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*What We Know About the Brain and
Learning: Integrating Neuroscience,
Psychology, and Education*



Chapter 1

What We Know About the Brain and Learning: Integrating Neuroscience, Psychology, and Education

In the past, educational methods . . . have never been based on neuroscience or any research based on an understanding of how the brain actually learns.
—Susan Y. Bookheimer, neuroscientist

Thousands of scientists from many disciplines have been on the great adventure of trying to figure out what's going on in the brain. One of the most exciting prospects of this new understanding has the power to help adolescents learn, live more productive lives, and achieve their maximum potential. Now that educators are caught up in the excitement, we are thinking about brain development with a different perspective.

For the first time we are beginning to look for neuroscience, psychology, and education to speak some common language, a language that communicates how we are bridging the gap between the three disciplines. Understanding the rudimentary anatomy and physiology of the brain will allow educators to talk to the neuroscientists and to transfer some discoveries into educational practice.

The Mechanic and the Neurosurgeon

Bob was a Volvo mechanic. To get where he was, Bob had years of experience and had training specifically for the computerized cars of today. Receiving his paycheck for the week, he realized again that his salary wasn't commensurate with what he valued his worth as a mechanic.

That afternoon as he was removing the computerized cylinder head from a newer model, he spotted a well-known neurosurgeon from UCLA in the customer waiting room. The surgeon was there waiting for the service manager to come take a look at his Volvo when the mechanic shouted across the hall, "Hey, Doc, can I ask you a question?" The neurosurgeon, a bit surprised, walked into the shop where the mechanic was working the cylinder head. The mechanic straightened up, wiped his hands on a rag, and asked, "So Doc, look at this engine. I open its heart, take the valves out, repair any damage, replace the computer, and then put it all back in, and when I finish, it works just like new. So how come I get such a meager salary and you get the really big bucks, when you and I are doing basically the same work?"

The neurosurgeon paused, smiled, and whispered to the mechanic, "Try doing it with the engine running!"

So it could be said of any understanding of the living, running human brain. When out of the skull, this nondescript-looking mass of reddish Jell-O has little to offer other than a mechanic's examination, but inside the skull, the living



With the Internet at every student's fingertips, researching in the stacks has become outdated.

brain is probably the most complex structure on the earth. Let's take a brief look from the beginning.

It All Happened So Fast!

Education has remained the same for several decades, except for the impact of technology on the students and the classroom. In high school we still issue big colorful textbooks that overload backpacks, provide homework much as we always have, and give tests on Fridays and at the end of the chapter. Now you can read a book on the video monitor and find everything you ever needed by looking it up on the Internet. What ever happened to teaching kids to use the abstracting journals or to sit in the stacks for hours on end to research one topic? Much has happened since the days that students needed those skills.

A graduate student preparing for a teaching credential recently expressed some dismay to her professor when challenged to figure out a science problem in class. The class was shown the "dunking duck" and was requested to figure out the solution as a teacher-led inquiry problem progressed. After

the activity, the frustrated student raised her hand and said, "I didn't care that we had to think. All I wanted to do was to 'Google it' to find the answer." This may typify our students' feelings toward taking advantage of the speedy technology so readily available. What happened to the value of having students think about a problem for a time?

We will need to adjust to the rapid flow of technological advances that will replace our traditional methodology in the classroom. With the aid of the world at their fingertips, adolescents will no longer tolerate a learning environment out of the last century. The research coming out of the neuroscience labs may be changing all of that.

In a short fifteen years, the study of neuroscience has morphed into an emerging source of information that would startle even the most forward thinking of yesteryear's scientists. Sigmund Freud would be baffled, B. F. Skinner would be perplexed, and Hans Selye would have been mystified. Even Einstein wouldn't have fathomed it! Jean Piaget, however, would have said, "Yes! Now they will believe me!"

The Caution Sign

Scientists have warned educators who have become fascinated with the latest findings in neuroscience that it is difficult to draw sweeping conclusions about

learning in the classroom. Despite this, many educators sense a growing need to translate the findings from brain science to some sort of useful guidelines. Where's the guidance for educators? There is a need to look for a balance between the two concepts:

Generalization #1

"Brain-based learning is the answer."

Generalization #2

"Neuroscience research is speaking directly to educators."

One extreme from generalization #1 might be exemplified by the then-governor of Georgia Zell Miller's initiative to give every mother in the state a classical CD featuring Mozart music. This was to be played to her baby in an effort to enhance the child's intelligence. Extrapolated from the Mozart effect research at the University of California at Irvine (Rauscher, 1993), the actual findings just do not support the expense and effort. The term "Mozart effect" was coined by the media after a 1993 *Nature* publication showed that college students who listened to the Mozart Sonata for Two Pianos in D Major had short-term subsequent enhancement of their spatial-temporal reasoning. The popularization of neurological research findings in the educational community should be tempered by cautious application and recommendations.

In spite of the politics, many teachers are delighted to learn how some of the brain research applies to learning and the classroom. Just as elated are the neuroscientists who see how beneficial their work can be when used in a conservative and meaningful context. The caution sign still needs to be heeded, however, because all of this has happened so fast to an industry (Education) that moves so slowly.

How have we come so far in such a short time? The partial answer lies in the advancement of technology and the rapid development of high-speed computers. In Chapter 2 we will look at some of this technology in closer detail. These inventions have allowed advancement unparalleled in the history of man. One wonders if the next few decades will show a continued extrapolation of the rate of discovery. A rather scary thought educators should recognize is that the dynamics of discovery are often impeded by the sluggishness of changes in educational practices.

The Aims of This Book

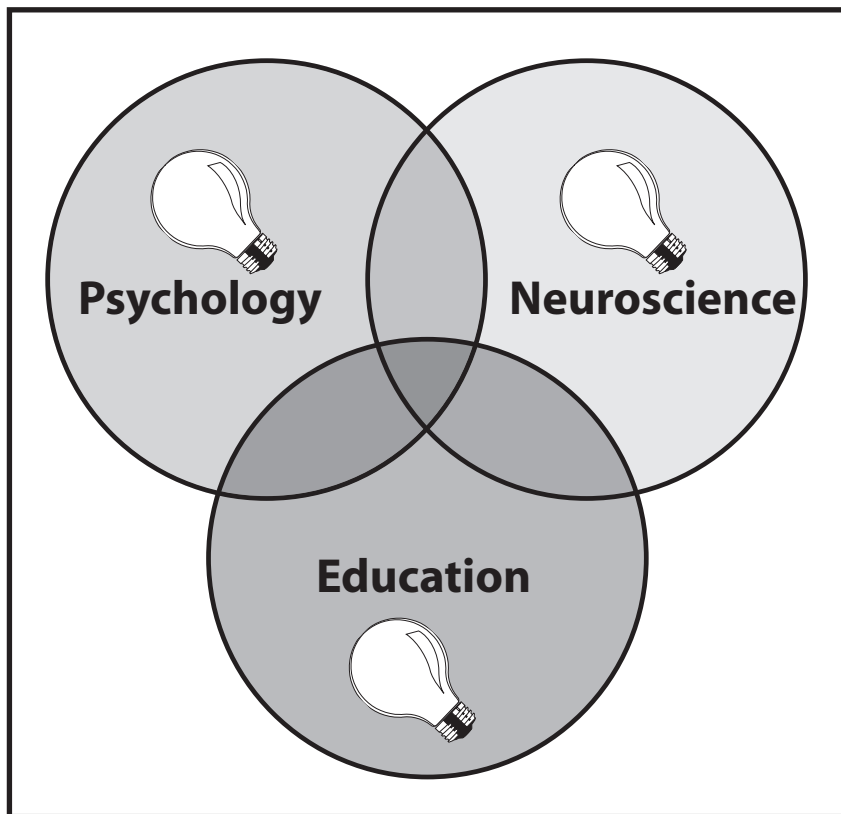
It has been said that neuroscience literature older than eight or nine years has little application to education, and prior to that, very little overlap is seen in the literature from the two disciplines. Fortunately, translators like Eric Jensen, Robert Sylwester, Pat Wolfe, and David Sousa changed all of that. Understanding the significance of the 1990s "Decade of the Brain," these translators and many others focused on helping educators understand the momentous, albeit small, fraction of applications from neuroscience and psychology to education.

There has been an almost inevitable backlash from skeptics who claim the translators have oversimplified neuroscience research and overinterpreted the findings (Bruer, 1999). What John Bruer and others have failed to see is the overwhelming enthusiasm from educators for understanding how people learn. For those of us in the classroom, it's easy to support the arguments in favor of incorporating findings from neuroscience into the field of education.

To put this in perspective, there are three themes to be pursued in this book. First, the inner workings of the brain at a rudimentary level with examples applicable to teachers of secondary students. Aspects of biology, physiology, and chemistry can help teachers understand the primary underpinnings of the structure, organization, and development of the human brain at different stages of maturity.

Second, the brain has been considered a black box until recently and studied only from the outside. The input from psychology will help us understand the cognitive aspects of behavior in educational contexts. Again, the examples and stories focus on the target audience—middle- and high-school teachers.

Third, the practical application of knowledge about adolescent human behavior to promote more effective learning and teaching. Understanding the link between education as a social function and a scientific one helps a teacher adapt to today's adolescent population.



Thanks to the "Decade of the Brain," information from psychology and neuroscience is now having an impact on education.

It is important in this endeavor to be careful in distinguishing between what neuroscience, psychology, and education are saying. We also need to be cautious about how we translate findings from one area to another.

The Beginnings

In the early part of her pregnancy, almost every mother wonders what this growing creation inside her belly will become. The baby's brain metamorphosis begins early. A faint neural plate forms just days after conception from a small ball of beginning cells. If you could see it under a microscope, the tiny neural groove would become quite distinct in a few days to form a tubelike figure that begins to form the mysterious brain and spinal cord. The protoplasm of life now takes over. Getting surges of chemical instructions and blasts of protein that tell it to produce glial cells, the primordial brain-like tissue starts its life by changing into something else—a tradition that will follow it throughout its existence. The glial cells tend to the potent neurons all of their lives. Like ladies in waiting, the glial cells spend their early existence ensuring that the neurons are moved to just the right places to form the brain's organization. Racing around and helping neurons find partners, groups, layers, and organizational networks seems to be the primary job of the glial cell force that outnumbers neurons ten to one. They provide sufficient care to help the wondrous neuron population to multiply into more than one hundred billion copies by the time of birth (Scheibel, 1998).



Foundational brain development takes place in the fetus during pregnancy.

The nine months that the individual's brain takes to develop in the womb are extremely critical. This is virtually the only time the person has to grow a full set of neurons. Called neurogenesis—*neuro* meaning "mind," *genesis* meaning "beginning"—the process was baffling to scientists when it was first discovered a few years ago. Here's why: At the rate of about 250,000 neurons a minute, the new brain starts building early. By about twenty-eight weeks, or seven months in utero, the fetal brain has proliferated about twice as many neurons as it will need when it is born. In the last two months of fetal development, genetically programmed cell death (apoptosis) takes place.

When scientists first discovered this seemingly wasteful procedure it was alarming. Yet we now know this happens during all normal brain development. In the last two months before birth, the brain prunes away about half of its cells. From that point on no appreciable number of neurons is lost in the healthy brain until adolescence, when another pruning takes place (Giedd, et al., 1999).

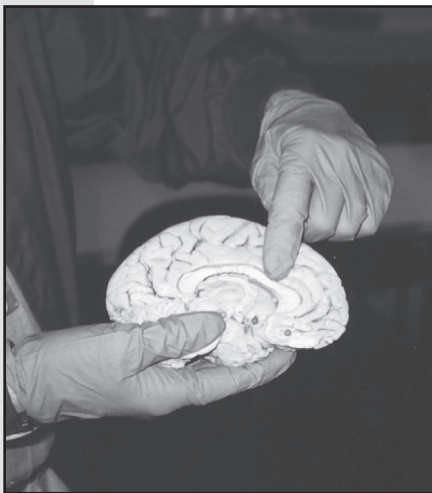
By the end of the human gestation period, an incredible mass of brain tissue in the soft, melonlike skull functions to provide the child with the potential for thinking, talking, feeling, and being a distinctively conscious human being.

The infant cortex, a mass of soft white matter, waits to be spun with insulating fatty material to cover the naked neurons that will allow a child to suckle, see, hear, touch, and curl tiny fingers. This process, called myelination, is what allows nerve cells to conduct electrical messages. What joy there is to know that quadrillions of connections will be made to form a brain capable of becoming a fully formed child in just a few years!

While the anxious and dazed postpartum mother wants to view her infant immediately to check out whether her child has all the fingers and toes, it is the mysterious brain that every mother should wonder about after she has given birth. It's what's inside that downy covered sphere that counts most.

Each child is born with an extraordinary range of potential, especially when compared to any other living thing. With a bulging neocortex yet to be explored and a palate capable of making complex sounds in only a few years, the human child stands like a giant redwood when compared to the tiny seedlings of the animal world. Neural templates will, when formed, influence cognitive functioning throughout life. Social and emotional organization will follow with the enormous influence of experience. Perhaps to a greater extent, the experience of the first five years of life will dominate the direction of this primitive little mass of neurons.

The influence of experience in determining how the brain will develop is greatest in the first years of life. Consistent, predictable, nurturing, and enriching experiences help a child to develop personal potential. While this research says to middle- and high-school teachers that the die is already cast by the time students reach us, the influence of the adolescent years and the formation of neural networks from twelve to sixteen years of age hold great potential for changing the templates formed in the first few years. The research to substantiate this statement comes to us from brain scans recently derived and studied (Giedd, 1999).



From the moment of birth, the brain has almost unlimited growth potential.

As the infant brain begins to grow, it starts to define who the person is. By the time a child begins to acquire rudimentary language, caretakers are making assumptions about what this person is going to be like. Like other illusionary correlations (people tend to remember times when two events co-occur and forget the times when they don't), mothers and fathers see their personalities and physical traits emerge in the infant. They see expressions, mannerisms similar to their own, and more important, a temperament beginning to form.

Multifunctioning Magic

The brain is the most complicated organ in the world. It consists of more than one hundred billion neurons and a trillion supporting cells. Every neuron is connected to hundreds, perhaps thousands of other neurons forming complex networks. These networks make more connections than stars in universe. The brain occupies only 2 percent of body's weight but uses 20 percent of the oxygen taken into the body. If you were to compare a piece of brain tissue to a sand grain at the beach, that tiny space would occupy about 100,000 neurons (Amen, 2001).

The brain is capable of doing many things at once. It can simultaneously drive a car, listen to music, see road signs, and complete unrelated tasks like developing a lesson plan while driving to school. Scientists are discovering how and where our brains analyze the environment by taking in data from all the senses—sight, hearing, touch, taste, and smell. The dilemma is how to find out what the brain does to bind all the elements of an event together and to interpret what is happening at a given time. For instance, we see a blue car pass us on the left. The shape, color, movement, and location are all processed in different parts of the brain, but we see the entire event as a whole without being conscious of the discrete input that is required to make the scene possible. How? How do you explain consciousness? Antonio Damasio in *The Feeling of What Happens: Body and Emotion in the Making of Consciousness* builds a model of how consciousness is constructed on emotional underpinnings. He is one of the first scientists to describe the neurobiology of consciousness. Scientists like Damasio are beginning to understand and describe what it means to “feel.” This human endeavor points to an awareness of the past and an anticipated future along with a feeling of self, i.e., this is where I live, this is the kind of person I am (Damasio, 1999).

How amazing it is to sense the world around you! Every fragment of information is stored or discarded in this complex system. We remember almost nothing before the age of three years. The hippocampus, which embeds the starting place for long-term memory isn't mature enough yet to do its job (Carter, 1999). Emotional memories, however, are already being stored in the amygdala, which most likely begins working at birth.

Connecting to other human beings is possible only because of the associations the brain has made through the vehicles of language, religion, and technologies. As humans we have the distinct advantage of being able to record and reflect the synthesized experiences of hundreds of human generations that had brains before us.

The future is on the other side of the fulcrum point. It connects you to the next generation. If you have children, you pass on the gene pool and experiences of your own life to them through your persona and what you have taught them. Interestingly, teachers influence the experience part of the learning ledger as much as anyone, and possibly more than some parents.

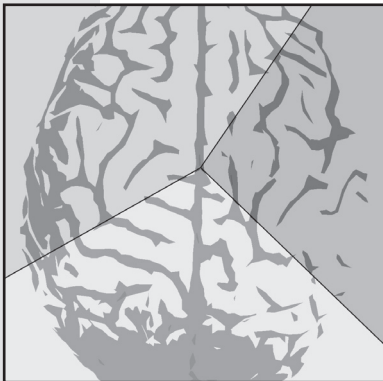
It's a Jungle in There

In order to perform all of the things a brain must do, it has morphed from the early beginnings after birth into an astonishing and highly elegant structure. The brain is not just one single mass of tissue but a complex organization within its parameters and beyond. The great mediator qualities of the brain control systems far and wide. In general, the complexity of brain structure and the functions that these different structures mediate are organized in a bottom-to-top way.

All kinds of analogies have been proposed to describe the functioning brain, none better than well-known brain research translator Eric Jensen's "Human Brain, Human Jungle" from *Completing the Puzzle* (1996):

The jungle is active at times, quiet at times, but always teeming with life. The brain is similar. It is very active at times, much less at others, but always alive and busy. The jungle has its own zones, regions, and sectors: the underground, the streams, the ground cover, the low plants and shrubs, the air, the taller plants, the trees, etc. The brain has its own sectors for thinking, sexuality, memory, survival, emotions, breathing, creativity, etc. While the jungle changes over time, one constant remains true—the law of the jungle is survival and no one's in charge. Just as no one runs the jungle, neuroscientist Michael Gazzaniga reminds us that no single region of the human brain is equipped to run our brain. It is well connected but there is no "command center" for best efficiency.

Jensen goes on to say, "Keep that concept in mind: that the brain is best at learning what it needs to survive—socially, economically, emotionally, and physically. From your typical student brain's point of view, remember that 'academic success' is often quite low on its list of to do's!"



Paul MacLean's Triune Brain theory paved the way for recent neurological advances.

The Basic Parts

The brain has tons of parts! While this is not a book on brain anatomy and physiology, a brief treatment of some critical structures and functions of the brain may help the reader appreciate how marvelous this apparatus is. Before examining the major areas of the brain, let's spend a few moments exploring how we got there.

Paul MacLean, a pioneer of modern neuroscience, in 1970 defined three distinct systems within the brain that correspond to key evolutionary systems that have developed across various species. This model is known as the Triune Brain model.

The Triune Brain model defined the lower, less complex areas of the brain as being similar in structure and function to the "reptilian brain." For years this model seemed to predominate as the way to explain that emotion was confined to MacLean's second level of evolutionary organization, the limbic system. It

also gave credence to the theory that the crude brains of reptilian forms may have given rise to high brain forms. In the last decade, Joseph LeDoux has urged that scientists drop that view and recognize that emotion engages many parts of the cortex. Credited with original research that traced the emotion of fear throughout the brain, LeDoux suggests that different emotions take different pathways and the use of MacLean's terms is outdated based on recent findings (LeDoux, 1996). Research continues to support the view that parts of the limbic system and emotion are related, if not exclusive (Zull, 2002).

Scientists would argue about any linear evolutionary trend from the primitive reptilian brain. The key observation in this organizational process is that, in all cases, the brain starts with the lowest complexity at the bottom and highest on top. The most complex part of the brain is the cortex. When compared to other animals, the frontal cortex (part of the neocortex) is the most uniquely human part of the brain. This big lump of brain tissue at the front of the head reminds us that we have no competitors here. Many animals have proportionally fairly large brains compared to their body weight, but they are all missing the large-sized neo- or "new" cortex in front of the head.

For the purposes of this treatise we might divide the brain into three major areas: the finger-sized brain stem, the limbic system, and the largest part of the brain, the cerebrum. The little brain stem at the base of our brain regulates all of the input/output mechanics of the brain. We have little control or exhibit hardly any plasticity in this section of the brain. It's a good thing, too: Who would want to have a say about such basic self-regulated functions as blood circulation and respiration? Fortunately, we never have to worry about these processes because the brain stem takes care of them automatically.

Our limbic system is composed of several interconnected structures around the midbrain. Some of the important structures contained here are the amygdala, the hippocampus, and the cingulate gyrus. Below the occipital region (or sight area) and next to the brain stem, the cerebellum is responsible for balance, coordination, muscle movements—and a host of new findings suggests that some memory is located here.

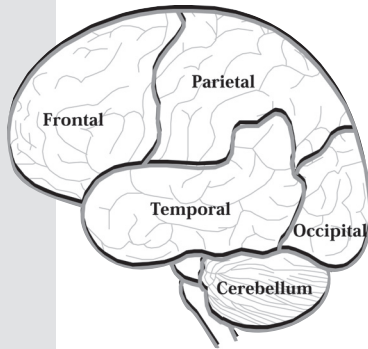
Deep inside the brain, researchers have found a small structure called the nucleus accumbens. This region has been shown to be activated by drugs such as cocaine and amphetamines, suggesting that it is involved with the rewarding or pleasure cycle. Recently there have been findings that suggest it is also activated during laughter and joy (Winters, 2004).

The largest part of the brain is called the cerebrum, which comprises about 85 percent of the brain's mass. It is composed of the left and right hemispheres. Nestled beneath the cerebral cortex are the central lobes of the brain, identified as the frontal, parietal, temporal, and the occipital. They are responsible for critical daily activities such as hearing, vision, speech, and executive functions like decision making and cause-and-effect recognition.

Each network processes a small segment of a brain function, but together in networks they process almost everything we think or feel.

The cerebral cortex is actually the gray, wrinkled surface encompassing the cerebrum. The cerebral cortex looks wrinkly because of its many folds.

There are ten to fourteen billion neurons contained within the cerebral cortex, and they are organized into several hundred million neural networks. Each network processes a small segment of a brain function, but together in networks they process almost everything we think or feel.



SOURCE: *Brain Mania! 50 Great Brains*

The Lobes

The frontal lobe has many functional areas, but it is probably best known for the containment of the prefrontal cortex, which is involved with just about everything human—the ability to form a personality, have insight and foresight, and make executive decisions are all here. The highest intellectual functions

of thinking, planning, and problem solving dwell in this wonderful space. One of the key structures located primarily in the left cerebral hemisphere is Broca's area, which is important in the production of speech and written language.

The temporal lobe is associated with the primary auditory cortex and, as part of the limbic system, houses the hippocampus. Many complex aspects of learning and memory recall can be traced to this section of the brain.

Much of the interior of the parietal lobe of one hemisphere (usually the left), together with a portion of the temporal lobe, is Wernicke's area, which is involved with the comprehension of language.

The occipital lobe is concerned with visualization. Both the visual cortex and a visual association cortex are involved in higher-order processing of visual information.

Alphabetical Brain Connections (ABC)

The following definitions will be helpful to you as you look for ways to build confidence and knowledge about the brain.

ACTH Also called corticotropin, ACTH is a stress-related hormone produced by the pituitary gland. When released into the bloodstream, it reaches the adrenal gland (located just above the kidneys) and triggers the hormones that work when your body experiences stress.

Adrenaline This hormone is released from the adrenal gland into the bloodstream within seconds in response to stress of any sort. Also known as epinephrine, this hormone is backed up by a group of steroid hormones called glucocorticoids.

Axons These are the long fibers extending from the brain cells (neurons) that carry an electrical nerve impulse to other neurons. An axon can be up to three feet long in the human lower leg.

Cingulate gyrus This structure lies directly above the corpus callosum. It mediates communication between the cortex and midbrain structures.

Corpus callosum A massive band of white matter that connects the left and right hemispheres and allows them to communicate with each other.

Dendrites These are the strandlike fibers emanating from one end of the cell body. They are the receptor sites for axons; when they come close to each other they make a synapse. Each cell (neuron) can have upwards of one thousand connections.

Dopamine This neurotransmitter is found in the “pleasure pathway” of the brain. The work of dopamine is critically impacted by drug and alcohol interaction. This “feel-good” substance appears to be reduced in patients suffering from Parkinson’s disease.

Endorphins A class of morphinelike substances or natural opiates, secreted by the pituitary gland and the brain. They can help reduce the sensation of pain.

Glial A “tending” cell, it is one of two types of brain cells. Glial cells outnumber neurons, the other brain cell, by ten to one, and are also known as interneurons. They carry nutrients, speed repair, and may form their own communication network.

Hypothalamus This structure controls appetite, body temperature, and other important functions. It’s a

complex collection of cell groups that also influences hormone secretion, digestion, sexuality, circulation, emotions, and sleep.

Lateralization Lateralization refers to the activity of using one side of the brain more than another. The term “relative lateralization” is more accurate since we are usually using at least some of the left and right sides of the brain at the same time.

Medulla Located in the brain stem, the medulla channels information between the cerebral hemispheres and the spinal cord. It controls respiration, circulation, wakefulness, breathing, and heart rate.

Myelin Myelin is a fatty white shield that coats and insulates axons. It can help make the cells (neurons) more efficient and without myelination—the process of depositing myelin around axons—the nerves aren’t able to conduct their chemical messages.

Norepinephrine Formally known as noradrenaline, norepinephrine is a neurotransmitter primarily involved in our arousal states: fight or flight, metabolic rate, blood pressure, emotions, and mood.

Neurons One of two types of brain cells. We have about one hundred billion neurons. Neurons receive stimulation from their branches (known as dendrites) and communicate by firing a nerve impulse along an axon.

Neurotransmitters Our brain’s biochemical messengers. There are more than two hundred known neurotransmitters in the brain and spinal cord. These are the stimuli that excite neighboring neurons or act as inhibitors to suppress activation.

Pons Located near the top of the brain stem, above the medulla, lays the pons. It's a critical relay station for our sensory information.

Reticular formation A small structure, located at the top of the brain stem and bottom of midbrain area. It's the regulator responsible for attention, arousal, sleep/awake states, and consciousness.

Serotonin A common neurotransmitter, most responsible for inducing relaxation, regulating mood, and sleep. Antidepressants like Prozac usually suppress the absorption of serotonin, making the user more active.

Synapse A synapse is the junction point or cleft where the axon of one neuron almost touches the dendrites of another. When an axon of one neuron releases neurotransmitters to stimulate the dendrites of another cell, the resulting junction point where the reaction occurs is a synapse. The adult human has approximately one hundred trillion synapses.

Thalamus Located deep within the midbrain, the thalamus is a key sensory relay station. Its functions are involved in hearing, muscle movement, and retrieving memories.

Vasopressin A stress-related hormone that is partly responsible for our aggression.

THE EDUCATIONAL CONNECTION



In today's middle and high schools there is a need to be realistic about our progress in the past few decades. Are we still teaching a 1970s curriculum with the tools of this century? If so, this would be comparable to equipping a new Toyota hybrid car with 1960s belted tires. Is there a need to change the use of instructional strategies popular in past generations? Do the findings and experience from neuroscience warrant changing the way we teach?

A common assumption in education is that if students are provided with enough information, they will make sense of most if it and put it to productive use. When weekly tests are given, however, it is evident that many of the students didn't understand the material. Looking for more effective ways to help us understand how the brain learns will improve our teaching.

Appreciating some of the basic structures and functions of the brain is important for teachers in today's secondary classrooms. It's equally as crucial to appreciate the complexity and the beauty found in the human brain. The brain doesn't like to take on dramatic changes or vast amounts of information straight-away; it prefers "nibbling" at small amounts of material (hence the very basic brain information in this chapter). By understanding the most rudimentary yet exciting structures and functions of the brain, teachers may begin to appreciate how valuable the care and feeding of the brain are to a successful life.

Summary of Chapter 1

- The “Decade of the Brain” led to increased interest in the implications of recent neuroscience research for education.
- It is important to recognize that neuroscience, psychology, and education are disciplines that need to work together.
- We must be careful in translating the findings from neuroscience to education.
- The brain is exceptionally complex and consists of structures and functions that are only now beginning to be understood.

ENGAGING THE BRAIN THROUGH ACTIVITIES

Applying the concepts of the content of each chapter is important. At the end of each succeeding chapter, the activities included are designed to engage students in the process of learning about the structure and function of the brain. Our challenge as teachers of adolescents is to encourage students to think about the relationships among knowledge of the brain, the choices they make, the behavior they display, and the enhancement of their personal health.

Activity #1

The Brain: A Road Map to the Mind

A wonderful illustrative resource for brain structures and functions can be found at MSNBC Interactive. Look for the box at the bottom of the article saying “Interactive.” The menu includes internal, external, fear factors, memory manager, and sensory switchboard.

URL- <http://www.msnbc.msn.com/id/6849058>

Activity #2

A Guided Tour of the Human Brain

This is a great visual tutorial that offers a guided tour of the human brain. It’s provided by the HOPES (Huntington’s Outreach Project for Education, at Stanford). The tour starts with a brief description of brain cells (neurons and glia) and the ventricular system, and then explores the different lobes of the brain. The tutorial gets more detailed in its discussion of the limbic system, basal ganglia, and diencephalon. The ability to add or subtract structures will help you get an idea of the three-dimensional configuration of the brain.

URL- <http://www.stanford.edu/group/hopes/basics/braintut/ab0.html>

Activity #3

Musical Shares

This activity can be applied to teach any content. It allows each student to become an “expert” about a fact or concept. When students are given an opportunity to teach something, several things happen. First, the students take pride in the fact that they can teach something. Second, other students will listen and reciprocate because they also get to teach something. Third, by teaching this information to a number of students, an important brain-compatible learning principle is practiced. Repetition by teaching the concept to other students will create a better opportunity for long-term memory.

To Play Musical Shares:

1. Select some music with a beat to play on your stereo. Songs like “Tango,” “In the Mood,” “Hernando’s Hideaway,” or “Country Roads” will work well.
2. Give each student a 3" x 5" card with one brain factoid (use the definitions in this chapter). Independently, ask them to become an expert on their particular definition.
3. Allow a few minutes to absorb the material, and then ask them to teach a person sitting next to them the information on the card. Encourage them to paraphrase and use animated discussion in teaching the information. After a few minutes, say, “We are now going to play Musical Shares.”
4. Use an overhead transparency or a PowerPoint slide to convey the following information:

Musical Shares

When the music begins, walk around the room silently.

When the music stops, find a partner and share the information that has been chosen to share.

When the music starts again, leave your partner and walk around the room.

When the music stops, find another partner and share the information that has been chosen to share.

Activity #4

Mind Mapping

Individual mind maps: Try using mind maps once with your middle- and high-school students, and you will find it becomes one of your staple strategies for assessment. Mind maps are creative ways to show a pattern of connected ideas.

A mind map uses both words and pictures to create a memorable pattern of how the brain interprets information. By adding colors, pictures, and symbols, the learner engages more of the brain than just the language centers. Most students say they understand the material much more when they have a chance to mind map as opposed to taking traditional notes.

To get started: Using a readily available supply of 8 ½" x 14" paper makes it easier for you to collect and return the mind maps to students. Provide students with colored pens and have them draw their own representation of the primary topic—in this case, the brain. Encourage them to make their own representation of what they think it should look like. While it's good for some students to branch curving lines off the center graphic, others may want to organize their mind maps differently. It's most important to allow students to express themselves. You will be surprised how different the finished products are from each other! It is only important that they create a picture, symbol, and some key words for every concept you want them to include. If they are mind mapping the structures and functions of the brain as discussed in this chapter, all the information is included here.

Selected Books for Enhancing This Chapter

Abraham, Carolyn	<p><i>Possessing Genius: The Bizarre Odyssey of Einstein's Brain.</i> St. Martin's Press: New York, 2002</p> <p>This is a page-turner! Abraham provides the history and fascination that occupied Einstein's brain for forty years after his death. The saga is almost science fiction but true to account as her research supports. This is a must for brain junkies.</p>
Damasio, Antonio R.	<p><i>The Feeling of What Happens: Body and Emotion in the Making of Consciousness.</i> Harcourt Brace: Orlando, FL, 1999</p> <p>A landmark treatment of the underlying biology of how emotions and feelings are stored and translated in the brain. Damasio's treaty on consciousness is different from current views, and this results in a fascinating study of how the human brain relates to its environment. One of the most talked-about books of 1999 in brain science.</p>
Jensen, Eric	<p><i>Teaching with the Brain in Mind, Second Edition.</i> ASCD: Alexandria, VA, 2005</p> <p>The author provides an extensive catalog of practical applications so often missing in similar books. Designed for all teachers, Jensen's book provides the reader with practical and usable insights from the research. A valuable tool for enhancing teaching innovations.</p>

