March 9, 2016  
Synaptic Transmission Refresher (cont)  
Crawdad Lab Exercises 5 & 6

Due Tomorrow: RP Lab Results,  
Lab Due Monday, March 14  
Nervous System Disease Presentations  
Next Week: Mon and Weds

Steps in transmitter release  
What is the cause of synaptic delay? over 1 ms

Synaptic delay due to Ca entry at end of AP

Pre-synaptic release machinery

Process of vesicle fusion and transmitter release

Sites of toxin action

I_{Ca} = g_{Ca} (V_m - V_{rev})  
(V_m - V_{eqpot}) = Driving force

200 micros!

200 micros!
Proof of Neurotransmitter Identity?

- Presence
- Action
- Release
- Pharmacological Congruence
- Synthetic/packaging machinery

Most common fast transmitters

<table>
<thead>
<tr>
<th>SMALL-MOLECULE NEUROTRANSMITTERS</th>
<th>Amino Acids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetylcholine (ACh)</td>
<td>Galanin</td>
</tr>
<tr>
<td>Dopamine</td>
<td>Glutamate</td>
</tr>
<tr>
<td>GABA</td>
<td>Phenylethanolamine</td>
</tr>
</tbody>
</table>

INDOLEAMINE

Serotonin (5-HT)

Excitation: Conductance increase (resistance decrease):

- Channels in membrane open
- Membrane potential goes towards V_{rev} (Equil. Pot)
Single ion: $V_{rev} = E_{ion}$

Results if synaptic potential were due to only Na$^+$ or K$^+$

Mixed ionic PSPS

$\text{Isyn} = g_{\text{Glu}}(V_{m} - V_{rev}) - 60 \text{mV}$

Depolarizing because of large Na driving force

Conductance change due to multiple ions

Synaptic inhibition

Stimulation of inhibitory nerve blocks AP production

Red: Inhibitory fibers
Green: MRO1 & 2

See synapse tutorial
Inhibitory conductance increase

\[ I = g (E_m - E_{ion}) \]

Inhibition: Conductance increase (resistance decrease):

Membrane potential goes towards \( V_{rev} \) (Equil. Pot)

Mechanisms of inhibition?

Red: Inhibitory fibers
Green: MRO1 & 2

Mechanisms of inhibition?
Reduce AP generation by:
1) Algebraic summation of excitation and inhibition
2) Reduction of space constant

Channel distribution on MRO
MSC: mechanoreceptor channel
Presynaptic inhibition

Presynaptic inhibition reduces transmitter release

EPSP trying to reach AP threshold

Spatial constant important
Spatial summation

Time constant important
Temporal summation

See Synapse tutorial