Check syllabus! We are starting with Section 6-7 in book.

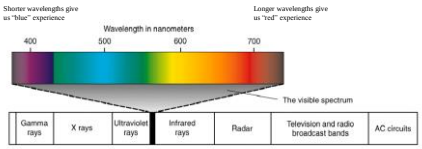
Sensation and Perception

Our Link With the World

Sensation: outside stimulus is detected by specialized receptors and *transduced* into electrical messages to be sent to brain

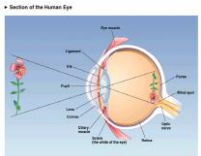
Perception: brain tries to organize, interpret & recognize what's being sensed

▸ The Electromagnetic Spectrum Page 94



Receptors in the eye are sensitive to a small range of wavelengths of electromagnetic energy – the "visible spectrum"

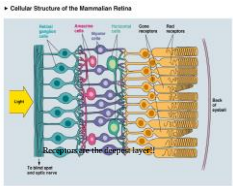
▸ Section of the Human Eye



Page 96

You are responsible for knowing the parts of the eye and their functions (p 94-95)

▸ Cellular Structure of the Mammalian Retina

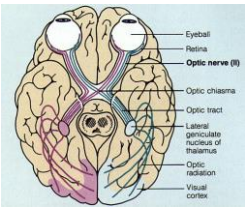


Receptors in the deepest layer

Two Kinds of Photoreceptors: Rods vs Cones

- ~120 million/eye
- more in periphery
- very sensitive – respond even in dim lighting
- ~100 rods share same optic nerve fiber to brain
- night vision

- ~6 million/eye
- most in fovea (center)region
- need bright light to work
- have more private lines to brain- good for detail vision or "visual acuity"
- 3 different types of cones - provide color vision



- Primary visual cortex is in occipital lobe but from there multiple parallel pathways head to temporal & parietal lobe to process separate aspects of vision (shape, color, location & movement, depth, etc)

2 Theories of Color Vision (p. 98-99)
Proposed in 1800's

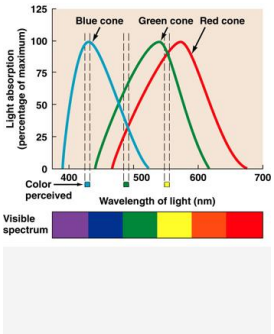
- Trichromatic Theory – 3 types of color (R,G,B) receptors work together to represent all colors of the spectrum.
- Opponent Process Theory – cells in the visual pathway receive input about **pairs** of colors (R-G or B-Y). One color makes them fire faster, the other makes them fire slower.

Color "Opposites" on the Color Wheel

"Afterimages" of strong visual stimuli are in opposite colors

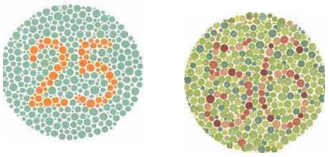
Cones

- Now have actual evidence for 3 different types of cones in retina, absorbing different ranges of wavelengths
- Supports Trichromatic Theory
- Some people don't have all types of cones

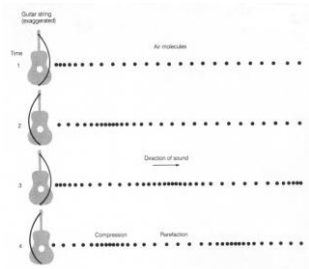


What Do You See?
Tests for Normal Color Vision

- Inability to distinguish red from green is the most common type of "color blindness"

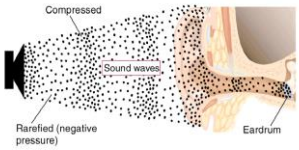


Thinking About Sound Waves



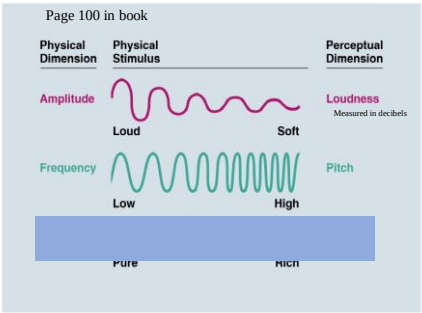
► Sound Waves

Waves vary in how many molecules are moved (amplitude) and how many waves per second (frequency)

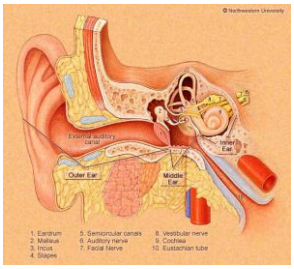


► Relation Between the Physical and Perceptual Dimensions of Sound

Page 100 in book

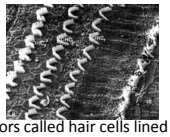


The Ear



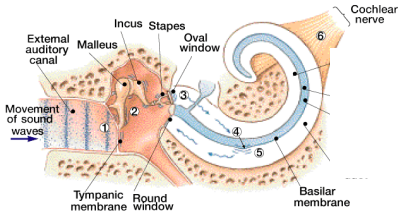
You are responsible for knowing the parts of the ear and their functions (p 227)

Audition (Hearing)



- ~ 15,000 auditory receptors called hair cells lined up on the long **basilar membrane** inside each cochlea
- Movements of membrane as fluid waves ripple thru cochlea result in bending of hair cells which triggers their electrical messages

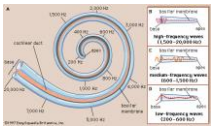
Fluid Motion in Cochlea



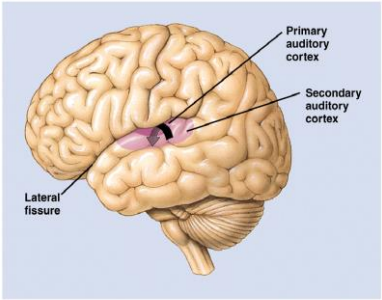
How Do We Hear Different Pitches (20-20,000) Hz?

- **Frequency theory** – for very deep pitches the auditory nerve fires at the same freq as the pitch we are hearing
- BUT – nerves can't fire faster than 1000/sec so this only works for the very lowest freq sounds
- **Place Theory** - for all but the deepest tones, diff. pitches maximally stimulate diff. places along the basilar membrane.
- This "place" tells the brain the pitch.

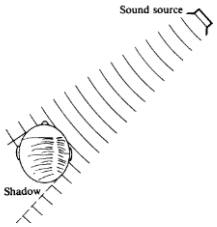
http://www.youtube.com/watch?v=lrewnzQYrPI



► Primary and Secondary Auditory Cortex



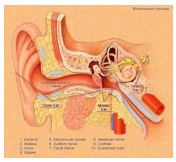
Sound Localization



- Brain processes time & intensity differences in what the right & left ears hear.
- Sound from right arrives sooner and louder in the right ear.

Types of Deafness (p. 228)

- Conduction Hearing Loss – auditory stimulus does not pass normally through auditory canal, ear drum or middle ear.
- Sensorineural Hearing Loss – due to damage to hair cells or auditory nerve.



Loud Sounds"Trample" Hair Cells

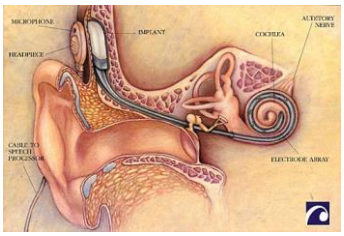
- Repeated exposure can cause permanent damage
- Researchers are really worried about this "ear-bud" generation
- Expect more rapid aging of your ears if abused

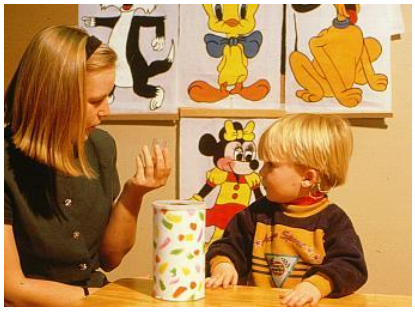
http://www.youtube.com/watch?v=9g0yThhJcxY

https://www.youtube.com/watch?v=VxcbppCX6Rk

https://www.youtube.com/watch?v=h584Rt4O7M

Cochlear Implant (p. 115)



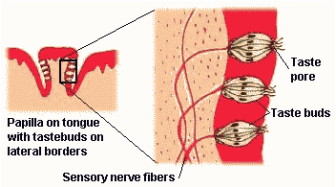


2 Chemical Senses

- Taste
- Smell (Olfaction)

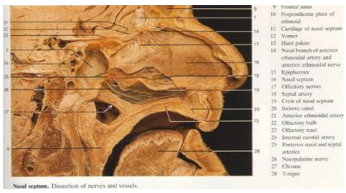
Fungiform Papillae (bumps on tongue)

Tastes Buds on Sides of Papillae

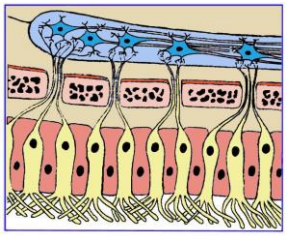


5 kinds of taste receptors: sweet, sour, salty, bitter & umami (savory)

Olfactory Receptors in a Real Head

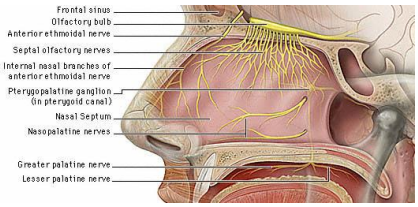


https://www.youtube.com/watch?v=vJXvVEzOKfI
Go to 4:44



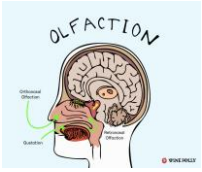
Olfactory receptors send their axons thru the skull to brain

Olfactory Nerves are in a precarious position in head injuries

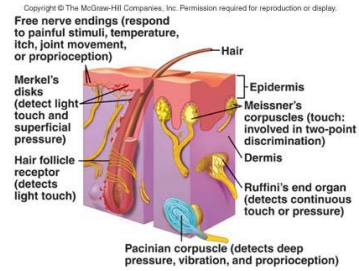


Olfaction (Smell)

- 6-10 million olfactory receptors at the top of each nostril in humans (there are about 10-20 times as many in dogs)
- More than 1000 different types of olfactory receptors to detect different shaped molecules
- Why so many receptors???
  - Most of what we consider "flavor" comes from olfactory receptors being stimulated by air wafting up our mouth
  - Olfactory stimuli can affect us at unconscious level (pheromones)

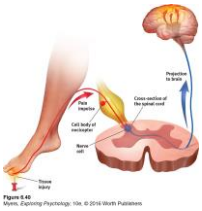


Body Sensory Receptors



Pain

Pain receptors *(nociceptors)* respond to damaging stimuli by sending an impulse to the spinal cord.



Pain - a "gated" sense

- Pain receptors are activated by irritating chemicals released by injured cells (example: prostaglandins)
- Built-in "gate" in spinal cord determines whether the pain message gets to brain full force or whether the gate will close & decrease the pain messages
- Things that 'close the gate': other sensory stimulation, acupuncture, endorphins, opiate pain relievers, motivation, laughter, feelings of control
- Acupuncture→ endorphin release; opiates activate endorphin receptors
- Pain also depends on how the brain interprets the sensory input it is receiving.

- The sensory processes we've discussed so far (sensory receptors sending messages up to the brain) are sometimes called **"bottom-up processing".**
- But what you experience is NOT just a function of these sensory receptor messages!

The Perception Regions of Brain Must:

Organize the input from millions of receptors

Interpret/recognize input in terms of **your past experience, expectations, context ("top-down processing")**

This means that perception is **very individualized.**

- **The Gestalt psychologists studied how the brain organized input from sensory receptors into a meaningful whole or "Gestalt".**

Figure 6.24
Myers: *Exploring Psychology*, 10e, © 2016 Worth Publishers

Necker cube

Perceptual Processing Tasks

- Pick out the **figure** or foreground from the background
- Identify patterns, continuous lines, what things go together, the "whole" or the "Gestalt"
- Match input to **your** memories of past sensory experiences (recognition)
- Maintain that recognition even if angle of view, lighting, or distance changes (perceptual constancy)
- Distinguish depth, distance, 3-dimensions

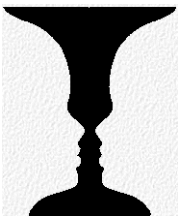
Figure/Ground

Multiple cues (brightness, shading, borders, decoration) to identify the vase as the **figure** against the dark background.

Without enough cues, **figure/ground task** becomes more difficult.

Face-Vase Illusion – A Reversible Figure

(not clear what is figure vs ground)



Gestalt Psychology

- What organizing principles does our perceptual system use to turn millions of pixels of input into a meaningful whole figure or "Gestalt"? It groups things that seem to go together.

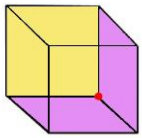
Closure

We see a whole face not 27 white lines

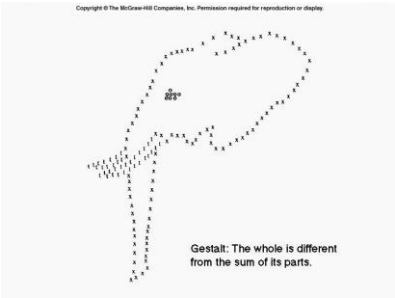
Our perceptual system is so skilled at identifying figures that it can often do so with very little or very ambiguous input. But recognition depends on YOUR past experiences.

Necker Cube – Another Reversible Figure

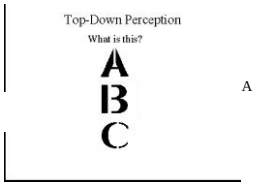
- Is the red dot at the front of the cube or the back corner of the cube? Can you make it switch?



- The brain's search for a figure and attempt to match what we see to things we've experienced in the past is so strong, we sometimes see a figure when none is there.



Perception Depends on Context, Past Experience, Expectations or "Perceptual Set"



A context example

Perception Depends on Context, Past Experience, Expectations or "Perceptual Set"

An expectations example:

- http://www.youtube.com/watch?v=BnKV4-jGhec&feature=related

What are your first impressions of the figures on next slide??

An Auditory Example of Top-Down Processing Influencing Perception

- "Backmasking" – are there hidden messages in a piece of music played backwards?
- http://www.albinoblacksheep.com/flash/queen

Binocular (2 eye) Cues

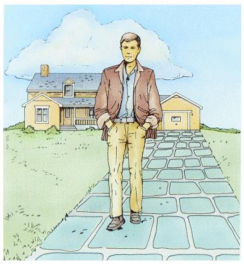
- *Retinal Disparity
  - Difference between what right eye sees and what left eye sees is used to determine depth perception and seeing objects as 3 dimensional.
- Convergence of Eyes
  - As objects get close to us, our eyes point inward. Perception system uses muscle feedback as depth cue.

Monocular ("one eye") Cues or "Artist's Cues" for Depth

- Relative Height
- Relative Size
- Texture Gradient
- Interposition
- Light & shadow
- Linear Perspective
- Aerial or Atmospheric Perspective
- Relative Motion

Relative Size & Height Cues

Interposition Cues (one thing blocks view of another)



Texture cues

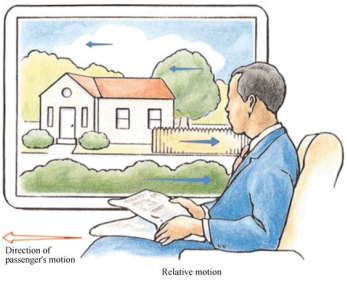
Parallel lines appear to converge on horizon)

Linear Perspective: Depth Cues

Distant things are fuzzier, less distinct

Aerial Perspective: Depth Cues

Relative Motion



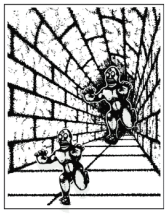
Closer objects appear to pass by quickly

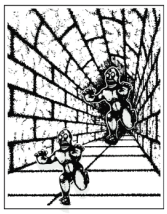
Manipulating Your Perceptions: Illusions

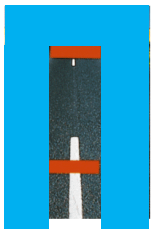
(when the cues we normally use deceive us)

Ames Room

http://www.youtube.com/watch?v=5ic7QGjGEX8
http://www.youtube.com/watch?v=Ttd0YjXF0no







Perceptual Constancy

- We perceive that objects remain constant, even though the retinal image continually varies as we or the object moves or the environmental conditions (like lighting) change.
  - Size constancy(as object moves closer or farther)
  - Shape constancy (as our angle of viewing changes)
  - Color constancy (as lighting changes)

Because of size constancy we are not bothered by the difference in the size of the guy in the white shirt.