Sensory Receptors

[Note: This is the text version of this lecture file. To make the lecture notes downloadable over a slow connection (e.g. modem) the figures have been replaced with figure numbers as found in the textbook. See the full version with complete graphics if you have a faster connection.]

How sensations are turned into perceptions

- **Sensations: the raw signals that reach the brain**
- **Perceptions: processed signals that our brain interprets as textures, shapes, smells, sounds, tastes.**

1. sensory transduction: molecules within receptors respond to stimulus and generate a potential (change in voltage)
2. amplification: small chemical signal generated by molecules is amplified into larger electrical signal
3. transmission: electrical signal is carried to the central nervous system (CNS)
4. integration: signals from multiple sources are combined to generate a more complete picture of the environment

e.g. combining signals from both ears to figure out where the sound came from

Five categories of sensory receptors

1. mechanoreceptors: touch, stretch (like muscle spindle), motion (like sound, sonar, or water currents)

2. pain (nociceptors): simulated by histamine and acids

3. thermoreceptors: heat or cold

4. chemoreceptors: osmolarity, glucose, oxygen, CO_2, other chemicals
- **includes gustatory (tastes) and olfactory (smells)**

5. electroreceptors: light, electricity, magnetism
- **includes photoreceptors, infrared receptors, electricity used by some fishes & platypus to sense prey, magnetism used to sense direction like a compass**

Eyes: collections of photoreceptors and other cells specialized for collecting light

Compound eye of a fly composed of individual <u>ommatidia</u>

[See Fig. 49.4]

[See Fig. 49.5]

Simple eye (eye cup) of a flatworm

The single-lens eye of mammals

Hyperopia (farsightedness): cornea and lens too close to retina.
Myopia (nearsightedness): cornea and lens too far from retina.
Astigmatism: aspherical lens (football shaped)
Glaucoma: high pressure in aqueous humor from slow drainage
Cataract: cloudy lens

[See Fig. 49.6]

- **Focusing the mammalian eye involves <u>changing the shape</u> of the lens = <u>accommodation</u>**

- **Squid, octopus, and fish <u>change the distance</u> of the lens from the retina**

[See Fig. 49.7]

<u>Rods</u>: night vision, <u>cones</u>: day and color vision

red, green & blue for cones

[See Fig. 49.8]

- **humans have 150,000 cones/mm² in fovea**
  birds have over 1,000,000

- **photoreceptors account for over 70% of all receptors in the body**

Light and dark reactions in vertebrate photoreceptors: dark current

[See Fig. 49.9]

Cells of the vertebrate retina

[See Fig. 49.10]

Crossover of the visual fields at the optic chiasm

[See Fig. 49.11]

The human ear

The ossicles are the three small bones of the middle ear

[See Fig. 49.12]

[See Fig. 49.13]

How the cochlea determines the pitch (frequency) of sounds

- **The thickness & stiffness of the basilar membrane determines its vibration frequency**

- **The semicircular canals are used to sense movement of the head.**
- **Inertia of the endolymph (fluid in canals) generates transient flow across hair cells**

[See Fig. 49.14]

- **The taste buds on the tongue (concentrated on papillae) distinguish simple differences between compounds (sweet, sour, salty, bitter) = gustation**

- **Most of what we call “taste” is really smell (olfaction). Thousands of different compounds can be distinguished**

[See Fig. 49.20]