



Science Behind the Story (SBS)
Move It or Lose It (🌈 A Physical Health Story)
(4th Grade – 9-10 yrs)

Your body is made of lots of muscles, so it only makes sense that our bodies were made to move. This story is about how your body moves and how using your muscles to move your body makes both your body and your brain healthy.

- 🌈 You may have heard the phrase “use it or lose it”. “Use it or Lose it” definitely applies to the muscles of our body and the parts of our brain that move these muscles.

Muscles which are not used tend to atrophy. This is why patients in a hospital who are immobile have their limbs moved periodically. The same thing applies to the brain. The early work of Marian Diamond in the early 1960s proved that enhancing the environment of an animal, which allowed the animal to use their brain, also helped to increase the brain mass (Diamond, 1964). The opposite also was true, if you keep an animal in an impoverished environment the animal will lose brain mass. Diamond spent her entire career proving that a healthy brain depended on the ability to “use it or lose it”.

Moving your body when you exercise is very good at helping us burn fat and convert food into energy (Koay YC, 2021). This also helps your brain health, as the brain is the most energy-demanding part of the body (Fehm, 2006).

- 🌈 Moving our bodies causes chemicals – endorphins – to be released in our brain. These chemicals do lots of different things that help our body and our brain.

When you move your body, your heart has to pump blood to the muscles so they can work. This causes the release of some very special chemicals in your brain – such as endorphins (Harber, 1984) and endocannabinoids (Forteza, F., 2021).

Endorphins and endocannabinoids are important because they help to decrease the release of the stress hormones (Dietrich, 2004). While a little bit of stress is a natural response and prepares your body and brain to produce behaviors to handle the stressful event (McEwen, 1998), prolonged stress or the perception that you have no control over the situation is detrimental to both the body and the brain (Kim, 2002).

- 🌈 You may have also heard the phrase “muscle memory”. If you have, FORGET ABOUT IT! There is no such thing as muscle memory – it is cerebellar memory.

Muscle contract and relax when they receive signals from the brain and spinal cord (Sweeney, 2018). Muscles can also increase or decrease in size by increasing or decreasing the size of the muscle cells (Schoenfeld, 2010). There is no mechanism for muscles to be able to store the memory of movements.

When you practice a movement, you are essentially forming a motor habit. Habit formation involves the cerebellum (Miquel, 2019). So the “muscle memory” which is such a part of our society is actually “cerebellar memory”.

National Standards:

Next Generation Science Standards

- Crosscutting Concepts
 - **Structures & Functions:** The way an object is shaped or structured determines many of its properties and functions.
 - The shape and stability of structures of natural and designed objects are related to their function(s).
 - **Cause & Effect:** Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.
 - Events have causes that generate observable patterns.
 - **Systems and System Models:** A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems
 - Systems in the natural and designed world have parts that work together.
 - Objects and organisms can be described in terms of their parts.

National Physical Health Education Standards (Shape America)

- **Standard 5:** The physically literate individual recognizes the value of physical activity for health, enjoyment, challenge, self-expression and/or social interaction.
 - S5.E1.4: Examine the health benefits of participating in physical activity

National Health Education Standards (Shape America) & CDC (Centers for Disease Control and Prevention)

- **Standard 1:** Students will comprehend concepts related to health promotion and disease prevention to enhance health.
 - 1.5.1: Describe the relationship between healthy behaviors and personal health. **(CDC)**
 - 1.5.2: Identify examples of emotional, intellectual, physical, and social health. **(CDC)**
- **Standard 7:** Students will demonstrate the ability to practice health-enhancing behaviors and avoid or reduce health risks.
 - 7.5.1: Identify responsible personal health behaviors. **(CDC)**
 - 7.5.2: Demonstrate a variety of healthy practices and behaviors to maintain or improve personal health. **(CDC)**
 - 7.5.3: Demonstrate a variety of behaviors to avoid or reduce health risks. **(CDC)**
- **Standard 8:** Students will demonstrate the ability to advocate for personal, family, and community health.
 - 8.5.1: Express opinions and give accurate information about health issues. **(CDC)**
 - 8.5.2: Encourage others to make positive health choices. **(CDC)**

References:

Diamond, M. C., Krech, D., & Rosenzweig, M. R. (1964). The effects of an enriched environment on the histology of the rat cerebral cortex. *Journal of Comparative Neurology*, 123(1), 111-119.

- Dietrich, A., & McDaniel, W. F. (2004). Endocannabinoids and exercise. *British journal of sports medicine*, 38(5), 536-541.
- Fehm, H. L., Kern, W., & Peters, A. (2006). The selfish brain: competition for energy resources. *Progress in brain research*, 153, 129-140.
- Forteza, F., Giorgini, G., & Raymond, F. (2021). Neurobiological processes induced by aerobic exercise through the endocannabinoidome. *Cells*, 10(4), 938.
- Harber, V. J., & Sutton, J. R. (1984). Endorphins and exercise. *Sports Medicine*, 1(2), 154-171.
- Kim, J. J., & Diamond, D. M. (2002). The stressed hippocampus, synaptic plasticity and lost memories. *Nature Reviews Neuroscience*, 3(6), 453-462.
- Koay, Y. C., Stanton, K., Kienzle, V., Li, M., Yang, J., Celermajer, D. S., & O'Sullivan, J. F. (2021). Effect of chronic exercise in healthy young male adults: a metabolomic analysis. *Cardiovascular research*, 117(2), 613-622.
- McEwen, B. S. (1998). Protective and damaging effects of stress mediators. *New England journal of medicine*, 338(3), 171-179.
- Miquel, M., Nicola, S. M., Gil-Miravet, I., Guarque-Chabrera, J., & Sanchez-Hernandez, A. (2019). A working hypothesis for the role of the cerebellum in impulsivity and compulsivity. *Frontiers in behavioral neuroscience*, 13, 99.
- Schoenfeld, B. J. (2010). The mechanisms of muscle hypertrophy and their application to resistance training. *The Journal of Strength & Conditioning Research*, 24(10), 2857-2872.
- Sweeney, H. L., & Hammers, D. W. (2018). Muscle contraction. *Cold Spring Harbor Perspectives in Biology*, 10(2), a023200.