

PCC Laboratory Success Guide

Biology 232 Anatomy & Physiology

2025-2026

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Exercise 9: Brain & Cranial Nerves

By the end of today's lab, you should be able to

- ☐ Identify the three meningeal layers and state their functions.
- ☐ State the function of the arachnoid villi and dural sinuses.
- ☐ Discuss the formation, circulation, and drainage of cerebrospinal fluid.
- ☐ Identify the listed brain structures on models, specimens, diagrams, or microscope slides and describe the functions of each structure.
- ☐ Describe the composition of gray and white matter.
- ☐ Define gyri, fissures, and sulci.
- ☐ Identify the cranial nerves by name and number.
- ☐ Discuss the origin and function of each cranial nerve.

1. Identify the following meningeal structures

- Dura mater
 - Periosteal layer
 - Meningeal layer
 - Venous sinuses
 - Superior sagittal sinus
 - Inferior sagittal sinus
 - What do the venous sinuses drain into?
 - Dural folds
 - Falx cerebri
 - Tentorium cerebelli
 - Falx cerebelli
- Arachnoid mater
 - Subarachnoid space
- Pia mater

2. Identify the following structures of the central cavity

- Choroid plexus
- Lateral ventricles
- Interventricular foramina
- Third ventricle
- Cerebral aqueduct
- Fourth ventricle
- Arachnoid villi

3. Identify the following brain structures on models and dissections and describe their functions

- Brainstem
 - Medulla oblongata
 - Decussation of pyramids
 - Pons
 - Midbrain
 - Cerebral peduncles
 - Corpora quadrigemina
 - Superior colliculi
 - Inferior colliculi

- Diencephalon
 - Thalamus
 - Intermediate mass / interthalamic adhesion / middle commissure
 - Hypothalamus
 - Infundibulum
 - Pituitary gland
 - Mammillary bodies
 - Optic Chiasma
 - Epithalamus
 - Pineal gland
- Cerebellum
 - Vermis
 - Arbor Vitae
- Cerebrum
 - Longitudinal fissure
 - Transverse fissure
 - Gyrus
 - Sulcus
 - Central sulcus
 - White and gray matter
 - Cerebral cortex
 - Corpus callosum
 - Septum pellucidum
 - Basal nuclei
 - Hippocampus
 - Fornix
 - Lobes
 - Frontal lobe
 - Precentral gyrus
 - Parietal lobe
 - Postcentral gyrus
 - Occipital lobe
 - Temporal lobe
 - Insula lobe

4. Identify the following microscopic structures

- Cerebrum
 - Pyramidal cells

- Cerebellum
 - Purkinje cells

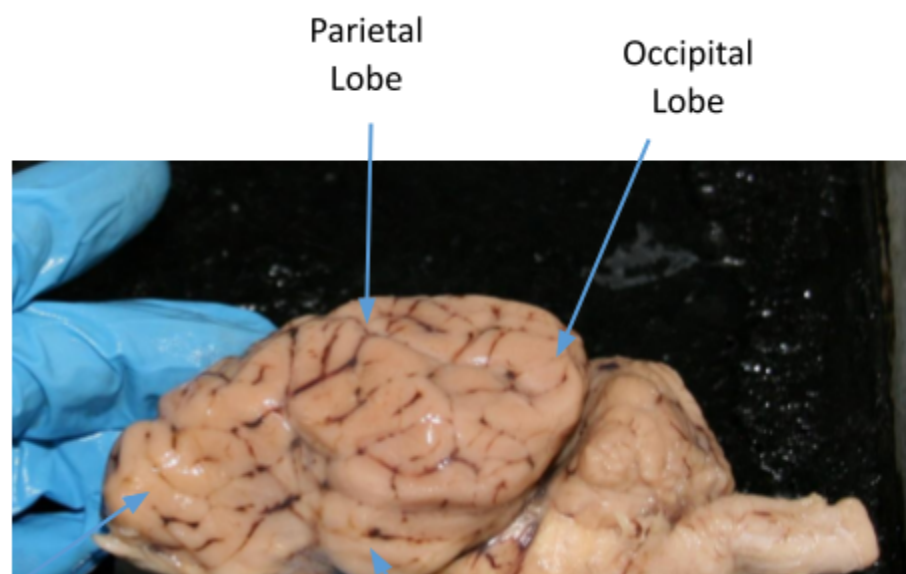
5. Identify the cranial nerves and know the information on the following chart

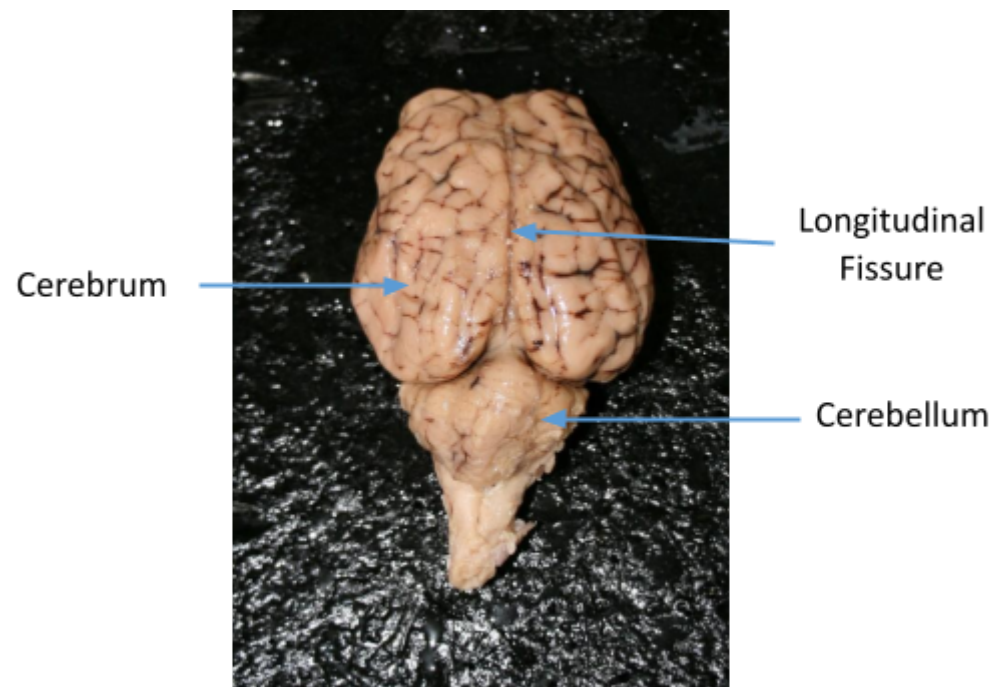
Name & Number	Sensory, Motor, or Mixed	Origin	Function
I: Olfactory	Sensory	Olfactory epithelium	Smell
II: Optic	Sensory	Retina	Vision
III: Oculomotor	Motor	Midbrain	Muscles of the eyeball (inferior rectus, inferior oblique, superior rectus & medial rectus). Focus lens of the eye. Parasympathetic: pupil constriction)
IV: Trochlear	Motor	Midbrain	Muscles of the eyeball (superior oblique)
V: Trigeminal Ophthalmic (V1) Maxillary (V2) Mandibular (V3)	Mixed	Pons, Face	Sensory: touch, temperature, pain on face Motor: muscles of the jaw
VI: Abducens	Motor	Pons	Muscles of the eyeball (lateral rectus)
VII: Facial Temporal Zygomatic Buccal Mandibular Cervical	Mixed	Taste buds, pons	Sensory: taste (anterior 2/3rds of tongue) Motor: facial muscles
VIII: Vestibulocochlear	Sensory	Inner ear	Hearing and equilibrium
IX: Glossopharyngeal	Mixed	Tongue, medulla	Sensory: tongue sensations, including taste buds (posterior 1/3 of tongue) Motor: Swallowing, salivary glands

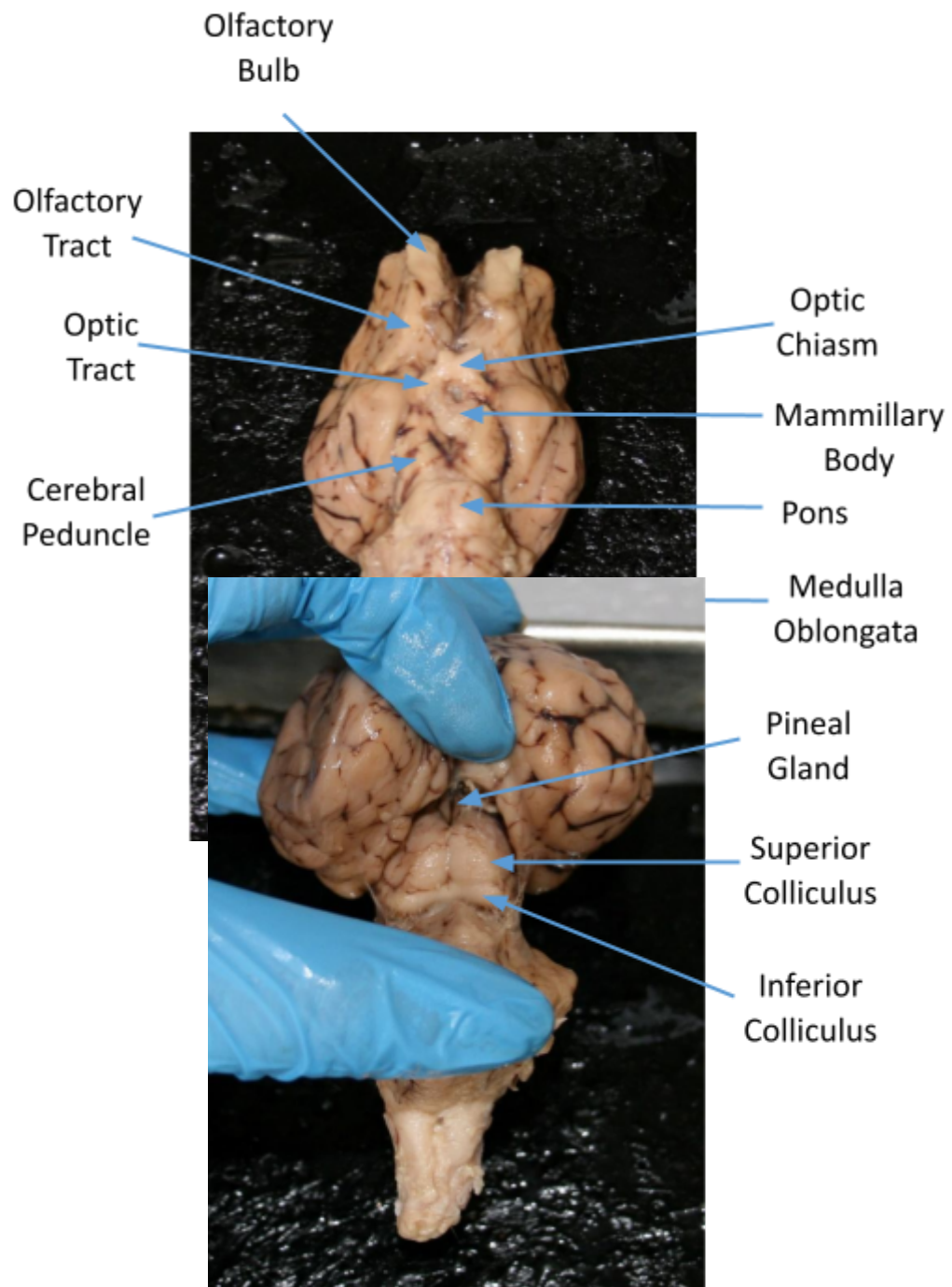
X: Vagus	Mixed	Medulla	Sensory: pharynx, internal viscera Motor: Parasympathetic (heart, lungs, digestive tract, viscera, etc)
XI: Accessory	Motor	Upper spinal cord	Sternocleidomastoid, upper trapezius, muscles of larynx, pharynx and soft palate
XII: Hypoglossal	Motor	Medulla	Motor control of tongue (speech, swallowing)

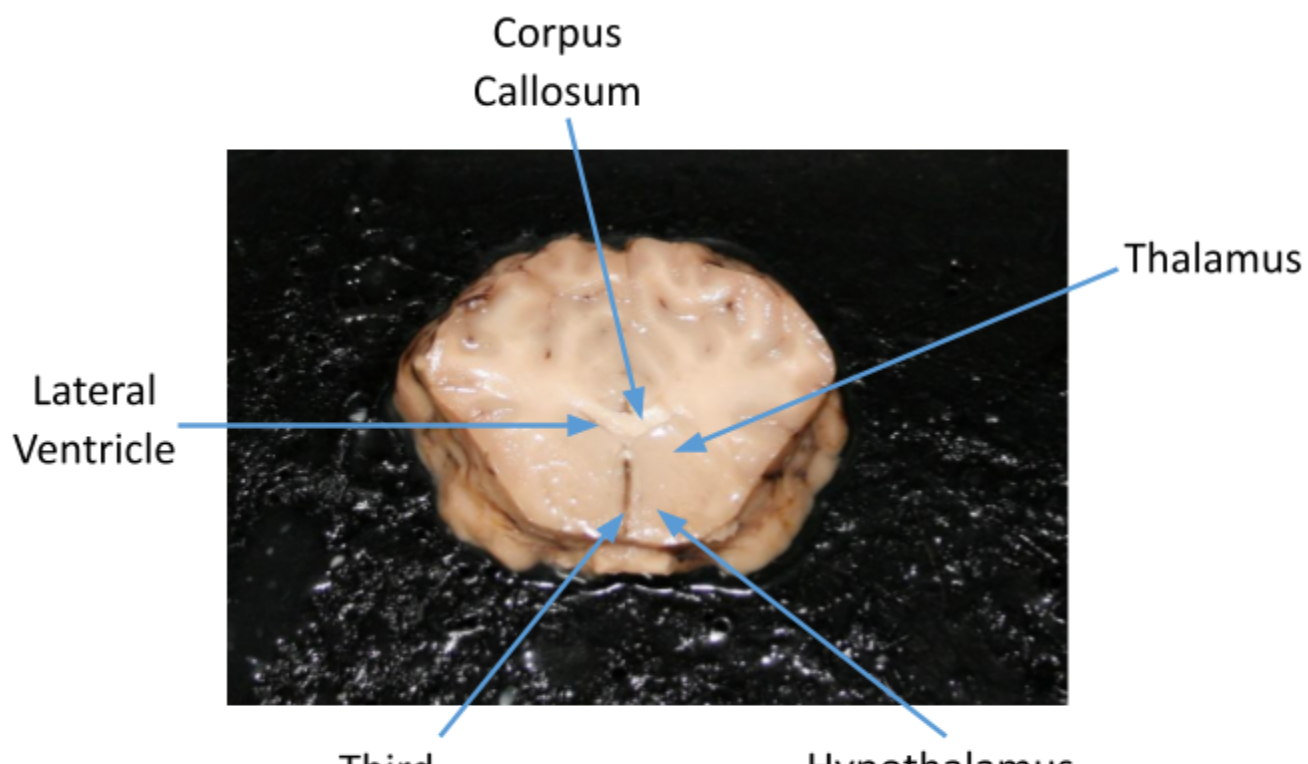
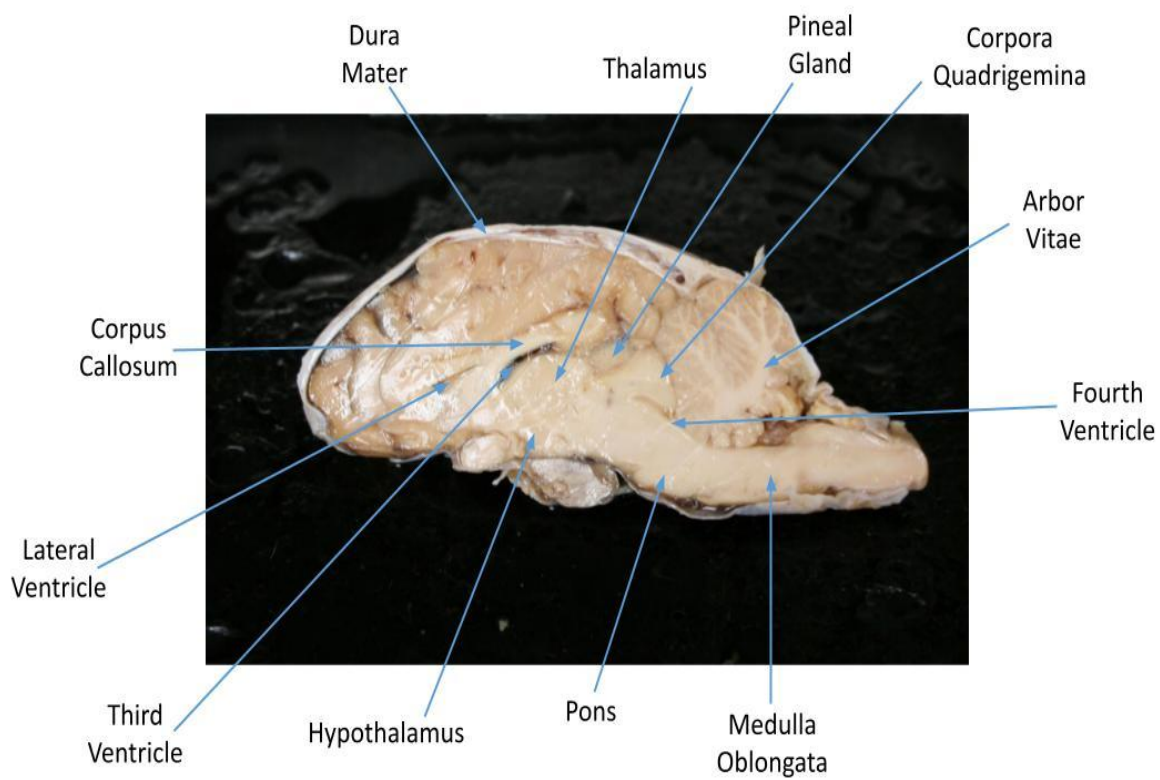
Sheep Brain Dissection Instructions

1. Lay the sheep brain on a dissecting tray.
2. Observe the dura mater if it is still intact.
3. Using sharp scissors, cut off the dura mater and peel away from the brain.
4. Observe the external brain structures: Gyri, sulci, longitudinal and transverse fissures, lobes of the cerebrum, brain stem, cerebellum, corpora quadrigemina, optic nerve, optic chiasm, optic tract, olfactory bulbs.
5. Using a knife, make a sagittal cut through the longitudinal fissure. Observe that you are slicing through the corpus callosum.
6. Identify internal brain structures in the sagittal view (diencephalon structures, brain stem structures, cerebellum structures, ventricular system structures).
7. Optional: Try holding the two halves together again and make a frontal cut to view the basal ganglia, corpus callosum, and ventricles (or view instructor demonstration).









Exercise 10: ANS, General Senses, Gustation, Olfaction

By the end of today's lab, you should be able to

- ☐ Describe the general functions of the sympathetic and parasympathetic divisions of the autonomic nervous system.
- ☐ Identify sympathetic nervous system structures on the spinal cord models or images and describe their functions.
- ☐ State the function and location of each type of general sensory receptor.
- ☐ Explain the tactile two-point discrimination test and state its anatomical basis.
- ☐ Describe how tactile localization varies in different areas of the body.
- ☐ Relate differences in relative density and distribution of tactile and thermoreceptors in the skin to their sensory adaptive properties.
- ☐ Identify the location of the olfactory epithelium and describe the cellular composition and function of the epithelium.
- ☐ Define olfactory adaptation.
- ☐ Describe the structure and location of the various types of lingual papillae.
- ☐ Name the five basic qualities of taste sensation and list the chemical substances that elicit them.
- ☐ Describe the location and function of the taste buds and taste bud structures.

Part I: Autonomic Nervous System

1. Know the function of each division of the autonomic nervous system
 - Sympathetic division
 - Parasympathetic division
2. Identify the following structures of the sympathetic nervous system and describe their functions
 - Sympathetic trunk
 - Sympathetic chain ganglia
 - White rami communicans
 - Gray rami communicans

Part II: General Sensation

3. Define the following terms and identify examples of each.
 - General senses
 - Special senses
 - Nociceptors
 - Thermoreceptor
 - Mechanoreceptors
 - Tactile receptors
 - Baroreceptors
 - Proprioceptors
4. Identify the following microscopic receptors histologically or with images and describe their functions
 - Free / naked dendritic nerve endings
 - Tactile / Merkel discs / Type I cutaneous mechanoreceptors
 - Hair root plexus / hair receptors
 - Encapsulated nerve endings
 - Tactile / Meissner's corpuscles
 - Lamellated / Pacinian corpuscles
 - Bulbous / Ruffini's corpuscles
 - Muscle spindles
 - Neurotendinous / Golgi tendon organs
 - Joint capsule receptors

5. Perform the following general sensation activities, with the expressed consent of your lab partner

- Two-point discrimination test
 - Supplies: calipers, ruler
 - Instructions
 - Work in groups of 2, assigning one student as the subject and one as the examiner.
 - Find a spot with least/no hair.
 - Using calipers with the arms completely together, touch the subject's skin, making sure that both points touch at the same time.
 - Gradually increase the distance between the caliper arms and repeat the touch test until two distinct points of contact can be felt.
 - Measure the distance in mm and record on the table below.

Area Tested	Student #1 Distance in mm	Student #2 Distance in mm
Palm of hand		
Fingertips		
Back of neck		
Ventral forearm		

- Answer the following questions related to this activity
 - Which area has the smallest distance for two-point discrimination? Which has the largest distance?
 - Explain why there is a difference.

- Testing tactile localization
 - Supplies: red felt-tipped marker, blue felt-tipped marker
 - Instructions
 - Work in groups of 2, assign one student to close their eyes.
 - The examiner should touch the area of the body indicated below with a blue marker.
 - With eyes still closed, the student should attempt to touch the same location with the red marker.
 - Complete two additional trials with each location, measuring the distance in mm between the colored dots.

Distance in mm

Area Tested	Attempt 1	Attempt 2	Attempt 3
Palm of Hand			
Fingertip			
Forearm			
Back of Hand			

- Answer the following questions related to this activity
 - Which area has the smallest error of localization? Why is this?
 - Does the ability to localize the stimulus improve with each subsequent attempt? Why or why not?

- **Adaptation of Temperature Receptors**

- Supplies: two bowls, one filled with 45° Celsius water, the other filled with ice and water.
- Instructions Part 1
 - Immerse left hand in 45° water and note the initial sensation.
 - After 1 minute immerse the right hand into the 45° water as well.
 - Answer the following questions
 - What is the sensation of the left hand after 1 minute compared to the initial sensation?
 - What is the sensation of the left hand after 1 minute compared to the sensation of the right hand?
 - Why is that?
- Instructions Part 2
 - Remove both hands and wait 5 minutes
 - Place the left hand in the ice bath and the right hand in the 45° bath.
 - Leave both hands in for 1 minute.
 - Answer the following questions
 - After 1 minute, what sensations are you detecting?
 - How is the sensation of the ice bath different from the warm water bath?
 - What information about temperature receptors does this give you?

Part III: Olfaction

6. Locate the following structures on models, images, and slides and know their functions

- Olfactory epithelium
 - Olfactory neuron (receptor cell)
 - Supporting cells
 - Basal cells
 - Olfactory / Bowman's gland
- Olfactory nerves
- Olfactory tract
- Olfactory bulb
- Cribriform plate with olfactory foramina

Part IV: Gustation

7. Locate the following structures on models, images and slides and know their functions

- Papillae
 - Circumvallate
 - Fungiform
 - Filiform
 - Foliate
- Taste buds
 - Taste pore
 - Gustatory receptor cells
 - Supporting cells
 - Gustatory hairs
- Stratified squamous epithelium

8. Describe the 5 primary tastants.

9. Complete the following activities for olfaction and gustation.

- Demonstrating Olfactory Adaptation
 - Supplies: Test tubes with various materials to smell, provided by lab staff (Notify instructor of any allergies to common materials).
 - Part 1: Identification
 - Hold each test tube to your nostril and see if you can identify the specific material. Check with your instructor's answer key.
 - Part 2: Olfactory adaptation
 - Press one nostril closed and hold one container under the open nostril.
 - Inhale through the nose while exhaling through the mouth.
 - Record the time for the odor to disappear.
 - Immediately test another scent with the same nostril.
 - Answer the following questions
 - What are the results of the adaptation test?
 - What conclusions can you draw?

- Stimulating Taste Buds (Optional in hallway or at home, no materials can be consumed in the lab classroom)
 - Supplies: Paper towels, sugar packet
 - Instructions:
 - Dry the surface of your tongue.
 - Sprinkle a few sugar crystals on your dried tongue and DO NOT close your mouth.
 - Record how long it takes to taste the sugar.
 - Answer the following questions
 - Why were you unable to taste the sugar immediately?

Exercise 11: Vision

By the end of today's lab, you should be able to

- ☐ Describe the structure and function of the accessory visual structures.
- ☐ Identify the structural components of the eye when provided with a model, diagram, preserved eye, or microscope slide and describe the function of each structure.
- ☐ Discuss the importance of the pupillary and convergence reflexes.
- ☐ Describe the cellular makeup of the retina.
- ☐ Discuss the mechanism of image formation on the retina.
- ☐ Define the following terms: refraction, accommodation, convergence, astigmatism, emmetropia, myopia, hyperopia, cataract, glaucoma, conjunctivitis.

1. Identify the following eye structures and describe their functions

- Accessory structures
 - Lacrimal apparatus
 - Lacrimal gland
 - Lacrimal punctum
 - Lacrimal ducts
 - Lacrimal canaliculi
 - Lacrimal sac
 - Nasolacrimal duct
 - Palpebra
 - Medial canthus / commissure
 - Lateral canthus / commissure
 - Caruncle
 - Conjunctiva
 - Palpebral conjunctiva
 - Ocular / Bulbar conjunctiva
 - Tarsal / Meibomian glands
- Fibrous tunic
 - Cornea
 - Sclera
 - Scleral venous sinus / Canal of Schlemm
- Vascular tunic / uvea
 - Iris
 - Circular muscles / pupillary constrictors
 - Radial muscles / pupillary dilators
 - Ciliary body
 - Ciliary processes
 - Suspensory ligaments
 - Ciliary muscle
 - Choroid
- Pupil
- Lens
- Neural tunic / retina
 - Ora serrata
 - Macula lutea
 - Fovea centralis
 - Optic disc
 - Retinal artery

■ Retinal vein

- Optic nerve
- Optic chiasm
- Anterior cavity / segment
 - Anterior chamber
 - Posterior chamber
 - Aqueous humor
- Posterior cavity / segment
 - Vitreous humor

2. Extrinsic Eye Muscles

- Identify the following muscles. For each, describe the movements they are responsible for and the name of the cranial nerve that innervates the muscle.

Muscle	Cranial Nerve	Movements
Superior oblique	Trochlear (IV)	Internal rotation, slight depression, abduction, torsion of eye
Superior rectus	Oculomotor (III)	Rotates eye superiorly
Lateral rectus	Abducens (VI)	Abducts eye
Medial rectus	Oculomotor (III)	Adducts eye
Inferior oblique	Oculomotor (III)	External rotation, slight elevation, abduction, torsion of eye
Inferior rectus	Oculomotor (III)	Rotates eye down

3. Intrinsic Eye Muscles of the Iris

- Which division of the ANS regulates pupil constriction?
- Name two things that cause the pupil to constrict.
- Which division of the ANS regulates pupil dilation?
- Name two things that cause the pupil to dilate.

4. Identify the following eye structures in a microscopic view

- Iris
- Lens
- Ciliary body
 - Ciliary processes
- Sclera
- Choroid
- Retina
 - Pigmented epithelium
 - Photoreceptors
 - Rods
 - Cones
 - Bipolar cells
 - Ganglion cells

5. Activities

- Demonstrating the Blind Spot
 - Hold the blind spot card (with a black x and a black circle) 18 inches from your right eye.
 - Use your other hand to cover your left eye.
 - Position the card so the X is directly in line with your right eye.
 - Move the card slowly toward your face, keeping your right eye focused on the X.
 - When the dot focuses on the blind spot, it will disappear.
 - What is the blind spot and why does the image disappear?
 - What is the location of the optic disc compared to the fovea centralis?
- Determining Near Point of Vision
 - Hold a straight pin at arm's length in front of one eye.
 - With the other eye closed, move the pin slowly towards your eye.
 - Stop when the image becomes distorted and measure the distance.
 - Repeat with the other eye.
 - What was the near point for the right eye?
 - What was the near point for the left eye?
- Testing for Astigmatism
 - Use the astigmatism chart in the lab to test for unequal curvature of the lens.
 - View the chart with one eye and then the other.

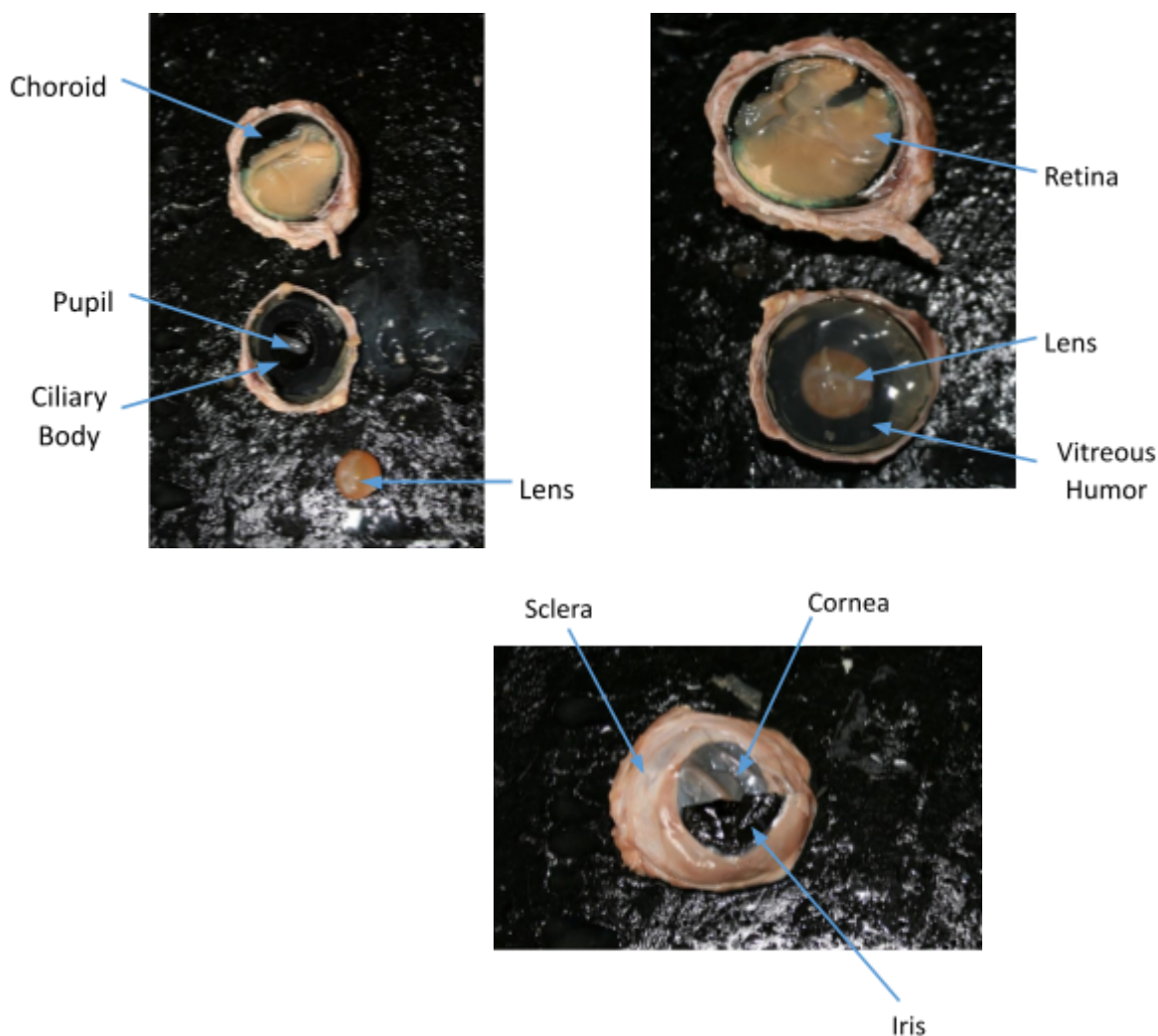
- If all radiating lines are equally dark, there is no astigmatism.
- If some of the lines are blurry or lighter in color compared to the others, then an astigmatism is present.
- Testing for Color Blindness
 - With your lab partner, look through the Ishihara color plates holding them 30 inches away.
 - Report what you see on each plate.
 - Check your accuracy with the answers provided.
- Testing Visual Acuity
 - Stand 20 feet away from a Snellen eye chart.
 - Covering one eye, read the smallest visible line and then switch eyes.
 - Interpreting the test
 - 20/20 is typical.
 - If the bottom number is larger than 20 (like 20/40), the person is myopic.
 - If the bottom number is smaller than 20 (like 20/15), the person has vision better than typical.

6. Define the following terms

- Refraction
- Focal Point
- Focal Distance
- Accommodation
- Convergence
- Emmetropia
- Myopia
- Hyperopia
- Presbyopia
- Astigmatism
- Cataracts
- Glaucoma
- Conjunctivitis

Eye Dissection Instructions

1. Cut away the fat and muscle.
2. Make the first incision where the sclera meets the cornea.
3. Cut until the aqueous humor is released.
4. Rotate the eye and cut around the cornea.
5. Once the cornea is removed, make a frontal cut creating front and back portions of the eye.
6. Beneath the cornea is the iris with the pupil passing through the iris.
7. On the posterior side of the iris, view the ciliary body and ora serrata.
8. The posterior portion of the eye is filled with the gelatinous vitreous humor
9. Remove the lens. It resembles a squished marble.
10. Identify the thin, brown membranous structure which is the retina.
11. Carefully move the retina around until you see its attachment point at the optic disc.
12. Underneath the retina is the choroid, which is blue-black. (The iridescent tapetum lucidum is not present in humans.)



Exercise 12: Hearing and Equilibrium

By the end of today's lab, you should be able to

- ☐ Identify the anatomical structures of the external, middle, and inner ear in models, images and slides, and explain their functions.
- ☐ Describe the anatomy of the spiral organ in the cochlea and explain its function in sound reception.
- ☐ Explain how an individual is able to localize the source of sounds.
- ☐ Describe the anatomy of the equilibrium apparatuses and explain their function in maintaining equilibrium.
- ☐ Describe the effects of acceleration on the semicircular canals and maculae.
- ☐ State the purpose of the Weber, Rinne, Barany, and Romberg test.
- ☐ Explain sensorineural deafness, conduction deafness, and nystagmus.

1. Identify the following ear structures (on models, images and slides) and describe their functions

- Outer ear
 - Pinna / auricle
 - External acoustic canal
 - Lobule
 - Tympanic membrane
- Middle ear
 - Ossicles
 - Malleus
 - Incus
 - Stapes
 - Auditory / eustachian tube
- Inner ear
 - Oval window
 - Round window
 - Bony labyrinth
 - Membranous labyrinth
 - Vestibulocochlear nerve (CN VIII)
 - Cochlear nerve branch
 - Vestibular nerve branch
 - Vestibular apparatus
 - Semicircular canals
 1. Semicircular ducts
 2. Ampullae
 3. Cristae ampullaris
 - a. Cupula
 - b. Hair cells
 - Vestibule
 1. Saccule
 - a. Macula
 - i. Otolithic membrane
 - ii. Otoliths
 - iii. Hair cells
 2. Utricle
 - a. Macula
 - i. Otolithic membrane
 - ii. Otoliths
 - iii. Hair cells

- Cochlea
 - Vestibular duct / scala vestibuli
 - Tympanic duct / scala tympani
 - Cochlear duct / scala media
 - Vestibular membrane
 - Basilar membrane
 - Spiral organ / organ of Corti
 1. Tectorial membrane
 2. Inner Hair cells
 3. Outer hair cells
- Which areas of the inner ear contain perilymph?
- Which areas of the inner ear contain endolymph?

2. Complete the following hearing and equilibrium activities

- Weber Test
 - Ring a 256 Hz or 512 Hz tuning fork and place on center of head.
 - Is the tone equally loud in both ears or louder in one?
 - What is this test evaluating?
- Rinne Test
 - Place a vibrating 512 Hz tuning fork on the mastoid process of the temporal bone on your lab partner.
 - When they can no longer hear the tone, move the tuning fork to the lateral side of the ear.
 - Repeat this again but start with the fork next to the ear and move to the mastoid process.
 - What is this test evaluating?

WEBER + RINNE TESTS			
	Weber without lateralization	Weber lateralizes left	Weber lateralizes right
Rinne both ears Air conduction (AC) > Bone conduction (BC)	Normal	Sensorineural loss in right	Sensorineural loss in left
Rinne left BC>AC		Conductive loss in left	Combined loss : conductive and sensorineural loss in left
Rinne right BC>AC		Combined loss : conductive and sensorineural loss in right	Conductive loss in right

- Barany's Test
 - Have your lab partner sit in a swivel chair with head tilted forward.
 - With the subject's eyes open, spin the chair 10 times.
 - Watch the subject's eyes once the chair stops rotating.
 - Describe the eye movement.
 - Define nystagmus.
 - What is this test evaluating?

- Romberg Test
 - Have your lab partner stand with their back to the wall, eyes open for one minute.
 - Watch for lateral swaying.
 - Do the test again but with eyes closed.
 - Watch for lateral swaying.
 - What is this test evaluating?

Exercise 13: Endocrine & Blood

By the end of today's lab, you should be able to on a model, image or histological slide

- ☐ Identify the major endocrine glands and tissues of the body.
- ☐ Describe the function of the hormones produced by each of the endocrine glands and their triggers for release.
- ☐ Describe the structural and functional relationship between the hypothalamus and pituitary.
- ☐ Identify the histological structure of the thyroid, parathyroid, pancreas, anterior pituitary, posterior pituitary, and adrenal glands.
- ☐ Identify the specialized hormone-secreting cells in the indicated tissues.
- ☐ Name the two major components of blood and state their average percentages in whole blood.
- ☐ Describe the composition and function of plasma.
- ☐ Define formed elements, list the cell types composing them, their functions, and their relative percentages in the blood.
- ☐ Identify erythrocytes, basophils, eosinophils, monocytes, lymphocytes, and neutrophils on a slide and state their function.
- ☐ Provide the typical values for a total white blood cell count, total red blood cell count, and hematocrit. State the importance of these tests.
- ☐ Describe the procedure for ABO and Rh blood typing and the importance of this blood test determination.
- ☐ Discuss the reason for transfusion reactions resulting from the administration of mismatched blood.
- ☐ Define anemia, polycythemia, leukopenia, leukocytosis, leukemia, thrombocytosis, and thrombocytopenia and their causes.

Part I: Endocrine System

1. Identify the following structures on models or images, the hormones they secrete, the target organ and the function of the hormones

- Hypothalamus
 - Releasing hormones
 - Corticotropin-releasing hormone (CRH)
 - Gonadotropin-releasing hormone (GnRH)
 - Thyrotropin-releasing hormone (TRH)
 - Growth hormone-releasing hormone (GHRH)
 - Prolactin-releasing hormone (PRLH) (hypothetical)
 - Inhibiting hormones
 - Somatostatin
 - Prolactin-inhibiting hormone (Dopamine)
- Anterior Pituitary
 - Adrenocorticotrophic hormone (ACTH)
 - Thyroid-stimulating hormone (TSH)
 - Growth hormone (GH)
 - Prolactin (PRL)
 - Follicle-stimulating hormone (FSH)
 - Luteinizing hormone (LH)
- Posterior Pituitary
 - Antidiuretic hormone (ADH)
 - Oxytocin (OT)
- Thyroid Gland
 - Thyroxine (T4)
 - Triiodothyronine (T3)
 - Calcitonin
- Parathyroid Glands
 - Parathyroid hormone (PTH)
- Thymus
 - Thymosin
 - Thymopoietin
- Pancreas
 - Insulin
 - Glucagon
- Adrenal Glands
 - Adrenal Medulla
 - Epinephrine

- Norepinephrine
- Adrenal Cortex
 - Glucocorticoids / Cortisol
 - Mineralocorticoids / Aldosterone
 - Gonadocorticoids / Androgens (primarily)
- Kidney
 - Calcitriol
 - Erythropoietin
- Pineal Gland
 - Melatonin

2. Identify the following microscopic structures and indicate what hormones they secrete

- Pituitary gland
 - Anterior pituitary / Adenohypophysis / pars distalis
 - Posterior pituitary / Neurohypophysis / pars nervosa
- Thyroid Gland
 - Follicles
 - Follicular cells
 - Colloid
 - Parafollicular / C- cells
- Parathyroid Gland
 - Chief cells
 - Oxyphil cells
- Adrenal Glands
 - Medulla
 - Cortex
 - Zona glomerulosa
 - Zona fasciculata
 - Zona reticularis
- Pancreas
 - Pancreatic islets / islets of Langerhans
 - Acinar cells

Part II: Blood

OR-OSHA Blood-borne Pathogens Standard

- Blood-borne pathogens include: HIV, Hepatitis B and C, Viruses, etc.

- Universal Precautions
 - Fluids: all human blood and other body fluids such as semen, vaginal secretions, CSF, saliva, and any other fluid contaminated with blood should be considered sources of blood-borne pathogens
 - Approach: treat all of the above fluids as if they contain blood-borne pathogens
- Protective Equipment
 - When to use: when known occupational exposure will occur. Employer or school needs to provide.
 - Disposable single-use gloves. Hypoallergenic, powderless, or liners to be supplied for those with allergies
- Housekeeping
 - Contaminated work surfaces: decontaminate with the appropriate disinfectant provided in lab
 - All lancets should be disposed of in the "sharps" container
 - All other materials that have contacted blood should be placed in an autoclave bag

1. Describe the components of blood

- Connective tissue
- Plasma
- Formed elements
 - Erythrocytes
 - Leukocytes
 - Platelets

2. Identify each microscopic structure and know functions and characteristics

- Erythrocytes
 - 4.5-5 million cells/mm³
- Platelets
 - 250,000-500,000 per mm³
- Neutrophils
 - Granulocyte
 - 40-70% of leukocytes
 - 3,000-7,000 cells/mm³
- Eosinophils
 - Granulocyte
 - 2-4% of leukocytes

- 100-400 cells/mm³
- Basophils
 - Granulocyte
 - < 1% of leukocytes
 - 20-50 cells/mm³
- Monocytes
 - Agranulocyte
 - 3-8% of leukocytes
 - 100-700 cells/mm³
- Lymphocytes
 - Agranulocyte
 - 25-45% of leukocytes
 - 1500-3000 cells/mm³

3. Answer the following questions about blood

	Estrogen-dominant individuals	Testosterone-dominant individuals
Typical hemoglobin concentration	12-16 g/dL	13-18 g/dL
Typical hematocrit (packed cell volume)	37-48%	45-52%

- What causes the typical sex difference regarding hemoglobin concentration and hematocrit?

4. Blood Typing Activity

- Place a blood typing plate on a paper towel.
- Be seated when lancing and drawing blood.
- Sterilize lancing area with alcohol wipe.
- Place 1-2 drops of blood in each of the wells.
- Place 1-2 drops of sera in each of the appropriate wells.
- Mix each well with a different toothpick to avoid cross-contamination.
 - Sera-A contains anti-A antibodies. When blood with type A antigens is placed in this serum it clumps.
 - Sera B contains anti-B antibodies. When blood with type B antigens is placed in this serum it clumps.
 - If neither A or B cause clumping, the blood is type O.

- If both A and B cause clumping, the blood is type AB.
- Sera Rh contains anti-Rh antibodies. When blood with Rh antigens is placed in this serum it clumps. This indicates Rh+ blood.

5. Blood Transfusions

- Only erythrocytes are donated during a blood transfusion.
- If an incompatible blood is given, the recipient's antibodies can attack the new erythrocytes.
- Know for each blood type (A, B, AB, O)
 - RBC antigens present
 - Serum antibodies produced upon exposure
 - Blood types that it can receive
 - Blood types to which it can donate
- Rh factor is inherited independently of the ABO blood group.

6. Answer the following questions about blood types

- Which blood type (ABO and Rh) is a universal donor? Why?
- Which blood type (ABO and Rh) is a universal recipient? Why?

7. Define the following hematologic terms, and know the causes (if appropriate)

- Total White Blood Cell Count
 - Leukocytosis
 - Leukopenia
 - Leukemia
- Differential White Blood Cell Count
- Total Red Blood Cell Count
 - Polycythemia
 - Anemia
- Buffy Coat
- Thrombocytosis
- Thrombocytopenia
- Sickle Cell Anemia
 - Identify on slides if present in lab

Exercise 14: The Heart

By the end of today's lab, you should be able to

- ☐ Describe the location of the heart.
- ☐ Locate the major anatomical areas and structures of the heart in models or images and dissections and describe their functions.
- ☐ Explain the function of the major anatomical areas and structures as they relate to the pathway of blood through the heart.
- ☐ Explain the operation of the atrioventricular and semilunar valves.
- ☐ Identify the major blood vessels supplying the myocardium.
- ☐ Describe the histology of cardiac muscle, including the importance of intercalated discs and the spiral arrangement of its cells.
- ☐ Describe how the cardiac conduction system initiates impulses and conducts them throughout the myocardium, as well as how this relates to the contraction cycle.
- ☐ Interpret ECGs in terms of depolarization and repolarization events occurring in the myocardium with regards to the P, QRS, and T waves.
- ☐ Define tachycardia, bradycardia, and fibrillation.

Part I: Heart Anatomy

1. Identify the heart structures and describe their functions

- Heart wall layers
 - Epicardium / visceral pericardium
 - Myocardium
 - Endocardium
- Apex
- Base
- Chambers
 - Right and left atria
 - Auricles
 - Pectinate muscles
 - Opening of coronary sinus in right atrium
 - Right and left ventricles
 - Papillary muscles
 - Trabeculae carneae
- Interventricular septum
- Superior vena cava
- Inferior vena cava
- Pulmonary trunk
 - Right pulmonary artery
 - Left pulmonary artery
- Right pulmonary veins
- Left pulmonary veins
- Aortic arch
- Chordae tendineae
- Valves
 - Pulmonary semilunar valve
 - Aortic semilunar valve
 - Right Atrioventricular (AV) / tricuspid valve
 - Left Atrioventricular (AV) valve / bicuspid / mitral valve
- Fetal remnants
 - Fossa ovalis (foramen ovale during fetal development)
 - Ligamentum arteriosum (ductus arteriosus during fetal development)
- Coronary arteries
 - Left coronary artery
 - Anterior interventricular / left anterior descending artery
 - Circumflex artery
 - Right coronary artery

- Posterior interventricular artery
 - Marginal artery
- Cardiac veins
 - Great cardiac vein
 - Coronary sinus
 - Middle cardiac vein
 - Small cardiac vein

2. Identify the following cardiac histology and describe functions

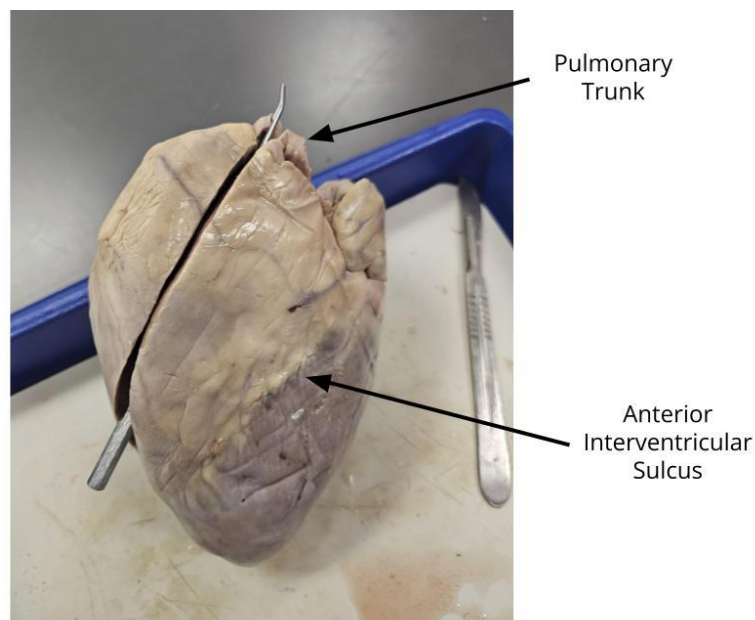
- Cardiac muscle cells
 - Intercalated discs

3. Dissect a heart specimen using the instructions below and identify the following structures

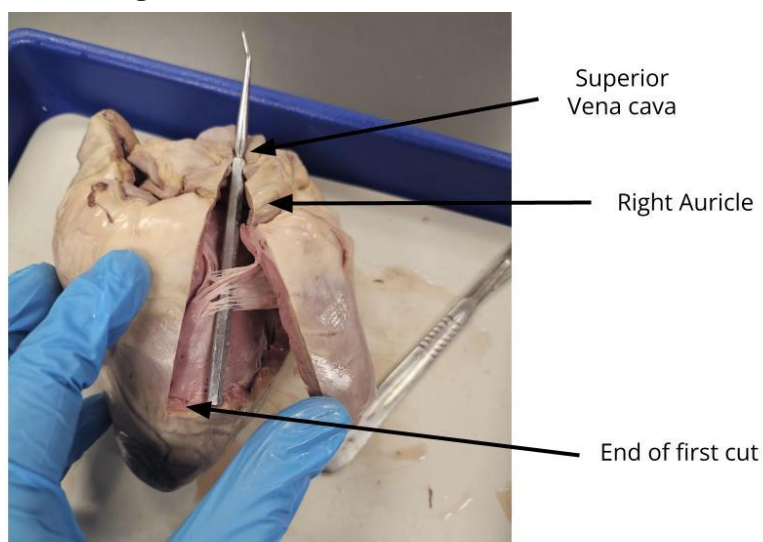
- Epicardium / visceral pericardium (shiny layer over the surface of the heart)
- Aorta
- Pulmonary trunk
- Superior vena cava
- Inferior vena cava
- Left and right auricles
- Left and right atria
- Left and right ventricles
- Left atrioventricular valve / Bicuspid valve
- Right atrioventricular valve / Tricuspid valve
- Aortic semilunar valve
- Pulmonary semilunar valve
- Chordae tendineae
- Papillary muscles
- Trabeculae carne
- Pectinate muscles
- Endocardium
- Myocardium
- Interventricular septum

Heart Dissection Instructions

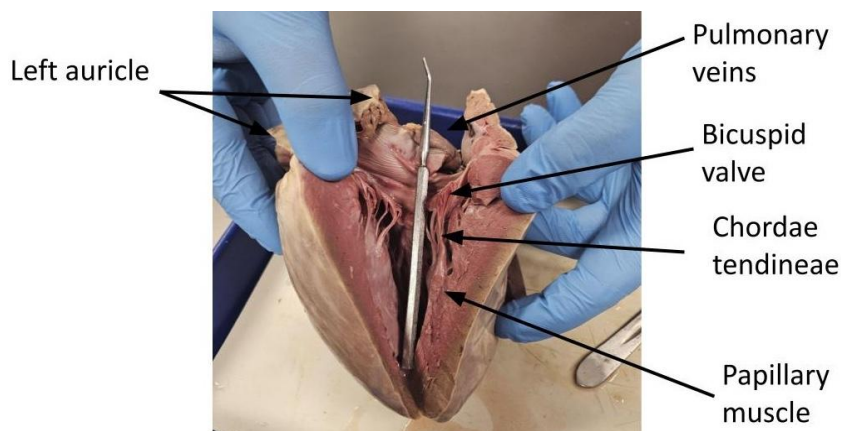
1. Before cutting, identify the posterior, anterior, apex, and base of the heart, and identify external structures (visceral pericardium, pulmonary trunk, superior and inferior vena cava, and auricles)
2. With the blunt end of a blunt probe, insert it down the pulmonary trunk, being careful not to push through the pulmonary semilunar valve (it is easier to open the valve using your finger before inserting the probe). Push the probe down toward the apex as far as possible, running parallel to the anterior interventricular sulcus. The wall is thin enough that you will be able to feel the end of the probe (in a pig heart, the entire probe will be inside the heart), and it is important to get the probe as near as possible to the apex; you want a long cut. You may open it a bit by opening the cut and using your scalpel to extend the cut, being careful not to cut into the interventricular septum.
3. Using the probe as a guide, make a straight cut through the wall of the pulmonary trunk and the right ventricular wall. See image below.



4. Now run the probe through the superior vena cava, you will be able to see the probe coming into the right ventricle in the first cut. Move the probe as far toward the apex as you can so that it is at the bottom of the first cut. Again, using the probe as a guide, make a straight cut along the probe so that the second cut joins the first at the apex, forming a triangular flap.
5. At this point, you will be able to see the internal structures of the right side of the heart (pectinate muscles, opening of the coronary sinus, tricuspid valve, chordae tendineae, papillary muscles, pulmonary semilunar valve, moderator band, trabeculae carne). See image below.

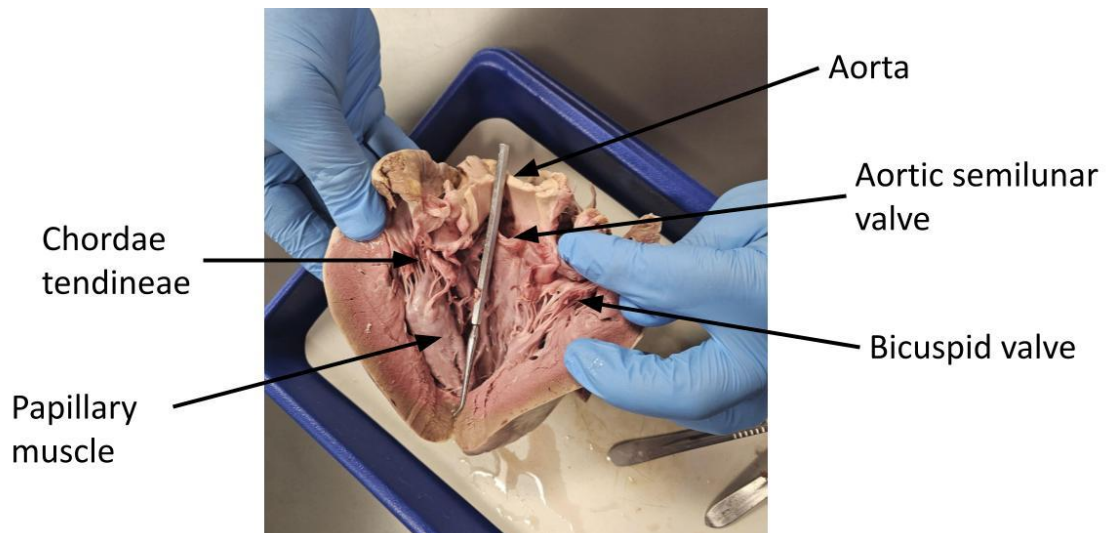
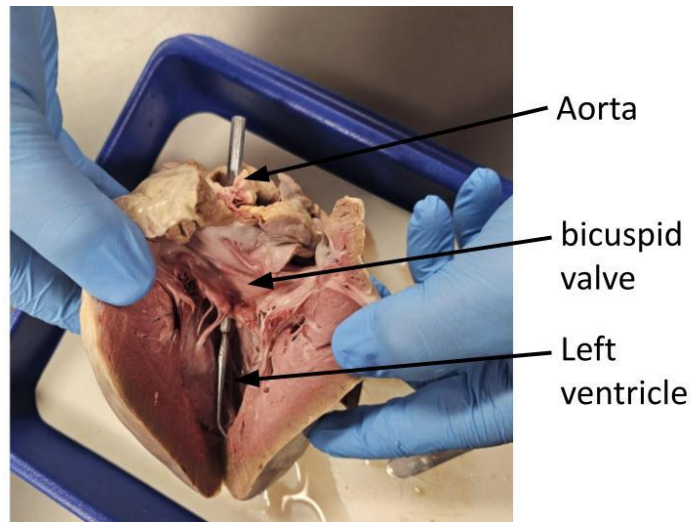


6. Now, put the probe into the pulmonary veins and extend it as deep as possible. The left wall is thick enough that you will not be able to feel the probe through the wall. Here, use the angle of the probe to determine the direction to guide your cut. This cut will go through the bicuspid valve and to the apex end of the ventricle, exposing the Bicuspid valve, chordae tendineae, and papillary muscle. See image below.



7. For the last cut, place the probe down the aorta, working through the aortic semilunar valve; you will see the probe enter the ventricle. Then just cut through

and you have access to all chambers and internal structures. See the images below. The first image shows the setup for the last cut. The second image shows the completed cut.



Part II: Cardiac Conduction

4. Identify and know the functions of the following structures

- Sinoatrial (SA) node
- Atrioventricular (AV) node
- Atrioventricular (AV) bundle / Bundle of His
- Right and left bundle branches
- Subendocardial branches / Purkinje fibers

5. Electrocardiogram (ECG)

- Follow the instructions given in lab to perform an ECG.
- Label each area on an ECG trace and know what they represent.
 - P wave
 - What is the typical duration and amplitude?
 - What would cause abnormalities in a P wave?
 - QRS complex
 - Q wave
 - R wave
 - S wave
 - T wave

6. Define the following terms

- Normal sinus rhythm
- Tachycardia
- Bradycardia
- ST elevation

Exercise 15: Blood Vessels

By the end of today's lab, you should be able to

- ☐ Describe the tunics of blood vessel walls and their functions.
- ☐ Identify a cross-sectional view of an artery and a vein on slides.
- ☐ Identify major arteries arising from the aorta and identify the body regions they supply.
- ☐ Identify the major veins draining into the superior and inferior vena cavae and indicate the body regions they drain.
- ☐ Describe the unique features of special circulations: hepatic portal system, cerebral arterial circle, pulmonary circulation, and fetal circulation.
- ☐ Trace the blood flow between regions/organs and the heart.

1. Identify the following structures on models, diagrams, and slides and describe their functions

- Blood vessel layers
 - Tunica interna / tunica intima
 - Endothelium: simple squamous epithelium
 - Basal lamina
 - Internal elastic membrane
 - Tunica media
 - Smooth muscle
 - Elastic fibers
 - Tunica externa
 - Areolar connective tissue
- Elastic artery
- Muscular artery
- Vein
- Vasa vasorum
- Capillary

2. Identify each artery below. Trace the pathway from the heart and know which area of the body it supplies.

- Ascending aorta
 - R. coronary artery
 - L. coronary artery
- Aortic arch
 - Brachiocephalic trunk
 - R. subclavian artery
 - Anterior intercostal arteries
 - R. vertebral artery
 - R. axillary artery
 - R. subscapular artery
 - R. brachial artery
 - R. radial artery
 - R. ulnar artery
 - R. common carotid artery
 - R. external carotid artery
 - R. superficial temporal artery
 - R. internal carotid artery
 - L. common carotid artery
 - L. external carotid artery

- L. Superficial temporal artery
 - L. internal carotid artery
 - L. subclavian artery
 - L. vertebral artery
 - L. axillary artery
 - L. subscapular artery
 - L. brachial artery
 - L. radial artery
 - L. ulnar artery
- Descending thoracic aorta
 - Posterior intercostal arteries (L & R)
- Abdominal aorta
 - Celiac trunk
 - Common hepatic artery
 - L. gastric artery
 - Splenic artery
 - Superior mesenteric artery
 - Renal arteries (L & R)
 - Gonadal arteries / testicular or ovarian arteries (L & R)
 - Inferior mesenteric artery
 - Common iliac arteries (L & R)
 - External iliac arteries (L & R)
 - Internal iliac arteries (L & R)
- Lower limb branches
 - External iliac arteries (L & R)
 - Femoral arteries (L & R)
 - Deep femoral arteries (L & R)
 - Popliteal arteries (L & R)
 - Anterior tibial arteries (L & R)
 - Dorsalis pedis arteries (L & R)
 - Posterior tibial arteries (L & R)
 - Fibular arteries (L & R)
- Blood supply to the brain
 - Basilar artery
 - Vertebral arteries (L & R)
 - Cerebral arterial circle / circle of Willis
 - Internal carotid arteries (L & R)
 - Anterior cerebral artery (L & R)
 - Anterior communicating artery

- Middle cerebral arteries (L & R)
- Posterior cerebral arteries (L & R)
- Posterior communicating arteries (L & R)

3. Identify each vein below. Trace the pathway towards the heart, and know which area of the body it drains.

- Head, Neck, and Brain
 - Superior sagittal sinus
 - Internal jugular veins (L & R)
 - External jugular veins (L & R)
 - Vertebral veins (L & R)
- Superior Vena Cava
 - Brachiocephalic veins (L & R)
 - Internal jugular veins (L & R)
 - Subclavian veins (L & R)
 - Cephalic veins (L & R)
 - Median cubital veins (L & R)
 - Axillary veins (L & R)
 - Basilic veins (L & R)
 - Brachial veins (L & R)
 - Radial veins (L & R)
 - Ulnar veins (L & R)
 - External jugular veins (L & R)
 - Vertebral veins (L & R)
 - Azygos vein
 - Posterior intercostal veins (R)
 - Hemiazygos vein
 - Posterior intercostal veins (L)
- Inferior Vena Cava
 - Hepatic veins (L & R)
 - Renal veins (L & R)
 - Common iliac veins (L & R)
 - External iliac veins (L & R)
 - Internal iliac veins (L & R)
 - Lumbar veins (L & R)
 - Gonadal veins (L & R)
- Lower Limb Branches
 - External iliac veins (L & R)
 - Femoral veins (L & R)

- Deep femoral veins (L & R)
- Great saphenous veins (L & R)
- Popliteal veins (L & R)
 - Small saphenous veins (L & R)
 - Posterior tibial veins (L & R)
 - Fibular veins (L & R)
 - Anterior tibial veins (L & R)
 - Dorsalis pedis veins (L & R)
- Hepatic Portal System
 - Hepatic portal vein
 - Inferior mesenteric vein
 - Splenic vein
 - Superior mesenteric vein
 - Gastric veins

4. Identify each vessel and describe the path of fetal circulation

- Umbilical vein
- Umbilical arteries
- Ductus venosus
- Foramen ovale
- Ductus arteriosus

Exercise 16: Blood Pressure & Lymphatic

By the end of today's lab, you should be able to

- ☐ Define systole, diastole, cardiac cycle, pulse, pulse pressure, blood pressure, and sounds of Korotkoff.
- ☐ Determine a subject's apical and radial pulse using palpation.
- ☐ Relate heart sounds to cycle events.
- ☐ Describe the clinical significance of heart sounds and heart murmurs.
- ☐ State thoracic locations where the first and second heart sounds are most accurately auscultated.
- ☐ Determine a subject's blood pressure with a sphygmomanometer relating the systolic and diastolic pressures to events of the cardiac cycle.
- ☐ Relate the function of the lymphatic system to that of the blood vascular system and the leukocytes.
- ☐ Describe the formation and composition of lymph and how it is transported through lymphatic vessels.
- ☐ Trace the flow of lymph through lymphatic vessels back into the bloodstream.
- ☐ Identify lymph node, spleen, thymus, and tonsil structures on models and slides and describe their functions.
- ☐ Identify the cells of the lymphatic system and state their functions.
- ☐ List the 3 primary functions of the lymphatic system

Part I: Blood Pressure

1. Define the following terms

- Cardiac Cycle
- Systole
- Diastole
- Dicrotic notch
- S1 (lubb)
- S2 (dub)
- Pulse pressure

2. Identify and palpate the following arteries to feel pulsations

- Carotid
- Radial
- Brachial
- Dorsalis pedis
- Posterior tibial

3. Blood pressure activity

- Supplies: sphygmomanometer (blood pressure cuff), stethoscope, alcohol wipes
- Working in pairs, clean the earpieces of the stethoscope and have the subject sit comfortably in a chair.
- Wrap the cuff around the upper arm just above the elbow.
- Place the stethoscope over the brachial pulse point.
- Inflate the cuff to approximately 160mmHg and slowly release the pressure valve.
- Watch the pressure gauge while listening, note the pressure when you first hear the soft thudding sounds of blood moving through the artery.
- When you can no longer hear those sounds, note the pressure.
- Make two trials of blood pressure and record the results.
 - Trial 1
 - Systolic:
 - Diastolic:
 - Trial 2
 - Systolic:
 - Diastolic:
- Answer the following questions

- What is a typical healthy blood pressure?
- What is hypertension?
- What would be a blood pressure that is considered pre-hypertension?
- What is hypotension?
- What is the pulse pressure for the blood pressures you took above?

4. Give the diagnosis for the consistent blood pressure measurements below; assume the person is otherwise healthy.

- 118/70
- 140/60
- 150/100
- 80/40

Part II: Lymphatic System

5. Identify the following on models

- Thymus
- Spleen
- Lymph nodes
 - Cervical
 - Axillary
 - Abdominal/Mesenteric
 - Inguinal
- Tonsils
 - Palatine
 - Pharyngeal
 - Lingual
- Lymphatic vessels
 - Valves
- Thoracic duct
- Right lymphatic duct
- Cisterna chyli
- Appendix

6. Identify the following microscopic structures

- Spleen
 - Red pulp
 - White pulp
- Lymph Node
 - Capsule
 - Cortex
 - Lymphoid follicle / lymphoid nodule
 - Germinal center
 - Cortex
 - Medulla
 - Medullary sinuses
 - Efferent vessel
 - Afferent vessel
- Thymus
 - Cortex
 - Medulla
 - Thymic / Hassall's corpuscles
- Tonsil
 - Crypt
 - Lymphoid follicle / lymphoid nodule