Math Anxiety
Icebreaker (Option 1)

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
“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

What is Math Anxiety?

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.

Ma & Xu (2004)
Reciprocal Cycle

- Math anxiety
- Math avoidance
- Poor preparation
- Worse performance

Ashcraft (2002)
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.

Ashcraft & Kirk (2001)
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.

Beilock & Willingham (2014)
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.”

Beilock, Gunderson, Ramirez, & Levine (2010); Maloney, Ramirez, Gunderson, Levine, & Beilock (2015)
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.

Master & Meltzoff (2017); Galdi, Cadinu, & Tomasetto (2014)
What's Inside a Stereotype?

Example: Gender stereotype
May represent multiple intertwined stereotypes (e.g., cultural fit and ability)

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.

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

Kutaka et al. (2017)
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
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.

Celebrate Mistakes: Inverted Test

Activity adapted from mindsetkit.org
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).

Activity adapted from mindsetkit.org
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.

Faust, Ashcraft, & Fleck (1996)
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.

Rattan, Good, & Dweck (2012)
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.

Brunyé et al. (2013); Khng (2016); Shobe, Brewin, & Carmack (2005)
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.

I’m not good at this and never will be.

You just need to try harder.

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

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

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

You just need to try harder.
Activity: Mixed Messages (continued)

How might students interpret these messages?

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

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

This assignment shouldn’t take you very long.
Activity: Mixed Messages (continued)

How might students interpret these messages?

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

I don't remember. Does that mean I'm dumb?

This assignment shouldn't take you very long.

So if it takes me awhile, does that mean I'm bad at this?

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

It wasn't easy. I guess I'm not smart.
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


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