



BOOSTING BRAIN POWER

52 Ways to Use
What Science
Tells Us



Jill Stamm, PhD

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This book is dedicated to my daughters,

Jenny and Kristin

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And I am always grateful to my daughter Jenny for showing me every day that, even with special needs and against all odds, each person can make a profound difference in this world. Jenny has been, and remains, my supreme teacher.

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INTRODUCTION

What Caregivers Can Easily Learn about Brain Development

In the desire to help our youngest children develop strong, healthy minds and important qualities of character and caring, we can start by thinking about how each of us will answer a common question, “*Why* does early childhood matter?”

I am asked this question often. I am asked to define, “What specifically has been discovered that requires a change in the kind of care young children receive?” Some of the new information comes from neuroscientists who detail how to protect a developing brain; some has been reported by economists who calculate cost savings resulting from improved early care and education for young children. Other new information is derived from longitudinal studies that link the quality of childhood experiences to long-term health outcomes.

This book is designed to help caregivers use new knowledge that has been created by a variety of sources. Anyone caring for young children has questions about everyday concerns. These questions deserve simple but accurate answers. This book provides caregivers—including center-based staff, in-home family child care providers, nannies, early childhood–education students, parents, and other family members—with easy-to-understand messages that translate complex science-based information about early brain development into simple actions you can take to encourage healthy development in infants, toddlers, and preschoolers. Now that neuroscience has revealed such critical

information about how brains actually develop, educators and caregivers can use these key ideas to implement a variety of new strategies and perspectives in their classrooms and child care settings.

This book provides short statements called “Brain Nuggets” that inform caregivers about the latest important information on early brain development. These are clustered into the categories of general science, attention, bonding, and communication. You might decide to skip some introductory information for now and go right to the first Brain Nugget. That is just fine. You can start and stop where you choose. Because there are fifty-two main ideas explained in the book, you could easily approach the content by reading and thinking about one idea each week of the year. I want to emphasize the notion of thinking about a main idea. Each person who cares for young children has a different story, a different reason she wants to help young children, and a different amount of formal education about child development. Because the science of early brain development is so new, caregivers also have different (and probably limited) amounts of formal instruction about the brain of a child. This book can guide your efforts to create environments and relationships that can make a difference, based on what researchers have learned about the social-emotional and intellectual development of young children.

For more than a decade, the general public has been exposed to reports detailing recent findings from neuroscience about how young brains develop. Yet only recently have leaders in government agencies, community organizations, and corporations committed to expecting educators to apply those findings to their practices and policies on caring for and educating children from birth to five years old. You can find a mountain of evidence revealing the factors that are known to have an impact on the trajectory of development, either healthy or challenged. The problem has been, and remains, that it can be difficult for the scientists who conduct and share study results to also offer clear, simple, and comprehensible applications of this important information. Their attempts may have missed the mark because either they are too technical and text laden, thereby making comprehension time consuming and demanding, or they provide only broad-sweeping summaries that lack enough detail for the reader to be able to know what to do with the information.

This book offers clear, succinct key findings from neuroscience to help teachers and caregivers understand some of what I call “Brain Basics 101,” which in turn help when

explaining why specific behaviors, environments, and practices can be so helpful in securing normal, healthy brain development. The book then offers prevention strategies that have been shown to be easily learned and implemented in care environments and classrooms for infants, toddlers, and preschoolers. The Brain Nuggets in this book offer simple, concrete ways of understanding why the quality of care matters so much to a developing brain. Anyone who cares for and loves a young child can benefit by knowing what the science shows. References to research are noted so that you can do further reading if you desire. But the main point is that easy-to-learn ideas, guides, and suggestions can help you be more deliberate in the interactions you have with young children. Quality care that is intentional matters. When caregivers understand why their role is so critical to the actual development of a child's brain, several things follow.

First, many caregivers will feel a novel sense of pride in their work. They can now see themselves as key figures in the lives of children. Even if they had hoped for this role, they often felt their contributions were not recognized. This increased sense of self-efficacy can benefit the overall field of early care. Because it is unlikely that early care-workforce wages will see a rapid increase in the near future, talented staff will more likely decide to continue in their current roles or perhaps seek additional education once they understand their true value to society.

Second, caregivers can start to create environments and activities on purpose, instead of by accident or by instinct. A growing body of scientific research on mindfulness explains why this development occurs. When you are *intentional*—meaning *mindful of your actions*—you can greatly increase the likelihood that you will take a desired action. From human behavior, we know that when you plan and understand why you want a certain outcome, you will naturally commit more fully to see that it happens. The quality of care given to children increases dramatically when teachers and caregivers understand the reasons they should take certain actions.

The educational mandates in most states now include an emphasis on school-readiness efforts and programs. In almost every incarnation, the school-readiness concept focuses on specific skills that a child should have before entering kindergarten. However, policy makers provide very little money or planning for accomplishing those goals. Although a mandate on meeting specific benchmarks is understandable, the policies seem to hinge on a general misunderstanding that school readiness can be achieved

simply by expecting historically agreed-upon primary-grade skills to be demonstrated earlier and earlier among preschool children. Parents feel it. Preschool teachers feel it. Caregivers know it is coming. The *it* is the unrealistic expectation that caregivers, child care directors, early care providers, and education staff will somehow automatically know how to protect and manage early brain development! This kind of knowledge will not happen by magic. Nor will it occur by just creating lists of activities that promise to result in school readiness. The activities themselves are not the most important aspect of school readiness. Rather, a child needs a ready brain that is capable of learning the different skills parents, caregivers, and teachers present at appropriate times in the child's development.

How then can we think about school readiness from the perspective of a child's brain? For a child to learn, she needs to allocate her attention to a task long enough to learn the information. The child needs to develop enough impulse control to be able to inhibit her desire to shift her attention and instead to stay on task.

A child's ability to focus involves understanding that he is safe and feeling secure that people love him. He needs to feel bonded to others. When a child has loving first relationships, he can grow and widen his circle appropriately to include others.

The child also needs to hear lots and lots of language spoken directly to her using words that describe and label not only objects in the environment but also relationships with others and the feelings the child experiences. Children need to develop both receptive and expressive communication. Mindfully, intentionally interacting with young children, promoting language-rich environments, and providing primary experiences for their brains to absorb can help prepare children for the challenges of formal schooling.

Preschool teachers and early care providers can work on being mindful every day to think about how they are focusing on each of these three areas: attention, bonding, and communication. This book will present these important concepts in short, pithy nuggets of information that can be applied in a classroom or used to create policies that benefit young children. The format is designed with busy caregivers in mind.

Each of the fifty-two segments provides a chunk of information or an idea summarizing research on early brain development. Each item begins with a concise statement that

captures the essence of a larger idea using easy-to-understand language. You can reflect on the concepts and then use your prior knowledge and experience to think of how you can apply the principles.

Following each concise statement is an explanation of why the information is important and how it can help caregivers. Each segment also provides suggestions for applying the information to different audiences. You may find strategies or various perspectives on how to begin modifying current environments and policies.

The information in this book has been field-tested in my work with thousands of early care and education staff members, caregivers, in-home providers, and families in Arizona for more than fifteen years. The organization I cofounded in 1998 to share early brain development information, New Directions Institute for Infant Brain Development, has taught these and related concepts in workshops to nearly 80,000 individuals.



PART 1

Brain Basics 101

To successfully interact with young children in ways that reflect current, well-informed understandings of the brain, you do not need to learn the formal name of every brain structure or to understand the workings of individual neurons, synapses, or neurotransmitters. However, you do need information about how a child's brain develops and what the brain needs to grow into a healthy, self-regulated, learning organ.

Thanks to imaging technologies, scientists can look inside a living person's brain and discover useful information for making a medical diagnosis. Researchers can also document in which specific brain regions the connections are emerging at various ages in a typically developing child. The ability to view the brain as a growing, changing organ has implications for anyone caring for a young child.

A child's brain develops in a predictable sequence. Knowing this sequence can help guide caregivers to choose which experiences to focus on and at what age. Caregivers should note that the timing of brain development matters because not all parts develop at the same time. Certain regions wire up rapidly, and other areas refine their connections over long periods of time.

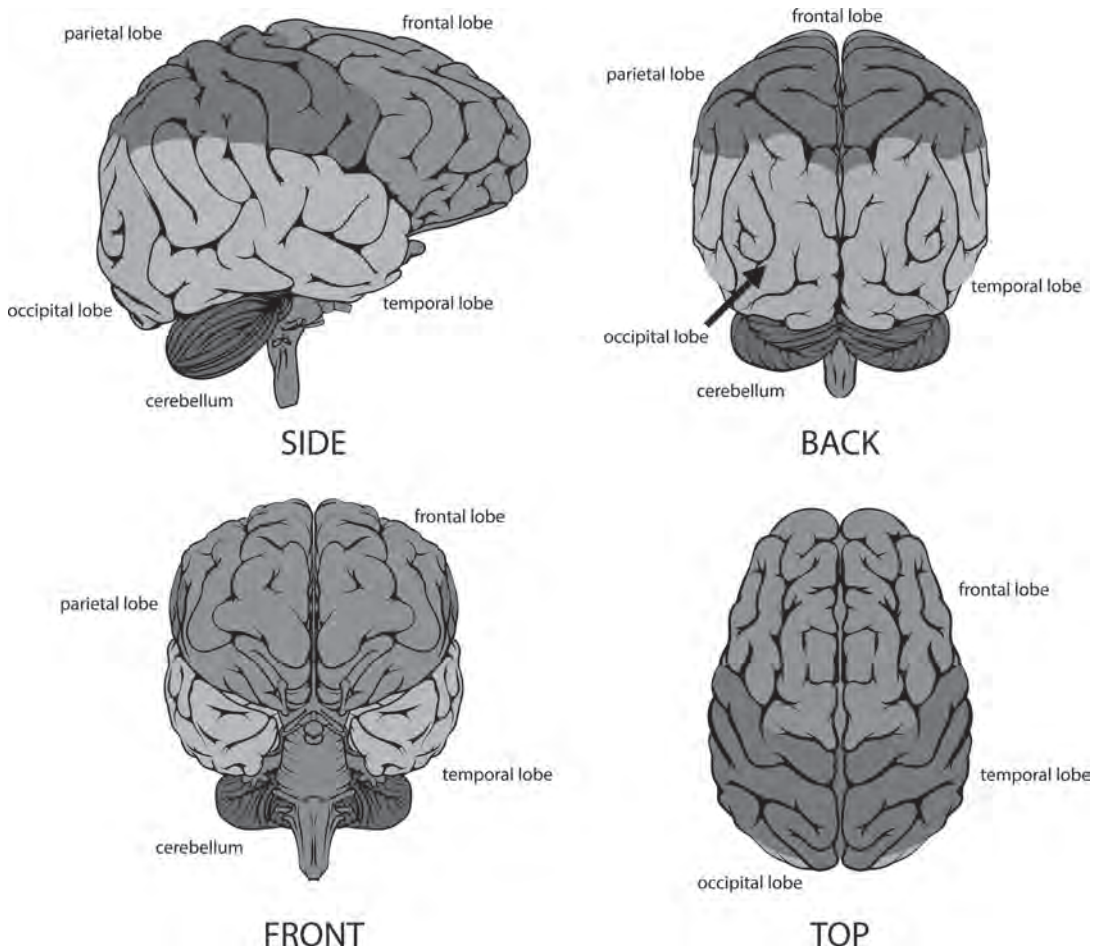
How the Brain Develops

As you begin thinking of the brain's growth and development, it will help to know several basic ideas. The sequence of brain development occurs in four simultaneous, dynamic ways: back to front, inside to outside, bottom to top, and right to left.

Primarily, the brain has three component areas: the brain stem, the limbic system, and the neocortex.

As you learn and think about the structures and functions of a brain, a critical organizing principle is that the earlier in life a structure develops and connects, the more resistant it is to change. But change is not impossible. To be specific, some of the early developing areas in the back, inside, and bottom develop rapidly. Once these general regions wire up, they are harder to influence and change. Therefore, the brain stem, which is both inside and at the bottom of the brain, and the limbic system, which is in the very center of the inside, are more difficult to change. The neocortex is the outermost area and continues to develop and change throughout a person's life span.

To envision the sequence of the developing brain, examine the accompanying drawing of the brain regions. This sequence is described in more detail in the following section.



The Sequence

As noted, the brain develops in four simultaneous, predictable ways:

1. From the back to the front—The parts of the brain that process vision wire up first. Although babies cannot see clearly at birth, the wiring for normal sight occurs rapidly. By about six months, infants can see almost as well as many adults!

Then the hearing system wires up. Babies can hear in utero, and at birth, they can recognize speech patterns and tones. However, newborns cannot yet hear distinct speech sounds. The ability to distinguish small variations in sounds develops at a fast pace, and children remain receptive to learning the sounds of new languages for the first few years of life.

Moving forward and up, large areas of the brain that bring together and combine sensory experiences of movement with sights and sounds wire up, allowing for sensory integration.

The regions located behind the forehead are responsible for more complex thinking such as planning, abstract reasoning, and understanding the consequences of one's behavior. They begin a longer process of wiring up that continues to develop even into adulthood.

2. From the inside out—Central structures of the brain that will eventually connect to the cortex to process and regulate emotions develop before the outer part, which controls the processing and storage of incoming information for thinking and planning. Those central structures are part of the limbic system, and the outer part is the cortex.

3. From the bottom up—The brain stem, which is responsible for basic functions such as heartbeat, breathing, and temperature control, develops very early. Controlling emotions, focusing thoughts, and coordinating fine motor movements are abilities that develop later in the cortex regions.

4. From right to left—The right hemisphere is more active than the left hemisphere early in infancy. The left hemisphere begins to achieve its power as receptive and expressive language skills localize, or lateralize, into the left hemisphere during the end of the baby's first year. Recent research, as outlined by Martha Burns

on the website *Scientific Learning*, indicates that once skills are mastered, they tend to migrate to the left hemisphere. However, both hemispheres continue to communicate with each other throughout a person's lifetime. Functions that tend to remain associated with the right hemisphere include recognizing faces, reading emotions, processing language syntax and intonation, and demonstrating some music competencies.

This four-way progression is useful to know because it helps determine which skills young children usually learn at different times. This knowledge can help guide your choice of activities for children to engage in and help you understand why the timing of certain simple interactions is so important. Bonding is critical in the first year, for example, because the emotional centers of the brain develop so early. Therefore, if you are taking care of infants and young toddlers, pay close attention to the Brain Nuggets that are concerned with providing security and consistency for very young children. For children to achieve optimal development of more complex, later-developing systems, they will need to experience healthy development of the less complex, earlier-developing systems. Yes, scientists now know that the degree of safety and love a young child feels can directly affect the later development of other brain regions.

The Components

As you think about brain development, consider the functions of the three components: the brain stem, the limbic system, and the cortex.

- *Brain stem*—extending from the spinal cord and underneath the limbic system, this structure connects the spinal cord to the brain's regulatory areas that control basic life-sustaining operations such as breathing, heart rate, and temperature regulation. It is also involved in arousal and alertness.
- *Limbic system*—a collection of several structures that, when taken together, are responsible for processing incoming information and tagging it for its emotional importance, and for filing and retrieving memories. This brain region also plays a key role in motivation.

- *Cortex*—the outermost area of the brain consists of mostly gray matter that processes and stores information. The cortex is that folded, gray-colored image you likely picture when someone talks about the brain. The structures in this system work together to help someone pay attention, manage emotions, form and retrieve memories, make rational decisions, and carry out actions. The cortex has a remarkable ability to change, a quality called *plasticity*. At every age, the cortex is capable of learning and therefore changing with new input.

Although the cortex appears thin (the name means *outer bark*), it is actually six layers thick, with each layer serving a different function. The cortex consists of a great number of neurons, and it stores most of the information you learned in school, such as your memory for reading, math, science, and social studies, and your first and second languages.

The Timing and Influence

The most important thing that a teacher, caregiver, or parent needs to know about these brain regions is that the first two, the brain stem and the limbic system, form almost completely in the first five years of life! Yes, that is when early caregivers are in charge! If you recognize the importance of timing and understand the resistance of early developing areas to change later on, then you can clearly see that learning about the brain can help you provide high-quality, personal, loving care to a child. As care providers and teachers, you have a relatively easy job of dispensing information that will be stored in the later-developing neocortex. However, if you want to influence a child's emotional center and memory capabilities in the limbic system, then earlier is better. The infant, toddler, and preschool years are when you will have the greatest impact. You, as the caregiver, are working with children in prime time, and you have tremendous power to help develop a child's brain. So the next time a casual acquaintance learns that you work with young children and says, "Oh, so you are a babysitter," you can politely correct that notion and proudly answer, "No, actually, what I do for a living is help form children's brains!"

Brain Structure and Function

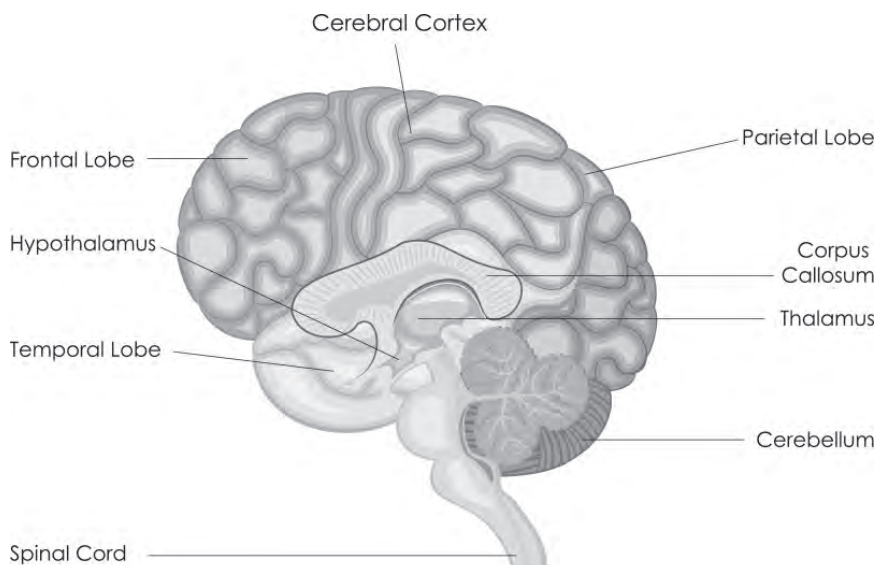
Because you have such a key role in fostering brain development, you have motivation to learn just enough about brain structure and function to do your job well. The diagrams of the brain included here, with various parts labeled, will give you reference points for information that follows.

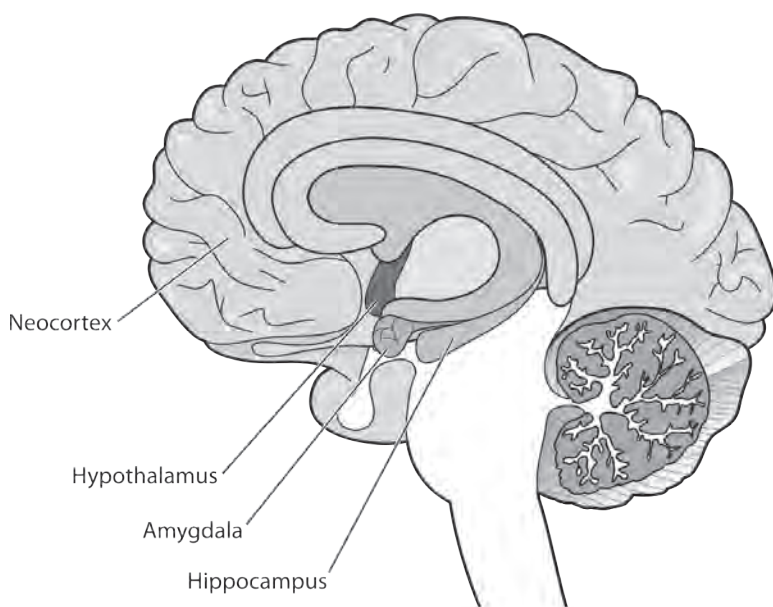
In addition to the brain stem, limbic system, and cortex, teachers and caregivers can benefit from knowing about several other structures: the corpus callosum, the cerebellum, and the four structures of the limbic system.

The *corpus callosum* is a band of fibers that connects the right and left hemispheres, allowing information to be sent back and forth between the hemispheres. The *cerebellum* is the area of the brain that houses many automatic, learned functions such as maintaining one's balance, riding a bike, and unconsciously knowing how high to lift your foot to walk up a flight of stairs.

The four structures within the limbic system serve different functions:

- *Amygdala*—This almond-shaped structure is your brain's alarm system. You have two amygdalae, one in each hemisphere. These structures are constantly monitoring your environment for any threat to your survival. The amygdala is the seat of the flight, fight, or freeze decisions that every person, child or adult,





must make in the face of a threat. Once activated, the amygdala takes a primary position in the way your body allocates energy. Survival trumps all.

- *Hippocampus*—This portion of the brain is critical to the storage of new memories. Again, you actually have two hippocampi. For teachers of any age level, knowing about this structure is key to promoting learning. The hippocampus works like a filing system, determining first if something is worth remembering and then determining where to file it so that this particular memory can be found again. Caregivers can help by capturing a child's interest and making the information worth remembering. You can also clarify and organize information so a child will be better able to file it. Repetition is the key to strengthening an experience so that the child forms a stronger and stronger memory. In addition, you can encourage the creation of links, so learners will be likely to find the information they have stored in their memories. Of the structures in the limbic area, the hippocampus is slow to develop and does not come fully online until ages three to five, depending on the child and the emotional strength of an early memory.
- *Thalamus*—This structure looks like and is about the size of a walnut. It serves as a primary processor of most incoming information entering the brain. It functions like a relay station, directing incoming information for further processing. The thalamus is continuously monitoring the external environment.

- *Hypothalamus*—This olive-sized structure is constantly monitoring the body's internal environment for input. The hypothalamus regulates many of the hormones of the body.

Characteristics That All Brains Share

You now know the sequence of brain development, some useful facts about the structures found in a brain, and the function of each part. In addition, knowing six characteristics of the brain will help you understand how it operates. The brain is characterized as follows:

- An adaptation organ—Brains are built to adapt in order to stay alive. The survival instinct is extremely powerful, with the brain learning and storing experiences in memory, in large part to increase your chances of surviving. The rapid speed with which a young brain adapts allows for maximum advantage to be gained for any particular setting, climate, or culture a baby happens to be born into. And the brain changes physically when it learns something. Early learning takes place so rapidly because nearly everything is new and must be explored and experienced to increase the probability of survival.
- A novelty-seeking organ—Directly related to survival is the need to seek out novel experiences. Brains attend most carefully when exposed to new objects, new sights, new sounds, and new people. The focus is on making a primal friend-or-foe assessment. “What is this new item?” “Can I eat it? Or might it eat me?” “What can I do with it?” Very young children are masters of paying attention to novel experiences. Once the child has categorized the experience, however, her attention moves quickly to the next new encounter.
- A pattern-seeking organ—When you can detect a pattern of how something works, you can better predict what will come next. A brain naturally seeks the patterns that exist in each new experience. Being able to make such predictions, including identifying whether you can count on someone, is essential to survival. Basic trust boils down to the brain determining, “Because this person behaves in a pattern and I recognize that pattern, I can figure out what is likely to happen next.” Of course, many important skills needed for successfully managing your life

are also organized in patterns. Pattern detection, whether it is focused on music, math, reading, or something more primal such as trust, can help us unconsciously manage our environment better.

- A pleasure-seeking organ—At the most basic level, humans prefer pleasure over pain, and we go to great lengths to satisfy that desire. Young babies who receive love and good care don't have to go far; they are pleased by a smiling face and a soothing, familiar voice; a warm blanket; and a reassuring rocking motion. As a child grows and begins to explore, the mere act of discovery and the developing sense of mastery over his environment also bring pleasure. Recent neuroscience discoveries tell us that pleasure has its own identifiable brain markers. Pleasure releases a cocktail of chemicals in the brain when humans of any age experience it. Then we want those positive feelings to come again. A child's familiar chant of "Do it again!" reminds us that the desire to reexperience pleasure is a driving force of any brain, at any age.
- An energy-conserving organ—Brains automatically shift energy to the systems that are currently being used. Brains also conserve energy and save it whenever possible to allow for future emergency needs. The body has only a given amount of energy at a given time. When more energy is being used by one function, less energy is available for other functions. This conservation-of-energy principle can help explain how energy is allocated to learning tasks as well.
- A meaning-seeking organ—To make sense of the flood of information coming from all of our senses, the brain tries to organize each and every bit into something meaningful. Experiences and sensations that are repeated form the foundations for later concepts, ideas, beliefs, and explanations of how the world works. At first, the brain notes pure, basic associations of two things occurring at the same time. (Example: "When I cry, Mom will come.") This type of learning (associative learning) continues throughout one's lifetime and represents a large amount of what each of us knows.

Another type of sense making called *cause-and-effect learning* begins between seven and twelve months. Endless hours of experimenting with what causes something to happen can help children come to conclusions that make sense to them. "What happens when I drop my toy from my high chair? Does it fall the same way every time?" "Does Nana frown at me every time I touch her crystal

vase?” “Will this egg break if I drop it from the countertop?” Children conduct endless experiments to determine “What happens if. . . .”

Now that you have a foundation of information about how the brain operates, you can get more details from the resources mentioned throughout the book.

Resources

Burns, Martha. 2011. “Left vs. Right: What Your Brain Hemispheres Are Really Up To.” *Scientific Learning*. <http://www.scilearn.com/blog/left-brain-right-brain-hemispheres>

Neville, Helen J., and Daphne Bavelier. 1998. “Neural Organization and Plasticity of Language.” *Current Opinion in Neurobiology* 8(2): 254–258.

Simple brain basics make a **BIG** difference.

If you want the children in your care to thrive, you need to know how the brain wires up from birth to age five, and what to do to support it. In easy to understand nuggets of information, this book provides scientifically based research explaining what you can do every day to stimulate healthy brain growth in young children. If the timing is right, the learning that occurs in the first five years can be a gold mine, promoting valuable cognitive and physical development that lasts a lifetime.

By reading this primer on brain development, you'll be armed with the basics about how young minds grow and connect with the world. You'll see how important attention, bonding, and communication are in this critical stage. From there, you can explore 52 easy-to-implement strategies—one for every week of the year—that can build boost their existing growth and prime them for future learning. By using your newfound knowledge of the brain intentionally with infants, toddlers, and preschoolers, you can ignite sparks that will light up their world!



Cofounder of New Directions Institute for Infant Brain Development, **Jill Stamm, PhD**, has been an associate clinical professor at Arizona State University in Tempe for more

than 25 years. She is the developer of Brain Boxes, a unique set of products designed to help adults interact with young children to encourage healthy brain development. She is an international speaker on brain research and serves on the advisory board for the Learning & the Brain Conference series.


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