

# Linking Brain Principles to High-Quality Early Childhood Education

by Stephen Rushton and Anne Juola-Rushton

## A Brain-Based Developmentally Appropriate Classroom

*The room is buzzing with a steady hum of students' conversations. The scent of apples lingers in the air as a parent works with two children peeling apples at the weekly cooking center. I hear the saw cutting through the wood at the carpentry center and water splashing at the water table. Nearby, Jeanna and Michael are authoring a piece about the recent fieldtrip to the Apple Farm — mostly pictures, a few consonant blends, all caps, no spaces — a natural progression. Every once in a while there is a burst of laughter as two or three students discover something new and exciting. I smile.*

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*Inside my students' brains are millions of branch-like structures (dendrites) sending electrical-chemical impulses from one neuron to another. At the end of each neuron are various chemicals called neurotransmitters. This is the biology of the learning process. I'm pleased with the levels of concentration and independence these kindergartners are making. It is exciting to realize just how much their brains are developing at such an extraordinarily rate, particularly during this period in their development. We live in a new world, one where education, neuroscience, and classroom instruction are joined.*

## Convergence of Neurosciences and Early Childhood Education

We live in fascinating times. Never before in the history of education have educators been provided with such conflicting information on how to best teach our most precious resource — the young child. Pressure from outside sources and standardized curriculum on the one hand and what we know about best practices on the other hand leave some teachers in a state of emotional dissonance. The art of teaching the whole child is slowly being eroded by standardized curricular packages throughout the United States. However, there is a renewed burst of energy and hope as educators around the world are recognizing the importance of science in

general and research gleaned from the neurosciences in particular in its support for early childhood education. Join us in the exploration of the connections between the neurosciences and developmentally appropriate practices: how these bodies of information support early childhood educators and children's natural ability to learn.

With the convergence of studies from the fields of neurosciences (Whalen & Phelps, 2009) and cognitive psychology, educators are making important links to help us stay true to our training and knowledge about how young children learn best (Rushton, Juola-Rushton, & Larkin, 2009). Many teachers, perhaps unknowingly, are applying new information gleaned from neurosciences by engaging children in meaningful experiences, encouraging cooperative learning, and supporting active ('hands-on') learning experiences.

The narrative above illuminates some of the 'meaningful experiences' that support both the natural curiosity and the developing brain of the young child, for example, the class field trip. Traveling to the apple farm and returning to the classroom where the children prepare apple pie, simultaneously teaches the child multiple skills, as well as supports their language development as they make a concrete connection to the sound

/a/. It also allows the child to make real-life connections between the classroom, the community, and their learning. The more experiences a child is engaged in, the more potential for dendritic growth. Strong connections between dendrites that develop through repetition help create and strengthen neuro-pathways of learning (Willis, 2006).

Neuroscientists now understand that the brain's neurons continue to both develop (*plasticity*) and disappear (*pruning*) throughout most of our lives. However, we experience the greatest growth — and a high volume of pruning — in early childhood. During pregnancy, neurons grow at an astonishing rate of 250,000 per minute (Miller & Cummings, 2007). This process slows down somewhat after birth. However, up until the age of 12, pathways continue to be formed and the thickening of the myelin sheaf, which supports the speed of the electrical impulse between neurons, thus creating a more efficient brain, continues to develop as the child interacts with her environment. Those neurons that are not stimulated or make connections to other neurons are pruned away and dissolve (Willis, 2006). Providing meaningful, positive experiences for children actually alters the formation of their brains! Each time a child enters a stimulating classroom — one in which the child is invited to talk, share ideas, and manipulate

materials — the number of connections made between neurons increases.

## Big Blocks and How the Brain Works

Each experience a young child has involves one or more of their senses. As the child interacts with his environment, various stimuli enter the body via the five senses. The brain actually filters out 99% of what it receives from the senses, processing only about 1% of all incoming stimuli (Wolfe, 2001). If our brains didn't filter, they would become overloaded with stimuli quickly and we would no longer be able to make sense of the world around us. All outside experiences are converted to electrical/chemical impulses that travel via the nervous system to the thalamus, an almond-shaped organ in the center of the child's brain. This important organ assigns the incoming stimuli to one of four lobes (occipital, temporal, parietal, and frontal) or the motor cortex part of the brain to be further processed. Let's watch what happens when a child plays with blocks:

*When Mary starts playing with the big blocks, various parts of her brain light up at once. In essence, more learning is taking place in various parts of the brain than in others. (The more varied the sensory stimulation the child is exposed to, the more con-*

*nections are made in various parts of the brain, thus increasing learning.)*

- *As Mary attempts to match two half-size blocks to the larger block in order to construct an even wall, she is simultaneously using several lobes and different parts of the brain all at once. First, she looks at the blocks deciding which one to use. The light rays enter through the pupils and are converted into an electro-chemical impulse behind the retina. This conversion allows the impulses to travel to the thalamus, which then sends the signal to the occipital lobe (at the back of the brain) to determine shape, size, and color.*
- *As Mary picks up the big block and proceeds to make the wall, the nerves from her fingertips send a similar electro-chemical message from the fingertips to the nerves within the hand, up the arm, to the spinal column and again to the thalamus. At which point, the signal is then sent directly to the motor cortex located midline center of the brain which allows her to place the block firmly on the wall she has made.*
- *As she decides how to build the wall and which block would best fit, the pre-frontal lobe is also activated. This is where the decision-making center of the brain resides. It is also considered the 'executive center' of the brain. As children mature into adults, this portion of the brain develops allowing sound judgments to be made.*

*Although this is, of course, a simplified explanation of how the brain works, it is clear that the process is very natural, and as educators we can have a profound effect on children's brain development.*

Simply hearing instructions from a teacher does not support higher forms of learning. Although the temporal lobes — those parts of the brain that decipher sound — will be activated, it is when multiple forms of meaningful learning and stimulations take place that real learning happens.

### Action Steps for Teachers

- Arm yourself with DAP as a lens to interpret standards by incorporating the language within your lessons. Provide or attend professional development with a DAP focus to streamline research and education effectiveness within your practices.
- Visit websites such as [www.dana.org](http://www.dana.org) to stay current on hot topics. Register for their free e-mail newsletter to ground your understanding of how the brain works.
- Post objectives with learning engagement artifacts when displaying student work. This helps parents understand the learning that is taking place while supporting you in maximizing the learning engagements you select.
- Incorporate opportunities to observe, engage, and interact with learning:
  - Attend local, state, and national professional development opportunities.
  - Visit colleagues' classrooms who are leaders in teaching practices.
  - Participate in an online blog or podcast with like-minded people.

## Support Children with DAP and Brain Research

Nearly 30 years ago, Bredekamp and Copple (1984) had a profound impact on the field of early childhood education with their first publication of *Developmentally Appropriate Practices* (DAP). With its publication, the National Association for the Education of Young Children (NAEYC) adopted 12 research-based position statements, and early childhood centers around the world quickly began to implement DAP in their classrooms. Children were encouraged to play and explore their natural sense of curiosity in learning environments that stimulated all of their senses. Learning centers were established to support the emotional, social, physical, and intellectual domains of learning. Recently, research from the neurosciences were found to support DAP principles. Rushton, Juola-Rushton, and Larkin (2009) connected many of NAEYC's 12 position statements to principles assembled from the research from the neurosciences.

One of the most important principles of DAP that is supported by new brain

### Some things to try today:

- Engage as many of the children's senses you can, as often as possible. Don't just read about cucumber sandwiches — see, smell, taste, touch, and have the students listen to it crunch when they eat it.
- Use anecdotal records to capture children's learning. Carry color-coded Post-It® notes to jot down the learning you see taking place. Or, keep a notebook with a section for each student.
- Scaffold materials:
  - First, exploration of blocks.
  - Next, blocks with paper and pencil to 'record.'
  - Then, dictation to teacher of 'masterpieces.'

research is the creation of learning environments that immerse young children in real-life experiences where the child's natural curiosity can flourish. DAP's domains 1 and 2 recognize learning as a multi-faceted experience for children. Although certain areas of the brain have specific functions, generally the brain works as a whole and is not compartmentalized; the billions of neuro-networks are all interconnected. A curriculum that allows the child to naturally explore engaging stimuli that connect from one area to another is both brain-compatible and developmentally appropriate.

### Domains One and Two:

1. Domains of development are closely related; development in one domain influences other domains.
2. Development occurs in a relatively orderly sequence, building on those skills already acquired.

We must also remember that as no two children are the same neither are any two brains the same. Using 'play' as a form of learning is both open-ended and congruent with individual differences. Each child develops at his or her own rate of growth (DAP 3). Children move from the concrete to the abstract as their brains develop. The pre-frontal lobe, the front part of the brain, is the last area of the brain to develop. This is where the child's reasoning and higher thinking skills reside.

Creating a classroom for young children to explore requires a variety of centers that challenge children at their own individual rate of growth. With this in mind, DAP 4 states "that early experiences have both cumulative and delayed effects on individual children's development" (Copple & Bredekamp, 2010). As the child experiences a variety of actions in the real world, neuro-pathways are forming inside her brain. The child's brain must first form neurons and continue using

them in order to create concrete pathways that are sustained over time.

The brain constantly seeks predictable patterns to better understand the world it lives in. If learning is new and if no prior network exists, then new dendrites will be formed. If previous neurons do exist, then hopefully the myelin sheath surrounding the neuron will thicken and the speed with which the impulse travels from one neuron to another will increase (Diamond & Hopson, 1989). Allowing the child to play freely at, say, the sand or water table, noticing how the natural elements (sand and water) fall back to the table after being poured through a container, helps form neurons in the occipital lobe, motor cortex, and parietal lobe. This is the beginning of the child's higher structural knowledge, such as the abstract concept of gravity (DAP 5).

Developmentally appropriate practices 7 and 8 go hand in hand when addressing the child's social context. Young children develop many of their cues about how to act in the world from the adults around them. The environments that we design, our teaching methods, and our disposition all impact children's developing brains. *Mirror neurons* (network of neurons that work together to literally

### Domains Three to Six:

3. Development proceeds at varying rates from child to child, and may be uneven within areas of each child's development.
4. Early experiences have both cumulative and delayed effects on individual children's development: optimal periods exist for certain types of development and learning.
5. Development proceeds in predictable directions toward greater complexity, organization, and internalization.
6. Development and learning occur in and are influenced by multiple social and cultural contexts.

## Domains Seven and Eight:

7. Children are active learners, drawing on direct physical and social experience, as well as culturally transmitted knowledge to construct their own understandings of the world around them.
8. Development and learning results from interaction of biological maturation and the environment, which includes both the physical and social worlds that children live in.

\*To review domains 9-12 or to learn more about each domain, go to [www.naeyc.org/DAP](http://www.naeyc.org/DAP)

'mirror' the outside world) may be responsible for such concepts as learning empathy, language, and social cues (Hurley & Chater, 2005). Using visual drama, as well as other kinesthetic forms of learning, as a means of supporting children's social-emotional development, are excellent ways to help connect the child's emotional world to the physical external world. Equally as important is the development of our own personalities; what we project is a powerful force. Recognizing the impact of our actions, tone of voice, and overall disposition on the developing child places a great responsibility on our shoulders to engage with them in sensitive and kind ways.

## Conclusion

Many educators are already knowledgeable about and skilled in best practices. And much of what is happening in developmentally appropriate programs exemplifies 'brain compatible' practices. Being educated in the connections between best practices and brain compatibility is an important part of the knowledge base of early childhood educators. Just as the profession has learned of the remarkable impact of the social and cognitive sciences, we can now recognize the important educational implications of the neurosciences. When we connect these with what we already know about developmentally appropriate practices our effectiveness increases.



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