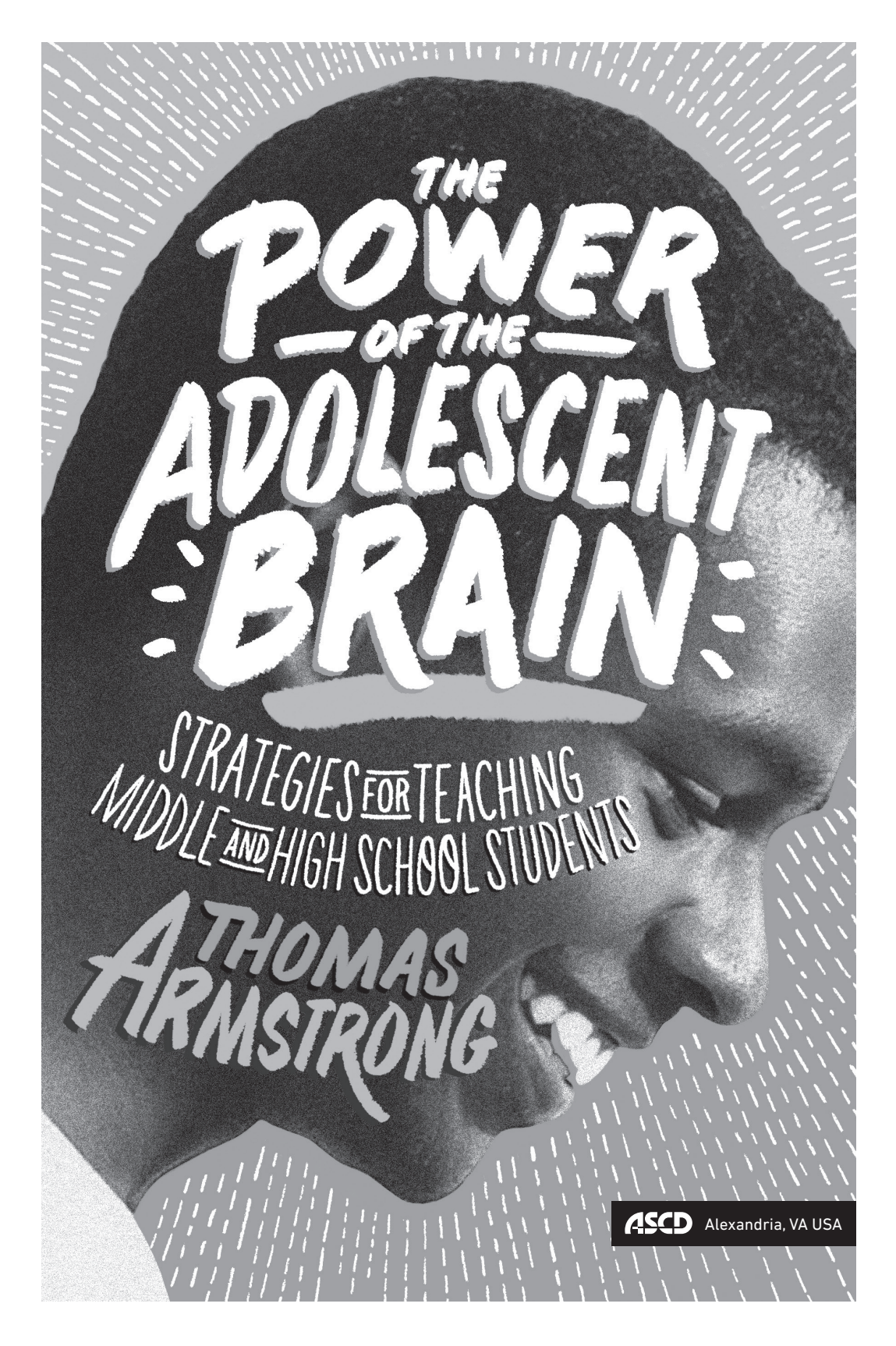


THE  
**POWER**  
— OF THE —  
**ADOLESCENT**  
**BRAIN**

STRATEGIES FOR TEACHING  
MIDDLE AND HIGH SCHOOL STUDENTS

THOMAS  
**ARMSTRONG**

**THE  
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# THE POWER —OF THE— ADOLESCENT BRAIN

## STRATEGIES FOR TEACHING MIDDLE AND HIGH SCHOOL STUDENTS

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# Introduction

I began my career in education 40 years ago as a junior high special education teacher in Montreal, Canada. The experience shaped me in a profound way. I will never forget the names, faces, and personalities of my first students. There was Helen: sullen, sometimes angry, occasionally up for a little learning. Then there was Bernice, a sly, catlike girl of 13 who seemed to prowl rather than walk around the class looking for little mischiefs that she could cook up and get away with scot-free. I also remember Vince, with his bright, cheery face, his welcoming demeanor, and his ability to pull the wool over my eyes at unexpected moments. He was helped in this endeavor by his partner in crime, George, a first-generation Portuguese immigrant from the Azores Islands, who charmed his way through the curriculum and should never have been in special education in the first place. Finally, I remember Manny, especially on that day when he painted a poster emblazoned with the slogan “Parents treat you like pets.” This phrase was a powerfully understated manifestation of the adolescent rebellion that left me feeling exhausted at the end of each school day. What saved me from burnout were cross-country skiing and hiking.

Since that time, I’ve learned a great deal about adolescence. I’ve engaged in a lot of reminiscing about my own adolescence, visited and taught demonstration lessons at middle schools and high schools throughout the United States, and taught courses in childhood and adolescent development at several graduate schools in the San Francisco Bay Area. During the last 40 years, I’ve always felt that there was something extraordinary about the years between 11 and 18 that I couldn’t quite put my finger on. Then I began to do my research for this book.

Combing through thousands of documents both online and offline, my eyes were opened by the revelations that had been coming out of neuroimaging labs since the start of the 21st century. I discovered that the adolescent brain was something very special, its 100 billion cells having been naturally selected over the course of millions of years to accomplish tasks that were absolutely necessary for the continuation of our species; tasks such as leaving the nest, mating, hunting, gathering, and fighting or fleeing from predators. Most significantly, these prehistoric genes are still part of teenagers' hereditary makeup, and they manifest in the classroom as inattention, rebellion, recklessness, charm, passion, insight, fatigue, and a seemingly insatiable need for approval from peers. Now I understood why we often joke about the teen years (e.g., "I teach 7th graders." "Well, good luck with that!"). What are we to do with all that energy and misdirection?

This book tries to answer that question by providing hundreds of ideas, tips, strategies, programs, and resources that are based on what we now know about how the adolescent brain works. This research-based data can empower us as educators to more fully engage middle and high school students in the classroom, so that instead of doing drugs, getting pregnant, dying in gang fights or car crashes, or binging on alcohol, they will develop the ability to think, make good choices, regulate their emotions, handle social conflict, consolidate their identities, and learn enough about the world to move into adulthood with dignity and grace.

In the first two chapters, you'll learn a lot about what's been discovered over the past 15 years about the adolescent brain, particularly its neuroplasticity (its ability to wire itself in response to environmental inputs), and why this knowledge is important for us to integrate into our practice as educators. In Chapters 3 through 10, I focus on how to take research on the adolescent brain and use it in the classroom by presenting eight basic interventions that I believe are critical to the optimal functioning of the adolescent brain in the classroom. They include

- Opportunities to choose.
- Self-awareness activities.



- Peer learning connections.
- Affective learning.
- Learning through the body.
- Metacognitive strategies.
- Expressive arts activities.
- Real-world experiences.

For each of these interventions, I provide several evidence-based action steps that teachers and administrators can take, and I illustrate each step with practical examples from middle and high schools around the United States and the world to demonstrate that these practices have already been successful in supporting adolescent learning and development. I've taken particular care to include student voices as much as possible so that we can learn directly from teens about what works and what doesn't work as far as helping them thrive in the classroom.

Because I use a lot of brain terminology, especially in Chapters 1 and 2, I've provided a glossary in Appendix A that you can use as a point of reference (these terms have been italicized when they first appear in the text). I've also included several lesson plans in Appendix B based on the eight interventions covered in this book, and in Appendix C, I provide a number of resources—books, organizations, and websites—to support further investigations in adolescent learning.

I hope that by reading this book and implementing some of the practices outlined in it, you will begin to see remarkable changes in the behaviors, attitudes, and achievement levels of your adolescent learners. Even more than this, however, I hope that you will feel recharged in your own teaching at the secondary level. More than anything else, it's your own excitement about what you're teaching that engages your students in the adventure of learning.

# 1

## The Amazing Adolescent Brain

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It appears that the brain changes characteristic of adolescence are among the most dramatic and important to occur during the human life span.

—Laurence Steinberg, “Commentary: A Behavioral Scientist Looks at the Science of Adolescent Brain Development,” in *Brain and Cognition* magazine

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There has never been a more exciting time to be a middle school or high school educator. New discoveries about the adolescent brain have completely transformed our understanding of how students between the ages of 11 and 18 need to learn in order to be successful in school and function optimally in the world.

As recently as the late 1990s, most scientists regarded the development of the brain as pretty much finished by age 5 or 6. By that age, 95 percent of the brain’s volume is complete, and by around age 10, the brain has reached adult size. But during the last 15 years, largely because of advances in neuroimaging technologies, especially those involving *structural* and *functional magnetic resonance imaging* (sMRI and fMRI), a whole new picture of the adolescent brain has emerged.

In this chapter, we’ll look at some of the major discoveries that have been made about the developing adolescent brain since the turn of the millennium. This survey will help lay the foundation for subsequent chapters’ discussions of the educational implications of this research.

## Raging Hormones and Beyond

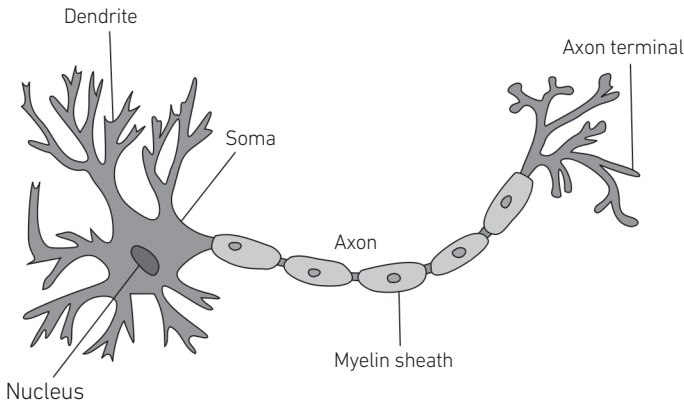
It used to be thought that the erratic behaviors of adolescents stemmed from the “raging hormones” accompanying puberty. It’s true that hormones do play a role in driving adolescent behaviors: sex hormones fuel sexual striving, sensitivity to physical attractiveness, and interest in romantic partners. Both *estrogen* and *testosterone* (the latter of which increases by a factor of 10 in adolescent boys) appear to organize structural connections in the brain (Arain et al., 2013) and directly affect *neurotransmitters* (chemicals that travel over the synaptic cleft and help pass information from one neuron to another), shaping brain maturation and cognitive functioning in adolescence (Sinclair, Purves-Tyson, Allen, & Weickert, 2014). However, direct links between testosterone and aggression have been called into question. Recent evidence (Eisenegger, Haushofer, & Fehr, 2011) suggests that testosterone has more to do with the search for and maintenance of social status, which may result in aggression but could also induce other actions, such as bargaining and cooperation.

More important than the specific effects of hormones are the broader developmental changes that occur in the adolescent brain. Perhaps the most fundamental change—and the discovery that seems to have driven us to rethink how the teenage brain works—comes from neuroimaging studies revealing that white matter and gray matter in the brain undergo significant changes during the adolescent years.

## White Matter Increases in the Adolescent Brain

*White matter* in the brain consists primarily of glia and myelinated axons. *Glia* are cells that create *myelin*, the fatty protective coating around *axons*, or the nerve fibers coming out of neurons in the brain. Axons conduct electrical impulses away from the neuron’s cell body (see Figure 1.1). When an impulse reaches the *presynaptic terminal* of a neuron (see Figure 1.2), it helps activate a chemical message (carried by a neurotransmitter) that takes place between brain cells.

**Figure 1.1** | Structure of a Neuron

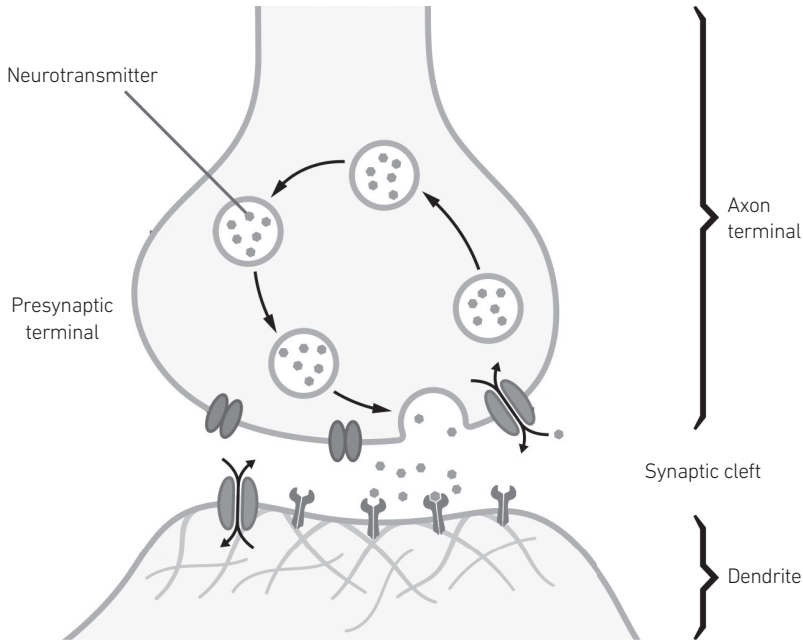


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Think of myelin as wire insulation for axons. An axon that is myelinated can conduct electrical impulses up to 100 times faster than an unmyelinated one. Moreover, myelination allows the axon to recover more quickly after firing—a feature that, combined with the quicker firing, represents a 3,000-fold increase in the nerve fiber’s bandwidth. Myelin also helps calibrate the coordination of inputs from other neurons. As Jay Giedd (2009), former chief of the Brain Imaging Section of the Child Psychiatry Branch of the National Institute of Mental Health, puts it,

In order for input from nearby and more distant neurons to arrive simultaneously, the transmission must be exquisitely timed. Myelin is intimately involved in the fine-tuning of this timing, which encodes the basis for thought, consciousness and meaning in the brain. The dynamic activity of myelination during adolescence reflects how much new wiring is occurring. (p. 4)

Advanced imaging techniques confirm an increase in white matter organization during adolescence in regions of the brain associated with

**Figure 1.2** | Structure of a Synapse

Source: Creative Commons Attribution-ShareAlike 4.0 International license. © Thomas Spletstoesser: [www.scistyle.com](http://www.scistyle.com).

cognition and behavior. As a result of myelination, the amount of white matter in the brain increases in a linear fashion throughout adolescence and into the late 20s.

## Gray Matter Decreases in the Adolescent Brain

*Gray matter* refers to the cell bodies of neurons, the nerve fibers that project from them (axons and *dendrites*), and support cells (see Figure 1.1). *Synapses* are the structures at the ends of axons and dendrites that allow for the chemical transmission of information from one neuron to the next (see Figure 1.2). When an electrical impulse travels along a neuron's axon, it can activate the flow of neurotransmitters across the *synaptic cleft*, sending a signal to the dendrite of an adjacent neuron. In this way, information travels from one neuron to another.

A baby's brain contains almost twice the number of synapses that an adult brain has. After the age of 2 or 3, however, the brain undergoes a process of *pruning*, which eliminates synapses that are not used or stimulated by the environment. By diminishing the number of connections in the brain, pruning actually results in a more efficient brain, unencumbered by a lot of unnecessary neuronal connections. Think of a gardener pruning a bush, clearing out the dead wood, and creating space for new growth to occur. The process of pruning continues during the elementary school years, particularly in the areas of the brain concerned with sensory and motor functions.

At around the age of 11 for girls and 12 for boys, there is a short period when the amount of gray matter increases again. After this period, during adolescence, the brain undergoes a second round of pruning, during which time the volume of gray matter continues to decrease (Giedd, 2008). During adolescence, the brain may lose 1 percent of its gray matter every year yet maintain the same volume because of a corresponding increase in the amount of white matter.

## **The Adolescent Brain: Pedal to the Metal Without Suitable Brakes**

Most pruning in adolescence takes place in the brain's frontal lobes, especially in the *prefrontal cortex*. The prefrontal cortex is the area responsible for planning, making decisions, setting priorities, forming strategies, and inhibiting impulses and inappropriate behavior. These activities are often referred to collectively as *executive functions*. A notable feature of brain development is that both pruning and myelination move in slow waves *from back to front*. This means that the prefrontal cortex (situated behind the forehead) is the last part of the brain to be pruned and myelinated.

In other words, the areas of the brain that are responsible for decision making, impulse control, and other skills necessary for effective functioning in the world do not reach their peak of efficiency until mid-adolescence. By the age of 15 or 16, an adolescent can pretty much perform as well as an adult in laboratory tests of executive function, with

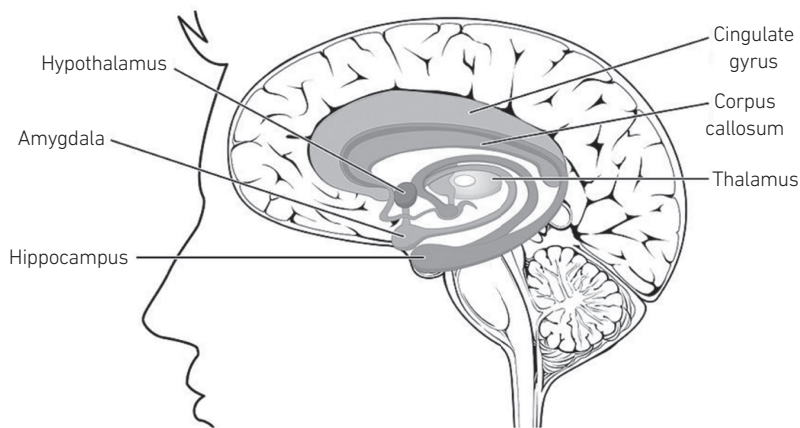
one important caveat: the adolescent can think as maturely as an adult *under laboratory conditions*, or in what has been termed a “cold” cognition setting—that is, in circumstances where there are no emotions or social interactions or pressures involved. Under conditions of “hot” cognition, where feelings come into play or people who are significant to the individual are involved, all bets are off: the thinking process of the adolescent becomes complicated by these other factors. This distinction is significant because most of an adolescent’s life is spent in circumstances involving “hot” cognition contexts.

An important source of this more emotionally and socially diffused thinking process is a set of *subcortical* (i.e., located underneath the prefrontal cortex) structures that frequently work at cross-purposes with the more rational prefrontal cortex during adolescence. These structures of the *limbic system*, or “emotional brain,” include the *hippocampus*, *amygdala*, *cingulate gyrus*, *thalamus*, and *hypothalamus* (see Figure 1.3).

Here’s a rundown of the roles of these structures:

- The hippocampus is a center of emotion, memory, and certain autonomic functions.

**Figure 1.3** | Structures of the Limbic System



- The amygdala is associated with emotional reactivity and strong feelings, such as anger, fear, and joy.
- The cingulate gyrus is instrumental in processing emotion, learning, and memory.
- The thalamus relays sensorimotor signals to the cerebral cortex and helps regulate sleep and alertness in the brain.
- The hypothalamus links the nervous system to the stress-sensitive endocrine system and plays a key role in the initiation of puberty.

While the limbic system finishes developing around puberty, pruning and myelination of the prefrontal cortex proceed more slowly and continue into late adolescence and even into the 20s. It might be helpful to think of the limbic system as an accelerator propelling a car along the highway, and the prefrontal cortex as the car's steering wheel and brakes. Because of the gap in the timing of the development of these two systems, adolescence is a time when the accelerator is being pushed down to the floor while the brakes have yet to be fully installed. Figure 1.4 provides a comparison of the functions of the limbic system and the prefrontal cortex.

Research conducted during the last 15 years supports the finding that adolescent decision making, reasoning, planning, and other forms of deliberative thinking do not function as optimally as the thought processes of adults. fMRI scans have revealed that when adolescents are shown photos of people with fearful expressions, the amygdala is activated, whereas in adults it's the prefrontal cortex that is activated (Casey, Jones, & Hare, 2008). This suggests that in social contexts involving strong feelings, adolescents may be more emotionally reactive and less capable of relying on rational faculties.

## **Rewards and Risks Bring Adolescent Highs and Lows**

Teenagers also have a different neural pattern in seeking pleasure and reward than either adults or children. In one experiment conducted at Cornell University (Galvan et al., 2006), scientists offered subjects



**Figure 1.4** | A Tale of Two Brain Systems

Limbic System	Prefrontal Cortex
Mostly developed by early adolescence.	Mostly developed by mid-adolescence, but the capacity to function smoothly with the limbic system and other parts of the brain doesn't mature until the early 20s.
Functions include <ul style="list-style-type: none"> <li>• Risk taking.</li> <li>• Motivation.</li> <li>• Hunger.</li> <li>• Sleep cycle.</li> <li>• Long-term memory.</li> <li>• Sensation seeking.</li> <li>• Reward seeking.</li> <li>• Novelty seeking.</li> <li>• Impulsivity.</li> <li>• Primacy of emotional expression.</li> <li>• Immediate needs.</li> </ul>	Functions include <ul style="list-style-type: none"> <li>• Decision making.</li> <li>• Planning.</li> <li>• Working memory.</li> <li>• Prioritizing.</li> <li>• Inhibiting impulses.</li> <li>• Reflecting.</li> <li>• Organizing.</li> <li>• Strategizing.</li> <li>• Self-control.</li> <li>• Coordinating thought and emotion.</li> <li>• Delaying gratification.</li> </ul>

being scanned in an MRI machine a small, a medium, or a large reward after successfully completing the task of identifying a photo's orientation. When the adolescents received a large reward, the *nucleus accumbens*—an area in the brain associated with aversion, reward, pleasure, motivation, and reinforcement learning—responded more dramatically than did the same area in children's or adults' brains. But when the teens were offered a small reward, their nucleus accumbens activation decreased to a level *below* that of children and adults, and their prefrontal cortex displayed a more diffused pattern than that of either of the other two groups. These results suggest that adolescents are primed for big rewards, not little ones. Educators who use behavior modification techniques involving reinforcement learning should take note!

Another fMRI study (Chein, Albert, O'Brien, Uckert, & Steinberg, 2011) suggests that teenagers may be willing to take big *risks* for those big rewards, especially when they are in the presence of their peers. In a

computerized simulation game called the Stoplight Game (played while in an MRI machine), participants raced an automobile to a finish line. Subjects were instructed to reach the end of the straight track as quickly as possible. At each of 20 separate intersections, they were presented with the option of pressing the STOP button or taking a risk by pressing the GO button and running a yellow or red light. A successful outcome that came from taking risks had no penalty attached to it, but an unsuccessful one resulted in a crash and a relatively long delay. When tested alone, adolescents performed pretty much as adults did, with minimal risk-taking activity. But when they were told that there were two same-age, same-sex peers watching them play on a monitor in a nearby room, their risk taking increased significantly compared with that of adults, and their brains displayed more activation in areas involved in reward valuation.

In another fMRI study (Masten et al., 2009), subjects played a computerized simulation game called Cyberball in which the adolescent being scanned believed that he or she was playing a game of ball toss with two other adolescents. In reality, the subject was playing with a preset computer program, not real people. At a certain stage, the subject was cut out of the game and observed the two peers tossing the ball to each other on the screen. The subject's emotional distress at being excluded activated the *subgenual anterior cingulate*, a region in the brain associated with mood, anxiety, and self-esteem that plays an important role in the incidence of major depression.

All these studies seem to suggest that adolescents are neurologically primed to experience “the thrill of victory and the agony of defeat” more deeply than are adults or children. One dramatic example of adolescent willingness to take big risks for big rewards is demonstrated in a study that asked adolescents and adults if they would be willing to play a game of Russian roulette in return for \$1 million. Every one of the adults said no. Half of the adolescents said yes. Cornell University researcher Valerie Reyna (quoted in Shute, 2009) comments on the adolescents' responses: “They'll tell you with a straight face that there's a whole lot

of money, and they're probably not going to die. It's very logical on one level, but on another level, it's completely insane" (p. 38).

## The Role of Neurotransmitters

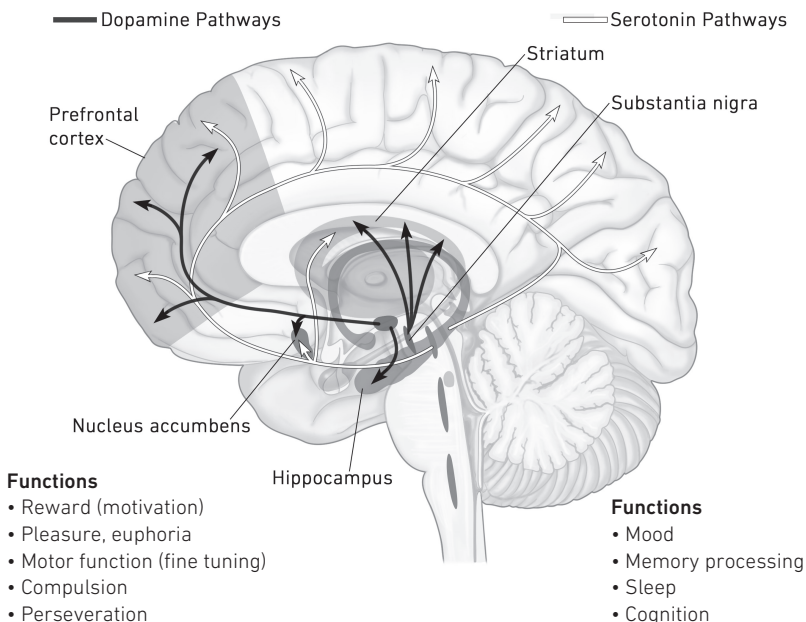
An important system in the adolescent brain that fuels these out-of-proportion reactions to the presence or absence of reward or social interaction is represented by the dopaminergic pathways. *Dopamine* is a neurotransmitter that plays a major role in reward-motivated behavior and sensation seeking. As science writer David Dobbs (2011) points out,

Physiologically, adolescence brings a peak in the brain's sensitivity to dopamine, a neurotransmitter that appears to prime and fire reward circuits and aids in learning patterns and making decisions. This helps explain the teen's quickness of learning and extraordinary receptivity to reward, and his keen, sometimes melodramatic reaction to success as well as defeat.

Other neurotransmitters that play a significant role in adolescence include *oxytocin* and *serotonin*. Oxytocin often works synergistically with dopamine to link social connections to feelings of reward. Puberty-related increases in sex hormones have been linked to a proliferation of *receptors* (the receiving end of a synapse) for oxytocin in the amygdala, the *striatum* (an important reward center), and other subcortical areas. The chemical's abundant presence during adolescence heightens the value that teenagers attach to being with and bonding with others, particularly their peers (Suraev et al., 2014).

Serotonin is a neurotransmitter that is associated with mood, appetite, and sleep. When optimally functioning, serotonin leads to well-being and happiness. Low serotonin levels in adolescence have been linked to loneliness, eating disorders, depression, and self-harming behaviors like cutting. Girls seem to be particularly hard hit by these serotonin fluctuations, perhaps because rising levels of sex hormones, especially estrogen, are linked to the regulation of serotonergic

**Figure 1.5** | Dopamine and Serotonin Pathways



Source: National Institutes of Health, U.S. Department of Health and Human Services.

pathways in the brain (Bethea, Lu, Gundlah, & Streicher, 2002). Figure 1.5 illustrates the dopamine and serotonin pathways in the brain.

## Nature's Design for an Adaptive Adolescent Brain

The studies cited above paint a picture of adolescents as sensation seekers, risk takers, and attention cravers who are vulnerable to countless insults and injuries on the road to maturity. However, the stereotype of the adolescent as an impulsive, erratic, moody, and hypersensitive creature, although partly true, ignores an important question: if adolescence is such an unstable period of life, why weren't the behaviors associated with this stage eliminated from the gene pool long ago? The answer to this question is that the traits associated with adolescence have been

**Figure 1.6** | Evolutionary Advantages of Adolescent Traits

Adolescent Traits	Evolutionary Advantages
Risk taking	Drives them out of the parental nest and into the world
Sensation seeking	Ignites a desire to explore the world of which they will become an integral part
Preference for being with peers	Creates affiliations with the people they will be spending most of their time with in adulthood
Reward seeking	Impels them to seek, find, and consume survival-essential natural rewards such as food, water, and warmth
Romantic and sexual attraction to others	Connects them with possible mates with the potential to procreate and pass along genes to the next generation

designed by nature to meet specific tasks that teenagers need to accomplish to become contributing members of society (see Figure 1.6). From an evolutionary point of view, risk taking is an essential trait that helps launch adolescents out of the parental nest and into the world. The combination of sex hormones, which propel adolescents toward finding a mate (and thus perpetuating the species), and a brain designed to take risks during these precious years means that adolescents will find “the world out there” more attractive and rewarding than the childhood home in which they have spent their whole lives.

Adolescents’ attraction to spending more time with their peers and less time with their parents and other authority figures (including teachers) likewise has a sound evolutionary basis. The people with whom adolescents will actually spend most of their time once they reach maturity will be peers, not authority figures. Consequently, nature has built into the teen brain a propensity to seek out friends, link up with partners, and affiliate with groups of their peers as preparation for adulthood, when bonds of friendship, group affiliations, and relationships with significant others will form a major part of their social world. It is no accident that many of the ancient rites of passage indigenous cultures have developed over the millennia have involved taking young

adolescents away from their parents and putting them with teens of their own age to undergo feats of strength, courage, and endurance and, at the end of the rites, to claim their reward, usually through a grand celebration attended by all the adult members of the community (see Eliade, 1998; van Gennep, 1961).

As we will see in Chapter 2, adolescence, with its dynamic processes of myelination, pruning of synapses, and new patterns of hormonal, endocrinal, and neurological functioning, represents a critical time for what scientists now refer to as *neuroplasticity*—the ability of the brain to form new neural connections and modify structures in response to environmental events, physical injury, behavior, neural processes, and other influences. This plasticity is a key factor in the transformation not only of individuals but also of cultures and civilizations—in fact, in the evolution of the human species itself. Adolescence is a relatively late entry in our evolution, occurring somewhere between 300,000 and 800,000 years ago in an evolutionary history that extends as far back as our hominid ancestors 9 million years ago (Pearson, 2001). This new stage of life emerged, at least in part, to extend humanity’s ability to adapt to an ever-changing environment.

As middle and high school educators, we need to appreciate the fact that although we confront an adolescent’s moodiness, impulsiveness, rashness, and quixotic nature, we also encounter the teen’s exuberance, passion, idealism, sensitivity, creativity, and caring for others—all qualities that can make a significant positive contribution to the betterment of society.



## TAKEAWAYS

- Sex hormones have an important role in affecting adolescent development, both directly (e.g., adolescents' acquisition of sex-specific physical traits and sexual attraction to others) and indirectly (e.g., influencing neurotransmitter activity in the brain).
  - Over the course of adolescence, white matter in the brain increases and gray matter decreases.
  - The adolescent brain loses gray matter primarily through the pruning of synapses, and it gains white matter primarily through the myelination (or insulation) of axons, or nerve fibers. Both of these processes contribute to a more efficient brain.
    - Pruning of gray matter occurs from the back of the brain to the front, meaning that the prefrontal cortex (the site of executive functions like planning, impulse inhibition, and decision making) is the last area of the brain to be fine-tuned in adolescence.
    - The limbic system, or emotional brain, matures before the prefrontal cortex does, meaning that emotion, sensation seeking, and social salience often override more rational ways of thinking and behaving until late adolescence or the early 20s.
    - Adolescents can reason, make decisions, plan, and engage in other rational modes of thought and behavior as well as adults by mid-adolescence (ages 15–16), but only under “cold” cognition conditions—not under “hot” cognition contexts in which emotions or peer influences are factors.
    - Adolescents are more likely to take risks if they believe that their peers are observing them.
    - During adolescence, fluctuations in neurotransmitter systems that involve dopamine, oxytocin, and serotonin can contribute to reward-based risk taking, intense desire for social connections, and mood disturbances.
    - Many of the natural traits of adolescence (e.g., sensation seeking, need for peer approval, and risk taking) are evolutionary adaptations that were genetically selected for because they lead teenagers away from the safety of home and toward the challenges of the world that they will fully enter in just a few short years.

# 2

## The Miracle of Adolescent Neuroplasticity

---

You are hard-wiring your brain in adolescence. Do you want to hard-wire it for sports and playing music and doing mathematics—or for lying on the couch in front of the television?

—Jay Giedd, quoted in “Adolescent Brains Are Works in Progress” (Spinks, 2002)

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What makes adolescence such an incredible time of life from the standpoint of an educator is that the teenager’s brain is still developing and, depending on the experiences adolescents encounter between the ages of 11 and 18, the brain will wire itself accordingly and become more or less structurally and functionally “fixed” in place for the remainder of their lives. This means that the experiences adolescents have during this time of life have huge consequences for their adult lives. As we observed in Chapter 1, this plasticity of the brain—its ability to transform its structures and functions as a result of environmental influences—is a key property of human evolution. Without neuroplasticity, humans wouldn’t be able to adapt to changing circumstances and would eventually die out. Neanderthals actually had bigger brains than modern humans do but lacked the neuroplasticity or flexibility necessary to adapt to change, and we all know what happened to them (Giedd, 2012).



There are three main features of adolescent *neuroplasticity*:

**1. Neurogenesis.** Until the 1990s, mainstream science didn't believe that neurogenesis—the creation of new neurons, or brain cells—was a process that was possible after childhood (Gage, 2002). Research (Pokhrel et al., 2013) now suggests that the rate of neurogenesis is four to five times higher among adolescents than it is among adults, and that the environment plays an important role in generating new neurons during adolescence.

**2. Synaptic pruning.** We now know that synaptic pruning is a key change that occurs during adolescence, allowing unnecessary brain connections to be eliminated while important connections are maintained. Beginning with experiments at the University of California, Berkeley, in the early 1970s, scientists (Rosenzweig & Bennett, 1972; Rosenzweig, Bennett, & Diamond, 1972) were able to demonstrate how environmental enrichment has a direct effect on the growth of dendrites in the brain.

**3. Myelination.** Chapter 1 discussed how a fatty substance called myelin insulates nerve fibers, making electrical transmission of messages quicker, more efficient, and able to connect to areas of the brain that had previously been more diffusely connected. Myelination increases during adolescence. Research (Spear, 2009) indicates that the rate of myelination of axons is directly related to their activation (impulse flow) and that environmental influences, including the repetition of new learning skills, can facilitate this repeated activation—thus leading to more myelination.

## Neuroplasticity: Use It or Lose It

From the educator's standpoint, adolescence is an incredible time of life because the teenager's brain is still developing. Between the ages of 11 and 18, the brain wires itself according to adolescents' experiences and environmental influences and becomes more or less structurally and functionally "fixed" for the remainder of their lives. Thus, adolescents' experiences hold huge consequences for their adult lives.

The regions most targeted for neuroplastic change during adolescence are in the prefrontal cortex (and the connections that this region has with the limbic system). This means that there is a “sensitive period” for the pruning and wiring of circuits involved with decision making, planning, reflecting, and other executive functions. The fact that puberty is coming earlier these days for both boys and girls (Woodham, 2015), consequently extending the period of adolescence, only reinforces how important this time of life is for “using it or losing it” before the brain becomes stabilized in adulthood.

As myelination proceeds in the maturing adolescent brain, the insulated nerve fibers actually begin to impede the *arborization* of dendrites (i.e., the branching out of dendritic connections), thereby decreasing plasticity (Giedd, 2012). By adulthood, fundamental changes in brain structure and function come to an end, and the “window of opportunity” closes (He & Crews, 2007). “We never lose it completely,” says neurologist Jay Giedd, “but it’s never going to be as good as it is when we’re adolescents” (quoted in Miller, 2015, p. 6). Thus, the experiences of adolescence—whether positive or negative—will send neural reverberations throughout a life span, with profound implications not just for the teenagers involved but also for the society within which these adolescents will function (as adults) for decades to come.

## The Risks of Adolescence

During humanity’s prehistory, the evolutionary advantages of adolescence had a darker flip side. It’s true that reward seeking, sensation seeking, and peer preference helped to kick teenage cave dwellers out of the parental home, enabled them to find partners with whom to hunt or gather, stimulated them to look for mates with whom to procreate, and gave them the impetus to seek food, shelter, and other basic resources. But they were also propelled into encounters with predators, poisonous plants, enemy tribes, inclement weather, infectious diseases, and other dangers that could maim or disable them or cause early death.

Although I can't speak authoritatively as to whether prehistoric dangers were worse than contemporary risks—I've never gone head-to-head with a raging mastodon—my sense is that the world today is in many ways more dangerous for teenagers than it was tens of thousands of years ago. One of the greatest paradoxes of the human life span is that adolescents are generally stronger and healthier than people of any other age group, yet they face a 200 percent greater chance of dying than do children (Selemon, 2013). The very characteristics designed by nature to help move adolescents out into the world are the same traits that make them vulnerable to a wide range of hazards that litter the contemporary landscape.

What follow are descriptions of some of these risks, a review of their prevalence among today's adolescents, and a look at the devastating effect they can have on adolescents' physical, mental, social, and emotional health.

- **Traffic accidents.** This is the leading cause of death among adolescents. Seven teenagers die every day in the United States as a result of motor accidents. Compared with adult drivers, teens are more likely to speed, underestimate dangerous conditions, drink alcohol while driving, and drive without a seat belt (Centers for Disease Control and Prevention, 2014a).

- **Violence.** Homicide is the second leading cause of death in adolescence. In a national survey (Centers for Disease Control and Prevention, 2012a), 40 percent of males and 25 percent of females in grades 9–12 reported having been in a physical fight in the previous 12 months, and more than 25 percent of males said they had carried a gun, knife, or club sometime during the previous 30 days.

- **Suicide.** Suicide is the third leading cause of death in adolescence, killing approximately 4,600 U.S. teenagers each year. In a survey (Centers for Disease Control and Prevention, 2015a) of students in grades 9–12, 16 percent reported having seriously considered suicide, 13 percent reported having created a suicide plan, and 8 percent reported having tried to take their own life in the previous 12 months.

- **Alcohol abuse.** Alcohol is the most abused substance among adolescents. In one survey (Kann et al., 2014), nearly 35 percent of teenagers reported that they had consumed alcohol in the previous 30 days, and 21 percent said that they had engaged in binge drinking (consuming five or more drinks on the same occasion) on at least one day in the previous 30 days. Research has shown that alcohol drinking inhibits neurogenesis in adolescents (Crews, Mdzinarishvili, Kim, He, & Nixon, 2006), suppresses the activity of synapse-strengthening receptors in the hippocampus, and damages areas of the prefrontal cortex crucial for inhibiting impulses and thinking through the consequences of an action (Butler, 2006). Binge drinking impairs both white and gray matter integrity in the prefrontal cortex, hippocampus, and amygdala (Jacobus & Tapert, 2013).

- **Marijuana abuse.** According to a national survey (Centers for Disease Control and Prevention, 2014b), almost 25 percent of adolescents in grades 9–12 are currently using marijuana, and nearly 9 percent started smoking the drug before the age of 13, which makes them vulnerable for poorer outcomes in later life. Heavy users of cannabis in adolescence performed significantly worse than did light users on tests of processing speed, memory, flexible thinking, attention, and learning, and demonstrated reduced levels of motivation. Marijuana use has been linked to structural alterations in gray matter, changes in white matter integrity, and less efficient synaptic transmission in the hippocampus (Jacobus & Tapert, 2014; Rubino et al., 2009).

- **Tobacco and nicotine use.** Adolescents have a higher vulnerability to nicotine addiction than adults. Tobacco use generally begins and is established as a habit during adolescence. According to the Centers for Disease Control and Prevention (CDC) (2015b), nearly 10 percent of high school students report having smoked cigarettes in the previous 30 days, while 13.4 percent used electronic cigarettes, 9.4 percent used hookahs, and 5.5 percent used smokeless tobacco during that same period. The same study further estimates that if the current rate of tobacco use among youth is sustained, 5.6 million of today's

U.S. adolescents will die prematurely from a tobacco-related illness. Nicotine affects brain growth and development during the teen years, leading to changes in limbic circuitry and in neurotransmitters such as dopamine, serotonin, and *acetylcholine* (a neurotransmitter involved in inhibiting impulses) (Dwyer, McQuown, & Leslie, 2009).

- **Mental disorders.** Half of all diagnosable mental health disorders in the human population begin by the age of 14 (Knopf, Park, & Mulye, 2009). The onset of schizophrenia usually occurs in late adolescence or early adulthood (Gogtay, Vyas, Testa, Wood, & Pantelis, 2011), and the incidence of depression rises sharply after puberty, particularly in girls (Thapar, Collishaw, Pine, & Thapar, 2012). According to Cornell University adolescent expert Laurence Steinberg, “Up to 20 percent of adolescents in the United States experience a diagnosable anxiety disorder” (quoted in Friedman, 2014). The median age for the onset of eating disorders—mostly seen in girls—is 12 (Swanson, Crow, Le Grange, Swendsen, & Merikangas, 2011).

- **Sleep difficulties.** Sleep-wake cycles change during adolescence due to pubertal changes and brain development, and as a result of late-night sleep patterns, 45 percent of all adolescents suffer from sleep deprivation (Hagenauer, Perryman, Lee, & Carskadon, 2009). Poor sleep in adolescence increases risk taking and contributes to failures in cognitive control (Luciana, 2013); increases substance abuse (Wong, Robertson, & Dyson, 2015); and is associated with obesity, depression, suicidal ideation, and motor vehicle accidents, among other consequences (Owens, 2014).

- **Sexually transmitted infections.** An American Academy of Pediatrics study (Forhan et al., 2009) indicated that 24.1 percent of all females ages 14–18 and 37.7 percent of all sexually active females ages 14–18 carry a sexually transmitted infection (STI) such as chlamydia, gonorrhea, herpes simplex, or human papilloma virus. Sexually coercive and deceptive behaviors by males are associated with risk of STIs in women (Silverman et al., 2011).

- **Prescription drug abuse.** The psychostimulant Adderall is the second-most abused drug among high school seniors (6.8 percent

of those surveyed), while 4.5 percent used the painkiller Vicodin, and 6.1 percent used other nonprescribed narcotics (National Institute on Drug Abuse, 2014). Psychostimulants can increase anxiety levels among adolescents (Friedman, 2014), while narcotics are among the most addictive substances known to humankind, and an overdose can lead to coma and death (Dart et al., 2015). In a recent report (Kann et al., 2014), the CDC revealed that 4 percent of male adolescents have used anabolic androgenic steroids to increase athletic performance or enhance physical attractiveness, with many reporting their first use at age 11. Steroid abuse can induce structural changes in the hippocampus and amygdala and alter levels of serotonin and other neurotransmitters in the brain (Cunningham, Lumia, & McGinnis, 2013).

- **Internet addiction.** A recent study (Kuss, van Rooijb, Shorter, Griffiths, & van de Mheen, 2013) suggests that nearly 4 percent of adolescents are candidates for Internet addiction. Internet addiction among adolescents has been associated with loss of functional connectivity between frontal and subcortical regions of the brain, including the *putamen*, a part of the *basal ganglia* that is important for learning (Hong et al., 2013).

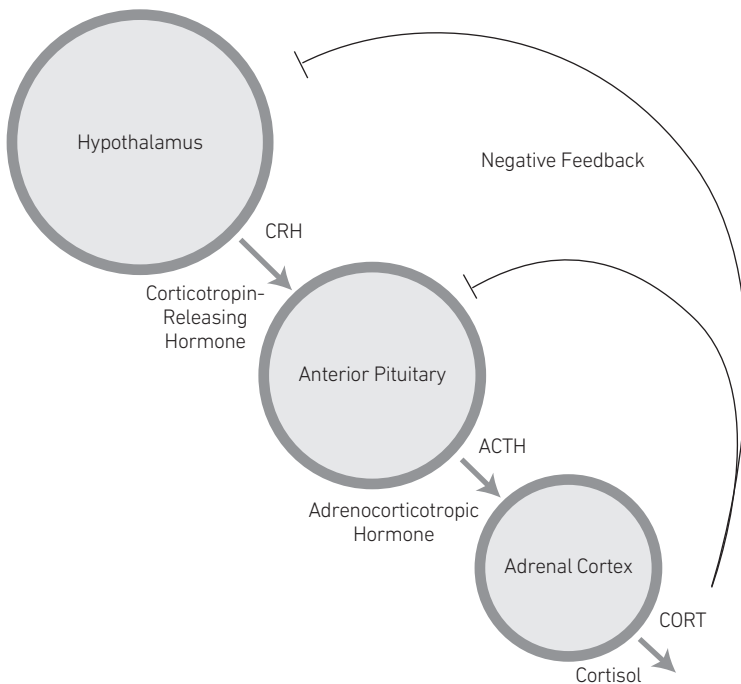
- **Bullying.** In a 2013 survey, 20 percent of all adolescents reported being bullied on school property during the previous 12 months, and 16 percent reported being bullied electronically (e.g., via social media) (Kann et al., 2014). Peer bullying is associated with suicidal ideation, suicide risk, an increased risk of psychiatric disorders, and alterations of functioning in dopamine transporters (Gini & Espelage, 2014; Novick, Forster, Tejani-Butt, & Watt, 2011).

## The Stress Factor

One final dimension that needs to be examined in terms of the potential downside of neuroplasticity is the adolescent's increased vulnerability to stress, a factor that can contribute to or be an outcome of many of the problems described above. To understand a teenager's stress response system, it's helpful to know something about the

*hypothalamic-pituitary-adrenal axis*, or the HPA axis (see Figure 2.1). These three structures—the first two residing in the subcortical areas of the brain and the third located just above the kidneys—participate in a complex system of influences and feedback loops that control reactions to stress and regulate many body processes, including digestion, the immune system, mood, and sexuality. When the body perceives a deviation from its ideal homeostatic state (e.g., a potential threat from the outside environment), a signal is sent via one of many inputs (e.g., the prefrontal cortex or the amygdala) to the hypothalamus, which then secretes *corticotropin-releasing hormone* (CRH). This hormone is sent to the pituitary gland, which secretes *adrenocorticotropic hormone*

**Figure 2.1** | The HPA Axis



Source: Creative Commons Attribution-ShareAlike 3.0 Unported license. © BrianMSweis: [https://commons.wikimedia.org/wiki/File:HPA\\_Axis\\_Diagram\\_%28Brian\\_M\\_Sweis\\_2012%29.png](https://commons.wikimedia.org/wiki/File:HPA_Axis_Diagram_%28Brian_M_Sweis_2012%29.png)

(ACTH) into the bloodstream. When this chemical reaches the adrenal glands, the glands release *cortisol*, the final chemical in this “cascade” of signals. Cortisol in turn signals various parts of the body to respond in different ways to the perceived stressor (e.g., increasing heart rate, quickening respiration, tensing up of muscles, and so on). Chronic exposure to stress can lead to anxiety, depression, feelings of social isolation, panic attacks, difficulty concentrating, and insomnia. It can also result in medical abnormalities such as high blood pressure and low immune function.

Studies have shown that adolescents have a higher daytime cortisol level than adults do, suggesting that their HPA axis is particularly active and sensitive to outer stressors. Simply put, humans at the adolescent stage are more vulnerable to stress than they will ever be again (Scherf, Smyth, & Delgado, 2013). Chronic exposure to stress has a more detrimental effect on teenagers than it does on adults, impairing structural and functional development in the brain (Sinclair et al., 2014), reducing activity in the prefrontal cortex and other areas associated with attention (Liston, McEwen, & Casey, 2008). *Allopregnanolone* (or *THP*), a chemical that normally soothes brain cells in children and adults by binding to receptors that inhibit electrical activity, actually becomes an *antagonist* in adolescence (Swaminathan, 2007). The adolescent’s increased susceptibility to stress can contribute to substance abuse, mental illness, violence, and other dangers that in turn can lead to more stress. And so the vicious cycle continues.

## **“Brain-Hostile” Education: How Schools Are Failing Adolescents**

Although the research outlined in the preceding section is certainly sobering, the fact that important regions of the adolescent brain possess neuroplasticity means that there is still time to change the environment within which teens are functioning and, thus, avoid the pitfalls described above. It’s true that there is a wide range of factors that



educators have no control over, including parent and family dynamics, peer encounters outside school, media influences (e.g., ads promoting muscular males and thin females, and movies portraying drug and tobacco use as cool), and students' individual genetic makeup and life history.

The one place where educators can have a high impact on adolescent brain development is school. Students in the United States spend about 1,000 hours in school each year (not counting extracurricular activities and before-school, after-school, and summer programs). This time, which amounts to about 15 percent of students' waking lives, presents a golden opportunity for educators to create instructional activities that can change brain functioning in positive ways.

This book presents “brain-friendly” strategies that secondary schools throughout the United States (and the world) are currently using that dovetail with the way the adolescent brain works. Regrettably, these proactive practices in middle and high school appear to be the exception rather than the rule. Evidence has been mounting to suggest that too many secondary schools are “brain-hostile” at worst and “brain-ignorant” at best in their use of outdated practices that fail to take advantage of the neuroplasticity of the adolescent brain (see Figure 2.2). These practices might even be termed “brain-damaging” to the extent that they create stress, apathy, and resentment among students that negatively affect brain functioning.

A large-scale national survey of middle and high school students (Quaglia Institute for Student Aspirations, 2014) revealed that more than half of all 10th grade students were bored in class and less than half enjoyed being at school, while another survey of 14- to 15-year-olds (Bundick, Quaglia, Corso, & Haywood, 2014) revealed that only 33 percent of girls and 20 percent of boys were seen by their parents to be actively engaged in school. A national Gallup Student Poll (Busteed, 2013) found that 75 percent of elementary school students were actively involved and invested in school, while only 44 percent of high school students had the same level of engagement.

**Figure 2.2** | 10 “Brain-Hostile” Middle and High School Practices

<b>Brain-Hostile Practice</b>	<b>Why It’s Hostile to Adolescent Brain Development</b>
Zero-tolerance discipline policy	Doesn’t give adolescents the opportunity to learn from their mistakes and make better choices next time
Emotionally flat classroom climate	Ignores or suppresses the youthful exuberance of the limbic system, thus inhibiting potential positive linkages between the emotional brain and the prefrontal cortex
Ban on social media apps in the classroom	Limits a potentially useful medium through which peers can learn from one another
More homework, tougher requirements, and a longer school day	Creates stress that can impair mental and physical health at a time when the adolescent is particularly vulnerable to the negative impact of stress
Early start time for the school day	Exacerbates adolescent sleep deprivation, which can have brain-altering consequences and contribute to a range of behavior problems
Public posting of grades and test scores	Embarrasses students at a time in their lives when they are acutely sensitive to what their peers think of them
Locking students into a set program of college-preparatory courses	Prevents adolescents from sampling a variety of potential work and lifestyle choices and choosing elective courses that are interesting to them
Requiring students to declare a major or course of study in 9th grade or earlier	Has students make crucial life-altering decisions when their own decision-making capacities are still in the early stages of development
Elimination or shortening of recess, physical education programs, and physical activity in the classroom	Contributes to adolescent obesity (thus compounding problems regarding adolescents’ own self-images) and fails to take advantage of the neuroplastic cerebellum’s role in higher-order thinking
Teacher-centered, lecture-based, textbook-driven curriculum	Stifles key aspects of adolescent brain development, including the need for peer interaction, self-actualization, decision-making opportunities, creative expression, and emotionally salient learning activities

“If we were doing right by our students and our future,” says Brandon Busteed (2013), executive director of Gallup Education, “these numbers would be the absolute opposite. *For each year a student progresses in school, they should be more engaged, not less* [emphasis added].” Even students who appear engaged may in many cases just be going through the motions by providing teachers with responses that are least likely to cause them harm or exposure (Halpern, Heckman, & Larson, 2013).

At a time when adolescents’ emotional brains are jacked up to the max, the middle and high school curriculum suddenly “gets down to business” and becomes emotionally flat in tone. This has only become more common during the last few years. One recent study (Horner, Wallace, & Bundick, 2015) revealed a strong pattern of emotional suppression in students’ relationships with teachers at urban high schools. The authors write,

As teachers come under increasing pressure to produce demonstrable student achievement gains because of newly developed teacher evaluation systems and enact challenging pedagogy because of the implementation of the Common Core State Standards, they may be more likely to think about understanding and improving emotion-related interactions as a distal goal—one that diverts time and energy from the primary task of fostering student learning. (p. 2)

Owing to challenges from interest groups and other factors, such as the “committee” authorship of most textbooks, the textbooks that dominate so much classroom time lack any real zip, as former U.S. Assistant Director of Education Diane Ravitch (quoted in Lindquist, 2012) points out, referring to high school history textbooks: “There seems to be something in the very nature of today’s textbooks that blunts the edges of events and strips from the narrative whatever is lively, adventurous, and exciting” (p. 405).

At a time when the adolescent’s brain increasingly craves stimulation from peers, education becomes more teacher-centered, offering less small-group interaction and cooperative learning than elementary classrooms. In addition, teachers promote student embarrassment by

posting students' grades and test results for everyone to see, and ban or restrict social media that could facilitate interpersonal learning in the classroom (Farrington et al., 2012; White & Hungerford-Kresser, 2014).

At a point when students' decision-making skills are at a critical stage of development and the prefrontal cortex is going through a process of fine-tuning, zero-tolerance discipline policies run roughshod over students' capacities to learn from their mistakes (Teske, 2011). In addition, schools heap required courses on students to prepare them for college, some actually requiring students to declare a major or course of study in 9th grade or even earlier (see Hu, 2007, for more on this growing trend). This approach deprives students of opportunities to take electives that are interesting to them and that might lead to a vocation in adulthood.

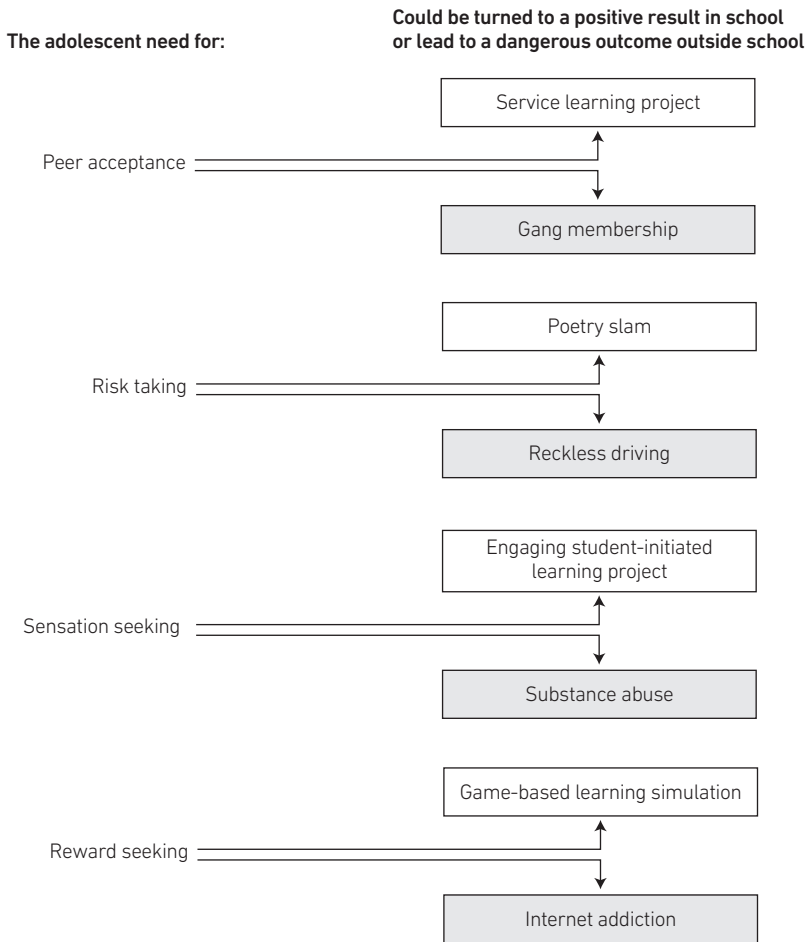
During a point when students are entering the developmental stage of formal operational thinking and are able to engage more deeply in metacognition (Flavell, 2011; Weil et al., 2013), the curriculum begins to devote more attention to lower-order skills, such as recall of facts, formulas, and details (Farrington et al., 2012).

Finally, at a time when adolescents have a huge appetite for rewards, teachers start employing higher standards in judging student competence and tend to give lower grades than elementary school teachers (Farrington et al., 2012).

It's clear that substantial reform is necessary to align classroom and schoolwide practices with the mountain of research now available on how the adolescent brain develops. One professor (quoted in Powell, 2006) has gone so far as to suggest that we need a Head Start program for adolescents.

The guiding principle in reforming secondary education should be to craft educational programs and instructional strategies that link the evolutionary advantages of the adolescent brain to socially appropriate and constructive learning outcomes (see Figure 2.3). So, for example, although risk taking can lead the adolescent to engage in unsafe driving practices, it can also lead him or her to try out new, challenging

**Figure 2.3** | Turning Peril into Promise



activities that promote learning, such as a poetry slam. As one 16-year-old commented after competing in a poetry slam, “It’s really scary. You’re nervous and shaking. Then afterwards you get that same feeling you get coming off a roller coaster. You want to go again” (D’Angelo, 2004, p. 18).

Similarly, adolescents' need for bonding with peers might propel them into membership in a violent gang—or it could drive them to get involved in a service learning project that benefits the whole community. The sensation-seeking behavior that can lead adolescents to drug abuse could alternatively be directed toward a highly engaging student-centered learning project. The reward-seeking behaviors that might lure teens into Internet addiction could be tapped through a game-based learning experience in the classroom.

## **A New Way: Recommendations for Brain-Friendly Learning**

Based on the information we now have about the developmental needs of adolescence and the workings of the adolescent brain, I'm proposing eight specific recommendations for middle and high school reform (see Figure 2.4).

The remainder of this book focuses on these recommendations, providing specific instructional strategies for the classroom, brain-friendly practices for schools, and resources to help implement these ideas in any secondary school setting. Descriptions of these practices follow.

**1. Opportunities to choose.** Because the prefrontal cortex of the adolescent brain (the seat of decision making) is gradually maturing throughout the teen years, and adolescents frequently make suboptimal choices during this time (Blakemore & Robbins, 2012), they need frequent opportunities to make decisions for themselves with regard to what they learn, how they learn, how fast they learn, and other matters connected with the curriculum and school life.

**2. Self-awareness activities.** The psychoanalyst Erik Erikson (1993a, 1994a, 1994b) viewed adolescence as a time when there is struggle within the psyche between two sets of forces: those that seek to forge a workable identity in the world and those that threaten to plunge the adolescent into “role confusion,” or a more diffuse identity. As Chapter

**Figure 2.4** | Eight “Brain-Friendly” Practices for Adolescents

Recommended Practice	Rationale for Practice
1. Opportunities to choose	Helps adolescents make less risky and more sensible decisions in life
2. Self-awareness activities	Assists adolescents in defining their still-developing sense of identity
3. Peer learning connections	Capitalizes on adolescents’ preference for hanging out with peers
4. Affective learning	Integrates the emotional brain (limbic system) with the rational areas of the brain (prefrontal cortex)
5. Learning through the body	Capitalizes on the highly plastic cerebellum by providing physical learning that teaches higher-order skills
6. Metacognitive strategies	Takes advantage of the adolescent’s emerging capacity for formal operational thinking (“thinking about thinking”)
7. Expressive arts activities	Channels burgeoning adolescent emotional energies into thoughtful and socially appropriate artistic products and processes
8. Real-world experiences	Gives adolescents an opportunity to practice executive functions under conditions of “hot” cognition

4 explains, scientists are beginning to articulate regions within the adolescent brain that relate to an emerging sense of self (see, for example, Sebastian, Burnett, & Blakemore, 2008). Thus, it is crucial for any middle or high school classroom to integrate activities that help students explore and express their own emerging sense of self.

**3. Peer learning connections.** Thus far in this book, we’ve reviewed a number of research studies that point to how important peer interactions, peer influence, and peer solidarity are to adolescents (see, for example, Chein et al., 2011). Because peer involvement is so important

at this time of life, educators must be willing to relinquish some of their teacher-centered practices (e.g., lectures, textbooks, student note taking) in favor of peer teaching, cooperative learning, and other strategies that have students collaborating, exchanging ideas, and interacting in other constructive ways.

**4. Affective learning.** When the adolescent limbic system is in full throttle, there are generally two ways educators can respond: either they can ignore the fact that emotions are happening in the classroom, and become punitive when those emotions inevitably erupt, or they can accept those emotions and integrate them into the curriculum. Unfortunately, too many educators choose the former path, a choice they make at their own peril (see, for example, Valiente, Swanson, & Eisenberg, 2012). In Chapter 6, I review a wide range of activities and strategies for bringing joy, zest, and laughter as well as an acknowledgment of the darker emotions into the classroom in a way that furthers the learning process.

**5. Learning through the body.** Thus far, I have not talked about the *cerebellum* (Latin for “little brain”) situated at the back of the skull, but this ancient part of the brain possesses a high degree of neuroplasticity and is therefore greatly responsive to environmental influences (Tiemeier et al., 2010). The cerebellum plays an important role in motor functions (e.g., running, jumping, dancing, gymnastics), but scientists (Keren-Happuch, Chen, Ho, & Desmond, 2014) have also discovered its importance in higher cognitive functions, such as language, executive function, and attention. With so much concern focused on the problem of obesity in the United States, there are calls for more physical activity to be integrated into the classroom (American Alliance for Health, Physical Education, Recreation and Dance, 2013). Chapter 7 describes a variety of activities that bring the body into classroom learning.

**6. Metacognitive strategies.** The Swiss genetic epistemologist Jean Piaget was the first scientist to suggest that starting around the age of 11 or 12 (just when there is a “spike” in gray matter development), the adolescent moves into a new stage of thinking. Piaget called it *formal*



*operations* and characterized it as a time when it becomes possible to “think about thinking” (Inhelder & Piaget, 2007). Brain researchers (Kuhn, 2006) seem to have confirmed his findings insofar as the development of executive functioning in the teen years and early 20s is now associated with the maturation of the prefrontal and parietal lobes during adolescence. Chapter 8 explores a wide range of metacognitive activities that provide learning strategies, mindsets, critical thinking skills, and other ways in which adolescents can rise above the concrete events of the world to confront and challenge their own emotionally charged and peer-influenced ways of thinking.

**7. Expressive arts activities.** Adolescence can and should be a time of great creative and artistic development. Specific regions of the *corpus callosum*, the bundle of nerve fibers that divide the two brain hemispheres, increase robustly between ages 5 and 18 (Giedd et al., 1999), while the corpus callosum itself has been associated with creative behavior (Bogen & Bogen, 1988). Expressive arts activities such as painting, sculpture, drama, music, photography, and collage represent a strategic way to channel the burgeoning subcortical energies of adolescence into thoughtful and socially appropriate representations, thus strengthening links between prefrontal cortex and limbic brain activity (see Chakravarty, 2012).

**8. Real-world experiences.** As observed in Chapter 1, by the age of 15 or 16, adolescents do as well as adults on tests of executive functioning in “cold” cognition contexts. However, in “hot” cognition contexts—when their higher-order thinking processes are impacted by social and emotional influences—their executive functioning rapidly deteriorates (Zelazo & Carlson, 2012). This means that teaching adolescents to plan, organize, think ahead, inhibit impulses, and engage in other executive functions is most effective when these efforts take place in an environment where students must make seat-of-the-pants judgments, anticipate novel situations, stifle emotional reactions, and perform in other real-life contexts. This type of environment can be simulated in the classroom, but there’s no substitute

for real-world experience in preparing an adolescent for the complexities of modern life. Chapter 10 explores practices and programs that equip adolescents for the real world by getting them involved in internships, apprenticeships, service learning, and other out-of-school learning opportunities.

## **Making a Difference in the Lives of Our Adolescent Students**

By any reckoning, it's a huge challenge for secondary school teachers to work with adolescents in today's complex and constantly changing world. Every day, teachers face students who lack motivation, whose attention wanders, who are engaged in off-task socializing or texting with classmates, or who may even be on drugs or otherwise chemically impaired. It's easy in such situations to harden oneself to the situation and forge ahead with the curriculum without bothering to stop and think deeply about what it means to be an adolescent today.

By educating ourselves about the evolutionary purpose of adolescence and the tremendous opportunity we have to transform the neuroplastic adolescent brain, we can embrace the promise of this special time of life and experience new levels of meaning, now truly believing that we can make a profound difference in the lives of our adolescent students.



## TAKEAWAYS

- During the teen years, the brain wires itself according to adolescents' experiences and environmental influences. The areas particularly affected are those associated with higher-order thinking, executive functioning, and social and emotional learning.
- Neuroplasticity in the adolescent brain takes place chiefly through neurogenesis, synaptic pruning, and myelination.
- As the brain myelinates, it becomes more efficient in transmitting electrical signals to distant regions of the brain, but it also becomes less *plastic*, or susceptible to environmental influences.
- The very traits that serve to propel adolescents toward maturity can also make them vulnerable to environmental risks.
- Contemporary life for adolescents is rife with potential dangers that can affect mental and physical health and alter brain functioning. These risks include traffic accidents, violence, suicide, substance abuse, mental disorders, sleep difficulties, sexually transmitted diseases, Internet addiction, and bullying.
- Adolescents are more vulnerable to stress than adults are, which can make them prey to stress-related illnesses and impairments in brain functioning.
- Educators can make a positive difference in the brain functioning of adolescents by instituting brain-friendly practices in the classroom.
- Current trends in secondary education suggest that educators are not engaging in sufficient brain-friendly practices and may in fact be doing the opposite by focusing attention on purely academic learning at the expense of adolescents' deeper developmental needs.
- Brain-hostile practices include early start times to the school day, zero-tolerance discipline policies, preplanned courses of study, banning of social media, cutbacks in P.E. and other physical activity, and teacher-centered, textbook-driven teaching that lacks emotional verve.

- Brain-friendly educational practices can move adolescents away from the negative dimensions of risk taking, sensation seeking, and peer bonding, and toward the positive aspects of these same proclivities.

- Brain-friendly practices in the secondary classroom include opportunities to choose, self-awareness activities, peer learning connections, affective learning, learning through the body, metacognitive strategies, expressive arts activities, and real-world experiences.

# 3

## Opportunities to Choose

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There's a radical—and wonderful—new idea here . . . that all children could and should be inventors of their own theories, critics of other people's ideas, analyzers of evidence, and makers of their own personal marks on the world. It's an idea with revolutionary implications. If we take it seriously.

—Deborah Meier, *The Power of Their Ideas*

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One of the sad ironies of modern education is that as students move into a stage where they need to develop the ability to make good decisions in preparation for adulthood, the school system provides fewer and fewer opportunities for them to make choices. After having spent years in preschool and elementary school engaged in cooperative learning, activity centers, and other endeavors that offered choice, adolescents frequently must adjust to a primarily lecture- and textbook-based approach to learning. Classes are larger, teachers focus more on control, and the classroom climate is more restrictive—conditions that are hardly conducive to practicing decision-making skills (Farrington et al., 2012; Holas & Huston, 2012).

As a result of this clash between developmental needs and educational realities, students begin to feel powerless. They believe that their voices are not being heard by their teachers or administrators. They disengage from the learning process, begin to cut classes, and think about (or actually go through with) dropping out of school (Mitra, 2004).

Students aren't passive learners or receptacles of information that AP courses, textbooks, and lectures are designed to fill. They're active participants in their own learning and should be treated with respect. Studies (Hafen et al., 2012; Shernoff, Csikszentmihalyi, Schneider, & Shernoff, 2002) have shown that when students perceive their classrooms as encouraging personal autonomy, their engagement increases. In this chapter, I present strategies that teachers and administrators can use to encourage students to make decisions about their learning and build skills that will prepare them for the responsibilities and complexities of adult life.

## **Ten Ways to Give Students Choices Over Their Own Learning**

There is a wide spectrum of choices that teachers can make available to students. Choices can be small and limited ("You can choose to work on the problems on either page 15 or page 37") or significant and open-ended ("Select the type of project you'd like to work on this semester"). Choice can be related to content ("Decide which topic you'd like to explore") or focus on process ("Choose how you'd like to demonstrate what you've learned this year"). Choices can be spur-of-the-moment and informal ("OK, would you rather stop now, or continue talking about this?"), or they can be carefully scripted and highly structured ("Write a detailed learning proposal that describes your course of study over the next two months") (Armstrong, 2009). What follow are 10 specific suggestions to help ensure that your students believe that their ideas, opinions, feelings, and decisions are being listened to, respected, and incorporated as an important part of their learning process.

### **1. Provide Homework Options**

Part of the reason homework is considered a chore by so many students is that they often don't have a say about what is assigned. Former middle school teacher Amanda Ronan (2015) recommends letting students choose the problems they'd like to solve in math, select the words

they'd like to work on in spelling, and decide on the ways in which they'd like to study their vocabulary words (e.g., by drawing illustrations of the words' meanings or writing sentences incorporating the words).

Other strategies include providing students with a homework options sheet that lets them decide what to focus on (see Figure 3.1) or assigning a certain amount of time per night for study (say, one hour) and then leaving it up to the students to decide how they'd like to use that time to master the material. Studies (Patall, Cooper, & Wynn, 2010) suggest that when students are provided with homework options, they experience higher intrinsic motivation to do the work, feel more competent in completing the work, and perform better on tests based on the homework than do students who were not given homework options.

### **Figure 3.1 | Homework Options Sheet**

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**Subject:** U.S. History

**Topic:** The stock market crash of 1929

**Complete one of the following activities:**

- Create a chart that provides significant statistics regarding the stock market crash.
- Read three articles online that discuss the stock market crash.
- Develop a time line showing events leading up to the stock market crash.
- Make up a list of 10 questions that you can ask your classmates to get them to think more deeply about the stock market crash.
- Write a poem that summarizes the events of the stock market crash.
- Prepare a speech to deliver to your classmates that will get them interested in the stock market crash.
- Make up a song that captures the essence of the stock market crash.
- Prepare a skit with three classmates that portrays the day of the stock market crash.
- Write a diary entry or first-person account of the day the stock market crashed.
- Put together a collection of images from the Internet that symbolize what the 1929 stock market crash meant for the American people.

## 2. Let Students Pick the Books They Read

Researchers (Rybakova, Piotrowski, & Harper, 2013) in the field of literacy agree that all students benefit academically and emotionally when they read books that they can relate to and have an interest in. Too often, assigned reading for middle and high schoolers consists of texts that were chosen years before by committees of educators more intent on readability scales, state standards, and the likelihood of state adoption than on what actually interests students. (For an insider's view of the education textbook industry, see Ansary, 2004.)

One Georgia middle school teacher decided to scrap the perennial required reading selection, *To Kill a Mockingbird*, and let students choose their own books. Among their choices were chick-lit novels and books from the *Captain Underpants* series along with selections like Toni Morrison's *The Bluest Eye* and Ernest J. Gaines's *A Lesson Before Dying*, a novel about black Americans in the South immediately following World War II. After several months of implementing her new reading plan, Ms. McNeill observed, "I feel like almost every kid in my classroom is engaged in a novel that they're actually interacting with, whereas when I do *To Kill a Mockingbird*, I know that I have some kids that just don't get into it" (Rich, 2009).

Sometimes teachers need to go beyond their own comfort level in letting students choose materials that reflect 21st century realities. Educational researcher Beverly S. Faircloth (2012) tells the story of a 9th grader who was given the option of choosing his own book but refused, telling the teacher that he wouldn't read anything except music lyrics. The teacher worked out an arrangement with him to do just that, within strict parameters, and he was soon fervently engaged in his reading.

## 3. Use Student Polling

The simplest way to use student polling is with a show of hands ("How many of you think that personally owned drones should be banned in the United States?"). Some teachers, however, have turned student polling into a more elaborate affair. Brian Sztabnik (2014), a



New York English teacher, asks his AP Literature and Composition students to come up with the best reading selection from all those they have read during the year. He then uses the NCAA March Madness bracketing system as the selection mechanism.

Sztabnik writes,

Students are ready and willing to defend their cherished reads. The student that loved *Grapes of Wrath* may be crestfallen when it is upset by Shelly's "Ozymandias." Some will argue that Dickinson's "There Is No Frigate Like a Book" should go all the way, knocking off such heavyweights like Tennyson's "Ulysses" or Orwell's *1984*. I just tally the votes and smile on the inside as debates form organically with impassioned voices. (para. 3)

Increasingly, teachers are using clickers, electronic polling devices, or student response systems (e.g., eInstruction, Sentio, TurningPoint, ActiVote) to gauge student opinion on a variety of topics or to glean responses to content-related questions and issues. Such technologies provide students with immediate feedback, get them to think more deeply about an issue, and may even prompt them to revise their views once they've heard other points of view (Magaña & Marzano, 2014). To sidestep the cost of such proprietary systems (which can range anywhere from \$2,500 to \$4,000), teachers are increasingly using free or low-cost apps, such as Poll Everywhere, LocaModa, Socrative, the Answer Pad, ClassPager, and even Twitter. All that's required is an LCD projector, a class computer, and students' cell phones.

Teachers can also use polling as a formative assessment strategy by having students report their level of understanding or agreement at any point during a lesson. Two such prompts might be

- How well do you understand the concept/topic/issue? (A) Completely understand; (B) Somewhat understand; (C) Barely understand; (D) Completely do not understand.
- How would you describe your perspective on this concept/topic/issue? (A) Completely agree; (B) Somewhat agree; (C) Somewhat disagree; (D) Completely disagree.

If you're apprehensive about permitting students to use their cell phones during class, Massachusetts history teacher and tech integration specialist Greg Kulowiec (2011) offers a simple strategy called "Screens Down": when students aren't using their phones for polling purposes, he asks them to place their phones on the corner of their desks with keyboard and screen facing down. By keeping the phones in plain sight, it's easy enough to make sure students aren't using their phones for texting or other nonacademic purposes during class.

#### **4. Allow Students to Create Their Own Projects**

A growing number of secondary school educators are realizing that if the goal of education is to create self-motivated lifelong learners, then students ought to be working toward that objective while they are in school. Consequently, more schools are allowing students to initiate, design, implement, and evaluate their own learning projects.

Perhaps the best example of this is the long-term "capstone" project that has seniors demonstrate their own maturity as learners by putting together a portfolio, designing a research project, conducting a set of experiments around a single problem, engaging in a community service project, or planning an event, among other projects (Kannapel, 2012). The Avalon School in St. Paul, Minnesota, is a 7th–12th grade charter school entirely structured around student-initiated projects. One senior at Avalon did his senior project on theater production. He analyzed several plays, took a course in stagecraft at nearby Hamline University, and produced, directed, performed in, and built stage sets for plays in the Avalon community. Another Avalon senior spent more than 800 hours working with a nonprofit educational advocacy group to help pass state legislation expanding opportunities for individualized learning programs (Traphagen & Zorich, 2013). Figure 3.2 shows the project brainstorming sheet that all Avalon students must fill out as they embark on their projects.

Technology often serves as an important component of student-initiated projects, the results of which students might publish on their own websites, podcasts, blogs, YouTube channels, Facebook pages, or

### Figure 3.2 | Project Brainstorm Sheet

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**Student name:**

**Name of project:**

**Goals and objectives:** List basic information/fact goals you would like to explore concerning your project. A few goals should be deeper defined goals that direct your research.

**Deliverables produced:** All projects have deliverables. In this section, describe the deliverables of the project. Provide enough explanation and detail that your advisor will be able to understand what is being produced.

**Tasks/milestones:** Please use the space below to list the major milestones you must reach to complete this project. Estimate the hours you will need to complete each of these milestones.

*Milestone:*

*Duration in hours:*

**Projected standards met:** Which standards do you plan to meet during this project, and which staff members do you need to check in with about the requirements for those standards?

**Resources:** List the resources for this project that you have already identified. Please list specific titles, web addresses, and names. Many outstanding projects include at least one person as a resource.

**Audience:** Please identify who the intended audience is for this project.

Advisor Approval: \_\_\_\_\_ Parent Signature: \_\_\_\_\_

**Next steps:** Once this form is complete, please make sure to work through all of the following steps before you meet with your proposal team.

\_\_\_\_ Revise the project rubric to fit your project.

\_\_\_\_ Fill out the Project Request Form on Project Foundry.

\_\_\_\_ Set up a meeting with your project proposal team.

*Source:* Used with permission from Avalon School, St. Paul, Minnesota.

other social networking outlets (Heick, 2014). Hawaii educator Douglas Kiang (2014) teaches interactive fiction at Punahou School in Honolulu using a programming language called Inform 7 that allows students to create their own simulated worlds. One student created a House of Seven Gables that the viewer could walk through and explore, while another student designed a movie museum that enabled viewers to go back and forth in time depending on which “theater” they entered. It’s important to keep in mind that a key ingredient for the success of any project is the inclusion of student choice and student voice (Larmer & Mergendoller, 2010); too often, project-based learning imposes a project on students without any substantive input from them.

## **5. Set Aside Time for Passion Projects**

The founders of Google, Larry Page and Sergey Brin (2004), famously wrote in their IPO letter, “We encourage our employees, in addition to their regular projects, to spend 20% of their time working on what they think will most benefit Google. This empowers them to be more creative and innovative” (para. 17). Projects that eventually emerged from this “20% time” initiative included Google News, Gmail, and AdSense.

Inspired by the Google experiment, a few schools have begun integrating “genius hour” into the school day to give students time to work on passion projects (see [www.geniushour.com](http://www.geniushour.com)). At Grosse Pointe South High School in Michigan, students are using their “genius time” to design T-shirts, master the guitar, write books, create documentaries, learn Polish, and design murals, among many other projects. At Thomas Middle School in Arlington Heights, Illinois, three students decided to use their genius hour to compare the quality of different types of sneakers. They requested samples from companies, canvassed their friends, and, with help from their science teacher, devised experiments to test the shoes (Grinburg, 2014).

Teachers and administrators who don’t believe that it’s possible to spare so much time in this age of standards and accountability can establish a shorter genius period. Montpelier High School in Vermont schedules a 15-minute “MHS Unplugged” interval each day during which

students and teachers can engage in activities such as basketball, knitting, speed chess, and yoga (Martin & Bunting, 2015). Education advocate Jennifer Bernstein (2014) acknowledges that some students will react with confusion and uncertainty when faced with having to create their own activities or projects. She advises, “If we want to nurture their growth as creators, we must resist solving their problems and alleviating feelings of discomfort. They have to learn how to cope” (para. 14). This is exactly the sort of brain-developing experience that adolescents need: practice integrating their limbic system passions with their prefrontal cortex decision-making and problem-solving abilities.

## 6. Permit Students to Learn at Their Own Rate

The concept of differentiated instruction has permeated education to the point that most teachers now recognize the importance of providing learning approaches and materials that dovetail with the needs of each unique learner (Tomlinson & Imbeau, 2010). One of the most important dimensions of differentiation is learning rate, yet the traditional secondary school too often employs a lockstep, one-size-fits-all curriculum that requires everybody to do the same activities at the same time. Students who lag behind in this kind of system experience stress, while those who catch on quickly must cope with boredom. Both stress and boredom inhibit the experience of “flow,” or deep absorption in a learning activity (see Csikszentmihalyi, 2008).

Fortunately, computer technology and the rise of software and apps for virtually every aspect of learning have come to the rescue, allowing students to work at their own pace, get immediate feedback, and proceed step-by-step as they master a given sequence of skills. Students at Summit Public Schools in California, for example, use a personalized e-reading system called *Curriculet* that enables them to work at their own pace, create personalized learning plans, set daily reading goals, and receive immediate feedback and teacher assistance when they need it (Hodson, 2015).

Recent reforms in education have given rise to the “flipped” classroom (Bergmann & Sams, 2012) and *blended learning* (Horn & Staker, 2014), models of instruction that allow students to proceed at their own

rate using a wide range of technologies. These approaches allocate time with teachers primarily for the purpose of resolving difficulties that students encounter during their self-paced learning sessions. In conjunction with learning portals like the Khan Academy (Sengupta, 2011), students can select learning modules and replay them as many times as they need to achieve mastery.

## **7. Involve Students in Decisions About School Policy**

Surprisingly little has been done in the last several decades of school reform to include students in the decision-making process. This is odd, given the fact that students are the ones who feel the greatest effects of school policies and whose brains would most benefit by exercising the executive functions of planning, organizing, advocating, and reflecting.

Happily, in the last few years, there's been a call to embrace "student voice": defined broadly as an effort to support student autonomy and more specifically as a campaign to include students in the design and implementation of school policies relating to curriculum, discipline, and other aspects of school life (Fielding, 2004). Student voice policies can be structured in a number of ways, including having students lead focus groups, develop surveys, codesign courses with teachers, or take part in actual school governance.

At Federal Hocking High School in Stewart, Ohio, for example, students are involved in the hiring of teachers, the development of curriculum, and the creation and enforcement of school rules (Phillips, 2015). At Vanguard High School in Manhattan, students involved with the Student Voice Collaborative, a group that supports student-led change in New York City, focused on improving student engagement and boosting graduation rates. They ended up recommending having students serve as cofacilitators in the classroom, a proposal that teachers readily accepted (Cervone, 2013).

We live in a democracy and believe that it's important to teach our students democratic values. Let's help them not just learn about democracy but also live it by giving them opportunities to get involved in decision-making processes that affect their school lives.

## 8. Provide Opportunities for Independent Study

Until recently, schools doled out educational content to their students in bite-size portions through the portals of lectures, textbooks, workbooks, slide shows, laboratory experiments, and other highly controlled forms of learning. Now, students have direct access to a whole world of online expertise. The Massachusetts Institute of Technology—recently ranked as the top university in the world (MIT News, 2015)—has made 2,180 courses available to online users (including more than 60 courses with complete video lectures) through its OpenCourseWare website (<http://ocw.mit.edu/OcwWeb>). The Monterey Institute for Technology and Education’s National Repository of Online Courses ([www.montereyinstitute.org/nroc](http://www.montereyinstitute.org/nroc)) provides access to an entire online high school curriculum free of charge. And Khan Academy (<https://www.khanacademy.org>) has a library of more than 6,500 short video lessons that span a wide range of topics.

These are just three among thousands of online learning opportunities that are available to students in the Internet age. Although online channels are already being used by teachers who incorporate blended learning and flipped classrooms into the school day, the day is coming when the teacher as “middleman” may be eliminated and students will engage in independent learning of their own choice, achieved at their own pace and used in their own way.

Although many teachers would not yet trust students with this level of autonomy, programs are starting to open up that allow adolescent learners to spread their wings and fly in this new universal learning academy. At Montpelier High School, students can enroll in Soar, a program consisting of independent study, internships, and a weekly seminar where students learn how to set goals, conduct research, and reflect on their learning (Martin & Bunting, 2015). And at Monument Mountain Regional High School in Massachusetts, students participating in a program called the Independent Project create their own curriculum and engage in learning of their choice, including traditional academic pursuits as well as projects like taking flight lessons, writing a novel, and building a kayak (Vangelova, 2014).

## 9. Offer More Electives

Increasingly, states are requiring students to go through some version of a mandatory college preparatory curriculum to graduate, usually involving four years of English and math and three or more years of science and social science. This trend continues to gain steam, even though research (Allensworth, Nomi, Montgomery, & Lee, 2010) indicates that it doesn't really improve learning or heighten student engagement. What it *does* do is leave less room for students to choose courses that interest them and that could actually help them decide on a career, a hobby, or a lifestyle they'd like to pursue in adulthood.

One solution to this problem is for schools to both institute a rigorous academic program and offer a wide range of electives. In a single year, for example, Pelham Memorial High School in New York State added 17 electives to its schedule (Hu, 2008). Currently, this high-performing school with a rigorous college preparatory program offers electives in jewelry making, ceramics, photography, broadcast production, military history, Hollywood, and human rights, among other selections. *Washington Post* reporter Valerie Strauss (2013) asserts that every course at a high school should be an elective and that if five or more students request a class that isn't offered, a teacher should work with the students to design and offer it.

## 10. Give Students More Control in How Their Learning Is Assessed

Assessment of educational experiences should ultimately be about learning, not comparing. The best way to make assessment a learning experience is to involve students in its design and implementation. Teachers need to do more to include students in the process of choosing assessment methods, creating the rubrics that describe levels of proficiency, and designing the scoring or rating procedures (Bruce, 2001). Dave Orphal (quoted in Ferlazzo, 2012), a teacher at Skyline High School in Oakland, California, says, "I've started letting my students co-write



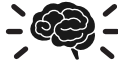
the grading rubrics in my classroom. I've been very impressed with how seriously they take the job of determining what criteria they should be graded on and what elements make an excellent example of the project that they will create" (para. 26).

The simplest way to involve students in self-assessment is to ask them frequently to reflect on what they've learned in the past hour, day, semester, or year—it works for any length of learning period. Students can engage in this reflection process by writing, drawing pictures, talking with a partner, or keeping a learning log or journal. One study (Chang, Liang, & Chen, 2013) found that the self-assessments high school students gave themselves for learning portfolios were highly consistent with teacher assessments. Self-assessment was also seen as a valid way to improve the writing achievement of students in middle and high school (Nielsen, 2014).

Another way in which students can take control of the assessment process is by leading conferences that evaluate their past learning. With parents and educators present, students can guide the meeting, show and discuss samples of their work, and reflect on strengths and challenges as well as envision plans for future learning (Martinez & McGrath, 2013).

## **Making the Choice for Student Voice**

It amazes me that education has gone along for so many decades (indeed, centuries) without acknowledging the need to include adolescent students as collaborators in their own learning. Perhaps this can be accounted for by society's bewilderment at how to deal with adolescents' burgeoning passions and its (faulty) reasoning that the best way to handle this challenge was to establish maximum control over teens' expanding energies. Thanks to the last 60 years of developmental psychology research and the last 15 years of brain research, we now know better. Students need to have the opportunity to take charge of their lives, and the function of educators should be to help them do so to prepare them for the challenges of adulthood.



## TAKEAWAYS

- At a time in their lives when adolescents need to practice decision-making skills, secondary schools begin to restrict their choices.
- A lack of student choice results in feelings of powerlessness and disengagement.
- Educators need to entrust students with more control over their own learning.
- Strategies for empowerment include giving students choices regarding homework and required books to read, using polling to gauge student understanding and opinion, allowing students to create their own learning projects, setting aside time during the school day for students to pursue “passion projects,” permitting students to learn at their own rate, including students in the school’s decision-making process, providing independent study programs, offering more electives in the school curriculum, and giving students more opportunities to assess their own work.

# 4

## Self-Awareness Activities

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I have called the major crisis of adolescence the identity crisis; it occurs in that period of the life cycle when each youth must forge for himself some central perspective and direction, some working unity, out of the effective remnants of his childhood and the hopes of his anticipated adulthood.

—Erik Erikson, *Identity and the Life Cycle*

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If you've ever used the phrase "identity crisis," then you've referred to the work of 20th century psychoanalyst Erik Erikson, who used that term specifically in reference to adolescence. Erikson (1993a, 1993b, 1994a, 1994b) believed that adolescence represented a critical time for the formation of identity. The sense of an enduring and coherent "I," according to Erikson, has to be pieced together, sometimes painfully (hence "crisis"), from a broad range of subjective and objective life experiences encompassing involvement in friendships and romance; negotiations with parents, teachers, and other authority figures; ruminations over values, beliefs, and ideals; experiments in trying out possible "selves"; and aspirations toward a still-unclear vision of how to function within the broader community.

According to Erikson's sociocultural model, either humans leave this stage of development in their late teens or early 20s with a workable sense of identity, or they suffer from *role confusion*: the failure to commit

to any meaningful sense of self. This suboptimal development follows them throughout their adult lives as relationship difficulties, workplace frustrations, emotional distress, and other chronic life problems.

Recent research on the adolescent brain seems to confirm Erikson's ideas about the importance of identity formation and the primacy of self-awareness during the teen years. In one study (Pfeifer, Lieberman, & Dapretto, 2007), subjects were asked while in an MRI machine whether a number of statements (e.g., "I like to read just for fun") applied to themselves (the self condition) or to a fictional character (in this case, Harry Potter; the social condition). The fMRI scan results indicated that the exercise activated different parts of the brain in adolescents and adults. In adolescents, the *dorsolateral prefrontal cortex*—an area important for self-reflective processing and, interestingly, one of the most recent areas of the brain to evolve in humans—was activated in the self condition. On the other hand, in the self condition, adults used the *lateral temporal cortex*, an area involved in semantic retrieval or stored memory (Pfeifer et al., 2007; Sebastian et al., 2008).

Another study (Blakemore, den Ouden, Choudhury, & Frith, 2007) asked adolescents and adults to think about actions they might take in a given situation (e.g., "You want to see what's on at the cinema: do you look at a newspaper?"), and yet another study (Burnett, Bird, Moll, Frith, & Blakemore, 2009) gauged responses of both age groups to specific social situations (e.g., "You were quietly picking your nose, but a friend saw you"). In both of these studies, adolescents similarly activated the dorsolateral prefrontal cortex, while adults used their lateral temporal cortex. Adolescents, then, seem to be actively engaged with their self-reflective/self-conscious brain, while adults appear to rely more on previously stored self-memories.

## **Five Ways to Promote Self-Awareness**

Although educators tend to think of self-development activities as outside the scope of an academic curriculum, there are important instructional reasons to include such experiences in the secondary-level classroom.

Research (Lannegrand-Willems & Bosma, 2006) has shown that school has an important influence on adolescent identity formation. In middle and high school, students are exposed to new ideas, role models, friends, and experiences that could have a significant effect on their explorations of self-formation (Sinai, Kaplan, & Flum, 2012). It is telling that when students report they are “bored” with school, they often provide the explanation, “It doesn’t have anything to do with me and my life.” On the other hand, research (Cohen, Garcia, Apfel, & Master, 2006; Faircloth, 2012) suggests that when students are provided with experiences and materials that relate to their own backgrounds, feelings, and identities, they become immediately engaged and academic achievement improves, especially among minorities.

Dweck’s (2007) research on mindset suggests that students’ beliefs about self, including such attributes as intelligence and capability, lead to self-judgment or self-development, and that these outcomes in turn can significantly affect their engagement and achievement in school (see also Brooks, Brooks, & Goldstein, 2012). Moreover, with education’s current emphasis on 21st century learning, students need to have the ability to explore and even reconstruct identities multiple times as they learn to cope with enormous amounts of information, rapid technological advances, a multiplicity of values and points of view, and other forms of continuous societal change and global uncertainty (Kaplan & Flum, 2012; Sinai et al., 2012).

In this chapter, I describe five practical strategies that middle and high school educators can integrate into any content area or curricular focus to promote student self-awareness and exploration of identity.

## **1. Use Self-Awareness Assessments**

Because students are actively working to formulate a sense of identity, it makes sense to give them an opportunity to learn more about their strengths, interests, and values. Although the field of education is replete with formal assessment instruments, including intelligence and achievement tests, interest inventories, and skills surveys, it isn’t practical or wise to use these as classroom activities because they invite

comparison with peers (a potentially mortifying experience). Moreover, they usually require professional interpretive assistance, cost money, and may reinforce a student's negative self-image.

On the other hand, quick and easy informal assessments can be fun, allow for personal reflection, and even be integrated with class content. The George Lucas Educational Foundation website Edutopia, for example, provides a quick emotional intelligence quiz (Brackett, Caruso, & Rivers, 2015; go to <http://www.edutopia.org/louisville-social-emotional-learning-quiz>) that could be used in a psychology class, in a history lesson on conflict among nations, or to introduce a social studies unit on violence in the community. Other no- or low-cost self-assessments available at bookstores or online include

- Gallup's *StrengthsExplorer for Ages 10 to 14* (Gallup Youth Development Specialists, 2007) or *StrengthsFinder 2.0* (Rath, 2007) (purchase of book provides access code for online assessment).
- The VIA Institute on Character's free online survey of character strengths (<http://www.viacharacter.org>).
- Search Institute's Developmental Assets Profile survey for ages 8–18 (<http://www.search-institute.org/surveys/DAP>).

In addition to these resources, there is a vast number of rough-and-ready self-assessments available online that explore a wide range of qualities, including personal interests, IQ, multiple intelligences, personality types, physical health, values, and learning preferences. Make sure to review these surveys or quizzes before administering them and use them in a fun and informal way, not as a means to place students in hard-and-fast categories. After students take an assessment, consider asking them questions like, “What did you learn about yourself?” “How can you use this information in your life?” and “How does this assessment help you to see the world differently?”

## **2. Have Students Create Autobiographies**

Psychologists (Habermas & Bluck, 2000) have suggested that people begin to formulate a “life story” (i.e., a coherent picture of the life

they have led thus far) during adolescence. Consequently, middle and high school presents a developmentally appropriate and even optimal time to engage students in activities that ask them to construct their life histories through writing, art, and other media.

Although the most obvious examples of this practice would be to have students write their autobiographies or illustrate them in art class, engaging students in autobiography can exercise skills that align with specific instructional objectives in a variety of content areas. In a 10th grade English lesson on metaphor, for example, the teacher asked students to come up with metaphors for themselves and to create posters adorned with those metaphors (Larsen & Larsen, 2004). One student wrote, “I am a wave . . . I can be very powerful or extremely weak. I can be fairly fast or very slow. I can be very large or I can be very small” (p. 251). Another wrote, “I am a race car . . . a race car is loud just as I have a loud and outgoing personality around the right people” (p. 251).

Another teacher introduced a poem by Israeli writer Tirza Atar titled “My Childhood Was a Ship,” asked students to complete the phrase “My childhood was . . .,” and then had students replace all the adjectives in the poem with adjectives that pertained to themselves (Sinai et al., 2012).

A 9th grade World History teacher engaged his class in a “Who am I?” project that had students merge their understandings of personal history and world history. Students conducted research, reflected, and made presentations on how past experiences, present life situations, and future intentions shaped their relationship to the world (Bernhardt, 2009).

### **3. Let Students Keep Their Own Journals**

Journaling connects students with their own feelings, values, beliefs, and ideals, and this contributes to their explorations in identity formation. AP literature teacher Maureen O’Leary Wanket (2005) doesn’t require students to read from or share their journal entries with others, but she notes that students almost invariably want to share them. (*Note:* although the journals are private, Wanket tells students that if she

**Figure 4.1 | Journal Prompts to Stimulate Self-Awareness**

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- What is your personal credo?
- What motivates you?
- What are you afraid of?
- What challenges have you set for yourself?
- What are you grateful for?
- What are you good at?
- Who inspires you, and why?
- What are your hopes for the future?
- What are the obstacles in your life?
- What did you love to do as a child?
- What event in your life meant the most to you this year?
- What would you like to learn on your own?

reads that they are hurting themselves or hurting or being hurt by someone else, she will have to report it to the school counselor.) An excellent way to stimulate journal writing is to provide prompts (Slotnik & Schulten, 2012). Figure 4.1 provides a list of self-awareness prompts that can help your students get started.

Another approach is to have students read famous journals and diaries, such as *The Diary of Anne Frank* (Frank, 1989), whose entries often relate to working out personal identity. In this passage, Anne Frank writes about her “two selves”:

I have, as it were, a dual personality. One half embodies my exuberant cheerfulness, making fun of everything, vivacity, and above all the way I take everything lightly. This includes not minding flirtation, a kiss, an embrace, a dirty joke. This side is usually lying in wait and pushes away the other, which is much better, deeper and purer. (p. 77)

Journal writing can also be integrated into the content areas in ways that promote identity exploration. Instead of having students maintain a lab notebook in chemistry, for example, ask them to keep a “Scientist’s Journal.” Other possibilities include a “Writer’s Notebook” in English class (Gemmell, 2008) and a “Historian’s Journal” in social studies



(Facing History and Ourselves, 2015). These assumed identities provide a tentative framework within which adolescents can “try on” alternative selves within a potential career focus. Similarly, students might keep a journal based on another person’s identity (e.g., a protagonist in a novel, an important historical figure, or a mathematical or scientific genius).

Finally, journals needn’t contain just words. Students can keep an inventor’s journal in a STEM class (Rushton, 2012) or an artist’s journal in art class in which they record images, illustrate ideas, and draw diagrams (McKay, 2012). It’s important that these integrated journals not be just information repositories but also give students an opportunity to project themselves into the content and reflect on how the material affects them personally. As one student (Faircloth, 2012) wrote, “I don’t usually care for writing in journals but in this one [that focused on exploring the student’s perspectives] I always have so much to say and then it became a story not a journal” (p. 190).

#### **4. Connect Content to Students’ Personal Lives**

This may seem like an obvious strategy, but too much secondary school instruction simply delivers information via lectures and textbooks without providing a context for students to link the material to their own lives. Failure to connect learning to students’ lives (e.g., ethnic backgrounds and cultures, families and communities, personal interests and hobbies, or daily experiences) obstructs students’ initial engagement with the material (“What does this have to do with *my* life?”). Crucially, it also prevents the material from being fully integrated into the student’s learning in a way that endures beyond the final examination.

One simple way of forming this kind of connection is to invite students to “think of a time in your life when . . .” and ask them to fill in the blank with a personal experience that relates to the particular classroom topic or objective being discussed or studied (see Figure 4.2).

To make these personal connections, students need time to reflect on the material and consider how it relates to or affects them. By providing these “reflection periods,” classroom lessons can become building blocks in students’ ongoing construction of identity. Even short periods

**Figure 4.2** | Connecting Learning to Students' Personal Lives

Content Area	Think of a time in your life when . . .
History (American Revolution)	You felt like revolting against authority.
Literature ( <i>Macbeth</i> )	You wanted something so badly that you were willing to break the rules to get it.
Biology (stress response)	You got stressed out and experienced one or more physical, mental, or emotional disturbances.
Mathematics (probability)	You weighed the possibilities/probabilities of doing something that was potentially dangerous.
Social science (prejudice)	You discriminated against someone because he or she was different from you OR someone else discriminated against you.
Physics (Newton's first law of motion)	You felt like staying in bed indefinitely until one of your parents yelled at you to get up.
Chemistry (Boyle's law)	You felt like you were under a lot of pressure.
Foreign language (Spanish)	You really needed to speak Spanish to communicate something important or to understand something important that someone was saying.

of reflection (say, one to three minutes), accompanied by a prompt that asks students to connect the material to their lives, can be effective. Here are some sample reflection prompts for different subjects:

- *Vocabulary*: “Take a minute to think of a vocabulary word you used that someone had to ask you the meaning of.”
- *Mathematics*: “Use the next two minutes to think about a situation in your daily life where you might use the proof you just learned.”
- *Civics*: “During the next three minutes, consider what kind of a voter you will be when you are eligible to vote in local, state, and national elections.”
- *Literature*: “Take a couple of minutes to think about whether you would have acted the way Hester Prynne did in this part of *The Scarlet Letter*.”

- *Science*: “Give yourself a minute to think about how your life might change if the average global temperature increased by three degrees.”

Education consultant and former classroom teacher Catherine Burger Kaye (2014) suggests three ways to help students establish personal connections to the material they have learned:

- Tell students to look out the window just before the end of class and think of a way they can apply what they’ve learned during the school day, and then share it with a classmate;
- Have students take photos over the weekend that provide wordless commentaries on topics covered the previous week; or
- Suggest that students identify song lyrics that resonate with them regarding particularly important learning moments.

## 5. Teach Students Mindfulness Meditation

As Chapter 2 noted, adolescents are more vulnerable to stress than adults are, and stress reduction methods such as mindfulness meditation can help teens cope with the ups and downs of daily living. Meditation may include different types of activities but most frequently involves sitting quietly on a cushion or in a chair while focusing the mind on the present moment. Meditators are advised to pay attention to the “in” and “out” rhythms of their breathing. Whenever distractions such as thoughts, feelings, noises, or sensations occur, students are advised simply to notice them nonjudgmentally and then turn their attention back to their breath (see Figure 4.3). Mindfulness meditation is an emerging intervention that holds great promise for benefiting adolescents’ well-being and executive functioning.

Although mindfulness meditation originated from the tradition of Theravada Buddhism (Swearer, 2010), the practice was adapted for nonreligious purposes in the late 1970s by Jon Kabat-Zinn, a scientist at the Stress Reduction Clinic at the University of Massachusetts Medical School. After the success of his stress reduction program, the practice began to spread and became the focus of an exponentially increasing

**Figure 4.3 | Simple Instructions for Mindfulness Meditation**

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1. Sit in a straight-backed chair with feet flat on the floor (or on a cushion with erect posture).
2. Close your eyes (optional).
3. Begin to focus your attention on your breathing without controlling it in any way. You can concentrate on the movement of air flowing through your nostrils or the rising and falling of your belly. To help you focus, you might silently say “in” as you inhale and “out” as you exhale or count breaths from 1 to 10.
4. If you become distracted by a thought, a sensation, a feeling, a noise, or anything else, simply notice the distraction in a nonjudgmental way and then return your focus to your breath.
5. Keep returning your attention to your breathing after each distraction.
6. When the signal to end the meditation is given, bring your attention back to the room.

number of books, programs, and research studies (see, for example, Goldstein & Kornfield, 2001; Kabat-Zinn, 1994; Siegel, 2010).

In the classroom, educators have adapted mindfulness meditation to the developmental needs of adolescents by shortening the meditation sessions (some teachers have students “sit” for just five minutes at a time); by including other techniques, such as guided imagery and body scanning; and by varying the setting and method (e.g., meditating while sitting in the classroom, walking outside, or eating in the cafeteria).

Research studies with adolescent subjects (Bluth & Blanton, 2014; Ciesla, Reilly, Dickson, Emanuel, & Updegraf, 2012; Jennings & Jennings, 2013; Pokhrel et al., 2013) have indicated that mindfulness meditation improves executive functioning, reduces stress, increases positive emotions and decreases negative emotions, and promotes general well-being. As one student noted after a meditation session, “I like mindfulness because it’s a good way to relax and I feel like I have a completely different outlook on everything afterwards. It makes me want to do different things than before the meditation” (Jennings & Jennings, 2013, p. 25).

## Seizing the Day in the Secondary School Classroom

Building a strong sense of self is a crucial aspect of human development. As Erik Erikson (1994b) noted,

It is only after a reasonable sense of identity has been established that real intimacy with others can be possible. The youth who is not sure of his or her identity shies away from interpersonal intimacy, and can become, as an adult, isolated or lacking in spontaneity, warmth or the real exchange of fellowship in relationship to others; but the surer the person becomes of their self, the more intimacy is sought in the form of friendship, leadership, love and inspiration. (p. 85)

Middle and high school educators have a golden opportunity to make a difference in the lives of their students by providing them with activities that support their ongoing process of constructing an identity. If students aren't provided with opportunities to engage in activities involving the construction of a coherent sense of self, they are more likely to "act out" distorted images of selfhood that they borrow from the media, from their poorly performing peers, and from other suboptimal role models. Teacher intervention, while only part of a larger picture, may go a long way toward ameliorating many of the problems adolescents face—including aggressive behavior, substance abuse, and mental health issues—thereby equipping these soon-to-be-young-adults to thrive in spite of any obstacles on their path to maturity.



## TAKEAWAYS

- Adolescents are engaged in the process of identity formation, the outcome of which will have a significant bearing on their adult functioning.
- The dorsolateral prefrontal cortex of the brain, important in self-consciousness and self-awareness processes, is more active in teens than in adults on tasks that involve self-reflection.
- Schools have a significant influence on adolescents' construction of self.
- Students' disengagement stems in part from the failure of instruction to connect with their personal lives and backgrounds.
- Strategies for incorporating self-awareness activities in the classroom (and thus boosting student engagement) include administering informal self-awareness assessments, integrating autobiography into the content areas, having students keep ongoing journals, connecting the curriculum to students' personal lives, and teaching mindfulness meditation.

# 5

## Peer Learning Connections

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To begin with the Youthful type of character. . . . They are hot-tempered, and quick-tempered . . . nature warms their blood as though with excess of wine. . . . They are fonder of their friends, intimates, and companions than older men are.

—Aristotle, *Rhetoric*

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Picture a scene from a typical day in a middle or high school somewhere in the United States: students are seated in rows listening to a lecture or working individually on a reading or writing assignment, a history project, or a set of math problems. Seems normal enough. So what's wrong with this picture?

*Answer:* there's no peer interaction. To teach a lesson without at some point having peers connecting with one another is to fly in the face of a growing body of research in cognitive psychology and neuroscience that points to the overwhelming influence peers have on one another during adolescence. Adolescents consistently spend more time with peers than with adults or children, report that they are happiest when they are with their peers, and, when deciding how to behave in a variety of situations, give the highest priority to peer norms (Dustin, Chein, & Steinberg, 2013).

Chapter 2 looked at the evolutionary reasons for specific adolescent behaviors and noted that a preference to be with one's peers is an

evolutionary adaptation: in the real world, engagement with others is a key to survival. As neuroscientist Jay Giedd (quoted in Miller, 2015) notes, “The peer group is the one that will help protect you, who will be your teammates, and who will supply resources. Job one for adolescents is navigating their social world” (p. 8).

Neuroimaging research on the power of peers in a teenager’s world backs up this perspective. Chapter 1 described how teens took more risks in a computerized driving simulation when they believed peers were watching, and explained that brain regions associated with emotional distress were triggered when adolescent subjects were cut out of a game of Cyberball. Researchers in another study (Jankowski, Moore, Merchant, Kahn, & Pfeifer, 2014) scanned the brains of both adolescents and adults while the subjects evaluated whether certain academic traits (e.g., “fast learner”), physical traits (e.g., “very good-looking”), and social traits (e.g., “socially awkward”) described themselves directly, described their best friend directly, or described themselves from their best friend’s perspective. Results indicated that in adolescent subjects only (and not in adults), the set of slides relating to social self-evaluations (e.g., “Do you think I’m cool?”) activated the *striatum*, an area of the brain connected to rewards and motivation (see also Northoff & Bermpohl, 2004).

In other words, adolescents are primed in the reward regions of their brain to respond to what their peers think about them. Moreover, adolescents seem to activate the *same* areas of the brain when they are directly evaluating *themselves* (Pfeifer & Blakemore, 2012). On a neurobiological level, their own individual identity seems to be tightly bound to their identification with friends, classmates, and other peers. In addition, research indicates that the onrush of sex hormones accompanying puberty has been linked to a proliferation of receptors for the hormone oxytocin, which is associated with social bonding and heightened attention to positive social stimuli (Dustin et al., 2013).

From the standpoint of neurobiology, then, adolescents are primed for social learning and not for listening to teacher lectures.



## Seven Ways to Foster Peer Interaction

It's safe to say that students are more likely to be engaged with learning when they have positive social connections in school. In a British national survey (Gorard & See, 2011) of what students particularly liked about being in school, student responses included the following:

- “Having fun, being yourself and being with people you like . . . having fun but learning. . . .”
- “I have enjoyed it as you make friends and have experiences which teach you things as well as achieving good grades.”
- “I prefer to work in a group, because if you have one-on-one it's really, really nervous. But if you have a friend with you it's like you've someone else to talk to.” (p. 678)

It's not just a student's immediate peer group that contributes to a positive school experience. More broadly identified peer groups (e.g., classmates, schoolmates, ethnic or interest groups) also significantly influence student engagement. Research (Lynch, Lerner, & Leventhal, 2013) indicates that in schools with high levels of hostility among peers and peer groups, there's less peer engagement, whereas when relationships are positive overall, student engagement rises.

The presence of peer support has the potential to make a substantial contribution to positive school outcomes, particularly for students in early adolescence (Ellis, Marsh, & Craven, 2009). In this chapter, I describe seven practices that make peer-to-peer interaction the focus of learning.

### 1. Establish Small Learning Communities

One of the most important outcomes of the high school reform movement of the 1980s was the broad acknowledgment among many secondary school educators that large and impersonal urban schools weren't working, and that there needed to be a concerted attempt to create a more personalized learning experience for students. Out of this

reform effort came a number of proposals, including smaller class sizes, schools within schools, career academies, theme-based schools, smaller teacher-to-student ratios, teacher-student coaching, and innovations in the quality of instruction (see Meier, 2002; Nehring, 1998; Sizer, 2004).

Although the process of breaking up a large school into smaller communities can be a massive undertaking, and research supporting this practice is mixed (David, 2008), there are practical steps educators can take to avoid some of the pitfalls of creating small learning communities and reap many of their benefits (see, for example, Allen, Almeida, & Steinberg, 2001; Sammon, 2007). On the macro scale, an important early step is to meet with community and school board members to initiate the foundational work needed in creating a magnet school, a school within a school, a career academy, or another small learning community model. On a smaller scale, educators who want to begin the process of developing smaller learning communities should

- Establish a student-advisor system so that adolescents will have at least one teacher who knows them personally and will keep tabs on their progress over time.
  - Include frequent small-group activities in each course.
  - Engage students in open-ended discussions during class.
  - Create before- or after-school “clubs” for students based on mutual interests.
  - Integrate project- or inquiry-based learning by having students work in teams on authentic problem-solving assignments.

More recent educational models promise to expand our understanding of how to create “communities of learners” (McCaleb, 1995) or “communities of practice” (Wenger, 2011) that encourage collaboration and cooperation.

## **2. Engage Students in Collaborative Learning Projects**

Many secondary educators are still reluctant to fully embrace a cooperative or collaborative approach to learning because of a deeply ingrained belief that “students should do their own work” in preparation for college

and life. One of the best refutations of this idea is the multi-author scientific paper. Look over the references to this book, and you'll discover that most of the neuroscience studies cited have been written by more than one author—in many cases, by several researchers working together.

Students at hard-driving institutions like Harvard Law School typically study in groups to make the workload manageable. Similarly, life in the business world is largely a matter of teamwork. Consequently, schools can do the best job of preparing students for college and career by engaging them in collaborative learning. As neurologist Judy Willis (2007a) has noted, this nourishes the adolescent brain by creating an association between cooperative learning and the dopamine reward centers of the brain. Studies of cooperative and collaborative learning (see, for example, Gillies, 2008; Hussain, Anwar, & Majoka, 2011) indicate their superiority over traditional lecture- and textbook-based teaching methods.

At Warrensburg High School in Missouri, history students engaged in a study of their town. Working in teams, they visited local museums, conducted research on the Internet, and produced their own web page as a medium for reporting their findings. Each student within a group was assigned a specific subtopic (e.g., reporting on the Howard School, a historic school in Warrensburg that served African American students during the time of segregation) and an individual role, such as photographer (taking photos, scanning images and inserting them into the web page) or web page editor (reviewing written work and typing text into the web page) (Scheuerell, 2010).

Geometry students at the College Preparatory School in Oakland, California, used rope and chalk on the school's courtyard blacktop to draw equilateral triangles in teams of three. As one student held the rope in place at one vertex of the triangle, for example, the other two slowly moved in a circle, using the rope as a compass to mark out the other points of the triangle (Davis, 2012).

It's important to note that working in groups doesn't automatically equate with cooperative learning. The projects described here, while different in scope, both provided rigorous learning experiences for students. Collaborative learning projects should require individual

accountability, have clear goals, promote interdependence of team members, and involve appropriate instruction in communication and problem-solving skills (Slavin, 2014).

### **3. Incorporate Peer Teaching**

In the early 19th century, a Quaker educator named Joseph Lancaster developed a method of instruction that possibly qualifies as the first institutional example of peer tutoring in the United States. Lancaster's basic principle was that when one student had successfully learned the material being taught, he or she was rewarded by being permitted to pass that information on to another student, and that student to another one, and so on until all the students had been taught. Through this approach and an intricate system of class management, Lancaster was reputed to be able to teach 1,000 students at a time (Joseph Lancaster, 2015).

It was Lancaster who first popularized the Latin proverb *Qui docet discit* ("He who teaches learns") (Monitorial System, n.d.). These words sum up the win-win nature of peer teaching: the student being taught learns, and the one who does the teaching may benefit even more. Research (see Bowman-Perrott, Davis, Vannest, & Williams, 2013; Sparks, 2015) backs up peer teaching as one of the most effective forms of instruction, regardless of "dosage," grade level, or disability status.

In its simplest form, peer teaching (perhaps better termed "peer learning") can take the form of having each student "explain what you've just learned to the person sitting next to you." On a more complex level, peer teaching merges with collaborative learning, as at the College Preparatory School in Oakland, where students take difficult group tests that require them to work out all of the answers collaboratively. As one student observed, "I like the group tests because there are more challenging questions . . . and if I were doing them by myself, I probably wouldn't get them. But when you have three other people to help, then we figure it out together" (Davis, 2012).

At the Envision Academy of Arts and Technology, also in Oakland, high school students are carrying peer teaching into the realm of

online instruction by filming their own short videos of lessons they've just learned (e.g., how to solve two-step equations) and posting them on a website called Upside Down Academy (<http://www.upsidedownacademy.org>), so that a wider audience can benefit from their expertise (MindShift, 2012).

Peer teaching dovetails nicely with another innovative educational practice: the flipped classroom. Here, students do their homework by watching videos from online sources such as the Khan Academy or the Upside Down Academy, or from teacher-designed videos, and then use their in-school time to receive personalized instruction from the teacher and engage in group projects and learning with peers. Originally developed in 2008 by Woodland Park (Colorado) High School chemistry teachers Jonathan Bergmann and Aaron Sams as a way of recording video lessons for absent students, this method has mushroomed into a new approach that allows teachers to spend quality time with students instead of just lecturing, and provides the time and space for a range of peer teaching opportunities (Bergmann & Sams, 2012; Tucker, 2012).

At Byron High School in Minnesota, for example, precalculus teachers Troy Faulkner and Rob Warneke use what they refer to as a Peer Instruction Flipped Model, utilizing class time as an opportunity for students to work together on what they have learned via video instruction homework. During one session where students were discussing the graphing of linear inequalities, Warneke reported,

As they were going through the questions I put up, I was walking around and listening to their conversations. Eventually, I started hearing “Ohhhhhhh” and I just love that . . . “Ohhhh, that’s why.” Students have a peer comfort level and I don’t think I could have gotten there with them with that level of sincerity. (quoted in Schell, 2013, para. 14)

#### **4. Establish a Peer Mentoring Program**

Educators and researchers have also seen successful outcomes in programs that have high school students serve as mentors to same-age

and younger students. At Landmark High School in New York City, for example, student mentors pair up with students who are having difficulty showing up for class or completing homework. One student commented about his mentor,

If I need help on a project, she'll be there. She texts me and tells me to come to school. She asks me, "Did you do your homework?" My mom asks me that too, but not as much. . . . It's hard. Sometimes I want to slack off. [But] it's good. Someone's actually looking out for me. (Zimmer, 2015)

At Haldane High School in Cold Spring, New York, high school seniors counsel middle school students regarding issues and questions about the transition into high school. As one 8th grader in the program remarked, "It's harder for adults to relate to people my age, and with high schoolers, it's easier for them to remember" (Rooney, 2015). A study (Johnson, Simon, & Mun, 2014) of a similar transition program at a low-income Mid-Atlantic high school that matched 12th grade peer leaders with incoming 9th graders revealed that mentored male students were more likely to graduate from high school four years later than were students in a comparable control group.

## **5. Let Peers Critique One Another's Work**

Peer assessment has traditionally been seen as a management tool that frees up teachers' time so that they can work more intensively with students who need special help. Its value in the classroom, however, goes far beyond simply having students grade one another's quizzes. Peer evaluation can help students think through and revise their projects or assignments more effectively and gain a greater appreciation for the work of their classmates. As middle school teacher Amy Reynolds (2009) points out, "Through peer critiques, students learn to appreciate the diversity and richness of one another's work—and to enrich their own work" (p. 54). In addition, peer critique models what goes on in the real world, where scientists and academics routinely submit their

### Figure 5.1 | Prompts to Guide Peer Assessment

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When assessing your classmates' projects, presentations, written assignments, or other schoolwork, here are some helpful ways to phrase your feedback (remember to use concrete examples from their work to illustrate your points):

- My favorite part was \_\_\_\_\_ because \_\_\_\_\_.
- One thing I really like about this is \_\_\_\_\_.
- A suggestion I can offer for improvement is \_\_\_\_\_.
- One way to make this stronger is \_\_\_\_\_.
- Have you ever thought about \_\_\_\_\_?
- Something that was unclear to me was \_\_\_\_\_.
- I really liked the way you \_\_\_\_\_.
- I didn't understand it when you \_\_\_\_\_.
- I would like to know more about \_\_\_\_\_.
- A question I'd like to ask you is \_\_\_\_\_?
- The thing that most impressed me was \_\_\_\_\_.

articles to peer-reviewed journals. Figure 5.1 includes a list of student prompts to help direct peer feedback.

At Durrington High School in the United Kingdom, English teacher Andrew Tharby (2014) uses a technique he calls “gallery critique,” which has students move around the classroom with sticky notes to read and give feedback on their classmates' writing—and, of course, to receive peer feedback on their own writing. He trains his students in providing feedback and suggests that they be guided by the philosophy of educator Ron Berger, who wrote, “In order to create beautiful work, we must be willing to refine. To refine, we require critique and feedback. In order to critique, we need models and standards. *For feedback to be useful to us, it must be: kind, helpful, and specific* [emphasis added]” (quoted in Michaels, 2012, para. 4; see also Berger, 2014).

Students at Hazelwood Central High School in Florissant, Missouri, collaborated with students from two other schools in the area on an art show. Midway through completion of the projects, the

participants took turns critiquing one another's work. Tracy Jay, the visual arts teacher at Hazelwood Central, observes that getting feedback from peers is quite different than hearing it from an adult: "I find peer critique incredibly helpful for student understanding. Students naturally hold their peers' opinions in high regard, and many times, they are able to communicate information in a way that is easy to understand" (Stltoday.com, 2011, para. 5).

Countering common teacher objections that peer assessments do not reflect fair or valid judgment of student work (i.e., that peers will evaluate one another more harshly or leniently than a teacher would), research on the effectiveness of peer assessment (Toppinga, 2009; Tseng & Tsai, 2007) suggests that student assessors' evaluations align with those of experts, as long as they are provided with the proper guidance and support.

## **6. Use Peer Mediation as Part of a School Discipline Plan**

As Chapter 2 acknowledged, adolescence in contemporary culture is associated with a broad range of hazards, many of which spill over into the school environment. Partly as a response to violent incidents such as the 1999 Columbine High School massacre, schools began adopting zero-tolerance policies for a number of problematic behaviors, such as violence and drug and alcohol abuse. Such infractions have often been met with automatic suspensions or expulsions, and have even involved the police and the juvenile justice system—despite the fact that these policies have generally been deemed ineffective in preventing a recurrence of these behaviors. In fact, such policies have often had a negative impact on school-community relations and failed to recognize the underlying needs of the developing adolescent (see, for example, American Psychological Association Zero Tolerance Task Force, 2008).

In the wake of these revelations, new approaches to discipline have opened up in many schools and communities, some of which involve peers in resolving disputes and dealing with infractions. Some programs



work directly with the city government and seek to keep high school students out of the juvenile court system. High school members of the Elgin, Illinois, peer jury, for example, have the authorization to assign community service hours or a project such as a time line storyboard of the incident (Walker, 2015).

Other programs originate directly from the school, including Fond du Lac (Wisconsin) High School's Student Court, which hears rule violations (e.g., cheating, tardiness, defiance) and provides offending students with ways to put things right. Sometimes the court recommends that the student write a letter of apology to the person wronged, or help a teacher with whom he or she has friction in cleaning up the classroom after school (Roznik, 2012).

Another program that takes this “restorative justice” approach to discipline is that of the Oakland Unified School District in California, which brings students together in peer-mediated small groups to talk, ask questions, and air grievances. Such programs strengthen campus communities, help prevent bullying, and reduce the incidence of student conflicts (Davis, 2013). Studies (Gregory, Clawson, Davis, & Gerewitz, 2014; Schiff & Bazemore, 2012) suggest that these peer-led approaches to discipline reduce schoolwide suspensions, decrease office referrals, and support racial equity.

## **7. Create Classwide Simulations Around Specific Academic Content**

A final way to stimulate peer learning connections is to create a classroom environment that simulates some aspect of the course's curriculum content (e.g., a specific historical period, the milieu of a novel or short story, or the operation of the federal government). In his AP U.S. history courses, for example, Matt Levinson, Head of School at University Prep in Seattle, Washington, engaged students in mock press conferences, trials, murder mysteries, dinner parties, spy dilemmas, and re-creations of reality TV shows like *Survivor* (Levinson, 2014). At Garfield High School, also in Seattle, AP student Duncan Skerrett reports,

“Rather than sitting and taking notes on the media’s role in an election, I get to be Jon Stewart covering a class election. Instead of reading about the speaker’s powers, I get to be the speaker of the House and run a floor session” (Moran, 2014, para. 10).

Although nontech simulations provide the most vivid approach to bringing a topic to life, the education arena has also seen huge growth in the use of online resources and, in particular, the application of gaming principles. In SimCityEDU, for example, middle school students take on the role of the mayor of a city dealing with pollution. Students must balance the environmental effects of development projects with employment needs and citizens’ well-being. Another popular video simulation called Minecraft can be adapted for a wide variety of educational applications. Players build structures in a virtual sandbox of unlimited dimensions using 3-D “cubes” (like virtual LEGOs). In the game’s “creative mode,” players have access to endless resources, don’t face any enemies, aren’t rated or scored for their performance, and can fly freely around the environment they’ve created. At Central Springs Middle School in Nora Springs, Iowa, social studies teacher Adam Hines has his students use Minecraft to build virtual colonies, design maps, and write backstories for their settlers (Rivera, 2015; see also MacQuarrie, 2013).

Through MinecraftEdu, players can “buddy-game” around one computer or work in multiplayer mode on different computers to create collective projects. Players in different parts of the world can communicate with one another in chat rooms (Miller, 2012). Other resources for online gaming in the classroom include Gen i Revolution (personal finance and economics), Geology Explorer, and Chemikul (science and chemistry). Figure 5.2 lists some ideas for integrating collaborative online tools into the learning environment.

## **Harnessing the Power of Peer Interactions**

When it comes to peer interactions at school, educators have a choice: to stand by and regard teens’ boisterous interactions in the hallways, their

### Figure 5.2 | Ideas for Using Online Tools to Foster Peer Learning Connections

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- Play electronic board games that teach specific academic skills (e.g., Cashflow 101 to teach money management or Sudoku 5 × 5 to teach logic skills).
- Create a class wiki that everyone can contribute to.
- Complete online puzzles keyed to learning objectives (e.g., brainteasers to teach problem solving, anagrams to develop vocabulary).
- Create a “quiz show” to review course content using software such as QuizXpress.
- Set up Skype conferences with same-age students in other schools.
- Use collaborative brainstorming and mind-mapping tools like Inspiration to supplement group discussions.
- Let students create a collaborative poster or mural illustrating learning through an online whiteboard tool such as Simple Surface.
- Have students create a collaborative video using an online tool such as WeVideo.
- Let students work together on a collaborative presentation using a tool like Prezi.
- Allow students to create collaborative blogs using WordPress or Blogger.
- Assign collaborative homework assignments that can be completed online through tools like Google Hangouts.
- Engage students in online chats with students in other schools using a tool like 99Chats.

obsessive texting, and their intense group affiliations as distractions from the academic world, or to harness the power of peer affiliation for the purpose of creating more engaging and effective classroom learning. The tools are there. We have only to use them.



## TAKEAWAYS

- Adolescents prefer their own company to the company of children or adults.
- Peer affiliation is an evolutionary adaptation that prepares adolescents for the social cooperation that is necessary for survival.
- Neuroimaging shows unique patterns of brain activation in response to events that involve social processing of peer relationships.
- Students are more engaged in learning when they can interact with their peers.
- Classroom strategies that make use of peer affiliations include establishing small learning communities; engaging students in collaborative projects; incorporating peer teaching, peer mentoring, peer assessment, and peer mediation; and creating classroom simulations that involve peer interactions.

# 6

## Affective Learning

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At the age of fifteen or sixteen . . . we live through great storms of feeling. . . . Love and anger, joy and scorn . . . go jolting through us like electric impulses, now engulfing the whole world, then again shriveling into nothing; sadness, tenderness, nobility, and generosity of spirit form the vaulting empty skies above us.

—Robert Musil, *The Man Without Qualities*

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During adolescence, human emotions assume a level of importance not seen since early childhood and not to be seen ever again. The limbic system (or “emotional brain”) of the adolescent has been pretty much fully installed by the onset of puberty, while the inhibitory functions of the prefrontal cortex are still under construction. Limbic system structures such as the amygdala, hippocampus, and hypothalamus are involved in the regulation and expression of emotions such as fear and anger, important to the fight, flight, or freeze response to stress, and vital to sexual feelings and strong positive emotions (Arain et al., 2013).

These neural circuits evolved in humans to facilitate their survival: hunger pangs drove prehistoric teens to seek food, sexual feelings propelled them toward finding a mate, aggression motivated them to hunt and combat predators, and strong feelings of excitement and joy inspired them to explore their expanding world and find solutions to daily challenges.

In today's world, adolescents are generally considered too young to marry or mate, and there are no mastodons to hunt. Nevertheless, the same emotional proclivities are still hard-wired into the adolescent brain, and secondary school educators must figure out what to do with all that bubbling emotion. Unfortunately, teachers all too often choose to ignore, and even suppress, emotional expression in school. In one study of U.S. high schools, researchers (Horner et al., 2015) wrote, "Across focus groups, participants indicated a common perception that the social norms within the educational settings supported emotional suppression and inhibited emotional expression" (p. 14).

The authors (Conner & Pope, 2013) of another study—this one of high-performing high schools—reflected,

Many of the students refer to themselves as "robo-students" and explain that school is a matter of going through the motions, "doing the lesson" . . . or "doing school." . . . In order to keep up with their heavy workloads, these students go through school on auto-pilot, moving from one assignment to the other with little time for reflection. Although they garner high grades and appear academically successful, students privately concede that they do not actually learn or retain the intended material. (pp. 1426–1427)

## **Six Ways to Encourage Affective Learning**

Clearly, the emotions have a vital role in determining how well students learn. Under optimal conditions of low stress and high engagement, emotional meaning in the amygdala is connected to previously stored information in the hippocampus and then travels along established neural circuits to the prefrontal cortex, the site of higher-order thinking where new learning is processed, categorized, and stored for later use.

Neurologist and former middle school teacher Judy Willis (2007b, 2012) points out that under conditions of anxiety and stress, metabolism in the amygdala (i.e., levels of glucose and oxygen use) surges, which can reduce the flow of neural information coming in and out of this key component of the emotional brain. Willis writes,

When students participate in learning activities that interest them, and do so in low-stress, high-engagement states, their brains are in the physiological state that results in low filter, high information transport. This condition is enhanced by choice, personal interest, prior experience and intrinsic motivation—the same factors that accompany progress toward an academic goal in which the student feels invested. (2012, para. 11)

The following sections describe six practical ways educators can emotionally support adolescent learners and engage their burgeoning affective life in ways that expand their understanding of themselves and the world.

## 1. Be Emotionally Supportive of Your Students

One of the conclusions arising out of a recent study on student disengagement (Horner et al., 2015) is that students all too often perceived their teachers as not caring about them as people, not having empathy for the emotions they may be bringing into the classroom, and not showing any interest in their lives outside school. One student in the study observed, “They don’t know nothing about your background or none of that and none of your problems or anything. They don’t know when you’re mad. They don’t know when you’re having problems” (p. 16).

Another student told an interviewer, “Even if you’re just sitting there not doing nothing, some teachers will just call to you and tell you, ‘Hey, do your work.’ But they’ll never tell you, like, ‘Oh, what’s wrong? Are you feeling all right? Do you need something?’ or stuff like that” (p. 19). At other times, teachers may intentionally or unintentionally provoke negative feelings or stressful reactions in their students, as one student reported: “Like, [the teacher] is trying to embarrass people, you know. . . . You want to react in a different way, mad, you know?” (p. 15).

On the other hand, when students were asked to reflect on particularly meaningful experiences in school, many of them spoke about a positive relationship with a teacher who listened to them and treated them with respect. Some of these comments follow:

- “My Spanish teacher, sometimes she would notice when I’m feeling down or happier, you know?” (p. 16)

- “My language arts teacher, he took his time one day. I wasn’t really doing good in school because I had other stuff in my head, and he took his time to like talk to me after school, and we pretty much just went through all of these things—feelings, likes, dislikes, and goals.” (p. 19)

- “Our track coach, we was connected to him a lot . . . we moved on to another school, like a 9th grade higher level, and then we still go back to talk to our old track coach because we was more connected to him than other teachers . . . he makes us feel like he’s one of us. And he acts in a way that is easier on us, and he tries to understand where we are coming from, and if we have a problem he’ll try and talk it out with us.” (p. 23)

The following tips for creating an emotionally supportive classroom may make *you* the teacher your students remember with appreciation for the rest of their lives.

- Greet students by name as they come into class and offer a handshake or an empathetic comment: “Are you feeling better today, Zeke?”

- Celebrate your students’ daily successes and accomplishments—for example, by making positive comments and displaying student work.

- Acknowledge both positive and negative feelings of students as they arise during class: “Joan, you seem unhappy about the project you’re about to start.”

- Give encouragement rather than criticism to students whose work falls short of expectations by providing targeted, constructive feedback: “I think I see what you’re trying to do with that character in your short story. Maybe giving him more dialogue would help readers get to know him better.”

- Be willing to lend an ear to students with difficulties during office hours, between classes, or before or after school. Make sure to



refer students with serious emotional problems to appropriate mental health services at your school or in your community.

- Engage in your own stress-reduction activities outside school (e.g., meditation, exercise, or yoga) so that you don't unintentionally project personal frustrations and stresses onto your students.
- Handle potentially destabilizing negative emotions that arise during class time in a constructive, nonpunitive, and nonjudgmental way: "I see that you're feeling angry today, Ron. Here's a little visualization strategy you might try to help you focus on your work."

Teachers naturally have concerns about the amount of time they can spend getting to know their students personally, especially at the secondary level, where a teacher might have 180 students coming into his or her classroom every day. As one high school teacher (quoted in Williams-Johnson et al., 2008) noted,

It's like you are so rushed and you are so pressed that I think emotions sometimes do get pushed to the side. A lot of times we'll just send them to the counselor because they don't know how to deal with it; it's like we don't have time for that, we have to do this now. We only have half an hour . . . I feel this pressure to cover everything and sometimes, hopefully, I'm not stampeding over people's emotions and feelings by just cutting them off. School's going to be over and I have to have this finished. (p. 1595)

Such feelings are more acute in today's educational climate of standardized testing and accountability, which places so much pressure on teachers. Yet classrooms should never become assembly lines for the construction of "robo-students," and all educators should be able to integrate at least some of the suggestions in this chapter to help create a more emotionally nurturing environment for their students. Such changes can only enhance student engagement and, thus, boost achievement in the long run.

## 2. Bring More Emotional Expression into Your Teaching Style

Most of us are familiar with the scene from *Ferris Bueller's Day Off* where Ben Stein's high school economics teacher lectures his students about the Smoot-Hawley Tariff Act. His eerily emotionless and monotone voice, repeatedly intoning the word "Anyone?", has become a classic representation of the boring high school teacher. The stupefied and numbed reactions of the class—one dozing student is almost drowning in his own drool—epitomize the disengagement many students experience while listening to teachers lecture.

This movie scene contrasts sharply with film portrayals of passionate teachers, including Robin Williams's John Keating in *Dead Poets Society* exhorting his students to "seize the day," and Edward James Olmos's Jaime Escalante in *Stand and Deliver* wearing a chef's hat and using apples and a meat cleaver to demonstrate fractions.

The message to educators is clear: it's more effective to teach with passion than from a place of emotional deadness. As one educator (quoted in Hargreaves, 1998) observed,

Good teaching is charged with positive emotion. It is not just a matter of knowing one's subject, being efficient, having the correct competences, or learning all the right techniques. Good teachers are not just well-oiled machines. They are emotional, passionate beings who connect with their students and fill their work and their classes with pleasure, creativity, challenge and joy. (p. 835)

The big question is, *How does one do this?* Some teachers appear to be more temperamentally equipped than others to express emotions and integrate them compellingly into their teaching style. Yet there are certain tips and tricks that can make even the most corpse-like lecturer an attention grabber in the classroom. Read on for some of these strategies.

**Use props or costumes.** In a YouTube video I watched some time ago, a calculus teacher, dressed in the costume of an Elizabethan courtier, heralded the beginning of his classes by blowing a trumpet. Another

high school teacher donned an Albert Einstein wig before launching into a lecture on the theory of relativity (Di Giulio, 2007).

Props can also serve a more serious purpose. Former high school teacher Elspeth Inglis (2009), who now teaches history at a Michigan museum, reports,

I usually begin any class on “what is history?” with an object. And I try to find a mystery object—something that my students, no matter what their age, might not have ever seen. And I do this on purpose, because I want to demonstrate first and foremost how difficult it is to understand history when you take a nugget of information out of context. (para. 3)

**Do something unexpected.** For a lesson on the Dutch resistance to Nazi occupation during World War II, a teacher walked into a classroom of sleepy 10th graders and immediately slipped into the role of a Dutch woman who had invited a group of non-Jewish members of the community to a secret meeting. She thanked them for coming and acknowledged their danger, saying, “You are putting yourself in great risk but you are kind, generous people, and I knew you would come.” The teacher recalled, “Slowly the students’ eyes began to rise, small smiles began to appear on a few faces—they were hooked” (Cawthon, Dawson, & Ihorn, 2011, pp. 5–6).

I once kept a class of 7th graders spellbound by pantomiming my lesson for the day instead of speaking it out loud. Upending the usual routine of a class can rouse students from their scholastic slumber and stimulate their limbic system and prefrontal cortex connections. As one student observed, “I had one teacher who would do, like, to show women’s liberation he wore a bra and took it off, and . . . I just . . . I will never ever forget that” (Gorard & See, 2011).

**Look for a teachable moment.** The *teachable moment*—a term coined by educator Robert Havighurst in 1952—is something that happens in the classroom, school, community, or world that offers a perfect opportunity to make a point relevant to the lesson of the day or to a learning objective that can spur further inquiry. Today, as I sit in my

office writing this chapter, it's the 14th anniversary of 9/11, and I've read that 65 percent of teachers plan on doing a lesson on it in their classrooms (Whitman, 2015). Many teachers will link the events of this day to a history lesson, while others may make connections to government, religion, aeronautics, journalism, or engineering.

Other teachable moments occur when a significant public figure dies, when someone says something insensitive in the class, or even when the teacher makes an error. In this last case, the teacher can serve as a role model for showing how we can learn from our mistakes.

**Be willing to share details of your personal life to illustrate a point.** If you've taught for any length of time, you've probably had the experience of encountering a student in the supermarket who does a double take at seeing you go about your business as a normal human being. This sort of experience illustrates the disconnect that many students feel toward teachers who maintain a cool reserve in the classroom in the belief that this is the best way to maintain professionalism.

On the other hand, I'm a great believer in sharing something of one's personal life while teaching. I'm not advising that you use your class as a therapeutic sounding board, but rather that you integrate observations that give life to an otherwise humdrum lesson. A geometry lesson can be enlivened with a story about the trajectory of a teacher's golf ball after a particularly good swing. A history teacher can add nuance to a lesson on the Vietnam War by showing a video she shot of her trip to the Vietnam Veterans Memorial during summer vacation. A chemistry teacher can share a memory of a childhood incident with a chemistry set that gave rise to an important discovery (or at least an explosion). There's no need to do a lot of personal sharing, but students really appreciate it when you're willing to reveal your humanness.

### **3. Integrate Controversy into Your Lessons**

Controversial topics are guaranteed to stir up emotions in your students—and sometimes in your school board members, so exercise discretion. I once taught a 12th grade world history demonstration lesson

on the factors contributing to the rise of fascism in Germany between the two world wars by slapping on a Hitler moustache, playing Wagner, and exhorting the “German people” (i.e., the class) to come together to solve the nation’s economic woes. The history teachers at the school were not amused.

Ron Jones (1976), a high school teacher extraordinaire in the 1960s, stirred up trouble when he answered students’ questions about how the German people could have accepted the Nazis’ authority by creating a new simulated political party, the Third Wave, with its own salute, membership cards, and assignments. On the fourth day of the project, the experiment slipped out of control as students took seriously their new roles as superior members of society. For an account of this experiment, which was made into a novel and an Emmy Award–winning TV movie, visit [http://www.thewavehome.com/1976\\_The-Third-Wave\\_story.htm](http://www.thewavehome.com/1976_The-Third-Wave_story.htm).

Taking these cautionary tales into account, you can still tap many ways to infuse controversy into your classroom without causing a small revolution. Read on for a few ideas.

**Assign controversial books.** The fact that classic works such as *The Catcher in the Rye* and *I Know Why the Caged Bird Sings* are still banned or challenged by some communities and school districts in the United States makes these books attractive to adolescents. In fact, a curriculum unit based on banned books would be an adolescent-friendly component to any course in U.S. history, U.S. government, or American literature, or to other courses whose frameworks integrate race, sexuality, gender, and other controversial topics. Controversial texts provide an entry point into exploring important, real-life issues and help students hone their critical thinking skills. As Chen (n.d.) points out, “The attempt to expose students to challenging topics and issues, as many teachers support, is not intended to force students into a certain mode of thought; . . . the books are to serve as opportunities for students to think, theorize, question, and explore” (para. 8).

**Look for controversy in math and science.** The STEM subjects may seem to be relatively controversy-free when compared with history,

literature, and social science, but a closer look reveals a number of contentious topics that are ripe for exploration. Delving into these issues will ignite the emotional brains of adolescents while also stimulating those vital connections to the prefrontal cortex that link feelings to higher-order thinking. Some possibilities for several subject areas follow.

- *Biology*: genetics and eugenics, abortion, evolution.
- *Physics*: nuclear war, cosmology and the death of the universe.
- *Chemistry*: climate change, psychedelic drugs.
- *Mathematics*: probability of getting AIDS, statistics on race-related killings in the United States.

**Conduct debates and discussions on controversial topics.** Each semester, Michele Haiken (2013), a middle school teacher at Rye Middle School in Rye, New York, has her students write a persuasive speech and participate in two debates. Some of the speech and debate topics she’s used include

- Does the Internet influence young people to engage in risky behavior?
  - Is obesity a matter of individual responsibility?
  - Should there be stronger limits on immigration?
  - Should students be required to wear school uniforms?
  - Are domestic wiretapping and surveillance acceptable without a court order?

**Teach social justice issues.** Getting engaged in social justice means becoming aware of social injustices in the community, nation, or world, and acting on one’s personal power to effect social change. Nora Alvarado, a teacher at South Division High School in Milwaukee, Wisconsin, used social justice as a motivator in a writing workshop for a college bridge program. In one assignment, she asked students to answer three questions:

1. What concerns you?
2. Which of these issues affect your family and community?
3. Do these same issues distress the world on a global level?

Her students wrote on such themes as human trafficking, poverty, and exploitation of Third World workers (Chapman, Hobbel, & Alvarado, 2011). For more ideas, seek out the excellent education magazines *Teaching Tolerance* and *Rethinking Schools*, which provide many examples of integrating social justice issues into the curriculum.

#### 4. Inject More Humor into the Classroom

Humor is an essential part of the learning process. Neuroimaging studies (see, for example, Goel & Dolan, 2001) suggest that humor activates the brain's dopamine reward systems, which play an important role in learning and memory. Healthy laughter in the classroom is a sign that students' limbic brains are actively integrating the learning that's going on.

Unfortunately, the standard secondary school curriculum doesn't make much room for humor (think *Macbeth*, *Of Mice and Men*, and Robert Frost's "Stopping by Woods on a Snowy Evening"). Here are some ways to bring more laughter into your classroom.

- Kick off each class with a funny cartoon that relates to the subject or that day's lesson. Gary Larson's *The Far Side* includes great humor that can often be connected to science, mathematics, and other academic subjects.
- Keep a file of humorous materials related to your subject area that you can use throughout the year.
- Use TV and movie comedies to teach content. For example, show clips of *Midnight Run* to teach about friendship, bounty hunters, or white-collar crime, or scenes from *Blazing Saddles* to teach about racism, the westward expansion, or corruption.
- Assign students the task of writing jokes, skits, or funny stories related to the content of the course and then have them tell or perform them in class.
- Do a Jay Leno "Headlines" segment in your class: ask students to bring in funny news items, ads, or captioned photos from the newspaper, and then critique them in class together. This can be, for example, a great way to teach grammar by laughing at the violations of grammar in ads and the news.

When using humor in your classroom, do make sure that students know what is appropriate and inappropriate. Off-limits humor may include, for example, ridicule and sarcasm directed at others and cruel, crude, or exploitative humor.

## 5. Engage Your Students' Imagination

Students' imaginations are, in my opinion, the single-most underutilized learning resource in education. Consider the research study (Csikszentmihalyi, Rathunde, & Whalen, 1996) that gave high school history students beepers to carry throughout the school day. Whenever the beepers went off—which they did at random times—the students were to write down exactly what was going on in their minds at that moment. The results were eye-opening. For example, of 27 students who were listening to a lecture on Genghis Khan's invasion of China in the 13th century, only two were thinking about China, albeit in a tangential way: one was thinking about what he'd eaten at a Chinese restaurant a few weeks before, while the other was wondering why men in imperial China wore their hair in pigtails. No one was thinking about the lesson—and these were students who'd been identified as gifted.

We have a choice: either we can forge ahead with our lectures and let students' imaginations run wild on topics having nothing to do with the curriculum, or we can recruit students' imaginations to help make our lessons more engaging. If you prefer the latter path, here are some ways to activate the imagination in the classroom.

- *English/literature*: have students visualize the imagery and action in the poems, plays, stories, and novels they study.
- *History*: after you deliver a lecture on a historical event, ask students to re-create the scene in their imaginations.
- *Biology*: take students on an imaginative journey through the circulatory system.
- *Geometry*: let students verify geometric proofs by visualizing them.
- *Physics*: have students design a robot entirely in their minds before setting down their ideas on paper.



- *Physical education:* demonstrate to students how professional athletes visualize a perfect soccer pass, basketball shot, or gymnastics move before putting it into action, and have students use the visualization technique themselves.

Remember that many of the world's geniuses, including Albert Einstein, have specifically cited imagination as a key factor leading to their great discoveries. By allowing students to use their imaginations to learn rather than as a means to escape boredom in the classroom, we can help them unleash their inner Einsteins.

## 6. Become More Aware of Adolescent Culture

As news reports constantly remind us, there's an enormous psychological divide between whatever generation we happen to belong to (I'm a baby boomer) and the generation of our students (at this writing, Generation Z). If we want to activate adolescents' emotions and direct them toward the learning objectives we have for them, we need to find out more about the world in which they live. I'm not talking about getting tattoos or aping their style of dress; kids tend to mock or even despise adults who try to be like them. But it's worthwhile to spend some time learning about the culture and interests of the generation you're teaching. Here are a few ways to get started.

- Listen to the music your students are listening to.
- Seek out and read some articles or books about your students' generation.
- Visit blogs, websites, or social networks frequented by your students.
- Observe your students interacting with one another between classes, during recess, and after school.
- Visit [www.urbandictionary.com](http://www.urbandictionary.com) or another online slang guide to help you understand a few of the terms and phrases your students use informally.

Perhaps the best way to gain true empathy for your students, however, is to look back at your own adolescence. Figure 6.1 includes a

### Figure 6.1 | Memories of Adolescence

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Check the boxes next to the statements that resonate with you. In my adolescence . . .

- The decisions I made were not often accompanied by a great deal of thought.
- I tended to be self-conscious of how I came across to others.
- I was more idealistic than I am now.
- I was more likely to have emotional outbursts than I am now.
- I thought more about sex than I do now.
- I was very concerned with being a part of the best possible social group.
- My relationship with my parents changed significantly compared to my elementary school years.
- I liked to spend time alone thinking, writing, listening to music, or doing other solitary things.
- I thought a lot about religious, spiritual, occult, or cosmic issues.
- I thought more about death and dying, and/or what it means to exist, than I do now.
- I engaged in creative activities that I don't do so much anymore.
- I was involved with at least one radical or controversial political, social, or religious group.
- I experimented with at least one type of illegal drug or drank alcohol.
- I was more rebellious against authority than I am now.
- I took more physical, psychological, or emotional risks than I do now.
- I hung out with people whom I would tend to avoid now.
- I tended to be more moody (e.g., angry, depressed, jealous, envious) than I am now.
- I was more concerned about what other people wore, looked like, said, or did than I am now.
- A big part of my life revolved around my time with my boyfriend or girlfriend or my attempts to secure one.

simple checklist that asks you to think about the feelings, dreams, hopes, fears, and actions that defined your teen years. When we remember the vulnerabilities, passions, friendships, and interests that drove us at that point in our lives, we walk for a few moments in the shoes of our students. You might also want to write down some reflections about how

your attitudes toward your students change when you think about the way you were between the ages of 11 and 18. Other ways to continue this process of retrospection include writing an autobiography or time line of your adolescent years, putting together a playlist of some of the music you loved as an adolescent, or keeping a journal where you periodically compare your adolescent students' behaviors with those you engaged in when you were that age.

## **Emotions Are “Fun”-damental to Effective Learning**

Emotions are part of every secondary school classroom at every moment of the school day. They can be found either underneath the surface of things in an otherwise “quiet” classroom (where they can sabotage learning), or as part of the outwardly observable school day. When outwardly present, emotions can either tie up learning in conflicts, fights, resentment, or passive-aggressive behavior, or boost the curriculum to new levels of engagement (this includes both positive and negative emotions). The question is whether you are going to ignore, stifle, or come down hard on emotions in the classroom—or instead are willing to acknowledge the emotions that are present, have fun with them, and use them to advance learning.



## TAKEAWAYS

- Emotions served the evolutionary purpose of helping to propel adolescents out of the parental nest and into the world to seek food, mates, and shelter and to confront new, adult challenges.
  - Because the limbic system is fully developed at puberty while the prefrontal cortex is still developing, it's important for secondary school educators to take students' emotions into account in their teaching and support students' emotional expression.
  - Traditional secondary education tends to either ignore or suppress emotional expression in the classroom.
  - Students are likely to become more engaged academically when they feel emotionally supported by their teachers and safe enough to express their emotions in class.
  - Under conditions of high stress and anxiety, students have more difficulty thinking and learning because the flow of information is blocked into and out of the amygdala and other structures of the limbic system, preventing the formation of new memories in the hippocampus and inhibiting the integration of emotion with higher-order thinking processes in the prefrontal cortex.
  - Adolescents are more vulnerable to stress than are either children or adults and learn best under conditions of low stress, high interest, personal choice, and intrinsic motivation.
  - Practical ways to safely integrate emotions into the classroom include being emotionally supportive of students, bringing more emotional expression into one's teaching style, integrating controversy into lessons, injecting more humor into the classroom, engaging students' imagination, and becoming more aware of generational issues and students' personal culture.
  - Teachers' willingness to think back to their own adolescence may lead them to feel more empathy for what students are going through developmentally at this time of life.

# 7

## Learning Through the Body

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The greater the duration of time in the chair, the greater the depth of student despair.

—Eric Jensen, *Learning with the Body in Mind*

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Emerging evidence from neuroscience suggests that middle and high school educators would do well to question the traditional image of students sitting quietly at their desks and begin to incorporate more opportunities for exercise, movement, drama, and hands-on learning in the classroom.

Much of this new awareness centers around discoveries concerning the *cerebellum* (Latin for “little brain”), the ancient part of the brain at the back of the skull traditionally associated with muscular activity and motor control. More recently, scientists (Stoodley, 2012; Travis, Leitner, Feldman, & Ben-Shachar, 2015) have begun to link the cerebellum with language functions and with visual-spatial, executive, and working memory processes. Neuroscientist Jay Giedd (quoted in Spinks, 2002) observes,

[The cerebellum is] like a math co-processor. It’s not essential for any activity . . . but it makes any activity better. Anything we can think of as higher thought, mathematics, music, philosophy, decision-making, social skill, draws upon the cerebellum. . . . To navigate the complicated social life of the teen and to get through these things instead of lurching seems to be a function of the cerebellum. (para. 12)

## Four Ways to Incorporate Physical Movement

Although it makes up just 10 percent of brain volume, the cerebellum contains more neurons than the rest of the brain combined. In fact, there are 3.6 times more neurons in the cerebellum than there are in the neocortex. Because the cerebellum continues to develop during adolescence (Tiemeier et al., 2010), is not highly genetically controlled, and is thus susceptible to environmental influences (Giedd, 2002), secondary educators are well positioned to take advantage of the cerebellum's neuroplasticity by engaging students in physical movements that are integrated directly with higher-order thinking skills. This chapter explores four ways in which teachers can capitalize on the brain's connection to physical movement to increase student engagement and academic achievement.

### 1. Provide Exercise Breaks During and Between Classes

A literature search (Strong et al., 2005) of nearly 1,000 studies on the relationship between exercise and the needs of school-age youth revealed that exercise results in improvements in academic achievement, attention, and classroom behavior and reductions in anxiety and depression. The authors recommend that students engage in at least 60 minutes per day of moderate to vigorous physical exercise that is developmentally appropriate, enjoyable, and varied.

Yet a study by the Centers for Disease Control and Prevention (2012b) revealed that only 2 percent of U.S. high schools required physical activity breaks in addition to P.E., and only 11.7 percent recommended this practice for all students. In middle schools, the numbers were only slightly higher, with 10.8 percent requiring physical activity breaks and 23 percent recommending the practice. In contrast, students in Finland—heralded for its high academic achievement in international rankings—are legally entitled to 15 minutes of free time every 45 minutes during which they can unwind and refocus (Faridi, 2014).

According to adolescent expert Laurence Steinberg (2015), “We know that aerobic exercise improves brain health in general by

increasing blood flow. Schools need to make sure that all students—not just the athletic stars—have adequate time for exercise every day” (p. 98). Providing students with frequent non-P.E. opportunities to move while in school helps them reduce stress, combat obesity, and activate the brain so that it functions optimally while learning new material.

Fortunately, schools are beginning to catch on. As part of the Colorado Education Initiative (2014), for example, secondary school teachers are encouraged to integrate a wide range of exercise and stress reduction techniques into the school day. These practices include deep breathing, stretching, yoga postures, simple aerobic activities to music, and other easy movements that stimulate the brain to greater levels of attention, engagement, and achievement.

Schools should also consider having students exercise while they work. Both standing desks and stability balls to sit on have been linked to greater attention in students (Chua, 2014; Fedewa & Erwin, 2011). Milton District High School, in Ontario, Canada, has created an “active classroom” complete with standing desks, four desk cycles, two treadmills, and six ergonomic balance ball chairs. Students take turns working at different stations to burn off calories and generate extra energy for learning (Halton District School Board, 2014).

Even if you don’t have access to such equipment, you can use your classroom space as a medium for moving and learning at the same time. Some ideas for several subject areas follow.

- *History*: create a historical time line down the length of the classroom with masking tape, making sure to label each key event with a date and a brief description on a piece of poster board. Then lead students along the time line as you (or they) comment on the events that occurred at each moment in time.

- *Geography*: turn the classroom floor into a giant map and lead the class through different features of the terrain (e.g., cities and towns, mountains, plains, rivers, and lakes).

- *Algebra*: turn the classroom (using masking tape) or an outdoor area (using chalk) into a huge coordinate graph and have students

move to different positions between the x- and y-axes as they work out functions such as  $y = 4x$ .

- *Government:* have students express opinions (yes or no) by moving to one side of the room or the other, or, alternatively, have them move along a continuum (created with masking tape) ranging from “strongly approve” to “strongly disapprove.”

Here are some additional ways to encourage physical activity during or between classes:

- Take students out for a walk while you deliver the lesson for the day.
- Have students run around the school building two or three times before coming into your classroom.
- Let students do their schoolwork on chalkboards or whiteboards on the walls around the classroom. After a selected period (say, five minutes), ring a bell to signal students to move clockwise to the next board.
- Set aside a paved area outside the school for students to play physical games like Hacky Sack.

## 2. Integrate Drama into the Curriculum

Drama needn't be reserved for theater class; it can and should be integrated into every subject in the middle or high school curriculum. Although props, costumes, and scenery can be used to make the experience flashy and memorable, you don't need to use any of these accessories. Effective drama can be created on the fly. Some years ago, I was at a UK high school and observed a class on one of Shakespeare's plays. As the students stood up and read their parts from the play, the teacher went around encouraging the students to make little gestures to express the essence of their words—for example, by slapping one student's book to show the anger that one character felt toward another. Anything that can be read or talked about can be acted out. Some possibilities across the content areas follow.



- *Science*: have students demonstrate the scientific method in action by role-playing a scientist creating a hypothesis (students can make one up), testing it, and then confirming it or revising it in line with gathered data.

- *U.S. history*: kick off a unit on the Great Depression by having students improvise a scene that could have taken place at a bank on October 24, 1929—Black Tuesday.

- *Geometry*: ask students to take on the role of Euclid formulating one of his geometric proofs on the blackboard.

- *Art*: after students conduct research on a great artist, have them perform monologues that detail the highs and lows of the artist's creative life. (*Note*: this activity can be used in any subject—to explore the achievements of prominent scientists, mathematicians, politicians, explorers, inventors, writers, and so on.)

A powerful way to use drama in the classroom is to have students create a *tableau*, or a fixed-frame living scene illustrating some aspect of the course content. Here, one UK student describes how this technique brought learning alive:

Like in English one time, we were doing poetry and we had a poem, and we had to do freeze frames for it, like for the poem. And we got to dress up and then we had to do a freeze frame to represent the whole poem, which was good. So you understood how people were feeling, like they might have been feeling in that poem and how they might have stood and things. (quoted in Gorard & See, 2011, p. 680)

Similarly, tableaux can be used to

- Enact a scene from history (e.g., the signing of the Declaration of Independence).

- Illustrate a famous scene from a motion picture (e.g., the rainy night escape scene from *The Shawshank Redemption*).

- Re-create a scene from a novel (e.g., the tarring and feathering of the two grifters in *The Adventures of Huckleberry Finn*).

- Depict a well-known work of art (e.g., Grant Wood's *American Gothic*).

While students are still in their “frozen” positions, they can talk about their particular roles in the scene and discuss how the scene as a whole pertains to the broader themes of the lesson.

### **3. Use Physical Movement to Teach Specific Concepts**

In my teacher training programs, I frequently demonstrate the importance of engaging secondary-level students in kinesthetic learning by acting out the physics concept of Boyle’s law. I enclose the students in a circumscribed space, tell them to begin moving around randomly, and then inform them that they are molecules in a container. Then I begin to restrict the space in which to move (reducing the volume) while asking the participants if the “pressure” has gone up or down (it’s getting crowded; the pressure is going up). Then I reverse the process and increase the space in which students are able to move (increasing the volume), and participants directly experience the “pressure” decreasing. This little physical experience (Armstrong, 2009) conveys Boyle’s law more effectively and engagingly than does the verbal definition: “For a fixed mass and temperature of gas, the pressure is inversely proportional to the volume.”

Michael Lazaroff (2011), a biology teacher at Staples High School in Westport, Connecticut, believes that cell membrane structure is more easily remembered when it’s acted out. Accordingly, he uses physical movement to teach students the important concept that cell membranes are both *hydrophilic* (taking in water) and *hydrophobic* (avoiding water). He has students lie down on the floor shoulder to shoulder in two facing rows, with their heads pointed toward opposite walls. He then explains that their heads represent the membrane’s hydrophilic polar phosphoglyceride heads, while their legs stand in for the hydrophobic nonpolar hydrocarbon fatty acid tails. After this activity, students can diagram the arrangement they made.

Some additional ideas for using movement to teach concepts across the content areas follow.

- *History*: ask students to move in a way that expresses the concept of *democracy* and then in a way that expresses *autocracy*.
- *English*: have students take photos or videos of themselves acting out each of their vocabulary words for the week and then post them on Instagram, where a dedicated hashtag can allow the whole class to view them together on a large screen.
- *Art*: invite students to work in groups to act out visual arts concepts, such as *perspective*, *surrealism*, *trompe l'oeil*, and *symmetry*.
- *Math*: direct the whole class in physically demonstrating some of the following mathematical concepts: *plane*, *function*, *algorithm*, *set*, *parity*, *fractal*, and *sine* and *cosine*.

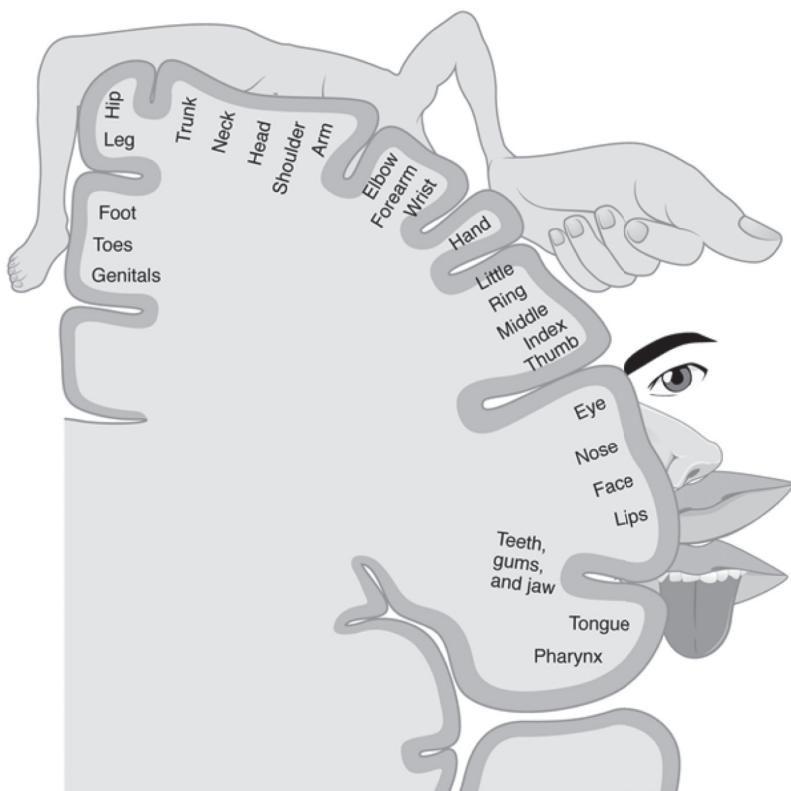
Teachers in all subject areas can make a regular practice of having students express concepts through movement. It doesn't always need to be elaborate; in fact, students can often remain at their desks and use gestures instead of whole-body movements. When having students analyze the traits of a literary character, for example, a language arts teacher could ask students to put their hands over their hearts when describing what the character loved or touch their shoulders while talking about the burdens the character carried.

#### 4. Engage Students in Hands-on Activities

The idea of using the hands to extend the reach of the mind is certainly not a new one. Scientists (Harmand et al., 2015) have traced the origins of tool use back 3.3 million years to hominids that predate *Homo sapiens*. A look at the *cortical sensory homunculus* (see Figure 7.1), a neurological “map” of the anatomical divisions of the body originally conceived by neurosurgeon Wilder Penfield, reveals how much of the motor cortex is given over to the hand.

Most people associate “hands-on learning” with preschool and elementary school. Yet students’ hands do not disappear when they reach middle school and high school, and research (Cook & Goldin-Meadow,

**Figure 7.1** | Sensory Homunculus



Source: Creative Commons Attribution-ShareAlike 3.0 Unported license. © OpenStax College-Connexions website: <http://cnx.org/content/col11496/1.6>. Available: [https://commons.wikimedia.org/wiki/File:1421\\_Sensory\\_Homunculus.jpg](https://commons.wikimedia.org/wiki/File:1421_Sensory_Homunculus.jpg)

2006; Riskowski, Todd, Wee, Dark, & Harbor, 2009; Wilson, 1999) is clear about the value of using one's hands to improve cognitive performance and understanding.

One recent trend that encourages hands-on learning at the secondary level is the maker movement. Maker culture emerged about a decade ago, when a group of inventors, tinkerers, computer geeks, hobbyists, and artisans began to promote a “do-it-yourself” ethos for the digital age using recycled materials, electronics, 3-D printers, open source

computer programs, and a potpourri of odds and ends to create useful products (Anderson, 2014; Hatch, 2013). The materials for such projects don't need to be elaborate: students can use string, mirrors, pipe cleaners, 3-D solids, D-Stix, and other hands-on manipulatives, for example, to learn geometry concepts. Jaymes Dec, a teacher at Marymount School in New York City, recommends that students get started with a kit for something simple like a circuit board, and then work toward more complex projects (Provost, 2013).

Websites such as [www.instructables.com](http://www.instructables.com) and [www.makezine.com](http://www.makezine.com) provide instructions for a variety of maker projects, including a "Raspberry Pi based wireless FM microphone," a "minibot" robot, and a "Bluetooth desk lamp." Students at Meyers High School in Wilkes-Barre, Pennsylvania, have created a fractal antenna with a 3-D printer, developed a virtual reality program that lets the user pull apart an image of a virus, and spearheaded a project that proposes to use a smartphone photo of a fingerprint to accurately identify a potential online voter (Guydish, 2015).

Hands-on learning is tailor-made for STEM courses, but there are many ways to integrate this physical approach to learning into non-STEM subject areas as well. At High Tech High in San Diego, California, a humanities teacher teamed up with a STEM teacher to engage 9th graders in an ambitious assignment on the rise and fall of cultures. They tasked the 50 students with building a six-foot-diameter geared wheel out of wood and coming up with a theory about why and how civilizations rise and fall based on the students' research on the Mayans, Greeks, and Romans. After presenting their theories, students worked in teams of five to "figure out a way to physically manifest those abstract concepts in the form of a mechanism to be affixed to and powered by the turning of the class's giant wheel" (Stewart, 2014).

More ideas for incorporating hands-on learning into non-STEM subject areas follow:

- *English:* have students create paper sculptures that express the meaning of their vocabulary words.

- *History*: engage students in designing artifacts that resemble objects of the historic period being studied.
- *Literature*: ask students to build dioramas that illustrate scenes from the stories, novels, or plays they are reading.
- *Geography*: assign students a project that involves creating a relief map (from a material such as clay, sand, or plaster) depicting the geographic region being studied.
- *Social science*: have students create window displays that advocate for different causes, such as women's rights, civil rights, or disability rights.

One final application of physical learning in the secondary classroom is just on the horizon after being talked about by educators for more than 20 years: *virtual reality*, or VR. This technology permits students to become immersed in a virtual environment that simulates the actual three-dimensional experience of being in a real-world setting or in an imagined world and allows users to directly interact with those worlds. Scientists are beginning to discover that virtual reality activates the same motoric areas of the brain as actual physical movement does (Diers et al., 2015).

At Northeast Regional Vocational High School in Wakefield, Massachusetts, students wear 3-D glasses and use a stylus to move virtual components around a virtual room to construct virtual engines with zSpace, an immersive 3-D technology (Ebben, 2015). Students at Singapore American School have used zSpace to dissect animals, explore aquatic habitats, and study chemical structures (Spier, 2015), and students at Egan Junior High School in Los Altos, California, have used this application to study the human heart, enabling them to rotate it, peel back layers of the heart, and even insert a camera inside to examine parts of the heart close-up (Lien, 2015).

Although it would cost thousands of dollars to fully equip a classroom with this technology or similar programs, such as Facebook's Oculus and Samsung's Gear VR, Google has introduced a low-cost VR

interface. Google Cardboard is literally a viewer made of cardboard that works with VR applications on Android smartphones and other compatible devices. It's been used by a high school English class studying Shakespeare's *Romeo and Juliet* to take a virtual trip to Verona, Italy (the site of the play), and by a math teacher who had her students visit the Great Wall of China to estimate the number of bricks in the wall (Lee, 2015). We're just seeing the bare beginnings of what I believe will be the next big revolution in education.

## **Whole-Body Learning**

Students can leave their notebooks, textbooks, and other school paraphernalia behind when they leave home or school, but they take their bodies with them wherever they go. When educators engage students in learning through the body, they essentially inscribe knowledge into the very sinews of their physical being.



## TAKEAWAYS

- The cerebellum, which continues to develop through adolescence, is associated with motor control, language, memory, and executive processing and is susceptible to environmental influences, including school-related experiences.
- Only a small percentage of U.S. secondary schools require or recommend daily physical activity breaks outside of physical education classes.
- Moderate to vigorous physical exercise is associated with reduced stress, increased levels of academic achievement, and improved attention and behavior in the classroom.
- Strategies for incorporating physical learning in the classroom include providing exercise breaks during and between classes, integrating drama into the curriculum, using physical movement to teach academic concepts, and engaging students in hands-on learning activities.
- The next big revolution in education will see virtual reality applications that enable students to physically immerse themselves in settings not otherwise available to them (e.g., a historical era, a scene from a novel, the circulatory system, a machine, and so on).



# 8

## Metacognitive Strategies

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Abstract thought is imagination seeing familiar objects in a new light and thus opening new vistas in experience.

—John Dewey, *How We Think*

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The Swiss genetic epistemologist Jean Piaget was among the first scientists to understand that adolescence brings with it a totally new kind of thinking that is qualitatively different from childhood cognition. He referred to this new way of thinking as the *formal operational* stage of cognitive development. One of his classic assessments to determine whether someone had entered this stage was to give a research subject three different weights and three lengths of string that could be attached to the weights to create pendulums. The subject would then be asked to determine which factor influenced the rate at which a pendulum would swing: the heaviness of the weight, the length of the string, or the force of the push given to the weight. Results indicated that children at the stage of concrete operational thinking (ages 7 to 11) seemed to engage in a haphazard process of trial and error, whereas young adolescents (11 and up) who were entering formal operational thinking tended to systematically experiment with the three variables (length, weight, and push) and arrive at the answer that the length of the string was the crucial variable (Inhelder & Piaget, 2007).

This stage of formal operational thinking heralds the young adolescent's capacity to think abstractly for the first time, to create hypotheses like a scientist, to be able to manipulate abstract symbols (as in  $x = 2y$ ), and, most important, to think about thinking itself—a process that John Flavell (1976), Piaget's chief disciple in the United States, was the first among cognitive psychologists to call *metacognition*.

During the last 40 years, research in cognitive psychology (Weil et al., 2013) has backed up Piaget's perspective and regarded adolescence as a time of substantial increases in the capacity to think metacognitively. Originally regarded by Piaget and his associates simply as a logical feature of adolescent thought, this cognitive capacity gained currency during the last two decades as educators and psychologists began to understand that if adolescents are able to think about their own thought processes, they have the capacity to monitor and change their thinking to help manage their schoolwork, control their behavior, and, ultimately, improve their lives. As Kuhn (2006) points out,

Thinking about thinking implies the potential for management of thinking, not simply reflection on it or rule-governed manipulation of it. This active, self-directed management, in turn, implies the potential for volition and, by implication, some degree of control. Adolescents increasingly take charge of their mental life, choosing what to think about, when and where to do so, and how to allocate their mental effort. (p. 64)

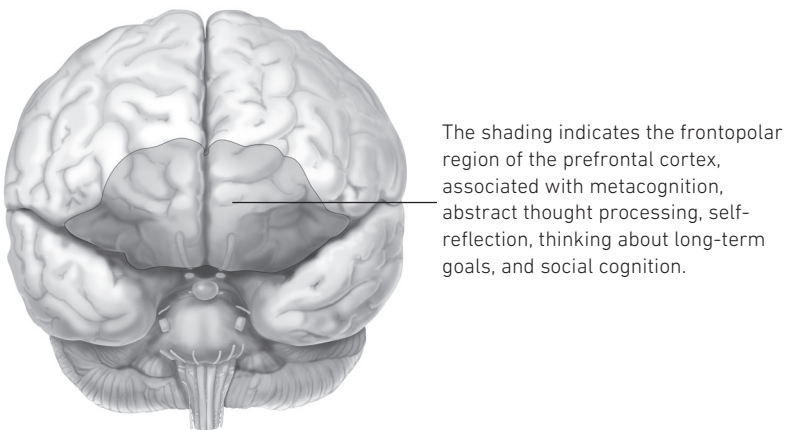
## Five Ways to Stimulate Metacognition

Piaget believed that children entered formal operational thinking at about age 11, which is right around the time when there is a spike in the growth of gray matter, before the brain undergoes a round of pruning and the volume of gray matter decreases (Giedd, 2008). More important, however, much of the pruning (as well as the myelination discussed in Chapters 1 and 2) during the teen years occurs in the prefrontal cortex, which is regarded by many neuroscientists as the chief locus of

metacognition. Suss (2011) associates the *frontopolar* (also called *rostrolateral*) region of the prefrontal cortex (see Figure 8.1) with metacognition, while Dumontheil (2014) similarly links this portion of the brain with abstract thought processes, self-reflection, thinking about long-term goals, and social cognition. As I've noted in previous chapters, this area of the brain is among the last to develop in adolescence and possesses considerable neuroplasticity (see also Budhachandra et al., 2013, who link these brain changes to Piaget's theory of cognitive development).

The implications of these revelations for educators are enormous. Traditionally, secondary school teachers have viewed their mission as providing content—facts, concepts, and skills—related to their particular subject areas. What we're now learning about the adolescent brain and its relationship to metacognition suggests that we should place as much (or more) emphasis on helping students develop the capacity to think critically, evaluate and control learning processes, monitor emotional responses, set short- and long-term educational goals, and develop other self-regulation strategies. Honing these crucial skills—sometimes grossly mislabeled “noncognitive” skills—enables teens to begin to exercise true agency in the complex world they're about to

**Figure 8.1** | Frontopolar Prefrontal Cortex



Source: Creative Commons Attribution-ShareAlike 3.0 Unported license. © Washington Irving. Available: [https://upload.wikimedia.org/wikipedia/commons/1/14/Brodman\\_area\\_10.png](https://upload.wikimedia.org/wikipedia/commons/1/14/Brodman_area_10.png)

enter. This chapter presents five practical ways in which educators can help their students do just that.

## 1. Engage Students in Critical Thinking

Although critical thinking is often regarded by educators as a particular set of skills that must be *taught* to students, it's more accurate to regard it as an overall attitude toward knowledge. This attitude doesn't take knowledge at face value but regards it as something to inquire into or evaluate, sifting fact from fiction, weighing sources and statements, challenging conventional beliefs, being curious, asking interesting questions, and being comfortable with complexity and ambiguity. To help students develop this type of attitude, it's key for teachers themselves to engage in the practices of critical thinking during classroom instruction. Middle and high school teachers can best encourage critical thinking by asking students tough or ambiguous questions, prompting them to challenge received opinions, and engaging them in meaningful activities and projects designed to push their thinking processes into more complex and inquiring modes of cognition than they were accustomed to using in childhood. Unfortunately, the traditional secondary school practices of lecture, memorization, and fact learning often serve as formidable obstacles to the development of these crucial skills. As Voelker and Armstrong (2013), speaking specifically about history and social science classes, note,

This level of simplicity in student thinking may be a consequence of the straightforward lecture and memorization method frequently utilized in social studies and history classrooms. In being asked only to recall and recite the teacher's thinking, rather than examining and constructing their own ideas around open-ended questions, students are denied opportunities to engage in critical thought, analysis, and interpretation. (p. 19)

Here are a few guidelines to stimulate adolescents' newfound capacity to think more deeply about the subjects they are studying.

- **Ask open-ended questions.** Replacing lecture and closed-ended questions with open-ended questions is a simple but powerful way to shift the responsibility for learning from teachers to students. Perkins (2003) provides an example of how a teacher can begin using critical questioning to take students more deeply into course material. In this case, a teacher is showing students a satellite photo of a hurricane but does not immediately identify it. Instead, she asks the class, “What’s going on here?” A student replies, “There’s a storm over Florida.” The teacher responds, “What do you see that makes you say so?” And so on. This approach requires students to examine their own assumptions instead of simply filing teacher content in an appropriate mental folder to be retrieved only at test time. Teachers should encourage students to ask open-ended questions themselves. A good question to begin with that can be used for any received opinion on a topic is “What makes you think that?”

- **Have students brainstorm contrasting ideas on a subject.** Rather than simply presenting a topic as a known quantity of knowledge, have students form groups and encourage them to provide different points of view on the subject. So, for example, if the topic is human cloning, have students generate reasons why it may be a bad idea, a good idea, a good idea that might turn out to be bad, a bad idea that might turn out to be good, an idea that requires further study, or a topic requiring still other points of view.

- **Teach students how to evaluate sources of information.** This skill is particularly important for navigating the Internet, where unsubstantiated and biased information thrives like a fungus. You might have students select several websites that focus on a course-related topic, inquire into the authorial background and expertise of each site, evaluate each site’s reliability and validity, and report back to the class.

- **Challenge students to take different sides of an argument.** When teaching about the American Revolution, for example, have different students argue from the perspectives of a soldier in the Continental Army, an officer in the British military, a French diplomat, and an American Indian. Then rotate the roles so that students have the

opportunity to reflect on other points of view. If a student expresses a strong positive opinion about an important work of art, suggest that he or she then speak about some of its negative qualities.

## 2. Demonstrate How to Use Metacognitive Tools

Since the beginnings of the cognitive psychology revolution in the mid-1960s, there has been a gradual accumulation of cognitive tools that empower individuals to organize, categorize, regulate, and prioritize their thinking processes. Many of these tools have found their way from cognitive science laboratories into the classroom. The following four tools can be especially useful to students when they are learning something new.

- **Cognitive organizers.** These are typically tools represented in visual form as diagrams, charts, checklists, graphs, time lines, conceptual maps, or other displays that help concretize both the process and the content of learning (Hyerle, 1996, 2008). One of the most well-known examples of a cognitive organizer is the *mind map*, which consists of a circle in the middle of a page and spokes radiating around it, where ideas associated with the central theme can be plotted. This approach works very well as a note-taking strategy, as a way to generate ideas around a given topic, or as a way to organize material for a report, an essay, or a fictional work (Buzan & Buzan, 1996). An excellent mind-mapping application that I've used for outlining and writing this book is Inspiration software, also available for students as Kidspiration ([www.inspiration.com](http://www.inspiration.com)).

- **Think-alouds.** In early childhood, we began to internalize our external speaking as private speech or self-talk (Vygotsky, 1934/1986). The think-aloud strategy has us reverse the process and externalize our thinking once again, so that we can more fully recognize our own cognitive process and change it as necessary. The best way to teach think-alouds is to model them in the classroom: "First I need to . . . then I have to . . . but I've got to remember that . . . and finally I'll . . ." Once

students get the gist, they can begin to externalize their own thinking processes and develop the ability to modify these schemas in ways that help them think more thoroughly about a problem or an issue (“I’m not sure what’s going on in this part of the novel. What can I do to find out?”). This approach can be used to support reading comprehension, problem solving, writing skills, and many other domains of learning (see, for example, Wilhelm, 2013).

- **Heuristics.** A heuristic is any problem-solving method that is not rigorously logical but is suitable for one’s immediate purposes. Originally popularized by Hungarian mathematician George Polya (1945), heuristics are a heterogeneous collection of tricks, tips, and suggestions for approaching both mathematical problems and problems associated with other fields of study. Polya’s chief problem-solving method consisted of four principles: (1) Understand the problem; (2) Make a plan; (3) Carry out the plan; and (4) Look back at your plan. There’s no single right way to achieve any of these steps; there are many reasonable ways to solve problems. Thus, for example, carrying out a plan could involve making a list, solving a simpler problem, eliminating possibilities, working backward, and/or guessing and checking. Heuristics is an effective problem-solving method for high school mathematics, especially for nonroutine problems involving thinking strategies that go beyond the application of simple algorithms (Mabilangan, Limjap, & Belecina, 2012).

- **Thinking journals.** Many of the world’s greatest innovators have used journals, diaries, or notebooks to help them generate new ideas and discoveries, including Charles Darwin, Leonardo da Vinci, Thomas Edison, and Virginia Woolf. One way to introduce the idea of thinking journals to students is to show them examples of famous journals (see, for example, Temple, 2012). Ideally, thinking journals should be open-ended journals where students can record ideas being studied that interest them, work out thoughts that appear to be confusing or contradictory, write down questions about a subject, or document material requiring further inquiry. Thinking journals are

also a good place to record what students have learned in the course of their studies. The journal can be structured to include words, pictures, photos, or other scrapbook-related material (see McKim, 1980).

### **3. Help Students Learn Goal-Setting Behaviors**

Research (Turkay, 2014) suggests that students who set goals and commit to them have higher levels of motivation and academic achievement than do students who don't. The capacity to set goals and monitor one's progress toward them is not an inborn skill; it must be learned and practiced. The critical reorganization happening in the prefrontal cortex during adolescence creates the right conditions for middle and high school students to regularly engage in the goal-setting process (Crone & Dahl, 2012).

The goals that you ask students to set may be short-term ("I want everybody to list five things they'd like to learn today") or long-term ("Tell me what you see yourself doing 10 years from now"). Goal-setting sessions could last just a few minutes, or they may involve in-depth planning over the course of several months. Goals can relate to academic outcomes ("What grade would you like to achieve in this class?"), broader learning outcomes ("What would you like to be able to do by the time you graduate from high school?"), or even life goals ("What sort of occupation do you see yourself involved in after you leave school?").

Goal setting can also be tied directly into the content of a course. In one large urban high school with a high dropout rate, students who were reading Homer's *Odyssey* discussed and wrote about goals that they would be willing to devote a lifetime to, as Odysseus had (Faircloth, 2012). Coughlin (2010) followed a high school science class where the focus was on studying ecosystems via a three-year project aimed at transforming a local wetland. The teacher talked to students about the skills and knowledge they would gain from the course and asked them to think about how they might use that learning in the future.

The SMART goal system can be useful when setting goals, whether long-term or short-term (Elias, 2014). Ask students to make sure their goal is



- **Specific.** *Not* “I will be a better student” *but* “I will learn how to solve quadratic equations.”
- **Measurable.** *Not* “I will get better at math” *but* “I will pass the final math exam with 85 percent proficiency.”
- **Attainable.** *Not* “I will become a star forward for the New York Knicks” *but* “I will make the varsity basketball team this year and work hard to win a sports scholarship for college.”
- **Relevant.** *Not* “I will try to impress my teachers this year” *but* “I will demonstrate to my teachers that I can get my homework done on time.”
- **Timely.** *Not* “I will write a short story in English class this semester” *but* “By October 15, I will have written a rough draft for a short story, and I will complete the final draft by November 20.”

#### **4. Show Students How to Think Clearly About Their Emotions**

Metacognition isn’t just good for boosting academic outcomes; middle and high school students’ capacity to think about their own thinking can also be a boon to dealing with the surging emotions and unpredictable behavior that accompany adolescence. We’ve established that 15- and 16-year-olds do quite well on tasks that require rational and analytical skills (i.e., in “cold” cognition contexts) but have difficulty reasoning clearly whenever emotions, peers, or real-life social situations are concerned (i.e., in “hot” cognition contexts) (Arain et al., 2013). The value of adolescents’ metacognitive abilities is that they can be called upon when students are caught in the midst of a “hot” cognition situation. Essentially, this is what social and emotional learning (SEL) is all about: helping students think more clearly about their feelings and social interactions while in the midst of everyday life.

SEL incorporates a set of skills that students can learn to help them cope when things seem to be spiraling out of control. These skills include dealing with strong emotions when they come up, maintaining positive relationships and defusing tension in negative relationships, and making responsible decisions amid pressure or confusion.

These skills are best learned in “hot” cognition situations. Former middle and high school teacher Todd Finley (2014) explains that a typical teacher response to student anger could escalate the problem, whereas an SEL approach alleviates the situation:

When a teen over-reacts and blows attitude your way, try not to take it personally. Matching a student’s fire with our own—“*Jeremy! Take that attitude outside!*”—can escalate the threat level, thereby triggering the adolescent’s “fight, flee, freeze, or faint” response. Instead, wait 90 seconds—the amount of time it takes for spiky emotions to subside. Then say, “I felt some heat back there. Can you name what you were feeling?” (para. 5)

One meta-study (Durlak, Weissberg, Dymnicki, Taylor, & Schellinger, 2011) of 213 school-based SEL programs from kindergarten through high school revealed that they overall improved students’ social and emotional skills, attitudes, behavior, and academic performance. The following tips will help students think more clearly when they are experiencing strong emotions or social pressure.

- Show students how to recognize behavioral cues that signal a potential outburst or social conflict, such as a hot face, a rapidly beating heart, or feeling anxiety in one’s back.
- Provide students with socially acceptable ways to blow off steam, such as running around the school, taking a voluntary time-out in a safe area of the school, or writing about their anger toward another person with respect to a specific problem or conflict.
- Ask students to come up with their own strategies for defusing social conflicts and handling difficult emotions.
- Let students know about school resources that can help them with their emotions, such as a counselor or trusted teacher.
- Teach students quick, practical ways of relaxing in the midst of stressful situations, such as taking a deep breath, visualizing a peaceful or enjoyable scene, or tensing and then relaxing muscles progressively from head to toe.

## 5. Teach Students How Their Brains Work and Why Mindset Is Important

Given all the research that has emerged in recent years regarding how the adolescent brain develops, and knowing what we now know about teens' metacognitive abilities, it should be mandatory for middle and high schools to share this important information with students. Teaching adolescents about the brain's neuroplasticity may motivate them to spend time learning new things so that they can produce new brain connections and even new brain cells. Providing students with strategies that make use of the brain's potential to learn more effectively can boost students' achievement and their sense of self-regard. Knowing about the limbic system and the influence of neurotransmitters on feelings and behaviors will reassure students that the turmoil going on in their bodies and minds is part of a natural developmental process. If as part of this instruction students were taught how to use stress reduction techniques like meditation and exercise, and shown research on the effectiveness of these practices in calming the mind and improving school achievement, *this might be the most valuable learning they receive in their entire school experience.*

At the Compass School in Westminster Station, Vermont, teacher Amir Flesher (2013) developed a six-week interdisciplinary elective course for 11th and 12th graders that integrates psychology, neuroscience, and mindfulness meditation to teach students about how their brains work. He observed that one of students' chief concerns was trying to understand why they experienced such strong feelings of sadness, anxiety, attraction, and joy. He writes,

I draw on scientific insights [e.g., on how meditation can help individuals manage negative emotions and cultivate positive ones] to help my students make sense of their own minds and their place in the world—in the process, hopefully making adolescence a bit less painful for them and nurturing their growth into healthy and happy adults. (para. 5)

Neurologist and teacher Judy Willis (2009/2010) discovered that when she taught her middle school students about how their brains worked, they became more engaged and confident in their studies. One 7th grader in Dr. Willis's class commented, "I imagine neurons making connections in my brain when I study. I feel like I'm changing my brain when I learn something, understand it, and review it." Another student reported, "If I use my prefrontal cortex to mentally manipulate what I learn, my dendrites and synapses grow, and I will own that learning for a long, long time. I won't have to learn fractions all over again each year" (para. 4).

Resources that teach adolescents how their brains work include *The Owner's Manual for Driving Your Adolescent Brain* (Deak & Deak, 2013) and *You're Smarter Than You Think: A Kid's Guide to Multiple Intelligences* (Armstrong, 2014).

In addition to teaching students about how the brain works, they should also learn about the concept of the *growth mindset*. Stanford psychologist Carol Dweck's (2007) research has revealed that a "fixed" mindset (the belief that intelligence and learning ability are innate) hampers learning, whereas a "growth" mindset (the belief that one's accomplishments are due in large part to effort) promotes school achievement and life success. Sharing this research with students can have a big impact on their attitudes toward learning. Books such as *The 7 Habits of Highly Effective Teens* (Covey, 1998) and *Mentally Tough Teens: Developing a Winning Mindset* (Su'a, 2014) can serve as guides to put students on the road to success.

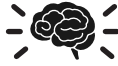
## **Taking Students to the Next Level of Thinking**

There is one more level to metacognition that is frequently ignored by educators but that students themselves believe is crucial to their own integrity and well-being: the exploration of deeper philosophical questions. With their newfound metacognitive capacities, adolescents discover that they're able to break free of the rule-oriented,

convention-rooted, tradition-based ideas and attitudes of their childhood years (and of their parents' belief systems) and explore powerful issues like justice, spirituality, time and space, being, and altered states of consciousness. Howard Gardner (2000) refers to this capacity as *existential intelligence*.

A trio of Seattle Pacific University education professors (Ellis, Denton, & Bond, 2014) have noted that “very little attention has been paid to the kind of metacognition and reflective thought that might lead to student perceptions of what is true, beautiful, honourable, and worthwhile” (p. 4022). Yet the student interest is there: Compass School teacher Amir Flesher (2013) observes that “a group of roughly half a dozen of my students regularly spends lunchtime kicking around a hackysack while vehemently debating the nature of time and space” (para. 4).

Teachers should keep in mind that metacognition goes far beyond graphic organizers and think-alouds, and that students' minds are now in a position to think broadly about the important issues that humanity grapples with on a daily basis. These explorations may lead to political idealism, the rise of a social conscience, ecological concern, a critical or even satirical perspective on social mores, or, finally, spiritual awakening, a phenomenon that was viewed by the pioneer of adolescent psychology, G. Stanley Hall (1904), as one of the defining features of the years between 11 and 18.



## TAKEAWAYS

- A key feature of thinking in adolescence is the development of what Jean Piaget called *formal operational thinking*; John Flavell, a key disciple of Piaget's, coined the term *metacognition* in 1976 to describe this way of thinking.
- The development of formal operational thinking coincides with a spike in gray matter in the brain but seems to be more associated with the gradual pruning and myelination of the prefrontal cortex (especially the frontopolar region) in adolescents.
- Assisting students in developing their capacity for metacognition may be more important for their learning than teaching them content-related facts and skills.
- Strategies for honing students' metacognitive capacity include engaging them in critical thinking, demonstrating how to use metacognitive tools, helping them learn goal-setting behaviors, showing them how to think clearly about their emotions, and teaching them how their brains work and why mindset is important.
- A frequently neglected area of metacognition involves adolescents' capacity to break out of conventional thought processes to inquire more deeply into fundamental issues like justice, spirituality, time and space, and the nature of being.

# 9

## Expressive Arts Activities

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Fantasy is one of the manifestations of creative activity of man, and this is especially true in adolescence, when the rapprochement with thinking in concepts occurs.

—Lev Vygotsky, "Imagination and Creativity of the Adolescent"

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The wellsprings of creativity and artistic expression may reside in early childhood, but the actual mature manifestation of creative potential begins in adolescence, as teens acquire the ability to express in a variety of forms their growing understanding of the world. The realization of creative behaviors during these years is closely tied to adolescents' development of a coherent sense of identity (Rothenberg, 1990). We have only to look back at the history of Western culture to see what adolescents are capable of achieving: the 19th century French poet Arthur Rimbaud wrote *all* of his great poems during his adolescent years. The 16th century German artist Albrecht Dürer produced the earliest-known self-portrait drawing in European art when he was 13. French composer Georges Bizet (the creator of the opera *Carmen*) composed his highly regarded Symphony in C at the age of 17.

It turns out that adolescents are neurobiologically primed to engage in creative and artistic behaviors. The reward centers in their brains, particularly in the nucleus accumbens, are primed by dopamine and other neurotransmitters to crave new sensations and feelings. That

is, adolescents become especially keen on novelty-seeking, which is a foundational quality in the creative process (Gillebaart, Förster, Rotteveel, & Jehle, 2013). As psychiatrist and adolescence expert Daniel Siegel (2014) observes, “Novelty-seeking emerges from shifts in the brain’s dopamine system with the downside of risk-taking behavior and injury, and the upside of having the courage to leave the familiar, certain, and safe home nest for the unfamiliar, uncertain, potentially unsafe world beyond” (para. 8). The fact that the neocortex, with its inhibiting influence, is not yet fully myelinated also means that adolescents are able to express unconventional thoughts and feelings without as much self-censoring as adults. Perhaps even more significantly, the arts provide an ideal means through which adolescents can engage in activities that help *develop* (via neuroplasticity) the neocortex and establish neural circuits with the emotional brain (see Catterall, 2011).

Unfortunately, secondary education has failed to take advantage of adolescents’ propensity to express themselves creatively. Stephanie Perrin (2004), former head of Walnut Hill School in Natick, Massachusetts, a private high school for the arts, notes,

Once students reach the middle school years . . . serious participation in the arts declines dramatically as students approach the “real” world and have to study “real” subjects such as math, science, literature, and language. By the time they get to high school, they often find that the arts are acknowledged, if at all, by modest requirements such as one “arts” credit for graduation, one which requires no significant skill development. (p. 20)

Poet and educator Adam Fitzgerald (2015) writes, “In high school, too many students learn to hate poetry at the very time they most want to express themselves and experiment with language. . . . More and more of my students each year report completing high school without ever encountering a single poem” (para. 1).

This state of affairs has serious implications. A recent study in the *Creativity Research Journal* (Kim, 2011) found that the ability to create new and unusual ideas increases up to 5th grade and then declines



during high school before increasing again in adulthood. According to creativity expert and author Jonas Lehrer (quoted in Paul, 2012), if you ask a group of 2nd graders the question “Do you think you’re creative?” 95 percent will answer yes, but ask high school seniors the same question, and only 5 percent will respond in the affirmative.

## **Five Ways to Foster Artistic Expression**

Many people hold the misconception that creativity is a frivolous “extra” that should be put aside once students enter secondary school. On the contrary, it’s a way of thinking that is crucial to students’ development as thoughtful, innovative members of society.

Creativity can be integrated into every subject area, not just “the arts,” but doing so can feel intimidating. Accordingly, in this chapter, I investigate what middle and high school educators are already doing to give students the time and space for expressing their ideas, channeling their turbulent emotions, and using artistic means to work out how they want to be in the world. The strategies in this chapter don’t specifically focus on the formal arts, as important as they are, but, rather, on how adolescents can be empowered to express themselves artistically in subjects like English, history, math, science, and foreign languages. This chapter describes five ways in which teachers can integrate spontaneity, creativity, and out-of-the-box thinking across the curriculum.

### **1. Incorporate Creative Writing**

Although creative writing is a traditional part of the secondary school curriculum, its practice has declined since the implementation of the Common Core, which emphasizes nonfiction reading and writing. This shift away from personal expression of thoughts and feelings is evidenced in the following statement from Common Core chief architect David Coleman (2011), addressing a group of New York educators:

Do people know the two most popular forms of writing in the American high school today? . . . It is either the exposition of a personal

opinion or the presentation of a personal matter. The only problem, forgive me for saying this so bluntly, the only problem with these two forms of writing is as you grow up in this world you realize people don't really give a sh\*t about what you feel or what you think. (p. 10)

This attitude constitutes both a callous disregard of adolescents' need to work out a sense of self in a complex and often bewildering world and an obliviousness to the last 15 years of research on the adolescent brain. Rebecca Wallace-Siegel (2012), executive director of Writopia Lab, a nonprofit creative writing lab for students ages 8–18, explains how powerful it is when students express what is in their hearts and minds (and how fragile that connection can be):

Rami, one of my light-hearted 7th grade boys, had been working on a memoir with me for a month and finally decided to share it with a small workshop of his peers. It was about not feeling masculine. We were all stunned. I caught sight of one girl holding his hand for support.

These moments of self-awareness are rare in a typical classroom, and all it takes is one adult to shatter them. When the principal of Rami's school became privy to the memoir, she simply scoffed, "Oh, Rami, trying to get attention again." Rami turned pale; he didn't write again for months. Thankfully, later that year, he won a regional Scholastic Award for his memoir. (paras. 14–15)

In a large urban high school in Toronto, Canada, 11th graders read graphic novels and then worked on creating their own. At the beginning of the unit, the teacher related, one student declared openly (and somewhat proudly) that "he had 'never finished a novel in [his] life.' By the end of the project, he had not only read a graphic novel but also created an eight-panel graphic narrative of his own" (Hughes, King, Perkins, & Fuke, 2011, p. 601).

English class should not be the only place for creative writing. A group of Pennsylvania secondary school educators assigned a chemistry class the task of writing a scientifically accurate poem that described

the molecular properties of gases in the atmosphere. One student's ode to oxygen contained the lines "With an atomic number of exactly eight/I fear you do not have a lot of weight" (Marcum-Dietrich, Byrne, & O'Hern, 2009, p. 17). Math teachers in Lebanon, New Hampshire, asked their students to write a 15-line poem that included at least six vocabulary terms from a list including *congruent function perpendicular, contrapositive parabola probability, coordinate isosceles pyramid, cylinder locus radical, and equation matrix rotation* (Keller & Davidson, 2001). The following list includes some additional ideas for bringing creative writing into other school subjects.

- *Social studies*: have students write short stories based on historical or current events.
- *Foreign language*: encourage students to write poems, stories, or plays in the language they are studying.
- *Science*: ask students to write science fiction that incorporates concepts from biology, chemistry, or physics.
- *English*: have students participate in National Novel Writing Month every November (see [www.nanowrimo.org](http://www.nanowrimo.org)) (Pogash, 2009).
- *All subjects*: put on a poetry slam (see [www.poetryslam.com](http://www.poetryslam.com)) (Smith, 2010).
- *All subjects*: have students keep a writer's journal containing ideas, sketches, and words to include in future written assignments.
- *In-school mediation*: address student conflicts by having each party write a fictional account of the conflict that takes it in a different narrative direction.

## 2. Encourage Students to Express Ideas Visually

Chapter 8 explored how students can use diagrams, conceptual maps, and other visual organizers to support their emerging meta-cognitive abilities. However, there are other, more creative ways in which students can express their learning. Students at High Tech High North County in San Marcos, California, provide a prime example of such creativity in their investigation of tagging and graffiti in their

community. As part of their interdisciplinary studies encompassing fine arts, social science, language arts, and technology, they created graffiti-style art that was displayed at the Escondido Arts Partnership Gallery (Leader, 2014).

Students can also work on collaborative projects across the content areas. At Central York High School in York, Pennsylvania, AP government students researched different aspects of public policy and generated practical examples of each aspect as evidenced in current events. Then art students created sculptures that reflected these findings (Nobori, 2011).

Stacey Goodman (2014), a teacher at the Athenian School in Danville, California, encourages divergent thinking by having students create “readymades,” an art form developed by early 20th century artist Marcel Duchamp that uses found objects in unconventional ways. She also engages students in the practice of *pareidolia*, a process of looking for hidden patterns or images in things (e.g., seeing a face in a scribble drawing). Additional tips for using the visual arts to express learning and externalize cognition follow:

- Invite students to create drawings, sculptures, or paintings to demonstrate their learning in any content area (e.g., painting a historical scene, constructing string or wire sculptures of mathematical patterns, or creating illustrations of events or themes in a novel).
- Ask students to make quick one-minute sketches of a concept you’ve just taught.
- Have students keep sketch diaries to visualize thoughts that occur to them in preparation for a project or an assignment.
- Suggest that students express what they’ve learned from a lesson by making an “idea sculpture” out of a sheet of paper, which they can shape, cut, or form in any way that conveys the concept.
- Allow students to hand in comic strips with dialogue in lieu of written assignments.
- Permit students to doodle while you lecture; research (see Levy, 2014) suggests that this activity facilitates thinking and learning.

### 3. Let Students Articulate Learning Through Drama and Dance

We know that incorporating physical movement is a powerful way to teach content (see Chapter 7). Students can also use creative movement, such as drama or dance, to express themselves and their learning. Students who find it difficult to articulate their thoughts or knowledge through words may be able to do so through their bodies. As one UK student observes, “My AP6 English teacher will say, ‘I need you to write an essay about your life.’ I may not know how to write it, but she will say, ‘you know what, let’s act it out.’ And I will act out the whole thing. It will be academic and theater” (Maguire, Donovan, Mishook, de Gaillande, & Garcia, 2012, p. 381).

There are countless ways to use drama or dance to convey learning. Peter Paccone (2014), a social studies teacher at San Marino High School in California, has his students work in small groups to produce a 10-minute television talk show script related to a topic of historical significance and then present it to an audience. Former science teacher Jane Burke (2009) brought in a professional dancer to work out how the class could use movement to explore the abstract ideas behind chemical reactions. One student recalled,

I was able to think about concepts in a completely different way. Because you cannot actually see what is happening on the atomic level during a reaction, it was helpful to dance it out. Over the days we worked on this, there wasn’t one person in the class who wasn’t always involved. That’s a record! (para. 5)

Other ideas for bringing drama and dance into the curriculum include the following:

- *Math*: have students communicate mathematical concepts through movement (e.g., dancing the Fibonacci sequence).
- *Social studies*: give students the option of demonstrating their learning by writing and presenting a play (e.g., portraying their knowledge of how a bill is passed in the U.S. government).

- *English*: let students act out scenes from the stories or novels they are reading or use improv to act out an alternative way a scene in a novel might have gone.
- *Foreign language*: reinforce the meanings of vocabulary words by having students act them out with their whole body (individually or in groups) or use gestures while seated at their desks.

Some students may initially feel uncomfortable dancing in front of classmates or dramatizing aspects of their learning, but in time, most will see such activities as far preferable to long, sedentary periods of writing, reading, or listening to a lecture. Here's a description of one such 8th grader's experience with improv:

It seemed cool [to the student] but kind of nerve-wracking. Her first few times on stage she felt anxious about what her peers would think of her, worrying that she might do something foolish or embarrassing. But the more times [she] did it, the less self-conscious she became, and the quicker she began to trust her own ideas and to think on her feet. (Flanagan, 2015, para. 9)

#### **4. Integrate Video, Photography, and Animation**

Technology represents a gold mine of resources to support middle and high school students in expressing both their learning and their personal feelings and insights. For example, a high school photography teacher could ask students to take and share a daily smartphone photo that conveys their mood. Student photography or other digital creations can be used by teachers as a starting point for a written assignment, to open a conversation about a topic in the course, or simply as a way of keeping connected to students' thinking. As Canadian education professors Sandra Weber and Claudia Mitchell (2008) point out,

Digital productions tell stories of sorts (often nonlinear and multi-voiced) and leave a digital trail, fingerprint, or photograph of “where I was then,” “where we are now,” “who I would like to be,” and so on.

In other words, young people's interactive uses of new technologies can serve as a model for identity processes. (p. 27)

For example, Reel Works Lab (a program providing filmmaking opportunities for New York youth) participant Noeman Samdani created a six-minute film called *Rules of Engagement* about his struggle to come to terms with his Pakistani parents' attempts to arrange his marriage and their refusal to honor his desire to be a filmmaker. He reflected,

Sometimes I find it hard to be a good Muslim and an American teenager. My dreams for my future are so different from what my parents want me to do. They think they have better plans for me. Throughout the making of this film, I have learned what being a Muslim is truly about and have realized that I am not the only Muslim teen going through this struggle. (Halverson, 2010, p. 2365)

Using these tools is an engaging way for students to learn required content and skills and to stretch outside their comfort zones. High school students in central Maine, in cooperation with the Mid-Maine Technical Center in Waterville, have filmed public service announcements supporting Habitat for Humanity and created videos promoting Waterville's Main Street businesses. More recently, they have worked on a class assignment called "The Spirit of Waterville," which requires them to capture a sense of community by creating 90-second videos that feature interviews with longtime residents and are set to music (Calder, 2015). Meanwhile, students in Atascocita High School's Advanced Animation class in Harris County, Texas, learn Claymation, graphic art and editing, and animation techniques that will prepare them for careers in media production. Their film *Parched*, about a lowly company intern who goes on a quest to find a cup of water for his boss, was chosen as an Official Selection in the All American High School Film Fest held in New York City (Community Reports, 2015).

Hernandez (2015) offers the following tips to help teachers across the content areas use digital tools to make assignments more authentic, enriching, and interactive.

- *English*: ask students to visually interpret a poem they are studying in class through a video poem or a photo montage that they post online (e.g., on a blog or social media).
- *Science*: have students document scientific phenomena and present their findings on a class blog.
- *Social studies*: ask students to document change in their community by recording older family members' reactions to specific changes in local history through photography or video.

Additional ways to use digital media tools to enhance learning across the curriculum include the following:

- *Mathematics*: have students create animations that humorously tell stories about mathematical ideas (e.g., Descartes's invention of Cartesian coordinates, inspired by watching a fly crawl on the ceiling of his bedroom, or Archimedes' "Eureka!" moment of discovering displaced volume in his bathtub).
- *Foreign language*: let students film skits featuring dialogue in the language being studied.
- *Family and consumer sciences*: film a home-cooking competition show like those seen on television.
- *History*: ask students to create a photo montage, a video, or an animation project that tells the story of an event in history.
- *Physical education*: have students create short video segments aimed at teaching specific sports skills to elementary school students.

## 5. Use Music to Enhance Learning

Music education has been one of the casualties of the last two decades' increased emphasis on core academic skills (Hawkins, 2012; Kalkavage, 2006). Yet recent research (Tierney, Krizman, & Kraus, 2015) suggests that music instruction may contribute to fundamental changes in brain structure that prolong the stability of subcortical sound processing, accelerate maturation of cortical auditory responses, and contribute to the development of language skills.



Perhaps even more significantly, adolescents themselves regard music as an important component of their personal lives (Campbell, Connell, & Beegle, 2007). One educator (Alvarez, 2015) thinking back to his adolescent years recalls, “It was through Hip Hop that I learned to develop my voice and build a positive peer group. Hip Hop taught me about myself, the world around me, and provided a channel for creative expression” (para. 2). At the High School for Recording Arts in St. Paul, Minnesota—commonly referred to as Hip Hop High—students learn about music production, entrepreneurship, and lyricism. During the last 10 years, hundreds of schools across the United States have been integrating hip-hop rhythms and lyrics into history, math, science, and social science lessons (Koebler, 2011).

Students are also learning to use cutting-edge technology to create music. In Canton, Ohio, students at McKinley High School and at the Canton Arts Academy at Summit engage in projects for which they must use recording software, music looping programs, and other music software and composition applications. Students learn to write and analyze music and share their music with classmates while producing work that meets required standards in Spanish, math, or science (Duer, 2010). Meanwhile, at Washington Middle School in Springfield, Illinois, Dawn-Elissa Fischer brought local hip-hop artists into the classroom and played radio-friendly edits of popular rap songs to study the parts of speech and other grammatical topics (Hellweg, 2005).

Additional ways to integrate musical expression into your lessons include the following:

- *History*: let students conduct research projects on historical eras by analyzing the music of those periods.
- *Science*: have students use simple percussion instruments to rhythmically “perform” scientific concepts such as Boyle’s law, nuclear fission, meiosis, and evolution.
- *English*: allow students to use musical composition software, such as Apple’s GarageBand, to create songs based on the characters and narratives of the literature they are reading.

- *Mathematics*: have students use drums to create rhythmic pieces that demonstrate their understanding of specific numerical patterns and concepts (e.g., *exponential, sequential, geometric*).
- *Government*: assign students a project to create a short musical based on a current event in the political arena.

## Tapping into Adolescent Creativity

In his critique of education systems, author and educator Sir Ken Robinson (2012) lists three primary ways in which schools fail students:

First, they promote standardization and a narrow view of intelligence when human talents are diverse and personal. Second, they promote compliance when cultural progress and achievement depend on the cultivation of imagination and creativity. Third, they are linear and rigid when the course of each human life, including yours, is organic and largely unpredictable.

The answer, he says, is for schools to do a better job of honoring creativity, innovation, and cultivation of students' inner talents and abilities. Nowhere is this truer than in the case of adolescents, whose burgeoning thoughts, feelings, and capacities demand ever more opportunities to think and grow creatively.



## TAKEAWAYS

- Creative expression first appears in its mature form during adolescence.
- The adolescent brain's dopamine reward systems prime teens to seek novelty, a key attribute of creativity.
- Despite adolescents' yearning for novel experiences and creative expression, the arts and creativity in general tend to decline during the middle and high school years owing, in large part, to the lack of value that schools place on these vital components of life.
- Artistic expression provides an opportunity for teens to channel turbulent energies, organize emerging modes of thinking, consolidate their identities, and find a sense of meaning for themselves in a complex and changing world.
- Secondary-level educators can provide students with opportunities for expression by engaging them in creative writing, visual composition, drama and dance, digital media projects, and musical performances.
- Music is important to learn for its own sake and also is a component that can be integrated into any subject matter at the secondary level.

# 10

## Real-World Experiences

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I believe that education . . . is a process of living and not a preparation for life.

—John Dewey, “My Pedagogic Creed”

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Adolescents hunger for real-life experiences. Field trips and career days no longer cut it as authentic ways to connect to the world outside the classroom. Students want to go beyond the school grounds and be part of the mix. They want to feel the pulse of the world. There’s a wide chasm, however, between the capabilities they possess as a result of the slow but steady development of their neuroplastic brain and what they are actually allowed to do in a middle or high school classroom. One of the great ironies of adolescent development in the United States is that students can open retirement accounts at 13, get a driver’s license in some states at 14 or 15, marry with parental consent at age 16, and vote or join the military at 18—but if they want to go to the bathroom in most secondary schools across the United States, they still have to raise their hand!

Although teens long to embrace real-world experiences, the education system seems to be heading in the opposite direction if we’re to judge by recent reform efforts that emphasize academic attainment and college preparation as key goals for secondary schools. The White House website (<https://www.whitehouse.gov/issues/education/k-12>) states a “national imperative” of “educating every American student to graduate from high school prepared for college and for a career.” Note

that it doesn't say "college *or* a career." I believe the distinction is significant. As U.S. economist Robert Lerman (2012) has noted, "Attention has shifted away [in U.S. education] from the school-to-career transition and toward how well elementary and secondary student [*sic*] perform on academic tests as well as the barriers to college enrollment and completion" (p. 15). This narrow focus on testing and college prep persists despite the fact that secondary school educators strongly believe that experiential programs such as apprenticeships, internships, and job shadowing are effective in engaging students, increasing academic achievement, and preparing students for college and life (Cavanaugh, 2004).

## Six Ways to Integrate Real-World Experiences

In real-world settings, adolescents are under optimal conditions for dealing with issues related to "hot" cognition, where on-the-spot behaviors and good decision making result in the formation of new neural connections between the emotional brain and the rational prefrontal cortex. Unlike formal schooling, with its planned-out textbook readings, worksheets, and project protocols, life is unpredictable. Most student outcomes in secondary school have no meaningful consequences, unless you consider grades, test scores, and disciplinary measures meaningful. Life, on the other hand, yields infinite consequences that spring from the choices we make.

A student who shadowed the owner of a company manufacturing granite kitchen countertops learned this valuable rule when he was told, "Being off by just an eighth of an inch can mean the entire counter has to be scrapped—and that translates to a loss of hundreds or even thousands of dollars for my company" (Junior Achievement, 2010, p. 4).

This chapter explores six programmatic strategies (as opposed to instructional strategies) that give middle and high school students opportunities to engage in learning outside the confines of the school campus.

### 1. Institute a Job-Shadowing Program

Job shadowing is perhaps the most easily implemented of the "real-world" reforms that can take place at secondary schools. Students spend

a day at a local business or organization following around managers or employees and learning about the challenges and rewards presented by different types of working environments. Schools simply need to communicate with companies in the community about opening their doors for student visits. Most businesses are happy to accommodate such requests as a way of strengthening school-community relationships and fostering future potential employees.

Although job-shadowing experiences tend to be short in duration, they can have a significant impact on students. Seventeen-year-old Sandra Miranda actually met her mentor during a job-shadowing event, recalling,

I remember most vividly the hours we spent in his office talking about the road he had traveled in order to get where he was. He told me to use obstacles as an inspiration to prove to the world that I can realize my goals if I have determination. . . . Sharing a day with a dedicated career mentor was one of the most rewarding experiences I had in high school. (Junior Achievement, 2010, p. 4)

At Westlake High School and Moorpark High near Los Angeles, California, 10 students were selected to job-shadow at a local hospital, where they had the opportunity to visit an actual operating room and view a live arthroscopic surgery. As one student noted, “I’ve seen it enough on television, but it’s still so much different being here. There’s so much work involved with a surgery” (Willier-Allred, 2010). In a survey administered by the entrepreneurial organization Junior Achievement (2010), 88 percent of students said after a job-shadowing event that it made them realize the importance of staying in school.

## **2. Provide Internship Experiences**

Internships are temporary paid or unpaid positions at workplaces that provide on-the-job training. They can prepare students for actually working at the site as well as provide invaluable work experience that helps students build their résumés and increases their chances of finding work when they graduate. At the Metropolitan Cleveland Consortium

STEM High School in Cleveland, Ohio, internships are required for all students. Senior Lily Rodriguez interned in three different professions before she found the right fit:

I got my NASA internship and I found out I don't want to be an astronomer; then I got my internship at University Hospitals and found out I don't want to do anything that has to do with hospitals; but the internship that I have now [at the American Civil Liberties Union], I really, really enjoy, and I think I'm going to end up doing something with protection of our rights because I'm very passionate about that. (Nobori, 2012, para. 4)

Education advocate Tom Vander Ark (2015) says, “Every student should graduate from high school having experienced success in several work settings. . . . There's no better way to earn job skills than on the job. Work-based learning experiences are a great way to narrow interests and focus future learning” (para. 1).

### **3. Create an Apprenticeship Program**

Whereas job shadowing usually takes place in the course of a day, and internships occur over a period of weeks or months, apprenticeships—where students work closely with individuals who are highly accomplished in their trade—typically continue for longer stretches of time. Although this kind of school-to-career program is uncommon in the United States, apprenticeships are a key part of secondary school programs in many countries around the world. Seventy percent of teenagers in Switzerland, for example, divide their time between a workplace, a sector organization (e.g., a professional or trade association), and school, earning a monthly wage that ranges from \$800 to \$1,000 (Luzer, 2013). Not surprisingly, youth unemployment in Switzerland is only 3.1 percent, compared with the United States' 10.5 percent.

In Australia, all students by law must take part in vocational education and training (VET), either integrated with their academic classes or as stand-alone apprenticeships. The program covers virtually every trade and professional or paraprofessional field (with the exception of

engineering, medicine, and dentistry, which students pursue full-time at the university level), and students can study and work in whichever field they wish as long as the school has the resources to support them (K. Fitzgerald, 2015).

Despite the clear advantages of such programs, government funding for apprenticeship programs in the United States is minuscule compared both with spending by other countries and with U.S. spending on less effective career and community college systems that provide education and training for specific occupations (Lerman, 2014).

Fortunately, a growing number of secondary schools around the United States are offering apprenticeship programs. In Kentucky, the Tech Ready Apprentices for Careers in Kentucky (TRACK) program, a partnership between the Kentucky Labor Cabinet and the Office of Career and Technical Education, enrolls students in apprenticeships that earn them wages, industry certification, and the option to continue in a Registered Apprenticeship program (Singmaster, 2015). And Wisconsin's Youth Apprenticeship program gives students the chance to engage in hands-on learning in an occupational area at a work site. Kyle Curry, a senior at Mishicot High School, spends mornings working in the engineering department of Jagemann Stamping Co. Brian Wendt, a tool designer who mentors Curry, says, "It can be hard to find people who put forth a good effort and do a good job. It's nice to have high school students because you can try and instill (good work ethic) at a young age where they don't yet have the bad habits" (Bock, 2015, para. 5).

Some apprenticeships occur after school hours. The Chicago Public Schools' After School Matters culinary arts program has been a big hit with 17-year-old Chom Pasidparchya, who says that the program has inspired him to pursue a career as a chef: "I love everything about cooking. It builds responsibility and teaches commitment and teamwork" (Taylor, 2007, para. 3).

To start an apprenticeship program at your school in conjunction with a business, technical school, or governmental agency, contact ApprenticeshipUSA at the Department of Labor, Frances Perkins



Building, 200 Constitution Avenue NW, Washington, DC 20210; e-mail: apprenticeship.USA@dol.gov.

#### **4. Establish a Career Academy**

A career academy employs a school-within-a-school framework grounded in a college preparatory program that focuses on a specific theme. Some of the themes schools have used for their academies include health services; media and communications; business, finance, and marketing; architecture and construction; education and child development; energy and utilities; hospitality, tourism, and education; marketing, sales, and service; and fashion and interior design. Research (Brand, 2009) suggests that students who have participated in career academies are more likely to complete the required school credits for high school graduation. In addition, a study (Kemple, 2008) has suggested that career academy graduates earn \$2,088 per year more as part of the work force than do students who go through nonacademy programs.

In addition, career academies can pave the way for entry into college programs that are based around the themes they studied. At Skyline High School STEM Academy in Longmont, Colorado, the four-year engineering program culminates with a senior class design project that can earn students a special STEM certification and guaranteed admission to the College of Engineering and Applied Science at the University of Colorado, Boulder (Tannenbaum, La Floch, & Boyle, 2013).

For information on setting up a career academy at your school, contact the College and Career Academy Support Network at the University of California, Berkeley, 1608 Tolman Hall, Berkeley, CA 94720; <http://casn.berkeley.edu>.

#### **5. Incorporate Community-Based Learning and Service Learning**

Making a difference in the world is what community-based learning and service learning are all about. Students engage in projects designed to help people—whether in their local community or across

the globe—and, in the process, fulfill course requirements and gain valuable 21st century skills. Only Maryland and the District of Columbia have a statewide requirement in service learning or community service, although 23 states permit schools to give students credit toward graduation for engaging in these activities (Education Commission of the States, 2014). In addition, several large urban school districts in cities such as Atlanta, Chicago, and Philadelphia require community service for graduation. A meta-analysis (Celio, Durlak, & Dymnicki, 2011) of 62 studies involving more than 11,000 students revealed that, compared with students in control groups, those who participated in service learning programs showed significant gains in academic performance, civic engagement, social learning, and positive attitudes toward self, school, and learning.

Community-based learning and service learning projects address a wide spectrum of social needs. At Troy Howard Middle School in Belfast, Maine, for example, students created a schoolwide garden that quickly engaged members of the local community. Local growers collaborated with students to help make the garden more productive and locate niche crops, such as winter greens, that wouldn't take business away from other growers in town, and helped them build three portable greenhouses. The town's co-op and the school cafeteria sold the school's produce as students learned about the economics of wholesale and retail markets. During the course of the project, students learned about the physics and mathematics of greenhouse temperature control and the communication skills (both oral and written) involved in marketing their food to the local community (Payne & Edwards, 2010).

Meanwhile, at the Lindblom Math and Science Academy in Chicago, students collaborated with a U.S. health care company to design a dialysis device that could be used by children receiving peritoneal dialysis treatment for kidney failure. The students synthesized their newly acquired knowledge about biotechnology, marketing, and design to create prototypes that combined the technical features of a dialysis device with an appeal to the youth market by packaging the machine in a brightly colored portable case that included a safe way to disconnect

from the machine for short periods (Gerdes & Ljung, 2009). And at High Tech High in San Diego, biology students developed methods of identifying bushmeat to help wildlife officials combat poaching in Tanzania, and engineering students built a fish pen to protect 11,500 sea bass from avian predators. In addition, humanities students teamed up with math and science students to create a documentary film about the scarcity of natural resources in Africa and to build a model water-purification plant (Rubenstein, 2008).

A critical requirement for successful community-based learning or service learning is that students need to have a high degree of voice in and ownership over their projects (Celio et al., 2011; Morgan & Streb, 2001). So, for example, rather than assigning students to an organization such as Habitat for Humanity, let them first develop a project they'd like to investigate (e.g., how the shelter needs of economically disadvantaged people are served in their community) and then explore options for engaging in a service learning program that will help meet that need.

## **6. Encourage Entrepreneurial Learning**

Giving students an opportunity to learn by creating their own businesses may be the best way of preparing them for the challenges of the workplace. It's also an effective way to boost student engagement and ownership of learning. In a Gallup survey (Calderon, 2011), nearly 80 percent of students in grades 5 through 12 said that they wanted to be their own boss, and 45 percent reported wanting to start their own business. At Dodd Middle School in Cheshire, Connecticut, students plan and manage businesses that sell products to the school's faculty, staff, and students. As part of their planning, they choose products, company names, and logos and write individual portfolios using industry vocabulary that set out their business and marketing plans and codes of ethics. Products include placemats from Dining Delights, children's shorts made by Little Chief's Briefs, and foods made by Man O' Man O' Cotti, the Grateful Breads, and Dough-si-Dough. Teacher Linda Biedrycki says, "The kids *are* the companies. . . . They take pride in their work" (Luddy, 2010, para. 3).

At Hawken School in Gates Mills, Ohio, seniors enrolled in a three-credit semester course on evidence-based entrepreneurship. In the first part of the program, they advised two existing start-up companies on problems related to lack of time, people, and money. During the second portion of the course, they came up with their own start-up ideas and pitched them to four local venture accelerators using the *Shark Tank*-style format popular on reality TV (Blank, 2014).

Other ways to involve students in entrepreneurial education include the following:

- Have students develop business products and then advertise them on funding platforms like Kickstarter and GoFundMe.
- Set up an art gallery with works of art created by students, who also help determine pricing and advertising, and open it to parents, faculty, students, or the public.
- Let students create their own advertising agency to promote student-made products.
- Permit students to set up consulting firms around their particular areas of interest (or around the topic or content being studied) and then plan how they might sell or donate their services to the school or local businesses.
- Ask students to think of a potential business and create a detailed business plan and then review and critique one another's plans.

## Going Beyond School Walls

Launching some of the more complex programs explored in this chapter may not be an option for you or your school, but I hope you feel inspired to incorporate entrepreneurial learning into your practice. Some additional ideas for real-world experiences follow (Washor & Mojkowski, 2013).

- Match students with mentors in the community who can provide guidance on their areas of interest or ability.

- Invite experts-in-residence (e.g., artists, scientists, poets) to spend time at the school and share their background and experience in ways that align with class content and objectives.

- Take students on “road trips” on which they can conduct interviews, observe social relationships, commune with nature, or take part in public events (see [www.roadtripnation.com](http://www.roadtripnation.com) for information on how to set these up).

- Develop a broad range of after-school programs to allow students to explore real-world issues and activities (e.g., photography, robotics, chess, journalism).

- Build relationships with local colleges, universities, and technical institutes that enable middle or high school students to take courses and practicums based on subject or skill areas they want to explore.

- Develop learning plans that grant students credit for the learning they gain in their jobs in the community.

- Encourage students to set up independent study projects that require them to get out in the world and explore practical issues and hands-on problem solving.

- Offer opportunities for students to travel abroad for periods of one month to one year through student exchange programs such as AFS, Quest Exchange, or the Alliance for International Exchange, or through student travel programs such as National Geographic Student Expeditions, Walking Tree Travel, or GoAbroad.com.



## TAKEAWAYS

- Adolescent students prefer the challenges and excitement of real-world experiences to sitting in a classroom day after day.
- Current trends in U.S. education favor college preparation over school-to-work programs.
- Real-world learning presents adolescents with opportunities to wire their brains under conditions of “hot” cognition, which helps secure connections between the rational prefrontal cortex and the emotional limbic system.
- Schools can incorporate a variety of opportunities for real-world learning, including job shadowing, internships, apprenticeships, career academies, community-based learning and service learning, and entrepreneurial learning.
- Research indicates that engaging in real-world experiences helps boost students’ academic achievement, motivation, civic engagement, and sense of social responsibility.

# Conclusion

I recently read something troubling on Urban Dictionary, a crowd-sourced online lexicon of slang words and phrases that receives 1 million visits a day from English language readers around the world. I was looking up the definition of *high school*, and here's what I found:

High school is a failed experiment in preparing young people for the adult world. . . . High schools are usually poorly run by a team of out of touch \*\*\*holes, also known as Principals, counselor[s], teachers, and ex-Marine drill sergeants (gym teachers). These people seem hell bent on destroying all hope for students through tedious testing, poorly planned projects, educational videos made during the Truman Administration, and text books. (Urban Dictionary, 2005)

I should mention that there were quite a number of other definitions for *high school* on the site, but this one was ranked as the “top definition,” with 10 times as many people voting for it as against it (20,000 versus 2,000). If you are a secondary school educator, this definition should trouble you, too. It suggests that beneath the surface of things, too many people regard secondary schools as places not for growth and learning but for stagnation and surrender.

This definition is not just some isolated joke buried in an offensive website. It accords with the copious findings in this book revealing that the number of disengaged and stressed-out adolescents who go through the motions in school every day is growing. I hope that reading this book has given you a better sense of why this is happening in our student population—that there is a colossal mismatch between how the adolescent brain has evolved over eons of human existence and the passive, rote

learning experiences that are all too often provided for students at the secondary level.

At the same time, I hope that you've been encouraged by what you've read here. There are hundreds of examples of schools and programs in the United States and around the globe that engage in practices that marvelously align with recent neuroscience findings about how the adolescent brain works. These programs and practices engage the emotions, provide opportunities for student voice and choice, encourage students to learn through their bodies, tap teen proclivities for peer interactions through collaborative learning, offer strategies that focus on adolescents' emerging metacognitive abilities, and develop projects that help students work out their sense of self amid a conflicting clamor for their attention from peers, family members, educators, the media, and others.

Naturally, some who read this book will have at least a few objections to these approaches. Accordingly, Figure C.1 provides a chart listing some of these "buts," along with my brief responses.

I also want to respond to readers who are excited about the adolescent brain and the changes that can occur in students through the application of the ideas in this book. I can't overstate the importance of engaging your adolescent students in brain-friendly learning activities. There are students in your classroom right now who are waiting for you to make a difference in their lives. Perhaps you have a student who's wired for high sensations and spends much of his time in school daydreaming about how he's going to score some weed as soon as school gets out. But then he walks into your classroom, and you immediately engage him in a high-energy learning activity that requires him to take some healthy risks and earns him meaningful rewards for his efforts—perhaps peer approval, or just the thrill of "getting" a new idea or skill. Sure, he may still go out later to buy drugs, but if you continue to engage him day after day in ways that reach deep into his brain's nucleus accumbens and dopaminergic system to satisfy his need for reward, then, just possibly, his need to go outside school for his thrills will abate. Perhaps, instead, he will begin to focus on getting thrills from creativity, innovation, and the pure joy of learning.



**Figure C.1** | Taking on the “Buts” in School Reform

“But . . .”	Response
“But we don’t have any time to do these things since we have to prepare our students for standardized tests!”	Much evidence cited in this book suggests that doing these things will raise levels of academic achievement.
“But we can’t depart from the dictates of the Common Core!”	Most of these ideas and strategies can be tied directly to Common Core standards.
“But we don’t have the money to follow through!”	Many of the suggestions in this book don’t require extra funding, just the will to change.
“But our school board and administration won’t support us!”	Many of the ideas in this book can be applied by one teacher working alone to make incremental changes in his or her classroom.
“But I don’t have the time to do all the things you suggest!”	Do the things in this book that you <i>do</i> have the time for.
“But I have too many students to do this!”	Use differentiated learning strategies to engage students with these activities.
“But we’ve tried all this in the past, and it didn’t work!”	Specify exactly what you tried in the past, find out why it didn’t work, and learn from your experiences.
“But it’s just too difficult to expect things to change in our community!”	Change begins with you.

Think about this transformation occurring in student after student in classroom after classroom across the country (and the world). Doesn’t it make you feel lucky to be in a position to intervene in the lives of teens at a critical moment in their brains’ development? Doesn’t it make your own dendrites tingle a little to realize that what you do in the classroom will help wire positive changes into your students’ brains that will last for the rest of their lives?

# Appendix A:

## Glossary of Brain Terms

**Acetylcholine:** An organic chemical that functions in the brain as a neurotransmitter important for regulating attention, decision making, memory, and learning.

**Adrenal glands:** Glands located just above the kidneys that produce a number of hormones, including corticosteroids, which are important to the stress response, immune functioning, and regulation of inflammation and metabolism.

**Adrenocorticotrophic hormone (ACTH):** A hormone secreted by the pituitary gland that regulates levels of the steroid hormone *cortisol*, which is released by the adrenal glands; often produced in response to stress.

**Allopregnanolone (THP):** A neurosteroid synthesized from progesterone that promotes stress reduction, sedation, and analgesia, but at increased levels can lead to negative mood, irritability, anxiety, and aggression.

**Amygdala:** Two almond-shaped masses of nuclei found deep within the temporal lobes of the brain; important in memory processing, strong emotional reactions, and quick decision making.

**Antagonist:** A substance (in this case, in the brain) that inhibits or interferes with the physiological action of another substance.

**Apoptosis:** A process of programmed cell death undertaken when cells are no longer needed or pose a threat to health.

**Arborization:** The branching out of dendrites from a neuron.

**Axon:** A long, thin projection coming out of a neuron or brain cell that transmits information to other neurons by conducting electrical impulses that move away from the cell body.

**Basal ganglia:** A collection of subcortical brain structures—including the *striatum*, *globus pallidus*, and *substantia nigra*—that are associated with voluntary motor movements, learning, emotion, and cognition.

**Cerebellum:** A region attached to the bottom of the brain that is involved with motor control (e.g., posture, balance, coordination) and certain higher-order functions, including language, attention, and learning.

**Cerebral cortex:** The principal and most anterior (frontal) part of the brain in humans and other vertebrates, which consists of two hemispheres (left and right) and whose surface folds inward and outward to create *gyri* (ridges) and *sulci* (folds) that increase the overall surface area.

**Cerebrum:** See **cerebral cortex**.

**Cingulate cortex:** An important part of the limbic system that helps regulate emotions and pain; also involved in predicting and avoiding negative consequences.

**“Cold” cognition:** Reasoning that takes place in the absence of emotion or social pressures (e.g., in a typical laboratory setting). Contrast **“hot” cognition**.

**Corpus callosum:** A wide, flat bundle of nerve fibers separating the two hemispheres of the brain. Latin for “tough body.”

**Corpus striatum:** See **striatum**.

**Cortex:** The outer layer of the cerebrum (the cerebral cortex) consisting of gray matter; has an important role in consciousness.

**Corticotropin-releasing hormone (CRH):** A peptide hormone and neurotransmitter secreted by the hypothalamus in response to stress.

**Cortisol:** A steroid hormone produced by the adrenal glands in response to stress.

**Dendrites:** The branched filaments of neurons that receive signals from other neurons via synapses.

**Dopamine:** A neurotransmitter that plays a key role in motor control and reward-motivated behavior.

**Dorsolateral prefrontal cortex:** An area in the prefrontal cortex involved with working memory, cognitive flexibility, planning, inhibition, abstract reasoning, and self-consciousness.

**Endocrine system:** The collection of glands that secrete hormones into the blood regulating metabolism, sexual function, sleep, mood, and growth and development. Includes the pineal gland, pituitary gland, pancreas, ovaries/testes, thyroid gland, parathyroid gland, hypothalamus, gastrointestinal tract, and adrenal glands.

**Estrogen:** The primary female sex hormone (also found in men) responsible for regulation of the female reproductive system and secondary sex characteristics, and for many other functions; fluctuations in this hormone are associated with lower mood.

**Executive functions:** The collection of processes that enable a person to plan, focus attention, remember instructions, juggle multiple tasks, reason, and solve problems, among other functions; primarily associated with the prefrontal cortex of the brain.

**Functional magnetic resonance imaging (fMRI):** A form of neuroimaging that takes place while a subject is involved in an activity (e.g., solving a problem, playing a computer game, looking at photos). Contrast **structural magnetic resonance imaging (sMRI)**. See also **magnetic resonance imaging**.

**Glia:** Nonneuronal cells that provide support and protection for neurons; they make the myelin that sheathes axons in the brain. Greek for “glue.” Also called *neuroglia*.

**Glutamate:** A neurotransmitter involved in the excitatory activity of nerve cells; generally considered the most important neurotransmitter for normal brain functioning.

**Gray matter:** A major component of the tissue of the brain, consisting of neurons and their dendrites, axons, and synapses, neuroglia, and capillaries. Contrast **white matter**.

**Hippocampus:** A structure in each of the two hemispheres of the brain that is part of the limbic system and plays an important role in translating short-term memory into long-term memory and aids in spatial navigation. Greek for “seahorse,” since it has that shape.

**“Hot” cognition:** Reasoning that takes place in the midst of an emotionally charged or socially influenced setting. Contrast **“cold” cognition**.

**Hypothalamic-pituitary-adrenal axis (HPA axis):** A complex series of hormonal influences and feedback loops that control reactions to stress and help regulate mood and emotion, sexuality, digestion, and other key bodily processes.

**Hypothalamus:** A part of the limbic system just above the brain stem that links nervous system activity to the endocrine system via the pituitary gland; helps regulate hunger, thirst, fatigue, sleep, and other aspects of the autonomic nervous system.

**Limbic system:** A complex set of brain structures under the cerebrum that help regulate emotion, behavior, motivation, memory, and olfaction; structures include the *hippocampus*, *amygdala*, *cingulate gyrus*, and *olfactory bulbs*. Also called the *paleomammalian brain* or the *emotional brain*.

**Magnetic resonance imaging (MRI):** A medical imaging technique used in radiology to investigate the anatomy and physiology of the body. Increasingly used in neuroscience research to map out the structures and functions of the brain, it works by using magnetic fields to identify

electromagnetic regions emitted by hydrogen atoms in the body, as well as by identifying radio waves in the oxygenated areas of the brain associated with blood flow. See also **functional magnetic resonance imaging (fMRI)** and **structural magnetic resonance imaging (sMRI)**.

**Myelin:** The fatty white substance surrounding the axon of a brain cell (neuron) that insulates it (as the myelin sheath) and facilitates the passing of electricity across its surface.

**Myelination:** The process of insulating brain connections to allow greater speed and efficiency in passing information throughout the brain; a process that begins in utero and extends into adolescence, young adulthood, and, to a lesser extent, mature adulthood.

**Neocortex:** The newest part of the cerebral cortex to evolve; represents about 90 percent of the cerebral cortex and consists largely of gray matter involved in higher functions such as sensory perception, motor control, executive processes, spatial reasoning, consciousness, and language. Latin for “new bark.”

**Neurogenesis:** The process by which neurons are created from neural stem cells and progenitor cells; most active during prenatal development, it also occurs in adolescence and, to a certain extent, throughout life.

**Neuroplasticity:** The ability of the brain to reorganize itself in response to environmental events, physical injury, behavior, neural processes, and other influences.

**Neurotransmitters:** Brain chemicals that transmit signals from one neuron to another target cell, such as a neuron, muscle cell, or gland cell. Examples include *dopamine*, *serotonin*, and *norepinephrine*.

**Nucleus accumbens:** An aggregation of neurons that forms part of the striatum and is strongly associated with reward and reinforcing stimuli; regarded as a primary locus for the etiology of addictive behaviors.

**Oligodendrocytes:** Glial cells (support cells for neurons) involved in the production of myelin, the insulation that sheathes axons and allows electrical impulses to travel more quickly and efficiently throughout the brain.

**Oxytocin:** A chemical produced in the hypothalamus and stored in the pituitary gland that acts as both a hormone and a neurotransmitter; involved in birth and breastfeeding and in generating feelings of sociability and intimacy throughout life.

**Pituitary gland:** A pea-sized gland situated behind the bridge of the nose and below the base of the brain that controls several other glands, including the thyroid gland and the adrenal glands; involved in puberty, physical growth, the stress response, sleep, and several other functions.

**Prefrontal cortex:** The gray matter that covers the front part of the frontal lobes (behind the forehead); plays an important role in the regulation of complex cognitive, emotional, social, and behavioral processes.

**Pruning:** See **synaptic pruning**.

**Putamen:** A round paired structure that is part of the basal ganglia and, along with the caudate nucleus, nucleus accumbens, and olfactory tubercle, makes up the corpus striatum; associated with motor control, emotions, cognition, and learning.

**Receptor:** A protein molecule in a cell that receives chemical signals from outside the cell.

**Serotonin:** A neurotransmitter primarily located in the gastrointestinal tract, where it regulates digestion, but also found in the brain, where it helps in the modulation of mood, appetite, and sleep; optimally associated with well-being, suboptimally associated with depression.

**Striatum:** Part of the basal ganglia; consists of a group of subcortical structures, including the caudate, putamen, and nucleus accumbens; an

important component of the human reward system (*ventral striatum*); also involved in motor control, executive functioning, and learning (*dorsal striatum*).

**Structural magnetic resonance imaging (sMRI):** A form of neuro-imaging technology that conducts a static scan of specific areas of the brain. Contrast **functional magnetic resonance imaging (fMRI).**

**Subcortical:** Pertaining to the regions of the brain below the cerebral cortex.

**Synapse:** A set of structures that allow a neuron to pass an electrical or chemical signal to another neuron; consists of a presynaptic ending (in one neuron) containing neurotransmitters, a postsynaptic ending (in another neuron) containing receptor sites for neurotransmitters, and a synaptic cleft, or tiny space between the pre- and postsynaptic regions across which the neurotransmitters travel.

**Synaptic pruning:** A process involving the elimination of synapses in the brain that are weaker and less functional and the preservation of synapses that are stronger and more frequently used; begins near the time of birth and extends throughout childhood and adolescence to early adulthood.

**Testosterone:** A steroid hormone secreted by the testicles of the male and, to a lesser extent, by the ovaries of the female (and also a small amount by the adrenal glands); involved in the development of secondary sex characteristics (e.g., voice change, pubic hair), sex drive, the growth of muscle mass, and dominance behavior (e.g., social status, aggression).

**Thalamus:** An important structure in the center of the brain that projects nerve fibers out into the cerebral cortex in all directions; serves as a hub or relay station between subcortical structures and the cerebral cortex; involved in processing sensory information, sleep and wake cycles, motor control, and memory.



**Transporter:** A protein whose function is to carry neurotransmitters into the synaptic cleft and then to remove neurotransmitters from the synaptic cleft, where they are reabsorbed by the presynaptic neuron, a process called *reuptake*.

**Ventral striatum:** The part of the striatum consisting of the nucleus accumbens and olfactory tubercle that functions as a dopamine-rich reward system in the brain.

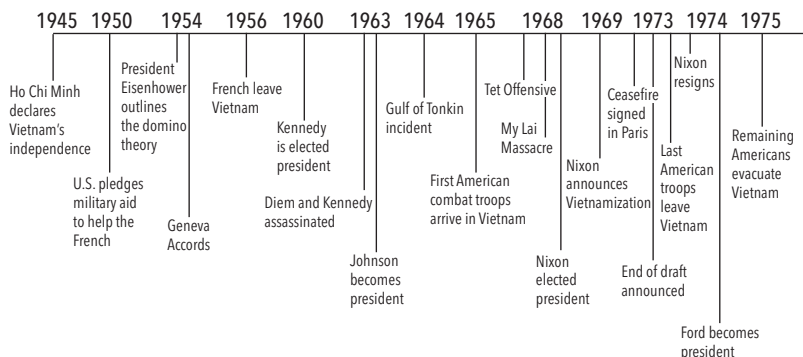
**White matter:** Brain tissue consisting mostly of glial cells and myelinated axons. Contrast **gray matter**.

# Appendix B: Adolescent Brain-Friendly Learning Experiences Across the Content Areas

This section provides ideas for learning experiences in the major content areas for each of the eight elements that are essential to optimizing adolescents' learning: opportunities to choose, self-awareness activities, peer learning connections, affective learning, learning through the body, meta-cognitive strategies, expressive arts activities, and real-world experiences.

## U.S. History: The Vietnam War

**1. Opportunities to choose: Become an expert.** Choose the period of the Vietnam War from the time line below that you would like to study in depth during the course of the semester. Be prepared to give an oral and visual presentation of your expertise at a “Gathering of the Experts” at the end of the semester.



**2. Self-awareness activities: “What would I have done?”** During the Vietnam War, there was a lottery to determine who would get drafted into the armed forces. Some young people went to Canada to avoid the draft, while others went to jail rather than be inducted into the army. Still others attempted to receive draft deferments by enrolling in college. And, of course, many went to Vietnam. If you had received a low lottery number and been drafted, what would you have done? Write out your response in detail.

**3. Peer learning connections: A day in the life of a squad.** During the Vietnam War, soldiers were divided into different military units, one of the smallest of which was the squad, containing fewer than 10 soldiers. The soldiers in a squad often became very close, largely because they depended on one another to survive: one inattentive or sloppy soldier could cost all the squad members their lives. Your job (with a group of your peers) is to re-create a day in the life of a squad. Determine your mission or task for the day and construct a scenario, creating a map and listing potential obstacles or dangers, the gear and weapons you are carrying, and any other factors affecting your ability to reach your objective. For the final product, your group should engage in one or more of the following activities:

- Enact a role-play of your day in the field before the class and
- Submit a written report that sums up the success or failure of your mission.

**4. Affective learning: Humor in war.** Every war yields its own unique forms of humor that provide release and relief from the relentless pain, suffering, drudgery, and boredom of war. Your assignment is to collect and study samples of humor from the time of the Vietnam conflict, including cartoons, jokes, stand-up comedy, and film comedies. Determine whether each sample of humor is funny to you and why or why not, and then show it to someone who was involved in the Vietnam War and determine how his or her response is similar to or different from your own. Create a collage, a written report, or an oral presentation that summarizes your reactions and those of the veteran you interviewed.

**5. Learning through the body: Diorama.** Build a diorama that depicts a specific episode or setting from the Vietnam War, using foliage, buildings, vehicles, soldiers, peasants, or any other miniature figures that communicate a vivid sense of the scene. Present your diorama to the class and give an oral commentary on how it expresses something significant about the events of the Vietnam War.

**6. Metacognitive strategies: Alternative histories.** What if the war in Vietnam had happened at another time or in another place? For this project, you must change one or more attributes of the Vietnam War to create an alternative history. Pick at least one of the following factors, and write a narrative incorporating your changed historical perspective:

- Time frame (other than 1954–1975).
- Geographic location (other than Southeast Asia).
- Length of conflict (longer or shorter than its actual 21-year duration).
- Key aggressors (other than the countries actually involved).

**7. Expressive arts activities: Collage.** Create a collage that expresses your feelings about the Vietnam War, addressing at least one of the following elements: the reasons for the war being fought; the experiences of individual lives involved in the war; attempts by different nations to negotiate the peace; the aftermath of the war; the ultimate toll on human lives, economies, and national destinies.

**8. Real-world experiences: Service learning.** Identify a local chapter of Vietnam Veterans of America and, with permission from the chapter, interview at least one member about veteran-related issues, such as the need for medical, financial, or psychological assistance. Then, with permission, help veterans get the services they are legally entitled to through such efforts as writing letters, making phone calls, raising public awareness, fund-raising, or other assistance that the organization would benefit from and specifically requests.

## English: *Romeo and Juliet*

**1. Opportunities to choose: Electronic polling.** Using a student response system (e.g., Poll Everywhere), respond to the following 10 questions.

1. Would you rather be part of the Montague or the Capulet family?
2. Do you believe that Prince Escalus's decree of death to any feuding member of either family was a just judgment?
3. Was Romeo wise to attend a banquet of a rival family, even in disguise?
4. Once they realized that they belonged to rival families, should Romeo and Juliet have decided to suppress their feelings and go their separate ways?
5. Was Friar Laurence wise to marry kids of feuding families?
6. Who had more justification to fight during their duel: Mercutio or Tybalt?
7. Should Juliet have gone ahead and married Tybalt for the sake of her family?
8. Do you think Friar Laurence's plan to help Romeo and Juliet had any chance of succeeding?
9. Do you think Friar Laurence should have forced Juliet to leave Romeo at the grave and to come with him after he hears the coming of the watch?
10. At the play's end, the two families pledge to end their feud. Do you think that this is really going to happen?

At the conclusion of the series of questions, participate in a whole-group discussion and give reasons for your responses.

**2. Self-awareness activities: Journaling.** As you read the play, keep a daily journal in which you record your thoughts and feelings, taking the role of either Romeo or Juliet. Journal entries could include personal reactions to events as they occur, responses to the actions of authorities (e.g., the prince's decree banning duels), poetry written to the

beloved (Romeo or Juliet), dreams the couple has for the future, and so on. You have the option of sharing your entries with the rest of the class.

**3. Peer learning connections: Mock student court.** Convene a simulated court of law wherein one or more of the characters of the play who have violated a Veronese law are charged with a crime and brought to justice (e.g., Romeo, Tybalt, Mercutio, Juliet, the apothecary). Students will take the roles of judge, bailiff, witnesses, attorneys, jurors, and any other parts deemed important to the case. A guide to preparing for a mock trial can be found at <http://graphics8.nytimes.com/images/blogs/learning/pdf/2010/20101004mocktrial.pdf>.

**4. Affective learning: Insult-a-Thon.** While reading the play, identify and write down any insults that occur in each scene (e.g., Act 2, Scene 4—Nurse: “My fan, Peter.”/Mercutio: “Good Peter, to hide her face; for her fan’s the fairer face.”). Then use the insults you have recorded as inspiration to create your own Shakespearean-style insults. When everyone has finished reading the play, share your work in a class “Insult-a-Thon.” Note that you are not to direct insults toward anyone in the class or the school unless given express permission to do so by the person involved. For further reference, see *Shakespeare’s Insults: Educating Your Wit* (Hill & Ottchen, 1995).

**5. Learning through the body: Dramatic role-play.** Working in a small group, choose a scene from the play to role-play in a space where you have room to move. When the narrative requires a gesture or a movement, dramatize that action, either alone or with one or more characters in the scene (depending on the context). For example, in Act 3, Scene 1, the students portraying Tybalt, Mercutio, and Romeo might engage in a mime of fighting. Use of props is optional.

**6. Metacognitive strategies: Meta-comment chart.** Provide students with a copy of the play or any single part of it contained within the left-hand column of a two-column chart. (This can be done on the computer as a paperless activity by creating a chart in Microsoft Word and then pasting the play or selections from it in the left-hand column.) The right-hand column is initially left blank. Now imagine that you are a time traveler who has been transported to 14th century Verona, Italy,

and are able to witness the action of the play as it unfolds. As you read through the play, make periodic comments in the right-hand column that represent how a person from the 21st century might regard or evaluate the ongoing action. For example, when Prince Escalus makes his decree to ban fighting in Act 1, Scene 1, describe how such a fight might be handled if it took place in your present-day community.

**7. Expressive arts activities: Touching the art of the matter.**

Working individually or in a group, express a key idea, theme, or question from the play through a dance, a poem, a musical composition, a video, a collage, a photo-essay, a painting, or a three-dimensional work of art. For example, you could express the conflict between the Montagues and the Capulets by composing a musical piece in which different rhythmic patterns or sounds represent each family and that overall portrays the narrative development of the families' conflict and its (apparent) resolution.

**8. Real-world experiences: Community service.** *Romeo and Juliet* contains themes that still represent big problems in 21st century society, including prejudice, gang violence, suicide, and drug abuse. Choose a contemporary social issue that you would like to help alleviate through some kind of community involvement outside school. Examples include volunteering at a suicide hotline, speaking about the dangers of drug abuse to 5th and 6th graders, developing an after-school program intended to serve as an alternative to gang membership, or attending a demonstration on racial, gender, or sexual orientation equality. Report back to the class on your experience.

## Science: Human Genetic Variation

**1. Opportunities to choose: Personal choice essay.** Read the *New York Times* article “Facing Life with a Lethal Gene” (Harmon, 2007) about an asymptomatic young woman with a family history of Huntington’s disease (an inevitably terminal progressive brain disorder that doesn’t produce symptoms until middle age) and her decision to be tested to see if she carries the gene. Imagine that you are in a similar situation, either with the Huntington’s gene or with another genetic

disease of your choice. Decide whether you, as a young person, would want to know the results of genetic testing, and write an essay in which you describe your thinking process behind this important choice.

**2. Self-awareness activities: Positive genetic trait project.**

Think about a specific trait that you wish you had: dimples, better reading ability, a happier disposition, greater sociability, or some other trait. Investigate the potential genetic basis of this trait: is it purely genetic, a combination of genetics and environment, or purely environmental? Imagine that there is a gene therapy program available that would make this change happen in your life. Decide whether you would pursue the gene therapy, and describe what you believe would be this therapy's impact on your life. Discuss both positive and potentially negative consequences of your decision, and back up your thinking with hard genetic facts. Your final product could be in the form of an essay, a short story, a news article, an oral report, or a multimedia project.

**3. Peer learning connections: Hereditary trait survey.**

There are a number of simple physical traits with a genetic basis, including tongue rolling, earlobe attachment, hitchhiker's thumb, dimples, nostril flaring, and the ability to taste the chemical phenylthiocarbamide. Working in a small group, choose one of these traits to investigate on the Internet. Then survey classmates and other students throughout the school to determine the frequency of that trait in the student population. Finally, bring your findings back to the classroom and discuss the results using a graph or some other graphic organizer as a visual aid.

**4. Affective learning: Genetics in fiction.**

Engage with a fictional media product (e.g., watch a film, play a video game, or read a graphic novel, literary novel, or short story) that involves a genetic scenario (e.g., a genetic experiment gone awry, or gene therapy used to create superhumans). Then investigate the extent to which the story was based in scientific fact. Share your findings in an oral presentation that incorporates excerpts from the work you've chosen and actual genetic research that either supports or contradicts various elements of the plot.

**5. Learning through the body: Genetic company role-play.**

Working in a cooperative learning group, write and act out a short play



based on the following scenario: you and your peers are key figures (businesspeople, marketers, and scientists) in a vector supply company that makes and sells genetic vectors for gene therapy. In the scene, you and your associates are discussing the pros and cons of producing and selling a particular vector to a controversial buyer. Prepare and perform a 10- to 15-minute mini-drama using diagrams, graphs, charts, and other visual aids to illustrate the vector's construction, process of insertion, and eventual packaging and distribution.

**6. Metacognitive strategies: Genetic controversy debate.** Pair up with a classmate and take opposite sides of a controversial issue in genetics that the class is discussing—for example, Should germline therapy be legal? Should human cloning ever be allowed? Is there any justification for eugenics to be brought back into practice? Debate the question with your partner for 15 minutes, and then switch sides and continue the debate. Finally, discuss with the whole class what it was like to argue for both sides of the issue. Did emotion carry you away? Did you bolster your arguments with genetic facts learned in this class? Did your original opinion on the issue change at all?

**7. Expressive arts activities: Genetic art project.** Pick a specific genetic process that the class has been studying, such as polymerase chain reactions, fluorescence in gene therapy, the etiology of genetic mutations, or dominant and recessive genes in family lines. Working individually or in a small group, illustrate the process through one of the expressive arts. Possibilities include choreographing a dance, painting a picture, assembling a collage, creating a multimedia project, putting on a play, composing a piece of music, or building a three-dimensional construction. Present your piece in a gallery show of *Genetic Art* along with those of your classmates (students may do individual projects or work together in teams).

**8. Real-world experiences: Work as a volunteer for a genetic disorder advocacy group.** Identify a group that advocates for people with a specific genetically based disorder, such as cystic fibrosis, Down syndrome, sickle cell anemia, or hemophilia. Research the background and genetic basis of this disorder, and then contact the group and

volunteer to help with advocacy work or to provide assistance to one or more individuals with the disorder. Keep an ongoing journal of your volunteer work.

## Mathematics: Interpreting Statistics

**1. Opportunities to choose: Pick-a-data-set oral report.** Choose one data set from a selection of possibilities (e.g., Iris flower data set, time series, extreme values, categorical data analysis), and apply it to a given sample of a population of your choice (generated from an Internet search or your own investigation). Present the data with an appropriate chart or graph, and then give an oral report to the class in which you interpret the data using easy-to-understand terminology.

**2. Self-awareness activities: Statistical autobiography.** Write the story of your life through statistics. The majority of the autobiography should consist of charts and graphs detailing 10–15 parameters of your life’s past, present, and future. For example, the data could include the number of seconds you’ve been alive compared with your family members (past); the estimated number of steps you take daily compared with the number recommended for good health (present); and your projected annual income at age 40 compared with the national average (future).

**3. Peer learning connections: Where in the world do these statistics come from?** Working in a group of four to six, you’re given a data set expressed in a graph, chart, or other visual format. The data set represents a significant event, experiment, study, survey, or census that actually took place somewhere in the world at an unspecified time, but you have no other information or context to work with initially. With your fellow group members, conduct research on the Internet to discover the story behind the graph, the social factors that gave rise to the graph, how the information was collected, potential problems with the data set (e.g., sampling errors), and the use to which the graph was put (and its ultimate impact). Each group then presents its findings to the whole class.

**4. Affective learning: What's my statistical lie?** Read excerpts from *How to Lie with Statistics* (Huff, 1993), and then draw a slip of paper from a bag provided by your teacher. Your slip will read either “truth” or “lie.” Your task is to create a set of statistics (with accompanying graphs and charts as needed) along with a story that supports the circumstances under which the data was collected, interpreted, and utilized. If you pick a “truth” slip, you will draw the data from real-life situations as researched on the Internet. If you pick a “lie” slip, you will make up your own data and the surrounding circumstances, using the Internet to help you construct the falsehood. Finally, you will present your project to the rest of the class, and classmates will vote on whether the data is real or fake.

**5. Learning through the body: Body stats.** Choose a specific parameter related to the physical body to investigate, such as weight, cholesterol, lung function, hemoglobin, blood sugar, or eye acuity. If possible, each student should investigate a different parameter. Then research the statistics and statistical methods pertaining to that particular parameter and how it relates to sample populations, health outcomes, or other variables of your choice. Finally, present your findings to the class, including your assessment of the reliability and validity of the data.

**6. Metacognitive strategies: Hidden statistical agendas.** Read excerpts from *A Mathematician Reads the Newspaper* (Paulos, 1997). Then pick a news item from a past or current newspaper that you believe makes use of statistics in the service of a hidden agenda. Finally, prepare a poster board presentation to the class that lays out your reasons for believing that underlying interests affected how the news story interpreted the statistics.

**7. Expressive arts activities: Stats art project.** Statistics and their interpretation are usually presented numerically to appeal to the logical-mathematical dimension of the human mind. For this activity, you will choose a statistical display (e.g., a histogram, a pie chart, a dot plot) and express the information *artistically*. Your product may be in any art form you like: a painting, a cartoon strip, a dance, a 3-D object, a collage, or a dramatic play, for example.

**8. Real-world experiences: Job shadowing.** With assistance from your teacher and school, you will identify individuals working in the community who use and interpret statistics as part of their work and arrange to spend all or part of a day visiting one of these individuals in his or her place of work and observing how his or her use of statistics dovetails with the demands of his or her specific occupation. Then, you will write up an account of your visit, describing how the experience has affected your attitude toward statistics in general and your feelings about the value of using statistics to effect change in the world.

## Health and Wellness: Tobacco Use Prevention

**1. Opportunities to choose: Prevention project.** Pick a topic that relates to tobacco use prevention, such as the effects of secondhand smoke, e-cigarette laws, suits against the tobacco industry, or nicotine replacement, and conduct research on it. Then present your findings to the rest of the class, using a format of your choice (e.g., a written report, poster board presentation, or multimedia report).

**2. Self-awareness activities: Personal tobacco associations mind map.** Use mind-mapping software or a pencil and paper to create a mind map, placing “tobacco associations” in the center and writing around the periphery as many examples as you can of how your life has been affected by tobacco use. These personal associations could include your experience of secondhand smoke, your own history of tobacco use (if relevant), your earliest memory of being offered a cigarette, and/or recollections of family or friends who are smokers, have tobacco-related diseases, or have quit or tried to quit smoking. Once you have finished the mind map, share your associations with a small group of classmates, and listen to them share their own connections.

**3. Peer learning connections: Peer pressure role-play.** Working in a small group, prepare a role-play scenario in which one member of the group offers a cigarette to another member, while others in the group attempt to persuade the person to take it. Act out several versions of the role-play that portray different forms of peer pressure and different

outcomes (e.g., the person being offered the cigarette takes it, refuses it, or thinks it over). Make sure that students understand that the role-play is occurring under conditions of “cold” cognition and that making good choices in real life (under “hot” cognition conditions) is likely to be much more challenging. Discuss with the class what those challenges may be.

**4. Affective learning: Anti-smoking “scare” commercial logs.**

Watch several “scare” commercials designed to discourage cigarette smoking in young people on YouTube. Keep a log in which you record your emotional reactions to each commercial (positive, negative, mixed, or neutral), noting the extent to which each commercial might affect your own attitude toward tobacco use. Then bring your log to the classroom to share with other students who have completed the same exercise. Show the YouTube ad before presenting your reactions to it.

**5. Learning through the body: Kinesthetic imagery simulation of COPD.** While sitting at your desk, kinesthetically “experience” yourself running, jumping, doing a somersault, or balancing on one foot. Now imagine that you’re a longtime smoker with COPD (chronic obstructive pulmonary disease), and kinesthetically imagine the following scenarios:

- You’re breathing but not able to get the air all the way down into your lungs.
- You’re walking down the street and gasping for breath.
- You’re experiencing dizziness and fatigue caused by not getting enough air in your lungs.
- You’re coughing and not able to stop.

After this guided imagery, write down your experiences and share them with the rest of the class.

**6. Metacognitive strategies: Anti-smoking positive self-talk scripts.** Positive self-talk has been shown to have a significant positive effect on behavior changes such as quitting smoking. For this activity, you will write “self-talk scripts” that can be memorized and used whenever a person feels tempted to smoke a cigarette. The intention of such scripts is to replace negative self-talk that perpetuates the vicious cycle

of addiction (e.g., “I’ll never be able to quit smoking” or “I’m a loser. I’ll feel better if I smoke a cigarette”). Once you have composed your script, pair up with a classmate. Person A will engage in the type of negative self-talk that might precede smoking a cigarette, and person B will reply with his or her positive self-talk script. Then switch roles. After practicing and discussing your scripts, you may want to edit them or create new self-talk scripts.

**7. Expressive arts activities: Anti-smoking “scare” art.** Create a piece of art that, when viewed, will *scare* smokers into quitting and keep nonsmokers from taking up the habit. The art can take any of a variety of forms: photo-essay, multimedia project, video, short story, painting, graphic novel, letter to the editor, dramatic performance, dance performance, musical composition, or a combination of these media. You may work individually or in a group. After completion of the projects, a student assembly will be held (a “Scare Art Share”), and you will be given an opportunity to share your artwork with the entire school.

**8. Real-world experiences: Expeditionary learning trip to a doctor’s office.** With the assistance of school administration, a visit will be arranged to the office of a doctor who treats patients with smoking-related ailments. Although patient confidentiality will prevent the doctor from talking about specific individuals, you are encouraged to ask him or her questions about the types of cases he or she treats, the severity of the symptoms, the extent to which smoking contributed to these symptoms, whether patients continue to smoke or quit after their diagnosis, the patients’ quality of life, and other related factors. Be sure to take notes and write down your reactions or further questions as the doctor speaks. Then, back in the classroom, take part in a whole-group discussion about the trip, the doctor’s comments, and the medical consequences of smoking.

# Appendix C: Resources

## The Adolescent Brain

- *Age of Opportunity: Lessons from the New Science of Adolescence* by Laurence Steinberg (2014). New York: Houghton Mifflin Harcourt.
- *Brainstorm: The Power and Purpose of the Adolescent Brain* by Daniel J. Siegel (2015). New York: Tarcher.
- *The Owner's Manual for Driving Your Adolescent Brain* by JoAnn Deak and Terrence Deak (2013). San Francisco: Little Pickle Press.
- *The Teenage Brain: A Neuroscientist's Survival Guide to Raising Adolescents and Young Adults* by Francis E. Jensen and Amy Ellis Nutt (2015). New York: Harper.

## Opportunities to Choose

- *The Personalized High School: Making Learning Count for Adolescents* by Joseph DiMartino and Denise L. Wolk (2010). San Francisco: Jossey-Bass.
- *Personalized Learning: Student-Designed Pathways to High School Graduation* by John H. Clarke (2013). Thousand Oaks, CA: Corwin.
- *Student Voice: Turn Up the Volume 6–12 Activity Book* by Joseph Quaglia, Michael J. Corso, and Julie A. Hellerstein (2015). Thousand Oaks, CA: Corwin.
- Student Voice (<http://www.stuvoice.org>): A for-students-by-students organization aimed at integrating student voices into the global conversation about education.

## Self-Awareness Activities

- *Being Me: A Kid's Guide to Boosting Confidence and Self-Esteem* by Wendy Moss (2010). Washington, DC: Magination Press.
- *The Mindful Teen: Powerful Skills to Help You Handle Stress One Moment at a Time* by Dzung Vo (2015). New York: New Harbinger.
- *Psychology for Kids: 40 Fun Tests That Help You Learn About Yourself* by Jonni Kincher (1995). Minneapolis, MN: Free Spirit Publishing.
- *Understanding Myself: A Kid's Guide to Intense Emotions and Strong Feelings* by Mary C. Lamia (2010). Washington, DC: Magination Press.
- *You're Smarter Than You Think: A Kid's Guide to Multiple Intelligences* (2nd ed.) by Thomas Armstrong (2014). Minneapolis, MN: Free Spirit Publishing.

## Peer Learning Connections

- *Joyful Learning: Active and Collaborative Learning in Inclusive Classrooms* by Alice Udvari-Solner and Paula M. Kluth (2008). Thousand Oaks, CA: Corwin.
- *Kagan Cooperative Learning* by Spencer Kagan (1994). San Clemente, CA: Kagan Cooperative Learning.
- *Psychology for Kids Vol. 2: 40 Fun Experiments That Help You Learn About Others* by Jonni Kincher (2008). Minneapolis, MN: Free Spirit Publishing.
- Voices of Youth (<http://www.voicesofyouth.org>): An organization founded by UNICEF to help children and adolescents around the world communicate with one another about a variety of important issues and topics.

## Affective Learning

- *Emotions, Learning, and the Brain: Exploring the Educational Implications of Affective Neuroscience* by Mary Helen Immordino-Yang (2015). New York: W. W. Norton & Company.



- *The Laughing Classroom: Everyone's Guide to Teaching with Humor and Play* (2nd ed.) by Diane Loomans and Karen Kolberg (2002). Novato, CA: HJ Kramer/New World Library.
- *Passion-Driven Classroom: A Framework for Teaching and Learning* by Angela Maiers and Amy Sandvold (2010). London: Routledge.
- *Teach Like a Pirate: Increase Student Engagement, Boost Your Creativity, and Transform Your Life as an Educator* by Dave Burgess (2012). San Diego, CA: Dave Burgess Consulting Inc.
- Institute of Play (<http://www.instituteofplay.org>): Creates authentic, engaging learning experiences rooted in the principles of game design and promotes gaming as a model tool to enhance student learning and personal and social development.

## Learning Through the Body

- *The Kinesthetic Classroom: Teaching and Learning Through Movement* by Traci L. Lengel and Michael Kuczala (2010). Thousand Oaks, CA: Corwin.
- *Smart Moves: Why Learning Is Not All in Your Head* (2nd ed.) by Carla Hannaford (2007). Salt Lake City, UT: Great River Books.
- *Spark: The Revolutionary New Science of Exercise and the Brain* by John Ratey (2013). New York: Little, Brown.
- SHAPE America—Society of Health and Physical Educators (<http://www.shapeamerica.org>): Committed to empowering all children to lead healthy and active lives through effective health and physical education programs.

## Metacognitive Strategies

- *Mindsets in the Classroom: Building a Culture of Success and Student Achievement in Schools* by Mary Cay Ricci (2013). Waco, TX: Prufrock Press.
- *Socratic Circles: Fostering Critical and Creative Thinking in Middle and High School* by Matt Copeland (2005). Portland, ME: Stenhouse Publishers.

- Collaborative for Academic, Social, and Emotional Learning (<http://www.casel.org>): Advances the development of academic, social, and emotional competence for all students.
- The Critical Thinking Community (<http://www.criticalthinking.org>): Promotes essential change in education and society through the cultivation of fair-minded critical thinking.

## **Expressive Arts Activities**

- *Creative Expression Activities for Teens: Exploring Identity Through Art, Craft and Journaling* by Bonnie Thomas (2011). London: Jessica Kingsley.
- *The Creative Journal for Teens: Making Friends with Yourself* by Lucia Capacchione (2008). Wayne, NJ: Career Press.
- International Expressive Arts Therapy Association (<http://www.ieata.org>): Supports expressive arts therapists, artists, educators, consultants, and others using integrative, multimodal arts processes for personal and community growth and transformation.
- National Novel Writing Month (<http://www.nanowrimo.org>): Supports individuals and groups in writing novels of up to 50,000 words during the month of November.
- Poetry Slam Inc. (<http://www.poetryslam.com>): Promotes the performance and creation of poetry while cultivating literary activities and spoken word events around the United States.

## **Real-World Experiences**

- *Leaving to Learn: How Out-of-School Learning Increases Student Engagement and Reduces Dropout Rates* by Elliot Washor and Charles Mojokowski (2013). Portsmouth, NH: Heinemann.
- Association for Career and Technical Education (<http://www.acteonline.org>): Advances education that prepares youth and adults for careers and provides educational leadership in developing a competitive workforce.
- Cooperative Education and Internship Association (<http://www.ceiainc.org>): Promotes work-integrated learning by providing

a member-driven learning community for participating programs, students, educators, and employers and by influencing policymakers and thought leaders.

- EL Education (<http://www.eleducation.org>): Comprehensive school reform model focusing on student excellence in three core areas: mastery of knowledge and skills, character, and high-quality student work.
- Junior Achievement USA (<http://www.juniorachievement.org>): Supports entrepreneurial activities in the schools.
- National Career Academy Coalition (<http://www.ncacinc.com>): Promotes implementation and support of career academies.
- National Service-Learning Clearinghouse (<https://gsn.nylc.org/clearinghouse>): Comprehensive library of free online service learning resources.
- National Society for Experiential Education (<http://www.nsee.org>): Supports educational practices based on practical experiences and active learning.
- Roadtrip Nation (<http://www.roadtripnation.com>): Assists students in finding out what they love, contacting people that inspire them, interviewing those people to learn from their stories, and then sharing those experiences with others.

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## About the Author



Thomas Armstrong, PhD, is an educator, a psychologist, and a writer who has worked in the education field for more than 40 years. He is the author of 16 books, including 7 for ASCD (*Multiple Intelligences in the Classroom*, *The Best Schools*, *Awakening Genius in the Classroom*, *ADD/ADHD Alternatives in the Classroom*, *The Multiple Intelligences and Reading and Writing*, *Neurodiversity in the Classroom*,

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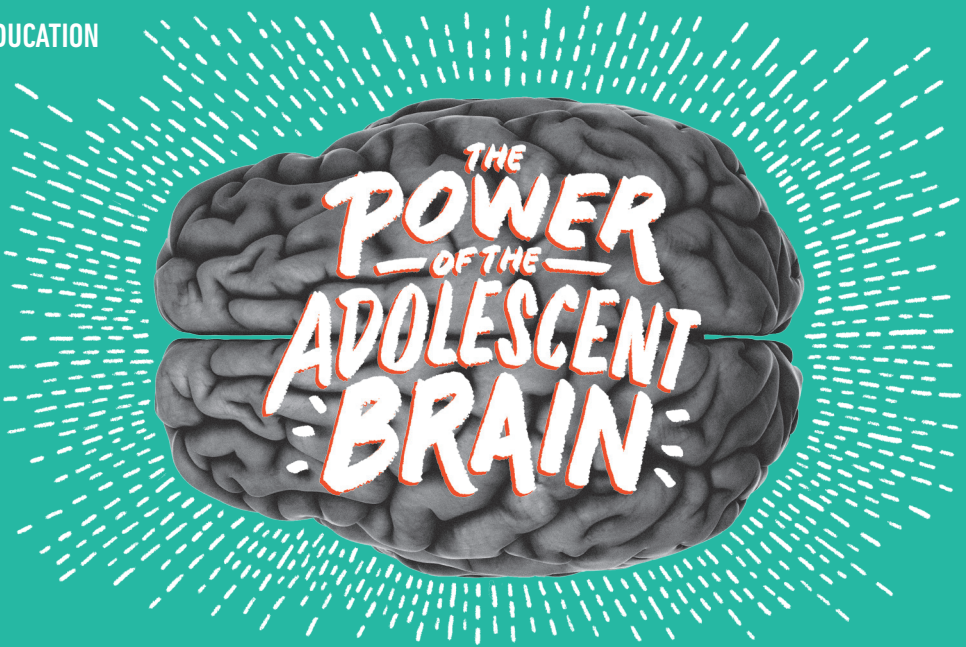
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