Introduction

Brain-Friendly Teaching: Teaching in Ways Brains Best Learn

We have a choice. We can teach in ways that align with how brains naturally learn. If we do, our students learn more, learn more quickly, retain and recall more, and enjoy learning more. And, we are not as tired at the end of the day. Teaching becomes more joyful. It is like swimming with the current. On the other hand, we can teach in ways that do not align with how brains naturally learn. If we do, our students learn less and like learning less. And, we are more exhausted at the end of the day. It is like swimming against the current.

Many traditional teaching methods do not align well with how brains most easily learn. Without changing what we teach, we can change how we teach in ways that make teaching and learning dramatically more efficient. And it is not difficult. The tools in this book transform both teaching and learning. Brain-friendly teaching and learning is more fun and more efficient.

Let's Do a Thought Experiment

After reading this paragraph and before reading on, close your eyes and recall what you had for dinner last night. Picture as fully as you can what you ate. Recall the flavor of the food. Remember whom you were with, what the table looked like, and even some of the things in the surroundings. Don't read on until you have closed your eyes and recalled last night's dinner in as much detail as possible.

The information about last night's dinner, and there was a lot of it, came back very easily. You memorized all that content without even being aware that you were doing so! It was effortless. Now, contrast that with how difficult it is to have our students memorize our academic content, whether it is math facts or formulas, science information, spelling words or vocabulary, or history dates and events. Why? Why are our students able to memorize some information effortlessly and other information only with a struggle?

6 Principles to Enrich the Brain

1. **Principle 1** Nourishment
2. **Principle 2** Safety
3. **Principle 3** Social
4. **Principle 4** Emotion
5. **Principle 5** Attention
6. **Principle 6** Stimuli

The brain is designed to attend to, process, retain, and recall certain kinds of information and, information presented in specific ways. When we understand how brains best function, we can align how we teach with how brains best learn.

What Is Brain-Friendly Teaching?

Brain-friendly teaching is teaching aligned with how brains best function—with how brains best attend to, process, retain, and recall information. The concept is simple and powerful. For example, if we know from cognitive neuroscience that brains naturally attend to and retain novel stimuli, then we can apply that finding to the way we teach to promote learning. A teacher who lectures for an hour in monotone, providing no novel stimuli, is not teaching the way brains best learn. In contrast, if a teacher punctuates the same lecture with unexpected movement among students to form novel pairs, and structures social interaction over the content within pairs in novel ways—that teacher is aligning how she teaches with how brains best learn. Her teaching is more brain-friendly. Students not only retain more of the lecture, they like class, content, and teacher more. Novel stimuli is one of many types of stimuli we can provide to make our teaching more brain-friendly. Brain-friendly stimuli are presented in Principle 6: Stimuli.

When we understand how brains best function, we can align how we teach with how brains best learn.

There has been an explosion of research on the brain in the past few decades. Some of it quite closely links teaching and learning to brain processes. This explosion of brain research has led to a new view of the brain. Not very many years ago we thought brain organization was fixed, and as a result we viewed certain abilities of our students as unchangeable. Now we know the brain is amazingly plastic, rewiring itself on a moment-to-moment basis. The research on neuroplasticity is pushing us to re-examine our assumptions. We no longer accept IQ and ADD as givens. How we teach can actually increase IQ and can focus students who otherwise would be labeled ADD.

We now know how to train the brain. In fact, teaching is the only profession that on a daily basis has the primary responsibility for rewiring a group of brains! And if we apply the findings of brain science, we can do our jobs more efficiently. We can unlock potential among our students, improving their performance for a lifetime.

Teaching is the only profession that on a daily basis has the responsibility for rewiring a group of brains!

Some of the brain-science research that is most relevant for improving teaching and learning comes from the work of cognitive neuroscientists that are not themselves applying their work to education. Nevertheless, applying those findings to teaching and learning empowers us to create more brain-friendly learning environments. For example, the work on mirror neurons demonstrates that when we watch someone perform an action, our brains fire as if we were performing that action (see Principle 3: Social). This finding has a number of direct applications for us as teachers. To take two examples: We are more likely to be successful modeling our instructions rather than just giving verbal instructions, and we are more likely to be successful calming our class by responding to disruptive behavior with a calm voice and a composed face, rather than letting our own agitation show.

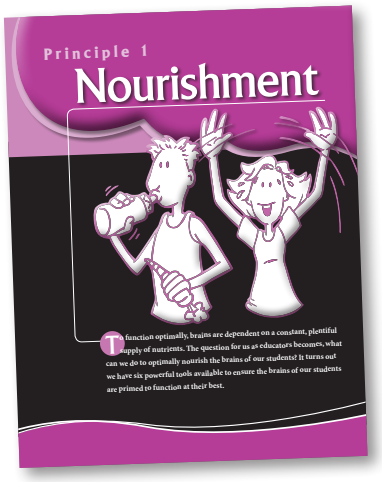
How Is this Book Organized?

This book is designed to present simple, but very powerful ways we can structure our classrooms and teach based on the understanding of brain function. This book contains five ingredients to help teachers make their classrooms and instruction more brain friendly: (1) Principles, (2) Tools, (3) Tips, (4) Brainiac Boxes, and (5) Structures.

Six Principles

Instead of many detailed and complicated principles of brain-based teaching, this book provides just six easy-to-understand principles. Any teacher or presenter that implements these six principles will reap dramatic benefits for themselves and for their students.

The book is organized around the 6 principles. Each principle begins with a full-page divider that gives a thumbnail sketch of the principle. The dividers look like this:



For each of the six principles of brain-friendly teaching we begin with a discussion of the theoretical and empirical rationale for that principle. For example, in introducing Principle 2: Safety, we begin with a discussion of how the brain functions under threat and how it functions in a safe environment, providing the rationale for creating threat-free classrooms.

The Six Principles:

Nourishment

1. Nourish the Brain. As the neurons in the brain talk to each other, they consume a huge percent of the nutrients in the body. Well-nourished brains learn better. Here we learn how to create well-nourished brains.

- **Interesting Finding:** Two high-intensity sprints of less than three minutes each led to a greater release of epinephrine and norepinephrine and to 20% faster acquisition of new vocabulary words compared to 40 minutes of low impact running!

Safety

2. Foster Safety. In the presence of threat, cognition and perception narrow, making learning difficult or impossible. Here we learn many ways to facilitate thinking and learning by creating brain-safe classrooms and schools.

- **Interesting Finding:** High-anxiety students score below low-anxiety students on a multiple-choice test when administered in the typical way, but when the same multiple-choice items are worded in a humorous way, high-anxiety students score as well as low-anxiety students!

Social

3. Promote Social Cognition and Cooperation. The brain is a social organ. There is a distinct social cognition network in the brain, which, when activated, makes our academic content more memorable. Here we learn how to reap the benefits of the social encoding advantage. The brain is never more engaged than when in social interaction, and never more positively engaged than when in cooperative social interaction. So, to have our students more engaged, we learn to structure positive, cooperative activities for our students. We explore three keys to structuring for successful cooperative learning.

- **Interesting Finding:** When told to memorize for a test a list of accomplishments of a person, students do not score as well on the test as when there is no mention of a test and students are told only to form an impression of the person based on their list of accomplishments. Entirely different parts of the brain are engaged under the two sets of instructions!

Emotion

4. Release the Power of Emotion. Emotion can facilitate or inhibit learning. It can turn off the ability to think and to be creative, or it can facilitate thinking, creativity, and the cementing of enduring memory for content. New research reveals the power of positive emotion to facilitate thinking and creativity. Thus we provide 37 ways any teacher with little effort can elicit positive emotion in their students. The discovery of *retrograde memory enhancement*—that anything followed by emotion is better remembered—has huge implications for teaching. Here we learn how to avoid downshifting and teach for memory by teaching with emotion.

- **Interesting Finding:** Following a good laugh, students have greater fluency, flexibility, and creativity of ideas. Eliciting positive emotion in any way broadens perception, increases creativity, and enhances problem solving!

Attention

5. Capture and Hold Attention. By capturing and holding attention, we radically increase retention. If the minds of our students are wandering, they have little chance of acquiring the skills and knowledge we offer. Attention yields retention. As obvious as this is, educators have failed to apply what we know about capturing and holding attention. Here we learn how to manage attention to radically improve learning.

- **Interesting Finding:** Mind-wandering is the default mode of the brain and occurs about 50% of the time throughout our day. Mind-wandering begins within 30 seconds of the start of a lecture, and increases in frequency as a lecture progresses!

Stimuli

6. Supply Stimuli Brains Seek. Brains seek, attend to, and retain certain kinds of information far better than other kinds. Here we learn to teach our content in ways brains are most likely to attend to and remember—to teach in the ways brains naturally seek to learn.

- **Interesting Finding:** Lecturers who gesture inspire more confidence among students. Teacher gestures during instruction increase performance on immediate posttests, delayed posttests, and transfer of concepts to new content! Teaching students to gesture improves their achievement!

60 Tools

For each of the six principles, after a presentation of the rationale for the principle, you will find tools to implement the principle. For example, after seeing why a threat-free environment is critical for optimal brain functioning, you will find 14 Tools to create safety, including how to provide safe forms of evaluation, and ways to ensure that every student feels included. Each of the six principles contains from 5 to 14 tools, many of which any teacher can implement immediately with little effort. There are 60 tools in all. For each tool, look for the following icon:

Theoretical and Empirical Rationale for the Tools. The rationale for each tool is provided. The tools are all based on brain research. Some spring from theory, others have a direct empirical basis, and some have both. For example, we know from brain research that exercise increases the nutrients in the brain. This would give us a theoretical basis for advocating more exercise for students. We also have direct empirical evidence demonstrating that the more exercise students get, the better they score academically. This gives us not just a theoretical basis for advocating exercise—it gives us an empirical rationale as well. Exercise, then, is an important tool to create brain-friendly instruction.

Let's take another example: eliciting positive emotion. Theoretical support: Positive emotions release dopamine that stimulates the motivation, attention, and reward centers in the brain. On a theoretical basis alone, we would do well to elicit positive emotions in our students. Empirical support: Just prior to a math test, half of a group of students were randomly assigned to think of a positive experience. Those students assigned to the positive emotion group finished more problems and solved more problems correctly than those in whom positive emotion was not elicited. Given this and a number of other true experiments showing that eliciting positive emotion improves problem solving, creativity, and test taking, I include 37 ways to elicit positive emotion.

Experimental v. Correlational Studies. In deciding which empirical research to present, I have had a strong bias. I give little weight to correlation studies, favoring instead experimental studies. For example, there is a correlation between students having positive emotions and doing better in school. I don't present that

research. From that correlation we can't tell if positive emotion causes better achievement, better achievement causes positive emotion, or some third variable causes both. I present correlation studies only rarely and only if they are consistent with the findings of theoretical and/or experimental studies.

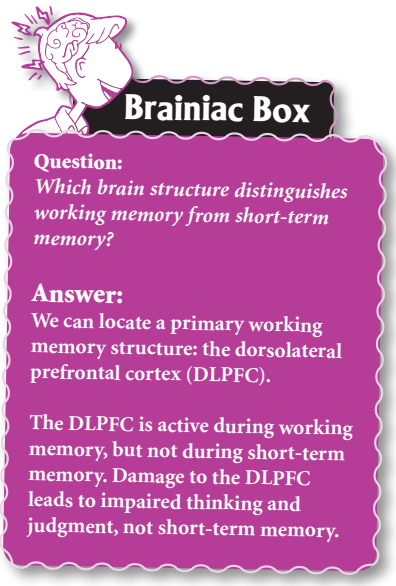
Hundreds of Tips

Within each tool there are numerous tips to make implementation easy and successful. Tips look like this:

For example, in Principle 3: Social, I provide the following tip: When creating teams, group students in pairs or in groups of four. Avoid groups of three. Groups of three too often become a pair and one student who is painfully isolated. Useful tips are sprinkled throughout the 60 tools. Any teacher can implement the simple tips to make a more brain-friendly class. There are hundreds of tips in all.

21 Brainiac Boxes

A fourth ingredient in this book is the inclusion of Brainiac Boxes. Would you like to know which brain structure is responsible for the experience of disgust? How activation of working memory and short-term memory light up different parts of the brain? How the four attention systems in the brain differ? For those who want to locate brain structures and functions and deepen their understanding of the brain, the book provides Brainiac Boxes—quick reference boxes that explain the brain and provide referenced research for those who would like to explore deeper. Those who would prefer to focus only on tools and tips are free to skip the Brainiac Boxes, focusing on practical techniques to align how we teach with how brains best learn. Brainiac Boxes look like this:



27 Structures

The final section of the book provides 27 structures. Structures are instructional strategies you can use tomorrow as part of any lesson. Structures are step-by-step ways to structure the interaction of students with the curriculum, with each other, and with the teacher. After you have used a structure just once, you and your students become familiar with the steps of the structure and you can use it again and again as part of any lesson to align your teaching with how the brains of your students best learn.

For those of you experienced with Kagan Structures, you will find new structures like **Swap Talk**, **Traveling RallyInterview**, and **Number Group Mania!** You will deepen your understanding of what is happening in the brains of your students as you use the 27 structures. For example, new brain research reveals **Paraphrase Passport** activates the social cognition network that dramatically enhances memory. For those of you new to Kagan Structures, you will find a way of teaching that produces intense engagement and indelible learning. Structures open up a world of success and joy in both teaching and learning.

The steps of each of the 27 structures are provided in the Structures section that follows the six principles. For easy reference, throughout the book, you will find the names of the structures in bold (like this: **Celebrity Interview**) and you will find an icon with the number of the structure so you can easily locate the structure in the structure section. The structure icon looks like:

Why include 27 Kagan Structures in a book on brain-friendly instruction? The Kagan Structures were developed before the concept of brain-friendly instruction. They were not designed as a way to align instruction with how brains best learn. Nevertheless, Kagan Structures are among the most powerful tools we have for implementing each of the six principles of brain-friendly instruction:

Nourishment: Kagan Structures integrate frequent movement into daily instruction, increasing the supply of nutrients to the brain. Movement is part of the reason students feel energized by the structures.

Safety: Kagan Structures include positive interdependence—students are on the same side, encouraging, tutoring, and praising each other. They feel included as part of a team. All of this creates a threat-free, safe social network quite in contrast to the isolation and competition common in most traditional classrooms. With threat reduced, the prefrontal cortex is freer to think and learn.

Social: The brain is never more engaged than during social interaction, and the Kagan Cooperative Learning Structures all involve cooperative social interaction. The structures release the power of the social encoding advantage.

Emotion: Kagan Structures include encouragement, praise, challenges, and celebrations that elicit positive emotion. The positive emotion makes content more memorable and opens brains to be more perceptive, thoughtful, and creative.

Attention: Brains do not process or retain that to which they do not attend. Heightened attention leads to increased memory of content. The Kagan Structures focus attention. There is no opportunity for students' minds to wander as they interact over the content. The Kagan Structures keep each student accountable for responding on a very frequent basis, in contrast to the call-on-one-at-a-time traditional approach that allows for the minds of many to wander. Attention yields retention.

Stimuli: Brains seek both novelty and predictability. This creates a dilemma for traditional teachers—should I emphasize procedures and routines, sacrificing novelty, or should I abandon procedures and routines, for the sake of novelty? The Kagan Structures are a unique solution to this dilemma. The structures are routines, satisfying the brain's need for a predictable world, but within the structures are plenty of novel stimuli as students interact. Further, using a variety of structures creates novelty as they provide different ways to interact—with partners, teammates, and classmates.

Attention yields retention and Kagan Structures focus attention.

When teachers use Kagan Structures, they align how they teach with how brains best learn. Because Kagan Structures are so flexible and repeatable, they are empowering. Once you know one structure, you can use it to generate an infinite number of activities for your class—just plug in your own content.

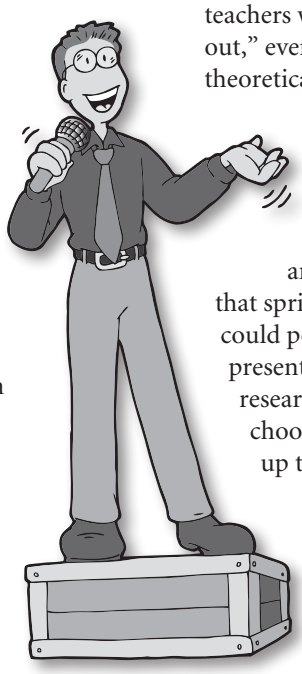
What Is Not Included? The Memory Systems

There is a very important, large area of brain research with direct implications for brain-friendly instruction that is not included in this book: The research on the memory systems. We now know that very different parts of the brain process different types of memories. For example, when we learn a new procedure (the steps of long division) we are acquiring a procedural memory. In contrast, when we memorize something ($7 \times 6 = 42$), we are acquiring a semantic memory and a very different part of the brain is involved. Further, we know that certain instructional strategies are efficient for acquiring procedural memories whereas different instructional strategies are efficient for acquiring semantic memories.

There are distinct memory systems, each most efficiently addressed with very different instructional strategies. The implications of this for educators are tremendous. We greatly improve efficiency in teaching and learning if at any moment we know which kind of memory we wish to create, and which instructional strategies will best accomplish that. This area of brain-friendly instruction is so important and so large, I have decided to address it in a second book: *Memorable Teaching: Engaging the Brain's Memory Systems.*

How to Use this Book

This book will be read and used differently by each educator. For example, I provide the details of what happens in the social cognition network of the brain when, preceding an encounter, a host greets a guest with a handshake and a smile. The research is clear: A handshake and a smile signal the brain to "approach," making class more attractive, and learning more likely. Some educators may want to read the brain research on the power of handshakes, and perhaps even follow up by reading the referenced articles that explain that research in depth. Others may want to simply read and apply the tip: *Greet students with a handshake and a smile.* Others yet might feel that greeting students with a handshake is not for them. Not all tools or tips will be useful to all teachers. The book is designed to be useful to you whether you want to learn more about the brain, whether you are simply looking for practical ways to make teaching and learning more successful and enjoyable, or both. It is up to each educator to pick and choose. I am certain, however, you will find many easy-to-use strategies that will make your classroom more brain-friendly.



In part, the book is written in the spirit of a cookbook. Included are many delightful recipes for making teaching more brain-friendly. Cookbooks, however, are not read cover-to-cover. We turn to them again and again as we seek new recipes or as we want to be reminded of old favorites. You will not want to try all the recipes included here, but I am certain you will find many that will delight you and your students.

Some educators when reviewing the research will go wherever the evidence leads. Others for a variety of reasons might balk at instituting some or even many of the brain-friendly tools. The book includes many brain-based strategies that are simple for any teacher to apply. The book also includes strategies that are not yet common practice among educators (including a prework cheer, encouraging students to drink water frequently, engaging social cognition while presenting curriculum…). Admittedly, many teachers will find some of the strategies too "way out," even if those strategies are supported by theoretical and empirical data, and rooted in solid brain science: *"My job is to teach geometry; not meditation!"* In creating this book, my job has been to evaluate the theory and research, present the best of it, and then provide tools and tips to implement the principles that spring from brain research. No teacher could possibly implement all the tools and tips presented here. What each of you does with the research, which tools, tips, and structures you choose to add to your pedagogical toolbox, is up to you.

My Recommendation

Pick tools and structures that fit your style and that of your students. Experiment with them. When you find success, make those tools and structures part of your instructional repertoire. You can, and should, start slow. Adopt and experiment with just one tool or structure. Make it your own. See the benefits. Having expanded your instructional repertoire, come back to this resource to find another tool, tip, or structure to try.

My Hope

My hope is that each of you will draw from this set of brain-friendly strategies in your own unique way, creating your own unique approach to brain-friendly teaching and learning.