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## INTRODUCTION

Improvement in the teaching of science, technology, engineering, and mathematics (STEM), is the foundation of economic growth in the United States<sup>1</sup>. Yet, while 17% of suburban students pursue STEM-based careers after high school, only 13% of rural Americans do the same<sup>2</sup>. Some factors that contribute to this disparity include a shortage of STEM teachers in rural America, high rates of teacher turnover, and a lack of internet access<sup>3</sup> – all of which contribute to a decreased early exposure to STEM. Our goal is to determine if the usage of an actively engaging lesson plan on free nerve endings can improve STEM education in our local rural community.

## METHODS

A one-hour lesson plan on the different types of nerve endings was taught to eight 7<sup>th</sup> or 8<sup>th</sup> grade classes with approximately 20 students each. Students were taught about merkel discs, pacinian corpuscles, ruffini corpuscles, and free nerve endings. In the classroom, pretests with 3 multiple choice questions and one free answer question were circulated. Students were walked through the lesson plan using a worksheet and two hands-on activities. The classes were divided into two groups – group A was not told to put their worksheet away while group B was. Subsequently, posttests that mimicked the pretest were conducted. Tests were graded out of four, with a point for each of the multiple-choice questions, and a point for the free answer question. A paired t-test was performed.

## RESULTS

### NERVES OF THE BODY

#### Review:

What is the nervous system?  
What makes up the nervous system?  
Use the diagram below to draw out the locations of the brain and spinal cord  
But how does your body tell apart different sensations of touch like pain, pressure, etc?

#### Practice Questions

1. A 21-year-old woman is lighting candles on a cake for her best friend's birthday party, and she accidentally burns herself on the candle while setting the cake down. She immediately pulls her hand away when she senses the searing hot flame. What nerve ending is activated due to the pain from this candle?  
(Do this one as a group)
2. A 12-year-old boy is taking dance lessons this summer. To be coordinated, the boy must know where his limbs are in the air at all times. What nerve endings help him tell the position in which his limbs are in?
3. A child is solving a rubik cube with a blindfold on. What nerve ending help this child tell that he is holding a rubik cube?
4. A woman is walking in a moving train in the middle side and feels vibrations in the floor of the train through her feet. What nerve type helps her feel these vibrations?
5. A woman goes to a hair salon and is getting a scalp massage. What nerve type helps her feel the stretching of the skin in her scalp during the massage?



#### Activity:

Using just your hands and not your eyes, tell us the identity of the object that you feel with your hands and what nerve ending you are using to tell us what it is.

Figure 1: A compressed version of the lesson plan handed to students.

1. What type of nerve senses temperature?
  - a. Free nerve endings
  - b. Meissner's corpuscles
  - c. Pacinian corpuscles
  - d. Merkel discs
  - e. Ruffin corpuscles
2. What type of nerve senses stretch in the skin?
  - a. Free nerve endings
  - b. Meissner's corpuscles
  - c. Pacinian corpuscles
  - d. Merkel discs
  - e. Ruffin corpuscles
3. What nerve helps differentiate the edges of a shape?
  - a. Free nerve endings
  - b. Meissner's corpuscles
  - c. Pacinian corpuscles
  - d. Merkel discs
  - e. Ruffin corpuscles
4. A 14-year-old girl has a disease where she can't feel the stretching of her skin. What nerves are still intact?

Figure 2: Pre- and post-test taken by participants

## REFERENCES

1. Xie, Y., Fang, M., & Shauman, K. STEM Education. *Annu Rev Sociol.* 2015, Aug 1; 41: 331-357. doi: 10.1146/annurev-soc-071312-145659.
2. Barshay, J. (2023, January 27). *Proof points: Rural American students shift away from math and science during high school.* The Hechinger Report. <https://hechingerreport.org/proof-points-rural-american-students-shift-away-from-math-and-science-during-high-school-study-finds/>
3. Lucas, F. (2019, November 14). *Rural America needs STEM education.* <https://science.house.gov/2019/11/rural-america-needs-stem-education/>

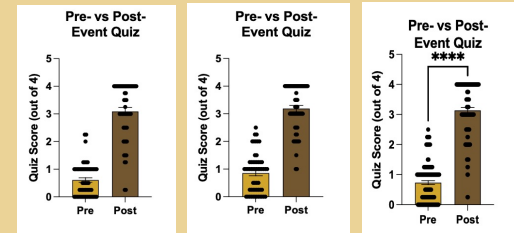


Figure 3: Paired-t-test results for Group A, t(52) = 15.34, p<0.0001

Figure 4: Paired-t-test results for Group B, t(55) = 16.39, p<0.0001

Figure 5: Paired-t-test results for both Groups A and B, t(108) = 22.45, p<0.0001

Student performance on the quiz significantly improved following the lesson plans in all groups. Paired t-test analysis of pre-test and post-test scores indicated a statistically significant increase for each group.

## CONCLUSION

The conduction of this lesson plan was effective. Especially, the usage of a follow-along worksheet and activities, which encouraged active engagement, proved to be an effective method of education for a STEM-related topic. This efficacy could translate to not only an increased understanding of STEM-related topics, but an increased exposure to STEM, and subsequently an increased rate of pursuit of STEM-related careers in students from rural communities.

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