

CHAPTER 15: SENSORY SYSTEMS

Building a Medical Terminology Foundation 2e by Kimberlee Carter; Marie Rutherford; and Connie Stevens

- 15.1 – Introduction to the Sensory Systems
- 15.2 – Anatomy & Physiology of the Sensory System
- 15.3 – Sensory Diseases, Disorders and Diagnostic Testing
- Vocabulary & Check Your Knowledge
- References

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15.1 - Introduction to the Sensory Systems

Learning Objectives

- Identify the anatomy of the sensory systems and describe the main functions of the sensory systems
- Analyze, translate, and define medical terms and common abbreviations of the sensory systems
- Practice the spelling and pronunciation of sensory systems terminology
- Identify the medical specialties associated with the sensory systems and explore common diseases, disorders, diagnostic tests and procedures related to the sensory systems

Sensory Systems Word Parts

Click on prefixes, combining forms, and suffixes to reveal a list of word parts to memorize for the sensory systems.

Prefix

- **bi-** (two)
- **bin-** (two)
- **a-** (absence of, without, no, not, negates meaning)
- **an-** (absence of, without, no, not negates meaning)
- **endo-** (within, in)

Combining Form

- **audi/o** (hearing)
- **aur/o** (ear)
- **aur/i** (ear)
- **blephar/o** (eyelid)

- **cochle/o** (cochlea)
- **conjunctiv/o** (conjunctiva)
- **cor/o** (pupil)
- **corne/o** (cornea)
- **core/o** (pupil)
- **cry/o** (cold)
- **dacry/o** (tear, tear duct)
- **dipl/o** (two, double)
- **ir/o** (iris)
- **irid/o** (iris)
- **is/o** (equal)
- **kerat/o** (cornea)
- **labyrith/o** (labyrinth, inner ear)
- **lacrim/o** (tear, tear duct)
- **mastoid/o** (mastoid bone)
- **myring/o** (tympanic membrane, eardrum)
- **ocul/o** (eye)
- **ophthalm/o** (eye)
- **opt/o** (vision)
- **ot/o** (ear)
- **phac/o** (lens)
- **phak/o** (lens)
- **phot/o** (light)
- **pupill/o** (pupil)
- **retin/o** (retina)
- **scler/o** (sclera)
- **staped/o** (stapes, middle ear)
- **ton/o** (tension, pressure)
- **tympan/o** (tympanic membrane, middle ear)
- **vestibul/o** (vestibule)

Suffix

- **-al** (pertaining to)
- **-algia** (pain)
- **-ar** (pertaining to)
- **-ary** (pertaining to)
- **-ectomy** (excision or surgical removal)
- **-eal** (pertaining to)
- **-gram** (record, radiographic image)
- **-graphy** (process of recording)
- **-ia** (condition of, diseased or abnormal state)
- **-ic** (pertaining to)

- **-itis** (inflammation)
- **-logist** (specialist or physician who studies and treats)
- **-logy** (study of)
- **-malacia** (softening)
- **-meter** (instrument used to measure)
- **-metry** (process of measuring)
- **-oma** (tumour, swelling)
- **-opia** (vision as it relates to condition)
- **-plegia** (paralysis)
- **-ptosis** (prolapse, drooping, sagging)
- **-stomy** (creation of artificial opening)
- **-pathy** (disease)
- **-pexy** (surgical fixation)
- **-phobia** (abnormal fear, aversion to specific things)
- **-plasty** (surgical repair)
- **-plegia** (paralysis)
- **-rrhea** (flow, discharge)
- **-sclerosis** (hardening)
- **-scope** (instrument used to view)
- **-scopy** (process of viewing)
- **-sis** (abnormal condition)
- **-tomy** (incision, cut into)

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Introduction to the Sensory Systems

Ask anyone what the senses are, and they are likely to list the five major senses as **taste, smell, touch, hearing, and sight**. However, these are not all of the senses. The most obvious omission from this list is **balance**. Touch can be further subdivided into pressure, vibration, stretch, and hair follicle position on the basis of the type of **mechanoreceptors** that perceive these touch sensations. Other overlooked senses include temperature perception by **thermoreceptors** and pain perception by **nociceptors**.

Within the realm of physiology, senses can be classified as either general or special. A **general sense** is one that is distributed throughout the body and has receptor cells within the structures of other organs. Mechanoreceptors in the skin, muscles, or the walls of blood vessels are examples of this type. General senses often contribute to the sense of touch, as described above, or to **proprioception** and **kinesthesia**, or to a **visceral** sense, which is most important to autonomic functions. A **special sense** is one that has a specific organ devoted to it, namely the eye, inner ear, tongue, or nose.

Gustation (Taste) and Olfaction (Smell)

Watch Taste & Smell: Crash Course Anatomy & Physiology #16 (11 min) on YouTube (<https://youtu.be/mFm3yA1nslE>)

Sensory Systems Medical Terms

Sensory Systems Medical Terms (Text Version)

Practice the following sensory system words by breaking into word parts and pronouncing.

1. **anisocoria** (an-ī-sō-KŌR-ē-ă)
 - condition of absence of equal pupil (size)
2. **aphakia** (ă-FĀ-kē-ă)
 - condition of no lens
3. **audiogram** (OD-ē-ō-gram)
 - graphic record (radiographic image) of hearing
4. **audiologist** (od-ē-OL-ŏ-jĭst)
 - specialist who studies and treats the hearing
5. **audiology** (od-ē-OL-ŏ-jĕ)
 - study of the hearing
6. **audiometer** (od-ē-OM-ĕt-ĕr)
 - instrument used to measure hearing
7. **audiometry** (od-ē-OM-ĕ-trĕ)
 - measuring hearing
8. **aural** (OR-ăl)
 - pertaining to the ear
9. **binocular** (bĭn-ŎK-ŭ-lăr)

- pertaining to both eyes
10. **blepharitis (blĕf-ār-Ī-tīs)**
 - inflammation of the eyelid
 11. **blepharoplasty (BLĕF-ă-rō-plās-tĕ)**
 - surgical repair of the eyelid
 12. **blepharoptosis (BLĕF-ă-rōp-TŌ-sīs)**
 - condition of drooping of the eyelid
 13. **cochlear (KOK-lĕ-ār)**
 - pertaining to the cochlea
 14. **cochlear implant (KOK-lĕ-ă IM-plant)**
 - pertaining to the cochlear implant
 15. **conjunctivitis (kŏn-jŭnk-tĭ-VĪT-ĭs)**
 - inflammation of the conjunctiva
 16. **corneal (KOR-nĕ-ă)**
 - pertaining to the cornea
 17. **cryoretinopexy (krĭ-ŏ-RET-in-ŏ-pek-sĕ)**
 - surgical fixation of the retina using extreme cold
 18. **dacrocystitis (dak-rĕ-ŏ-sis-TĪT-ĭs)**
 - inflammation of the tear (lacrimal) sac
 19. **dacryocystorhinostomy (dak-rĕ-ŏ-sis-tŏ-rĭ-NOS-tŏ-mĕ)**
 - creation of an artificial opening between the lacrimal sac and the nose
 20. **diplopia (dip-LŌ-pĕ-ă)**
 - condition of double vision
 21. **electrocochleography (ĕ-lek-trŏ-kok-lĕ-OG-ră-fĕ)**
 - process of recording the electrical activity in the cochlea
 22. **endophthalmitis (ĕn-dŏf-thăl-MĪ-tīs)**
 - inflammation within the eye

23. **intraocular (in-tră-OK-yŭ-lăr)**
 - pertaining to within the eye
24. **iridectomy (ir-ĭ-DEK-tŏ-mē)**
 - excision of (part of) the iris
25. **iridoplegia (ir-ĭ-dŏ-PLĒ-j(ē-)-ă, ĭr)**
 - paralysis of the iris
26. **iridotomy (ĭr-ĭ-DŎT-ŏ-mē)**
 - incision into the iris
27. **iritis (ĭ-RĪT-ĭs)**
 - inflammation of the iris
28. **isocoria (ĭ-sŏ-KŌ-rē-ă)**
 - condition of equal pupils
29. **keratitis (ker-ă-TĪT-ĭs)**
 - inflammation of the cornea
30. **keratomalacia (kĕr-ă-tŏ-mă-LĀ-shĕ-ă)**
 - condition of softening of the cornea
31. **keratometer (kĕr-ă-TŎM-ĕ-ter)**
 - instrument used to measure (the curvature) of the eye
32. **keratoplasty (KER-ăt-ŏ-plas-tĕ)**
 - surgical repair of the cornea
33. **labyrinthectomy (lab-ĭ-rin-THEK-tŏ-mē)**
 - excision of the inner ear (labyrinth)
34. **labyrinthitis (lab-ĭ-rin-THĪT-ĭs)**
 - inflammation of the inner ear (labyrinth)
35. **lacrimal (LAK-rĭ-măl)**
 - pertaining to the tear duct
36. **leukocoria (loo-kŏ-KŎR-ĕ-ă)**

- condition of white pupil
- 37. **mastoidectomy (mās-tōy-d-ĔK-tō-mē)**
 - excision of the mastoid bone
- 38. **mastoiditis (mas-toyd-ĪT-īs)**
 - inflammation of the mastoid bone
- 39. **mastoidotomy (mās-toyd-ŎT-ō-mē)**
 - incision into the mastoid bone
- 40. **myringitis (mīr-īn-JĪ-tīs)**
 - inflammation of the tympanic membrane
- 41. **myringoplasty (mīr-ĪN-gō-plāst-ē)**
 - surgical repair of the tympanic membrane
- 42. **myringotomy (mīr-īn-GŎT-ō-mē)**
 - incision into the tympanic membrane
- 43. **nasolacrimal (nā-zō-LAK-rī-māl)**
 - pertaining to the nose and the tear duct
- 44. **nasopharyngeal (nā-zō-FAR-in-gēl)**
 - pertaining to the nose and pharynx (throat)
- 45. **oculomycosis (ŏk-ū-lō-mī-KŎ-sīs)**
 - abnormal condition of the eye caused by a fungus
- 46. **ophthalmalgia (ŏf-thāl-MĀL-jē-ă)**
 - condition of pain in the eye
- 47. **ophthalmic (of-THAL-mik)**
 - pertaining to the eye
- 48. **ophthalmologist (ŏf-thāl-MŎL-ō-jīst)**
 - specialist of the eye
- 49. **ophthalmology (Ophth) (ŏf-thāl-MŎL-ō-jē)**
 - study of the eye

50. **ophthalmopathy** (ōf-thāl-MŌP-ă-thē)
 - disease of the eye
51. **ophthalmoplegia** (of-thal-mō-PLĒ-j(ē)-ă)
 - paralysis of the eye
52. **ophthalmoscope** (of-THAL-mō-skōp)
 - instrument used to view the eye
53. **ophthalmoscopy** (of-thal-MOS-kō-pē)
 - process of viewing the eye
54. **optic** (OP-tik)
 - pertaining to vision
55. **optometry** (op-TOM-ĕ-trē)
 - measuring vision
56. **otalgia** (ō-TĀL-jē-ă)
 - condition of pain in the ear
57. **otologist** (ō-TŌL-ō-jīst)
 - specialist who studies and treats disorders and diseases of the ear
58. **otology** (ō-TŌL-ō-jē)
 - study of the ear
59. **otomastoiditis** (ō-tō-mas-toyd-ĪT-īs)
 - inflammation of the ear and mastoid bone
60. **otomycosis** (ō-tō-mī-KŌ-sīs)
 - abnormal condition of fungus in the ear
61. **otopyorrhea** (ō-tō-pī-ō-RĒ-ă)
 - discharge of pus from the ear
62. **otorhinolaryngologist** (ō-tō-RĪ-nō-lār-ĭn-GŌL-ō-jīst)
 - specialist or physician who studies and treats diseases and disorders of the ears,
63. **otorrhea** (ō-tō-RĒ-ă)

- discharge from the ear
- 64. **otosclerosis (ō-tō-sklē-RŌ-sīs)**
 - condition of hardening of the ear
- 65. **otoscope(Ō-tō-skōp)**
 - instrument used to view the ear
- 66. **otoscopy (ō-TŌS-kō-pē)**
 - process of viewing the ear
- 67. **phacomalacia (fāk-ō-mā-LĀ-shē-ă)**
 - condition of softening of the lens
- 68. **photophobia (fō-tō-FŌ-bē-ă)**
 - condition of sensitivity to light
- 69. **pseudophakia (SOOD-ō-FĀ-kē-a)**
 - condition of fake lens
- 70. **pupillary (PŪ-pī-lēr-ē)**
 - pertaining to pupil
- 71. **pupillometer (pū-pīl-ŌM-ě-tēr)**
 - instrument used to measure the pupil
- 72. **pupilloscope (pū-pīl-ŌS-kōp)**
 - instrument used to view the pupil
- 73. **retinal (RĚT-ī-nāl)**
 - pertaining to the retina
- 74. **retinoblastoma (ret-īn-ō-blas-TŌ-mă)**
 - tumour arising from a developing retinal cell
- 75. **retinopathy (ret-īn-OP-ă-thē)**
 - disease of the retina
- 76. **retinoscopy (ret-īn-OS-kō-pē)**
 - process of viewing the retina

77. **sclerokeratitis (sklĕr-ō-kĕr-ă-TĪ-tīs)**
- inflammation of the sclera and cornea
78. **scleromalacia (sklĕ-rō-mā-LĀ-sĕ-ă)**
- softening of the sclera
79. **sclerotomy (sklĕ-ROT-ō-mĕ)**
- incision into the sclera
80. **stapedectomy (stā-pĕ-DEK-tō-mĕ)**
- excision of the stapes
81. **tonometer (tō-NOM-ĕt-ĕr)**
- instrument used to measure pressure (within the eye)
82. **tonometry (tō-NOM-ĕ-trĕ)**
- process of measuring pressure
83. **tympanometer (tĭm-pă-NŌM-ĕ-tĕr)**
- instrument used to measure the middle ear
84. **tympanometry (tĭm-pă-NŌM-ĕ-trĕ)**
- measurement of the tympanic membrane
85. **tympanoplasty (tĭm-păn-ō-PLĀS-tĕ)**
- membranesurgical repair of the tympanic
86. **vestibular (ves-TIB-yŭ-lăr)**
- pertaining to the vestibule
87. **vestibulocochlear (ves-tĭ-bŭl-ō-KŌ-klĕ-ar)**
- vestibul/o/cochle/ar
 - pertaining to the vestibule and cochlea
88. **xerophthalmia (zer-of-THAL-mĕ-ă)**
- xer/ophthalm/ia
 - * Rebel, does not follow the rules*
 - condition of dry eye

Activity source: Sensory Systems Medical Terms by Kimberlee Carter, from *Building a Medical*

Gustation (Taste)

Gustation is the special sense associated with the tongue. The surface of the tongue, along with the rest of the oral cavity, is lined by a stratified squamous epithelium. Raised bumps called papillae contain the structures for gustatory transduction. There are **four types of papillae** based on their appearance:

1. **circumvallate**
2. **foliate**
3. **filiform**
4. **fungiform**

Within the structure of the papillae are taste buds that contain specialized gustatory receptor cells for the transduction of taste stimuli. These receptor cells are sensitive to the chemicals contained within foods that are ingested, and they release **neurotransmitters** based on the amount of the chemical in the food. Neurotransmitters from the gustatory cells can activate sensory neurons in the facial, **glossopharyngeal**, and vagus cranial nerves.

Only a few recognized **submodalities** exist within the sense of taste, or gustation. Until recently, only four tastes were recognized: **sweet, salty, sour,** and **bitter**. Research at the turn of the 20th century led to the recognition of the fifth taste, **umami**, during the mid-1980s. Recent research has suggested that there may also be a sixth taste for **fats** or lipids.

Olfaction (Smell)

Like taste, **olfaction** is also responsive to chemical stimuli. The olfactory receptor neurons are located in a small region within the superior nasal cavity. The nasal epithelium, including the olfactory cells, can be harmed by airborne toxic chemicals. Scent receptor messages travel to the cerebrum, specifically to the primary olfactory cortex that is located in the inferior and medial areas of the temporal lobe and additionally to the hypothalamus, where smells become associated with long-term memory and emotional response.

Did You Know?

The human body can detect over 10,000 odours.

Concept Check

- Which parts of the brain are active with recording and associating scents with memories and emotions?
- Recall and list the four types of papillae (taste buds) found on the tongue.

Attribution

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15.2 - Anatomy & Physiology of the Sensory System

Audition (Hearing), Equilibrium (Balance), and Somatosensation (Touch)

Watch **Hearing & Balance: Crash Course Anatomy & Physiology #17 (11 min) on YouTube** (<https://youtu.be/1e2j7GpC4JU>)

Audition (Hearing)

Hearing, or **audition**, is the **transduction** of sound waves into a neural signal that is made possible by the structures of the ear (see Figure 15.1).

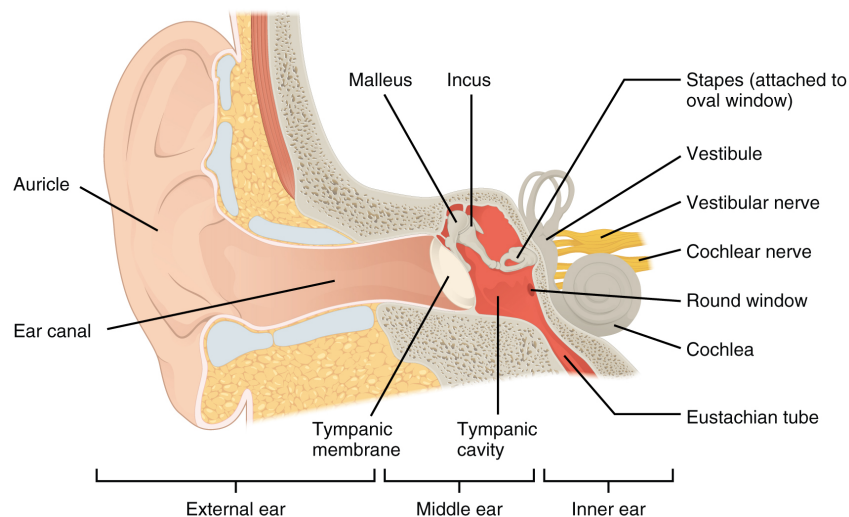


Figure 15.1 Structures of the Ear. The external ear contains the auricle, ear canal, and tympanic membrane. The middle ear contains the ossicles and is connected to the pharynx by the Eustachian tube. The inner ear contains the cochlea and vestibule, which are responsible for audition and equilibrium, respectively. From Betts et al., 2013. Licensed under CC BY 4.0. [Fig. 15.1 Image description.]

- The **external ear** consists of the auricle, sometimes referred to as the pinna, ear canal, and tympanic membrane. The C-shaped curves of the auricle direct sound waves toward the **auditory canal**. The canal enters the skull through the external auditory meatus of the **temporal bone**. At the end of the auditory canal is the

tympanic membrane, which vibrates after it is struck by sound waves.

- The **middle ear** consists of the ossicles, oval window, and tympanic membrane. The three **ossicles** are the malleus, incus, and stapes, which are Latin names that roughly translate to hammer, anvil, and stirrup. The malleus is attached to the tympanic membrane and articulates with the incus. The incus, in turn, articulates with the stapes. The stapes is then attached to the inner ear, where the sound waves will be transduced into a neural signal. Vibrations of the ossicles travel through the **oval window**, moving fluid in a wave-like motion. The frequency of the fluid waves match the frequencies of the sound waves. The middle ear is connected to the pharynx through the Eustachian tube, which helps equilibrate air pressure across the **tympanic membrane**. The tube is normally closed but will pop open when the muscles of the pharynx contract during swallowing or yawning.
- The **inner ear** is often described as a **bony labyrinth**, as it is composed of a series of canals embedded within the temporal bone. It consists of the **cochlea which is responsible for hearing** and the **vestibule that is responsible for balance**. The neural signals from these two regions are relayed to the brain stem through separate fiber bundles. However, these two distinct bundles travel together from the inner ear to the brain stem as the **vestibulocochlear** nerve. Sound is transduced into neural signals within the cochlear region of the inner ear, which contains the sensory neurons of the spiral ganglia. These ganglia are located within the spiral-shaped cochlea of the inner ear. The cochlea is attached to the stapes through the oval window.

The image below is a cross-sectional view of the cochlea that shows the scala vestibuli and scala tympani run along both sides of the cochlear duct (see Figure 15.2). The cochlear duct contains several organs of Corti, which transduce the wave motion of the two scala into neural signals. The organs of Corti lie on top of the basilar membrane, which is the side of the cochlear duct located between the organs of Corti and the scala tympani. As the fluid waves move through the scala vestibuli and scala tympani, the basilar membrane moves at a specific spot, depending on the frequency of the waves. Higher frequency waves move the region of the basilar membrane that is close to the base of the cochlea. Lower frequency waves move the region of the basilar membrane that is near the tip of the cochlea.

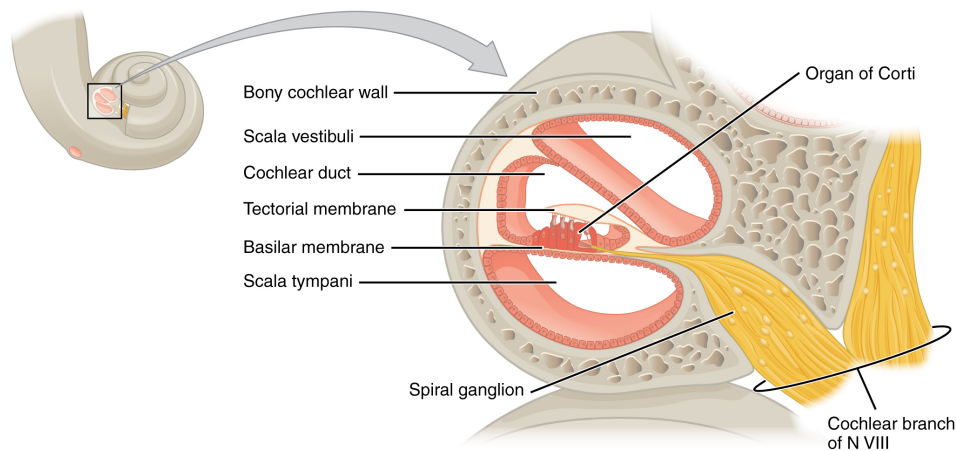


Figure 15.2 Cross Section of the Cochlea. The three major spaces within the cochlea are highlighted. The scala tympani and scala vestibuli lie on either side of the cochlear duct. The organ of Corti, containing the mechanoreceptor hair cells, is adjacent to the scala tympani, where it sits atop the basilar membrane. From Betts et al., 2013. Licensed under CC BY 4.0. [Fig. 15.2 Image description.]

The cochlea encodes auditory stimuli for frequencies between 20 and 20,000 Hz, which is the range of sound that human ears can detect. The unit of Hertz measures the frequency of sound waves in terms of cycles produced per second. Frequencies as low as 20 Hz are detected by hair cells at the apex, or tip, of the cochlea. Frequencies in the higher ranges of 20 KHz are encoded by hair cells at the base of the cochlea, close to the round and oval windows. Most auditory stimuli contain a mixture of sounds at a variety of frequencies and intensities (represented by the amplitude of the sound wave). The hair cells along the length of the cochlear duct, which are each sensitive to a particular frequency, allow the cochlea to separate auditory stimuli by frequency, just as a prism separates visible light into its component colours.

Did You Know?

Sound travels at speed of 1,130 feet per second.

Equilibrium (Balance)

Along with audition, the **inner ear** is responsible for **encoding** information about **equilibrium**. The cells that sense head position, head movement, and body motion are located within the vestibule of the inner ear. Head position is sensed by otolith organs, whereas head movement is sensed by the semicircular canals (see Figure 15.3). The neural signals generated in the vestibular ganglion are transmitted through the vestibulocochlear nerve to the brain stem and cerebellum.

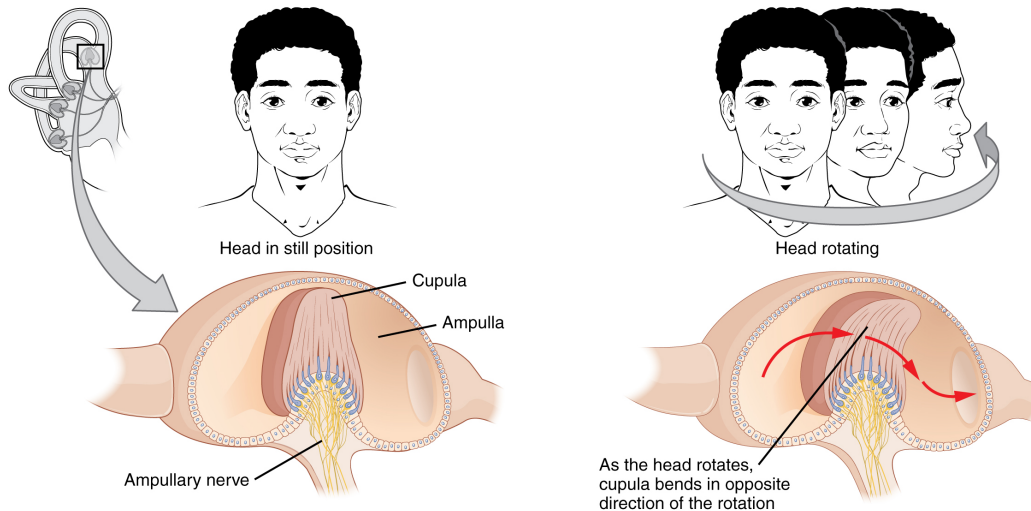


Figure 15.3 Rotational Coding by Semicircular Canals. Rotational movement of the head is encoded by the hair cells in the base of the semicircular canals. As one of the canals moves in an arc with the head, the internal fluid moves in the opposite direction, causing the cupula and stereocilia to bend. The movement of two canals within a plane results in information about the direction in which the head is moving, and activation of all six canals can give a very precise indication of head movement in three dimensions. From Betts et al., 2013. Licensed under CC BY 4.0. [Fig. 15.3 Image description.]

Somatosensation (Touch)

Somatosensation is considered a general sense, as opposed to the special senses discussed in this section. Somatosensation is the group of **sensory modalities** that are associated with touch, **proprioception**, and **interoception**. These modalities include pressure, vibration, light touch, tickle, itch, temperature, pain, proprioception, and kinesthesia. This means that its receptors are not associated with a specialized organ, but are instead spread throughout the body in a variety of organs. Many of the somatosensory receptors are located in the skin, but receptors are also found in muscles, tendons, joint capsules, ligaments, and in the walls of visceral organs.

Did You Know?

With the aging process, humans lose sensory receptors cells including cells which detect pain and temperature changes.

The two types of somatosensory signals that are transduced by free nerve endings are pain and temperature. Temperature receptors are stimulated when local temperatures differ from body temperature. Some

thermoreceptors are sensitive to just cold and others to just heat. **Nociception** is the sensation of potentially damaging stimuli. Mechanical, chemical, or thermal stimuli beyond a set threshold will elicit painful sensations. Stressed or damaged tissues release chemicals that activate receptor proteins in the nociceptors.

For example, the sensation of heat associated with spicy foods involves capsaicin, the active molecule in hot peppers. Capsaicin molecules bind to a transmembrane ion channel in nociceptors that is sensitive to temperatures above 37°C. The dynamics of capsaicin binding with this transmembrane ion channel is unusual because the molecule remains bound for a long time. Because of this, it will decrease the ability of other stimuli to elicit pain sensations through the activated nociceptor. For this reason, capsaicin can be used as a topical analgesic, such as in products such as Icy Hot™.

Concept Check

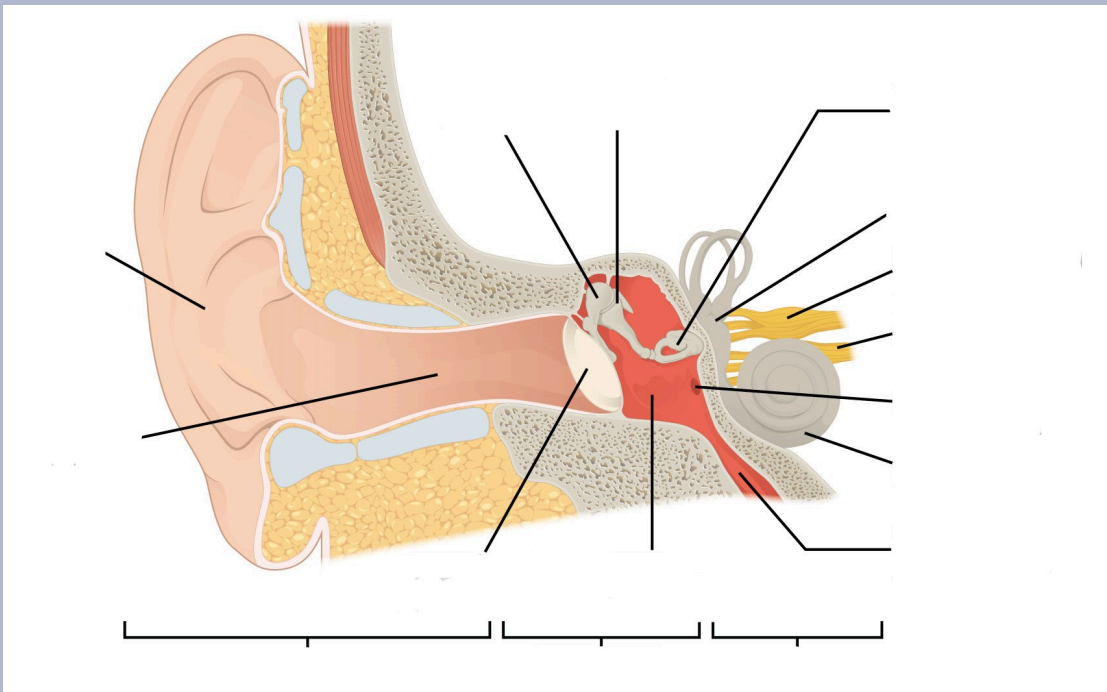
- What structure exists within the ear to assist with maintaining **equilibrium**?
- What are the medical terms used to describe the sense of taste and touch?

Sensory System Ear Anatomy

Sensory System Ear Anatomy labeling activity (Text Version)

Label the diagram with correct words listed below:

- | | | |
|-------------------------------------|----------------------|----------------------|
| 1. Parieto-occipital sulcus | 7. Eustachian tube | 13. Round window |
| 2. Ear canal | 8. Middle ear | 14. External ear |
| 3. Stapes (attached to oval window) | 9. Tympanic membrane | 15. Cochlea |
| 4. Tympanic cavity | 10. Malleus | 16. Vestibular nerve |
| 5. Vestibule | 11. Incus | |
| 6. Cochlear nerve | 12. Inner ear | |



Check your answers¹

Activity source: Sensory System Ear Anatomy by Gisele Tuzon, from *Building a Medical Terminology Foundation*, illustration from *Anatomy and Physiology (OpenStax)*, licensed under CC BY 4.0./ Text version added.

Vision (Sight)

Watch Vision: Crash Course Anatomy & Physiology #18 (10 min) on YouTube (<https://youtu.be/o0DYP-u1rNM>)

Vision is the special sense of sight that is based on the transduction of light stimuli received through the eyes. The eyes are located within either orbit in the skull. The bony orbits surround the eyeballs, protecting them and anchoring the soft tissues of the eye (see Figure 15.4). The eyelids, with lashes at their leading edges, help to protect the eye from abrasions by blocking particles that may land on the surface of the eye.

The inner surface of each lid is a thin membrane known as the palpebral conjunctiva. The conjunctiva extends over the **sclera**, connecting the eyelids to the eyeball. Tears are produced by the lacrimal gland, located beneath the lateral edges of the nose. Tears produced by this gland flow through the lacrimal duct to the medial corner of the eye, where the tears flow over the conjunctiva, washing away foreign particles.

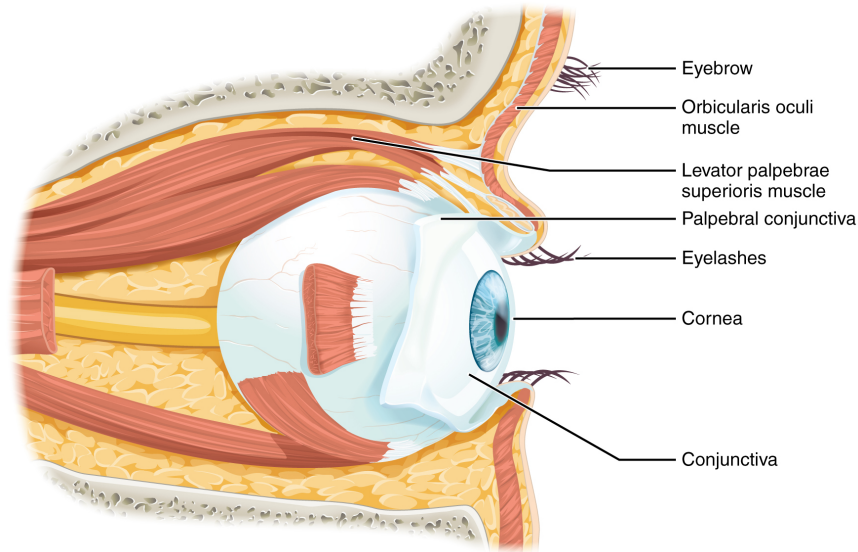


Figure 15.4 The Eye in the Orbit. The eye is located within the orbit and surrounded by soft tissues that protect and support its function. The orbit is surrounded by cranial bones of the skull. From Betts et al., 2013. Licensed under CC BY 4.0. [Fig. 15.4 Image description.]

Movement of the eye within the orbit is accomplished by the contraction of **six extraocular** muscles that originate from the bones of the orbit and insert into the surface of the eyeball. Four of the muscles are arranged at the cardinal points around the eye and are named for those locations. They are the:

1. superior rectus
2. medial rectus
3. inferior rectus
4. lateral rectus

When each of these muscles contract, the eye moves toward the contracting muscle. For example, when the superior rectus contracts, the eye rotates to look up.

The eye itself is a hollow sphere composed of **three layers** of tissue.

1. The **outermost layer** is the fibrous tunic, which includes the white sclera and clear cornea. The sclera accounts for five-sixths of the surface of the eye, most of which is not visible, though humans are unique compared with many other species in having so much of the “white of the eye” visible (see Figure 15.5). The transparent cornea covers the anterior tip of the eye and allows light to enter the eye.
2. The **middle layer** of the eye is the vascular tunic, which is mostly composed of the choroid, ciliary body, and iris. The choroid is a layer of highly vascularized connective tissue that provides a blood supply to the eyeball. The choroid is posterior to the ciliary body, a muscular structure that is attached to the lens by zonule fibers. These two structures bend the lens, allowing it to focus light on the back of the eye. Overlaying the ciliary body, and visible in the anterior eye, is the iris—the coloured part of the eye. The iris is a smooth muscle that opens or closes the pupil, which is the hole at the center of the eye that allows light to enter. The iris constricts the pupil in response to bright light and dilates the pupil in response to

dim light.

3. The **innermost layer** of the eye is the neural tunic, or retina, which contains the nervous tissue responsible for photoreception.

The eye is also divided into **two cavities**:

1. The **anterior cavity**

- The anterior cavity is the space between the cornea and lens, including the iris and ciliary body. It is filled with a watery fluid called the aqueous humor.

2. The **posterior cavity**

- The posterior cavity is the space behind the lens that extends to the posterior side of the interior eyeball, where the retina is located. The posterior cavity is filled with a more viscous fluid called the vitreous humor.

The **retina** is composed of several layers and contains specialized cells for the initial processing of visual stimuli. The photoreceptors (rods and cones) change their membrane potential when stimulated by light energy. The change in membrane potential alters the amount of neurotransmitter that the photoreceptor cells release onto bipolar cells in the outer synaptic layer. It is the bipolar cell in the retina that connects a photoreceptor to a retinal ganglion cell (RGC) in the inner synaptic layer. There, amacrine cells additionally contribute to retinal processing before an action potential is produced by the RGC. The axons of RGCs, which lie at the innermost layer of the retina, collect at the optic disc and leave the eye at the optic nerve (see Figure 15.5). Because these axons pass through the retina, there are no photoreceptors at the very back of the eye, where the optic nerve begins. This creates a “blind spot” in the retina, and a corresponding blind spot in our visual field.

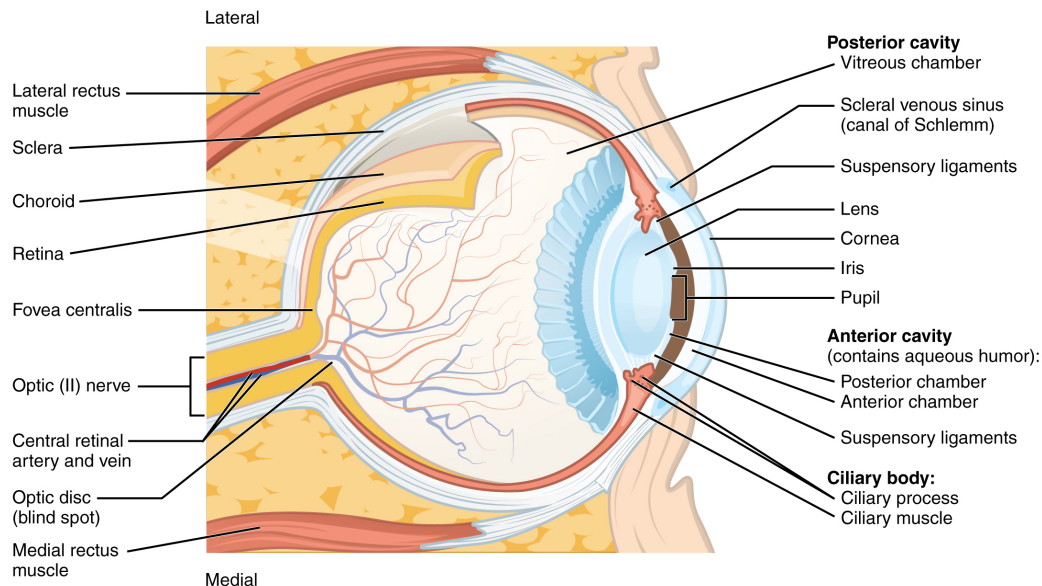


Figure 15.5. Structure of the Eye. The sphere of the eye can be divided into anterior and posterior chambers. The wall of the eye is composed of three layers: the fibrous tunic, vascular tunic, and neural tunic. Within the neural tunic is the retina, with three layers of cells and two synaptic layers in between. The center of the retina has a small indentation known as the fovea. From Betts et al., 2013. Licensed under CC BY 4.0. [Fig. 15.5 Image description.]

Photoreceptors in the retina (rods and cones) are located behind the axons, RGCs, bipolar cells, and retinal blood vessels. A significant amount of light is absorbed by these structures before the light reaches the photoreceptor cells. At the exact center of the retina is a small area known as the fovea. At the fovea, the retina lacks the supporting cells and blood vessels, and only contains photoreceptors. Therefore, **visual acuity**, is greatest at the fovea. This is because the fovea is where the least amount of incoming light is absorbed by other retinal structures (see Figure 15.5). As one moves in either direction from this central point of the retina, visual acuity drops significantly.

Example: Visual Acuity (VA) between the fovea and peripheral retina

The difference in visual acuity between the fovea and peripheral retina is easily evidenced by looking directly at a word in the middle of this paragraph. The visual stimulus in the middle of the field of view falls on the fovea and is in the sharpest focus. **Without moving your eyes off that word, notice that words at the beginning or end of the paragraph are not in focus.** The images in your peripheral vision are focused by the peripheral retina, and have vague, blurry edges and words that are not as clearly identified. As a result, a large part of the neural function of the eyes is concerned with moving the eyes and head so that important visual stimuli are centered on the fovea.

There are **three types of cone opsins**, that are sensitive to different wavelengths of light and provide us with **colour vision**. By comparing the activity of the three different cones, the brain can extract colour information from visual stimuli (see Figure 15.6). For example, a bright blue light that has a wavelength of approximately 450 nm would activate the “**red**” cones minimally, the “**green**” cones marginally, and the “**blue**” cones predominantly. The relative activation of the three different cones is calculated by the brain, which perceives the colour as blue. However, cones cannot react to low-intensity light, and rods do not sense the colour of light. Therefore, our low-light vision is, in essence, in **grayscale**. In other words, in a dark room, everything appears as a shade of gray. If you think that you can see colours in the dark, it is most likely because your brain knows what colour something is and is relying on that memory.

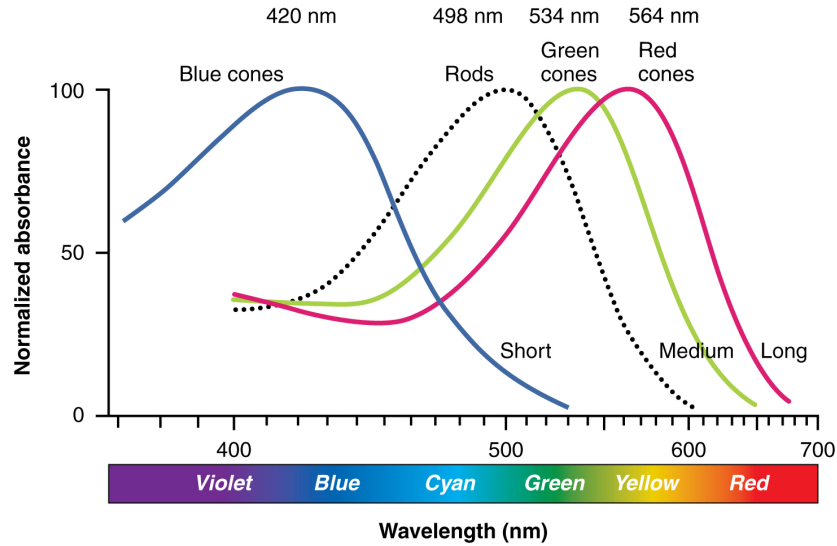


Figure 15.6 Comparison of Colour Sensitivity of Photopigments. Comparing the peak sensitivity and absorbance spectra of the four photopigments suggests that they are most sensitive to particular wavelengths. From Betts et al., 2013. Licensed under CC BY 4.0. [Fig. 15.6 Image description.]

Sensory Systems Medical Terms, Abbreviations and Anatomy

Sensory System Medical Terms

Sensory System Medical Terms (Text Version)

Practice the following sensory system words by breaking into word parts and pronouncing.

1. **anisocoria** (an-ī-sō-KŌR-ē-ă)
 - condition of absence of equal pupil (size)
2. **aphakia** (ă-FĀ-kē-ă)
 - condition of no lens
3. **audiogram** (OD-ē-ō-gram)
 - graphic record (radiographic image) of hearing
4. **audiologist** (od-ē-OL-ŏ-jĭst)

- specialist who studies and treats the hearing
- 5. **audiology (od-ē-OL-ō-jē)**
 - study of the hearing
- 6. **audiometer (od-ē-OM-ēt-ēr)**
 - instrument used to measure hearing
- 7. **audiometry (od-ē-OM-ě-trē)**
 - measuring hearing
- 8. **aural (OR-āl)**
 - pertaining to the ear
- 9. **binocular (bīn-ŌK-ū-lār)**
 - pertaining to both eyes
- 10. **blepharitis (blěf-ār-Ī-tīs)**
 - inflammation of the eyelid
- 11. **blepharoplasty (BLĚF-ā-rō-plās-tē)**
 - surgical repair of the eyelid
- 12. **blepharoptosis (BLĚF-ā-rōp-TŌ-sīs)**
 - condition of drooping of the eyelid
- 13. **cochlear (KOK-lē-ār)**
 - pertaining to the cochlea
- 14. **cochlear implant (KOK-lē-ā IM-plant)**
 - pertaining to the cochlear implant
- 15. **conjunctivitis (kōn-jūnk-tī-VĪT-īs)**
 - inflammation of the conjunctiva
- 16. **corneal (KOR-nē-ā)**
 - pertaining to the cornea
- 17. **cryoretinopexy (krī-ō-RET-in-ō-pek-sē)**
 - surgical fixation of the retina using extreme cold

18. **dacrocystitis (dak-rē-ō-sis-TĪT-īs)**
 - inflammation of the tear (lacrimal) sac
19. **dacryocystorhinostomy (dak-rē-ō-sis-tō-rī-NOS-tō-mē)**
 - creation of an artificial opening between the lacrimal sac and the nose
20. **diplopia (dip-LŌ-pē-ă)**
 - condition of double vision
21. **electrocochleography (ē-lek-trō-kok-lē-OG-ră-fē)**
 - process of recording the electrical activity in the cochlea
22. **endophthalmitis (ĕn-dōf-thăl-MĪ-tis)**
 - inflammation within the eye
23. **intraocular (in-tră-OK-yŭ-lăr)**
 - pertaining to within the eye
24. **iridectomy (ir-ĭ-DEK-tō-mē)**
 - excision of (part of) the iris
25. **iridoplegia (ir-ĭ-dō-PLĒ-j(ē-)ă, ĩr)**
 - condition of paralysis of the iris
26. **iridotomy (ir-ĭ-DŌT-ō-mē)**
 - incision into the iris
27. **iritis (ĭ-RĪT-īs)**
 - inflammation of the iris
28. **isocoria (ĭ-sō-KŌ-rē-ă)**
 - condition of equal pupils
29. **keratitis (ker-ă-TĪT-īs)**
 - inflammation of the cornea
30. **keratomalacia (kĕr-ă-tō-mă-LĀ-shĕ-ă)**
 - softening of the cornea
31. **keratometer (kĕr-ă-TŌM-ĕ-ter)**

- instrument used to measure (the curvature) of the eye
- 32. **keratoplasty (KER-ăt-ō-plas-tē)**
 - surgical repair of the cornea
- 33. **labyrinthectomy (lab-ĭ-rin-THEK-tō-mē)**
 - excision of the inner ear (labyrinth)
- 34. **labyrinthitis (lab-ĭ-rin-THĪT-ĭs)**
 - inflammation of the inner ear (labyrinth)
- 35. **lacrimal (LAK-rĭ-māl)**
 - pertaining to the tear duct
- 36. **leukocoria (loo-kō-KŌR-ē-ă)**
 - condition of a white pupil
- 37. **mastoidectomy (mās-tōy-d-ĔK-tō-mē)**
 - excision of the mastoid bone
- 38. **mastoiditis (mas-toyd-ĪT-ĭs)**
 - inflammation of the mastoid bone
- 39. **mastoidotomy (mās-toyd-ŌT-ō-mē)**
 - incision into the mastoid bone
- 40. **myringitis (mĭr-ĭn-JĪ-tĭs)**
 - inflammation of the tympanic membrane
- 41. **myringoplasty (mĭr-ĪN-gō-plăst-ē)**
 - surgical repair of the tympanic membrane
- 42. **myringotomy (mĭr-ĭn-GŌT-ō-mē)**
 - incision into the tympanic membrane
- 43. **nasolacrimal (nā-zō-LAK-rĭ-māl)**
 - pertaining to the nose and the tear duct
- 44. **nasopharyngeal (nā-zō-FAR-in-gēl)**
 - pertaining to the nose and pharynx (throat)

45. **oculomycosis** (ōk-ū-lō-mī-KŌ-sīs)
 - abnormal condition of the eye caused by a fungus
46. **ophthalmalgia** (ōf-thāl-MĀL-jē-ă)
 - condition of pain in the eye
47. **ophthalmic** (of-THAL-mik)
 - pertaining to the eye
48. **ophthalmologist** (ōf-thāl-MŌL-ō-jīst)
 - specialist of the eye
49. **ophthalmology** (Ophth) (ōf-thāl-MŌL-ō-jē)
 - study of the eye
50. **ophthalmopathy** (ōf-thāl-MŌP-ă-thē)
 - disease of the eye
51. **ophthalmoplegia** (of-thal-mō-PLĒ-j(ē)-ă)
 - condition of paralysis of the eye
52. **ophthalmoscope** (of-THAL-mō-skōp)
 - instrument used to view the eye
53. **ophthalmoscopy** (of-thal-MOS-kō-pē)
 - process of viewing the eye
54. **optic** (OP-tik)
 - pertaining to vision
55. **optometry** (op-TOM-ē-trē)
 - measuring vision
56. **otalgia** (ō-TĀL-jē-ă)
 - condition of pain in the ear
57. **otologist** (ō-TŌL-ō-jīst)
 - specialist who studies and treats disorders and diseases of the ear
58. **otology** (ō-TŌL-ō-jē)

- study of the ear
- 59. **otomastoiditis (ō-tō-mas-toyd-ĪT-īs)**
 - inflammation of the ear and mastoid bone
- 60. **otomycosis (ō-tō-mī-KŌ-sīs)**
 - abnormal condition of fungus in the ear
- 61. **otopyorrhea (ō-tō-pī-ō-RĒ-ă)**
 - discharge of pus from the ear
- 62. **otorhinolaryngologist (ō-tō-RĪ-nō-lār-ĭn-GŎL-ō-jĭst)**
 - specialist or physician who studies and treats disease and disorder of the ears,
- 63. **otorrhea (ō-tō-RĒ-ă)**
 - discharge from the ear
- 64. **otosclerosis (ō-tō-sklē-RŌ-sīs)**
 - condition of hardening of the ear
- 65. **otoscope(Ō-tō-skōp)**
 - instrument used to view the ear
- 66. **otoscopy (ō-TŎS-kō-pē)**
 - process of viewing the ear
- 67. **phacomalacia (făk-ō-mă-LĀ-shē-ă)**
 - condition of softening of the lens
- 68. **photophobia (fō-tō-FŎ-bē-ă)**
 - condition of sensitivity to light
- 69. **pseudophakia (SOOD-ō-FĀ-kē-a)**
 - condition of fake lens
- 70. **pupillary (PŪ-pĭ-lēr-ē)**
 - pertaining to pupil
- 71. **pupillometer (pū-pĭl-ŎM-ĕ-tēr)**
 - instrument used to measure the pupil

72. **pupilloscope (pū-pīl-ŎS-kōp)**
- instrument used to view the pupil
73. **retinal (RĚT-ī-nāl)**
- pertaining to the retina
74. **retinoblastoma (ret-īn-ō-blas-TŎ-mă)**
- tumour arising from a developing retinal cell
75. **retinopathy (ret-īn-OP-ă-thē)**
- disease of the retina
76. **retinoscopy (ret-īn-OS-kō-pē)**
- process of viewing the retina
77. **sclerokeratitis (sklēr-ō-kēr-ă-TĪ-tīs)**
- inflammation of the sclera and cornea
78. **scleromalacia (sklě-rō-mā-LĀ-sē-ă)**
- condition of softening of the sclera
79. **sclerotomy (sklě-ROT-ō-mē)**
- incision into the sclera
80. **stapedectomy (stā-pě-DEK-tō-mē)**
- excision of the stapes
81. **tonometer (tō-NOM-ēt-ēr)**
- instrument used to measure pressure (within the eye)
82. **tonometry (tō-NOM-ě-trē)**
- process of measuring pressure
83. **tympanometer (tīm-pă-NŎM-ě-tēr)**
- instrument used to measure the middle ear
84. **tympanometry (tīm-pă-NŎM-ě-trē)**
- measurement of the tympanic membrane
85. **tympanoplasty (tīm-păn-ō-PLĀS-tē)**

- membranesurgical repair of the tympanic

86. **vestibular (ves-TIB-yŭ-lār)**

- pertaining to the vestibule

87. **vestibulocochlear (ves-tĭ-bŭl-ō-KŌ-klē-ar)**

- vestibul/o/cochle/ar
- pertaining to the vestibule and cochlea

88. **xerophthalmia (zer-of-THAL-mē-ă)**

- xer/ophthalm/ia
- condition of dry eye

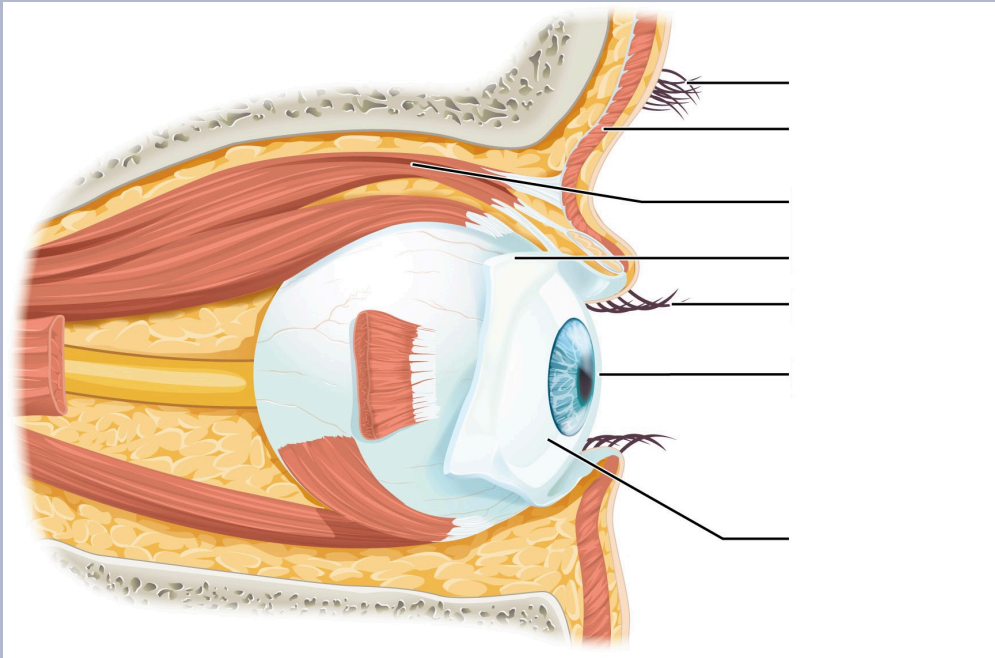
Activity source: Sensory System Medical Terms by Kimberlee Carter, from *Building a Medical Terminology Foundation* by Kimberlee Carter and Marie Rutherford, licensed under CC BY- 4.0. /Text version added.

Anatomy Labeling Activity

Sensory System Eye Anatomy (Text Version)

Label the diagram with correct words listed below:

1. Eyebrow
2. Conjunctiva
3. Levator palpebrae superioris muscle
4. Palpebral conjunctiva
5. Cornea
6. Eyelashes
7. Orbicularis oculi muscle



Check your answers ²

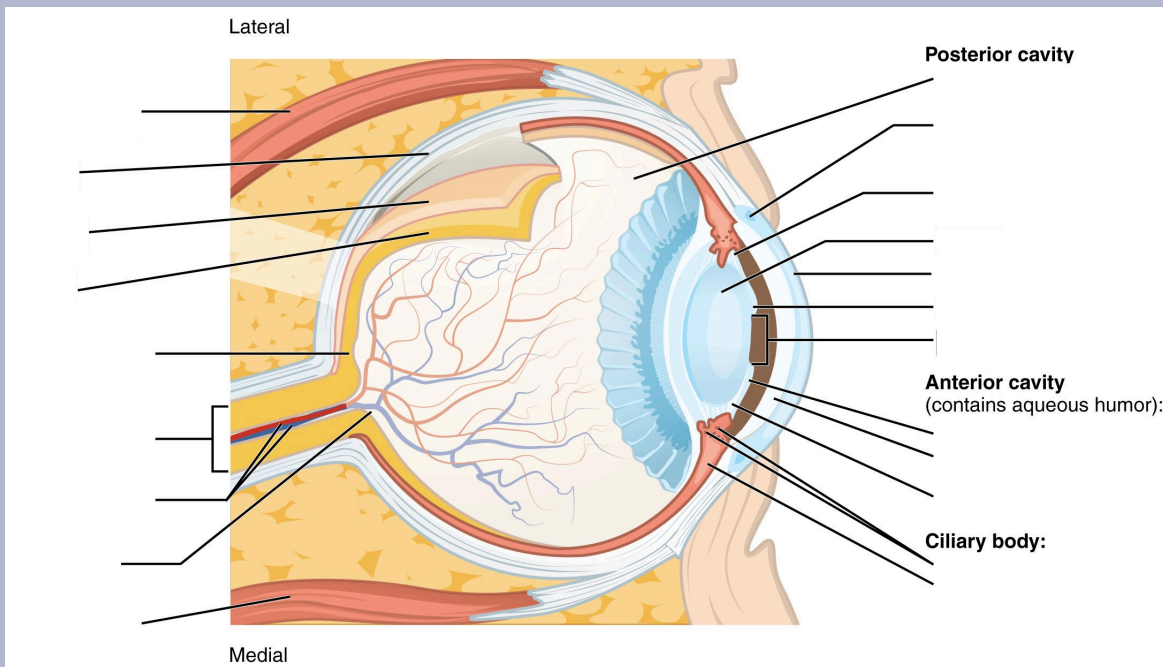
Activity source: Sensory System Eye Anatomy by Gisele Tuzon, from *Building a Medical Terminology Foundation*, illustration from *Anatomy and Physiology (OpenStax)*, licensed under CC BY 4.0./ Text version added.

Sensory System Eye Anatomy

Sensory System Eye Anatomy (Text Version)

Label the diagram with correct words listed below:

- | | | |
|-------------------------|-------------------------------------|---|
| 1. Fovea centralis | 9. Choroid | 17. Sclera |
| 2. Suspensory ligaments | 10. Ciliary process | 18. Medial rectus muscle |
| 3. Ciliary muscle | 11. Optic disc (blind spot) | 19. Scleral venous sinus (canal of Schlemm) |
| 4. Retina | 12. Lens | 20. Cornea |
| 5. Posterior chamber | 13. Central retinal artery and vein | 21. Pupil |
| 6. Iris | 14. Suspensory ligaments | |
| 7. Vitreous chamber | 15. Lateral rectus muscle | |
| 8. Anterior chamber | 16. Optic (II) nerve | |



Sensory System Eye Anatomy Diagram (Text Version)

This diagram shows a lateral and medial view of the eyeball. The major parts are labelled. Labels read from top, clockwise: showing the posterior cavity including the following structures: _____[Blank 1], _____[Blank 2] (canal of Schlemm), _____[Blank 3], _____[Blank 4], _____[Blank 5], _____[Blank 6], and _____[Blank 7]. Next is the anterior cavity (contains aqueous humor), _____[Blank 8], _____[Blank 9], and _____[Blank 10]. The Ciliary body _____[Blank 11] and _____[Blank 12], _____[Blank 13], _____[Blank 14] (blind spot of the eye), _____[Blank 15], _____[Blank 16], _____[Blank 17], _____[Blank 18], _____[Blank 19], and _____[Blank 20].

Check your answers ³

Activity source: Sensory System Eye Anatomy by Gisele Tuzon, from *Building a Medical Terminology Foundation*, illustration from *Anatomy and Physiology (OpenStax)*, licensed under CC BY 4.0./ Text version added.

Sensory System Terms Not Easily Broken into Word Parts

Sensory System not easily broken into word parts (Text Version)

1. **astigmatism (Ast)**
 - blurry vision due to irregular curvature of the cornea or lens
2. **Optician**
 - specialist who fills prescriptions for lenses but cannot prescribe
3. **anosmia**
 - condition of being without smell/inability to smell
4. **stye**
 - infection of an oil gland of the eyelid (hordeolum)
5. **amblyopia**
 - reduced vision in one eye
 - associated with strabismus (lazy eye)
6. **Optometrist**
 - specialist who diagnoses, treats, and manages diseases and disorders of the eye
 - Doctor of Optometry
7. **visual acuity (VA)**
 - sharpness or clearness of vision
8. **cataract**
 - abnormal progressive disease of lens characterized by lack of transparency or cloudiness

Activity source: Sensory System Terms Not Easily Broken into Word Parts by Kimberlee Carter, from *Building a Medical Terminology Foundation* by Kimberlee Carter and Marie Rutherford, licensed under CC BY- 4.0. /Text version added.

Common Abbreviations for the Sensory System

Sensory System Abbreviations

- **ARMD** (age-related macular degeneration)
- **Ast** (astigmatism)
- **Em** (emmetropia)
- **IOL** (intraocular lens)
- **IOP** (intraocular pressure)
- **LASIK** (laser-assisted in situ keratomileusis)
- **Ophth** (ophthalmology)
- **PHACO** (phacoemulsification)
- **PRK** (photorefractive keratectomy)
- **VA** (visual acuity)
- **AOM** (acute otitis media)
- **ENT** (ears, nose, throat)
- **EENT** (eyes, ears, nose, and throat)
- **HOH** (hard of hearing)
- **OM** (otitis media)

Activity source: Sensory System Abbreviation by Kimberlee Carter, from *Building a Medical Terminology Foundation* by Kimberlee Carter and Marie Rutherford, licensed under CC BY- 4.0. / Text version.

Image Descriptions

Figure 15.1 image description: This image shows the structure of the ear with the major parts labeled. The ear is divided into 3 parts from left to right: external ear, middle ear, and inner ear. Labels for each part read: external ear (auricle, ear canal), middle ear (tympanic membrane, malleus, incus, tympanic cavity), inner ear (stapes, vestibule, vestibular nerve, cochlear nerve, cochlea, round window, eustachian tube). [Return to Figure 15.1].

Figure 15.2 image description: This diagram shows the structure of the cochlea in the inner ear. Labels read (from top, counterclockwise): bony cochlear wall, scala vestibuli, cochlear duct, tectorial membrane, basilar membrane, scala tympani, spiral ganglion, cochlear branch of N VIII, organ of Corti. [Return to Figure 15.2].

Figure 15.3 image description: The left panel of this image shows a person's head in a still position. Underneath this, the ampullary nerve is shown. Labels read: cupula, ampulla, ampullary nerve). The right panel shows a person rotating his head, and the below that, the direction of movement of the cupula is shown. Label reads: as the head rotates, cupula bends in opposite direction of the rotation. [Return to Figure 15.3].

Figure 15.4 image description: This diagram shows the lateral view of the eye. The major parts are labeled. Labels read (from top): eyebrow, orbicularis oculi muscle, levator palpebrae superioris muscle, palpebral conjunctiva, eyelashes, cornea, conjunctiva. [Return to Figure 15.4].

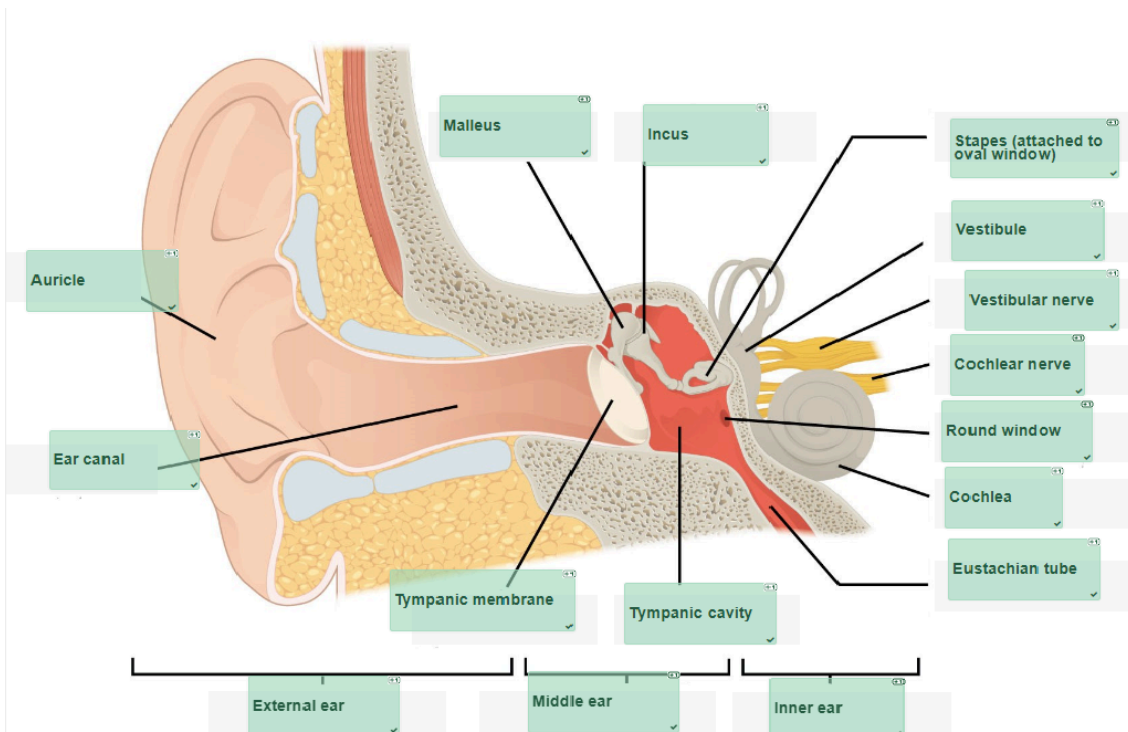
Figure 15.5 image description: This diagram shows a lateral and medial view of the eyeball. The major parts are labelled. Labels read (from top, clockwise): posterior cavity (vitreous chamber, scleral venous sinus (canal of Schlemm), suspensory ligaments, lens, cornea, iris, pupil); anterior cavity (contains aqueous humor, posterior chamber, anterior chamber, suspensory ligaments); Ciliary body (ciliary process and muscle), medial rectus muscle, optic disc (blind spot), central retinal artery and vein, fovea centralis, retina, choroid, sclera, lateral rectus muscle. [Return to Figure 15.5].

Figure 15.6 image description: This graph shows the normalized absorbance versus wavelength for different cell types in the eye. The Y-axis is normalized absorbance, and the X axis is wavelength (nm) with the colours violet, blue, cyan, green, yellow, and red across the bottom. The lines in the graph indicate blue cones which peak at 420 nm; rods which peak at 498 nm; green cones, which peak at 534 nm, and red cones which peak at 564 nm. Blue cones line is labelled as short, green cones as medium, and red cones as long. [Return to Figure 15.6].

Attribution

Except where otherwise noted, this chapter is adapted from “Sensory Systems (<https://ecampusontario.pressbooks.pub/medicalterminology/chapter/sensory-systems/>)” in *Building a Medical Terminology Foundation* by Kimberlee Carter and Marie Rutherford, licensed under CC BY 4.0. / A derivative of Betts et al., which can be accessed for free from *Anatomy and Physiology (OpenStax)* (<https://openstax.org/books/anatomy-and-physiology/pages/1-introduction>). Adaptations: dividing Sensory Systems chapter content into sub-chapters.

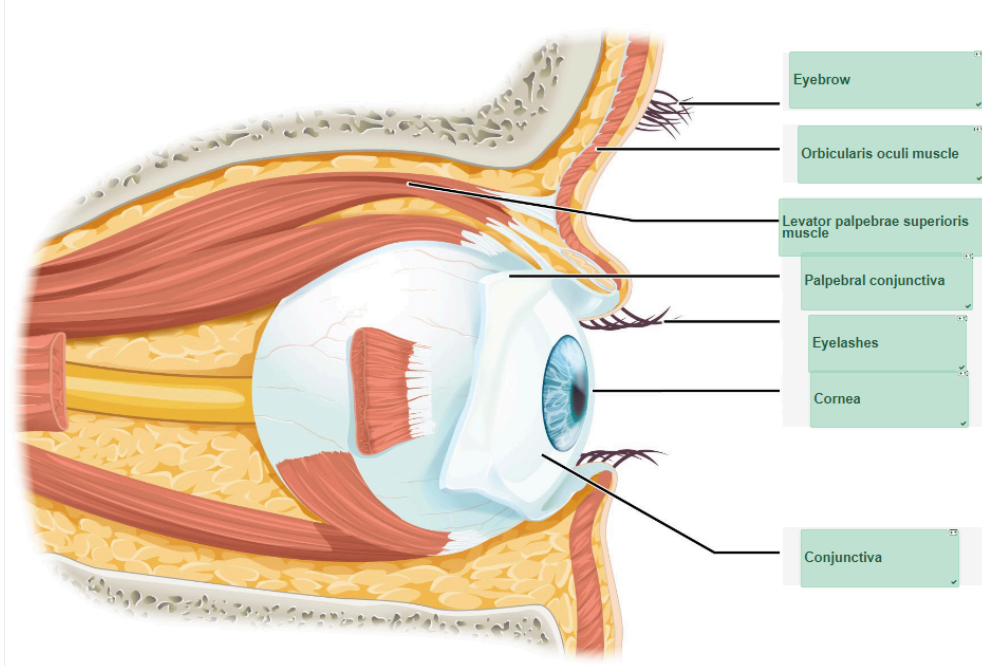
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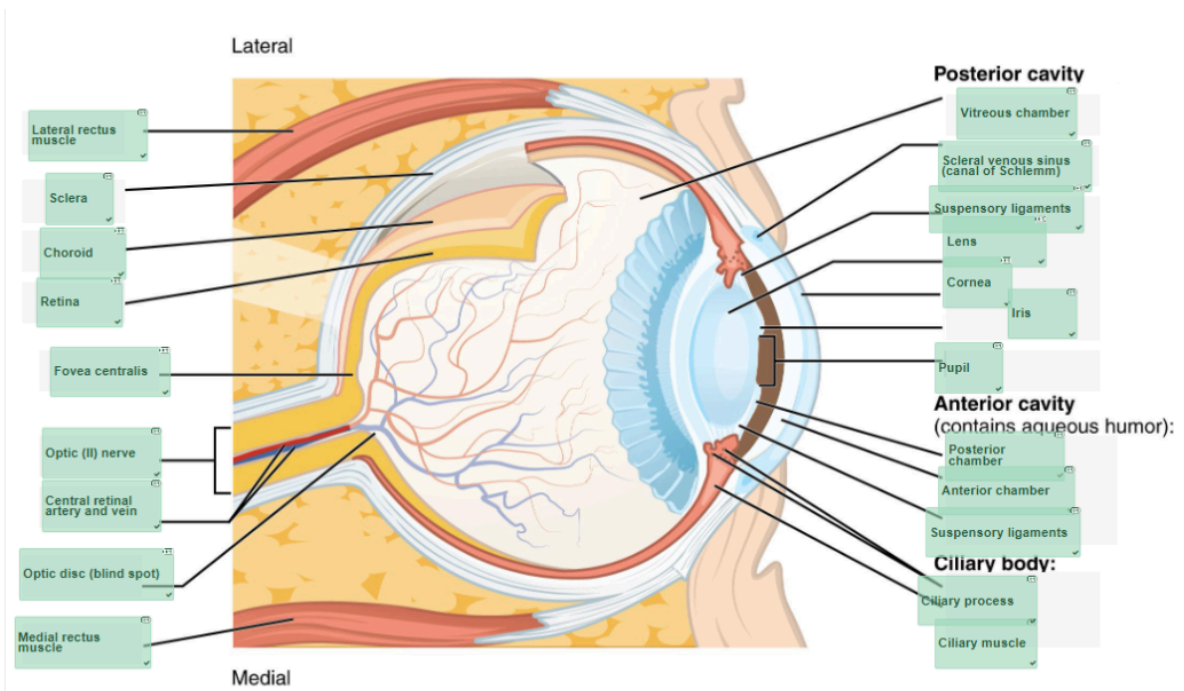
1.

Check your answers: Sensory System Ear Anatomy labeling activity (Text Version)text

Sensory System Eye Anatomy



2.



3.

Check your answers: Sensory System Eye Anatomy Diagram (Text Version) This diagram shows a lateral and medial view of the eyeball. The major parts are labelled. Labels read from top, clockwise: showing the posterior cavity including the following structures: **vitreous chamber**, **scleral venous sinus** (canal of Schlemm), **suspensory ligaments**, **lens**, **cornea**, **iris**, and **pupil**. Next is the anterior cavity (contains aqueous humor), **posterior chamber**, **anterior chamber**, and **suspensory ligaments**. The Ciliary body **ciliary process** and **ciliary muscle**, **medial rectus muscle**, **optic disc** (blind spot of the eye), **central retinal artery and vein**, **foveal centralis**, **optic nerve**, **retina**, **choroid**, **sclera**, and **lateral rectus muscle**.

15.3 - Sensory Diseases, Disorders and Diagnostic Testing

Olfactory Diseases and Disorders

Anosmia

Blunt force trauma to the face, such as that common in many car accidents, can lead to the loss of the olfactory nerve, and subsequently, loss of the sense of smell. This condition is known as **anosmia**. When the frontal lobe of the brain moves relative to the ethmoid bone, the olfactory tract axons may be sheared apart. Professional fighters often experience anosmia because of repeated trauma to the face and head. In addition, certain pharmaceuticals, such as antibiotics, can cause anosmia by killing all the olfactory neurons at once. If no axons are in place within the olfactory nerve, then the axons from newly formed olfactory neurons have no guide to lead them to their connections within the olfactory bulb. There are temporary causes of anosmia, as well, such as those caused by inflammatory responses related to respiratory infections or allergies. Loss of the sense of smell can result in food tasting bland. A person with an impaired sense of smell may require additional spice and seasoning levels for food to be tasted. Anosmia may also be related to some presentations of mild depression because the loss of enjoyment of food may lead to a general sense of despair. The ability of olfactory neurons to replace themselves decreases with age, leading to age-related anosmia. This explains why some elderly people salt their food more than younger people. However, this increased sodium intake can increase blood volume and blood pressure, increasing the risk of cardiovascular diseases in the elderly (Betts, et al., 2013).

Ears, Nose, and Throat Diseases and Disorders

Otitis Media

Otitis Media is known as inflammation of the middle ear canal that involves the eardrum. It is commonly seen in younger children due to bacterial and viral infections. Symptoms include possible fever, cough and cold symptoms, hearing loss, irritability and **otalgia**. Treatment involves symptomatic control as well as antibiotic (Amoxicillin) use if necessary (Government of Canada, 2016). To learn more about **otitis media**, review this website by the Government of Canada [PDF] (https://www.canada.ca/content/dam/hc-sc/migration/hc-sc/fniah-spnia/alt_formats/pdf/services/nurs-infirm/clin/clin/pediat/ent-ori-eng.pdf).

Otitis Externa

Otitis Externa is inflammation of the external ear canal and is known as swimmer's ear because it is associated

with its exposure to water. Its clinical presentation and management are the same as otitis media (Piercefield et al., 2011). To learn more about **otitis externa**, review this website from the Centers for Disease Control and Prevention [New Tab] (https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6019a2.htm?s_cid=mm6019a2_w).

Conductive Hearing Loss

Hearing loss occurs when something disrupts sound through the mid and outer ear, such as physical damage to the ear drum (perforation). Hearing loss can be managed with pharmacotherapy, surgery, or a combination of the two (Centers for Disease Control and Prevention, 2023).

Sensorineural Hearing Loss

This hearing loss results from damage to the neural structures. Tumors as well as exposure to loud noises (acute/chronic) can lead to this type of hearing loss (Centers for Disease Control and Prevention, 2023). To learn more about sensorineural hearing loss, review the Centers for Disease Control and Prevention's web page about sensorineural hearing loss [New Tab] (<https://www.cdc.gov/ncbddd/hearingloss/types.html>).

Tinnitus

Tinnitus is a condition of ringing in the ears. It is due to inflammation of the middle ear. It is the first indicator of nerve damage, particularly in sensorineural hearing loss (National Library of Medicine, 2022). For more information, review this page on the role of inflammation in tinnitus [New Tab] (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8878384/>) from the National Library of Medicine.

Otosclerosis

This is hardening of the ear due to new bone formation of the inner ear ossicles. The etiology is idiopathic or may be hereditary. Clinical features are consistent with that of conductive hearing loss. Further management is required by an ENT surgeon (Veterans Affairs Canada, 2019). To learn more, visit the Veterans Affairs Canada web page on Otosclerosis [New Tab].

Rhinitis

Rhinitis is inflammation of the nasal cavity mucosal lining, which can lead to congestion and rhinorrhea (runny nose). The causes may be due to allergic reactions as well as viruses. Treatment regimens include symptomatic management, saline sprays, and oral antihistamines (Naclerio, Bachert, & Baraniuk, 2010). To learn more about rhinitis and other nasal conditions, please view Naclerio, Bachert, & Baraniuk's article *Pathophysiology of Nasal Congestion* [New Tab].

Dacryostenosis

Also known as nasolacrimal obstruction, this is an obstruction of the nasolacrimal duct. It prevents tears from draining from the eyes into the ducts and thus individuals have excessive tearing. The etiology is congenital and is the result of the duct not forming properly. This condition is managed via observation, as it resolves overtime (usually after 1 year) (Merck Manual, 2024). To learn more, visit the Merck Manual's web page about dacryostenosis [New Tab] (<https://www.merckmanuals.com/en-ca/home/eye-disorders/eyelid-and-tearing-disorders/dacryostenosis/>).

Eye Diseases and Disorders

Blindness

The term “blindness” may cover a broad spectrum of visual disabilities such as the inability to see because of injury, disease, or a congenital condition. The parameters for legal blindness are a visual field of 20 degrees or narrower and/or visual acuity is 20/200 or less in both eyes, even after correction. Many of the conditions described below can lead to visual disability, low vision, and legal blindness (Canadian National Institute for the Blind, n.d). To learn more about blindness, visit this website by the Canadian National Institute for the Blind [New Tab] (<https://cnib.ca/en/sight-loss-info/blindness/what-blindness?region=on>).

Cataract

A cataract is a clouding of the normally clear lens of your eye. For people who have cataracts, it may feel like they are looking through cloudy lenses or windows. The lens of the eye loses its flexibility due to the aging process, leading, in some cases, to senile cataracts. Infants are sometime born with congenital cataracts. Treatment usually involves surgery to remove the clouding of the lens (Mayo Clinic Staff, 2023). To learn more, visit the Mayo Clinic's web page about cataracts [New Tab] (<https://www.mayoclinic.org/diseases-conditions/ataracts/symptoms-causes/syc-20353790>).

Conjunctivitis

This is a condition involving inflammation of the conjunctiva. Its common causes are due to allergens, chemicals, foreign objects, as well as bacterial and viral pathogens. The cause of conjunctivitis determines if it is transmissible from one individual to another. Pink eye caused by the adenovirus, for example, is highly contagious compared to pollen, which is not. Management involves treating the underlying cause of conjunctivitis (Centers for Disease Control and Prevention, 2019). To learn more about conjunctivitis, please visit the Centers for Disease Control and Prevention's web page about conjunctivitis [New Tab] (<https://www.cdc.gov/conjunctivitis/about/causes.html>).

Diabetic Retinopathy

This is a disease of the retina caused by diabetes mellitus. The retinal veins dilate, leading to swelling as fluid leaks from blood vessels into the retina. It is estimated that 20% of newly diagnosed diabetics suffer from diabetic retinopathy (American Optometric Association, 2020). To learn more, visit the American Optometric Association's website on diabetic retinopathy [New Tab] (<https://www.aoa.org/patients-and-public/eye-and-vision-problems/glossary-of-eye-and-vision-conditions/diabetic-retinopathy>).

Glaucoma

This disease is part of a group of eye diseases which lead to progressive degeneration of the optic nerve. This, in turn, can lead to loss of nerve tissue that results in gradual irreversible vision loss and potential blindness if not detected and treated early. The most common form of glaucoma is primary open-angle glaucoma. This form is associated with elevated pressure caused by a backup of fluid in the eye (Canadian Association of Optometrists, n.d.). To learn more, visit the Canadian Association of Optometrists' web page about glaucoma [New Tab] (<https://opto.ca/health-library/about-glaucoma>).

Macular Degeneration/Age-related Macular Degeneration (AMD)

Progressive damage of a portion of the retina is known as the macula. Severe central vision is lost while peripheral vision is retained. This is the leading cause of blindness in people over the age of 55 years (Canadian Association of Optometrists, 2024). To learn more, visit the Canadian Association of Optometrists' web page on AMD [New Tab] (<https://opto.ca/eye-health-library/age-related-macular-degeneration-amd>).

Nystagmus

This is a condition whereby involuntary repetitive eye movements make it impossible to fixate on a single object. The condition is often referred to as dancing eyes (Dubow, 2020). To learn more about nystagmus, view this website from All About Vision [New Tab] (<https://www.allaboutvision.com/conditions/nystagmus.htm>).

Retinal Detachment

According to the Eye Physicians & Surgeons of Ontario, this condition occurs when the retina gets pulled away or separated from its normal position. Flashing lights, floaters, and what appears to be a grey curtain are all symptoms of a retinal tear, which can lead to a retinal detachment. An ophthalmologist is a retinal specialist who can repair the retinal detachment. If left untreated, a retinal detachment could lead to blindness (Canadian Ophthalmological Society, 2007). To learn more, visit the Canadian Ophthalmological Society's brochure on Retinal Tear and Detachment [PDF] (<https://www.cos-sco.ca/wp-content/uploads/2021/12/RetinalDet.pdf>).

Strabismus

This is a condition where the affected eye rotates due to mismatched eye coordination. Each eye is focused differently, as described in the conditions below:

- **Esotropia:** the convergence of one or both eyes medially
- **Exotropia:** the deviation of one eye laterally
- **Hypertropia:** the deviation of one eye superiorly
- **Hypotropia:** the deviation of one eye inferiorly

If not managed, the brain may reject input from one eye, resulting in vision loss of the respective eye (amblyopia). **Amblyopia** is a condition also known as lazy eye, which is caused when there is an imbalance of stimuli from the brain to the eyes (one eye receives more than the other). It usually occurs in childhood and requires early intervention to rectify this condition (Canadian Association of Optometrists, 2023). To learn more about strabismus, go to The Canadian Association of Optometrists' page on the subject [New Tab].

Sensory Systems Terms in Use

Sensory System – Consultation Report Activity

Sensory System – Consultation Report (Text Version)

Use the words below to fill in the consultation report:

- eye
- halos
- acuity
- iris
- dilate
- ophthalmoscope
- cataracts
- subcapsular
- surgery
- intraocular

PATIENT NAME: Betty FOX

AGE: 72

SEX: Female

DOB: October 2

DATE OF CONSULTATION: August 5

CONSULTING PHYSICIAN: Brian Gates, MD, Ophthalmology

REASON FOR CONSULTATION: Cataracts

HISTORY: I saw Mrs. Fox, a 72-year-old, for her regular _____[Blank 1] examination. She has been wearing reading glasses for several years now but has noticed that she has been having trouble reading and has been seeing _____[Blank 2] around lights while driving at night.

PHYSICAL EXAMINATION: A visual _____[Blank 3] test was performed. I used a slit lamp to view the cornea, _____[Blank 4], lens, and the space between the iris and cornea. I detected tiny abnormalities. I administered drops to _____[Blank 5] the pupils to examine the retina. Using an _____[Blank 6], I was able to examine the lenses for signs of _____[Blank 7]. I was able to determine that Mrs. Fox has posterior _____[Blank 8] cataracts in both eyes.

PLAN: I explained to Mrs. Fox that she required cataract _____[Blank 9]. I explained that her clouded lens would be replaced with an _____[Blank 10] lens – a clear artificial lens. She was in agreeance to having the surgery. I told her we would perform the surgery on her right eye first, then in about eight weeks we would do the left eye. Arrangements for her surgery will be made for next month.

Brian Gates, MD, Ophthalmology

Note: Report samples (H5P and Pressbooks) are to encourage learners to identify correct medical terminology and do not represent the Association for Health Documentation Integrity (AHDI) formatting standards.

Check your answers ¹

Activity source: Sensory System – Consultation Report by Heather Scudder, from Building a Medical Terminology Foundation by Kimberlee Carter and Marie Rutherford, licensed under CC BY- 4.0. / Text version added.

Sensory System – Consultation Report

Sensory System – Consultation Report Activity (Text Version)

Use the words below to fill in the consultation report:

- OS
- watering
- antihistamines
- ophthalmalgia
- erythematous
- thyroid
- abnormalities
- masses
- anaesthetic
- puncta
- nasolacrimal
- dacryocystitis
- dacryocystorhinostomy
- medication

PATIENT NAME: Rose MACKENZIE

AGE: 57

SEX: Female

DOB: November 25

DATE OF CONSULTATION: April 16

CONSULTING PHYSICIAN: Ashley Cook MD, Ophthalmology

REASON FOR CONSULTATION: Epiphora in left eye.

HISTORY: Patient is a 57-year-old female who reports epiphora in _____[Blank 1]. Prior to the encounter, she attempted to cure the condition with various _____[Blank 2]. She states that this has been an ongoing issue for the past 2 years, but the _____[Blank 3] has affected her ability to safely drive over the past 8 months. She denied any persistent _____[Blank 4], although noted that the surface of the eye was occasionally irritated and _____[Blank 5] due to rubbing away the tears. She has had no prior eye surgery and no relevant family or personal history of dermatitis or _____[Blank 6] pathologies.

PHYSICAL EXAMINATION: Patient is alert and oriented x 3, and in no acute distress. Examination of the eye surface revealed no _____[Blank 7] other than the erythema and tearing. The skin surrounding the eye appeared normal, with no _____[Blank 8] or swelling.

An irrigation test was then conducted. The eye was treated with _____[Blank 9] eye drops prior to the test. A syringe filled with saline was inserted into the left _____[Blank 10] using a hollow wire. The syringe was then pressed to assess the pressure of the left _____[Blank 11] duct. The fluid did not pass through the nose, indicating inflammation of the duct. No further diagnostic testing was required.

ASSESSMENT: Chronic _____[Blank 12] of the left nasolacrimal duct.

PLAN: Return for _____[Blank 13] in 3 months. Patient was instructed to remove tears using tissue instead of her hand to avoid the risk of infection. No _____[Blank 14] is required in the meantime.

Ashley Cook MD, Ophthalmology

Note: Report samples (H5P and Pressbooks) are to encourage learners to identify correct medical terminology and do not represent the Association for Health Documentation Integrity (AHDI) formatting standards.

Check your answers ²

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Medical Specialties and Procedures Related to the Sensory Systems

Several medical specialties support the sensory systems. An **optometrist** is an eye specialist that examines and evaluates for ocular pathology and an optometrist prescribes corrective lenses. An **ophthalmologist** evaluates and manages eye pathology as well as performs surgery. An **otorhinolaryngologist** (ENT) is a physician that

specializes in the ears, nose and throat treatment and conditions. An **audiologist** evaluates and manages individuals with hearing loss.

Attribution

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Notes

1. 1.eye, 2.halos, 3.acuity, 4.iris, 5.dilate, 6.opthalmoscope, 7.cataracts, 8.subcapsular, 9.surgery, 10.intraocular
2. 1.OS, 2.antihistamines, 3.watering, 4.opthalmalgia, 5.erythematous, 6.thyroid, 7.abnormalities, 8.masses, 9.anaesthetic, 10.puncta, 11.nasolacrimal, 12.dacryocystitis, 13.dacryocystorhinostomy, 14.medication

Vocabulary & Check Your Knowledge

Sensory System Vocabulary

Acoustic Neuroma

A benign tumour in the internal auditory canal.

Blepharitis

Inflammation of eyelids.

Epistaxis

Nosebleed.

Glossopharyngeal

Pertaining to tongue and throat.

Hyperopia

Farsightedness. Near objects look blurred but distant objects are more clearly visible.

Kinesthesia

Body movement.

Mechanoreceptors

A sensory neuron that responds to mechanical pressure.

Myopia

Nearsightedness. Near objects are clear and seen but far objects are not.

Nociceptors

Sensory neurons that respond to pain.

Ophthalmia Neonatorum

Conjunctivitis in newborns (severe).

Pharyngitis

Inflammation of the pharynx.

Pharyngotonsillitis

Inflammation of the pharynx and tonsils.

Proprioception

Body movement.

Rhinitis

Inflammation of the nasal cavity, which can lead to rhinorrhea.

Rhinorrhea

Runny nose.

Sinusitis

Inflammation of the sinuses.

Stye

Acute infection of the eyelash's hair follicle.

Thermoreceptors

Specialized neurons that respond to changes in temperature.

Tonsillitis

Inflammation of the tonsils.

Tympanic Membrane

Eardrum.

Visceral

Pertaining to internal organs.

Visual Acuity

Sharpness of vision.

Sensory Systems Glossary Reinforcement activity

Sensory Systems Glossary Reinforcement activity (Text Version)

1. Specialized neurons that respond to changes in temperature are called _____. [Blank 1].

- a. thermoreceptors
 - b. mechanoreceptors
 - c. nociceptors
2. Body movement is called _____[Blank 2].
- a. kinesthesia
 - b. visceral
 - c. proprioception
3. Sharpness of vision is called _____[Blank 3].
- a. visual acuity
 - b. proprioception
 - c. kinesthesia
4. Sensory neurons that respond to pain are called _____[Blank 4].
- a. thermoreceptors
 - b. nociceptors
 - c. glossopharyngeal
5. The eardrum is also called _____[Blank 4].
- a. glossopharyngeal
 - b. mechanoreceptors
 - c. tympanic membrane

Check your answers¹

Activity source: Sensory Systems Glossary Reinforcement activity by Kimberlee Carter, from *Building a Medical Terminology Foundation* by Kimberlee Carter and Marie Rutherford, licensed under CC BY- 4.0. /Text version added.

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Notes

1. 1. thermoreceptors, 2. kinesthesia, 3. Sharpness of vision is called..., 4. Sensory neurons that respond to pain are called..., 5. The ear-drum is also called...

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