ACTIVITY 7: NERVOUS SYSTEM HISTOLOGY, BRAIN, CRANIAL NERVES

OBJECTIVES:

1) How to get ready: **Read Chapter 14 & 15 McKinley *et al*., Human Anatomy, 5e. All text references are for this textbook.** Read dissection instructions BEFORE you come to class.
2) **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.**
3) **Human brain: Identify listed structures of the human brain on classroom models, the cranial meninges, and structures involved in cerebrospinal fluid circulation.**
4) **Human brain: Identify the 12 pairs of cranial nerves** by name and number **on a model and on the sheep brain.**
5) ★ **Dissect a sheep brain and identify structures listed.** YOU MUST BRING YOUR OWN GLOVES FOR THIS ACTIVITY.
6) 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 1. SPINAL CORD SMEAR AND NEURON MODEL

STRUCTURE	TEXTBOOK REFERENCE 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 2. CROSS SECTION OF A NERVE

STRUCTURE	TEXTBOOK REFERENCE AND SKETCH
❑ **nerve**	**described: pp. 424-425** **fig. 14.12a & b**
❑ **axon (with myelin sheath)**	
❑ **endoneurium**	
❑ **fascicle**	
❑ **perineurium**	
❑ **epineurium**	

TABLE 3. TEASED MYELINATED NERVE FIBERS

STRUCTURE	TEXTBOOK REFERENCE AND SKETCH
❑ **axon**	**described: pp. 414; 421-422** **fig. 14.12c**
❑ **myelin sheath and neurilemma**	
❑ **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 4. **CEREBRUM:** Basic organization of the cerebrum is -- superficial gray matter, deep (central) white matter, and deeper gray matter (cerebral nuclei).

STRUCTURE	SIGNIFICANCE	TEXTBOOK REFERENCE 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**
❑ **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**, controlling most 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	
❑ **temporal lobe**	lateral portion of the cerebral cortex involved with **hearing and smell**	

STRUCTURE	SIGNIFICANCE	TEXTBOOK REFERENCE AND NOTES
❑ **fornix**	thin tract of **white matter** involved in limbic system functions	**described: p. 468** **fig. 15.15, 15.23**
❑ **septum pellucidum**	thin double-layered partition that separates lateral ventricles	**described: p. 446** **fig. 15.15**
❑ **cerebral nuclei (*or* basal nuclei)** often *incorrectly* called basal ganglia	deep bodies of **gray matter** within the cerebrum, often paired: **amygdaloid body** participates in the expression of emotions, control of behavioral activities, and development of moods **caudate nucleus** stimulates muscles to produce rhythmic patterns of arm and leg movements associated with walking **putamen** functions in subconsciously controlling muscular movement **globus pallidus** controls activities of the thalamus to control and adjust muscle tone	**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 5. **DIENCEPHALON:** Composed of epithalamus, thalamus, and hypothalamus and other associated structures

STRUCTURE	SIGNIFICANCE	TEXTBOOK REFERENCE 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	
❑ 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)**	**o**ptic 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 6. **BRAINSTEM:** Composed of the mesencephalon, pons, medulla oblongata, and other associated structures

STRUCTURE	SIGNIFICANCE	TEXTBOOK REFERENCE AND NOTES
❑ MIDBRAIN (OR MESENCEPHALON)		**described: pp. 437, 461** **fig. 15.1c, 15.18, 15.19**
❑ **corpora quadrigemina (tectal plate)**		**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**	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. **CEREBELLUM:** Involved in coordinated movements, balance, and muscle/joint proprioception; helps maintain balance.

STRUCTURE	SIGNIFICANCE	TEXTBOOK REFERENCE 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 8. **CRANIAL MENINGES AND SPACES, CRANIAL DURAL SEPTA, AND DURAL VENOUS SINUSES**

STRUCTURE	SIGNIFICANCE	TEXTBOOK REFERENCE 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 the cerebellum	
❑ **falx cerebelli**	portion of dura mater that divides cerebellar hemispheres	
DURAL VENOUS SINUSES: Large veins that drain blood from the brain into the internal jugular veins		
❑ **superior sagittal sinus** ❑ **inferior sagittal sinus** ❑ **straight sinus** ❑ **transverse sinus (R & L)** ❑ **confluence of sinuses** ❑ **sigmoid sinus (R & L)**		**described: pp. 445, 447-449, 691 fig. 15.4, 15.5, 15.8, 23.11b**

TABLE 9. **VENTRICLES:** 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	TEXTBOOK REFERENCE
❑ **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 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**
❑ IX	**glossopharyngeal nerve**	**S = touch and taste on posterior 1/3 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, from an 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.

4. 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.

IDENTIFY THE FOLLOWING STRUCTURES ON THE SHEEP BRAIN, from a 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.

IDENTIFY THE FOLLOWING STRUCTURES ON THE SHEEP BRAIN, from a 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.

IDENTIFY THE FOLLOWING STRUCTURES ON THE SHEEP BRAIN, from a 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.

IDENTIFY THE FOLLOWING STRUCTURES ON THE SHEEP BRAIN in a 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 BRAIN AS INSTRUCTED, AND COMPLETELY CLEAN, DRY, AND PUT AWAY ALL INSTRUMENTS AND TRAYS IN ORDER TO EARN FULL CREDIT FOR THE LAB.