

<u>Lecture Date</u>	<u>Topic</u>	<u>Reading in Marieb, Mallatt, and Wilhelm</u>	
L23	Tues 4/14	Special senses I	Ch. 16, pp. 480-506
L24	Tues 4/21	Special senses II	Ibid

Special (localized) senses

specialized receptor cells, not free nerve endings

special visceral senses

smell (olfaction)

taste (gustation)

special somatic senses

vision

hearing

equilibrium

The chemical senses: taste and smell

chemoreceptors

Taste (Gustation)

taste cells occur in taste buds in the mucosa of the mouth and pharynx

taste buds

location

fungiform papillae

smaller

distributed over entire surface of tongue

large circumvallate papillae

arranged in an inverted V near the back of the tongue

types of cells in taste buds

gustatory cells (taste cells)

gustatory hairs (actually, long microvilli)

taste pore

basal cells

replace taste cells every 7-10 days

taste sensations

sweet

sour

salty

bitter

umami

stimulated by glutamate (monosodium glutamate, MSG)

gustatory pathway

facial nerve (VII)

anterior two-thirds of the tongue

glossopharyngeal nerve (IX)

posterior one-third of the tongue, pharynx
vagus nerve (X)
epiglottis, lower pharynx
innervate solitary nucleus in medulla > thalamus > gustatory area of cerebral cortex (parietal lobe)

Smell (olfaction)

olfactory receptors

location

roof of nasal cavity

olfactory epithelium

covering superior nasal concha

covering superior part of the nasal septum

pseudostratified ciliated columnar epithelium

structure

bipolar neurons (olfactory receptor cells)

olfactory cilia (contain olfactory receptors for binding odor molecules)

surrounded by columnar supporting cells

basal cells

short cells located at the base of the epithelium

undifferentiated cells that form new olfactory receptor cells

olfactory pathway

axons gather into filaments of the olfactory nerve (cranial nerve I) > olfactory

bulb > synapse with mitral cells in clusters called glomeruli > limbic

regions (emotional responses) and piriform lobe

Disorders of the chemical senses

anosmia

uncinate fits

The eye and vision

photoreceptors

Accessory structures of the eye

eyebrows

eyelids

tarsal glands (sebaceous glands)

chalazion

eyelashes

ciliary glands

sty

conjunctiva

transparent mucous membrane

palpebral conjunctiva

bulbar conjunctiva

stratified columnar epithelium underlain by a thin lamina propria

goblet cells

conjunctivitis

pinkeye

lacrimal apparatus

lacrimal gland

lacrimal canaliculi
lacrimal sac
nasolacrimal duct
nasal cavity
lacrimal fluid
mucus
antibodies
lysozyme

extrinsic eye muscles

Anatomy of the eyeball

anterior pole
posterior pole
external wall (3 layers)

The fibrous layer

dense connective tissue

sclera

posterior 5/6ths of fibrous layer
opaque white, tough

cornea

anterior 1/6th of fibrous layer
transparent
layers

corneal epithelium (superficial)

thick layer of dense connective tissue

corneal endothelium (deep)

avascular

limbus (junction between sclera and cornea)

contains epithelial stem cells

The vascular layer

choroid

highly vascular

darkly pigmented

posterior 5/6ths of the vascular layer

ciliary body

continuous with the choroid, encircles the lens

ciliary muscle

ciliary processes

ciliary zonule

iris

visible, colored part of the eye

attaches to ciliary body

pupil

papillary light reflex

The inner (sensory) layer (retina)

retina

outer, thin pigmented layer

lies against the choroid

flat-to-columnar melanocytes

inner, thicker neural layer

contains light-sensitive photoreceptor cells

photoreceptor cells (external)

bipolar cells

ganglion cells

Photoreceptors

rod cells

provide neither sharp images nor color vision

cone cells

red

green

blue

outer segments

inner segments

regional specializations of the retina

macula lutea

fovea centralis

contains cones only (high visual acuity)

optic disc

axons of ganglia cells converge to exit the eye as

the optic nerve

blood supply of the retina

capillaries in the choroid

central artery and vein of the retina

radiate from optic disc

internal chambers and fluids

anterior segment

aqueous humor

anterior chamber (between the cornea and iris)

posterior chamber (between the iris and the lens)

posterior segment

vitreous humor

98% water

transmits light

support the posterior surface of the lens and hold the retina

firmly in place against the pigmented layer

help maintain intraocular pressure

lens

lens epithelium

lense fibers

Visual pathways

*optic nerve > optic chiasma > optic tract > lateral geniculate nucleus of the thalamus
> optic radiation > primary visual cortex*

*optic tract > superior colliculi
visual reflexes*

*optic tract > pretectal nuclei
papillary light reflexes*

*optic tract > suprachiasmatic nucleus
circadian clock*

The Ear: Hearing and Equilibrium

External ear

*auricle (pinna)
helix (rim)
elastic cartilage
lobule (earlobe)
external acoustic meatus
sebaceous glands
ceruminous glands
cerumen (ear wax)
tympanic membrane
boundary between external and middle ear*

Middle ear

*air-filled cavity lined by thin mucous membrane
oval window
round window
mastoid antrum
pharyngotympanic tube (formerly auditory tube or eustachian tube)
links middle ear to pharynx
normally flattened and closed
auditory ossicles
malleus (hammer)
incus (anvil)
stapes (looks like the stirrup of a saddle)
skeletal muscles
tensor tympani
stapedius*

Internal ear (labyrinth)

*bony labyrinth
a cavity
(1) semicircular canals
(2) vestibule
(3) cochlea
membranous labyrinth
membrane-walled sacs and ducts within the bony labyrinth
(1) semicircular ducts (in semicircular canals)*

(2) utricle and saccule (in vestibule)

(3) cochlear duct (in the cochlea)

lined by simple squamous with thin underlying connective tissue

parts of membrane are thickened and contain receptors for equilibrium and hearing

endolymph (clear fluid within membranous labyrinth)

perilymph (clear fluid around membranous labyrinth)

continuous with cerebrospinal fluid that fills the subarachnoid space

Cochlea

modiolus

osseous spiral lamina

cochlear nerve (cochlear division of the vestibulocochlear nerve (VIII))

cochlear duct (scala media)

sensory receptors for hearing

perilymph cavities

scala vestibuli

scala tympani

helicotrema

vestibular membrane

stria vascularis

basilar membrane

spiral organ (of Corti)

receptor epithelium for hearing

columnar supporting cells

one row of inner hair cells

true receptors

three rows of outer hair cells

tune the cochlea and amplify sound

stereocilia

tectorial membrane

cochlear nerve

spiral ganglion

Vestibule

central cavity of bony labyrinth

utricle (“leather bag”)

saccule (“little sac”)

macula (“spot”)

static equilibrium—receptors monitor position of the head when the head is held still

linear acceleration—receptors monitor straight line changes in the speed and the direction of head movements

columnar supporting cells

hair cells (receptor cells)

stereocilia (long microvilli)

kinocilium (a true cilium)

otolithic membrane

otoliths (“ear stones”)

calcium carbonate crystals

vestibular nerve (vestibular division of the vestibulocochlear nerve (VIII))

superior vestibular ganglia

inferior vestibular ganglia

Semicircular canals

rotational acceleration of the head

ampulla (“flask”)

anterior semicircular canal

posterior semicircular canal

lateral semicircular canal (horizontal canal)

semicircular duct

membranous ampulla

crista ampullaris (“crest of the ampulla”)

contain receptor cells for rotational (angular) acceleration

supporting cells

receptor hair cells

cupula (jellylike mass; “little barrel”)

vestibular nerve

Auditory and Equilibrium Pathways

Auditory pathway

cochlear receptors of inner hair cells > cochlear nerve > cochlear nuclei (medulla) > superior olivary nucleus (medulla/pons) > inferior colliculus > medial geniculate nucleus of the thalamus > primary auditory cortex

Equilibrium pathway

Vestibular nerve > reflex centers in the medulla and cerebellum

Conscious awareness of the position and movements of the head

vestibular nerve > vestibular nuclei > thalamus > posterior insula