Resting Potential

February 11, 2013

Due today- Nerve 3 Recording

Happy Chinese New Year

Simulation 3 highlights, a. unmyelinated axon

Left right same?

Why do you see more of the AP with smaller diameter axon?

Why less stimulus current with smaller axon?

Effect of stimulus current on delay?

Warming up axon

Velocity versus Axon Size

Simulation 3b. myelinated axon- how does myelin increase conduction speed?

Effect of Myelin Wrap on Velocity

Small diameter squid axons conduct about same speed as large diameter squid axon

19 m/s = 43 mph

500 micron

What do these have in common?

“rubbing salt in a wound”
Lethal injection cocktail
Dr. Kevorkian’s suicide machine
Hyperkalemia
Hypokalemia

Resting Potential

Dr. Wright, 2005

Simulation week 5
Ion distributions across cell membrane

Ionic basis of the resting potential

1) Unequal distribution of ion species across membrane

Donnan Equilibrium

What happens if we open pores in the membrane permeable to K+?

http://www.youtube.com/watch?v=3mhSfQio8mp0

Donnan Equilibrium

What happens to the relative voltage differences between outside and inside when K+ goes out?
2. Selective permeability of ion species through membrane

Donnan Equilibrium

At Nernst Potential

When will the voltage change stop?

K+ experiment

![Ion concentrations table]

<table>
<thead>
<tr>
<th>Ion</th>
<th>External (mM)</th>
<th>Internal (mM)</th>
<th>Nernst potential (mV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frog muscle K</td>
<td>2.25</td>
<td>124</td>
<td>−101</td>
</tr>
<tr>
<td>Na</td>
<td>109</td>
<td>10.4</td>
<td>+59</td>
</tr>
<tr>
<td>Cl</td>
<td>77.5</td>
<td>1.5</td>
<td>−99</td>
</tr>
<tr>
<td>Squid axon K</td>
<td>20</td>
<td>400</td>
<td>−75</td>
</tr>
<tr>
<td>Na</td>
<td>440</td>
<td>50</td>
<td>+55</td>
</tr>
<tr>
<td>Cl</td>
<td>560</td>
<td>40</td>
<td>−66</td>
</tr>
</tbody>
</table>

Why does the line deviate from the K theoretical values at lower [K]?
Squid giant axon - a model prep

Squid giant axon - membrane prep

Squid giant axon - RP experiment

Squid giant axon - experimental chamber

40,000 APs can fire!
Results: K: RP relationship

At Rest: \( I_{Na} = I_K \)
\[ I_K = g_K(V_m - E_K) \]
\[ I_{Na} = g_{Na}(V_m - E_{Na}) \]

\[ g_K(V_m - E_K) = g_{Na}(V_m - E_{Na}) \]

Application of Principal

1. Pre-injection 10c. administration, one half hour prior to execution.
2. Pre-injection 10c. Sodium-Dextrose Solution (as above) over a ten second time period.
3. One minute wait.
4. Pre-injection 15c. Sodium-Pentobarbital Solution (as above) over a ten second time period.
5. One minute wait.
6. Pre-injection 15c. Dorsal Column Deafferentation (as above) over a ten second time period.
7. One minute wait.
8. Injection 15c. Dorsal Column Deafferentation (as above) over a ten second time period.
9. Execution over.
Dynamic contributions to the RP

Complex Changes in “RP” by changing ionic conductances dynamically