ACTIVITY

7

NERVOUS SYSTEM HISTOLOGY, BRAIN, CRANIAL NERVES

OBJECTIVES

- ❒ **How to get ready:** Read CHAPTERS 14 & 15 MCKINLEY ET AL., *HUMAN ANATOMY*, 5E. All text references are for this textbook. **Read dissection instructions BEFORE you come to class.**
- ❒ Histology: Identify structures indicated on three different slides or images of nervous system tissue. Some of these structures are also visible on the classroom model of a neuron.
- ❒ Human brain: Identify listed structures of the human brain on classroom models, the cranial meninges, and structures involved in cerebrospinal fluid circulation.
- ❒ Human brain: Identify the 12 pairs of cranial nerves **by name and number** on a model and on the sheep brain.
- ❒ Dissect a sheep brain and identify structures listed. **YOU MUST BRING YOUR OWN GLOVES FOR THIS ACTIVITY.**
- ❒ **Before next class:** Preview Peripheral Nervous System, Eye, and Ear terms lists from SLCC Anatomy Laboratory website or your printed laboratory manual and your textbook.

NERVOUS SYSTEM TISSUES: HISTOLOGY SLIDES

TABLE 7-1. Spinal cord smear and neuron model

STRUCTURE	TEXT REFERENCES AND SKETCH
▫ multipolar neuron	**DESCRIBED: PP. 414–418, 421** **FIG. 14.3**
▫ cell body (soma)	
▫ nucleus	
▫ chromatophilic substance (or Nissl bodies)	
▫ dendrites	
▫ axon hillock	
▫ axon	
▫ axon telodendria	
▫ axon terminals/synaptic knobs/synaptic bulbs	
▫ glial cell	

TABLE 7-2. Cross section of a nerve

STRUCTURE	TEXT REFERENCES AND SKETCH
▫ nerve	**DESCRIBED: PP. 424–425** **FIG. 14.12A & B**
▫ axon (with myelin sheath)	
▫ endoneurium	
▫ fascicle	
▫ perineurium	
▫ epineurium	

TABLE 7-3. Teased myelinated nerve fibers

STRUCTURE	TEXT REFERENCES AND SKETCH
▫ axon	**DESCRIBED: PP. 414; 421–422** **FIG. 14.12C**
▫ myelin sheath	
▫ neurofibril nodes	
▫ neurolemmocyte (*or* Schwann cell) nucleus	

Brain Anatomy

The adult brain is composed of the **cerebrum**, the **diencephalon**, the **brainstem**, and the **cerebellum**. There are spaces within the brain called ventricles. The cranial nerves are (PNS) nerves directly attached to the brain.

TABLE 7-4. **Cerebrum:** Basic organization of the cerebrum is—superficial gray matter, deep (central) white matter, and deeper gray matter (cerebral nuclei).

STRUCTURE	SIGNIFICANCE	TEXT REFERENCES AND NOTES
▫ gyrus (pl., *gyri*)	"hills" (gyri) and "valleys" (sulci) create surface area necessary for the massive amount of cerebral cortex tissue within the cranial cavity	**DESCRIBED: P. 437 FIG. 15.1**
▫ sulcus (pl., *sulci*)		
▫ gray matter ▫ cerebral cortex	location of neuron cell bodies, dendrites, and unmyelinated axons	**DESCRIBED: P. 440 FIG. 15.3**
▫ white matter	connects regions within the nervous system; derives its color from the myelin in the myelinated axons; bundles of white matter in the CNS are called **tracts**	
▫ cerebral hemispheres (right and left)	each hemisphere receives and sends information to the opposite side of the body (with a few exceptions)	**DESCRIBED: P. 450 FIG. 15.10**
▫ longitudinal fissure	separates cerebral hemispheres	
▫ corpus callosum	provides the primary white matter communication link between the cerebral hemispheres	**DESCRIBED: PP. 450–451, 457 FIG. 15.1C, 15.3**

TABLE 7-4. **Cerebrum:** Basic organization of the cerebrum is—superficial gray matter, deep (central) white matter, and deeper gray matter (cerebral nuclei).

STRUCTURE	SIGNIFICANCE	TEXT REFERENCES AND NOTES
▫ frontal lobe	anterior portion of the cerebral cortex; primarily concerned with voluntary motor functions, concentration, verbal communication, decision making, planning and personality	DESCRIBED: PP. 451–452 FIG. 15.10, 15.11
▫ precentral gyrus	portion of the frontal lobe that houses the **primary motor cortex**, where neurons control voluntary skeletal muscle activity	
▫ central sulcus	boundary between frontal and parietal lobes	
▫ parietal lobe	portion of the cerebral cortex involved with general sensory functions	
▫ postcentral gyrus	portion of the parietal lobe that houses the **primary somatosensory cortex**, where neurons receive somatic sensory information from touch, pressure, pain, and temperature receptors	
▫ parieto-occipital sulcus	boundary between parietal lobes and occipital lobe	
▫ occipital lobe	posterior portion of the cerebral cortex responsible for processing incoming visual information and storing visual memories	
▫ lateral sulcus	boundary between frontal/parietal lobes and temporal lobe	
▫ insula	portion of the cerebral cortex deep to the lateral sulcus	
▫ temporal lobe	lateral portion of the cerebral cortex involved with hearing and smell	

TABLE 7-4. **Cerebrum:** Basic organization of the cerebrum is—superficial gray matter, deep (central) white matter, and deeper gray matter (cerebral nuclei).

STRUCTURE	SIGNIFICANCE	TEXT REFERENCES AND NOTES
▫ fornix	thin tract of white matter involved in limbic system functions	**DESCRIBED: P. 468 FIG. 15.15, 15.23**
▫ septum pellucidum	thin partition that separates lateral ventricles	**DESCRIBED: P. 446 FIG. 15.15**
▫ cerebral nuclei (*or* basal nuclei)	deep bodies of gray matter within the cerebrum, often paired	**DESCRIBED: PP. 457–458 FIG. 15.14**
▫ lateral ventricles	spaces within the cerebral hemispheres that produce and circulate cerebrospinal fluid (CSF)	**DESCRIBED: P. 446 FIG. 15.6, 15.14**

TABLE 7-5. **Diencephalon:** Composed of **epithalamus**, **thalamus**, and **hypothalamus** and other associated structures.

STRUCTURE/REGION	SIGNIFICANCE	TEXT REFERENCES AND NOTES
▫ **EPITHALAMUS**	an endocrine gland; secretes the hormone melatonin, which helps regulate the body's circadian rhythm	**DESCRIBED: P. 459 FIG. 15.15**
▫ pineal gland		
▫ **THALAMUS**	relays sensory impulses from all conscious senses (except olfaction) to cerebral cortex	**DESCRIBED: P. 459 FIG. 15.15, 15.16**
▫ interthalamic adhesion (*or* intermediate mass)	gray matter that connects the right and left halves of the thalamus	

TABLE 7-5. **Diencephalon:** Composed of **epithalamus**, **thalamus**, and **hypothalamus** and other associated structures.

STRUCTURE/REGION	SIGNIFICANCE	TEXT REFERENCES AND NOTES
▫ **HYPOTHALAMUS**	• control of autonomic nervous system and endocrine system • regulation of body temperature and circadian rhythms • control of emotional behavior, food and water intake	**DESCRIBED: PP. 460, 607** **FIG. 15.1B, 15.17, 15.18, TABLE 15.6**
▫ mammillary body	processes sensations related to smell	
▫ infundibulum	attaches hypothalamus to pituitary gland	
▫ pituitary gland	hormone secretion; attached to hypothalamus via the infundibulum	**DESCRIBED: PP. 607–608** **FIG. 15.15, 15.17, 20.4**
▫ optic chiasm (chiasma)	optic nerves cross here before becoming optic tracts	**FIG. 15.1B, 15.24, 15.18**
▫ optic tracts	CNS tracts carrying sensory impulses from eyes and optic nerves, through the optic chiasm to the brain	**DESCRIBED: P. 578** **FIG. 15.1B, 15.24**
▫ third ventricle	space between the halves of the thalamus that produces and circulates CSF	**DESCRIBED: P. 446** **FIG. 15.6, 15.13, 15.14**

TABLE 7-6. **Brainstem:** Composed of the **mesencephalon**, **pons**, **medulla oblongata**, and other associated structures.

STRUCTURE	SIGNIFICANCE	TEXT REFERENCES AND NOTES
▫ **MIDBRAIN (OR MESENCEPHALON)**		**DESCRIBED: PP. 437, 461 FIG. 15.1C, 15.18, 15.19**
▫ corpora quadrigemina		**DESCRIBED: P. 461 FIG. 15.15, 15.18, 15.19**
▫ superior colliculus (pl. *colliculi*)	visual reflex center	
▫ inferior colliculus (pl. *colliculi*)	auditory reflex center	
▫ cerebral peduncles	largely composed of white matter tracts connecting pons and cerebrum	
▫ **PONS**	• contains white matter tracts for communication between brain and spinal cord • contains gray matter for control of respiration	**DESCRIBED: PP. 461, 464 FIG. 15.1, 15.18, 15.20**
▫ **MEDULLA OBLONGATA**	• contains white matter for communication between brain and spinal cord • contains gray matter that regulates vital functions like cardiovascular function and respiration	**DESCRIBED: P. 464 FIG. 15.1, 15.18**
▫ cerebral aqueduct	CSF passageway between third and fourth ventricles	**DESCRIBED: P. 446 FIG. 15.6, 15.15, 15.22**
▫ fourth ventricle	space between brainstem and cerebellum that produces and circulates CSF	

TABLE 7-7. **Cerebellum:** Involved in coordinated movements, balance, and muscle/joint proprioception; helps maintain balance.

STRUCTURE	SIGNIFICANCE	TEXT REFERENCES AND NOTES
▫ vermis	narrow band of cerebellar cortex that separates cerebellar hemispheres	**DESCRIBED: PP. 465–466 FIG. 15.22**
▫ cerebellar hemispheres	two halves of the cerebellum	
▫ arbor vitae	white matter pattern within cerebellum	

CSF Circulation Structures and Cranial Meninges

TABLE 7-8. Dural venous sinuses, cranial meninges and spaces, and cranial dural septa

STRUCTURE	SIGNIFICANCE	TEXT REFERENCES AND NOTES
▫ **MENINGES AND SPACES**		**DESCRIBED: P. 444** **FIG. 15.4, 15.5**
▫ dura mater	two-layered dense irregular connective tissue membrane protecting the brain and spinal cord	
▫ subdural space	potential space between the dura mater and the arachnoid; subdural hematomas occur here	
▫ arachnoid mater	delicate web of collagen and elastic fibers between the dura mater and the pia mater	
▫ subarachnoid space	• space within the arachnoid • CSF circulates here • contains arachnoid villi and connecting fibers between arachnoid mater and pia mater	
▫ pia mater	thin layer of delicate areolar connective tissue in contact with brain and spinal cord; highly vascularized	
▫ **CRANIAL DURAL SEPTA**—Flat partitions of dura mater extending into the cranial cavity		**DESCRIBED: P. 445** **FIG. 15.5**
▫ falx cerebri	portion of dura mater that projects between cerebral hemispheres	
▫ tentorium cerebelli	portion of dura mater that separates occipital and temporal lobes from cerebellum	
▫ falx cerebelli	portion of dura mater that divides cerebellar hemispheres	

TABLE 7-8. Dural venous sinuses, cranial meninges and spaces, and cranial dural septa

STRUCTURE	SIGNIFICANCE	TEXT REFERENCES AND NOTES
▫ **DURAL VENOUS SINUSES**—Large veins that drain blood from the brain into the internal jugular veins		**DESCRIBED: PP. 445, 447–449, 691** **FIG. 15.4, 15.5, 15.8, 23.11B**
▫ superior sagittal sinus ▫ inferior sagittal sinus ▫ straight sinus ▫ transverse sinus (R & L) ▫ confluence of sinuses ▫ sigmoid sinus (R & L)		

TABLE 7-9. Ventricles: Ventricles are hollows within the brain in which cerebrospinal fluid is produced and circulated. The ventricles are continuous with the central canal of the spinal cord.

STRUCTURE	SIGNIFICANCE	TEXT REFERENCES
▫ lateral ventricles		**DESCRIBED: P. 446** **FIG. 15.6, 15.14**
▫ third ventricle		**DESCRIBED: P. 446** **FIG. 15.6, 15.13, 15.14**
▫ cerebral (mesencephalic) aqueduct		**DESCRIBED: P. 446** **FIG. 15.6, 15.15, 15.22**
▫ fourth ventricle		
▫ central canal (of spinal cord)		**DESCRIBED: P. 446** **FIG. 15.6, 15.14**

TABLE 7-10. **Cranial nerves:** Cranial nerves are **not part of the CNS**. They are peripheral nerves (PNS) directly attached to the brain.

FIG. 15.24, TABLES 15.7, 15.8

NUMBER	NAME	FUNCTION (S = SENSORY; M = MOTOR)	FORAMINA
▫ I	olfactory nerve	S = olfaction (smell)	cribriform plate of _____ bone
▫ II	optic nerve	S = vision	optic canal of _____ bone
▫ III	oculomotor nerve	M = *somatic motor*: four extrinsic eye muscles (medial rectus, superior rectus, inferior rectus, inferior oblique); opens eyelid *autonomic motor*: pupil constriction and focusing	superior orbital fissure of _____ bone
▫ IV	trochlear nerve	M = superior oblique eye muscle	superior orbital fissure
▫ V	trigeminal nerve	S = sensation from scalp, nose, face, mouth, touch on anterior part of tongue M = chewing (mastication) muscles	• superior orbital fissure • foramen rotundum of _____bone • foramen ovale of _____ bone
▫ VI	abducens nerve	M = *somatic motor*: lateral rectus eye muscle	superior orbital fissure
▫ VII	facial nerve	S = taste from anterior two-thirds of tongue M = *somatic motor*: muscles of facial expression *autonomic motor*: lacrimal gland, submandibular and sublingual salivary glands	internal acoustic meatus of _____ bone
▫ VIII	vestibulocochlear nerve	S = hearing (cochlear branch); equilibrium (vestibular branch)	internal acoustic meatus

TABLE 7-10. **Cranial nerves:** Cranial nerves are **not part of the CNS**. They are peripheral nerves (PNS) directly attached to the brain.

FIG. 15.24, TABLES 15.7, 15.8

NUMBER	NAME	FUNCTION (S = SENSORY; M = MOTOR)	FORAMINA
▫ IX	glossopharyngeal nerve	S = touch and taste on posterior ⅓ of tongue M = *somatic motor*: swallowing *autonomic motor*: parotid salivary gland	jugular foramen of _____bone
▫ X	vagus nerve	S = sensation from heart, lungs, most abdominal organs; sensation from ear M = *somatic motor*: speech *autonomic motor*: motor function of heart, lungs, and most abdominal organs	jugular foramen
▫ XI	accessory nerve	M = trapezius muscle; sternocleidomastoid muscle	• foramen magnum of _____ bone • jugular foramen
▫ XII	hypoglossal nerve	M = tongue muscles	hypoglossal canal of _____ bone

INSTRUCTIONS FOR SHEEP BRAIN DISSECTION

Before you begin the dissection, you will need to obtain a dissecting tray, scalpel, and sheep brain from your instructor or the laboratory assistant. YOU MUST WEAR GLOVES FOR THIS DISSECTION.

1. Observe the gross anatomical structures of the sheep brain (nerves, **dura mater**, blood vessels, etc.). Note how tough the dura mater is.

    a. Place the sheep brain on the tray so the inferior surface is facing up. Identify the ***optic chiasm***.

    b. Find the ***pituitary gland***, if present (notice the capillary beds both posteriorly and lateral to the pituitary gland).

    c. Find the ***trigeminal nerves (CNV)***.

2. **Carefully remove the dura mater without breaking off the pituitary gland.** Note: If the sheep brain doesn't have dura mater skip to step 2f.

    a. Cut the trigeminal nerves and the capillaries away from the ***pituitary gland***.

    b. Next, cut around the optic chiasm, pituitary gland, and trigeminal nerve.

    c. Gently lift the dura mater on the posterior side of the pituitary gland until you can see the small nerves that go through the deep surface of the dura mater.

    d. Use your scalpel to detach the nerves at the point where they enter the dura mater. Make sure you are cutting the nerve where it comes in contact with the dura, not where it attaches to the brain!

    e. Now make a cut in the dura mater between the ***olfactory bulbs and olfactory tracts***. Gently pull the dura mater away from the brain. The best way to do this is to pull the dura in a posterior, superior direction. Be sure to gently cut any remaining connections as you pull the dura mater away from the brain.

    f. Remove as much of the dura as possible, making sure you keep the pituitary gland intact.

IDENTIFY THE FOLLOWING STRUCTURES ON THE SHEEP BRAIN

INFERIOR VIEW		
▫ cerebellum	▫ medulla oblongata	▫ pituitary gland
▫ cerebral peduncle	▫ olfactory bulb	▫ pons
▫ frontal lobe	▫ optic chiasm	▫ temporal lobe
▫ longitudinal fissure	▫ optic nerve (CN II)	▫ hypothalamus

g. Next, observe the ***mammillary body***, a part of the ***hypothalamus***. Do this by carefully lifting the pituitary gland. Note: The human brain has two mammillary bodies but the sheep brain only has one.

h. Now identify the ***cranial nerves***. Note: Cranial nerves IX–XII might not be visible because they might have been torn off when the brain was being removed from the skull.

3. **Superior view of the sheep brain:** Place the brain on the dissecting tray so the superior side is facing up. Notice the thin layer of ***arachnoid*** that covers the surface of the brain but does not dip into the sulci of the brain. Also notice the vast amounts of blood vessels that are between the arachnoid mater and the pia mater. The space the blood vessels occupy is the ***subarachnoid space*** where cerebrospinal fluid flows in the sheep.

Identify the Following Structures on the Sheep Brain

SUPERIOR VIEW		
▫ arachnoid (mater)	▫ cerebrum	▫ spinal cord
▫ blood vessels	▫ gyrus	▫ sulcus
▫ cerebellum	▫ longitudinal fissure	▫ cerebral cortex

Now, pick up the brain, hold it with the cerebellum facing you, and carefully pull the cerebellum away from the cerebrum.

POSTERIOR VIEW		
▫ cerebellum	▫ inferior colliculi*	▫ pineal gland
▫ cerebrum	▫ superior colliculi*	

*superior colliculi + inferior colliculi = corpora quadrigemina

Midsagittal and Coronal Sections of the Sheep Brain

Note: Some of you will dissect a midsagittal section of the sheep brain, and some will dissect a coronal section. Ask your instructor which section you are to dissect before you begin cutting. Make sure you observe both dissections, even though you are only performing one.

Midsagittal Section

1. Place the sheep brain on your dissecting tray with its superior surface facing you. Starting on the anterior end, place your scalpel in the ***longitudinal fissure*** and cut the brain in half along the midsagittal plane.

2. Once you have cut the brain in half down the longitudinal fissure, identify the following structures on the cut, midsagittal surface.

MIDSAGITTAL SECTION		
▫ central canal	▫ fornix	▫ pituitary gland
▫ cerebellum	▫ fourth ventricle	▫ pons
▫ cerebral aqueduct	▫ mammillary body	▫ spinal cord
▫ cerebral peduncle	▫ medulla oblongata	▫ superior and inferior colliculi
▫ cerebrum	▫ optic chiasm	▫ thalamus, with interthalamic adhesion
▫ corpus callosum	▫ pineal gland	▫ septum pellucidum

Coronal section

1. Place the sheep brain on your dissection tray with the inferior side facing you. Identify the pituitary gland. Use your scalpel to cut the brain in half along a coronal plane.

2. Once you have cut the brain in half, identify the following structures on the cut surface.

CORONAL SECTION		
▫ cerebral peduncle	▫ hypothalamus	▫ pons
▫ cerebrum	▫ thalamus	▫ third ventricle
▫ corpus callosum	▫ lateral ventricles	▫ cerebral nuclei
▫ fornix	▫ longitudinal fissure	▫ cerebral cortex

YOU MUST DISPOSE OF THE SHEEP AS INSTRUCTED, AND COMPLETELY CLEAN, DRY, AND PUT AWAY ALL INSTRUMENTS AND TRAYS IN ORDER TO EARN YOUR PARTICIPATION GRADE FOR THE LAB.

STUDY AIDS FOR NERVOUS SYSTEM I

Helpful terms for Nervous System I

ANATOMICAL TERMS	DESCRIPTION
abducens	to take away (as in abduction)
aqueduct	channel for conducting fluid
arachnoid	like a spider web
arbor vitae	tree of life
axon	axis
callosum	callum= tough
chiasm/chiasma	cross
colliculus	hill
corpus/corpora	body
dendrite	a tree, like branches of a tree
denticulate	tooth, small tooth-like projections
dura	tough
falx	sickle-shaped
filum	a thread
fissure	a cleft
fornix	arch
glossal	tongue
gyrus	circle, coil of brain cortex
mater	mother, pertaining to the meninges of the brain
matter	substance(s) an object or structure is made of
neurolemma	covering layer of a nerve
olfactory	pertaining to smell
optic	pertaining to sight
pia	gentle or faithful, the faithful membrane that follows the contours
pineal	a pine cone
pituitary	mucous; gland was believed to secrete mucous through the nose
quadrigemina	four twins
septum	wall, partition
sulcus	a groove
tentorium	tent
trigeminal	triplets
trochlear	a pulley
vagus	wanderer
vermis	worm