Building Students’ Confidence, Fulfillment and Achievement Through the Understanding of Expandable Intelligence

GO!

PART III. LESSONS & MATERIAL GUIDE FOR TEACHERS

UNIT 3: BRAIN BUILDING

www.brainology.us
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GET READY!

Unit Goal

Students discover how learning changes the brain through the growth of connections in neural networks with repeated use—the key to the growth mindset. Students learn that intelligence can be developed through mental exercise, and what sorts of activities promote learning.

Key Challenge

Students have difficulty learning, especially in certain subjects, because they don’t put in effective effort and practice over time.

Background: Suggested Teacher Reading


http://www.nais.org/Magazines-Newsletters/ISMagazine/Pages/Brainology.aspx

Unit 3 Takeaways:

- The brain and intelligence are not fixed; they both change when you learn.
- The brain grows more new cells and the cells make new connections when you learn.
- You get smarter by exercising your brain, much the same way that you get stronger by exercising your muscles.
- How can you exercise the brain?
  - You exercise the brain by exploring new information, learning new concepts, and practicing skills.
  - Practice is the key to learning. Only by practicing something over and over again can you ensure that you grow new connections in the area of your brain responsible for learning that thing.
    - The more connections you make, the easier it gets to make new ones.
- Learning actually causes the brain to grow denser (as shown in studies with lab rats) and areas of the brain to grow larger and more active (in studies with people).
- Different environments can influence brain growth; stimulation and active learning are the keys.
- You are never too old to learn and develop your brain!
For the teacher: Hard Work Is Hard!

Let’s face it, working hard can feel unpleasant—particularly when you aren’t sure that it will lead to success. What makes it worthwhile is the belief that you can gain something valuable by doing it. Research shows that students who believe that effort will make them more successful work more persistently and do better in school than students who think that success is something that should come easily. When students have a growth mindset and see their ability as something they can develop, they are more likely to be willing to work hard and want to learn. As a teacher, you can reinforce the importance of effort by giving feedback that lets students know how valuable it is, and by reminding students that when they work hard they are “working out” their brains.

Unit 3: GET SET! Building and Maintaining the Growth Mindset

Providing student feedback:

- If it were easy, you wouldn’t be learning anything.
- When the work is hard, that’s how you know you’re building your brain!
- Every time you practice, you’re making the connections in your brain stronger.
- You’re good at things you like because you put in the effort to learn them.
- You just need to put in more time and thought and you’ll get this.
- If you work as hard at this as you do at (video games, basketball, etc.) you’ll be doing great!
Concrete Strategies:

- **Do repetitions or sets of types of problems over time:** Much like when you exercise in the gym, you can build up your “brain muscles” by practicing a skill repeatedly through multiple problems or tasks. You also build a mental skill more effectively when you vary the task enough to make more connections. Finally, allowing some breaks between practicing a skill conditions your brain as rest breaks between exercise sessions helps build your strength. All of these forms of practice help to build long-lasting connections between neurons.

- **Isolate key skills and practice these:** If you are learning a complicated physical skill, you can practice small parts of the skill by themselves to make your whole performance stronger. For example, in learning to dance or to play ball, you practice one move over and over to perfect it and make it automatic. You can do the same in school by picking one skill that you find difficult by practicing it many times.

Sample Outline of Sessions- Unit 3

**Note:** Because Unit 3 of Brainology contains the key neuroscience content to support a growth Mindset—the fact that the brain changes and grows stronger with learning—we recommend that an additional session be devoted to this unit, allowing for introduction of the concept of Fixed and Growth Mindsets and student reflection on how these mindsets apply to their own lives.

<table>
<thead>
<tr>
<th>Session</th>
<th>Activity</th>
<th>Pages</th>
<th>Approx. Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>“Connect It #1” - Discussion: Your Favorite Thing</td>
<td>7</td>
<td>15-30 min.</td>
</tr>
<tr>
<td></td>
<td><em>Brainology® Online Unit 3</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>“Practice It” – Research on the Brain</td>
<td>10-14</td>
<td>30-45 min.</td>
</tr>
<tr>
<td></td>
<td>“Apply It” Discussion: What Holds Students Back?</td>
<td>16</td>
<td>20-30 min.</td>
</tr>
<tr>
<td>Bridge*</td>
<td>“Check It” Quiz</td>
<td>17-18</td>
<td>10-20 min.</td>
</tr>
<tr>
<td>3</td>
<td>Supplemental Activity: The Two Mindsets</td>
<td>20-22</td>
<td>35-50 min.</td>
</tr>
<tr>
<td>Bridge*</td>
<td>The Two Mindsets Follow-Up Reflection #1</td>
<td>23-25</td>
<td>20-30 min.</td>
</tr>
<tr>
<td>Optional**</td>
<td>Reinforce It”: What Challenges Have I Faced?</td>
<td>15</td>
<td>10-15 min.</td>
</tr>
<tr>
<td></td>
<td>Supplemental Activity: Two Mindsets Reflection #2</td>
<td>26-28</td>
<td>30 min.</td>
</tr>
</tbody>
</table>

*Bridge* activities can be used as exit activities at the end of class, as homework between classes, or as “Do Now” activities at the beginning of the next class.

**Optional** activities can be used as additional activities for students who complete other assignments more quickly, as alternative assignments for differentiation, or to make up an extra session focused on this unit of Brainology.
Unit 3: GO!
Printable Activities and Materials
Unit 3 “Connect It #1”: Discussion/Reflection: Your Favorite Thing

Description: Brainology Unit 3 Connecting Activity

Objective: Students will make connections between their own experience and the content of Brainology Level 3: Brain Building.

Timeline: approximately 15-30 minutes

Instructions:

- Explain to students that the focus today will be on how we learn; they will find out how the brain changes with learning, and how we can build our brains through effort.
- Introduce the discussion topic:
- It seems effortless to perform many of our favorite activities and to learn some of our favorite things: playing games, remembering basketball stats, playing video games, learning new dance moves, writing songs etc. However, the things that seem “easy” to us actually are complex tasks that require lots of work and effort. Have students discuss:
- What is your favorite thing to do? (Don’t limit yourself to school: think of any activity that you love.)
- Recall when you first did this activity. How did you learn how to do it?
- Do you think you’re better at this activity now? If so, how did you get to that point? What did you do to get better?
- Did you have to make mistakes before you got it right? Do you think you were learning from your mistakes too?
Unit 3 “Connect It #2 - Reflection: What Leads to Success?

Description: Brainology Unit 3 Connecting Activity #2

Objective: Students will use existing knowledge to review the growth of neurons, and explain how our emotions and attitudes can affect our learning.

Timeline: approximately 15-30 minutes

Instructions:

- Explain that the class will be using the information they learned in Level 3 to respond to the questions and sentence frames in this Connect It activity.

- Briefly introduce the information about Dweck’s research on successful people, as follows: Dr. Carol Dweck is a psychologist who is fascinated with why some people are successful and why some fail. Here is what she discovered after decades of research:

  - When people believe they failed because they are not smart, they stop trying to learn—and continue to fail.
  - When people believe that they failed because of not working hard enough, they work harder and learn—and eventually become successful.

- Ask students if they have found this to be true in their own lives. Do they try harder and practice more if they think that effort and practice will make them successful?

- Ask students to complete the sentence frames.
Dr. Carol Dweck is a psychologist who is fascinated with why some people are successful and why some fail. Here is what she discovered after decades of research:

- ✓ When people believe they failed because they are not smart, they stop trying to learn.
- ✓ When people believe that they failed because of not working hard enough, they work harder and learn.

How does a person’s attitude affect his/her success?

Fill in the sentences below to show how our new learning about neurons supports Dr. Dweck’s research findings about successful people!

When I am learning something, my practice and my studying grow _________________.

Dendrites stretch, lengthen, and grow until _________________. The more I grow dendrites, the more _________________.

It can be very hard to learn when _________________,

because _________________.

If I work hard, _________________.

I think that a person’s attitude...
Unit 3 “Practice It”- Research on the Brain

Description: Research briefs on the brain

Timeline: approximately 30-45 minutes

Instructions:

- Explain to students that today they will be reading research “briefs” (short summaries of months or years of research) and using the information to complete an assignment.
- You can select one of 2 activities for the class:

Option 1:

- Place students in pairs or small groups. Each will read one brief, and will then be responsible for teaching the class about the research brief they read through creating an illustration and oral presentation.
- Everyone reads “Babies Brains” – Think-aloud your understanding of this research brief as a model for your class. It might sound like this: “So, after reading this research brief, I understand that as people grow up, their neurons grow and strengthen. Babies’ neurons are not as developed because they have not practiced much yet. The more a person learns and practices, the denser our brains get.”

- Model creating a picture (non-linguistic) representation for “Babies Brains.”

It might looks something like this:

![A newborn's neurons](A newborn's neurons)
![A teenager's neurons](A teenager's neurons)
![An adult's neurons](An adult's neurons)

- Assign each team one of the briefs. Differentiate for your class based upon their reading fluency. Some passages are longer than others; some require some knowledge of the world (for example the one about cabbies requires that students understand that different cities are laid out in different ways). You will have several teams doing the same research brief. This is desirable, as they will come up with different pictures which will deepen all the students’ understanding of each research brief.
• Ask students to read the briefs together, and draw a picture or series of pictures representing their own research brief.
• Teams share out with the class. Take this opportunity to hold students accountable for their public speaking standards practice.

**Option 2:**

• Students work individually, in pairs, or in small groups to read all of the briefs. (If working in small groups, students may split up the reading responsibilities.)
• Students then complete the research exercise on pp. 13-14. For each statement, explain whether it is true or false based on the research that you have read about, and why.
• Model how to think through the first example for the class.
• If desired, students may complete part of the assignment as homework.
• Share responses by calling on teams to answer questions, or by taking a poll of the class on whether each statement is true or false and then asking students to defend their choice.
BRAIN GROWTH RESEARCH

Here are some different research studies that all showed how learning changes the brain.

**Babies’ Brains:** Newborn babies have lots of brain cells (called neurons), but the neurons have very few connections between them. In their first few years, babies’ brains develop many new connections, or synapses, between their neurons. By the time they are one year old, toddlers have about 1,000 trillion connections. Then the brain starts to get picky: the connections that are being used the most get stronger, and the ones that are not being used disappear. The connections between cells continue to change throughout life with learning—in other words, we “use it or lose it.”

**Clever Cabbies:** London cab drivers have to memorize the locations of many different places, because their streets don’t have numbers. They have to keep a “map” of the city in their heads to find their way around. Researchers measured the size of the hippocampus—the area of the brain that remembers information about places—in London cabdrivers, and compared them to other people’s. The hippocampus of the average cabbie was bigger, and the longer the cabbie had been on the job, the larger it was. This shows that learning and practicing this skill made that area of their brains grow.

**Learning Languages:** Most people think that learning a second language once you are an adult is very hard. But researchers had adults use special exercises to practice hearing different sounds from foreign languages. Using a PET scan to measure the activity in the brain, the researchers found that when people did the special exercises, areas of their brain that they had never used before became active, and they improved their ability to understand the new language. This shows that you can retrain your brain and develop new abilities all through your life if you put in effort and use good strategies.

**Musical Mastery:** When people play an instrument, they use a special area of the brain in the “motor cortex” to control the movement of their fingers. Researchers found that when people practiced playing musical instruments, the area of their brains that controlled the fingers grew larger! This shows that when you learn and practice a new skill, you can build up the brain.

**New Neurons:** Scientists used to think that we had a fixed amount of brain cells and that we could never grow new ones. But in the past 20 years, research has shown that the brain actually grows new cells every day. The cells are grown in the hippocampus, an area of the brain that is important for memory, and they travel to other areas of the brain. They also found that the brain grows more new cells when you are learning new information and skills. So, by learning and practicing, you actually add new brain cells as well as new connections.

**Remarkable Rats:** Identical rats were raised in two different environments: either a bare cage with food in water, or a cage with lots of toys and exercise equipment to explore. In the bare cages, the “cage potato rats” just ate and drank and lay around, while in the cages full of things to do, the “summer camp rats” were busy exploring and learning, exercising their brains. It turned out that the summer camp rats became smarter than the cage potato rats—they were better at learning new things. Their brains were heavier, too: they had more connections between the neurons. This research shows that mental exercise builds up your brain and makes it smarter. Even old rats got smarter, proving that you’re never too old to grow your brain!
Brainology Unit 3 Brain Behavior: “Practice It”

Name: ________________________________

Brainology™ Research Exercise - Unit 3: Brain Building: Be a Brain Scientist!
Part I. For each of the following four statements, say whether you think the statement is true or false. Then write the name of at least one research study from your handout that supports your opinion, and explain why.

Here is an example showing how you might answer a question:

Statement: The brain doesn’t change when we learn.

A: True or False? How do you know?
1) Clever Cabbies shows that when people learn about places and practice how to get around the city, their hippocampus gets bigger. The hippocampus is important for memory. 2) Musical Mastery showed that when people learned to play an ___ instrument the part of the brain that controls their finger movements got bigger.

1) Statement: When we are born our brains don’t have very many connections, but every time we learn something, we grow lots of new ones.

A: True or False? How do you know?

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

2) Statement: When we are born we have a set amount of brain cells and then as they die off, we lose mental ability.

A: True or False? How do you know?

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
Brainology Unit 3 Brain Behavior: “Practice It”

Name: ____________________________________________

3) Statement:  When you exercise your brain by learning and practicing new skills you can actually get smarter.

A: True or False? How do you know?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

4) Statement:  People can keep learning and developing their brains all through their lives.

A: True or False? How do you know?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Part II. Name three things that you could do to get smarter in school.
1) ____________________________________________
2) ____________________________________________
3) ____________________________________________

What would happen in your brain if you did all these things?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
Brainology Unit 3 Brain Behavior: “Reinforce It”

Reflection: What challenges have I faced?
Give Yourself a Brain Scan!

What did I find challenging in school this week?

Did I put in my full effort to overcome the challenge?

Tips for success:

- Picture the nerve cells in your brain growing as you put in effort and practice.
- If you get discouraged, think about how much smarter you are now than you were two years ago.
- Remember how much practice you put in on things that you like, and try as hard on this!
Unit 3 “Apply It” - Discussion/Reflection: What Holds Students Back?

Description: Brainology Unit 3 Apply It Activity

Objective: Students will apply what they have learned in Brainology Level 3: Brain Building to real school situations.

Timeline: approximately 20 minutes

Instructions:

- Explain to students that the focus today will be obstacles to learning; they will reflect on how the information they have learned in Level 3 applies to situations in school.

- Introduce the discussion topic:
  
  You may have heard other kids or adults make negative comments about someone’s ability—even calling them names, such as “stupid” or “dummy.” Sometimes people even put negative labels on themselves, or get so worried that someone else might put a negative label on them, that they are afraid to try to learn something new, or to practice something they’re not good at yet—so they don’t put in effort. This is called **self-handicapping**: it means that you set yourself up to fail.

- Have you ever heard people make negative remarks like this in school?

- How does that make people feel? Does it make them try harder, or give up?

- Have you ever set yourself up to fail by not putting in effort?

- Based on what you learned in Brainology, what happens when you give up, or don’t put in effort on something?

- What are messages like that doing to us?

- What is a better strategy to succeed? (Hint: think about what you did to succeed at your “favorite thing.”)
Unit 3 “Check It”:

[Teacher’s KEY]

Brainology Checkup – Unit 3

1. What happens to the brain when you learn something new?
   a. Your brain neurons (dendrites) grow and make new and stronger connections with other cells; your brain grows denser.

2. The study of summer camp rats and couch potato rats showed that:
   a. When a person or animal practices, plays and interacts with information, the brain grows denser and intelligence is increased.

3. When they studied the brains of cab drivers in London they found that:
   a. The hippocampus of the cabbies was stronger and larger than the hippocampus of regular people, because they had learned more.

4. When they studied adults practicing the sounds of new language they found that:
   a. A PET scan showed that an area of the brain they had never used before became active.

✓ You grow new neurons when you are learning a lot of new things.
✓ Babies have more connections in their brains than grownups.
✓ If you learn too much, you will use up all of your neurons.
✓ A good way to make brain connections strong is to practice.

T  F  F  T
What happens to the brain when you learn something new?

The study of summer camp rats and couch potato rats showed that:

When they studied the brains of cab drivers in London they found that:

When they studied adults practicing the sounds of new language they found that:

True or False?

✓ You grow new neurons when you are learning a lot of new things.
✓ Babies have more connections in their brains than grownups.
✓ If you learn too much, you will use up all of your neurons.
✓ A good way to make brain connections strong is to practice.
Unit 3: Supplemental Printable Activities and Materials
Supplemental Activity #1 – The Two Mindsets

Description: The Two Mindsets Initial lesson (Introduces the two Mindsets)

Timeline: approximately 35-50 minutes

Instructions:

- Tell the class, “Today I have something to show you that is a graphic organizer. This graphic organizer’s purpose is to help us understand an important concept about people and what makes them successful. Would you like to learn about how to become successful at something that you want to master?”

- Complete the reflection as a model for your students. Show them how you struggled with something that you had to figure out how to overcome. Model that you did not have all the answers easily.

- Ask students to complete the reflection for something they want to succeed in doing well.

- Present the Nigel Holmes graphic on the two Mindsets. Explain that this came from years of research showing that people can choose to respond in one of two ways whenever they have a challenge (whether that challenge is large or small). Ask them to think about the reflection they just wrote as the class reviews the two Mindsets.

- Begin with the Fixed Mindset. Review and have students help to read each part to the class. Next go over the Growth Mindset.

- Ask the class to think about their reflection. Are they approaching their challenge in the Growth or the Fixed Mindset? Ask them to explain, using language from the graphic organizer.
Brainology® Curriculum Guide for Teachers: Unit 3

Unit 3: Brain Building

**Fixed Mind-set**
- Intelligence is static
- Leads to a desire to look smart and therefore a tendency to...
  - ...avoid challenges

**Growth Mind-set**
- Intelligence can be developed
- Leads to a desire to learn and therefore a tendency to...
  - ...embrace challenges

**CHALLENGES**
  - ...give up easily
  - ...fail

**OBSTACLES**
  - ...avoid obstacles
  - ...give up easily

**EFFORT**
  - ...see effort as fruitless or worse
  - ...see effort as the path to mastery

**CRITICISM**
  - ...ignore useful negative feedback
  - ...learn from criticism

**SUCCESS OF OTHERS**
  - ...feel threatened by the success of others
  - ...find lessons and inspiration in the success of others

As a result, they **may plateau early and achieve less than their full potential.**

All this confirms a **deterministic view of the world.**

As a result, they **reach ever-higher levels of achievement.**

All this gives them a **greater sense of free will.**

**GRAPHIC BY NIGEL HOLMES**
The Two Mindsets

Name: ____________________________ Class: __________________________

Write about a challenge you have. It may be a relationship with a friend or family member, a class or subject, or a sport or art form. What is one area where you are not feeling successful, but you would like to be successful?

Now explain what steps you have taken to overcome this challenge. Have those steps worked? Why?
If they haven’t, why do you think they haven’t?
The Two Mindsets Follow-up Activity #1 – Reflection

Description: The Two Mindsets Follow-Up Activity #1 - Reflection
Timeline: 2-300 minutes
Instructions:

- Explain to the class that today they will be reflecting on an event in their lives when they were met with a challenge and failed. The reflection should be about something they wanted to do well.

- Model this exercise for them, using something from your life.

- Ask students to briefly write about the event in the box provided.

- After they have written, model completing the boxes on the next page for your own experience. Did you (the teacher) respond in the growth mindset or the fixed mindset for each of those categories?

- Ask students to do the same for their own experience individually.

- Finally, ask students to write to the reflective question on the second page. Here again, a model from the teacher will greatly increase the quality of responses you receive. In your model, explain how a growth-minded response would have enhanced your learning and contributed to your development. Do not focus on a desire to have avoided failure, but rather model the ability to learn constructively from failure.
The Two Mindsets: Supplemental Activity Follow Up #1 - Reflection

Name: ______________________________  Class: __________________

For this activity, consider the graphic about the two Mindsets by Nigel Holmes. Think about a time when you failed at something that was very important to you. Maybe it was a “try-out” for a team, a big test, a sports game, a performance, or a project.

Briefly describe the event:

For each of the categories below, check the appropriate box. In the above situation, how did you respond? Then finish the statement on the right.

<table>
<thead>
<tr>
<th>In the situation above I…</th>
<th>I know this because…</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided challenges</td>
<td>Embraced challenges</td>
</tr>
<tr>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Gave up easily</td>
<td>Persisted with setbacks</td>
</tr>
<tr>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Put in little effort</td>
<td>Put in my full effort</td>
</tr>
<tr>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Ignored feedback</td>
<td>Learned from criticism</td>
</tr>
<tr>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Felt threatened by the success of others</td>
<td>Found inspiration in another’s success</td>
</tr>
<tr>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>
The Two Mindsets: Supplemental Activity Follow Up #1 continued (p.2)

Reflection Question:

In the situation you described on the previous page, what could you have done differently to get a better outcome? Refer to the column describing growth-minded behaviors for inspiration.
**Additional Activity #2 (Optional)**

**Description:** The Two Mindsets: Supplemental Activity Follow Up #2

**Timeline:** approximately 30 minutes

**Instructions:**

- Explain to the class that today you will reflect more on the two mindsets and how we can hold both mindsets at the same time. We are not necessarily completely “fixed” or “growth” in mindset. We make choices constantly – some that are influenced by a fixed mindset and some that are influenced by a growth mindset.
- It boils down to our beliefs about our ability in that area.
- Ask students to read each of the scenarios below and respond honestly. There are NO correct or incorrect answers, only honest responses. Ask them to answer only 1-4.
- If you choose to apply points for this activity, make it clear that the score will be based only on their completeness in answering the questions.
- Ask them to put their pencils down when they finish and not to go on.
- When class is finished, revisit the Nigel Holmes graphic on the two mindsets. Briefly review the fixed vs. growth mindsets.
- Ask students to take a look at the last question on the back of the paper and to review their responses to each of the scenarios, thinking about which mindset they see in their answers. Was there an emphasis on one Mindset? Did it depend on the question? How could they take a scenario where they answered with a fixed mindset, and turn their answer it into a growth mindset one?
Mindset Reflection

Pretend that you are in each of the four scenarios below. Explain what you would do, feel, and/or say.

1. An adult (like a parent or teacher) gives you critical feedback about how you performed (for example, on a test, in a game, at a family event, etc.) What is your reaction?

2. You have a friend who is more skilled at soccer than you. You are both on the same team; s/he gets more playing time, and you feel s/he gets more attention from the coach. How do you react?

3. You made a big mistake on the English essay and wrote to the wrong topic. Your paper came back with an Incomplete and a zero at the top. What do you do?

4. You are selecting classes to begin High School. You may choose Honors/advanced English, or regular English. Both qualify you for college. Which do you choose? Why?
Review your answers to the four (4) questions on the previous page. Which Mindset (growth or fixed) did you use in those situations? Did it depend on the question? If so, what do you think makes you hold a fixed mindset in one area and a growth mindset in another?

Pick one scenario where you used Fixed Mindset thinking, and explain how you could respond differently using a Growth Mindset.