(Continued from last lecture...)

- Methods in Brain Research

**Invasive (animal)**
- **In vitro**
  - Study of brain tissue (extracted from animal)

**Acute:** Brain slices. Study of live single cells and smaller network properties. Calcium Imaging.

**Culture:** Study of live single cells, and intercellular mechanisms.

- **Histology (non-living tissue)**
  - Staining
    - Fixative: Formalin
    - Cut into slices (10-50 μm), on a microtome.
    - Treated (e.g. staining)
    - Mounted on slides
    - Observed under a microscope-(4 different types of microscopes):
      - Regular light
- Fluorescent light (need laser)
- Electron microscope (fig. 5.9)
- Scanning Electron Microscope (3D infos)
● Histology: Locating Cell Bodies (figure 5.8- Nissl stain)
● Tracing [anterograde (fig. 5.12), retrograde (fig. 5.13)]
  • Ex. use of tracing
  • General Question: What regions of the brain are involved in Sexual Behavior?
  • Fact: Stereotaxic region VMH→no female reproductive behavior
  • Experimental Questions: What controls VMH? What does VMH control?
  • Figure 5.10
● Histology: PHA-L (figure 5.11, 5.12)
  • Staining: Immunocytochemistry-: (staining with an antibody)
● Retrograde Transport Afferent Projections
  • Note: Transneuronal Tracing
  • Use of pseudorabies virus: going through multiple synapses.

Non Invasive, Non Animal

• Computational Neuroscience/ Neural Modeling
  ■ Using a computer to simulate single neurons and synapses→Computational Model
  ■ →Putting together to build artificial neural networks
  ■ →Simulating neural activity
  ■ →Brain-Machine Interface:
  ● Restore function through use of a brain-controlled machine
  ● Has already been used to make an artificial arm and retina.
  ● A very dynamic area of research
Vision (Chapter 6):

- **Sensing and Perceiving**

- **Sensing:**
  - Physical Stimulus → Sensory Receptors → (transduction) → Receptor Potentials → Sensory Processing → Perceiving

- Proof that we are not just sensing…
- Perceiving shapes: *count the black dots* (visual test).
- Perceiving distances: *Are the horizontal lines parallel or do they slope?* (Visual test).
- [Perceiving motion: *Is the picture moving?* visual test].

- **Physical Stimulus: Light (figure -6.1):**
  - Photons and the electromagnetic spectrum. Light is a “radiation.” A sine wave.
  - Light is characterized by 3 parameters:
    - Hue (wavelength)
    - Saturation (purity)
    - Brightness (brightness)
  - Electromagnetic Spectrum Picture (figure 6.1)
  - Saturation and Brightness (figure 6.2)
  - Hue is related to the “frequency” of the sine wave.

<table>
<thead>
<tr>
<th>High Frequency</th>
<th>Low Frequency</th>
</tr>
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<tbody>
<tr>
<td>Wavelength=1/ frequency</td>
<td></td>
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- Saturation and Brightness- fig 6.2
  - Brightness=height of sine wave
  - Saturation= purity of sine wave
  - (video)- about brightness, hue and motion
• **Vision: Sensing**
  - The eye: not all eyes are the same: species to species variations
  - Visual field: The “visual space” that you sense *monocular* (seen by one eye) vs. *binocular* (seen by both eyes.)

• The Human eye vocabulary
  - Conjunctiva
  - Cornea
  - Iris
  - Pupil- opening in iris, changes size depending on light
  - Layers of the retina
  - Retina
  - Optic nerve
  - Blood vessels
  - Sclera- encasing the whole thing
  - Lens
  - Vitreous humor
  - Muscles
    - Oculomotor
    - Trochlear
    - Abducens
  - Muscles are responsible for saccadic eye movements
  - Can be controlled during pursuit movement

• **The Eye: Fovea vs. Blind Spot**
  - Fovea: Just behind the pupil- objects are inverted.
  - Blind Spot: Where all axons/ blood vessels exit the eye.

• **WARNING: IN BOOK:** Figure 6.3 is incorrect: The optic disk/ blind spot is not the same as the fovea.
  - Differentiate fovea from blind spot
  - Blind Spot practice- figure 6.4

• **The Retina**
  - At Least 5 types of cells organized in three layers.
  - Photonic Receptors: rods and cones
  - Visual acuity: central (fovea) vs. peripheral vision.
- **Rods**-table 6.1
  - 120 millions
  - Periphery
  - Not color sensitive
  - Poor spatial activity
  - Good in dark'
  - Good for motion

- **Cones**-table 6.1
  - 6 millions
  - Fovea
  - Color sensitive
  - High spatial activity
  - Poor in dark
  - Poor for motion

- **Neuroanatomy: Cells in the retina**
  - Fig 6.5
  - Central and Peripheral Activity- fig 6.8
    - Cells have receptive fields that cover a small part of the visual field.
    - Ganglion cells in the fovea are more accurate that ganglion cells in the periphery.
  - Photoreceptors: Rods and Cones- figure 6.5 (bipolar neurons)
    - Photo pigment + light =opsin (e.g. rhodopsin + retinal from vitamin A)⇒RELEASE NEUROTRANSMITTER ON BIPOLAR NEURONS
  - Ganglion Cell Responses
    - Receptive fields
    - On/Off or Off/On receptive fields, sensitive to contrast.
    - On center, Off surround cells are active when they are presented with bright light in the center, or dark spot on surround.
      - 1. On center, off surround
      - 2. Off center, on surround
  - Ganglion Cell Responses
- Trichromatic: 3 types of cones (colors: R, G, B) Much less blue cones.
- Protanopia- red cells filled with green opsin
- Deuteranopia- green cones filled with red opsin
- Tritanopia- no blue cones
- All: Intact visual activity
- Ishihara color test

- Color Sensitive Ganglion Cells
  - 3 types of photoreceptors, but only 2 types of color sensitive ganglion cells. RG and YB colors.
  - Ganglion Cells: opponent processing
    - Yellow sensitivity is due to simotentors red and green cones inputs.
  - On/off Color fields are color specific.

- Visual Pathway
  - Each eye receives information from the Right and Left visual fields (binocular area)
  - Lateralization
    - left visual field~right hemisphere
    - Right visual field~left hemisphere
    - Mapping: two nearby cells in the visual cortex have 2 nearby receptive fields.
  - LGN: Lateral Geniculate Nucleus.
  - Fig 6.6: 6 layers of neurons in 3 groups:
    - Parvocellular- red/ green cones, high resolution, slow.
    - Magnocellular-low spatial resolution, fast
    - Konio cellular groups (in between)-blue cones, low resolution