April 6, 2015
Spatial and Temporal Summation
Snail II
Ca APs
Voltage Clamp H&H I

Snail 1 Lab Results due Thursday
Set up data folders in lab
(April 9)

Space and Time constant important for Spatial and Temporal summation

Snail feeding video
https://video.search.yahoo.com/video/play?p=snail+feeding&vid=a5dba17f4aae10de6cd21687211aa4df0&l=1%3A18&c=14&sigr=11bpq257p&sigt=11ej63s1v&sigi=11r9aje5v&back=https%3A%2F%2Fsearch.yahoo.com%2Fyhs%3Fp%3Dsnail%2Bfeeding%2Bvideo%26ei%3DUTF-8%26hsimp%3Dyhs-004%26hspart%3Dmozilla&sigb=12vla776e&ct=p&age=1267891200&fr2=p%3Cv%2Cv%3Av&hsimp=yhs-004&hspart=mozilla&tt=b

Easter Squid

Snail Buccal Ganglia- control of rhythmic feeding movements

Snail burster neuron

https://video.search.yahoo.com/video/play?p=snail+feeding&vid=a5dba17f4aae10de6cd21687211aa4df0&l=1%3A18&c=14&sigr=11bpq257p&sigt=11ej63s1v&sigi=11r9aje5v&back=https%3A%2F%2Fsearch.yahoo.com%2Fyhs%3Fp%3Dsnail%2Bfeeding%2Bvideo%26ei%3DUTF-8%26hsimp%3Dyhs-004%26hspart%3Dmozilla&sigb=12vla776e&ct=p&age=1267891200&fr2=p%3Cv%2Cv%3Av&hsimp=yhs-004&hspart=mozilla&tt=b

Synapse tutorial
Snail week 2. Ionic mechanisms of excitability

- Reduced Na

- Reduced Ca

K+ Channel block with TEA for Na AP

4 mV

50 ms

TEA/CS block progressing over time (5 minutes)

K+ Channel block with TEA/CS for Ca AP
K+ Channel block with barium

Serotonin modulation in an identified V2a spinal interneuron (3/23/2011, ~9 pm)

Calcium APs

Ca2+ counts entirely for APs in muscles of:
1) arthropods
2) molluscs
3) nematodes
4) adult tunicates
5) smooth muscles of verts.

Ca2+ works with Na+ for APs in:
1) cardiac muscle of verts
2) nerve cell bodies of
   a) molluscs
   b) annelids
   c) arthropods
   d) amphioxans
   e) birds
   f) mammals

Examples of calcium APs
Na AP vs. Heart AP

Cardiac AP currents

<table>
<thead>
<tr>
<th>Principal ion</th>
<th>Response to depolarization</th>
<th>Speed of response</th>
<th>Inactivation</th>
<th>Function</th>
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</thead>
<tbody>
<tr>
<td>Na</td>
<td>Open</td>
<td>Fast</td>
<td>Initial</td>
<td>Depolarization</td>
</tr>
<tr>
<td>K</td>
<td>Close</td>
<td>Fast</td>
<td>None</td>
<td>Maintenance phase</td>
</tr>
<tr>
<td>K</td>
<td>Open</td>
<td>Slow</td>
<td>Little</td>
<td>Repolarization</td>
</tr>
<tr>
<td>K</td>
<td>Open due to Ca influx</td>
<td>Slow</td>
<td>Change at internal Ca level</td>
<td>Repolarization</td>
</tr>
<tr>
<td>Ca</td>
<td>Open</td>
<td>Slow</td>
<td>Slow</td>
<td>Maintenance phase and proline contraction</td>
</tr>
</tbody>
</table>

Hodgkin and Huxley I- Ionic currents underlying the AP


Voltage clamp of squid giant axon

“This is in agreement with the hypothesis that the inward current is carried by Na\(^+\) ions, which as a result of a decrease in \(\text{RP}\), are permitted to cross the membrane in both directions under a driving force that is the result of both the concentration difference and the electrical potential difference.”

\[ \text{I}/\text{V plot for current flow with depolarizations} \]

\[ \text{Predicted NaEq = Observed} \]

<table>
<thead>
<tr>
<th>Ame</th>
<th>(7%)</th>
<th>(10%)</th>
<th>(50%)</th>
<th>(100%)</th>
<th>(I_{\text{Na}})</th>
<th>(V_{\text{Na}})</th>
<th>(V_{\text{Na}})</th>
<th>(E_{\text{Na}}-E_{\text{K}})</th>
<th>(10%)</th>
<th>(50%)</th>
<th>(100%)</th>
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<tbody>
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<td>-45</td>
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\[ \text{Depolarization shift} \]

\[ \text{Predicted NaEq = Observed} \]
Isolation of currents 1952

Ion replacement

Quantification of inward and outward currents 2014

Calculation of conductances

How do we get $Keq$ potential?

Determining reversal potential for K from tail current??

How did they do it?