Engaging the Brain

4th Edition

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20 Unforgettable Strategies for Growing Dendrites and Accelerating Learning

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Marcia L. Tate

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About the Author

Marcia L. Tate is the former executive director of professional development for the DeKalb County Schools in Decatur, Georgia. During her 30-year career with the district, she has been a classroom teacher, reading specialist, language arts coordinator, and staff development executive director. Marcia was named Staff Developer of the Year for the state of Georgia, and her department was selected to receive the Exemplary Program award for the state.

Marcia is currently an educational consultant and has presented her workshops to over 500,000 administrators, teachers, parents, and community leaders from all over the United States and the world, including Australia, Canada, Egypt, Hungary, Oman, New Zealand, Singapore, and Thailand. She is the author of the best-selling series *Worksheets Don't Grow Dendrites: 20 Instructional Strategies That Engage the Brain*, as well as *"Sit & Get" Won't Grow Dendrites: 20 Professional Learning Strategies That Engage the Adult Brain* (2nd ed.), *Preparing Children for Success in School and Life: 20 Ways to Increase Children's Brain Power*, and *Formative Assessment in a Brain-Compatible Classroom*. Her more recent books, *100 Brain-Friendly Lessons for Unforgettable Teaching and Learning (K-8)* and *(9-12)*, provide teachers with exemplary lessons replete with brain-compatible strategies. Marcia's latest book, *Healthy Teachers, Happy Classrooms*, enables educators to renew the passion inherent in the profession. Participants in her workshops call them some of the best ones they have ever attended, since Marcia models the 20 strategies in her books to engage her audiences.

She received her bachelor's degree in psychology and elementary education from Spelman College in Atlanta, her master's in remedial reading from the University of Michigan in Ann Arbor, and her specialist and doctorate degrees in educational leadership from Georgia State University and Clark Atlanta University, respectively. Spelman College awarded her the Apple Award for excellence in the field of education.

Marcia is married to Tyrone Tate and is the proud mother of three children: Jennifer, Jessica, and Christopher. If she had known how wonderful it would be to be a grandmother, Marcia would have had her nine grandchildren, Christian, Aidan, Maxwell, Aaron, Roman, Shiloh, Aya, Noah, and Alyssa, before she had her children. She and her husband own the company Developing Minds, Inc. and can be contacted by calling the company at (770) 918–5039, by e-mailing her at marciata@bellsouth.net, or by visiting her website at www.developingmindsinc.com.

Introduction

SCENARIO I

Mrs. Anderson teaches American History at Washington High School. The bell rings for class to begin, and only a few students are seated and ready. The others are hanging out in the hall socializing with friends, reluctant to come into the classroom. A frustrated Mrs. Anderson goes to the door and threatens students that any time lost in instruction due to their behavior will be made up in time spent in in-school suspension. Additional students take their seats within a few minutes, the roll is checked, and the lesson begins.

Today's lesson objective will be for students to analyze the meaning, importance, and relevance of the Bill of Rights. Students are instructed to open their textbooks to page 231 and silently read from page 231 to page 235. No purpose for reading is given. During this time devoted to silent reading, individual conversations break out, and Mrs. Anderson constantly reprimands students to be quiet so that others can concentrate. After approximately 15 minutes, she requests that certain students read selected passages from the text regarding the Bill of Rights. The content from these passages will be needed to answer the questions on the worksheet that follows. Students are then given the worksheet and allowed an additional twenty minutes to respond to the following:

- Write down a couple of sentences describing the Bill of Rights.
- Summarize the main idea of each amendment in a sentence or two.

SCENARIO II

Mr. Copeland teaches American History at McNair High School. He is standing at the door greeting each student as they enter his doorway. He refers to them as Mr and Ms. and calls them by their last name. The songs *Times, They Are a-Changing* by Bob Dylan and *Changes* by David Bowie are softly playing. From day one, Mr. Copeland taught them that if he could hear their voices over the music as they talked, then they were talking too loudly. Students are taught to look on the board for a riddle to be solved. Today's riddle is as follows: *Why was the broom late for school?* Answer: *It overswept*.

Mr. Copeland begins a whole class discussion regarding the specific protections for individuals that apply to students and those that apply to teachers.

They then discuss the limits that are placed on the authority of students and those of teachers. This leads to an introduction to the Bill of Rights.

Mr. Copeland has set up six learning stations. The class will be divided into six groups and will rotate through each station every few minutes. During their time in the learning station, they will have a copy of the Bill of Rights to refer to and will be asked to complete a graphic organizer with their group. Each station addresses a different amendment and has a different assignment. For example, the assignment for the Seventh Amendment is to explain the importance of having the right to a trial by jury. Following the station rotation, students work with their groups to either create a picture or diagram as a visual aid for teaching an amendment to the class or design a skit depicting an amendment being violated.

BRAIN-COMPATIBLE INSTRUCTION

The world has just fallen prey to an unexpected pandemic, and school systems worldwide have suffered severe consequences. The face-to-face teacher and student interactions that customarily occurred during instruction prior to COVID-19 were replaced with virtual offerings. In many cases where parents were not available to ensure that students were online, there were no guarantees that students were even paying attention. As things began to improve and a modicum of students returned to the schoolhouse, some teachers were challenged to offer a hybrid model where they were simultaneously teaching those students who sat in front of them in the classroom and the ones whose parents insisted that they remain at a distance. As a result, educators have been telling me that students have fallen behind, have experienced gaps in their learning, and need to make up ground as quickly as possible. It stands to reason that the best way to expedite learning would be to teach students' brains in ways that their brains learn best.

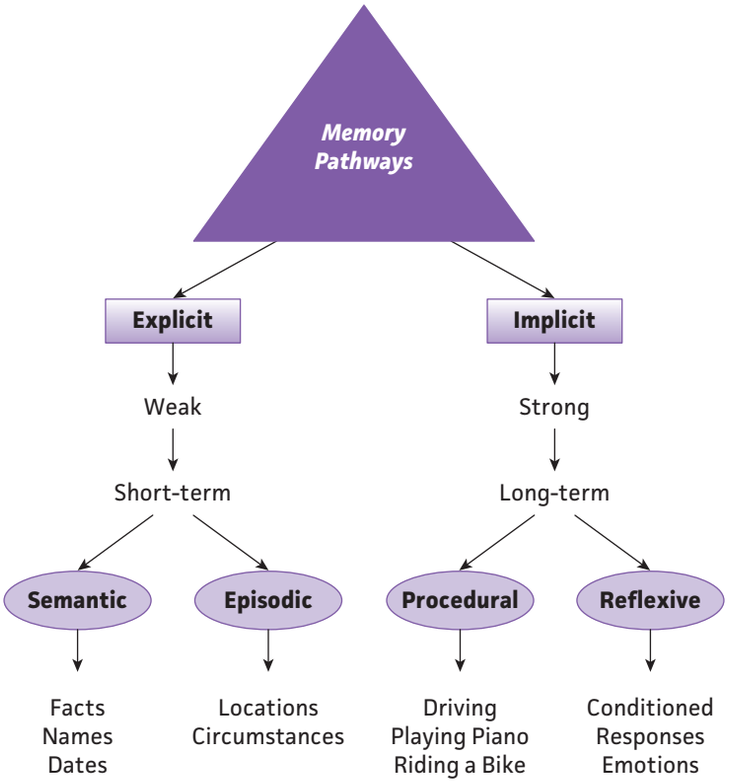
Thousands of years of history support one major concept. When students actively engage in experiences with content, they stand a much better chance of learning and remembering what we want them to know. Yet, with increased emphasis on *high-stakes testing*, teachers are still apt to spend the majority of time using worksheets and lectures to teach lower-level concepts that traditional methods can best assess.

Let's explore why brain research tells us that lectures and worksheets may not be the best way to accelerate learning for most students.

MEMORY PATHWAYS

There are two major memory pathways in the brain, as depicted in the graphic organizer below. One is called *Explicit Memory,* and the other is called *Implicit Memory*. For most people, *Explicit Memory* tends to be weak and more

short term, while *Implicit Memory* tends to be stronger and more long term. An understanding of the function of these pathways provides justification as to how we ought to teach if learning is to be accelerated.



SEMANTIC MEMORY

One of the explicit memory pathways in the human brain is called *semantic memory*. It involves our capacity to recall words, facts, names, concepts, or numbers and is an essential part of understanding language. Without semantic memory, we would have trouble communicating since we would be unable to recall the names of everyday objects. Here is the problem! While the majority of content taught in traditional classrooms is explicit, that content is being forced into a weak semantic container. This is why students can cram for an exam and not remember much of anything once the exam has ended. It is also the reason that I never spend time in my workshops having participants stand and say their names to the entire class. If participants did not know the name of each participant before they got up, they would not know the names after they had sat down.

EPISODIC MEMORY

Another explicit memory system is *episodic memory,* which involves our conscious recollection of the condition, time, and place of previous experiences. Since it is still a weak memory system, it becomes the reason why the police do not consider eyewitness testimony as reliable.

Let me relate a true story to illustrate the difference between episodic and semantic memory and how they work together. Many years ago, I was instructing a group of high school teachers in Wiley, Texas. Since they would be with me for five days, I wanted a way to remember their names so that I could call them by name from day one. One teacher had a long, blonde ponytail extending from the top of her head. She stood and told me that her name was Jeannie. She then folded her arms and bowed her head the way Barbara Eden used to do whenever she granted a wish in the television show *I Dream of Jeannie*. I know that many of you will not even remember that show. It was easy for me to call her by name on that first day since I loved the show, and her connection to it helped to embed her name into my semantic memory.

On the second day, when class began, I could not find Jeannie. You see, she had taken down her ponytail, changed her clothes, and her location in the classroom. In other words, she had messed up my episodic memory. When I remembered her name, I also remembered her ponytail, what she wore, and where she sat in class. The two memory systems had worked together. Now, they were not in sync!

PROCEDURAL MEMORY

Good news! There is a stronger memory system in the brain called implicit memory; one of the types of this memory system is procedural. Procedural is a type of long-term memory involved when performing various actions or skills. In other words, it is the memory of how to put on our shoes, ride a bike, play the piano, or cook without a recipe. Therefore, anytime we can engage students in performing an action or skill, we stand a better chance of ensuring that the content ends up in long-term memory. One teacher related to me that her mother has dementia and can no longer recall the names of her children and grandchildren, which would be in her semantic memory. Since her mother is a pianist, she can still go to the piano and play the songs she has always played. Her ability to play is procedural.

REFLEXIVE MEMORY

A final type of memory system is called reflexive. This is one's memory for a conditioned response or an emotional connection to the content. For example, how many times would a person have to touch a hot stove before it dawns on their brain that it is hot? Usually, only once! The pain experienced would be a constant reminder not to touch the stove again.

Emotional connections also tend to correlate with long-term memories. Consider an emotional event that has happened in the United States, such as the Challenger disaster during which we lost seven astronauts, including teacher Christa McAuliffe; the tragic death of Martin Luther King Jr. or Princess Diana; or the attack by al-Qaeda on the Twin Towers on September 11, 2001. Even though these events are obviously negative, there is research to support that unless a student has a positive emotional connection either to

the teacher or to the content itself, there is a real chance that the content may not be remembered. For example, if a student is in a teacher's classroom he cannot stand, he will not forget the experience of being in that teacher's room but will not be able to recall much of the content.

If teachers truly want to accelerate learning, they will find ways to place as much content as possible into the implicit memory systems of students so that they can recall content, not just for standardized, criterion-referenced, or teacher-made tests. However, they will still remember content long after the tests have ended.

BRAIN-COMPATIBLE INSTRUCTIONAL STRATEGIES

Learning-style theorists (Gardner, 1983; Marzano, 2007; Sternberg & Grigorenko, 2000) and educational consultants (Jensen, 2008, 2022; Sousa, 2011, 2022; Willis, 2006, 2007) have concluded that there are some instructional strategies that, by their very nature, result in long-term retention. Those strategies are addressed in numerous books about the brain but were not previously delineated in any one text. Now they are, and this is the text!

For more than 30 years, I have been studying the incredible functions of brain cells. Through my extensive reading, participation in workshops and courses with experts on the topic, and my observations of best practices in classrooms throughout the world, I have synthesized these instructional strategies into 20 methods for delivering instruction and accelerating learning. These strategies work for the three following reasons:

1. They increase academic achievement for *all* of the following students: students who are in elementary, middle, high school, and college; students who are in gifted classes, regular education classes, and special education classes; students for whom English is a second language; and students who are learning in all content areas across the curriculum.
2. They decrease behavior problems by minimizing the boredom factor in class since students are actively engaged and increasing the confidence factor in those students who would use their inadequacy as a cause for misbehavior.
3. They make teaching and learning fun for all grade levels so that even calculus students are just as excited about learning as kindergarten students on the first day of school.

The 20 strategies are as follows:

1. Brainstorming and discussion
2. Drawing and artwork
3. Field trips
4. Games

5. Graphic organizers, semantic maps, and word webs
6. Humor
7. Manipulatives, experiments, labs, and models
8. Metaphors, analogies, and similes
9. Mnemonic devices
10. Movement
11. Music, rhythm, rhyme, and rap
12. Project-based and problem-based learning
13. Reciprocal teaching and cooperative learning
14. Roleplays, drama, pantomimes, and charades
15. Storytelling
16. Technology
17. Visualization and guided imagery
18. Visuals
19. Work study and apprenticeships
20. Writing and journals

As millions of dollars are being spent in an effort to find cures for brain abnormalities such as Alzheimer's disease, dementia, and Parkinson's disease, more and more information is being gleaned about the brain. Teachers should be the first to avail themselves of this information since they are teaching students' brains every day. In fact, I tell teachers that the next time they complete a resumé, they need to include that they are not only *teachers but also gardeners*—better known as *dendrite growers*—because every time students learn something new in their classrooms, they grow a new brain cell, called a dendrite.

Refer to Table 0.1 for a correlation of these 20 strategies to Howard Gardner's Theory of Multiple Intelligences as well as to the four major learning modalities: (1) visual, (2) auditory, (3) kinesthetic, and (4) tactile. Each lesson incorporating multiple modalities increases students' test scores and stands a better chance of being remembered by students long after the teacher-made, criterion-referenced, or standardized tests are over. After all, isn't that why we teach—long-term retention?

The book you are about to read attempts to accomplish five major objectives:

1. Delineate the characteristics of a classroom that takes advantage of the way students' brains learn best
2. Review more than 200 pieces of research regarding the 20 brain-compatible strategies, as well as best practices in instruction regardless of the grade level or content area

3. Supply more than 200 examples of the application of the 20 strategies for teaching objectives at a variety of grade levels and in multiple cross-curricular areas
4. Provide time and space at the end of each chapter for the reader to reflect on specific Action Plans as they enable the reader to accelerate learning
5. Demonstrate how to plan and deliver unforgettable lessons by asking the five questions on the lesson plan template in the book's Resource section

The brain-compatible activities in each chapter are only samples of lessons that can be created when the strategies are incorporated from kindergarten to calculus. They are intended to get the reader's brain cells going as they think up a multitude of additional ways to deliver effective instruction to their students.

When you really examine the list of 20, you will find that they are used most frequently in the primary grades. It is when the strategies begin to disappear from the repertoire of teachers that students' academic achievement, confidence, and love for school also diminish. You may remember the book *Everything I Needed to Know I Learned in Kindergarten*. This also applies to teaching. If every teacher would teach the way a kindergarten teacher teaches, most students would learn. The content should change, but the way of delivering that content should not.

What if every teacher used the 20 strategies, including art, drama, music, and storytelling, to teach the academic subject areas of English, mathematics, science, and social studies? Would we not see gaps being closed, learning accelerated, and more students graduating at the end of high school? After all, *if students don't learn the way we teach them, then we must teach them the way they learn*. Here's an analogy. When you go fishing, do you use bait you like or bait the fish likes? There are 20 instructional strategies that brain research shows that your students will like and that you should be using as bait.

This book is the foundational text in a series of multiple cross-curricular bestsellers about *growing dendrites*. The books are as follows:

- *Worksheets Don't Grow Dendrites: 20 Instructional Strategies That Engage the Brain,* Third Edition
- *"Sit & Get" Won't Grow Dendrites: 20 Professional Learning Strategies That Engage the Adult Brain,* Second Edition
- *Reading and Language Arts Worksheets Don't Grow Dendrites: 20 Literacy Strategies That Engage the Brain,* Second Edition
- *Shouting Won't Grow Dendrites: 20 Techniques to Detour Around the Danger Zones,* Second Edition

- *Mathematics Worksheets Don't Grow Dendrites: 20 Numeracy Strategies That Engage the Brain, PreK–8*
- *Science Worksheets Don't Grow Dendrites: 20 Instructional Strategies That Engage the Brain*
- *Social Studies Worksheets Don't Grow Dendrites: 20 Instructional Strategies That Engage the Brain*

Two more recent books contain 100 lessons written by exemplary content specialists from across the country using the lesson plan template in this book's Resource section. Both books below contain 25 lessons in each of the four content areas of language arts/English, mathematics, science, and social studies.

- *100 Brain-Friendly Lessons for Unforgettable Teaching and Learning (K–8)*
- *100 Brain-Friendly Lessons for Unforgettable Teaching and Learning (9–12)*

The activities outlined in each chapter of this text are designed to be starting points for planning lessons intended to be brain compatible. They are in no way meant to be an exhaustive list of possibilities. The advantage of having activities that range from elementary through high school in the same book is that the reader can easily select activities that will meet the needs of students performing below, on, and above grade level and can, therefore, more easily differentiate instruction. You will also find that an activity designated for a specific grade range can be taken as is or easily adapted to fit the grade level the reader is teaching. Therefore, as you peruse this text, examine not only those activities in each content area that are age- or grade-appropriate but also look for ones at other grade levels that can easily meet your needs once you change the conceptual level of the material.

The Action Plan page at the end of each chapter enables readers to reflect on the activities described in the chapter that incorporate the strategy. Teachers can indicate which ones they are already using and commit to add others to their repertoire. The lesson planning section helps the reader synthesize the process of planning unforgettable lessons by asking and answering the five essential questions on the template.

CHARACTERISTICS OF A BRAIN-COMPATIBLE ENVIRONMENT

Teachers who use the brain-compatible instructional strategies addressed in the following chapters for lesson design and delivery deserve to have a classroom environment that is, likewise, brain compatible. Teachers who cannot create these environments for their students have students who may not be excelling at optimal levels. My observations in hundreds of classrooms and knowledge of brain-compatible instruction tell me that

there are 10 characteristics of classrooms where students tend to excel. After you peruse the 10, your project will be to identify those characteristics that you are already very comfortable implementing and to identify two that you will work on for the next 21 days. Why 21 days? That is the minimum of how long it will take to make those two characteristics a habit in your daily instruction. You see, I have a theory. No matter how wonderful you are, you should be making specific plans to improve!

(1) A POSITIVE ENVIRONMENT

When you enter a brain-compatible classroom, you know it immediately! The teacher is standing at the door smiling, greeting students, asking them about their weekends or evenings, and complimenting them on some positive aspects of their lives. Did you know that the word *SMILE* is a mnemonic device that stands for *Show Me I'm Loved Everyday*? Students are not loitering in the hall but are entering class, excited about what they can expect in the day's lesson. As the class proceeds, the room has an obvious air of enthusiasm and optimism. The teacher is passionate about the subject matter, and students support each other in the learning and do not put one another down, as I see in so many classrooms. Students are confident that they can be successful and know that if a concept is not understood, the teacher and peers are there to assist and support them. Consult Strategy 4: Games and Strategy 6: Humor for specific activities to help create a positive environment.

(2) VISUALS

We live in a very visual world! With computers, video games, smartphones, television, and the like, students' brains absorb much information visually. At least 50% of students who walk into any classroom today will be predominately visual learners. Another 35% are likely to be kinesthetic, which is why they need to be moving, but we will discuss that under another characteristic. This means that if your primary method for delivering instruction is auditory, then *Houston, We Have a Problem!* Only 15% of the class is listening. Brain-compatible teachers accompany their lectures with images from the SMART board, video clips, virtual field trips, and so forth. They even ensure that those anchor charts and other visuals on the wall in the peripheral vision of students are content related.

Teachers often worry about taking down visuals from the walls before a test. I tell teachers, *Do not dismay!* If those visuals have been up long enough, your students can still visualize what was on the wall even if you remove them. Consult Strategy 17: Visualization and Guided Imagery and Strategy 18: Visuals for specific ways to engage the visual modalities of students.

(3) MUSIC

As students are assembling, brain-compatible teachers have soft, calming music playing, and students have learned from day one that if the teacher hears their voices over the music, they are talking too loudly! This music is used around 30% of the time but never while the teacher is delivering

direct instruction. It can be distracting to many students to have music playing while your expectation is that students are giving you their undivided attention.

So when do these teachers play music? It may be when students are working together in cooperative groups, writing creatively, or solving math problems. The type of music used during these times should probably be instrumental with no lyrics, and the volume should be turned extremely low so as not to disturb students' thought processes. At other times, these teachers want high-energy, motivational music interwoven with the content or played during transition times or an engaging activity. Be sure that any music you use with students has appropriate lyrics for putting students' brains in a positive state. Consult Strategy 11: Music, Rhythm, Rhyme, and Rap for specific activities for infusing music into your classroom.

(4) RELEVANT LESSONS

What came first—school or brains? Of course, human beings had brains long before there was a formal place called school. Therefore, the purpose of the brain was never to make straight As or score high on a standardized or teacher-made test. The purpose of the brain is survival in the real world. Wouldn't it make sense that those things in real life that are crucial to man's survival are more easily remembered than those needed for tests in school?

I know that at some point in your teaching career, a student has asked you this question, *Why do we have to learn this?* When students cannot see the connection between what is being taught in school and their personal lives, they will often ask the question. Brain-compatible teachers attempt to take the objective they are teaching and relate it to students' personal lives. For example, rather than using the math problems in the book initially, these teachers create real-life problems and integrate the students' names into the problems so that they can actually see themselves solving them. Consult Strategy 12: Project-Based and Problem-Based Learning for specific activities for infusing relevant projects and problems into your instruction.

(5) RITUALS TAUGHT

A brain-compatible classroom is an active, engaging classroom but never a chaotic classroom. The teacher's routines, expectations, and procedures have been determined, taught, and practiced so often that they have become rituals that keep the classroom orderly and organized. In fact, effective classroom managers spend more time teaching those rituals than teaching their content at the beginning of the school year or term. When done well, the teacher can spend more time teaching the content for the remainder of the year.

Students must know how you expect them to begin and end class, when to talk and when to be quiet and listen, when to move and when to remain in their seats, or how to get into groups when cooperative learning is

warranted. Chapter 14: Teach Your Rituals in the bestseller *Shouting Won't Grow Dendrites: 20 Techniques to Detour Around the Danger Zones* (2nd ed.) gives definitive suggestions for teaching and practicing those determined routines, expectations, and procedures.

(6) STUDENTS TALKING ABOUT CONTENT

The person doing the most talking about the content is growing the most dendrites, or brain cells, regarding the content. In many classrooms I observe in, that is the teacher. In a brain-compatible classroom, it should be the students. Making all students a part of the conversation helps ensure the content is understood and remembered. The teacher's job comes before the lesson—that of planning a lesson that can then be facilitated when it is taught. Some teachers have unrealistic expectations—that students will sit quietly for long periods and are even chastised for wanting to converse with their friends. Yet, we learn 70% to 90% of what we are capable of teaching to someone else. Strategy 1: Brainstorming and Discussion and Strategy 13: Reciprocal Teaching and Cooperative Learning, will provide teachers with multiple ways to engage students' brains as they process information.

(7) STUDENTS MOVING TO LEARN CONTENT

Students sit entirely too much! Brain-compatible teachers have students moving at certain points during the lesson, knowing that this behavior will give them some relief from sitting on the most uncomfortable piece of furniture known to man, the student desk. More importantly, movement correlates to procedural or long-term retention. Anything one learns while moving is hardwired into one of the strongest memory systems in the brain. If you have ever driven a stick shift, you will never forget how to do it—even if you have been driving an automatic for years. A Texas football coach once commented in a workshop that this research explains why football players who may not remember the content in class can remember every play on the field. Movement is probably my favorite strategy since it not only correlates with long-term retention but also makes teaching and learning so much fun! Consult Strategy 10: Movement and Strategy 14: Roleplays, Dramas, Pantomimes, and Charades for additional research to support the need to have students in motion.

(8) HIGH EXPECTATIONS

More than 50 years of research, beginning at Harvard University in the 1960s with the work of Dr. Robert Rosenthal and his famous 1968 study, *Pygmalion in the Classroom* with Lenore Jacobson, point to the fact that one gets what one expects. If teachers don't expect much from their students, they will not get much from those students. If the expectations are high and teachers give students the confidence to believe they can meet them, then exceptional things can happen. Instilling confidence in students should be a major part of the equation. A sports figure with the confidence to do well in a game has a much better chance of doing well than one who doesn't have such confidence. When the confidence in a game shifts from one team

to another, that concept is known as a *momentum shift* and can often determine the game's outcome. We all have seen instances where one sports team was not as skilled as another and yet beat the more skilled team simply because they believed they could.

Brain-compatible teachers visualize every student in their class being successful! If a teacher cannot see that success, it is not likely to happen. One teacher told me that on the first day of class each year, she has every student write the word *can't* on a piece of paper. Then, she has students symbolically shred the paper and throw it in the trash. She then teaches students this motto: *Success comes in cans, not in can'ts*.

(9) HIGH CHALLENGE, LOW STRESS

A brain-compatible classroom is one where students are consistently challenged but have low levels of stress. There is no sense of accomplishment when people are successfully completing tasks that are too easy for them. If you don't believe that students want to be challenged, you have never watched them engage with video games that they have a difficult time abandoning. The creators of video games are smart and know how the brain reacts. Teachers would be wise to pay attention. Game makers have students start playing the game at an easy level where they can build up their confidence with appropriate responses. Then, as soon as the student is hooked, the difficulty level of the game increases. Students continue to play because they have the confidence that they can move to a more difficult level and still succeed. In addition, no image has ever appeared on a video game that pops up with the following message, *You have failed! Stop playing!* Students can continue perfecting their craft until they get it right. Then, they move on to the next, more difficult level. Brain-compatible classrooms are ones where students are consistently challenged, but the probability of failure is low.

(10) CONTENT TAUGHT IN CHUNKS WITH ACTIVITY

It may surprise you to know that even the adult brain can hold an average of only seven isolated bits of information simultaneously. This is why so much in the world comes in a series of seven. This concept will be addressed in more detail in the lesson planning section of this book. Effective teachers teach in small parts or chunks. They know that the brain can only hold a limited amount of information at one time, so they divide their lessons into meaningful bites or chunks and feed students one chunk at a time until the entire lesson is digested.

Here's a story to illustrate my point. I attended the wedding of one of my daughter's friends when the minister did not chunk the wedding vows appropriately. The bride and groom were expected to repeat the vows after the minister. However, the minister gave the bride too much to say in the first chunk. I turned to my husband and commented that unless the bride had memorized her vows, she would never be able to remember all she was given. Sure enough, when it was time for the bride to repeat the vows,

she turned to the minister and asked, *Could you repeat that, please? I didn't get it all!* I really needed to give that minister some chunking lessons! Brain-compatible teachers divide the lesson into small parts and ensure that an activity is integrated into each part so that the brain has time to process the information contained in the chunk. Even your GPS knows that you can only hold one brief direction at a time and that you need that direction repeated if your trip is to be successful.

These are the 10 characteristics of a classroom that facilitates brain-compatible instruction. How many of them are already natural parts of your classroom? Which two will you work on for a minimum of the next 21 days?

The remainder of this book centers on delivering brain-compatible lessons within that context. Numerous teachers have told me that their instructional practice has been revolutionized since they began consciously incorporating more of the brain-compatible strategies (see Table 0.1 for a list of the 20 strategies). Turn the page and start your journey down a path that may help revolutionize your instructional practices or support the effectiveness of some of the practices you are currently using. We owe it to our students to accelerate their learning, to close gaps, and to increase academic achievement.

TABLE 0.1 ● Comparison of Brain-Compatible Instructional Strategies to Learning Theory

BRAIN-COMPATIBLE STRATEGIES	MULTIPLE INTELLIGENCES	VISUAL, AUDITORY, KINESTHETIC, TACTILE (VAKT)
Brainstorming and discussion	Verbal-linguistic	Auditory
Drawing and artwork	Spatial	Kinesthetic/tactile
Field trips	Naturalist	Kinesthetic/tactile
Games	Interpersonal	Kinesthetic/tactile
Graphic organizers, semantic maps, and word webs	Logical-mathematical/ spatial	Visual/tactile
Humor	Verbal-linguistic	Auditory
Manipulatives, experiments, labs, and models	Logical-mathematical	Tactile
Metaphors, analogies, and similes	Spatial	Visual/auditory
Mnemonic devices	Musical-rhythmic	Visual/auditory
Movement	Bodily-kinesthetic	Kinesthetic
Music, rhythm, rhyme, and rap	Musical-rhythmic	Auditory

(Continued)

(Continued)

BRAIN-COMPATIBLE STRATEGIES	MULTIPLE INTELLIGENCES	VISUAL, AUDITORY, KINESTHETIC, TACTILE (VAKT)
Project-based and problem-based learning	Logical-mathematical	Visual/tactile
Reciprocal teaching and cooperative learning	Verbal-linguistic	Auditory
Roleplays, drama, pantomimes, and charades	Bodily-kinesthetic	Kinesthetic
Storytelling	Verbal-linguistic	Auditory
Technology	Spatial	Visual/tactile
Visualization and guided imagery	Spatial	Visual
Visuals	Spatial	Visual
Work study and apprenticeships	Interpersonal	Kinesthetic
Writing and journals	Intrapersonal	Visual/tactile

Source: istock.com/kali9

Positive conversations trigger higher levels of a neurochemical brain cocktail consisting of dopamine, endorphins, and oxytocin (Balboa & Glaser, 2019).

STRATEGY 1

Brainstorming and Discussion

WHAT: DEFINING THE STRATEGY

What is the main idea of this passage? Cite text evidence to support your answer.

What answer did you get for problem number eight? Defend your answer.

Did the science experiment support our hypothesis? Why, or why not?

Compare and contrast the American Revolution and the French Revolution.

What are the advantages and disadvantages of living in a technological society?

Participants in my workshops can be some of the chattiest people in the world. This fact is based on my over 40 years of teaching teachers and administrators. Yet, some of those same people who love to and should talk to one another in my classes will not let their students participate in that same behavior in their classrooms. Many students get in trouble for doing something that comes so naturally to the human brain—talking.

When people open their mouths to speak, they send more oxygen to the brain. If the brain is deprived of oxygen for three or more minutes, it can be declared dead. Those who were watching the Buffalo Bills football game will never forget when Damar Hamlin was knocked unconscious on the field. If medical professionals had not been close by, his brain would have suffered irreparable damage from a lack of oxygen. Fortunately, that did not happen! I have observed in some classrooms where students are breathing, but it is hard to tell. Their heads are on their desks! They are lethargic! Their brains are figuratively dead since the teacher is doing the majority of the talking.

Another benefit of talking is that it facilitates the growth of dendrites or brain cells. Having students discuss the answers to open-ended questions,

express opinions, or brainstorm a variety of ideas is advantageous to the brain. According to Allen and Currie (2012), during discussion, students *can increase the amount of paper manipulated and stored into the filing cabinets of the brain, slowly forming a more complex outlook on the topic* (p. 41).

WHY: THEORETICAL FRAMEWORK

Five ways to organize discussions that literally run themselves include the following: (1) Video class discussions to ensure that you are not monopolizing the conversation; (2) Use a graphing tool (i.e., a spiderweb graph) to determine who is contributing and who is not; (3) Design a rubric to help define what a successful discussion looks like; (4) Assign students a coaching partner to track their contributions; and (5) Design good, open-ended questions that call for higher-order thinking and raise additional questions (Boryga, 2023).

Class discussions are beneficial with ESL students since they allow students to produce language in context, boost their confidence, practice specific content-area vocabulary, and enhance their critical thinking skills (Kialo Edu, 2023).

Brainstorming is one of the techniques a teacher can use to achieve positive transfer by assisting students in seeing the connection between what they already know and new learnings (Sousa, 2022).

Information is shared during conversations that trigger emotional and physical changes in the brain capable of opening one up or shutting one down (Balboa & Glaser, 2019).

Positive conversations trigger higher levels of a neurochemical brain cocktail (consisting of dopamine, endorphins, and oxytocin) that instills a sense of well-being (Balboa & Glaser, 2019).

Discussion strategies break complex concepts into digestible units, challenge students to analyze and synthesize information from a variety of perspectives, require students to participate even if only listening, engender confidence as students express their thoughts, and provide opportunities for immediate feedback (Ellis, 2023).

Having students dialogue with peers who have different perspectives is a civic engagement strategy used in social studies to help students prepare for becoming competent and responsible citizens (National Council for the Social Studies, 2010).

The quality and quantity of the questions that real-life scientists ask determine the progress of science in the real world (Berman, 2008).

Students up to the age of 10 learn better when an academic discussion is directed by the teacher. Adolescents and adults benefit from discussions led by a cooperative group (Jensen, 2007).

When a new math skill is viewed within the context of a problem, English language learners have opportunities to develop language skills through discussion (Coggins et al., 2007).

The most widely known technique for stimulating creativity in the brain is probably the act of brainstorming, where all ideas are accepted, and there is a greater chance of reaching a workable solution (Gregory & Parry, 2006).

Students with special needs benefit when the class works in groups of fewer than six and the teacher uses directed response questioning so that students have a chance to think aloud (Jensen, 2007).

Teachers can guide students through very difficult solutions to mathematics problems by using a series of well-thought-out questions that address process rather than procedure (Posamentier & Jaye, 2006).

HOW: INSTRUCTIONAL ACTIVITIES

WHO: Elementary/Middle/High

WHEN: During a lesson

CONTENT AREA(S): Cross-curricular

- Give students a content-area question with more than one appropriate answer. Students brainstorm as many ideas as possible in a designated time while complying with the following ***DOVE*** guidelines:
  - ***D****efer* judgment when other students are contributing ideas.
  - ***O****ne* idea at a time is presented.
  - A ***V****ariety* of ideas are encouraged.
  - ***E****nergy* is directed to the task at hand.

WHO: Elementary/Middle/High

WHEN: Before a lesson

CONTENT AREA(S): Cross-curricular

- Stauffer's (1975) Directed Reading Thinking Activity (DR-TA) has stood the test of time with narrative and informational texts. Have students orally predict from a picture, a story title, or a chapter what the text will be about. Have them read a segment of text to confirm those predictions. Then, have them make another oral prediction from the new text they

read. The sequence of predicting, validating, and predicting again continues until the end of the passage or text (Tate, 2014a).

WHO: Elementary/Middle/High

WHEN: During a lesson

CONTENT AREA(S): Cross-curricular

- Use the process of close reading described below to help students comprehend complex texts. These steps can be implemented with the whole class and may take more than one or two days to complete.
  - Following little or no prereading discussion, introduce the text to students.
  - ***First Reading***—Have students read the entire text by themselves without assistance. If time is at a premium, this step can be done for homework.
  - ***Second Reading***—Provide a fluent model by reading the entire text aloud. Stop periodically to discuss vocabulary, the historical or social context of the passage, or a complicated sentence structure. Do not explain the text's characters, ideas, or specific events. Have students discuss the text.
  - Formulate questions students can only answer from the text and pose them to the class. Students should not be able to rely on personal experiences to answer the questions.
  - ***Third Reading***—Have students read the text and locate evidence to answer the text-dependent questions.
  - When appropriate, have students use other brain-compatible strategies, such as drawing, roleplay, or graphic organizers, to improve comprehension of the text. Subsequent chapters of this book will address these strategies.
  - Have students develop one concise sentence to answer each of the text-dependent questions.
  - Have students provide an analysis of the text orally or in writing, including text-based evidence to support their analysis (McLaughlin & Overturf, 2013).

WHO: Elementary/Middle/High

WHEN: During a lesson

CONTENT AREA(S): Cross-curricular

- When writing quality questions that can be used during discussion, Walsh and Sattes (2005) delineate the following five criteria for assessing those questions:
  - There should be a purpose in asking the question.
  - Each question should be clearly focused on the content.

- Each question should engage students at multiple cognitive levels.
- Each question should be concise and clear.
- No question should be asked merely by chance.

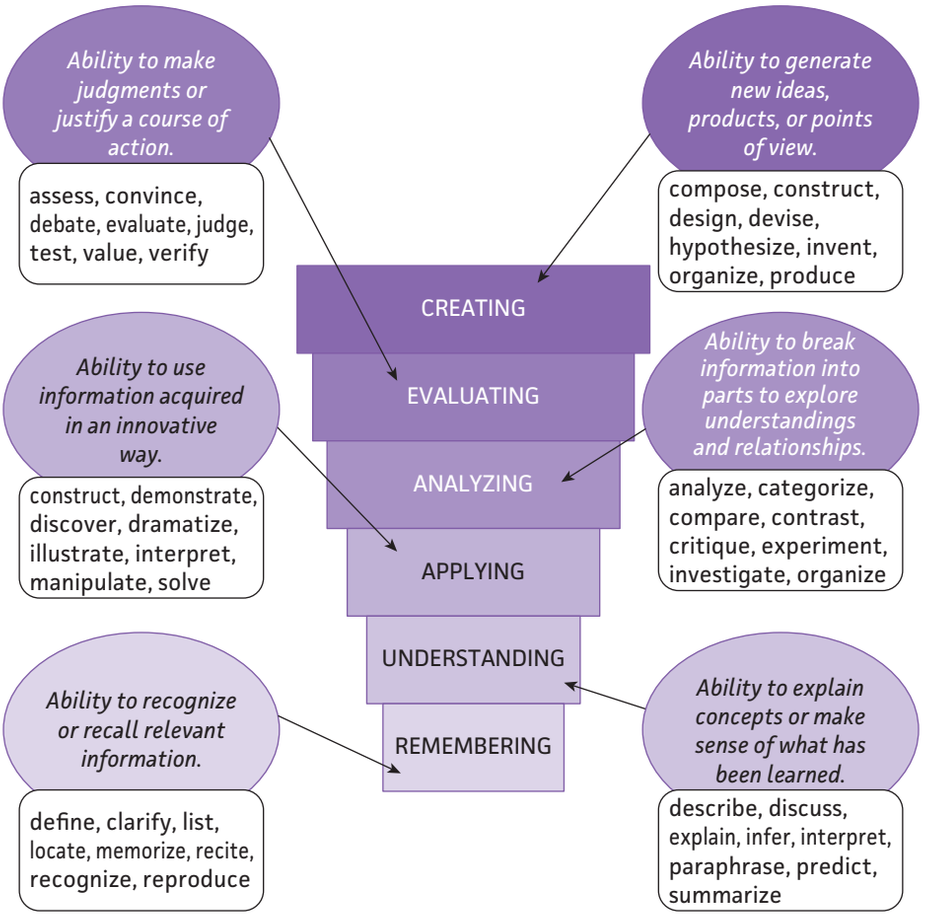
WHO: Elementary/Middle/High

WHEN: During or after a lesson

CONTENT AREA(S): Cross-curricular

- When asking questions in class or creating teacher-made tests, provide opportunities for all students to be successful by asking both knowledge or short-answer questions as well as those that enable students to use their reasoning, critical thinking, and creative-thinking skills. Refer to the circles in Figure 1.1 to ensure that students have opportunities to answer questions at all levels of the revised Bloom's taxonomy, particularly those above the *Remembering* level.

FIGURE 1.1 ● Bloom's Taxonomy (Revised)



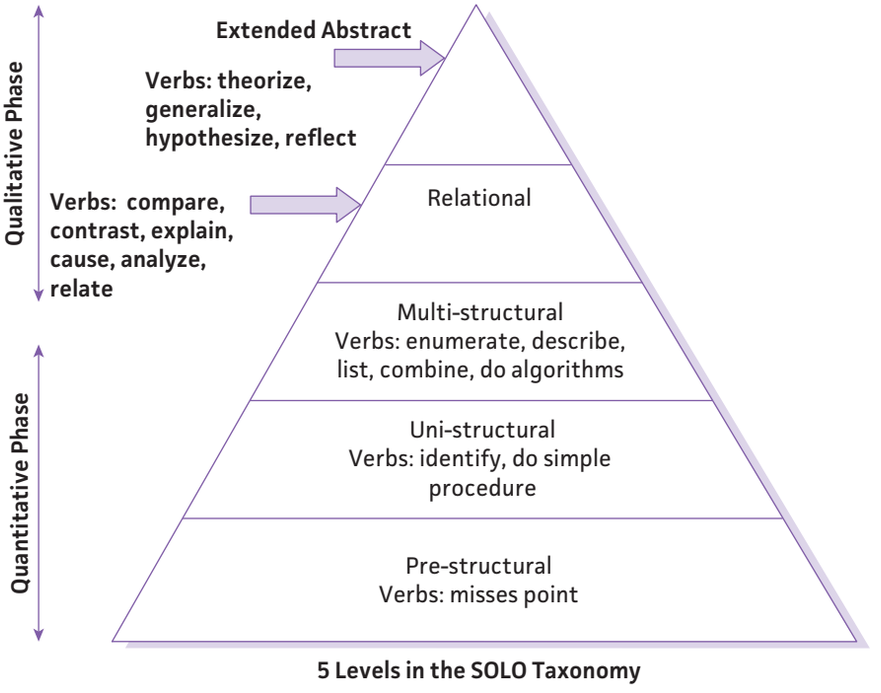
WHO: Elementary/Middle/High

WHEN: During or after a lesson

CONTENT AREA(S): Cross-curricular

- A different taxonomy is the *SOLO* pyramid in Figure 1.2. *SOLO* is a mnemonic device for *Structure of Observed Learning Outcomes* since it encourages students to think about where they are currently performing with their learning and what they need to do to make progress. The five main stages are as follows:
  - **Pre-structural**—*I am not sure about . . .*
  - **Uni-structural**—*I have one relevant idea about . . .*
  - **Multi-structural**—*I have several ideas about . . .*
  - **Relational**—*I have several ideas about . . .* or *I can link them to the big picture . . .*
  - **Extended Abstract**—*I have several ideas about . . . , I can link them to the big picture,* and *I can look at these ideas in a new and different way.*

FIGURE 1.2 ● SOLO Taxonomy



Source: Adapted from Biggs and Collis, 1982.

WHO: Elementary/Middle/High

WHEN: During or after a lesson

CONTENT AREA(S): Cross-curricular

- During cooperative group discussions or as students create original questions for content-area assessments following a unit of study, have them use the verbs in Figure 1.1. These verbs will help to ensure that questions representing various levels of thought are created.

WHO: Elementary/Middle/High

WHEN: During or after a lesson

CONTENT AREA(S): Cross-curricular

- According to Bellanca et al. (2012), there are seven rigorous proficiencies in the area of thinking that students need to master. Each of the proficiencies has three explicit-thinking skills that can be taught from kindergarten through Grade 12 and across all curricular areas. They are as follows:
  - **Critical Thinking—**Analyze, Evaluate, Problem Solve
  - **Creative Thinking**—Generate, Associate, Hypothesize
  - **Complex Thinking—**Clarify, Interpret, Determine
  - **Comprehensive Thinking—**Understand, Infer, Compare
  - **Collaborative Thinking—**Explain, Develop, Decide
  - **Communicative Thinking—**Reason, Connect, Represent
  - **Cognitive Transfer of Thinking—**Synthesize, Generalize, Apply

WHO: Elementary/Middle/High

WHEN: During a lesson

CONTENT AREA(S): Cross-curricular

- Have students work with peers in *families* of four to six. During the lesson, stop periodically and have families discuss answers to questions related to what is being taught. For example, in math class, students could compare their answers to the homework assignment, and when answers differ, they could engage in a discussion to reach a consensus on the correct answer. Have students stay together with their families long enough to build relationships and then change the composition of the families.

WHO: Elementary/Middle/High

WHEN: During a lesson

CONTENT AREA(S): Cross-curricular

- During discussions, sentence starters similar to the ones listed below are particularly effective for English language learners because they enable all students to take an active part (Coggins et al., 2007):
  - I realize that . . .
  - I agree with _____ that _____.

- I would like to add to _____'s idea.
- I don't understand what _____ meant when she said _____.

WHO: Elementary/Middle/High

WHEN: During a lesson

CONTENT AREA(S): Cross-curricular

- Use the **think, pair, share** technique with students. Pose a question or discussion topic to the class. Have them *think* of an individual answer. Then, have them *pair* with a peer and *share* their answer. Then, call on both volunteers and nonvolunteers to respond to the entire class. Always allow students to debrief with a peer before calling on them as a nonvolunteer.

WHO: Elementary/Middle/High

WHEN: During a lesson

CONTENT AREA(S): Cross-curricular

- Present a controversial issue to the class, such as, *Are we controlling technology, or is technology controlling us?* Divide the class in half, and have them research and prepare a debate for one side of the issue or another. Then, role-play the debate by having students take turns serving on opposing teams and orally presenting their arguments to the class. You can judge which side was more convincing at the culmination of the debate.

WHO: Middle/High

WHEN: During or after a lesson

CONTENT AREA(S): Cross-curricular

- Have students participate in a ***Socratic Seminar***. Arrange the class so that students are sitting in two concentric circles. The inner circle speaks first and is given 15 minutes to discuss a couple of analysis questions regarding content previously read. Students in the outer circle are asked to listen carefully and record their thoughts or feedback in a shared Google doc. Then, the roles are reversed, and the protocol is repeated (Tate, 2020a).

Action Plan for Incorporating *BRAINSTORMING and DISCUSSION*

WHAT ARE MY PLANS FOR INCORPORATING MORE *BRAINSTORMING* AND *DISCUSSION* INTO MY LESSONS TO ACCELERATE LEARNING?		
RECOMMENDATIONS	**ALREADY DOING**	**PLANNING TO DO**
Have students brainstorm ideas according to *DOVE* guidelines.		
Use the *Directed Reading Thinking* activity to assist students in predicting what the text will be about.		
Engage students in the process of *close reading* to comprehend text.		
Use the Walsh and Sattes criteria for assessing your discussion questions.		
Ask discussion questions at all levels of *Bloom's* taxonomy.		
Use the *SOLO* taxonomy to assist students in evaluating their progress.		
Have students use the verbs in *Bloom's* taxonomy to create original questions.		
Engage students in the seven rigorous proficiencies for thinking.		
During a lesson, stop and have students discuss an answer to a question with their peers or families.		
During discussions, incorporate sentence starters to enable all students to participate.		
Have students use the *think, pair, share* technique with a partner.		
Have students debate a controversial issue.		
Have students participate in a *Socratic Seminar.*		
Goals and Notes:		

Source: istock.com/SDI Productions

Drawing simultaneously taps into the linguistic, kinesthetic, and visual areas of the brain (Fernandes et al., 2018).