**Standard 1: Scientific and Theoretical Knowledge**

**Element:** 1.2 Describe and apply motor learning and psychological/behavioral theory related to skillful movement, physical activity, and fitness.

**Artifact:** Exercise Physiology Research Paper

**Date:** Spring 2011

**Reflection:** In my exercise physiology class I wrote a research paper reflecting on how exercise benefits the brain. I looked at multiple resources and studies providing evidence that physical activity can help increase brain activity. Not only does fitness improve health, it also expands the brains ability to perform higher in academic classes. I learned exercise can help prevent or even reverse cognitive decline; and it serves to promote health and movement functions in individuals. Due to my research for this paper I am now able to successfully describe and apply physiological concepts related to fitness. It is important for my students to understand how beneficial exercise is not only for the body, but psychologically as well.

**Exercise Benefits the Brain**

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A common topic discussed all over the news today is based on the belief of how the world has entered into a period of obesity, lack of discipline, and laziness. It is not surprising that a vast majority of Americans do not practice healthy living styles. There is reason to believe that children in industrialized countries are growing progressively unfit and unhealthy partly due to the luxuries of technological developments. Rather than playing outside with friends, it is becoming more common for children to play on the computer, video game, or watch the television. I have found that children would prefer to sit and do something instead of being up and active. Rather than stopping this problem, people all over the world are helping it to become worse.

It is shocking that throughout the USA the press is discussing how physical education programs are being cut down and even deleted from school curriculums. Healthy habits and knowledge on how to be fit are two of the most important factors of life. The government and school committees are deciding to leave out physical education class in order to keep what they consider ‘academic classes’. The academics of physical fitness are far more beneficial than information student will not remember in six months. What is overpowering the world now is the thought that physical education is just not necessary. The lack of knowledge on how important exercise is truly inhibits a persons’ ability to be well. A healthy lifestyle is essential in keeping someone up and running, able to learn more. Exercise has the power to help people all over the word. Rather than eliminating the physical education programs in schools, America needs to promote and increase the significance of exercise. Children need to understand the basics of how to be healthy and take care of their bodies in order to live a well life. The Public Health Service specified “Physical Fitness and Exercise” and 1 of the 15 greatest importance for improving the health the public. What people are not realizing is the fact that exercise actually helps the brain activate in order to learn more. Getting rid of a physical education class is ultimately limiting a child’s academic performance. Physical exercise directly effects and enhances brain activity.

In many studies today researchers are reporting a great correlation between active exercise and brain functions. It is not a total shock that being a healthy person helps people feel better and activates the brain. In the article *“Be Smart, Exercise Your Heart: exercise effects on brain and cognition”* by reviews Hillman, Charles H., Kirk I. Erickson, and Arthur F. Kramer they discuss the fact that exercise does indeed help the brain function better. This article examines the study on positive effects of aerobic physical activity on cognition, at the molecular, cellular, systems and behavioral levels. An increasing number of studies support the idea that physical exercise is crucial and can lead to increased physical and mental health. (Hillman) There has been no empirical evidence to imply that the elimination of non-academic programs (PE) is related to higher academic achievement. Actually, the experimental evidence suggests that opposite. This article gives examples of tests that they have reviewed proving their theory. The research has mainly focused on the effects of exercise on cognition with paper and computer based tests. Neuroimaging methods, such as event-related brain potentials (ERP) and structural and functional MRI are also being used to observe the association between exercise and cognition development. A study shows that MRI has been used to examine the effects of fitness on the cognitive domain. “In cross-selections comparisons between individuals with high and low levels of fitness and aerobic fitness training studies, Colcombe and colleagues (48,53) found that higher levels of fitness improvements were related to larger volumes of prefrontal and temporal grey matter, as well as anterior white matter” (Hillman).

Physical activity during childhood might encourage ideal brain development, encouraging lifelong changes in brain function. A recent meta-analysis showed a positive connection between physical activity and cognitive performance in children 4-18 years of age. The study measured categories such as personal skills, intelligence, quotient, achievement, verbal tests, mathematic tests, memory, and developmental level/academic readiness. A positive relationship was discovered for all categories (with the exception of memory) and all age groups. The article continues to research this study and finds that “the effect size observed by Sibley and Etnier in this meta-analysis was 0.32 (standard deviation=0.27), which is similar to that which was observed in a meta-analysis of the effects of physical activity on cognition (ES=0.25) across the lifespan” (Hillman). These findings propose that even though physical activity is beneficial at all ages, early involvement can be important for the preservation of intellectual health throughout the adult lifespan.

John R. Best wrote an article called *“Effects of Physical Activity of Children’s Executive Function”.* He read and reviewed studies that tested children to see how their executive function increased or decreased during and after exercise. According to the article executive function ‘refers to the cognitive processes necessary for goal-directed cognition and behavior, which develop across childhood and adolescence” (Best). If children can increase their goal orientated intellect with physical activity it should be a no brainer for adults to enforce this at a young age. To test this theory Best explains how several studies done over many years had conclusions resulting in a positive correlation. One study takes the process of choosing random children which are then assigned to typical aerobic exercise over several weeks. There are multiple studies where children are watched as they increase the work the load of exercise then at the end take standardized paper tests to see if anything has improved. Students that were assigned to aerobic running performed better on the Torrance Test of Creative Thinking; “this measure of creativity assesses flexibility and divergent thinking” (Best). Even though this does not exactly measure executive function (EF), creativity is believed to enhance giving plenty reasoning that EF is sensitive to the effects of chronic aerobic exercise. The findings of this study along with many other Best discussions raise the possibility that the more the exercise requires complex, controlled, and adaptive cognition and movement; it will determine its impact on EF. According to the research of Active Living Research, a national program of the Robert Wood Johnson Foundation, compromising physical education for classroom time does not improve academic performance. In fact, students whose schools increased time for physical activity had maintained or improved their grades, and their scores on standardized tests also improved, even though they received less classroom instructional time.

To determine if exercise truly enhances brain function it is important to examine whether an increase in fitness would result in improvements in executive control processes. Multiple scholarly reviewers took a look at studies done based on cognition and physical exercise. They looked at a four month study on 75 participants comparing the fitness testing, running training, affective and cognitive testing, and COMT genotyping. COMPT genotyping is defined on dictionary.com as the genetic makeup, as distinguished from the physical appearance, of an organism or a group of organisms. This study ultimately resulted that a running training along with increased physical fitness improved cognitive flexibility and cognitive control. Along with this study are multiple others. One in particular was reviewed in the article *“Capitalizing on Cortical Plasticity: Influence of Physical Activity on Cognition and Brain Function”* by Arthur Kramer and Kirk Erickson. This literature supports the claim that physical activity improves cognitive and brain function, and protects against the growth of neurodegenerative diseases. Exercise is not only helpful to increase brain function; it benefits also preventing sickness later in life. While physical fitness mainly increases cognition effects of younger people, it can ultimately save an elder later in life.

Literature reviewer Henriette Van Praag states that ‘an active lifestyle might prevent or delay loss of cognitive function with aging or neurodegenerative diseases.” After reviewing study after study she also believes that physical activity advances cognition and can delay age related memory loss. Furthermore exercise defends against brain damage caused by stroke, stimulates recovery after injury, and is an antidepressant; all which could benefit students and increase their learning potential. Depression is becoming a very common disease for younger students these days. If exercise can help prevent this, actions to help encourage students need to be taken. In her article, Praag writes about a study based on college students. The study testes students reaction time and vocabulary faster than before the run. Another reviewer, Bernward Winter, agrees in his findings that vocabulary learning was 20 percent faster after intense physical exercise. “Objective measurements of aerobic fitness and exercise intensity, such as VO2max, would optimize research validity” (Praag). Her conclusion shapes the idea that exercise influences the brain vasculature; the arrangement of blood vessels in the brain. Particularly physical activity increases the creation of brain endothelial cells and angiogenesis throughout the brain. (Praag)

Similar findings of this hypothesis run from the 1800’s all the way up through today. It would only make sense that the world would see this positive correlation and make constructive changes. Instead we are going backwards and trying to focus in on everything but health. There are parents out there that only want their children to be better at math, science, English, and history, but could care less if they are motivated to take care of their bodies. An exceptionally smart child can only get so far in life without being physically active. Jennifer Etnier reviewed 37 different studies and compared them to base her conclusion off of. Her cardiac fitness hypothesis was tested in several ways. First there was a regression analysis conducted to determine the expected degree fitness cognitive performance. Next was a regression analyses conducted to see if there is a relationship between fitness and cognitive performance that are influenced by predicted moderators. Lastly studies in which the relationship between fitness and cognition was directly testes were examined to identify the nature of those findings. From the 10 studies that specifically researched the relationship between fitness and cognition, 37 statistics were recorded for subjects ranging from ages 17 to 85 years. From all 37 statistics, 32 relationships showed that a higher fitness score was associated with improved cognitive performance.

A new study shows that one year of reasonable physical exercise can increase the size of the brains hippocampus (helps regulate emotion and memory) in older adults, leading to an improvement in all around memory. The study conducted by researchers at multiple Universities is the first study focusing on older adults who are already experiencing weakening of the hippocampus. The scientists engaged 120 inactive older people without dementia and randomly placed them in one of two groups; those who began an exercise routine of walking for 40 minutes a day, three days a week, or those restricted to stretching and toning exercises. The aerobic exercise group established an increase in volume of the left and right hippocampus of 2.12 percent and 1.97 percent. Those who did stretching exercises decreased in volume by 1.40 and 1.43 percent. Exercise is definitely beneficial for the hippocampus region of the brain. Even modest amounts of exercise by older adults can lead to significant improvements in memory and brain health. While exercise for youth helps improve reasoning, awareness, goal-orientated decisions, and may prevent them from sleep deprivation, depression, and much more; during adult hood exercise focuses in on improving memory and preventing neurogenesis diseases. Either way, exercise is completely favorable for a wellbeing and longevity.

All this evidence clearly highlights the importance of encouraging physical activity. Not only for children, but it is important throughout a person’s entire lifetime in order to help reverse obesity and disease trends. Exercise can help to prevent or even reverse cognitive decline; it can serve to promote health and function in individuals. Ultimately this can turn American around and also help correct the health and economic problems society faces today. Physical Education in schools today should be about getting children’s heart rates up, teaching them about nutrition and the benefits of exercise. According to current public health guidelines, physical activity requests for children o accumulate 60 minutes of moderate to intense physical activity daily. And with approximately 25 million kids in this country considered obsess, why would schools want to eliminate physical education from their programs? Experts say if you want to raise truly well balanced children, physical education needs to be a part of their daily lives. If the school is not going to be providing an opportunity for physical activity, parents should fight for it. Now that it is known and proven that exercise serves multiple purposes other than purely physical, should it be made mandatory for schools? Physical education not only provides much needed physical activity that can help a child in the beginning of their life, it can also teach students the developmental and psychomotor skills that will help them be physically active later in life; continuously increasing brain functions.