



# Brain-Based Learning

Teach smarter, using powerful principles derived from brain science. Ignite your students' natural love for learning by delivering brain-compatible lessons. Stimulate students' brains by crafting a challenging, enriched curriculum. Increase motivation and comprehension with active learning. Boost students' memory through multiple channels. Uncover patterns in learning to help students make connections. Create an inclusive, nonthreatening environment to skyrocket learning. This SmartCard translates brain research into practical, easy-to-understand principles so you can teach with the brain in mind.



## Brain-Smart Practices for Teaching & Learning

### Nourish the Brain

#### Feed the Brain

The brain needs food and oxygen. They are provided primarily through the blood pumped straight to the brain. Even though the brain is only about 2 percent of the body's adult weight, it consumes about 20 percent of the body's energy. Good nutrition is essential for proper brain functioning. Brain foods include fish, eggs, leafy greens, wheat germ, chicken, fruits.

#### Light It Right

Natural light and full-spectrum lights that simulate natural light are correlated with missing fewer school days and more positive emotional states. Fluorescent lights may cause eyestrain and anxiety.

#### Care for the Air

Better quality air, which includes more oxygen and less carbon dioxide, has been linked to improved mental functioning. Green leaf and flowering plants cleanse the air. Keep room temperature around 68-72 degrees. Avoid pollutants and strong fragrances.

#### Sleep Tight

Sleep is critical for the brain to process learning and to rearrange neural circuitry. The lack of sleep negatively impacts thinking, creativity, and long-term memory. Although there is no set amount of time that fits everyone, all students need adequate deep sleep. Have students keep a sleep chart and monitor their sleeping habits.

#### Keep 'Em Hydrated

The brain is approximately 80% water. Students become restless and have scattered attention when they are mildly dehydrated; slow and lethargic when severely dehydrated. Drinking plenty of water improves brain functioning (and overall health). Soft drinks, fruit juices, teas, and coffee do not hydrate nearly as well as pure water. Provide students with water bottles so they may hydrate without interrupting a lesson. Prepare for inevitable bathroom breaks.

#### Avoid Abuses

Drugs and alcohol can kill brain cells and retard learning. Teach and encourage prevention programs.

### Tune Up the Brain

#### Take Note of Music

Neuroimaging reveals that music activates many different parts of the brain, many of which overlap with brain centers involved in educational operations. The term the "Mozart Effect" is derived from a study which found students who listened to Mozart for ten minutes performed better on spatial tasks than those who listened to white noise or relaxation music.

Research suggests making music positively influences spatial reasoning, creativity, generalized mathematical skills, language, and reading skills. Encourage students to play an instrument. Developing the musical brain strengthens other cognitive skills.

#### Feel the Rhythm

Music with different tempos, measured in beats per minute (bpm), helps reach different classroom objectives:

- 90-120 bpm to energize students. Play before class, during brain breaks, transitions, exiting class.
- 60-70 bpm for creativity. Play during brainstorming, problem-solving, creative writing, journal writing.
- 50-60 bpm for learning. Play during studying, practicing skills.
- 40-60 bpm for reflection. Play during visualization, guided imagery, relaxing.
- 30-60 bpm to de-stress. Play after presentations, tests.

Speed, volume, rhythm, instrumentation, timbre, texture, form, structure, and pitch of music influence your students' state of mind. Use music in your class to: welcome students; set an emotional tone; get students motivated (up tempo music); enhance enjoyment and concentration during projects, journaling, reflecting (background music). Integrate music into your daily lessons.

Music students enjoy has a positive influence on their moods and emotions. Occasionally let students vote on the music they want to hear. Their love for music will transfer to their love for your class and learning.



# Brain-Based Learning

Brain-Smart Teaching & Learning

## Provide Safety

### Reduce Threat & Stress

Perceived threat causes a "narrowing of the perceptual field" and "downshifting." Students revert from higher-order neocortical cognitive functioning and creativity to limbic and reptilian survival fight or flight instincts. Chronic stress kills brain cells that control memory, reduces student's ability to sort out what's important and what's not, lowers immunities, results in fewer and shorter dendrites, which impairs communication among neurons.

Avoid embarrassment, finger-pointing, blaming, unrealistic deadlines, sarcasm, and humiliation. Don't give unannounced tests or quizzes. Don't threaten students with detention, loss of privileges, lowered grades, or a visit to the principal's office. Enforce class rules. Don't tolerate physical or mental abuse. Teach conflict resolution. Model appropriate behavior. Implement a classroom discipline plan. Reduce stress through predictable routines.

### Enhance the Class Climate

Create a safe, supportive, nonthreatening classroom environment to promote learning. Allow your students to feel loved—yes loved—with smiles, warm greetings, positive affirmations from you and classmates, and your genuine personal interest and concern. Create an inviting classroom with cheerful appearance and motivational posters. Proudly display students' work. Include classbuilding activities so students have the opportunity to establish positive relationships with classmates. And have FUN. Team cheers, parties, classroom celebrations, and special events all contribute to a positive class tone. Maintaining a positive emotional tone translates into increased learning and productivity.



### Manage Stress

Stress is the enemy of learning. When students are stressed or anxious, their memory is impaired, their concentration is diverted, their judgment is clouded, and learning is retarded. Wherever possible minimize stress. Teach your students to manage stress using proven techniques including: peer discussions, physical activity, self-talk, relaxing music, celebrations, drama, muscle relaxation, visualization, and breathing.

### Foster Relaxed Alertness

Maximum learning and performing occurs in a state of "relaxed alertness." As the term suggests students achieve a state of relaxation, yet are mentally alert. This optimal state results from students feeling safe and secure, and motivated to learn.

## Enrich Your Classroom

### Enrich Your Environment

Environmental enrichment results in increased dendritic branching, more support cells, and even the growth of new neurons. This means we can actually build larger and heavier brains by enriching our classroom environment. Some important principles to enrich your classroom include:

- **Novelty** - Keep learning and the classroom fresh and new. Students' brains habituate to the same old stimuli and it loses its power.
- **Challenge** - Provide challenging learning tasks and content.
- **Meaning** - Make learning meaningful for students. Avoid isolated facts.
- **Redundant** - Revisit the content repeatedly in fresh and interesting ways. Avoid repetitive drill and kill which lacks meaning.
- **Feedback** - Provide frequent and immediate feedback to keep students on target.

**One caution:** Overstimulation may be harmful. More is not always better. Strive for an enriched environment, but monitor your students for signs of overstimulation.



### Add Aromas

Smell is the only sense that has a direct connection to the limbic system.

Scents can be used to keep students alert, and may help to embed memory. Some scents include:

- **Lavender** - Reduces stress
- **Lemon** - Induces positive mood
- **Peppermint** - Refreshes and invigorates
- **Apple** - Relaxes brain waves and reduces blood pressure
- **Vanilla** - Relaxes and soothes

### Balance Familiarity with Novelty

As a general principle, change is good. Changing the classroom layout, decorations, bulletin boards, and seating arrangement provides novelty and maintains an enriched environment. But don't overdo it. A major change about once a month is enough. If you change too much too often, you'll create anxiety because students won't know what to expect. Balance novelty with predictable classroom norms and procedures.

### Stimulate the Senses

Make learning more enjoyable and memorable through multisensory stimulation. Integrate sights, sounds, touch, taste, smells into your classroom and into your lessons.

### Optimize Challenge

Your curriculum must be challenging, but not excessively difficult. If a task is too easy, students become bored. If it is too difficult, students become anxious. Create developmentally appropriate learning tasks for your students. Start with tasks that students can do comfortably, then incrementally increase the challenge. It doesn't have to make the task so challenging that students don't feel they can succeed. In "Flow," the state of intense enjoyment and concentration, of activity and learning is maximized. To create "Flow," match task difficulty to student skill level.

### Color Your World

Colors impact the mind and body. Use the guidelines below to color areas of your classroom and school.

- **Blue** - Studying, thinking, concentration
- **Purple** - Tranquilizing, good for appetite control
- **Pink** - Restful, calming
- **White** - Disrupting
- **Red** - Creative thinking, short-term energy boosts
- **Green** - Productivity, long-term energy
- **Light Colors, Pastels** - Minimum disruption across all moods/activities
- **Yellow, Orange, Coral** - Physical work, exercising, positive moods



# Learning Practices

## Uncover Patterns in Learning

Our brains make and extract patterns out of our experiences to derive meaning. As students learn, the brain actually rewires itself. Smarter people don't necessarily have bigger brains. They have more intricately interwoven neural connections. So one of the most important things we can do as teachers is to make patterns and connections explicit for students. Integrated instruction links learning across subject areas. Thematic instruction unifies knowledge based on a central theme. Graphic organizers and mind maps visually depict relationships for students: cause and effect, parts to whole, cycles, categories, trends, continuums, step-chart, time and number lines, matrices, comparison charts. Also have students discover patterns for themselves and practice identifying patterns across stimuli: visual patterns, verbal, logical, musical stimuli; patterns of events; patterns across stories.

## Cultivate Meaning

The brain is a natural meaning-maker. It strives to make sense of the world and our experiences in the world. When we make learning meaningful for students, it is more likely to be attended to, processed, and remembered. To make learning meaningful for students, allow them to make the content their own. Have students explain in their own words, negotiate the meaning through peer discussions, write about what it means to them or how the new knowledge fits into their mental schema. Use mind maps and other concept formation graphic organizers.

## Relate and Motivate

What's motivating for some is less motivating for others. Learning that is personally relevant is more motivating. Have students read, write, and discuss what interests them. Have them share personal experiences. Release students' inquisitive nature and immerse them. Make lessons and activities fun and engaging by linking content to students' interests and backgrounds.



# Make Learning Meaningful

## Focus on Process, Not Outcome

Brain development results more from engaging in the process of learning than achieving a specified outcome. That is, students learn more in the process of searching for meaning than from retrieving an answer. Neurons in their brains branch out to make new connections when students grapple with a new idea, invent, interpret, investigate, analyze, apply, compare, contrast, predict, and prioritize. Open-ended questions and investigations invite students to branch out. Right/wrong answers create threat and tell us only if the connection exists or not. Overly specified learning objectives interfere with true learning and limit students' potential to make new connections. Deemphasize getting the right answer. Focus on the most important part of education—the process.

## Build Bridges to New Learning

Link new learning to prior knowledge. The brain resists meaningless, unconnected information. Content that is out of context, such as isolated facts, is less likely to be remembered.



## Engage Emotional Learning

Brain research reveals the dichotomy between the rational mind and the emotional mind does not hold up. Emotions are critical to learning. Emotions tell us how to set priorities, what to focus on, and how to be passionate about learning and achieving goals. Engage students' emotions through the use of stories, videos,

pictures, and activities. Ask students how they "feel" about topics. Debate emotionally-charged controversies. Express emotions through theater and drama. Emotionally-laden experiences generate more interest, engagement, and retention because emotional learning has preferential processing in the brain.

# Respect Students' Unique Brains

## Acknowledge Developmental Differences

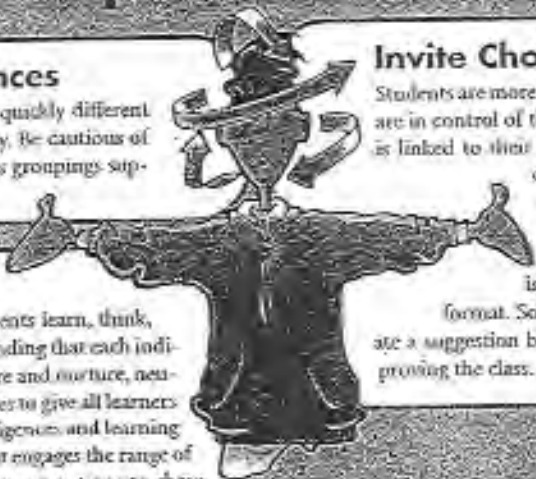
Healthy brains develop at different rates. People's DNA affects how quickly different brain structures grow. Education is not a race, it is a lifelong journey. Be cautious of standards based on age groups. Multiage practices and heterogeneous groupings support a developmental perspective.

## Honor Uniqueness

Multiple intelligences and learning styles theories tell us that students learn, think, and display their learning differently. Brain research supports the finding that each individual has a "custom-made" brain based on a combination of nature and nurture, neuronal branching, and pruning. Use a wide range of teaching strategies to give all learners the opportunity to learn according to their unique patterns of intelligences and learning styles. Stretch students' many ways of being smart with learning that engages the range of intelligences and learning styles. Provide students multiple assessment options to show what they've learned in their own unique way.

## Invite Choice and Self-Direction

Students are more motivated and learn when they feel they are in control of their environment and that their success is linked to their efforts. Invite student choice and self-direction. Allow students to choose topics to research or write about. Empower students by having them vote on issues that have an impact on them. Discuss issues openly and freely in a class meeting format. Solicit and validate everyone's input. Create a suggestion box for students to submit ideas for improving the class.



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# Boost Memory

## Activate Multiple Memory Pathways

We have different memory pathways for different types of learning. Boost students' memory of important information and skills through multiple pathways. If students are having a difficult time remembering, try a different memory pathway.

### Explicit Memory Pathways

We remember by explicitly trying to remember. Explicit memory requires attention and practice.

• **Semantic** - Memory of facts, names, dates. Students remember through words, rhymes, associations.

• **Episodic** - Memory of locations, events, circumstances, stimulated by novelty, curiosity, expectations. Episodic memory is enhanced through sensory cues.

### Implicit Memory Pathways

We remember automatically.

• **Emotional** - Memory of emotionally-laden events, especially traumatic and pleasurable events.

• **Procedural** - Memory of how to do procedures (e.g., riding a bike). Students remember by doing, body learning, hands-on experiences.

• **Reflexive** - Natural reflexes are automatically recalled (e.g., moving hand off hot stove). Overlearning material through rote practice can create reflexive memories.

• **Sensory Conditioning** - Memory based on specific sensory pathway (e.g., smell of popcorn reminds me of...). Link memories to senses and provide sensory-specific cues for recall.

• **Spatial** - Memory based on the surroundings and the context. Involves formation of mental maps.

## Make it Memorable

Much of what we call learning is measured by what students remember. Students can naturally remember things remarkably easy. Yet, forced memorization is difficult. Here are some memory-boosting suggestions:

- Use novelty
- Evoke emotions
- Chunks of information are easier than long strings of information
- Process information through reflection and discussion
- Use rhymes and music
- Use mnemonics, peg words and acronyms
- Have students visualize information

## Grab Your Students' Attention

Students are more likely to remember what they pay attention to. Successful students tune out irrelevant information and tune into what's important. We can help all students pay attention to important details through priming, "This is the really important part..." or "Pay special attention to..." Contrast and novelty also garner attention. Change the speed, volume, tone, and pitch of your voice. Change your dress, physical location, and behavior.



# Teach with the Brain in Mind

## Use Active Learning Strategies

Different brain structures are engaged by different instructional strategies. If we teach in the traditional lecture format, we limit students' learning potential. Multimodal teaching strategies engage various parts of the brain simultaneously. No single instructional strategy will effectively develop the whole brain. Endeavor to use a range of instructional strategies to engage the many learning pathways. Provide students with many sources of input such as books, videos, lectures, discussions, visuals, stories, and songs. And allow students many output avenues such as essays, presentations, plays, dances, songs. Changing instructional strategies frequently creates novelty and activates whole-brain learning.

## Make Learning Intrinsically Rewarding

Extrinsic rewards—tokens, gold stars, stickers, prizes, coupons are not as powerful as the brain's natural opiates which are released when students are intrinsically motivated. This may explain why students get "hooked" on things they find intrinsically rewarding. Foster intrinsic motivation with personally relevant and challenging tasks.

## Promote Early Learning

A wealth of evidence suggests that some of the most dramatic brain development occurs before students enter school. Team up with parents and other community caregivers to implement principles derived from brain research. Students exposed to enriched educational environments before they enter school are more likely to succeed in school and beyond.



## Take Time to Process

Receiving constant input is not as effective as receiving input punctuated by breaks for processing the input. It is not helpful to pour more water into a cup that is already full. Reflection time reinforces the neural connections that are created through learning. Give students frequent breaks in reading, videos, lectures, filmstrips to process what they've learned. Students may discuss, reflect, or write about their learning to make the content their own. Think Time, a mere three to five seconds of silent time after teacher questions and after student responses enhances the quality of thinking and subsequent responses.



## Maximize Feedback

Specific and immediate feedback reduces uncertainty and stress, providing the brain with directions for improvement. Focus feedback on specific ways to improve, not on overall evaluation. After student performances, assignments, and tests, provide immediate feedback with specifics on what went well and what needs improvement. Include peer feedback. Work with students on how to provide each other specific, supportive feedback. Types of feedback include grades, corrections, self-checks and evaluations, written and oral comments, discussions, peer feedback.

# Move and Groove

## Take Brain Breaks

The brain alternates between high and low and left- and right-hemisphere cycles throughout the day. When students get stuck or energy seems low, take a brain break. Effective brain breaks include: physical activity, creative movements, teambuilding, classbuilding, energizers, silly

sports and goofy games, stretching, cross-lateral activities, and free time with student choice of activities. Brain breaks actually increase learning and reduce errors, so don't be afraid to take several daily. Snacks, recess, lunch are all brain-friendly breaks.



## Integrate Physical Activity

The cerebellum, the part of the brain that controls some motor functions such as coordination, also plays a role in memory, decision making, emotion, attention, spatial perception, language. So, the notion that the body and the brain are separate entities is outdated. Physical activity reduces stress (lowers cortisol levels that kill brain cells), strengthens key areas of the brain, provides oxygen and glucose to the brain, can trigger the release of endorphins (the "feel good" chemical) and adrenaline (the "challenge" hormone), and enhances neuronal growth and connections. Aerobic exercise helps with memory. Studies reveal students who exercise outperform those who don't. Integrate movement such as energizers, dance, theater, stretching, and creative expression into classroom activities. Make sure students are receiving a physical as well as a mental education.



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