April 23, 2014
Patch Clamp
Defining Behavior
Channel Ecosystems

The Gohm seal is possible:
1) the membrane lipid bilayer is attracted to the surface of electrode glass.
2) the membrane is fluid, allowing it to be pulled into the electrode tip.

Mechanisms of channel modulation?
Ex.: 5HT reduction of $I_k$, leading to an enhancement of transmitter release

FINAL PAPER & PRESENTATION: 4010 Final
exam time: Tuesday, May 20 9:00 am

Special Project- Two lab sessions for your own experiments.
Continue with a lab exercise you liked and feel comfortable technically with.
Start with suggestions for Further Exploration from lab exercises.
Research project that is an extension of your lab research*
Engineering project that relates to the class*
* Needs prior approval
Neuromodulation enhancing transmitter release through AP broadening

Mechanisms of channel modulation?
Ex: 5HT reduction of \( I_{\text{Cl}} \), leading to an enhancement of transmitter release

Possibilities:

Ex.: 5HT reduction of \( I_{\text{Cl}} \), leading to an enhancement of transmitter release

Possibilities:

Mechanisms of channel modulation

Example- 5HT closes channels

Problems:

Subconductance states- ACh receptors
Technology can determine results and interpretation-
Anesthetic example

Chapman et al 1997
Perforated patch recordings maintain intracellular integrity

Monitoring Behavior; Examples of behavioral components of male fly aggression

Table 1. Ethogram of offensive and defensive actions of male flies during agonistic encounters

<table>
<thead>
<tr>
<th>Component Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Offensive actions</td>
</tr>
<tr>
<td>Approach: One fly lowers body, then advances in the direction of the other</td>
</tr>
<tr>
<td>Low-level fencing: Both flies extend one leg and tap opponent's leg</td>
</tr>
<tr>
<td>Wing threat: One fly quickly raises both wings to a 45° angle towards opponent</td>
</tr>
<tr>
<td>High-level fencing: One or both flies face each other, extend leg forward and push opponent</td>
</tr>
<tr>
<td>Chasing: One fly runs after the other</td>
</tr>
<tr>
<td>Leaping: One fly jumps up on total legs and jumps down onto the other</td>
</tr>
<tr>
<td>Boxing: Both flies rear up on hind legs and strike the opponent with forelegs</td>
</tr>
<tr>
<td>Tussling: Both flies tumble over each other, sometimes leaving food surface</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Defensive actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walk away: Loser turns and retreats slowly from advance of winner</td>
</tr>
<tr>
<td>Defensive wing threat: Loser flakes wings at 45° angle while facing away from opponent</td>
</tr>
<tr>
<td>Run away: Being chased Loser runs away quickly from advance of winner</td>
</tr>
<tr>
<td>Fly away: Loser flies off food surface</td>
</tr>
</tbody>
</table>

Within each category the order of the components is roughly in increasing levels of intensity.
Larval Ethograms

Complex Activity of Neurons Driven by Tailored Channel Ecosystems

Thalamic relay neurons

Activation of different currents produces varied neuron activity
Real neurons have many types of currents

Block sodium and potassium currents

<table>
<thead>
<tr>
<th>Voltage (mV)</th>
<th>Current (nA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-60</td>
<td>I_A</td>
</tr>
<tr>
<td>-40</td>
<td></td>
</tr>
<tr>
<td>-20</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td></td>
</tr>
</tbody>
</table>

Common Inward and Outward Currents

Inward currents
- Na^+ current
- K^+ current
- Ca^2+ current

Outward currents
- Na^+ current
- K^+ current
- Ca^2+ current

Switch from bursting to tonic spiking controlled by leak and I_h voltage range

A: Sleep
- Oscillatory mode
- tonic mode

B: Bursting mode
- Fast excitatory amino acids
- Slow excitatory amino acids

C: Tonic spiking
- L_is voltage range

Switches used to model the activity of a thalamic relay neuron

- I_n, transient: The fast Na^+ transient current which underlies the generation of action potentials
- I_h, persistent: A persistent, non-inactivating Na^+ current
- I_Ca, voltage dependent Ca^2+ current
- I_K, delayed rectifier K^+ current
- I_V, voltage dependent Na^+ current
- I_P, slow inward rectifier K^+ current
- I_A, adenosine triphosphate sensitive K^+ current
- I_Na, non-inactivating Na^+ current

References:
Neuromodulation induces plasticity in neural networks

Ionic Targets of Dopamine in Pyloric Network

PY rebound firing is timed by its intrinsic properties, also modulated by DA

Assignment for Weds, April 30

Pen your poison:
http://www.amnh.org/exhibitions/current-exhibitions/the-power-of-poison


Each lab group describe a neurotoxin