Introduction to Anatomy & Physiology
Lab Manual

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for

BIOL 2404
Introduction to Anatomy & Physiology

Laboratory Activities,
Homework and Lab Assignments
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Biol 2404 Lab Manual
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Biol 2404 Lab Orientation

The laboratory portion of this course is designed to study anatomical details of each body system more thoroughly than it is presented in lecture. While human models are also used, your core learning will come from your dissections and tissue studies. If you have a *real* moral objection to animal dissections then you should not take this course at ACC since you would not be able to learn some of the essential lab skills and would therefore be missing an essential part of the course. This method of 'hands on' learning should also enhance and strengthen the knowledge you gain in lectures.

At times you will be working individually, in pairs or in groups of three or four. Each lab period is loosely structured to begin with a short introduction to the exercise that highlights the activities of the day, what materials are available for use and any changes in procedures. After that you will work independently to learn the material.

There is never enough time in lab to go over each and every item that you are assigned. The lab is a designated a time when you have access to materials that you will not have available during home study time. Some of the information assigned in lab you can learn at home, other items, particularly anatomical terms identified on dissected organs, animals and models and microscopic details viewed with a microscope can only be learned adequately in the lab room.

General Lab Rules:

1. **Read the lab exercise** before you come to lab. There is not time to review every aspect of each exercise and still give you time to work on your own. I will assume that you know what the exercise covers in general and I will only review changes or specific materials that you will use.

2. **Before each lab**, use the **terminology list** to mark the items in your manual's text and illustrations that you are responsible for learning.

2. **Read and memorize the laboratory safety rules** of the lab below. The preservatives are irritants and some of you may be allergic to them. Gloves must be used during dissections and will be provided. Your dissecting tools will be provided for you as well.

3. The PIN lab room is open on Fridays, 8:00 am to 12:00 pm for **extra lab study time**.

Dissections:

Dissections are an integral part of the anatomy and physiology lab experience. There is no substitute for handling and dissecting real tissues and organs as a way to learn anatomy:

The term "dissection" means "to expose to view". Many beginning students assume that dissecting automatically means "cutting things up" but actual cutting is rare and then it will usually be done with scissors, not scalpels. Scalpels more often damage the material and make things harder to see and their use is discouraged in most cases. While you will occasionally use scissors to begin the process of dissection your primary tools of dissection will be forceps and blunt probes and fingers.

Any dissections will be performed as a group. Typically one person reads the instructions and one or two other students will actually do the dissection. Your instructor will be watching to ensure that this is a *shared* project. Rolls should be rotated frequently. Generally, the person actually doing the dissection is the one who learns the material best.

Dissecting tools and gloves are provided in the student drawers. Any dissected materials to be discarded must be placed in the designated container; NOT in the sinks. You will be expected to rinse your i tray, rinse and dry your pins and utensils and replace them where you found them and clean off your counter with disinfectant spray.

Biology Lab Safety Procedures and Information

Health and safety are paramount values in science classrooms, laboratories and field activities. You are expected to learn, understand and comply with ACC environmental, health and safety procedures and agree to follow the ACC science safety policy. You are expected to conduct yourself professionally with respect and courtesy to all. You can read the complete ACC science safety policy at: *http://www.austincc.edu/sci_safe/*

All safety policies and procedures apply to scheduled lab classes as well as open labs.

Consequences for not complying with safety procedures:

1. You will not be able to participate in a lab activity if:
    a. you are late for class and have missed safety training specific for that day's lab or field activity;
    b. you have forgotten your personal protective equipment;
    c. you refuse to wear personal protective equipment;
    d. you have not followed safety policies and procedures for that lab or field activity.
2. You may be withdrawn from the class and not reinstated if:
    a. you missed required safety training at the beginning of the semester;
    b. you repeatedly fail to follow lab safety policies and procedures.
3. You may be expelled from ACC if you thoughtlessly or intentionally jeopardize the health or safety or another individual.

Emergencies

If there is a life-threatening emergency (fire, major chemical spill, explosion, injury):

1. Report the situation and your specific location (campus, room) by
    using the safety phone in a lab classroom; it will automatically connect you to ACC Police Dispatch (location of safety phone_____
    calling 222 from any ACC phone to reach ACC Police Dispatch
    calling 512-223-7999 from a cell phone or non-ACC phone to reach ACC Police Dispatch

2. Evacuate if necessary:
    a. take your personal belongings with you if possible;
    b. on your way out, close but do not lock the classroom door;
    c. go to the designated rally point for your campus and building.
        Directions to nearest exit: _____
        Location of rally point:_____

In the event of an extreme emergency or impending threat, ACC Emergency Alert can send critical voice and text messages to your cellphone. Verify and update your ACC Emergency Alert information. For non-emergency calls, dial 512-223-1231.

Safety Equipment and How to Use It:

→ Information about chemicals used in this laboratory can be found in Material Safety Data Sheets (MSDSs) and in a chemical inventory located _____.

→ The emergency gas shut-off for this lab is located: _____. Shut

off the gas immediately if gas nozzles or valves are damaged or if there is a fire.

→ Fire extinguishers are located: (1) _____.
(2) _____.

To use a fire extinguisher:

1) twist the pin and then pull it out of the handle
2) hold the end of the hose and point it at the base of the fire
3) squeeze the handle

→ Fire blankets are located: (1) _____.
(2) _____.

If you are on fire, stop, drop and roll. Let someone else to get the fire blanket.

→ A safety shower is located _____. If you spill a significant quantity of chemical, especially an acid or base on yourself immediately stand under the shower and pull the handle. Disrobe. The instructor will evacuate the room and close the doors for your privacy. Someone of your gender will stay to help you. Stand under the shower for at least 20 minutes. You will be given clothing after the shower.

→ An eyewash is located _____. If a chemical is splashed or rubbed into your eyes you must use an eyewash for at least 20 minutes with your eyes held open. Someone will help you with this.

→ If a person is experiencing electrical shock from touching wires or equipment, use a belt or other non-conducting material to pull them away from the electrical source.

→ First aid kits are located: (1) _____.
(2) _____.

a. Only minor cuts and burns will be treated in the lab. Serious injuries must be treated in a medical facility. Emergency Medical Services (EMS) will be called if you are injured and are unable to take yourself to a medical facility.

b. The instructor must fill out a report describing your injury.

Personal Protective Equipment (PPE)

1. Required when biological, chemical or physical hazards are present on the lab benches, open shelves or counters:

a. Safety Eyewear

*You must wear non-tinted safety eyewear (safety glasses or goggles) marked Z87 when directed to do so by the lab instructor or lab safety instructions.

*You must bring your protective eyewear with you to every lab class. If you forget your eyewear and the lab room does not have a pair to loan to you, you will not be able to participate in the lab and may forfeit your lab grade for that day. ACC cannot guarantee that loaned safety glasses or safety goggles are uncontaminated by microbes or chemicals.

*People who wear contact lenses must wear goggles and may not wear safety glasses.

b. Gloves – You will be provided with nitrile gloves for handling biohazards and hazardous chemicals. Please notify the instructor if your skin is irritated by these gloves.

c. Shoes – Shoes must cover the top, front and sides of your feet. They must be impervious to liquids.

d. More specific requirements may exist for labs in which unique hazards are present (for example: BSL2 organisms or physical hazards such as sharps, open flame, UV light, pressurized gases, or liquid nitrogen.

2. Recommended when biological, chemical or physical hazards are present on the lab benches, open shelves or counters:

a. Apron or Lab Coat – You may be instructed to wear an apron or lab coat over your clothes when handling biohazards or hazardous chemicals.
b. Wear natural fiber clothing for any lab activity involving open flame (synthetic material melts onto skin in a fire).
c. Before putting on gloves remove watches, rings, and bracelets that could either puncture the glove from the inside or interfere with rapid removal of the gloves.
d. Tie back long hair. e. Do not wear clothing with long, loose sleeves.

Waste Disposal

You must precisely follow the waste disposal procedures. Never dispose of anything in lab without prior direction from the instructor.

→ Hazardous chemical waste containers are located:
solids _____
liquids _____
→ Biohazard bags are located: _____ → Sharps containers are located: _____ → Glass (rinsed test tubes and broken glass) disposal boxes are located:
_____
→ Regular trash containers are located: _____

Lab Conduct

1) At the beginning of any class held in a lab room, do not enter the room until your instructor is present. Wait in the hall, even if the door is open.

2) Do these things:
*follow all procedures in manuals, in handouts, and as given by the instructor;
*store backpacks, coats, and other personal items as directed;
*report broken glass and chemical spills to your instructor immediately.

3) Do NOT do these things:
*come to class while intoxicated or while under the influence of drugs that impair your ability to safely perform the lab or field activity;
*horse around or perform unauthorized experiments;
*eat, drink, or chew (tobacco or gum);
*bring drinks or food (even in closed containers) into the lab;
*pipet by mouth; taste chemicals or directly smell chemical fumes.

Lab Hygiene

→ Clean up your individual work area/equipment and community work areas/equipment (e.g., sinks, balances).
→ Put lids back on bottles and containers immediately after use.
→Do not put excess chemicals back into original containers.
→ Dispose of chemicals and waste only as directed by the instructor.
→ Turn off equipment as instructed.
→ Wash your hands prior to leaving lab.
→ Assume that chemicals used in lab are corrosive or irritating. If at any time chemicals come into contact with your skin wash the affected area immediately.

Standard / Universal Precautions

Diseases such as HIV and hepatitis can be transmitted from person to person through contact with human blood or other body fluids. Follow the Standard or Universal Precautions whenever exposure to human body fluids is possible:

→ Consider all body fluids (saliva, blood, urine, feces, vomit) to be potentially infected with a harmful pathogen.

→ Do not touch or come into contact with anyone else's body fluids.

Student Accident Insurance

All students enrolled in lab classes are covered by Student Accident Insurance that pays for injuries occurring from school sponsored activities related to the class. It does not pay for illnesses such as allergies or the flu, or fainting.All faculty and students should read the guidelines at: http://www.austincc.edu/offices/environmental-health-safety-and-insurance/student- insurance. You can also download the claim form from this location.

Chemical Hazard Labels

*Label all containers and test tubes as directed.
*Inform your instructor immediately if a label is damaged in any way.
*Read all labels and pay special attention to hazard information.

A typical chemical hazard label conveys two kinds of information: 1) the category of the hazard (flammable, toxic, reactive, or corrosive) and 2) the level of the hazard.

There are three types of labels: 1) GHS (Globally Harmonized System - the international system of hazard identification), 2) diamond-shaped hazard labels, and 3) bar-shaped hazard labels.

GHS labels are found mostly on primary containers, the jars or packages in which the chemical manufacturer packaged the chemicals.The GHS system labels include icons that warn you about the major type or types of hazards associated with the chemical. (see next page)

Most of the containers you use in lab are secondary containers such as flasks, test tubes, jars, and beakers. Secondary containers will have either the diamond shapes or the bar shapes. In both of those labels the category of hazard is represented by a color and the level of the hazard is represented by a number.

1. Hazard categories are coded by color:

red	fire hazard, flammability
blue	health hazard, toxicity
yellow	reactivity
white diamond	provides more specific information about the hazard
white bar	identifies protective equipment (PPE) required to handle chem.

2. Hazard level is coded by a number:

0	1	2	3	4
minimal	slight	moderate	severe, serious	extreme

3. Refer to the training poster in your lab for examples.

Other types of hazard warning labels you must recognize are:

a. biohazards	b. radioactive materials
	

Course Specific Cautions (PIN Biol 2404)

1. Do not bring food or drinks into the lab room.

2. Learn the locations of the vent switch, safety shower, extinguisher, glass disposal boxes, discarded tissue buckets, first aid kit and spill kits and be able to use each

3. Wash lab benches with lysol spray BEFORE and AFTER each lab period

4. Place your books beneath the lab bench, if you have a jacket or sweater there are hooks available on which to hang them. Keep your countertop clear of all but your lab manual and materials you are actually working with.

5. Check your lab stool to be sure the back is tightened

6. If you drop and break a beaker or other glassware do not pick it up, notify me and I'll take care of it.

7. If the floor is wet cover it with paper towels and notify the instructor

8. Follow the procedures as directed for proper handling and care of microscopes and slides

9. Do not have more than one or two prepared slides at your bench at any time.

10. Slides and coverslips that you prepare should be discarded in the glass disposal boxes, do not attempt to clean them ***(Do not discard any of the prepared slides)***.

11. Make sure the venting switch is on when dissections are being done.

12. Use latex or nitrile gloves while dissecting since the preservatives used can be quite strong and may be toxic.

13. Aprons are available as needed to protect your clothes, we recommend that you wear older clothes for lab.

14. Wash and dry any dissecting utensils that you used and return them to the case in your lab drawer.

15. Wash your hands after dissecting.

Assuming reasonable care and caution required for any lab procedure, exposure to preservatives will require special attention as you work in this lab:

Some specimens will be preserved in either 70% alcohol or 10% formalin. both solutions are irritants, some students may be allergic.

Overall, the hazard levels are low as long as the vents are on, you are wearing protective gloves, and you rinse your specimens well before dissecting or handling them.

Notify your instructor if you know you are allergic to these solutions

Your instructor will discuss additional precautions available in lab.

Laboratory Safety & Equipment

Familiarized yourself with the various supplies and equipmentin the labroom. Keep this sheet accessible throughout the semester.

Assume the blackboard is at the "front" of the room and the windows are on the "left" side

	Describe The *Specific* Location of Each
nitrile gloves	
aprons	
safety glasses/goggles	
eyewash station	
sinks	
disinfectant spray bottles	
paper towels	
biohazard bag	
glass disposal boxes	
deionized water spigots	
fire extinguisher	
first aid kit	
hazardous materials spill kit	
dissecting kits	
blank slides & coverslips	
trash & recycling containers	
prepared A&P slides	

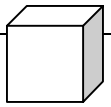
Units of Measurement and the Metric System

Biol 2404 Laboratory & Homework Activities

Materials Needed:
meter sticks
metric rulers
calculators

It is essential that people working in scientific and medical fields develop some facility with units of measurement including the ability to convert between different systems of measurement. Unlike the English (Apothecaries) system, conversions within the metric system are relatively easy; all being based on increments of 10.

Quantity	Metric Unit	Symbol	Approximate Equivalents
Length	millimeter	**mm**	thickness of dime or paper clip wire
	centimeter	**cm**	width of a paper clip
	meter	**m**	1 yard or 3 feet height of door is about 2m
	kilometer	**km**	0.6 miles distance you can walk in 12 minutes
Area	square centimeter	**cm^2**	area of this space:
	square meter	**m^2**	area of a card table top
	hectare	**ha**	area of a football field including end zones

Volume	milliliter	**ml**	a teaspoon holds about 5 ml
	liter	**l**	a quart
	cubic centimeter	**cm^3**	volume of this cube: 
	cubic meter	**m^3**	a cubic yard
Mass	milligram	**mg**	a grain of salt
	gram	**g**	3 small paperclips
	kilogram	**kg**	2.2 lbs weight of Webster's Collegiate Dictionary
	metric tonne	**mt** or **tonne**	1.1 tons a Volkswagen 'Beetle'
Energy	**centigrade**	**ºC**	0ºC = 32ºF; 100ºC = 212ºF
	Calorie	**Cal**	1 lb of fat stores 3500 Calories of food energy

Name:_____

Due:_____

The Metric System

Biol 2404 Homework Sheet

The following activities will help to familiarize you with units of the metric system, use your text or lab manual to answer each:

1. What is the metric prefix that means:

   one thousand _____ one thousandth _____

   one hundred _____ one hundredth _____

2. Complete the following sentences with the correct *word*(not abbreviation).

   One thousand grams is a _____

   One one thousandth of a gram is a _____

   One thousand meters is a _____

   One one thousandth of a meter is a _____

   One one hundreth of a meter is a _____

3. Convert the following:

.45 liters =	_____ml	670 cm =	_____m
1250 ml =	_____ l	1250 g =	_____kg
0.065 mg =	_____g	0.15 liters =	_____ml
3.7 km =	_____m	120 mm =	_____cm
3.6 kg =	_____g	5000 m =	_____km

4. Make a diagram of your textbook, below, use arrows to indicated how the terms below apply, then measure and record these dimensions of your textbook ***in centimeters*** below:

   "superior" to "inferior" _____

   "medial" to "lateral" _____

   "anterior" to "posterior" _____

   "dorsal" to "ventral" _____

5. What is the average normal body temperature in degrees Fahrenheit and Celsius (show your work, or formula used)?

6. What was yesterday's high and low temperature in degrees Celsius (show your work or formula used):

   high: _____ low: _____

7. If someone weighs 154 lbs how much do they weigh in kilograms (show your work):

8. When you leave the ACC parking lot (either light on 290) and have driven **one kilometer**, where are you (be specific)?

9. Find and describe an everyday object not mentioned in this exercise, the textbook, or the lab manual that measures approximately:

   one meter: _____

   one centimeter _____

   one millimeter _____

   one liter _____

   one gram _____

   one kilogram _____

The Language of Anatomy
[Landmarks, Cavities, Planes, Organ Systems]
Biol 2404 Laboratory Activities

Lab Materials:

male & female surface landmarks models
various models

Lab Activities:

1. Define and give examples of the following directional terms:
   - superior/ inferior
   - anterior/ posterior
   - medial/ lateral
   - dorsal/ventral
   - proximal/ distal
   - superficial/deep

2. Use the models above to find and describe the location of common surface landmarks listed below
   - axial region
   - appendicular region
   - head, neck, thorax, abdomen, pelvis
   - nasal, orbital, oral, buccal, occipital, cervical, axillary, thoracic, umbilical, lumbar, sacral, gluteal, brachial, pelvic, abdominal, pubic, inguinal, femoral, patellar, calcaneal

3. Describe and recognize the variety of sections on all many models in the lab that show various types of sections.
   - sagittal plane
   - frontal plane
   - transverse plane

4. List the major body cavities and name organs found in each
   - Dorsal
     - Cranial
     - Spinal
   - Ventral
     - Thoracic
     - Abdominopelvic
       - Abdominal
       - Pelvic

5. Study torso models and illustrations to be able to name which abdominal quadrants or regions various organs are found in.

   - upper right and left quadrate; lower right and left quadrate
     - epigastric hypogastric, umbilical
     - rt & lft hypochondriac, rt & lft lumbar, rt & lft inguinal

Terminology List for Landmarks, Cavities, Planes, Organ Systems:

Body Orientation and Direction:
- superior/ inferior
- anterior/ posterior
- medial/ lateral
- cephalad/ caudad
- dorsal/ventral
- proximal/ distal
- superficial/deep

Body Planes and Sections

- sagittal plane
- frontal plane
- transverse plane

Body Cavities

- Dorsal
  - Cranial
  - Spinal
- Ventral
  - Thoracic
  - Abdominopelvic
    - Abdominal
    - Pelvic

Body Landmarks and Surface Features:

- axial region
- appendicular region
- head, neck, thorax, abdomen, pelvis
- nasal, orbital, oral, buccal, occipital, cervical, axillary, thoracic, umbilical, lumbar, sacral, gluteal, brachial, pelvic, abdominal, pubic, inguinal, femoral, patellar, calcaneal

Abdominopelvic Quadrates

Abdominopelvic Regions

- epigastric hypogastric, umbilical
- rt & lft hypochondriac, rt & lft lumbar, rt & lft inguinal

Organ Systems Overview

Biol 2404 Laboratory Activities

Lab Materials:

Tables and Illustrations
Torso Models

Lab Activities:

1. Use models and charts to learn the major systems and some of the major organs of *each* organ system listed below.

Terminology:

Integumentary System
[the skin can be considered a membrane, a single organ or an organ system]

Skeletal System
each individual bone is a separate organ of the skeletal system
(eg. humerus, radius, femur, etc.)

Muscular System
each individual muscle is a separate organ of the muscular system
(eg. biceps, triceps, gastrocnemius. etc.)

Nervous System
brain, spinal cord, each cranial nerve, each spinal nerve

Endocrine System
anterior pituitary gland, posterior pituitary gland, thyroid gland, pancreas, adrenal cortex, adrenal medulla, ovaries, testes

Circulatory System
heart, each individual artery and vein is a separate organ of the circulatory system
(eg. aorta, pulmonary artery, hepatic portal vein, etc.)

Lymphatic System
right lymphatic duct, thoracic duct, tonsils, spleen, lymph nodes

Immune System
[Specific cells and chemicals in virtually every body organ help to protect the body from pathogens]

Respiratory System
nose, pharynx, larynx, trachea, bronchi, lungs, diaphragm

Digestive System
mouth, pharynx, esophagus, stomach, small intestine, large intestine, liver, gall bladder, pancreas, mesenteries, teeth, salivary glands

Urinary System
kidneys, ureters, urinary bladder, urethra

Reproductive System
male: penis, scrotum, testes, epididymus, vas deferens, ejaculatory duct, urethra, seminal vesicles, prostate gland, bulbourethral glands
female: vulva, , mammary glands , ovaries, oviducts, uterus, cervix, vagina

Identification of Biomolecules

Biol 2404 Experiments in Physiology

Our physical bodies are essentially a collection of both common and some exotic chemicals. Many of these chemicals are simple **inorganic** combinations such as sodium chloride, hydrochloric acid, molecular oxygen, and carbon dioxide. Most of the different kinds of chemicals comprising our bodies are larger more complex **organic** molecules. The biochemical reactions that are occurring constantly within our cells synthesize new, larger molecules or decompose larger molecules into smaller pieces. **Anabolism** is a term used for all the **synthesis** reactions occurring at any time; **Catabolism** is a term that refers to all the **decomposition** reactions occurring at any time. **Metabolism** is a term that refers to ALL of these reactions together. While our bodies can metabolize a wide variety of organic molecules, the vast majority belong to three major groups: **carbohydrates**, **lipids** and **proteins**.

Carbohydrates are composed of carbon, hydrogen and oxygen atoms in a ration of $(CH_2O)_n$ where *n* can be any number depending on the complexity of the carbohydrate. **Simple sugars** such as glucose and fructose are called **monosaccharides**. More complex carbohydrates such as starches are **polymers** of these monosaccharide units and are called **polysaccharides**. Simple carbohydrates are broken down or catabolized in a process called **glycolysis** which provides the cells with most of its energy.

Lipids, including fats and steroids are composed of carbon, hydrogen and oxygen atoms. They are important components of cell membranes and are used as hormones and for energy storage. Excess food is usually stored as fat in adipose tissue cells.

Proteins are constructed from long chains of amino acids and contain carbon, hydrogen, oxygen, nitrogen and sulfur atoms. Proteins provide the major structural components of our cells and therefore our bodies. Other proteins serve as **enzymes** which are the major catalysts that facilitate complex biochemical reactions in our cells

We can perform simple tests to identify the presence of some of these kinds of molecules by adding **indicators** to a solution to be tested. A change in color or other physical characteristic indicates the presence or absence of a particular kind of organic molecule.

A. **Simple carbohydrates (sugars)**.
Benedicts solution causes some sugars to turn green, yellow, orange or red when heated to boiling. The color of a positive reaction depends on how much sugar is present (green indicates low levels; red high sugar levels)

B. **Complex carbohydrates (polysaccharides or starches)**.
Lugol's iodine causes a solution containing starch to turn dark blue to black. The more starch there is the darker the color.

C. **Lipids (fats and oils)**.
Large amounts of concentrated lipids leave a translucent spot on absorbent paper after drying.

D. **Proteins (and Polypeptides)**
Biuret solution causes a protein solution to turn pink or violet.

The first step in learning to detect these chemicals is to perform **control** tests with substances **known** to contain or not to contain specific chemicals. You will perform each of the above tests on a "positive"

and a "negative" solution (the "negative" is usually water). After completing the tests you will see both the positive and negative results for each of the different kinds of molecule above. Then you can compare your experimental tests to these **control** results to see if any of the different kinds organic molecules are present in each test (unknown) solution.

Control Test Procedures:

1. **Sugars:**
   a. take two clean test tubes and label one su+ and the other su-.
   b. add about 1 cm (use ruler to measure) of **glucose solution** (10% Karo) to su+ test tube
   c. add about 1 cm of DI water to su-
   d. add 5 drops of **Benedict's solution** to each test tube
   e. using test tube clamp, place both test tubes in a boiling water bath at your table for about 2 minutes
   f. record the reaction as either "+" or "-" in the table on your data sheet

2. **Starches**
   a. swirl the starch bottle to mix then add a drop of **starch solution** (1% starch) to one of the wells in the spot plate and a drop of DI water to another well
   b. add 1-3 drops of **Lugol's iodine** to each of the wells
   c. record the reaction as either "+" or "-" in the table on your data sheet

3. **Lipids**
   a. with a dropper add a drop of **vegetable oil** to a 2" square of a paper towel
   b. with another clean dropper add a drop of DI water to another paper towel square
   c. place the paper towel in the incubator on a warming tray for 5 minutes or until dry.
   d. record the reaction as either "+" or "-" in the table on your data sheet

4. **Proteins**
   a. swirl the protein solution bottle to mix then add a drop of **protein solution** to a clean spot plate
   b. then add a drop of **Biuret solution** to the same well
   c. add a drop of DI water to another well on the spot plate
   d. then add a drop of Biuret solution to the same well
   e. record each of the two reactions as either "+" or "-" in the table on your data sheet

Experimental Test Procedures

In the second part of this exercise you will be testing each of the unknown solutions that you are given by adding indicators (like you did to the controls) to test for the presence of the above molecules. But before you actually perform the tests you must first make predictions (hypotheses) by noting which organic molecules you would *expect* to find in each of the solutions. Indicate which organic molecules you expect to find in each of the test solutions by placing a "+" sign in the "**expected results**" column of your data table. Place a "-" if you do not expect to find that kind of molecule. As you make your predictions be able to explain why you did or did not expect to find a particular kind of molecule in each sample.

Now, test for the presence or absence of each kind of organic molecule by using the same amounts of indicator solutions that you used in your control tests. Record your results in the "**experimental results**" columns of your table on your data sheet.

Notes:

Use the spot plate for the starch tests & protein tests
Use a paper towel for the oil test
Use test tubes for the sugar test.

Cleanup and Disposal

Discard all test solutions into the sink with the water running
Do NOT empty water or boiling stones from beaker on hot plate
Make sure the hot plate is turned off and unplugged before you leave; leave the beaker and boiling stones on the hot plate
Dispose of used test tubes in the glass disposal box; keep any unused tubes in the rack
Dispose of plastics and paper towels in trash
Clean spot plates with soap and water and return it to the tray on your lab table
Return all dropper bottles to the tray on your table, make sure caps are screwed on
Wipe down counters with disinfectant

Name:_____
Group:_____
Due Date:_____

Identification of Biomolecules

Bio 2404 Lab Data Sheet

Control Tests: For each control test below record your results as a "+" or "-" in the column to the right.

Control Tests	Result +/-
sugar test	
Sugar Sol	
DI water	
starch test	
Starch Sol	
DI water	
lipid test	
Oil	
DI water	
protein test	
Protein Sol	
DI water	

Did all the control tests give the expected results, if not explain?

Why are these called "control" tests

What would be the consequences for the rest of this experiment if any of the control tests did not produce the expected results? Describe a specific example.

Experimental Tests: Write out your 'hypothesis' being tested (your expected results) for each solution below and then record your experimental results as a "+" or "-" in the columns to the right.

solution	Hypotheses (Expected Results) [+/-]					Experimental Results [+/-]			
	sugar	starch	lipid	protein		sugar	starch	lipid	protein
apple juice									
diet soda									
powdered sugar sol									
potato sol									
bottled water									
tuna sol									

Circle any experimental result that does not support your hypothesis, i.e. any **discrepancies** between what you *expected* to find (your hypotheses) and what you *actually* found (your experimental tests) in each of the solutions. Then try to ***explain*** each of these specific discrepancies, ie. why***, specifically***, do you think you did not get your expected results in each case? Was it a problem with your hypothesis? Was it a problem with the data you collected? Be VERY specific with your explanation; eg. "I was wrong" is NOT an explanation. (use additional sheets as needed):

The Microscope

Biol 2404 Laboratory Activities

Lab Materials:

Slides: Letter "e"
colored threads or threads colored

Lab Activities:

1. Identify the major parts of the microscope and know the functions of each:

   ocular lens, objective lenses, nosepiece, power switch, light control switch, mechanical stage, condenser, iris diaphragm, coarse & fine focus , pointer

2. Be able to define and understand the following terms related to microscopy:

   magnification, resolution, contrast
   compound microscope, dissecting microscope

3. Distinguish between the **scanning**, **low power**, **high power**, and **oil immersion** objectives.

4. Demonstrate proper focusing techniques and light adjustments at all magnifications and determine the **total magnification** you are using when viewing the two slides listed above

5. Demonstrate proper handling, use and care of the microscope and of prepared slides.

6. Learn the meanings of the abbreviations below that are used on prepared slides:

wm	=	whole mount
sec	=	section of an organ or tissue; no specific kind of section designated
cs	=	cross section
ls	=	longitudinal section
sag	=	sagittal section
sm	=	smear → cells are spread out in a single layer across the slide
ts	=	teased → individual cells are pulled apart from each other on the slide

Terminology List for Microscope:

magnification, resolution, contrast
compound microscope, dissecting microscope
ocular lens, objective lenses, nosepiece
power switch, light control switch, mechanical stage, condenser, iris diaphragm, coarse & fine focus, pointer

terminology for microscope slides: wm, sec, cs, ls, sag, sm, ts

The Cell & Cell Division

Biol 2404 Laboratory Activities

Lab Materials:

Models:	animal cell
	mitosis plaque
Slides:	epithelium simple squamous oral smear
	wet mount of cheek cells
	sperm smear
	Human blood Wright's smear
	amphibian smooth muscle, teased
	Wards-animal mitosis fish blastodisc IH sec

All living matter is composed of **cells**. The human body contains trillions of cells. The metabolism of living organisms, all their biochemical activities, takes place within cells and as a result of cellular activity. All cells arise from other cells by cell division.

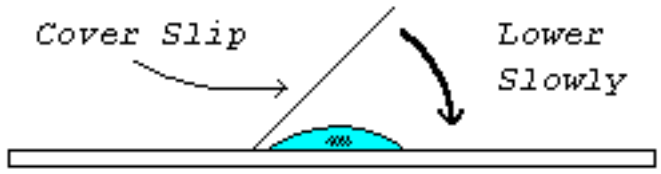
All cells are surrounded by a **cell membrane** which encloses the **cytoplasm** (protoplasm) and various other internal structures. The cell membrane restricts passage of materials in and out of the cell and helps to protect the cells structural and functional integrity. Internally, floating in the cytoplasm, are various **organelles** (small organs), each with a specific function similar to some of the organs found in our bodies. A **nucleus** is found in almost all of our cells and is often the largest cellular structure present. The nucleus contains the genetic material, the **chromosomes**, which are made of **DNA** and control all metabolism. Most cells also contain **mitochondria** which contain most of the enzymes for extracting energy from organic foods, a chemical process called **respiration**. Additional organelles and cellular structures are listed in the lab activities below.

Lab Activities:

1. Study the cell model and identify the following organelles and structures:
   - cell membrane
   - cytoplasm
   - nucleus & nucleolus
   - organelles: ribosome, endoplasmic reticulum, golgi bodies, mitochondria, centrioles, lysosomes, cilia & flagella

2. Study the general **functions** of each cell structure and organelle listed above

3. Make a **wet mount** of cheek cells following your instructor's directions and identify as many cellular structures as you can. (image: http://mrsdlovesscience.com/MICROSCOPEpgs/lifemicrowetmount.html)



4. Compare some of the different kinds of cells (epithelium, blood, muscle and sperm) from the slides indicated above and describe their visible similarities and differences

5. Identify the stages of mitosis on prepared slides and models and be able to find good examples of each of the major stages of mitosis.

    interphase, prophase, metaphase, anaphase, telophase

Terminology List for Cells and Cell Division:

Cell Structures:

- cell membrane
- cytoplasm
- nucleus
  - nucleolus
- organelles
  - ribosome
  - endoplasmic reticulum
  - golgi bodies
  - mitochondria
  - centrioles
  - lysosomes
  - cilia & flagella

Cell Division (Mitosis)

- interphase, prophase, metaphase, anaphase, telophase

Human Tissues

Biol 2404 Laboratory Activity

Lab Materials:

Slides:

epithelium:
epithelium simple squamous (oral smear)

connective:
mammal areolar tissue spread

muscular:
skeletal muscle teased

nervous:
mammal, neuron, motor nerve cells, smear

In multicellular organisms such as humans various groups of cells become **specialized** for specific functions. Some cells are responsible for movement, others for protection and still others for transferring food and oxygen throughout the body. None of these cells could survive independently from the others. Each has become specialized not only in function but in shape and internal makeup to perform a relatively few functions. Groups of cells with similar morphology and function are called **tissues**. Tissue cells are usually embedded in a noncellular **matrix**. The proportion of cells to matrix varies between tissue types. The matrix of many tissues also contains one or more kinds of protein **fibers** such as **collagen**, **elastin** and **reticular** fibers. All mammalian organs and organ systems are composed of just 4 basic or **primary tissue types**: **Epithelial, Connective, Muscular,** and **Nervous** Tissues. Each of these four primary tissue types can be further subdivided into several more specific tissue types.

Epithelial tissues line body surfaces and the lumen of all tubes and ducts within the body; including the digestive system, lungs, kidneys, exocrine glands, etc. Epithelial cells function in protection, filtration, secretion and absorption. They are packed tightly together with little or no intercellular matrix. Epithelium generally lacks a direct blood supply and is bound to underlying tissue layers by the basement membrane.

Connective tissue morphology is less well defined than the other 3 tissue types. Noncellular matrix material often accounts for a major portion of the space occupied by connective tissues. Tissue cells are scattered throughout the usually highly vascularized matrix. The matrix itself consists of an amorphous jelly-like collection of mucopolysaccharides which sometimes contain fibers of collagen or elastin. Connective tissue provides support in the form of cartilage and bone, stores fats in the form of adipose tissue, and transports oxygen and metabolic products as blood and lymph.

Muscle tissue is composed of elongated spindle shaped cells that can be up to a foot long arranged in layers or bundles. Each muscle cells (=muscle fiber) is bounded by a cell membrane called a sarcolemma. The cytoplasm inside is referred to as the sarcoplasm. Contractile threadlike organelles called myofibrils fill the interior of the cells.

Nervous tissue is made up of highly specialized cells called neurons whose primary job is to conduct impulses throughout the body for coordination and control of body activities. Another type of nervous tissue is neuroglia which supports, protects, insulates and nourishes the neurons.

Lab Activities:

1. Examine the slides of each of the four **primary** (basic) **tissue types** as assigned, make sketches of each and be able to distinguish them from each other

2. Review the general functions of each specific tissue type you view

Tissue Identification

Biol 2404 Homework Assignment

After discussing **primary** and **specific** tissue types in lecture and lab complete the following exercise on your own.

List 3 different **organs** that contain each of the specific tissue types in the table below. Remember, an organ is a group of tissues working together to perform a specific function. Refer to the **Organ System Overview** exercise that you studied earlier in this manual. Your text and lab manual gives you some suggestions but in some cases they do not mention specific *organs*; it may only mention a general location or a part of an organ. **Make sure you know whether the structure you are listing is actually an organ**.

Also, you must name ***specific organs***; for example 'humerus', *not* 'bones', or 'gluteus maximus' *not* 'muscles', or 'aorta', not blood vessels, etc.

There may be a few tissue types that you cannot find in 3 different organs, in those cases list as many organs as you can find.

Name:_____

due date:_____

Epithelial Tissues	
Specific Tissue Types	***3 Specific Organs***
Simple Squamous	
Simple Cuboidal	
Simple Columnar	

Muscle Tissues	
Specific Tissue Types	***3 Specific Organs***
Striated (Skeletal, Voluntary)	
Smooth (Visceral)	
Cardiac	

Nervous Tissues	
Specific Tissue Types	***3 Specific Organs***
Neurons	
Neuroglia	

Connective Tissues	
Specific Tissue Types	***3 Specific Organs***
Areolar	
Adipose	
Fibrous (Dense, Regular)	
Hyaline Cartilage	
Fibrous Cartilage	
Elastic Cartilage	
Bone	
Blood	

Dissection of the Fetal Pig

Biol 2404 Laboratory Activities

In this course, we are primarily concerned with learning anatomical terminology as it pertains to the human organism. Ideally, human cadavers would provide the best subjects for examination. Lacking enough student volunteers, we are forced to make use of the fetal pig, *Sus scrofa*, as a fairly reasonable substitute.

These pigs are usually within one or two weeks of births and are obtained from the sows at the time of their slaughter. A sow produces, on average, eight piglets per litter, which are about 30 cm long at birth. Pigs have a gestation period of 112-115 days. In contrast, humans average one baby per litter, about 50 cm long at birth, and the human gestation period is about 275 days. Measure the length of your pig from snout to the base of the tail, in millimeters, and the use the graph provided in lab to estimate the **gestational age** of your fetal pig.

Review the general instructions for dissections on pages 3 & 4 of the course packet. Understand how to use the phrase "**anatomical position**" before you begin.

Obtain a pig and rinse it in the sink then place it in a dissecting pan for observation. These pigs have been injected through a slit in the neck with colored latex to highlight the blood vessels. In your dissection later, arteries will appear pink, veins blue. Begin your study by examining the surface features of the pig. Determine the possible orientations of the pig in terms of dorsal/ventral; anterior/posterior; superior/inferior; superficial/deep. Note from the illustrations provided that some of these terms have different meanings in 4 legged animals than in humans.

Note the **snout** with prominent **nostrils** and the **eyes** which may be sealed closed in smaller specimens. Also note the external ear or **pinna**. Notice the pig's short, stocky **neck** with its powerful muscles adapted for rooting. Posterior to the neck is the **thorax**. Palpate the **ribs** and **sternum** under the skin. In the **abdominal area**, note the **umbilical cord** with its injected arteries and vein. Along the sides of the ventral region are pairs of **mammary papillae**, commonly called teats or nipples, which become functional mammary glands only in mature females. The male is identified by finding the **urogenital opening** directly posterior to the attachment of the umbilical cord. Also posterior to the hind legs is the **scrotum**, a sac of skin that contains the **testes** in a mature male. In both sexes, the **anus** is directly ventral to the base of the **tail**. A female pig is recognized by the **urogenital opening** directly ventral to the anus that serves as a common opening for both the urinary tract and the vagina. Beneath the urogenital opening is a prominent **genital papilla**.

We will begin our study of the pig's digestive and respiratory systems by taking a close look at the mouth. Stick one point of the larger scissors into a corner of the pig's mouth and cut posteriorly through the **masseter** muscle for approximately 3.5 cm. Now make the same cut on the other side. Take the bone cutters and cut through the jaw bone on each side until the lower jaw can be opened enough to see the epiglottis (see below).

Now examine the mouth cavity and find the teeth, the **hard** and **soft palates** and the **tongue**. In the back of the mouth is a small protruding flap of cartilage called the **epiglottis** which prevents food being swallowed from entering the **glottis**. The glottis is the opening into the **larynx** (or voice box) that you will locate later in the throat area. Just behind the glottis is a space called the **pharynx** (or throat) That leads to the **esophagus**. You will find the esophagus later in your dissection.

Now, place the pig on its back in the dissecting tray. Get two pieces of string about 60 cm long. Tie one end of a string to the front foot and then pass the string under the pan and tie the other end to the opposite foot. Make sure the limbs are spread widely apart. Tie the hind legs in the same manner. Look at the illustration provided showing how to dissect the ventral surface of the pig. With the larger scissors make a shallow, midventral incision in the neck near the base of the lower jaw. insert the blunt edge of the scissors into the incision and cut posteriorly to within about 15 mm of the umbilical cord. Cut all the way through the body wall and at the same time lift the body wall toward you to avoid cutting into any internal organs. Avoid gouging by holding the scissors parallel to the surface of the abdomen. Next make a pair of incisions, each lateral to the umbilical cord and posterior teats.

Roll the strip of skin with the umbilical cord back slightly and locate the **umbilical vein**, then cut it. Examine the **abdominal cavity** and find the muscular **diaphragm** separating it from the **thoracic cavity**. Now make lateral incisions through the body wall just posterior to the attachment of the diaphragm. Follow the attachment of the diaphragm to the body wall all the way to the back muscles. Cut through the diaphragm on both sides where it attaches to the body wall. Carefully cut the membranes binding the thoracic organs to the ventral thoracic wall. Bend back the flaps of body wall and wash out any coagulated blood and fluid.

The **thoracic cavity** is partitioned to form two lateral **pleural cavities** containing the lobed **lungs**. A **pericardial sac** containing the **heart** is located between the pleural cavities. above and partly covering the heart is a large, brownish, elongated mass of tissue which is the **thymus gland**. Open the pericardial sac to expose the heart. Note that both the pericardial sac and the surface of the heart is made of **serous membrane**. Also note that the inner wall of the thoracic cavity and the outer surface of the lungs is covered in serous tissue. Distinguish between **visceral** and **parietal pleura** and **visceral** and **parietal pericardium**.

The serous tissue of the **abdominopelvic cavity** is called **peritoneum**. Again, distinguish between **parietal** and **visceral peritoneum**. Note also that serous membrane forms thin, clear **mesenteries** between many of the abdominal organs. These mesenteries are composed of two layers of peritoneum. Between the layers are connective tissue, blood vessels, and nerves that supply the various abdominal organs.

Just beneath the skin of the neck and several small strips of muscles is a large pair of **thymus glands** that extend down to the heart. Carefully lift the antrior portion of the thymus and find a “bulge” that is the **larynx**. Just beneath the larynx is an oval purplish mass which is the **thyroid gland**. Find the **trachea** which leads from the **larynx** and branches into three bronchi in the lungs.

Flip the left lung over to the right side being extremely careful to avoid disturbing the heart and associated vessels. Carefully remove enough parietal pleura to locate the **esophagus**. Trace the esophagus through the **diaphragm** and into the **peritoneal cavity** to find the **stomach** which is nearly covered by the left lobe of the **liver**. The **cardioesophageal valve** of the stomach is located at its juncture with the esophagus and closes upon swallowing to prevent gastric fluids from ascending into the throat. A **pyloric valve** separates the **stomach** from the **small intestine** and allows food to pass once it has been thoroughly mixed with gastric juices. Note the large **liver**, often blue from the latex dye. Lift the liver and examine its inferior surface to locate a greenish **gallbladder** embedded there. The **spleen** is a long fingerlike organ extending down the left side of the stomach. Note that it is proportionately larger than the human spleen. The **pancreas** is located along the ventral border of the stomach and often extends along several intestinal folds. Follow the coils of the **small intestine** and note the supporting mesentery loaded with blood vessels and lymph nodes. Cut open a section of the

small intestine. Remove a portion of the velvety lining and prepare a wet mount. Observe your slide under the microscope and note the numerous fingerlike **villi**. These villi help to increase the surface area of the intestine for the absorption of nutrients into the blood

Finally, the small intestine enters the **large intestine**, along one side. The **large intestine** is subdivided in the the **cecum**, **colon**, and **rectum** as is ours. The first part of the large intestine is a short blind sac called the **cecum** which extends down from the point where the small and large intestines join. Note that the pig cecum lacks an appendix. Make an incision in the **colon** opposite the entrance of the small intestine and find the papilla-like **ileocaecal valve**. The rectum is the terminal part of the large intestine and opens to the outside through the **anus**.

Carefully shove the intestines to one side. The **kidneys** lie dorsally, just inside the body wall, but outside the peritoneal cavity against the ventral surface of the back muscles (= retroperitoneal). Gently tear the peritoneal layer away without damaging the attached blood vessels. Note the **ureter** which exits each kidney near the attachment of the **renal artery** and **renal vein**. Trace the ureters posteriorly along the dorsal body wall. They will turn ventrally and enter the **urinary bladder**, an elongated sac between the two **umbilical arteries**. Trace the bladder into the **umbilical cord** where it continues as the allantoic stalk. After birth, the allantoic stalk degenerates.

If you have a male pig, you previously located the **testis** in the **scrotal sac**. The testes begin embryonic development in the body cavity immediately posterior to the kidneys. usually they descend into the paired scrotal sacs before birth. Open one of the sacs and find a **testis**. Examine the testis and find a band of tissue, the **epididymus**, which begins at the anterior end of the testis and proceeds posteriorly along one side of the testis to its most posterior point where it joins the **vas deferens** (=ductus deferens). The **penis** is located directly inside the urogenital opening of the male pig in the midventral strip of body wall that also contains the **urinary bladder**. Trace the **vas deferens** (ductus deferens) from the scrotal sac through the body wall, into the abdominal cavity. The vas deferens and associated nerves and blood vessels are referred to as the **spermatic cord**. Gently pull the spermatic cord and note that it slides through a minute opening in the posterior wall of the abdomen Locate the **urethra** and follow it posteriorly and then anteriorly to the **urogenital opening**.

In the female pig, find the **kidneys** and locate the paired **ovaries** posterior and ventral to them. They are loosely supported by thin **mesenteries**. The ovaries are connected by mesenteries to two, much coiled, projections called **uterine horns** which are extensions of the "Y"-shaped **uterus**. The uterus leads to the **urogenital opening** of the female pig.

Begin your study of the pig's circulatory system by removing any vestiges of the **pericardial sac** from the **heart**. Examine the heart and located a surface groove that is a line of demarcation between the **right** and **left ventricles**. Notice that the **left ventricle** is larger than the **right ventricle** and extends to the posterior tip of the heart. Running along this groove are **coronary arteries** and **veins** which are the major suppliers of blood to the heart. Next locate the two darker anterior flaps on the heart making up the **right** and **left auricles**, these are pouches containing the chambers called the **atria** that can expand when they fill with blood. The large whitish blood vessel attached to the anterior ventral surface of the heart is the **pulmonary artery** which supplies the lungs with blood. Immediately dorsal to the pulmonary artery and partially obscured by it is the **aorta** which leads outward from the heart then bends 180º to the left as it passes down toward the **diaphragm**. The **aorta** can be viewed by shoving the heart and lungs to the right. The pulmonary artery leads posteriorly and branches to the lungs. A short duct, the **ductus arteriosus**, connects the pulmonary artery with the aorta. The **ductus arteriosus** shunts fetal blood away from the lungs. After birth, the smooth muscles in the wall of this duct constrict and close off this shunt.

Return to the pleural cavity and cut away tissue in the neck to expose the aortic arch and its major branches. Locate the right and left **subclavian arteries** which take blood to the arms, and the right and left **carotid arteries** which take blood to the head.

Now look at the venous system. In the same area, the **anterior vena cava** receives blood from two **subclavian veins** that drain the arms, and two **jugular veins** that return blood from the head.

Locate the **abdominal aorta** and find the **renal arteries** that supply blood to the kidneys. Below the kidneys the aorta divides into two large arteries that supply blood to the lower torso and the legs. On each side of the urinary bladder are two **umbilical arteries** that can be traced to the **umbilical cord**.

The major veins that drain the legs join in the pelvic area to form the **posterior vena cava** which leads back to the heart. The posterior vena cava receives several large vessels as it progresses toward the liver. Trace the posterior **vena cava** into the liver. Also, trace the **umbilical vein** into the liver where it becomes a large **ductus venosus** that empties into the **posterior venal cava**. The ductus venosus degenerates after birth.

Disposal & Cleanup after Dissection:

1. after each dissection dispose of materials as below:
   - slides and coverlsips → glass disposal box
   - dissecting scraps → "scraps" bucket
   - gloves, paper towels, etc → regular trash

2. spray and wipe down your table with disinfectant spray

3. clean off your dissecting tray and place on drying rack

4. rinse and dry your dissecting tools and pins and return them to their proper containers

Terminology List for Fetal Pig Dissection

External Anatomy
- Head: snout nostrils eyes pinna neck
- Trunk: thorax, ribs, sternum, abdomen, umbilical cord, mammary papillae, urogenital opening, scrotum, anus, tail, genital papilla (female)

Internal Anatomy
- Digestive System
  - masseter, hard palate, soft palate, pharynx, tongue, esophagus, stomach, liver, cardioesophageal valve, pyloric valve, rugae, liver, gall bladder, spleen pancreas, small intestine, villi, large intestine, caecum, colon, ileocaecal valve, rectum, anus
- Respiratory Systems
  - glottis, epiglottis, larynx, trachea, lungs, diaphragm
- Cavities & Membranes
  - thoracic cavity: pleural cavities, pericardial cavity
  - abdominopelvic cavity
  - serous membranes:
    - pleural cavities; visceral and parietal pleura
    - pericardial cavity; visceral and parietal pericardium

peritoneal cavity; visceral and parietal peritoneum, mesenteries

Urinary & Reproductive Systems
kidneys, ureter, urinary bladder, scrotal sac, testes, epididymus, vas deferens, spermatic cord, inguinal canal, urethra, penis, ovaries, oviduct, uterine horns, vagina

Circulatory System
Heart: right & left ventricle, right and left auricles, atria
Pulmonary Circuit: pulmonary artery
Systemic Circuit:
Arteries: aorta, ductus arteriosus, subclavian arteries, carotid arteries, brachiocephalic arteries, renal arteries, common iliac arteries, umbilical arteries
Veins: anterior vena cava, brachiocephalic veins, subclavian veins, jugular veins, common iliac veins, posterior vena cava, hepatic portal vein, umbilical vein

Body Membranes

Biol 2404 Laboratory Activities

Lab Materials:

Diagrams and illustrations
sheep heart with pericardium
fresh knee joint (if available)
Torso Models and Male & Female Pelvic Models

Lab Activities:

1. Identify and be able to describe the structure and function of all membranes as indicated on models, preserved materials and figures
   - Mucous
   - Serous
   - Synovial
   - Cutaneous

2. Distinguish between visceral and parietal pleura, pericardium and peritoneum.
   - pleura: parietal, visceral
   - pericardium: parietal, visceral
   - peritoneum: parietal, visceral

Terminology List for Body Membranes:

Kinds of Membranes:

- Mucous
- Serous
  - pleura: parietal, visceral
  - pericardium: parietal, visceral
  - peritoneum: parietal, visceral
- Synovial
- Cutaneous

The Integumentary System (Skin)

Biol 2404 Laboratory Activities

Lab Materials:

Models: skin section models (3 kinds)
skin section plaque

Slides: human scalp, hair shafts, ls
skin hair follicles sec
skin negroid sec
human palmar skin, sec
palmer skin silver human sec
mammal palmar skin sec
skin Negroid section

Lab Activities:

1. Describe and identify the three major layers of the skin: **epidermis, dermis and hypodermis** on the models available

2. Locate and identify the sublayers of the epidermis and dermis on **models** of the skin.

Epidermis:	stratum corneum
	stratum basale (=s. germinativum)
Dermis	papillary layer
	reticular layer

3. Locate and identify the layers and sublayers of the epidermis of the dermis, and the hypodermis on the slides above. Note: palmar and plantar skin has thich st. corneum and lots of sweat glands; "negroid" skin has a clearly delineated st. basale; scalp has hair follicles and oil glands.

Epidermis:	stratum corneum
	stratum basale (=s. germinativum)
Dermis	papillary layer
	reticular layer
Hypodermis (=subcutaneous layer)	adipose tissue

4. Locate the the major histological features of a hair follicle, oil glands, sweat glands and scent glands on the skin models.

5. Locate and identify the major histological features of a hair follicle and its associated structures on microscopic examination.

Hair: follicle, root, shaft, bulb, hair papilla, sebaceous glands, arrector pili muscle

6. Determine which slides above will have **sweat glands** and which will have **oil (sebaceous) glands** and be able to recognize each on microscopic examination

Glands: sweat glands, sebaceous glands

Terminology List For Integumentary System:

Skin Layers

Epidermis:	stratum corneum
	stratum basale (=s. germinativum)
Dermis	papillary layer
	reticular layer
Hypodermis (=subcutaneous layer)	adipose tissue

Structures

Hair: follicle, root, shaft, bulb, hair papilla, arrector pili

Glands: sweat glands, sebaceous glands, scent glands

The Skeletal System

Biol 2404 Laboratory Activities

Lab Materials:

slides: human white fibrous tissue, tendon, ls
mammal hyaline cartilage, sec
bone dry ground human, cs,

models and bones:
articulated skeleton
bone tissue model
sectioned long bones
skulls (natural bone & casts)
sagittal sectioned head
vertebral column with pelvis
ear ossicles (malleus, incus, stapes)
articulated arm and pectoral girdle
articulated leg and pelvic girdle
male and female pelvis models
articulated vertebral column
disarticulated bones; including sphenoid, ethmoid, vertebrae
sectioned skulls
xrays (if available)
fetal skull model
model of bone tissue section
trachea model
ear model

illustration:
fetal skeletal preparation showing ossification

Reminder: **Do not use pencils and pens to point to bones and bone markings; use the blunt or pointed probe in your dissection kit**

Lab Activities:

1. Study the microscopic structure of compact bone on the model & slide below;

model: bone tissue model

Identify: periosteum, haversian canal, lamellae, canaliculi, lacunae, osteocytes, endosteum

slide: bone dry ground human, cs,

Identify: haversian canal, lamellae, canaliculi, lacunae

2. Study the microscopic structure of hyaline cartilage on the slide below:

slide: mammal hyaline cartilage, sec

Identify: hyaline cartilage: matrix, lacunae, chondrocytes

3. Know the locations and kinds of cartilage in the human skeleton and internal organs

4. Be able to recognize fibrous connective tissue on the slide below:

slides: human white fibrous tissue, tendon, ls

5. Study the general terminology for types of bones and be able to recognize examples of each:
long, short, flat, irregular

6. Study the anatomy of a typical long bone and be able to identify the following terms:
epiphyses, diaphysis, marrow (medullary) cavity, articular cartilage, periosteum, endosteum, spongy bone, compact bone, trabeculi, yellow marrow, red marrow

7. Know the definition of each of the general kinds of **bone markings** (see table in text) and be able to give an example of each from the list of markings belos

8. Distinguish between the bones of the axial and bones of the appendicular skeleton as listed below

9. Locate and identify the fontanels on the fetal skull model:

frontal (anterior), occipital (posterior), sphenoid, mastoid fontanels

10. Identify all the **major bones** and **bone markings** of the axial skeleton and **sinuses** in both the articulated skeleton, models and on individual bones as listed below.

11. Identify all the **major bones** and **bone markings** of the appendicular skeleton in both the articulated skeleton and on individual bones as listed below.

12. Observe the illustration of fetal ossification as the cartilaginous skeleton is converted to bone tissue

Terminology List for the Skeletal System:

Histology (slides):
fibrous connective tissue: collagen fibers
hyaline cartilage: matrix, lacunae, chondrocytes
bone: haversian canal, lamellae, canaliculi, lacunae, osteocytes

Sectioned Long bone:
epiphyses, diaphysis, medullary cavity, articular cartilage, periosteum, endosteum, spongy bone, compact bone, trabeculi, yellow marrow, red marrow

Bones and Markings:
Fontanels of fetal skull: frontal (anterior), occipital (posterior), sphenoid, mastoid fontanels

Axial Skeleton

Skull (cranium)
- Frontal Bone (frontal sinus, coronal suture)
- Parietal Bone (sagittal suture)
- Sphenoid Bone (sella turcica, sphenoid sinus)
- Temporal Bone (mastoid process, styloid process, zygomatic process, external auditory meatus, malleus, incus, stapes)
- Occipital Bone (occipital condyle, foramen magnum)
- Ethmoid Bone (nasal conchae, cribriform plate, ethmoid sinus)
- Lacrimal Bone
- Zygomatic Bone
- Maxilla Bone (hard palate, palatine process, maxillary sinus)

Palatine Bone
Nasal Bone
Vomer Bone
Mandible
Hyoid Bone

Vertebral Column (general markings: body, vertebral foramen, transverse process, spinous process, superior and inferior articular processes, intervertebral discs)
- Cervical Vertebrae (transverse foramina)
  - Atlas (absence of body, "yes" movement)
  - Axis (dens, "no" movement)
- Thoracic Vertebrae (facets on body and transverse processes)
- Lumbar Vertebrae (largest)
- Sacral Vertebrae (5 fused vertebrae)
- Coccyx (3 to 5 vestigial vertebrae, body only)

Bony Thorax
- Ribs (costal cartilage, true ribs, false ribs, floating ribs, facets)
- Sternum
  - Manubrium
  - Body
  - Xiphoid Process

Appendicular Skeleton

Upper Limb
- Pectoral Girdle
  - Scapula (acromion, coracoid process, glenoid cavity)
  - Clavicle
- Upper Arm
  - Humerus (head, olecranon fossa)
- Forearm
  - Radius
  - Ulna (olecranon process)
- Hand
  - Carpals
  - Metacarpals
  - Phalanges

Lower Limb
- Pelvic Girdle
  - Os Coxae (sacroiliac joint, acetabulum, false pelvis, true pelvis, difference between male and female pelvis)
    - Ilium (iliac crest)
    - Ischium (ischial tuberosity)
    - Pubis (pubic symphysis)
- Thigh
  - Femur (head, neck)
  - Patella
- Lower Leg
  - Tibia
  - Fibula
- Foot
  - Tarsals
  - Metatarsals
  - Phalanges

Articulations and Body Movements

Biol 2404 Laboratory Activities

Lab Materials:

articulated skeleton
models of hip, knee, shoulder and elbow joints
fresh beef joint (if available)
joint X-rays (if available)

Lab Activities:

1. Describe each of the three major kinds of skeletal articulations in terms of both structure and function.

2. Locate examples of each of the three different kinds of joints on the articulated skeleton.

3. Describe the major features and anatomy of a typical synovial joint. Know:
joint capsule, articular cartilage, joint cavity, synovial membrane, synovial fluid ligaments, bursa

4. Identify major anatomical features on models of selected synovial joints as assigned from the list below:

a. Examples of Ball and Socket Joints

Ball shaped head of one bone fits in concave depression of another; allows movement around three or more axes, in three or more planes

Shoulder:

- note fit of ***glenoid cavity*** with ***head of humerus***,
- note ***ligaments*** enclosing the ***joint capsule*** (*see illustration*)

Hip:

- note fit of ***acetabulum*** with ***head*** of femur,

b. Examples of Hinge Joints

Articulating heads of bones form hinge-shaped joint; permits movement around only 1 axis, in only 1 plane

Elbow:

- note fit of ***olecranon process*** into ***olecranon fossa***
- note attachment of ***ligaments*** (*see illustration*)

Knee:

- note that the knee is the largest and most complex joint in body
- it allows flexion and extension and a little rotation
- note fit of femur onto ***articular surfaces*** of tibia
- note ***lateral and medial meniscus*** (fibrocartilage)
- note ***anterior and posterior cruciate ligament***
- note ***patella*** or kneecap embedded in ***ligaments*** and ***tendons***
- note numerous other ***ligaments*** enclosing the ***joint capsule***

Terminology List for articulations and body movements:

types of joints:

immoveable (fibrous) joint; slightly moveable (cartilaginous) joint; freely moveable (synovial) joint

anatomy of synovial joint:

joint capsule, articular cartilage, joint cavity, synovial membrane, synovial fluid, ligaments, bursa

shoulder joint:

glenoid cavity, head of humerous, ligaments

hip joint:

acetabulum, head of femur, ligaments

elbow joint:

olecranon process, olecranon fossa, ligaments

knee joint:

lateral and medial meniscus; anterior and posterior cruciate ligaments

The Muscular System

Biol 2404 Laboratory Activities

Lab Materials:

slides:	muscle striated ls
	motor nerve endings, wm ***or*** motor nerve endings reptile, wm
models:	muscle cell model (3B; *Not* Somso)
	motor end plate model
	muscle cross section with fibrous C T layers
	human torsos
	mini and half size human models
	sagittal heads
	eye model with extrinsic eye muscles
	respiratory system plaque
	muscular arms & legs
	any other models showing specific voluntary muscles

Lab Activities:

1. Identify the primary and specific tissue type on the slide of muscle; also note the striations and nuclei; understand what produces the striations

2. Identify the **muscle fibers, nerve fibers**, **synapse** and **motor end plate**s (neuromuscular junction) on the slide and the model of motor nerve endings

3. Identify the parts of skeletal muscle cells as seen on the muscle cell model:

   sarcolemma, sarcoplasm, sarcoplasmic reticulum, myofibrils, thick and thin filaments, nuclei, T-tubules, motor neuron, motor end plate, neuromuscular junction, synapse, endomysium

4. On the motor end plate model identify:

   motor neuron, motor end plate, synaptic cleft, muscle cell

5. Study the model and illustrations of a muscle organ to identify the structures below:

   fascicle, epimysium, perimysium, endomysium, tendon, aponeurosis

6. Recognize and identify the assigned human muscles & their functions from the terminology list below on all models available

   note: extrinsic eye muscles are the 6 muscles attached to each eyeball (see senses chapter)
   note: the rhomboideus is actually several muscles, you can refer to all of them as one
   note: not all muscle models show both the internal and the external intercostals
   note: not all muscle models show all three muscle layers of the abdominopelvic body wall

Terminology:

Muscle Cell Structure:

sarcolemma, sarcoplasm, sarcoplasmic reticulum, myofibrils, thick and thin filaments, nuclei, T-tubules, motor end plate, neuromuscular junction

General Muscular Anatomy:

fascicle, epimysium, perimysium, endomysium, tendon, aponeurosis

Human Muscles

a. Muscles on the Head and Neck

frontalis	→raises eyebrows	
orbicularis oris	→closes mouth; pucker up	
orbicularis oculi	→closes eyes; squint	
extrinsic eye muscles	→all eye movements	
masseter	→closes jaw	
temporalis	→ closes jaw	
sternocleidomastoid	→flexes and/or rotates head	

b. Breathing Muscles

diaphragm	→inspiration	
external intercostals	→raise ribcage; forced inspiration	
internal intercostals	→lower ribcage; forced expiration	

c. Muscles of the Abdominal Wall

external oblique	→supports body wall	
internal oblique	→supports body wall	
transverse abdominis	→compresses abdomen	
rectus abdominis	→flexes vertebral column	→ *"6-pack"*

d. Muscles that Move Pectoral Girdle

trapezius	→levation and depression of scapula	

e. Muscles that Move Upper Arm

pectoralis major	→flexes humerus	→ *main muscle of "pecs"*
deltoid	→abducts upper arm	
trapezius	→extends head; allows several movements of scapula	
latissimus dorsi	→adducts & extends humerus	→ *"lats"*

f. Muscles that Move Forearm

biceps brachii	→flexes forearm	→ *"biceps"*
brachialis	→flexes forearm	
triceps brachii	→extends forearm	→ *"triceps"*

g. Muscles that Move Hand and Fingers

flexors of hand	→flexes phalanges	
brachioradialis	→flexes lower arm	
extensors of hand	→extends phalanges	

h. Muscles that Move Thigh

gluteus maximus	→extends thigh	→ *most of "glutes"*
adductor longus	→adducts thigh	
gracilis	→adducts thigh; flexes lower leg	
sartorius	→flexes thigh	
tensor fascia latae	→abducts thigh	

i. Muscles that Move Lower Leg

biceps femoris	→extends thigh; flexes lower leg	*most of "hamstring"*
semimembranosus	→extends thigh; flexes lower leg	
semitendinosus	→extends thigh; flexes lower leg	
rectus femoris	→extends lower leg	*most of "quads"*
vastus lateralis	→extends lower leg	
vastus medialis	→extends lower leg	

j. Muscles that Moves Foot

gastrocnemius & achilles tendon	→plantarflexion of foot
soleus	→ plantarflexion of foot
tibialis anterior	→dorsiflexion of foot

The Nervous System

Biol 2404 Laboratory Activities

Lab Materials:

slides:

mammal neuron motor nerve cells, smear
Human spinal cord cs [Carolina]
mammal peripheral nerve cs & ls [look at cs only]
spinal cord and ganglia cs [Wards/Turtox] or spinal cord dorsal root ganglion sec

models:

neuron with Schwann cells
human brain
brain ventricles
sagittal sectioned head
heads of large torsos
brain stem
spinal cord cross sections
vertebral column with spinal column and spinal nerves
cross section of spinal cord in vertebrae with sympathetic ganglia
nerve cross section with fibrous C T layers
peripheral nervous system plaque

preserved materials:

human brain
sheep skull-sag sec
sheep brain
sheep meninges
cat nervous system biosmount

Lab Activities:

1. Recognize and identify the **cell body** and **processes** on the motor neuron slide.

2. Identify the structures and layers indicated on nerve cell model:

   neuron, cell body, axon, dendrite, axon terminal, neuroglia, Schwann cells, myelin, neurilemma, endoneurium

3. Locate and identify the anatomical features as assigned below on the human brain models

   Cerebrum: cerebral hemispheres, gyri, sulci, lobes (frontal, parietal, occipital, temporal), olfactory bulbs, olfactory tracts, optic nerves, optic chiasma, corpus callosum,
   Diencephalon: epithalamus (or pineal gland), thalamus hypothalamus, pituitary gland
   Cerebellum: arbor vitae
   Brain Stem:
   midbrain (corpora quadrigemina; superior and inferior colliculi)
   pons
   medulla

4. Identify the surface features of the sheep brain, then make a midsagittal section to identify the internal structures as assigned below

Cerebrum: cerebral hemispheres, gyri, sulci, olfactory bulbs, olfactory tracts, optic nerves, optic chiasma, corpus callosum
Diencephalon: epithalamus (or pineal gland), thalamus
hypothalamus, pituitary gland
Cerebellum: arbor vitae
Brain Stem:
midbrain
pons
medulla

Disposal: When you have finished with your sheep brain dissection return whole and sectioned brains to their original buckets if undamaged. Otherwise place in "dissecting scraps" bucket. Rinse dissecting pans and place upsidedown on drying rack. Rinse and dry dissecting tools and return to your drawer.

5. Locate and identify the major layers and structures associated with the **meninges** on all appropriate models:

layers of meninges: dura mater, arachnoid layer, pia mater
folds of meninges: falx cerebri, falx cerebelli, tentorium cerebelli

6. Meninges of sheep brain dissection: some of the sheep brains have the meninges still attached. Identify the three layers of the meninges on the preserved sheep brain.

Also locate the falx cerebri and the tentorium cerebelli (the sheep meninges does not have a falx cerebelli)

7. Locate and identify the ventricles, canals, and choroid plexuses (capillary beds) associated with the circulation of cerebrospinal fluid on appropriate brain models and preserved sheep brains:

lateral ventricles, third ventricle, cerebral aqueduct, fourth ventricle, choroid plexuses, arachnoid villi (=arachnoid granulations)

8. Identify the major features on the models and slide of a cross section of the **human spinal cord**; also note the three layers of the meninges on the cross section models

central canal, posterior median sulcus, anterior median fissure, gray matter, white matter (tracts),

meninges; dura mater, arachnoid layer, pia mater

9. Review the difference between a **nucleus** and a **ganglion**; and between a **tract** and a **nerve**.

10. Distinguish between a **nerve** and a **nerve fiber**. Observe and recognize the microscopic anatomy of a **nerve** and its connective tissue coverings on slide, model & illustrations:

epineurium, perineurium, endoneurium, nerve fiber

11. Identify the major features on the models of the spinal cord that includes its attachments to each spinal nerve and on the slides labeled spinal cord with ganglia .

dorsal root, dorsal root ganglion (sensory), ventral root (motor), spinal nerve

12. Identify the major groups of spinal nerves on nervous system plaque and the cat nervous system preparation

13. Find and be able to identify the major spinal nerve plexuses as available on models and illustrations

Cervical Plexus (C1 - C5)
Brachial Plexus (C5 - C8, T1)
Lumbar Plexus (L1 - L4)
Sacral Plexus (L4 - S4)

14. Locate, name the plexus each arises from and list the general function of each major nerves listed: **Phrenic, Femoral** and **Sciatic Nerves.**

15. Locate and identify any parts of the autonomic system on models available

Sympathetic Branch: sympathetic trunks are comprised of fibers mainly from the **thoracic spinal nerves** which form a pair of "**chain ganglia**" anterior and lateral to the vertebral column

Parasympathetic Branch: individual fibers **from cranial nerves** III, VII, IX and X and **sacral spinal nerves** S2, S3, and S4. Innervation of most visceral organs is from fibers of the **Vagus (X) Nerve**

16. On the cat nervous system biosmounts:
    a. observe the general structure and interrelationships between the Central and Peripheral nervous systems;
    b. note the relationship between eyes, optic nerve and brain
    c. note the relationship between the brain stem and the spinal cord
    d. locate and identify the brachial and lumbosacral plexus
    e. locate and identify the **vagus nerve**

Terminology:

Organization of the **Nervous System**:

I. Central Nervous System: Brain, Spinal Cord } **interneurons**

II. Peripheral Nervous System

sensory neurons } Cranial Nerves – 12 pairs; Spinal Nerves – 31 pairs
motor neurons
- **Somatic motor neurons**
- **Autonomic motor neurons**
  - **Sympathetic**
  - **Parasympathetic**

Histology (slides &/or models): neuron, cell body, axon, dendrite, axon terminal, neuroglia, Schwann cells, myelin, neurilemma
Distinguish between: nuclei & ganglia; tracts & nerves; gray matter & white matter
Structure of a nerve: epineurium, perineurium, endoneurium

Brain - External Anatomy: (on brain models and sheep brains)
Cerebrum:cerebral hemispheres, gyri, sulci, lobes (frontal, parietal, occipital, temporal) olfactory bulbs, olfactory tracts, optic nerves, optic chiasma,
Diencephalon: pituitary gland
Cerebellum
Brain Stem:
- midbrain
- pons
- medulla

Brain - Internal Anatomy: (on brain models and sheep brains)

Cerebrum: corpus callosum
Diencephalon: epithalamus (or pineal gland), choroid plexus, thalamus, third ventricle, hypothalamus, pituitary gland
Cerebellum: arbor vitae
Brain Stem: fourth ventricle, choroid plexus

Meninges: (on models and sheep brain)
structures: falx cerebri, falx cerebelli, tentorium cerebelli
layers: dura mater, arachnoid layer, pia mater

Spinal Cord - cross section (models and slide)
Spinal Cord: central canal, posterior median sulcus, anterior median fissure, gray matter,white matter (tracts), meninges
Spinal Nerve: dorsal root, dorsal root ganglion (sensory), ventral root (motor)

Spinal Nerve Plexuses And Their Major Nerve Branches (cat demo & models)
Cervical Plexus (C1 - C5)
Phrenic Nerve - innervates diaphragm
Brachial Plexus (C5 - C8, T1)
[T2 - T12 - No Plexus Formed]
Lumbar Plexus (L1 - L4), Femoral Nerve
Sacral Plexus (L4 - S4) Sciatic Nerve

Autonomic Nervous System
Sympathetic Branch: sympathetic trunks are comprised of fibers from the thoracic and two lumbar spinal nerves which form a pair of "**chain ganglia**" anterior and lateral to the vertebral column
Parasympathetic Branch: individual fibers from cranial nerves III, VII, IX and X and spinal nerves S2, S3, and S4. Innervation of most visceral organs is from fibers of the **Vagus (X) Nerve**

Sense Organs

Biol 2404 Laboratory Activities

Lab Materials:

Slides:

vater-pacini corpuscle wm
cochlea guinea pig ls [use 'Wards' NOT 'Wards Science' slide]
mammal foliate papillae with taste buds, sec
eye monkey, ls

Models:

skin models
eye models
ear models
Cochlear duct cross section
sagittal section of head

Preserved Materials:

sheep eyes
cribriform plate of ethmoid bone (skull)
temporal bone
ear ossicles

Other: penlights

Lab Activities:

1. Locate and identify examples of simple receptors of general sensation. These receptors are in the form of free nerve endings or sensory neurons encapsulated by connective tissue. Find the following receptors in the **skin models** using the illustrations provided:

Free nerve endings:	pain, heat, cold
Encapsulated receptors:	
Merkel discs	light touch and pressure
Meisner's corpuscles	light touch, changes in texture
Pacinian corpuscles	deep pressure, fast vibrations

2. Observe the slide of Pacinian corpuscles (vater-pacini corpuscles) and be able to recognize them and know their general function

3. Identify the location of the **olfactory neurons** and its relationship to the **olfactory bubs** and the **cribiform plate** of the **ethmoid bone** on the *3B*-eye model & sagittal head model.

4. Recognize the histological structure of the papillae with **taste buds** on the taste bud slide:.

   tongue, papillae, taste buds, taste (gustatory) cells

5. Identify the following anatomical features of the eye on appropriate models:

   extrinsic eye muscles (superior & inferior rectus muscles, superior and inferior oblique muscles; medial and lateral rectus muscles), eyelids, conjunctiva, eyelashes, lacrimal gland, nasolacrimal duct (tear duct)
   sclera, cornea, choroid layer, ciliary body, suspensory ligaments, lens, iris, pupil, retina, optic disc, fovea centralis, aqueous humor, vitreous humor

6. Observe the slide of the monkey eye and be able to recognize:

   sclera, cornea, choroid layer, ciliary body, suspensory ligaments, lens, iris, pupil, retina

7. Section the preserved sheep eye as shown in the illustration provided. Use a scalpel or sharp point of scissors to first penetrate the sclera, then use scissors to cut the rest of the way around the eye (you might need a penlite to see some of the structures). Identify the following anatomical features of the eye on the preserved sheep eye:

   sclera, cornea, choroid layer, ciliary body, lens, iris, pupil, retina, optic disc, vitreous humor

8. Identify the major anatomical features on the ear models provided.

   outer (external) ear: pinna, external auditory canal, ceruminous (=wax) glands, tympanic membrane

   middle ear: ossicles [malleus (hammer), incus (anvil), stapes (stirrup)], auditory (eustachian) tube, oval window

   inner ear: bony labyrinth: vestibule, cochlea, semicircular canals, perilymph

   membranous labyrinth: utricle, saccule, cochlear duct, semicircular ducts, endolymph Organ of Corti (in cochlear duct): hair cells, tectorial membrane

9. Recognize the histological structure of the cochlear duct including the Organ of Corti on cochlear duct section model and slide:

   Organ of Corti (in cochlear duct): hair cells, tectorial membrane

10. Identify the mechanoreceptors for static and dynamic equilibrium on illustrations available:

    Macula (in utrucle & saccule)
    Ampullae (in membranous semicircular canals)

<u>Cleanup:</u> Place dissected sheep/cow eye in "dissecting scraps" bucket. Rinse pan and hang on drying racks at sinks. Rinse and dry dissecting tools and return to drawers. Return scaplels to instructor. If razor blades were used dispose of them in the "glass disposal" boxes.

<u>Terminology:</u>

Cutaneous Receptors: (skin model and slide)
- Free nerve endings:
- Merkel discs
- Meisner's corpuscles
- Pacinian corpuscles

Taste:

Taste: (slide)
- tongue, papillae, taste buds, taste (gustatory) cells

Smell:

Smell (models)
- nasal cavity, olfactory neurons, receptor cells, cribiform plate, olfactory bulb, olfactory tract

Visual Receptors:

The Eye - External Anatomy: (models and sheep eye)

extrinsic eye muscles (superior & inferior rectus muscles, superior and inferior oblique muscles; medial and lateral rectus muscles), eyelids, conjunctiva, eyelashes, lacrimal gland, nasolacrimal duct (tear duct)

The Eye - Internal Anatomy: (models, sheep eye, slides)

sclera, cornea, choroid layer, ciliary body, suspensory ligaments, lens, iris, pupil, retina, optic disc, fovea centralis, aqueous humor, vitreous humor

Auditory Receptors:

The Ear - Gross Anatomy: (models & charts)

outer (external) ear: pinna, external auditory canal, ceruminous glands, tympanic membrane

middle ear: ossicles [malleus (hammer), incus (anvil), stapes (stirrup)], auditory (eustachian) tube, oval window

inner ear: bony labyrinth: vestibule, cochlea, semicircular canals, perilymph
membranous labyrinth: utricle, saccule, cochlear duct, semicircular ducts, endolymph

The Ear - Microscopic Anatomy (models & slides)

Organ of Corti (in cochlear duct): hair cells, tectorial membrane,

Proprioceptors of the Inner Ear:

Macula (in utrucle & saccule)

Ampullae (in membranous semicircular canals): crista ampullaris

The Endocrine System

Biol 2404 Laboratory Activities

Lab Materials:

models:	human torso
	endocrine system plaque
	brain model
	heart with thymus gland
	kidney with adrenal glands
	thyroid and parathyroid glands
	pancreas model
	male and female reproductive organs
	any other model showing major endocrine glands
slides:	human pancreas sec
	human adrenal gland sec
	mammal hypophysis pituitary gland sag sec H&E

Lab Activities:

1. Be able to locate and identify endocrine glands listed below on all appropriate models available and be able to list the major hormones produced by each.

Endocrine Glands	***Major Hormones Secreted***
Anterior Pituitary	Tropic Hormones: TSH,ACTH,FSH,LH; also: GH, & PRL
Posterior Pituitary	Oxytocin, ADH
Thyroid Gland	TH, Calcitonin
Parathyroid Glands	PTH
Pancreas	Insulin, Glucagon
Adrenal Cortex	Glucocorticoids, Mineralocorticoids, Gonadocorticoids
Adrenal Medulla	Epinephrine, Norepinephrine
Ovaries	Estrogen Progesterone
Testes	Testosterone
Thymus	Thymosin
Pineal Gland	Melatonin

2. Recognize histological structure of selected glands and be able to distinguish between the endocrine glands listed below:

Pituitary Glands ***Slide:*** mammal hypophysis pituitary gland sag sec H&E

+Distinguish between the anterior pituitary gland (larger, darker area) and the posterior pituitary gland (smaller, lighter area)

Pancreas ***Slide:*** human pancreas sec.

+ Note pancreatic islets (Islets of Langerhans) which are the endocrine portion of the pancreas

Adrenal Glands ***Slide:*** human adrenal gland sec

+ Distinguish between the cortex (darker, with vertically arranged rows of cells) and the

medulla (lighter) (use only slides marked in pencil with an asterisk)

Terminology:

Endocrine Glands	***Major Hormones Secreted***
Anterior Pituitary	Tropic Hormones: TSH,ACTH,FSH,LH; also: GH, PRL
Posterior Pituitary	Oxytocin, ADH
Thyroid Gland	TH, Calcitonin
Parathyroid Glands	PTH
Pancreas	Insulin, Glucagon
Adrenal Cortex	Glucocorticoids, Mineralocorticoids, Gonadocorticoids
Adrenal Medulla	Epinephrine, Norepinephrine
Ovaries	Estrogen Progesterone
Testes	Testosterone
Thymus	Thymosin
Pineal Gland	Melatonin

The Circulatory System

Biol 2404 Laboratory Activities

Lab Materials:

slide:	heart intercalated sec IH Wards sec
	artery, vein, capillary section
models:	heart models
	artery/vein model
	blood vessel plaque
	liver model
	torsos
	skull with blood vessels
	muscular arms and legs
	male and female pelvis
	respiratory system model
	lymphatic system model
preserved:	sheep heart
	cow heart

Lab Activities:

1. Identify the major structural features of the human heart on the models available:

External Anatomy:
pericardium, apex, base, auricles, atrioventricular sulcus, interventrucular sulcus, layers of heart wall (epicardium, myocardium, endocardium)
Major Vessels: superior and inferior vena cava, pulmonary trunk, aortic artery (aorta), pulmonary veins
Cardiac Circulation: coronary arteries, coronary veins
Internal Anatomy:
Heart Chambers: r & l atria, r & l ventricles
Heart Valves: r & l atrioventricular valves (tricuspid & bicuspid, resp.), pulmonary semilunar valve, aortic semilunar valve
Other: interventricular septum, chordae tendinae, papillary muscles

2. Note the serous tissue surrounding the heart on appropriate models and on a sheep heart still enclosed within the pericardial sac

pericardial sac = parietal pericardium
epicardium = visceral pericardium

3. Dissect and identify the same major structural features that you found in the models on the cow and the sheep hearts.

note: for the major blood vessels trace them from the chambers to which they connect, do not try to identify them from outside the heart

4. Distinguish between an artery and a vein on the model and slide

5. Identify the three layers of the blood vessel walls on the artery & vein model and microscope slide.
Note: the model shows 2 veins (one with valves) and one artery; the gray layer represents the tunica externa, the pink layer is the tunica media and the orange layer is th tunica interna

tunica externa, tunica media, tunica intima

6. Locate and identify the major human arteries and veins below on all appropriate models:

Major Human Arteries and Veins

(where right and left are not indicated you do not need to distinguish)

Pulmonary Circuit

Arteries	pulmonary a. (or trunk)	Veins	pulmonary v.

Systemic Circuit

Arteries	aorta aortic arch rt. brachiocephalic a. rt common carotid a. internal carotid a. external carotid a. circle of Willis rt subclavian a. lft common carotid a. lft subclavian a celiac trunk common hepatic a. superior mesenteric a. renal a. inferior mesenteric a. common iliac a. internal iliac a. external iliac a.	Veins:	superior vena cava brachiocephalic v. int. jugular v. ext. jugular v. subclavian v. inferior vena cava hepatic v. hepatic portal v. renal v. common iliac v. internal iliac v. external iliac v. great saphenous v.

7. Locate and describe the special circulation patterns discussed in lecture and the major blood vessels associated with each:

Circle of Willis
Coronary Vessels:
coronary arteries – base of aorta just above aortic SL valve
coronary veins – coronary sinus at jct with right atrium
Hepatic Portal System with hepatic portal vein

8. Recognize and identify cardiac muscle tissue on the slide listed. Note:

cardiac muscle tissue, intercalated discs, striations, branching

Terminology:

Histology (slide): cardiac muscle tissue, intercalated discs, striations, branching
Vessel Layers (slide & models): tunica externa, tunica media, tunica intima

Heart Anatomy

External Anatomy:
pericardium, apex, base, auricles, atrioventricular sulcus, interventrucular sulcus, layers of heart wall (epicardium, myocardium, endocardium)
Major Vessels: superior and inferior vena cava, pulmonary trunk, aortic artery (aorta), pulmonary veins
Cardiac Circulation: coronary arteries, coronary veins

Internal Anatomy:

Heart Chambers:	r & l atria, r & l ventricles
Heart Valves:	r & l atrioventricular valves (bicuspid & tricuspid, resp.), pulmonary semilunar valve, aortic semilunar valve
Other:	interventricular septum, chordae tendinae, papillary muscles

Major Human Arteries and Veins

(where right and left are not indicated you do not need to distinguish)

Pulmonary Circuit

Arteries	pulmonary a.	Veins	pulmonary v.

Systemic Circuit

Arteries	aorta aortic arch rt. brachiocephalic a. rt common carotid a. internal carotid a. external carotid a. circle of Willis rt subclavian a. lft common carotid a. lft subclavian a celiac trunk common hepatic a. superior mesenteric a. renal a. inferior mesenteric a. common iliac a. internal iliac a. external iliac a.	Veins:	superior vena cava brachiocephalic v. int. jugular v. ext. jugular v. subclavian v. inferior vena cava hepatic v. hepatic portal v. renal v. common iliac v. internal iliac v. external iliac v. great saphenous v.

Special Circulation Patterns:

- Circle of Willis
- Coronary Vessels:
  - coronary arteries – base of aorta just above aortic SL valve
  - coronary veins – coronary sinus at jct with right atrium
- Hepatic Portal Vein

The Lymphatic System

Biol 2404 Laboratory Activities

Lab Materials:

models:	human torsos
	lymphatic system plaque
	head – sag section
	villi with lacteals
	heart with thymus gland
	pancreas/spleen model
slides:	mammal lymph node sec
	lymph vessel valve wm

Lab Activities:

1. Identify the major anatomical features of the human lymphatic system including the lymphatic vessels, lymph ducts (trunks), nodes and accessory organs on models and illustrations

lymphatic ducts:
- Right Lymphatic Duct
- Thoracic Duct
  - cisterna chyli

lymphatic vessels

major lymph nodes:
- cervical
- axillary
- inguinal

accessory organs & structures:
- thymus
- spleen
- tonsils; pharyngeal (adenoids), palatine, lingual
- lacteals

2. Be able to recognize lymph nodes, and to identify the **sinuses** on the slide

3. Be able to recognize the **one-way valves** on the slide of a lymphatic vessel

Terminology:

Histology (slides): lymph nodes, valves of lymphatic vessels

Anatomy of Lymphatic System (models & illustrations):

lymphatic trunks:
- Right Lymphatic Duct
- Thoracic Duct
  - cisterna chyli

lymphatic vessels

major lymph nodes:
- cervical nodes
- axillary nodes
- inguinal nodes

accessory organs & structures:
- thymus
- spleen
- tonsils; pharyngeal (adenoids), palatine, lingual
- lacteals

Hematology, Heart Sounds, & Blood Pressure

Biol 2404 Experiments in Physiology

Safety Precautions:

Note: Failure to observe the safety precautions for this lab will result in your being evicted from the lab and receiving a zero for this lab report!

1. **If you know you have a blood disorder that might endanger you or the class do not perform this exercise. Let me know and I will give you an alternate exercise to do to get your points.**
2. **No food or drink in the lab room.**
3. **Work alone**
4. **Collect and test only your own blood**
5. **Spray table with disinfectant before and after lab**
6. **Wear latex gloves on both hands except while you are doing finger punctures**
7. **Do not recap or reuse lancets**
8. **Safely dispose of all disposable and reusable supplies and equipment that you have used on your own blood.**
9. **Wash the lab bench area that you have been using with disinfectant solution before you leave.**

I. Prepared Slides

Lab Materials:

slides: blood smear-Wright's stain
sickle cell anemia

1. Recognize and identify the three major formed elements in Blood on the prepared slides:

   erythrocytes (red blood cells)
   leucocytes (white blood cells),
   thrombocytes (platelets)

2. Recognize and identify the major types of leucocytes as instructed

   neutrophils, lymphocytes

3. Compare the shapes of the red blood cells in sickle cell with that of normal cells and explain how the shape of sickle cells affect their function

Terminology:

formed elements
- **erythrocytes** (red blood cells)
- **leucocytes** (white blood cells), neutrophils, lymphocytes
- **thrombocytes** (platelets)

plasma

II. Blood Analysis

A. Collecting and handling Blood

Follow instructions given at the beginning of the lab

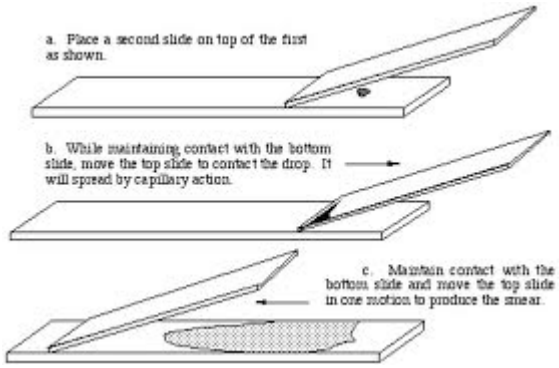
Disposal:

Dispose of lancets in plastic sharps container on your lab table immediately after use
Dispose of cotton balls, alcohol swabs and contaminated paper towels in biohazard bag

B. Examining the Formed Elements of Blood Microscopically

1. Prepare a smear of a drop of your own blood as directed (see illustration: http://www.microscopesblog.com/page/2):

-get 2 glass microscope slides from your drawer
-take one slide and place a drop of blood toward one side of the slide
-take the other slide and, holding it at a 45° angle, back it up until it touches the blood drop
-then carefully and smoothly push the angled slide across the surface of the blood slide
-if done correctly you should end up with a continuous smear of blood that thins an one end



2. allow the smear to air dry on the slide
3. stain the blood smear using the Hemacolor system on side counter; see instructions at the station
4. Find and draw examples of each of the three kinds of **formed elements** on your data sheet.
5. Find and identify two of the 5 different kinds of WBC's and draw them as well

Disposal:

Dispose of alcohol swabs, cotton balls, and other paper supplies in biohazard bag
Dispose of slides used to make smear in bleach beaker

C. Typing for ABO and RH Blood Groups

1. We will use "Eldon Cards" to determine blood types;
2. Follow the instructions in the pamphlet at your lab table; note: use tap water, not DI water

Disposal:

Dispose of Eldon Cards, stirring sticks and contaminated paper towels in biohazard bag
Dispose of paper towels used to clean counter in regular trash

III. Listening to Heart Sounds

You can listen to your own heart sounds or those of your lab partner (with their permission, of course)

Use an alcohol pad to sanitize the ear pieces.

Insert each of the two ear pieces into your ears. Be sure that the ear pieces fit snugly and have a good seal to keep out ambient noise. It is best to use stethoscopes on bare skin but for this demonstration you will probably be able to hear the heart sounds well enough through a single layer of clothing. In cold weather, warm up the stethoscope, or the first sound you will hear is a screech from your poor victim. Be careful not to make any loud noises near the chest piece after you have inserted the earpieces.

Hold the round part (the chest piece) up to the person's chest or heart (see illustration). You should hear a steady lub-dub, lub-dub sound. Different heart sounds are best heard at different areas of a person's chest. Also, heart sounds differ depending on the patient's position: i.e., sitting, standing, lying on one's side, etc.

Describe the sound you hear on your data sheet. Can you detect any "murmurs"?

IV. Measuring Blood Pressure & Heart Rate

Sit down comfortably in the chair with your feet flat on the floor.

Follow instructions for using the blood pressure cuff given at the beginning of the lab and illustrated on the cuffs

Record your blood pressure and pulse rate on the data sheet.

Blood pressure for both men and women should be at or below 120/80. A typical value for males between 20-40 yrs old is 125/82. for comparable women, 110/75. A low blood pressure , eg. 90/60, is significant ***only*** if accompanied by symptoms of dizziness or fatigue.

Heart rates are generally higher in women than in men but can range overall from 60 to 100 bpm. Typical values for women are 74-76 bpm, for men, 70-74 bpm.

Name:_____

Due Date:_____

Hematology, Heart Sounds & Blood Pressure

Biol 2404 Data Sheet

The microscopic analysis of blood (prepared slides/your own blood sample):

1. Define and distinguish between **blood**, **plasma**, **serum** and **formed elements.**

2. Draw an example of each of the three kinds of formed elements:

Erythrocytes **Leucocytes** **Thrombocytes**

3. Describe the general functions of each of the three kinds of formed elements.

4. Of the 3 different kinds of formed elements in normal blood:

   a. which are the most abundant

   b. which are the largest

   c. which are the shortest lived

5. How does the shape and function of erythrocytes in a person with sickle cell anemia differ from those of normal cells?

6. Which two white blood cells were the most abundant in your own blood sample? Identify and draw each of them below:

Blood typing for ABO and RH Blood Groups:

7. If you already know your blood type report it here: _____

   Your Blood Type from **this** lab test: _____

8. Based on your blood type as determined **in this exercise**, (ABO & Rh):

   what blood **antigens** are present in your blood?: _____

   what blood **antibodies** can you produce?: _____

9. Based on your blood type as determined **in this exercise**, (ABO & Rh), what blood types can you receive? Explain

10. What recipients can you donate to? Explain

Listening to Heart Sounds

11. Describe the heart sounds you were able to hear

Blood Pressure and Pulse Rate

12. If you have checked your blood pressure in the last few months record it here:_____

Your blood pressure recorded here:_____

Your pulse rate: _____

13. compare your lab values to normal values and **interpret** your data; ie are your values normal, above or below normal.

14. List two reasons why a persons blood pressure might be above normal and two why they might be below normal

15. List two reasons why a persons pulse rate might be above normal and two why they might be below normal.

The Respiratory System

Biol 2404 Laboratory Activities

Lab Materials:

slides:	lung mammal sec H&E
	lung emphysema (human) sec
	lung smoker's lung (human) sec
models:	human torsos
	human respiratory system
	skull
	larynx-trachea-bronchi model
	human head sagittal sec
	trachea and larynx
	bronchiole & alveoli model
preserved:	rabbit lungs
	pig lung section

Lab Activities:

1. Recognize and identify the major organs of the human respiratory system on models available

nose: external nares (nostrils), nasal septum, nasal cavity, nasal conchae, (paranasal) sinuses (frontal, maxillary, sphenoid, ethmoid)
mouth: hard palate, soft palate
pharynx:
- nasopharynx: auditory tube, pharyngeal tonsils (adenoids)
- oropharynx: palatine and lingual tonsils
- laryngopharynx

larynx: epiglottis, thyroid cartilage, cricoid cartilage, false vocal cords, true vocal cords, glottis
trachea: note the shape of the tracheal cartilages
bronchi note the bands of cartilage
lungs: bronchioles, alveoli, the "respiratory tree", diaphragm

2. Understand the relationships between the serous membranes associated with the thoracic and pericardial cavities

mediastinum, parietal pleura, visceral pleura, diaphragm

3. Recognize the histological structure of lung tissue on the slide, including:

alveoli, squamous epithelium, bronchioles, blood vessels

4. Compare the structure and quality of the lung tissue on the samples or images of lungs from; normal, smoker, and emphysema patients.

Terminology:

Upper Respiratory System:
nose: external nares (nostrils), nasal septum, nasal cavity, nasal conchae, (paranasal) sinuses (frontal, maxillary, sphenoid, ethmoid)
mouth: hard palate, soft palate
pharynx:

nasopharynx: auditory tube, pharyngeal tonsils (adenoids)
oropharynx: palatine and lingual tonsils
laryngopharynx

larynx: epiglottis, thyroid cartilage, cricoid cartilage, false vocal cords, true vocal cords, glottis

Lower Respiratory System:

trachea: tracheal cartilages
bronchi 'C'-shaped bands of cartilage
lungs: bronchi, bronchioles, alveoli, the respiratory tree

The Human Lungs and Pleural Coverings

mediastinum, parietal pleura, visceral pleura, diaphragm

Histology of the Respiratory System (slides)

lung: alveoli, squamous epithelium, bronchioles, blood vessels

Measuring Vital Capacity

Biol 2404 Experiments in Physiology

Vital Capacity is the maximum amount of air you can get into or out of your lungs in a single breath. A measure of vital capacity provides a relatively simple way to assess the condition of one's respiratory system. A persons vital capacity is compared to a standardized chart based on gender and height. Many factors can affect ones vital capacity; general health, respiratory diseases, regular exercise, etc.

Measuring Your Vital Capacity using a Wet Spirometer

1. The spirometer measures the volume of air in an exhaled breath. Take one of the cardboard mouthpieces, firmly attach it to the end of the hose and blow briefly into the tube. Note that the black indicator will move as the chamber fills with air. The numbers on the scale are **liters**. After each use you will need to slide the black indicator back to the zero mark.
2. Put the cardboard mouthpiece on the spirometer and inhale as much as possible before placing your mouth on the mouthpiece.
3. Hold your nose or use a nose clip and blow as much air as you possibly can into the spirometer.
4. Record the volume, your vital capacity, on your data sheet. Record this value in **milliliters** not liters.
5. Use the table provided to determine your "predicted vital capacity" and enter this value in the table on your data sheet.

Name:_____

Due Date:_____

Measuring Vital Capacity

Biol 2404 Data Sheet

A. Measuring Your Vital Capacity

Vital Capacity		
		Vital Capacity (ml)
Predicted Vital Capacity (from table)	**VC_p**	
Directly Measured Vital Capacity (from spirometer measurement)	**VC_{dm}**	

1. Calculate the difference between your predicted vital capacity and your directly measured vital capacity:

$VC_{dm} - VC_p =$ _____

2. How well did your actual vital capacity match your predicted vital capacity. Explain.

3. Describe one factor, not related to respiratory disease, that would tend to cause ones vital capacity to be greater than the value on the standardized chart.

4. Describe one factor, not related to respiratory disease, that would tend to cause ones vital capacity to be significantly less than the value given in the table.

5. List and describe some other major factors that are related to respiratory diseases that could affect ones vital capacity.

6. What three lung volumes, when added together, should equal ones vital capacity? List and define each of these lung volumes

7. Define **residual volume** and how it is related to pneumothorax.

Enzyme Activity

Biol 2404 Experiments in Physiology

Human Physiology at its most basic level is biochemistry. For every physiological activity that our body performs; individual cells are carrying out dozens or hundreds of specific chemical reactions required for that activity. Almost all of the chemical activity that is occurring inside our body cells involves **enzymes**. Enzymes are the biological **catalysts** that allow these reactions to occur. Many enzymes are found in the body and each facilitates a specific chemical reaction. Enzymes are required for both **anabolic** and **catabolic reactions**. In catabolic reactions a **substrate** is broken down into one or more smaller **end products**. In this exercise we will investigate one of the simplest and best known of these kinds of catabolic reactions, called **hydrolysis**, that is involved in the chemical digestion of foods. Specifically, we will study the enzyme **amylase** that decomposes the substrate starch (=a **polysaccharide**), a large organic molecule, into its products, **monosaccharides**. Amylase enzymes are found in saliva and begin the process of chemical hydrolysis as soon as we put food in our mouths. You will be collecting your own saliva (amylase enzymes) in order to perform this experiment. Like all enzymes, amylase is very sensitive to changes in temperature and pH, even slight changes can **denature** the proteins and slow or stop the activity of the enzyme.

Enzyme Activity - Effects of Temperature

1. Work in groups of 3 or 4 (write your group number on your test tubes and your data sheet)

2. Collect 3 ml of saliva in the 10 ml graduate cylinder provided (don't count foam).

3. Take 8 of the test tubes at your counter and label each as below:

   2 – 0° C
   2 – 37° C } = Experimental Tubes
   2 – 100° C
   2 – C = Control Tubes

4. Gently shake the bottle of starch then, using a disposable plastic pipette, place 1 ml of starch and 1 ml of DI water in one of the control tubes and 3 ml of DI water in the other using the plastic disposable pipettes, add 3 drops of Iodine (IKI) solution to both tubes and note the reactions:

   Iodine (Lugols) is an indicator for the presence of starch. Iodine is normally a yellowish – orange liquid. When added to the tube with water this should be the color you see, ie. no reaction. When starch is present and iodine is added, the solution will turn dark blue to black, this is a positive test for starch. Save these control tubes for comparison to your experimental tubes at the end of the experiment.

5. Dilute the saliva mixture in the graduate cylinder by adding DI water up to the 10 ml line. Swirl to mix.

6. Use a clean disposable 1 ml plastic pipette to add 1 ml of the saliva mixture to each of the 6 experimental test tubes.

7. Place the tubes at the designated temperatures as labeled: 2 in the ice; 2 in the 37° water bath, and

2 in the beaker of boiling water (use test tube clamps) at your counter. Allow all tubes to incubate about 5 minutes.

8. After 5 minutes, use a 1 ml disposable pipette to add 0.25 ml of starch solution to each of the 6 test tubes being incubated at the three temperatures (do not remove them from the temperatures) and note the time. Gently swirl each tube after adding the starch.

9. Continue to incubate tubes at their designated temperatures for **exactly 2 minutes.**

10. Remove the tubes from incubation (use test tube clamps) and return to your test tube rack at your table and *immediately* add 3 drops of the iodine indicator to all 6 tubes, gently swirl, and note the color of each. Use the scale below to record the color change on your data sheet:

-	=	yellow or no change, same color as the negative control tube
+	=	very slight hint of blue or black
++	=	distinct change in color to blue or black
+++	=	same color as the positive control tube with starch

Enzyme Activity – effects of pH

1. Collect three additional test tubes and label them 4, 7, and 10

2. Place 2 ml of the appropriate pH buffer solution (pH = 4,7,10, respectively) into each of the tubes.

3. Add 1 ml of the saliva mixture to each tube, swirl to mix

4. Add 0.25 ml of starch to each tube, gently swirl the tubes to mix, and note the time

5. Allow the tubes to incubate at room temperature for **exactly 2 minutes**.

6. Immediately add 3 drops of the iodine indicator to all 3 tubes and note the color change as you did above. Record the information on your data sheet.

Cleanup & Disposal

1. Empty all test tubes in the sink with water running
2. Dispose of the empty test tubes in glass disposal box
3. Wash your graduate cylinder and return to the tray on your table
4. Dispose of plastic pipettes in the trash
5. Turn off and unplug hotplate, DO NOT discard beaker with water and boiling stones, leave it on hot plate.
6. Wipe your table down with disinfectant before you leave

Name:_____

Group:_____

Enzyme Activity

[Effects of Temperature and pH on Enzyme Activity]

Biol 2404 Lab Data Sheet

1. What exactly <u>is</u> the reaction you are investigating; include substrate, enzyme & product?

2. Explain how the iodine indicator can show you whether the enzyme was working or not (be specific)?

The Effects of Temperature on Enzyme Activity			
<u>Temp</u>	Tube Number	**Presence of Starch** (+/-)	**Presence of Starch** (total # of '+' for both tubes)
0º C	**1**		
	2		
37º C	**1**		
	2		
100º C	**1**		
	2		

3. Which temperature produced the greatest enzyme activity? Is this what you expected? Why or why not.

The Effects of pH on Enzyme Activity	
pH of Tube	**Presence of Starch** (+/-)
4	
7	
10	

4. At which pH did you get the greatest enzyme activity? Explain.

5. Based on where the enzyme, amylase, is found in the body, do your results from these two experiments make sense? Explain.

6. Name 3 other **specific enzymes** used by the body and describe or diagram the reaction that each facilitates.

The Digestive System

Biol 2404 Laboratory Activities

Lab Materials:

slides:	pancreas human sec
	liver pig sec mal
	tooth root human cs
	human tooth crown sec
models:	torsos and digestive system models
	liver model
	liver lobules model
	pancreas & duodenum model
	teeth in skull
	model tooth
	male and female pelvis
	model cross section of GI tract model (esophagus, stomach, small intestine, large intestine)
	villi model
preserved:	see mesenteries on cat display

Lab Activities:

1. Locate and identify the major organs and structures of the human digestive system on torso models and on all other appropriate models:

Mouth: lips, palate, hard palate, soft palate, uvula, tongue, frenulum, parotid, sublingual and submaxillary salivary glalnds
Pharynx: nasopharynx, pharyngeal tonsils, oropharynx, palatine tonsils, lingual tonsils, laryngopharynx
Esophagus
Stomach: cardiac region, cardioesophageal sphincter, fundus, body, pyloric region, pyloric sphincter, rugae, greater curvature, lesser curvature, greater omentum
Small Intestine: mesenteries, duodenum, jejunum, ileum, ileocecal valve, villi, goblet cells, lacteal
Large Intestine: cecum, appendix, colon (ascending, transverse, descending, sigmoid), haustra, taenia coli, rectum, anus
Teeth: incisors, canines, premolars, molars, crown, root, enamel, dentin, pulp, cementum
Salivary Glands: parotid, submandibular, sublingual glands
Liver & Gall bladder: hepatic duct, common bile duct, cystic duct
Pancreas: pancreatic duct

2. Identify the four layers of the GI-tract on the model showing the cross section of the esophagus, stomach, small intestine and large intestine, and on the villi model

   mucosa, submucosa, muscularis, serosa

3. Locate and identify the serous membranes on the cat dissection display:

   parietal peritoneum, visceral peritoneum, mesenteries

4. Recognize the general histological structure of accessory organs of the digestive system including the teeth, liver and pancreas

Teeth: (model: tooth; slide: tooth root cs; human tooth crown cs)
cementum, dentin, pulp, enamel

Liver: (model: liver lobule)
liver lobule, central vein, bile ducts, sinuses, hepatic arteries, hepatic portal vein, hepatic vein
(slide: liver pig section mal)
liver lobule, central vein, sinuses

Pancreas: (slide: pancreas human sec)
distinguish between exocrine and endocrine tissue (=Islets of Langerhans)

Terminology:

Organs of the G I Tract
Mouth: lips, palate, hard palate, soft palate, uvula, tongue, frenulum, parotid, sublingual and submaxillary salivary glalnds
Pharynx: nasopharynx, pharyngeal tonsils, oropharynx, palatine tonsils, lingual tonsils, laryngopharynx
Esophagus
Stomach: cardiac region, cardioesophageal sphincter, fundus, body, pyloric region, pyloric sphincter, rugae, greater curvature, lesser curvature, greater omentum
Small Intestine: mesenteries, duodenum, jejunum, ileum, ileocecal valve, villi, goblet cells, lacteal
Large Intestine: cecum, appendix, colon (ascending, transverse, descending, sigmoid), haustra, taenia coli, rectum, anus

Accessory Organs
Teeth: deciduous, permanent, incisors, canines, premolars, molars, crown, root, gum, enamel, dentin, pulp, cementum
Salivary Glands: parotid, submandibular, sublingual glands
Liver & Gall bladder: liver lobule, central vein, bile ducts, sinuses, hepatic arteries, hepatic portal vein, hepatic vein, common hepatic duct, bile duct, cystic duct
Pancreas: pancreatic duct
Membranes: parietal peritoneum, visceral peritoneum, mesenteries

Microscopic Structure and Histology
General Histology: mucosa, submucosa, muscularis, serosa
Teeth: cementum, dentin, pulp, enamel
Liver: lobule, central vein
Pancreas: Islets of Langerhans
Intestine: villi, goblet cells

pH, Buffers & Urinalysis

Biol 2404 Experiments in Physiology

Electrolytes are molecules that tend to disperse in solutions as charged atoms or molecules (**ions**). Many atoms and molecules in the body are electrolytes. Large organic molecules, especially proteins, are very sensitive to changes in electrolyte concentrations, particularly to particular groups of electrolytes called **acids** and **bases**. Any dramatic change in the balance between acids and bases in the body can denature proteins and wreak havoc within our cells. The ratio of acids and bases is measured on the **pH scale** where a pH of 7 indicates a neutral solution in which the concentrations of acids and bases are evenly balanced. A value below 7 indicates **acidity**, ie. there are more acids than bases; and above 7, **alkalinity**, ie. there are fewer acids than basis.

The pH of our blood varies only slightly, between 7.35 and 7.45. A change in pH to a value less than 7 or greater than 7.8 is lethal. One of the primary ways our bodies have to combat such drastic changes is by using **buffers**. Buffers are chemicals that have the ability to absorb excess acids or bases to prevent drastic changes in pH within our cells or body fluids. These buffers cannot work indefinitely however, there must be some way to get rid of excess acids. Our bodies have two major systems to remove excess acids; the respiratory system and the excretory system.

You will be using a dilute solution (0.2N) of hydrochloric acid (=HCl) to change the pH of samples of three body fluids. You will measure the pH of various solutions in this exercise using a **pH meter**. Your instructor will demonstrate how to correctly use the equipment.

Safety Precautions for handling urine :

In this lab you will be using your own urine as one of the specimens that you will be analyzing. You must follow the usual safety precautions for working with body fluids:

1. Wear gloves
2. Test and handle only your own urine
3. Follow proper disposal procedures as described below

I. Activity: Effects of acids on buffered and unbuffered solutions:

a. HCl in deionized water

1. Take a clean 100 ml beaker and add deionized water up to the 50 ml mark.
2. Turn on the pH meter and note the initial pH of the solution by immersing the electrodes and stirring briefly. Record the pH on your data sheet.
3. Add HCl solution drop by drop while stirring with the pH electrode continuously. Continue to slowly add and count the drops of HCl until the pH decreases by one complete unit.
4. Record the final pH of the solution and the number of drops of HCl in the table on your data sheet
5. Turn off the pH meter and rinse the pH probe by holding it over a large beaker and squirting a stream of DI water over it.

b. HCl in saliva

1. Collect at least 2 or 3 ml of saliva in a small graduated cylinder (chewing on a rubber band or a piece of parafilm stimulates saliva production), pour the saliva into a 100 ml beaker then add DI water to the 50ml mark

2. Turn on the pH meter and record the initial pH of the solution by immersing the electrode in the solution, slowly stirring it or swirling the beaker. When the pH stops changing dramatically, record the pH on your data sheet.
3. Add HCl solution drop by drop while stirring with the pH electrode continuously. Continue to slowly add and count the drops of HCl until the pH decreases by one complete unit.
4. Record the final pH of the solution and the number of drops of HCl in the table on your data sheet
5. Turn off and rinse the pH probe well with a stream of DI water.

c. HCl in urine

1. Take a clean 100 ml beaker and add urine up to the 50 ml mark.
2. Turn on the pH meter as above to record the initial pH of the solution by immersing the electrodes and stirring them and recording the pH on your data sheet.
3. Add HCl solution drop by drop while stirring with the pH electrode continuously. Continue to slowly add and count the drops of HCl until the pH decreases by one complete unit.
4. Record the final pH of the solution and the number of drops of HCl in the table on your data sheet.
5. Turn off and rinse the pH probe well with a stream of DI water.

d. HCl in Plasma

1. Take a clean100 ml beaker and add plasma up to the 50 ml mark.
2. Turn on the pH meter as above to record the initial pH of the solution by immersing the electrodes and stirring them and recording the pH on your data sheet.
3. Add HCl drop by drop, counting the drops while continuously stirring with the pH electrode, until the pH changes one complete unit.
4. Record the final pH of the plasma and the number of drops of HCl used in the table on your data sheet.
5. Turn off and rinse the pH probe well with a stream of DI water.

II. Activity: Effect of CO_2 Gas on the pH of Water

Carbon dioxide naturally dissolves in water as it does in our blood. This dissolved CO_2 is spontaneously converted to carbonic acid and then to bicarbonate and hydrogen ions. The more CO_2 in the water the more acidic the water becomes. A similar reaction occurs in the blood so that the more carbon dioxide that our blood is carrying, the more acidic our blood will become.

1. Take a clean 150 ml beaker and add DI water to the 100 ml mark.
2. Using a pH meter, determine the initial pH of the water and record it on your data sheet.
3. Have subject blow into the bottom of the beaker through a straw for 10 seconds and immediately read the pH and record it.
4. Immediately repeat, blowing into the water 5 additional times and record the pH of the water after each exhaled breath.
5. **Graph** your results on a piece of graph paper (link on course website) with pH on the y (=vertical) axis and number of breaths on the x (=horizontal) axis and attach the graph to your data sheet.

III. Activity: Urinalysis: Unknown Samples

Analyze each of the unknown urine samples by using the urine test strips (dipsticks). Follow the instructions on the bottle. Read results after the time specified in the instructions. For some of the

tests, positive results may be a little slow to show up so check negatives again after about 30 more seconds. Record the results in the table on your Data Sheet; Place an asterisk next to any "abnormal" values for each sample. Then suggest one possible cause that might explain the abnormal results in each of the samples that you tested.

Where possible, record your results as "relative amounts" rather than as exact numerical values; for example: "neg, trace, small, moderate, large" or" -, +, ++, +++"

For 2 pts extra credit, collect a sample of your own urine and perform the same set of tests and analyses. Use the paper or plastic cups as provided.

Disposal

1. Dispose of all test solutions from the beakers and your urine cup into the sink with water running
2. Return remaining stock solutions (unknowns A, B, C, D) to your tray – DO NOT DISCARD.
3. Discard your specimen cups and urine test strips in the regular trash.
4. Rinse glassware and return it to your tray
5. Rinse pH electrode, cover with cap or leave in buffer solution as directed, turn off and close the pH meter
6. Wipe down counters with disinfectant.

Name: _____
Group: _____
Due Date:_____

pH and Buffers

Bio 2404 Lab Data Sheet

I. Activity: Effects of Acids on Buffered and Unbuffered Solutions

Test Solution	initial pH	final pH	# drops of HCl
DI Water			
Saliva			
Urine			
Plasma*			

*the plasma has been diluted to 1/4th its normal strength

1. How did the **initial pH** of the three biological solutions vary. Which of them was closer to the normal pH of blood.

2. What exactly is a buffer?

3. How is the number of drops of acid needed to change the pH of a solution related to that solutions buffering capacity?

4. Compare the effects of acids on the four solutions. How does the buffering ability of each of the three biological solutions compare with that of deionized water?

5. A change in blood pH to below ~7 or above ~7.8 is usually lethal. How do you account for the fact that the pH of saliva and urine can vary considerably and can be below 6.8 or above 7.8 even in healthy individuals?

II. Effect of carbon dioxide on the pH of water

	pH after deep breaths
original pH	
after 1st exhalation	
after 2nd exhalation	
after 3rd exhalation	
after 4th exhalation	
after 5th exhalation	

6. Diagram the reaction of carbon dioxide and water (where do you think you might find this equation in your textbook?)

7. Interpret your **graph**; describe and explain the effects of exhaled air on the pH of the water in the beaker with each breath.

8. What *exactly* caused the change in pH of the water? Where did the hydrogen ions come from?

9. How do you think the amount of Carbon Dioxide in the blood would affect body pH? How does the body prevent a build up of excess carbon dioxide in the blood?

III. Urinalysis: Unknown Samples

Urinalysis Results:Urine Reagent Strips					
	Sample A	**Sample B**	**Sample C**	**Sample D**	**your urine***
Leucocytes					
Nitrite					
Urobilinogen					
Protein					
pH					
Blood					
Specific Gravity					
Ketone					
Bilirubin					
Glucose					

*optional for 2 pts extra credit

10. Using your text or the web, suggest an explanation for any abnormal components in each of the urine samples:

Sample A:

Sample B:

Sample C:

Sample D:

Your own Urine:

11. List three additional examples of abnormal constituents in a urine sample (other than those you found in your unknown samples above) and describe what problems each might indicate.

The Urinary System

Biol 2404 Laboratory Activities

Lab Materials:

slides:	mammal kidney sec H&E
models:	human models and torsos as available
	kidney models
	nephron models

Lab Activities:

1. Locate and identify the major organs of the human urinary system on models available.

   kidneys, retroperitoneal position, renal arteries, renal veins, ureters, urinary bladder, urethra, penis (male)

2. Identify the major layers and structures seen on a frontal section of the kidney.

   cortex, medullary region, pyramids, calyces, renal pelvis

3. Locate and identify the microscopic structure of the nephron on the models available

   cortex: renal corpuscle, glomerulus, Bowman's Capsule, proximal convoluted tubule, distal convoluted tubule, afferent arteriole, efferent arteriole, peritubular capillaries
   medulla: loop of Henle, collecting tubule

4. Locate the following structures on the slide of a kidney section

   cortex, medulla, glomerulus, Bowman's capsule, renal corpuscle

Terminology:

Gross Anatomy of Human Urinary System (models, charts)
kidneys, retroperitoneal position, renal arteries, renal veins, ureters, urinary bladder, urethra, penis (male)

Gross Internal Anatomy (models)
cortex, medullary region, pyramids, calyces, renal pelvis

Microscopic Anatomy (models, slides)
cortex: renal corpuscle, glomerulus, Bowman's Capsule, proximal convoluted tubule, distal convoluted tubule, afferent arteriole, efferent arteriole, peritubular capillaries
medulla: loop of Henle, collecting tubule

The Reproductive System

Biol 2404 Laboratory Activities

Lab Materials:

slides:	penis, mammal, cs (do not use slides marked H&E)
	mammal testis, sec.
	mammal ovary-Graafian follicle, sec
	mammal ovary-corpus luteum, sec
	human sperm smear, wm
models:	human male and female reproductive systems
	meiosis and gametogenesis model

Lab Activities:

1. Locate and identify the major organs and structures of both the male and female human reproductive system on models available

   Gross Anatomy of Male Reproductive System
   testes, scrotal sac, epididymus, ductus deferens, ejaculatory duct, urethra, prostate gland, seminal vesicles, bulbourethral glands, penis

   Gross Anatomy of the Female Reproductive System
   ovaries, uterine tubes (fallopian tubes, oviducts), fimbriae, uterus, broad ligament, ovarian ligament, cervix of uterus, vagina, vulva

2. Identify the features below in a slide and models of a penis cross section including:

   corpora cavernosa, corpus spongiosum, urethra

3. Identify the layers in a model of the uterine wall including:

   endometrium, myometrium, epimetrium (=serosa; perimetrium)

4. Identify the **seminiferous tubules** and the **interstitial cells** on a slide of testes

5. Distinguish between the **head** and **tail** of **sperm cells** on the slide provided

6. Identify the **Graafian follicle** with egg and the **corpus luteum** on the slides provided

Terminology:

Gross Anatomy of Male Reproductive System
testes, scrotal sac, epididymus, ductus deferens, spermatic cord, ejaculatory duct, urethra, prostate gland, seminal vesicles, bulbourethral glands, penis

Microscopy of Male Reproductive System
Testes: seminiferous tubules, interstitial cells, developing sperm, mature sperm
Penis: corpora cavernosa, corpus spongiosum, urethra

Gross Anatomy of the Female Reproductive System
ovaries, uterine tubes (fallopian tubes, oviducts), fimbriae, uterus, broad ligament, ovarian ligament, cervix of uterus, vagina, vulva
Uterus: endometrium, myometrium, epimetrium

Microscopy of Female Reproductive System

Ovary: follicle cells, ovum, Graafian follicle, corpus luteum

Spermatogenesis: seminiferous tubules, interstitial cells, spermatogonia, sperm, lumen of seminiferous tubules

Oogenesis: follicle cells, Graafian follicle, ovum, corpus luteum

A Survey of Human Development

Biol 2404 Laboratory Activities

Lab Materials:

slides:	starfish development
	starfish all stages
	starfish, early cleavage wm
	starfish, late cleavage wm
	chick 18 hr wm
	chick 33 hr wm
	chick 72 hr wm (Do not use high power with this slide)
models:	human pregnancy series models
	cell to embryo plaque
	tailbud stage model
	fetal circulation model
other:	illustrations and other materials as available

Review the main stages of human development as discussed in lecture. Be able to relate these stages to the study materials available in lab

Lab Activities:

[Preembryonic Stages]

1. View the various slides of starfish development and the appropriate models to find examples of the early cleavage divisions

   cleavage divisions

2. View the slide of starfish late cleavage and the appropriate models to identify

   morula

3. **Implantation** begins at the **Blastocyst** Stage. Identify the **blastocyst** in appropriate illustrations and distinguish between the **inner cell mass** and the **trophoblast cells**. Describe the fate of each.

4. View the slide of the 18 hour chick (this is equivalent to about 2-2.5 weeks of human development) and appropriate models to identify the **primitive streak** and describe its significance.

5. Name the three **embryonic tissue layers** and name two organs or systems derived from each:

   ectoderm, mesoderm, endoderm

[Embryonic Stages]

6. The **neurula** stage is seen in the 33 hr chick embryo slide (4^{th} week in humans). Identify the **nervous** and **circulatory systems**.

7. Identify the **tailbud** stage in appropriate models and in the slide of the 72 hr chick embryo (6^{th} week in humans) and locate the

   brain, eyes, spinal cord, somites and heart

[Fetal Stages] (>8weeks in humans)

8. Recognize and identify and be able to distinguish between the various models of **embryonic** and **fetal** stages of human development. Identify the amnion (bag of waters), placenta, and umbilical cord on appropriate models.

9. Identify the 4 temporary modifications of the fetal circulatory system in the model and illustrations and describe the function and the fate of each structure after birth

   umbilical arteries & veins
   ductus venosus
   foramen ovale
   ductus arteriosis

Terminology:

Stages of Human Development:

a. Fertilization
b. Preembryonic Stage: cleavage divisions, morula, blastocyst, inner cell mass, trophoblast, ectoderm, mesoderm, endoderm,
c. Embryonic Stage: embryonic membranes, placenta, neurula, brain, spinal cord, tailbud, brain, eye, spinal cord, heart, somites
d. Fetal Stage: fetus, umbilical arteries & veins, ductus venosus, foramen ovale, ductus arteriosus