BIOL 213
LAB HANDOUTS

You are responsible for all of the information contained within these handouts. Lab practicals will be directly related to the terms and concepts outlined in this document. You are encouraged to bring these handouts with you to each lab to ensure that you fully understand the material. Remember, spelling counts on lab practicals, so be sure to practice spelling anatomical terms.

INTRODUCTION TO ANATOMY AND PHYSIOLOGY

Identify the following terms on pictures and models. Be able to correctly use anatomical terminology.

BODY CAVITIES:

Posterior Aspect
- Cranial Cavity
- Vertebral Canal

Ventral Cavity
- Thoracic Cavity
  - Mediastinum
  - Left Pleural Cavity
  - Right Pleural Cavity
  - Pericardial Cavity
- Abdominopelvic Cavity
  - Abdominal Cavity
  - Pelvic Cavity

Diaphragm

SEROUS MEMBRANES:

Parietal Pleura
Visceral Pleura
Pleural Cavity
Parietal Pericardium
Visceral Pericardium
Pericardial Cavity
Parietal Peritoneum
Visceral Peritoneum
Peritoneal Cavity

ANATOMIC DIRECTIONS:

Superior/Inferior
Anterior/Posterior
Medial/Lateral
Proximal/Distal
Superficial/Deep

SECTIONS AND PLANES:

Sagittal/Median (Midsagittal)
Transverse (Horizontal)
Frontal (Coronal)
Oblique

ABDOMINOPELVIC REGIONS:

Epigastric
Right/Left Hypochondriac
Umbilical
Right/Left Lumbar
Hypogastric
Right/Left Iliac

ABDOMINOPELVIC QUADRANTS:

Right Upper Quadrant
Right Lower Quadrant
Left Upper Quadrant
Left Lower Quadrant

REGIONAL ANATOMY:

Abdominal
Antebrachial
Antecubital
Auricular
Axillary
Brachial
Buccal
Calcaneal
Carpal
Cephalic
Cervical
Coxal
Cranial
Crural
Deltoid
Digital
Femoral
Frontal
Gluteal
Inguinal

ANATOMICAL TERMINOLOGY (CONTINUED):

Lumbar
Mammary
Manus
Mental
Nasal
Occipital
Olecranal
Oral
Orbital
Palmar
Patellar
Pectoral
Pelvic
Perineal
Pes
Plantar
Popliteal
Pubic
Sacral
Sternal
Sural
Tarsal
Thoracic
Vertebral

MICROSCOPES

TERMS TO IDENTIFY ON A MICROSCOPE:

Eyepiece
Head
Arm
Stage
Coarse Adjustment Knob
Fine Adjustment Knob
Base
Condenser
Iris Diaphragm
Rotating nosepiece
Objectives (4x, 10x, 40x, 100x)
Stage Clip

CONCEPTS:

1. Calculate total magnification.
2. Correctly focus on an object through multiple lenses.

MICROSCOPES WORKSHEET

PART I: ORIENTATION ON A MICROSCOPE

Collect a slide with the letter "e" on it. Place the slide on the stage and use the clip to secure. The stage should be in the lowest position possible. Make sure the letter "e" is facing you correctly on the stage. Position the 4x objective (also called scanning) and use the coarse adjustment knob to focus on the letter. Continue focusing on the letter using the fine adjustment knob. Describe the orientation of the letter "e." Is it the same, upside down, etc.?

_____

When you move the slide to the right, which way does the image move?

_____

When you move the slide up, which way does the image move?

_____

Now move to the 10x objective (also called low power). **Focus using the fine adjustment knob only (do NOT use the coarse adjustment knob at this point).** Describe the orientation of the letter "e." Did anything change from the 4x objective?

_____

PART II: MAGNIFICATION

So far you have used the 4x and 10x objectives. In order to calculate total magnification, you multiply the magnification of the objective by the magnification of the eyepiece (usually this is 10x). What is the magnification of the eyepiece on your microscope?

_____

When using the 4x objective, the total magnification is:
4 (from the objective) x 10 (from the eyepiece) = 40x

What is the total magnification when using the 10x objective?

_____

Now move to the 40x objective (also called high power). **Focus using the fine adjustment knob only (do NOT use the coarse adjustment knob at this point).** What is the total magnification when using the 40x objective?

What happened to light intensity when moving from 10x to 40x objective?

CELL MEMBRANE TRANSPORT

Complete the PhILS #1 lab for Osmosis and Diffusion: Varying Extracellular Concentration.

I. SOLUTIONS

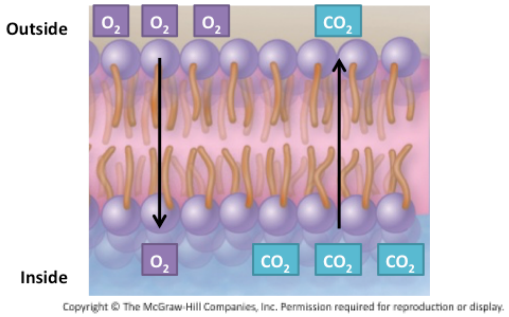
A. A **solution** is composed of:

1. **Solvent** (water)
2. **Solute** (molecules) dissolved in solvent

Biological membranes are **selectively permeable**, allowing only certain solutes through.

II. DIFFUSION

A. **Diffusion**: movement of molecules from areas of higher concentration to areas of lower concentration. A great example of this is the diffusion of oxygen into cells and the diffusion of carbon dioxide out of cells.



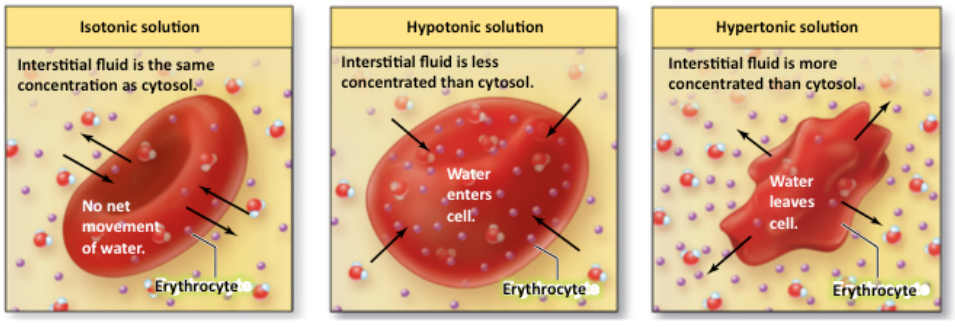
B. **Facilitated diffusion**: uses a channel (example – potassium channel).

III. OSMOSIS

A. **Osmolarity**: concentration of all molecules in a solution.

B. **Osmosis**: diffusion of water down its concentration gradient.

1. **Isotonic**: no net movement of water.
2. **Hypotonic**: water enters cell and it swells (it can burst or lyse).
3. **Hypertonic**: water leaves cell and it shrinks (crenate).



C. Most cell membranes have few open sodium channels, so when cells are placed in solutions of NaCl, some sodium will move, but mostly water will move by osmosis.

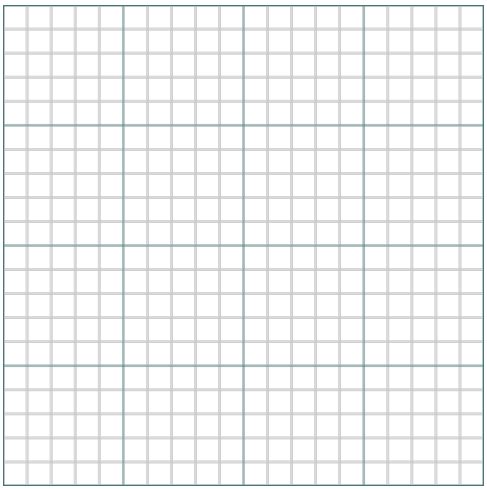
IV. GOALS OF THE LAB

1. Place red blood cells in solutions with different concentrations of sodium chloride (0mM to 240 mM).
2. Measure the color of the solutions using a spectrophotometer.
   a. Normal solutions: 510 nm wavelength reflected by cell membranes.
   b. Hypotonic solutions: water moves into cells, they burst and less light is reflected. Therefore, amount of light transmitted increases.
   c. Hypertonic solutions: water leaves cells and they shrink. Therefore, amount of light transmitted decreases.

V. DATA COLLECTION

Complete the data table below with your results and plot the data on the graph provided.

[NaCl]	Transmittance
0	
50	
100	
120	
140	
160	
180	
200	
220	
240	



Graph paper image: https://commons.wikimedia.org/wiki/File:Graph-paper.svg

VI. APPLICATION QUESTIONS

1. What happened to the carrot placed in the saturated salt solution overnight? How would you classify this solution?

   What happened to the carrot placed in the filtered water solution overnight? How would you classify this solution?

2. Based on your data, during approximately which range of [NaCl] are red blood cells losing water and have shrunk in size?

3. The principles of osmosis are used in the clinic when administering IV solutions. For example, which solution would you administer to a patient suffering from cerebral edema (hypotonic or hypertonic)? Why?

HISTOLOGY

Identify the following tissues (and associated structures) under the microscope and using pictures. For each, categorize as epithelial or connective tissue and give main locations and functions in the body.

EPITHELIAL TISSUE:

Simple squamous (nucleus)
Simple cuboidal (nucleus, lumen)
Nonciliated simple columnar (nucleus)
Ciliated pseudostratified columnar (nucleus, cilia, goblet cells)
Stratified squamous (nucleus)
Transitional (nucleus)

SUPPORTING CONNECTIVE TISSUE:

Hyaline Cartilage (chondrocyte in lacuna)
Elastic Cartilage (chondrocyte in lacuna)
Fibrocartilage (chondrocyte in lacuna)
Bone (osteocyte, central canal)

FLUID CONNECTIVE TISSUE:

Blood (WBC, RBC, platelet)

CONNECTIVE TISSUE PROPER:

LOOSE CONNECTIVE TISSUE:

Areolar (fibroblast)
Adipose (nucleus)
Reticular (reticular fiber)

DENSE CONNECTIVE TISSUE:

Dense regular (fibroblast nucleus)
Dense irregular (collagen fiber)
Elastic (elastic fibers)

INTEGUMENTARY SYSTEM

Identify the following structures on models and pictures.

LAYERS:

Epidermis
- Stratum corneum
- Stratum lucidum
- Stratum granulosum
- Stratum spinosum
- Stratum basale

Dermis
- Dermal papilla
- Meissner's corpuscle
- Pacinian corpuscle
- Sweat gland (merocrine and apocrine)

Subcutaneous layer/Hypodermis

HAIR:

Hair follicle
Hair shaft
Sebaceous gland
Arrector pili muscle
Hair papilla

SKELETAL SYSTEM

Classify bones according to their shape.

BONE SHAPES:
Long
Short
  Sesamoid
Flat
Irregular

Identify the following structures on a long bone.

LONG BONE:
Proximal epiphysis
Distal epiphysis
Diaphysis
Metaphysis
Articular cartilage
Epiphyseal plate
Endosteum
Medullary cavity

Identify the following structures on a microscopic bone model.

MICROSCOPIC BONE:
Spongy bone
  Trabeculae
Compact bone
Osteon
Central canal
Perforating canal
Osteocyte
Lacuna
Canaliculus
Periosteum
Lamella

SKELETAL SYSTEM

There are 206 bones in the adult human skeleton. Identify these bones in both articulated and disarticulated forms. Include marking and bone name when applicable.

SKULL:

Cranial Bones
- Frontal
- Parietal
- Occipital
  - Foramen magnum
  - Occipital condyles
- Temporal
  - Mandibular fossa
  - Mastoid process
  - Styloid process
  - Zygomatic process
- Sphenoid
  - Sella turcica
  - Optic canal
- Ethmoid
  - Cribriform plate
  - Crista galli

Facial Bones
- Maxilla
  - Infraorbital foramen
  - Palatine process
  - Incisive foramen
- Palatine
- Zygomatic
  - Temporal process
- Lacrimal
- Nasal
- Vomer
- Inferior nasal conchae
- Mandible
  - Mental foramen

Sutures
Coronal, sagittal, squamous, lambdoid

HYOID BONE

VERTEBRAL COLUMN:

Markings to identify on any vertebra:
- Body
- Vertebral foramen
- Spinous process
- Transverse process

Types of Vertebra
- Cervical (7)
  - Transverse foramen
  - Atlas (C1)
  - Axis (C2)
    - Dens
- Thoracic (12)
- Lumbar (5)
- Sacrum
- Coccyx

THORACIC CAGE:

- True ribs (7 pairs)
- False ribs (5 pairs)
- Floating ribs (2-3 pairs)
- Sternum
  - Manubrium
  - Body
  - Xiphoid process

PECTORAL GIRDLE:

- Clavicle
  - Sternal end
  - Acromial end
- Scapula
  - Spine
  - Acromion
  - Coracoid process
  - Glenoid cavity
  - Supraspinous fossa
  - Infraspinous fossa
  - Subscapular fossa

UPPER LIMB:

- Humerus
  - Head
  - Greater tubercle
  - Lesser tubercle
  - Intertubercular sulcus
  - Anatomical neck
  - Surgical neck
  - Olecranon fossa
  - Coronoid fossa
  - Trochlea
  - Capitulum
- Radius
  - Head
  - Radial tuberosity
  - Styloid process
- Ulna
  - Coronoid prcoess
  - Olecranon
  - Trochlear notch
  - Styloid process
- Carpals (8)
- Metacarpals (5)
- Phalanges (14)

PELVIC GIRDLE:

- Coxa
  - Ilium
    - Iliac crest
    - Anterior inferior iliac spine
  - Ischium
    - Ischial tuberosity
    - Ischial spine
  - Pubis
- Obturator foramen
- Acetabulum

LOWER LIMB:

- Femur
  - Head
  - Neck
  - Fovea capitis
  - Greater trochanter
  - Lesser trochanter
  - Linea aspera
  - Lateral condyle
  - Medial condyle
  - Lateral epicondyle
  - Medial epicondyle
- Tibia
  - Lateral condyle
  - Medial condyle
  - Tibial tuberosity
  - Medial malleolus
- Fibula
  - Head
  - Lateral malleolus
- Patella
- Tarsals (7)
  - Talus
  - Calcaneus
- Metatarsals (5)
- Phalanges (14)

CONCEPTS:

- ☐ Compare and contrast the skull of an infant with an adult.
- ☐ Compare and contrast the male and female skeleton.
- ☐ Identify bones in the axial and appendicular skeletons.

ARTICULATIONS

Classify articulations (joints) based on structure and function and identify examples of each. Demonstrate various joint movements and know key ligaments of the four major joints in the body.

STRUCTURAL CLASSIFICATION:

- Fibrous
  - Suture
  - Syndesmosis
  - Gomphosis
- Cartilaginous
  - Synchondrosis
  - Symphysis
- Synovial
  - Ball and socket
  - Hinge
  - Condylar
  - Saddle
  - Pivot
  - Plane

FUNCTIONAL CLASSIFICATION:

- Synarthrosis
- Amphiarthrosis
- Diarthrosis

JOINT MOVEMENTS:

- Flexion
- Extension
- Hyperextension
- Abduction
- Adduction
- Circumduction
- Supination
- Pronation
- Protraction
- Retraction
- Lateral rotation
- Medial rotation
- Eversion
- Inversion
- Plantar flexion
- Dorsiflexion
- Elevation
- Depression

MAJOR JOINTS AND THEIR LIGAMENTS:

- Shoulder
  - Coracohumeral ligament
  - Coracoacromial ligament
  - Glenohumeral ligament
- Hip
  - Iliofemoral ligament
  - Pubofemoral ligament
  - Ischiofemoral ligament
- Knee
  - Anterior cruciate ligament (ACL)
  - Posterior cruciate ligament (PCL)
  - Patellar ligament
  - Tibial collateral ligament
  - Fibular collateral ligament
- Elbow
  - Ulnar collateral ligament
  - Radial collateral ligament
  - Anular ligament

MUSCULAR SYSTEM

Identify muscle tissues (and associated structures) under the microscope and using pictures. For each, give main locations and functions in the body, type of control (voluntary/involuntary), and whether striations are present or absent.

MUSCLE HISTOLOGY:

Skeletal Muscle (nucleus, striations)
Smooth Muscle (nucleus)
Cardiac Muscle (nucleus, striations, intercalated discs)

Identify the following structures on the microscopic muscle model.

MICROSCOPIC MUSCLE:

Sarcolemma
Nucleus
Triad
    Two cisternae of sarcoplasmic reticulum
    One transverse tubule
Myofibril
Sarcomere

MUSCULAR SYSTEM

Identify the following muscles of the body using models and pictures.

FACE AND NECK:
Frontalis
Occipitalis
Temporalis
Masseter
Buccinator
Orbicularis oris
Orbicularis oculi
Zygomaticus major
Zygomaticus minor
Sternocleidomastoid

TORSO:
Pectoralis major
Pectoralis minor
Serratus anterior
Trapezius
Latissimus dorsi
Rectus abdominis
External oblique
Internal oblique
Transversus abdominis

UPPER LIMB:
Deltoid
Rotator cuff muscles:
- Supraspinatus
- Infraspinatus
- Subscapularis
- Teres minor

Teres major
Biceps brachii
Triceps brachii
Brachioradialis
Pronator teres
Flexor carpi radialis
Palmaris longus
Flexor carpi ulnaris
Extensor digitorum

LOWER LIMB:
Gluteus maximus
Gluteus medius
Tensor fasciae latae
Sartorius
Gracilis
Adductor longus
Adductor magnus
Quadriceps femoris muscles:
- Rectus femoris
- Vastus lateralis
- Vastus medialis
- Vastus intermedius

Hamstring muscles:
- Biceps femoris
- Semitendinosus
- Semimembranosus

Gastrocnemius
Soleus
Calcaneal tendon
Tibialis anterior
Fibularis longus

MUSCULAR SYSTEM

Define the terms **origin** and **insertion**. Identify the origins, insertions, actions, and innervations for the following muscles.

Muscle	Origin	Insertion	Action	Innervation
Supraspinatus	Supraspinous fossa of scapula	Greater tubercle of humerus	Abducts arm	Suprascapular nerve
Infraspinatus	Infraspinous fossa of scapula	Greater tubercle of humerus	Adducts and laterally rotates arm	Suprascapular nerve
Teres minor	Lateral border of scapula	Greater tubercle of humerus	Adducts and laterally rotates arm	Axillary nerve
Subscapularis	Subscapular fossa of scapula	Lesser tubercle of humerus	Medially rotates arm	Subscapular nerve
Biceps femoris	Ischial tuberosity and linea aspera of femur	Head of fibula	Flexes leg and laterally rotates leg	Tibial and fibular divisions of sciatic nerve
Semitendinosus	Ischial tuberosity	Proximal, medial surface of tibia	Flexes leg and medially rotates leg	Tibial division of sciatic nerve
Semimembranosus	Ischial tuberosity	Medial condyle of tibia	Flexes leg and medially rotates leg	Tibial division of sciatic nerve
Rectus femoris	Anterior inferior iliac spine	Patella via patellar ligament to tibial tuberosity	Extends leg	Femoral nerve
Vastus medialis	Linea aspera of femur	Patella via patellar ligament to tibial tuberosity	Extends leg	Femoral nerve
Vastus intermedius	Anterior and lateral surfaces of femur	Patella via patellar ligament to tibial tuberosity	Extends leg	Femoral nerve
Vastus lateralis	Greater trochanter and linea aspera of femur	Patella via patellar ligament to tibial tuberosity	Extends leg	Femoral nerve

CONNECTING CONCEPTS:

Connect the skeletal, nervous, and muscular systems to understand joint movements in the body. For example, the nervous system sends a signal along the femoral nerve to stimulate the quadriceps femoris group of muscles (rectus femoris, vastus lateralis, vastus intermedius, and vastus medialis). Contraction of these muscles pulls their insertions (patella/tibial tuberosity) toward their origins (coxa/femur) leading to extension at the knee joint. Be able to explain flexion at the knee joint and movements of the shoulder joint based on the table above.

MUSCULAR SYSTEM

Complete the PhILS #5 lab for Skeletal Muscle Function: Stimulus-Dependent Force Generation.

I. MUSCLE CONTRACTION

A. Muscles contract upon receiving a stimulus from the nervous sytem at the **neuromuscular junction**. This stimulus must reach a critical level called **threshold** in order for the muscle fiber to contract.

B. There are two types of contractions:

1. **Isometric contraction:** muscle tenses, but length stays the same.
2. **Isotonic contraction**: muscle contracts and changes length.
   a. **Concentric contraction**: muscle shortens.
   b. **Eccentric contraction**: muscle lengthens.

II. MOTOR UNIT

A. **Motor unit:** composed of one motor neuron and all of the muscle fibers it innervates.

B. **Motor unit recruitment:** with increased stimulation, more motor units are activated to increase muscle contraction force.

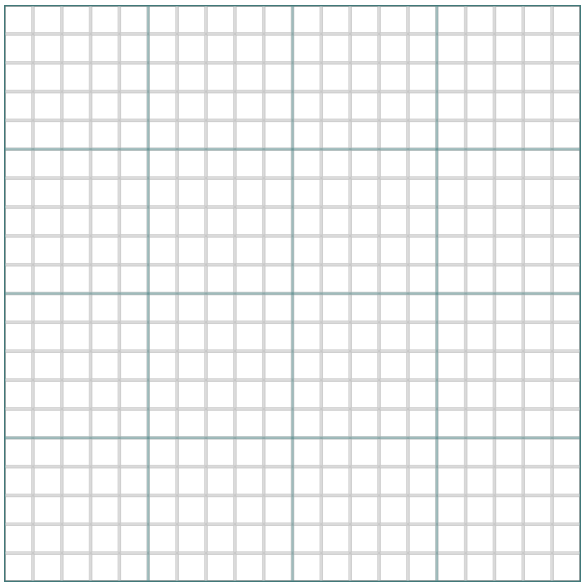
III. GOALS OF THE LAB

1. Dissect the gastrocnemius (calf) muscle from a frog and prepare for stimulation and recording.
2. Apply varying electrical voltages and record muscle tension as it contracts.

IV. DATA COLLECTION

Complete the data table below with your results and plot the data on the graph provided.

Applied Voltage (V}	Muscle Tension (g)
0	
0.1	
0.2	
0.3	
0.4	
0.5	
0.6	
0.7	
0.8	
0.9	
1.0	
1.1	
1.2	
1.3	
1.4	
1.5	
1.6	



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V. APPLICATION QUESTIONS

1. Why was there no muscle tension response when low voltage shocks were applied?

2. What is the minimum voltage required to produce muscle tension?

3. Why does applying more voltage produce greater tension?

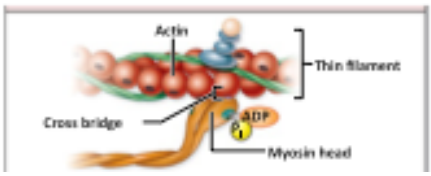
MUSCULAR SYSTEM

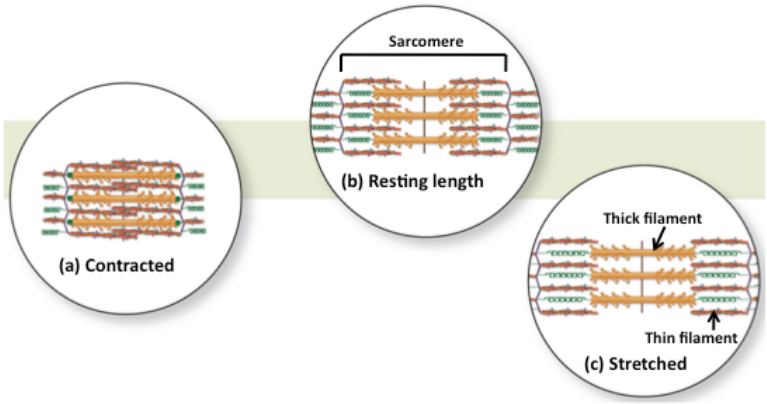
Complete the PhILS #7 lab for Skeletal Muscle Function: The Length-Tension Relationship.

I. MUSCLE CONTRACTION

A. During muscle contraction, thin filaments (containing actin) slide over thick filaments (containing myosin) in what is described as the **sliding filament theory**. Actin and myosin make contact at cross bridges in order to slide the thin filaments over the thick filaments. The amount of tension during muscle contraction is related to the number of cross bridges formed.

B. Changing the length of the muscle changes the length of the sarcomeres and this impacts muscle tension during contraction.





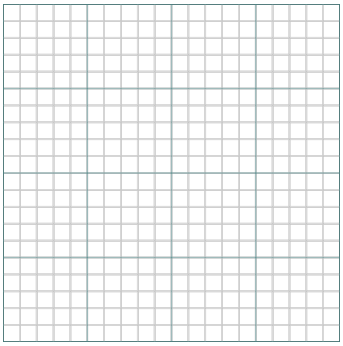
II. GOALS OF THE LAB

1. Dissect the gastrocnemius (calf) muscle from a frog and prepare for stimulation and recording.
2. Record muscle tension at various muscle lengths.

III. DATA COLLECTION

Complete the data table below with your results and plot the data on the graph provided.

Muscle Length (mm)	Muscle Tension (g)
26.0	
26.5	
27.0	
27.5	
28.0	
28.5	
29.0	
29.5	
30.0	



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IV. APPLICATION QUESTIONS

1. What is the optimum muscle length for maximum muscle tension?

2. At what muscle length can the muscle lift the heaviest weight?

3. When muscle length is too short, why does tension decrease (explain at the molecular level)?

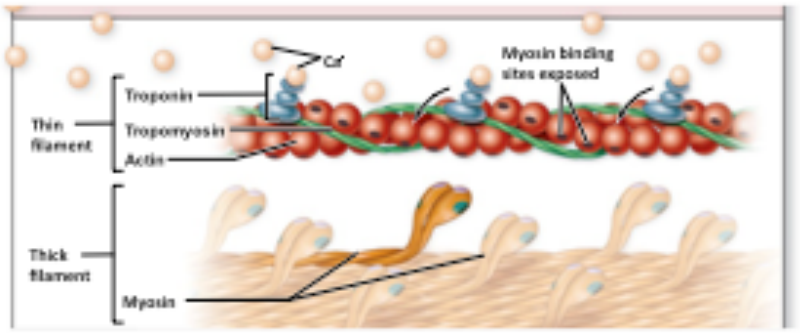
4. When muscle length is too long, why does tension decrease (explain at the molecular level)?

MUSCULAR SYSTEM

Complete the PhILS #8 lab for Skeletal Muscle Function: Principles of Summation and Tetanus.

I. MUSCLE CONTRACTION

A. During muscle contraction, **calcium** is released from the sarcoplasmic reticulum to initiate actin and myosin binding. Calcium binds to the thin filament protein, troponin, which moves tropomyosin and reveals binding sites on actin. Myosin binds to actin, leading to the power stroke and sliding of the thin filaments over the thick filaments.



B. During contraction, muscle tension can be further increased if calcium release is prolonged. Increasing the frequency of action potentials increases calcium release in a process called **summation**.

II. TETANUS

A. When a muscle is stimulated repeatedly before it can fully return to a relaxed state, muscle tension increases in a process called **incomplete tetanus**.

B. If a muscle does not relax at all between stimulations, muscle tension is maximum in **complete tetanus.**

III. GOALS OF THE LAB

1. Dissect the gastrocnemius (calf) muscle from a frog and prepare for stimulation and recording.
2. Record muscle tension at increasing stimulation frequencies.

IV. DATA COLLECTION

Complete the data table below with your results and match the graphs presented with the appropriate term.

	Time interval (milliseconds)
(A) Summation	
(B) Incomplete Tetanus	
(C) Complete Tetanus	

Figure 1: Muscle Twitch (Baseline)

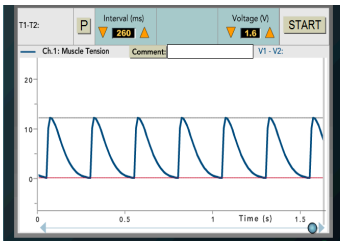


Figure 2

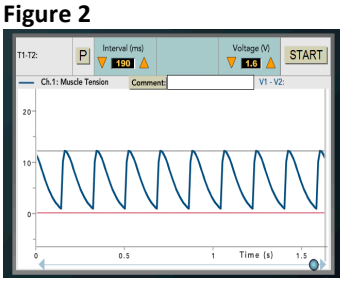


Figure 3

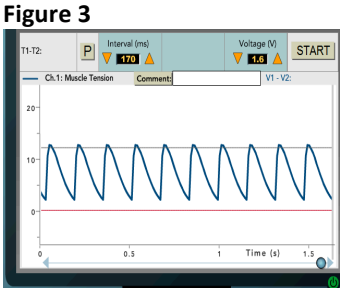
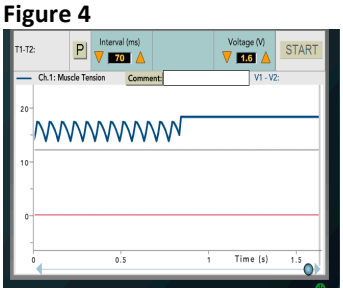


Figure 4



V. APPLICATION QUESTIONS

1. Figure 1 represents baseline muscle twitches. Match the other three Figures with the correct term below:

   a. Summation –

   b. Incomplete tetanus –

   c. Complete tetanus –

2. As the frequency of stimulation increases, muscle tension increases. What happens to calcium l evels in the cytoplasm during this time?

NERVOUS SYSTEM

Identify nervous tissue (and associated structures) under the microscope and using pictures. Give main locations and functions in the body.

NERVOUS HISTOLOGY:

Nervous tissue (neuron, nucleus of neuron, neuronal processes, nuclei of glia)

Identify the following structures on the neuron, brain, and spinal cord models. Identify the components of a reflex arc.

NEURON MODEL:

Dendrites
Cell body
- Nucleus
- Nissl bodies

Axon
- Axon hillock
- Nodes of Ranvier

Neurofibril
Schwann cell
- Myelin sheath
- Neurilemma

BRAIN MODEL:

Cerebrum
- Frontal lobe
- Parietal lobe
- Temporal lobe
- Occipital lobe

Diencephalon
- Thalamus
- Hypothalamus
- Pineal gland (in epithalamus)

Brainstem
- Midbrain
- Pons
- Medulla oblongata

Pituitary gland
Corpus callosum
Cerebellum
Gyrus
Sulcus

SPINAL CORD MODEL:

White matter
- Lateral funiculus
- Posterior funiculus
- Anterior funiculus

Gray matter
- Dorsal horn
- Ventral horn
- Lateral horn

Central canal
Posterior median sulcus
Anterior median fissure
Dorsal root ganglion
Dorsal root
Ventral root
Spinal nerve

REFLEX ARC:

Receptor
Sensory (afferent) neuron
Interneuron
Motor (efferent) neuron
Effector

NERVOUS SYSTEM

Identify the 12 pairs of cranial nerves including name, number, sensory/motor/mixed, and function. Complete the cranial nerve testing lab to apply concepts to the clinical setting.

Number	Name	Sensory, Motor, or Mixed	Function
I	Olfactory	Sensory	Smell
II	Optic	Sensory	Vision
III	Oculomotor	Motor	Eye movement, pupil constriction
IV	Trochlear	Motor	Eye movement
V	Trigeminal	Mixed	Sensory: scalp, face, oral cavity for touch, pain, and temperature. Motor: muscles of mastication
VI	Abducens	Motor	Eye movement
VII	Facial	Mixed	Sensory: taste Motor: muscles of facial expression
VIII	Vestibulocochlear	Sensory	Hearing and equilibrium
IX	Glossopharyngeal	Mixed	Sensory: taste Motor: one pharyngeal muscle
X	Vagus	Mixed	Sensory: heart, lungs, abdominal organs Motor: most pharynx muscles and all larynx muscles
XI	Accessory	Motor	Trapezius and sternocleidomastoid
XII	Hypoglossal	Motor	Tongue muscles

CRANIAL NERVE TESTING

With a partner, test for cranial nerve function by following the instructions below. Record your personal information collected in the sections provided.

CN I: Olfactory

Have your partner close his/her eyes and close one nostril. Present one of the three scents provided and have your partner identify the smell. After a minute break, close the same nostril and present one of the other scents. Repeat for the last scent. Now close the other nostril and present the same scents in a different order. Be sure to allow a break in between scents.

LEFT NOSTRIL		RIGHT NOSTRIL	
Scent used	**Recognized (Yes or No)?**	**Scent used**	**Recognized (Yes or No)?**
Peppermint		Peppermint	
Orange		Orange	
Coffee		Coffee	

CN II: Optic

Have your partner close one eye and read the smallest line possible from left to right on the visual acuity chart. Now close the other eye and read the smallest line possible from right to left. Record the response below and state whether it matches the chart.

	Response	**Matches the chart (Yes or No)?**
Left eye		
Right eye		

CN III: Oculomotor

Have your partner sit facing you and look straight ahead. Use a pen light to shine light into one eye (come in from the side) and determine if the pupil in that eye constricts. Also note if the pupil in the other eye constricts. After a minute break, use the pen light to shine light into the other eye and determine if the pupil constricts.

	Constricts when light is presented to left eye?	**Constricts when light is presented to right eye?**
Left eye		
Right eye		

CN IV: Trochlear

Have your partner sit facing you. Ask your partner to follow your finger while you move it inferiorly. Track the eye movement and record if it is WNL (within normal limits) or O (abnormal).

	Eye movement
Left eye	
Right eye	

CN V: Trigeminal

Have your partner sit facing you and close his/her eyes. Use a cotton swab and gently move it across the face on one side. Have your partner identify where they feel the object. Repeat on the other side. Next, have your partner open his/her mouth against resistance to determine jaw function. Record as WNL or O.

	Response to touch
Left side	
Right side	

	Jaw movement
Response	

CN VI: Abducens

Have your partner sit facing you. Ask your partner to follow your finger while you move it laterally (to the left and the right). Track the eye movement and record as WNL or O.

	Eye movement
Left eye	
Right eye	

CN VII: Facial

Have your partner smile, blink, and squint. Observe facial expressions on both sides and record as WNL or O.

	Facial expression
Left side	
Right side	

CN VIII: Vestibulocochlear

Have your partner sit facing you. Strike the tuning fork gently against your palm and place the handle on the top of your partner's head in the middle. Ask your partner where they hear the sound (abnormal is along one side, normal is in the middle). Record WNL or O for the Weber test below.

	Weber test
Response	

Now use the same tuning fork and gently strike it against your palm. Place the handle on the mastoid process of your partner on one side. When your partner no longer hears the sound, place the end opposite to the handle near the opening of the pinna. If your partner can still hear the sound, then hearing is normal in that ear. Repeat with the other ear and record WNL or O for the Rinne test below.

	Rinne Test
Left ear	
Right ear	

CN IX: Glossopharyngeal
Have your partner open his/her mouth and say "ahh." Check that the soft palate elevates and the uvula stays along the midline. Record as WNL or O.

	Soft palate and uvula
Response	

CN X: Vagus
Have your partner swallow and ask if there are any difficulties completing this action. Record as WNL or O. Note: there is overlap in testing for CN IX and X.

	Swallowing
Response	

CN XI: Accessory
Have your partner elevate shoulders (trapezius) and turn head side to side (sternocleidomastoid). Record as WNL or O.

	Response
Trapezius	
Sternocleidomastoid	

CN XII: Hypoglossal
Have your partner stick out his/her tongue. Determine if tongue deviates to one side (abnormal). Record as WNL or O.

	Tongue
Response	

SPECIAL SENSES

Identify the following structures on the ear and eye models.

EAR MODEL:

External ear:
- Auricle/Pinna
- External acoustic meatus

Tympanic membrane

Middle ear:
- Auditory tube
- Auditory ossicles:
  - Malleus
  - Incus
  - Stapes

Oval window

Inner ear:
- Cochlea
- Semicircular canals
- Vestibule

Vestibulocochlear nerve

EYE MODEL:

External tunic:
- Cornea
- Sclera

Middle tunic:
- Choroid
- Iris
- Pupil
- Ciliary body

Internal tunic:
- Retina
- Fovea centralis
- Optic disc

Optic nerve

Anterior cavity
- Aqueous humor

Posterior cavity
- Vitreous humor

Lens

Suspensory ligaments

Identify the following muscles associated with the eye including innervation and functions for each.

EXTRINSIC EYE MUSCLES:

Muscle	Innervation	Action
Superior rectus	Oculomotor nerve (III)	Moves eye superiorly and medially
Inferior rectus	Oculomotor nerve (III)	Moves eye inferiorly and medially
Medial rectus	Oculomotor nerve (III)	Moves eye medially
Lateral rectus	Abducens nerve (VI)	Moves eye laterally
Superior oblique	Trochlear nerve (IV)	Moves eye inferiorly and laterally
Inferior oblique	Oculomotor nerve (III)	Moves eye superiorly and laterally

COW EYE DISSECTION

Identify the structures below by following the dissection instructions.

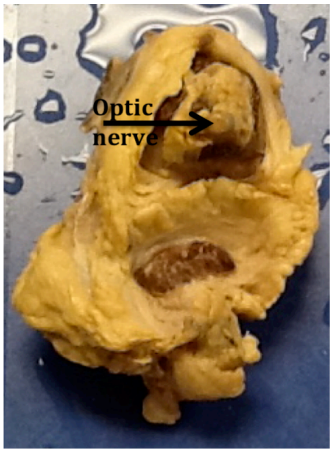
Structures to identify in the cow eye:

- Cornea
- Sclera
- Iris
- Pupil
- Anterior cavity
- Posterior cavity
- Vitreous humor
- Choroid
- Retina
- Optic nerve
- Optic disc
- Ciliary body
- Lens
- Suspensory ligaments

Dissection instructions:

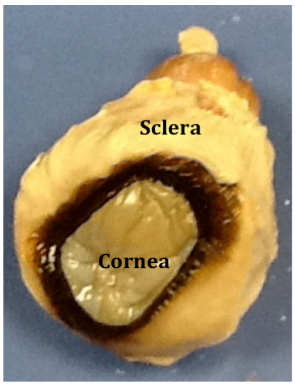
1) The cow eye you receive will have several layers of connective tissue, muscle, and fat surrounding it. You will need to cut away these layers before you can begin dissection on the eye. Be careful not to cut the optic nerve on the posterior side.

Anterior

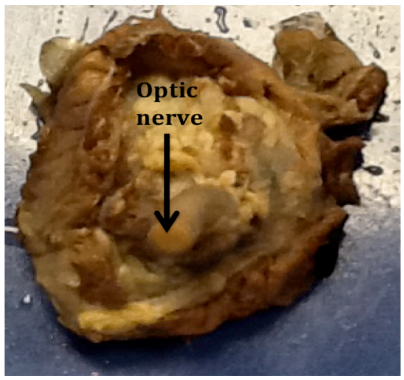


Posterior

2) Once you remove the muscle and fat, you will be able to see the **sclera**, **cornea**, and **optic nerve** clearly.

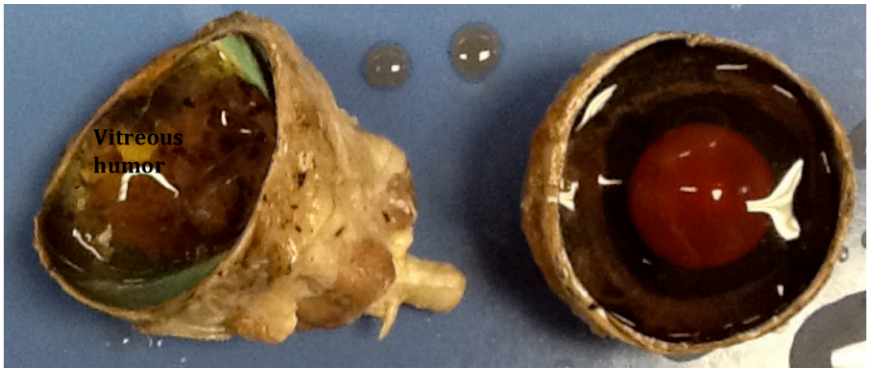


Anterior

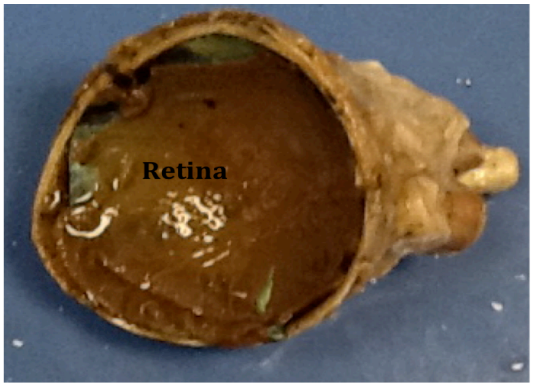


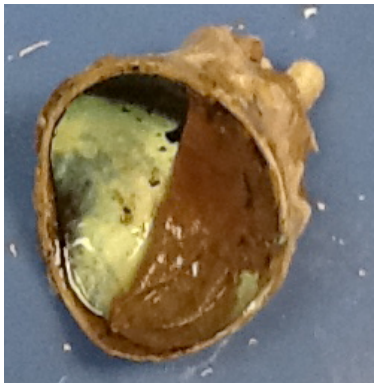
Posterior

3) Carefully make a coronal cut through the eye dividing it into the **anterior and posterior cavities**. Use the scalpel to make a small incision and then use the scissors to cut around the eye. You will need to go through all 3 layers of the eye. Be careful when separating the two parts as you want to keep the retina intact. You will be able to see and feel the jelly-like **vitreous humor** at this point.

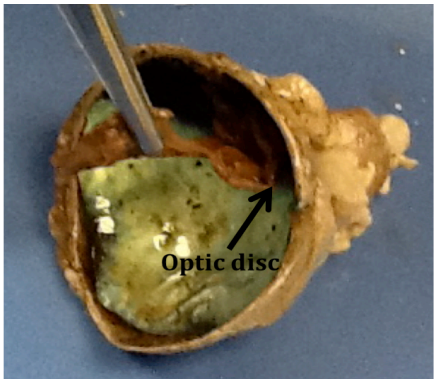


4) Carefully remove the vitreous humor from the posterior cavity. You want to avoid the retina detaching from the back of the eye. The **retina** will appear as a light brown thin layer. You can gently pull back on the retina using the forceps.





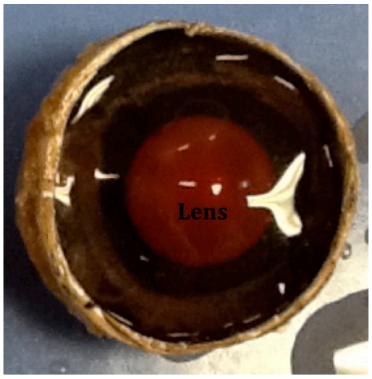
5) As you pull away the rest of the retina, you will notice that it easily detaches except at one spot-this is the **optic disc** or blind spot.

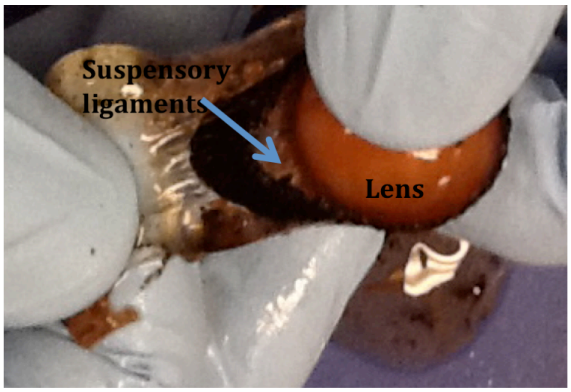


6) Next, you will see an irridescent layer. This is called the tapetum lucidum and is used to aid in night vision. This is often found in nocturnal animals, like cats and cows, but is not seen in humans. The glow of cat's eyes seen when a light is reflected into them is due to this layer.

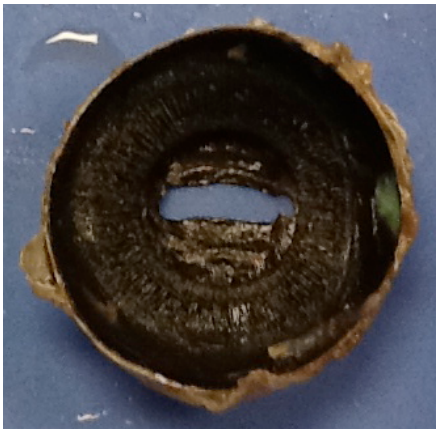
7) The dark pimented layer underneath the tapetum lucidum is the **choroid.**

8) Move to the anterior portion of the eye now. Carefully remove the vitreous humor while keeping the **lens** intact. Next, slowly pull the lens away from the ciliary body and note the **suspensory ligaments**.

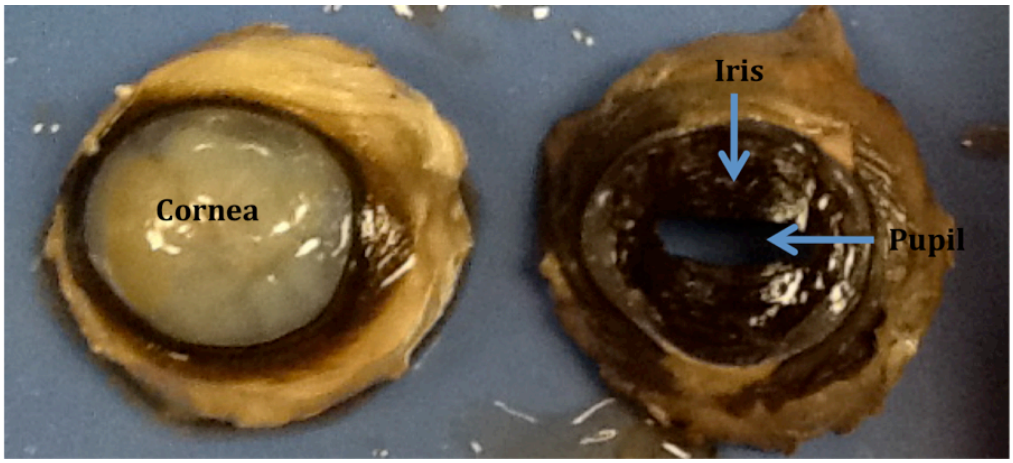




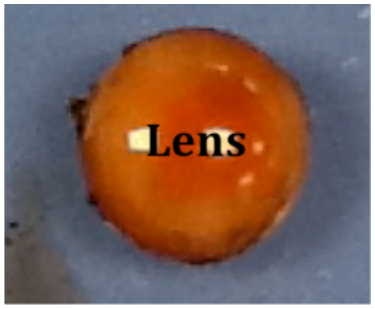
9) From the posterior view, the **ciliary body** is now visible.



10) From the anterior view, the cornea is visible. Cut away the cornea (you will need to go through several tough layers) to see the **iris** and the **pupil**.



11) Now take the **lens** and carefully make a mid-sagittal cut. You will see several layers that look like an onion. You can peel away these layers of the lens.



Lab Clean-up:

- ☐ All dissected parts should be placed in the plastic bags provided by the instructor.
- ☐ Dissection trays and tools should be cleaned with soap and water and then dried thoroughly.
- ☐ Lab tables should be wiped with disinfectant spray.
- ☐ Gloves and paper towels can be disposed of in the lab trash.

SHEEP BRAIN DISSECTION

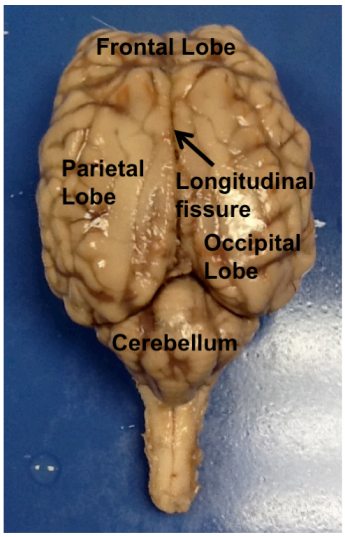
Identify the structures below by following the dissection instructions.

Structures to identify in the sheep brain:

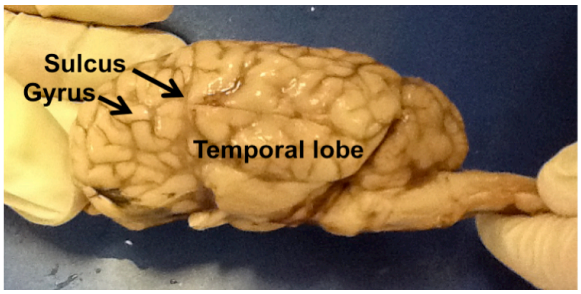
- Frontal lobe
- Parietal lobe
- Temporal lobe
- Occipital lobe
- Cerebellum
- Gyrus
- Sulcus
- Longitudinal fissure
- Pineal gland
- Superior colliculus
- Inferior colliculus
- Olfactory bulb
- Optic nerve
- Optic chiasma
- Optic tract
- Mammillary body
- Midbrain
- Pons
- Medulla oblongata
- Corpus callosum
- Thalamus
- Hypothalamus
- Lateral ventricle
- Third ventricle
- Fourth ventricle

Dissection instructions:

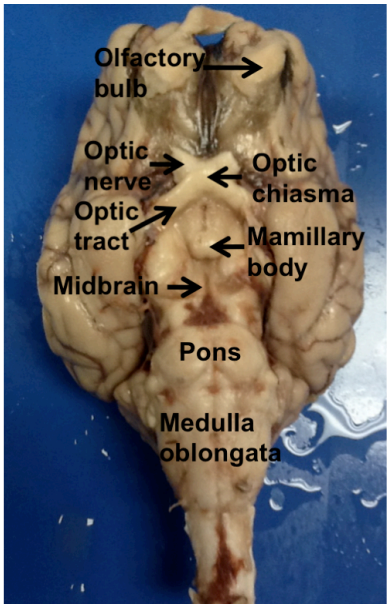
1) The sheep brain you receive may have some meninges still attached. Carefully cut away these layers being sure not to damage the brain in the process. Place the brain ventral side down in the dissection tray and locate the following structures: **frontal lobe, parietal lobe, occipital lobe, longitudinal fissure, cerebellum.**



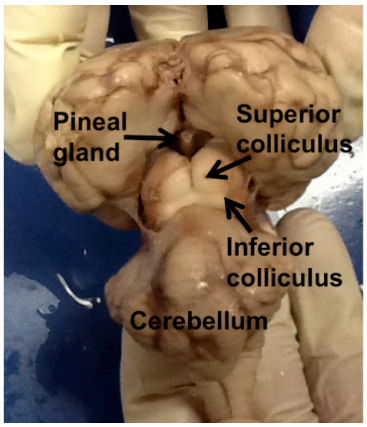
2) Now place the brain on the lateral side and locate the following structures: **sulcus, gyrus, temporal lobe.**



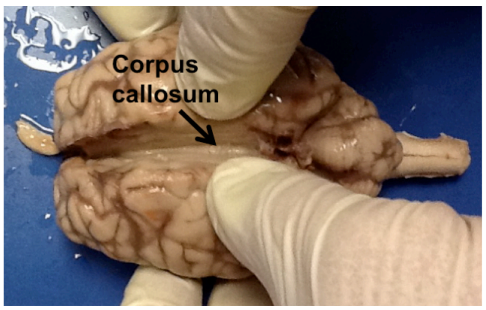
3) Now place the brain on the dorsal side and locate the following structures: **olfactory bulb, optic nerve, optic chiasma, optic tract, mamillary body, midbrain, pons, medulla oblongata.**



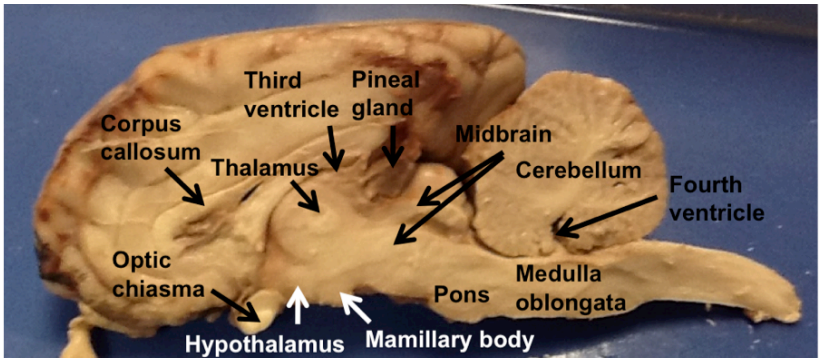
4) With the dorsal side facing you, carefully pull apart the cerebellum from the cerebrum. This will allow you to locate the following structures: **pineal gland, superior colliculus, inferior colliculus, cerebellum.**



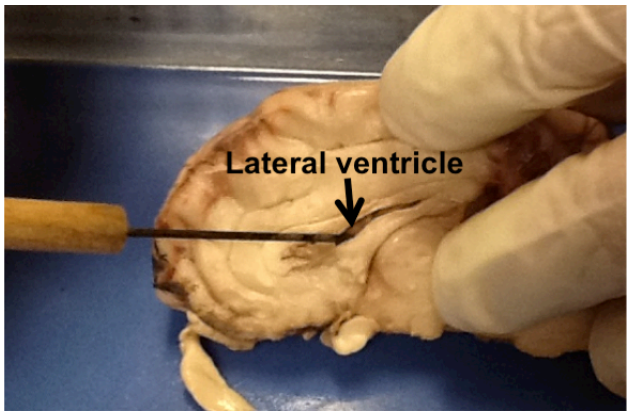
5) With the dorsal side facing you, gently separate the two cerebral hemispheres along the longitudinal fissure. You will find a white band of fibers, the **corpus callosum**, that allows communication between the two hemispheres.



6) Now take a scalpel and make a median cut. Your cuts should be smooth (don't saw the tissue). You will likely make several cuts as you work through the median section. Carefully separate the two halves and locate the following structures: **corpus callosum, optic chiasma, thalamus, hypothalamus, third ventricle, pineal gland, mamillary body, midbrain, pons, medulla oblongata, cerebellum, fourth ventricle.**



7) Note the **lateral ventricle** near the corpus callosum.



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