When American classrooms were designed over a hundred years ago, we knew little about how our brains work or the optimal conditions for our brains to learn. The goal then was efficiency: straight rows with the teacher at the front seemed the best manner to deliver information. Today, however, experimental psychologists, cognitive neuroscientists, and evolutionary biologists can teach us quite a bit more about how brain science affects student achievement and improves learning. What we now know is that the human brain was designed to solve problems related to survival in outdoor settings in unstable meteorological conditions under constant motion. In short, our brains have been evolutionarily adapted to learn in a setting antithetical to the traditional American classroom. So what should we do with this new knowledge? How should we modify the schoolhouse or our behavior as educators to maximize student learning now that we understand how students’ brains operate?

As anyone who has worked in a school knows, the institution is notoriously unwieldy. As the saying goes, “It’s easier to change history than it is to change a history class.” But since student learning is every school’s raison d’être, appreciation for what brain scientists can teach us about how students learn seems invaluable.

Allen Broyles, Assistant Head at The Howard School (GA), agrees that the sit-and-get model of traditional school works against the evolutionary structure of our brains. However, he argues that while some students can still succeed in those less than ideal conditions, the needs of the students at his school, which provides an educational program for students with learning differences and disabilities, have forced the school’s teachers to be more attentive to brain research to offer the most optimal conditions for students to learn. On Friday, January 25, Allen will present a two hour Lunch and Learn at our headquarters in Atlanta titled “Neuroscience, Learning Differences, and the Students You Might Be Missing Out On.”

Yet, as Allen underscores, the pedagogy employed at Howard is the same research-based pedagogy that should be employed at every school that seeks to maximize learning. Intent on educating the faculty on brain-based research, his school, like many others including The Baylor and Randolph Schools, engaged in a faculty summer read of John Medina’s Brain Rules, a lively, informative, and most importantly applicable book that
outlines “12 Principles for Surviving and Thriving at Work, Home, and School.” Medina is a developmental molecular biologist and the director of the Brain Center for Applied Learning Research at Seattle Pacific University. He is also a professor at the University of Washington School of Medicine. His book devotes a chapter to each of his 12 brain rules, explaining how the brain functions and providing illustrations of the rule in everyday life.

In a community lecture hosted by The Baylor School (TN) January 9th, Medina lamented the divide between scientists and educators, stating, “his colleagues don’t talk to teachers and vice versa.” While he is skeptical of applying neurological science too avidly to education, he advocates a partnership between brain researchers and educators that will provide more opportunities for research to actually see what does work.

For educators, his book is an excellent resource to test his research-based practices. Below is a brief explanation of each brain rule and how the traditional classroom and its precepts might be modified to honor these scientific findings about how students learn.

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**Exercise Rule #1: Exercise boosts brain power.**

Our evolutionary ancestors walked up to 12 miles a day, developing our modern brains through the process of movement. When we exercise, we increase blood volume to our brains, which increases our mental sharpness. Yet, our schools, like our offices, often encourage sedentary behavior, working against our bodies’ natural desire to move. How might we change that? Medina refers to one study in which children jogged for 30 minutes two or three times a week. After 12 weeks, their cognitive performance had improved significantly. When the children reverted back to their previous levels of inactivity, their scores did the same. Medina advocates movement in the classroom and more recess. What if a math teacher were to ask students to ponder a difficult problem, then allow them to take a short five-minute walk? How would the performance of those students compare to those who remain seat-bound?
Survival Rule #2: The human brain evolved, too.

Although humans are not the strongest or biggest animals, we are the smartest. We are able to solve complicated problems, learn from failure, and develop alliances with others. We built these relationships by understanding each other’s desires and motivation. Alone, we might not be able to overcome a saber tooth tiger, but as a group we were very successful hunters. Essentially, we became the most dominant species by learning to interpret each other’s feelings. Extending this understanding to education, Medina explains, “our ability to learn has deep roots in relationships” and “may in part depend on the relationship between student and teacher.” Creating a safe, empathetic environment leads to stronger student achievement. Do your students feel valued and understood? Is it possible for a teacher to truly know thirty students in five classes?

Wiring Rule #3: Every brain is wired differently.

Each brain, just like its owner, is unique. Yet our school system presumes that age should determine readiness, expecting all students within a grade to be prepared to develop certain skills and understand the same concepts. Medina argues that these “lockstep models ... are guaranteed to create a counterproductive mismatch to brain biology.” Instead, Medina suggests that a brain-based classroom should have fewer students to allow for individualized instruction and the pursuit of mastery rather than simply competency.

Attention Rule #4: We don’t pay attention to boring things.

Everyone can agree that better attention leads to increased learning. Unfortunately, the brain, when presented with the delivery of dry information, generally loses interest after ten minutes. Instead, our brains are more apt to focus on events that arouse our emotions. Evolution simply didn’t teach us to concentrate on a lecture for almost an hour. Moreover, our minds attend first and foremost to big ideas, not particulars. Medina offers a solution. Don’t start with details. Rather organize particulars around core, relevant concepts similar to those advocated by McTighe and Wiggin’s backward design model. Place hooks in your lectures – narratives or events rich in emotion - that reengage your audience every ten minutes. Consider experimenting with your students by teaching one chapter in the traditional format and another in ten-minute segments. Test and determine which method provides better results.

Short-term Memory Rule #5: Repeat to remember.

Although there’s certainly room to debate the merits of education’s focus on memorization, a student who possesses a strong memory often finds success in the classroom. For those of us who struggle to remember names, dates, and events easily, understanding how we commit information to memory would be beneficial. Medina emphasizes, “People usually forget 90% of
what they learn in a class within 30 days.” In fact, we forget most of that 90% in the first few hours. So why was that 10% committed to memory? Medina suggests that how a teacher presents an initial concept is critical: “your ability to create a compelling introduction may be the most important single factor in the later success of your mission.” Grab your audience from the outset, and you stand a better chance of their presence at the conclusion. Memory also is strongly aided by replicating the same conditions under which the initial learning took place. In order to boost recall, ensure that the “encoding and retrieval environments” are the same. In other words, teach and test in the same place. Want to see brain rule #5 tested in a classroom, watch this brief video.

**Long-term Memory** Rule #6: Remember to repeat.

Most teachers would be depressed to learn how little of what they teach is actually committed to long-term memory in their students. After all, how many of us adults remember the rights granted by each of the 27 amendments, the elements in the periodic table, or the characters in Shakespeare’s plays? Cramming, the strategy employed by many students to prepare for a test, is highly ineffective; students are better served by spreading the studying over time. In fact, Medina suggests, “The way to make long-term memory more reliable is to incorporate new information gradually and repeat it in timed intervals.” In his “fantasy,” school periods are divided into 25 minute intervals repeated cyclically throughout the day, allowing for repeated exposure to the same lesson. Medina focuses primarily on the permanent retention of learning, yet wonders why schools seem more intent on the initial encoding. He comments, “Today, students are expected to know certain things by certain grades. Curiously absent from this model is how durable that learning remains after the student completes the grade.” Can we claim as educators that students have *learned* in our classes if they cannot pass those same tests a year later?

**Sleep** Rule #7: Sleep well, think well.

Those of us who can recall our dreams know that our bodies may rest when we sleep, but our brains remain as active as ever. Although researchers can’t detail the exact processes our brains undergo as we sleep, they do know some type of offline processing takes place that leads to enhanced retention of learning. Additionally, lack of sleep also severely undermines our ability to learn, impairing our “attention, executive function, working memory, mood, quantitative skills, logical reasoning, and motor dexterity.” Without a good night’s sleep, we aren’t fully equipped to learn. Medina suggests adjusting the school schedule to meet the biological sleep needs of students at different times of their lives. He also encourages schools to allow all students a 30-minute nap midday, citing studies that reflect a 34% improvement in performance. Who hasn’t experienced the overwhelming tiredness that hits us in the afternoon? Medina urges us not to fight that feeling; instead, take a snooze.

**Stress** Rule #8: Stressed brains don’t learn the same way.
As we all know, a little stress can be a great motivator, but too much stress can be paralyzing, especially chronic stress in which we feel we have little control over our environment. The brain, after all, is designed to handle short bursts of stress that lasts seconds or minutes, not years. Students who feel besieged by high parental expectations, excessive homework, or overscheduling can experience symptoms of chronic stress, which can impair sleep, weaken the immune system, and even lead to depression. Our brains learn best according to the Goldilocks principle – they feel under or overwhelmed with too little or too much stress, but perform optimally when the pressure is “just right.” Interestingly, researchers also discovered that an emotionally unstable home also strongly impacts a student’s learning capacity. The playing field in the classroom is often quite uneven because of the stressful environments some children endure at home.

**Sensory-Integration** Rule #9: Stimulate more of the senses.

Classrooms are generally designed to appeal to students’ auditory and visual senses, but as Medina argues, “We have three other senses also capable of contributing to the educational environment.” In fact, our brains evolved to use our senses simultaneously, not one at a time; as a result, “We learn best if we stimulate several senses at once.” Research shows students engaged in multi-sensory presentations enjoy better recall, are more adept at problem-solving, and even produce more creative solutions than students who saw presentations involving only one sense. For example, students learn better from words and pictures than from words alone, and better from animation and narration than from animation and onscreen text. Medina also encourages educators to test the power of smell, which he argues can profoundly evoke memory. It may seem preposterous to use cinnamon incense when teaching a difficult lesson and again when you are testing students on their recall of that lesson, but if the experiment reveals a significant uptick in learning, it may be worth a try.

**Vision** Rule #10: Vision trumps all other senses.

The “eyes” have it. Of all the five senses, sight is by far our strongest and the one on which we most rely. Pictures are worth a thousand words … literally. As Medina explains, “If information is presented orally, people remember only 10 percent, tested 72 hours after exposure. That figure goes up to 65 percent if you add a picture.” Education over the years has placed enormous emphasis on both the written and the spoken word, yet brain research shows that we learn best through pictures. The solution for teachers concerned primarily about student retention of learning is less text, more images, an admonition worth remembering when creating our next Power Point Presentation.

**Gender** Rule #11: Male and female brains are different.

While stopping short of claiming the sexes are from different planets, Medina does explain that male and female brains function differently. Men are more likely to suffer from schizophrenia,
alcoholism, and drug addition. Women are more likely to suffer from depression, anxiety, and anorexia. Women traditionally use language to build relationships; men to negotiate status. Medina summarizes the research succinctly: “The difference between the genders could be described as the addition of a single powerful word. Boys might say, “Do this.” Girls would say, “Let’s do this.” That single word often defines power in the larger culture. Women who exert a “male” leadership model are often defined as “bitchy.” Likewise, men who assume a conciliatory approach are often perceived as “effeminate.” While this distinction between the sexes has been used as a rationale by some schools for employing single gender classrooms, educating students about the different ways their brains function might help them better understand how they engage with each other and how this behavior may affect their learning.

Exploration Rule #12: We are powerful and natural explorers.

Most independent schools express in their mission statements an intention to develop students who are lifelong learners. Actually, though, our evolutionary history taught us naturally to be curious, to problem solve, to learn from failure. We learned through the context of relevant, personal experiences. Medina suggests that we have anesthetized both the process and the child by divorcing education from the real world and by placing the emphasis on acquiring high scores instead of mastering skills and possessing knowledge. He suggests we look to babies to discover how we learn. They do not learn passively; rather, they act like scientists, testing their environments to draw conclusions. He offers the example of companies like Google who respects its employees’ natural desire to explore: “For 20 percent of their time, employees may go where their mind asks them to go.” The company has found that curiosity pays off: 50 percent of all new products are produced by “Google’s 20% rule.” Eleanor Roosevelt once said, “I think, at a child's birth, if a mother could ask a fairy godmother to endow it with the most useful gift, that gift should be curiosity.” Yet, each child is born with curiosity. The quest for educators is to nourish that gift.

As a scientist interested primarily in how we learn, Medina would like to see a new partnership develop between brain researchers and educators. Perhaps in the future, we will see brain-based schools pedagogically designed to maximize student learning. Until then, individual educators have the opportunity to test the brain research outlined in Medina’s book in their own classrooms. Aren’t you curious to see what you might learn?