Anatomy and Physiology BIOL&241

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Lecture notes are separated by dividers that indicate a new topic or section.

NOTE : ***Laboratory assignments*** will follow this sequence for summer quarter.

CELL BIOLOGY

CELL BIOLOGY BIOL&241

This is information that you are expected to have or to acquire on your own. I highly recommended that you have a basic understanding of the following before continuing. Please see me if you have questions, but remember this is a 200 level class and you are expected to come to the class with or be able to obtain this background information quickly.

LEARNING OBJECTIVES

Define a cell and list its principle parts.
Define an organelle and a cellular inclusion.
Explain the difference between smooth and rough endoplasmic reticulum, relating structure and function.
Describe the organization of the Golgi apparatus, how are vesicles derived from it.
Explain the roles of cilia and flagella.
Explain the structure and function of these organelles: cytosol, nucleus, lysosomes, peroxisomes, mitochondria, centrosomes, and cytoskeleton.
Explain the structure and functions of the plasma membrane.
Describe the stages and events of somatic cellular division.
Describe cancer cells and how they represent an imbalance of homeostasis.

OUTLINE

I. Cellular Biology
- A. What is a cell?
- B. General Organization
  1. Plasma (cell) membrane
     - a. Structure:Fluid Mosaic
       - Phospholipid bilayer
       - Proteins and Lipids
     - b. Functions:
       - Physical isolation
       - Exchange w/ environment
       - Sensitivity
       - Structural support
     - c. Molecular Characteristics
       - Hydrophobic/Hydrophilic
     - d. Lipid Layer:
       - Phospholipids
       - Glycolipids
       - Cholesterol
     - e. Membrane Proteins:
       - Integral or Peripheral
       - Functions:
         - Channel (pore)
         - Transporter
         - Receptor
         - Enzymes
         - Cytoskeleton anchor proteins
         - Cell identity markers
  2. Cytoplasm:
     - Viscous
     - 75-90% water
     - Colloids
     - Inorganic/organic substances

Cellular Biology - continued

3. Organelles - know structure and function; membranous vs. nonmembranous
   a. Nucleus - DNA
   b. Mitochondria
   c. Endoplasmic reticulum (ER): Smooth and Rough
   d. Golgi Apparatus
   e. Lysosomes
   f. Perioxisomes
   g. Nucleolus
   h. Ribosomes
   i. Nutrient Pools
   j. Cytoskeleton:

Microfilaments	Intermediate filaments
Thick filaments	Microtubules

   k. Cilia
   l. Flagella
   m. Centrioles

II. Mitosis = Cell division where two identical daughter cells are created from a parent cell. Occurs in the somatic cells of the body.

A. Cell cycle

1. Two stages

a. Cytokinesis - division of cytoplasm b. Karyokinesis - division of genetic material

B. Interphase - no rod shaped chromosomes are seen, DNA is still uncoiled. Biochemical reactions of life are taking place.

2 phases - Gap (Growth) and synthesis

a. G_0 = proteins, lipids, and carbohydrates are synthesized. major portion of the cells life. Growth phase of the cell. Performing all other cell functions.

b. G_1 = more proteins are synthesized in preparation for cell division, proteins for new organelles are formed, along with new organelles such as mitochondria

c. S = replication of genetic material, microtubules are formed - to be used to make spindle apparatus, each chromosome is made into 2 daughter structures - chromatids. Each chromatid is held together by a centromere.

d. G_2. = The chromosomes condense, and there is microtubule formation. New organelle membranes are stored in vesicles. Microtubules are added for spindle apparatus. Centrioles replicate.

End = DNA starts winding around associated proteins and is able to be seen with stains - condensation of chromosomes

C. Prophase - chromosomes are visible with a light microscope.

Formation of spindle apparatus continues. Condensation continues. Nuclear envelope breaks down (absorbed by the ER). rRNA synthesis stops. The nucleolus disappears. Centriole(not seen in plants), pulls to opposite sides of the cell and microtubule spindle fibers are connected. Centromeres are attached to the centrioles through microtubules in the spindle apparatus

D. Metaphase - sister chromatids (46 pairs) align along the plane of division in the center of the cell.

Kinetocore, made of protein, attaches the microtubule to the centromere, acts as a link of the chromatid to the spindle. At the end of Metaphase - the centromeres divide

E. Anaphase - separation of sister chromatids to opposite sides of the cell. Lasts a very short period of time.

The poles of the spindle apparatus move apart and pull the chromatids. As the centromeres are pulled to the poles, the microtubules are shortened by removing the tubulin subunits.

F. Telophase - spindle apparatus is disassembled. Nuclear membranes (nuclear envelope) are reformed around each sister chromatids, the nuclei reform. Microtubules are broken down, spindle apparatus is disassembled. Tubulin is disassembled. rRNA genes start expression in the nucleolus. Chromosomes uncoil.

End of karyokinesis

G. Cytokinesis - end of Telophase, two nuclei on each side of the cell, and reassortment of the organelles. Division of cytoplasm. In animal cells there is a cleavage furrow made up of a microfilament belt. In plant cells the division centers around a cell plate.

Meiosis We will not cover this, but it may be useful in future studies

Meiosis = gamete production.

Meiosis vs. Mitosis:

1. Meiosis - homologous pairs split lengthwise, chromatids exchange information by crossing over.
2. Meiosis - sister chromatids are not identical after crossing over. Homologous pairs - chromosomes of like size pair up, genetic information is exchanged in crossing over.

Two Stages - Meiosis I and Meiosis II

Continued on the back

MEIOSIS I

I. Prophase I - DNA replicated and the chromosomes become visible by coiling. Synapsis - homologous pairs come together and are bound by proteins. There are 4 chromatids for each chromosome, 23 chromosomes - 4 stands. Or two sister chromatids joined together. Homologues exchange information by crossing over.
Homologous chromosomes pair and exchange segments.

II. Metaphase I - Nuclear envelope disappears. Microtubules form spindles (just like mitosis). Homologous pairs align along the central plane. Microtubules span from the kinetocores to the centrioles.
Homologous chromosomes align along a central plane.

III. Anaphase I - Centromeres move to the poles (do not split as in mitosis). Each pole will contain both sister chromatids, and is haploid The movement to the poles is a process of Independent Assortment.
Homologous chromosomes move toward opposite poles.

IV. Telophase I- Chromosomes are at each pole - but the genetic make up of each pole is different. Cytokinesis may or may not occur.
Individual chromosomes gather at each pole.

MEIOSIS II - same as mitotic division, same steps - Prophase, Anaphase, Metaphase, Telophase. Pull apart chromosomes to produce 4 haploid cells - these are gametes in animal cells. In plants, fungi, and protista - these may go into mitosis and cell division.

TISSUES

LEARNING OBJECTIVES

1. Define a tissue and classify the tissues of the human body.
2. Describe the structure and functions of cell junctions.
3. Describe the general features of epithelial tissues.
4. List the structure and function of the following types of epithelium: simple squamous, simple cuboidal, simple columnar, stratified squamous, stratified cuboidal, stratified columnar, transitional, pseudostratified, and glandular.
5. Distinguish between endocrine and exocrine glands.
6. Describe the general features of connective tissues.
7. Discuss the cell, ground substance, and fibers that compose connective tissue.
8. List the structure and function of the following types of connective tissue: loose (areolar), dense regular collagenous, dense regular elastic, adipose, reticular, hyaline cartilage, fibrocartilage, elastic cartilage, cartilage, bone, and blood.
9. Define mucous, serous, cutaneous and synovial membranes.
10. Compare and contrast the three types of muscle cells as regarding structure and location.
11. Describe the structure and function of nervous tissue.

OUTLINE

I. Tissues - know structure and function
   A. Epithelial
      1. Functions

      2. Arrangement:

         Simple

         Stratified

         Pseudostratified

      3. Shapes:

         Squamous

         Cuboidal

         Columnar

         Transitional

4. Surfaces:

    Apical

    Basal

    Basement Membrane = basal lamina/reticular lamina

5. Glandular:

    Apocrine

    Merocrine

    Holocrine

    Types:

        Unicellular: Goblet cells

        Multicellular:
            Tubular
            Alveolar
            Combination

    Secretions:
        Serous
        Mucous
        Mixed

B. Connective Tissue

1. Types:

CT Proper

Loose vs. Dense

Fluid CT

Blood and Lymph

Supporting CT

Bone/Cartilage

2. Cell types:

Fixed cells

Wandering cells

3. Structure:

CT Fibers

Ground Substance

4. Fascia:

Superficial

Deep

Subserous

C. Muscle Tissue:

Smooth

Striated(Skeletal)

Cardiac

D. Nervous Tissue

BONE HISTOLOGY AND DEVELOPMENT

LEARNING OBJECTIVES

1. Describe the role of the following structures in relation to the skeletal system: tendons, ligaments, hyaline cartilage, chondroblasts, chondrocytes, perichondrium, osteoblasts, osteocytes, osteoclasts, collagen, and hydroxyapatite.
2. Describe the microscopic structure of bone including organic and inorganic material as well as the anatomical structures such as the Haversian canal, lamellae, lacunae, canaliculi, and Volkman's canal. Be able to either describe or identify the structure on a diagram or model.
3. Describe the structure of long bone including the compact and spongy bone, epiphysis, diaphysis, medullary cavity, endosteum, and articular cartilage. Be able to either describe or identify the structure on a diagram or model.
4. Compare and contrast the processes of intramembranous, and endochondral bone formation, including the role of chondrocytes, osteocytes, osteoblasts, and osteoclasts.
5. List the four types of bone and give an example.
6. Describe the characteristics of the newborn skull including the fontanels: frontal (anterior), sphenoid (anterolateral), mastoid (posterolateral), and occipital (posterior).
7. List the types of joints by functional classifications and describe the associated function.
8. List the types of joints by structural classification and give an example of each: fibrous, cartilaginous, and synovial.
9. Diagram and describe a synovial joint including the following: synovial cavity, articular cartilage, articular capsule, fibrous capsule, synovial membrane, synovial fluid, menisci, bursae, and articulating bones.
10. Identify the kind of joint between any two bones in the skeleton.
11. Identify the various types of movement possible at the joints.
12. Identify the bones and parts of bones that are required for your lab exercises. Be able to identify these on a skeleton, model, diagram, or isolated bone.

OUTLINE

I. Skeletal system: 206 bones, CT - cartilage, tendons, ligaments, discs

A. Functions

1. Bone

2. Cartilage

Types:

Hyaline

Elastic

Fibrocartilage

3. Tendons and Ligaments

B. Bone Structure

1. Shapes of bone:

   Long

   Short

   Irregular

   Flat

   Sesamoidal

   Sutural

2. Matrix:

   Organic components

   Inorganic components

3. Compact Bone - structure

   a. Osteons or Haversian systems

   b. Lamellae

   c. Haversian Canal

   d. Osteocytes

   e. Lacunae

   f. Canaliculi

   g. Perforating (Volkman's) canal

4. Spongy/Cancellous Bone:

    Trabeculae

5. Terms

    Epiphysis

    Diaphysis

    Periosteum

    Articular cartilage

    Medullary Cavity:

    Red and Yellow marrow

C. Bone Formation

1. Intramembranous

2. Endochondral: Primary and Secondary Centers of Ossification

3. Process of bone formation

D. Bone Repair

1. Hematoma - blood clot near fracture

2. Granulation - fibroblasts and capillaries invade fracture

3. Callus formation -granular tissue becomes dense, cartilage laid down

4. Ossification - osteoblast from periosteum lay down, cancellous bone to replace cartilage, later compact bone replaces cancellous

II. JOINTS

A. Function

B. Types

1. Synarthroses

2. Amphiarthroses

3. Diarthroses

a. Non-axial

b. Uniaxial

c. Biaxial

d. Multiaxial

C. Synovial Joints - Structure

1. Articular cartilage

2. Joint Cavity

3. Fibrous Capsule

4. Reinforcing Ligament

5. Synovial Fluid

6. Bursae

7. Tendons

8. Menisci

D. Disorders

1. Inflammation

2. Arthritis:

Osteoarthritis

Rheumatoid arthritis

Gout

D. Disorders- continued

3. Sprains

4. Cartilage injuries

5. Dislocation

C. Movements:

flexion (dorsiflexion, plantar flexion)

extension (hyperextension)

abduction

adduction

circumduction

rotation

supination

pronation

inversion

eversion

protraction

retraction

elevation

depression

opposition

MUSCLES

LEARNING OBJECTIVES

1. Describe the characteristics and functions of muscle tissue. Include the structural elements - tendons, aponeuroses, epimysium, fascia, perimysium, endomysium, muscle fiber (cell).
2. Describe the organization of muscle tissue at the cellular level. Include the sarcoplasm, t-tubules, sarcoplasmic reticulum, myofibril, myofilament, actin, troponin, tropomyosin, crossbridge, Z line, H zone, A band, I band, sarcolemma, and sarcomere. Be able to identify the structure on a diagram or model.
3. Differentiate between skeletal, cardiac, and smooth muscle.
4. Identify the structural components of a sarcomere.
5. Identify the components of a neuromuscular junction and the events involved. Including the motor end plate, neurotransmitters, and how to stop the activity.
6. Explain the steps involved in a muscle contraction. Include the role of Ca^{2+}, role of ATP, and the steps leading to contraction and relaxation.
7. Describe the mechanisms by which muscle fibers obtain energy for contraction: the role of ATP in the transfer of energy, how it is made, how it is degraded, how it is built up, and why it is important.
8. How do different muscle types perform based upon the structure and type?
9. Distinguish between aerobic and anaerobic muscle performance. Describe the characteristics of slow and fast twitch muscles, including red fibers and white fibers.
10. Discuss the roles of skeletal, cardiac, and smooth muscle in the body.

OUTLINE

I. Muscle Cells

Skeletal

size

multinucleated

development

Cardiac

Smooth

II. Whole skeletal Muscle

III. Internal structure of a skeletal muscle

Epimysium

Perimysium

Endomysium

Fascicle

IV. Internal structure of a muscle cell

1. Sarcolemma = plasma membrane

   structure

   ability to conduct neuronal impulse

   T-tubules

2. Sarcoplasm = cytoplasm

   mitochondria

   granules of glycogen

   myofibrils

   sarcoplasmic reticulum

   myoglobin

3. Myofibrils

4. Myofilaments = bundle together to make up myofibrils

   actin

   mysosin

5. Sarcomeres - repeating units of myofibrils, make myofibril subunits

   A band

   I band

   Z disk

   H zone

V. Neuromuscular junction

VI. Sliding Filament theory

Structure of **Thick** Filament -

Myosin 10-12nm diameter, 1.6*u*m length

chains - or tails w/ globular heads

Structure of **Thin** Filaments -

Actin 5-6nm diameter, 1*u*m length

Three different proteins
f-actin

tropomyosin

troponin

Sarcoplasmic reticulum – Ca^{2+}

Powerstroke of Muscle Contraction - the cycle
1. Sequence

2. Relaxation

VII. Muscle Contractility

Rate ATP hydrolyzed

Muscle Energetics and Metabolism

1. Resting

2. Contracting

3. Creatine phosphate

F. Skeletal Muscle Fiber Types

1. Slow oxidative = red fibers

2. Fast oxidative/somewhat glycolytic

3. Fast glycolytic = white muscle

G. Effects of Training

1. Increase oxygen capacity

2. Decrease lactic acid production

3. Increase lactic acid export

4. Increase density of mitochondria and capillaries!

Oxidative

Glycolytic

Body Builders

Atrophy

VIII. Physiology of Cardiac Muscle

A. Structure

B. Differences

Structural

Functional

IX. Physiology of Smooth Muscle

A. Structure

B. Differences

Structural

Functional

Neural Control

Altering neuromuscular junctions- if there is enough time to cover this

1. Curare

2. Inhibit AChase

3. Botulism

4. Myasthenia gravis


HEART

THE CARDIOVASCULAR SYSTEM Ch 20 and 21

LEARNING OBJECTIVES:
1. Describe the histological structures of the heart, pericardial sac, and clinical conditions.
2. Identify the components of the conduction system of the heart.
3. Explain dysrhymias and heart blocks
4. Determine blood pressure and factors that influences it.
5. Where does blood go as it travels through the heart?
6. What are some common pathologies of the heart?
7. Explain what an ECG is and what information it provides.
8. Explain the process of fetal circulation and changes that occur at birth.

2 parts to the system:

1. SYSTEMIC CIRCUIT

2. PULMONARY CIRCUIT

3. O_2 rich and O_2 poor blood

4. Cellular features of cardiac muscle
   Gap junctions

Living Anatomy of the Heart

RIGHT ATRIUM

RIGHT VENTRICLE

LEFT ATRIUM

LEFT VENTRICLE

EPICARDIUM

MYOCARDIUM

ENDOCARDIUM

CT

Intrinsic Conduction System

SA node

Internodal pathway

AV Node

AV bundle

Bundle branches

Pukinje Fibers

ELECTROCARDIOGRAM (ECG/EKG))

P wave

QRS wave

T wave

Cardiac Action Potential

Autorythmic cells

Contractile cells

Gap Junctions

Sodium channels

Potassium Channels

Calcium Channels

Cardiac Cycle

Five phases:

1. PASSIVE FILLING
2. ATRIAL CONTRACTION
3. ISOVOLUMETRIC VENTRICLUAR CONTRACTION
4. EJECTION
5. ISOVOLUMETRIC VENTRICULAR RELAXATION

Correlation of events on the left side of the heart

Cardiac Output:

CO = HR (heart rate) X SV (stroke volume)

Factors effecting cardiac output

Cover on your own if not done in class
VALVULAR DEFECTS

MURMURS

MITRAL VALVE PROLAPSE

CONGENITAL HEART DEFECTS
SEPTAL DEFECTS

CORONARY CIRCULATION

CORONARY PATHOLOGIES
ATHEROSCLEROSIS

HYPERTENSION

ANGINA

CORONARY THROMBOSIS

CORONARY ANGIOGRAPHY: newer methods include CAT scan and MRI

.Arrhythmia - Disrhythmia

Abnormal ECG's – Please find some on the Internet

A) partial heart block - part of the electric impulse is blocked
    the QRS sequence does not follow every P wave
    the ventricle misses impulses (about every 2nd or 3rd) → causes "dropped beats"
        ventricle beats about every 3rd time to the atrial beats
    when QRS is present it is in the correct position and sequence

B) complete heart block
    has both P and QRS waves
    indicates both atrial and ventricular contractions but with no correlation to their positions
        independent atrial and ventricular rhythms

C) atrial fibrillation - rapid uncoordinated contractions
    no regular contractions of the atria: no P wave on the tracing
    without the P wave the ventricular contractions are irregular and independent

D) ventricular fibrillation
    irregular heartbeat occurs
    life threatening - use electric shock and defibrillation to hopefully rectify

FETAL CIRCULATION

I. Maternal

II. Fetal

III. Changes at Birth - closing the shunts

IV. Faulty Shunt Transformation

BLOOD VESSELS

BLOOD VESSELS OUTLINE Ch 21

LEARNING OBJECTIVES

1. Compare and contrast the structures and function of veins and arteries.
2. What are the functions of **each layer** of the blood vessels?
3. How is blood flow controlled and detected?
4. Identify & explain some common pathologies of arteries and veins.

Blood vessel structure and function

Blood vessel walls – 3 tunics (layers)

Tunica intima

Tunica media

Tunica adventitia

Comparing Arteries, Veins and Capillaries

Pathway of blood through the vessels

Arteries

ELASTIC (Conducting)

MUSCULAR (Distributing)

ARTERIOLES

CAPILLARIES

Exchange of material between the blood and tissues

VENULES

LARGER VEINS

LARGEST VEINS

Venous pathologies

Venous valves

Respiratory Pump

Measuring BP

Laminar Flow

Blood pressure graph

Systole

Dicrotic Notch

Diastole

Pulse pressure

Mean arterial pressure

Blood pressure sounds

FACTORS THAT AFFECT BLOOD PRESSURE:

Peripheral resistance (what influences this?)

Viscosity (influences?)

Diameter (influences?)

FACTORS THAT AFFECT BLOOD PRESSURE: continued

Sympathetic stimulation (influences?)

Vasoconstrictors

Vessel length

Vessel elasticity

ATHEROSCLEROSIS/ARTERIOSCLEROSIS

Techniques for Elimination of Plaques

Blood volume

Cardiac output

BLOOD PRESSURE REGULATION

Where is it measured?
Baroreceptors

Where is it regulated?
Sympathetic and Parasympathetic NS

Vasoconstriction

Short term versus long term

Kidney

Osmolarity

Autoregulation and Capillary Dynamics

Sphincters

Extrinsic control/Intrinsic Control

Chemoreceptors

O^2

CO^2

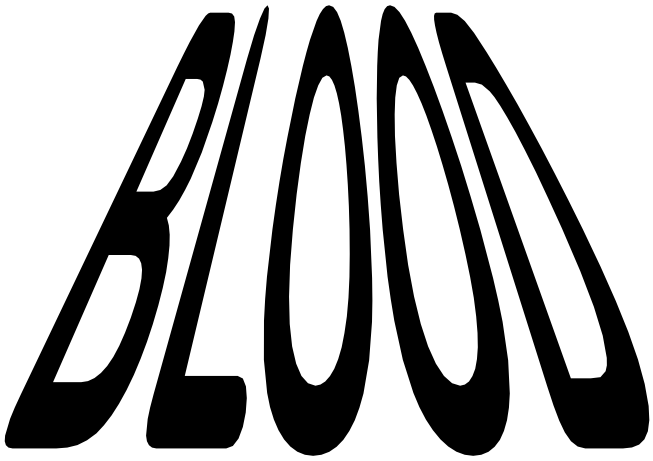
pH

Nutrients

Temperature

BP/Blood volume

CV reflexes


BLOOD

BLOOD OUTLINE Ch 19

LEARNING OBJECTIVES

1. What are the major components of blood?
2. How do RBC's, WBC's, platelets, and plasma function?
3. How are blood types determined?
4. What are the differences between the WBC's in terms of structure and function?
5. What are the basic functions of blood? Explain how each works.

I. FUNCTIONS

A. Transport

B. COAGULATION

C. TEMP. REGULATION

D. ANTI-BACTERIAL ACTION

E. PHYSIOLOGICAL ACTIVITY

F. HORMONE TRANSPORT

G. BUFFER: ACID/BASE

II. LIQUID CT

A. RBC's (ERYTHROCYTES)

B. WBC'S (LEUKOCYTES)

NEUTROPHILS

EOSINOPHILS

BASOPHILS

LYMPHOCYTES

MONOCYTES

C. PLATELETS (THROMBOCYTES)

D. PLASMA: (NONLIVING MATRIX)

E. BLOOD TYPES


IMMUNITY

IMMUNITY Ch 22

LEARNING OBJECTIVES
1. Explain what is meant by non-specific and specific defense.
2. Explain how the physical barrier of skin is reinforced by chemical defenses.
3. Describe phagocytic white blood cells.
4. How do natural killer cells function.
5. Describe the inflammatory response.
6. What are complements and interferon and how do they function?
7. Distinguish between active and passive immunity.
8. Explain how humoral and cell mediated immunity are different.
9. How do T cells and B cells function?
10. Distinguish between a primary and secondary immune response.
11. What are antigens? Antibodies?
12. What are the T cells and how do they differ in function?

Group Study Worksheet
1. What are the three primary types of T-cells and how is each unique?

2. What are the primary events of the cell-mediated immune response? Briefly explain each.

3. What are the primary events of the humoral immune response? Briefly explain each.

IMMUNITY

OUTLINE

I. Nonspecific Defense

A. Skin and Mucous Membranes

B. Leukocytes

neutrophils -

monocytes -

eosinophils -

natural killer cells -

C. Antimicrobial Proteins

complement -

interferon -

D. Inflammatory Response

E. Lymphatic System

F. Temperature

II. Specific Response

A. Cells

T Cells

B Cells

B. Strategies

Innate immunity

Active immunity

Passive immunity

Humoral response

Cell mediated response

C. Memory

Respiration

Respiration Ch 23

LEARNING OBJECTIVES
1. Identify the structure and their functions of the respiratory system.
2. Explain the exchange of gases at the alveolar/capillary level and the tissue/capillary level.
3. Explain how inspiration and expiration occur.
4. Explain the structure and functions of hemoglobin.
5. Describe the various factors that control respiration.
6. Be able to discuss the pathologies that were presented in class.

TENTATIVE OUTLINE

I. Function

Respiration -

Pulmonary ventilation,

External respiration

Internal respiration

II. Anatomy – we will do this in lab

A. Clinical

1. Rhinoplasty
2. Laryngitis
3. Cancer of the larynx
4. Tracheostomy
5. Nebulization
6. Atelectasis
7. Pleurisy
8. Asthma
9. Emphysema
10. Hypoxia. - Hypoxic, Anemic, Stagnant, Histotoxic

III. The physics of it all

A. Inspiration -Boyle's Law

A. Inspiration continued:
Muscles:

costal breathing

diaphragmatic breathing

B. Expiration

C. Compliance

D. Airway resistance

E. 12 inspire/expire per minute = normal

F. Pulmonary Volumes
1. Tidal volume - Anatomical Dead Space

2. Minute Volume of Respiration (MVR)

3. Inspiratory Reserve Volume

4. Inspiratory capacity

5. Expiratory Reserve Volume

6. Residual volume

7. Functional reserve volume

8. Vital capacity

9. Total lung capacity

G. CO2 - O2 exchange

IV. Hb - polypeptide

V. Oxygen Dissociation Curves

VI. Factor Affecting the curve

1. Temp
2. pH - Bohr Effect
3. 2,3 DPG
4. P_{CO2}

VII. Fetal Hb

VIII. Control of Respiration

A. Nervous

1. Medulla
2. Pneumotaxic area of pons
3. Apneustic area of pons
4. Cortex - voluntary
5. Preset

B. Receptors

1. Stretch
2. Chemical
3. Proprioceptors
4. Baroreceptors

LABORATORY ASSIGNMENTS

Lab #3 and #5.1 & 5.2 and #1 The Microscope and Transport BIOL&241

LEARNING OBJECTIVES

1. Develop the ability to make precise observations through proper focusing.
2. Be familiar with the parts of the microscope and their functions.
3. Develop skill using the microscope and demonstrate proper care.
4. Define the following: total magnification, resolution, parfocal, field, depth of field.
5. Estimate the size of an object in a microscope.
6. Differentiate between diffusion and osmosis.
7. Discuss the ability of cells to transport material across the plasma membrane.

KEY WORDS

Lab 3: Base, Condenser, Head, Parfocal, Field, Objectives: scanning, low, high, oil, Light source, Iris diaphragm lever, Ocular, Total magnification, Working distance, Stage, Course/fine adjust, Nosepiece, Resolution, Depth perception

If you know all the parts of the microscope – you have a good start to using the microscope efficiently.
Here are some thought questions to prepare you to understand the microscope.

1. What is happening to the image, as is "travels" through the microscope?
2. What are some practical reasons for understanding the *total magnification* on a microscope?
3. Why does the image move the opposite direction in the *ocular lenses* versus the actual movement from the *mechanical stage*?
4. As a microscope repair technician, why do you think the *working distance* has importance?
5. How would you explain to a sixth grader what *depth perception* is in the microscope?

SKIP THIS ACTIVITY

Lab 5A and B: selective permeability, passive transport, active transport, diffusion, osmosis, hypotonic/hypertonic, isotonic, plasma membrane, concentration gradient

EXPERIMENTS

In groups, work on lab exercise 1, 3, & 5. You will work on one exercise at a time and then move onto the next.
Do the sections of lab exercise 3 - work on your own with your own microscope.

Look at the slides of different cells.

Hints: draw a picture of a slide noting as much detail as possible, try using a circle
use colored pencils to make your drawings
ability to draw is not important - labels will help with clarification
observe color, variations in color, shape, edges of the shape, and objects inside the shape

Read through lab 5A and 5B to gain an understanding of the basic concepts.

For lab 5A – do activities 2 & 3, read through the rest. Do lab 5B on your own.
Use the CD-ROM for lab 5B

Questions for exercise 5

1. When the kidneys fail, often dialysis needs to take place to rid the body of substances that may be toxic or unneeded. What do you predict would be necessary for dialysis to occur? Is this passive transport, diffusion, active transport, or some other mechanism? How is it possible to perform dialysis without a kidney?
2. Why do cells need to regulate transport in and out of the cell? Why not just let everything in? Or keep everything out?
3. Why are there several methods for transport in and out of the cell? Why not just one method such as diffusion?

Lab #1The Language of Anatomy BIOL&241

LEARNING OBJECTIVES

1. Describe the anatomical positions: verbally and by demonstration.
2. Be able to describe the body orientation and direction, planes, sections and surfaces.
3. Name the body cavities and the major organs present.

KEY WORDS

Section	Plane: Sagittal, Frontal, Transverse	Superior/Inferior
Anterior/Posterior	Medial/Lateral	Cephalic/Caudal
Dorsal/Ventral	Proximal/Distal	Superficial/Deep
Anterior body land marks	Posterior body land marks	Cranial cavity
Spinal cavity	Thoracic cavity	Abdominopelvic cavity
Abdominal cavity	Pelvic cavity	Quadrants
Regions	Serous membranes	Parietal serosa
Visceral serosa	Peritoneum	Pericardium

EXPERIMENTS

Do all the sections of lab exercise 1 - work in groups no larger then 4 people.

Using a piece of tape and uppercase letters to label the following anatomical areas on the body of someone of your group.

____ calcaneal	____ lumbar	____ abdominal
____ acromial	____ peroneal	____ cervical
____ sural	____ gluteal	____ inguinal
____ tarsal	____ carpal	____ thoracic
____ nasal	____ sternal	____ plantar
____ femoral	____ antecubital	____ axillary
____ coxal	____ patellar	____ brachial
____ olecranal	____ scapular	____ popliteal
____ thoracic	____ buccal	____ mental
____ palmar	____ crural	____ antebrachial
____ deltoid	____ digital	____ frontal
____ mammary	____ oral	____ orbital
____ pedal	____ pelvic	____ pubic
____ sternal	____ cephalic	____ perineal
____ occipital	____ sacral	____ vertebral

Study Guide: Do RS pages in the back of your lab manual

Lab #6A & B Classification of Tissues: EPITHELIA BIOL&241

LEARNING OBJECTIVES

1. Identify epithelial tissues.
2. Name the 4 major tissues in the human body and the major subcategories of each.
3. Identify the subcategories of tissues through microscope observation.
4. Indicate the location of various tissues types throughout the body.
5. State the general functions and structures of the four major tissues types.

KEY WORDS

Tissues	Organs	Histology	Epithelium
Squamous	Cuboidal	Columnar	Simple
Ciliated	Apical surface	Basal surface	microvilli
Stratified	Pseudostratified	Endocrine glands	Exocrine glands

EXPERIMENTS

Familiarize yourself with the features of the following tissues. Be able to identify and describe the features of each tissue. Note that structure and function are related. Use the pictures and micrographs in exercise 6 and histology atlas – the red a purple pages in your lab manual, to help you identify these features.

Note where each different epithelial tissue is found. Identify the principal functions of that particular epithelium.

Do lab 6b on your own. This is an excellent resource!

Simple squamous (blood vessel)

Dark stained nuclei of the cells that line the inside of blood vessels.

Simple cuboidal

Features include a round nucleus and square shaped cells.

Simple columnar

Cells are tall and thin in shape; the nuclei are oval and located at one end of the column. Some may have cilia (hair-like structures) or microvilli (brush border).

Stratified squamous (skin)

Note the cell shape and nuclei as you progress from deeper to more superficial layers.

Pseudostratified columnar

Note cilia, goblet cells with clear mucous vacuoles, and the cellular arrangement of the epithelium.

Transitional

Note the shape of the cells and nuclei as you progress from the deeper layers to the more superficial. Look for dome shaped cells and binucleated cells closest to the surface.

Glands (salivary glands)

Note the clustering arrangement of glandular cells. Observe that some cells have clear cytoplasm (mucus) and others have some coloration (serous cells).

Study questions:

1. Why are the cells that make up epithelial tissues different in structure? Is each cell structure that is used an "optimal" cell structure? Any changes?
2. Transitional epithelium is considered by some to be a misnomer. The name transitional arose from indications that cells could stretch to extend the bladder and ducts of the urinary system, and that when relaxed the cell appeared bunched and multilayered. In actuality, the cells form a single layer with each cell attached to the basement membrane. What type of tissue do you think would be a more appropriate name? Explain why.
3. Glands can be multicellular or unicellular in structure. What other features or cell types might be present in glands? Are glands ectodermal, endodermal, or mesodermal in origin? Support your hypothesis with some features of glands. Why did you choose the embryonic tissue type(s) that you chose?

Lab #6 A & #8 CONNECTIVE TISSUES BIOL&241

LEARNING OBJECTIVES

1. Identify connective tissues.
2. Familiarize yourself with the features of the following tissues (listed under key words).
3. Understand the relationship of structure to function of these tissues.
4. What are the properties of each tissue?
5. Where in the body are these tissues located?

KEYWORDS -and the structures listed below under Experiment

Areolar	Adipose	Hematopoietic	Ground substance
Collagen fibers	Elastic fibers	Extracellular matrix	Reticular fibers
Mast cell	Adipose tissue	cutaneous membranes	mucous membranes
Lamina propria	goblet cells	serous membranes	synovial membranes

EXPERIMENT: Take only one or two slides at a time. Return the slide or trade with another student. Become familiar with the different tissue types and the structure that makes up these tissues listed beneath them.

Group I: Connective Tissue, General

AREOLAR CONNECTIVE TISSUE slide H4C
mast cells, fibroblasts, collagenous fibers, reticular (darker and thicker) and elastic fibers

DENSE REGULAR (white fibrous) slide H4A
collagenous fibers, fibroblast nuclei

DENSE IRREGULAR slide H5A - skin
collagenous fibers, fibroblast nuclei

Group II: Cartilage

HYALINE CARTILAGE slide H3D
hyaline matrix., lacunae, chondrocytes, perichondrium with chondroblasts and fibers

FIBROCARTILAGE slide H3A
collagenous fibers, lacunae, chondrocytes

ELASTIC CARTILAGE slideH3B, H3C
elastic fibers, chondrocytes

Group III: Connective Tissue, Specialized

RETICULAR TISSUE slide H4D
reticular fibers, reticular cells

ADIPOSE TISSUE slide H4E
adipose cells, nuclei of adipose cells

COMPACT (Ground) BONE slide H2B, H2C, H2D
osteon (Haversian system), (Haversian) canals, lacunae (location of osteocytes), canaliculi

BLOOD SMEAR slide H8D, H8F, H8H

erythrocytes
monocytes - large cells, lots of cytoplasm, indented nucleus
neutrophils - multilobed nucleus, no apparent granules
lymphocytes - round nucleus filling most of the cell
eosinophils - multilobed nucleus, pink granules
basophils - dark granules, blue or purple, small in size
platelets

Study questions:

Do you truly believe that all these tissues fit into a "neat" category of connective tissue? Is there another method that may be an improvement? Why do you support the current categorization OR why do you want to re-arrange the categories? Please give structural and functional reasons.

(1) List the FOUR major Connective tissues, and the subtypes of each one.

(2) Draw EACH of the connective tissues in the groups above.

(3) Label EACH drawing with 3 distinguishing features, the LOCATION in the body and the FUNCTION of each.

(4) Identify which of the groups have chondrocytes in lacunae.

Lab #6 MUSCLE AND NERVE BIOL&241

LEARNING OBJECTIVES

1. Familiarize yourself with the three types of muscle tissue.
2. Be able to distinguish different features of the three muscle types by microscopic features.
3. Be able to identify the different parts of a neuron, nodes of Ranvier, myelin, and dendrites by their microscopic features. How does each of these function in nerve tissue?

KEYWORDS

Muscle tissue	Skeletal muscle	Smooth muscle	Cardiac muscle
Intercalated discs	Nerve tissue	Neuroglia	Neurons
Cell body	Node of Ranvier	Dendrites	Myelin

EXPERIMENT: Take only one or two slides at a time. Return the slide or trade with another student. Become familiar with the muscle and nerve tissue types and the structure that make up these tissues.

Muscle tissue (lab 6 and 14)	Plates 2, 3, 13
skeletal muscle	slide H7D, H11E
skeletal muscle teased	slide H11B
smooth muscle isolated	slide H11F
smooth muscle	slide H11H
teased cardiac muscle	slide H7A
cardiac muscle	slide H7B
intercalated disks	slide H7C
all three muscle types	slide H11G

Nerve tissue(lab 6 and 17)	Plates 3, 4, 5, 6, 7, 8, 9
nerve (c.s. and l.s.)	slide H19H
artery, vein, nerve	slide H9A
Nissl bodies	slide H20C, H20D

(1) Draw each of the THREE types of muscles.

(2) Label banding, striations, intercalated disks and nuclei.

(3) Draw a neuron.

(4) Label the Node of Ranvier, cell body and myelin sheath.

Lab #9, #10, and # 11 Bone Classification BIOL&241

LEARNING OBJECTIVES

1. List the functions of the skeletal system.
2. Identify the two major types of bone.
3. Identify the anatomical areas of a longitudinally cut bone.
4. Identify major regions of an osteon (compact bone) and trabeculae (spongy bone) on histological specimens.
5. Explain the role of inorganic salts and organic matrix in flexibility and hardness of bone.
6. Learn the bones of the skull, significant bone markings, and locations.
7. Learn the bones of the axial skeleton, significant bone markings, and locations.
8. Name the three bone groups composing the axial skeleton: by isolated bones, on an articulated skeleton - and note the bone markings of each as listed below.
9. Distinguish by examination the different types of vertebrae from each area.
10. Differentiate lordosis, kyphosis, scoliosis and identify a herniated disc.
11. Define the fontanels and discuss its function and fate in the fetus.
12. Learn the bones of the upper appendage, significant markings, and locations.
13. Learn the bones of the lower appendage, significant markings, and locations.
14. Identify the bones on an articulated skeleton: bones of the shoulder and pelvic girdles and attached limbs
15. Arrange a disarticulated skeleton with the bones in the relative proper positions.
16. Identify bone markings.
17. Differentiate between a female and a male pelvis.
18. Relate structure and function of the Appendicular skeleton.

KEY WORDS

Axial/Appendicular skeleton	Compact bone	Spongy bone	
Long bones	Short Bones	Flat bones	Irregular bones
Wormian (Extra sutural) bones	Sesamoid bones	Diaphysis	Periosteum
Osteoblasts	Epiphysis	Articular cartilage	Epiphyseal plate
Medullary cavity	Yellow marrow	Red marrow	Endosteum
Trabeculae	Central canal	Osteocytes	Lacunae
Lamellae	Osteon	Canaliculi	Perforating canals

And all bones and bone parts listed below

EXPERIMENTS

Do all the sections of lab exercises 9, 10 and 11 work on your own and/or in a group.

Locate the following bones and note the position in the body relative to each other and the organs of the body.

I. Bones of the Axial skeleton

Skull

Vertebrae

Hyoid

Sternum

Ribs and costal cartilage

II. Bones of the Appendicular Skeleton

Clavicle

Scapula

Humerus

Radius

Ulna

Carpals

Metacarpals

Phalanges

os coxa (pelvic bones)

Femur

Patella

Tibia

Fibula

Tarsals

Metatarsals

Phalanges

Study questions:

1. Somewhere between 5 and 10 million years have passed since distant human ancestors swung through trees. We still retain evidence of this *brachiating* mode of locomotion and *bipedal* locomotion. What features of the human skeleton support this arboreal type of locomotion?
2. What is the significance of the materials that make up bones; i.e. what do these indicate about our origins (*think about how bones form developmentally*)? What functions do they perform now?
3. Why do you think it is important to learn many parts of the skeleton? Is there any future use? What do you gain from such an exercise?

SKELETAL SYSTEM

I. Bone Classification, Structure, and Relationships

A. Bone markings - Identify the markings listed under Key Words or after the bones on the list below

B. Classification of Bones

Differentiate between compact and spongy bone in diagrams.

Differentiate the relative gross anatomy of the bones into the four groups - be able to place any bone into one of these groups

C. Gross Anatomy of a Typical Long Bone

Be able to label the diaphysis, periosteum, epiphysis, articular cartilage, epiphyseal plate/line, marrow (medullary) cavity and endosteum

D. Microscopic Anatomy of Bone

Differentiate between compact and spongy bone under a microscope and the parts that make up these two different types of bone.

II. Axial Skeleton lab 10

A. Skull - cranial bones

Frontal (1):	frontal sinus
Parietal (2):	sagittal suture, coronal suture
Temporal (2):	squamous suture, external auditory meatus, zygomatic process, mastoid process, mandibular fossa, jugular foramen
Occipital (1):	lamboidal suture, foramen magnum, occipital condyles
Sphenoid (1):	greater and lesser wings, superior orbital fissure, sella turcica, foramen rotundum, foramen ovale, foramen spinosum
Ethmoid (1):	crista galli, cribiform plate

B. Facial -

Mandible (1):	body, ramus, mandibular condyle, coronoid process, mental foramen, mandibular symphysis
Maxillae (2):	palatine process, infraorbital foramen
Palatine (2)	
Zygomatic (2)	zygomatic arch
Lacrimal (2)	
Nasal (2)	
Vomer (1)	
Paranasal sinuses -	
Fetal skull	same major bones as above, anterior, posterior, mastoid, sphenoid fontanels

C. Neck region

Hyoid (1):

SKELETAL SYSTEM - continued

D. Vertebral Column

Intervertebral discs	
Vertebrae:	body, vertebral foramen, transverse processes, spinous process, superior and inferior articular processes, intervertebral foramina
Cervical (7):	atlas, axis, odontoid process (dens)
Thoracic (12):	
Lumbar (5):	
Sacrum (5 fused):	sacral foramina, sacral canal
Coccyx (3-5):	

E. Bony Thorax

Sternum:	manubrium, body, xiphoid process
Ribs:	true, false, floating, head, neck, shaft

III. Appendicular Skeleton lab 11

A. Shoulder Girdle

Clavicle	
Scapula:	acromion, coracoid process, glenoid cavity, spine,

B. Arm:

Humerus:	greater and lesser tubercles, anatomical neck, deltoid tuberosity, trochlea, capitulum, medial and lateral epicondyles, olecranon fossa

C. Forearm:

Radius:	radial tuberosity, styloid process
Ulna:	coronoid, olecranon and styloid processes

D. Wrist:

Carpals (8)

E. Hand:

Metacarpals (5 each hand)
Phalanges (14 each hand): proximal, middle, distal

F. PELVIC GIRDLE Coxal bones:

Ilium:	auricular surface, iliac crest, anterior and posterior superior iliac spine (ASIS and PSIS), anterior and posterior inferior iliac spine (AIIS and PIIS), iliac fossa
Ischium:	ischial tuberosity, ischial spine
Pubis:	rami, obturator foramen, pubic symphysis

Other features

Acetabulum Pelvic brim False and True pelvis

G. Thigh:

Femur:	greater and lesser trochanter, lateral and medial condyles and epicondyles, linea aspera, patellar surface

SKELETAL SYSTEM - continued

H. Leg:

Tibia:	lateral and medial condyles, tibial tuberosity, medial malleolus
Fibula:	lateral malleolus

I. Foot:

Tarsals (7):	calcaneus and talus
Metatarsals (5 in each foot)	
Phalanges (14 each foot):	proximal, middle, distal

(1) Draw a typical long bone and label it with periosteum, diaphysis, articular cartilage, epiphyseal plate, medullary cavity and endosteum.

(2) Develop an acronym or ridiculous poem for the bones of the **skul**l. It is easier in groups!

(3) Develop an acronym or ridiculous poem for the bones of the **upper appendicular skeleton**. It is easier in groups!

(4) Develop an acronym or ridiculous poem for the bones of the **pelvic girdle**. It is easier in groups!

(5) Develop an acronym or ridiculous poem for the bones of the **lower appendicular skeleton**. It is easier in groups!

Lab #13 Joints (Articulations) BIOL&241

LEARNING OBJECTIVES

1. Identify the types of joints that join each pair of bones.
2. Name the structural categories of joints and compare their mobility.
3. Identify the types of movement seen in synovial joints.
4. Define the origin and insertion of muscles.
5. Be able to demonstrate or identify various body movements.

KEY WORDS

Types of joints:

Functional Classification =

Synarthroses amphiarthroses diarthroses

Structural Classification =

Fibrous - sutures syndesmoses

Cartilaginous - symphysis synchondroses

Synovial - structural characteristics

Gliding hinge pivot condyloid
Saddle ball and socket

Joint Disorders:

Bursitis
Sprain
Dislocation
Arthritis

Body Movements:

Origin	Insertion	Flexion	Extension
Abduction	Adduction	Rotation	Circumduction
Pronation	Supination	Inversion	Eversion
Dorsiflexion	Plantar Flexion		

EXPERIMENTS

Do all the sections of lab exercises 11 work on your own and/or in a group. Also note the extra joints that are listed above.

Study questions:

1. Which bones in the skull are movable?
2. How do the bones fit together?
3. What type of joint do the bones form?
4. How much movement is there at each joint?

(1) Using stick figure (s) draw and label **EACH** body movement and next to the label note a nifty way to remember it!

(2) For EACH of the THREE structural classification note **ONE** distinguishing feature of the group and ONE distinguishing feature of each of the subtypes.

(3) List functional classifications with **ONE** distinguishing feature of each.

Synovial Joints: Additional Information

Glenohumeral - head of humerus and glenoid fossa
cartilage lip around the fossa = glenoid labrum
superior and inferior glenohumeral ligaments
subacromial bursa - under acromion
rotator cuff - tendons of subscapularis, supraspinatus, infraspinatus, teres minor muscles
coracohumeral ligament - coracoid process to the greater tubercle of humerus
Intervertebral - synovial (between articulating facets) and fibrous (between vertebrae)
ligaments = anterior longitudinal, posterior longitudinal, interspinatus, supraspinatus
Hip (coxal) - deep ball and socket
cartilage lip around fossa = acetabular labrum
ligaments = superior & anterior iliofemoral, anterior pubiofemoral, posterior & inferior ishiofemoral
ligamentum teres - from fovea capitis to acetabulum
Knee - actually three joints
subpatellar bursa - from the synovial membrane
Extracapsular ligaments -
medial collateral - med. epicondyle of femur to med. condyle of tibia
lateral collateral - lat. epicondyle of femur to head of fibula
oblique popliteal - posterior part of the joint
Intracapsular ligaments -
Anterior cruciate ligament (ACL) - ant. intercondylar fossa to med. surface of lat. femur condyle
Posterior cruciate ligament - post. intercondylar fossa to lat. surface of med. femur condyle
Mensci - semilunar cartilage, C shaped, fibrocartilage, between condyles of tibia and fibula
Injuries - usually collateral ligaments
"Unhappy Triad" - medial meniscus, medial collateral, and ACL
Bursitis
Elbow - humeral trochlea and capitulum, with trochlear notch and head of radius = hinge
ligaments = annular - encloses head of radius
medial collateral - around the ulna - three bands
lateral collateral - around the radius - forms a triangle
these may be hard to locate on the model
- do the best you can and be able to describe the location
Flexion limited by soft tissue of arm and forearm, extension stopped by medial ligament

Lab #14 Microscopic Anatomy of Muscle BIOL&241

LEARNING OBJECTIVES

1. Describe the structure of skeletal muscle from the microscopic to gross anatomy.
2. Describe the role of neuromuscular junctions and their structure.
3. Identify the three types of muscle through diagrams, models or microscope slides.
4. Understand the criteria in naming skeletal muscles

KEY WORDS

myofibrils	myofilaments	actin	myosin
sarcomeres	I band	Z line	A band
endomysium	perimysium	fascicle	epimysium
deep fascia	tendons	aponeuroses	
synaptic cleft	neurotransmitter	neuromuscular junction	
agonist	antagonist	synergists	fixators

EXPERIMENTS

Do the section on Organization of Skeletal Muscle Cells into Muscles, The Neuromuscular Junction, and Classification of Skeletal Muscles.

Compare and contrast the three types of muscle: smooth, cardiac and skeletal through diagrams, charts and microscope slides.

Hints: Draw each type of muscle, observe as many examples as possible (look at slides of others around you). Use shape and tissue structure as clues to identification, not the color of the stains.

Lab #15 Skeletal Muscle

LEARNING OBJECTIVES

1. Learn the names and locations of the head and neck muscles.
2. Learn the names and locations of the trunk, shoulder, and abdominal muscles.
3. Learn the names and locations of the arm muscles.
4. Learn the names and locations of the leg muscles.
5. Develop an understanding of opposing muscle groups and the necessity to balance the fitness of muscles around a joint.
6. Identify on a model or diagram each of the muscles listed below.

KEY WORDS

Muscles of the Head and Neck:

occipitofrontalis (epicranius)
orbicularis oculi
orbicularis oris
zygomaticus major
buccinator
temporalis
masseter
sternocleidomastoid

Thorax and Ribs

diaphragm
external intercostals
internal intercostals

Abdominal Region

rectus abdominis
external oblique
internal oblique
transverse abdominis

Lab #15 Skeletal Muscle continued

Back, Shoulder and Chest

- trapezius
- levator scapulae
- rhomboid major/minor
- serratus anterior
- pectoralis major/minor
- deltoid
- latissimus dorsi
- supraspinatus
- infraspinatus
- teres major
- teres minor

Upper Arm

- biceps brachii
- brachialis
- triceps brachii
- brachioradialis

Forearm

- flexor carpi radialis
- flexor carpi ulnaris
- extensor carpi radialis: longus and brevus
- extensor carpi ulnaris
- extensor digitorum
- palmaris longus
- pronator teres

Hip and Thigh

- iliopsoas: iliacus & psoas
- gluteus med., max., min
- piriformis
- tensor fascia lata
- gracilis
- quadriceps femoris:
  - rectus femoris
  - vastus medius
  - vastus intermedius
  - vastus lateralis
- sartorius
- hamstrings:
  - semimembranosus
  - semitendinosus
  - biceps femoris

Lower Leg

- tibialis anterior
- gastrocnemius
- soleus
- fibularis (peroneus) longus
- extensor digitorum

Pelvis

- pelvic diaphragm:
  - levator ani
  - coccygeus

EXPERIMENTS

Do all of exercise 15: using the models and diagrams, identify the muscles listed above.
Use a skeleton and tape or string to place the muscles in the proper locations.
Locate the muscles on your own body and identify them.

Study questions:

1. Are marathon runners born or achieved/made during life? Are sprinters born or achieved/made during life? Explain your answer with scientific information concerning muscles, their function and the effects of training.
2. Are muscles the only factor in determining athletic greatness? Can we do a muscle biopsy at an early age and determine those who are destined to be great athletes? What other factors may or may not be involved.
3. Which types of muscles are able to produce more force and why: parallel or pinnate muscles?
4. Can a muscle that is the same cross sectional area generate more force if the length is increased? What if length remains the same and the cross sectional area increases? What accounts for these occurrences, if they do in fact occur?

(1) For the **HEAD and NECK** : develop an acronym for the names of the muscles.

(2) For the **TRUNK, SHOULDER AND ABDOMEN** : develop an acronym OR SOME OTHER WAY TO REMEMBER THEM for the names of the muscles.

(3) For the **ARM** : develop an acronym OR SILLY POEM for the names of the muscles.

(4) For the **LEG** : develop an acronym OR LEWD COUPLET for the names of the muscles.

Lab 16B Skeletal Muscle Physiology: Computer Simulation

LEARNING OBJECTIVES

1. Define the terms maximal stimulus, treppe, wave summation, multiple motor unit summation, and tetanus
2. Describe the different manner stimulation can alter muscle force of contraction.
3. Explain how smooth slow sustained contractions are possible in skeletal muscles.
4. Graphically understand relationships between passive, active and total forces.
5. Describe isometric and isotonic, including length and force transitions.
6. Explain experimental results in terms of muscle structure.

KEY WORDS

multiple stimulus	treppe	wave summation
tetanus	isotonic contraction	isometric contraction

Study questions:

1. Why is treppe important in understanding muscle function?
2. Is tetanus a disease?
3. Look at questions from Isometric contractions.

LEARNING OBJECTIVES

1. Describe the location of the heart.
2. Name and locate the general structures of the heart that are listed below.
3. Trace the pathway of blood through the heart.
4. Explain the pulmonary and systemic circuits.
5. Why is the heart a double pump?
6. Explain the operation of the valves.
7. Describe the histology including intercalated discs, striations, nuclei etc.

Structures that have an * - are structures that you will need to know on the models and on the sheep heart. All others you need to know on the models/diagrams only.

I. General Structures

Right Atrium *
Left Atrium*
Right Ventricle*
Left Ventricle*
Interventricular Septum*
Interatrial Septum

II. Right Atrium*

Inferior vena cava*
Superior vena cava*
Coronary sinus
Fossa ovalis

III. Right Ventricle*

Tricuspid valve*
Chordae tendonae*
Papillary muscles*
Pulmonary trunk*
Pulmonary semilunar valve

IV. Left Atrium*

Pulmonary veins

V. Left Ventricle*

Bicuspid (mitral valve)*
Chordae tendonae*
Papillary muscles*
Aortic semilunar valve*
Ascending aorta

VI. External Structures

Auricles*
Ligamentum arteriosum
Ascending aorta, aortic arch, descending aorta
Right coronary artery
Posterior interventricular artery
Left coronary artery
Circumflex artery
Anterior Interventricular (descending) artery
Great cardiac vein
Middle cardiac vein
Small cardiac vein
Coronary sinus
Anterior cardiac vein

*******DISSECTION INFORMATION: IMPORTANT

Always wear gloves and keep your hands away from your face and mouth.

Place a sheep heart on a dissecting tray and grab the necessary instruments.

Example: a sharp scalpel/razor blade, 1-2 blunt probes, 1-2 dissecting probes, several large T-pins

Identify the external structures first before starting to cut open your heart.

Be sure that you are cutting in the correct plane for the dissection - ask if unsure.

Use a blunt probe/handle of a dissecting probe to follow the vessels into the chambers.

WHEN FINISHED:

PUT THE ORGANIC DEBRIS IN A BIOHAZARD BAG
CHECK WITH INSTRUCTOR TO SEE IF YOU SHOULD DISPOSE OF THE HEART
we may keep it if it is a good dissection
CLEAN ALL INSTRUMENTS AND TRAYS IN SINK IN THE BACK OF ROOM
be sure that no organic matter is washed into the sink and clogs the drain
WASH OFF THE TABLE AREA WHERE THE DISSECTION TOOK PLACE
REMOVE YOUR GLOVES AND THOROUGHLY WASH YOUR HANDS

(1) Draw a stylized diagram of the heart from TWO points of view. Label with ALL terms.

(2) Now draw the real sheep heart from those same TWO points of view and label.

(3) Write down the TWO most difficult things there are to remember about the heart structure.

Lab 31 Conduction System of the Heart and ECG.

LEARNING OBJECTIVES FOR THIS EXERCISE

1. List and identify the elements of conduction in the heart: describe initiation and conduction through the heart muscle.
2. Interpret the ECG in terms of depolarization, and repolarization events.
3. Identify the P, QRS, and T waves on an ECG and demonstrate the functions they indicate.
4. Calculate heart rates and intervals from an ECG.

Procedure:

Choose a subject to record the ECG.
Read the introduction to the ECG.
Go through the placement of leads and preparation of the subject
Do the Recording the ECG - do baseline recording only
some of the instructions will not apply to the system that we have available
follow the instructions given at the beginning of class and ask questions if you are unsure

Study Questions:

1. Why are there three major waves of the ECG? What events correspond to each of them?
2. What different information would you get from a 12 lead ECG versus a 3 lead ECG? Why do we attach a wire to each limb?
3. What is meant by the electrical axis of the heart?
4. What are some of the diagnostic features an ECG can provide? Are there other tests or information that might be useful? If so, what tests and what information? Why?
5. Why is atrial contraction relatively unimportant in the function of the heart?
6. What events are responsible for the first and second heart sounds?
7. What processes are responsible for ventricular filling?
8. What is the Frank-Starling law? What property of heart muscle is responsible for it?
9. What is congestive heart failure? What are some causes?
10. What is cardiac output? What are the major factors that contribute to stroke volume?
11. What is the effect of arterial pressure on cardiac output? Why?
12. Increasing the plasma Ca^{2+} concentration increases the strength of contraction of cardiac muscle but not of skeletal muscle. Why is there a difference?

(1) Draw a single cycle of the ECG

(2) Label the P, QRS and T waves

(3) Label next to the waves the functional process that is taking place to produce those waves.

(4) Describe in THREE sentences the electrical process of the conduction system in the heart.

Lab 34B Cardiovascular Physiology: Computer Simulation

LEARNING OBJECTIVES

1. Define automaticity and rhythmicity.
2. Discuss the ability of the heart to be myogenic.
3. Understand the definition of tetanus and compare tetanus in cardiac and skeletal muscle.
4. Describe the effects of cold, heat, vagal stimulation, pilocarpine, digitalis, atropine, epinephrine, potassium ions, sodium ions, and calcium ions of the functions of the heart. Define blood flow, viscosity, peripheral resistance, systole, diastole, stroke volume, and cardiac output.
5. Understand how heart and blood vessels work together to create blood pressure.
6. Understand pressure differences and what effects these have upon blood pressure throughout the system.
7. Identify the factors that control blood flow.
8. Examine the effects of stroke volume, heart rate and cardiac output.

KEY WORDS

rhythmicity automaticity atrial contraction ventricular contraction
Blood pressure peripheral resistance blood viscosity
blood flow diastole systole
cardiac output

Lab #32 Anatomy of Blood Vessels BIOL&241

LEARNING OBJECTIVES

1. Describe the tunics of arteries and veins, and the function of each layer.
2. Compare and contrast the similarities and differences between arteries and veins both in structure and functions.
3. Recognize arteries and veins under the microscope - especially a cross section view.
4. How does fetal circulation happen?

KEY WORDS

Tunica interna	Tunica media	Tunica externa	elastic arteries
Muscular arteries	endothelium	Umbilical arteries	Umbilical vein
ductus venosus	foramen ovale	ductus arteriosus	fossa ovalis
ligamentum arteriosum		umbilical ligaments	ligamentum teres
ligamentum venosus			

Study Questions:

1. What are the distinguishing features of each of the following: arteries, arterioles, capillaries, and veins?
2. What is the difference between laminar flow in a vessel versus turbulent flow in a vessel? Where are you likely to see turbulent flow? Laminar flow? Which is faster? Why?
3. What are the relationships between driving force, flow rate and resistance?
4. What factors determine the resistance of a single vessel?
5. Which vessels contribute the most to the total peripheral resistance?
6. The diameter of a capillary is smaller than that of an arteriole, yet collectively the capillaries have a lower flow resistance than the arterioles. Explain.
7. Why does systolic pressure normally increase with age?
8. What effect would a decrease in venous compliance have on the volume of blood in the veins? On the venous pressure? On the venous return? On the total peripheral resistance? What effect would arteriole dilation have on the total peripheral resistance? On venous return?

(1) Draw a cross section (from the microscope) of EACH of an ARTERY AND A VEIN.

(2) Give TWO structural differences and the functional reasons for each.

(3) List the tunics of arteries and veins and give the function of each layer.

(4) Describe in a diagram fetal circulation. Give THREE differences from adult circulation.

BIOL&241 Anatomy of Blood Vessels

LEARNING OBJECTIVES:

1. List and/or identify the major vessels that are demonstrated below.

I Blood vessels of the upper limb

ARTERY	REGION OF THE BODY
1. Aorta	mediastinum of the thoracic region
2.	mediastinum of the thoracic region, off aorta
3.	between the 1st rib and clavicle
4.	between the clavicle and humerus
5.	in the arm region
6.	in lateral forearm region
7.	in medial forearm (in between the two above is the *anterior interosseus*)

Blood flow to the left hand is similar to the above, but for one exception. Which of the above arteries is NOT present in the flow to the left hand? _____

Now follow the veins back to the heart (right atrium), naming each as you go. Note that there are deep and superficial veins. Start just distal to the antecubital region.

vein	region of the body
1.	lateral superficial forearm and arm
2.	medial superficial forearm and arm
3.	medial to #1, located deeper
4.	also called *anterior interosseus*, superficial
5.	lateral to #2, located deeper

Veins

6.	deep arm
7.	between clavicle and arm
8.	between 1st rib and clavicle
9.	mediastinum
10. Superior vena cava	mediastinum

II. Blood vessels of the lower limb

artery	region of the body
1. aortic arch	superior mediastinum/thoracic cavity
2. Descending thoracic aorta	mediastinum, posterior the heart
3.	abdomen/lumbar region
4.	one large vessel along each pelvic brim
5.	in the pelvic cavity
6.	along pelvic brim after splits from #5
7.	in femoral region
8.	behind the knee

Now follow the veins that bring the blood back to the heart

	vein	region of the body
1.		superficial, medial leg and thigh
2.		deep thigh, #1 drains into
3.		superficial lateral leg (not on ADAM)
4.		deep posterior knee, #3 drains into it (not on ADAM)
5.		deep thigh, same as # 2
6.		along pelvic brim
7.		pelvic cavity
8.		along pelvic brim, union of #6 and #7
9.		to the right of the aorta in the abdomen

III. Blood vessels of the head and neck

	artery	region of the body
1.	aorta	mediastinum of thoracic cavity
2.		mediastinum of thoracic cavity
3.		lower neck region
4.		division of #3, supplies face and neck
5.		division of #3, no branches in neck region, enters skull

Now follow the veins that come down either side of the neck and return to the right atrium.

vein	region of the body
1.	largest vein in the neck
2.	mediastinum
3. Superior vena cava	mediastinum

IV. Blood vessels of the thorax and abdomen

Find the following veins and arteries and describe their location

blood vessel	region of the body
1. pulmonary arteries/veins	connects heart and lungs
2. Celiac trunk	attaches to the abdominal aorta
3. Superior mesenteric artery	attaches to the abdominal aorta inferior to the celiac
4. Inferior mesenteric artery	
5. Renal arteries/veins	
6. Suprarenal arteries/veins	
7. Ovarian arteries/veins Testicular arteries/veins	

(1) Draw a stylized version of the ARTERIES of the UPPER LIMB. Label major branches. Develop an acronym or easy way to remember them.

(2) Draw a stylized version of the VEINS of the UPPER LIMB. Label major branches.

(3) Draw a stylized version of the ARTERIES of the LOWER LIMB. Label major branches. Develop an acronym or easy way to remember them.

(4) Draw a stylized version of the VEINS of the LOWER LIMB. Label major branches.

(5) Draw a stylized version of the AORTA. Label major branches. Develop an acronym or easy way to remember them.

(6) Draw a stylized version of the VEINS of the ABDOMEN. Label major branches.

(7) Draw a stylized version of the ARTERIES of the HEAD AND NECK. Label major branches. Develop an acronym or easy way to remember them.

(8) Draw a stylized version of the VEINS of the HEAD AND NECK. Label major branches.

Lab 33 A and B Human Cardiovascular Physiology - Blood pressure and Pulse Determinations

LEARNING OBJECTIVES FOR THIS EXERCISE

1. Describe the timing and events of the cardiac cycle, including diastole and systole.
2. Describe normal heart sounds and explain how heart murmurs differ from normal sounds.
3. Describe cardiac output and the factors that contribute to determining cardiac output.
4. Define pulse, pulse deficit, blood pressure, and sounds of Korotkoff.
5. Accurately determine your lab partner's pulse.
6. Understand the effects of exercise, smoking, and standing vs. lying down positions on the heart

Procedure:

Choose ONE subject - perhaps the person with the most easily measured BP and HR. Note the subjects age, sex, general condition, and any pertinent information that may effect the BP and HR. (What are some examples?)

I. Auscultation of Heart Sounds (Activity 1):

DATA: How long is the interval between heart beats?

How does this compare to the interval between the first and second sounds of a single heart beat?

What have you determined from attempting to obtain sounds of the AV valves and semilunar valves closing?

II. Palpating superficial pulse points (Activity 2):

DATA: Which pulse point has the greatest amplitude? Which has the least? Why?

What is the average radial pulse?

Apical count = Radial count = Pulse deficit =

III. Blood Pressure Determinations (Activity 4 & 5):

DATA: What is the average BP for **three** trials?

What is the average pulse pressure for three trials?

What is the Mean Arterial Pressure for each trial?

Skip the venous pressure exercise.

IV. Observing the Effect of Various Factors on Blood Pressure and Heart Rate (Activity 6):

DATA - Use **ONE** individual for this information

Instead of using the bench step - the subject should run up and down the stairs to the first floor and back, or run laps around the third floor.

Fill out the charts in your lab manual on pages 344-346 for one individual.

When was the greatest elevation of blood pressure? Why?

What differences may be noted if you had compared a well conditioned vs. a non-conditioned person?

Were there any unusual changes in the BP? HR? Why might these have occurred?

What difference may be noted if a person that smokes (does not smoke) were the subject?

Skip the nicotine (unless you happen to choose a smoker for the subject) and the sensory stimulus part.

Skip the rest of the lab.

(1) Using a diagram you make up, describe the sounds of the heart and label the FIRST and SECOND sounds.

(2) Next to the label note the functional process that is giving rise to that sound.

(3) List the information you can get from heart sounds that you **cannot** get from the pulse.

(4) List the information you can get from the pulse that you **cannot** get from the heart sounds.

(5) Explain the meanings of the TWO blood pressure measurements.

Lab #29A and B Blood BIOL&241

LEARNING OBJECTIVES

1. Name the major components of blood and the functions of each.
2. What is the composition and functions of plasma?
3. Define formed elements, list the cell types, cite the relative percentages, and describe their major functions.
4. Identify erythrocytes, basophils, eosinophils, monocytes, lymphocytes, and neutrophils.
5. Define anemia.
6. Discuss the reasons for transfusion reactions and mismatching of blood.
7. Understand the concepts of differential white blood cells counts and hematocrit.
8. Describe the events of coagulation time and how blood typing is determined and cholesterol determination is measured.

KEY WORDS

plasma	erythrocytes	formed elements	leukocytes
platelets	diapedesis	ameboid movement	granulocytes
neutrophils	eosinophils	basophils	agranulocytes
lymphocytes	monocytes	thromboplastin	thrombin
fibrin	antigens	antibodies	Rh

EXPERIMENTS - ***read through the entire lab***

DO Formed elements of blood - use a prepared blood smear.

Read through the sections on Hematological tests:

Differential white blood cells counts and hematocrit.

Read through the sections on coagulation time, blood typing and cholesterol measurements.

(1) Draw a smear and label at least **FIVE** elements of Blood

(2) Describe the **WBC with diff. test**. List each blood component that is measured. Next to EACH PUT A NOTE TELLING YOU WHAT AN INCREASE IN THIS COMPONENT LIKELY MEANS.

(3) Give the most common blood type and the least common blood type. What does blood type mean?

Lab #35A Lymphatic System BIOL&241

LEARNING OBJECTIVES

1. Name the components of the lymphatic system.
2. Relate the functions of the lymphatic system to that of the blood vascular system.
3. Describe the formation, composition, and circulation of lymph.
4. How is memory, and the ability to differentiate self from non-self, important in the immune system?
5. How do B cells and T cell function in different roles?
6. Describe the structure and function of lymph nodes.
7. What are antibodies? How are they formed? What is their structure?

KEY WORDS

lymphatic vessels phagocytic cells Thymus lymphoid organs
immune response: memory, specificity Spleen Rheumatoid factor
Self vs. Non-self B cells T cells lymph nodes: capsule, cortex, medulla
antibodies: gamma globulins, heavy and light chains

EXPERIMENTS

Lab 35 - Read through the parts; there is no actual exercise
Skip the actual rheumatoid factor test section.

Study Questions:

1. What is the role of the lymphatic system in regulating the volume of interstitial fluid?
2. What is edema? What conditions favor the development of edema?
3. What changes would favor the transfer of liquid from tissues to plasma across capillary walls?
4. What is the fundamental difference between specific and nonspecific immunity?
5. What is meant by the concept of memory in the immune system?
6. What is an antigen?
7. What is the difference between a primary and secondary immune response?
8. Describe the structural similarities and differences between an antibody and a T-cell receptor.
9. What is the function difference between killer T cells and Helper T cells?
10. What is the importance of antigen presentation in the specific immune response?
11. What happens during inflammation?
12. What is an autoimmune disease?
13. What are the advantages of having a complement cascade that is activated by antibody binding?
14. People with type I diabetes who have been treated with insulin may develop antibodies to insulin; those without diabetes do not make such antibodies. Explain.
15. What is the role of the immune system in preventing cancer? Could aging in the immune system contribute to the fact that cancer is much more frequent in older individuals? Explain.
16. In most cases, transfusion reactions are the result of the recipient's antibodies attacking the transfused cells. In what situations is an attack of donor antibodies on the recipient's cells possible? Such reactions are usually not a problem – can you figure out why?
17. Draw a diagrammatic representation of the different cell types in the lymphatic system and label EACH with both distinguishing structure and FUNCTION.
18. Draw a stylized diagram of a lymph node. Label.
19. Draw a stylized diagram of the process of inflammation. Label Structures and indicate their FUNCTIONS.
20. Give the FOUR signs described by the Greeks as indicating inflammation.
21. List THREE examples of Autoimmune diseases.

Labs 36, 37A and B: Anatomy and Physiology of the respiratory tract

LEARNING OBJECTIVES

1. Define the words to know listed below or identify the location.
2. Be able to label the parts of the respiratory system that tare listed below on models, diagrams or preserved specimens.
3. Be able to recognize the histological structures of the trachea, lung, and pathologies presented.
4. Explain the breathing process - the role of muscles, mechanical and chemical factors, breathing sounds, and blood pH.

KEY WORDS - Anatomy

nasal cavity	larynx	pharynx
lungs	apex	cardiac notch
hilus	parietal pleura	visceral pleura
primary bronchi	bronchioles	respiratory bronchioles
diaphragm	alveolar ducts	alveolar sacs
alveoli	trachea (w/pseudostratified ciliated columnar)	

Microscope: be able to identify - smooth muscle layer, pseudostratified ciliated columnar epithelium, goblet cells, alveolar sacs, squamous epithelium.

KEY WORDS - Physiology

Respiratory system	Pulmonary ventilation	External and internal respiration
Inspiration	Expiration	Tidal volume
Inspiratory reserve volume	Vital capacity	Expiratory reserve volume
Minute respiratory volume	Emphysema	bronchial sounds

EXPERIMENTS

For lab 36:

Activity 1: Look at the upper and lower respiratory structures.
Activity 2: Do the sheep pluck demonstration.
Activity 3: Examine the prepared slides of lung tissue and the diseased lungs.

For lab 37:

Activity 3 & 4: Measure the Respiratory Volumes and Capacities, and Forced Expiratory Volume.
Activity 1: Respiratory sounds

Study Questions

Why is it significant that the human trachea is surrounded by cartilaginous rings?
What is the function of cilia in the respiratory system? goblet cells?
Why is tracheal epithelium pseudostratified?
How does the contraction of the external intercostals and the diaphragm aid in breathing?
What would happen to breathing if the chest cavity were opened by a puncture wound?
What were the values your group obtained for respiratory volumes and capacities.
Any interpretations that can be made?
Draw the microscope histology of the **trachea and the lung**. Label with **TWO** distinguishing features.
Do a graphic representation of a respiratory cycle, label **ALL** the ways volumes of air in the lungs are measured.