



THE SIX RED MARBLES NATURAL LEARNING APPROACH

We developed the Six Red Marbles *Natural Learning Approach* by looking at the most current, well-respected insights in educational and neuroscientific research. We used this research to create supplemental classroom tools that are grounded in how kids learn, why they learn, what they learn, when they learn, and where they learn. And we make it fun. Because fun matters.

These core insights guide our process:

- Whole-brain learning is best.
- Humans are naturally inquisitive and motivated by novelty (fun really is important).
- Multiple learning paths result in better performance and more creativity.
- Emotion directly affects perception, cognition and action.
- Social interaction is critical to developing attention.
- Exercising memory helps develop awareness.
- The best learning technologies have a simple, clutter-free and intuitive interface.
- Previous knowledge influences on-going learning—for better or for worse!

From here, we consider research and insights that are appropriate to each age group or grade level. We know that all kids respond strongly to visuals, story-telling and role-playing. We look at where children are struggling—and we also notice where they thrive.

Then we create fun classroom tools that make kids fight for their turn at learning.

Research

Not all neuroscience research is useful in education. We hear a lot about the left brain vs. the right brain. But in normal brains, the two hemispheres interact in parallel and complementary ways. We focus on complete learning. We believe methods that develop sequential thinking skills (traditional left-brain activities like reading, writing and arithmetic) have to be complemented by methods that develop holistic, creative, right-brain processes.

We designed *Juba*[™], *Waza*[™], and *Cabanga*[™] to support whole-brain learning. Here's how.

Restoring Balance

We know that normal learning involves the whole body and mind. This table shows the complementary orientations of traditional educational methods and innovative methods. Why start a fight? Six Red Marbles combines both. That’s how we arrive at whole-brain learning.

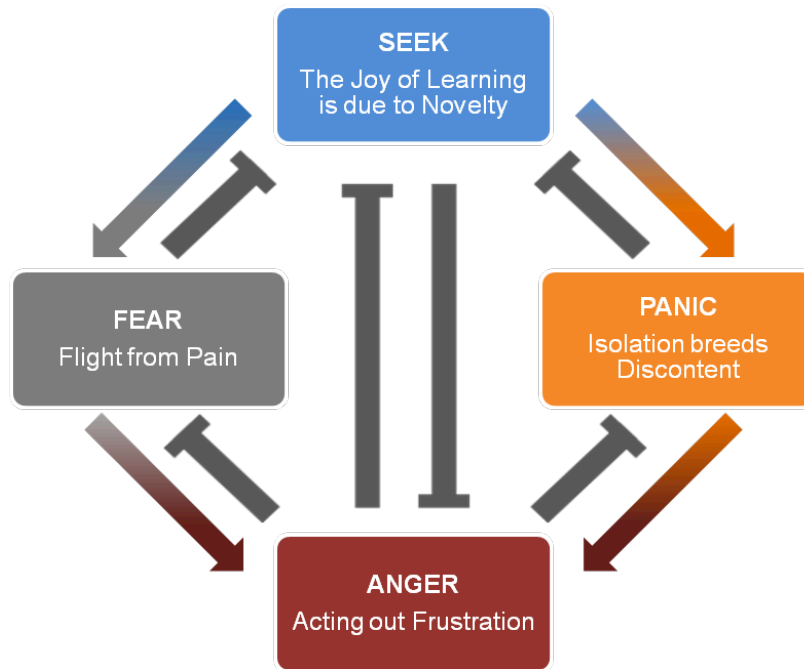
	Traditional	Innovative
Learning model	Left-brain Sequential Analytical Systems	Right-brain Holistic Synthetic Creative
Brain function emphasis	Verbal Literal	Visual Metaphorical
Attention span	Sustained	Short
Pedagogy & curriculum	1-2 media Defined narrative Single assessment model	Multi-media Topic-based dynamic learning Multiple assessment options
Success definition	Individual	Team
Emotional connection	Extrinsic motivation External orientation Egocentric concerns	Intrinsic motivation Inner awareness Group belonging, caring
Health focus	Body	Body, brain, mind

Emotional Development and Function

Any parent or teacher can tell you—kids feel strong emotions when they’re learning. Discovering something new can lead to feelings of real happiness, while insecurity (plain old fear) can lead to negative emotions and actions. There is good news. Using the psychobiology of emotion, we can design instruction methods that manage kids’ emotions to enhance their learning.

Six Red Marbles adapted the chart below from Jaak Panksepp’s work in affective neuroscience. This research recognizes that by nature, children are social and inquisitive. Seeking is a natural behavior for them, and it’s stimulated by its own reward—novelty. A seeking kid is generally a happy kid. But seeking can sometimes lead to fear or panic. Negative feelings disrupt cognitive, perceptual and autonomic processes—and the behavioral reaction is “fight or flight” or paralysis. From there, it’s easy

for kids to become angry. And anger, once it's out of control, puts an end to seeking. Panic, fear and anger all extinguish the joy of learning.



Note: arrows indicate activation; cross-bars indicate inhibition.

Knowing this, we're empowered to design activities that anticipate kids' emotional responses to learning (and learning challenges, in particular). We can anticipate emotions and adapt to individual needs and experiences in real time.

When kids' emotions are positive, they can be completely engaged. They're excited by discovery about the world, and they take a hands-on approach to their own learning. We know that behavioral responses to emotions can be learned and unlearned. So we can use multiple sensory modalities to keep the feeling of discovery alive. We just need to mix it up. And Six Red Marbles does.

This table describes how we can apply the dynamics of emotions to school curriculum and learning methods.

Curriculum Design & Emotion		
Goal	Method	Related Outcomes
Increase SEEKING	Engage students' current knowledge; develop motivation and joy of learning through novelty [adaptive curriculum with applications]	Reduced FEAR, PANIC and RAGE
Reduce FEAR	Increase opportunities for success; discuss anxiety	Increased SEEKING
Reduce PANIC	Social contact; interactions with peers and teacher [cooperative learning, peer interaction]	Increased SEEKING
Reduce RAGE	Channel energy into play and games [software/video games with embedded learning objectives]	Increased SEEKING; reduced RAGE, FEAR and PANIC

Cognitive Development: Associative Learning

Let's get basic. Learning = acquiring knowledge, skills, attitudes and values. Learning happens all the time, formally and informally. Every child's learning path combines study and personal experiences. And using their memories, kids recall and apply what they've learned.

Associative learning and memory are basic forms of cognition for both people and animals. There are different ways that we learn and adapt to our environments:

Categorical learning: This type of learning teaches, through experience, that a certain object is part of a particular group. A category is defined by certain features, and an object belongs in that category only if it has those features. In categorical learning, the brain learns to create and use categories and determine which category best describes each object.

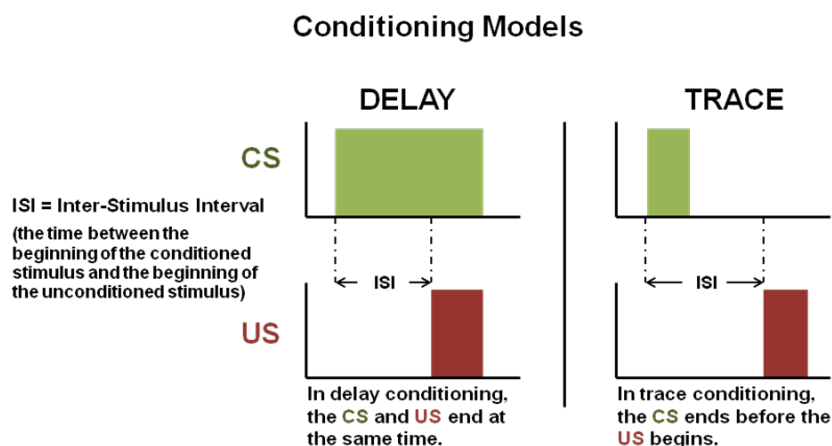
Operant conditioning: This type of learning teaches that, in a particular situation, a certain behavior leads to a certain outcome. The behaviorism theory proposes that the frequency of a behavior is affected by rewards and/or punishments that follow that behavior. B.F. Skinner

studied operant conditioning in pigeons, which learned to press levers to receive a reward. (There are critics who believe firmly that operant conditioning should not be part of education.)

Classical conditioning: This type of learning helps people develop associations between things. Ivan Pavlov famously conducted the foremost study on classical conditioning, which he discovered by accident while studying dogs’ salivation response. Within classical conditioning, any object or event that a person can sense is referred to as a stimulus. There are two types of stimuli:

1. **Unconditioned stimulus (US)**—A stimulus that naturally evokes a response or reflex called the Unconditioned Response (UR).
2. **Conditioned stimulus (CS)**—A stimulus that does not naturally evoke a response but can *acquire* the ability to elicit the response, called the Conditioned Response (CR), through classical conditioning.

There’s more! There are two models of conditioning: delay and trace. Trace conditioning requires conscious awareness and use of memory, while delay conditioning doesn’t. This makes trace conditioning a higher-level cognitive task—and more difficult. This chart illustrates the differences between the two:



Conditioning requires internal storage (memory) of the CS to form an association with the US

Activities that require trace memory develop self-awareness, and self-awareness is necessary to develop empathy. This makes classical conditioning very important for developing social skills. Through classical conditioning, we learn to be nice.

What are the different types of memory?

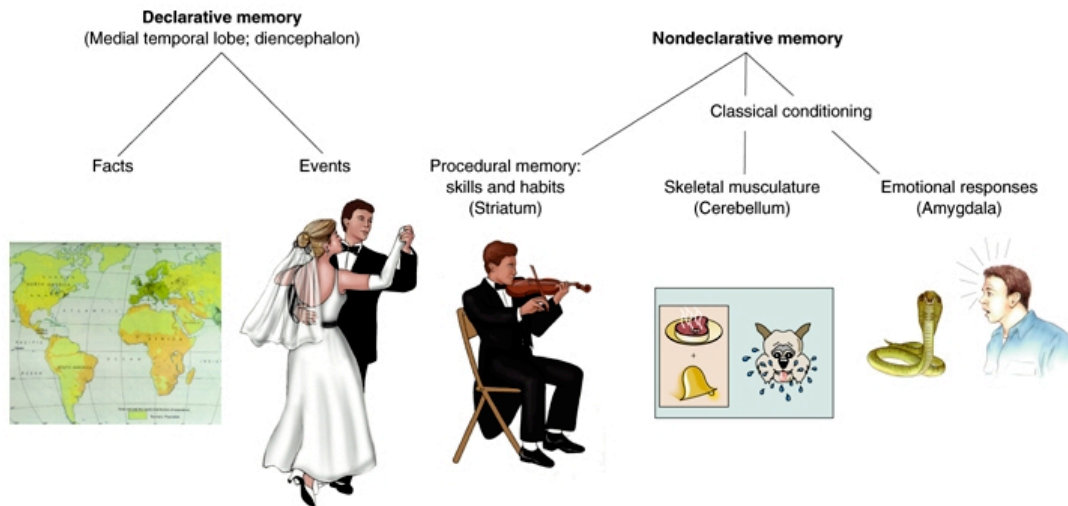
It's much easier to remember what you ate at your desk seven seconds ago than it is to remember what you ate at your desk seven years ago. That's because our working memory and our long-term memory are very different. By studying these two types of memory, we can better understand kids' thinking—and how they'll recall what they learn in the classroom.

Working Memory, as the name implies, involves acting thinking. But it's **very** fragile. We forget the information stored in our working memories very fast—most of it only lasts seconds or minutes. If someone tells you a telephone number, and then someone else asks you for directions to the store, it's perfectly normal to immediately forget the phone number. (Really, it's natural, don't feel bad.) We need our working memory in daily life to store temporary information, and our brains also use it to access and send items to our long-term memory. But it's not stable, and it's not designed for long-term use.

Long-term Memory is very stable, and the information stored there is not easily forgotten. Even if you get distracted by that request for directions, you will remember your own phone number (thank goodness). These memories persist for long periods—days, months, years.

There are two types of long-term memory: declarative memory and procedural memory (part of a larger category called non-declarative memory). Declarative memory stores knowledge about what things are. It saves facts and events, and useful information like the password to your email account. When you can remember the names of your favorite ball players and your best friend's birthday, it's because your declarative memory is working. Procedural memory stores knowledge about how to do things. It saves skills, habits and emotional/physical behaviors. You can remember how to ride a bike, throw a football and take notes in class because of your ability to store procedural memories.

This image shows how declarative and non-declarative memories are organized, as well as some of the structures in the brain that govern them.



Neuroscience: Exploring the Brain, 3rd Ed, Bear, Connors, and Paradiso Copyright © 2007 Lippincott Williams & Wilkins

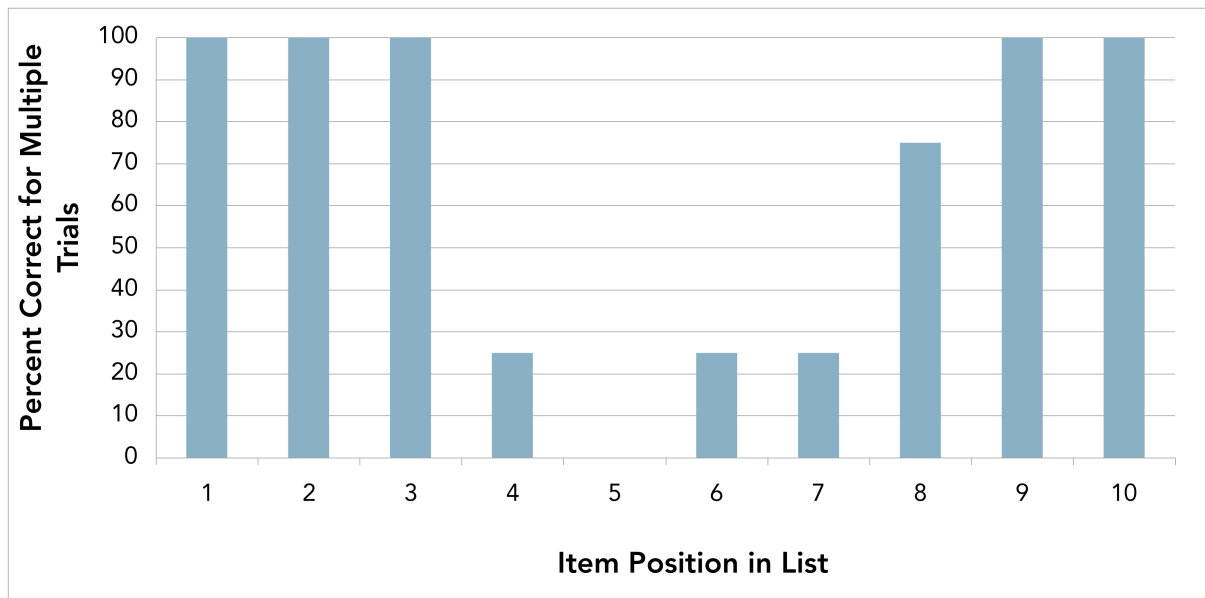
The two types of memory are specialized, but they're designed to work together. Neuroscience and cognitive research tell us that working memory varies over time—and that we can expand its capacity with effort. In fact, certain important sequences are best learned using working memory. By understanding the interplay between the two, we can support transfer of information to long-term memory. Rapid new learning reinforces stable, old learning.

The Six Red Marbles *Natural Learning Approach* improves the interaction between working memory and long-term memory. We do it by focusing on kids' attention. We know that if kids are engaged in things that fascinate them, their working memories become stronger.

Sequence Learning

Sequence learning is important for mastering digits, letters, words, pictures, lengths of items, where each item belongs in a list and whether or not items belong in a group. As you'd expect, distractions can really mess up sequence learning. Noise and competing tasks knock information out of working memory and otherwise lead to poor performance. But focus and attention have very positive effects. Being very interested in something causes memory capacity to expand.

This chart displays psychometric data showing typical primacy and recency effects when people perform tasks. You'll notice that performance is better for items near the beginning and end of a list.



Trying to challenge people by asking too much of their working memory turns out to be counterproductive. Once we exceed working memory's small storage capacity, we start to store sequences in incorrect temporal order. To learn new sequences without forgetting old ones, we need to transfer working memory to long-term memory. Repetition is effective at accomplishing this—but wow, is it boring. And boredom pulls people out of being focused, the state in which they learn most efficiently.

There are ways to improve working memory that can be formally taught. Our brains naturally strategize to overcome working memory's limitations, and one strategy is called "chunking." When the brain is chunking, it's storing memories in groups, rather than as individual pieces of information. There are two types of chunking: temporal (an automatic response) and associative (which can be either a voluntary or automatic response).

If you can immediately pronounce all the syllables in a very long word after hearing it just once, your brain is doing some temporal chunking. If you group together all the pictures of animals that start with the letter "A" to remember them, your brain is practicing associative chunking. Either strategy can be applied to lessons.

All this research empowers us to craft better teaching methods for sequence learning. Each activity should last only a short time. The content should be somewhat randomized to maximize the number of primacy/recency events. Randomly practicing lists (like the alphabet, at various points throughout the day, week or month) is more effective than scheduling routine, blocked drills.

It's all about making progress. Smart sequence learning helps kids move on to their next phase of learning. When a child first learns to speak or read a multi-syllabic word, they focus all their attention on remembering each syllable in sequence. Once they've mastered that, they can move on to understanding and applying the word's meaning. Brilliant.

For more information, please visit: www.sixredmarbles.com

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