edutopia *presents*

SIX TIPS *for* BRAIN-BASED LEARNING

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PLUS A BONUS CLASS PROJECT, RESOURCES, *and a* READING LIST

Six Tips for Brain-Based Learning

Plus, a bonus class project, resources, and a reading list

BY UNDERSTANDING HOW THE BRAIN WORKS, educators are better equipped to help students with everything from focusing attention to increasing retention. That's the promise of brain-based learning, which draws insights from neurology, psychology, technology, and other fields. Bringing this information to the classroom can help teachers engage diverse learners, offer effective feedback that leads to deeper understanding, and create a rich learning environment that attends to students' social and emotional needs along with their developing brains.

Chances are, you already know more about brain-based learning than you think you do. When you introduce topics to your students, do you begin by activating prior knowledge? That helps learners build on what they already know, strengthening connections in the brain. Do you use tools like graphic organizers, songs, or rhymes? These strategies help students represent their thinking visually, kinesthetically, and phonetically. These techniques all deserve a place in your tool kit because they get the brain primed for learning.

Patricia Kuhl, renown language and brain development researcher, puts it this way, "We are embarking on a grand and golden age of knowledge about the child's brain development. . . . In investigating the child's brain, we are going to uncover deep truths about what it means to be human, and in the process, we may be able to help keep our own minds open to learning for our entire lives."

In this guide, you'll get practical tips across the K-12 spectrum, a reading list, and a variety of resources to help you learn more about this fascinating field. To help you and your students learn more about their own brainpower, we've also included a bonus project that will get students thinking critically about thinking.

As promising as brain-based discoveries may sound, some educators are understandably cautious about introducing lab findings in the classroom. Anyone who remembers fallout over the so-called Mozart effect knows that there's no magic solution when it comes to education. As always, if a particular claim sounds too good to be true, that's a clue to trust your common sense and engage your own critical thinking.

We're eager to hear how you apply brain-based learning with your students. Please share your insights and help build the bridge from neuroscience research to engaging classroom practice.

—Suzie Boss
Edutopia blogger and co-author of
Reinventing Project-Based Learning
On Twitter @suzieboss

TIPS AT A GLANCE

1. **Create a Safe Climate for Learning**
2. **Encourage a Growth Mind-set**
3. **Emphasize Feedback**
4. **Get Bodies and Brains in Gear**
5. **Start Early**
6. **Embrace the Power of Novelty**

BONUS PROJECT

Build a Brain Owner's Manual

+ **Recommended Reading**

TIP #1

Create a Safe Climate for Learning

WHEN STUDENTS ARE FEELING ANXIOUS or fearful, they aren't in the mood to learn. That's because one part of the brain that processes emotions —the amygdala—responds to perceived threats by blocking information flow to the learning centers of the brain. In layman's terms, stress scrambles the learning circuits. To understand more about how the brain responds to stress, read the Edutopia article "To Enable Learning, Put (Emotional) Safety First" **(http://www.edutopia.org/neuroscience-brain-based-learning-emotional-safety).**

Although educators can't overcome every stressor in a child's life, they can take practical steps to make the classroom environment more conducive to learning. Veteran teacher Linda Lantieri, author of *Building Emotional Intelligence,* recommends concrete strategies to help students stay calm and learn to manage their sometimes tumultuous emotions. As she explains in an Edutopia interview, "The prefrontal cortex of the brain is the area for paying attention, calming, and focusing as well as the area for short- and long-term memory. So you need to focus in order to connect with your memory." Read more of her interview at **http://www.edutopia.org/linda-lantieri-how-to-relaxation.**

Morning meetings, developmental discipline, and student leadership teams are among the strategies that can foster healthy social and emotional learning. Learn how a school district in Louisville, Kentucky, has implemented strategies to build students' emotional health in this Schools That Work segment: **http://www.edutopia.org/stw-jefferson.**

Learning environments that keep students highly engaged, that foster community and family connections, and that consider the needs of the whole child are the focus of a recent podcast by The Whole Child from ASCD. For more ideas, listen to "School Environments: Transforming Learning Spaces" **(http://whatworks.wholechildeducation.org/podcast/school-environments-transforming-learning-spaces/).**

Learn more:

- Watch a University of Minnesota video seminar on the impacts of stress on learning: **http://www1.umn.edu/ohr/teachlearn/workshops/videos/StressandLearning/index.html.**
- Watch a lecture by Professor Claude M. Steele on Identity and Stereotype Threat: **http://www.youtube.com/watch?v=q1fzIuuXlkk.**
- Watch the Edutopia video "An Introduction to Social and Emotional Learning": **http://www.edutopia.org/social-emotional-learning-introduction-video.**
- Watch the previously recorded webinar "Social and Emotional Learning: Making a Case in an NCLB World": **http://www.edutopia.org/webinar-february.**
- Eric Jensen, author of *Teaching with Poverty in Mind,* shares teaching tips in the post "Why Teach Differently to Those from Poverty?" **http://www.jensenlearning.com/news/why-teach-differently-to-those-from-poverty/teaching-with-poverty-in-mind#postcomment.**

TIP #2

Encourage a Growth Mind-set

ASK STUDENTS TO DESCRIBE their brain with a metaphor and they're likely to suggest a computer, command center, or maybe a lightning-fast communications network. But they'd be better off thinking of the brain as a muscle that gets stronger with use. Researchers now understand that IQ isn't fixed at birth. Just as we get more physically fit from exercising, we can build brainpower through the act of learning.

Children who adopt what psychologist Carol Dweck calls a growth mind-set understand that intelligence isn't fixed but can be developed through effort. In *Mindset,* Dweck explains why students who have a growth mind-set are more willing to tackle challenges, learn from failure, and see criticism as useful feedback rather than a reason to give up. This is the kind of thinking that keeps students motivated, even when learning is hard work. To learn how Dweck's research can improve the classroom environment, read Milton Chen's Edutopia post "Smart Talking: Tell Students to Feed Their Brains" **(http://www.edutopia.org/carol-dweck-intelligence-research).**

The good news is that even mind-set isn't fixed. A growth mind-set can be learned and reinforced by messages that praise persistence and set high expectations. For example, help students understand that challenging assignments will stretch their "thinking muscles." At the same time, provide them with necessary support so they don't get discouraged. (Edutopia blogger Rebecca Alber offers suggestions in "Six Scaffolding Strategies to Use with Your Students": **http://www.edutopia.org/blog/scaffolding-lessons-six-strategies-rebecca-alber.)**

Curious to learn more? In *Mind, Brain, and Education Science,* a comprehensive guide based on more than 4,500 studies, (***continued on next page***)

Learn more:

- Watch Dr. Norman Doidge's talk on brain plasticity: **http://youtu.be/dJxASN-_WtU.**
- Listen to an interview on the growth mind-set with Carol Dweck: **http://www.npr.org/templates/story/story.php?storyId=7406521.** And listen to Dweck explain her research in a series of video segments: **http://www.brainology.us/webnav/videogallery.aspx.**
- Diane Dahl is an elementary teacher who regularly applies brain-based learning strategies. Visit her blog to hear how she incorporates "thinking about thinking" into daily learning activities, such as this lesson about having students model neural pathways: **http://www.fortheloveofteaching.net/2010/10/metacognition-lesson-was-huge-success.html.**

Tracey Tokuhama-Espinosa presents five key concepts on the topic. These concepts give us an accessible framework for talking about, and learning about, brain-based learning:

- Human brains are as unique as faces.
- All brains are not equal because context and ability influence learning.
- The brain is changed by experience.
- The brain is highly plastic.
- The brain connects new information to old.

Read an excerpt from Tokuhama-Espinosa's book in *New Horizons for Learning,* a new journal from Johns Hopkins University School of Education **(http://education.jhu.edu/newhorizons/Journals/Winter2011/Tokuhama1).**

Effective teaching strategies help students move toward higher-order thinking, or what neurologists call executive function. As neurologist turned teacher Judy Willis, MD explains, "When you provide students with opportunities to apply learning, especially through authentic, personally meaningful activities with formative assessments and corrective feedback throughout a unit, facts move from rote memory to become consolidated into related memory bank, instead of being pruned away from disuse." Follow Willis's Edutopia posts to learn why, as she says, "the neurons that fire together wire together" **(http://www.edutopia.org/spiralnotebook/judy-willis).**

Of course, all this brain activity is happening in a unique way for each student. By addressing learners' individual needs, educators can help students strengthen the connections that will lead to deeper understanding. Experts David A. Sousa and Carol Ann Tomlinson team up to explain the science behind differentiated instruction in *Differentiation and the Brain: How Neuroscience Supports the Learner-Friendly Classroom.* They suggest having faculty discussions about how teachers' and administrators' attitudes and behaviors (as well as school environments and procedures) can encourage—or discourage—a growth mind-set. Download their discussion Reproducibles: **http://go.solution-tree.com/instruction/Reproducibles_DAB.html.** And for ideas about delivering differentiated instruction on a slim budget, see Edutopia's Schools That Work installment about a high-achieving elementary school in Tucson, Arizona: **http://www.edutopia.org/stw-differentiated-instruction-budget-overview.**

TIP #3

Emphasize Feedback

EDUCATIONAL RESEARCHERS HAVE long stressed the value of feedback for keeping learning on track. Savvy classroom teachers use a range of formative assessment strategies to check in on understanding and address misconceptions early. Not surprisingly, feedback is a cornerstone of brain-based learning.

In *Mind, Brain, and Education Science,* Tokuhama-Espinosa points out, "Great teachers know that moments of evaluation can and should always become moments of teaching." That means students need to know more than whether their answers were right or wrong. Understanding where and how they went wrong helps students adjust their thinking so they can improve. Positive feedback, meanwhile, builds learner confidence. Whether it's corrective or affirming, feedback needs to be delivered in a way that's encouraging rather than discouraging.

And implementing an effective on-the-fly feedback process is what's driving much of the excitement around using video games in classrooms. Neurologist turned middle school teacher Judy Willis, MD explains how the dopamine-reward system works, why feedback matters, and what educators can learn from the achievable challenges of games in her Edutopia post "A Neurologist Makes the Case for the Video Game Model as a Learning Tool" **(http://www.edutopia.org/blog/video-games-learning-student-engagement-judy-willis).**

Longtime advocate of brain-based learning Eric Jensen says a wide range of activities—particularly peer editing—can deliver the personal and relevant feedback students' brains need to thrive. In a recent blog post, he suggests, "Use gallery walks, have students build a physical model, provide games with competition, implement using an author's chair, small-group discussion, use audio or video feedback, peer editing, student presentations, hypothesis building and testing, have students use a checklist, engage them in brainstorming, compare and contrast work" **(http://www.jensenlearning.com/news/getting-priorities-right/brain-based-teaching).**

A variety of Web 2.0 tools can be used to deliver timely, specific feedback that will help students make academic gains. Web2ThatWorks Wiki **(http://web2thatworks.com)** is a collaborative space developed by instructional coach Stephanie Sandifer (@ssandifer on Twitter) where educators are sharing ideas about technologies that support effective instruction.

Learn more:

- Read Edutopia blogger Heather Wolpert-Gawron's practical post "Tips for Grading and Giving Students Feedback": **http://www.edutopia.org/blog/grading-tips-student-feedback-heather-wolpert-gawron.**
- To help you maximize feedback opportunities during projects, download a copy of the Edutopia Classroom Guide *Top Ten Tips for Assessing Project-Based Learning:* **http://www.edutopia.org/10-tips-assessment-project-based-learning-resource-guide.**
- See a demonstration of peer feedback in the classroom in Edutopia's video on how to teach math as a social activity: **http://edutopia.org/math-social-activity-cooperative-learning-video**

TIP #4

Get Bodies and Brains in Gear

DEVELOPMENTAL MOLECULAR BIOLOGIST John Medina, author of *Brain Rules,* describes himself as a "grumpy scientist" who demands a gold standard from research before he'll pass it along. His No. 1 research-based rule for brain owners to keep in mind? Exercise boosts brainpower. Cardio activity increases oxygen-rich blood flow to the brain and increases students' ability to concentrate. Acknowledging that more study is needed to fully understand the relationship between exercise and learning, Medina argues for incorporating more physical activity into the school day—now.

For an action-packed example, see how students at Naperville Central High School in Illinois combine fitness with academics. Ninth and tenth graders in a learning readiness program take fitness-based PE before their most challenging academic courses **(http://www.learningreadinesspe.com).** PE teachers collaborate with academic colleagues to find more opportunities for "brain breaks" that get students moving during class. Watch a PBS "Need to Know" episode about the program **(http://www.pbs.org/wnet/need-to-know/video/a-physical-education-in-naperville-ill/7134/).**

For a global look at how young learners are benefiting from physical activity, check out the Learning Landscape Network **(http://www.learninglandscapenetwork.com/).** This open-source community, developed by the nonprofit design firm Project H Design, is collecting creative ideas for using low-cost play spaces built from discarded tires to develop core subject skills. Originally intended for math instruction, the Learning Landscape concept has expanded to include physically active learning games across the curriculum.

Learn more:

- Read the American Physiological Society's description of the benefits of exercise on brain health: **http://www.the-aps.org/press/releases/11/22.htm.**
- John J. Ratey, MD, author of *Spark: The Revolutionary New Science of Exercise and the Brain,* shares videos and articles about exercise and learning on his blog: **http://johnratey.typepad.com/blog/.**
- Take multimedia tutorials or listen to an interview with John Medina at the website **http://www.brainrules.net.**
- Visit KaBOOM! for research on recess, play, and healthy child development. Go to **http://www.kaboom.org,** then click on the tab "Take Action for Play" and scroll to "Why Play Matters."
- Watch a TED talk with Project H founder Emily Pilloton: **http://www.ted.com/talks/emily_pilloton_teaching_design_for_change.html.**

TIP #5

Start Early

FORMAL SCHOOLING MAY NOT START until age five, but we all know children are learning long before they begin kindergarten. By reaching out to parents of preschoolers with research and practical information, schools can help incoming students arrive at school ready—and eager—to learn.

At Education Nation 2011, an annual summit on education hosted by NBC News, researchers from the University of Washington shared never-seen-before research about what happens in the brain and its 100 billion neurons during the first 2,000 days of life. Patricia Kuhl and Andrew Meltzoff explained the importance of a series of images showing how children's brains change as they listen to language, interact with other people, and develop connections. Watch the video presentation at Education Nation (go to **http://www.educationnation.com** and search for *Patricia Kuhl*).

Many states have launched early childhood campaigns to help children arrive at kindergarten ready to learn. Less than half the children in Washington, for example, enter school kindergarten-ready, according to University of Washington data, and only a quarter of the lowest-income students start school ready to learn. To improve these odds, Washington has launched a grassroots campaign around the themes "Love. Talk. Play." See suggestions for activities that parents can do with their young children at **http://www.lovetalkplay.org.**

What's really happening when babies play? Psychology professor Alison Gopnik, author of *The Philosophical Baby,* answers that question with some surprising answers in her TED talk "What do babies think?": **http://www.ted.com/talks/alison_gopnik_what_do_babies_think.html.**

Learn more:

- Read about the impacts of preschool education from a 25-year longitudinal study: **http://www.sciencedaily.com/releases/2011/06/110609141556.htm.**
- Watch a video about the importance of early learning, featuring the Center on the Developing Child at Harvard University: **http://youtu.be/7Qb3DXY_7fU.**
- Read the *New York Times* opinion piece "Delay Kindergarten at Your Child's Peril" written by Sam Wang and Sandra Aamodt, authors of *Welcome to Your Child's Brain: How the Mind Grows From Conception to College:* **http://www.nytimes.com/2011/09/25/opinion/sunday/dont-delay-your-kindergartners-start.html.**

TIP #6

Embrace the Power of Novelty

WHEN WE ENCOUNTER NEW information, the brain quickly goes into pattern-recognition mode. If it reminds us of something we've encountered before, we know how to respond. But what happens when the new information doesn't "fit" with existing understanding? That's when the brain really gets excited. The brain doesn't just detect new information —it craves novelty.

As Judy Willis, MD explains in *How Your Child Learns Best,* a part of the brain called the reticular activating system (RAS) filters incoming stimuli, deciding which information to trust to autopilot and what deserves our full attention. Surprise and novelty are the attention-grabbers. In the classroom, this means that changing routines, asking students to consider similarities and differences, field trips, and guest visitors all help to keep learning fresh.

In an article for *Scholastic,* psychiatrist and child trauma expert Bruce Perry explains why repetitive classroom activities, such as lectures or worksheets, inhibit the brain's craving for novelty and can interfere with learning. "Only four to eight minutes of pure factual lecture can be tolerated before the brain seeks other stimuli, either internal (e.g., daydreaming) or external (Who is that walking down the hall?). If the teacher is not providing that novelty, the brain will go elsewhere," he writes in "How the Brain Learns Best." (For more of his advice for teachers, visit **http://teacher.scholastic.com/professional/bruceperry/.)**

Integrating a robust arts program is one way educators can capture student curiosity and keep them engaged. According to a recent landmark report from the President's Committee on the Arts and the Humanities, the benefits of studying the arts go far beyond enrichment. *Reinvesting in Arts Education—Winning America's Future Through Creative Schools* found that a high-quality program can improve student engagement, focus attention, heighten educational aspirations, and increase intellectual risk taking. Download a copy from **http://www.pcah.gov/.**

And planning inquiry-driven projects that connect to students' interests will boost the engagement factor and cut down on boredom, which is actually a stressor for young brains. Willis explains why in the video interview "Big Thinkers: Judy Willis on the Science of Learning" **(http://www.edutopia.org/big-thinkers-judy-willis-neuroscience-learning-video).**

Learn more:

- Skype in the Classroom offers educators a way to add novelty at no cost through videoconferencing. Join this global educator community and connect your students with new faces from around the world: **http://education.skype.com/.**
- Field trips add novelty, but at a cost that many schools can't afford. Read this Edutopia article about virtual field trips to find out how to expand your students' world on a budget: **http://www.edutopia.org/virtual-field-trips.**
- Inquiry-based curriculum can also bring new energy to class. Check out the sample assignments from Quest to Learn, an innovative New York school that addresses serious academic goals through a challenging standards-based curriculum via game building, scientific experiments, and a myriad of other activities: **http://q2l.org/node/27#curriculum.**

BONUS PROJECT:

Build a Brain Owner's Manual

BRAIN-BASED EDUCATION reinforces the importance of learning activities that are relevant, novel, multisensory, and challenging enough to stretch students' "thinking muscles." If you're a student, what could be more personally relevant than learning about your own brain? By combining project-based learning with neuroscience, you can offer students an opportunity to follow their curiosity and engage their creativity when it comes to understanding the brain. **Here's how to get started.**

Step 1 Build YOUR UNDERSTANDING

Before diving into project design, you may want to build your own background knowledge about how to integrate brain study across the curriculum. Increasing brain-science literacy is something that will benefit students of all ages, according to Michaela Labriole, science instructor at New York Hall of Science. In *Cerebrum,* she makes a strong case for why K-12 teachers should integrate brain-related topics in the classroom. Online resources and classroom activity suggestions help get you started **(http://www.dana.org/news/cerebrum/detail.aspx?id=28896).**

Neurologist and former teacher Judy Willis describes how her elementary and middle school students benefited from studying the brain in an article for *Educational Leadership.* She explains, "When I began incorporating basic instruction about the brain into my classes and teaching simple activities to improve brain processing, students not only became more engaged and confident, but they also began changing their study practices in ways that paid off in higher achievement." Read her article "How to Teach Students About the Brain" **(http://www.ascd.org/publications/educational-leadership/dec09/vol67/num04/How-to-Teach-Students-About-the-Brain.aspx).**

Step 2 Craft A COMPELLING DRIVING QUESTION

Plan your project with a driving question that will set the stage for deep learning. Crafting the right question for your project will depend on grade level, subject area, and important learning goals. It should be open-ended enough so that students can't easily Google an answer and sufficiently intriguing to grab their attention. (Remember: The brain craves novelty.)

For example: How can we develop a brain owner's manual?

Depending on students' ages and interests, this open-ended question could lead them to investigate sleep habits for healthy brains, how athletes can avoid head injuries, strategies to improve long-term memory, how to inspire more creative thinking, how to be smart about taking risks, and a wide range of other topics.

(continued on next page)

Step 3 Plan
ENGAGING ACTIVITIES

During the research phase of the project, plan activities that will help students investigate what they need to know. A wide range of resources are available. Here are a few:

- BrainWorks, a video from the University of Washington, takes students on a journey through the brain. Kids also visit research labs to learn about brain function and brain research **(http://www.uwtv.org/video/player.aspx?dwrid=4909).**
- Brainology **(http://www.brainology.us/)** is an online program designed to help students develop a growth mind-set. It was developed by psychologist Carol Dweck and researcher Lisa Sorich Blackwell.
- Teens can take a risk-tolerance quiz from a recent National Geographic article about teenage brains **(http://ngm.nationalgeographic.com/2011/10/teenagebrains/risk-quiz).** (The full article, "Beautiful Brains," is available at **http://ngm.nationalgeographic.com/2011/10/teenage-brains/dobbs-text.)**
- Brainy Kids **(http://www.dana.org/resources/brainykids/)** is a youth education site about the brain from the Dana Foundation. It includes games, online labs, and links to lessons and activities.
- Make a brain cap: University of Texas Health Science Center at San Antonio outlines an activity that engages students in modeling their understanding of the brain's anatomy **(http://teachhealthk-12.uthscsa.edu/curriculum/brain/brain01b-BrainCap.asp).**
- Contribute to science: Students can participate in research by taking part in online experiments at Test My Brain **(http://www.testmybrain.org/).** After they take part in experiments such as identifying emotions from tone of voice or testing their "gut number sense," students get personalized feedback.

As a professional development activity, consider exploring the growing literature about brain-based learning with colleagues. You might do jigsaw readings of key research or choose a brain-based title for an all-staff book club. The Dana Foundation maintains links to research in neuroeducation **(http://dana.org/neuroeducation/).** See our suggested reading list at the end of this guide for more ideas.

Step 4 Share
YOUR RESULTS

- Let others know about your project by describing your results in the Edutopia PBL community: **http://www.edutopia.org/groups/project-learning.**
- Visit Edutopia's resource roundup of brain-based learning links and share your favorite websites and tools **(http://www.edutopia.org/brain-based-learning-research-roundup).**
- Join The Educator's PLN, a personal learning network for educators, and take part in active discussions in the Brain Based Teaching group: **http://edupln.com/group/brainbasedteachingtechniques.**

RECOMMENDED READING

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How People Learn: Brain, mind, experience, and school: Expanded Edition.
By J.D. Bransford, A.L. Brown & R.R. Cocking (2000)
Washington, DC: National Academy Press.

Mindset: The new psychology of success.
By C. Dweck, (2006)
New York, NY: Ballantine Books.

The Philosophical Baby: What children's minds tell us about truth, love, and the meaning of life.
By A. Gopnik (2010)
New York, NY: Picador.

Teaching with Poverty in Mind: What being poor does to kids' brains and what schools can do about it.
By E. Jensen (2009)
Alexandria, VA: ASCD.

Brain Rules: 12 principles for surviving and thriving at work, home, and school.
By J. Medina
Seattle, WA: Pear Press.

Mind, Brain, and Education: Neuroscience implications for the classroom.
By D. Sousa (Ed.) (2010)
Bloomington, IN: Solution Tree Press.

Differentiation and the Brain: How neuroscience supports the learner-friendly classroom.
By D. Sousa & C. Tomlinson (2010)
Bloomington, IN: Solution Tree Press.

Mind, Brain, and Education Science: A comprehensive guide to the new brain-based teaching.
By T. Tokuhama-Espinoza (2011)
New York, NY: W.W. Norton & Co.

How Your Child Learns Best: Brain-friendly strategies you can use to ignite your child's learning and increase school success.
By J. Willis (2008)
Naperville, IL: Sourcebooks.

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ABOUT EDUTOPIA

Edutopia is where The George Lucas Educational Foundation's vision to highlight what works in education comes to life. We are a nonprofit operating foundation dedicated to improving K-12 learning by documenting, disseminating, and advocating for innovative strategies that prepare students to thrive in their future education, careers, and adult lives.

Through our award-winning website, videos, and growing online community, Edutopia is supporting and empowering education reform by shining a spotlight on real-world solutions and providing proven strategies, tools, and resources that are successfully changing how our children learn.

To find and share solutions, visit Edutopia.org.

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