

# 1 Introducing the Brain- Compatible Framework for Student Achievement

*The educator cannot start with knowledge already  
organized and proceed to ladle it out in doses.*

—John Dewey, *Experience and Education*

I have always believed that students of brain-compatible teachers who understand how the brain learns stand a greater chance to achieve on high-stakes tests—and to learn. I set out to find research to help me design a conceptual model that would demonstrate the likelihood that brain-compatible classroom practices indeed advanced student achievement. I chose reputable sources: the five core propositions of the National Board for Professional Teaching Standards (NBPTS, 2007) and the six features of effective instruction identified in Judith Langer’s research (2000) conducted by National Research Center on English Language and Achievement.

The five propositions and six features interface elegantly with the four brain-compatible classroom principles I introduced in the first edition of my book and reiterate in the second. The brain-compatible framework for student achievement will help teachers protect and defend the brain-friendly practices they use to develop the writer within each one of their high-stakes-tested students. The first part of the model relates to my four brain-compatible classroom principles.

## FOUR BRAIN-COMPATIBLE CLASSROOM PRINCIPLES

*SAFETY.* The classroom must be a safe, caring, and trusting environment before learning can take place.

*RESPECT.* Children flourish when their unique combination of learning styles is respected and encouraged.

*NOVELTY.* Interesting, novel, and challenging activities create positive emotional states that promote engagement and genuine learning opportunities.

*MEMORY.* Tapping into and building on existing memories influences genuine learning and nourishes new lifelong memories.

These four brain-compatible classroom principles, which I use to define brain-friendly writing environments, enhance learning across curricula at all levels of instruction from early childhood to young adulthood. If you agree with their tenets, you are likely brain-friendly teachers who care about students and know instinctively how to help students learn. In the twenty-first century's high-stakes testing environment, we need evidence beyond our instincts if we are to successfully defend brain-friendly practices against the test-prep packages forced upon us by administrators pressured to raise test scores. We need evidence that illustrates brain-compatible principles related to safety, respect, novelty, and memory align with reputable research related to student achievement. The second part of the brain-compatible framework for student achievement consists of the five core propositions of the National Board for Professional Teaching Standards (NBPTS, 2007), which provides such evidence.

## FIVE CORE PROPOSITIONS OF ACCOMPLISHED TEACHING

No matter the certification area a teacher pursues, all candidates for National Board Certified Teacher (NBCT) certificates must successfully demonstrate how their teaching practices satisfy tenets grounded in five core propositions that distinguish them as *accomplished* teachers. Since 1987, only 55,000 teachers have earned National Board Certification (NBC). Clearly, the standards are high. Here are the five core propositions that represent the NBPTS policy statement (NBPTS, 2007) on what accomplished teachers *should know and be able to do*:

- Teachers are committed to students and their learning.
- Teachers know the subjects they teach and how to teach those subjects to students.
- Teachers are responsible for managing and monitoring student learning.
- Teachers think systematically about their practice and learn from experience.
- Teachers are members of learning communities.

National Board Certified Teachers (NBCTs) are not only certified, accomplished teachers but also teachers whose students perform well on high-stakes tests. Findings (e.g., Cavalluzzo, 2004; Goldhaber, 2004; Smith, 2005; Vandevort, 2004) have shown that students of NBCTs do better on standardized tests than do students of teachers who are not NBCTs. Of note are the Goldhaber study, which involved the achievement of minority students, and the Vandevort study, which involved the achievement of minority and special-needs students. The research findings strengthened my decision to associate brain-compatible classroom principles with NBPTS core propositions. Research findings from the National Research Center on English Language & Achievement provided another critical component of my framework designed to help brain-compatible teachers defend their instructional practices.

## **SIX FEATURES OF EFFECTIVE INSTRUCTION**

The six features of effective instruction are based on a five-year study (Langer, 2000, 2004) reported by the National Research Center on English Language & Achievement. The study took place in four states and eighty-eight classes in twenty-two middle and high schools that were demographically comparable, from rural to suburban and middle class to urban poor. Though the research was observational versus causal, findings identified six instructional features used by effective teachers in schools where student achievement in reading and writing were higher than they were in typically performing schools. To identify effective instruction, the study looked for features that reflected much more than the current “back to the basics” notions of literacy (where passing tests somehow means proficiency). The features reflected “high literacy” (Langer, 2000) that

refers to understanding how reading, writing, language, content, and social appropriateness work together and using this knowledge in effective ways. It is reflected in students’ ability to engage in thoughtful reading, writing, and discussion about content in

the classroom, to put their knowledge and skills to use in new situations and to perform well on reading and writing assessments including high stakes testing. (p. 1)

Readers familiar with brain-friendly approaches to teaching will appreciate the similarity between the six discrete features of effective instruction fostering student achievement and brain-friendly teaching practices.

1. Successful teachers make connections across instruction, curriculum, and life.
2. Students learn skills in multiple lesson types.
3. Successful teachers integrate test preparation into instruction.
4. Students learn strategies for doing the work.
5. Students are expected to be generative thinkers.
6. Classrooms foster cognitive collaboration.

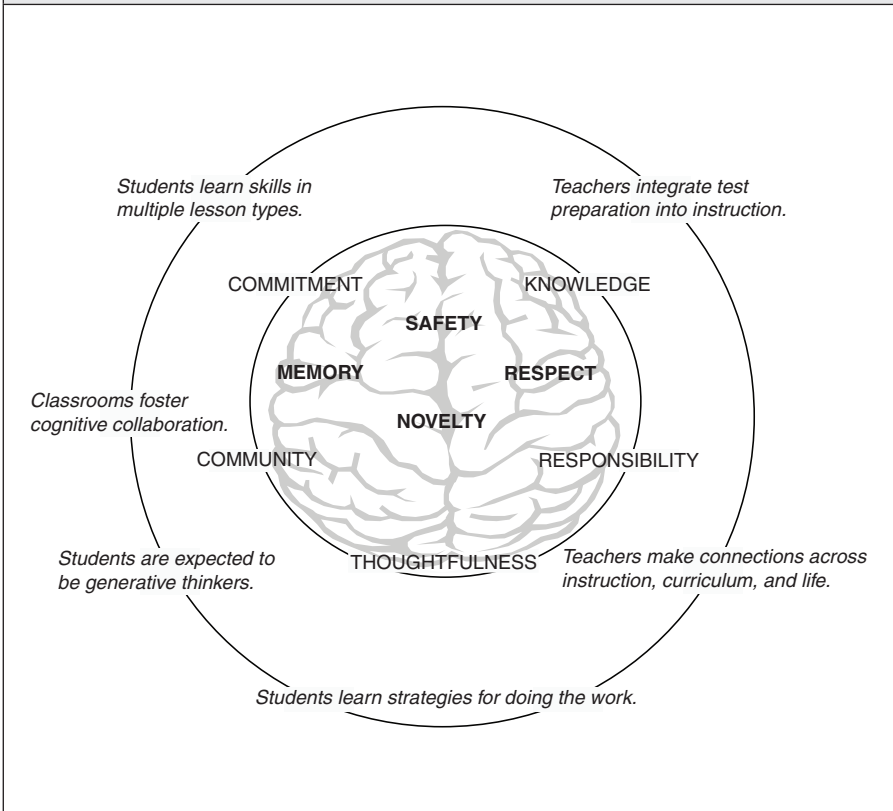
## **THE BRAIN-COMPATIBLE FRAMEWORK FOR STUDENT ACHIEVEMENT**

Concentric circles in the framework (see Figure 1.1) depict the harmony I believe exists among the four core principles of brain-compatible classrooms, the five core propositions of accomplished teaching, and the six features of effective instruction delivered by *effective* teachers. As you read, you will discover how the research-based brain-compatible framework for student achievement will help convince those who would have you use teach-to-the-test practices that the brain (indeed) matters in the classroom.

## **A BRAIN JOURNEY**

The action research that occurs in our classrooms daily is something in which teachers can take pride. The lessons we try, the risks we take, all in the name of our students and their progress, confirm we are teacher-researchers who, ultimately, can become the accomplished teachers (NBPTS, 2007) and effective teachers (Langer, 2000, 2004) that research suggests make the difference in student achievement. As brain-compatible teacher-researchers, we owe it to ourselves to share with students some of the amazing aspects of the learning brain (Blodget, 2007; Caskey & Ruben, 2003). By sharing with students how the brain learns, we share with them that we know our actions, words, and deeds influence the extent to which authentic learning takes place.

**Figure 1.1** Integrated Framework for Today's Brain-Compatible Classroom



Writing on the brain's plasticity and ability to self-repair, Ross (2006) contended educators, like therapists, can make a difference in helping students scarred by negative school experiences restore their faith in teachers, themselves, and learning. Ross's work punctuated the importance of remembering we teachers should do no harm to the learning brain. Let's review brain basics to generate ideas about what we might want to share with our students to help them understand how they think and how they learn.

As a language arts teacher, I start my year by introducing students to me, their curriculum, and to my belief in brain-compatible learning. The brain journey that follows represents the parts and characteristics of the brain I have found most useful to share with my young writers. The journey helps me explain and recommit myself to my four brain-compatible classroom principles of safety, respect, novelty, and memory. The journey lays the foundation for my entire year, so let the journey begin!

## Brain Stem

Imagine we are climbing up and through our spinal column. The brain inside our skull is connected to every part of the body through the spinal cord protected within our spinal column. Our climb up the spinal cord finds us meeting the *brain stem* (see Figure 1.2). The brain stem is the area of the brain in charge of monitoring vital bodily systems, such as the respiratory, circulatory, and digestive systems. The brain stem also is the site of the *reticular activating system* (RAS), which filters information, interprets it as important and worth paying attention to, or *not* worth paying attention to. We may want to share with students our realization that lessons that are interesting and engaging—that is, fun—stand a greater chance of getting noticed by the RAS than do boring test-prep lessons. However, there are ways to make high-stakes test preparation engaging enough to get the “pay attention” green light from the RAS, as we will discover in Chapter 2.

## Cerebellum

As we continue our climb from the brain stem, we encounter the *cerebellum*. This tiny area comprises a tenth of the brain’s weight yet houses more neurons than the rest of the entire brain! Once thought to be responsible solely for movement and coordination, the cerebellum is actually involved in cognitive processes as well. Besides helping us walk, jump, drive, and otherwise move, functionality of the cerebellum enables us to visualize our rehearsal of motor tasks, from doing back flips off diving boards and shooting three-pointers to presenting speeches before audiences, moving across a stage gracefully, imagining our gestures flawless.

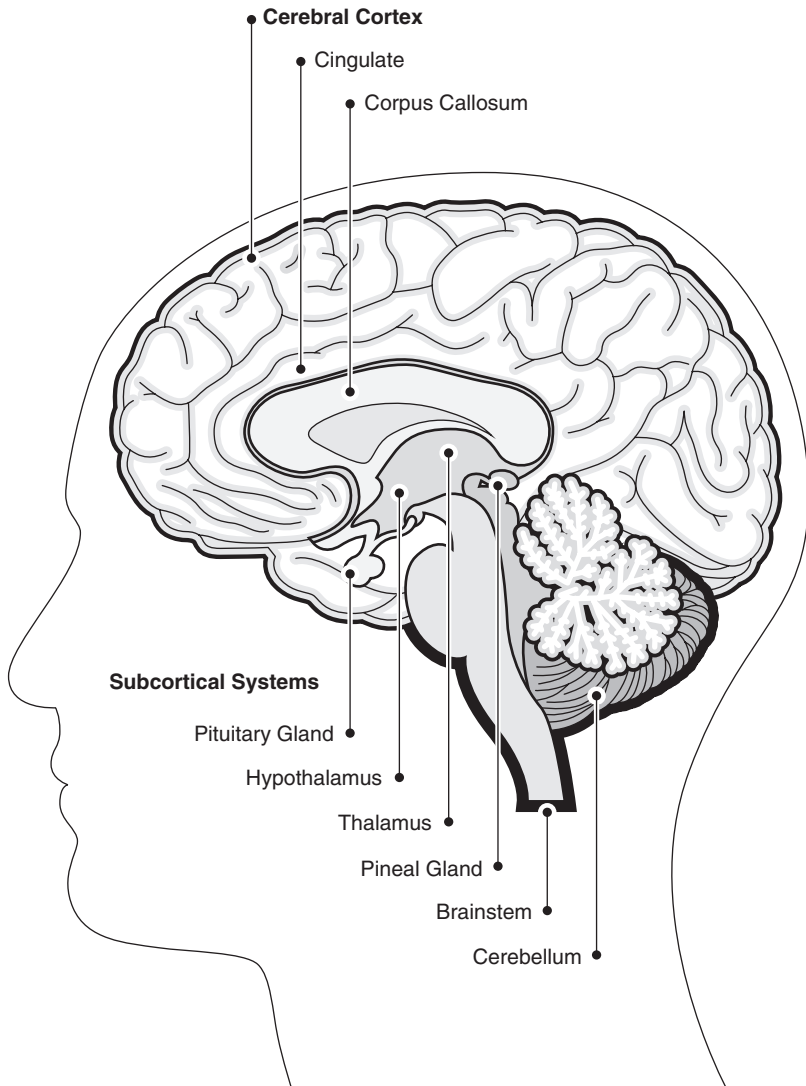
## Cerebral Cortex (Cerebrum)

Climbing upward and around, we meet the amazing *cortex*. Unraveling a nylon shower sponge and laying it flat helps to illustrate that the gray matter of the cortex that covers the grapefruit-sized (Sousa, 2006b) mass is actually two square feet! Weave through its tenth-of-an-inch depth, its thousands of miles of connective fibers, its millions of intricate neural highways connecting with white matter to appreciate how the brain processes complex functions like thinking, planning, critical thinking, and controlling our emotion (Sylwester, 2007).

## Corpus Callosum

The gray and white matter of what is most often known as the *cerebrum* is made up of two hemispheres connected by the *corpus callosum*, millions of nerve fibers that bridge the two hemispheres in their unique crossover

**Figure 1.2** Selected Interior Brain Systems



SOURCE: Sylwester, R. (2007). *The Adolescent Brain*. Thousand Oaks, CA: Corwin Press. Illustration by Peter Sylwester.

communication system. You can demonstrate for students the crossover of nerves from the right side of the body to left hemisphere and from the left side of the body to right hemisphere using a simple arm reach. Reaching your right arm across to the left side of the body is an action controlled by the *left*, not right hemisphere. Reaching your left arm across to the right side of the body is an action controlled by the *right*, not left hemisphere.

## Cerebral Lobes

We observe that the wrinkles and folds of the two hemispheres appear divided into four segments or *lobes* (see Figure 1.3)—the *frontal*, *parietal*, *occipital*, and *temporal* lobes—that primarily process the following:

- *frontal lobes*: decision making, higher order thinking, problem solving, working memory
- *parietal lobes*: space and location relationships
- *occipital lobes*: vision
- *temporal lobes*: hearing, recognition of faces and objects, memory

We will develop more effective classroom management strategies if we remember the frontal lobes do not fully develop until adulthood. Sometime our students act out because they have little choice; their ability to reason and control themselves is still forming.

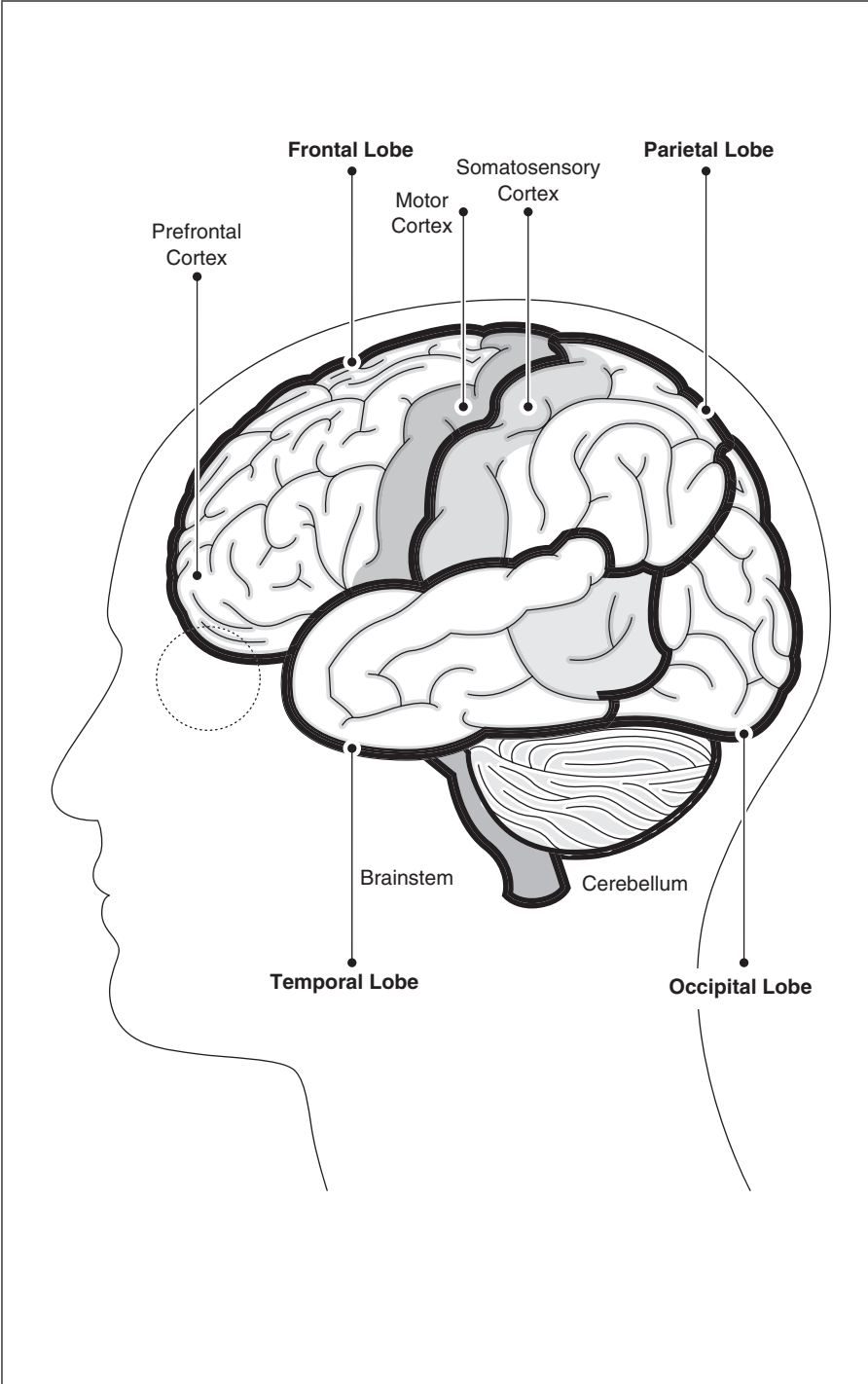
## Amygdala and Hippocampus

Among the structures to be discovered deep inside the temporal lobe as we traverse a hemisphere of the cerebrum's white matter are two structures particularly relevant to learning. The almond-shaped *amygdala* signals our *fight-or-flight* response to environments deemed unsafe or threatening. When students feel unsafe or threatened, they cannot help but attend to self-preservation rather than cerebral processes. Brain research most assuredly suggests that the human brain is an emotional brain: to the extent that we attend to the brain's emotional needs, we will harness all else, including authentic learning.

The importance of a threat-free classroom cannot be overemphasized. But what is threat, exactly, and how does it influence the brain and learning? When students feel threatened by intimidation, embarrassment, failure, lack of choice, and other dangers, their anxiety and fear, coordinated by the brain's amygdala, trigger the production of cortisol and epinephrine, stress hormones that put the body in a fight-or-flight survival mode. Unfortunately,



**Figure 1.3** Selected Interior Brain Systems



SOURCE: Sylwester, R. (2007). *The Adolescent Brain*. Thousand Oaks, CA: Corwin Press. Illustration by Peter Sylwester.

learning and other cognitive functions must take a back seat when the brain's priority is to cope with real or perceived danger.

On the other hand, what happens when learners feel safe, supported, and trusted? The brain can relax and learning can soar. Teachers who consistently provide respectful encouragement, feedback, and choice create classrooms where learning naturally happens. For example, the brain's response to choice usually includes an increased production of serotonin, dopamine, and noradrenaline. These chemicals are known to enhance a sense of well-being and motivation. Choice, therefore, may actually "feed the brain."

Students who feel safe and respected are more likely to accept challenges and sustain the motivation necessary to learn. Teachers who refrain from demanding immediate responses to their questions reduce their students' anxiety and allow them to engage in the kind of critical thinking necessary for meaningful learning to occur. Feedback that is prompt, supportive, and specific provides learners with a vital barometer by which to measure their strengths, understand and correct their weaknesses, and progress toward mastery.

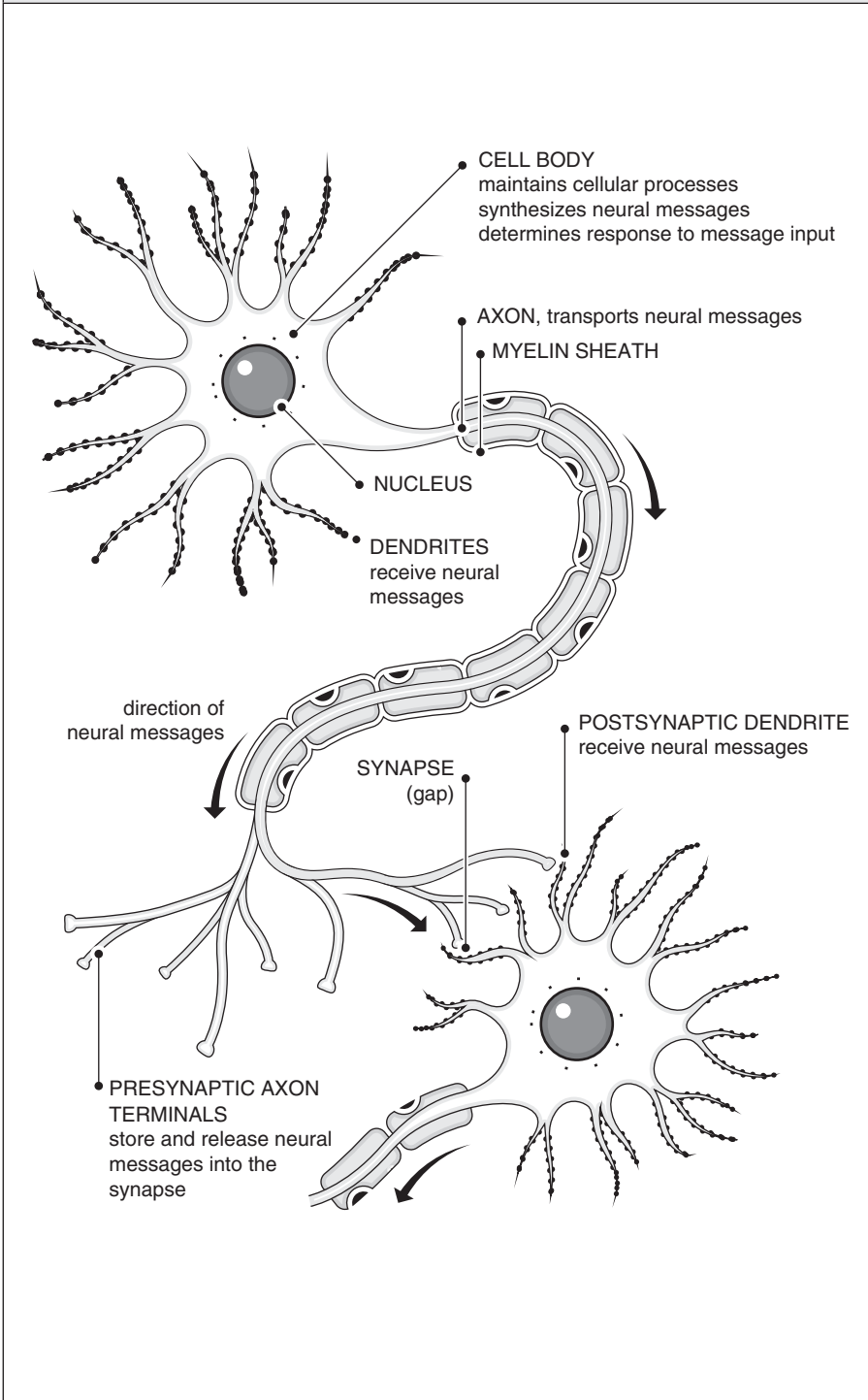
Understanding that not all stress is bad is important. In fact, when we are underaroused and lack the stimulation to perform optimally, boredom can set in. Assignment deadlines, accountability pressures, and delays are just some of the stressors that are part of learners' daily lives and that, in moderate amounts, can help drive learning and achievement.

Attached to the amygdala is the seahorse-shaped *hippocampus*, essential to memory consolidation. Stress interferes with hippocampus processes involved in memory making (Sprenger, 2007), so ensuring a safe and caring environment is well advised. We may want to share with our students that our awareness of the proximity of the flight-or-fight structure of the amygdala to the memory-making structure of the hippocampus helps us appreciate the importance of creating and sustaining safe and positive environments that help make their learning experiences indeed *memorable*.

## The Neuron

Our journey is not complete until we have explored the cellular structure that is the essential element of the brain: the *neuron* (see Figure 1.4). The neurons of the brain, 100 billion of them, are designed to move information. Visual, auditory, problem-solving, emotional, any information at all, is moved in a manner that may be compared to information moved through the thousands of wires, cables, and computer chips that electrically receive and send information into our homes where we experience everything from telephone conversations to virtual reality television shows.

**Figure 1.4** A Functional Model of Two Related Neurons



SOURCE: Sylwester, R. (2007). *The Adolescent Brain*. Thousand Oaks, CA: Corwin Press. Illustration by Peter Sylwester.

Each neuron is its own information processor, its own little computer chip. Each neuron has tens of thousands of connections to other neurons! Like any computerized system, the brain's approximately 100 billion neurons rely on their unique and intricate hardware system to perform input and output processes. The neuron's primary mechanisms are *dendrites*, *axons*, and *synapses*. *Dendrites*, the input hardware of the neuron, are lacelike branches that receive information from other neurons. The *axon*, the output hardware of each neuron, is an armlike structure that sends information to the tens of thousands of dendrite branches of *each* neuron waiting to receive information. *Synapses* are miniscule gaps that serve as the brain's processing conduits. Learning happens when electrical and chemical (*neurotransmitter*) activities enable the axon of one neuron to *transmit* information to the receiving dendrites of another. Caskey and Ruben (2003) suggested that evidence of synaptic pruning occurring during adolescence helps to explain the adage "Use it or lose it." Connections that are reinforced through repetition are strengthened, whereas those connections that are not reinforced are pruned away. Daily practice of correct skills will help students make the connections necessary to identify errors when they present themselves in their writing or on high-stakes tests (see Chapter 2).

The 100 billion neural axons electrochemically communicating with the ten thousand dendrite branches of *each* of the billion neurons makes for one incomprehensible number of potential synaptic events and one mighty powerful supercomputer that is the brain. Imagine how excited students will become when they know the potential power of their brains and the importance of the adage "Use it or lose it"!

## CELEBRATING THE LEARNING BRAIN

As technology advances, brain researchers and science have been able to use newer and more sophisticated techniques and methods to monitor brain activity. They have discovered there are few absolutes regarding brain components and their functionality (Jensen, 2007). We do know that the brain's plasticity enables it to change, to accommodate the myriad of events, accidents, trauma, and disappointments each person experiences. We should celebrate the brain's resilience and malleability as it pursues its quest to learn. One study (Draganski et al., 2004) that illustrated the plasticity of the learning brain used MRI images of the brains of student jugglers. Images showed an increased density in the part of the brain (i.e., occipital lobes) responsible for vision as students learned how to juggle three balls. However, when the students stopped practicing, they lost their juggling skills and the

## MORE ABOUT THE BRAIN

Often the only familiarity students have with the brain and scientists is what they know from movies and tales about Dr. Frankenstein. When they ask questions (and they will) about how scientists really learn about the brain and its functionality, encourage them to do research on the brain. Invite them to search the Internet to learn more about the incredible technology science uses. Provide them with a list of keyword suggestions such as *magnetic resonance imaging* (MRI), *functional magnetic resonance imaging* (fMRI), and *positron emission tomography* (PET). Be sure to offer several Web resources that will help them learn more about the amazing brain. Here are a few:

*Brain Connections* at <http://www.brainconnections.com>

*The Dana Foundation's Brain Kids* at <http://www.dana.org/resources/brainykids/>

*National Institute of Environmental Health Services Kids' Pages* at <http://kids.niehs.nih.gov/home.htm>

brain density that had occurred as well, the brain region returning to its original density, graphically demonstrating “Use it or lose it.”

Another study (Immordino-Yang, 2005) demonstrating plasticity involved two subjects, both boys, both successful in school, who had brain hemispheres removed due to seizures—one boy, the right hemisphere at age three; the other, the left hemisphere at age eleven. Findings suggested their brains capitalized on the strengths of their existing hemispheres and adapted them to fulfill the processing roles of their missing hemispheres.

Sharing such stories about the brain with our students helps them understand how their brains are truly supercomputers that can adjust and compensate and have the capacity to override incredible obstacles.

## TWENTY-FIRST CENTURY BRAIN-COMPATIBLE TEACHERS

If we hope to become or remain brain-compatible teachers, we need a resource like the brain-compatible framework for student achievement

because it relies on research related to the single most important issue driving NCLB legislation and state and district decisions: high-stakes test *results*.

The framework can arm us with the resources to keep our classroom practices and core values intact rather than give them up for packaged promises of higher test scores. Even better, we can take comfort in the knowledge that even while we rely on research related to higher test scores, we know we are really defending what we truly believe in: brain-compatible teaching.

Research on the psychological syndrome of burnout in the NCLB teaching environment led me to discover significant numbers of teachers are dissatisfied with being forced to implement programs they do not believe in (e.g., Abrams, Pedulla, & Madaus, 2003; Clarke et al., 2003; Moon, Callahan, & Tomlinson, 2003). It becomes critically important, therefore, that teachers find ways to arm themselves with research related to student achievement so they can better defend the brain-friendly decisions they make in their classrooms. Unless teachers can defend their brain-compatible teaching practices with research findings that illustrate the compatibility of their practices with student achievement, they will be unable to question and challenge school and district directives to replace best practice with test practice. Administrators, likewise, understanding that brain-compatible classroom principles are compatible with research-based propositions (NBPTS, 2007) and features that foster student achievement (Langer, 2000, 2004), may better defend leadership decisions that work to keep safe their students' brains as well as their test scores.

## **TWENTY-FIRST CENTURY HIGH-STAKES-TESTED STUDENTS**

How very different today's students are when compared to their pre-NCLB counterparts focused on in the first edition of this book. The pressure of high-stakes mandates has piled high their desks with standardized tests in reading, mathematics, writing, science, and more. Add the testing pressure to the plate of pressures our students already endure: pressures to have the right friends, the perfect body, complexion, clothes and, worse, pressures to survive poverty, neglect, abuse, and illegal entry status. What of our English language learners who struggle with communication barriers? State laws often mandate districts to mainstream English language learners into regular classes before they have mastered even their own languages, let alone English.

Beyond what school records report, how little we know about the outside lives and inner thoughts of our high-stakes-tested students. They speak in a

cell phone language that connects them with friends, family, and music. They write in a text message code whose abbreviations and syntax confound the most astute language arts teachers (especially those who remember phones with dials, not buttons). Cellular-phone language has made teaching effective oral and written communication skills more challenging than ever before and may even alter our notion of effective communication.

## CAN YOU HEAR ME NOW?

Educators of all types, from teachers to board members, but especially writing teachers and coaches, must remain motivated in their desire to help students of all ages, colors, and creeds know the power of high literacy skills.



I hope the following chapters help you discover how brain-friendly approaches to learning harmonize with core propositions related to accomplished teaching and the six features of effective instruction that foster high literacy *and* high performance on tests. Collectively, each chapter's commentary, stories, examples, and reflections provide teachers a comprehensive road map. If used, the map will help teachers design defensible plans for their brain-compatible classrooms, plans that help ensure students will not only survive but thrive within their high-stakes-testing classrooms.

As stated in the preface, the following chapters are organized around six research-based features of effective instruction that fostered achievement among students in schools with poor and diverse student populations (Langer, 2000, 2004).

## SIX FEATURES OF EFFECTIVE INSTRUCTION

1. Successful teachers make connections across instruction, curriculum, and life.
2. Students learn skills in multiple lesson types.
3. Successful teachers integrate test preparation into instruction.
4. Students learn strategies for doing the work.
5. Students are expected to be generative thinkers.
6. Classrooms foster cognitive collaboration.

The setting of the study (Langer, 2000) is significant because students in such settings are the very students identified by NCLB in its drive to close the achievement gap. *Beating the odds*, part of the study's title, is exactly what the teachers in the study did.

The next six chapters describe for you the features of effective instruction that emerged as patterns in schools where teachers were beating the odds and helping students not only succeed on high-stakes tests but also learn. I hope exploration of the six features within the brain-compatible framework for student achievement will help you discover how you might defend your best practice against test practice.

## QUESTIONS FOR REFLECTION

1. How well does your classroom reflect a safe, caring, and supportive environment for all students?
2. To what extent do your learners feel their unique qualities and learning styles are respected and encouraged?
3. In what ways and how often do you facilitate interesting, novel, and challenging activities in your classroom?
4. In what ways and how often do you tap into learners' existing memories when presenting new topics or engaging students in learning activities?