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Steam Project

What will you be researching for your STEAM project?

For my STEAM project, I will be researching how muscle reactiveness changes across different stages of life. My goal is to understand how age affects muscle response, coordination, and reaction time. This research will explore how the muscular and nervous systems adapt with age, focusing on the action potential (AP) reactions that occur during a motor response. These electrical signals play a key role in how quickly and effectively muscles contract after stimulation. Even if an individual maintains a solid reaction time, their overall motor coordination and muscle recruitment patterns may diminish as they grow older. Understanding these changes can help explain differences in balance, agility, and reflexes between younger and older adults, with implications for injury prevention, rehabilitation, and active aging.

Which course objective will your STEAM project cover?

My project will address the course objective to explain how sensory cells translate stimulus into action potentials. I will investigate how age-related changes in muscle fiber composition, neural transmission speed, and coordination contribute to slower reflexes and decreased motor performance. Increased reaction time (RT) and reduced muscle synchronization are key factors that contribute to slower movement and reduced postural stability in older adults.

What media/medium will you use for your project?

For my project, I plan to create a video compilation featuring six different subjects, each representing a distinct age group. The video will demonstrate how muscle reactiveness and coordination vary across the lifespan by capturing participants' reaction times and muscle responses during simple physical tests (e.g., catching a dropped object or responding to visual cues). Visual comparisons will highlight the physiological differences in movement speed, precision, and muscular engagement at each life stage.

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For my STEAM project, I chose the course objective **"Explain how sensory cells translate stimulus into action potentials."** To deepen my understanding of this concept, I explored how aging affects the speed and efficiency of the sensory-to-motor pathway. Reaction time (RT) is the process by which humans use their cognition to respond towards the sensory input; visual or auditory, it involves the attention and processing speed coordinated with the performance of motor skills (John et al., 2016). I applied this knowledge to study how age-related changes in the neuromuscular system influence reaction time. My overall hypothesis was that as age increases, reaction time slows due to changes in sensory cells, neural conduction, and muscle coordination. (Betts et al., 2022). These age-related shifts in neural processing help explain why older adults often require more time to perceive a stimulus and generate an appropriate motor response.

To investigate this, I tested six individuals of different ages using two reaction-time tasks: the ruler-drop test and a reaction-time smartphone app. In the ruler test, a subject tries to catch a falling ruler as quickly as possible, and the point at which they catch it typically shifts over their three attempts. This catching point reflects differences in reaction speed, older participants generally catch the ruler lower than younger participants because they naturally respond slower (Arnold et al., 2015). The app test records how quickly each subject taps the screen after a visual cue appears. Both tests measure simple reaction time, the delay between noticing a stimulus and starting a movement.

Through sensory transduction, a receptor protein converts the stimulus energy into a change in the membrane potential (Arnold et al., 2015). In sensory receptors such as taste cells or the photoreceptors in the eye, the incoming stimulus creates small, graded electrical changes in the cell's membrane. These changes trigger the release of neurotransmitters onto sensory neurons, forming what's known as a receptor potential. Since reaction time depends on how quickly these receptor potentials lead to signals traveling through the nervous system, comparing reaction times across different age groups can show how this process slows as the sensory and neural systems age (John et al., 2016). Across the 6 different age groups I examined, the difference was about a 2-inch change in reaction distance per age group, showing a steady slowing of reaction time as age increases.

Across the six age groups I tested, a clear pattern emerged showing how reaction time changes as the body ages. The 7-year-old averaged 7 inches on the ruler drop and 0.438 seconds on the reaction time app, while the 15-year-old reacted slightly faster at 6 inches and 0.314 seconds. In the 27-year-old group (myself), reaction distance dropped to 2.5 inches with a reaction time of 0.36 seconds, showing the quicker neural processing typical

of young adults. The 39-year-old averaged 6 inches and 0.41 seconds, and the 52-year-old averaged 7 inches and 0.37 seconds, both showing the beginning of a gradual slowing. The 71-year-old displayed the slowest responses, averaging 8.3 inches on the ruler test and 2.608 seconds on the reaction time game.

Overall, my results show a clear pattern: reaction speed declines with age as sensory and neural processing slow over time. This trend aligns with previous research documenting age-related decreases in reaction performance (Arnold et al., 2015). Notably, aging impacts more than just motor output; it also affects multiple stages of the sensory pathway, as highlighted in recent studies (Siedlecki et al., 2025). As receptor potentials take longer to develop, the body becomes less efficient at translating sensory input into quick motor responses. Recent studies have shown that neural signals also travel more slowly through aging pathways (John et al., 2016). The increasing ruler-drop distances and reaction-time delays observed in older participants are consistent with these physiological changes. Together, the findings support my hypothesis and demonstrate how the sensory-to-motor pathway becomes less responsive with age, tying back to the course objective of how sensory cells translate stimuli into action potentials.

Citations

Arnold, P.,Vantieghem, S., Gorus, E., Lauwers, E., Fierens, Y., Pool-Goudzwaard, A., & Bautmans, I. (2015). Age-related differences in muscle recruitment and reaction-time performance. *Experimental Gerontology*. https://www.sciencedirect.com/science/article/pii/S0531556515300280?via%3Dihub

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