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Top 18 Key Pieces of Research Driving Active Learning

Activity and Neurogenesis

Study suggests running and other aerobic activity **promotes brain cell generation.**

Dr. H. Van Praag, Dr. F. Gage. The Salk Institute (1999)

Long Term Potentiation (LTP)

Long term potentiation (LTP) is the way cells communicate with each other.
The discovery that running mice in the SALK study are capable of sustaining stronger LTP than sedentary mice may be one of the reasons they learn more readily.

F. Gage (2000)

Cerebellum…Our Brain's Sleeping Giant

The cerebellum takes up just 1/10th of the brain by volume, but **contains over half of all its neurons**.

It has some 40 million nerve fibers, 40 times more than
even the highly complex optical tract.

Those fibers not only feed information from the cortex to the cerebellum, but they feed them back to the cortex.

H. Leiner, A. Leiner, STANFORD (1980), Ratey HARVARD (2001)

Increases of Cognition with BDNF

Aerobic activity promotes brain cell generation.

Brain-derived neurotrophic factor (BDNF) promotes neuronal survival and growth, in addition to protecting neurons against deterioration.

An important role in the hippocampus.
UCLA study showed that rats performed regular voluntary exercise consistently learned faster and scored higher on tests with increased BDNF levels in the hippocampus.

P. Kesslak (1997), Gomez-Pinilla UCLA (2001)

Oxygen to the Brain Brain uses 1/5 of body's oxygen.

A **lack of oxygen** to the brain results in disorientation, confusion, fatigue, sluggishness, concentration, and memory problems.

L. Bernardi, E. Jensen (2000)

Glucocorticoids and Learning

The researchers found that obesity stimulate the over-production of a complex set of **stress hormones called glucocorticoids.**

Overexposure to glucocorticoids damages and destroys neurons in the hippocampus.

J. Raber (1998)

Impact of Obesity on Learning

The damaging effect of **glucocorticoids** on the hippocampus may be the reason why below-average cognitive results were noted in studies of persons with obesity and heart disease.

L. Kilander (1997), K. Nolan, J. Blass (1992)

Aerobic Activity and Cognition

Hogervorst study indicated that athletes who had trained for endurance **outperformed on complex word tests**.

Japan study suggest that regular exercise can improve **cognitive function** and increase levels of **BDNF**. 2nd half of study, bad diet contributed to a cognitive decline … exercise could compensate for the negative decline.

E. Hogervorst (1996), Kubota (2001)

Standardized Testing and Fitness

Reading and mathematic scores were matched with fitness scores (close to 1 million 5th, 7th, and 9th graders).
Key findings:

Higher achievement with higher levels of fitness.
Students who met minimum fitness levels in 3 or more fitness areas showed the **greatest gains in academic achievement** in all grades.

Females showed the highest gains.

Mathematics showed the biggest increases.

California Department of Education CDE (2001)

Violence and a Lack of Movement

Deprivation from touch/movement may not develop the movement-pleasure link in the brain.

***Fewer connections** are made between the cerebellum and the brain's pleasure centers.*

R. Kotulak (1996)

Vestibular System and Reading

Efficient eye teaming enables the student to focus, track and concentrate when reading.

As the eye muscles strengthen and move more in concert with each other, **more connections to the brain are developed and available**.

M. Albalos, G. Dennison (1995)

Strengthening Immature Brain Regions

Less spinning activities … **more learning disabilities**.

The studies suggest that **certain spinning activities led to alertness, attention and relaxation in the classroom**.

Strengthens immature brain regions controlling motor and spatial functions.

C. Clarke, Ohio State (1980), F. Secadas

	(1984)
White and Grey Matter Density **Aerobic exercise** helps preserve white and gray matter density in the brain's frontal, temporal and parietal cortexes, areas vital to higher-order thinking. *Colcombe (2003); Thompson (2003)*	**Exercise Increases Neuronal Growth** **Voluntary exercise** showed a strong positive correlation between running distance and new cell number, as well as improved learning. *R.E. Rhodes (2003)*
Social Environments and Play These findings demonstrated that **social environments** and **play** can increase LTP in groups and significantly reduce when isolated. Lu L, Bao G, Chen H. (2003)	**Traumatic Brain Injury and Voluntary Exercise** This study focused on **voluntary exercise** and the upregulation of BDNF (good stuff for neurons to grow). Griesbach, Hovda, (2004)
High-Fat Diet and Harmful Effects on BDNF **Exercise** reverses the harmful effects of consumption of a high-fat diet on BDNF, a predictor of learning efficacy. Molteni, Wu, Vaynman, Ying (2004)	**Exercise and New Natural Stem Cells** The survival of new neurons is improved depending on the environmental conditions and **physical exercise**. Griesbach, Hovda, (2004)