The Senses

Sensory Receptors

- Receptor classification based on structure
  - Free dendrite – such as a pain receptor
  - End-organ – such as those for touch
  - Specialized cell – such as rods or cones
- Receptor classification based on stimulus
  - Chemoreceptor – detect chemicals in solution
  - Photoreceptor – in the eye, respond to light
  - Thermoreceptor – detect changes in temperature
  - Mechanoreceptor – respond to movement

Special Senses

- Localized in specific organs
- General Senses – widely distributed throughout body

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Sensory Adaptation

- Receptors often become less sensitive to a continuous unimportant stimulus.
  - Such as putting on clothes, getting into bath

The Eye and Vision

Protective Structures of the Eye

- Bony orbit – protects the posterior of eyeball
- Eyelids – close to keep materials out
- Eyelashes/brows – keep foreign matter out
- Conjunctiva – thin clear membrane that covers sclera
- Lacrimal glands – produce tears to lubricate and fight infection
- Why do we blink?

Figure 11-1 The eye’s protective structures.
The Eye and vision

Structure of the Eyeball - has three separate coats (tunics)

1. Outside Fibrous tunic composed of:
   - Sclera – outside fibrous white layer;
   - Cornea – continuation of sclera, but clear; rounded shape to refract light

2. Vascular tunic – composed of:
   - Choroid – delicate network of blood vessels
   - Ciliary muscle & suspensory ligaments which hold the lens in place and change its shape
   - Iris – colored area that controls how much light enters the eye

3. Innermost nervous tunic composed of the retina
   - Comprised of light sensitive cells: rods and cones

The Eye and Vision

Pathway of Light Rays and Refraction

Refraction – the bending of light rays as they go through substances of different density

- Transparent parts of the eye that refract light
  - Cornea – main refracting structure, curved forward
  - Aqueous humor – watery fluid behind cornea
  - Crystalline lens – clear, circular, firm, biconvex, elasticity allows for focusing of objects on retina
  - Vitreous body – fills the interior of the eye and holds its shape

Function of the Retina

- Rod cells – there are about 120 million in each eye
  - Function in dim light; highly sensitive, but not providing clear images
  - Dark adaptation- when rods start functioning after entering a dark room
  - Use the pigment rhodopsin

- Cone cells – localized in the fovea centralis
  - Function in bright light
  - Enable color vision and images are very sharp
  - 3 types – red, green & blue; color blindness is a deficiency in the number of cones
The Eye and Vision

Muscles of the Eye

- Adjust eye so retina receives clear images
  - Extrinsic muscles – on outside attached to sclera
  - Voluntary – move eyeball
  - Convergence enables three-dimensional vision
- Intrinsic muscle – within eyeball
  - Iris regulates amount of light entering eye
  - Ciliary muscle shapes lens for near and far vision (called accommodation)

Extrinsic muscles of the eye.

What characteristics are used in naming the extrinsic eye muscles?

Function of the iris.

What muscles of the iris contract to make the pupil smaller? Larger?
The Eye and Vision

Nerve Supply to the Eye

- Sensory nerves:
  - Optic nerve (CN II) - carries visual impulses to brain
  - Trigeminal nerve (CN V) - carries impulses of pain, touch and temperature

Eye Disorders

Strabismus

Lazy eye; poor eyeball muscle coordination

Astigmatism

Irregular curvature of the cornea or lens causes multiple focal points

5. Cataracts

Cloudy lens; can be taken out and replaced with new ones
6. Conjunctivitis
- Inflammation of the tear film (conjunctiva)

7. Retinal Detachment
- Retina pulls away from choroid

8. Macular degeneration
- Deterioration of the fovea centralis nerve endings

9. Glaucoma
- Excess pressure of aqueous humor causes nerves to die
- Peripheral vision is lost first

Figure 11-13 The ear.

What structure separates the outer ear from the middle ear?

The Outer Ear
1. Pinna – external ear flap (also called the auricle)
2. External auditory canal – 2.5cm leads to eardrum
3. Ceruminous glands – line the inside of the canal, secrete cerumen (ear wax)
4. Tympanic membrane – thin membrane at end of canal, vibrates with sound waves
The Middle Ear

- Ossicles – three small bones that transmit sound through the middle ear
  1. Malleus – between eardrum and incus
  2. Incus – between malleus and stapes
  3. Stapes – between incus and cochlea; covers the oval window
  4. Auditory tube – connects middle ear to throat; relieves pressure inside

The Inner Ear

1. Vestibule – open chamber with receptors for equilibrium for head position
2. Semicircular canals – 3 tubes that register equilibrium of body position
3. Cochlea – snail shaped, filled with receptors for hearing; connects to auditory nerve

The Ear

The Steps in Hearing
1. Sound waves enter external auditory canal
2. Tympanic membrane vibrates
3. Ossicles transmit vibrations across middle ear
4. Stapes transmits vibrations at oval window to inner ear fluid

(continued)
5. Vibrations travel through perilymph of bony labyrinth
6. Spiral organ’s hair cells vibrate against tectorial membrane, generating nerve impulses
7. Impulses travel via cochlear nerve to temporal lobe cortex, where they are interpreted
8. Sound waves leave inner ear through the round window
The Ear

Equilibrium

- Ciliated equilibrium sensory receptors are located in vestibule and semicircular canals.
- Nerve supply via vestibular nerve

Figure 11-16 Action of the vestibular equilibrium receptors (maculae).

What happens to the cilia of the macular cells when the fluid around them moves?

Figure 11-17 Action of the equilibrium receptors (cristae) in the semicircular canals.

The Ear

- Ear infection – of middle ear, called otitis media
- Hearing loss – deafness can occur two ways
  - Conductive hearing loss – interference from outside to inside of ear (ie. ear wax build up)
  - Sensorineural hearing loss – deficiency of cochlea, brain, or auditory nerve
- Vertigo – sensation of you or environment spinning; caused by inner ear inflammation