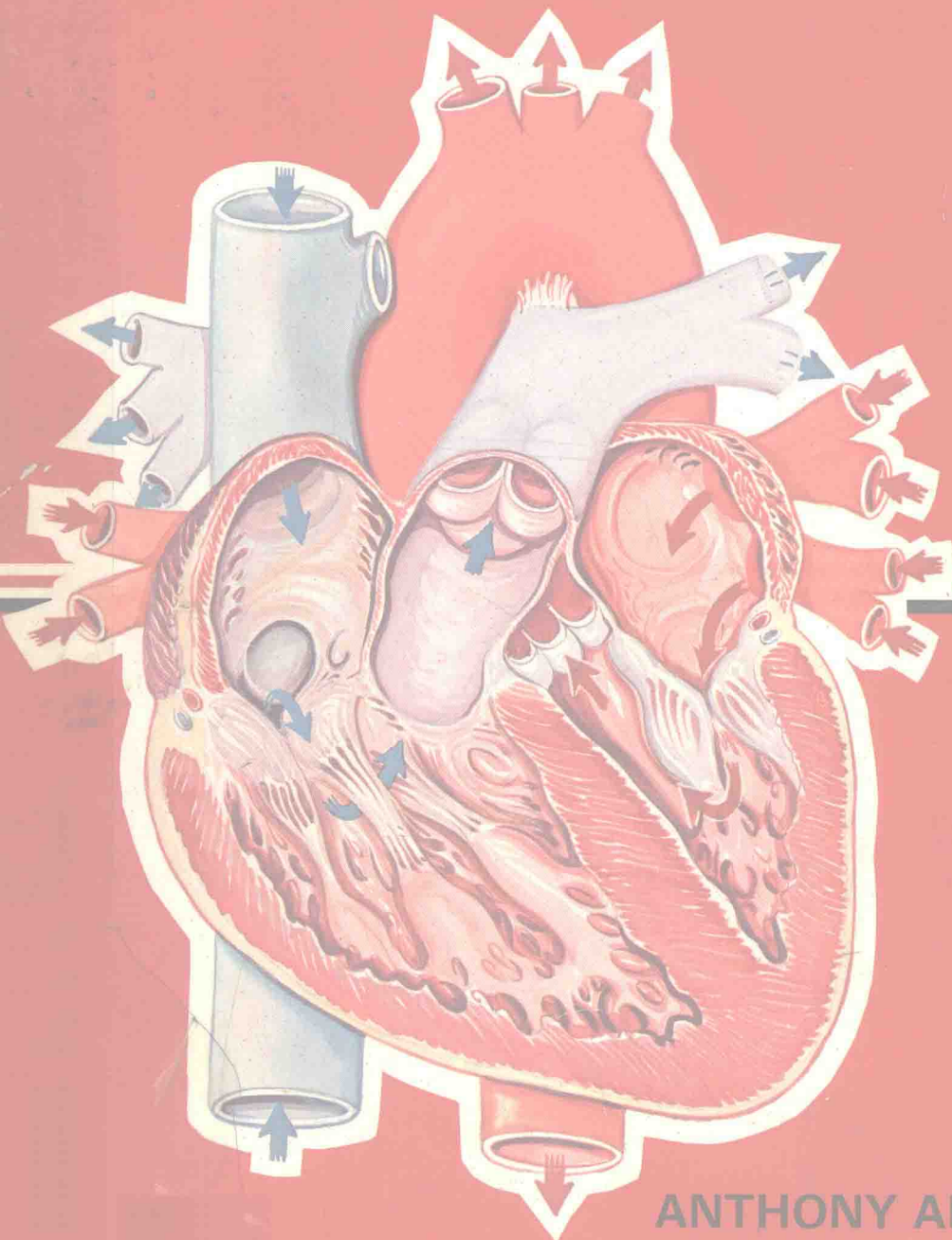


# Structure and function of the body



SIXTH EDITION

ANTHONY AND THIBODEAU

# Structure and function of the body

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## **SIXTH EDITION**

with 186 illustrations

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## **Structure and function of the body**

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# Preface

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*Structure and Function of the Body* is an introductory textbook about the human body. The selection and organization of its content and especially its writing style make this book particularly well suited for courses for practical nurses and other allied health students.

To evaluate this sixth edition you might begin by examining the table of contents. A quick glance will show you that the book is organized not only into chapters but also into groups of chapters or units. Each unit develops one major theme, a theme clearly identified by the unit's name. The content of the book as a whole is organized around the seven major themes designated by the units. The content of every chapter is also clearly organized. Brief introductory outlines alert students to the main topics discussed in the chapter, and text headings call attention to the chapter's text, summarizing it and emphasizing and tying together its contents. Finally, key questions follow the summarizing outline to help students with those difficult tasks of identifying and learning essential information. How much does a textbook's organization contribute to its effectiveness? Immeasurably!

In our view, students take their first giant step toward understanding and learning when they perceive clearly the organization of material.

The organization of this sixth edition differs somewhat from the previous one. The main changes are the following: a new unit titled "Systems that Provide Transportation and Immunity"; separate chapters about the blood, the cardiovascular and lymphatic systems, and the somatic and autonomic divisions of the nervous system; and a new chapter on the immune system.

Many changes in content appear in virtually every chapter of this edition. A few examples of material added are discussions of diffusion, osmosis, filtration, active transport, mitosis, neurotransmitters, prostaglandins, cardiopulmonary resuscitation, and clinical applications.

The many new color illustrations created for this edition by the eminent medical artist, Ernest W. Beck, have added considerable beauty to the book. Not only will they make it easier for students to understand and learn much of the text, but they will also surely make them enjoy it more.

Some final notes about this edition—un-

like previous editions it contains a list of abbreviations, prefixes, and suffixes commonly used in medical literature. Also, for the first time instructors will be supplied a test manual.

As senior author, I acknowledge with

warm appreciation the valuable contributions made by my new coauthor, Dr. Gary A. Thibodeau, by the artist, Mr. Beck, and by the hosts of people who have produced this book and who will distribute it.

**Catherine Parker Anthony**

## **Structure and function of the body**

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# The body as a whole

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### **1 An introduction to the structure and function of the body**

Some basic facts about body structure  
Some words used in describing body structures  
Some basic facts about body functions

### **2 Cells and tissues**

Cells  
Tissues

### **3 Organs and systems**

The skin  
Systems

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## chapter 1

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# An introduction to the structure and function of the body

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### Some basic facts about body structure

Units of body structure  
Structural organization  
Body cavities  
Body structure related to age

### Some words used in describing body structures

Superior and inferior  
Anterior and posterior  
Medial and lateral  
Proximal and distal  
Sagittal, frontal, and transverse planes  
Abdominal regions  
Anatomical position

### Some basic facts about body functions

Survival, the body's dominant function  
Survival depends on homeostasis  
Homeostasis depends on many functions  
Body functions are ultimately cell functions  
Body functions related to age

**W**onders are many in our world today, but none is more wondrous than the human body. This is a textbook about that incomparable structure. Chapter 1 relates a few basic facts about the body's structure and its functions. It also defines some of the words scientists use in talking about the body.

### Some basic facts about body structure

**1** The body is a single structure, but it is made up of billions of smaller structures of four major kinds: cells, tissues, organs, and systems. The smallest and most numerous of these are cells. Although long recognized as the simplest units of living matter, cells are, in truth, far from simple. They are extremely complex, a fact you will discover in Chapter 2.

Tissues are somewhat more complex units than cells. By definition, a tissue is an organization of a great many similar cells with varying amounts and kinds of nonliving, intercellular substances between them.

Organs are more complex units than tissues. An organ is a group of several different kinds of tissues so arranged that together they can perform a special function. For example, the stomach is an organization of muscle tissue, connective tissue, epithelial tissue, and nervous tissue so arranged that

together they can perform part of the function of digestion.

Systems are the most complex of the units that make up the body. A system is an organization of varying numbers and kinds of organs so arranged that together they can perform complex functions for the body. For example, the digestive system consists of the mouth, esophagus, stomach, intestines, and a few other structures so arranged that together they can perform the complex functions of digestion and absorption.

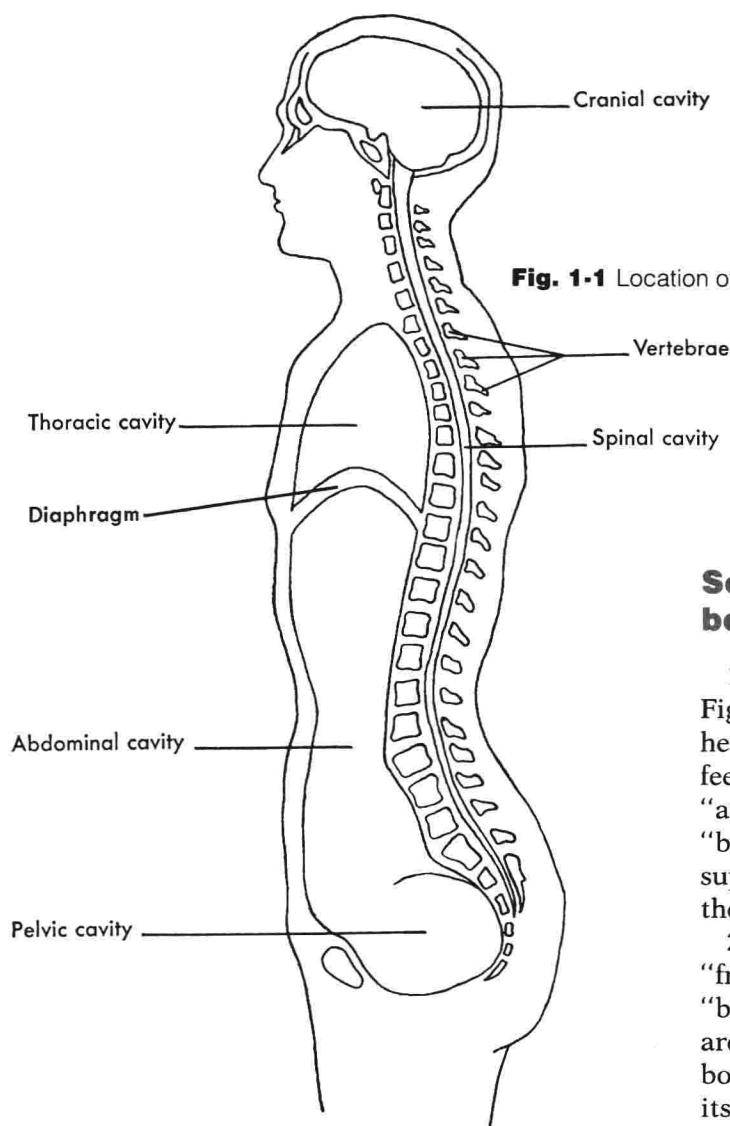
**2** Organization is a most important characteristic of body structure. No haphazard conglomerations, but only orderly arrangements, exist in the body and in every living thing. Even the name “organism,” used to denote a living thing, implies organization.

**3** The body, contrary to its external appearance, is not a solid structure. It contains four cavities, which in turn contain compact, well-ordered arrangements of internal organs. To discover the names and locations of the cavities, look at Fig. 1-1. What anatomical name do you find for the space that you perhaps think of as your chest cavity? The midportion of this cavity is named the *mediastinum* and its other divisions are the right and the left *pleural cavities*. Fig. 1-1 also identifies an abdominal cavity and a pelvic cavity. Actually they form only one cavity—the *abdominopelvic cavity*—since no partition of any kind sepa-

rates them. Notice, however, that a partition does separate the thoracic cavity from the abdominal cavity. It is a dome-shaped muscle and is the most important muscle we have for breathing. What is its name? The space inside the skull contains the brain and is called the *cranial cavity*. The space inside the spinal column is called the *spinal cavity*; it contains the spinal cord. The cranial and spinal cavities are classified as *dorsal cavities*, whereas the thoracic and abdominopelvic cavities are called *ventral cavities*. Dorsal (or posterior in humans) means “back.” Ventral (or anterior in humans) means “front,” that is, the stomach side.

Fig. 1-2 shows some of the organs contained in the largest body cavities. For example, it shows the trachea, aorta, and heart in the mediastinal portion of the thoracic cavity and the lungs in the pleural portions. Observe the many organs shown in the abdominal cavity: the liver, gallbladder, stomach, spleen, pancreas, and parts of the small intestine (cecum and ascending, transverse, and descending colon). The sigmoid colon and rectum lie in the pelvic cavity. Among the organs not visible in Fig. 1-2 are the thymus gland in the mediastinum, the urinary bladder, certain reproductive organs in the pelvic cavity, and numerous blood vessels and nerves.

Find each body cavity in a model of the human body if you have access to one. Try



**Fig. 1-1** Location of the body cavities, side view.

to identify the organs in each cavity, and try to visualize their locations in your own body. Study Figs. 1-1 and 1-2.

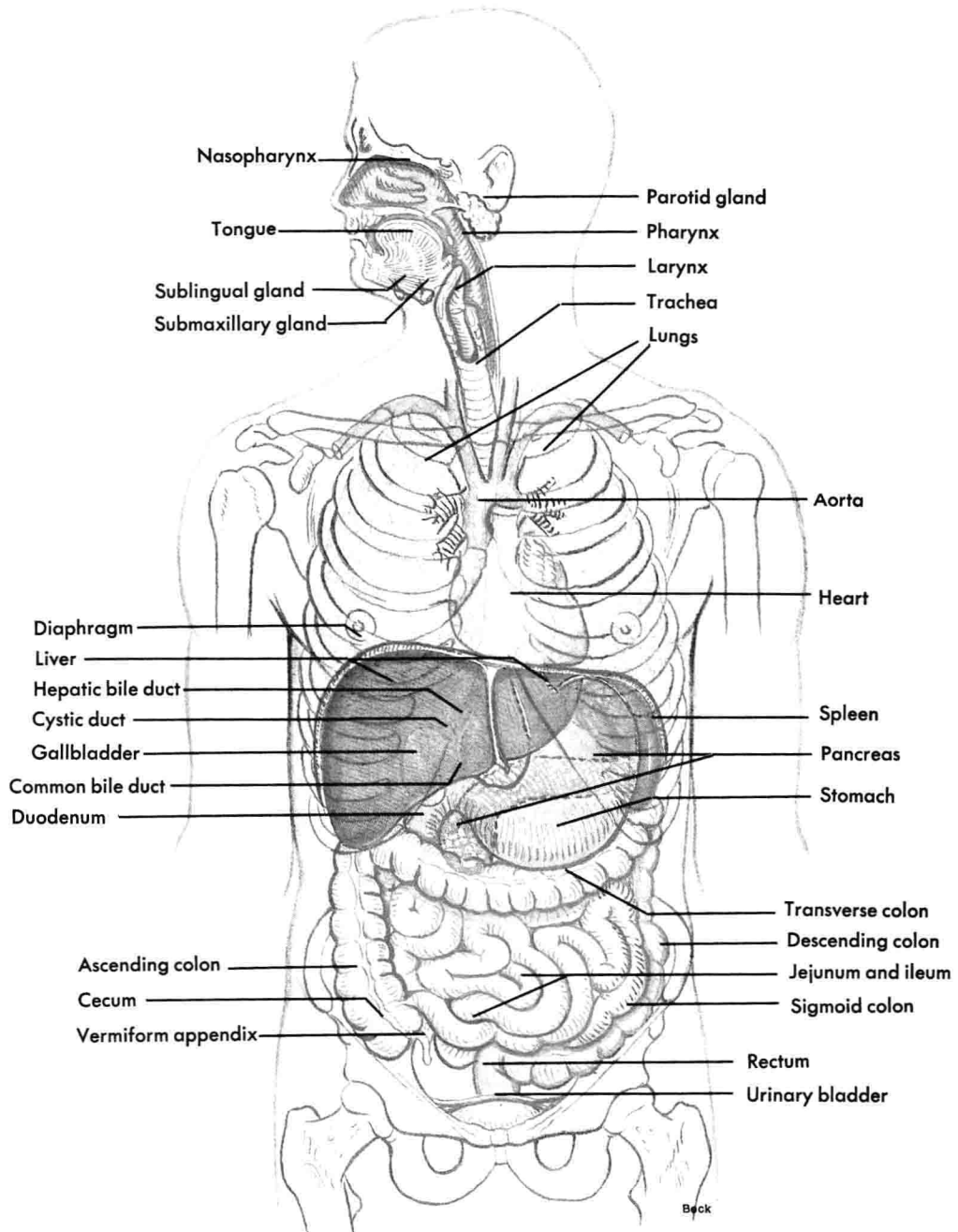
**4** The structure of the body changes in many ways and at varying rates during a lifetime. Before young adulthood it develops and grows. After young adulthood it gradually undergoes various changes and, in general, atrophies. Nearly every chapter of this book will mention a few of these changes.

## Some words used in describing body structures

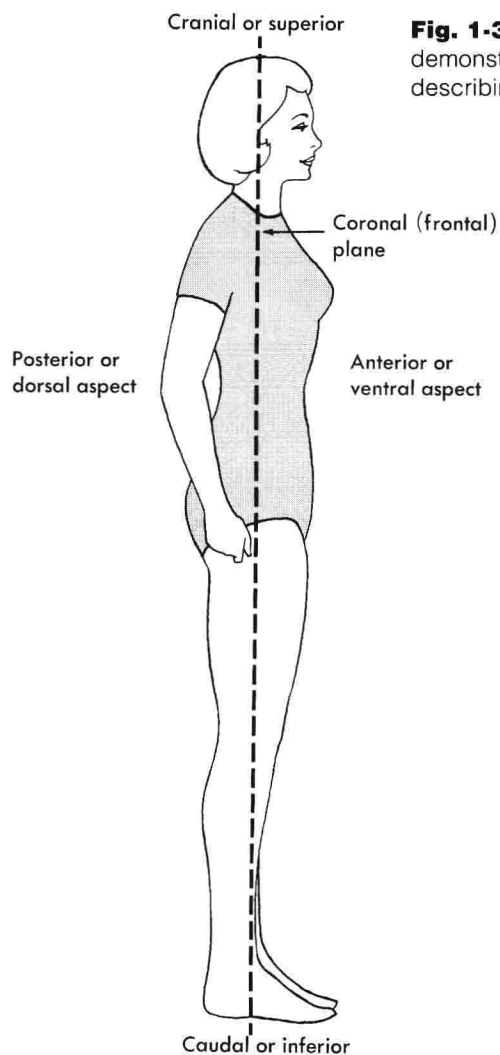
**1** *Superior* and *inferior*—as you can see in Fig. 1-4, superior means “toward the head,” and inferior means “toward the feet.” Superior also means “upper” or “above,” and inferior means “lower” or “below.” Examples: The lungs are located superior to the diaphragm muscle, whereas the stomach is located inferior to it.

**2** *Anterior* and *posterior*—anterior means “front” or “in front of”; posterior means “back” or “in back of.” Examples: The knees are located on the anterior surface of the body and the shoulder-blades are located on its posterior surface. The liver lies anterior to the gallbladder and the gallbladder lies posterior to the liver. The terms anterior and posterior are used in referring to a human. In reference to animals, ventral and dorsal are substituted for anterior and posterior in man.

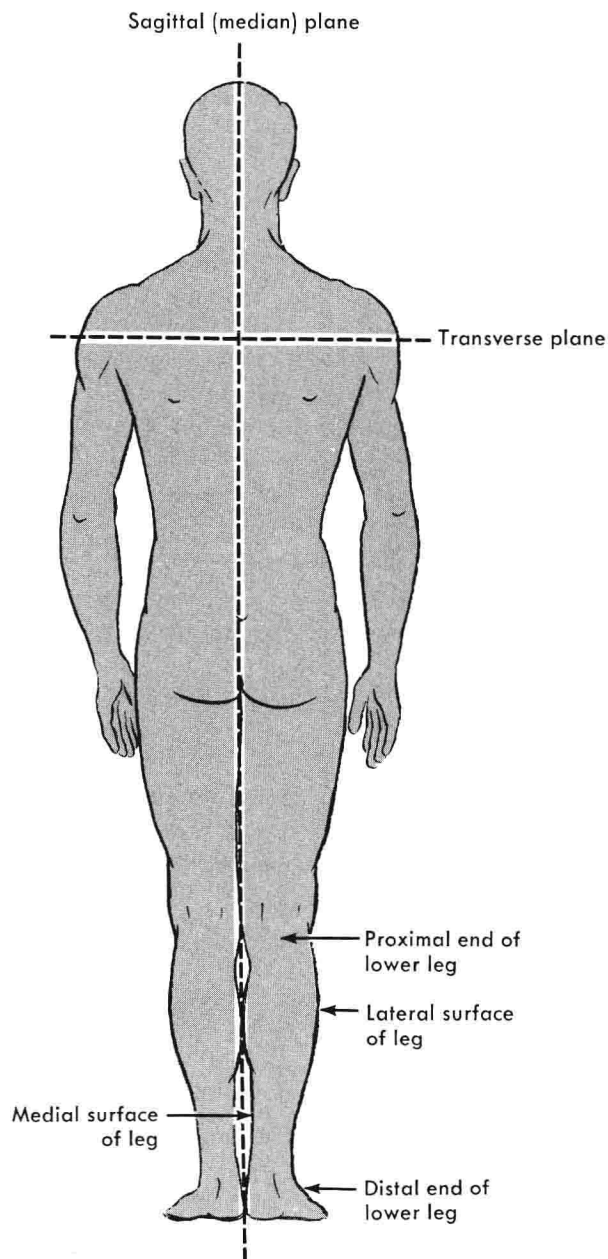
**3** *Medial* and *lateral* (Fig. 1-3)—medial means “toward the midline of the body”; lateral means “toward the side of the body or away from its midline.” Examples: The great toe is located at the medial side of the foot and the little toe is located at its lateral



**Fig. 1-2** Organs of the thoracic and abdominal cavities viewed from the front.



**Fig. 1-3** Lateral view of the human figure demonstrating several terms used in describing the body.



**Fig. 1-4** Posterior view of the body indicating meanings of some commonly used anatomical terms.

side. The heart lies medial to the lungs and the lungs lie lateral to the heart.

**4 Proximal and distal**—proximal means “toward or nearest the trunk of the body, or nearest the point of origin of one of its parts”; distal means “away from or farthest from the trunk or the point of origin of a body part.” Examples: The elbow lies at the proximal end of the lower arm, whereas the hand lies at its distal end.

**5 Sagittal, frontal, and transverse planes**—a sagittal plane is a lengthwise plane running from front to back; a cut made through the sagittal plane of an organ therefore divides it into right and left sections. A frontal plane is a lengthwise plane running from side to side as indicated in Fig. 1-4. Cutting an organ through its frontal plane divides it into anterior and posterior sections. A transverse plane is a horizontal or crosswise plane. Cutting an organ through the transverse plane divides it into upper and lower sections.

**6 Abdominal regions**—to make it easier to locate abdominal organs, anatomists have divided the abdomen into the nine regions shown in Fig. 1-3 and defined them as follows:

- a *Upper abdominal regions*—right hypochondriac, epigastric, and left hypochondriac regions; lie above an imaginary line across the abdomen at the level of the ninth rib cartilages
- b *Middle regions*—right lumbar, umbilical, and left lumbar regions; lie below an imaginary line across the abdomen at the level of the ninth rib cartilages and above an imaginary line across the abdomen at the top of the hipbones
- c *Lower regions*—right iliac, hypogastric, and left iliac regions; lie below an imaginary line across the abdomen at the level of the top of the hipbones (see Fig. 1-5)

**7 Anatomical position**—if you stand erect with your arms at your sides and the palms

of your hands turned forward, your body is in the anatomical position.

## Some basic facts about body functions

**1 Survival** is the body’s most important business—survival of itself and survival of the human species. Although the body carries on a great many different functions, each one contributes in some way to survival of the individual or of humankind.

**2 Survival** depends on the body’s maintaining or restoring homeostasis. Homeostasis means relative constancy of the internal environment. More specifically, homeostasis means that the chemical composition, the volume, and certain other characteristics of blood and interstitial fluid (fluid around cells) remain constant within narrow limits.

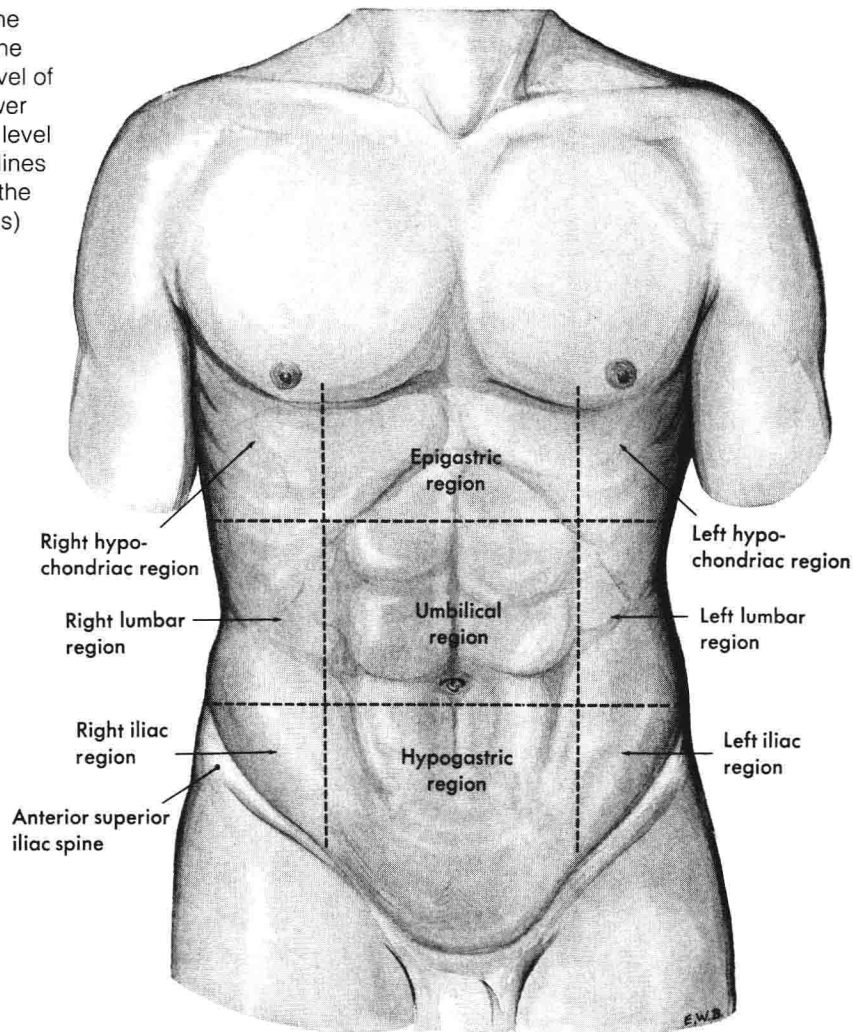
**3 Homeostasis** depends on the body’s ceaselessly carrying on many activities. It must continually respond to changes in its environment, exchange materials between its environment and its cells, metabolize food, and control all of its diverse activities.

**4 All body functions** are ultimately cell functions.

**5 Body functions** are related to age. During childhood, body functions gradually become more and more efficient and effective. They operate with maximum efficiency and effectiveness during young adulthood. During late adulthood and old age, they gradually become less and less efficient and effective. Changes and functions that occur during the early years are called developmental processes. Those that occur after young adulthood are called aging processes. In general, developmental processes improve functions. Aging processes usually diminish them. Future chapters will refer to many functional age changes.



**Fig. 1-5** The nine regions of the abdomen. The top horizontal line crosses the abdomen at the level of the ninth rib cartilages. The lower horizontal line crosses it at the level of the iliac crests. The vertical lines pass through the midpoints of the right and left inguinal (Poupart's) ligaments.



### Outline summary

#### Some basic facts about body structure

- A** The body is a unit constructed of the following smaller units—cells, tissues, organs, systems
- 1 Cells—the smallest structural units; organizations of various chemicals
  - 2 Tissues—organizations of similar cells
  - 3 Organs—organizations of different kinds of tissues
  - 4 Systems—organizations of different kinds of organs

**B** Organization is an outstanding characteristic of body structure

**C** The presence of the following cavities is a prominent feature of body structure

#### 1 Anterior cavities

##### a Thoracic cavity

- (1) Mediastinum—midportion of thoracic cavity; heart, trachea, esophagus, and thymus gland located in mediastinum
- (2) Pleural cavities—right lung located in right pleural cavity, left lung in left pleural cavity