The Science Behind Learning & Movement – The Brain-Body Connection:

The most important part of brain development is synapse formation and all areas of the brain must function in order for learning to occur.
Thus…it is crucial to understand each part of the brain in the learning process.

Lower Brain –

Contains cerebellum and brain stem
Sensations travel through brain stem & control circulation, respiration, heart rate, wake and sleep patterns
Cerebellum aids balance, coordination, posture, muscle movements, cognition and emotions

Mid-Brain –

"emotional and social brain" – connects lower and upper brain
Contains:
Thalamus – reception for incoming senses (temp., touch, pain, light, etc.) and relates to memory and emotion
hypothalamus – controls appetite, thirst, digestion, hormone secretions and sleep patterns and connects to life situations (reactions to threats, pleasure, aggressiveness, etc.)
Amygdale – controls emotions and processes sensations…assists us with imagination and decision making, recognitions and connections
Hippocampus – controls memory

Upper Brain –

2 hemispheres with 4 lobes each
Right and Left…
Frontal – voluntary movement, creativity, problem solving, verbal expression and planning
Parietal – relations in space, and sensations
Temporal – hearing, balance, language, memory

Occipital - vision
Hemispheres connected by corpus callosum (nerve fibers) that communicates to each hemisphere
Cerebral cortex (outer layer of cerebrum) is full of neurons that carry sensory information to the motor commands of the body

In order to learn, we first must have a sensory experience, then reflect and make connections, and finally take action on the experience.

In order to learn, the brain must develop –
Conception to Birth – cells grow and grow and grow
Birth to 3 yrs – synapses connect
4 to 12 yrs – cells grow, dendrites reach out to synapses creating neural connections...brain learns the fastest!
12 yrs to adult – brain is plastic and still learning

Movement is essential to the development of the brain... Why?

1. lack of exercise by the mother may cause malformation in the fetus
2. sensory deprivation or lack of sensory stimulation may cause loss of synaptic connections (can be irreversible)
3. experience through the senses, repetition, and stimulation establish a foundation for life-long learning and long term memory
4. the brain develops faster with more synaptic and neural connections through multi-sensory activities (movement, arts, appropriate mental and physical challenges, positive feedback, nutrition, etc.)
5. continued stimulation (mental and physical) allows for the brain to remap the connections and maintain them for better learning over time

"Life long learners and movers have fully functioning brains" (Green-Gilbert, 2006)

Green-Gilbert, A. (2006). *Brain-compatible dance education*. Reston, VA: National Dance Association.

Why movement matters in Learning…

Movement is considered the human being's first language.

Movements strengthen the neural pathways between the brain and body.

In education, learning should occur at the students' readiness…when putting learning to song, movement, or other sensory associations, it creates pathways for the information to be stored and retrieved at later times (even if the learner is not ready to understand, process or use the information at that time)

For learning to occur easily, each hemisphere must communicate with the other as they depend on each other for successful learning…
There is less play involved in the development of a child today (tv, computers, readiness of information, etc.)…
But the same connections need to build in the brain and body (to read and write, students need to also have developed balance, coordination, etc.)

Since movement/play is not as evident in the development of children, we should be expected and eager as educators of these children to find ways of incorporating movement into their lessons…we should want to build their brain-body connections to enhance their learning!

(Blythe, 2009)

Blythe, S.G. (2009). *The well balanced child*. Gloucestershire, UK: Hawthorn Press.

Why learning is not all in your head!

Learning, thought, creativity, and intelligence are not process of the brain along but the whole body.
Why?
Physical movement plays an important role in the creation of nerve cells and neural pathways which provide the map for the essence of learning.
These neural pathways enhance learning because the connections become stronger between the right and left hemispheres of the brain –

Left	Right
Pieces of information	whole picture
Parts of language	comprehension of language
Syntax, semantics	image, emotion, meaning
Letters, sentences	rhythm, flow
Numbers	image, intuition
Linear process	estimates, trial/error
Look at differences	look at similarities
Controls feelings	explores feelings
Planned, structured	spontaneous, free
Sequential thinking	simultaneous thinking
Language oriented	feeling/experience oriented
Technique based	creative based
Sports skills	sports rhythm/patterns
Art process	art experimentation
Music details	music expression

Our thinking skills are directly affected by our doing skills. "Movement is the door to learning" paul E. Dennison
"Every movement is a sensory-motor experience linked to our physical world." (Hannaford, 2005)
Learning occurs through out interactions with the world around us, stimulation of our senses, and activities in which we participate...the more we interact and engage in activity, the more connections occur in our brain and between our brain and body and these interactions and actions help us interact with our environment, process information and ultimately learn more easily.

Hannaford, C. (2005). *Smart moves why learning is not all in your head*. Salt Lake City, Utah: Great River Books.

Simply being physically active promotes brain growth:

Biologically...
Movement creates an increased production of a protein in neurons called brain-derived neurotrophic factor (BDNF)
This protein is responsible for the growth and repair of neurons and intersynaptic connections which improves cognitive function (memory and learning as well as emotional level, energy level, and motivation)

Cognitively...
Exercise and movement enhances memory, planning, decision making, and problem solving

Behaviorally and emotionally...
Helps decrease ADD/ADHD, depression, fatigue and stress

Physical activity has a positive effect on learning...
Neurochemicals released in exercise and movement provide sense of reward, accomplishment, pleasure and achievement ...Why?
Based on the evolution of the human brain –
Humans used to have hours upon hours of physical activity/labor in their daily lives thus the brain was wired for that activity level/movement demands...
Neurotransmitters and hormones that built mental and physical energy for cognitive functioning...
It is believed that we still poses that capacity today!
However...
Schools are not testing physical activity levels thus movement (PE, dance integration, etc.) is not valued or given preference in education today
But...
The evidence of the Brain-Body Connection shows that there are obvious benefits to student learning and

ENGAGEMENT THAT COME FROM INCREASED OR SUPPLEMENTAL PHYSICAL ACTIVITY IN ACADEMIC AREAS!

Berg, K. (2010). Justifying physical education based on neuroscience evidence. *JOPERD*, *81*(3), 24-29.