**Sensory Systems – Chapter 22**

1. Sight
2. Hearing
3. Smell
4. Taste
5. Touch
6. Balance??
7. Pain??

**Differences between Nerve Cells and Receptor Cells**

**Nerve Cells:**
1. Action Potential
2. All or none response (like a rat trap)

**Receptor Cells:**
1. Receptor Potential
2. “Graded Response” *Increased stimulus causes increased depolarization*

Sensory receptors are located throughout the body – can be classified by:

1. Based on origin of stimuli:
   - Exteroceptors (external)
   - Interceptors (within body organs)
   - Proprioceptors
2. Based on energy they respond to (modality):
   - Mechanoreceptor - Thermoreceptor
   - Chemoreceptor - Osmoreceptors
   - Photoreceptor - Nociceptors

**Classification of Receptors**

3. by distribution
   - general (somesthetic) senses - widely distributed
   - special senses - limited to head
     - vision, hearing, equilibrium, taste, and smell
   - Some receptors are neurons

**Receptors Transmit Four Kinds of Information**

1. Modality - type of stimulus or the sensation it produce
   - vision, hearing, taste
2. Location – encoded by which nerve fibers are issuing signals to the brain
   - receptive field – area that detects stimuli for a sensory neuron
     - receptive fields vary in size – fingertip versus skin on back
     - two-point touch discrimination

**Receptive Fields**

- One large receptive field
- Three small receptive fields
Receptors Transmit Four Kinds of Information

3. Intensity –
   • which fibers are sending signals
   • how many fibers are firing
   • how fast these fibers are firing

4. Duration – how long the stimulus lasts
   1. phasic receptor – generate a burst of action potentials when first stimulated, then quickly adapt and sharply reduce or stop signaling even though the stimulus continues
      • smell, hair movement, and cutaneous pressure
   2. tonic receptor - adapt slowly, generate nerve signals more steadily
      • proprioceptors - body position, muscle tension, and joint motion

Fig. 41.8

Semicircular canals
Ampullae
Vestibular nerve
Vestibule (Utricle & Saccule)
Cochlea

Figure 39.13(1) Bony labyrinth

In the Saccule and Utricle - macula

Force of gravity
Otoliths
Gelatinous substance
Stereocilia
Hair cell
Support cell
Dendrite
Nerve

Figure 41.6
Gravity and speed

Vestibular apparatus

Another Mechanoreceptor
- Auditory receptors in the cochlea
- Hair cells respond to pressure waves (sound waves)

Vibrations Fluid in cochlea

Basilar membrane vibrates
Hair cells are stimulated Info. to brain

Figures
41.6
41.7
41.8
Chemoreceptors: Sensory receptors that respond to chemicals
- Taste (gustation) (taste buds)
- Smell (olfaction) (olfactory cells)

Gustatory Sensation: Taste
- Taste requires dissolving of substances
- Four classes of stimuli—sour, bitter, sweet, and salty
- 10,000 taste buds found on tongue, soft palate & larynx
- Found on sides of circumvallate & fungiform papillae
- 3 cell types: supporting, receptor & basal cells

Taste bud:
1. Support cells
2. Gustatory receptor cells
3. Basal cells

A taste map
Dad!!
Flavor Flav!!
Umami
Meaty/savory

Adaptation???

The Retina
Cornea
Lens
Retina
Fig. 41.6
Tunics (Layers) of Eyeball

- **Fibrous Tunic**
  (cornea, sclera)
- **Vascular Tunic**
  (choroid, ciliary body, iris, pupil)
- **Nervous Tunic**
  (Retina)

**Fig. 41.16**

Rods = dim light  
Cones = color

Layers of Retina

- Pigmented epithelium
  - nonvisual portion
  - absorbs stray light & helps keep image clear
- 3 layers of neurons (outgrowth of brain)
  - photoreceptor layer
  - bipolar neuron layer
  - ganglion neuron layer
- 2 other cell types (modify the signal)
  - horizontal cells
  - amacrine cells
Generating the Optic Nerve Signal
Rhodopsin Bleaching/Regeneration

Visual cycle of retinal

Generating Visual Signals

Electrical Activity of Retinal Cells

- Rods and cones contain many Na⁺ channels that are open in dark
  - This depolarizing Na⁺ influx is the dark current
  - Depolarized they release an inhibitory NT.

- Light cause Na⁺ channels to close
  - Cells become hyperpolarized!!!
  - Quit releasing inhibitory NT
  - Bipolar cell no longer inhibited – released excitatory NT

Phototransduction
Generating Visual Signals

Rhodopsin absorbs light:
(a) In the dark
Rhodopsin absorbs no light
(b) In the light
Rod cell releases glutamate
Bipolar cell inhibited
No synaptic activity here
No signal in optic nerve fiber
Glutamate secretion ceases
Bipolar cell no longer inhibited
Bipolar cell releases neurotransmitter
Signal in optic nerve fiber

Brain Pathways of Vision