The Science & Research supporting

action based learning™

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"A brain is only as healthy as the body that carries it. She says that neurons that fire together wire together. Practice doesn't make perfect. Practice makes permanent connections. Practicing basic movement patterns in the Action Based Learning Lab prepares the brain for learning."

- From the book Brain Matters: *Translating Research into Classroom Practice* by Pat Wolfe -

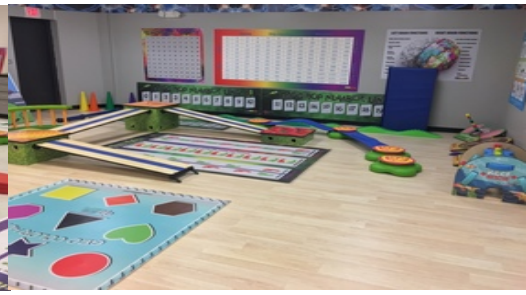
Research suggests that increased physical activity can impact student performance and elevate test scores. In his book, *Spark: The Revolutionary New Science of Exercise and The Brain*, Dr. John Ratey states that aerobic exercise physically transforms our brains for peak performance. He also states that exercise is the body's natural Ritalin and the body's natural Zoloft. Dr. Ratey's book has convinced many decision makers about the link of movement to learning. Other research summaries also can be found in Eric Jensen's books, *Teaching with the Brain in Mind* and *Learning with the Body in Mind*, excellent resources for brain-based learning theory.

A 2002 California study shows that physically active kids perform better academically. The statewide study provides compelling evidence that the physical well-being of students has a direct impact on their ability to achieve academically. The results suggest that students achieve best when they are physically fit. The research study individually matched scores from the spring 2001 Stanford Achievement Test, Ninth Edition (SAT-9), given as part of California's Standardized Testing and Reporting Program, with scores of the state-mandated physical fitness test, known as the Fitnessgram, given in 2001 to students in grades five, seven, and nine. In the study, reading and mathematics scores were matched with fitness scores of 353,000 fifth graders, 322,000 seventh graders, and 279,000 ninth graders. Key findings of the study are:

- Higher achievement was associated with higher levels of fitness at each of the three grade levels measured.
- The relationship between academic achievement and fitness was greater in mathematics than in reading, particularly at higher fitness levels.
- Students who met minimum fitness levels in three or more physical fitness areas showed the greatest gains in academic achievement at all three grade levels.
- Females demonstrated higher achievement than males, particularly at higher fitness levels.

In a June 2008 study, Budde and his research group hypothesized that exercise may positively affect cognitive performance. Similar studies are being replicated nationwide. Due to the neuronal connection between the cerebellum and the prefrontal cortex, cognitive performance may be already visible after short bouts of exercise. Budde and his group summarized the study by saying that, "bilateral coordinative exercise was effective in completing the concentration and attention task after exercise that raised the heart rate. With the heart rate being the same in both groups, the coordinative nature of the exercise may be responsible for the significant differences. Bilateral coordinative exercises lead to the pre-activation of parts of the brain which are also responsible for mediating functions like attention. Taken together, our results support the request for more short bouts of exercise in schools with a focus on coordinative skills, for example, via instructed exercise in school breaks."





Researchers James Pollatschek and Frank Hagen (1996) say, "Children who engage in daily physical education show superior motor fitness, academic performance, and attitude toward school as compared to their counterparts who do not participate in physical education." Adding to the growing body of research supporting the cognitive benefits of physical exercise, a recent study concludes that mental focus and concentration levels in young children improve significantly after engaging in structured physical activity (Caterino and Polak 1999). Findings suggest that such physical exercise as running, jumping, and aerobic game playing have a definite impact on children's frontal lobe—a primary brain area for mental concentration, planning, and decision-making. Aerobic conditioning seems to assist in memory (Brink 1995). Dustman's research (Michund and Wild 1991) tested three groups of students. The group that engaged in vigorous aerobic exercise improved short-term memory, creativity, and reaction time.

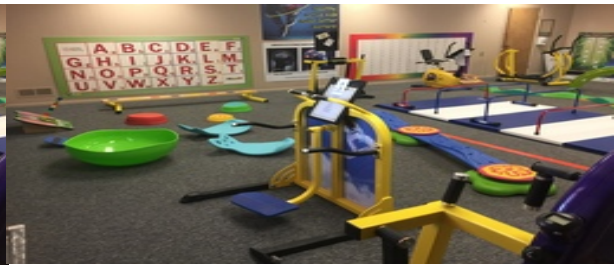
Directly from the Experts

Dr. John Ratey has stated that exercise causes neurogenesis, the growth of new neurons in the hippocampus. Exercise activates BDNF, brain derived neurotrophic factor, which he nicknamed "Miracle Gro®" for the brain!

• Many brain researchers in educational circles advocate for physical activity citing strong evidence that supports the link of movement to learning. Here's what some of the leading experts in brain compatible learning say: Dr. Howard Gardner has stated that one of the eight multiple intelligences is the bodily kinesthetic multiple intelligence. Many students rely on kinesthetic intelligence for learning. Physical education is one of the few disciplines that incorporates most of the eight identified intelligences simultaneously. Dr. Marion Diamond, author of *Magic Trees of the Mind*, conducted research on enriched environments supporting the importance of play in early brain development. This critical motor development sets the stage for brain processes used later for decoding and problem solving, a strong argument for using the Action Based Learning™ Lab in daily elementary physical education starting in kindergarten.

• Dr. Candance Pert, author of *Molecules of Emotion*, lauds the importance of proper diet and exercise to balance emotions naturally. New evidence shows that regular exercise is just as effective as drugs in relieving the symptoms of major depression (John Fauber, 2000). Dr. Robert Sylwester, author of "A *Celebration of Neurons* and *A Biological Brain in a Cultural Classroom*, states that movement facilitates cognition." A central mission of the brain is to intelligently navigate its environment. Since efficient movement facilitates cognition, the curriculum MUST include movement concepts and skills." He says that the reason humans have the brain we do is to move.





• Susan Kovalik, leading authority on brain compatible learning whose ITI model serves 250,000 students, includes movement to enhance learning as one of the brain compatible components based on brain biology findings. She believes that students retain information better when movement is used with intention to teach academic concepts kinesthetically.

• Eric Jensen at the Fragile Brain Conference outlined the causes and brain changes in several learning differences. He concludes that movement, physical activity, and exercise may help control many of the conditions such as Learned Helplessness, Hyperactivity, Delayed Sleep Disorder, Oppositional Disorder, Learning Delays, Reactive Attachment Disorder, Brain Injury and Insults, and Conduct Disorder. The Action Based Learning™ Lab provides not only activity and exercise, but also builds relationships, provides team membership and celebrations, promotes rhythm and cross lateral movement, and encourages manipulatives for control. Many students with learning disabilities find success in the gymnasium because our curriculum meets their needs in a way that the traditional classroom may not.

How Does Movement Enhance Cognition?

There are two aspects of movement that benefit learners:

• Physical fitness: having a healthy body, healthy mind

• Cognitive reinforcement: using a kinesthetic tactile approach to anchor academic concepts

Action Based Learning: The Brain Body Balance

• Movement has three areas: movement, physical activity, and exercise. Movement is the navigation of one's environment, in other words not sitting still or not lying down. Physical activity is voluntary movement that expends energy. Examples of physical activity in the classroom are role-playing, building a model, or playing a toss and catch game to review material. Exercise is physical activity that elevates the heart rate into the target heart rate zone. Examples are jogging, running, jumping rope, swimming, biking.

• When humans exercise, the body/brain goes into a homeostatic state, balancing brain chemicals, hormones, electricity, and system functions. When the body/brain is out of balance because of poor nutrition and lack of physical activity, the student is not in a good learning state. Movement, physical activity, and exercise change the learning state, increasing the ability to retain or retrieve memory. The beneficial effects of physical activity may last for a 30-60 minute period depending on the student. Blood traveling to the body/brain at greater rates feeds the brain the needed nutrients of oxygen and glucose. Glucose is to the brain what gasoline is to a car, i.e. brain fuel and each time you have a thought, the brain uses glucose. Brain activity is measured by glucose utilization and vigorous activity gives the brain its needed nutrients.

A young body does not have the same cardiovascular capacity as an older child. The younger brain/body benefits more from coordinative motor movement that develops learning systems and fills in developmental gaps.

• Scientists know that brain cells have an especially high rate of metabolism, so the brain requires much more oxygen than any other organ of the body. Although the brain makes up only one-fiftieth of the body's weight, it uses an amazing one-fifth of the body's oxygen. Oxygen is essential for learning. Proper breathing provides sufficient oxygen for the correct and efficient functioning of brain cells. Without sufficient oxygen, cells cannot metabolize food properly or rid themselves of all the noxious by-products of metabolism, especially carbon dioxide. A human exchanges about 10% of his oxygen with each normal breath, meaning that about 90% of the oxygen in our body/brain is stale until we deep breathe or exercise. A lack of oxygen to the brain results in disorientation, confusion, fatigue, sluggishness, concentration, and memory problems

EXERCISE BENEFITS THE BRAIN FIRST

PHYSICAL ACTIVITY PROVIDES ENRICHED ENVIRONMENTS

In early studies in 1991, William Greenough discovered that rats who exercised in enriched environments had a greater number of synaptic connections than sedentary counterparts. Exercise strengthens key areas of the brain like the basal ganglia, cerebellum, and corpus callosum.

EXERCISE GROWS NEW BRAIN CELLS

Van Praag and Associates (1999) have conducted animal studies that suggest running and other aerobic activity promotes brain cell regeneration and growth. Neurogenesis was discovered in humans by Scott Small of Columbia University in 2006. Also, aerobic activity releases endorphins, the class of neurotransmitters that relax us into a state of cortical alertness and reduce the symptoms of depression. Exercise also tends to raise levels of glucose, serotonin, epinephrine, and dopamine, chemicals that at elevated levels are known to inhibit hunger.

AEROBIC FITNESS AIDS COGNITION

Researchers found that subjects who were the most aerobically fit had the fastest cognitive responses, measured by reaction time, the speed that subjects processed information, memory span, and problem solving. More studies are being done to determine the precise relationship between aerobic fitness, age, and cognition. Earlier research supported by a new study suggests that aerobic exercise-nonstop and lasting a minimum of 12 minutes-may serve to slow or minimize normal age related dedines in cognitive functioning. Aerobic activity not only increases blood flow to the brain, but also speeds recall and reasoning skills. (Etnier, et al. 1999) (Van Boxtel, et al. 1996)

EXERCISE TRIGGERS BDNF

Exercise triggers the release of a brain-derived neurotrophic factor (BDNF) that enables one neuron to communicate with another. (Kinoshita 1997) Dr. John Ratey nicknamed BDNF as the Miracle Gro™ for the brain. He states that the chair is the least effective environment for learning. Students who sit for longer than twenty minutes experience a decrease in the flow of BDNF. Recess and physical education are places where students can develop sharper learning skills.