Sec.: _____ Name: _________

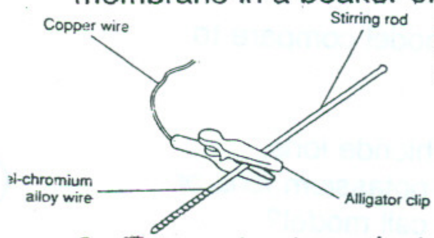
Experiment: Constructing a Model of a Nerve Cell
(B. Science 10-35-2b)

Purpose: To construct a model of a nerve cell and to observe how the distribution of ions around the membrane generates a resting potential.

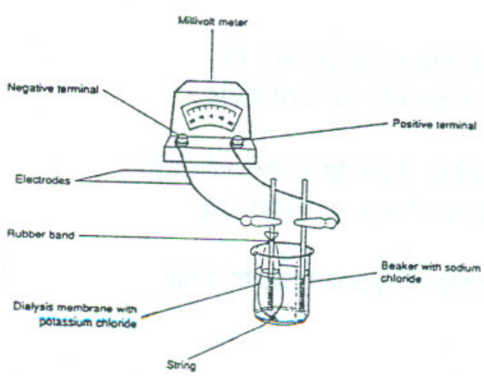
Materials: 2 alligator clips with copper wire
2 - 150 mL beakers DC millivolt meter
dialysis membrane 2 glass stirring rods
2 -15 cm pieces of nickel - chromium wire
3 M KCL 3 M NaCl string
rubber band scissors screwdriver

Methods: SAFETY: WEAR GOGGLES

1. Using scissors, cut a 20 cm strip of dialysis membrane. CAUTION: Be careful when using sharp instruments. Place the dialysis membrane in a beaker of water. Put the beaker aside for now.



2. Tightly coil a 15 cm strip of nickel - chromium alloy wire around one end of a glass stirring rod. Allow 3 cm of the nickel - chromium alloy wire to remain uncoiled an parallel to the length of the stirring rod (see fig. 1). Repeat this procedure using the other piece of nickel - chromium alloy wire and stirring rod.
3. To construct an electrode, clamp each alligator clip to a stirring rod so that the jaws of the alligator clip make contact with the uncoiled portion of the nickel - chromium alloy wire (see fig. 1).
4. Attach one electrode to the positive terminal of the millivolt (mV) meter to the copper wire of the alligator clip. Attach the other electrode to the negative terminal of the mV meter.
5. Half fill a clean 150 mL beaker with the 3 M sodium chloride (NaCl) solution. CAUTION: Be careful when using chemicals. Place the electrode attached to the positive terminal of the millivolt meter in the beaker. (DO NOT allow the alligator clip to touch the NaCl).
6. Remove the dialysis membrane from the beaker. To open it, rub both ends between your fingers. Tie off one end of the dialysis membrane with the string to make a sac.



7. Half fill the dialysis membrane with 3 M potassium chloride solution. CAUTION: Be careful when using chemicals. The dialysis membrane sac represents a membrane of a nerve cell. (A model of a cell).
8. Insert the electrode attached to the negative terminal of the mV meter into the potassium chloride solution in sac.
9. Use a rubber band to close the open end of the dialysis membrane and to hold the dialysis membrane around the stirring rod.

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10. Place the dialysis membrane sac into the beaker containing sodium chloride. The beaker of sodium chloride represents the fluid surrounding the nerve cell. Make sure the sac does not touch the other electrode and the wires do not touch each other. See fig. 2.

11. Observe the direction in which the indicator on the millivolt meter moves. Note the number of millivolts registered on the meter. Record this information in the appropriate place in results.

Results:

11. direction: ________________ number of millivolts: ______ mV

Conclusions:

1. Electrons have a negative charge. Do electrons flow toward or away from the potassium chloride solution located inside the dialysis tube?

2. Because the electrons are negatively charged, they are repelled by other negative charges and tend to move away from them. Based on your observations, what is the charge inside the nerve cell model?
How does this compare to the charge inside an actual nerve cell?

3. How does the distribution of sodium and potassium ions in the model compare to the distribution of ions in an actual nerve cell?

4. Both sodium ions and potassium ions are positively charged. Chloride ions, however, are negatively charged. Based on your observations, do potassium ions or sodium ions move more easily through the membrane of the nerve cell model? Explain your answer.

5. How do (real) nerve cells develop a resting potential.
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Discussion:

1. Unlike an actual nerve cell, the model does not have a sodium - potassium pump to maintain the distribution of ions. How would this affect the functioning of the model over time? Explain your answer.

2. Too much sodium in the diet can cause high blood pressure in some individuals. What would happen to the functioning of the nervous system if there were no sodium in the diet? Explain your answer.

3. In the model nerve cell you constructed, how can you tell that the movement of potassium & sodium ions caused the voltage rather than the movement of chloride?

4a. Worry creates stress on our nerves that could lead to sickness. Quote the last half of Philippians 4: 6 which tells us what to do when we are being anxious or worring.

4b. Quote the first part of vs. 7 which tells us how to "guard (protect) your hearts and your minds (nervous system) in Christ Jesus".