1. Sensory Systems (Ch13)
    - Finish hearing, vision

http://eebweb.arizona.edu/eeb_course_websites.htm

The Edges of Life – 7pm at Centennial Hall
Wednesday, February 13
LIFE’s Cognitive Edge: The Role of the Mind and What it Means to be Human
Anna Bohnsack, Assistant Professor, Ecology and Evolutionary Biology
Our human mental distinctions are they different from other animal life or does it? Recent research has revealed culture and social learning, tool use, complex communication, self-recognition, and planning for the future are not unique to the human experience. With these new findings, science is finally getting closer to understanding exactly what makes us human.

Wednesday, February 20
LIFE’s Human Edge: Changing Perspectives on the End of Life
Michael Gill, Associate Professor, Philosophy
Nothing looms with more certainty than the final edge of one’s own life. But in fact, the edge between life and death is anything but clear. This lecture will address the attempts that have been made to define the line between life and death and will explore the biological, legal, ethical, and spiritual debates that have raged around that line.

Wednesday, March 5
LIFE’s Technological Edge: The Singularity is Near: When Humans Transcend Biology
Ray Kurzweil, via Teleportec Teleporter
Founder, Chairman and Chief Executive Officer, Kurzweil Technologies
Humanity is on the edge of a vast transformation, when what it means to be human will be both enriched and challenged. Inventor and futurist Ray Kurzweil will introduce this radically optimistic singularity, an era when we break our genetic shackles to create a nonbiological intelligence trillions of times more powerful than today. In this new world, humans will transcend biological limitations to achieve entirely new levels of progress and longevity.

These do not count as physiology lectures.

Barn Owl
Konishi and Knudsen (1977) identified an area in the midbrain containing cells called space-specific neurons that fired only when sounds were presented in a particular location. Astonishingly, the cells were organized in a precise topographic array, similar to maps of cells in the visual cortex of the brain. Aggregates of space-specific neurons, corresponding to the precise vertical and horizontal coordinates of the speaker, fired when a tone was played at that location.

http://people.eku.edu/ritchisong/birdbrain2.html

Self Quiz:
1. What causes NT to be released?
2. What area of the vertebrate has an unusually high [K+] outside the cell?
3. What role do glomeruli play in chemoreception?
4. How can a hair cell transmit two kinds of information?
5. Why is the oval window smaller than the tympanum?
Type of sensation received depends on where in CNS (~brain) AP arrives (LABELED LINES).

Rub eyes and see light!

Synesthesia: e.g., smell colors

Vision

**FOCUS**
- light is focused by lens (and cornea) to create an image on the retina
- refraction by cornea (85%) and by lens (15%)
- alter focal length by altering shape and curvature of lens (zonular fibers and ciliary muscle `sphincter`)
- binocular convergence (both eyes on same part of retina)

**LIGHT INTENSITY**
- pupil for variable aperture via iris and radial muscle

Mechanisms and Molecules

Lots of Evolutionarily Conserved Elements
e.g., 7 transmembrane helices and G-protein intermediate

e.g., Vision, olfaction, sweet and bitter taste (also muscarinic ACh receptors and many hormone receptors)
Vision

**ANATOMY**
- sclera: white tough outer layer
- choroid: lots of blood vessels
- pigment layer: with photoreceptors
- fovea: where highest acuity and highest # cones (visual streak?)

**TRANSDUCTION**
- photoreceptors (rods and cones)
  - Transduce photons (light) into electrical signal
- rhodopsins (visual pigments)
  - Opsin (7-transmembrane lipoprotein) plus retinal (absorbs photon)

**Vision Receptor Cells**

<table>
<thead>
<tr>
<th>Rods</th>
<th>- Dim light, low resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cones</td>
<td>- Bright light, high resolution</td>
</tr>
</tbody>
</table>

- Rhodopsins (visual pigments) located in stacked lamellae
- Pigment epithelium
- Membranes hyperpolarize in response to light

- When light hits, Na⁺ "dark current" into the cell is stopped and membrane hyperpolarizes, stopping release of NT

- Na⁺ "dark current"
Bleaching of retinal photoreceptors

Photoreceptors called cones respond to particular wavelengths of light. Their response involves "bleaching" of their responsive pigment, so that for some seconds they are unable to respond again.

Expectation after 15 seconds?

Rod and Cone details

Action spectrum (where absorb light)

3 (e.g., humans, fish)
5 (e.g., birds)
different photopigments (opsin varies, retinal ~same)

Porphyropsins (different retinal) seem better than rhodopsins in freshwater

Rhodopsin

Rhodopsin mechanism:
cis-trans isomerization of retinal molecule

Changes conformation of opsin molecule and therefore initiates transduction
Activated retinal changes conformation of opsin molecule (opsin and retinal separate) and initiates transduction.

G-protein amplification requires to reconstitute the rhodopsin (night blindness).

**Physiology Players Theatre**

- 2 competing casts
  - Judge(s)
  - Accuracy
  - Enthusiasm

**Act I**

Photon enters stage right. Other players assembled within or near membrane. …photo transduction… Dark current reduced as curtain closes.

**Actors:**
1. Photon 4. Transducin 7. Ion channel
2. Retinal 5. PDE 8. Ion channel
3. Opsin 6. cGMP

**Photon Transduced...Now what?**

- Horizontal
- Bipolar
- Amacrine
- Ganglion

**Enhancing Receptor Sensitivity**

- Lateral Inhibition
  - e.g., improve touch sensitivity and visual acuity (edges especially)