

# Math Anxiety

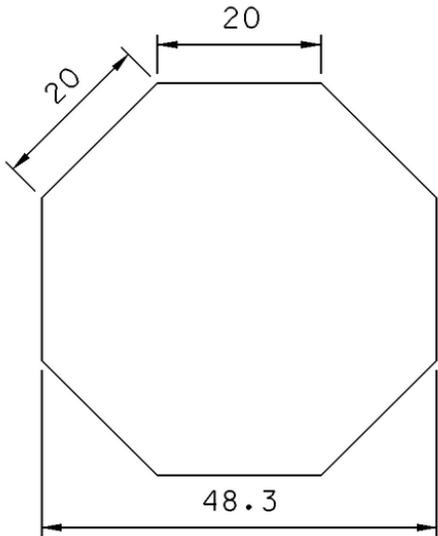


*Note.* These materials were produced for the WA STEM partnership coaching meeting on 2/1/18.

# Icebreaker (Option 1)



| Family Budget Planner   |       |       |       |       |       |       |       |       |       |       |       |       | Total               | Ave     |
|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|---------------------|---------|
| <a href="http://www.vertex42.com/ExcelTemplates/family-budget-planner.htm">http://www.vertex42.com/ExcelTemplates/family-budget-planner.htm</a> |       |       |       |       |       |       |       |       |       |       |       |       | © 2008 Vertex42 LLC |         |
|   | JAN   | FEB   | MAR   | APR   | MAY   | JUN   | JUL   | AUG   | SEP   | OCT   | NOV   | DEC   | Total               | Average |
| <b>Starting Balance</b>   | 1,500 |       |       |       |       |       |       |       |       |       |       |       |                     |         |
| <b>Total Income</b>   | 4,352 | 4,360 | 4,365 | 4,370 | 4,380 | 4,380 | 4,380 | 4,380 | 4,380 | 4,380 | 4,380 | 4,380 | 52,487              | 4,374   |
| <b>Total Expenses</b>   | 3,925 | 3,925 | 3,910 | 3,905 | 3,895 | 3,890 | 3,920 | 3,915 | 3,895 | 3,895 | 3,905 | 3,915 | 46,895              | 3,908   |
| <b>NET (Income - Expenses)</b>  | 427   | 435   | 455   | 465   | 485   | 490   | 460   | 465   | 485   | 485   | 475   | 465   | 5,592               | 466     |
| <b>Projected End Balance</b>  | 1,927 | 2,362 | 2,817 | 3,282 | 3,767 | 4,257 | 4,717 | 5,182 | 5,667 | 6,152 | 6,627 | 7,092 |                     |         |
| <b>INCOME</b>   |       |       |       |       |       |       |       |       |       |       |       |       |                     |         |
| Wages & Tips  | 4,200 | 4,200 | 4,200 | 4,200 | 4,200 | 4,200 | 4,200 | 4,200 | 4,200 | 4,200 | 4,200 | 4,200 | 50,400              | 4,200   |
| Interest Income   | 112   | 120   | 125   | 130   | 140   | 140   | 140   | 140   | 140   | 140   | 140   | 140   | 1,607               | 134     |
| Dividends   | 40    | 40    | 40    | 40    | 40    | 40    | 40    | 40    | 40    | 40    | 40    | 40    | 480                 | 40      |
| Gifts Received  |       |       |       |       |       |       |       |       |       |       |       |       | 0                   | 0       |
| Refunds/Reimbursements  |       |       |       |       |       |       |       |       |       |       |       |       | 0                   | 0       |
| Transfer From Savings   |       |       |       |       |       |       |       |       |       |       |       |       | 0                   | 0       |
| Other   |       |       |       |       |       |       |       |       |       |       |       |       | 0                   | 0       |
| Other   |       |       |       |       |       |       |       |       |       |       |       |       | 0                   | 0       |
| Other   |       |       |       |       |       |       |       |       |       |       |       |       | 0                   | 0       |
| <b>Total INCOME</b>   | 4,352 | 4,360 | 4,365 | 4,370 | 4,380 | 4,380 | 4,380 | 4,380 | 4,380 | 4,380 | 4,380 | 4,380 | 52,487              | 4,374   |
| <b>HOME EXPENSES</b>  |       |       |       |       |       |       |       |       |       |       |       |       |                     |         |
| Mortgage/Rent   | 987   | 987   | 987   | 987   | 987   | 987   | 987   | 987   | 987   | 987   | 987   | 987   | 11,844              | 987     |
| Electricity   | 85    | 85    | 85    | 85    | 85    | 90    | 120   | 115   | 90    | 85    | 85    | 85    | 1,095               | 91      |
| Gas/Oil   | 100   | 100   | 85    | 80    | 70    | 60    | 60    | 60    | 65    | 70    | 80    | 90    | 920                 | 77      |
| Water/Sewer/Trash   | 100   | 100   | 100   | 100   | 100   | 100   | 100   | 100   | 100   | 100   | 100   | 100   | 1,200               | 100     |
| Phone   | 120   | 120   | 120   | 120   | 120   | 120   | 120   | 120   | 120   | 120   | 120   | 120   | 1,440               | 120     |
| Cable/Satellite   | 98    | 98    | 98    | 98    | 98    | 98    | 98    | 98    | 98    | 98    | 98    | 98    | 1,176               | 98      |
| Internet  | 45    | 45    | 45    | 45    | 45    | 45    | 45    | 45    | 45    | 45    | 45    | 45    | 540                 | 45      |



Perimeter=160 ft.  
Area=1931 sq.ft.

*What is the first word that comes to mind when you see these images?*

*What do you notice about your reactions to these images?*



## Icebreaker (Option 2)

Take a few minutes to write your “math autobiography”:

The last math course I took was \_\_\_\_\_.

When I think about having to do math, I feel \_\_\_\_\_.

An early experience in a math class that stands out for me was when  
\_\_\_\_\_.

One math teacher I remember is \_\_\_\_\_.

My family’s attitude toward math was \_\_\_\_\_.

I think I learned my present attitude toward math when  
\_\_\_\_\_.

# Learning Objectives

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

-  Define math anxiety
-  Describe the impact of math anxiety on academic performance and other outcomes
-  Apply actionable strategies to alleviate math anxiety in classrooms



## What is Math Anxiety?

“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 to write about her least favorite subject

Quote reported in Maloney, Schaeffer, & Beilock (2013)

## What is Math Anxiety?

- It is different from just “not liking math” or having poor math skills.
- People with math anxiety feel apprehensive, tense, and fearful about situations involving math.
- It is a global phenomenon, and it is highly prevalent—even in very young children.
- It increases with age, particularly math test anxiety.



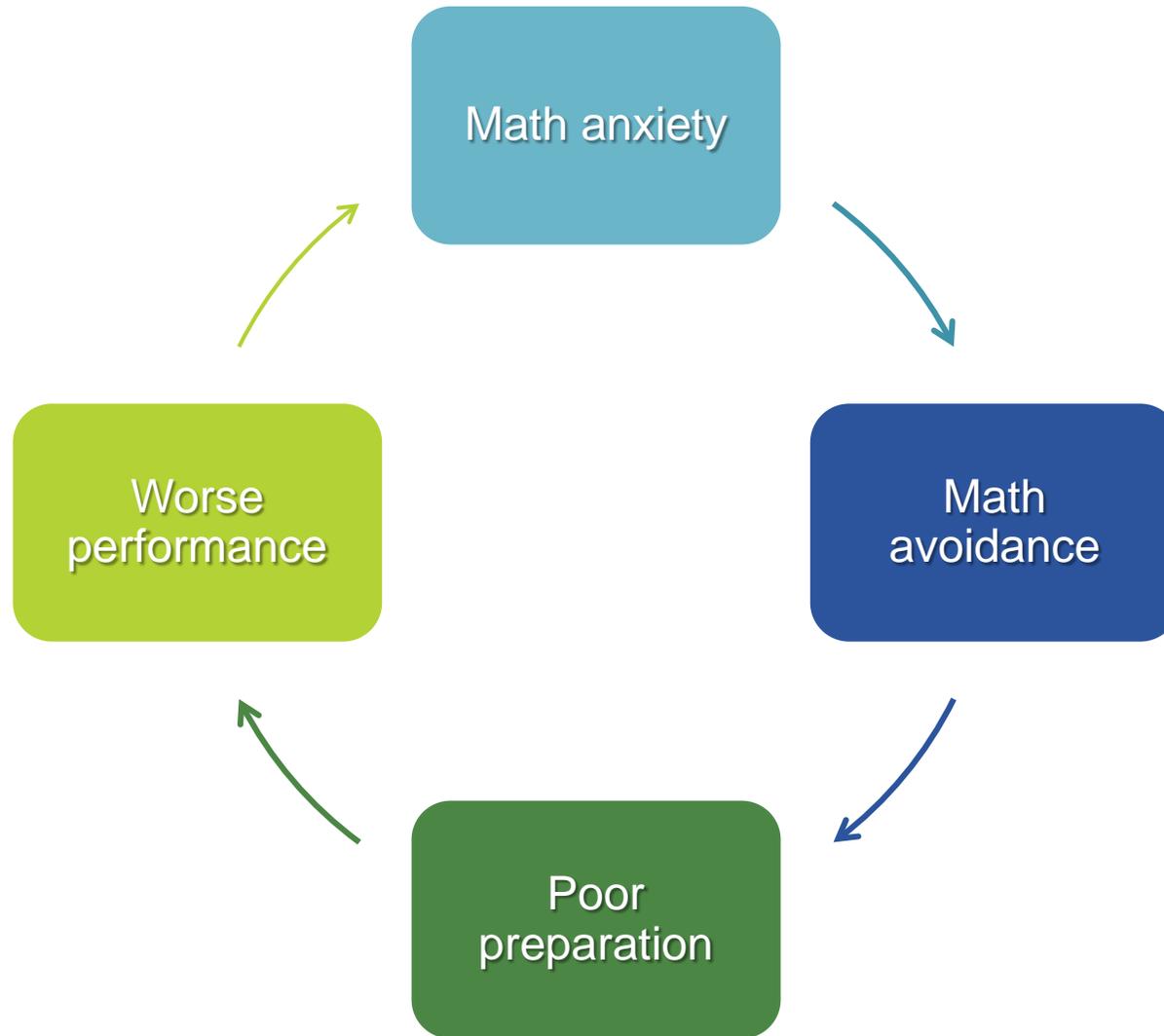
Ashcraft (2002); Gierl & Bisanz (1995)

## Implications of Math Anxiety

Students with math anxiety perform worse in math compared with their less math-anxious peers from elementary school through college.



# Reciprocal Cycle



# Math Anxiety Robs Performance

- Math anxiety disrupts **working memory**. (Working memory is necessary for holding concepts in your mind and manipulating information.)
- Thus, math anxiety hurts performance by robbing the brain of cognitive capacity that could be spent on solving the math problems at hand.



# What Causes Math Anxiety?



## Multiple interrelated sources:

- The student perceives that their math skills need work.
- The student is trying to use a lot of higher-order approaches instead of simpler ones.
- The student didn't learn some of the fundamental “building blocks” in early years.
- The student is picking up subtle (and not-so-subtle) cues from their environment that convey negative messages about math.

# Adult Math Anxiety Impacts Students

- Children whose parents are anxious about math are more likely to have math anxiety themselves.
- Higher math anxiety among female elementary school teachers is related to lower math achievement among their female students and a greater likelihood that girls believe that “boys are good at math, and girls are good at reading.”

# Math Stereotypes



- Stereotypes about race and gender can act as barriers that prevent girls and students of color from developing interests in science, technology, engineering, and math (STEM).
- “Stereotype threat” is when someone underperforms because of a negative stereotype about how they *should* perform.
- Math anxiety and stereotype threat likely share a common mechanism: working memory.
- Both math anxiety and stereotype threat start early. Children can form automatic associations that affect performance before they even consciously endorse stereotypes.

# What's Inside a Stereotype?

Example: Gender stereotype

May represent multiple intertwined stereotypes (e.g., *cultural fit* and *ability*)

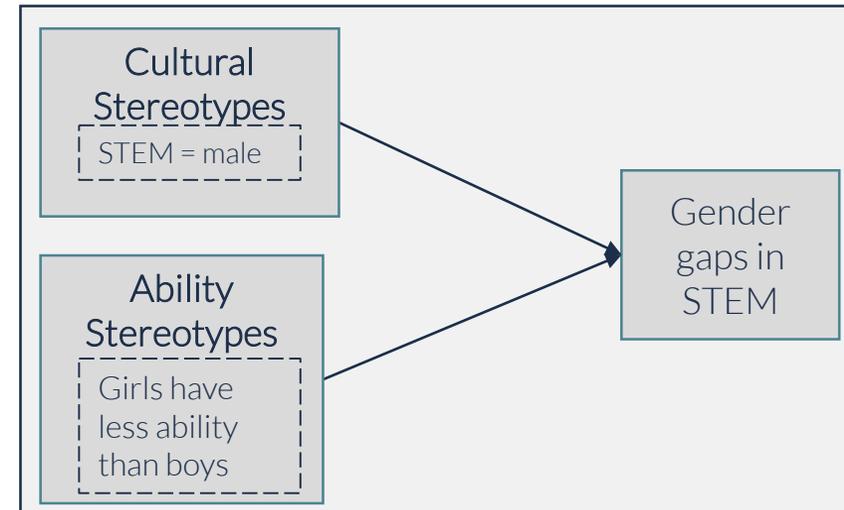


Figure adapted from Cheryan, Master, & Meltzoff (2015)

**Counteracting stereotypes can increase interest in STEM among girls and students of color by increasing their confidence and making them feel like they belong in math.**



# Classroom Strategies to Reduce Math Anxiety

## Key Strategies

- Cultivate your own math self-awareness and skills
- Celebrate mistakes
- Support students
- Be conscious of messages
- Practice and teach mindfulness



## Cultivate Your Own Math Self-Awareness and Skills



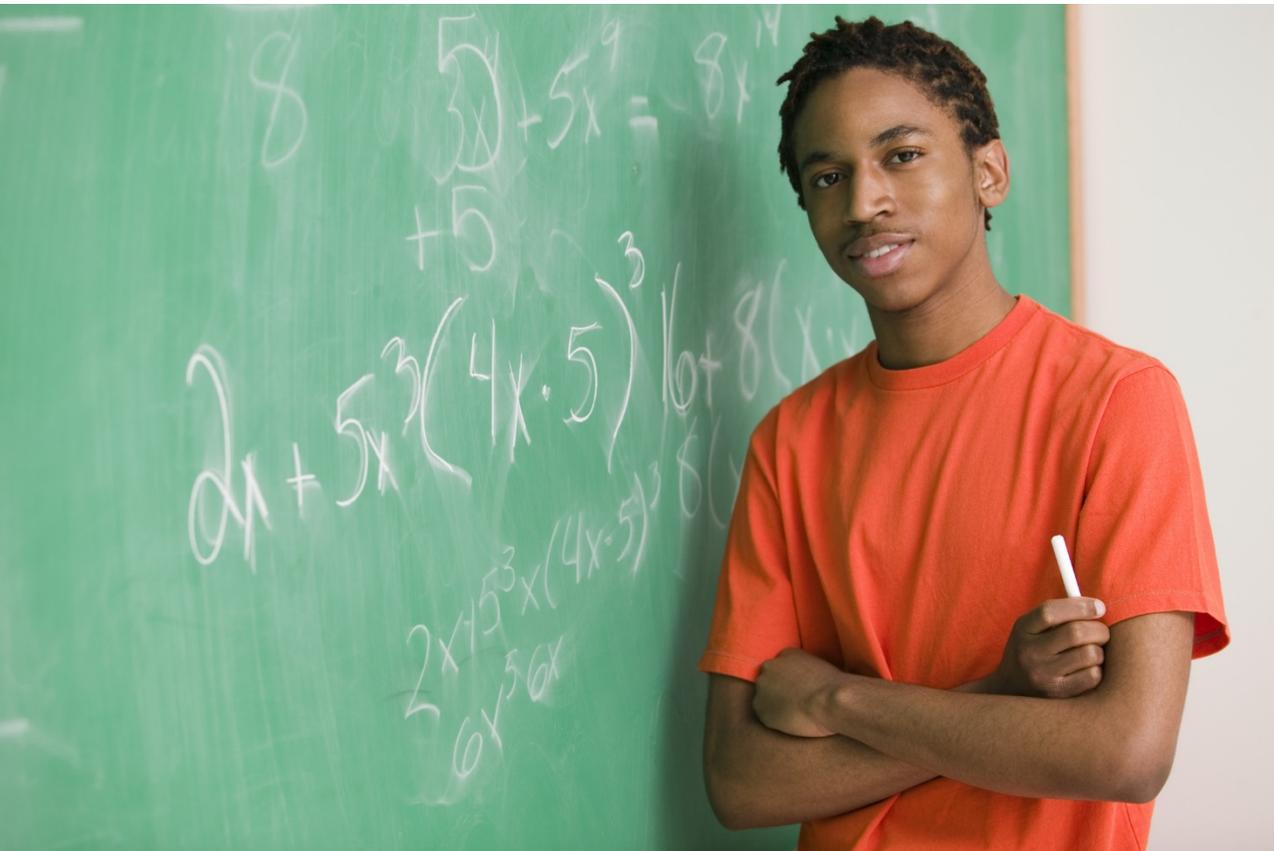
- Be aware of your own feelings about math and how you express them
- When possible, seek professional development to gain confidence in teaching new concepts

## Celebrate Mistakes



Create a classroom culture that normalizes struggles and **celebrates** mistakes:

- Communicate to students that you **love** mistakes and welcome them in your class
- Give work that encourages mistakes by keeping students at the edge of their skills
- Consider having students present incorrect solutions to the class and then work as a team to find a correct answer



Activity adapted from [mindsetkit.org](http://mindsetkit.org)

## Celebrate Mistakes: Inverted Test

1. Give students a test/assignment completed by a fictitious student that has several incorrect answers.
2. Have students correct the test. Ask them to identify the mistakes and explain how they would approach or solve the problems differently.

What's my mistake?

Solve:  $42 \times 5$

$$42 = 40 + 2$$

So...

$$\begin{array}{r} 40 \\ \times 5 \\ \hline 200 \end{array} \quad \begin{array}{r} 2 \\ \times 5 \\ \hline 12 \end{array}$$

My answer:

$$42 \times 5 = 212$$

## Celebrate Mistakes: Mistakes Game

1. Have students complete a set of problems independently.
2. Put students into groups. Each group is assigned one problem to present to the class.
3. During the presentation, each group must make (at least) one intentional mistake in its solution.
4. The rest of the class listens to the group's presentation and tries to find the mistake(s).

## Support Students



- Identify students who may need a refresher on the basics.
- Avoid having anxious students perform in front of a large group.
- Avoid unnecessary time pressures (e.g., timed drills). When appropriate, consider an untimed option for a quiz or other assessments.

## Be Conscious of Messages



Be conscious of how you speak to students when they are struggling; consoling students can comfort them in the moment, but it can also be demotivating. It's better to express confidence and encouragement.

## Practice and Teach Mindfulness



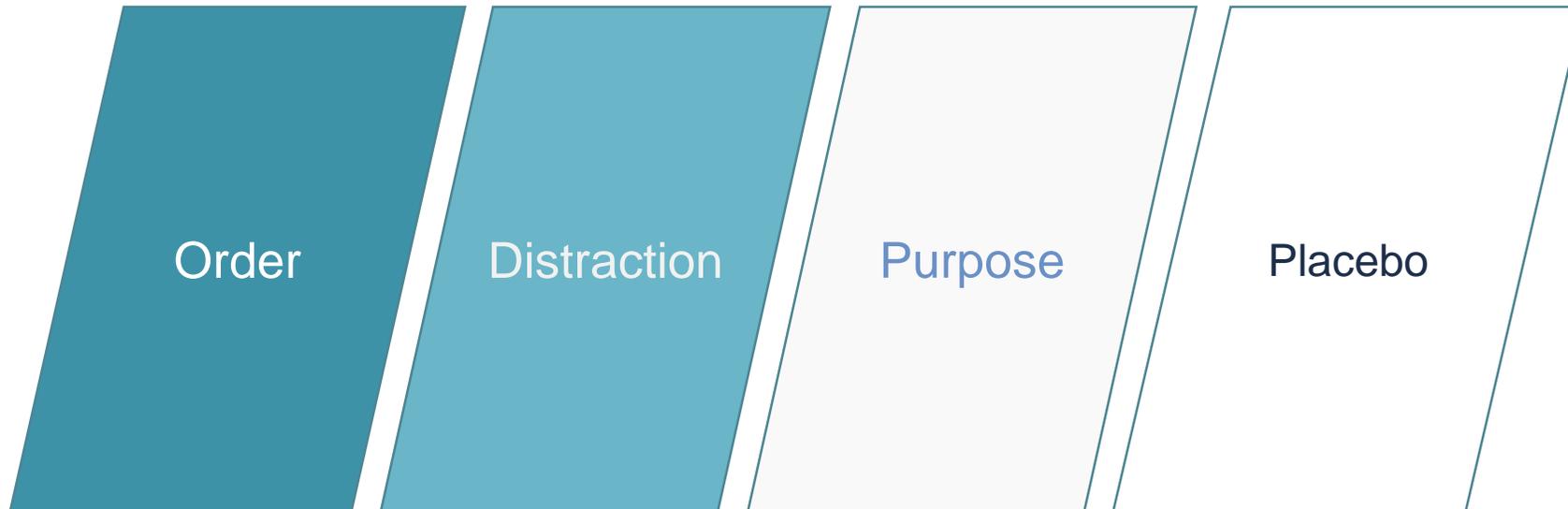
Mind Full, or Mindful?

Mindfulness is a focused awareness on the present, without judgment, to calmly attend to the present state.

Research shows that mindfulness can have benefits for both teachers and students.

## Focused Breathing

1. Deep breathing is a quick and simple technique even young children can use to calm themselves and free up working memory.
2. Focused breathing can be done as a form of **ritual** before performing high-anxiety math tasks.



## Activity: Mixed Messages

How might students interpret these messages?

It's OK, not everyone can be good at this kind of problem.

You just need to try harder.

Don't worry about it. I'm not good at math either.

## Activity: Mixed Messages (continued)

It's OK, not everyone can be good at this kind of problem.

You just need to try harder.

Don't worry about it. I'm not good at math either.



*I'm not good at this and never will be.*

*I DID try hard, but I still don't get it. I must not be cut out for this.*

*They never improved at math, and I won't either.*

## Activity: Mixed Messages (continued)

How might students interpret these messages?

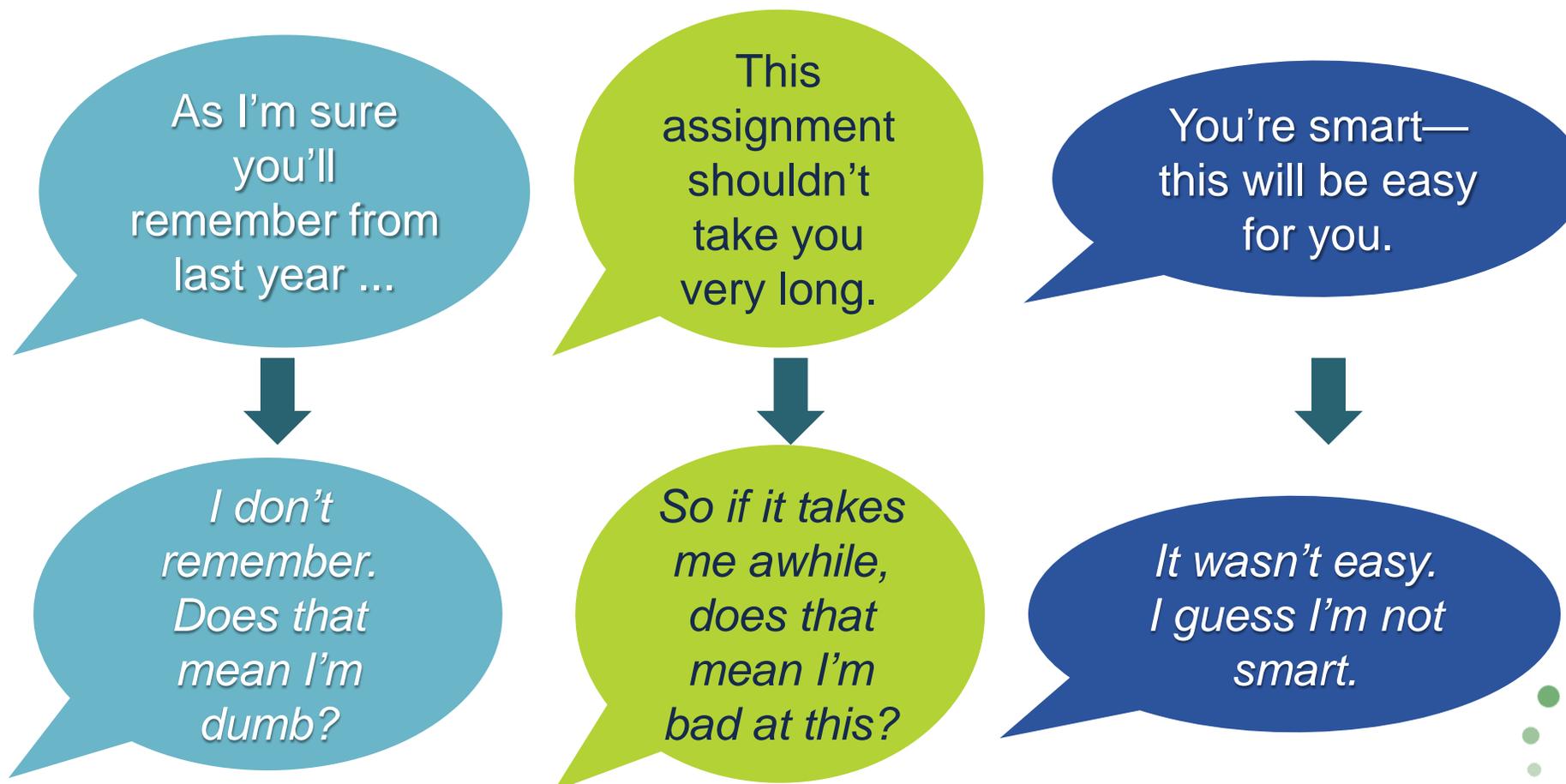
As I'm sure  
you'll  
remember from  
last year ...

This  
assignment  
shouldn't  
take you  
very long.

You're smart—this  
will be easy for  
you.

## Activity: Mixed Messages (continued)

How might students interpret these messages?



## Activity: Focused Breathing Practice





## Reflection

What stood out to you, increased your knowledge, or changed your thinking during this session?

What is one thing you learned or discussed today that you will apply to your work with teachers and/or your classroom?

# References

- Ashcraft, M. H. (2002). Math anxiety: Personal, educational, and cognitive consequences. *Current Directions in Psychological Science*, 11(5), 181–185.
- Ashcraft, M. H., & Kirk, E. P. (2001). The relationships among working memory, math anxiety, and performance. *Journal of Experimental Psychology: General*, 130(2), 224–237.
- Beilock, S. L., Gunderson, E. A., Ramirez, G., & Levine, S. C. (2010). Female teachers' math anxiety affects girls' math achievement. *Proceedings of the National Academy of Sciences*, 107(5), 1860–1863.
- Beilock, S. L., & Willingham, D. T. (2014). Math anxiety: Can teachers help students reduce it? Ask the cognitive scientist. *American Educator*, 38(2), 28–32, 43. <http://eric.ed.gov/?id=EJ1043398>
- Brooks, A. W., Schroeder, J., Risen, J. L., Gino, F., Galinsky, A. D., Norton, M. I. et al. (2016). Don't stop believing: Rituals improve performance by decreasing anxiety. *Organizational Behavior and Human Decision Process*, 137, 71–85.
- Brunyé, T. T., Mahoney, C. R., Giles, G. E., Rapp, D. N., Taylor, H. A., & Kanarek, R. B. (2013). Learning to relax: Evaluating four brief interventions for overcoming the negative emotions accompanying math anxiety. *Learning and Individual Differences*, 27, 1–7.
- Faust M. W., Ashcraft M. H., & Fleck D. E. (1996). Mathematics anxiety effects in simple and complex addition. *Mathematical Cognition*, 2(1), 25–62. <http://eric.ed.gov/?id=EJ525151>
- Galdi, S., Cadinu, M., & Tomasetto, C. (2014). The roots of stereotype threat: When automatic associations disrupt girls' math performance. *Child Development*, 85(1), 250–263. <http://eric.ed.gov/?id=EJ1027527>
- Gierl, M. J., & Bisanz, J. (1995). Anxieties and attitudes related to mathematics in grades 3 and 6. *Journal of Experimental Education*, 63(2), 139–158. <http://eric.ed.gov/?id=EJ509291>

# References

- Khng, K. H. (2016). A better state-of-mind: Deep breathing reduces state anxiety and enhances test performance through regulating test cognitions in children. *Cognition and Emotion*, 31(7), 1–9.
- Kutaka, T. S., Smith, W. M., Albano, A. A., Edwards, C. P., Ren, L., Beattie, H. L. et al. (2017). Connecting teacher professional development and student mathematics achievement: A 4-year study of an elementary mathematics specialist program. *Journal of Teacher Education*, 68(2), 140–154.
- Ma, X., & Xu, J. (2004). The causal ordering of mathematics anxiety and mathematics achievement: A longitudinal panel analysis. *Journal of Adolescence*, 27(2), 165–179. <http://eric.ed.gov/?id=EJ730091>
- Maloney, E. A., Ramirez, G., Gunderson, E. A., Levine, S. C., & Beilock, S. L. (2015). Intergenerational effects of parents' math anxiety on children's math achievement and anxiety. *Psychological Science*, 26(9), 1480–1488.
- Maloney, E. A., Schaeffer, M. W., & Beilock, S. L. (2013). Mathematics anxiety and stereotype threat: Shared mechanisms, negative consequences and promising interventions. *Research in Mathematics Education*, 15(2), 115–128. <http://eric.ed.gov/?id=EJ1090367>
- Master, A., & Meltzoff, A. N. (2017). Building bridges between psychological science and education: Cultural stereotypes, STEM, and equity. *Prospects: Quarterly Review of Comparative Education*, 46(2), 215–234. <http://eric.ed.gov/?id=EJ1143727>
- Rattan, A., Good, C., & Dweck, C. S. (2012). “It's ok—Not everyone can be good at math”: Instructors with an entity theory comfort (and demotivate) students. *Journal of Experimental Social Psychology*, 48(3), 731–737.
- Shobe, E., Brewin, A., & Carmack, S. (2005). A simple visualization exercise for reducing test anxiety and improving performance on difficult math tests. *Journal of Worry & Affective Experience*, 1(1), 34–52.
- Transforming Education. (2017). *Mindfulness toolkit*. Retrieved November 16, 2017, from <https://www.transformingeducation.org/mindfulness-toolkit/>

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