Balancing With the Brain in Mind

by Deborah Stevens-Smith

It’s the beginning of a new school year and you are excited about getting your physical education program started. The principal approaches and asks if you would be willing to assist with some kindergarten testing during the first week of school. You are asked to test the students in their balancing skills. The test is simple. You ask students one at a time to balance on one foot, then the other foot, eyes open, and eyes closed. As you notice different levels of development within the children, you begin to speculate about the value of information derived from this simple balancing test. What does balancing have to do with being ready to function in the school environment? What possible value does this skill have in predicting early success in school?

It’s important for physical educators to understand the connection between balancing and learning. Balancing is a movement skill that is often overlooked and undervalued in the physical education curriculum. However, how efficiently children balance provides insights into their ability to function in an educational setting and, therefore, is a predictor of future learning success (Palmer, 1980). Delacato (1982) states that balance is intertwined with visual (seeing) and auditory (hearing) channels of the brain. Neither is possible without assistance from the other. A child who cannot balance likely has problems with seeing and hearing that ultimately influence academic work as well. Therefore, balancing activities can be used by classroom teachers to enhance learning in a variety of ways. The academic viability of physical education in the school curriculum can be enhanced by promoting the link between the skill theme of balancing and wiring within the brain.

Balancing activities are a fundamental component of any developmentally appropriate physical education program. They directly address Standard 1 (NASPE, 2004), which states that students will demonstrate competency in many motor skills and movement patterns. That includes the skill of balancing. In the context of this discussion, balancing plays a dual role in wiring the brain for academic learning while learning to move efficiently as well. However, to establish the practical utility of this information, educators need to understand exactly how the brain works so they can enhance the ways children take in and process information as they learn.

Recent brain research reinforces the strong link that exists between movement and learning. Researchers (Hannaford, 1995; Jenson, 2000) have learned more about the brain in the last ten years than had been understood in the previous one hundred years. Research using advanced techniques like magnetic resonance imaging (MRI) to examine brain activity has substantiated an assumption that movement enhances other learning processes. The MRI shows which regions of the brain are engaged (lit up) when a child reads or does math problems. Subsequent MRIs have shown that the same areas of the brain are engaged when a child is moving and active (Jeannerod, 1997). To achieve efficient brain development, integration of movement and sensory experiences during the early developing years is necessary (Greenough & Black, 1992; Shatz, 1992). Once initiated, experience strengthens and bonds nerve synapses, connections made between neurons.
Growth and Development . . . 
Back to the Basics

In early infant motor development, brain patterns are enhanced through children moving in a variety of environments and ways. Rich environments and sensory stimulation are vital to basic brain and body development. Children’s play and activity are primary vehicles for development of mental growth (Fromberg, 1986; Sponseller, 1982). As a child begins to move and explore, the brain uses motor sequences and patterns to develop neural networks in the brain. The neural networks used for moving and explorations are the same networks used to process reading, math, and most learning activities (Jenson, 1998).

The brain is not a static system that sits and waits for information to enter. It changes constantly over time and is subject to manipulation, depending on the input it receives. Stimulation via a variety of inputs affects neural connections that are created and used throughout the lifespan. Babies and young children are naturally influenced (e.g., via reflexes and rudimentary skills) to perform developmental movements that increase neural connections in the brain. As children interact with the environment, many neural connections are made, so the greater the opportunity for stimulation within the environment, the greater the number of interconnections that will be made. As children approach puberty, connections that the brain finds useful become permanent; those that are not are eliminated. Because so much of learning up to this point is psychomotor, much of the neural stimulation taking place is in response to movement. So, optimal neural pathways are initiated and developed as children acquire motor skills thorough play and movement (Dennison & Dennison, 1994; Hannaford, 1995).

A child’s mental development is based in part on corresponding motor development. Cratty (1982) proposed in the early 1960s that reading deficiencies were a result of faulty perceptual-motor patterning. The value of this theory rested solely on the assumption that movement and learning were linked. Strick (1995) reinforced this connection when he traced a link from the cerebellum to other parts of the brain that support memory, attention, and spatial perception. In essence, this showed that parts of the brain that process movement also process learning in the cognitive domain. Related research has shown that a child who skips early developmental steps often experiences learning problems, because the brain is not wired correctly (Delacato, 1982). From a practical perspective, infants who skip crawling often experience problems with learning later on in school.

The brain does not always know how to sort or categorize certain types of information, but balance activities can aid in this processing ability. Hannaford (1995) says, “Every movement of the child stimulates the vestibular system, which stimulates the brain for new learning.” Balance activities work with the sensory systems (visual, auditory, motor, tactile) to develop neural networks and help the brain perform more effectively. Work done by Houston (1982), Ayers (1972), and Hannaford (1995) verifies that sensory-motor integration is fundamental to school readiness. As the brain and body collaborate to process motor sequences and patterns, pathways necessary for processing sequences in reading and math are also created.

The Doorway to Learning

The vestibular (balance) system is the first system to develop in young infants that provides the brain with meaningful information. It subsequently functions as an organizational tool for other brain processes, so the vestibular system serves as the doorway to learning. It performs much like a traffic cop in that it tells each sensation where to go and when it should stop (Cheatum & Hammond, 2000).

As a child grows and develops in the womb, other major brain systems (motor, tactile, auditory, visual) develop in relation to the vestibular system. The vestibular system enables one to perform motor skills, control body parts in space, project objects into visual or auditory space, overcome inertia and gravity problems, develop language, and to think, create, act, read and write (Belgau, 2002). Since the vestibular system plays such a key role in the foundation of perception, balance problems can cause many other seemingly unrelated problems, so delays in vestibular development cause problems in the other senses that are then related to learning.

Many times teachers in the classroom or gym hinder vestibular development without knowing it. As children enter the gym and wait for class to start, they experience a natural urge to hop, spin, or twirl, but they are admonished by the teacher: “Stop it! Sit still! And, listen!” Teachers are unaware that these actions stimulate the vestibular system, which actually helps children focus and pay better attention (Hannaford, 1995). It supports learning in reading, math, and language development. If educators have a better understanding of this complex relationship, they are more likely to recognize what is going on and less likely to hamper such activity, instead, integrating it into the teaching process.

Other disturbances to the vestibular system can cause more major learning difficulties. Levinson & Levinson (1973) found that 94%-97% of children with dyslexia and learning disabilities have experienced trauma to the cerebella/vestibular system as infants, in the form of ear infections, allergies, or trauma. The same study found that movement and stimulation of balance abilities have a positive influence on attention deficit disorder (ADD) and improve reading ability in children with this problem. In contrast, keeping the head still for long periods of time (such as in watching television, doing computer work, playing computer games, or even sitting in an infant car seat) has a negative influence on the vestibular system (Belgau, 1982):
Subtle balance disturbances can impair the fundamental brain processing structures that are critically involved in attention, memory, vision and visual processes, auditory perception, reading, speech, coordinated efficient movement, spatial orientation, proper sequencing of information, and the thought processes that are involved in understanding complex mathematical relationships (p. 17).

Components of Balancing

To lay a foundation for learning balance, activities need to include two components: (a) crossing the midline of the body, and (b) utilizing all three brain dimensions.

Crossing the Brain/Body Midline

Bihemispheric lateralization is the biological term for crossing the midline of the body (an imaginary line splitting the body into right and left). Each hemisphere (side of the brain) controls multiple functions that occur on the opposite side of the body, i.e., the left side of the brain controls the right side of the body and the right side of the brain controls the left side of the body. However, the brain is forced to use both hemispheres in an integrated fashion when moving an arm or leg across the midline. Purposely engaging children in these types of activities develops greater neural connections for learning.

During growth and development, children progress through a series of movements, beginning with movements in which the whole body moves at the same time to movements in which all four limbs cross the midline of the body. Though a full discussion is beyond the scope of this article, suffice to say that developmental delays are often found in children who have failed to progress into movements that integrate cross lateral patterns (Cheatum & Hammond, 2000). Making the arms and the legs cross over forces the brain to talk to itself, which provides for more efficient and effective learning and development (Hannahford, 1995).

Paul and Gail Dennison (1994) developed Brain Gym activities to assist in stimulating the brain for learning. The Dennisons researched physical movements and developed a new way to understand the learning process. They have termed the emerging field as Educational Kinesiology (Edu-K) and movements within that field as Brain Gym (Dennison & Dennison, 1994). Many of the brain gym activities (cross crawl, lazy 8, brain buttons, hook-ups) require children to cross the midline of the body. As brain gym activities send information along the neural networks, cross lateral connections are created that enable children to learn and function effectively (Cohen & Goldsmith, 2002).

Brain Dimensions

The Dennisons’ (1994) work within Educational Kinesiology has established that information leading to physical movement is received from three different dimensions of the brain. These three dimensions process information from left to right (laterality), top to bottom (centering), and front to back (focus) aspects of the brain. Learning requires successful integration of all three brain dimensions working together.

Laterality, communication between the left and right sides of the brain deals with movement from side to side (ex: rolling). An inability in this dimension presents visual, linear, symbolic, and written code problems that often result in children being labeled as learning disabled or dyslexic. So, left/right brain communication is fundamental to children’s ability to read, write, listen, or speak (Dennison, 1985, 1994).

Centering, communication between the top and bottom portions of the brain, involves movement of the upper and lower parts of the body (ex: jumping). Proper integration in this area enables children to relax and organize their thoughts and actions. An inability to center results in fear, the fight or flight response, or an inability to express emotion, generate clear responses, or get organized (Dennison & Dennison, 1985, 1994).

Focus, communication between the back and front portions of the brain, involves movement from back to front (ex: walking). Focus affects children’s ability to comprehend
and blend details for meaning and purpose. Incomplete development results in the inability to express oneself with ease and participate in the learning process. Children without this skill often have attention disorders and an inability to comprehend (Dennison & Dennison, 1985, 1994).

Normal brain function requires efficient communication between all three dimensions of the brain. Learning disabilities can occur when information does not flow freely between these centers. Each brain dimension corresponds directly with the way information travels in the brain and with the fundamental motor skills that are taught and used in class each day.

**What’s Balance Got to Do With It??**

Balance is used for much more than might be assumed. Balance allows one to keep the head upright and still while reading, orient eyes on a page to discern letters and words, grasp a football in the hand, remain upright throughout a throwing motion, or hold food on a fork or spoon. Without balance, an athlete would be unable to travel through space to get to the basket or the goal line.

Since the 1960s, NASA has funded basic research looking at how balance affects brain processing and sensory integration (Graybiel et al., 1967; Miller & Graybiel, 1973; Stone & Letko, 1965). Belgau (2002) has analyzed much of that research and found that activities having a strong balance component significantly affect vision, reading, learning difficulties, and overall academic achievement. That is because balance activities use the same neural networks responsible for visual, auditory, motor, and sensory processes that influence efficiency of the brain’s neural networks. In children not able to integrate the senses in an efficient way, learning problems are a common result. So Belgau’s findings support Dennison’s theory that balance activities, eye teaming, and hemisphere integration contribute to the integration process. The same activities provide stimulation to other sensory input areas that enhance attentional focus and, ultimately, learning ability by providing the feedback necessary for sensory integration (Belgau, 2002).

Palmer (1980) has demonstrated significant gains in attention and reading ability with children who were exposed to spinning, crawling, rolling, rocking, and tumbling. Twenty-two kindergarten children did rolling, spinning, crawling, and somersaulting activities for a minimum of 20 minutes per day for five months. Every child was subsequently able to perform a single flip (forward roll), completed the kindergarten year with only five months of instruction, and had reading scores significantly above normal expectations. Palmer argues that these were all the result of vestibular stimulation and sensory integration activities.

A quick summary of other research related to balance activities shows that children

1. Improve academic achievement (CDE News Release, 2002; Hannaford, 1995; Hubert, 2001; Kearney, 1996; Pollatschek & Hagan, 1996): Children who perform poor academically also have poor motor skill development because the same brain processes are involved.
2. Enhance reading and visual processing (Ayers, 1972; Blaydes & Hess, 2002; Gilbert, 1977; Houston, 1982): Reading and visual processing problems are caused by inefficient coordination and integration between the brain and sensory systems. Balance activities increase integration between the brain hemispheres.
3. Improve writing skills (Ayers, 1991; Dennison & Dennison, 1994; Hannaford, 1995): Writing is a fine motor activity that requires good hand-eye coordination; poor handwriting is caused by poor sensory integration.
4. Enhance athletic performance (Jenson, 2000; Kramer, 1999; Shepherd, 1996): Athletes need to be able to make quick decisions and evaluate information in the field, all of which depend on the brain’s ability to integrate information from all senses, especially the vestibular system.
5. Decrease learning disabilities (Hannaford, 1995; Hubert, 2001): Balance activities effectively increase brain processing. Activities that improve brain processing improve performance in both academics and athletics.

**Balance Activities and Equipment**

Balance activities come in many forms and can be developed with or without equipment and integrated into almost any lesson idea. Following are examples of balance activities to incorporate into quality developmentally appropriate physical education lessons.

**Balance Activities**

**Spinning** can be done standing, sitting, on scooters or knees, while traveling, as part of a sequence (jump/spin/land, bounce/spin/land [ball hops]). Spinning also takes place on merry-go-rounds, in amusement parks, and on flight simulators. All these are sensory events that capitalize on the vestibular system. They activate the vestibular system and wake up the rest of the brain to incoming stimuli.

**Crawling:** The process of alternating sides of the body initially integrates the brain hemispheres.

**Tumbling, Rolling, and Turning:** Done while standing, sitting, or lying down, these movements are great for the developing brain because they enhance development of each of the three brain dimensions.
Balancing: Both static and dynamic balances performed on lines, ropes, beams, or boards enhance development of the front/back and left/right brain dimensions.

Balance Equipment

Balance Boards: The boards cause side-to-side tipping, which stimulates the entire vestibular system—especially the left/right brain dimension—which in turn enhances overall brain function. Enhance back-to-front tipping by turning on the balance board to face its length.

Ball hops (hoppity hops): Ball hops enhance the top/bottom brain dimension.

Beams: Beams enhance the front/back dimension of brain.

Gonge cup (see Figure 1): Children who have difficulty in reading usually cannot maneuver the cup to make it go around in a circular manner; they just rock side to side. No research exists to support use of the gonge cup for this purpose, but it simulates a spinning movement and, therefore, provides vestibular input which should aid in brain organization and integration.

Balance puzzles/mats: The brain is a pattern seeker and specific movements help to cement those patterns.

As children travel on the ABC and math mats, they must cross the midline of the body, balance, and, therefore, use all dimensions of the brain. The figure-8 mat (see Figure 2 below; Blaydes & Hess, 2002) helps to embed every letter of the alphabet in children’s brains. They can use different locomotor skills to travel along the letters and numbers, mapping out those patterns in the brain.

Body tubes (top/bottom brain dimension), Stilts (front/back brain dimension), Swings (front/back brain dimension), Merry-go-rounds (left/right & brain dimension), and Skateboards/Skating (top/bottom & front/back brain dimensions): Depending on how they are used, each of these has the potential to enhance balance in a variety of ways, crossing the midline and influencing all three brain dimensions.

Putting It All Together

Physical educators need to be aware of the tremendous impact that balancing activities can have on the developing brain of young children. Teachers can begin to integrate these activities into quality developmentally appropriate physical education lessons. Begin with warm-up routines that include crossovers of the arms and legs or crossing the midline of the body in other ways.

Floor balances, as part of instruction related to fundamental skill development, help children learn the basic components of manipulative skills, such as throwing or other skills that require a solid base of support. Spins, twirls, crawling, rolling, and turning, as part of both locomotor and non-locomotor skill development, help child balance under more dynamic conditions. Finally, equipment such as balance boards, balls, feathers, and the gonge cup can be used to enhance the three brain dimensions. These types of activities develop brain integration that helps children function successfully in the classroom. So, balancing activities provide a link between physical education and the classroom that can enhance both academic learning and physical skill development.
References


Web Site Addresses

www.braingym.com [Brain Gyms]
http://pecentral.org [PE Central]
www.balametrics.com/index.htm [Balametrics]
http://www.bal-a-vis-x.com [Bal-A-Vis-X]
www.actionbasedlearning.com [Jean Blaydes site]
http://people.Clemson.edu/~Stevens/ [brain mat jpeg’s]
www.abilities.com [gonge cup]

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