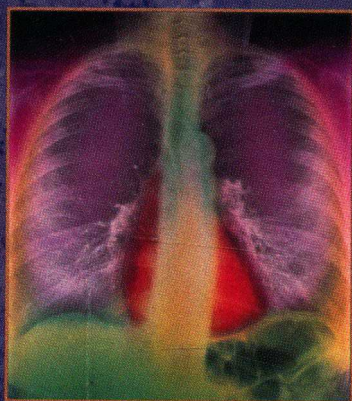


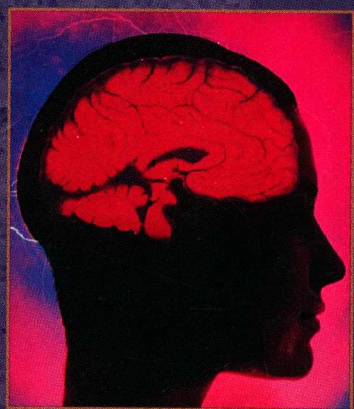
Harold J. Benson

Kathleen P. Talaro



HUMAN anatomy

LABORATORY TEXTBOOK



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fifth edition

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Pasadena City College

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H U M A N a n a t o m y

LABORATORY TEXTBOOK

fifth edition



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Some of the laboratory experiments included in this text may be hazardous if materials are handled improperly or if procedures are conducted incorrectly. Safety precautions are necessary when you are working with chemicals, glass test tubes, hot water baths, sharp instruments, and the like, or for any procedures that generally require caution. Your school may have set regulations regarding safety procedures that your instructor will explain to you. Should you have any problems with materials or procedures, please ask your instructor for help.

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LABORATORY SAFETY PROCEDURES

Due to the fact that certain experiments in this manual utilize a variety of laboratory equipment, hazardous chemicals, and new, unfamiliar procedures, it is apparent that you must be alerted to regulations that will promote safety and laboratory harmony. The following laboratory rules must be observed:

1. Avoid tardiness to class. It is during the first fifteen minutes of the period that your instructor will outline procedures for the session and alert you to any problems that you may encounter.
2. Keep your work area uncluttered at all times. Unnecessary books, lunches, purses, etc., should be stored somewhere other than on your desktop.
3. Always be aware of the incompatibility of electricity and water when using electronic equipment.
4. Keep the open flame of Bunsen burners out of reach of clothing and hair (beards included).
5. Before attempting to use a piece of equipment, be sure you are completely familiar with its controls. Instructions on equipment controls are provided in Part 5. When in doubt ask your instructor.
6. When transferring fluids by pipette use mechanical pipetting devices. Pipetting by mouth is prohibited in this laboratory.
7. When working with chemical agents, avoid skin contact. Certain biologicals such as blood and blood sera in particular, must be avoided. Although biologicals that are extracts from human blood products are manufactured under strict controls, it is still prudent to avoid skin contact.
8. Keep your hands away from your mouth while in the laboratory. Remember to moisten labels with tap water, not your tongue.
9. Sponge down your desktop and wash all laboratory utensils at the end of the period.
10. Return all equipment and glassware to designated storage areas at the end of the period.
11. Before leaving the laboratory at the end of the period, wash your hands with soap and water. If a skin disinfectant is available, use it.

MY SCHEDULE

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
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Preface

The fifth edition of the *Human Anatomy Laboratory Textbook* differs from the previous edition in the following ways: (1) all text has been rewritten to upgrade content, (2) one new exercise has been added, (3) more eponyms have been eliminated, (4) more color has been added where it was needed, (5) several new 4-color illustrations were added, and (6) an Appendix consisting of bar codes for the *Slice of Life* videodisc has been added.

Although the content of this book is essentially the same as the previous edition, the presentation of steps in performing some of the exercises has been considerably improved for clarity. Users of this edition will find more protocol uniformity than existed in previous editions.

The only new exercise in this edition is Exercise 26: The Neuromuscular Junction. The addition of this short exercise helps to fill a gap that existed between the nervous and muscular systems.

Although we eliminated many eponyms in the fourth edition, some were retained since no good substitutes seem to be available at the time of fifth edition publication. There are still a few eponyms in this edition, but they will undoubtedly be reduced in number in subsequent editions.

Five areas that have been upgraded with new illustrations are: The Cell (figure 5.1), Arteries and Veins (figures 33.2 and 33.4), Fetal Circulation (figure 34.1), The Kidney (figure 38.2), and The Reproductive Organs (figures 40.1 and 40.4). Most of these new illustrations have been provided by Brian Evans, master illustrator.

Professors in some institutions that use the *Slice of Life* videodiscs in their instructional programs have requested that bar codes be made available in this manual for student use. A perusal of the appendix will reveal that bar codes for applicable laboratory exercises have been included.

As was true in all previous editions, an Instructor's Handbook is available that provides setup information and time allotments for each exercise. Answers to the questions on the Laboratory Reports are also provided.

A set of 2" × 2" Kodachrome slides related to the Histology Atlas illustrations are still available to users of this fifth edition. A legend explaining the slides is provided in the back of the Instructor's Handbook that is helpful when projecting the slides to groups of students. The slides can be had at no cost by simply contacting the Educational Services department at William C. Brown Publishers.

The changes in this edition are the result of suggestions made by individuals who use the various versions of the Anatomy and Physiology Laboratory Textbook as well as this book. We are indebted to the following who have contributed considerable time and effort to help mold this book into its present form: Thomas M. O'Connor of Washburn University of Topeka, Ralph W. Stevens, III, of Old Dominican University, Frank Veselovsky of South Puget Sound Community College, Paul Yokley, Jr., of the University of North Alabama, Thomas F. Mace of Camosun College, Victoria, British Columbia, Alan F. Posey of the University of Arkansas at Pine Bluff, Buford P. Howard of Somerset Community College, Herbert House of Elon College, Clarence Wolfe of Northern Virginia Community College, and Karen A. Carlberg of Eastern Washington University.

Another group of significant contributors are all the respondents to a survey conducted by Colin H. Wheatley and Jane De Shaw of William C. Brown Publishers. Although we haven't been able to make all the changes requested, most ideas have been incorporated into this edition.

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Introduction

The exercises in this laboratory guide consist, essentially of three kinds of activities: (1) illustration labeling, (2) dissections, and (3) cytological and histological studies. Upon the completion of these assignments, questions on the Laboratory Reports will be answered to test your understanding of the work. The following suggestions should be helpful.

Labeling As you glance through the manual you will note that most of the illustrations are not labeled. To label each illustration it is necessary to read the text in the manual very carefully. You will discover that all significant anatomical structures are printed in **bold type** (occasionally, in *italics*) and are carefully described so that identifying the structures on the illustrations is not difficult. This method of labeling a diagram by reading the text is a learning experience that helps you to remember anatomical minutiae. Incorrectly labeled illustrations usually indicate a lack of comprehension.

Once the illustrations are labeled they can be useful to you in two other ways. First of all, the illustrations are often used for reference purposes in dissections or examinations of anatomical specimens. This is particularly true in the skeletal and nervous systems. Second, the illustrations can be used for review purposes. If the number legends of the labels are covered over as you mentally attempt to name the structures on the illustration, you can easily determine your level of understanding. Periodic reviews of this type during the semester will be very helpful.

In general, the labeling of illustrations will usually be performed *prior* to coming to the laboratory. In this way the laboratory time will be used primarily for dissections and microscopic examinations.

Dissections Once the illustrations of an exercise are labeled, the next step is to study the organs of a system on a cadaver or other animal. Although cadavers are obviously best, the cat has been selected because of its availability and similarity to human

anatomy. In many instances fresh organs, such as lungs, kidneys, and hearts, from other animals are also dissected. When doing a dissection, you will be expected to find specific structures . . . often the same ones labeled on the illustrations.

Histological Studies Unless cytological and histological studies are made of the various organs of the body, complete anatomical understanding cannot occur. The realization that all organs function at the cellular level makes microscopic anatomy the basis of all subsequent physiological study.

For assistance in performing histological studies, become familiar with the Histology Atlas that can be found between pages 168 and 205 (note colored edges of these pages). If histology drawings are required by your instructor, execute them with care and label the significant structures.

Laboratory Reports These sheets, which are located at the back of the manual, are used to evaluate your understanding of each exercise. On these sheets you will record the labels for each illustration and answer questions pertaining to dissections or the text. Approximately one week after the dissections are completed in the laboratory, the Reports will be collected, graded, and returned to you.

Since these record sheets are located at the back of the manual, *it is recommended that they be removed from the binding as soon as you begin to record information.* Trying to shift from the front of the book to the back is very inconvenient and time-consuming. It is also recommended that the torn perforations along the binding edge of each sheet be trimmed with a pair of scissors prior to handing in. These ragged edges make handling of the sheets very difficult. Any drawings that are made on separate paper should be handed in at the same time.

Once these Laboratory Reports are corrected and returned to you, it will be possible for you to correct the illustrations and determine how well you understand the specific unit. You will also be able to use these sheets for review purposes when studying for tests.

Introduction

Independent Study This laboratory manual is only a tool intended to help you learn human anatomy. It can only be of value to you if you are willing to work with it. If, by yourself, you struggle through the problems it presents, you will learn this material. The easier route of letting someone else

solve the problems may satisfy the requirement of getting the Laboratory Report completed on time, but it will do you little benefit at examination time. You are taking this course to learn anatomy, no one else can learn it for you.

Some of the laboratory experiments included in this text may be hazardous if materials are handled improperly or if procedures are conducted incorrectly. Safety precautions are necessary when you are working with chemicals, glass test tubes, hot water baths, sharp instruments, and the like, or for any procedures that generally require caution. Your school may have set regulations regarding safety procedures that your instructor will explain to you. Should you have any problems with materials or procedures, please ask your instructor for help.

Contents

Preface	v
Introduction	vii

PART 1

SOME FUNDAMENTALS

1. Anatomical Terminology	2
2. Body Cavities and Membranes	6
3. Organ Systems: Rat Dissection	9

PART 2

CELLS AND TISSUES

4. Microscopy	20
5. Basic Cell Structure	26
6. Mitosis	32
7. Epithelial Tissues	34
8. Connective Tissues	38
9. The Integument	44

PART 3

THE SKELETAL SYSTEM

10. The Skeletal Plan	48
11. The Skull	52
12. The Vertebral Column and Thorax	62
13. The Appendicular Skeleton	67
14. Articulations	73

PART 4

THE MAJOR SKELETAL MUSCLES

15. Muscle Tissue	78
16. Muscle Structure	80
17. Body Movements	82
18. Cat Dissection: Skin Removal	84
19. Head and Neck Muscles	86
20. Trunk and Shoulder Muscles	93
21. Upper Extremity Muscles:	102
22. Abdominal, Pelvic, and Intercostal Muscles	108
23. Lower Extremity Muscles	111

PART 5

THE NERVOUS SYSTEM

24. Nerve Tissue	122
25. The Spinal Cord, Spinal Nerves, and Reflex Arcs	128
26. The Neuromuscular Junction	134
27. Brain Anatomy: External	137
28. Brain Anatomy: Internal	150
29. The Eye	155
30. The Ear	163

THE HISTOLOGY ATLAS HA-1 to HA-36

PART 6

METABOLIC SUPPORT

31. The Blood	206
32. The Heart	210
33. The Arteries and Veins	217
34. Fetal Circulation	230
35. The Lymphatic System and the Immune Response	232
36. The Respiratory System	236
37. Anatomy of the Digestive System	244
38. The Urinary System	256

PART 7

THE ENDOCRINE AND REPRODUCTIVE SYSTEMS

39. The Endocrine Glands	263
40. The Reproductive System	276

Laboratory Reports	287
Appendix: <i>Slice of Life</i> Videodisc Directory	363
Index	373

Some Fundamentals

This unit, which consists of only three exercises, attempts to accomplish two things: (1) to equip you with some of the basic anatomical terminology that you will need to get started, and (2) to present an overview of the systems and organs of the body that are going to be studied in greater detail as we progress through the book.

When you start Exercise 1 scan the entire exercise before attempting to label any of the illustrations. Note that the first two pages consist of descriptive terminology, followed by an *Assignment*, which describes what you are to label. This, in turn, is followed by additional descriptive text, and another *Assignment* on page 5. After all the illustrations in the exercise have been labeled, you will transfer the label numbers from the legends of each illustration to the *Laboratory Report* sheet, which is located in the back of the manual beginning on page 287. Once the *Laboratory Report* is completed, it can be turned in to your instructor for evaluation, or self-graded if a key is made available.

Anatomical Terminology

Anatomical description would be extremely difficult without specific terminology. A consensus prevails among many students that anatomists synthesize multisyllabic words in a determined conspiracy to harass the beginner's already overburdened mind. Naturally, nothing could be further from the truth.

Scientific terminology is created out of necessity. It functions as a precise tool which allows us to say a great deal with a minimum of words. Conciseness in scientific discussion not only saves time, but it promotes clarity of understanding as well.

Most of the exercises in this laboratory manual employ the terms defined in this exercise. They are used liberally to help you to locate structures that are to be identified on the illustrations. If you do not know the exact meanings of these words, obviously you will be unable to complete the required assignments. Before you attempt to label any of the illustrations in this exercise, read over the text material first.

RELATIVE POSITIONS

Descriptive positioning of one structure with respect to another is accomplished with the following pairs of words. Their Latin or Greek derivations are provided to help you understand their meanings.

Superior and Inferior These two words are used to denote vertical levels of position. The Latin word *super* means *above*; thus, a structure that is located above another one is said to be superior. Example: The nose is *superior* to the mouth.

The Latin word *inferus* means *below* or *low*; thus, an inferior structure is one that is below or under some other structure. Example: The mouth is *inferior* to the nose.

Anterior and Posterior Fore and aft positioning of structures are described with these two terms. The word *anterior* is derived from the Latin, *ante*, meaning *before*. A structure that is

anterior to another one is in front of it. Example: Bicuspids are *anterior* to molars.

Anterior surfaces are the most forward surfaces of the body. The front portions of the face, chest, and abdomen are anterior surfaces.

Posterior is derived from the Latin *posterus*, which means *following*. The term is the opposite of anterior. Example: The molars are *posterior* to the bicuspids.

When these two terms are applied to the surfaces of the hand and arm, it is assumed that the body is in the *anatomic position*, which is as shown in figures 1.1 and 1.2. In the anatomic position the palms of the hands face forward.

Cranial and Caudal When describing the location of structures of four-legged animals, these terms are often used in place of anterior and posterior. Since the word *cranial* pertains to the skull (Greek: *kranion*, skull), it may be used in place of anterior. The word *caudal* (Latin: *cauda*, tail) may be used in place of posterior.

Dorsal and Ventral These terms, as used in comparative anatomy of animals, assume all animals, including man, to be walking on all fours. The dorsal surfaces are thought of as *upper* surfaces, and the ventral surfaces as *underneath* surfaces.

The word *dorsal* (Latin: *dorsum*, back) not only applies to the back of the trunk of the body, but may also be used in describing the back of the head and the back of the hand.

Standing in a normal posture, man's dorsal surfaces become posterior. A four-legged animal's back, on the other hand, occupies a superior position.

The word *ventral* (Latin: *venter*, belly) generally pertains to the abdominal and chest surfaces. However, the underneath surfaces of the head and feet of four-legged animals are also often referred to as ventral surfaces. Likewise, the palm of the hand may also be referred to as being ventral.

Proximal and Distal These terms are used to describe parts of a structure with respect to its point of attachment to some other structure. In the case of the arm or leg, the point of reference is where the limb is attached to the trunk of the body. In the case of a finger, the point of reference is where it is attached to the palm of the hand.

Proximal (Latin: *proximus*, nearest) refers to that part of the limb nearest to the point of attachment. Example: The upper arm is the *proximal* portion of the arm.

Distal (Latin: *distare*, to stand apart) means just the opposite of proximal. Anatomically, the distal portion of a limb or other part of the body is that portion that is most remote from the point of reference (attachment). Example: The hand is *distal* to the arm.

Medial and Lateral These two terms are used to describe surface relationships with respect to the median line of the body. The *median line* is an imaginary line on a plane that divides the body into right and left halves.

The term *medial* (Latin: *medius*, middle) is applied to surfaces of structures that are closest to the median line. The medial surface of the arm, for example, is the surface next to the body because it is closest to the median line.

As applied to the appendages, the term *lateral* is the opposite of medial. The Latin derivation of this word is *lateralis*, which pertains to *side*. The lateral surface of the arm is the outer surface, or that surface farthest away from the median line. The sides of the head are said to be lateral surfaces.

BODY SECTIONS

To observe the structure and relative positions of internal organs it is necessary to view them in sections that have been cut through the body. Considering the body as a whole, there are only three planes to identify. Figure 1.1 shows these sections.

Sagittal Sections A section parallel to the long axis of the body (longitudinal section) that divides the body into right and left sides is a *sagittal section*. If such a section divides the body into equal halves, as in figure 1.1, it is said to be a *midsagittal section*.

Frontal Section A longitudinal section that divides the body into front and back portions is a *frontal* or *coronal* section. The other longitudinal section seen in figure 1.1 is of this type.

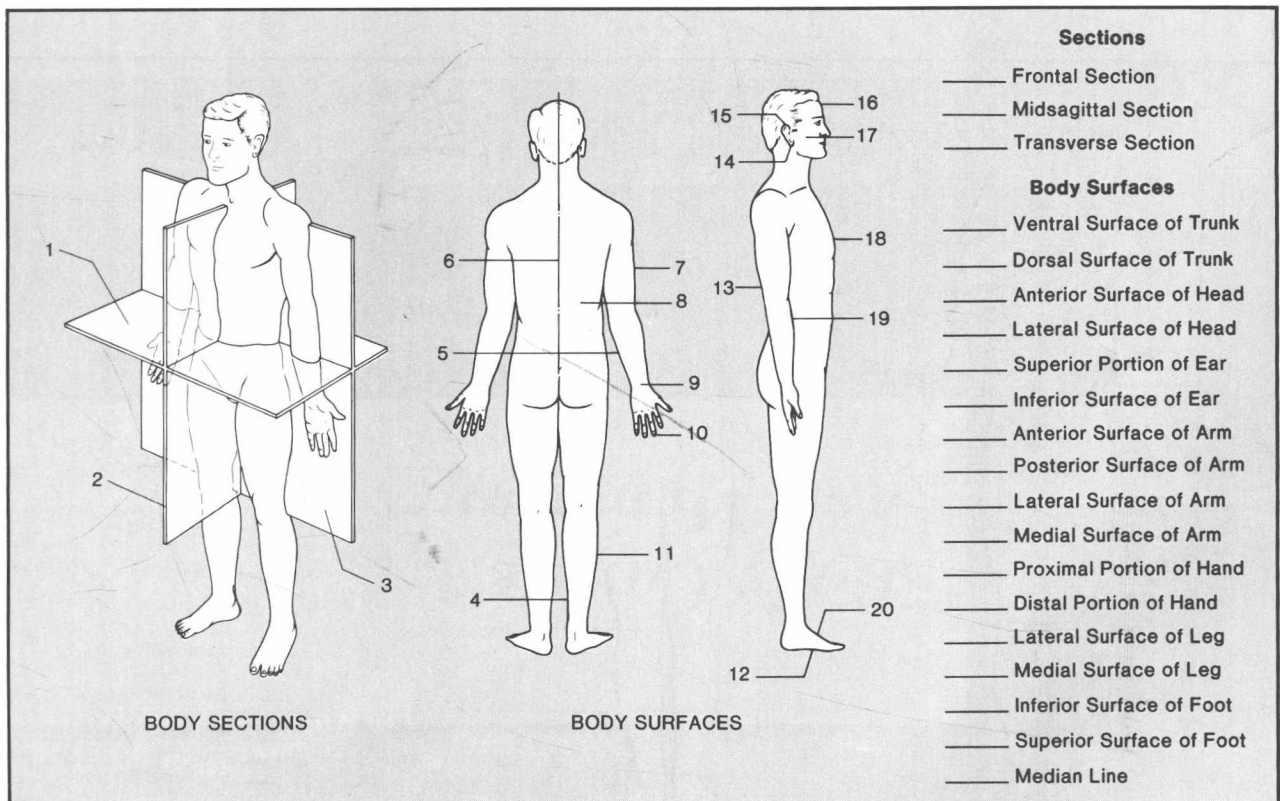


Figure 1.1 Body sections and surfaces.

Transverse Sections Any section that cuts through the body in a direction that is perpendicular to the long axis is a *transverse* or *cross section*. This is the third section shown in figure 1.1. In this case it is parallel to the ground.

Although these sections have been described here only in relationship to the body as a whole, they can be used on individual organs such as the arm, finger, or tooth.

Assignment:

To test your understanding of the above descriptive terminology, identify the labels in figure 1.1 by placing the correct numbers in front of the terms to the right of the illustrations. Also, record these numbers on the Laboratory Report.

REGIONAL TERMINOLOGY

Various terms such as *flank*, *groin*, *brachium*, and *hypochondriac* have been applied to specific regions of the body to facilitate localization. Figures 1.2 and 1.3 pertain to some of the more predominantly used terminology.

Trunk

The anterior surface of the trunk may be subdivided into two pectoral, two groin, and the abdominal

regions. The upper chest region may be designated as **pectoral** or **mammary** regions. The anterior trunk region not covered by the ribs is the **abdominal** region. The depressed area where the thigh of the leg meets the abdomen is the **groin**.

The posterior surface or dorsum of the trunk can be differentiated into the costal, lumbar, and buttocks regions. The **costal** (Latin: *costa*, rib) portion is the part of the dorsum that lies over the rib cage. The lower back region between the ribs and hips is the **lumbar** or **loin** region. The **buttocks** are the rounded eminences of the rump formed by the gluteal muscles; this is also called the **gluteal** region.

The side of the trunk that adjoins the lumbar region is called the **flank**. The armpit region that is between the trunk and arm is the **axilla**.

Upper Extremities

To differentiate the parts of the upper extremities, the term **brachium** is used for the upper arm and **antebrachium** for the forearm (between the elbow and wrist). The elbow area on the posterior surface of the arm is the **cubital** area. That area on the opposite side of the elbow is the **antecubital area**. It is also correct to refer to the entire anterior surface of the antebrachium as being antecubital.

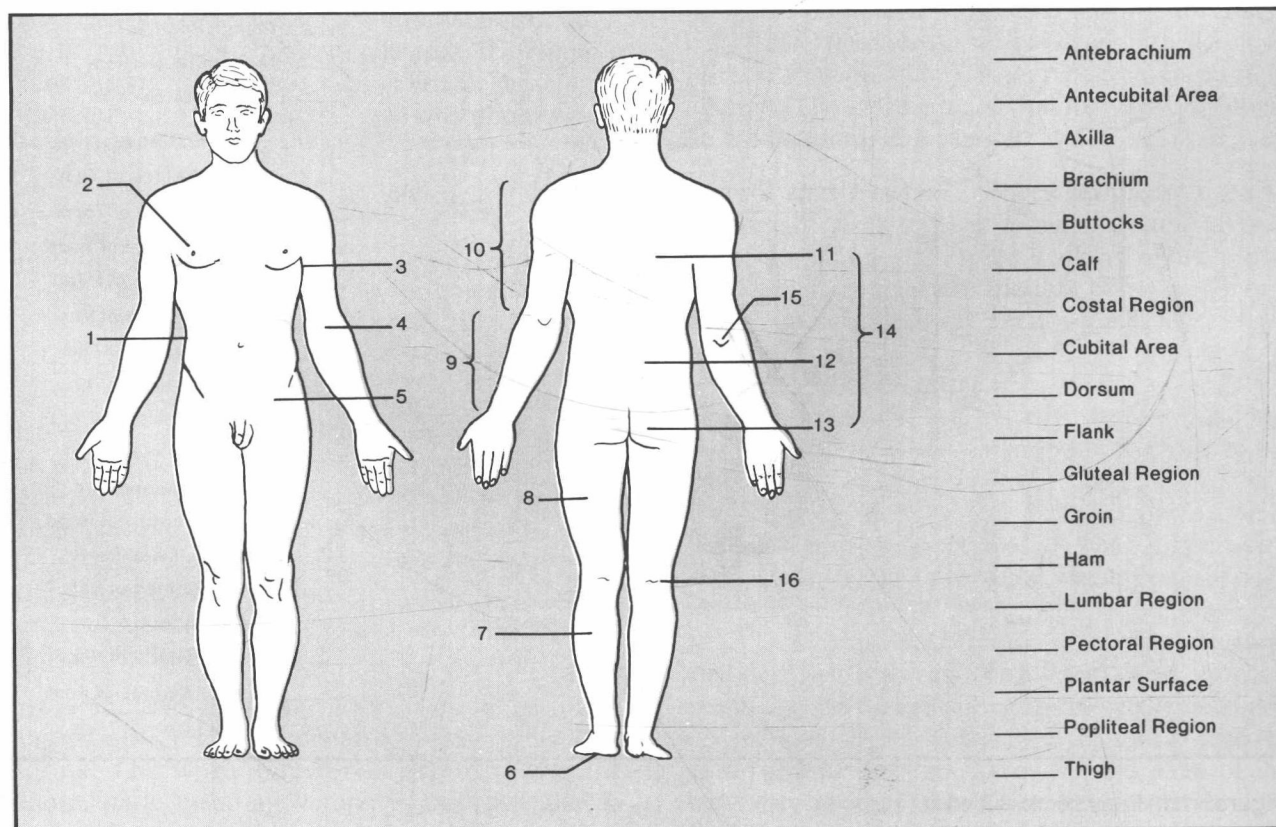


Figure 1.2 Regional terminology.

Lower Extremities

The upper portion of the leg is designated as the **thigh**, and the lower fleshy posterior portion is called the **calf**. Between the thigh and calf on the posterior surface, opposite to the knee, is a depression called the **ham** or **popliteal** region. The sole of the foot is the **plantar** surface.

Abdominal Divisions

The abdominal surface may be divided into quadrants or into nine distinct areas. To divide the abdomen into nine regions one must establish four imaginary planes: two that are horizontal and two that are vertical. These planes and areas are shown in figure 1.3. The **transpyloric plane** is the upper horizontal plane which would pass through the lower portion of the stomach (pyloric portion). The **transtuberular plane** is the other horizontal plane that touches the top surfaces of the hipbones (iliac crests). The two vertical planes or **right** and **left lateral planes**, are approximately halfway between the midsagittal plane and the crests of the hips.

The above planes describe the umbilical, epigastric, hypogastric, hypochondriac, and lumbar regions. The **umbilical** area lies in the center, includes the navel, and is bordered by the two horizontal and two vertical planes. Immediately above the umbilical area is the **epigastric**, which covers much of the stomach. Below the umbilical zone is the **hypogastric**, or *pubic area*. On each side of the epigastric are a right and left **hypochondriac** area, and beneath the hypochondriac areas are the right and left **lumbar** areas. (Note that although we tend to think of only the lower back as being the lumbar region, we see here that it extends around to the anterior surface as well.)

Assignment:

Label figures 1.2 and 1.3 and transfer these numbers to the Laboratory Report.

LABORATORY REPORT

After transferring all the labels from figures 1.1 through 1.3 to the proper columns on Laboratory Report 1,2, answer the questions that pertain to this exercise.

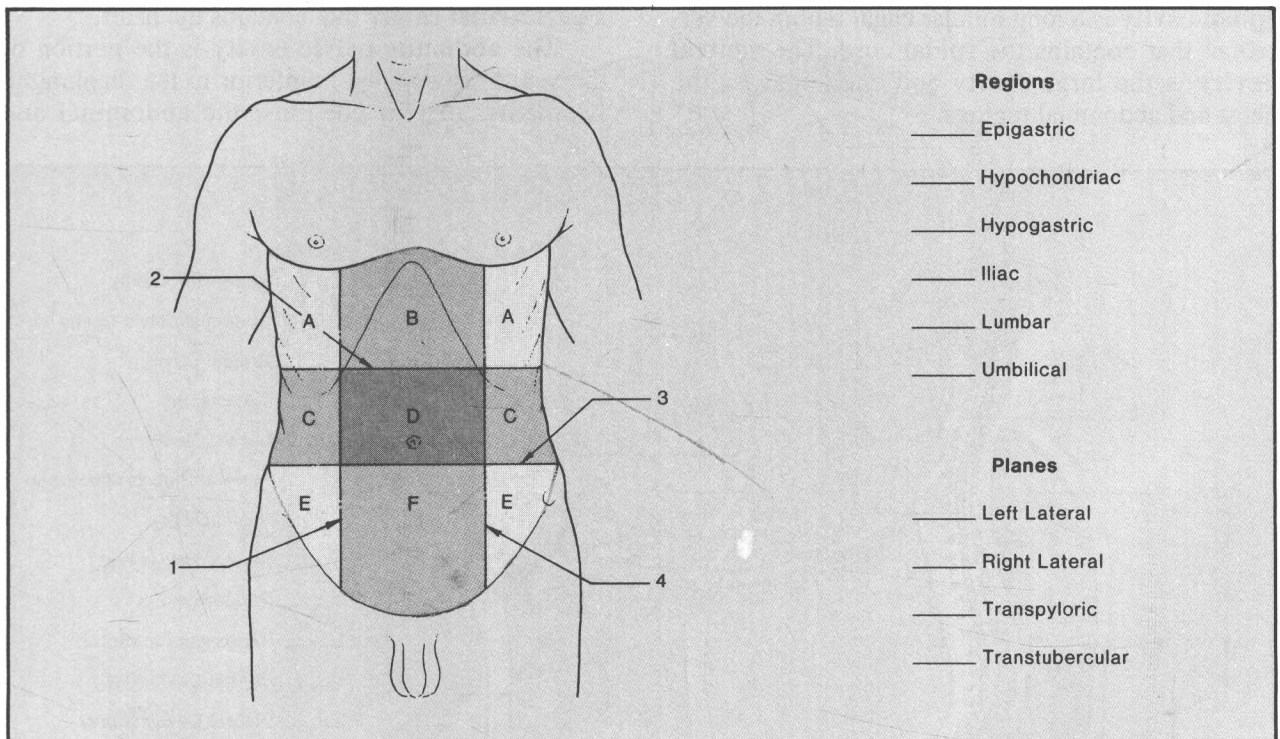


Figure 1.3 Abdominal regions.

Body Cavities and Membranes

All the internal organs (*viscera*) are contained in body cavities that are completely or partially lined with smooth membranes. The relationships of these cavities to each other, the organs they contain, and the membranes that line them will be studied in this exercise.

BODY CAVITIES

Figure 2.1 illustrates the seven principal cavities of the body. The two major cavities are the dorsal and ventral cavities. The **dorsal cavity**, which is nearest to the dorsal surface, includes the cranial and spinal cavities. The **cranial cavity** is the hollow portion of the skull that contains the brain. The **spinal cavity** is a long tubular canal within the vertebrae that contains the spinal cord. The **ventral cavity** is the large cavity and encompasses the chest and abdominal regions.

The superior and inferior portions of the ventral cavity are separated by a dome-shaped thin muscle, the **diaphragm**. The **thoracic cavity**, which is that part of the ventral cavity superior to the diaphragm, is separated into right and left compartments by a membranous partition or septum called the **mediastinum**. The lungs are contained in these right and left compartments. The heart, trachea, esophagus, and thymus gland are enclosed within the mediastinum.

Figure 2.2 reveals the relationship of the lungs to the structures within the mediastinum. Note that within the thoracic cavity there exists a pair of right and left **pleural cavities** that contain the lungs and a **pericardial cavity** that contains the heart.

The **abdominopelvic cavity** is the portion of the ventral cavity that is inferior to the diaphragm. It consists of two portions: the abdominal and

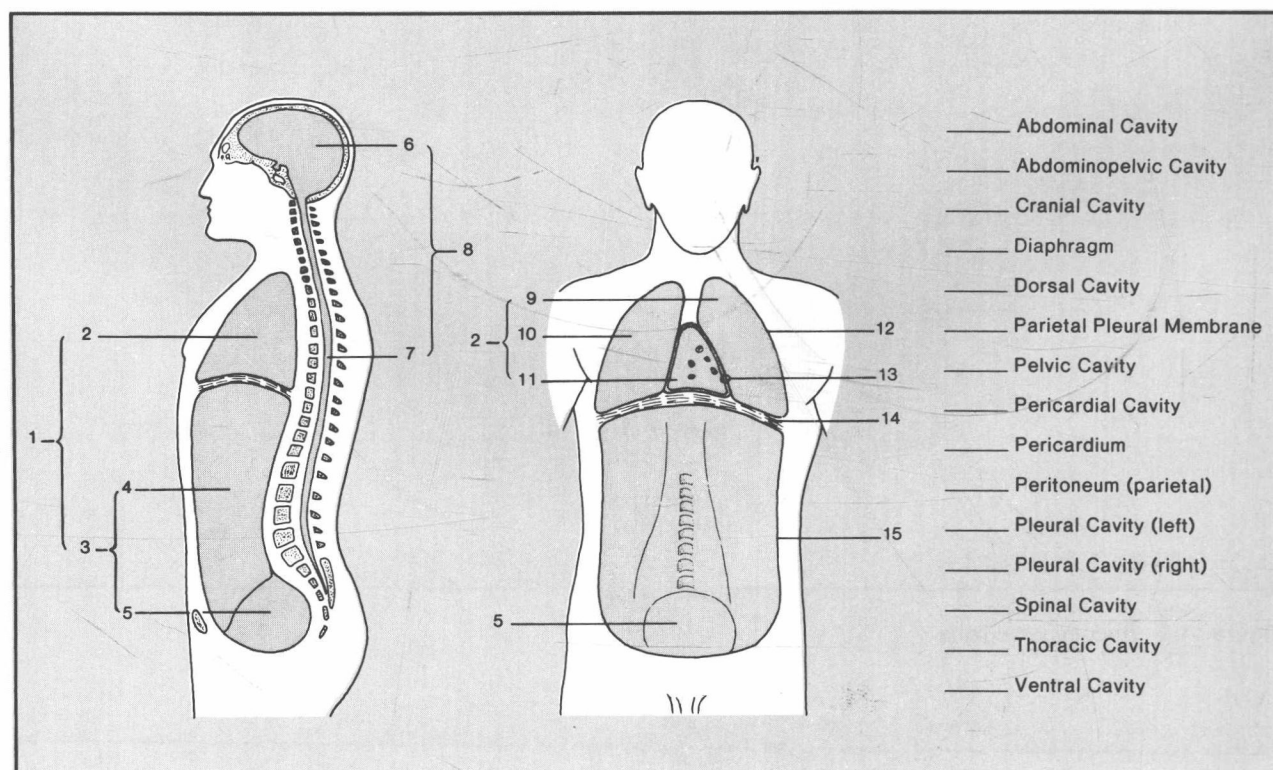


Figure 2.1 Body cavities.

pelvic cavities. The **abdominal cavity** contains the stomach, liver, gallbladder, pancreas, spleen, kidneys, and intestines. The **pelvic cavity** is the most inferior portion of the abdominopelvic cavity and contains the urinary bladder, sigmoid colon, rectum, uterus, and ovaries.

BODY CAVITY MEMBRANES

The body cavities are lined with serous membranes that provide a smooth surface for the enclosed internal organs. Although these membranes are quite thin, they are strong and elastic. Their surfaces are moistened by a self-secreted *serous fluid* that facilitates ease of movement of the viscera against the cavity walls.

Thoracic Cavity Membranes

The membranes that line the walls of the right and left thoracic compartments are called **parietal pleurae** (*pleura*, singular). The lungs, in turn, are covered with **visceral** (pulmonary) **pleurae**. Note in figure 2.2 that these pleurae are continuous with each other. The potential cavity between the

parietal and visceral pleurae is the **pleural cavity**. Inflammation of the pleural membranes results in a condition called *pleurisy*.

Within the broadest portion of the mediastinum lies the heart. It, like the lungs, is covered by a thin serous membrane, the **visceral pericardium**, or **epicardium**. Surrounding the heart is a double-layered fibrous sac, the **parietal pericardium**. The inner layer of this sac is a serous membrane that is continuous with the epicardium of the heart. Its outer layer is fibrous, which lends considerable strength to the structure. A small amount of serous fluid produced by the two serous membranes lubricates the surface of the heart to minimize friction as it pulsates within the parietal pericardium. The potential space between the visceral and parietal pericardia is called the **pericardial cavity**.

Abdominal Cavity Membranes

The serous membrane of the abdominal cavity is the peritoneum. It does not extend deep down into the pelvic cavity, however; instead, its most inferior boundary extends across the abdominal

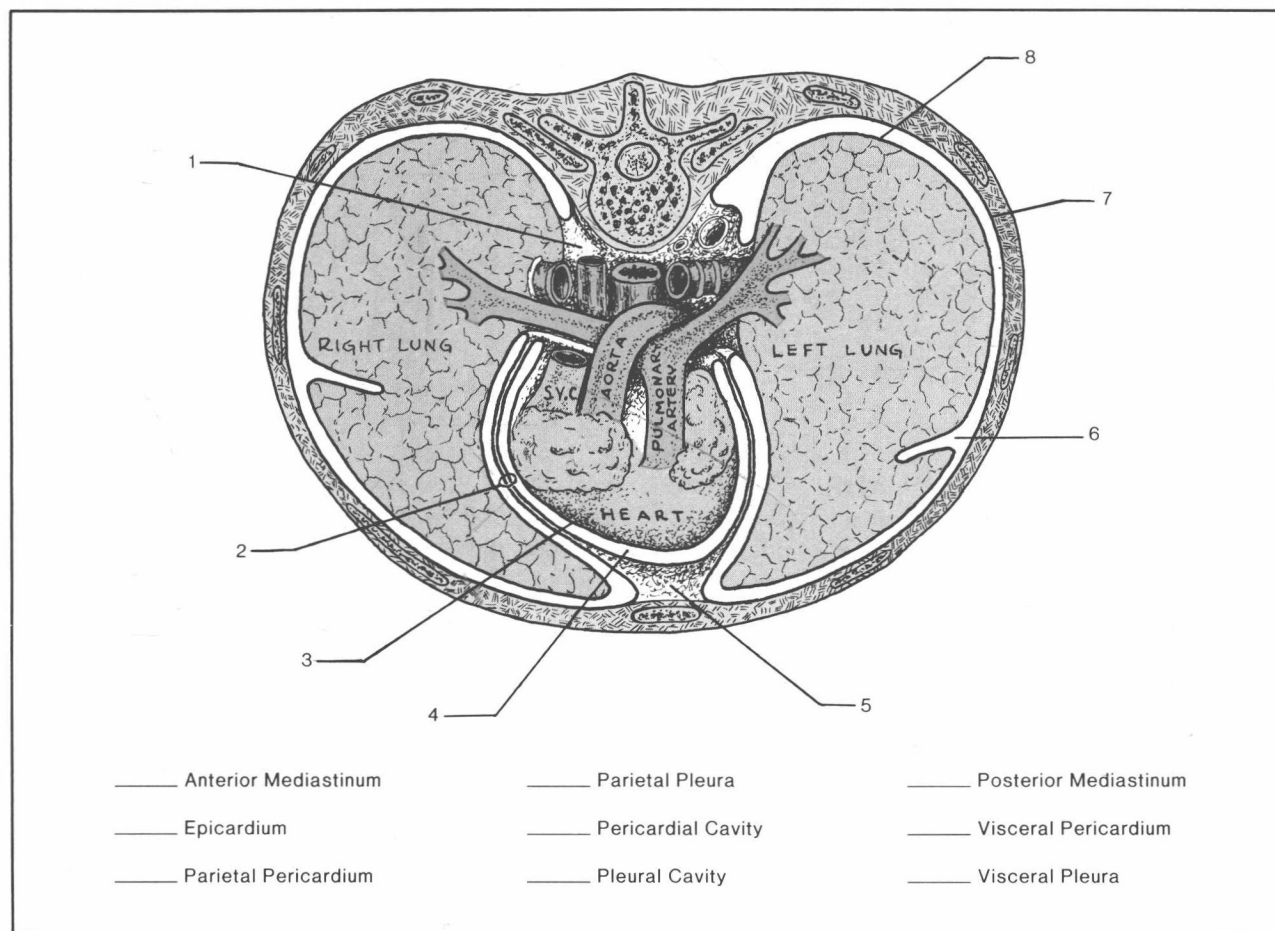


Figure 2.2 Transverse section through thorax.