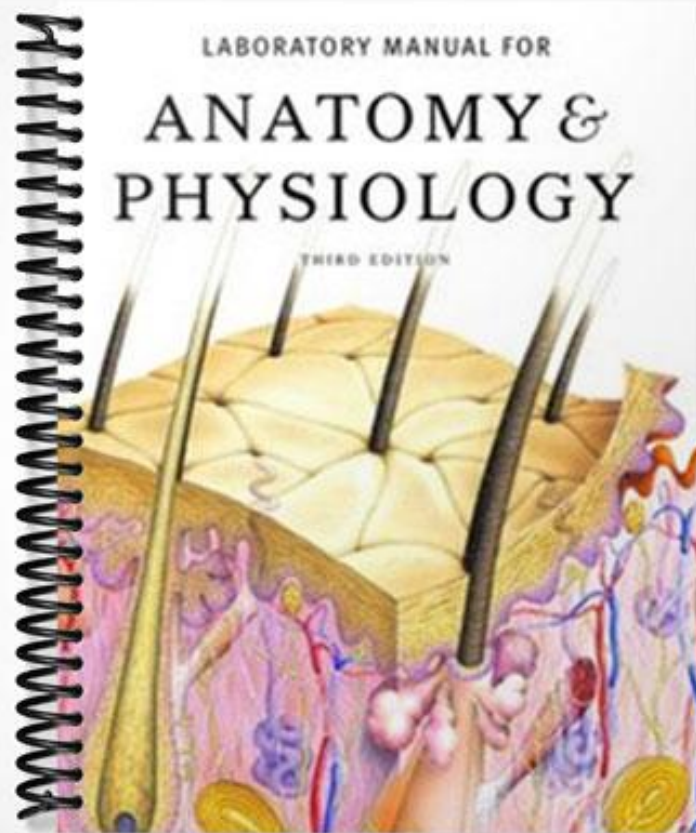


SOLUTIONS MANUAL



Instructor Guide

Anatomy & Physiology Laboratory Manual

Third Edition

ELAINE N. MARIEB, R.N., PH.D.
Holyoke Community College

This Instructor Guide is based upon the
Human Anatomy & Physiology Laboratory Manual
(Main 7/e, Cat 8/e, Fetal Pig 8/e) Instructor Guide,
by Linda Kollett.



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Preface

Organization of this Instructor Guide

The Instructor Guide for the third edition of *Anatomy & Physiology Laboratory Manual* by Elaine N. Marieb features a wealth of information for the anatomy and physiology laboratory instructor.

Each exercise in this manual includes detailed directions for setting up the laboratory, comments on the exercise (including common problems encountered), some additional or alternative activities, and answers to the questions that appear in the text of the lab manual. (Answers to questions regarding student observations and data have not been included.)

Answers to the Review Sheets that are offered in the laboratory manual have been integrated to conveniently follow each exercise. In some cases several acceptable answers have been provided.



The time allotment at the beginning of each exercise, indicated by the hour glass icon, is an estimate of the amount of in-lab time it will take to complete the exercise, unless noted otherwise. If you are using multimedia, add the running time to the time allotted for a given exercise.



Suggested multimedia resources, indicated by the computer icon, are listed for each exercise. Format options include VHS, CD-ROM, and DVD. The resources are also listed by system in Multimedia Resources in Appendix A (page 183) of the guide. Information includes title, distributor, running time, and format. The key to format abbreviations is on the first page of this appendix. A listing of the multimedia resource distributors, along with address and contact information, can be found in Appendix B (page 193). In addition, a list of supply houses is in Appendix C (page 197).



Suggested *InterActive Physiology*[®] modules are listed at the beginning of relevant exercises and included in Multimedia Resources in Appendix A. Students are enabled to understand, rather than memorize, difficult physiological concepts with these detailed interactive animations, puzzles, quizzes, and other tools. Nine major topic areas are covered: Muscular System; Nervous System I: The Neuron—The Action Potential; Nervous System II: Synaptic Potentials and Neurotransmitters; Cardiovascular System; Respiratory System; Urinary System; Fluids, Electrolytes, and Acid/Base Balance; Endocrine System; and Digestive System. Available on CD-ROM and at www.interactivephysiology.com.



Each exercise includes directions for preparing needed solutions, indicated by the test tube icon.

Laboratory Safety

Always establish safety procedures for the laboratory. Students should be given a list of safety procedures at the beginning of each semester and should be asked to locate exits and

safety equipment. Suggested procedures are on page v, along with a student acknowledgment form on page vi. These pages may be copied and given to the students. Signed student acknowledgment forms should be collected by the instructor once the safety procedures have been read and explained and the safety equipment has been located.

Special precautions must be taken for laboratories using body fluids. Students should use only their own fluids or those provided by the instructor. In many cases, suitable alternatives have been suggested. All reusable glass and plasticware should be soaked in 10% bleach solution for 2 hours and then washed with laboratory detergent and autoclaved if possible. Disposable items should be placed in an autoclave bag for 15 minutes at 121°C and 15 pounds of pressure to ensure sterility. After autoclaving, items may be discarded in any disposal facility.

Disposal of dissection materials and preservatives should be arranged according to state regulations. Be advised that regulations vary from state to state. Contact your state Department of Health or Environmental Protection Agency or their counterparts for advice. Keep in mind that many dissection specimens can be ordered in formaldehyde-free preservatives; however, even formaldehyde-free specimens may not be accepted by local landfill organizations.

Anatomy & Physiology

Laboratory Safety Procedures

1. Upon entering the laboratory, locate exits, fire extinguisher, fire blanket, chemical shower, eye wash station, first aid kit, broken glass containers, and cleanup materials for spills.
2. Do not eat, drink, smoke, handle contact lenses, store food, and apply cosmetics or lip balm in the laboratory. Restrain long hair, loose clothing, and dangling jewelry.
3. Students who are pregnant, taking immunosuppressive drugs, or who have any other medical condition (e.g., diabetes, immunological defect) that might necessitate special precautions in the laboratory must inform the instructor immediately.
4. Wearing contact lenses in the laboratory is inadvisable because they do not provide eye protection and may trap material on the surface of the eye. If possible, wear regular eye-glasses instead.
5. Use safety glasses in all experiments involving liquids, aerosols, vapors, and gases.
6. Decontaminate work surfaces at the beginning and end of every laboratory period, using a commercially prepared disinfectant or 10% bleach solution. After labs involving dissection of preserved material, use hot soapy water or disinfectant.
7. Keep liquids away from the edge of the lab bench to help avoid spills. Liquids should be kept away from the edge of lab benches. Clean up spills of viable materials using disinfectant or 10% bleach solution.
8. Properly label glassware and slides.
9. Use mechanical pipetting devices; mouth pipetting is prohibited.
10. Wear disposable gloves when handling blood and other body fluids, mucous membranes, or nonintact skin, and/or when touching items or surfaces soiled with blood or other body fluids. Change gloves between procedures. Wash hands immediately after removing gloves. (Note: cover open cuts or scrapes with a sterile bandage before donning gloves.)
11. Place glassware and plasticware contaminated by blood and other body fluids in a disposable autoclave bag for decontamination by autoclaving or place them directly into a 10% bleach solution before reuse or disposal. Place disposable materials such as gloves, mouthpieces, swabs, and toothpicks that come into contact with body fluids into a disposable autoclave bag, and decontaminate before disposal.
12. To help prevent contamination by needle stick injuries, use only disposable needles and lancets. Do not bend needles and lancets. Needles and lancets should be placed promptly in a labeled puncture-resistant leakproof container and decontaminated, preferably by autoclaving.
13. Do not leave heat sources unattended.
14. Report all spills or accidents, no matter how minor, to the instructor.
15. Never work alone in the laboratory.
16. Remove protective clothing and wash hands before leaving the laboratory.

Laboratory Safety Acknowledgment Sheet

I hereby certify that I have read the safety recommendations provided for the laboratory and have located all of the safety equipment listed in Safety Procedure Number 1 of these procedures.

Student's Name _____

Course _____ Date _____

Instructor's Name _____

Adapted from:

Biosafety in Microbiological and Biomedical Laboratories. 1988. U.S. Government Printing Office, Washington, D.C. 20402.

Centers for Disease Control. 1989. "Guidelines for Prevention of Transmission of Human Immunodeficiency Virus and the Hepatitis B Virus to Health-Care and Public-Safety Workers." *MMWR*: 38 (S6).

———. 1987. "Recommendations for Prevention of HIV Transmission in Health-Care Settings." *MMWR*: 36 (2s).

Johnson, Ted, and Christine Case. 2007. *Laboratory Experiments in Microbiology*, Eighth Edition. San Francisco, CA: Benjamin Cummings Publishing Co.

School Science Laboratories: A Guide to Some Hazardous Substances. 1984. U.S. Consumer Product Safety Commission. Washington, D.C. 20207.

U.S. Department of Health and Human Services Centers for Disease Control and Prevention and National Institutes for Health, Fourth Edition. May 1999. U.S. Government Printing Office. Washington, D.C.
<http://www.cdc.gov/od/ohs/manual/labsfty.htm>.

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The Language of Anatomy

If time is a problem, most of this exercise can be done as an out-of-class assignment.



Time Allotment: (in lab): 1/2 hour.



Multimedia Resources: See Appendix B for a list of multimedia resource distributors.

Systems Working Together (WNS, 15 minutes, VHS)

The Human Body: The Ultimate Machine (CBS, 22 minutes, VHS)

The Incredible Human Machine (CBS, 60 minutes, VHS)

Interactive Atlas of Human Anatomy (ICON, CD-ROM)

Advance Preparation

1. Set out human torso models and have articulated skeletons available.
2. Obtain three preserved kidneys (sheep kidneys work well) and three bananas. Cut one of each in transverse section, one in longitudinal section (usually a sagittal section), and leave one uncut. Label the kidneys and put them in a demonstration area. You may wish to add a fourth kidney to demonstrate a frontal section.
3. The day before the lab, prepare gelatin or Jell-O® using slightly less water than is called for and cook the spaghetti until it is al dente. Pour the gelatin into several small molds and drop several spaghetti strands into each mold. Refrigerate until lab time.
4. Set out gelatin spaghetti molds and scalpel.

Comments and Pitfalls

1. Students will probably have the most trouble understanding proximal and distal; other than that there should be few problems.

Answers to Questions

Activity 3: Practicing Using Correct Anatomical Terminology (p. 3)

1. The wrist is *proximal* to the hand.
2. The trachea (windpipe) is *anterior* or *ventral* to the spine.

3. The brain is *superior* or *cephalad* to the spinal cord.
4. The kidneys are *inferior* or *caudal* to the liver.
5. The nose is *medial* to the cheekbones.
6. The chest is *superior* to the abdomen.

NAME _____

LAB TIME/DATE _____

The Language of Anatomy

Surface Anatomy

1. Match each of the following descriptions with a key term, and record the term in front of the description.

Key: brachial carpal deltoid patellar
 buccal cervical digital scapular

- | | | | |
|-----------------------|-----------------------------|-----------------------|----------------------------|
| <u>buccal</u> _____ | 1. cheek | <u>patellar</u> _____ | 5. anterior aspect of knee |
| <u>digital</u> _____ | 2. referring to the fingers | <u>brachial</u> _____ | 6. referring to the arm |
| <u>scapular</u> _____ | 3. shoulder blade region | <u>deltoid</u> _____ | 7. curve of shoulder |
| <u>carpal</u> _____ | 4. wrist area | <u>cervical</u> _____ | 8. referring to the neck |

Body Orientation, Direction, Planes, and Sections

2. Several incomplete statements are listed below. Correctly complete each statement by choosing the appropriate anatomical term from the key. Record the key terms on the correspondingly numbered blanks below.

Key: anterior inferior posterior superior
 distal lateral proximal transverse
 frontal medial sagittal

In the anatomical position, the umbilicus and knees are on the 1 body surface; the calves and shoulder blades are on the 2 body surface; and the soles of the feet are the most 3 part of the body. The ears are 4 and 4 to the shoulders and 5 to the nose. The breastbone is 6 to the vertebral column (spine) and 7 to the shoulders. The elbow is 8 to the shoulder but 9 to the fingers. The thoracic cavity is 10 to the abdominopelvic cavity and 11 to the spinal cavity. In humans, the ventral surface can also be called the 12 surface; however, in quadruped animals, the ventral surface is the 13 surface.

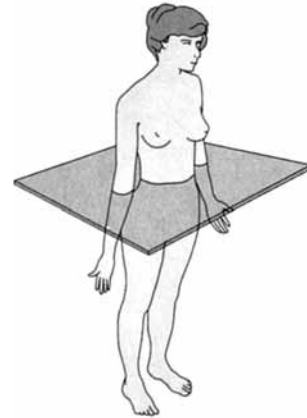
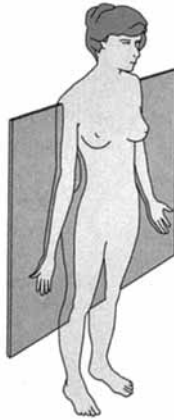
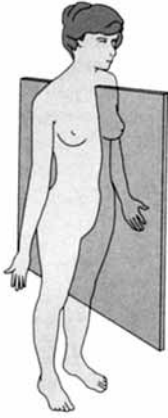
If an incision cuts the brain into superior and inferior parts, the section is a 14 section; but if the brain is cut so that anterior and posterior portions result, the section is a 15 section. You are told to cut a dissection animal along two planes so that the lungs are observable in both sections. The two sections that meet this requirement are the 16 and 17 sections.

- | | | |
|---------------------------|---------------------------|-----------------------------|
| 1. <u>anterior</u> _____ | 6. <u>anterior</u> _____ | 12. <u>anterior</u> _____ |
| 2. <u>posterior</u> _____ | 7. <u>medial</u> _____ | 13. <u>inferior</u> _____ |
| 3. <u>inferior</u> _____ | 8. <u>distal</u> _____ | 14. <u>transverse</u> _____ |
| 4. <u>superior</u> _____ | 9. <u>proximal</u> _____ | 15. <u>frontal</u> _____ |
| <u>medial</u> _____ | 10. <u>superior</u> _____ | 16. <u>transverse</u> _____ |
| 5. <u>lateral</u> _____ | 11. <u>anterior</u> _____ | 17. <u>frontal</u> _____ |

3. A nurse informs you that she is about to give you a shot in the lateral femoral region. What portion of your body should you uncover?

Side of upper thigh

4. Correctly identify each of the body planes by inserting the appropriate term for each on the answer line below the drawing.



1. Median (mid-sagittal) plane

2. Frontal

3. Transverse

Body Cavities

5. Which body cavity would have to be opened for the following types of surgery? (Insert the key term(s) in the same-numbered blank. More than one choice may apply.)

Key: abdominopelvic dorsal thoracic
 cranial spinal ventral

- | | |
|--|----------------------------------|
| 1. surgery to remove a cancerous lung lobe | 1. <u>thoracic/ventral</u> |
| 2. removal of an ovary | 2. <u>abdominopelvic/ventral</u> |
| 3. surgery to remove a ruptured disk | 3. <u>spinal/dorsal</u> |
| 4. appendectomy | 4. <u>abdominopelvic/ventral</u> |
| 5. removal of the gallbladder | 5. <u>abdominopelvic/ventral</u> |

6. Correctly identify each of the described areas of the abdominal surface by inserting the appropriate term in the answer blank preceding the description.

hypochondriac region 1. overlies the lateral aspects of the lower ribs

umbilical region 2. surrounds the "belly button"

hypogastric region 3. encompasses the pubic area

epigastric region 4. medial region overlying the stomach

7. What are the bony landmarks of the abdominopelvic cavity? _____

Rib cage and pelvis

8. Which body cavity affords the least protection to its internal structures? Abdominopelvic cavity

Organ Systems Overview



Time Allotment: 1½ hours (rat dissection—1 hour; human torso model—½ hour).



Multimedia Resources: See Appendix B for a list of multimedia resource distributors.

Homeostasis (FHS, 20 minutes, VHS)

Homeostasis: The Body in Balance (HRM, IM, 26 minutes, VHS, DVD)

The Human Body: The Ultimate Machine (CBS, 27 minutes, VHS)

The Incredible Human Machine (CBS, 60 minutes, VHS)

Organ Systems Working Together (WNS, 14 minutes, VHS)

Advance Preparation

1. Make arrangements for appropriate storage and disposal of dissection materials. Check with the Department of Health or the Department of Environmental Protection, or their counterparts, for state regulations.
2. Designate a disposal container for organic debris, set up a dishwashing area with hot soapy water and sponges, and provide lab disinfectant such as Wavicide-01 (Carolina) for washing down the lab benches.
3. Set out safety glasses and disposable gloves for dissection of freshly killed animals (to protect students from parasites) and for dissection of preserved animals.
4. Decide on the number of students in each dissecting group (a maximum of four is suggested, two is probably best). Each dissecting group should have a dissecting pan, dissecting pins, scissors, blunt probe, forceps, twine, and a preserved or freshly killed rat.
5. Preserved rats are more convenient to use unless small mammal facilities are available. If live rats are used, they may be killed a half hour or so prior to the lab by administering an overdose of ether or chloroform. To do this, remove each rat from its cage and hold it firmly by the skin at the back of its neck. Put the rat in a container with cotton soaked in ether or chloroform. Seal the jar tightly and wait until the rat ceases to breathe.
6. Set out human torso models and a pre-dissected rat.

Comments and Pitfalls

1. Students may be overly enthusiastic when using the scalpel and cut away organs they are supposed to locate and identify. Have blunt probes available as the major dissecting tool and suggest that the scalpel be used to cut only when everyone in the group agrees that the cut is correct.
2. Be sure the lab is well ventilated, and encourage students to take fresh air breaks if the preservative fumes are strong. If the dissection animal will be used only once, it can be rinsed to remove most of the excess preservative.
3. Organic debris may end up in the sinks, clogging the drains. Remind the students to dispose of all dissection materials in the designated container.

Answers to Questions

Activity 6: Examining the Human Torso Model (p. 15)

Digestive: *esophagus, liver, stomach, pancreas, small intestine, large intestine (including rectum)*

Urinary: *kidneys, ureters, bladder*

Cardiovascular: *heart, descending aorta, inferior vena cava*

Endocrine: *thyroid gland, pancreas, adrenal gland*

Reproductive: *none*

Respiratory: *lungs, bronchi, trachea*

Lymphatic: *spleen*

Nervous: *brain, spinal cord, medulla of adrenal gland*

NAME _____

LAB TIME/DATE _____

Organ Systems Overview

1. Using the key choices, indicate the body systems that match the following descriptions. Then, circle the organ systems (in the key) which are present in all subdivisions of the ventral body cavity.

Key: cardiovascular integumentary nervous skeletal
 digestive lymphatic reproductive urinary
 endocrine muscular respiratory

- urinary _____ 1. rids the body of nitrogen-containing wastes
- endocrine _____ 2. is affected by removal of the adrenal gland
- skeletal _____ 3. protects and supports body organs; provides a framework for muscular action
- cardiovascular _____ 4. includes arteries and veins
- endocrine _____ 5. composed of “ductless glands” that secrete hormones
- integumentary _____ 6. external body covering
- lymphatic _____ 7. houses cells involved in body immunity
- digestive _____ 8. breaks down ingested food into its absorbable units
- respiratory _____ 9. loads oxygen into the blood
- cardiovascular/endocrine _____ 10. uses blood as a transport vehicle
- muscular _____ 11. generates body heat and provides for locomotion of the body as a whole
- urinary _____ 12. regulates water and acid-base balance of the blood
- reproductive _____ and endocrine _____ 13. necessary for childbearing
- integumentary _____ 14. is damaged when you fall and scrape your knee

2. Using the above key, choose the *organ system* to which each of the following sets of organs or body structures belongs:

- lymphatic _____ 1. lymph nodes, spleen, lymphatic vessels respiratory _____ 4. trachea, bronchi, alveoli
- skeletal _____ 2. bones, cartilages, ligaments reproductive _____ 5. uterus, ovaries, vagina
- endocrine _____ 3. thyroid, thymus, pituitary cardiovascular _____ 6. arteries, veins, heart

3. Using the key below, place the following organs in their proper body cavity:

Key:	abdominopelvic	cranial	spinal	thoracic
<u>abdominopelvic</u>	1. stomach	<u>abdominopelvic</u>	6. urinary bladder	
<u>thoracic</u>	2. esophagus	<u>thoracic</u>	7. heart	
<u>abdominopelvic</u>	3. large intestine	<u>thoracic</u>	8. trachea	
<u>abdominopelvic</u>	4. liver	<u>cranial</u>	9. brain	
<u>spinal</u>	5. spinal cord	<u>abdominopelvic</u>	10. rectum	

4. Using the organs listed in item 3 above, record, by number, which would be found in the following abdominal regions:

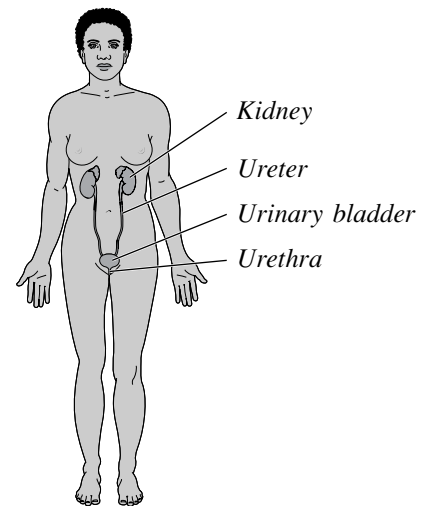
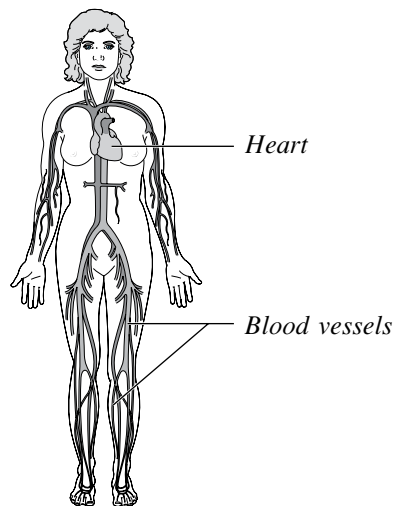
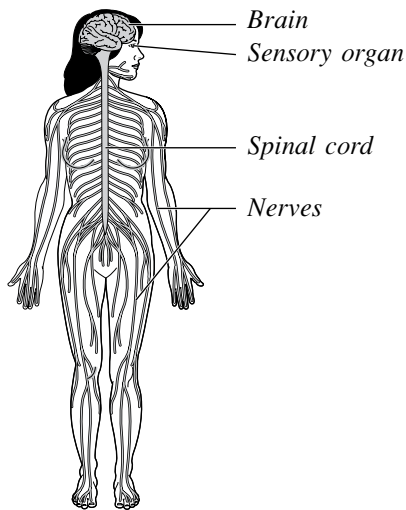
<u>3, 6, 10</u>	1. hypogastric region	<u>1, 4</u>	4. epigastric region
<u>3</u>	2. right lumbar region	<u>3</u>	5. left iliac region
<u>3</u>	3. umbilical region	<u>1</u>	6. left hypochondriac region

5. The five levels of organization of a living body, beginning with the cell, are: cell, tissue, organ, organ system, and organism.

6. Define *organ*: A structure composed of two or more tissues that performs a specialized function

7. Using the terms provided, correctly identify all of the body organs provided with leader lines in the drawings below. Then name the organ systems by entering the name of each on the answer blank below each drawing.

Key:	blood vessels	heart	nerves	spinal cord	urethra
	brain	kidney	sensory organ	ureter	urinary bladder



1. Nervous

2. Cardiovascular

3. Urinary