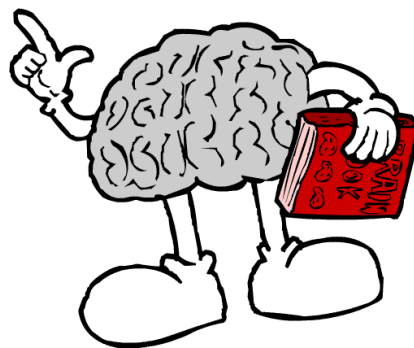




*Building Students' Confidence, Fulfillment and Achievement
Through the Understanding of Expandable Intelligence*



CURRICULUM GUIDE FOR PARENTS

www.brainology.us

What is this Curriculum Guide for Parents for?

This Curriculum Guide for Parents includes an introduction to the Brainology™ curriculum, an outline of the goals, lessons, common challenges and at-home reinforcement strategies for each unit and an overview of the research behind Brainology™. It is our belief that all of us can gain knowledge and forge positive relationships over the course of this program that will yield benefits for years to come.

The Separate User Guide

You should also review the User Guide, which has instructions on how to enroll your children in the program and it has a quick visual guide to using the program. You can find the User Guide, along with other curricula that comes with Brainology™, in the [My Resources](#) section of our website, specifically at <http://www.brainology.us/websitemedia/userguide.pdf>.

Other Resources

Please do visit the [My Resources](#) section of our website. You will find there other worksheets and key lesson summaries to use in between sessions and after completing the Brainology™ program. It is important to reinforce the Brainology™ material in the everyday life of the children so that they incorporate the lessons into their thinking and behavior. Those materials in the [My Resources](#) section, as well as the content in this Curriculum Guide for Parents, will help you to support your children's growth mindset development.

Customer Support & Feedback

If you have any questions or run into any issue please contact us anytime at support@brainology.us. We also always welcome your questions, comments and ideas on what we can do to better serve you at feedback@brainology.us.

We look forward to serving you and hope that Brainology™ is very helpful to you and your children.

BRAINOLGY™ CURRICULUM OVERVIEW

The goal of the Brainology™ curriculum is to help children develop a growth mindset. Children with a growth mindset think of their intelligence as something that they can develop through learning and study rather than as something fixed. Cultivating a growth mindset can help increase a child's sense of self-efficacy and motivation to learn.

We help children develop a growth mindset by teaching them how the brain functions, learns and remembers, and how it changes physically when we exercise it through study and learning. In addition, we provide a practical set of skills for tackling academic challenges by showing them how to apply this knowledge to their schoolwork.

Brainology™ is designed as a challenge-based, interactive multimedia instructional program. In an introduction plus four ~30 minute units, children follow animated teenaged characters Chris and Dahlia as they tackle various problems in their most difficult subjects. They visit the lab of eccentric brain scientist Dr. Cerebrus and learn about the basic structure and function of the brain: how thinking occurs, how learning and memory work, how to develop and change the brain, and how to improve their study habits and skills in light of this knowledge. They gain experience in visualizing and applying these ideas through interactive activities and exercises. Throughout the program they reflect on their challenges and their learning through an E-Journal. The goal is for them to understand that they have great, untapped potential and that the development of their mental ability is largely within their own control, and to provide them with study habits and skills that will help them take action.

Through this Curriculum Guide for Parents we hope to help you support your children by providing information and strategies that you can use to reinforce their growth mindset development.

GUIDING YOUR CHILD TO THE GROWTH MINDSET

It is important that the adults around the child are well versed on and embrace the growth mindset. They need to be able to guide their children in their everyday life, and model the behavior that the growth mindset advocates.

Of particular relevance to parents is the topic of praise, which we briefly discuss below. If you would like a more in-depth discussion of this and other growth mindset topics, we highly recommend our co-founder Carol Dweck's book *Mindset: The New Psychology of Success*. Additional resources are listed at the end of this section.

The Mindsets

Dr. Carol Dweck's research shows that someone's mindset profoundly affects the way this person leads his or her life. It determines behavior which has significant consequences.

- **Fixed Mindset:** The belief that one or more of your basic qualities are set in stone. This mindset creates an urgency to prove yourself over and over by undertaking efforts with low risk and high probability of success. Students with a fixed mindset will frequently lose interest in a subject when it becomes difficult.
- **Growth Mindset:** The belief that your basic qualities can be cultivated through your own effort and that we don't know the upper bounds of what anyone can accomplish with years of passion, toil and training.

The Danger of Praise

No parent thinks "I wonder what I can do today to undermine my children, subvert their effort, turn them off learning, and limit their achievement." Of course not. They think "I would do anything, give anything, to make my children successful." Yet many of the things they do boomerang. Their helpful judgments, their lessons, their motivating techniques often send the wrong message.

In fact, every word and action sends a message. It tells children – or students or athletes – how to think about themselves. It can be a fixed mindset message that says: “You have permanent traits and I’m judging them.” Or it can be a growth mindset message that says: “You are a developing person and I am interested in your development”...

Messages About Success

Listen for the messages in the following examples:

- “You learned that so quickly! You’re so smart!”
- “Look at that drawing. Martha, is he the next Picasso or what?”
- “You’re so brilliant, you got an A without even studying!”

If you’re like most parents, you hear these as supportive, esteem-boosting messages. But listen more closely. See if you can hear other messages, the ones that children hear:

- “If I don’t learn something quickly, I’m not smart.”
- “I shouldn’t try drawing anything hard or they’ll see I’m no Picasso.”
- “I’d better quit studying or they won’t think I’m brilliant.”

Messages About Failure

Nine-year-old Elizabeth was on her way to her first gymnastics meet. Lanky, flexible, and energetic, she was just right for gymnastics, and she loved it. Of course, she was a little nervous about competing, but she was good at gymnastics and felt confident of doing well. She had even thought about the perfect place in her room to hang the ribbon she would win.

In the first event, the floor exercises, Elizabeth went first. Although she did a nice job, the scoring changed after the first few girls and she lost. Elizabeth also did well in the other events, but not well enough to win. By the end of the evening, she had received no ribbons and was devastated.

What would you do if you were Elizabeth’s parents?

1. Tell Elizabeth you thought she was the best.

2. Tell her she was robbed of a ribbon that was rightfully hers.
3. Reassure her that gymnastics is not that important
4. Tell her she has the ability and will surely win next time.
5. Tell her she didn't deserve to win.

There is a strong message in our society about how to boost children's self-esteem, and a main part of that message is: protect them from failure! While this may help with the immediate problem of a child's disappointment, it can be harmful in the long run. Why?

Let's look at the five possible reactions from a mindset point of view and listen to the messages:

- The first (you thought she was the best) is basically insincere. She was not the best – you know it, and she does too. This offers her no recipe for how to recover or how to improve.
- The second (she was robbed) places blame on others, when in fact the problem was mostly with her performance, not the judges. Do you want her to grow up blaming others for her deficiencies?
- The third (reassure her that gymnastics doesn't really matter) teaches her to devalue something if she doesn't do well in it right away. Is this really the message you want to send?
- The fourth (she has the ability) may be the most dangerous message of all. Does ability automatically take you where you want to go? If Elizabeth didn't win this meet, why should she win the next one?
- The last option (tell her she didn't deserve to win) seems hardhearted under the circumstances. And of course you wouldn't say it quite that way. But that's pretty much what her growth-minded father told her.

Healthy Praise

After seven experiments with hundreds of children, we have clear findings that praising children's intelligence lessens their motivation and harms their performance. Instead of praising talent and intelligence, focus on your child's effort and behavior. For example: rather than saying, "You are very smart for getting an A in math", you can say "You must have tried very hard to get an A in math". This puts the praise on the effort and the behavior rather than on the outcome, the A in math. Upon failure, you could say "I know how you feel. It's disappointing to have your hopes up and to perform your best but not make the squad, but it happens to everybody and we must take it as a learning experience. If this is something that you really want, then it's something you'll really have to work for, as with everything else in life. We can try different approaches and learn from them to find the way to success." This approach allows you to console and empathize with your child. It also gives your child the opportunity to grow from her failure and teaches her that through hard work and effort she can undertake lifelong learning and self-improvement.

Additional Resources

For additional resources on these topics you may want to read:

- Dr. Carol Dweck's book *Mindset: The New Psychology of Success*, which includes a chapter on Parents, Teachers and Coaches. The book's website is <http://www.mindsetonline.com/>
- A summary of the research that led to Brainology™: http://www.brainology.us/websitemedia/info/brainology_intro_pres.pdf
- How Not to Talk to Your Kids: The inverse power of praise, New York Magazine cover article, Feb. 17 2007: <http://nymag.com/news/features/27840/>
- The Secret to Raising Smart Kids, Scientific American, Dec. 2007: <http://www.sciam.com/article.cfm?id=the-secret-to-raising-smart-kids>

UNIT 1: BRAIN BASICS

Unit Goal

Children learn the basics of brain structure and function, particularly what is required to maintain readiness to learn and how attention and concentration are supported. This unit prepares children both for higher-level understanding of thinking and learning processes that underlie a growth mindset, and for more advanced study strategies.

Key Challenge Children have difficulty concentrating on school work.

Main Information from Unit 1

- The brain needs certain things in order to function well. Some examples are sleep, and foods like eggs, nuts and fish that contain important chemicals.
- The brain is the body's control center: it gets information from all your senses, and is in charge of all of the body's voluntary and involuntary movement.
- Different areas of the brain take in information from different senses and do different things.
- Your senses serve as different "pathways" to the brain: using more than one sense to learn about something lets you use more of your brain and aids learning and memory.
- Using different *complementary modes* of learning one thing can help focus your attention and increase learning. For example, seeing a picture while hearing an explanation is a very effective way to learn.
- In contrast, getting information about different *competing things* through different senses can interfere with learning. For example, playing a CD and watching a cartoon while trying to read may distract you and reduce your learning capacity.
- In other words, we can ask ourselves: are my different senses pulling me in the same direction, or in all different directions?
- Active learning approaches are best, because they help to keep your attention *focused on* the subject, and increase *understanding of* the subject.

What promotes self-efficacy?

Self-efficacy is the feeling that you have the power to achieve or do something through your own efforts. Young people usually do not feel in control—of their environment, of the things they must learn, of the standards they must meet, of their success or achievement level. By helping children understand how to use their brains in a more effective way, you can help your child to feel more in control of themselves and of what they can achieve.

Discussion Activities

These discussion activities are ideas to get you started, and ways to reinforce the concepts that your child is learning. Discussions should take place after each interactive lesson, or during other time throughout the week. Or, you may ask your child to write about these questions and then share their responses.

All of Your Brain!

Why do you think it is easier to learn things you are interested in than things you find boring? What do you do differently when you are learning about something you like?

Possible responses include:

- I pay attention!
- I take an active approach, practicing and getting involved.
- I keep working at it even when it is hard.
- I think about it even when you are not doing it.
- I share it with others.
- I stay focused on the task.
- I use my whole brain!

How could you use these strategies in your studies? How could you use more senses, and more of your brain, in your coursework? Possible responses include:

- I could discuss the information with others.
- I could draw myself a diagram.
- I could repeat aloud the information to myself.

Reinforcement Strategies

Child Feedback:

Use opportunities at home to praise your child for using all the different parts of their brains through varied learning strategies. Some examples include:

- Drawing a diagram to help you see your work is a great problem-solving strategy!
- Good job explaining the problem aloud; it really helps to talk things out!

Concrete Strategies:

The use of different learning strategies can also be facilitated while learning different subjects. Some examples include:

- After reading part of a math text book, or a math problem, ask your child to rephrase the main ideas of the text, or explain the main points of the problem to you.
- Children can design their own cartoon strips to rephrase key parts of a lesson, re-tell a story problem or sequence problem-solving steps.
- Children can use other senses and abilities when they work in small groups to cooperatively solve problems.

Give Yourself a Brain Scan:

Remind your child that they need to think about whether they have given their brains everything they need to learn well. Suggest that they be their own brain scientist and use a checklist to make sure they are giving their brains all the help they need:

- Have you eaten a good breakfast/lunch today?
- Did you get enough sleep last night?
- Did you keep your attention on this when you were trying to learn it?
- Were there other distractions in your environment when you were trying to learn?
- Did you use more than one sense to learn this material?
- Did you find an active way to practice this material?

By helping your child understand how their brain works and how they can help it to work better, you are laying the groundwork for them to develop a sense of self-mastery and a growth mindset!

UNIT 2: BRAIN BEHAVIOR

Unit Goal

Children learn that the brain functions by sending chemical messages through a network of nerve cells, and that these cells are responsible for thought. This insight provides a foundation for understanding how learning changes the brain—the growth mindset. They also learn how emotions can influence the brain and are taught strategies for managing their negative emotions and enhancing the positive ones.

Key Challenge

Children whose learning and performance are hampered by test anxiety and other negative emotions need to learn to manage their anxiety with a little knowledge about how the brain works.

Main Information from Unit 2

- The brain is made up of nerve cells, called **neurons**, in a network of over 1 trillion connections.
- Neurons communicate with each other through these connections, using chemicals called neurotransmitters.
- The branching parts, called dendrites, receive messages, and the long part, called the axon, transmits a signal through the neuron.
- Thinking is influenced by the emotions, especially anxiety.
- When facing any type of threat, the brain sets off a fight-or-flight response that causes physical signs of anxiety, which interfere with thinking.
- Many students have performance anxiety—stress related to taking tests, giving presentations, or other performance-oriented situations—that can interfere with performance even when they know the material.
- You can lower your anxiety level by being prepared, thinking positively, and calming your breathing.

What makes children want to learn?

When children are focused on learning as a goal, they are more likely to stick with difficult things, to seek help when they need it, and to work hard even when they don't have to. But, because many children are worried about performing poorly in the very areas where they most need to learn, they may be too afraid of “looking dumb” to risk trying to learn. Anxiety is often a product of a fixed mindset, in which every performance is high-stakes. We can help to focus children on a learning goal by letting them know that learning usually involves making mistakes, showing one's lack of skill and not doing as well as others who are more expert. Children often feel that only top performers are successful and admired by others. Focusing on a child's growth and progress, rather than on their performance relative to others, can decrease their fear of “looking dumb.” Remind your child that everyone blunders when they are learning something. Let your child know that mistakes are not only okay, they can be useful feedback in the learning process. Praise your child for their effort and progress, and don't overemphasize perfect performance.

Discussion Activities

Meeting the Challenge

Michael Jordan did not make his high school basketball team. Helen Keller was mistaken for mentally disabled early in life. Albert Einstein failed classes in grammar school. Yet they all went on to achieve great things in their fields of expertise and in their lives.

- What do you think they did to overcome these challenges and achieve their goals?
- Is there a high-pressure situation in your students' lives where they overcame a challenge? In this situation, what did they do to achieve their goals?
- Consider the strategies that Dr. C. shares with Chris and Dahlia. Have your child discuss how these strategies have worked for them in the past or could work for them in the future.

- Often people are judged based not on their ability to learn but rather on unusual beliefs they hold or because of a prejudice, such as “Girls can’t do math.” Women such as Mae Jemison, the first African American woman in space, faced such prejudice. And Jill Cornell Tarter, the first woman to head SETI, a group that uses technology and science to search for life on other planets, struggled because of her unusual beliefs. How do you suppose these women used Dr. C’s strategies to stay focused and meet their goals?

Reinforcement Strategies

Child Feedback:

Encourage your child to use new strategies and not be discouraged by difficulties they are having by praising their process. Making mistakes is an important part of learning. Reminding your child that math is tough, especially when it is a brand new skill will help them stay persistent. Knowing that other people struggle, too, helps children overcome their frustration with difficult new applications.

For example,

- If you could already do it perfectly, you wouldn’t be learning anything.
- I don’t know anyone who hasn’t struggled with this kind of word problem, until they learn how to do it.
- Your skills have really improved in this subject!
- You can use this mistake. Think about why it didn’t work, and learn from it.
- Don’t worry about getting it wrong—I just want you to understand how to do it.
- You know, if you learn how to do this type of problem it will really help you with _____ (e.g. mention some way that a math skill might be applicable in your child’s life, for example keeping track of sports scores, comparing two items to see which is a better value for purchase, etc.)

Give Yourself a Brain Scan!

Children often have performance anxiety, particularly when it comes to test-taking, giving presentations, or discussing their questions and problems with the class. This anxiety can interfere with learning and performance much more often than we may recognize. To deal with anxiety about performance, address stress directly to show that it is perfectly normal to feel anxious when being tested or performing new skills. Suggest that your child tries the following strategies to manage anxiety:

- Change thoughts and preconceptions about test taking from negative to positive—instead of saying, “I’m going to fail,” say, “I’m going to do my best.” Set positive and realistic goals.
- Focus on the **PROCESS**, not the **OUTCOME**. A learning or test-taking strategy (process) that includes studying as well as ways to relax before and during a test, if your child begins to panic, will ultimately yield a better test score (outcome) without placing emphasis on the score alone.
- Square breathing can really help your child if they start to panic during a test, or any other time they feel overcome with anxiety. Use a moment of square breathing to relax your mind during a test—taking time out can help you finish what you need to do and feel good about it, too.

UNIT 3: BRAIN BUILDING

Unit Goal

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

Key Challenge

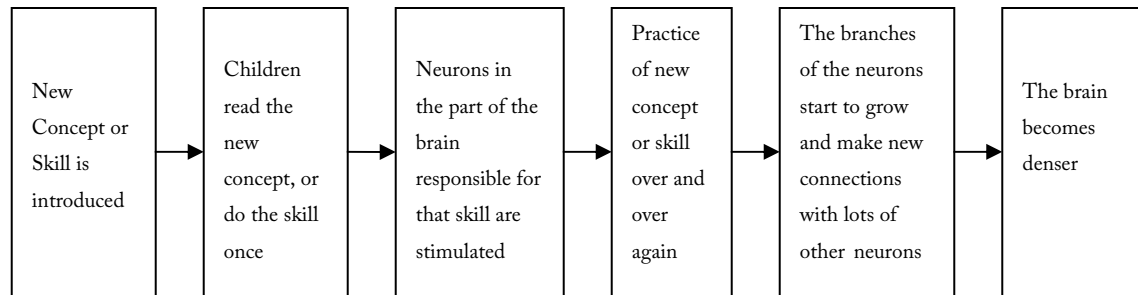
Children have difficulty learning, especially in certain subjects, because they don't put in enough effort.

Main Information from Unit 3

- 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 grow new connections in that 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 more dense (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--active learning is the key.
- You are never too old to learn and develop your brain!

Additional Information for Parents

This is the model of strengthening the brain and building intelligence that is introduced in this unit:



Unintelligence → (Learning is Occurring; Student is Becoming Smarter) → Intelligence

Discussion Activities

These discussion activities are ideas to get you started, and ways to reinforce the concepts that your child is learning. Discussions can take place after each interactive lesson, or during other time throughout the week.

Remember when we learned about?

It seems “easy” to learn some of our favorite things to do: playing games, remembering basketball stats, playing video games, writing songs etc. The things that seem “easy” to us actually are complex tasks that require lots of work and effort. Have your child discuss:

- What is your favorite thing to do? (Don’t limit yourself to school subjects: 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; how were you able to get better?
- Did you have to mess up lots of times before you got it right? Do you think you were learning from your mistakes too?

What holds children back?

- Do you ever hear other kids call each other “stupid” or “dummy”?
 - How does that make people feel? Does it make them try harder, or give up?
 - What happens when you give up, or don’t put in effort on something?
 - So what are messages like that doing to us?
 - Based on what you have learned in this unit, does that make sense? Why not?
- Sometimes people put those kinds of 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. This is called **self-handicapping**. It means you set yourself up to fail. What is a better strategy to succeed? (Hint: think about what you did to succeed at your “favorite thing.”)

What makes children work hard?

Let’s face it, working hard can be—hard! What makes it worthwhile is the belief that you can gain something by doing it. As long as children don’t receive a paycheck, learning and developing their ability is their main payoff for hard work! Research shows that children 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. And when children 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 parent, you can reinforce the importance of effort by giving feedback that lets your child know how valuable it is and by reminding your child that when he/she works hard he/she is “working out” his/her brain.

Reinforcement Strategies

Child feedback:

- If it were easy, you wouldn’t be learning anything.
- When it’s hard work, that’s how you know you’re building your brain!
- Every time you practice, you’re making the connection in your brain stronger.
- Everything is hard before it gets easy.
- You’re good at things you like because you work at them.

- You just need to put in more time and thought and you'll get this.
- If you work half as hard at this as you do at (video games, basketball, etc.) you'll be doing great!

Concrete Strategies:

- **Do reps or sets of types of problems:** Just like when you exercise in the gym, you can build up your “brain muscles” by practicing solving sets of problems that use the same mental skills, or neuron connections. The more you practice similar problems together, the stronger those skills will become.
- **Isolate key skills and practice these:** If you are learning a complicated physical skill, you 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 get it down. You can do the same in your schoolwork by picking one skill that you find difficult by practicing it many times.

Give Yourself a Brain Scan:

In order to learn and get smarter at something, you need to build up your brain by working it out—by practicing and learning challenging new things. The next time you have something difficult to learn, use the following strategies to keep yourself motivated and give it your best effort:

- Do I feel worried about how well I'm going to do this? (Use strategies from Unit 2 to manage anxiety)
- Have I been holding back my effort—self-handicapping—on this in the past?
- Do I want to choose to get smarter and better at this?
- Am I willing to put in the effort it takes?
- How much time do I need for this, and am I giving myself enough time?
- Picture the nerve cells in your brain growing when you practice.
- If you get discouraged, think about how much smarter you are now than a year ago.
- Remember how much practice you put in on the things you like, and try to put in half that much!

UNIT 4: BRAIN BOOSTERS

Unit Goal

Extend the concept of the malleable brain to understanding the processes of memory. Introduce a variety of study strategies to capitalize on the way the brain works and learns, to deepen and reinforce your child's understanding of the growth mindset, and guide your child to the study skills resources within the program.

Key Challenge

Children give up when they encounter initial difficulty because they lack a variety of good learning strategies.

Main Information from Unit 4

- Memory is stored in the new connections your brain makes between neurons when you have a new experience.
- There are different stages in memory, each lasting different a amount of time: sensory memory, working memory, and long-term memory.
- Memory is a process, and if you skip one stage, the memory will not last.
- All information enters through sensory memory, which lasts less than a second.
- Things you pay attention to go on to working memory, which lasts from seconds to minutes. This memory can only hold 5-7 separate pieces of information at once.
- Information moves from working memory to long-term memory through a process called encoding. In order for encoding to happen, you must pay attention, attach new information to existing information that supports it and repeat the information.
- An example of connecting information together to help expand memory is **chunking**, where you remember several bits of information together in a pattern. Other mnemonics (memory strategies) that connect information together in multiple ways include **visual images** and **acronyms**.
- Most good study strategies are those that reinforce this memory process, helping your brain to make many strong connections between neurons and build a strong communication network of knowledge.

Some examples of good study strategies can be remembered through the acronym

BRAIN:

- **B**reak down information into basic elements
- **R**epeat, review, practice skills and information to strengthen memory
- **A**ctively practice new information
- **I**nformation-seeking through expert sources
- **N**ever give up—stay with the task long enough to let learning and memory take hold!

Discussion Activities

To study effectively you need to “study smart”—find the right strategy and use time well. Below are two ways of studying. Each takes 45 minutes. Which way will work better?

1) Sit and stare at your math book, but don't open it up. Stare at it **REALLY HARD** for 12 minutes. Then open it up and read one problem. Get frustrated when you don't understand it in 3 minutes, and close the book. Turn on the TV for 10 minutes. Spend 20 minutes looking for your math homework sheet. Give up when you can't find it.

2) Write down math rules and problems on index cards. (15 minutes) Read them a few times (15 minutes) Then find a friend to quiz you on the problems (5 minutes) Pick the ones you had trouble with and read them over again (10 minutes).

- Which one sounds the most like your own study time?
- Does this method work for you?
- Remember the acronym BRAIN. Can you see any ways that study method (1) used these strategies? How about study method (2)?

What are the most important study skills?

By encouraging your child to focus on effort, strategy, and incremental learning, you are laying the foundations for a constructive approach to learning and supporting a growth mindset. To help them turn that positive motivation into practical achievement gains, remind them of the importance of using the right strategies. Many children fail to understand their role in controlling their own learning. There are a few key skills and

principles that underlie the majority of study strategies, yet are unknown to many children. Focusing one's attention, taking an active role in learning, repetition, and monitoring one's own knowledge, are among these strategies.

Reinforcement Strategies

Strategy-Supporting Feedback

By encouraging your child to emphasize their learning strategies, you will help them remember that they can control how much they learn. When we associate the things we want to remember with the things we already know and find to be important, the move from working to long-term memory can be more easily made! Suggestions for feedback include:

- Remember, nothing gets in unless you shine your “attention spotlight” on it!
- Take charge of this, get active!
- Think about what you need to do: what strategies can you use?
- Question yourself: What do I already know about this subject? What do I need to know? Am I using the right strategy?
- If you don't understand something, ask!
- See if you can explain it to someone else. That's the best way to learn.

Concrete Strategies

Like a network of neurons, a math class is a series of ideas connected together to make solving math problems possible. The following ideas might help remind your child that just like their brains, math is a complex connection of messages:

- PEMDAS (*please excuse my dear aunt sally*) is a mnemonic that helps you remember the order of mathematical operations you must follow in solving a problem. Have your child create their own mnemonic devices and post them around the house or in their bedroom for inspiration.
- Learning the most basic way to solve a problem leads us to figure out how to manage similar problems with more complexity and more steps. Have your child map out math problems, showing the series of steps and the basic operations needed to solve the problem.

- Write a problem on a sheet of paper that is solved in several lines. Cut the paper into strips so that each step is on a separate strip. Have your child put the pieces together in the correct order.
- Consider things children have strong emotional attachments to and make school connect with those topics, for example keeping a diagram of the Final Four or tracking the rate at which a tropical storm is approaching the city.
- Making connections with things your child is interested in will help them remember concepts. Link a new concept in math with a favorite song.

Give Yourself a Brain Scan

To learn well, you shouldn't stop with working hard—you need to work smart too! Use the mnemonic **BRAIN** to check whether you have brought your toolkit of strategies.

Did you:

- **B**reak down information into basic elements
- **R**epeat, review, practice skills and information to strengthen memory
- **A**ctively practice new information
- **I**nformation-seeking through expert sources
- **N**ever give up—stay with the task long enough to let learning and memory take hold!

RESEARCH BACKGROUND OVERVIEW

During adolescence, students are at risk for underachievement, particularly in the area of mathematics and sciences. Over the past two decades, the main goal of two of our co-founders, Carol S. Dweck, Ph.D., and Lisa Sorich Blackwell, Ph.D., has been to research what helps students to achieve highly, and to apply the lessons learned to improving their motivation and achievement.

Achievement Motivation

In Drs. Dweck and Blackwell's research, we have found that the beliefs and attitudes held by students when they begin junior high school have a strong influence on their achievement in mathematics over these critical years.

In particular, the research found that students who believed that their intelligence was something that they could develop and increase—what we term a **growth mindset**—also held many other positive attitudes. First, believing that their ability could be increased, they **valued learning** as a goal, even when it involved hard work or initial errors. They also believed in the **efficacy of effort**—that is, they viewed effort in a positive way and felt that they had the ability, through their own efforts, to learn and master new material up to standard. When they had difficulty in a subject, they made more constructive, **mastery-oriented explanations**—rather than just saying, “I’m not smart enough,” or “I just can’t do math,” they explained their difficulty as due to lack of effort or inadequate strategy. And responded with more **positive, effort-based strategies** to work harder and spend more time on the subject instead of giving up.

Even more striking, students with a growth mindset had an **upward trajectory in mathematics grades** over seventh and eighth grade, while those who viewed their intelligence as a fixed quality did not. This was true even though students had equal levels of prior achievement: students who believed that their intelligence was malleable did better than did equally able students who viewed their intelligence as an unchangeable, fixed “entity.” This was true for students at all levels of ability (see Figure 1).

Our research, as well as that of others, has shown that students who hold a growth mindset use more sophisticated strategies in their coursework. For example, they use more complex **cognitive and meta-cognitive strategies**—those that involve active and deeper-level processing of material, and self-monitoring of the learning process.

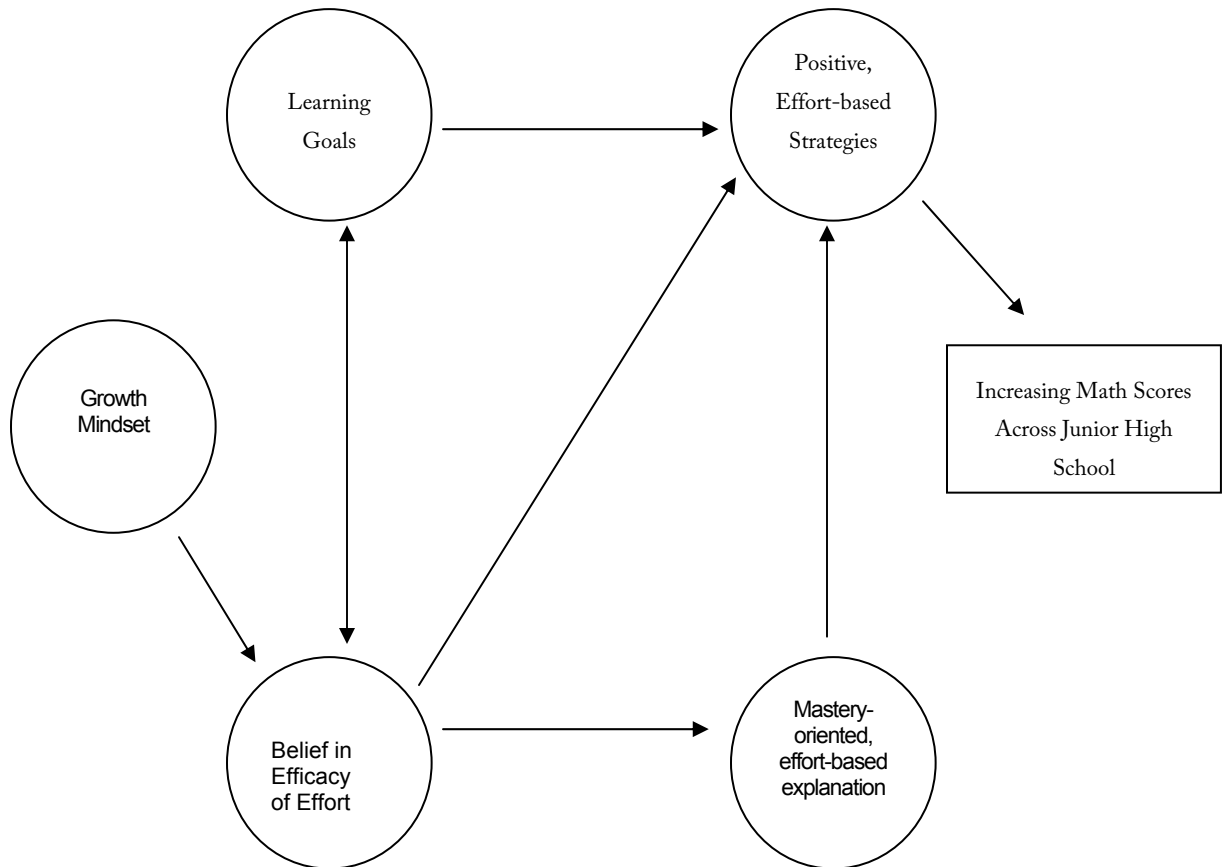


Figure 1. How beliefs and goals promote higher mathematics achievement as shown in prior research.

Research on Learning and the Brain

In the same period of time, research has shown that the brain is in fact much more malleable than previously thought. It was once believed that the brain did not grow new cells, and that there were severe limitations on the malleability, or **neuroplasticity**, of the brain after early childhood. But in the past few decades, research has shown that learning causes substantial changes in the brains of both animals and human beings throughout life.

Thinking occurs in the brain through the chemical communication of nerve cells connected in a complex network. With learning, the cells of the brain develop new connections between them, and existing connections become stronger. Studies in neurophysiology, neuroanatomy, and brain imaging have shown that when people practice and learn new skills, the areas of the brain responsible for those skills actually become larger and denser with neural tissue, and that new areas of the brain become active when performing related tasks. Furthermore, it has been found that the brain continues to grow new nerve cells, or neurons, daily, and that this process speeds up when a lot of active learning is occurring.

Thus, the brain has the capacity to develop throughout life. However, this development depends on the stimulation of challenge and learning. This fact makes it all the more critical that students be given challenging material and motivated to apply effort and take an active role in learning.

Intervention Approach: Teaching a Growth Mindset

Would it be possible to improve students' motivation and achievement by teaching them a growth mindset? In a pilot study, we did just that by teaching middle school students about what has been learned about the flexibility of the brain to develop and grow new networks with challenge and learning. We then examined changes in their motivation and mathematics achievement over the year of the intervention, comparing them with a similar group of students in the same school who did not receive this intervention.

Pilot Study Results

Gains in motivation: We asked teachers to assess changes in their students’ classroom motivation over the period of the intervention. Note that in the pilot study we taught the growth mindset intervention to students outside of their class periods, and teachers did not participate in the intervention. Thus, teachers were unfamiliar with the content of the intervention, and they did not know which of their students had received instruction in the malleable brain. Yet teachers cited significantly more of the students who had received the growth mindset training as showing positive change in their effort and interest in (see Figure 2).

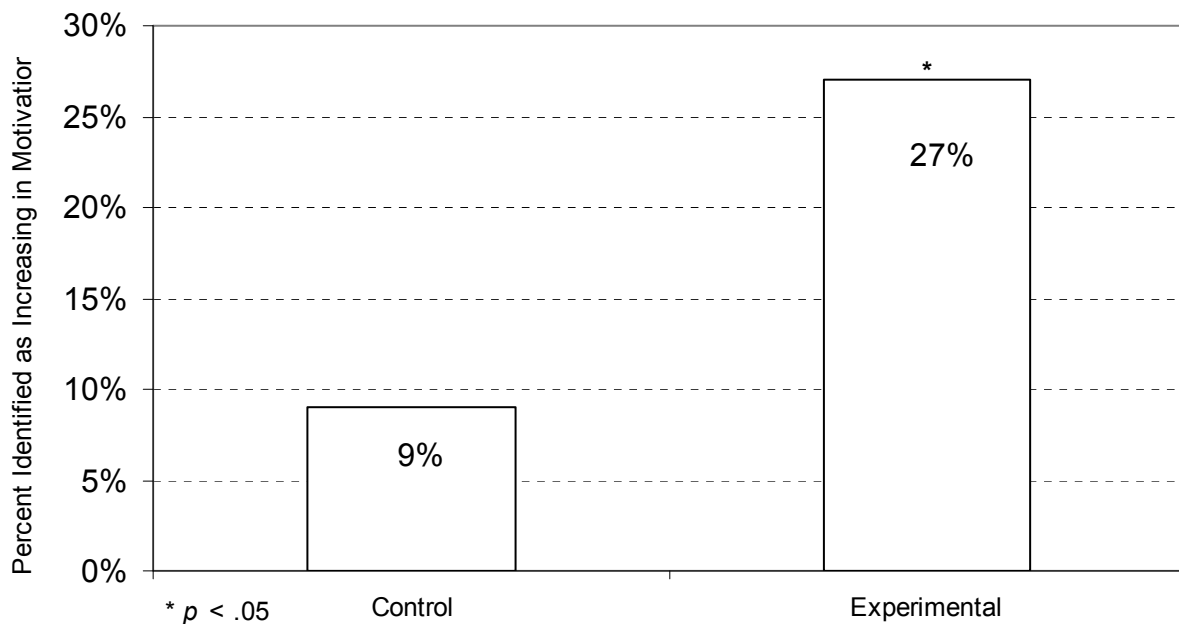


Figure 2. Teacher-rated change in students’ classroom motivation (effort, interest in learning) following intervention. (Note: Experimental group was taught lesson on malleable intelligence.)

Following are some comments from teachers about these students:

“M. was performing far below grade level. During the past few weeks, she has voluntarily asked for extra help from me during her lunch period in order to improve her test-taking performance. Her grades drastically improved from failing to an 84 on the most-recent exam.”

“Lately I have noticed that students have a greater appreciation for improvement in academic performance. R. was performing below standards, but now he has learned to appreciate the improvement from his grades of 52, 46, and 49 to his grades of 67 and 71. He valued his growth in learning Mathematics.”

“Your workshop has already had an effect. L., who never puts in any extra effort and often doesn’t turn in homework on time, actually stayed up late working for hours to finish an assignment early so I could review it and give him a chance to revise it. He earned a B+ on the assignment (he had been getting C’s and lower).”

“Several students have voluntarily participated in peer tutoring sessions during their lunch periods or after school. These students were passing when they requested the extra help and motivated by the prospect of sheer improvement.”

Gains in Math Achievement: The mathematics grades of all students in the study had been declining prior to the intervention. However, after the intervention, the grades of those students who learned about the growth mindset (experimental group) took an upward turn, while those of their fellow students who did not receive this curriculum continued to decline (see Figure 3.)

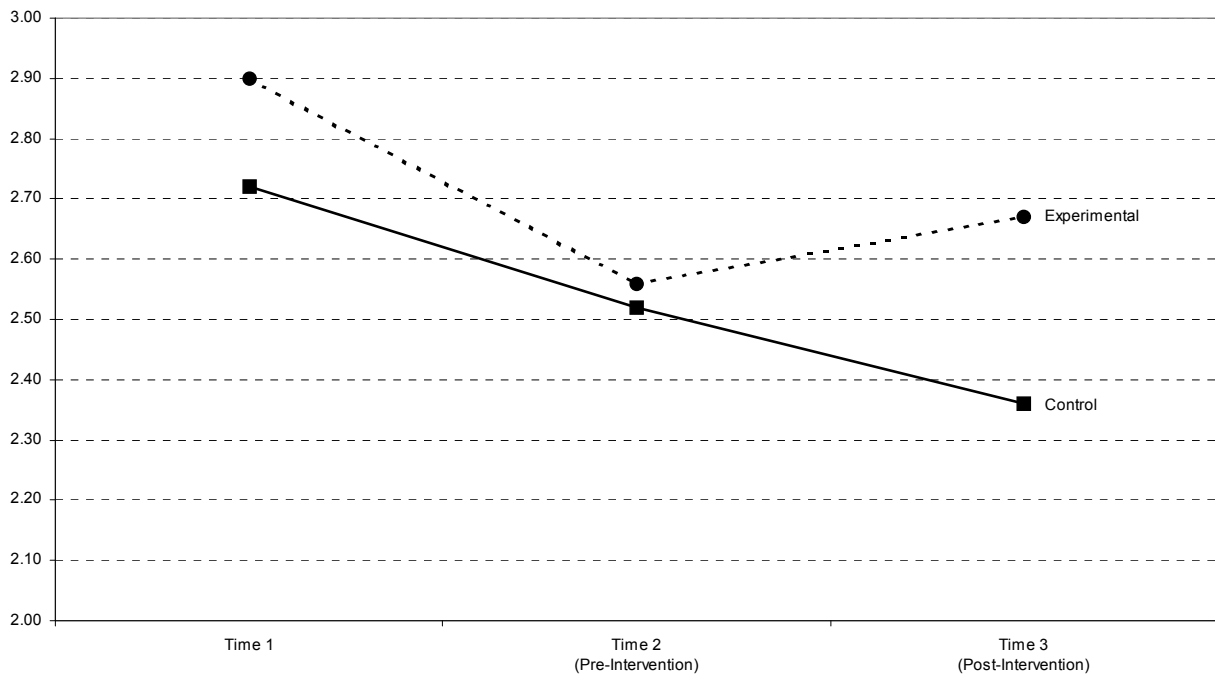


Figure 3. Math grade curves over period of the intervention (T1=spring 6th, T2=fall 7th, T3=spring 7th)

References

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Dweck, C. (2006). *Mindset: The New Psychology of Success*. Random House: New York.

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