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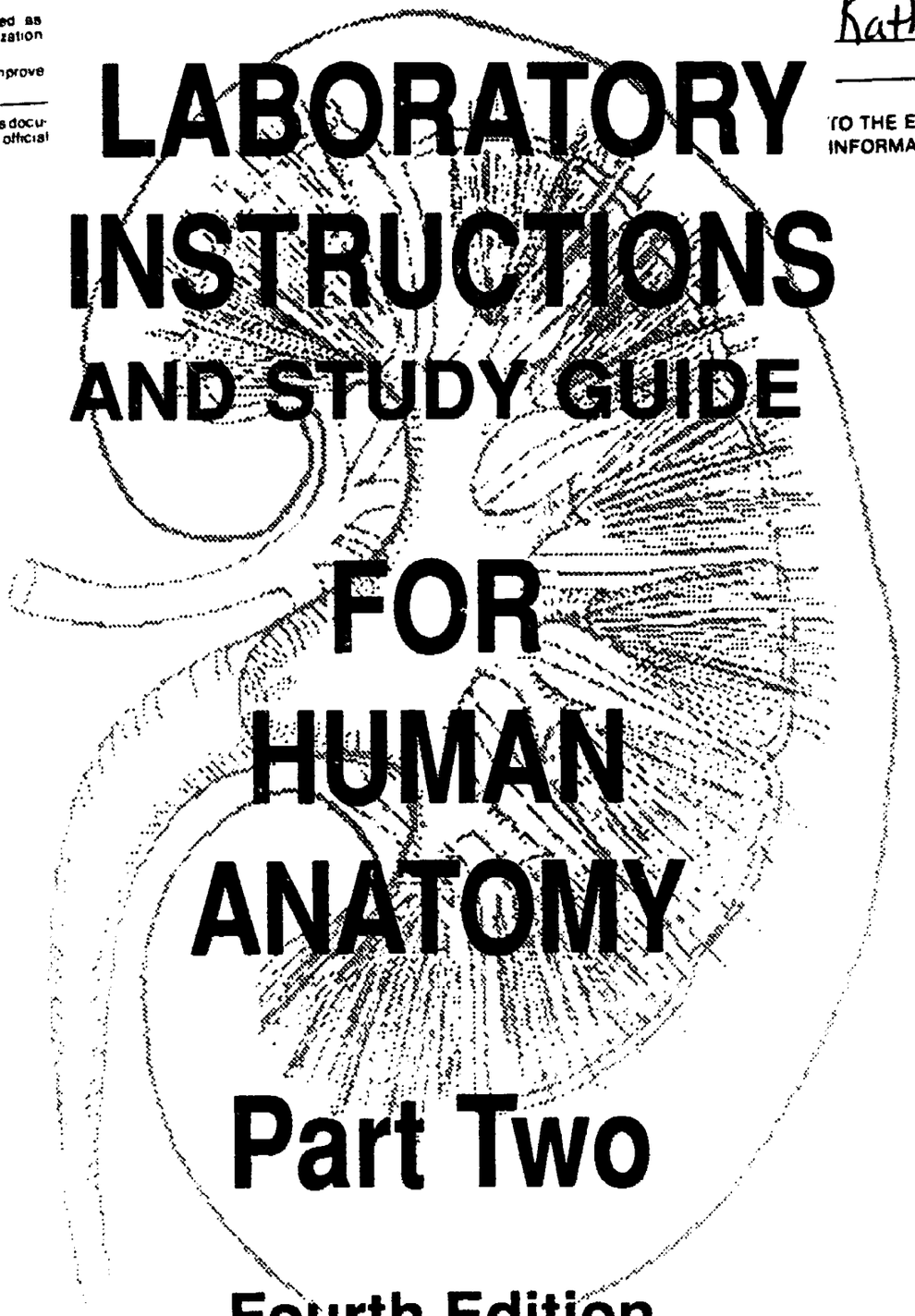
ABSTRACT

During the process of studying the specific course content of human anatomy, students are being educated to expand their vocabulary, learn to deal successfully with complex tasks, and use a specific way of thinking. This is the second volume in a set of laboratory instructions and study notes which are designed to accompany a lecture series in human anatomy. General instructions and laboratory procedures are followed by illustrations of anatomical concepts using cat and sheep organs as dissection specimens. This volume includes investigations of tissues, cells, and histology; development and embryology; epithelial, glandular, connective, blood, and muscular tissues; and the internal viscera including the digestive system, the urinary system, the reproductive system, the respiratory system, the circulatory system, and the lymphatic system. Appendices include anatomical checklists and a set of homework sheets to accompany the laboratory exercises. (CW)

LABORATORY INSTRUCTIONS AND STUDY GUIDE FOR HUMAN ANATOMY



Part Two

Fourth Edition

by KATHLEEN CONREY

LABORATORY INSTRUCTIONS
AND STUDY GUIDE

FOR HUMAN ANATOMY

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EL CAMINO COLLEGE

The author is a Professor of Natural Sciences at El Camino College. She holds a master's degree from the Department of Human Anatomy, University of California, San Francisco, and has been teaching human anatomy at the community college level since 1967.

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TABLE OF CONTENTS

Histology Laboratory Procedures

MICROSCOPE WORK PRELIMINARIES

❖ Control of illumination is of prime importance to success in tissue study. Your microscope will have at least one and perhaps two ways to control the substage illumination.

❖ Find the iris diaphragm on your microscope and experiment with it to see how it works.

❖ If your scope has a condenser learn where the control knob is and what happens when you raise or lower the condenser.

❖ Before you begin work use lens paper and xylene or windex to clean and polish the ocular and objective lenses on the microscope. Use only lens paper for this purpose.

❖ The pointer is mounted on the distal end of the ocular. ***Do not*** attempt to clean the distal end of the ocular because if it's alignment is disturbed the pointer becomes useless.

❖ If you can see dirt on one of your lenses a simple way to determine if the dirt is on the ocular or on the objective lens is to rotate the ocular while looking through the microscope. If the dirt spot moves when you do this then you know that the ocular lens is dirty.

❖ Examine the ocular and objective lenses. What power is each lens? Total magnification is the product of the magnification power of the ocular times the magnification power of the objective.

❖ Find an illustration in one or more of your reference books for each assigned slide. These illustrations will help you interpret what you see through the microscope.

❖ Before you put the slide on the stage polish it clean with lens paper and examine it with the naked eye to determine where the specimen is on the slide and roughly how big it is.

❖ Place the slide on the stage of the microscope with the label side up and the specimen centered under the objective lens. This will save a lot of hunting around through vacant space.

❖ Always start with the 10x objective lens. It is impossible to break a slide with this objective, and your microscope is ***parfocal***, so that if you do need to move to a higher power it will already be in focus if you have started with the 10x.

❖ Click the 10x objective into place and bring it as close as possible to the slide, using the coarse adjustment focus knob. All microscopes have an automatic stop that will prevent the 10x lens from hitting the slide.

❖ While looking through the ocular lens, first decrease the illumination, and then begin to bring the specimen into focus by slowly turning the coarse adjustment knob. Too much light on low power will sometimes make your specimen invisible.

❖ Always stay on the low power lens as long as you can. The available field of view is larger with this lens, so you will be able to see more and interpret what you are seeing more easily with this lens than with either of the other two lenses. In any case do not proceed to the high dry power (43x) until the specimen is in sharp focus and you have located the feature that you are looking for. The high power lenses are for examining in more detail something that you have already found with the low power (10x) lens.

❖ If you do wish to go to the high dry power, first put the specimen you are exam-

ining in the exact center of your field of view, then simply rotate the objectives until the new lens clicks into place. Once on the 43x you will need to focus with the fine adjustment knob and you will also need to increase the illumination. If the material disappears it is probably not centered under the objective. Move it into place using the mechanical stage.

❖ You will need to use oil immersion when you study white blood cells on the blood smear. You will find instructions for the use of oil immersion on that page of procedures.

HOW TO PUT THE MICROSCOPE AWAY PROPERLY

❖ Clean oil off of all surfaces.

❖ Turn off light switch and unplug cord.

❖ Wrap cord around base of microscope.

❖ Put low power lens in place.

❖ Center the mechanical stage so that it is as compact as possible and won't be knocked out of alignment.

❖ Put the dust cover over the microscope.

❖ Use two hands to put microscope in cabinet.

❖ Do not leave any personal items in the microscope cabinet since other students have access to this cabinet.

❖ Lock the cabinet.

❖ Turn in the key. If you take it home with you, you will be charged for the cost of having the lock changed.

EPITHELIUM

❖ **1. SIMPLE SQUAMOUS EPITHELIUM**

a. slide #31, Turtox H8.23

Find the slide labeled x.s. of Artery, Vein, Nerve in your slide set. Scan the slide until you can identify an artery and a vein. Compare what you see under the microscope with a textbook picture showing an artery and vein in cross section (DiFiore p 87). Next identify the **endothelium** (simple squamous epithelium) which lines the lumen of each vessel.

b. slide #32, Carolina H8200

Find the slide of kidney tissue in your slide set. Find a textbook picture of kidney tissue (DiFiore p 189), then scan your slide until you locate a Bowman's Capsule. Focus on the lining of the capsule (facing the lumen); identify the simple squamous epithelium.

❖ **2. SIMPLE CUBOIDAL EPITHELIUM**

a. slide #32

Again using the slide and the illustration of kidney tissue (DiFiore p 189-191) identify kidney tubules in both cross section and longitudinal section. The cross sections are more numerous so you may have to scan the slide for a minute or two before you locate the longitudinal sections. The epithelium of the walls of these tubules is of the simple cuboidal type. The cells of some tubules look more cuboidal than do others. Usually the cuboidal nature of the cells shows more clearly in the tubules which are cut longitudinally.

Look closely at the lumen side of the cells seen in the tubule cross sections. With careful focusing you may be able to see a 'brush border" due to the presence of submicroscopic *microvilli.*

b. slide #4, Triarch HA 2-1

See if you can find the simple cuboidal epithelium on the slide labeled simply "Simple Cuboidal Epithelium". The source tissue of this slide is not specified so can not go to a textbook picture for help, however,

knowing the characteristic appearance of the epithelium in question should be enough for successful recognition. As you are searching, remember that epithelia are always found on the free surfaces or hollow lumena of organs.

❖ 3. SIMPLE COLUMNAR EPITHELIUM

a. slide #26, Turtox H5.4515

Find the cross section of stomach wall in your slide set. Find a textbook picture of the fundic or the cardiac region of the stomach (DiFiore p 141-147), then scan your slide until you locate the simple columnar epithelium which lines the inner surface of the stomach wall. Most of these columnar cells are mucus secreting cells and hence will have the typical pale appearance of such cells.

The stomach wall is very highly convoluted, so that during the process of making this slide the microtome knife will have sliced through the epithelial lining of the stomach at a variety of angles. Scan the slide carefully looking for the clearest possible example of simple columnar cells.

b. slide #27, Turtox H5.512

Repeat the above process for the cross section of the duodenum wall. All of the comments made regarding the stomach wall also hold true for this slide of the wall of the duodenum.

c. slide #7. Triarch HA3-33

See if you can find the simple columnar epithelium on the slide labeled "goblet cells". Goblet cells are mucus secreting simple columnar epithelial cells which have become swollen and wine glass shaped due to the accumulation of mucus in their interior prior to discharge of same. The source of this slide is not specified however you can probably find a textbook picture of a goblet cell. Knowing the characteristic appearance of these cells should be enough for successful recognition. Remember that epithelial cells are always found on the free surfaces or hollow lumena of organs.

d. slide #5, Turtox Hl.31

See if you can find the simple columnar epithelium on the slide labeled simply "Columnar Epithelium". The source tissue of this slide is not specified but knowing the characteristic appearance of the epithelium in question should be enough for successful recognition. As you are searching, remember that epithelia are always found on a surfaces or lumen.

❖ 4. PSEUDOSTRATIFIED COLUMNAR EPITHELIUM

a. Parco slide H. 1.8 will be issued at the check-out window.

A special trichrome stain was used for this slide which stains connective tissue blue and muscle tissue red. Find a textbook picture which shows a cross section of a trachea (DiFiore p 181), then scan your slide until you locate the pseudostratified columnar epithelium which lines the inner surface of the trachea. Identify the cilia and the goblet cells. If you can see both cilia and goblet cells in an epithelium then you can safely classify that epithelium as pseudostratified. Look very carefully and you should also be able to see the basement membrane on at least some parts of the slide. Because of the special stain used, this is the only slide on which you can hope to see basement membrane.

b. slide #6, Turtox Hl.32

The stain used for this slide is different than the stain used for the above slide. Find the cross section of the trachea on this slide. Scan your slide until you locate the pseudostratified columnar epithelium which lines the inner surface of the trachea. Identify the cilia and the goblet cells. The trachea and upper bronchi are the only locations in the body for pseudostratified columnar epithelium and hence this epithelium is also known as standard respiratory epithelium.

❖ 5. TRANSITIONAL EPITHELIUM

Parco slide H.1-11 will be issued at check-out window.

Find a textbook picture of the wall of the urinary bladder (DiFiore p 195) then scan your slide until you locate the transitional epithelium which lines the luminal surface of the bladder. This is a stratified epithelium of a specialized variety found only in the urinary bladder. It is adapted for stretching without tearing. When the bladder is empty the top layer of epithelial cells will appear to be large and dome shaped. When the bladder is full the top layer of epithelial cells will be stretched out into a squamous shape.

❖ 6. STRATIFIED SQUAMOUS NONKERATINIZED EPITHELIUM

Slide #3, Turtox H 1.14

This slide is taken from the wall of the esophagus. Find a textbook picture which matches this description (DiFiore p 131). Scan your slide. Identify the cells of the basal layer and notice that they are not squamous. Now focus your attention on the layer of "cells" on the free surface. Notice that they have readily visible nuclei and are clearly squamous. The presence of nuclei in this top layer of cells is diagnostic for the nonkeratinized variety of stratified squamous epithelium.

❖ 7. STRATIFIED SQUAMOUS KERATINIZED EPITHELIUM

Slide #2, Triarch HA 4-23

This slide is taken from the thick hairless skin of the foot pad. Find a textbook picture which matches this description (DiFiore p 105). Scan your slide. Identify the cells of the basal layer and notice that they are not squamous. Now focus your attention on the layer of "cells" on the free surface. Notice that they are extremely flattened flakes and do not, have nuclei.

❖ 8. GLANDULAR EPITHELIUM

Optional procedure

All glandular cells are derived from cuboidal epithelium. Simply scan the slide and notice the cuboidal appearance of the cells. Find a textbook picture which will help with the slide you are looking at.

a. Slide #28, Turtox H 5.71, Liver

b. Slide #29,Turtox. H5.81, Pancreas

❖ 9. REPRODUCTIVE EPITHELIUM

Optional Procedure

The cells which give rise to the future egg and sperm cells are simple cuboidal epithelium.

a. Slide #33, Turtox.H9.310, Ovary

Focus your attention on the outside surface of the ovary, looking for a very thin layer of simple cuboidal epithelium called oogenic epithelium. This layer of cells gives rise to the future eggs. Due to technical difficulties when making this slide you may find that the epithelium you are looking for is only present on a small.

CONNECTIVE TISSUE

❖ 1.AREOLAR (LOOSE FIBROUS) CONNECTIVE TISSUE

slide #10, Turtox H2.13

Scan the slide and find the least dense area. Reduce the substage illumination as far as you can. This is very important in order to see as much detail as possible. Find a textbook illustration of areolar connective tissue (loose fibrous connective tissue) (DiFiore p 29 and 31) and compare it with what you see under the microscope. Differentiate between collagen and elastic fibers. Identify fibrocytes, and mast cells. Does your slide happen to have a visible blood capillary? If so notice the red blood cells in the interior of the capillary.

❖ 2. ADIPOSE CONNECTIVE TISSUE

slide #31, Turtox H8.23

The most reliable place to look for a good teaching example of adipose tissue is on a slide showing a cross section of an artery, vein, and nerve. Adipose tissue is used as packing material around the vessels and

nerves. Turn to a textbook illustration of adipose tissue (DiFiore p 35 and 87) and compare it with what you see on this slide.

❖ 3 DENSE REGULAR COLLAGENOUS CONNECTIVE TISSUE

slide #8, Turtox H. 11
This is a longitudinal section of a tendon; it is practically pure collagen fibers which are packed tightly together parallel to one another. All the cells seen in this preparation are fibrocytes.

❖ 4. DENSE REGULAR ELASTIC CONNECTIVE TISSUE

slide #31, Turtox H8.23
The easiest place to find an example of this classification is in the wall of an artery. The elastic fibers in the artery wall are densely packed and are arranged parallel to one another. Consult an illustration if you need help identifying the elastic fibers (DiFiore p 87).

❖ 5. DENSE IRREGULAR FIBROUS CONNECTIVE TISSUE

Optional Procedure: slide #3
The connective tissue layer beneath the stratified squamous nonkeratinized epithelium is a good place to look in order to see dense irregular elastic fibers.

❖ 6. RETICULAR CONNECTIVE TISSUE

slide #11, Turtox H2.31 or Triarch HB6.5
Reticular connective tissue is used as a supporting skeleton (loose irregular meshwork) for the glands and lymphoid organs of the body. When you examine this slide scan it until you find the least dense area, then focus your attention on the fiber framework, ignoring the gland cells. If you need help finding the fibers consult a textbook illustration (DiFiore p 97 #2).

❖ 7. CARTILAGE

a. slide #13, Turtox H 2.61
Compare this slide to an illustration (DiFiore p 37 1A and 2). Identify: **matrix, lacunae, chondrocytes.**

b. Slide Parco H. 1.8 will be issued at the check-out window.
The trachea contains horseshoe shaped rings of hyaline cartilage. Scan this slide and locate the cartilage. Compare what you see with a textbook illustration (DiFiore p 37 #3).

❖ 8. ELASTIC FIBROCARTILAGE

Optional Procedure: slide #14, Turtox H 2.62
This cartilage is heavily laden with elastic fibers in a dense irregular arrangement. There are so many elastic fibers present that it will be difficult to see the chondrocytes. Compare what you see with an illustration (DiFiore p 39).

❖ 9. COMPACT BONE

slide #16, Turtox H 2.735
Consult an illustration of ground bone (DiFiore p 41 #1). The term ground bone refers to the technique used to prepare two slide. A slice of bone is ground to wafer thinness on a jewler's grinding wheel. In order to be examined with the light microscope the specimen must be thin enough to transmit light. Identify the following architectural features:
Haversian system
Haversian canal
concentric lamellae
interstitial lamellae
lacunae
canaliculi. (In order to see the canaliculi the substage illumination may have to reduced.)

❖ 10. DEVELOPING BONE

slide #15, Turtox H 2.63 Disregard the name on the label of this slide, it is misleading.

1. This slide is a longitudinal section of a digit of a small rodent showing bone ossification. Consult an illustration of developing bone (DiFiore p 45, 47, 49). Begin by examin-

ing the slide with your naked eye. Locate the epiphyseal plate of cartilage; it is usually found in the center of the specimen and it typically is stained a very dark purple.

2. Now scan this slide under the microscope. Locate the **epiphyseal plate.** You will be able to identify it by recognizing the healthy hyaline cartilage in the center of the epiphyseal plate. On each side of the band of healthy hylaine cartilage is a **hypertrophic zone** of cartilage. Notice that the cartilage cells in this zone are stacked and swollen. The edges of this zone show evidence of lysis. In the midst of the debris of the lysed cartilage you will see **spicules** of newly deposited osteoid tissue. A bone spicule is a small strand or spine of bone. Inside each spicule you can identify osteocytes.

3. Scan the spicules on your slide looking for **osteoblast** cells on the free surfaces of the spicules. The number of osteoblasts present will depend on the age of your specimen, there will be more osteoblasts in a younger specimen.

4. Now focus your attention on the **red bone marrow** found in the pockets between the spicules. You should be able to recognize the **adipose cells** which look like white balloons.

5. The other cells in the red bone marrow are stem cells for the red and white blood cells and the platelets. The only stem cell that you need identify is the **megakaryocyte.** Even a novice can recognize these cells by their sheer size. They look like enormous bulls eye targets. A megakaryocyte is a stem cell for blood platelets (thrombocytes).

6. Note the absence of Haversian systems in the collar of compact bone; they are organized later in development.

BLOOD

❖ 1. BLOOD SMEAR PRELIMINARIES

slide # 17, Turtox H 2.85 1

An illustrated booklet on blood may be checked out at the laboratory window for use during class time. Page 8 in this booklet is the only relevant page.

You will need to use the oil immersion lens (97x) for this exercise. This lens is longer than the other objective lenses, and the working distance (clearance) between the glass slide and the lens is very much smaller than it is for the others. Furthermore, there is no stop mechanism to prevent you from cranking the lens right down into the slide during focusing maneuvers. Therefore it is necessary that you follow instructions carefully in order to avoid breaking the slide.

Begin by cleaning all the microscope lenses and the glass slide. Before you put a slide on the stage experiment with the focus knob until you discover which way to turn the knob in order to move the objective lens away from the stage. Memorize this direction so that you know which way to turn the knob without having to look at it.

Now focus on the stained blood smear with the10x objective. The brightness must be turned down low at this stage.

Next swing the 10x objective to one side and place a small drop of immersion oil directly on the glass slide. Rotate the oil immersion objective (97x) into place. Listen for the click.

Now while looking through the microscope use the fine focus adjustment knob to improve the image. Always move this adjustment knob in such a way as to move the objective lens away from the glass slide. Never use the coarse adjustment knob when using the oil immersion lens.

Increase the substage illumination to improve the picture.

Observe the red blood corpuscles in every field of view. Remember that the typical RBC is 7.5 μ in diameter. You can use this knowledge to estimate the size of the white blood cells which you encounter. Identify the following:
erythrocytes
thrombocytes
platelets

❖ 2. BLOOD SMEAR DIFFERENTIAL

Scan the slide, looking for leukocytes. WBCs are much fewer in number than RBCS. Consult various illustrations and written descriptions for help with your identification. Identify the following.

neutrophils
lymphocytes
monocytes
eosinophils
basophils

Do a differential: Plan your scan so that you do not cross back into an area of the slide that you have already examined. A laboratory differential involves tallying 100 different WBCS. At the end of this exercise you can express the ratios in terms of percentages.

Doing a differential can be very tedious unless you learn to increase the speed of your scan. You will learn that you can move the mechanical stage quite rapidly. Every time you pass a WBC you will see a flash of color. Stop the scan and force yourself to decide winch type of leukocyte it is. If the cell is broken you may disregard it.

Another trick that will make the differential less tedious and will decrease eyestrain and headache is the following: Keep a running tally in your head of the neutrophils and the lymphocytes. For example, 26/15 would mean 26 neutrophils and 15 lymphocytes. Do no take your eye away from the microscope when you see these cells. In this way you only have to make a tally mark on paper when you find one of the other cells.

MUSCLE TISSUE

❖ 1. SKELETAL MUSCLE, TEASED

slide #18, Turtox H3.1

The term teased refers to the fact that the muscle fibers have been separated (teased apart) with a pair of dissection needles. Separation is necessary in order to reduce density and let sufficient light pass through the tissue to illuminate the fibers. Scan the slide and find a area where the fibers are least dense. Reduce the substage illumination. Notice that the fibers are boldly striated and multinucleated. Also observe that the nuclei are positioned at the edges of the fibers. (DiFiore p 61 #2 may help.)

❖ 2. SKELETAL MUSCLE, CROSS SECTION

slide #19, Turtox H3.12

Look at this slide with your naked eye and notice that there are two tissue samples on the slide. One sample is a cross section of skeletal muscle, the other is a longitudinal section. Use only the cross section portion of the slide. Consult textbook illustrations **(DiFiore p 63 #1 and p65 #1)** to help you identify the following:

muscle fiber - single muscle cell
fascicle - bundle of muscle cells
endomysium - connective tissue around individual muscle cells
perimysium - connective tissue around a fascicle
epimysium - connective tissue around the outside of the whole muscle.
sarcolemma- muscle cell membrane
sarcoplasm - cytoplasm of a muscle cell

❖ 3. SMOOTH MUSCLE

a. slide #20, Turtox H3.21

This is a slide of teased smooth muscle. Reduce the substage illumination and focus carefully.Notice that the fibers are small and spindle shaped with pale centrally placed nuclei. Notice the absence of striations. Consult textbook illustrations if you need help **(DiFiore p 61 #1, and p 63 # 2 and #4).**

b. slide#31, artery,vein,nerve. Find the smooth muscle in the wall of the artery.

❖ 4. CARDIAC MUSCLE

a. slide #21, Turtox H3.31

This is a slide of teased cardiac muscle. Scan the slide looking for the area of least density. Notice that the cells are blunt ended, with pale, centrally placed nuclei. Focus very very carefully with reduced illumination to observe the faint striations and the hard to find intercalated discs. Refer to textbook illustrations (DiFiore p 63 #5).

STUDIES IN ORGAN ARCHITECTURE

❖ 1: SKIN ARCHITECTURE

a. Slide # 2, Triarch HA 4-23. Foot Pad

Identify the following architectural layers:

- Epidermis
  - Stratum corneum
  - Stratum lucidum
  - Stratum granulosum
  - Stratum spinosum
  - Stratum germinativum
- Dermis (fibrous connective tissue)
- Hypodermis (fibrous connective tissue +fat)

Identify the *dermal papillae* and the *sudoriferous glands*. They may begin in the dermis or hypodermis; they have ducts that travel to the surface of the epidermis.

Note the absence of sebaceous glands. These occur only in hairy skin.

b. Slide #35, Turtox H ll.14, Scalp

This slide is not good for study of the subsections of the epidermis, but it is excellent for seeing:

- hairs and hair follicles
- Sebaceous glands
- Sweat glands

❖ 2: BLOOD VESSEL WALL ARCHITECTURE

a. Slide #31, Turtox 8.23. Artery, Vein, Nerve in cross section

Focus your attention on the wall of the artery. Identify the following layers:

- Tunica intima (intima)
  - endothelium
  - internal elastic membrane
- Tunica media
  - smooth muscle
  - external elastic membrane
- Tunica Externa (fibrous connective tissue)

b. Slide #36, Coronary atherosclerosis.

Examine this slide for evidence of an atheroma or tumor of the blood vessel wall. You should see a ***narrowed lumen*** and a ***broken internal elastic membrane***. These disruptions are due to migration, overgrowth and transformation of the tunica media. The cells have de-differentiated, i.e. they no longer look like smooth muscle cells; they appear to be accumulating fatty material and are out of control in terms of cell division.

❖ 3: RESPIRATORY TUBE ARCHITECTURE

Check out Parco H.1.8, trachea in cross section from the window.

Identify the following architectural layers:

- Mucosa
  - epithelium
  - lamina propria
  - muscularis mucosa
- Submucosa
- Adventitia (fibrous connective tissue)

❖ 4: DIGESTIVE TUBE ARCHITECTURE

Scan the following slides looking for which ever one shows the architectural layers to best advantage.

a. Slide #26, Turtox H5.415: stomach.
b. Slide #27, Turtox H5.512, duodenum.
c. Slide #3, Turtox Hl.14, esophagus.
d. Slide #7, Triarch HA 3-33.

Identify the following:

- Mucosa
  - epithelium

lamina propria
muscularis mucosa

Submucosa (fibrous connective tissue)

Muscularis externa
multiple layers of *smooth muscle*; 3 in the stomach (innermost oblique, inner circular, and outer longitudinal) and 2 (inner circular, and outer longitudinal) in other parts of the gut.

Adventitia (fibrous connective tissue)

Dissection of Cat Digestive System

INTRODUCTION

Man is an omnivore and as such has a much bulkier diet than does the cat, which is a carnivore. As a result the cat has a much shorter alimentary canal than does the human. The shortness of the gut tube is especially true for the large intestine; therefore you are not expected to identify in the cat all the sections of the gut that are identifiable in man.

Note in addition that the cat has no: uvula, vermiform appendix, haustra, taenia coli, epiploic appendages, Peyer's patches, or duodenal papilla.

With the exceptions of the greater omentum and part of the liver, ***do not remove any of the organs from the body of the cat, and do not bisect any of the tubular structures***. It is important to critically observe the relationships of the various organs to one another; try to absorb mental visual images of the organs in their proper locations.

You may find that the normal serous exudate of the visceral cavities in your specimen has been stained with the dark reddish brown color of blood. If this is the case, after opening the body walls, take your specimen to the sink and hold it under the running water to wash it clean. This is also a useful technique to use after you have opened the stomach, and caecum.

PERITONEAL MEMBRANES

PERITONEUM

1. Observe the tough, clear, shiny membrane (reminiscent of "saran wrap") lining the interior of the abdominal wall. This is the ***parietal peritoneum***. Also observe the ***visceral peritoneum*** covering the outer surfaces of the visceral organs. These two layers are continuous with one another at the various reflections, ligaments, etc. .

MESENTERY

2. Observe the ***mesentery*** of the small intestine, which suspends the small intestine from the dorsal body wall. It is a fan shaped double fold of peritoneum that provides a "highway" for the passage of mesenteric arteries and veins. In the cat a very large mass of lymph node material ***(the pancreas of Aselli)*** is embedded in the mesentery. This lymphoid tissue serves the same function in the cat that the Peyer's patches do in man.

GREATER OMENTUM

3. Observe the undisturbed abdomen. The apron-like membrane which first strikes the eye, directly beneath the anterior abdominal wall and covering the intestines like a blanket, is the ***greater omentum***. The amount of fat in this structure varies greatly from one animal to another, almost totally changing the appearance, so be sure to look at more than one example in the laboratory. With your fingers gently loosen this membrane from its entanglements with the abdominal viscera. Observe its attachment to the greater curve of the stomach and to the colon. Tear it slightly and observe the pocket ***(omental bursa)*** between the two double layers of omentum. When you are through observing the omentum you may remove it from the body of the animal.

LESSER OMENTUM AND PORTA HEPATIS

4. Find the lesser omentum, the bit of visceral peritoneum stretching between the underneath side of the liver and the lesser curvature of the stomach. It forms the ***porta hepatis***, or "gateway to the liver", and in it travel the ***triad*** of common bile duct, common hepatic artery, and hepatic portal vein, all of which will be described further in sections to follow.

LIGAMENTS OF THE LIVER

CORONARY LIGAMENT

5. Lift the diaphragm away from the upper surface of the liver and observe the ***coronary ligament***, which is the reflection and attachment of parietal peritoneum onto the upper surface of the liver.

FALCIFORM LIGAMENT

6. Also observe the ***falciform ligament***, the double layer of visceral peritoneum on the ventral surface of the liver between the two largest lobes, and attaching the liver to the ventral body wall. Find it in the midline, below the diaphragm.

LIGAMENTUM TERES

7. Embedded in the edge of the falciform ligament can sometimes be felt a hard round cord, the ***round ligament of the liver***, a remnant of the umbilical vein from the time when this specimen was a fetus. This vein brought nutrient rich blood from the placenta to the fetus. It is a vein because it carries blood toward the fetal heart.

ALIMENTARY CANAL

ESOPHAGUS

8. Trace the esophagus through the thorax, through the diaphragm, and into the abdomen. It will lead you to the stomach.

STOMACH

9. Note the greater and lesser **curvatures**. Also locate the cardiac region, fundus, body, and pyloric **regions**.

10. Open the stomach by slitting its ventral wall, and clean it out (use forceps and/or the handle of the scalpel) in order to see the **rugae**. Depending on what the cat has been eating and how recently it ate, the contents of the stomach will vary in appearance. In addition you may find hair balls, round worms, or tapeworms in the stomach or intestine. If worms are present they will have all been killed by the embalming fluid and are of no danger, but rather an added point of interest. If your cat does not have rugae be sure to look around the lab until you see a good example of them.

DUODENUM

11. Find the duodenum, and tie a ligature (tightly tied and knotted string, ends cut short) around it three to four inches below the pylorus of the stomach. The purpose of this ligature is to prevent the contents of the lower parts of the small intestine (if any) from leaking out into the opening that you are now going to make in the duodenum.

12. Extend the cut that you made in the wall of the stomach down through the **pyloric sphincter** and into the ventral wall of the duodenum. The duodenum is usually empty in a dead animal. Look closely at the junction of the pyloric stomach with duodenum, to see the pyloric sphincter cut in cross section. Use the dissection scope to aid in this observation.

13. There is usually no observable **duodenal papilla**, but try to mark the location of the opening of the bile duct and pancreatic duct by squeezing the gall bladder slightly. Sometime this will cause a drop of green bile to appear in the duodenum.

14. Look closely at the interior surface of the small intestine and notice that it has a velvety texture. This texture is due to the presence of thousands of **villi**. Use the dissection scope to help you see these.

CAECUM

15. Run the small intestine through your fingers until you reach it's termination where it enters the **caecum** (cecum) at an abrupt right angle. Tie a tight ligature around the caecum about two inches away from its blind end. The purpose of the ligature is to prevent the contents of the large intestine from leaking into the caecum.

16. Open the caecum and clean it out in order to see the **ileocecal valve**. Note the absence of villi in the wall of the large intestine.

RECTUM

17. Locate the rectum and notice the organs and structures that are in close proximity to it.

ACCESSORY DIGESTIVE ORGANS

SALIVARY GLANDS

18. Identify the **parotid salivary gland** in front of the external ear and the **submandibular salivary gland** beneath the mandible. These were most likely exposed during dissection of the muscles of the neck. If you did not do the dissection of the neck earlier you need to do it now. please refer to the Muscle Labs, "anterior neck and head".

LIVER & GALL BLADDER

19. The cat liver has more lobes than does the human liver. You do not need to learn the names of these lobes in the cat. Lift the ventral edge of the liver and bend it toward the head of the cat.

20. Beneath the liver, wedged between its lobes and attached to its surface by connective tissue is the ***gall bladder.*** The gall bladder is usually stained a dark green due to the bile it contains at the time of death, however, it may look white if by chance it is empty of bile. Gently peel the gall bladder away from the surface of the liver. The wall of the gall bladder (and of its ducts) is very subject to tearing, probably because of the chemical action of the bile on the tissue after death.

BILE DUCTS

The branching pattern of the bile duct approximates the shape of a capitol letter Y. The cystic duct is equivalent to the upper left arm of the Y; the common hepatic bile duct is equivalent to the upper right arm of the Y; and the common bile duct is equivalent to the stem of the y .

CYSTIC DUCT

21. The duct which is directly continuous with the gall bladder is the ***cystic duct.*** Gently peel away the connective tissue wrappings around the cystic duct. When successfully stripped of its connective tissue coverings you will see that the cystic duct is characteristically serpentine.

COMMON BILE DUCT

22. Follow the cystic duct downwards. At its branching point continue to follow the stem ***(the common bile duct)*** towards the duodenum. The common bile duct is the largest of the ducts, and it is often stained green from the bile. It travels in the lesser omentum along with the hepatic artery and portal vein.

COMMON HEPATIC BILE DUCT

23. Return to the branching point of the Y and trace the ***common hepatic bile duct*** upward toward the liver. It is formed by the confluence of the ***right and left hepatic bile ducts*** in man; in the cat there will be additional tributaries because of the additional liver lobes. Identify and emphasize the right and left hepatic bile ducts.

PANCREAS

The pancreas in the cat is a loosely aggregated mass of grayish brown glandular tissue embedded in the mesentery of the duodenum. It has a characteristic lobulated appearance similar to that of the parotid salivary gland. The pancreas in the cat does not have as defined a shape and form as it does in humans, but nevertheless it is located in the same mesentery, just as it is in all vertebrates. In the cat there are separate ducts from the head of the pancreas and from the body of the pancreas. These ducts unite to form a short (about 1/4 inch) broad, **common pancreatic duct.**

24. The ***pancreatic ducts*** are quite tough and strong, and the recommended technique for finding them is to scrape away bits of pancreatic tissue with the closed tips of a pair of forceps, leaving the stronger ducts behind. Begin this procedure at the point where the common pancreatic duct joins the

common bile duct at the duodenum. Do not attempt to proceed until you have first located the common bile duct. Take care not to break the connection between these ducts and the duodenum.

25. Find the ***common hepatic artery*** and ***hepatic portal vein*** in the porta hepatis area next to the common bile duct. The portal vein is very thin, flabby and easy to tear.

SPLEEN

26. The spleen may have been examined at the time that the splenic artery and vein were dissected, however it is appropriate to review it at this time. The spleen is located in the upper left quadrant of the abdominal cavity. The tail of the pancreas makes contact with the hilum of the spleen in both cat and man. Its shape in the cat is quite different than its shape in the human. In the cat it is dark brown and shaped like a long tongue. Its size and appearance may be quite different from one specimen to the next, so it is advisable to look at more than one cat during the laboratory dissection period.

The spleen is a lymphatic system organ which filters the blood as well as the lymph by phagocytic activity. It also adds lymphocytes and antibodies to the blood.

DIGESTIVE SYSTEM MODELS & X-RAYS

Use the checklists as a guide for the study of the models and X-Rays.

Dissection of Urinary System

CAT URINARY SYSTEM

PERIRENAL FAT

1. The kidneys in the cat lie on either side of the vertebral column at level L3 to L5. In the human they are located a little higher, between T12 and L3. The right kidney is usually a little more craniad than the left kidney. In all vertebrates the kidneys are surrounded by fat, and this ***perirenal*** fat is essential to keep the kidneys upright. If a kidney should fall from its position against the dorsal body wall there is risk of crimping the ureter and creating serious back pressure in the urinary system.

RETROPERITONEAL

2. Separate the peritoneum from the ventral surface of one of the cat kidneys, using forceps and scissors. The kidneys, urinary bladder, ureters, and adrenal glands, as well as the rectum, duodenum, pancreas, abdominal aorta, and inferior vena cava, are ***retroperitoneal*** (behind the peritoneum); *i.e.* they are attached to the body wall and covered by peritoneum on one side only. The kidneys provide your best opportunity for first hand observation of this condition for yourself.

3. The peritoneal cavity is the space between the parietal and visceral peritoneum. The peritoneum covers the visceral organs, whether on one surface or on all surfaces, but ***none*** of the organs actually lie in the peritoneal cavity. These peritoneal membranes secrete a thin serous lubricating fluid which allows the viscera to move and slide against one another without creating friction.

URETERS

4. Carefully trace both of the ureters to the urinary bladder. If your cat is a male you must take special care not to cut the ductus deferens as it hooks over the ureter near the bottom of the bladder.

URINARY BLADDER

5. The urinary bladder will vary in size and thickness of wall from one animal to another, depending on the habits of urinary retention (and therefore bladder distension) that the animal had. The bladder is connected to the body wall by three ***suspensory ligaments***, one in the midline between bladder and ventral body wall, and two on the sides in the inguinal region. These lateral ligaments characteristically contain large amounts of adipose tissue

RENAL VESSELS

6. Identify the renal artery and renal vein attached at the renal **hilum**, the concave depression on the medial surface of the kidney.

ADRENAL GLANDS

7. Locate the adrenal glands, small grayish brown masses of glandular tissue located medial to the kidney near its cranial pole. The left adrenal lies close to the aorta between the superior mesenteric artery and the renal artery. The right adrenal lies close to the inferior vena cava slightly higher than the left adrenal.

URETHRA

8. Locate the urethra, the tube that leaves the bottom of the bladder, and heads for the ***perineum***.

9. Make a ventral incision in the bladder and open it to see the ***trigone***, the triangular area at the bottom of the bladder between the openings of the two ureters and the urethra.

10. In order to see the full length of the urethra you must split the pubic symphysis. Before doing so you must first separate the adductor muscles of the thigh from one another in the midline with a scalpel.

11. If your cat is a female please skip this step and go directly to step number 12. If your cat is a male please do the following:

a. Incise the skin of the scrotum and remove the testicles; don't cut the spermatic cord.

b. Insert the scissors into the opening at the tip of the penis and incise the ***prepuce***. The skin is thick here and the ***glans penis*** is small so there will be plenty of room for the scissors between the skin and the glans; ***you will not be cutting the penis itself, only the skin covering the penis***.

c. Peel away all the perineal skin, including the scrotum and prepuce, exposing the testicles, spermatic cords, and penis.

12. Clear away all tissue overlying the pubic symphysis and look closely for the bluish white line of cartilage, which is about one inch long and 1/16 inch deep.

13. Insert the handle of your forceps behind the pubic symphysis to act as a guard should your knife slip. One of the lab partners should now press down on both knees of the cat while another partner applies a sharp scalpel to the midline of the cartilage. This method will only work if the scalpel is lined up dead center on the cartilage of the pubic symphysis. If your landmarks are correct the pubic symphysis should separate abruptly.

14. Trace the urethra from the bladder to the perineum. In both male and female cats it passes through the ***urogenital diaphragm*** which acts as an external sphincter for the bladder. In the male cat the urethra then passes through the length of the penis. In the female cat it opens into the ***urogenital sinus***. Note that the female cat only has two outside openings in the perineal region rather than the three that human females have.

INTERIOR OF CAT KIDNEY

15. Remove one of the cat kidneys and slice it longitudinally, making a series of thin parallel sagittal sections. Lay the sections out on a piece of white paper. Distinguish between the ***cortex*** (lighter colored superficial tissue) and ***medulla*** (darker colored core tissue). Depending on the age of the cat, there may be only one ***pyramid*** (older cats) or as many as four pyramids (younger cats). The pyramids tend to fuse together as the cat ages. Adult human kidneys contain about 12 pyramids.

16. Distinguish between the ***renal pelvis***, and the ***renal sinus***. The latter is filled with fat and is outside of the renal pelvis. The renal pelvis is the expanded upper end of the ureter.

17. Identify the ***renal papilla***, which is the pointed end of the medullary pyramid which projects into the renal sinus. In the human kidney each pyramid has its own papilla which drains into a ***minor calyx*** and then into a ***major calyx***. If your cat kidney has only one pyramid it will also have only one papilla, and there will be no subdivisions of the pelvis into calyces.

SHEEP KIDNEY

18. Repeat steps 15 through 17. with a double or triple injected sheep kidney. If the specimen is triple injected there will be yellow latex in the urine collection cavities of the kidney. Since the sheep kidney is much larger than the cat kidney it should be easy to do the following dissection:

19. Scrape away medulla tissue until the renal artery can be seen branching into four or five ***interlobar*** arteries within the ***medulla*** Trace these interlobar arteries upward until they anastomose with one another as they arch over the base of the medullary ***pyramids***. These arching linkages are called the ***arcuate*** arteries.. Numerous ***interlobular*** arteries leave the arcuate arteries at right angles, and penetrate the ***cortex***.

URINARY SYSTEM MODELS & X-RAYS

Use the checklists as a guide for the study of the models and X-Rays.

Dissection of Cat Reproductive Systems

Note: You are expected to study the reproductive systems of both male and female cats.

MALE CAT:

PRELIMINARIES

1. If you have a male cat the following procedure may have already been done, in which case skip to paragraph #2 below.

a. Incise the skin of the ***scrotum*** and remove the ***testicles***, leaving the ***spermatic cord*** intact.

b. Now incise the skin covering the ***penis*** by inserting the scissors into the opening at the tip of the penis. The skin (***prepuce***) is quite thick here and the ***glans*** penis is quite small so there will be plenty of room for the scissors between the skin and the glans; *you will not be cutting the penis itself, only the skin covering the penis.*

c. Peel away all of the skin in the perineal region, including the scrotum and the prepuce, and discard it, leaving behind the exposed testicles, spermatic cords, and penis.

DUCTUS DEFERENS

2. Trace the spermatic cord from the testicle to the ventral abdominal wall, and locate the ***internal and external inguinal rings*** and the ***inguinal canal.*** Follow the ***ductus deferens*** from the internal inguinal ring to the ***prostate*** gland. Notice that it hooks around the ureter and descends behind the urinary bladder.

PROSTATE GLAND

3. The **prostate** gland, in the cat is much smaller and in a slightly different location than in the human. Whereas in the human the prostate is the size of a walnut and located snug up against the underneath side of the bladder, in the cat it is a pea sized swelling around the urethra about one inch below the bladder. It can best be identified at first by touch; run your fingers down the length of the urethra until you locate it.

BULBOURETHRAL GIANDS

4. The male cat has no ejaculatory duct and no seminal vesicles, but look for the paired ***bulbourethral glands*** at the junction of urethra, penis, and urogenital diaphragm.

TUNICA VAGINALIS

5. Return to the testicle and notice that it is enveloped in a fascial sac, the ***tunica vaginalis***. Open the sac and notice that the inside surface is shiny and smooth. This is actually a small bit of the peritoneum that was pulled down into the scrotum during the descent of the testicle.

EPIDIDYMIS

6. The flattened body of the ***epididymis*** can now be seen on the surface of the testicle. It is continuous with the ductus deferens. Peel away as much of the fascia covering the epididymis as possible, and examine the whole structure under the dissecting scope. You should be able to observe that it is highly coiled and tubular in nature.

SEMINIFEROUS TUBULES

7. Cut a section from the testicle and look at it with the dissection scope. Can you see the minute ***seminiferous tubules*** ?

PENIS

8. Examine the ***glans penis***, which in the cat is covered with numerous spines.

9. Remove connective tissue from the perineum in successively deeper layers until you have exposed the ***crura*** of the ***corpora cavernosa***, and the ***bulb*** of the ***corpus spongiosum***. Look closely at the surface of a crus to see the ***ischiocavernosus*** muscle. Likewise look closely at the surface of the bulb to see the ***bulbocavernosus*** muscle.

10. Lastly, do a ***hemisection*** of the shaft of the penis, leaving it hinged on the dorsal side. From this preparation you will be able to identify the ***spongy urethra***, the ***corpus spongiosum***, and the two ***corpora cavernosa***.

FEMALE CAT

OVARIES

1. The ***ovaries*** are small pea sized organs with a lumpy surface lying just caudal to each kidney. The lumpy appearance is due to numerous ***Graafian*** follicles and perhaps ***corpora lutea*** in the interior. Do a longitudinal ***hemi-section*** of the ovary and examine thecut surface with the dissection scope.

FALLOPIAN TUBES

2. The ***fallopian tubes*** are exceedingly small and highly convoluted. They coil around the ovary, and the expanded ***infundibulum*** with its fringed edges (***fimbria***) almost completely covers the ovary. This is in contrast to the condition in the human where the fallopian tube is much more mobile and only loosely attached to the ovary. It will take some effort to peel away the connective tissue holding the fallopian tube to the ovary, but this should be done in order to clearly distinguish its features.

UTERUS

3. The ***uterus*** in the cat is very different (perhaps startlingly so) from that in the human. Whereas in the human it is a compact pear shaped organ, in the cat the uterus has two long tubular horns. These ***uterine horns*** are widely variable in size, depending on whether or not the cat is pregnant, and if so how far along the pregnancy is. In the non-pregnant cat the uterine horn is about the diameter of a pencil. In a pregnant cat the diameter will be more the size of a carrot. In this latter case you must be careful to distinguish it from the rectum as they will look very similar. The two horns are joined together caudally to form the ***body of the uterus***. The body of the uterus lies between the rectum and the bladder. There is no distinguishable cervix.

PERITONEAL POUCHES

4. Locate the ***rectouterine and vesicouterine pouches***, which are simply pockets of peritoneal cavity between the two organs named.

PERITONEAL LIGAMENTS

5. Examine the ***broad ligaments of the uterus***, double folds of peritoneal membrane which suspend the uterus from the dorsal body wall. Locate the ***ovarian ligament***, a solid cord by which the ovary is attached to the tip of the uterine horn.

UROGENITAL SINUS

6. Female cats do not have a separate vagina and urethra opening to the perineum. Rather they have a common chamber called the ***urogenital sinus***, into which both urethra and uterus open. In the cat the body of the uterus is continuous with the upper end of the urogenital sinus. Open the urogenital sinus by cutting thru its wall with scissors. Locate the ***urethral meatus*** and the ***os uterus***.

CLITORIS

7. Near the urogenital meatus, inside the urogenital sinus and against its dorsal wall is the barely visible ***clitoris***. Cats are ***reflex ovulators***, that is, they do not ovulate until the nervous system receives suff. ient stimuli from the clitoris to indicate that insemination has probably occurred hence the location of the clitoris and the spines on the tip of the glans penis.

REPRODUCTIVE SYSTEM MODELS

Use the checklists as a guide for the study of these models.

Dissection of Cat Respiratory System

TRACHEA

1. In the midline of the ventral neck separate the muscles from one another and clear away the small amount of connective tissue that you find overlying the trachea. Try to preserve the ***thyroid glands***, two small dark lobes found on each side of the upper trachea. The ***trachea*** can be recognized by the rings of cartilage that give it the appearance of a piece of flex-hose. Actually the rings of cartilage are incomplete (horseshoe shaped), the back side of the horseshoe is closed in by a soft tissue membrane or muscle called the ***trachealis membrane*** or trachealis muscle.

LUNGS & PLEURAE

2. In the cat the left lung is divided into three lobes and the right lung is divided into four lobes. The outside surface of the lung is shiny due to the presence of ***visceral pleura***. The inside of the chest cavity is likewise covered with pleura, the ***parietal pleura***. Note the ***hilum*** of the lung where the pleural reflections occur and the bronchi and pulmonary vessels enter and leave the lung.

Identify the right and left ***costodiaphragmatic recesses***.

3. Attempt to inflate the lungs. Make a small slit thru the wall of the trachea and insert one end of a plastic thinking straw into the trachea. You will need to pinch the trachea closed around the straw and close off any obvious tears that have been made in the lungs. Blow into the straw.

MEDIASTINUM

4. The mediastinum is the middle section of the chest, between the lungs. Locate the ***thymus*** gland. It tends to look like a mass of brownish fat, and it lies anterior and ventral to the heart. Its size will vary depending on the age of the cat. It is large in young animals and ***involutes*** with age.

LARYNX

5. Clean away the muscles from the cartilages of the larynx until you can dearly distinguish the shapes of the thyroid and cricoid cartilages. The ***thyroid cartilage*** is the largest cartilage. It has two large flat plates on its ventral surface. The ***cricoid cartilage*** is inferior (caudal) to the thyroid cartilage. It is a complete ring of cartilage shaped like a signet ring with the narrow rim facing ventrally and the "signet" part facing dorsally.

6. To see the remaining cartilages you must first open up the oral cavity and pharynx of the cat. The purpose of the following rather drastic maneuver is to expose the larynx from behind, allowing you to see the epiglottis and the arytenoid cartilages.

Begin by cutting through the soft tissue at the corner of the mouth on both sides with a scalpel, and then, using bone shears or wire cutters, cut through the angle of the jaw on each side.

7. Next choose which side of the neck to "sacrifice", usually it is best to choose the side where strings can be seen tied around the blood vessels of the neck. With scissors, cut down one side of the neck, cutting through the oropharynx (the part of the throat at the back of the mouth), and ***laryngopharynx*** (the laryngopharynx is the part of the throat behind the larynx), and extending the cut on into the esophagus.

The ***epiglottis*** is the most superior in position of all the cartilages of the larynx. It is a tongue-like white cartilage poised over the larynx near the root of the tongue; it is attached ventrally to the thyroid cartilage. The ***arytenoid*** cartilages are two small triangular cartilages sitting on top of the cricoid cartilage on the dorsal side of the larynx.

8. Inspect the vocal cords and determine the difference between the true and false vocal cords. The ***true vocal cords*** are white ligamentous structures embedded in the mucous membrane of the larynx at the edge of the glottis. The ***false vocal cords*** are superior to the true cords, and are really nothing more than an edge of the ventricle, a space created by a slackness in the mucous membrane of the larynx. The mystery of the false vocal cord will clear up for you if you will press on the mucous membrane of the larynx with the blunt end of a probe. This maneuver will cause the false vocal cord to disappear and it will emphasize the true vocal cord at the edge of the ventricle.

9. Open up the larynx for a better view by making a longitudinal incision through the cricoid cartilage on the dorsal side of the larynx.

PHARYNX:

10. With scissors slit open the soft palate in the midline, extending the cut forward to the edge of the hard palate. Next make two lateral cuts and bend the soft palate tissue out of the way. If necessary gently blot the surface of the nasopharynx with cotton. You must be very gentle in this maneuver or you will accidentally remove the adenoids.

11. Examine the nasopharynx, looking in particular for the two lateral slit-like ***openings of the eustachian tubes***. Between the Eustachian tube openings will be found a single patch of nodular epithelium which often has a different color than the surrounding tissue. This patch is the ***pharyngeal tonsil, or adenoids***.

Next look for the two ***palatine tonsils*** located on the lateral wall of the oropharynx next to the glossopalatine arch, at the junction between the oral cavity and the oropharynx. These tonsils each look like small well encapsulated lymph nodes, three quarters of which is beneath the surface of the mucous membrane.

RESPIRATORY SYSTEM MODELS

Use the checklists as a guide for the study of these models.

Heart Labs

SHEEP HEART DISSECTION

PRELIMINARY STEPS:

1. Remove the ***parietal pericardium*** if any is present. Identify any adhering pieces of diaphragm, lung, thymus gland, trachea, or esophagus.

2. Be able to distinguish an artery from a vein. The thin walls of the veins are practically transparent. The thicker walls of the arteries are white colored.

3. Separate the fat and connective tissue from the large arteries (***pulmonary trunk*** and ***aorta***). Take care not to cut or tear the ***ligamentum arteriosum*** which connects the two.

4. Distinguish the aorta from the pulmonary trunk by inserting a finger into the ***ventricle*** from which each artery arises.

5. Distinguish the ***vena cavae*** from the ***pulmonary veins*** by determining which chamber the vessel empties into.

6. Check your identification with the instructor before preceding.

INCISIONS:

1. Make a straight line incision from the ***Inferior Vena Cava*** through the right ***auricle***, right ***atrium***, and right ***ventricle***. Stop at the ***median septum***.

2. Make an incision in the left heart starting at the pulmonary vein closest to the left auricle. Cut through the left auricle, left atrium, and left ventricle. Stop at the ***apex*** of the left ventricle.

3. Cut through the wall of the aorta until the ***aortic semilunar valve*** and the openings of the ***coronary arteries*** are visible.

4. Cut through the wall of the pulmonary trunk until the ***pulmonary semilunar valve*** is clearly visible.

5. Identify all structures included on the check list for the sheep heart.

HEART MODELS

Use the checklists as a guide for the study of these models.

Dissection of Cat Arteries and Veins

INTRODUCTION

The major arteries are accompanied by veins of the same name. Begin your dissection by concentrating your attention on the major arteries, followed by a dissection of the major veins if they are different than the arteries. Numerous smaller vessels (especially veins) will be sacrificed in order to clearly see the main artery and vein.

CHEST & NECK ARTERIES

1. Begin your dissection by opening the pericardium of the heart and clearing off fat and other connective tissue from the ***ascending aorta, arch of the aorta***, and ***pulmonary trunk***. Watch out for the ***ligamentum arteriosum*** during this procedure, and try to save it.

2. The arch of the aorta has two branches in the cat (three in man). The right hand branch is the ***brachiocephalic*** (innominate) artery which in the cat gives off both ***right and left common carotid arteries***, as well as the ***right subclavian artery***.

3. The ***carotid*** arteries head up the neck toward the head, and you need not follow them beyond the level of the chin.

4. The second branch off of the aortic arch is the ***left subclavian artery***. The main branches of the subclavian artery are easiest to work out on the left subclavian artery.

5. Starting from the point closest to the common carotid and moving laterally, the first small branch of the subclavian artery heads in a caudal direction. This is the ***internal mammary artery (a.k.a. internal thoracic artery)***. It supplies the in le surface of the chest wall, and gives off the anterior intercostal arteries.

6. The next branch of the subclavian artery is the ***vertebral artery***, and on the left side of the body it is almost directly "across the street" from the internal mammary artery. It dives deep into the neck, heading for the transverse foramena of the cervical vertebrae, by which it travels to the brain. Use your hooked metal probe to explore the transverse foramena.

SHOULDER ARTERIES

Optional procedure

7. Moving laterally the next branch is the ***thyrocervical*** artery which supplies the deep neck and shoulder. This artery characteristically hooks downward in a caudal direction.

Optional procedure:

8. The next branch is the ***costocervical*** artery which passes toward the head and shoulder. Its name changes to transverse scapular when it reaches the scapula. These arteries supply neck, chest, and shoulder muscles.

UPPER LIMB ARTERIES

9. The two ***subclavian*** arteries are identical to each other. Each extends into the arm where its name changes to ***axillary*** artery in the armpit region and then to ***brachial*** artery within the upper arm.

10. Optional Procedure

The largest branch of the axillary artery is the ***subscapular*** artery which heads for the subscapularis muscle and supplies the shoulder and upper arm.

11. The ***brachial*** artery in the cat passes through the distal end of the humerus along with the ***median nerve***; in the forearm the artery gives off two branches, the ***radial*** artery and ***ulnar*** artery.

DESCENDING THORACIC AORTA

12. Read this whole paragraph before proceeding: Lift the left lung up and out of the way so that you can visually inspect the ***descending aorta*** as it passes through the thorax, through the diaphragm, and into the abdomen. The thoracic ***lymphatic duct*** runs

parallel to the descending aorta on the left side of the chest. It lies under the parietal pleura, and is practically transparent. If you are lucky it may be stained brown from blood that has backed up into it from the subclavian vein.

13. The descending thoracic aorta gives off many small paired arteries, like rungs on a ladder. These are the ***posterior intercostal*** arteries.

Optional procedure: You may also see small bronchial and esophageal branches.

ABDOMINAL AORTA, SINGLE BRANCHES

14. Trace the thoracic aorta into the abdominal cavity. Directly under the diaphragm the aorta gives off its first abdominal branch, the ***celiac trunk*** artery. In the cat this vessel is about 1/2 inch long. It has three main branches which can be identified by following them to their destination. These branches are the: ***hepatic*** artery to the liver, pancreas, stomach and gall bladder; ***left gastric*** artery to the lesser curvature of the stomach; ***splenic*** artery to the spleen, pancreas, and stomach.

15. Below the celiac trunk artery, the next branch of the abdominal aorta is the ***superior mesenteric*** artery, which supplies the small intestine and the upper part of the large intestine.

16. The next branch of the aorta is the last single (unpaired) branch, the ***inferior mesenteric*** artery, which supplies the lower part of the large intestine, in particular the rectum.

ABDOMINAL AORTA, PAIRED BRANCHES

17. The largest branches of the aorta are the paired ***renal*** arteries. These are short arteries, and they are accompanied by veins of the same name. You may also see a small artery branching off of the renal artery and heading for the ***adrenal*** gland.

18. The origin of the ***adrenal*** artery is variable. If you do not find the artery as a branch of the renal artery, look for it as a branch of the aorta. The adrenal gland in the cat is itself somewhat surprising; it does not rest on top of the kidney as it does in humans, but instead is a small hard oval lump of grey tissue lying close to the aorta on the left side of the body or close to the vena cava on the right side of the body. The adrenal gland can often be found more easily by touch than by sight.

19. Below the renal arteries and veins will be a pair of very small (thread like) ***gonadal*** arteries and veins. In a male cat they will head for the inguinal canal. In a female cat they head for the ovary. The ***left gonadal vein*** will most often drain into the ***left renal vein***; the right gonadal vein is attached to the inferior vena cava. These vessels look different (larger and distended with blood) in a pregnant cat.

Optional Procedure:

20. Numerous small paired ***lumbar*** arteries come off of the aorta along its whole length, supplying the muscles of the lumbar region.

PELVIC ARTERIES

21. The aorta in the cat ends in the pelvic region by dividing into three arteries, the paired ***external iliac*** arteries, and the single ***middle sacral*** artery. There are no common iliac arteries in the cat as there are in humans, because in the cat the internal iliac arteries arise from the middle sacral artery, and thus there is no common origin for the internal and external iliac arteries.

22. The ***internal iliac*** arteries (hypogastric arteries) supply the pelvic organs, and among their branches the most interesting is the pair that goes to the bladder. These are called the ***umbilical*** arteries due to the fact that when the individual was a fetus, branches of these arteries extended out of the body in the umbilical cord taking fetal blood to the placenta.

LOWER LIMB ARTERIES

23. The external iliac artery passes into the leg. As soon as it crosses the inguinal ligament into the thigh its name changes to ***femoral*** artery. There is another name change behind the knee where the artery is called the ***popliteal*** artery. Below the knee the artery branches into ***anterior tibial*** artery and ***posterior tibial*** artery.

24. The posterior tibial artery quickly gives off a branch, the ***peroneal*** artery, which supplies the muscles in the lateral compartment of the lower leg. You need not trace the vessels beyond this point.

CHEST & NECK VEINS

25. Locate the ***superior vena cava*** (precava) and ***inferior vena cava*** (postcava) which attach to the right side of the heart and empty blood into the right atrium.

26. The superior vena cava is formed by the jright and left ***brachiocephalic*** (innominate) veins. The superior vena cava also receives blood from the internal mammary veins and the azygos vein.

27. The ***internal mammary veins*** (internal thoracic veins) receive blood from the anterior intercostal veins. In the cat, but not in the human, the two internal mammary veins fuse and enter the superior vena cava as one vessel.

28. The unpaired ***azygos*** vein receives blood from the ***posterior intercostal*** veins, and in turn empties into the superior vena cava. To find the azygos vein lift the right lung and look behind it on the posterior wall of the chest.

29. In the cat the veins of the shoulder and chest region come together somewhat differently than they do in humans. Locate the two major tributaries of the brachiocephalic vein. They are the ***external jugular*** vein and the ***subclavian*** vein. In the cat the external jugular vein is larger than the internal jugular vein, just the reverse of the way it is in humans.

30. Relocate the ***thoracic duct*** on the left side of the chest. Trace it upward into the neck. It will drain into the left subclavian vein at the point where the left external jugular vein is also attached.

31. Look for the ***internal jugular*** vein on the left side of the neck. It may drain into the external jugular or it may join the brachiocephalic vein just medial to the point where the external jugular vein joins.

PAIRED VEINS OF ABDOMEN

34. Trace the inferior vena cava through the diaphragm and behind the liver. Lift the diaphragm, and use a blunt instrument (handle of the scalpel or handle end of the forceps) to scrape away liver tissue near the vena cava. This maneuver will expose some of the ***hepatic*** veins which drain blood from the liver into the inferior vena cava.

35. Locate the paired ***renal*** veins, ***gonadal*** veins, ***adrenal*** veins, and ***lumbar*** veins. These all correspond to the arteries of the same name and were probably identified earlier in your dissection of the arteries.

SINGLE VEINS OF THE ABDOMEN: HEPATIC PORTAL SYSTEM

Note that the veins which correspond to the single branches of the aorta do not join the vena cava.

36. The ***splenic*** vein, ***superior mesenteric*** vein, and ***inferior mesenteric*** vein are the three main tributaries of the ***hepatic portal*** vein. They will not be filled with latex material because they begin and end as capillaries. The latex injected into the jugular vein at the time your specimen was prepared will cannot pass through a capillary bed.

Locate these veins by looking for the accompanying artery of the same name. Though thin walled and flabby, they will be visible because they contain coagulated blood.

37. There are two common patterns by

which the ***inferior mesenteric*** vein may join the portal system. Usually it is a tributary of the superior mesenteric vein, but sometimes it joins the splenic vein.

38. The ***porta hepatis,*** or "gateway to the liver", is the area on the underneath surface of the liver where the lesser omentum is attached and where three major vessels/ ducts enter or leave the liver. These three are described in the following paragraph.

39. The ***hepatic portal vein*** is a short wide vein. It travels with the small greenish brown ***common bile duct,*** and with the ***common hepatic artery.*** The vein is short, wide, and quite fragile. Care should be taken not to tear its walls.

PELVIC CAVITY & LOWER LIMB VEINS

40. In the pelvis, the ***inferior vena cava*** is formed by the junction of the two common iliac veins, and the **middle sacral** vein.

41. The ***common iliac vein*** is formed by two tributaries, the ***internal iliac*** vein bringing blood from the pelvic organs, and the ***external iliac*** vein, bringing blood from the leg.

The deep veins of the leg correspond to the arteries, In addition locate the superficial ***greater saphenous*** vein which empties into the femoral vein in the groin.

MODELS SHOWING BLOOD VESSELS

Use the checklists as a guide for the study of these models.

APPENDIX A

CHECKLISTS

One of the greatest difficulties encountered by any student of anatomy is that the amount of material in the various reference books is so overwhelming that left to himself or herself the student cannot decide what to study and what to leave alone. One of the chief functions of the checklists provided here is that they serve to set boundaries for the student so that he or she will not become bogged down by this familiar dilemma. However, you are expected to know the checklist thoroughly, and you would be well advised to rehearse the list frequently, until you know it's details from memory.

Histology √ list: Review of Assigned Slides

EPITHELIUM REVIEW

On each of the following slides find the epithelium and learn the classification.

SLIDE # 31:
Endothelium (simple squamous epithelium) lining lumen of artery and vein.

SLIDE # 32:
a. Simple squamous epithelium lining Bowman's capsule
b. Simple cuboidal epithelium of kidney tubule wall

SLIDE # 4
Simple cuboidal epithelium

SLIDE # 26:
Simple columnar epithelium

SLIDE # 27:
Simple columnar epithelium

SLIDE # 7:
Simple columnar epithelium

SLIDE # 5:
Simple columnar epithelium

PARCO SLIDE H.1.8
(check out at window). Pseudostratified columnar epithelium with cilia and goblet cells.

SLIDE # 6
Pseudostratified columnar epithelium with cilia and goblet cells.

PARCO SLIDE H.1-11
(check out at window)
Transitional epithelium

SLIDE #3
Nonkeratinized stratified squamous epithelium

SLIDE #2
Keratinized stratified squamous epithelium

CONNECTIVE TISSUE REVIEW

On each of the following slides find the connective tissue listyed and learn the classification.

SLIDE # 10. AREOLAR CONNECTIVE TISSUE
(loose fibrous irregular). Identify:
collagen fiber
elastic fiber
fibrocyte
mast cell

SLIDE # 31:
Find the adipose tissue.

SLIDE # 8
Dense regular collagenous connective tissue. Identify the fibrocytes.

SLIDE # 31
Find the dense regular elastic connective tissue in the wall of the artery.

SLIDE # 3
Find the dense irregular fibrous connective tissue.

SLIDE # 11
Find the reticular connective tissue meshwork.

SLIDE # 13. HYALINE CARTILAGE.
Identify:
matrix
lacunae
chondrocytes

SLIDE # 14. ELASTIC CARTILAGE
Identify:
cartilage
elastic fibers

SLIDE # 16. COMPACT BONE
Identify:
Haversian system
Haversian canal
concentric lamellae
interstitial lamellae
lacunae
canaliculi

SLIDE # 15. DEVELOPING BONE.
Identify:
hyaline cartilage
hypertrophic zone of cartilage spicules of
osteoid material osteocytes
osteoblasts
bone marrow
fat cells
megakaryocytes
periosteum
muscle attached to periosteum

SLIDE # 17. BLOOD SMEAR.
Identify:
RBCs
Thrombocytes
Neutrophil
Lymphocyte
Eosinophil
Monocyte
? basophil

MUSCLE REVIEW

SLIDES # 18, 20, 21
Be able to differentiate between skeletal muscle, smooth muscle and cardiac muscle.

SLIDE # 19. CROSS SECTION OF SKELETAL MUSCLE.
muscle fiber
fascicle
endomysium
perimysium
epimysium
sarcolemma
sarcoplasm

SLIDES # 21, 22 CARDIAC MUSCLE:
intercalated discs

ORGAN ARCHITECTURE REVIEW

SLIDE # 2, SKIN.
Epidermis
- Stratum corneum
- Stratum lucidum
- Stratum granulosum
- Stratum spinosum
- Stratum germinativum

Dermis
Hypodermis
dermal papillae
sudoriferous

SLIDE # 35. SCALP
hair follicles
sebaceous glands
sweat glands.

SLIDE # 31, ARTERY WALL.
Tunica interna (intima)
- endothelium
- internal elastic membrane

Tunica media
- smooth muscle
- external elastic membrane

Tunica Externa
- fibrous connective tissue

PARCO H.1.8 RESPIRATORY TUBE ARCHITECTURE.
Mucosa
- epithelium
- lamina propria

muscularis mucosa
Submucosa
Adventitia

SLIDES 26, 27, 3, 7: DIGESTIVE TUBE ARCHITECTURE.
Mucosa
- epithelium
- lamina propria

muscularis mucosa
Submucosa (fibrous connective tissue)
Muscularis externa
- innermost oblique
- inner circular
- outer longitudinal

Adventitia (fibrous connective tissue)

Digestive System √ lists

CHECKLIST FOR THE CAT

HEAD AND NECK

buccal cavity
labial & lingual frenula
papillae of the tongue
gingiva
hard palate
  transverse rugae
soft palate
parotid salivary gland
submandibular salivary gland
oropharynx
esophagus

PERITONEUM

greater omentum
lesser omentum
visceral peritoneum
parietal peritoneum
peritoneal cavity

STOMACH

greater curvature
lesser curvature
cardiac region
fundus
body
pyloric region
pyloric sphincter
rugae

INTESTINE

duodenum
ileum
caecum
ileocaecal valve
rectum
anus

LIVER, GALL BLADDER, PANCREAS, & DUCTS

ligaments of the liver
  coronary ligament
  falciform ligament
  round ligament (ligamentum teres)
porta hepatis triad
  hepatic artery
  portal vein
  bile duct
gall bladder
cystic bile duct
common bile duct
common hepatic bile duct
right hepatic bile duct
left hepatic bile duct
pancreas
pancreatic duct

CHECKLISTS FOR MODELS

HEAD & NECK MODEL

parotid gland
submandibular (submaxillary) gland
buccal cavity
gingiva
tongue
uvula
esophagus
oropharynx

LIVER MODEL

right lobe
left lobe
quadrate lobe
caudate lobe
coronary ligament
falciform ligament
round ligament (ligamentum teres)
gall bladder
porta hepatis
cystic bile duct
common bile duct
common hepatic bile duct
right hepatic bile duct
left hepatic bile duct
bile canaliculi
hepatic portal vein
common hepatic artery
hepatic veins
inferior vena cava
sinusoids of the liver

PANCREAS MODEL

duodenum
duodenal papilla
plicae circularis
head, body, tail of pancreas
main pancreatic duct (of Wirsung)
accessory pancreatic duct

X-RAYS

STOMACH X-RAYS

greater curvature
lesser curvature
cardiac region
fundus
body
pyloric region
pyloric sphincter
rugae

INTESTINE X-RAYS

duodenum
jejunum
ileum
haustra
taeniae coli
caecum
ileocecal valve
appendix
ascending colon
hepatic flexure
transverse colon
splenic flexure
descending colon
sigmoid colon
rectum
anal canal

Urinary System √ lists

√ LIST FOR THE CAT

perirenal fat
ureters
bladder
urethra
trigone of the bladder
external sphincter (urogenital diaphragm)
urethral meatus
cortex of the kidney
medulla of the kidney
pyramid of the medulla
renal hilum
renal sinus
pelvis of the kidney
renal artery and vein
interlobar a. and v.

SHEEP KIDNEY CHECKLIST

cortex of the kidney
medulla of the kidney
pyramid of the medulla
renal hilum
renal sinus
pelvis of the kidney
ureter
renal artery and vein
interlobar a. and v.
arcuate a. and v.
interlobular a. and v.

MODELS CHECKLISTS

KIDNEY MODELS

cortex of the kidney
medulla of the kidney
medullary pyramids
renal columns
renal hilum
renal sinus
pelvis of the kidney
major calyx
minor calyx
renal artery and vein
interlobar artery and vein
arcuate artery and vein

RENAL LOBULE MODEL

arcuate artery and vein
interlobar artery and vein interlobular artery and vein
afferent arteriole
glomerulus
efferent arteriole
Bowman's capsule
renal corpuscle
proximal convoluted tubule
descending limb of the loop of Henle ascending limb of the loop of Henle distal convoluted tubule
collecting tubule
peritubular capillary plexus

URINARY APPARATUS MODELS

ureters
urethra
bladder
trigone of the bladder
external sphincter (urogenital diaphragm)
internal sphincter

X-RAYS

kidney
renal artery
minor calyx
major calyx
pelvis of the kidney
ureter
bladder
urethra

Reproductive System √ lists

CAT CHECKLISTS

MALE CAT

scrotum
prepuce
testicle
spermatic cord
ductus deferens
external inguinal ring
internal inguinal ring
inguinal canal
prostate gland
urogenital diaphragm (muscle)
bulbourethral glands
epididymis
seminiferous tubules
glans penis
crura of the penis
bulb of the penis
ischiocavernosus muscle
bulbocavernosus muscle
corpora cavernosa
corpus spongiosum
spongy urethra

FEMALE CAT

ovaries
Fallopian tubes
infundibulum
fimbria
uterus, body
uterus, horns
rectouterine pouch
vesicouterine pouch
broad ligament of the uterus
ovarian ligament
urogenital sinus
urethral meatus
os uterus
clitoris

MODELS CHECKLISTS

MALE PELVIS MODEL

testicle
scrotum
epididymis
spermatic cord
cremaster muscle
tunica vaginalis
ductus deferens
testicular artery and vein
inguinal rings and canal
seminal vesicles
prostate
urogenital diaphragm
membranous urethra
prostatic urethra
penis
- corpora cavernosa
- crura of the penis
- ischiocavernosus muscle
- corpus spongiosum
- bulb of the penis
- bulbocavernosus muscle
- spongy urethra
- glans penis
- prepuce

FEMALE PELVIS MODEL

ovaries
round ligament of the ovary
ovarian artery and vein
Fallopian tubes (oviducts; uterine tubes)
- infundibulum
- fimbriae

uterus
- fundus
- body
- cervix
- fornices

round ligament of the uterus
broad ligament of the uterus
rectouterine pouch
vesicouterine pouch
vagina
labia majora
labia minora
vestibule
vulva
clitoris

Respiratory System √ lists

CHECK LIST FOR THE CAT

Nasopharynx
Oropharynx
Laryngopharynx
pharyngeal tonsil
pharyngotympanic orifices (openings of Eustachian tubes)
palatine tonsils
glottis
opening to esophagus
epiglottis
thyroid cartilage
cricoid cartilage
arytenoid cartilages
true vocal cords (folds)
false vocal cords (ventricular folds)
trachea
trachealis muscle
lung lobes
lung apex
base of lung
diaphragmatic surface of lungs
cardiac impression on lung
costal surfaces of lung
parietal pleura
visceral pleura
pleural cavity
costodiaphragmatic recesses

CHECKLISTS FOR MODELS

HEAD & NECK MODEL

NASAL CAVITY

nasal conchae
nasal meatuses
sphenoethmoidal recess
olfactory mucosa
paranasal sinuses

PHARYNX

pharyngeal tonsil
pharyngotympanic orifice
palatine tonsils
esophagus opening
glottis

LARYNX MODELS

epiglottis
thyroid cartilage
cricoid cartilages
arytenoid cartilages
corniculate cartilages
vocal folds (cords)
ventricular folds

CHEST & LUNG MODELS

Trachea & Bronchi
cartilage "rings" of trachea
trachealis muscle or membrane
bifurcation of the trachea
primary bronchi
cartilage plates of the bronchi
Lung
lobes
bronchopulmonary segments
lobules
apex of the lung
base and inferior border of lung
vertebral (posterior) border of lung
anterior border of lung
cardiac notch of left lung
diaphragmatic surface of lung
mediastinal surface of lung
costal surface of lung
hilum and root of lung
cardiac impression on left lung

Heart √ lists

SHEEP HEART CHECKLIST

pericardium
right ventricle
right atrium
left ventricle
left atrium
right auricle
left auricle
superior vena cava
inferior vena cava
coronary sinus
left A-V valve (bicuspid or mitral)
right A-V valve (tricuspid)
interventricular septum
pulmonary trunk
pulmonary arteries
pulmonary veins
aorta
pulmonary semilunar valve
aortic semilunar valve
coronary artery openings inside aorta
papillary muscles
chordae tendineae
musculi pectinati
trabeculae carneae
interatrial septum
fossa ovalis
ligamentum arteriosum

HEART MODEL CHECKLIST

right and left ventricles
light and left atria
right and left auricles
superior vena cava
inferior vena cava
coronary sinus
left A-V valve (bicuspid or mitral)
right A-V valve (tricuspid)
interventricular septum
pulmonary trunk
pulmonary arteries
pulmonary veins
aorta
pulmonary semilunar valve
aortic semilunar valve
right coronary artery
  marginal branch
  posterior interventricular branch
left coronary artery
  circumflex artery
  anterior interventricular artery
great cardiac vein
  (main tributary to coronary sinus)
papillary muscles
chordae tendineae
musculi pectinati
trabeculae carneae
interatrial septum
fossa ovalis
ligamentum arteriosum

Blood Vessel √ lists

CAT VESSELS CHECKLIST

CHEST AREA VESSELS

arch of aorta
pulmonary trunk
superior vena cava (precava)
inferior vena cava (postcava)
brachiocephalic (innominate) a & v
common carotid a.
external jugular v.
subclavian a & v
internal mammary (internal thoracic) a & v
anterior intercostal aa & vv
vertebral a
descending thoracic aorta
thoracic (lymphatic) duct
posterior intercostal aa & vv
azygos v.

UPPER LIMB VESSEIS

subclavian a & v
axillary a
brachial a
radial a
ulnar a

ABDOMINAL VESSELS

celiac trunk a.
hepatic a.
hepatic v.v.
hepatic portal v.
left gastric a.
splenic a & v
superior mesenteric a & v
inferior mesenteric a & v
renal a & v
gonadal a & v

PELVIC VESSEIS

common iliac v.
middle sacral (caudal) a & v
external iliac a & v
internal iliac (hypogastric) a & v

LOWER LIMB VESSEIS

femoral a & v
popliteal a & v
greater saphenous v.
anterior tibial a & v
posterior tibial a & v

CHECK LISTS FOR MODELS

CHEST AREA VESSELS

aorta
brachiocephalic (innominate) a & v
right & left common carotid aa.
subclavian a & v
vertebral a & v
superior vena cava
inferior vena cava
internal jugular vein
external jugular vein

ABDOMINAL VESSELS

celiac trunk a.
hepatic a.
hepatic v.v.
hepatic portal v.
left gastric a.
splenic a & v
superior mesenteric a & v
inferior mesenteric a & v
renal a & v
gonadal arteries
right & left gonadal vein

PELVIC VESSELS

common iliac a.& v.
internal iliac (hypogastric) a & v
external iliac a & v

APPENDIX B

Homework

Histology Homework

THE MICROSCOPE

1. Look up the following terms in your medical dictionary. Note the meaning of the Latin/Greek root, as well as the meaning of the word itself.

ocular

parfocal

2. What power is the ocular lens?

3. What powers are the 3 objective lenses?

4. How do you calculate total magnification. Show an example.

5. What objective lens do you *always* start with.

List two important practical reasons why.

a.

b.

6. How do you recognize the oil immersion lens?

7. Why is the medium power lens called the "high dry" lens?

8. Specify the solvent that are used to clean the slides and lenses with.

9. What material are you permitted to wipe the lenses with?

10. You are not permitted to clean the distal end of the ocular lens. Why not?

TROUBLE SHOOTING PROBLEMS

11. What simple one step procedure will allow you to diagnose that the dirt you are seeing through the microscope is on the ocular lens, not on the objective lens?

12. Problem: You are looking at your specimen under low power, and now you want to look at it under high power. You carefully focus, and then rotate the objectives. The specimen you were looking at is not to be found. Name two things that might be wrong.

13. Problem: You have been looking at your specimen under high power, and now you want to look at it under low power. You rotate the objectives and look again, but can't see your specimen. What might be wrong?

14. You know that you are expected to look at white blood cells with oil immersion. You place the slide on the stage, add a small drop of oil, swing the oil immersion objective into place so that the nose end is in the oil, and look thru the ocular. As you are searching for the correct focal plane you hear the sound of cracking glass. Horror or horrors, the slide is broken. How might this disaster have been prevented?

THE CELL

1. Look up the following terms in your medical dictionary. Take notes on the meaning of the Latin/Greek root, as well as the meaning of the word itself.

phag-

phagocyte

pinocytosis

lysosome

microvillus

cilia

semipermeable

hyper-

hypo-

iso-

transport, active

TISSUE CIASSIFICATION

1. Look up the following terms in your medical dictionary. Take notes on the meaning of the Latin/Greek root, as well as the meaning of the word itself.

intercellular

avascular

epithelium

squamous

pseudo-

stratified

keratin

connective tissue

matrix

reticular

areolar

collagen

hyaline

EMBRYOLOGY

1. Look up the following terms in your medical dictionary. Take notes on the meaning of the Latin/Greek root, as well as the meaning of the word itself.

zygote

morula

blastula

germ layers

diploid

haploid

implantation

endometrium

trophoblast

chorion

chorionic villi

amnion

amniocentesis

placenta

sibling

teratology

anomaly

trimester

perinatology

postpartum

2. Name the tissue types which are derived from each of the germ layers.

3. Name the adult organs which are derived from each germ layer.

4. What is the difference between the words:

embryo

fetus

child?

5. The word teratogenic may not be in your dictionary but teratology is. Make an educated guess as to the meaning of teratogenic.

6. What does the word differentiation mean as it is used in embryology?

EPITHELIUM

1. What is the function of microvilli, and where are they found?

2. What is the name of the glue like layer directly underneath the epithelium?

3. What type of tissue is always found beneath an epithelium?

4. Definethe following words as they apply to the classification of epithelia.

simple

stratified

5. How are simple epithelia further classified?

6. In a stratified squamous epithelia most of the cells are cuboidal in shape. Which ones are flat?

7. What functions are simple squamous epithelia specialized for?

8. What are keratinized epithelia specialized for?

9. Where are stratified squamous non-keratinized epithelia found? Why are they stratified?

10. Where is transitional epithelium found and what is it specialized for?

11. Define endothelium and mesothelium. Where are they found?

12. Draw a diagram of standard respiratory epithelium . Label: basement membrane, goblet cells, cilia, nuclei. Write a sentence or two to accompany your drawing, pointing out verbally the features of the epithelium which make it pseudostratified.

GLANDS

1. Look up the following terms in your medical dictionary. Take notes on the meaning of the Latin/Greek root, as well as the meaning of the word itself.

holo-

apo-

mucosa

mucous membrane

goblet cell

alveolus

cerumen

sudoriferous

sebaceous

2. Describe the sequence of steps by which glands develop from epithelium.

3. Clearly distinguish between exocrine and endocrine glands.

4. What criteria are used to further classify exocrine glands? Name the categories.

5. Compare and contrast the three methods of cellular secretion: apocrine, holocrine, and merocrine. Give an example of each.

6. From the following description, classify the gland: an exocrine gland with a branched duct and many secretory units, some of which are socket shaped, and some of which are long and tubular.

7. List the endocrine glands and where in the body they are found.

CONNECTIVE TISSUE

1. Look up the following terms in your medical dictionary. Take notes on the meaning of the Latin/Greek root, as well as the meaning of the word itself.

lamina as in lamina propria

mesenchyme

pluri-

in vivo

in vitro

anastomosis

proto-

argyrophilic

fixative

fixing

edema

2. Name the three components of all connective tissues:

3. Draw a classification map for ordinary connective tissue, and list examples of each.

4. What does regular/irregular refer to in the classification scheme for connective tissue?

5. Name the three kinds of fibers in connective tissue, and give examples of where each can be found.

6. Name the two kinds of matrix material and give examples of each.

7. What do fibroblasts make? (two items)

8. What is a signet ring cell?

9. What is the reticuloendothelial system? (What is it composed of, where is it found, and what does it do?)

10. What do the granules of mast cells contain?

11. What is passive immunity, and why is it only temporary?

12. What happens to elastic connective tissue during the aging process?

CARTILAGE AND BONE

1. Look up the following terms in your medical dictionary. Take notes on the meaning of the Latin/Greek root, as well as the meaning of the word itself.

chondroblast

chondrocyte

osteoblast

osteocyte

osteoclast

lacuna

canaliculus

2. Draw and label a cross section of an Haversian system, including interstitial lamellae.

3. List some examples of where each of the following can be found:
hyaline cartilage

elastic cartilage

white fibrocartilage

BLOOD

1. Look up the following terms in your medical dictionary. Take notes on the meaning of the L itin/Greek root, as well as the meaning of the word itself.

fibrin

thrombocyte

-penia as in:

thrombocytopenia

thrombus

embolus

megakaryocyte

hemopoiesis

hematocrit

hemoglobin

anemia

erythrocyte

erythropoietin

homozygous

heterozygous

carrier

-phil, as in

eosinophil

eosinophilia

polymorphonuclear

leukocyte

placenta

siblings

leukopenia (leukocytopenia)

2. Look up hemo- . List five similar prefixes (in addition to hemo-) all of which pertain to blood.

3. Why are erythrocytes and thrombocytes not really cells?

4. What is the function of the erythrocytes?

5. What is the function of the platelets?

6. What are the average percentages for the five WBC types in a differential.

7. What is a "shift to the left"? What does it indicate?

8. List the functions of each of the 5 different kinds of WBCS.

9. How long does a RBC live?

How long does a neutrophile live?

How long does a monocyte live?

How long does a platelet live?

10. What is the average number of RBCS? . What is the average number of WBCs?

11. How do most anticoagulants work?

12. Write the three step clotting reaction given in class. Memorize it.

MUSCLE

1. Look up the following terms in your medical dictionary. Take notes on the meaning of the Latin/Greek root, as well as the meaning of the word itself.

myo - as in:

myocardium

myofibril

sarco -, as in:

sarcoplasm

sarcolemma

sarcoma

fascicle

2. Draw a diagram of a sarcomere. Label it.

3. When skeletal muscle contracts:
a. Do the I bands change length? Why/why not?

b. Do the A bands change length? Why/why not?

c. Does the H band change length? Why/ why not?

4. ACh initiates contraction of skeletal muscle. Where does it come from and how does it get inside of the cell?

5. What is the literal translation of "sarcasm".

6. Create a comparison/contrast chart for the three kinds of muscle tissue. Use separate paper.

ORGAN ARCHITECTURE

1. Look up the following terms in your medical dictionary. Take notes on the meaning of the Latin/Greek root, as well as the meaning of the word itself.

tunica

arteriosclerosis

stratum, as in:

stratum germinativum

stratum lucidum

papilla, dermal

keratin

serosa

mesothelium

2. a. Name the three layers of blood vessel walls.

b. Which layer (tunic) does the internal elastic membrane belong to?

c. Which layer (tunic) does the external elastic membrane belong to?

3.a. What **type** of epithelium lines the interior of blood vessel walls?

b. What is the **name** of this epithelium?

4. a. What is the **name** of epithelium on the outer surface of the serosa of the gut tube?

b. What **type** of epithelium is it?

5. How many layers of muscle are there in a mucous membrane. Name them.

6 How many layers of muscle are there in the wall of the trachea? Name them.

7. How many layers of muscle are there in the wall of the stomach? Name them.

8. How many layers of muscle are there in the wall of the intestine? Name them.

Digestive System Homework

1. Find the following terms in a dictionary; notice the root words as well as the term itself, also notice the singular/pleural forms where given.

cecum (caecum)

cholecystectomy

cholecystitis

cholecystolithiasis

chyme

haustra

mesentery

omentum

papilla

parotid

plica

porta

pylorus

raphe (raphae)

ruga

sacculation

taenia (not capitalized)

uvula

vallate

vermiform

2. Diagram a midsagittal view of the relationship of greater omentum to stomach, transverse colon, and peritoneum.

3. What is the function of the greater omentum?

4. Explain the dental formula for an adult and for a child.

5. Name the three different kinds of papillae of the tongue and give their location, abundance, and function.

6. Where is the esophagus in relation to the trachea?

7. Is the so called "cardiac sphincter" an anatomical sphincter? Is there a physiological sphincter here?

8. What kind of epithelium lines the esophagus?

9. Why is there such an abundance of deep mucus glands in the esophageal wall?

10. What is unusual about the muscularis externa of the stomach wall?

11. Draw a sketch of the stomach and label the regions.

12. Compare/contrast the rugae, plicae circulares, and semilunar folds.

13. Name the three kinds of cells in the gastric pits. What does each secrete?

14. Compare/Contrast the functions of the stomach, small intestine, and large intestine.

15. How is surface area maximized in the small intestine?

16. What is the difference between chyme and chyle?

17. What are Peyer's patches? What are they analogous to?

18. Where are Brunner's glands found and what do they secrete?

19. Route blood from a villus of the small intestine, to the heart.

20. Route bile from a liver cell, to the gall bladder, to the duodenum.

21. The hepatic portal system is one of three venous portal systems in the body. Define a portal system.

22. Outline the functions of the liver.

23. Why does the liver bother to produce urea if we just turn around and get rid of it through the kidneys?

24. Draw the duct system of the liver and pancreas in relation to the duodenum.

25. Compare and Contrast "pancreatic tissue proper" and the "Islands of Langerhans".

Urinary System Homework

1. Find the following terms in a dictionary; notice the root words and the pleural forms where given.

arcuate

calyx

convoluted

corpuscle, renal

cortex

filtrate, glomerular

hilum (hilus)

medulla

nephron

pelvis

pelvis, renal

ray, medullary

2. How is the function of the kidney related to protein metabolism (specifically to amino acid catabolism)?

3. Draw a simplified (untangled) diagram of a nephron unit and label the following: glomerulus, afferent arteriole, efferent arteriole, Bowman's capsule, proximal convoluted tubule, loop of Henle, distal convoluted tubule, collecting tubule.

4. Draw and label a sketch of the Renal Portal System, showing: interlobar artery , arcuate artery, interlobular artery and vein, afferent arteriole, glomerulus, efferent arteriole, peritubular capillary plexus.

5. Of the following items which ones are filtered? If filtered, which ones are reabsorbed and where?

Glucose

Water

Salts

Urea

RBCs

Plasma Proteins

6. Define the concepts of tubular reabsorption and reabsorption threshold.

7. For each of the following trace their flow into and out of the kidney, starting with the renal artery:

Glucose

Salts

Water

Urea

RBCs

Plasma Proteins

Reproductive System Homework

PERINEAL ANATOMY

1. Find the following terms in a dictionary; notice the root words and the pleural forms where given.

circumcision

clitoridectomy

clitoris

[illegible]us

corpus cavernosum

corpus spongiosum

crura

erectile tissue

erection

genitalia

homologous

hymen

hypospadia

labia minora

mons veneris

nympha

penis

perineum

prepuce

scrotum

smegma

vestibule

vulva (pudendum)

2. Compare and contrast the female homologues for the following male structures:

testes

scrotum

corpora cavernosa

corpus spongiosum

gubernaculum

3. Draw and label a simple sketch of a cross section of the male penis.

4. The crura of the penis are the proximal ends of the:

5. The glans penis is the distal end of the:

6. The glans clitoris is the distal end of the:

7. The bulb of the vestibule is equivalent to the proximal end of the:

INTERNAL REPRODUCTIVE ORGANS

1. Find the following terms in a dictionary; notice the root words and the pleural forms.

cryptorchidism

ectopic

epididymis

fimbria

fornix

gubernaculum

oophorectomy

orchitis

prostatitis

rete

retroflexion

salpingitis

semen

tunica vaginalis

vesicle

2. List in sequence the sperm cell pathway from the seminiferous tubules to the urethral meatus.

3. Where in the female reproductive tract does fertilization usually take place?

4. What is the endometrium? The myometrium?

5. Approximately what number of sperm cells are contained in an average ejaculation?

6. Why are all of the seminal fluids alkaline?

7. The external sphincter of the urethra (in both male and female) is also known as the?

_____ _____
(two words)

8. What is the difference between the spermatic cord and the ductus deferens.

9. Why does enlargement of the prostate result in difficulty with urination?

10. In terms of the end result, what is the essential difference between mitosis and meiosis?

11. Where precisely are the interstitial cells (cells of Leydig) found and what do they do?

MENSTRUATION

12. Briefly summarize the purpose and major events of the menstrual cycle (pretend as though you are trying to explain it to your own teenage child.

THE FEMALE BREAST

1. List the parts of the breast.

2. Where does lymph drainage from the breast go ?

3. What is the milk let-down reflex, and what hormone causes it?

4. What kind of "priming action" is needed in order to induce milk secretion by the breast? (what hormones and for how long)?

ENDOCRINE CONTROL

1. Find the following terms in a dictionary; notice the root words and the pleural forms.

albicans

antrum

diploid

feedback

follicle, atretic

germinal

gonadotrophic (gonadotropic)

hypophysis (cerebri)

interstitial cells

luteum, corpus

meio -

miosis (meiosis)

menses

mittelschmerz

Sertoli cells

target organ

theca

titer

2. Name three pituitary gonadotropins.

5. Name one gonadotropin that is not from

the pituitary. Where is it made?

6. What hormone causes each of the following events:

ovulation

menstruation

follicle development

endometrial development

voice change

male libido

female libido

secretion of FSH

shut off of FSH

shut off of LH

secretion of LH

testosterone production

7. With reference to hormones, explain the concept of "target organ".

8. How do oral contraceptives work?

9. Diagram the negative feedback loop for estrogen.

10. Diagram the negative feedback loop for progesterone.

11. Fill out the chart on the facing page.

HORMONE NAME	WHERE MADE	TARGET ORGAN	ACTION
Estrogen			
Progesterone			
Testosterone			
FSH			
ICSH			
(LH)			
LTH			
HCG			
FSH-RF			
LH-RF			
Oxytocin			
ADH			
Relaxin			

Respiratory System Homework

1. Look up the following terms in your medical dictionary. Note the meaning of the root word(s) as well as the meaning of the word itself.

alveolus

ambient

aspiration

bifurcate

bronchi

concha

cricoid

glottis

meatus

patent

reflection

sinus

tertiary

vocal folds cords)

2. List the functions of the respiratory system (consider the conduit system as well as the lungs).

3. Describe the function of the following features of standard respiratory epithelium:

a. mucus secretion

b. cilia

4. Name the paranasal sinuses. What are they for?

5. What is the function of the conchae (turbinate bones)?

6. Where are the following recesses located, and what drains into them:

sphenoethmoidal recess

superior meatus

middle meatus

inferior meatus

7. Name the three parts of the throat. Which comes in contact with air only, and which comes in contact with both air and food?

8. What is another name for the adenoids and where are they located?

9. Where are the palatine tonsils located?

10. Explain how an upper respiratory infection can spread to the middle ear.

11. Where is the uvula located?

12. Where is the larynx located in relation to the esophagus, trachea, and laryngopharynx.

13. List the cartilages of the larynx and describe their position relative to one another.

14. How are sounds produced in the larynx, and how do you account for differences in pitch and loudness?

15. On the average the adult male voice is pitched deeper than that of the adult female. When does it change and why (Keep cause and effect clear in your answer).

16. Compare the cartilage of the trachea to the cartilage of the bronchi at various levels.

17. Why is it that aspirated objects are more likely to enter the right side of the respiratory tree?

18. At what vertebral level does bifurcation of the trachea occur?

19. What is the clinical significance of the pleural recesses?

20. Rank order the following in terms of relative size and position: lung, lobules, alveoli, bronchopulmonary segments, alveolar sacs, lobes.

21. What is the surgical significance of a bronchopulmonary segment?

22. What are the effects of the two parts of the autonomic nervous system on the smooth muscle in the walls of the respiratory tree?

23. What is the function of elastic connective tissue in the lung?

24. The macrophages of the lung have a special name. Name them.

25. Pleurisy is painful? What is happening that makes it painful?

26. In a patient with emphysema, what is wrong with the elastic connective tissue, and how does this affect breathing and oxygenation of the blood?

27. In a patient having an asthma attack, what is happening to mucus secretion and to the smooth muscle of the respiratory tree?

28. Name the type of epithelium found in the following parts of the respiratory system:

a. in most of the conduit system

b. in the various regions of the pharynx

c. on both surfaces of the epiglottis

d. on the vocal folds

e. in the alveoli of the lungs.

29. What is the effect of smoking on:

a. the cilia of the respiratory system

b. clearance of mucous and inhaled particles

c. the epithelium of the larynx

d. the elastic tissue around the alveoli

e. the muscle tissue in the arteries

Heart Homework

1. Look up the following words, staying alert for useful roots.

auricle

septum

interatrial

interventricular

cusp, as in tricuspid

vena cava

semilunar

coronary

sinus

coronary sinus

papilla; as in papillary

chorda as in chordae tendineae

pectinate

fossa as in fossa ovalis

patent, as in ductus arteriosus, patent

trabeculae carneae

systole

diastole

sinoatrial

pacemaker

atrioventricular bundle

Purkinje fibers

ischemia

infarct

angina

2. Describe the position of the apex of the heart in the chest cavity. (Where would you put a needle if you wanted to inject directly into the left ventricle?)

3. Name the 3 layers of the heart wall and the 3 layers of the pericardium.

4. Fill in the following chart:

	right heart	left heart
veins		
artery		

5. What structures prevent overclosure of the A-V valves ?

6. Use words and arrows to trace the flow of blood through the heart from right atrium to left ventricle. Name all vessels and valves.

7. Use words and arrows to trace the flow of blood through the coronary circulation. Name only the coronary arteries and veins you have been asked to learn. *Note: the capillary bed of the heart is called the *subendocardial plexus*.

8. List all the parts of the impulse conducting system of the heart in their correct sequence.

9. What changes take place in the fetal heart/ lung system after birth?

10. Use words and arrows to trace the flow of blood through the fetal heart/lung system.

11. What effect does the autonomic nervous system have on the heart?

sympathetic:

parasympatheti

12. Relate the heart sounds to the events of the cardiac cycle by filling out the chart:

	name of cycle stage	which valves are closing	which valves are open
lub:			
dub:			

Blood Vessels Homework

1. Look up the following terms in your medical dictionary. Note the meaning of the root word(s) as well as the meaning of the word itself.

brachiocephalic

innominate

carotic

subclavian

azygos

jugular

circle of Willis

axillary

brachial

cubital

celiac

popliteal

ped -, as in pedis

plantar

2. The only branches from the ascending aorta are the:

3. The common carotid divides into:

4. True or False: There are more arteries than veins in the body.

5. True or False: The superficial neck vein is the external carotid.

6. The azygos vein drains into the

7. The external jugular vein drains into

8. True or False: Hemorrhage from an artery results in a steady (as opposed to pulsating) flow of blood.

9. The subclavian vein drains into the

10. The cephalic vein drains into the

11. The basilic vein drains into the

12. The greater saphenous vein drains into

13. The lesser saphenous vein drains into the

14. How is the portal circulation pattern different from ordinary circulatory patterns?

15. Diagram the main veins of the hepatic portal system.

16. Draw and label the Circle of Willis.

17. Using words and arrows trace blood from the brachiocephalic artery to the intercostal spaces on the light side of the chest and back to the right atrium of the heart.

18. Using words and arrows trace blood from the aortic arch to the left side of the face and back to the right atrium of the heart.

19. Using words and arrows trace blood from the brachiocephalic artery to the middle cerebral artery and back to the right atrium of the heart.

20. Using words and arrows trace blood from the left common carotid to the middle cerebral artery and back to the right atrium of the heart.

21. Using words and arrows trace blood from the brachiocephalic artery to the hand and back to the right atrium of the heart.

22. Using words and arrows trace blood from the aortic arch to the spleen and back to the right atrium of the heart.

23. Using words and arrows trace blood from the aortic arch to the small intestine and back to the right atrium of the heart.

24. Using words and arrows trace blood from the aortic arch to the-sigmoid colon and back to the right atrium of the heart.

25. Using words and arrows trace blood from the bifurcation of the aorta to the rectum and back to the right atrium of the heart.

26. Using words and arrows trace blood from the abdominal aorta to the foot and back to the right atrium of the heart.

Lymphatic System Homework

1. Look up the following terms in your medical dictionary. Note the meaning of the root word(s) as well as the meaning of the word itself.

lymph

edema

osmosis

ascites

cisterna chyli

chyle

metastasis

lacteal

involution

2. Discuss the functions of a lymph node. Mention in your discussion the afferent and efferent vessels, the germinal centers, and the medullary cords and lymphatic sinuses.

3. What are the functions of the spleen? Can you live without it?

4. Where are the greatest concentrations of lymph nodes found?

5. What does elephantiasis (filariasis) have to do with the lymphatic system.

6. Exactly where does the thoracic duct join the cardiovascular system? Where does the the light lymphatic duct join?

7. What part of the body is drained by the

a. right lymphatic duct?

b. thoracic duct?

8. What is the function of the thymus gland?

9. Analyze how the lymphatic system is related to the cardiovascular system.

Angiology Homework

1. Look up the following words, staying alert for useful roots.

venule

arteriole

capillaries, blood

vasoconstriction

vasodilation

anastomosis

sphincter

shunt

collateral circulation

hydrostatic

osmotic pressure

aneurysm

atherosclerosis

thrombophlebitis

2. What is the function of the valves in small veins and in the lymphatics.

3. Do all veins have valves? Explain.

4. What forces cause blood to move from the tissue spaces into the veins, and once it is there how is it kept flowing.

5. Analyze the function of elastic connective tissue in artery walls.

6. Analyze the function of smooth muscle in the walls of the smaller arteries by discussing the distribution (shunting) of blood during emergencies *vs* during digestion.

7. Compare and contrast arteries and veins with particular reference to the numbers of each, their diameter, and anatomy of their walls.

NOTES