COGS 107B

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Office Hours: Mondays 1-2pm CSB114
or by appointment
Week 2

Have covered so far:
Neuron Doctrine & System Basics
Somatosensory
Proprioceptive
Vestibular

Questions on material thus far?

Midterm 1 is (1/31/2019, CENTER 115) (2 weeks)

Slides will be on the website dnitz.com under the (teaching - 107b) resources tab.
Question for you:

What do all the somatosensory & proprioceptive receptor cells have in common?

What differences do they have?

How could you classify them?

Meissner’s Corpuscles
Pacinian Corpuscles
Merkel Discs
Hair Receptor (NOT Aud./Vest. hair cell)

Golgi Tendon Organ
Muscle Spindle Cell

Otolith Organs (Utricle/Sacule)
Semicircular Canals

What are the properties of ion channels?

Ion selectivity
Gating
Kinetics
State
Distribution
Continuous to Discrete

Going from real world phenomena to binary action potentials

Sensory cells have many different ways to accomplish this

The structure of the sensory neuron’s afferent determines what gets ‘picked up’

Synaptic (Generator) potentials -> Action potentials

True or False:
A Generator Potential is similar to a Synaptic Potential
True
What real world phenomena are being picked up?

Sensations

Sensorimotor

Proprioceptive

Vestibular

Vision

Auditory

How is each system set up to accomplish this?

True or False:

- Afferents are like the axons for sensory neurons
  
  False

  Afferents are like the dendrites for sensory neurons
Convergence

Signals are ‘specialized’ for one feature of the world at first

When one neuron gets input from multiple different information-streams the output is the result of convergence

All perceptual information converges in the cortex

Endolymph has particularly high levels of what ion? [K+]

[Diagram: Convergence of rods, rod bipolar and All amacrine cells to alpha and beta cells of cat retina.]
Parietal cortex - making associations and spaces

A lot of information (sensory, visual, auditory...) all converge on neurons of the PPC

The neurons here have representational qualities for spaces (eye movement space, posture & grip space)

Prof. Nitz’s favorite place in the brain

True or False:
The non-contractile portion of the intrafusal muscle never stretches

False
Head direction cells

Neurons which only fire when looking a particular direction within a particular space.

True or False: If you were lost seeing Geisel (which you recognize) would not change your H.D. Cells’ firing

False
Circuits I think you should study

**True or False:**
Both the otolith organ and the semicircular canals have hair cells that are oriented in one particular way

**False**
The otoliths orient in many directions
S.C.Canals are oriented in one particular direction
Glycine acts very similar to _______ in this circuit.

**GABA**
Glycine activates inhibitory Cl- channels.
DRG -> Cortex

How sensory and proprioceptive information gets into the brain

True or False: Signals stay separated until cortex
True
Cortical Column

(Convergence/Divergence) of signals happens within the cortical column

Convergence
Vestibular -> Cortex

The 2nd stream of information to the brain so far

What is the signal going into the ventral spinal cord for?
Righting reflex
Oculomotor reflex

Turning your head to the left causes endolymph to travel in what direction?

To the right
Exciting the Left S.C.C
Other cool diagrams

(a) Action potential frequency increases during stretch

(b) Action potential frequency declines during contraction
(a) At rest: About 10% of the ion channels are open and a tonic signal is sent by the sensory neuron.
How does receptor density contribute to the phenomenon of cortical magnification?
<table>
<thead>
<tr>
<th>Type</th>
<th>RA / SA</th>
<th>Depth</th>
<th>Response Field</th>
<th>Sensitivity</th>
<th>Info. Processed/Best Stimulus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pacinian</td>
<td>RA</td>
<td>deep</td>
<td>very large (hand)</td>
<td>very high (10 nm)</td>
<td>high-freq. vibration</td>
</tr>
<tr>
<td>Meissner</td>
<td>RA</td>
<td>shallow</td>
<td>3-5 mm</td>
<td></td>
<td>slip / low-freq. vibration</td>
</tr>
<tr>
<td>MerKl</td>
<td>SA</td>
<td>shallow</td>
<td>spotty 2-3 mm (0.5 mm)</td>
<td>broad depth range</td>
<td>form, texture / points, edges</td>
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<tr>
<td>SA2</td>
<td>SA</td>
<td>deep</td>
<td>12-25 mm</td>
<td></td>
<td>hand shape / stretch</td>
</tr>
<tr>
<td>Hair</td>
<td>RA</td>
<td>deep</td>
<td>10 mm</td>
<td>1 micron</td>
<td>hair displacement</td>
</tr>
</tbody>
</table>
How does mechanotransduction work?

• We don't know what ion channel(s) underlie the mechanoreceptor potential!
• Hypothetical scheme: