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Neuro 430  
Kids Judge Neuroscience Fair 2006 Exhibit  
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## **Putt Putt Pathways**

### Abstract:

Ion channels play a vital part in the functioning of cells. They allow ions to flow into and out of the cells; this allows the cells to communicate with other cells. It also allows the cells to generate action potentials. Action Potentials are crucial in the functioning of our body; they allow the brain to communicate with the rest of the body, and the rest of the body to communicate with the brain.

Kid's Judge Neuroscience was a perfect opportunity for us to introduce kids to the idea of ion channels. We accomplished this by first doing a quick background demonstration using a poster. During this presentation we discussed what we meant by ions, namely sodium (Na) and potassium (K). We also showed them the importance that ions play in the regulation of bodily functions.

For the bulk of our presentation we used a miniature golf type game with Na and K being represented by golf balls of different colors. The object of the game was to putt your golf balls through "channels" constructed out of balloons.

The kids really liked the game, and it received first place in our group. This does not mean that there was nothing wrong with our presentation. According to feedback from the kids, they did not feel as though they learned enough. Given another opportunity we would present the kids with more background information, as well as ask them questions at the end.

### Introduction:

Ion channels are proteins found in the membranes of all cells. They are responsible for maintaining the balance of ions inside and outside of the cell. The most crucial role of ion channels is the generation of the action potential. This allows nerve cells to communicate with other cells, and allows the transfer of information from sensory cells to nerve cells and ultimately to the brain where the information is interpreted. Ion channels allow the flow of several ions through the cell membrane. These include, but are not limited to K, Na, Cl, and Ca. The two ions most involved in the generation of the action potential are K and Na (3).

In the early sixties by Muller and Rudin developed an artificial membrane in order to study membrane potential, and the action of ion channels. It was crucial to develop an artificial membrane because the equipment had too much noise to measure individual channels in vivo. With the artificial membrane they knew the composition of the membrane allowing them to study many channels at once and take the average to get the membrane potential of one channel(1).

Ion channels are made from specific sequences of amino acids. The exact structure of these proteins has been studied over the last twenty years. There are positively charged amino acids on the inside of the ion channel that draw negatively charged ions into the cell, as well as positively charged amino acids that draw in negatively charged ions. Several subunits usually make up these channels. Surrounding the pore region are alpha subunits which make up the channel itself. Other subunits respond to neurotransmitters changing change the conformation of the channel thus allowing more or less ions to flow in or out (1).

Many ion channels have ways of gating when ions enter the cell. There are three ways that ion channels are gated; voltage gated, ligand gated, and mechanically gated. There are three general ways in which the gating mechanisms work; there is a blocking particle that swings in front of the pore thus blocking ions, a chemical binds to another part of the ion channel causing a conformational change in the pore region, or a stretch causes the cytoskeleton to pull on part of the channel, opening it (2).

The purpose of our model was to show kids that cells include ion channels. These ion channels are vital to the function of the cell and allow nerve cells to produce action potentials. They also maintain a concentration gradient across the cell. This allows the TCA cycle to function. We demonstrated the ion channels by placing oversized representations of them into a giant cell. There were different colors representing the different ions each channel is permeable to. Our model had two channels flush with the ground. These served as the holes through which the kids putted balls through. When a child hit the ball through the ion channel on their side they received a point. When they sent a ball through the wrong colored channel they will receive no points. This demonstrated that ion channels are only permeable to certain ions.

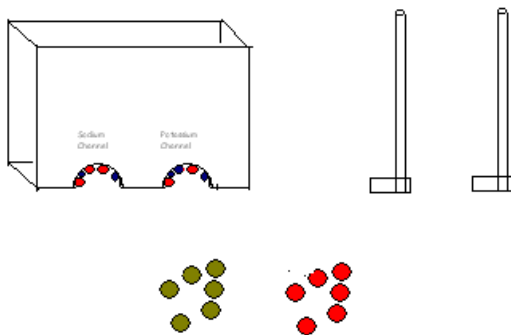
We wanted the kids to learn that ions play a vital role in the function of cells. They cause a change in the membrane potential allowing an action potential to be generated; this allows the cells to communicate with other cells.

#### Materials and Methods:

The model we used for Kids Judge Neuroscience was made from the following materials: 2 pieces of heavy poster board, cardboard boxes, party balloons, 1 large balloon, spray paint, plastic golf club holders, and 12 practice golf balls. To make the model, we first cut two six inch diameter half circles in the bottom of each of our pieces

of poster board. We then spaced these two pieces about six inches away from each other with the holes lined up. Using tape and pieces of cardboard from our boxes we attached the pieces of poster board. We covered the edges of the holes with party balloons; these holes represented a sodium and potassium channel. These represented the protein segments of the ion channels. The putters were fashioned by taping cardboard to the bottom of the golf club holders. To represent the sodium ions we spray painted 6 golf balls red. To represent the potassium channels we spray painted the other 6 gold. To play the game the students were broken up into two groups. One group was on one side of the model and the other group on the other side. The goal of each group is to make their six golf balls through their ion channel before the other group makes theirs. If a team made the ball in the wrong “channel” it was not counted; this represented channel’s ion selectivity. We made a poster that showed the kids how ion channels work and what function they play in the body. We also showed them representations of the ions used, namely, salt for sodium, and bananas for potassium.

Figure 1



### Results:

Judging from the results (fig 2) the kids enjoyed playing the miniature golf game. This enjoyment in the game seemed to lessen their questions regarding ion channels and cell function. They seemed to understand that there are indeed channels in cells that allow certain things to pass through them, and not other things. We used examples that they were all familiar with to demonstrate the theme of our game. Before and after our presentation, we asked the kids questions about ion channels, such as: what is an ion, what is an ion channel, and what do ion channels do. Afterwards they were able to answer these questions, from this we gleaned that the kids learned something from our demonstration. Our team placed first in our group of four. This was mainly due to how fun our model was. In the other categories we did not place as well. The kids did not understand our project as well as they understood some of the other projects. They also felt as though they could have learned more. The loud and crowded atmosphere of the

Kid's Judge Neuroscience Fair made it hard to teach well. However, this does not remove all responsibility from our group. We could have taught more.

Figure 2.

Project Name and code	Number of Votes	Place	Q1: Understand?	Q2: Friendly?	Q3: Fun?	Q4: Learn more?
Putt Putt Pathways	11	1	4.52	4.82	4.78	3.47
Why you can't sleep with the lights on	6	2	4.57	4.74	4.52	3.48
The Totally Tasting Tongue	5	3	4.88	4.96	4.48	3.74
Lobalization	2	4	4.48	4.57	4.48	3.57
Place of Putt Putt Pathways			3	2	1	4

### Discussion:

Judging from the results, the model we made was fun, but it was not as informative as it could have been. This could have been rectified by providing the kids with more background information, or asking them more questions after the game was completed. The topic we picked, ion channels, is an abstract topic. It requires that the kids imagine that each cell has thousands of unimaginably tiny ion channels in it. This made it a hard topic to demonstrate in a way that would be understood by fifth graders. That fact does not mean that this is not an important topic in neuroscience that needs to be explained and addressed. Ion channels are vital in the generation of action potentials, and without action potentials, our cells could not receive or give information to our central nervous systems. Individual cells also need ion channels to communicate with each other, as well as maintain homeostasis.

Using miniature golf to simulate ion channels was a way to show kids how ions flow into and out of cells. It also showed that there are different ions involved in cell regulation. There were several reasons why this model was not a perfect representation of ion channels or cells in general. Due to size constraints the ion channels were quite large compared to the cell. It was only possible to use two ions whereas a real cell has ion channels for several different ions. Most ion channels have a gating mechanism, we could not think of a feasible way to demonstrate the various gating mechanisms.

The kids definitely had fun playing with our model. This made it fun for us and kept their attention. The background portion of our demonstration could have been more thought out. We used the information we knew, and read off the poster we made. It would have been helpful to rehearse what we were going to say to the kids before we did our demonstration. If I were to do this model again I would also try to install some sort of simple gating mechanism, maybe a fan. This demonstration went well, and we would love to do it again. If we were to do a presentation like this in the future, we would ask the kids more questions at the end of the demonstration.