Week 3 Section
IA: Ryan Szeto (rszeto@ucsd.edu)
OH: Wednesday 1PM @ CSB Kitchen
New OH: Wed 1PM @ CSB Kitchen

when it’s soup time
Question 1: What are the four functions of the vestibular system?

functions of the vestibular system:

- postural reflexes
- gaze adjustment
- assessment of self motion
- a reason not to drink too heavily?
Circle the correct answers: When cilia lean toward the (stereocilia/kinocilia), they become more hyperpolarized and release (more/less) neurotransmitter. When cilia lean toward the (stereocilia/kinocilia), they become more depolarized and release (more/less) neurotransmitter.
The otolith organ is composed of the utricle and the saccule.
The semicircular canal activates for **rotational** velocity and is **rapidly** adapting, while the otolith organ activates for **linear** velocity and is **slowly** adapting.
Question 5: Draw how the stereocilia are organized for the left and right side of the head.
Question 6: What happens to the hair cells, stereocilia, kinocilia, etc. when the individual turns their head right?

Hair cells are embedded in the gelatin-like cupula, which is surrounded by fluid known as the endolymph. If the skull turns right (like turning head right), the fluid will move to the left and move stereocilia with it. The stereocilia/kinocilia on the left side of the head will move toward the stereocilia, causing hyperpolarization. The stereocilia/kinocilia on the right side of the head will move toward the kinocilia, causing depolarization.
Question 7

The utricle handles horizontal dimensions- its hair cells point straight up. The saccule handles vertical dimensions- its hair cells point outwards (toward the face).
Question 8: Fill in the pathway

Semicircular canals/otolith organ → vestibular nucleus → ventral horn of spinal cord → Cerebellum → Oculomotor centers
Head-direction cells show activity for the individual’s head orientation relative to the environment. When the head is pointed in a preferential direction, these cells will show slowly-adapting/persistent firing.
Question 10: List the four maps found in the visual system.

- Retinotopic map
- Ocular dominance map
- Pinwheel/orientation tuning map
- Koniocellular/color/blob map
Question 11: How do photoreceptors and bipolar-on/off cells work together to send visual information to retinal ganglion cells?

- **Bipolar-on:**
  - Light shines on photoreceptor
  - This hyperpolarizes the photoreceptor, causing it to produce less glutamate
  - Which decreases inhibition of bipolar-on neurons (causing depolarization)
  - Leading the bipolar-on neurons to increase release of glutamate

- **Bipolar-off:**
  - Light shines on photoreceptor
  - This hyperpolarizes the photoreceptor, causing it to produce less glutamate
  - Which hyperpolarizes bipolar-off neurons
  - Leading the bipolar-off neurons to decrease release of glutamate
<table>
<thead>
<tr>
<th>Property</th>
<th>Parvocellular-(X)</th>
<th>Magnocellular-(Y)</th>
<th>Koniocellular</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surround inhibition (luminance opponency)</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Color opponency</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Receptive field size / resolution</td>
<td>small / high</td>
<td>large / low</td>
<td>?</td>
</tr>
<tr>
<td>Response to light</td>
<td>Sustained</td>
<td>Transient</td>
<td>?</td>
</tr>
<tr>
<td>Low-contrast, moving stimuli</td>
<td>Weak response</td>
<td>Strong response</td>
<td>?</td>
</tr>
<tr>
<td>Percent of ganglion cell population</td>
<td>~80%</td>
<td>~10%</td>
<td>~10%</td>
</tr>
</tbody>
</table>
Question 13: Label each graph with one of the four options: X-on, X-off, Y-on, Y-off

- Top left: X-on (parvocellular)
- Bottom left: X-off (parvocellular)
- Top right: Y-on (magnocellular)
- Bottom right: Y-off (magnocellular)
Question 14: Explain the structure of the layering found in the LGN

- Layers 1-2 code for magnocellular input, while layers 3-6 code for parvocellular input.
- Layers alternate between eyeballs—each retina sends information to only one of the magnocellular layers. Each retina sends information to only two of the parvocellular layers, in alternating fashion.
- Neurons that get input for koniocellular cells lie between layers.
- LGN shows retinotopic topographic representation—kind of like a homunculus, but with your visual field.
- The LGN relays information on to the primary visual cortex.
Question 15: What are the areas involved in the ‘what’ and ‘where’ pathways? What do each of these pathways do?

- **What pathway** - Object identification
  - V1 → V2 → V4 → TE, TEO
- **Where pathway** - Visuospatial abilities
  - V1 → V2 → V4 → MT, MST, 7a, VIP, LIP
Questions?