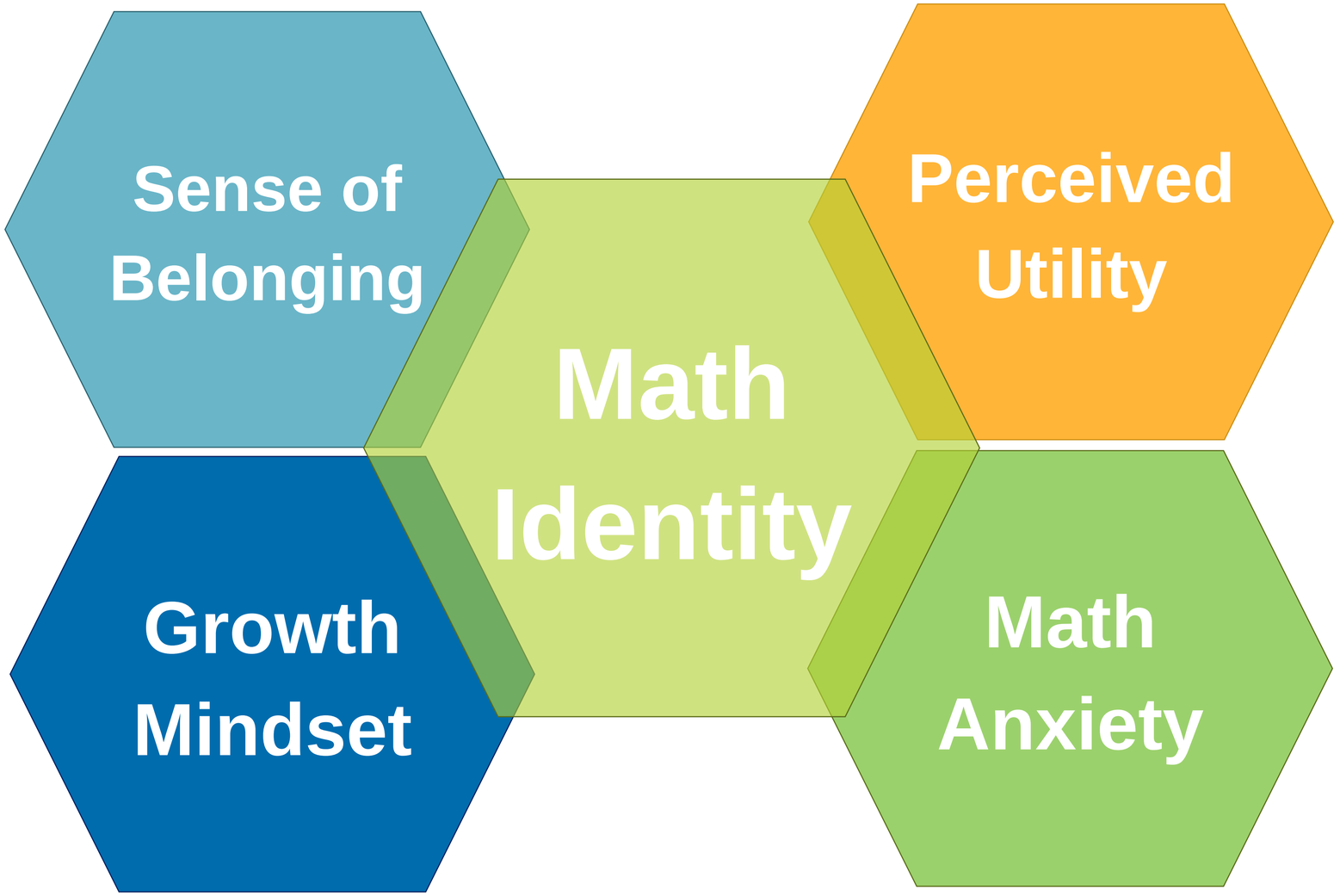

- Key components of math identity are distinct but interrelated
- Promoting one can benefit the others

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Promoting math identity in the classroom

Video source: Inside Mathematics, n.d.

Promoting math identity in the classroom

- What key aspects of identity did you see in this discussion? How did these support one another?
- Which SMPs did you see students engage in?

Image source: Inside Mathematics, n.d.

Connection with Standards for Math Practice

Standards for Mathematical Practice

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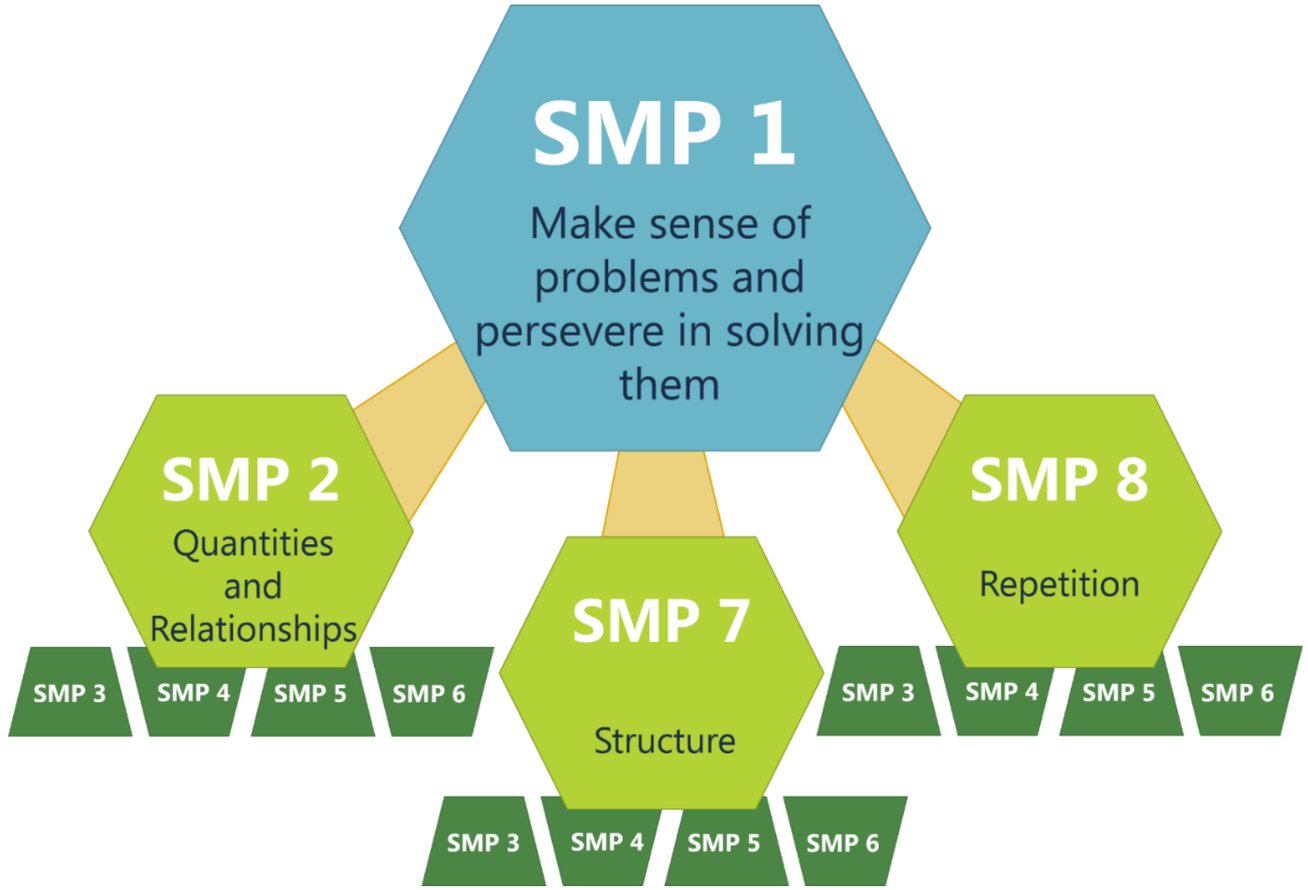

Content source: Common Core State Standards Initiative, n.d. ; Kelemanik, Lucenta, & Janssen Creighton, 2016

Reflection

Given what you've heard today, what do you think the math autobiographies of your typical student might look like?

How can you apply what you've learned to change how you help your students write their own math autobiographies?

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What's next?

Module 1

The importance of math identity for math success

- Build knowledge of what math identity is and why it is important for math success

Module 2

Building the math environment (2 parts)

- Learn how to create a classroom environment that supports a positive math identity

Module 3

Kernels of practice

- Learn how to implement targeted activities that promote a positive math identity

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About REL Northwest

Regional educational laboratories (RELs) partner with practitioners and policymakers to use data and evidence to help solve educational problems that impede student success. We do this by:

- Conducting rigorous research and data analysis
- Delivering customized training, coaching, and technical support
- Providing engaging learning opportunities

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