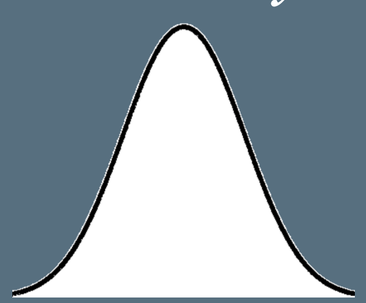
Promoting Positive Mathematics Attitudes

Strengthening mathematics learning in and beyond the school



Normal distribution

Paranormal distribution

IES Institute of Education Sciences

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REL Appalachia

Workshop objectives

- Together we will:
  - Develop knowledge and understanding of research-based practices to foster positive mathematics attitudes.
  - Plan to implement strategies to foster positive mathematics attitudes in our settings — in classrooms, after school, and with families.

Agenda

- Welcome and introductions (20 min.)
- The power of positive mathematics attitudes – research and reflections (20 min.)
- Fostering positive mathematics attitudes – exemplar activity (40 min.)
- Break (10 min.)
- Integrating support for positive mathematics attitudes into your activities, routines, and norms (40 min.)
- Collaborative planning (40 min.)
- Wrap-up and next steps (10 min.)

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Warm-up activity: Melting calculator problem

- **The number 1 key on your "chocolator" has melted off. Make the number 1111 show up on the screen.**
  - What strategy did you use?
  - Find another solution using that strategy.
  - Turn and talk to an elbow partner. Share strategies and solutions with one another.
- **Now both the number 1 and number 2 keys have melted off. Make the number 1212 show up on the screen.**
  - Find a solution.
  - Find a solution using a different operation.

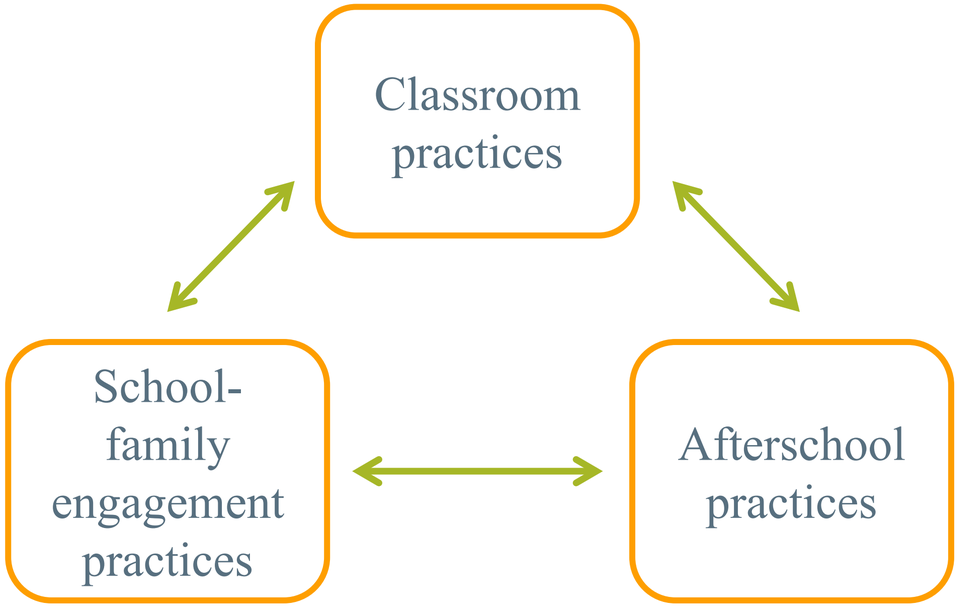
Check-in: Melting calculator problem

- Did the problem feel like a trick or a treat?
- **In your groups, discuss:**
  - What was your initial reaction to the problem? Did it feel like a trick or a treat?
  - Did you feel confident you could find additional solutions?
  - What kind of internal self-talk did you generate as you completed the problems?
  - How did you feel when you were allowed to “turn and talk”?

Coordinated support for mathematical mindset

- What are we trying to accomplish?
- How do we plan to get there?
- Who is in the room?

Strengthen mathematical attitudes & habits of mind



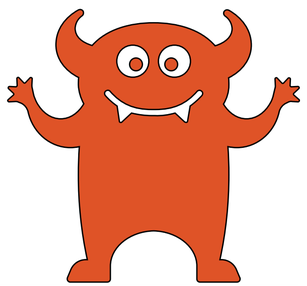
(National Research Council, 2001; Traphagen & Traill, 2014)

The Power of Positive Mathematics Attitudes

Research and reflections

How many monsters are good at math?

None, unless you count Dracula….or all, if you help them build positive math attitudes!



Mathematical mindset

Attitudes

Growth mindset
"Challenges are an opportunity to grow and learn."

Self-efficacy
"I can succeed in mathematics."

Sense of belonging
"I am welcomed and valued in my mathematics class."

Habits of mind

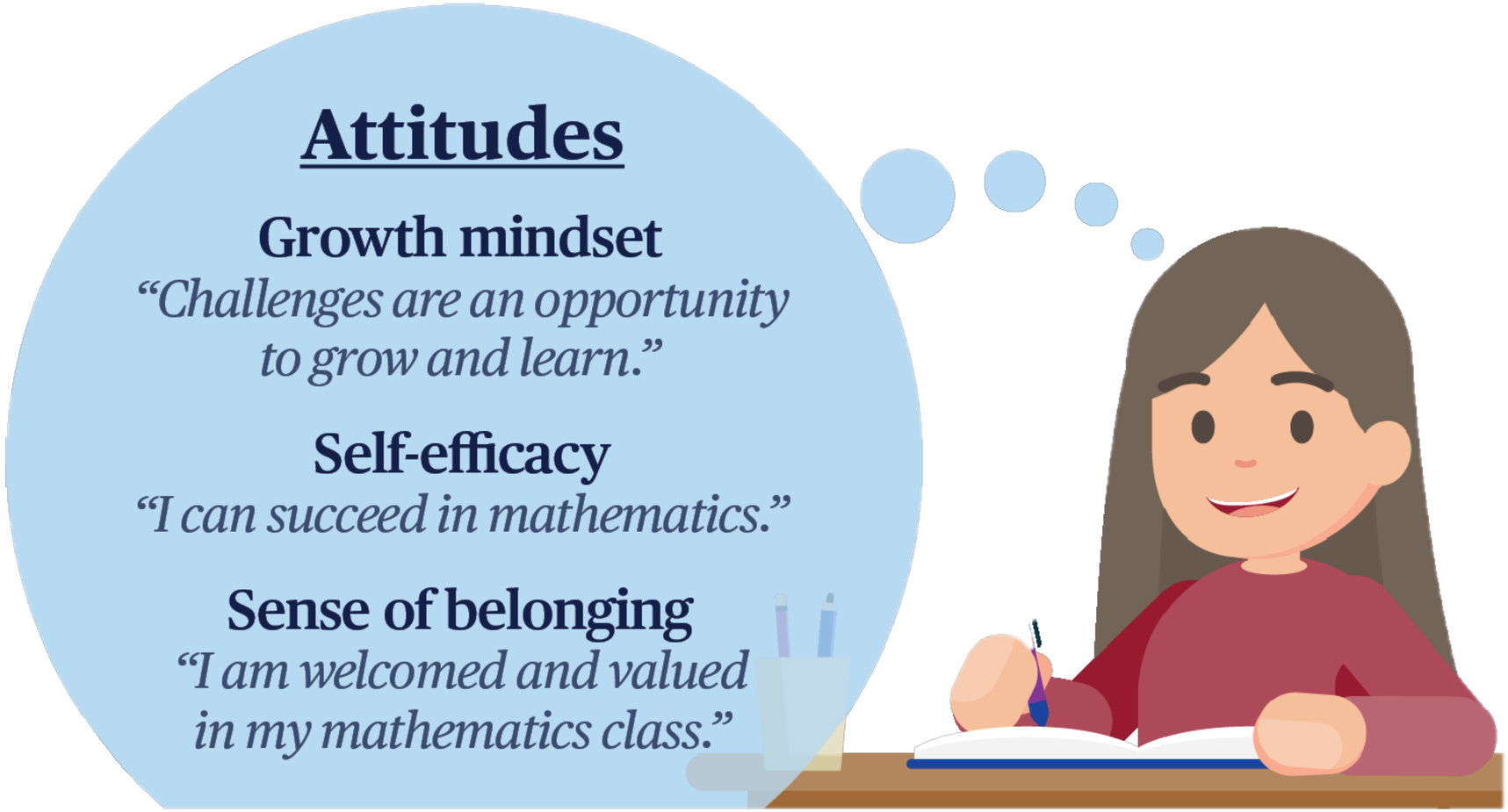
Looking for patterns
"What do I expect to see next?"

Monitoring and reflecting on problem-solving
"Why did these steps work or not work?"

Using alternative representations
"Let me try drawing this equation out."

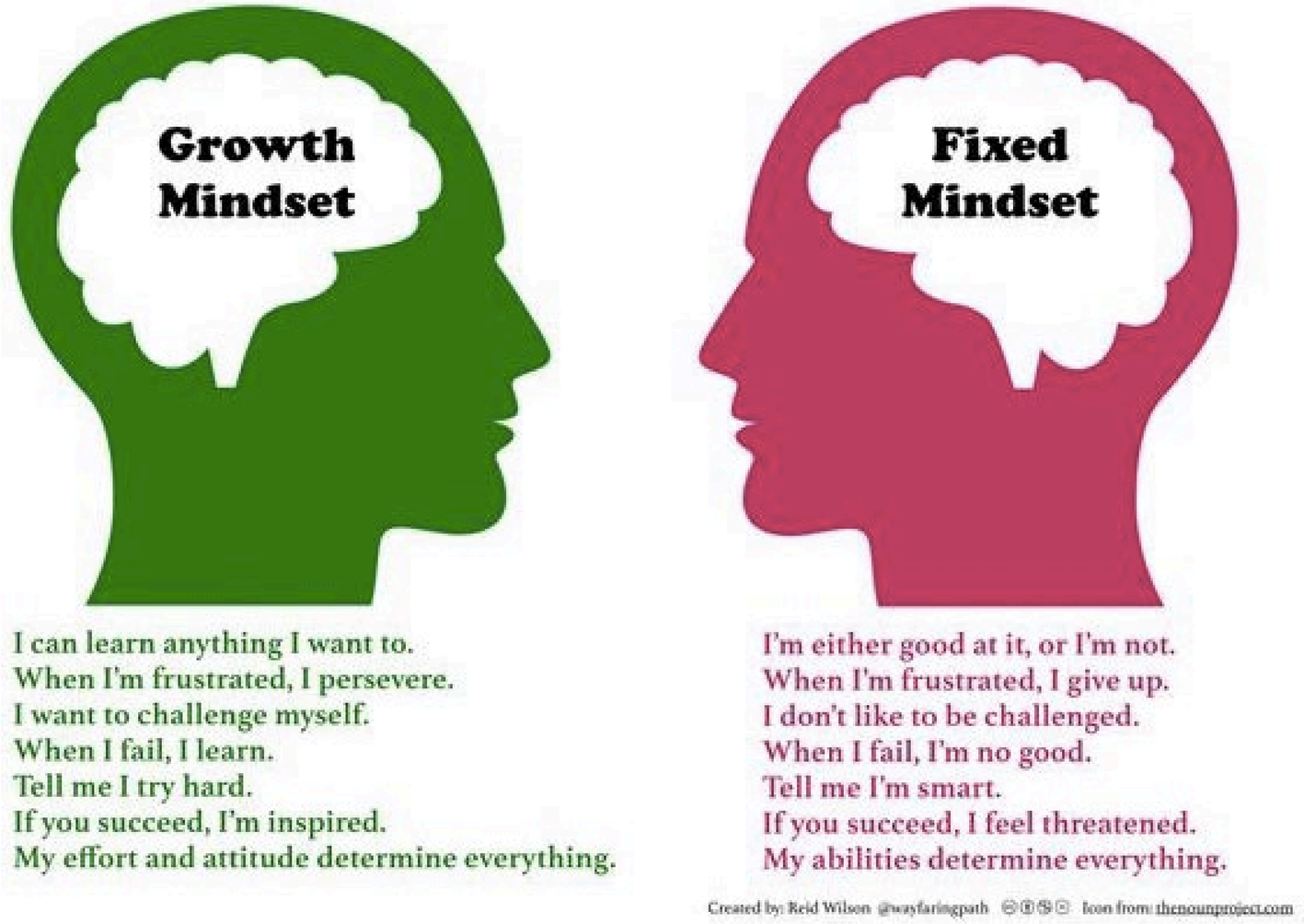
(Blackwell, et al., 2007; Juvonen, 2006; Pajares, 1996; Cuoco et al., 2010)

Mathematics attitudes



(Boaler, 2015; Dweck, 2000, 2006; Hiebert & Grouws, 2007; Ma & Kishor, 1997; REL Northwest, 2017)

Growth mindset



(Dweck, 2006)

Why growth mindset?

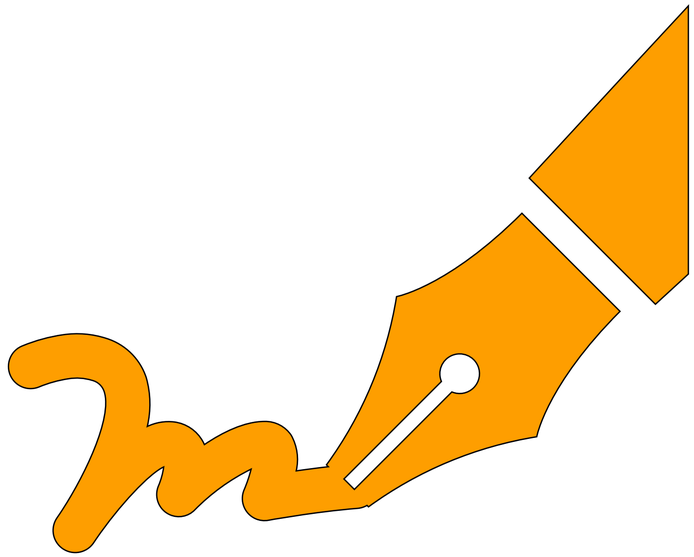
Students who embrace a growth mindset believe that their understanding and aptitudes can improve with effort, and these students **tend to persist and perform better in mathematics**.

(Blackwell, 2007; Boaler, 2015; Claessens & Engel, 2013; Dweck, 2000, 2006; Rothwell, 2013; Siegler et al., 2012)

Stop and jot – growth mindset

- Do I have a growth mindset when it comes to my abilities in general? In mathematics specifically?
- How is this reflected in how I view myself?
- How is my growth mindset reflected in my interactions and supports with students and families?

Handout 1



Self-efficacy

A person's belief they can succeed at a given task.

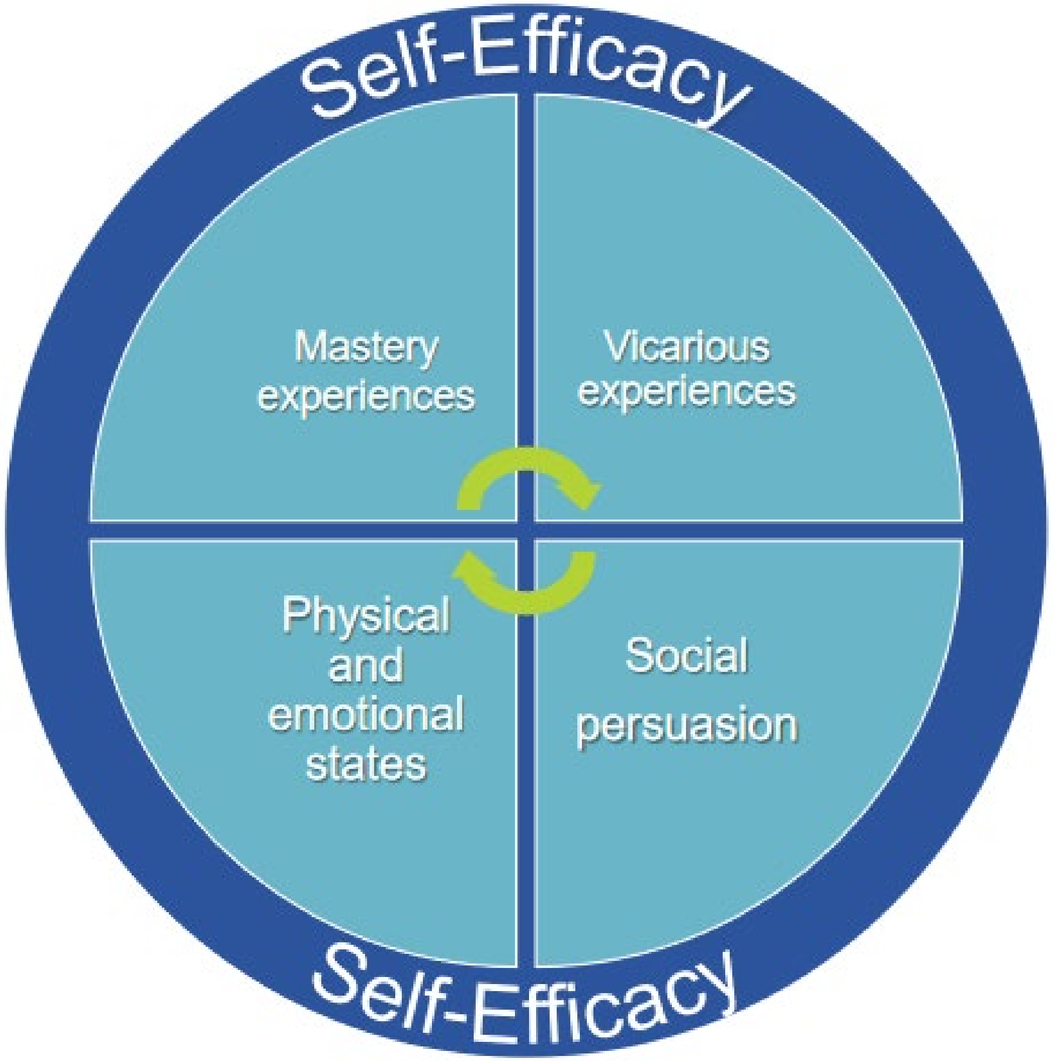
"Whether you think you can, or you think you can't, you're right."
Henry Ford

Why self-efficacy?

Students tend to seek situations where they feel confident…and avoid those where they do not.

Students with higher self-efficacy:

- Are more interested.
- Persist longer and are more engaged.
- Respond more adaptively when they encounter challenges.
- Show stronger academic performance.

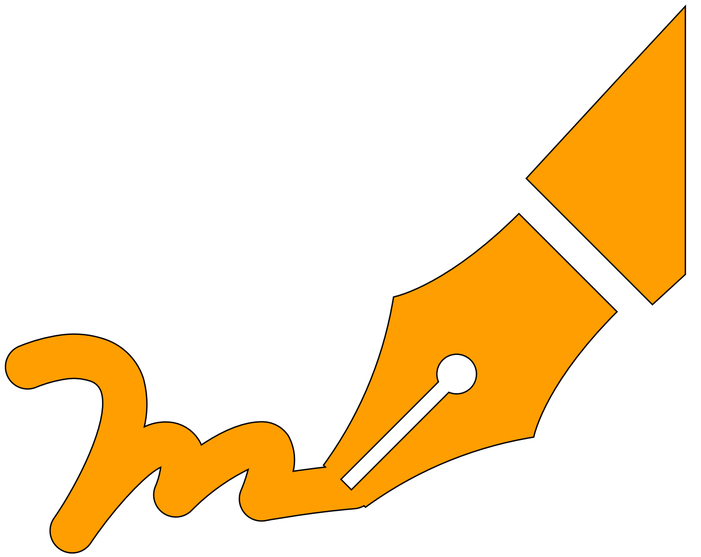


(Bandura, 1986; Parajes, 1996, REL Northwest, 2017; Zimmerman, 2000)

Stop and jot – self-efficacy

- Think of a time when your performance surprised you – a time when you succeeded or failed unexpectedly. How did your success or failure impact your feelings about yourself and your abilities?
- How did this experience influence your self-efficacy in that area? How did it influence your self-efficacy in other areas?

Handout 1



Sense of belonging

- Belonging is feeling a sense of connection with:
  - **Peers:** "I am an accepted, valued, and legitimate group member."
  - **Academic content**: "I belong in this math class."
- Belonging is a **fundamental need**, not a want.

(Goodenow, 1993; REL Northwest, 2017)

Sense of belonging (cont.)

- The need to belong is particularly intense for:
  - Early adolescents
  - Children transitioning between schools and grades
  - Children with marginalized identities
  - Children with identities that are stereotyped as “not good at math”

(Good et al., 2012; Steele, 1997)

Why sense of belonging?

Belonging in school leads to:

Increased:

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

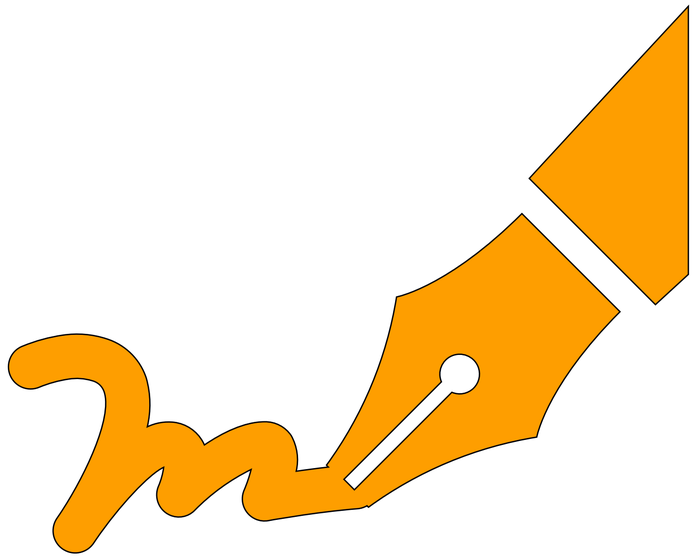
Decreased:

- Substance abuse
- Early sexual initiation
- Violence
- Suicidal ideation
- Disordered eating

(Dweck et al., 2014; Farrington et al., 2012; Juvonen, 2006; Walton & Cohen, 2011)

Stop and jot – sense of belonging

- Think of a time when you felt like you didn't belong. How did this impact your engagement and success?
- Do you feel like you belong when in a mathematics classroom, participating in mathematics activities, or discussing mathematics teaching and learning?
- How do you see the impact of belonging and exclusion on your students in mathematics?



Handout 1

Group reflection!

- In what ways do you see **growth mindset**, **self-efficacy**, and **sense of belonging** at work among your **fellow educators**, **students**, and **families**?

- How have you seen the effects of these components impacting your students' enthusiasm and engagement in mathematics?

Handout 1

Fostering Positive Mathematics Attitudes

Exemplar activity

What does a math teacher say to his students on Halloween?

…Trig or treat!

Fostering positive mathematics attitudes

Students need dispositions that will enable them to persevere in more-challenging problems, to take some responsibility for their own learning, and to develop good work habits in mathematics.

Glenda Lappan
National Council of Teachers of Mathematics (NCTM) president, 1998–2000

West Virginia Mathematics Standards (Grade 7)

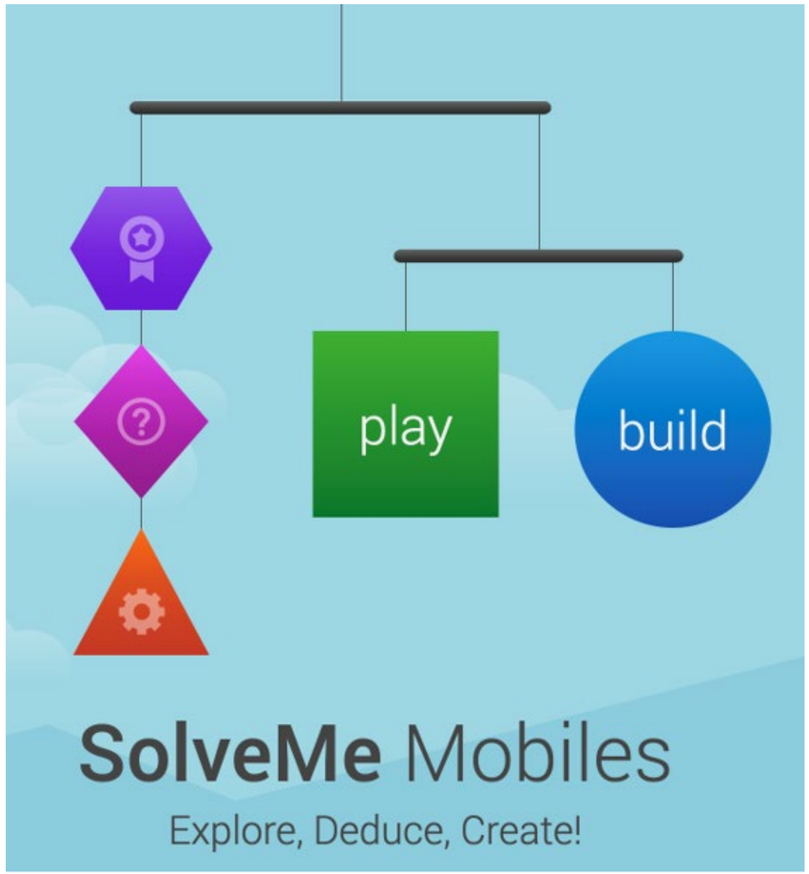
Expressions and Equations:

Use properties of operations to generate equivalent expressions.

M.7.7

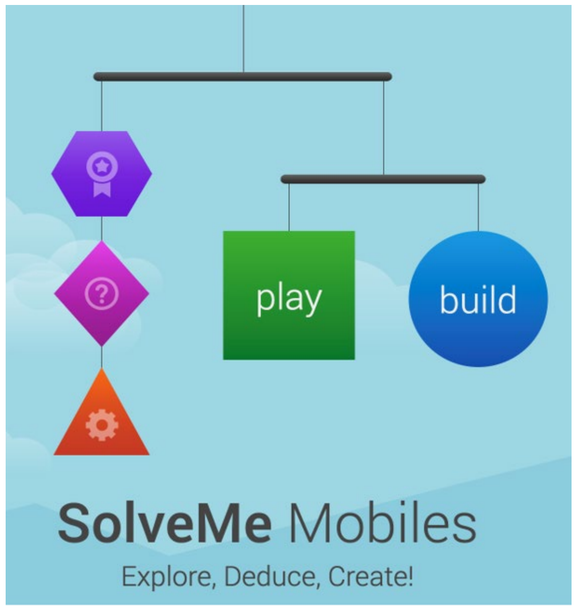
- Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.

https://solveme.edc.org/mobiles/#play

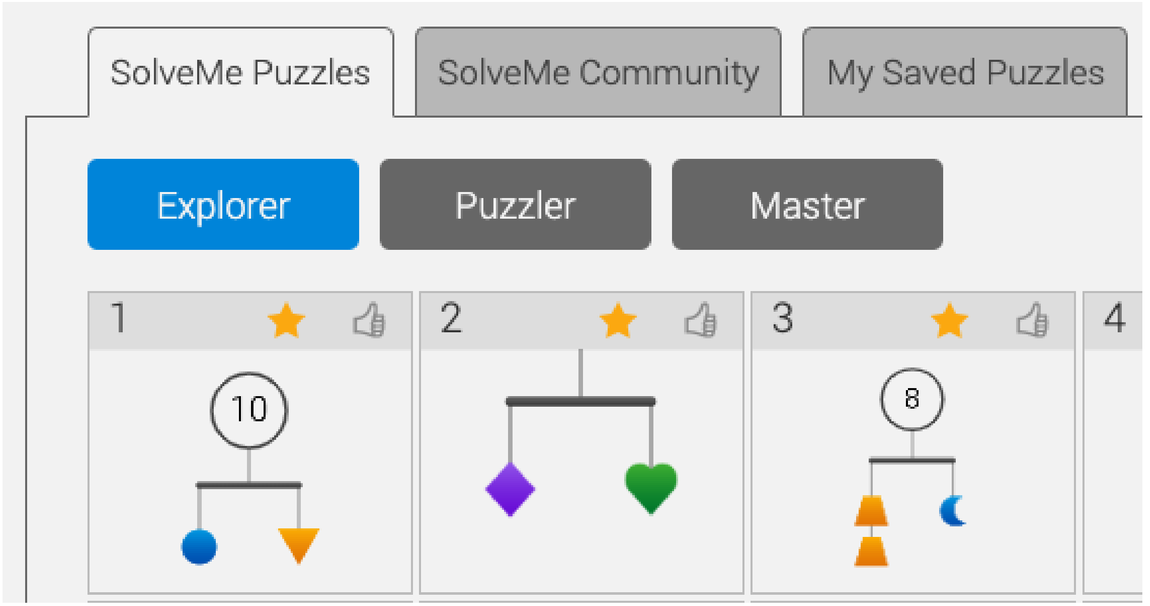


SolveMe Puzzles

1. Click on the green “play” block

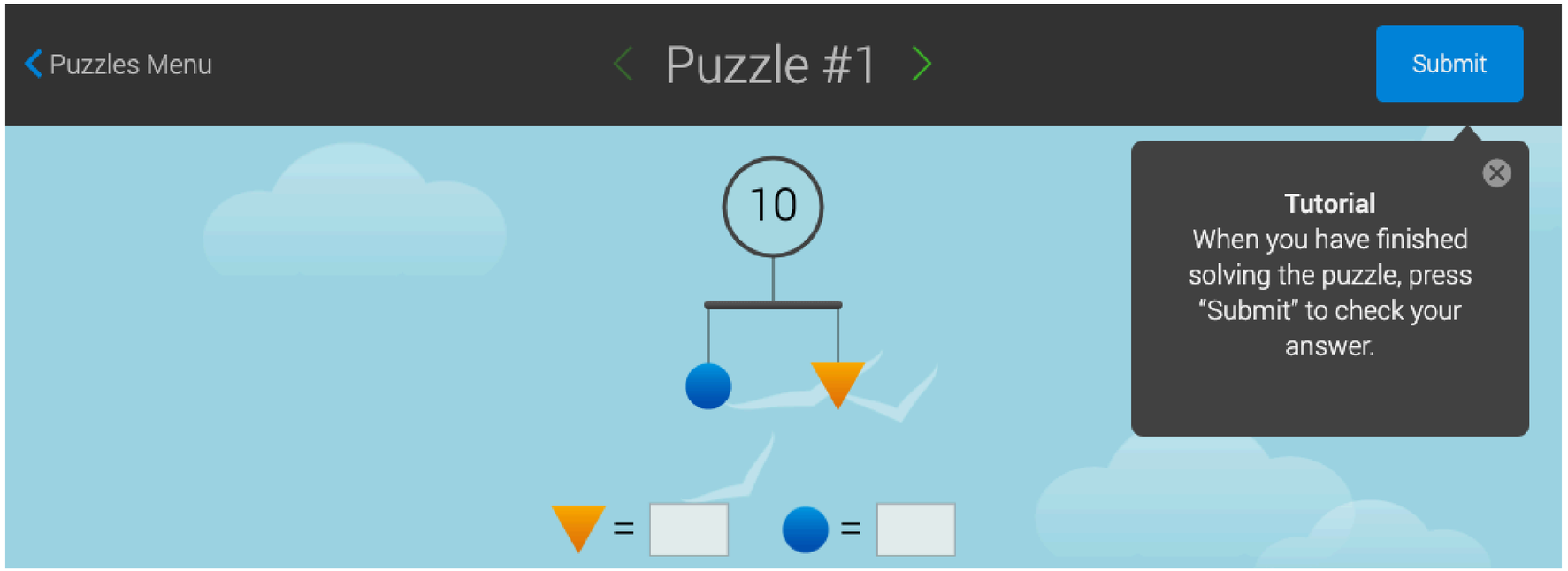


2. Click on problem 1 under the blue “Explorer” tab



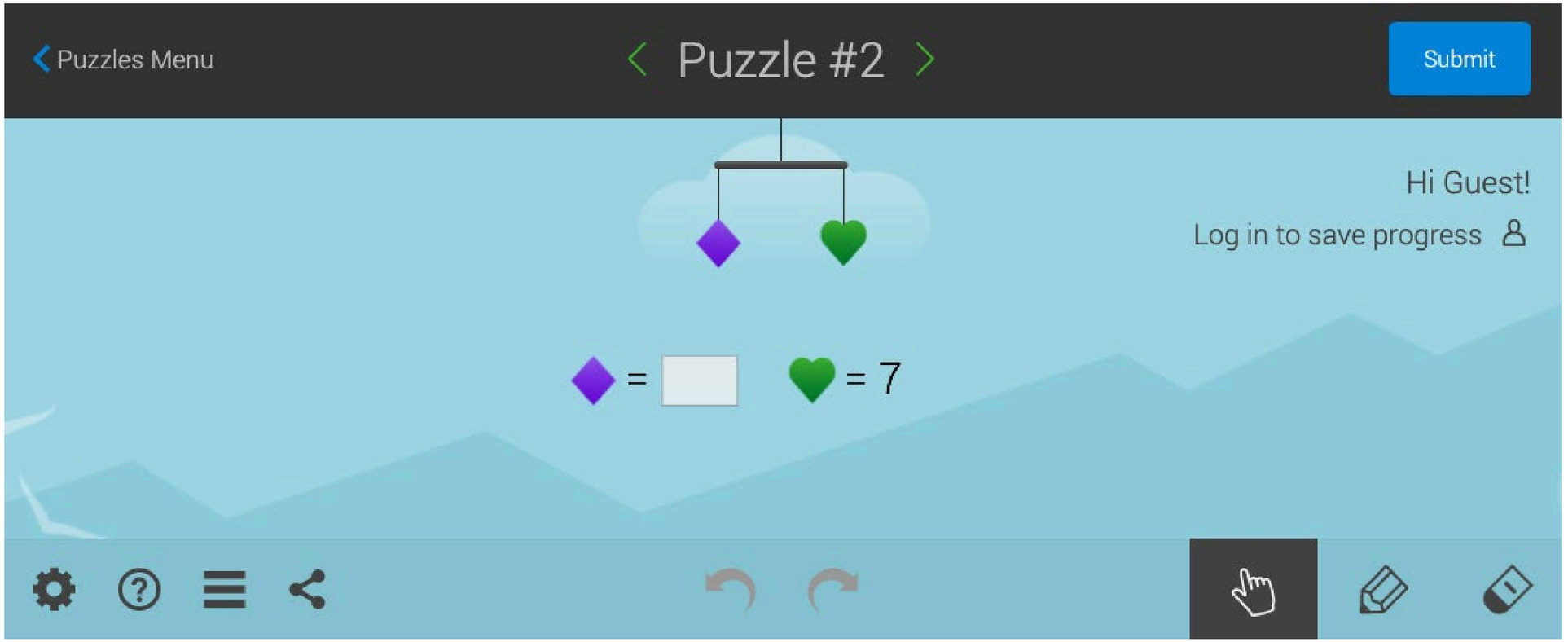
SolveMe Puzzles (2)

Complete Puzzle # 1 tutorial



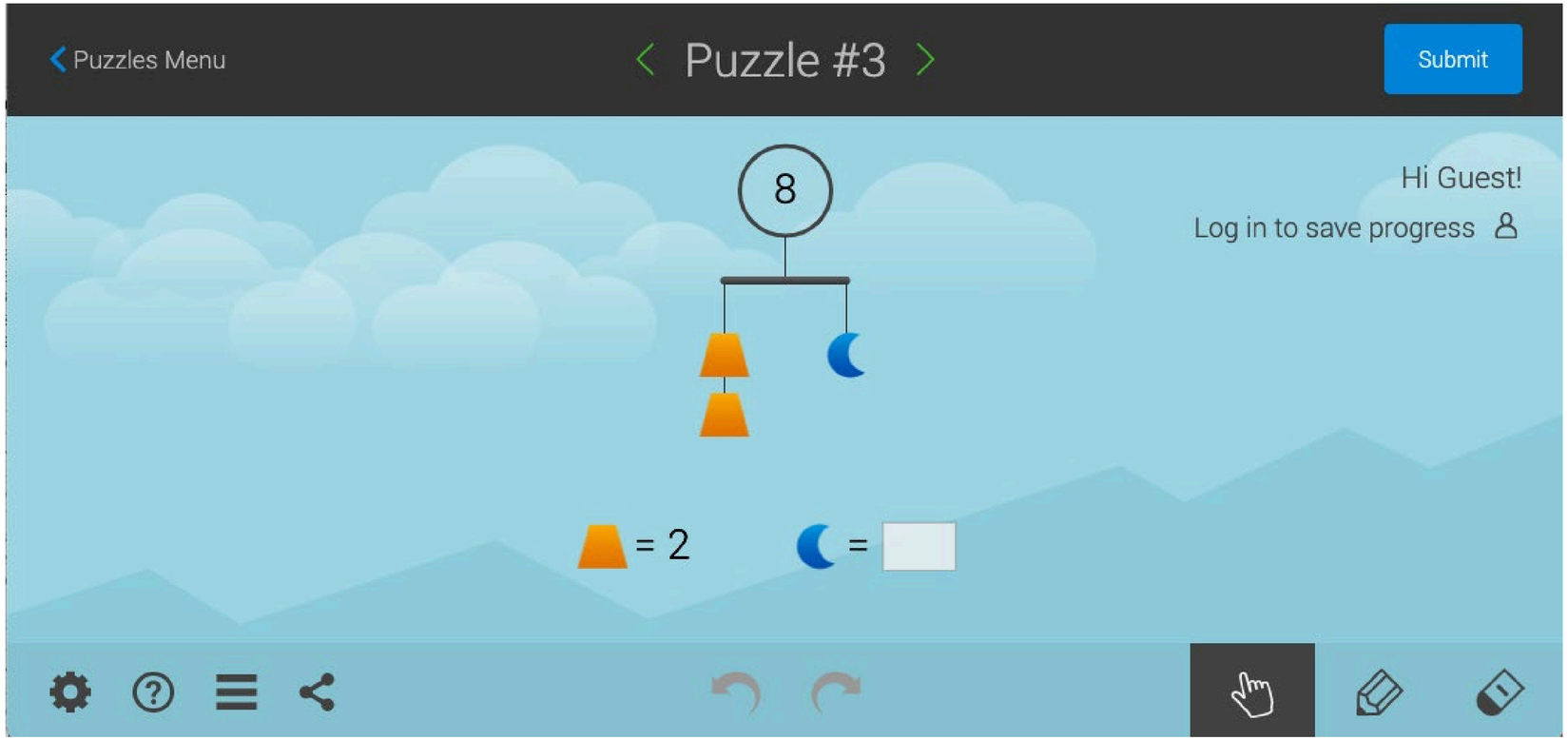
SolveMe Puzzles (3)

Complete Puzzle # 2



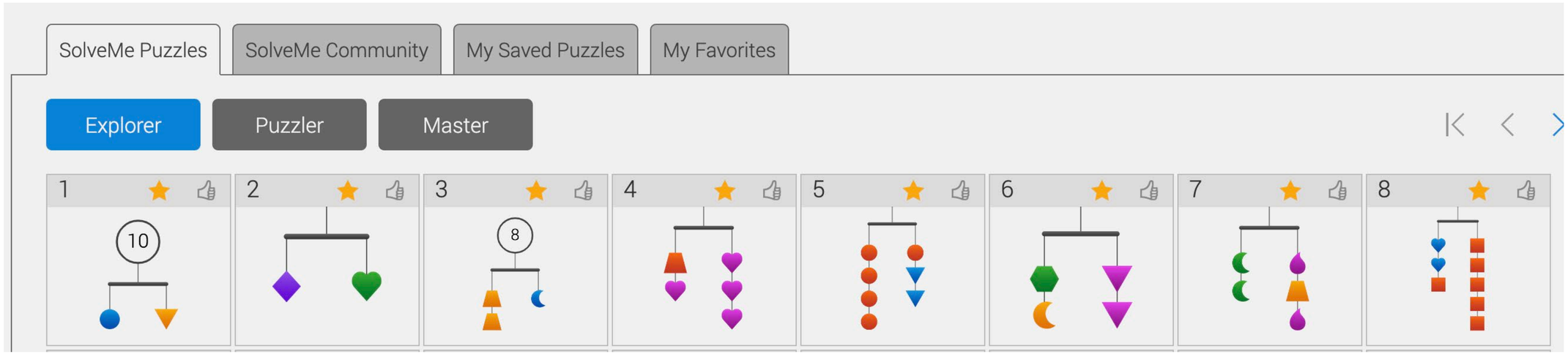
SolveMe Puzzles (4)

Complete Puzzle # 3



SolveMe Puzzles – group work

- Count off by 2 to split into two groups (1's together and 2's together).
- Complete puzzles # 4 – 8 together and share strategies as you work on the problems.



Group reflection

- What did you discover while completing the puzzles?
- How do the puzzles contribute to students' learning of the mathematics standards content?
- How does solving the puzzles contribute to making sense of problems and persevere in solving them?
- How does solving the puzzles contribute to the development of a positive attitude and mathematical mindset?

Expressions and Equations: Use properties of operations to generate equivalent expressions.

M.7.7 Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.


15-minute
break

Integrating Support for Positive Mathematics Attitudes Into Your Activities and Norms

Did you hear about the vampire who became a logician?

...He studies Boo-lean algebra.

How to promote positive mathematics attitudes

Growth mindset

- Teach students/families about growth mindset and how learning happens.
- Use growth-focused communication.

Self-efficacy

- Increase mastery experiences.
- Create successful vicarious experiences.

Sense of belonging

- Normalize uncertainty.
- Create opportunities for group membership.

Teach students/families about growth mindset and how learning happens, by:

- Explicitly teaching students about growth mindset can improve performance in mathematics.
- Regularly reminding students about growth mindset can reinforce this learning.

Handouts 2 and 3

(Aronson et al., 2002; Blackwell et al., 2007; Halpern et al., 2007)

Use growth-focused communication

- **Which of these statements do you think supports growth mindset?**
  - a. Wow, great job, you are so smart!
  - b. Wow, I'm impressed by all the strategies you tried until you found the solution!
  - c. Today's lesson is going to expand your thinking. It will be an opportunity for us to stretch our brains and become stronger mathematicians.
  - d. This new unit is going to be really challenging and require you to have advanced math skills.

- To reinforce growth mindset with students and families, consider shifting how you introduce new topics, goals, and expectations, as well as how you provide praise and feedback.

Handouts 2 and 3

(Elawar & Corno, 1985; Miller et. al, 1975; Mueller & Dweck, 1998)

Increase “mastery experiences”

- Mastery experiences are the biggest influence on self-efficacy. In other words, students who have succeeded in the past are going to expect to succeed in the future.

- Two key approaches to building mastery experiences are:
  - **Using scaffolding** to promote success.
  - Helping students **set goals and track progress.**

Handouts 2 and 3

(Anghileri, 2006; Schunk, 1989)

Cultivate successful vicarious experiences

- Having students observe others to whom they can relate is a powerful strategy to promote self-efficacy.

- Two ways to create vicarious experiences are:
  - **Fishbowl activities,** in which a small group in the center of the class engages in an activity and models how it's done for the larger group.
  - **Collaborative learning opportunities.**

How have you helped create vicarious successful experiences for students learning math?

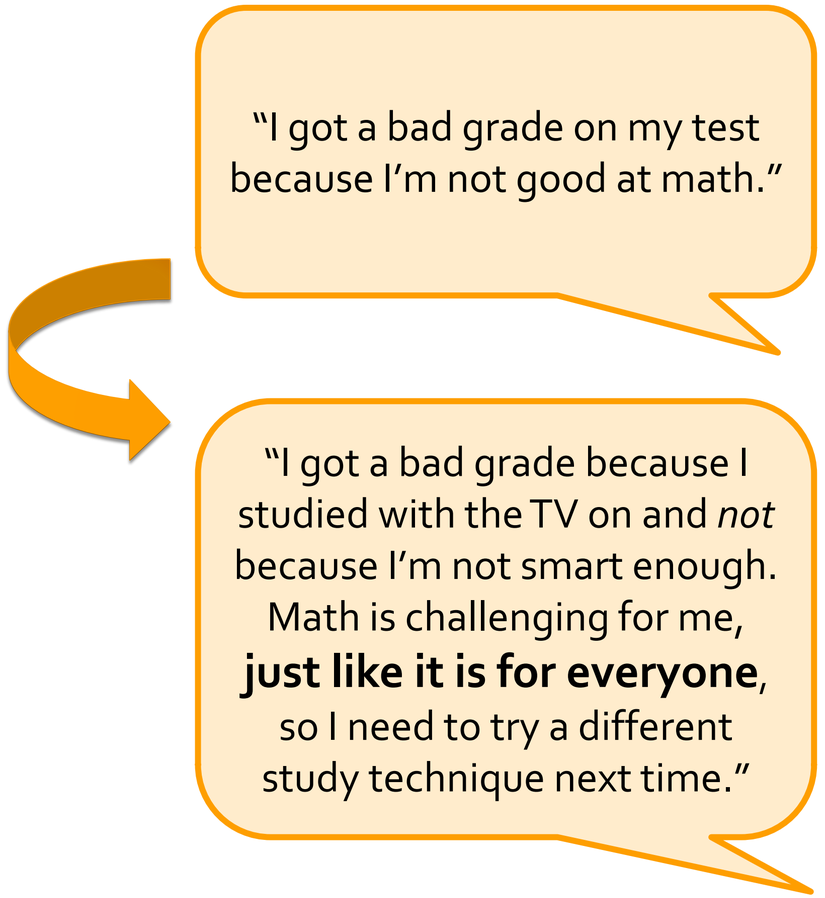
Handouts 2 and 3

(Master & Walton, 2013; Slavin, 2011)

Normalize uncertainty

- When students understand it's **normal to encounter challenges** and **normal to worry about belonging**, it can help them reframe their own struggles.

- Two strategies to normalize uncertainty are:
  - Learning that scientists and mathematicians struggle.
  - Hearing first-person stories from older students.



Handouts 2 and 3

(Lin-Siegler et al., 2016; Marx & Roman, 2002; McIntyre et al., 2003)

Create opportunities for group membership

- Students perceive social groups to be important, forging a sense of common purpose; however, outcomes improve only if students identify with their group.

- Try out the **jigsaw technique,** where students learn different content and then rotate within the space to share their knowledge with their classmates.

How could you use a Jigsaw to teach an upcoming concept in your setting?

Handouts 2 and 3

(Master & Walton, 2013; Slavin, 2011; Walton & Cohen, 2011)

Sense of belonging with families

- Due to past experiences, some families feel as if they belong in the school setting, and others do not.

- Promote a sense of belonging with *all* students and families by incorporating aspects of students' and their families' culture, values, and language into all settings and interactions.

"Is this a place that reflects my culture, values, and language?"

Handouts 2 and 3

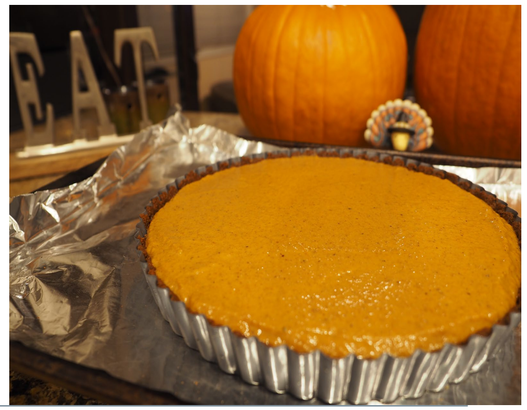
Positive mathematics attitudes in practice

- How might the example activities, routines, or norms be used in or adapted for your setting?
- What challenges might you face in integrating these activities, routines, or norms?
- What support or solutions can you identify to reduce or resolve these challenges?
- What other ideas do you have for activities, routines, or norms that you could integrate to promote positive mathematics attitudes?

Collaborative Planning

What do you get if you divide the circumference of a jack-o-lantern by its diameter?

…Pumpkin Pi!



Collaborative planning 101

Collaboration is the process of working together to achieve a common goal.

Benefits of collaborative planning:

- Breaks down silos and opens communication.
- Creates the time and space to work together intentionally.
- Provides feedback and mentoring opportunities.
- Builds problem-solving capacity among team members.

(Nevin et al., 2009; Rufo-Tepper, 2014)

Collaborative planning 101 (cont.)

Collaborative planning tips:

- Don’t be married to ideas.
- Apply the KISS principle.
- Use what’s around you.
- Build on strengths and interests.
- Cultivate trust.

(Nevin et al., 2009; Rufo-Tepper, 2014)

Collaborative-Action-Planning Template

Which math attitude will you focus on in your setting?	Which activity, routine, or norm will you implement?	What will this look like in each setting?
Sense of belonging	*Homework buddies*	*Paired students collaborate on math assignments*

Collaborative-Action-Planning Template (2)

Who will be responsible?	When will you implement this activity, routine or norm?	What resources do you need?
Homework tutors	*October 10–31*	*None*

Collaborative-Action-Planning Template (3)

What are potential barriers?	How will you measure success?	What support do you need from your team?
Students may need additional support to complete assignments	*Students will complete assigned homework during allotted time for tutoring*	*Recommendations for student pairings from classroom teachers*

Handouts 3 and 4

Collaborative planning next step

- Are there any gaps or overlaps in your plan?
- What questions do you still have before you can implement your plan?
- Are there additional stakeholders you need to consult before finalizing and implementing your plan?
- How will you check in with your team about any changes or questions that come up during implementation?
- How can you mutually reinforce each other's plans?

"If you want to go fast, go alone. If you want to go far, go together."
– African proverb

Wrap-up

Reflecting and postcard-writing

One **new or deeper learning that** surfaced today for me was….

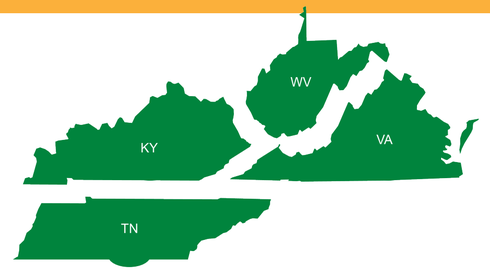
I will know I developed positive math attitudes in my setting when ….

(This could be a moment, a transition, an activity, or a year-long theme. Think big or small.)

I will **know my team has successfully collaborated** in support of developing positive math attitudes when…

Questions?

Thank you!



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