HOME

**Cultivating Your Growth Mindset**

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SURVEY

**What's your current mindset?**

Students arrive at college with very different past experiences and opportunities, and thus diverse mindsets about mathematics. Let's explore your current perspective on learning mathematics. There are no right or wrong answers. We are just interested in your ideas.

For this survey, indicate the extent to which you agree or disagree with each of the following statements.

SURVEY RESULTS

**Let's Review Your Results**

People vary in how they view ability and learning. People with a ‘fixed mindset’ believe that you are born with the potential to be good or bad at math, and that practicing math does little to change your natural-born abilities. Alternatively, people with a ‘growth mindset’ believe you can improve at anything, including math, with effort, patience, and practice. A growth mindset suggests that you are not limited by natural abilities but only by the amount of time and energy you commit to learning.

Let’s see where you start on the spectrum between a fixed versus growth mindset.

Although we’d like to already have a growth mindset towards learning, the truth is that we are all on a journey, starting out at different points on the mindset spectrum. The goal is to recognize fixed mindset elements in ourselves and reflect on how we can improve through practice.

Now that we know a little about your starting mindset, let's continue to the Topic Exploration section to learn more about cultivating a growth mindset.

EXPLORATION 1

**Cultivating a Growth Mindset**

“In a growth mindset, people believe that their most basic abilities can be developed through dedication and hard work — brains and talent are just the starting point. This view creates a love of learning and a resilience that is essential for great accomplishment.”

- Carol Dweck

EXPLORATION 2

**Outline**

1: "Natural ability" is most often the result of lots of practice.

2: Your brain changes as you learn new tasks and as you practice

3: When we say we “just aren’t good” at something, we limit our own potential.

EXPLORATION 3

**1: "Natural ability" is most often the result of lots of practice.**

Think of some areas or careers that you associate with ‘natural talent.’ Did you think of sports, music, perhaps art or dance? Now think of some activities that you associate with long hours of exhausting practice. Did you think of sports again? Perhaps music? Dance?

This is a paradox in how we think about where ability comes from. Often if we aren’t good at a particular activity (sports, anyone?), we look at others that are good at it and think that they must have a special talent. We might wish that we had that talent too.

However, if we are the person working at developing our abilities in that field, we realize that there is a lot of work going into that ability. If you play sports, you probably devote many hours to practice. If you play an instrument, likewise. Perhaps by the time you meet someone in college, they might seem naturally good at music. But you haven’t observed all of the hours and experiences that went into developing those abilities, often starting at a very young age.

The same logic applies to math. Many people believe that you are born either good or bad at math. When you hear someone say, ‘I’m just not good at it,’ they are demonstrating a ‘fixed mindset.’ A fixed mindset suggests you are born with the potential to be good or bad at certain tasks and, thus, you have limited control over your ability to excel. People often have a fixed mindset when it comes to learning mathematics.

**But having a fixed mindset limits your learning potential AND goes against what we know from studies in brain and learning science.**

EXPLORATION 4

**2: Your brain changes as you learn new tasks and as you practice**

Your brain is plastic! Not plastic like Tupperware, but plastic in the sense that it is moldable, changeable, and flexible. When you take on difficult mental tasks, like learning math, your brain gets busy rewiring itself in a process that is analogous to the way your muscles build themselves up each time you work out.

**Much like strengthening your muscles, learning new skills can be difficult (and painful) at first, but your brain will adjust and it will get easier.**

Scholz et al. (2009) studied the brains of people learning to juggle (Figure 1 below). They found that the density of grey matter increased and the structure of white matter changed in those that learned to juggle, even after just a few weeks. People's brains were changing in response to new demands.

Figure 1. A) Red areas show areas of increased grey matter density from scan 1 (pre-training) to scan 2 (after six weeks of training) to scan 3 (four weeks later with no additional training). B) People that did not train (the control group) saw no increase in grey matter density during the experiment, while those training to juggle saw increases at scan 2 and again at scan 3, even though training had stopped.

In London, prospective cab drivers have to pass a tremendously demanding test of the crowded and complex road network. Woolett and Maguire (2011) examined the brains of people studying for the cab driver’s test and found that people who studied for (and passed) the test had developed more grey matter in their posterior hippocampi, the brain regions associated with spatial reasoning (Figure 2 below).

Figure 2. A) Street map of London. What a mess! B) Results before and after subjects studied for their test of London streets. Those that studied hard and qualified (qualified trainees) had an increase in gray matter density in their hippocampi, but those that gave up on the training (non-qualified trainees) or never trained (controls) did not see an increase in gray matter. Panel A is from openstreetmap.org; panel B is modified from Woollett and Maguire 2011.

With math, some people experience the ‘pain’ of doing new, difficult work and conclude that they don't have a gift for math. Unfortunately, parents and teachers may accidentally reinforce this message, saying things like ‘maybe math just isn’t your strength’ or ‘maybe math isn’t for you.’ This might seem like a relief, as it gives you permission to stop trying. But in fact, no one is born good at math. Just like at the gym, by the time you get to college you are all starting at different ‘fitness levels,’ with different previous experiences and skills in math. It might take you longer to see improvement than your classmates, and you might feel like you have to work harder to see the same progress. This might be true! But it’s not a sign that you aren’t meant for math. You’re just starting at a different point along this journey. Eventually the effort will pay off.

**3: When we say we “just aren’t good” at something, we limit our own potential.**

The idea that you can increase your own brainpower through hard work is called a ‘growth mindset.’ Someone with a growth mindset believes they can increase their ability through effort and practice. In contrast, someone with ‘fixed mindset’ believes they are inherently good or bad at certain tasks, and there is little to be done about it.

**Growth and fixed mindsets aren't simply ‘good’ and ‘bad’ attitudes, but instead reflect a person's ideas about how much they can improve.**

A growth mindset is empowering because it reinforces a person's control over their own growth and learning. People with growth mindsets welcome new challenges, and are ok with being wrong. They see challenges as opportunities to grow and get better. Conversely, someone with fixed mindset limits their own potential, because if they believe that no matter how hard they work they won't get any better, they will give up easily and avoid challenging work.

EXPLORATION 5

**What can brain research teach us about you and your ability to learn mathematics?**

1: Expect learning to feel hard, especially at first

2: Your brain will rewire itself to accommodate the increased demands

3: The only way to get better at math is to do more math

EXPLORATION 6

**References**

[**Scholz J, Klein MC, Behrens T, Johansen-Berg H. 2009. Training induces changes in white-matter architecture. Nature Neuroscience 12:1370-1371.**](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2770457/pdf/ukmss-27837.pdf)

[**Woollett K, Maguire EA. 2011. Acquiring ‘the knowledge’ of London's layout drives structural brain changes. Current Biology 21:2109-2114.**](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3268356/)

REVIEW

**Let's Review the Material**

Let’s explore your comprehension of the information presented in this module. This short review presents examples of fixed and growth mindsets that we may encounter in our everyday lives, when we interact with teachers, coaches, and classmates. Can you tell when someone is demonstrating a fixed versus growth mindset?

**Complete the review and see how you do. You can always re-read the module and try again.**

SUMMARY

**Summary of main points**

**1: People are not born with the ability to perform tasks**

**2: Your brain changes as you learn new tasks and as you practice**

**3: When we say we “just aren’t good” at something, we limit our own potential.**

**Steps to Further Your Growth Mindset**

So which mindset is "right"? Scientific research suggests we all have tremendous potential to improve our abilities through practice. Science supports a growth mindset!

But just because everyone has the potential to be good at math, doesn’t mean it will be easy. Learning happens at different speeds for every person, and you may have a lot of catching up to do. Research assures us, however, that with enough practice and patience, you will get there.

The truth is that we are all on a journey, starting out at different points on the mindset spectrum. And interestingly, some people hold fixed mindsets for some activities (e.g., art), and growth mindsets for other activities (e.g., sports). Our goal here is to recognize how our own mindsets can either propel us forward or hold us back.

Here are some steps that you can take to cultivate your growth mindset:

**1: Recognize that this won’t be easy**

It may not be easy or comfortable to change your mindset about learning math. Mindsets are cultivated over the course of our lives by the things that we see, hear, learn, and experience. Mindsets can be deeply rooted and can be difficult and slow (maybe even painful) to change. But with patience, practice, and an awareness of your own fixed-mindset tendencies, you can develop a growth mindset about your own math abilities.

**2: Notice when you are avoiding activities due to fear of poor results**

We all like to feel that we are good at things, so it is natural to seek out activities where we are likely to have success, and avoid those where we are struggling. Start noticing when you are doing this and why. Are you worried about the consequences of getting the wrong answer? Do difficult problems make you feel stupid? These are signs of a fixed mindset. Once you notice that you are avoiding something (for example, studying math) for these reasons, you can make a conscious effort to change your behavior.

**3: Change the way you talk about success and failure**

You may hear and or think fixed mindset statements frequently in everyday life. Start to become aware when this happens. These statements might even come from people you respect, such as your professors. Make an effort to change your own language to support a growth mindset, even if you feel like you’re faking it at first.

**This module was created by** [**Arietta Fleming-Davies**](https://sites.google.com/site/flemingdavies/) **and** [**Jeremy Wojdak**](https://www.radford.edu/content/csat/home/biology/faculty/jeremy-wojdak.html) **as part of** [**BIOMAAP.**](http://biomaap.org)

BIOMAPP (Biology Students Math Attitudes and Anxiety Program) is an initiative supported with funding from the [National Science Foundation.](https://www.nsf.gov) BIOMAAP aims to help undergraduate biology majors improve their attitudes and decrease their anxiety towards mathematics. BIOMAAP is a resource for educators who are looking to implement non-invasive techniques to change student attitudes and reduce anxiety towards math.

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