

Exercise 11: Peripheral Sensory and Special Senses

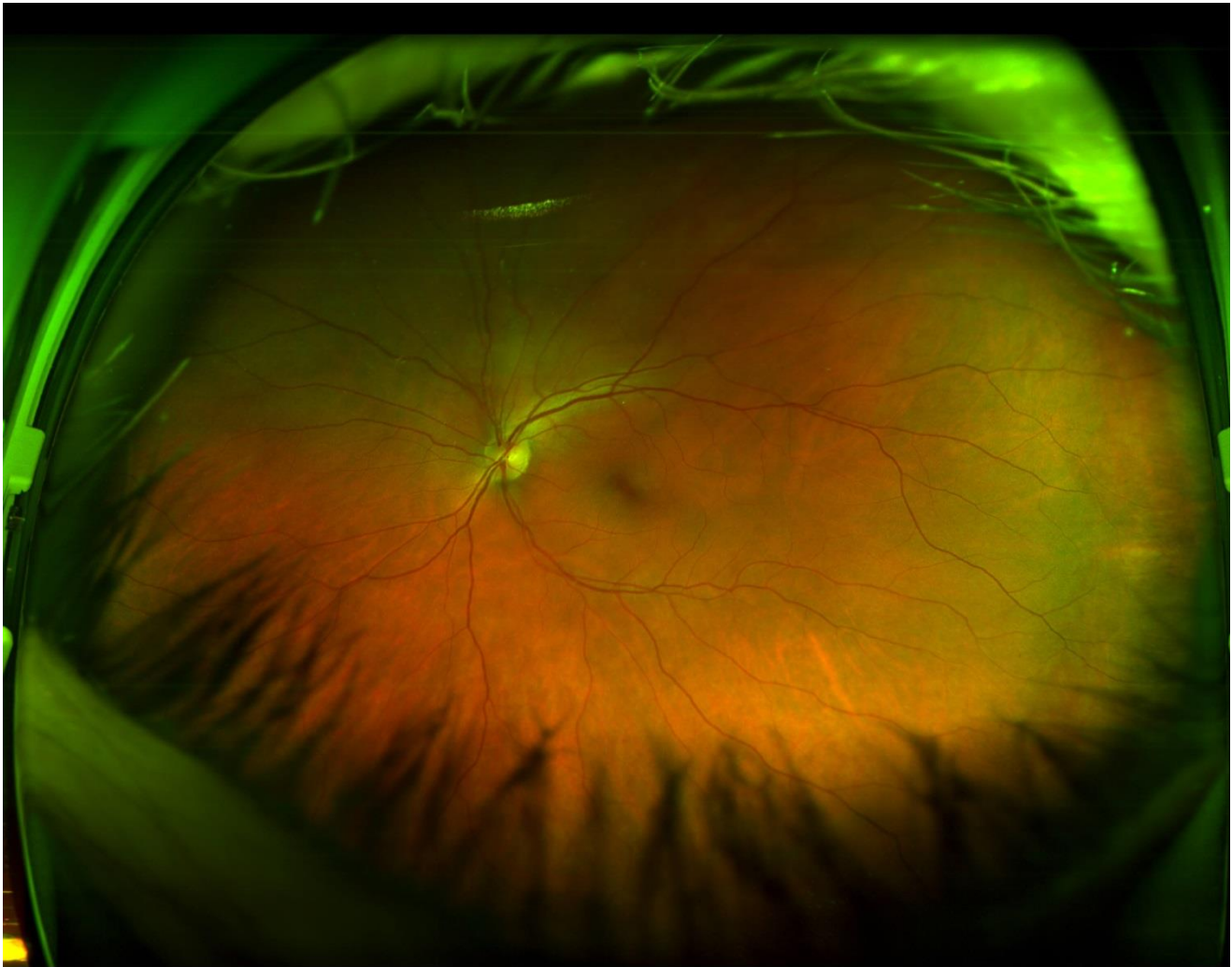


Figure 11.1: The image above is a view of the left retina from a dilated eye, taken during a routine eye exam. You can see the optic disc and the vasculature of the retina. Credit: Eye of Dr. Cathcart.

Exercise 11 Learning Goals

After completing this lab, you should be able to:

- Understand the difference between somatic and special senses
- Describe the structure and function of touch receptors
- Identify and define structures of the eye
- Recognize and name structures of the ear
- Distinguish and explain structures associated with taste

Pre-Lab Activity 11.1: Classifying receptors

Sensations may be conscious or subconscious and are defined as the awareness of changes in the environment. The general senses include the somatic and visceral (hollow organs) senses. Somatic sensations originate from peripheral receptors that vary in response to the type of stimulus. The somatic senses include touch, pressure, vibration, temperature, pain, itch, tickle and proprioception. Explore the classification of somatic sensory receptors by completing the table below.

Receptors	Define	Location
Tactile	Sense of touch	Skin and visceral structures
Thermal		
Pain		
Mechanoreceptor		
Proprioceptors		
Nociceptors		
Chemoreceptors		

Which part of the brain processes somatic sensory information?

Pre-Lab Activity 11.2: Classifying Special Senses

Special senses are a conscious sensation which includes smell, taste, vision, hearing and balance. These receptors are in specific areas of the head and are distinct separate cells compared to the somatic or visceral receptors

Sensation	Receptors	Associated Cranial Nerve	Associated Lobe of the Brain	Stimuli
Smell	Olfactory or Chemoreceptors	CN 1 Olfactory	Frontal	Chemicals in air
Taste				
Vision				
Hearing				
Balance				

Pre-Lab Activity 11.3: Define Parts of the Eye

The eyes are protected in the boney orbits of the skull. The retina of the eye is derived from the diencephalon during nervous system development and houses the photoreceptors which are optimized for responding to light stimuli. Explore the major structures of the eye by defining key terms in the table below.

Structure	Definition
Lacrimal Gland	
Sclera	
Cornea	
Choroid	

Ciliary Body	
Iris	
Retina	
Optic Disc	
Lens	
Vitreous Humor	
Aqueous Humor	
Optic Nerve	
Extraocular muscles	
Tapetum Lucidum	

Which cranial nerves are associated with eye movements? List their CN-number & name.

Pre-Lab Activity 11.3.1: Label Parts of the Eye

Using a diagram from your textbook, label the structures of the eye in the diagram below.

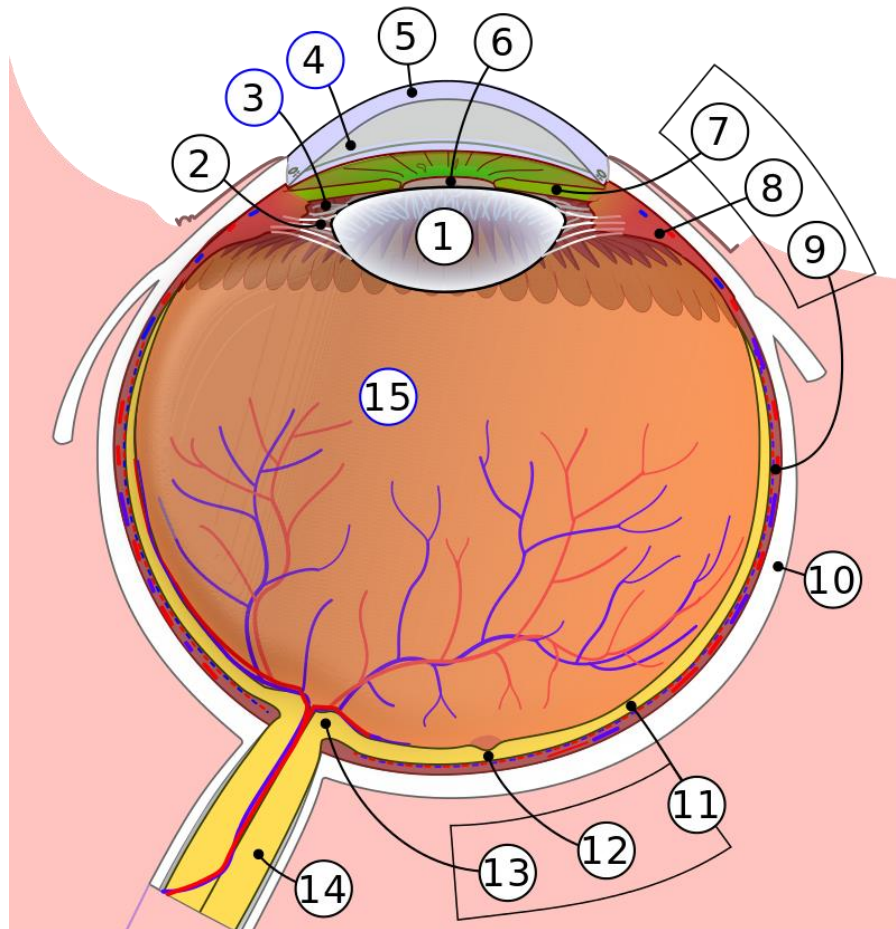


Figure 11.2: Credit: https://commons.wikimedia.org/wiki/Eye#/media/File:Schematic_diagram_of_the_human_eye.svg

1.	8.
2.	9.
3.	10.
4.	11.
5.	12.
6.	13.
7	14.

Pre-Lab Activity 11.4: Define Parts of the Ear

The ears are located bilaterally on the skull and each ear is divided into three regions: the external, the middle and the internal ear. The sensory receptors of the ear include hair cells which move in fluid based on vibrations from sound waves that are transmitted through air. The external ear captures sound waves and funnels them to the middle ear which conveys sound vibrations to the inner ear. The inner ear houses the hairs cells for the senses of hearing and equilibrium. Explore the major structures of the ear by defining key terms in the table below.

Structure	Definition
Auricle	
External Auditory Canal	
Tympanic Membrane	
Auditory Ossicles	
Bony labyrinth	
Endolymph	
Perilymph	

Vestibule	
Semicircular canal	
Cochlea	
Spiral Organ	
Round Window	
Oval Window	

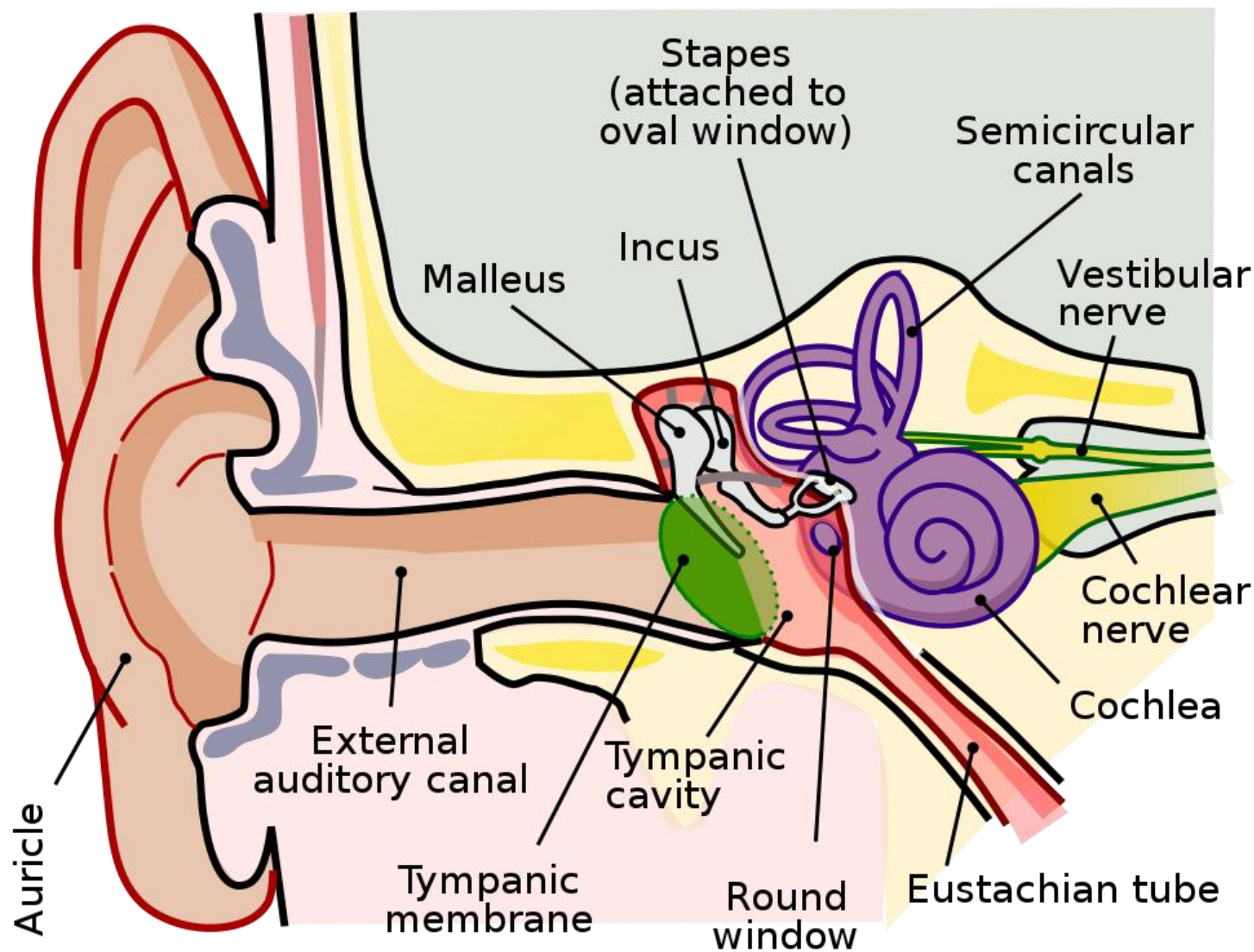


Figure 11.3: Credit:

<https://outlook.office.com/mail/inbox/id/AAQkAGYxNmUzMjEwLWU2NzltNGIxZS1hNTFhLTlhZmMyMjdKZjE2MgAQaIC6OI8vnk34pLakUIKaSig%3D>

Pre-Lab Activity 11.5: Taste

The tongue is a muscular structure located in the oral cavity and has most of the thousands of taste buds responsible for the perception of tastes. Gustatory receptors are located within in taste buds that are found in raised areas known as papillae. Taste receptors are stimulated by molecules dissolved in saliva are distinguished as salty, sour, sweet, bitter and umami.

Structure	Definition
Tongue	
Taste buds	
Gustation	
Vallate papillae	
Fungiform papillae	
Foliate papillae	
Filiform papillae	

Lab Activity 11.1: Visualizing Receptors of Touch

Tactile sensations are mediated through encapsulated mechanoreceptors that vary in abundance and location, across and within the skin. Tactile receptors are numerous and varied detecting touch, pressure, vibration, itch and tickle. **Meissner's corpuscles** are specific superficial receptors optimized for fine touch sensations, while **Pacinian corpuscles** are specific deep receptor located in the dermins and provides information about pressure.

Activity 11.1.1 Examine the Meissner's corpuscle slide

Using low or high-power magnification, identify several Meissner's corpuscles. Describe/draw them below.

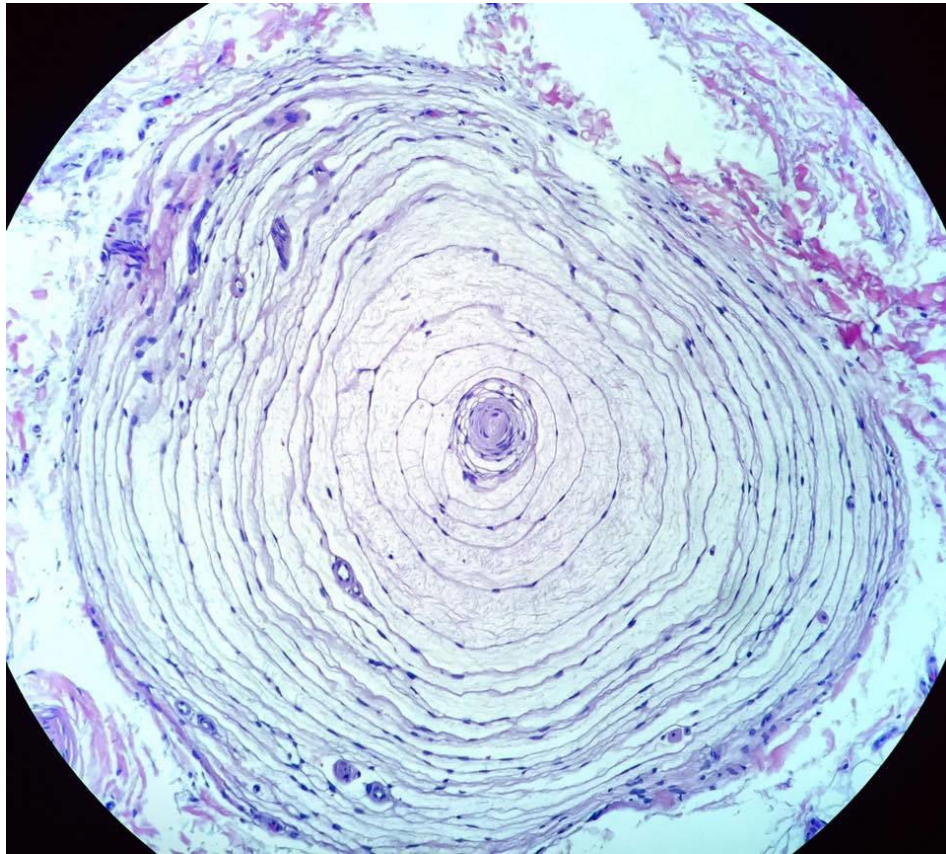
Activity 11.1.2: Examine the Pacinian corpuscle slide

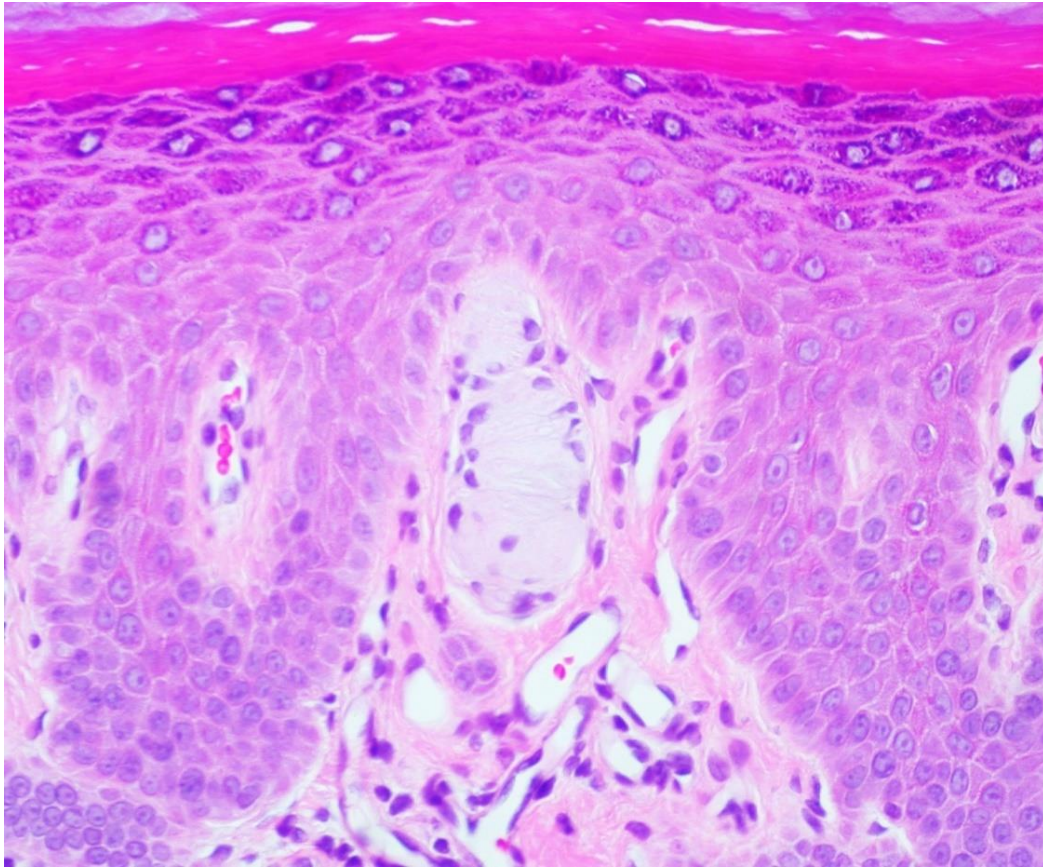
Using low or high-power magnification, identify several Pacinian corpuscles. Describe/draw them below.

Label the following images as either a:

Meissner corpuscle (credit: [https://commons.wikimedia.org/wiki/File:Meissners_Corpuscle_\(3384752409\).jpg](https://commons.wikimedia.org/wiki/File:Meissners_Corpuscle_(3384752409).jpg)) **or**

Pacinian corpuscle (credit: [https://commons.wikimedia.org/wiki/File:Pacinian_Corpuscle_\(36298105211\).jpg](https://commons.wikimedia.org/wiki/File:Pacinian_Corpuscle_(36298105211).jpg))





Lab Activity 11.2: Pig Eye Dissection

Important Safety Information:

Most of our dissection specimens were preserved in formalin, an aqueous colorless solution that is a suspected carcinogen. Normally, the formalin will be replaced with a nontoxic preservative that may cause mild skin irritation. There is no need for concern provided you follow the guidelines outlined here and wear proper protective equipment.

- 1) WEAR GLOVES when handling your preserved specimen, tray, tools, or soiled paper towels.
- 2) WEAR SAFETY GLASSES when actively dissecting.
- 3) REMOVE GLOVES when you are not working at the lab bench or handling your specimen.
- 4) ALWAYS KEEP YOUR SPECIMEN inside the dissection tray.
- 5) ALL ORGANIC MATERIAL (identifiable animal parts) should be placed in the orange biohazard bins.
- 6) IN THE EVENT OF CONTACT: DO NOT PANIC. Wash skin with soap and water; flush eyes with water. There is an eye-wash station at every sink in the lab. Also, please inform your instructor immediately.

1) Put on safety goggles and gloves

2) Obtain your dissecting tray and instruments

3) Obtain a preserved eye

1. Examine the external surface of the eye and note the presence of extraocular muscles which may look tan and fat that pads the posterior part of the eye in the orbit. Remove as much of the fat as you can using scissors; however, take care not to remove the optic nerve.
2. Find the **optic nerve**, a collection of nerve fibers that exit at the posterior surface of the eye.

3. Locate the white **sclera**, the tough external two-thirds of the eye, and the **conjunctiva**, a delicate membrane that covers the anterior surface of the eye and is attached near the edge of the cornea. The **cornea** is the anterior one-third of the eye and is transparent. The cornea is continuous with the sclera.
4. If possible identify the four **extraocular muscles** that appear as flat (tan) bands near the posterior part of the eye (6 in humans)
5. Using a sharp scalpel, make a small incision at the junction between the sclera and the cornea. Be aware that the **anterior chamber** of the eye is filled with fluid. Try not to apply too much pressure when making the cut.
6. Insert the scissors into the incision, then slowly and carefully cut all the way around the cornea. Drain the fluid and then examine the inside of the anterior part of the eye.
7. The **iris** can be seen just anterior to the lens and is pigmented. The **pupil** is the circular opening in the center of the iris. The iris will sometimes remain attached to the cornea during the dissection.
8. The **lens** is held into position by **suspensory ligaments** that attach the lens to the ciliary muscle. Examine the round outer margin of the eye. You will notice that just past a pleated looking structure is the dark **ciliary body**, responsible for altering the shape of the lens. Remove the lens and notice how hard it is. Is it clear or cloudy?
9. Examine the inside of the **posterior chamber** of the eye, identify the clear jellylike **vitreous humor** that fills the space between the lens and retina.
10. The **retina** is the white or peachy innermost layer with the choroid layer beneath.
11. The **choroid** layer is a dark, iridescent tissue in vertebrates due to a special structure called the **tapetum lucidum**. The tapetum lucidum, which is not present in the human eye, functions to reflect light back onto the retina and makes night vision possible.
12. Finally, identify the **optic disc** or the blind spot, the point at which the retina is attached to the back of the eye and where the axons of neurons from the eye exit forming the optic nerve.

Clean up procedure:

Dispose of all organic debris in the appropriate biohazard containers and clean the dissecting instruments and tray with soap and water before leaving the laboratory. Do not forget to wash your hands with water and soap, and to disinfect the table tops.

List some similarities between the human and the bovine /sheep eye.

What are the major differences between the human and the bovine/sheep eye?

Activity 11.3: Vision Testing

A common vision test involves using a Snellen Chart. It consists of letters of different sizes which are read at a distance of 20 ft. If the subject reads to the line that is marked "50," they are said to possess 20/50 vision in that eye, meaning that they can read at 20ft what a person with normal vision can read at 50ft. If you have 20/20 vision your eyes are normal. If you wear glasses you may have a refraction abnormality. You are

nearsighted or **myopic** if you can not see objects in the distance well and are considered farsighted or **hyperopic** if you can not see objects up close.

Procedure:

1. The subject should stand 20ft from the Snellen Chart and cover the right eye with a card or folded sheet of paper (DO NOT put pressure on the eye).
2. The subject should slowly read each line moving down the chart until they can no longer read the letters correctly (right eye should still be covered).
3. Record the number of the last line that was successfully read.
4. Repeat the procedure covering only the left eye.

What is your visual acuity for the right eye? Left eye?

Activity 11.4: Testing for Color Blindness

Color blindness is an inherited inability to distinguish between certain colors or to detect certain wavelengths of light. It is a sex-linked (X-linked) disorder, which means that males are more commonly impacted than females. The most familiar form is red-green color blindness, because the genes for those colors are located on the X chromosomes.

Procedure:

Locate the Color Vision Perception Kit and show the subject each of the 16 shape cards (NOT the scribble side). Record their results in the table below. If you see all the shapes correctly then you have normal color vision. The reverse side of each shape card demonstrates to normal sighted individuals, what it is like to be color blind.

Card	Actual Shape	Shape Seen by the Subject
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		

13.		
14.		
15.		
16.		

Is it easy to identify the shapes buried within the scribble card?

Examine the eight photo cards on the normal and then color blind side. Define **deutanopia**, **tritanopia** and **protanopia**. In the table below identify the type of colorblindness represented by each card.

Card	Represented form of Color Blindness
1. Rainbow	
2. Traffic light	
3. Forest	
4. Bird	
5. Hands	
6. Flowers	
7. Animal	
8. Fruit	

Activity 11.5: Label the Ear

1.	10.
2.	11.
3.	12.
4.	13.
5.	14.
6.	15.
7.	16.
8.	17.

9.

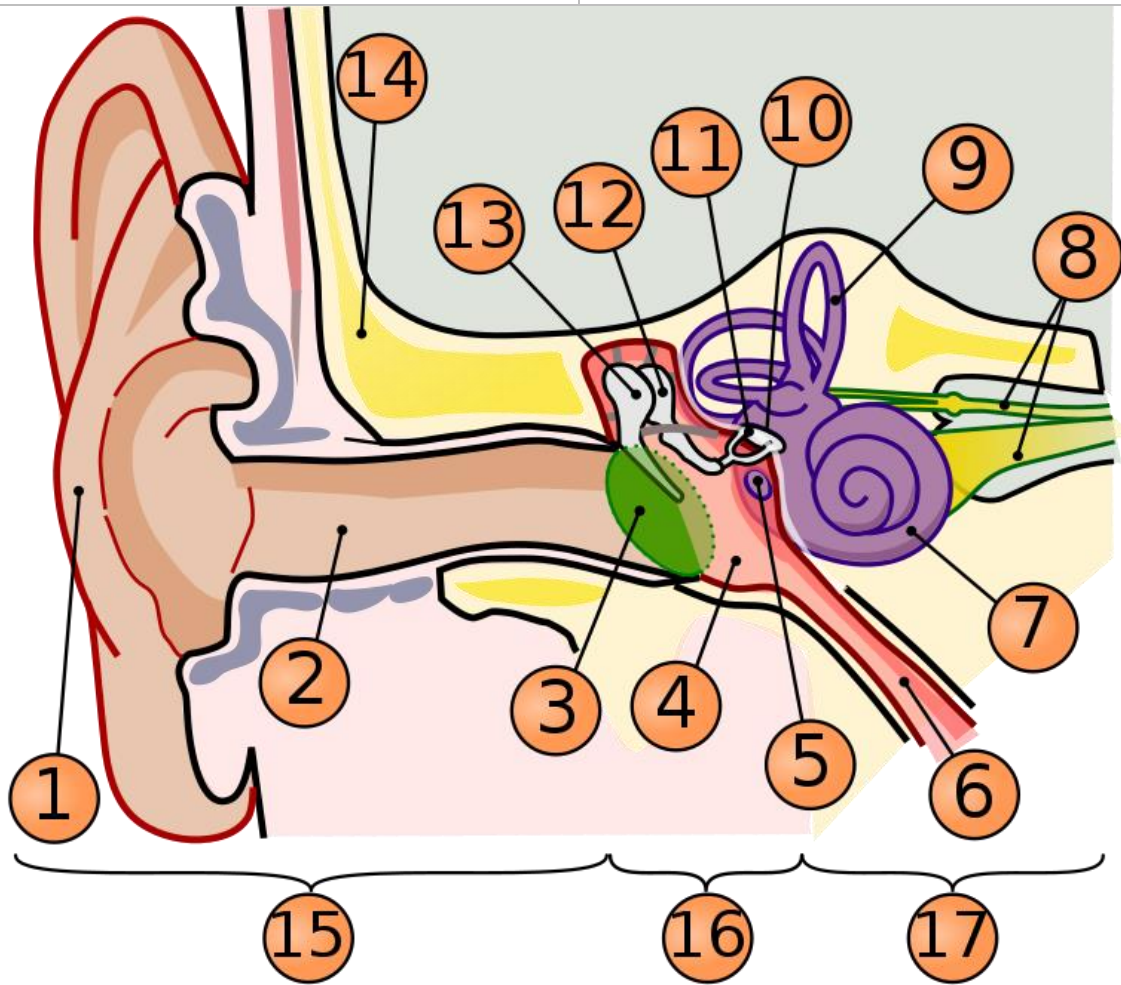


Figure 11.4: Credit - https://commons.wikimedia.org/w/index.php?search=human+ear&title=Special%3ASearch&profile=advanced&fulltext=1&advancedSearch-current=%7B%7D&ns0=1&ns6=1&ns12=1&ns14=1&ns100=1&ns106=1#/media/File:Anatomy_of_the_Human_Ear-Number.svg

Using the 3D ear models available in lab identify all the structures listed above.

What are the receptors of hearing and balance?

What cranial nerves transmit hearing and equilibrium information to the brain?

In which lobe(s) of the brain is this information processed?

Describe the path of sound conduction from the auditory auricle to the inner ear.

Activity 11.5: Label the Tongue

Using the photograph of the tongue below, circle in green where you would find vallate papillae, in red the fungiform papillae, in blue foliate papillae, and in yellow filiform papillae

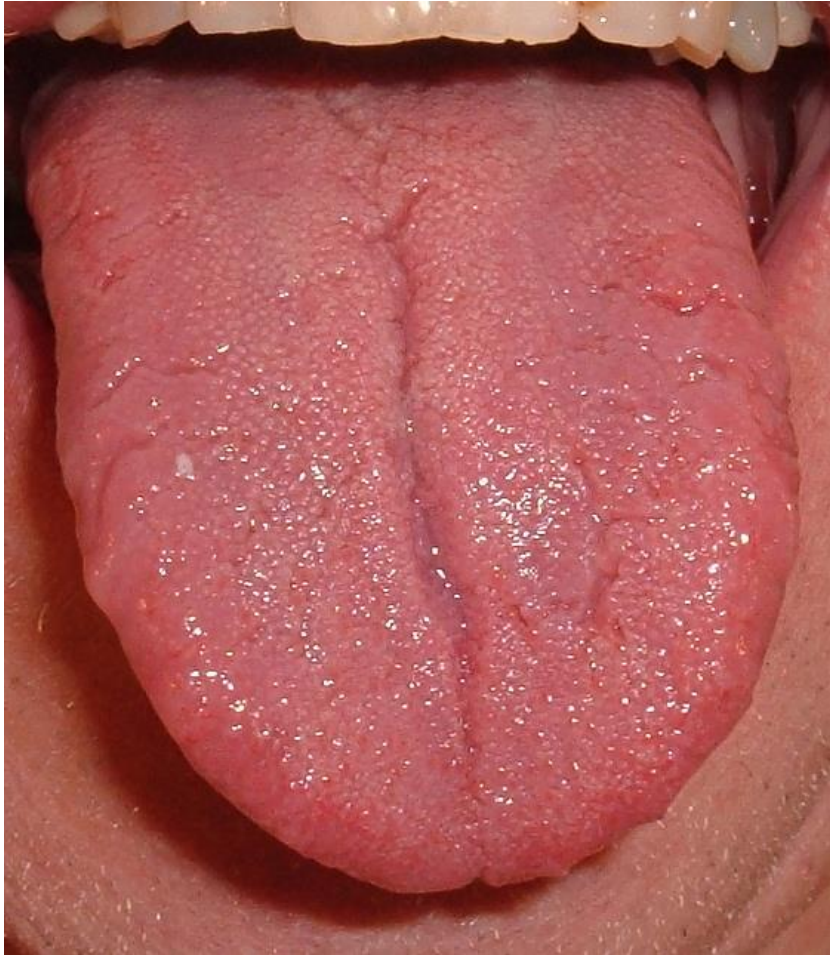


Figure 11.5: Credit: <https://upload.wikimedia.org/wikipedia/commons/a/a6/Tongue.agr.jpg>

Describe how a taste receptor cell transmit the chemical signal to the brain.

Which lobe of the brain processes information obtained from taste buds?

Which cranial nerves are associated with the taste?

Which cranial nerves are associated with tongue movement?