Believing in the Brain

Marcus Conyers and Donna Wilson

Teaching students about brain plasticity can help them develop a growth mindset.

Around the world on every school day, students arrive in classrooms with their brains powered by some 86 billion neurons. Potentially, a single cubic centimeter of cortex may have as many connections as there are stars in the Milky Way galaxy. Learning changes the structure and function of the brain, and the creation, strengthening, and pruning of neural connections are key to the learning process (National Academies of Sciences, Engineering, and Medicine, 2018). This concept, known as brain plasticity, is foundational to the understanding that intelligence can be developed.

If students are explicitly taught about their brain's capacity to change, their motivation to learn can increase. If they also receive specific instruction on how to use effective learning strategies, there is tremendous potential for students to make steady academic gains. Furthermore, as students make these gains, their growth mindsets (the belief that intelligence is malleable) can be sustained over time.

Helping students develop an understanding of brain plasticity, coupled with cultivating growth mindsets and teaching students to use effective strategies for gaining knowledge and skills, has been the central focus of our work in teacher education and professional development for the past 22 years. One classroom example of our approach comes from a teacher who learned about neuroplasticity in our graduate program and shared her knowledge with her elementary students. She stressed to her students that by working hard and using effective learning strategies, they could enable their brains to make more connections and become functionally smarter.

This helped her students to develop growth mindsets and to be motivated to learn a range of metacognitive and cognitive strategies, resulting in what she called an "explosion of growth" in students' reading abilities. This emphasis is what we term "teaching students to drive their brains." Among the many strategies she used to facilitate this improvement were thinking stems, which encouraged students to indicate what they wondered, inferred, or thought would occur in a particular story they were reading.

Active engagement of thought processes such as these supports learning. The teacher's students wrote down their thoughts in a blog that she had set up to share how her students were responding to learning about brain plasticity and what strategies were working well in her classroom. These posts generated comments from a network of educators around the world. This activity and many others proved to be highly motivational for the students, who made five months' worth of gains in their reading levels over a three-month period (Germuth, 2012; Wilson & Conyers, 2020).

Teachers like this know that teaching about the brain's amazing malleable nature, especially the changes that occur during learning, provides a scientific foundation for the cultivation of growth mindsets. In our new book, *Developing Growth Mindsets* (ASCD, 2020), we discuss a framework that includes seven principles designed to assist educators in continuing to develop their own growth mindset—which hinges on the belief that intellectual abilities are malleable and can be improved (Dweck, 2019)—and in supporting the cultivation of growth mindsets in their students. Here we'll examine one of these principles—"keeping plasticity front of mind"—and offer lesson ideas for teaching students about brain plasticity that will help them develop growth mindsets.

Game-Changing Knowledge

The growth in student achievement that our teacher observed aligns with the most recent study from the Programme for International Student Assessment (PISA), based on a triennial survey of 15-year-old students around the world. In the United States, students who disagreed with the statement, "Your intelligence is something about you that you can't change very much," achieved scores in reading that were, on average, 58 points higher than those who agreed with the statement, after taking schools' and students' socioeconomic profiles into account (OECD, 2019).

A range of other studies across grade levels and from around the world show that students with growth mindsets are more likely to push themselves to learn new things and persist until they achieve their goals. Over time, students who apply this outlook to their learning perform at higher levels than those with fixed mindsets on a variety of outcomes (Dweck, 2019).

We have worked with many teachers, from preK through college, to help them teach students about the malleability of the brain. By emphasizing this concept, educators show students that brain plasticity will equip them to learn almost anything if they are willing to put in the effort and apply effective learning strategies (ASCD, 2018; Wilson & Conyers, 2020). This knowledge can truly be a game-changer since it helps students understand they have the potential to succeed, regardless of past academic performance. Dweck (2019) reported similar findings from studies on interventions used "to teach students how the brain changes with learning and how intellectual abilities can be developed" (p. 21). These studies suggest that a growth mindset could have a significant impact on student achievement and test scores.

Learning at Any Age

The realization that the brain has the capacity to change during learning is important not only for students, but for educators as well. One of our graduates found this revelation to be highly motivating. "One of the most fascinating things [we learned] was [about] brain plasticity—the finding that the brain is pretty elastic even as you get old," she told us. Another classroom teacher similarly saw brain plasticity as an important concept for educators to understand "because educators need to be aware of the fact that everyone has the ability to learn …. Educators and leaders will also benefit as they recognize learning never stops, regardless of an individual's age" (Germuth, 2012, p. 28).

And studies prove that learning never stops. Recent research shows evidence of synaptic development seen in brain scans from diverse subjects such as medical students studying for exams, musicians learning mastery of an instrument, and cab drivers who taught themselves to navigate the streets of London (Draganski et al., 2006; Gaser & Schlaug, 2003; Woollett & Maguire, 2011). This research has identified visible changes in areas of the brain associated with memory, spatial reasoning, and problem solving, thus supporting a conceptualization of intelligence as malleable and dynamic.

Michael Fitzgerald, who teaches at-risk students at Eagle Academy, an alternative high school in Boise, Idaho, helps students understand the power of their amazing brains by drawing a diagram (like that shown in fig. 1) that illustrates how neurons form connections with other neurons in response to new experiences and learning. This helps him drive home the point to students that learning changes their brains and allows them to grow academically—a concept that, he notes, "can be very empowering" since it challenges students to take charge of their own learning. "I tell them there are things in your life you are not in charge of, but you are in charge of you," says Fitzgerald. Over time, he says, his students become more open to taking on challenging academic tasks with the potential for higher achievement fueling their growth mindsets (Wilson & Conyers, 2016).

Figure 1. Neurons Making Connections

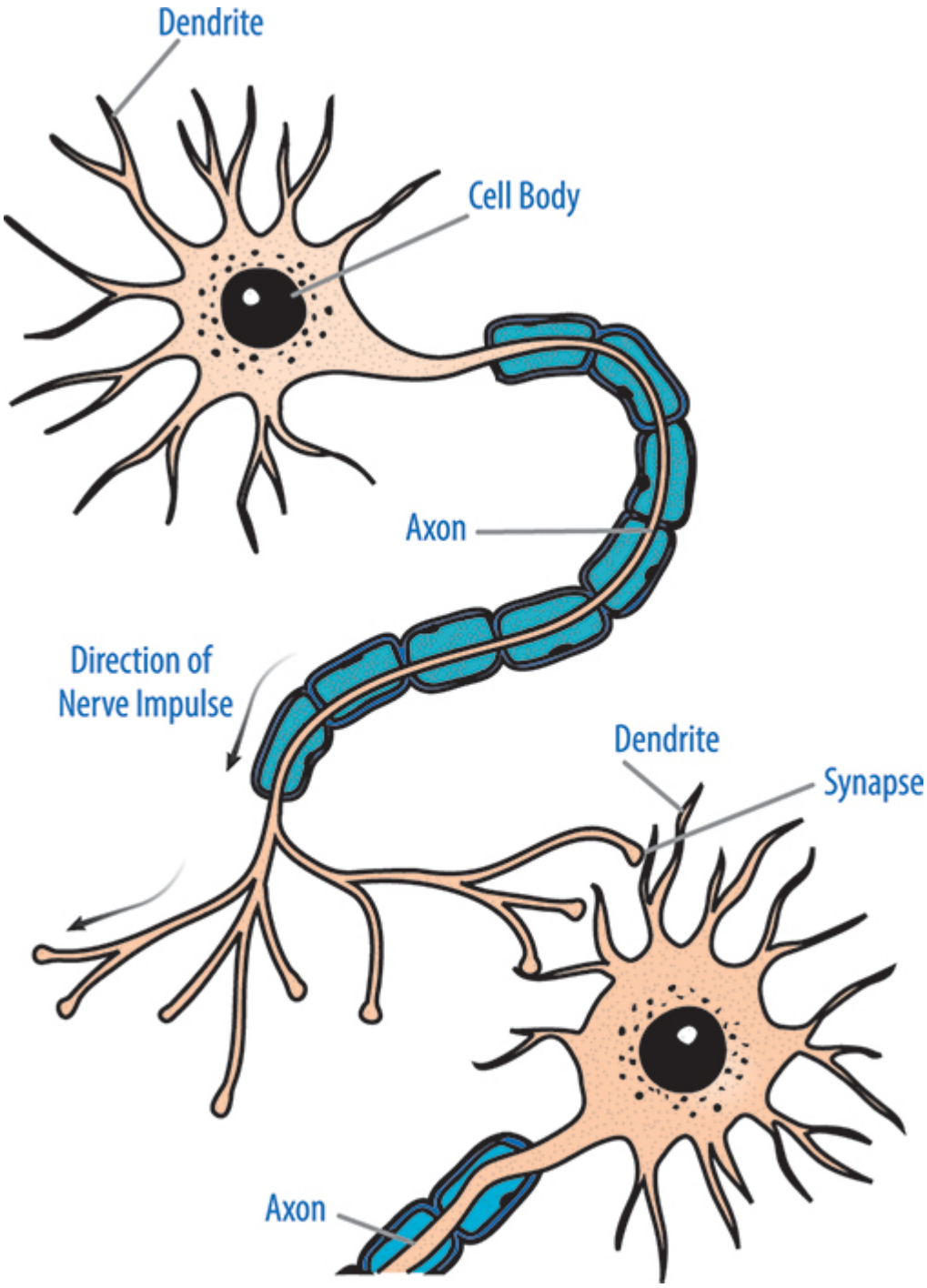

Figure Credit: BrainSMART, Inc.

Another educator we know, a high school teacher and part-time coach who graduated from our program, describes the concept of neuroplasticity to his students on the first day of school. He facilitates a discussion about the connectivity between neurons, describing how the brain can change with experience—like muscles getting stronger with exercise. This teacher tries to convince his students that they can learn more than they think they can, even if they have had learning challenges in the past. To facilitate this, he teaches them to set learning goals, self-test, summarize, and manage their time (Wilson & Conyers, 2020).

Younger children can also benefit from learning about brain plasticity. Texas teacher Diane Dahl teaches her 2nd graders about the brain during the first week of school, describing what *neurons, axons*, and *dendrites* are and how learning creates new connections in the brain (Wilson & Conyers, 2016). She helps students visualize these connections by having them work together to make a model of their "class's brain," using pipe cleaners and sticky notes to represent what they are thinking and learning.

Each student is given three pipe cleaners to twist together to represent axons. Dahl tells them to leave the ends untwisted to represent the dendrites. Students work together to build the class brain structure, connecting all the axons and dendrites (see fig. 2). The structure represents the class's brain at the beginning of the school year. Then, as they learn more and more concepts, the students create and add new axons and dendrites to the brain and label them with what they've learned.

Figure 2. Diane Dahl's Classroom Brain

Second graders in Texas teacher Diane Dahl's class create a model of their class's brain, using pipe cleaners and sticky notes to represent what they are learning. Photo Courtesy of Diane Dahl.

Dahl suspends the "brain" from the ceiling, high enough to be out of the way but low enough for students to interact with it and read the labels. As the year progresses, the

brain model gets more complicated, and whenever possible, Ms. Dahl connects new learning with previous lessons.

A Powerful First Step

As the teachers highlighted in this article know, explicitly teaching brain plasticity is a powerful first step for the development of growth mindsets, but it's not sufficient on its own. It is also important to teach students how to be metacognitive, so that they can set learning goals, monitor their progress, and apply high-yield strategies such as regularly testing themselves on the material they are studying. Furthermore, it is important that teachers use formative assessment to ensure that students are tackling content at an appropriate challenge level, to provide useful feedback, and to give praise for hard work and effective use of strategies rather than for "being smart."

More is known about the human brain and strategies for enhancing the learning process than ever before. By explicitly teaching students about their brain's plasticity and equipping them with effective learning strategies that can lead to higher levels of academic achievement, we can better empower them with the growth mindsets that can set them on a positive trajectory of lifelong learning.

Reflect & Discuss

➛ What insights about the brain did this article give you? How might this impact your practice?

➛ Do you agree that students have more motivation to learn if they know that their brains can grow and change? Why or why not?

➛ How might you incorporate the idea of brain plasticity into your classroom lessons?

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