Meeting Your Potential

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INTRODUCTION

Researchers have described the action potential as the basic property of neurons, by which information is encoded in number and frequency (White, et al., 1989). Therefore, an understanding of this fundamental property can enhance our understanding of the way we perceive and interact in the world. Hodgkin and Huxley (1952) first characterized the electrophysiological background for the action potential in the middle of the twentieth century. They found that sodium would flow into the cell upon depolarization and then potassium would leak out of the cell after the spike to reestablish resting potential. Also, further research found that drugs and toxins could alter the properties of the action potential. For example, TTX blocks sodium channels and allows no excitation to occur. Likewise, TEA decreases the conductance of potassium, which leads to prolonged sodium influx, thus changing the falling phase characteristic (Ramon and Moore, 1979). However, the effects of drugs were secondary for this project. Our primary focus was to explain the properties of action potential, its propagation, and subsequent effects on neurotransmitter release at the synapse to 5th grade students using an interactive model.

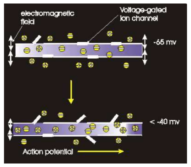

Fig 1. Shows the ion flux of cations and anions during a depolarization.

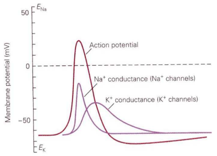

Fig 2. A graph of the action potential and the effects of sodium and potassium on the duration.

MATERIALS AND METHODS

Two groups with equal quantities of children were aligned (facing the same direction) and spaced approximately five feet apart, one group named "Pre-Synapse," and the other called "Post-Synapse." A single child centered in the space between the two groups acted as the post-synaptic receptor. Another child stood about eight feet directly across from the child whom was in the middle of the two groups, acting as the neurotransmitter releasing point, and faced him or her. To start, the group representing the pre-synaptic axon terminal began to do the wave starting from left to right. As the wave approached the center, the child initially holding the ball made a bounce-pass to the child in between the two groups, thus modeling the effect of neurotransmitter exchange. Then, the group acting as the post-synaptic cell did the wave until the last child raised his or her hands. At this point, we opened a box labeled "Response," which was filled with assorted candies, when the action potential progressed appropriately. As a side note, we would intercept the ball to display the blocking effects of some drugs on "NT" exchange. Candy was not rewarded in this case to discourage drug use.

Fig 3. The kids were encouraged to act out the "wave" made popular at sporting events.

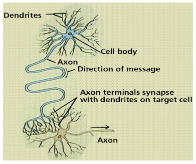

Fig 4. The task performed by the children modeled the propagation of nerve impulse from one neuron to another.

RESULTS

In our group (the "A" group), we were awarded third place out of four groups in a tie with another team. The figure and table for the scoring data are represented below. For the most part, the children were attentive and they seemed to have fun, by the smiles on their faces. Some groups even asked if they could stay longer and play the game longer without the candy! The team that scored the highest and took first place (A1) used a live mouse in their model, which the children appeared to focus on.

After we presented to our first group of kids, we spent a few more of the ten minutes we were granted speaking about our topic and asking questions from the students, rather than spending the entire time on the game. There were only about four to six children per group, so organizing them for the task took less time than we had anticipated.

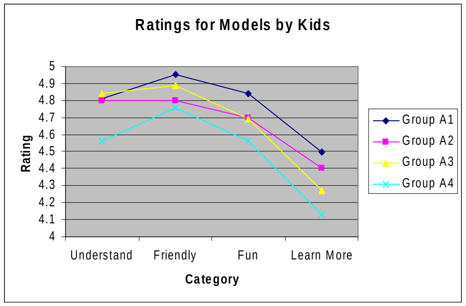

Table 1

Team Name	Group #	Understand	Friendly	Fun	Learn More	Average vote	Place
Palce Power	A1	4.81	4.95	4.84	4.5	4.7875	1
Ouch My brain	A4	4.8	4.8	4.7	4.4	4.675	2
Meeting your	A3	4.84	4.89	4.69	4.27	4.672	3
Seeing is	A2	4.56	4.76	4.56	4.13	4.5025	4

The data we received to produce the figure and table above were based on evaluation forms filled out by the fifth graders. There were also questions on the forms, which had an area for the children to relay what they remembered about our model and what they liked or disliked about it. Almost all of our evaluations stated that our model was "cool" and that they thoroughly enjoyed playing the interactive game. Most of the children recalled the fact that the neurotransmitter was exchanged at the synapse and resulted in an action potential that could happen at an incredible rate. Based upon the reactions we got during our presentation, it appeared that the candy was the most intriguing part of the model. After lunch, the children were less enthusiastic about receiving candy for completing the task successfully and seemed less attentive.

CONCLUSIONS

We developed a clever way to convey the properties of an action potential to children, as was shown by a high ranking in the category of "Understand." Hopefully this means that the children actually understood the concept. Feedback from the children did reiterate what we had told them, in fact. During the overview, children would say things like, "I didn't know that the brain worked by electrical patterns," and "Is that why eating healthy is important?" Candy, of course, was a good reward.

In order to bring the concepts down to the 5th grade level, our model oversimplified the exchange of neurotransmitters to a single molecule exchange. Also, the act of intercepting the ball to portray the negative effects of drugs only actually modeled the blocking effect of certain drugs. Finally, our model would have been much more effective if we would have had a greater number of participants. We had originally intended on having no less than ten children, so the act of propagation could be understood more easily. In total, the Kids Judge! Science fair was a success. We all presented many topics to fifth graders that they would not otherwise see until high school or college. Not surprisingly based on the age of the children, a model derived from a topic on the functional properties of neuroscience appears to be most effective. As the kids age and are introduced to more chemistry and biology, their opinions may change and the appreciation for the physiological properties may increase.

I believe that several of the children were attentive and generally intrigued by neuroscience, which will hopefully lead to the recruitment of future scientists.

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Pictures found online at:

www.surrey.ac.uk/_qe/cemi.htm
http://courses.washington.edu/biophys/homework
members.cox.net/rangerhaljax/crowd-wave.jpg

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