NAS 162 Campus Lab

Northern Virginia Community College (Annandale Campus)
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Professor: Dr. Raj Bawa
June 2009

DAY 1

EXERCISE I – Dissection of the Fetal Pig

A. Dissection of the fetal pig respiratory system

Place your pig in a dissecting pan, and obtain a scalpel, scissors, blunt probe, string, plastic bag, and a label. Note that all the pigs have a large incision on the neck made when colored latex was injected into the blood vessels for aid in identifying the arteries and veins.

The goal of dissection is to expose and separate the parts of the systems studied so that they may be clearly seen. They are covered and held in position by layers of connective tissue. This connective tissue must be removed - a process which requires an absolute minimum of cutting. Use instead a blunt probe to separate tissues and a pair of forceps to remove connective tissue.

Examine the external anatomy and determine the sex of your pig following the information given in the Fetal Pig Dissection Guide.

Now follow the instructions for beginning the actual dissection.

For specific directions on the dissection of the respiratory system, follow the instructions, except omit the dissection of the hyoid apparatus. Additionally, do not remove the lungs or learn the names given to the various lobes of the pig lungs since they differ from the human. Be very careful not to damage the blood vessels in the area of the heart.

In addition to the directions in the manual, cut back from the corners of the mouth along the line of the palate, through the rami of the lower jaw, in order to expose the pharynx This should be done to gain an understanding of the relationships between the glottis, epiglottis, hard and soft palate, internal nares, and other pharyngeal structures.

B. Dissection of the fetal pig urinary system

Dissect the urinary system of your fetal pig. Follow instructions in the Fetal Pig Dissection Guide carefully so that damage to the reproductive system does not occur. You may remove one of the kidneys and make a frontal section to observe the internal details.

C. Dissection of the fetal pig circulatory system

Dissect the circulatory system of your fetal pig using the Fetal Pig Dissection Guide as your guide and locate as many vessels as you can.

Fetal Pig (arteries)	**Fetal pig (veins)**
Right & left common carotid	Right & left external jugular
Right & left subclavian	Brachiocephalic
Brachiocephalic (Innominate)	Right & left subclavian
Axillary	Umbilical
Aorta	Anterior & posterior vena cavae
Arch of aorta	Right & left renal
Pulmonary	Right & left common iliac
Ductus arteriosus	Right & left external iliac
Abdominal aorta	
Celiac	
Right & left renal	
Anterior & posterior mesenteric	
Right & left external iliac	
Right & left internal iliac	
Right & left femoral	
Right & left umbilical	

D. Dissection of the fetal pig lymphatic system

On your fetal pig, locate the thymus gland and spleen. As an animal ages, its thymus tends to decrease in size.

E. Dissection of the fetal pig digestive system

Examine and locate digestive system organs and features on the fetal pig following the instructions in the Fetal Pig Dissection Guide.

Cut a small portion of both the large and small intestine from your fetal pig. Open the sections and use a dissecting scope to observe the differences.

F. Dissection of the fetal pig reproductive system

Dissect, identify, and learn the reproductive structures of a male fetal pig. If you have a female, examine a dissected male of another group.

Dissect, identify, and learn the reproductive structures of a female fetal pig. If you have a male, examine a dissected female of another group.

EXERCISE II – Anatomy Models

Study the main anatomical features of organ systems on the models displayed in the lab. Make sure you find and identify all anatomical features dissected in the fetal pig on the organ models.

EXERCISE III – Respiratory Volumes

The total capacity of the lungs is divided into various volumes. It is necessary that you become become familiar with these volumes in order to understand the respiratory process. These volumes are determined by the use of a spirometer. (NOTE: Review *Hole's Anatomy and Physiology* prior to lab)

Each student is to measure or compute the capacities listed below. For use of the lab spirometer, obtain a clean mouthpiece. Insert it into the spirometer hose. Use this mouth-piece for all your determinations. When you have taken all your measurements, dispose of the mouthpiece in the indicated container. Take the required measurements as described. You do not have to reset a dial to zero for our spirometers.

NOTE: You cannot measure inhaled air using this type of spirometer; therefore, calculate the inspiratory reserve volume and inspiratory capacity using the formulas provided.

1. Measure tidal volume (TV)
   Take two or three normal breaths then inhale normally, place the spirometer to your lips and exhale normally into the spirometer. Record the values in table below. Repeat this process two more times. Calculate and record the average TV.

2. Measure expiratory reserve volume (ERV)
   Take two or three normal breaths, then inhale normally and forcefully exhale. Place the spirometer to your lips and exhale as much are as you can. Record values in the table below. Calculate and record the average EVR.

3. Measure vital capacity (VC)
   Take two or three normal breaths, then inhale as much air as possible. Then put the spirometer to your lips and forcefully exhale as much air as you can as fast as you can. Record the value for VC in the Table below. Repeat this process two more times, calculate and record the average VC.

Measurements	Value 1	Value 2	Value 3	Average Value
TV				
ERV				
VC				

4. Compare your VC with the predicted VC value.
   Use the appropriate equation in the table below to calculate your predicted VC, based on your gender and age.

Height in cm = height in inches x 2.5

Your VC _____
Predicted VC _____
Your VC as percentage
of predicted VC _____
(your VC/predicted VC x 100)

Equation for Predicting Vital Capacity

Gender	Age	Equation to Predict Vital Capacity
Female	11-19	VC = (0.0416 x height in cm) – 4.4470 + (0.0699 x age in years)
Female	20-69	VC = (0.0444 x height in cm) – 3.1947 - (0.0169 x age in years)
Female	>69	VC = (0.0313 x height in cm) – 0.1889 - (0.0296 x age in years)
Male	12-24	VC = (0.0590 x height in cm) – 6.8865 + (0.0739 x age in years)
Male	>24	VC = (0.0844 x height in cm) – 8.7818 - (0.0298 x age in years)

Tidal Volume (TV) _____

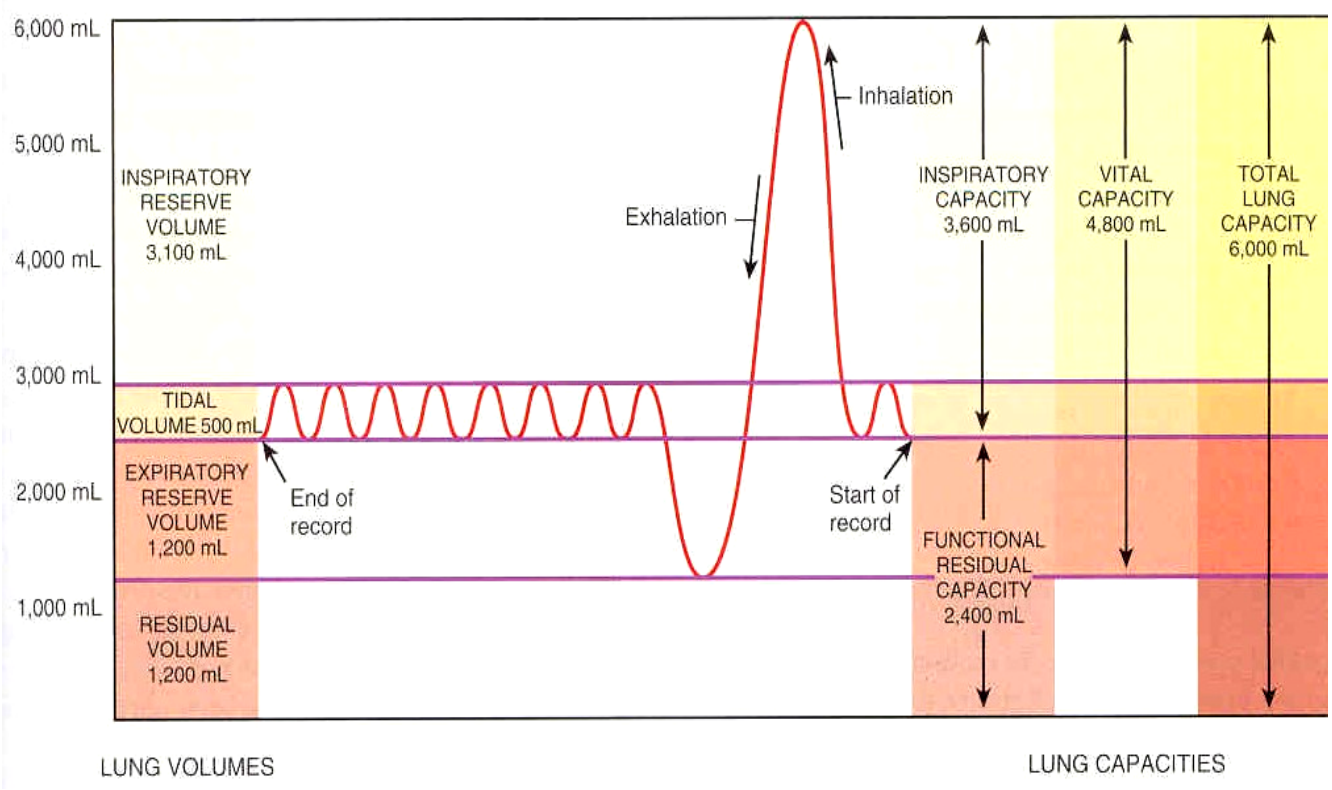
Expiratory Reserve Volume (ERV) _____

Inspiratory Capacity (IC)
IC = VC – ERV _____

Inspiratory Reserve Volume
IRV = VC - (ERV + TV) _____

Residual Volume (RV) 1200 ml. (average)_____

Total Lung Capacity
TLC = VC + RV _____



An analysis of the changes in the size of the body wall associated with the mechanical events of ventilation should aid in understanding the process.

Using a tape measure, record the circumference of the body at the indicated times and body levels.

Type of Respiratory Activity	Axillary	Body Level	
		Xiphoid	Umbilical
Normal inspiration			
Normal expiration			
Maximal inspiration			
Maximal expiration			

Explain the differences in your measurements.

6. Bell jar analogy.

Observe the bell jar demonstration and discuss the analogy to the respiratory system.

To compare your vital capacity to your expected VC:

a. Determine your height in inches or centimeters using the scale at the front of the room.

b. Make a dot on the **nomogram** below in the "height" column that corresponds to your height. Be sure to use the nomogram that corresponds to your sex.

c. Make a dot on the nomogram below in the "age" column that corresponds to your age.

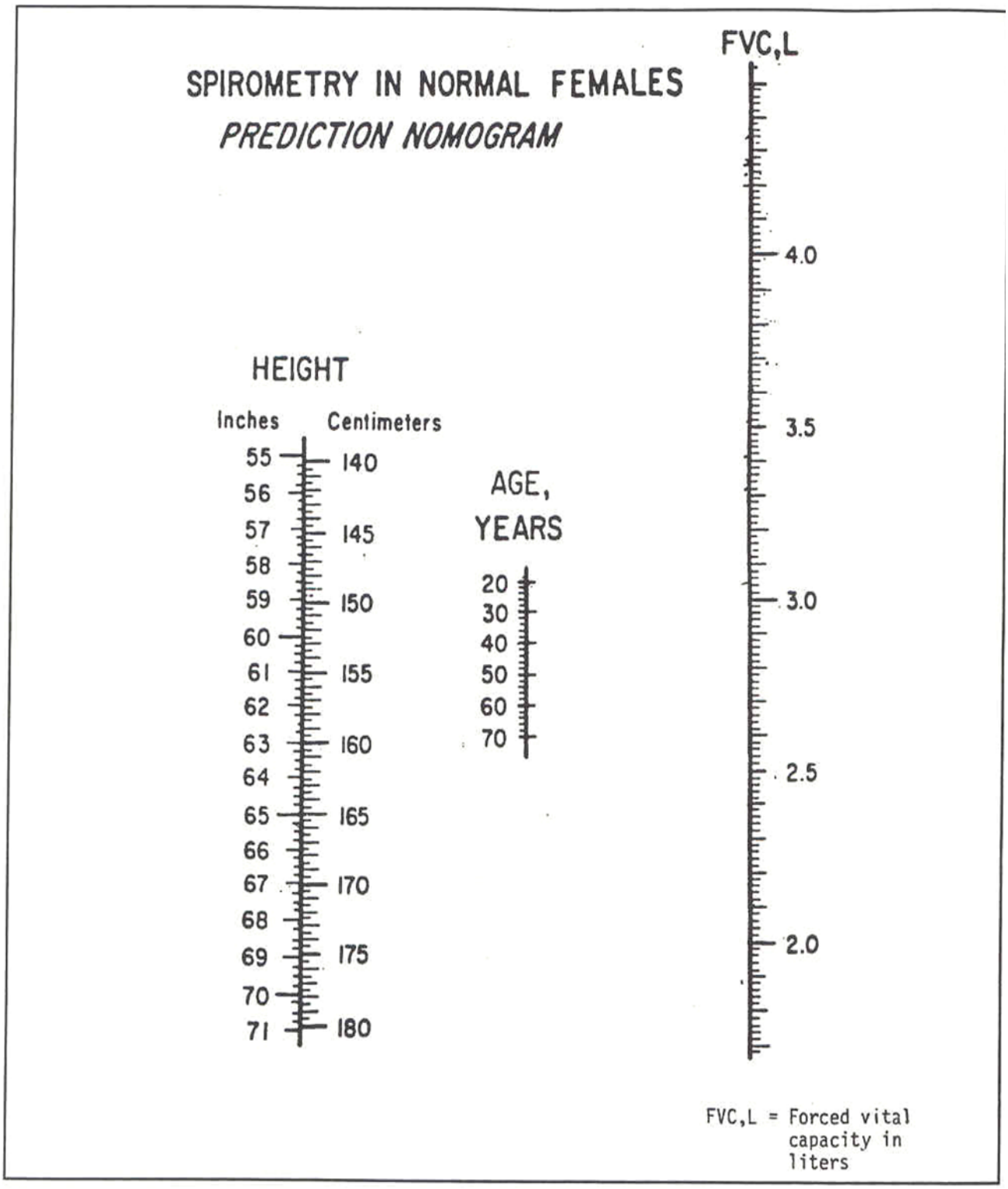
d. Using a ruler, draw a line through those 2 dots and extend it into the VC column.

e. Read your expected vital capacity from this column. Note that these values are in liters.

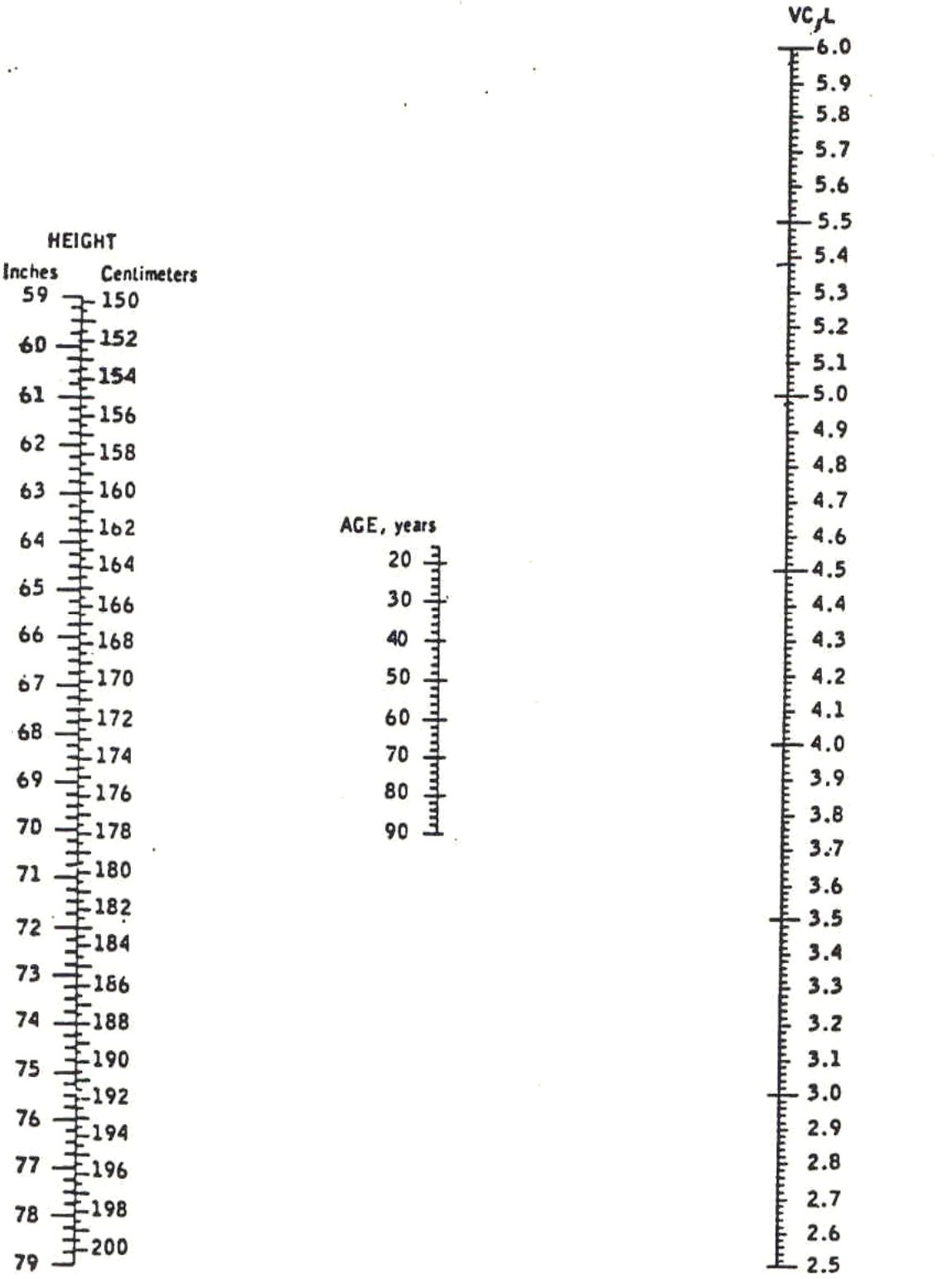
Actual VC in liters: _____

Expected VC in liters: _____

Percentage of expected VC you actually delivered: _____


SPIROMETRY IN NORMAL FEMALES
PREDICTION NOMOGRAM
FVC,L
4.0
3.5
3.0
2.5
2.0
HEIGHT
Inches
Centimeters
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
140
145
150
155
160
165
170
175
180
AGE,
YEARS
20
30
40
50
60
70
FVC,L = Forced vital capacity in liters

Clinical Spirometry in Normal Men
PREDICTION NOMOGRAM



DAY 2

EXERCISE IV – Blood Pressure, Heart Sounds and Pulse

GENERAL OBJECTIVES:

1. Be able to demonstrate the ability to take blood pressure readings by the stethoscope method.
2. Be able to correlate those blood pressure readings with diastolic/systolic pressures and functioning of the heart.
3. Be able to detect the two major heart sounds and discuss the heart action which produces them.
4. Be able to explain the general principles used in electrocardiography.
5. Be able to recognize a normal electrocardiogram relating the features seen to the causative heart activities.
6. Be able to demonstrate the ability to perform the following tests:
   a. A Wright's stained blood smear and recognition of the different blood cell types observed.
   b. A hemoglobin determination using the Tallquist Test.
   c. A coagulation time determination.
   d. ABO and Rh blood typing.
7. Be able to explain the above listed test procedures and relate them to physiological conditions.

INSTRUCTIONS:

Part I – Taking Blood Pressure (stethoscope method)

Review Holes Anatomy and Physiology Blood Pressure pages 590 to 594. Study 15.3 Clinical Application Measurement of Arterial Blood Pressure.

Blood Pressure Measurements

1. Measure resting systemic arterial blood pressure.
   - Work in teams of two, alternating who will be the subject and who will measure blood pressure.
   - The subject should sit and rest for 5 minutes before measuring blood pressure.
   - Place the cuff of the sphygmomanometer around the arm as shown in figure 15F in your textbook. If the cuff does not fit the arm, the blood pressure measurements will probably be inaccurate. The inflatable portion of the cuff should be over the anterior surface of the arm. If there is an arrow on the cuff, place it over the brachial artery. The bottom of the cuff should be approximately one inch above the elbow.
   - Close the valve on the rubber bulb.
   - Place the large bell of the stethoscope over the brachial artery, insert the earpieces, and listen for the brachial pulse. The brachial artery is located in the anterior arm, immediately superior to the antecubital fossa and lateral to biceps brachii.
   - Inflate the cuff to 160-180mm Hg
   - Immediately use the valve on the hand pump to slowly release air to deflate the cuff, and listen for the first sound.

- The first sound, the systolic pressure, is the return of blood flow through the partially occluded brachial artery. Watch the pressure gauge and continue to listen; the sound will increase, then muffle, and stop. The diastolic pressure is the pressure when the last, faint sound is heard.
- Record blood pressure measurements in the table below.
- Deflate cuff and have subject rest for 2 minutes before repeating the blood pressure measurements.

2. Regulation of Blood Pressure
Observe the effect of body position on blood pressure (BP) . Measure BP seated, standing up (after 2 minutes standing), in the supine position (after 2 minutes lying down), and after 5 minutes of exercise (running in place, or running stairs). Record blood pressure measurements in the table below.

Position	**Systolic Pressure/Diastolic Pressure**
Seated	
Seated	
Standing Up	
Reclining	
After Exercise	

3. Compare your seated values with those listed in the Table of Normal Blood Pressure Ranges.

NORMAL BLOOD PRESSURE

Age (years)	**Male**	**Female**
1	96/66	95/65
5	92/62	92/62
10	103/69	103/70
15	112/75	112/76
20-24	123/76	116/72
25-29	125/78	117/74

Age (years)	**Male**	**Female**
30-34	126/79	120/75
40-44	129/81	127/80
50-54	135/83	137/84
60-64	142/85	144/85
70-74	145/82	159/85
80-84	145/82	157/83

4. Questions to answer:

a. How did standing up, reclining, and exercise affect blood pressure?

b. How would you expect sleep to affect blood pressure readings? Why?

c. If the bicuspid valve leaks, what effect would this have on systolic pressure readings? Why?

d. When taking blood pressure, what causes the disappearance of the Korotkoff sounds?

Part II – Heart Sounds

1. Read *Holes Anatomy and Physiology* on heart sounds.

    1. Auscultate Heart Sounds.
        - Obtain a stethoscope and alcohol swabs.
        - Clean the earpieces with the alcohol swab and let air dry
        - Earpieces should be pointed forward when placed in the auditory canal.
        - Gently tap the bell with the earpieces in place as a check before auscultation
        - Auscultation of the aortic valve may be performed on your own chest or that of your partner. Palpate the suprasternal (jugular) notch and then the sternal angle (marks the insertion of the 2nd rib). Now drop down another 1 inch on the sternum form the sternal angle and then move right 1 inch. You should be in the 2nd intercostal space just to the right of the sternum where you can hear. Use the large bell end of the stethoscope.

2. Questions to Answer:

    a. Which of the heart chambers are filling immediately after the first heart sound? Which are emptying?

    b. Which of the heart chambers are filling immediately after you hear the second heart sound? Which are emptying?

    c. Which heart valves are open when you hear the first sound? The second?

    d. What are heart murmurs?

Part III – Electrocardiography (ECG)

NOTE: Review information about the Electrocardiogram (ECG) in *Hole's Anatomy and Physiology.*

1. This portion of the instruction will consist of a demonstration of both electrocardiography and pulse recording.

2. The instructor will use a volunteer to demonstrate the ECG and pulse monitor. (A three lead setup will be used).

3. Questions to answer:

    a. Compare the characteristics of the volunteer's ECG with the standardized, "normal" ECG.

b. What is happening during each of the following?

1. P wave _____
2. QRS complex _____
3. T wave _____

4. Determining Heart Rate Using an ECG.
In an adult, a heart rate of 60-100 beats/min is a normal sinus rhythm (NSR). A heart rate above 100 beats/min is called tachycardia, but in young children, this rate would be considered normal. Heart rates below 60 beats/min are called bradycardia. Neither condition is considered to be pathological. Prolonged tachycardia can develop into fibrillation (rapid uncoordinated heart contractions that do not pump blood).
Heart rate can easily be calculated from an ECG. Standard ECGs are printed on paper moving at a paper speed of 25mm/sec. Therefore, the distance of 1mm (1 small square on standard ECG paper) is equivalent to 0.04 sec.
To calculate heart rate:

1. Measure the distance between the start of one P wave to the start of the next P wave by counting the number of small squares between them.
2. Multiply the number of squares by 0.04 to give the time in seconds for one beat, or sec/beat. This is the length of one cardiac cycle.
3. Since there are 60 seconds in one minute, divide 60 by your answer in step 2.

EXERCISE V –Hematology

1. Before drawing blood, read the information for each blood test below and obtain and/or prepare needed slides, tubes, and other test equipment.

2. Work with your own blood and put all blood contaminated items in the discard container provided. Wear disposable gloves when you handle blood. Disinfect the area when finished.

3. Follow the steps listed for drawing a blood sample.

a. Clean the finger from which the blood sample is to be drawn thoroughly with sterile cotton and 70% alcohol.

b. Remove the sterile lancet from its packaging at the end opposite the point. DO NOT TOUCH THE POINT.

c. Stick the finger with the sterile lancet. Remember, it is necessary to penetrate the epidermis to draw blood.

d. Immediately, place the used lancet in the discard container provided.

e. Obtain blood for the four tests.

f. Clean the finger again with sterile cotton and alcohol.

Blood Handling Safety Procedures:

- When using human or animal blood samples, you must protect yourself from any blood-borne infectious disease (hepatitis, HIV, etc.)
- Wear gloves and safety goggles while performing blood tests.
- Place all blood slides and toothpicks in a biohazardous container according to your instructor's directions.
- Wash tabletops thoroughly with 10% bleach solution at the end of the lab.
- Wash your hands with soap and water before leaving the lab.
- If a blood spill occurs, cover the spill with paper towels soaked in 10% bleach solution and immediately inform your instructor.

Part I - Hemoglobin Determination

1. Use the Tallquist method:
   - After reviewing safety tips on using blood, obtain a blood sample provided by the instructor or your own blood.
   - Place one drop of blood on the absorbent Tallquist paper. Be sure the blood spot is large enough to be seen in all the chart holes simultaneously.
   - Allow blood to dry until it is no longer shiny, but not so dry as to turn brownish. Match its color with the color scale provided.
   - Record the results as grams of hemoglobin/100ml blood in the table below.

2. Questions:

   a. Is the Tallquist method an accurate method of determination of hemoglobin content?

   b. When would it be most useful to use the Tallquist test?

Part II – Coagulation Time

The process of blood clotting or coagulation prevents excessive blood loss. There are many blood clotting factors present in the plasma. Other factors are released by injured tissues and platelets to initiate the chemical chain reaction that forms a blood clot. Fibrin is a long insoluble threadlike protein strand that forms a mesh to trap platelets. Fibrin is formed form soluble fibrinogen molecules during clotting. The coagulation test determines the time it takes for clotting to take place when blood is removed form the body. Normal clotting time is within 2–6 minutes.

1. Observe the demonstration of clotting blood.
   - Your instructor will place animal or sterile human blood into 2 test tubes, one with and one without and anticoagulant.
   - Observe the clot form and settle to the bottom of the tube without anticoagulant. Observe the straw colored serum above the clot.
   - Compare the tube with the blood clot to the blood in the test tube with an anticoagulant.

2. Determine coagulation time.
   - After reviewing safety tips for using blood, obtain a blood sample form your instructor, alcohol swabs, a nonheparinized capillary tube, a lancet, cotton balls, and a small metal file.
   - If using your own blood, use and alcohol swab on a clean finger and prick the finger with a clean, sterile lancet. Have a free flow of blood.
   - Hold the nonheparinized capillary tube at an angle to collect the blood and put the upper end in the drop of blood.
   - Fill the tube a minimum of two-thirds full and record the time started. Time_____
   - Lay the tube on a paper towel.
   - After 30 seconds, scratch the glass with the metal file close to an end of the tube. Holding the tube close to each side of the scratch, gently break the tube away form you.
   - Gently pull the tube apart and observe the blood to see if a fibrin thread is present.
   - Repeat this process every 30 seconds until fibrin occurs. Record the amount of time required for coagulation below.
   - Write results on the board to pool class data. Calculate average coagulation time for your class.

3. Questions:

   a. What is the coagulation time of your blood sample? How does this compare with normal times?

   b. Clinically, why is it important to know a patient's coagulation time?

   c. What effect would a decrease in the amount of circulating platelets have on coagulation time?

Part III – ABO and Rh Blood Typing

NOTE: Review ABO and Rh blood groups in *Hole's Anatomy and Physiology*.

Procedure for Obtaining Blood Sample
- Thoroughly wash hands with soap and dry with a clean paper towel.
- Thoroughly clean the tip of index finger with an alcohol swab.
- Open a new, sterile blood lancet exposing the sharp tip only (or use an Autolet). Lance just to the side of the finger pad with the new lancet. Never reuse a lancet, even your own.
- Deposit the used lancet in the sharps container for biohazardous materials only.
- Wipe away the first drop of blood with a cotton ball and dispose of it in a biohazard waste container. Gently squeeze one drop of blood on each side of a clean prepared slide.

1. Perform ABO blood typing according to the procedure below.
   - Obtain a clean glass slide (test cards if using a typing kit), two new toothpicks, a wax marking pencil, and anti-A and anti-B sera.

- Your instructor will tell you whether you will be using sterile blood, your own blood, or simulated blood.
- Divide the glass slide in half with a wax pencil. Mark A on the left side and B on the right side. Place one drop of anti-A serum on the left side and one drop of anti-B serum on the right side.
- Place one drop of blood on sides A and B of slide. If using your own blood, follow the procedure in above.
- Using *separate* new tooth picks, mix each sample of blood with the corresponding antiserum.
- Results may take up to 2 minutes. Observe each sample for agglutination or the appearance of granulation.
- Record your results below.

2. Perform Rh blood typing according to the procedure below.
   - Obtain a clean glass slide and antiserum D (Rh) and add a drop of blood. If using your own blood, follow the procedure above.
   - Mix the two liquids with a new toothpick.
   - Place the slide on the warm Rh typing box and rock gently to mix. Rh typing requires a higher temperature than ABO typing does.
   - Results may take up to 2 minutes. Observe your sample for clumping or the appearance of granulation.
   - Sometimes it is more difficult to obtain positive results with the anti-Rh serum, depending on the supply and delivery situations.
   - Dispose of blood slides and materials according to your instructor's directions.
   - Record your results below.

3. Questions to Answer:

   a. What is your ABO blood type?

   b. What is the Rh type of your blood?

   c. Is ABO and Rh typing an example of the antigen-antibody reaction? Why?

   d. When is it necessary to know a person's blood type?

Part IV - Blood Smear and Differential Staining

NOTE: Review various types of white blood cells (WBCs) in *Hole's Anatomy and Physiology*.

1. Use a prepared blood slide and identify various WBCs.
   - Complete this activity as a group.

- Take out a microscope and set it up on your lab bench.
- Using a prepared normal blood slide, focus using the low power objective lens and then switch to a higher power objective lens as directed by your instructor.
- Begin at one end of the slide that has good separation of cells and slowly scan systematically, moving the slide down and over, then up and over, and repeat.

2. Questions:

   a. What is the size relationship between RBC's and the various types of WBC's?

   b. What is the significance of an abnormal WBC count?

   c. Draw and label as many different WBC's in your stained smear as you can.

EXERCISE VI – Urinalysis

This section is based on analysis of urine. Since the kidney is involved in maintenance of homeostasis in the body, any divergence from the normal constituents of urine can be of great diagnostic significance. In addition, any evidence of pathology of this organ is also of great importance.

NOTE: Review Urine composition in *Hole's Anatomy and Physiology*.

Procedure:

- Obtain four 100ml beakers and mark them to match the labels on the 4 urine samples.
- Obtain 50 ml from each of the four artificial urine samples and transfer into the appropriate beaker. Record the color and turbidity in the table below.
- Optional: Collect and test your own urine sample. Collect your urine in a specimen container supplied by your instructor.

- Using a urine test strip, measure pH, presence or absence of glucose, albumin, blood and ketone bodies. Urine test strips contain squares of different reagent paper that change color when they contact specific reagents (chemicals). Record the results.
- Handling of reagent strips:
  Use only one reagent strip at a time.
  NEVER touch the reagent area - hold strip by plastic end only.
  KEEP THE BOTTLE TIGHTLY CAPPED after removing a strip. Water from the air, light and contaminants from your hands can decompose the chemicals on the reagent areas.
  Check the expiration date on the bottle. In a clinical situation, never use any material with a passed expiration date.

A. Testing of Sample Urines

1. Three samples are available. Test each urine sample and record your results in the blocks below.

Urine	pH	protein	glucose	ketone	blood	color	transparency
Urine A							
Urine B							
Urine C							

2. Record the results for the same tests on a sample of your urine you obtained in the paper cups provided.

	pH	protein	glucose	ketone	blood	color	transparency
Student							

B. Application of dialysis technique.
Note the dialysis equipment for use during kidney failure.

C. Microscopic examination of urine.

Normal urine is sterile. Urine may contain one or many “formed elements” which must be reported quantitatively.

Microscopic elements in urine include cells, casts, crystals, bacteria, yeast cells, and protozoans.

You will examine a sample of your urine microscopically.

Procedure:

- Shake your urine sample to resuspend any sediment and pour approximately 5 ml into a centrifuge tube. Be sure the centrifuge is balanced with an even number of loaded tubes.
- Centrifuge at 5 for 5 minutes. You should have a white sediment at the bottom of the tube. Pour off the urine carefully. Add a drop of the sedistain and mix.
- Place a drop of the sediment on a clean slide and add a cover slip.
- Examine with a microscope at low magnification first, then a higher power to identify microscopic elements.
- Check if your urine contains any of the elements shown in the next page.
- When you have finished with all the tests, discard your urine directly down the sink and place all disposable materials in the container provided. Wash all glassware with soap and water.

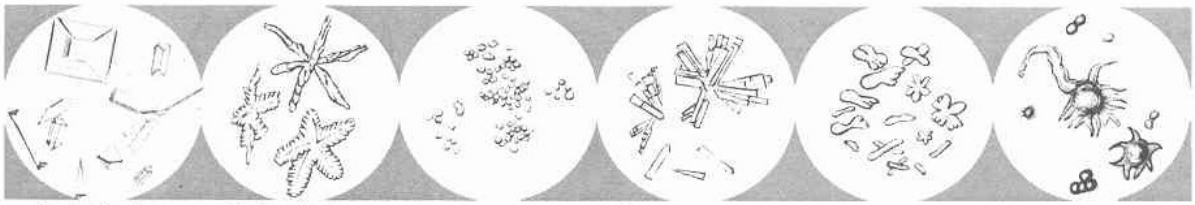
LAB EXAMINATION

*****

CRYSTALS FOUND IN ACID URINE 400 X

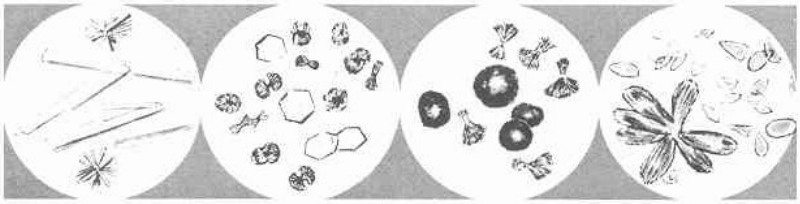
Uric acid | Amorphous urates and uric acid crystals | Hippuric acid | Calcium oxalate | Tyrosine needles Leucine spheroids Cholesterin plates | Cystine

CRYSTALS FOUND IN ALKALINE URINE 400 X



Triple phosphate Ammonium and magnesium | Triple phosphate going in solution | Amorphous phosphate | Calcium phosphate | Calcium carbonate | Ammonium urate

SULFA CRYSTALS



Sulfanilamide | Sulfathiazole | Sulfadiazine | Sulfapyridine

Ames Atlas of Urine Sediment

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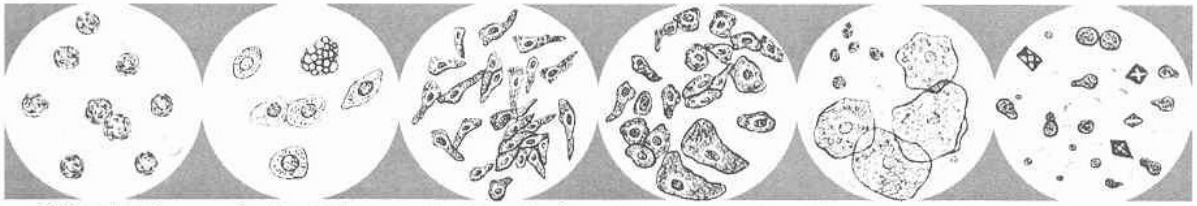
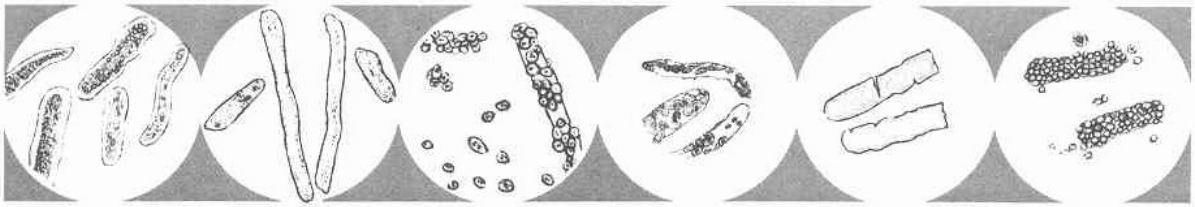
Elkhart, Indiana 46515

CELLS FOUND IN URINE

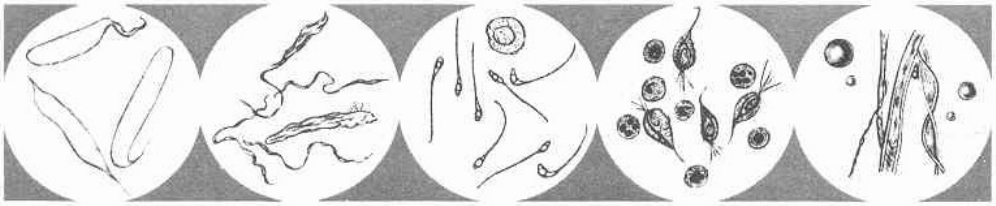


RBC and WBC | Renal epithelium | Caudate cells of Renal Pelvis | Urethral and bladder epithelium | Vaginal epithelium | Yeast and bacteria

CASTS AND ARTIFACTS FOUND IN URINE 400 X



Granular casts fine and coarse | Hyaline cast | Leukocyte cast | Epithelial cast | Waxy cast | Blood cast



Cylindroids | Mucous thread | Spermatozoa | Trichomonas vaginalis | Cloth fibers and bubbles