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The Human Body
in
Health and Disease

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Preface to the Second Edition

THIS second edition, as in the case of the first, is intended as an introduction to the fascinating study of the human body. It is hoped that additions and improvements in both the text and the drawings will increase the usefulness of this text for beginning students in many health fields.

In order to help the student integrate in his mind the sciences of body structure (anatomy), dynamics and function (physiology) and disease (pathology), the author has undertaken to contrast the normal with the abnormal at every possible opportunity. Such immediate comparisons usually are fascinating to students, and it is hoped that this plan will provoke the sort of curiosity which, when pursued further, yields great rewards.

Although sections of this text include brief discussions of microorganisms and of minute structures of the body, many instructors may find that emphasis on gross structure at the beginning is easier for the average student. It may be better gradually to introduce the study of microscopic structure following some study of larger parts that can be seen with the naked eye. Also, it is definitely not necessary to follow the order presented if the instructor finds that some other may work out better. For example, if he suspects that students already may know something about the digestive system, there is no reason why he could not begin this book with Chapter 10 and proceed from there. Whatever the plan, the educational principle of progressing from the known to the unknown should be found useful.

In order to make learning more palatable for beginning students, most of whom have had very limited experience with scientific words, an indication of the correct pronunciation is included in the text as the word is first introduced. Students so often say "I know it but I can't say it." Looking up each word is so time-consuming that most readers just do not do it as much as they should. It is hoped that this simplified pronunciation key in the text will add materially to the usefulness of the book. It is also helpful to the student to say the word aloud when it is first encountered. The teacher should give the correct pronunciation first. The student should be required to take notes because

writing these words also will aid in learning. Looking at words and diagrams, and then trying to reproduce them from memory, also is an effective method of learning. Students enjoy classes in which they participate by saying words out loud and by doing simple drawings with appropriate labeling, and where many visual aids are used.

Most measurements are expressed in the British system as used in the United States, since many students have no real familiarity with the metric system. This is not to say that we would not prefer the metric system; but until the United States changes certain of its educational policies and children are required to learn the metric system, the present measurements should be more readily visualized.

It is hoped that students will be encouraged to find more difficult texts for additional study and that they will recognize the limitations of such a short book on such a complex subject. A little knowledge is not a dangerous thing if the possessor does not, in the words of William Allen White, "mistake it for a great deal." Those who have devoted their lives to the investigation of the scientific miracles of the human organism often find many perplexing and difficult problems that remain unanswered, and in their wisdom they admit their ignorance. If the student learns enough to know what he does not know, he will have accomplished a great deal.

My thanks go out to the many people who have given encouragement, suggestions, and assistance to this little effort. I would like especially to mention my husband, Eugene Memmler, and my teen-age daughter, Dena. Many thanks, too, to the staff of the publishers, particularly Barton H. Lippincott, editor, and David T. Miller, associate editor, for their help.

PRONUNCIATION KEYS INCLUDED IN TEXT MATERIAL

In order to help the student or layman new to this field, we have included pronunciation keys in parentheses following some of the more difficult words as they appear in the text.

We have used the American Medical dictionary by W. A. N. Dorland and Webster's New Collegiate Dictionary as the chief authorities. In order to simplify this presentation we have not attempted to use the symbols usually found over the vowels in most dictionaries.

Many vowels in scientific words are pronounced with the long sound, particularly if there is no consonant following the vowel in the same syllable. We have assumed that most of the vowels and consonants have their usual English sounds. A short vowel is followed by a consonant in the same syllable while the long vowel is not. We urge the student to vocalize the new words as he sees them for the first time, in order to help in the learning process. It would be advisable to have a medical dictionary at hand to look up words not understood from the simplified material found in the text. This text information cannot replace the dictionary but we hope it will save some time.

Contents

1 The General Plan of the Human Body

Living matter and cells · Organs and organ-systems · Directions and locations in the body · Dorsal and ventral body cavities.

WHAT ARE LIVING THINGS MADE OF?

According to a nursery rhyme children are made of sugar and spice, or perhaps of puppy dogs' tails, depending on which sex we are discussing. More accurately, the "stuff" of which all living things are made is called **protoplasm** (pro'to-plazm). This word is made up of 2 Greek words: *proto*, meaning "original," and *plasm*, meaning "substance." Chemically, protoplasm is composed of quite ordinary elements: carbon, oxygen, hydrogen, sulfur, nitrogen and phosphorus. There is nothing extraordinary, either, in the appearance of protoplasm; it looks very much like the white of an egg. Yet, nobody has been able to explain why protoplasm has that characteristic which we call life.

If the building material of all living things, both plants and animals, is protoplasm, the building blocks made of this are called **cells** (see Fig. 1). Cells vary a great deal in size. Something as small as a worm may be composed of millions of cells, yet we all are familiar with at least one of the larger kinds of cell, of which an egg is a perfectly good example. In fact, if we keep the egg in mind, the construction of the cell will be quite easy to visualize. Let us work our way from the outside to the center.

First comes the outer covering, called the **cell membrane.** Next is the main substance of the cell, the **cytoplasm** (si'to-plazm), which might be likened to the white of the egg. The cytoplasm contains water, food particles, pigment and other specialized materials. In the center of the cell, comparable with the egg yolk, is a globule called the **nucleus** (nu'kle-us), which controls some of the activities of the cell including its reproduction. Within the

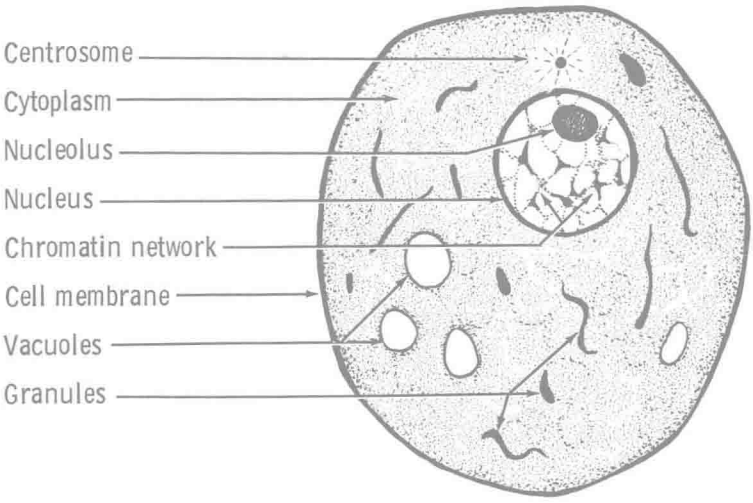

FIG. 1. A typical cell. The entire structure is made of protoplasm.

nucleus is still another tiny globule of matter called the **nucleolus** (nu-kle-o'lus), whose function is related to reproduction. The unique ability of a cell to reproduce itself will be discussed in Chapter 3.

The cell, then, is the basic unit of all life. In Chapter 2, when we study the causes of disease, we shall encounter a number of primitive living things which are composed of but one cell. However, for the moment we shall confine our discussion to the human body, which is made up of many millions of cells. The body is composed of specialized groups of cells, the first of which are called **tissues.** Various tissues combine to form **organs,** and several organs and parts grouped together for certain functions form **systems.** The systems have been variously stated to be 9, 10, or 11 in number, depending on how much detail one wishes to include. Here is one list of systems:

1. **The Skeletal System.** The basic framework of the body is a system of over 200 bones with their joints, collectively known as the skeleton.

2. **The Muscular System.** Body movements are due to the action of the muscles which are attached to the bones. Other

types of muscles are present in the walls of such organs as the intestine and the heart.

3. **The Circulatory System.** The heart, blood vessels, lymph vessels and lymph nodes all make up the system whereby blood is pumped to all the body tissues, bringing with it food, oxygen and other substances, and carrying away waste materials.

4. **The Digestive System.** This system comprises all organs which have to do with taking in food and converting the useful parts of it into substances that the body cells can use. Examples of these organs are the mouth, the teeth, and the alimentary tract (esophagus, stomach, intestine and accessory organs such as the liver and the pancreas).

5. **The Respiratory System.** This includes the lungs and the passages leading to and from them. The purpose of this system is to take in air, and from it extract oxygen which is then dissolved into the blood and conveyed to all the tissues. A waste product of the cells, carbon dioxide, is taken by the blood to the lungs, whence it is expelled to the outside air.

6. **The Integumentary System.** The word "integument" means skin. The skin is considered by some authorities to be a separate body system. It includes the hair, nails, sweat and oil glands, and other related structures.

7. **The Urinary System.** This is also called the excretory system. Its main components are the kidneys, the ureters, the bladder and the urethra. Its purpose is to filter out and rid the body of certain waste products taken by the blood from the cells. (Note that other waste products are removed via the digestive and the respiratory systems.)

8. **The Nervous System.** The brain, the spinal cord and the nerves all make up this very complex system by which all parts of the body are controlled and co-ordinated. The organs of special sense (eyes, ears, taste buds, organs of smell, etc.), sometimes classed as a separate **sensory system,** together with the sense of touch, bring stimuli from the outside world to the brain. The brain determines to a great extent the body's responses to messages from without and within, and in it occur such higher functions as memory and reasoning.

9. **The Endocrine System.** A few scattered organs known as endocrine glands produce special substances called hormones, which regulate such body functions as growth, food utilization

within the cells, and reproduction. Examples of endocrine glands are the thyroid and the pituitary.

10. **The Reproductive System.** This system includes the external sex organs and all related inner structures which are concerned with the production of new individuals.

DIRECTIONS IN THE BODY

Because it would be awkward and incorrect to speak of bandaging the "southwest part" of the chest, a number of terms have been devised to designate specific regions and directions in the body. Some of the more important of these are listed as follows (note that they refer to the body in the "anatomic position"—upright with palms facing forward):

1. **Superior** is a relative term meaning "above" or "in a higher position." Its opposite, **inferior,** means below or lower. The heart, for example, is superior to the intestine.

2. **Ventral** and **anterior** mean the same thing in humans: located near the belly surface or front of the body. Their corresponding opposites, **dorsal** and **posterior,** refer to locations nearer the back.

3. **Cranial** means near the head; **caudal,** near the sacral region of the spinal column (i.e., where the tail is located in lower animals).

4. **Medial** means nearer an imaginary plane that passes through the midline of the body, dividing it into left and right halves. **Lateral,** its opposite, means farther away from the midline, toward the side.

5. **Proximal** means nearest the origin of a structure; **distal,** farthest from that point. For example, the part of your thumb where it joins your hand is its proximal region. The tip of the thumb is its distal region.

For convenience in visualizing the spacial relationships of various body structures to each other, anatomists have divided the body by means of 3 imaginary planes. Think of a body plane as a huge cleaver (see Fig. 2).

1. The **midsagittal** (mid-saj'i-tal) plane. If the cleaver were to cut the body in two down the middle in a fore-and-aft direction, separating it into right and left halves, the sections you would see would be midsagittal.

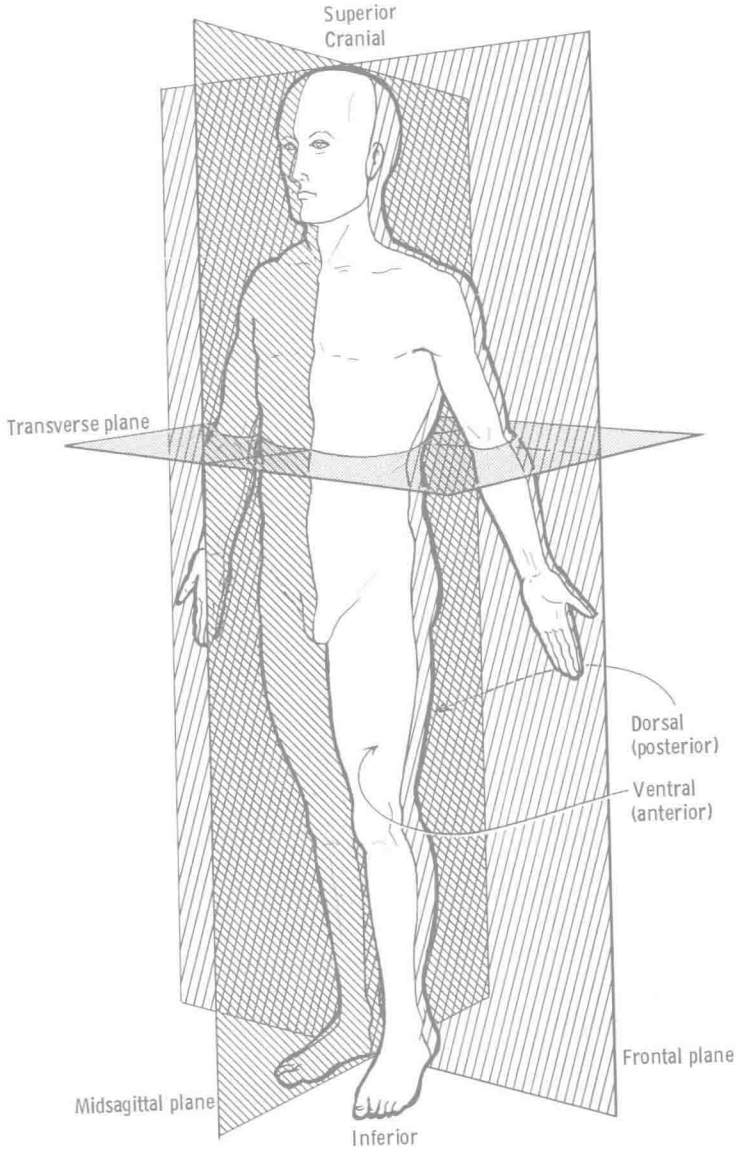

FIG. 2. Body planes and directions.

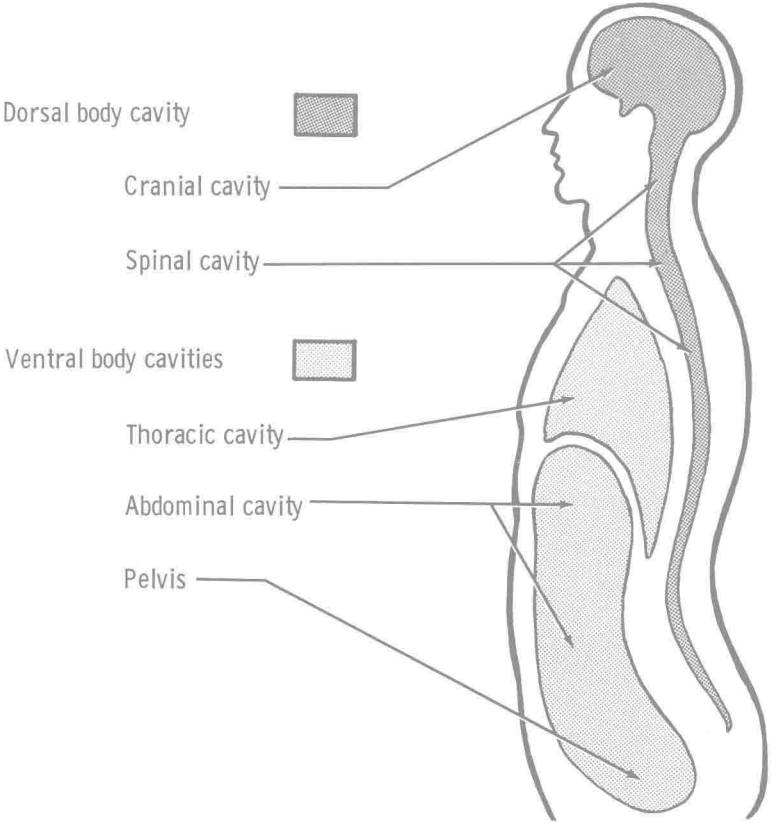

FIG. 3. Side view of body cavities.

2. The **frontal** plane. If, instead of the above operation, the cleaver were held in line with the ears and then were brought down the middle of the body, creating a front and a rear half, you would see a front (anterior or ventral) section and a rear (posterior or dorsal) section.

3. The **transverse** plane. If the cleaver blade were swung horizontally, it would divide the body into an upper (superior) part and a lower (inferior) portion. There could be many such cross sections, each of which is on a transverse plane.

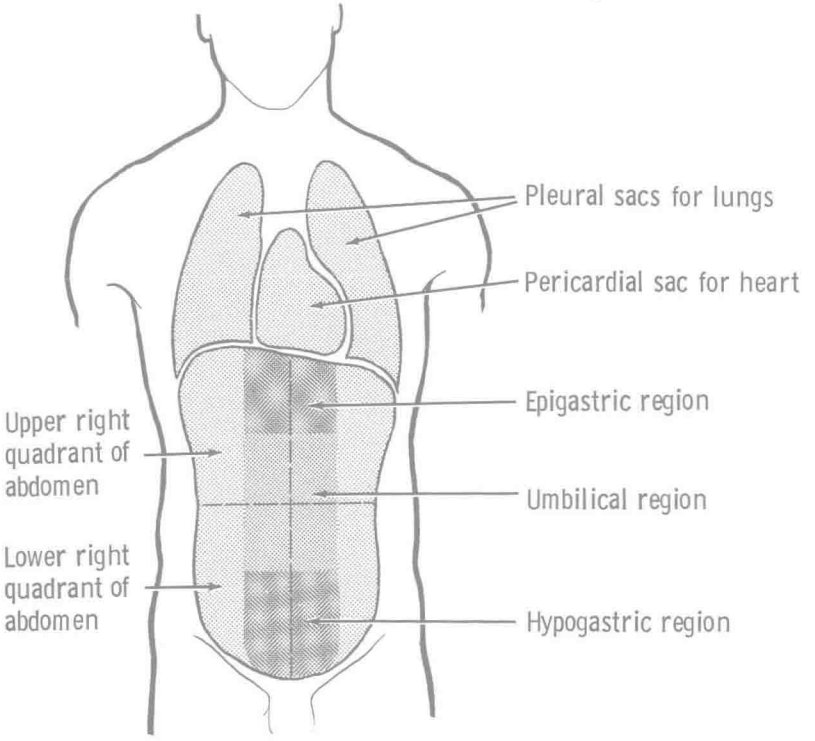

FIG. 4. Front view of body cavities.

BODY CAVITIES

The body contains a few large internal spaces or **cavities** within which various organs are located. There are 2 groups of cavities: **dorsal** and **ventral** (see Fig. 3).

DORSAL CAVITIES

There are 2 dorsal cavities: 1) the **cranial cavity,** containing the brain; and 2) the **spinal canal,** enclosing the spinal cord. Both these cavities join, hence they are a continuous space.

VENTRAL CAVITIES

The ventral cavities are much larger than the dorsal ones. There are 2 ventral cavities: (1) the **thoracic** cavity, containing mainly the heart, the lungs and the large blood vessels, and (2) the **abdominal** cavity. This latter space is subdivided into 2 portions, one containing the stomach, most of the intestine, the

kidneys, the liver, the gallbladder, the pancreas and the spleen; and a lower one called the **pelvis**, in which are located the urinary bladder, the rectum and the internal parts of the reproductive system.

Unlike the dorsal cavities, the ventral cavities are not continuous. They are separated by a muscular partition, the **diaphragm** (di′ah-fram), the function of which is discussed in Chapter 11.

Regions in the Abdominal Cavity. Because the abdominal cavity is so large, it has been found helpful to divide it into 4 sections or **quadrants** (see Fig. 4). But since quadrants still cover a lot of area, anatomists have divided the abdomen into 9 distinct regions. Three of these are shown in Figure 4: the **epigastrium**, located just under the breastbone; the **umbilical** (um-bil′i-kal) **region** about the navel; and the **hypogastric** (hi″po-gas′trik) **region**, lowest of all.

SUMMARY

1. **Living matter**
   - A. Basic substance: protoplasm.
   - B. Structural unit: cell.
   - C. Principal parts of cell: cell membrane, cytoplasm, nucleus, nucleolus.
   - D. Organization of body cells: tissues, organs, systems.
2. **Body systems**: skeletal, muscular, circulatory, digestive, respiratory, integumentary, urinary, nervous (and sensory), endocrine, reproductive.
3. **Body directions**
   - A. Superior, near head; inferior, away from it.
   - B. Ventral (anterior) near belly; dorsal (posterior) near back.
   - C. Cranial, near head; caudal, near end of spinal column.
   - D. Medial, near midsagittal plane; lateral, toward side.
   - E. Proximal, near origin; distal, distant from it.
   - F. Body division by planes
     - (1) Midsagittal: left and right halves.
     - (2) Frontal: front and rear halves.
     - (3) Transverse: top and bottom halves.
4. **Body cavities**
   - A. Dorsal
     - (1) Cranial.
     - (2) Spinal Canal.

B. Ventral
   (1) Thoracic.
   (2) Abdominal (upper portion and pelvis)
      a) Large division: quadrants.
      b) Small division: 9 regions including epigastrium, umbilical and hypogastric regions.

C. Dorsal cavities continuous, abdominal cavities separated by diaphragm.

QUESTIONS AND PROBLEMS

1. Of what substance is living matter composed?
2. Define a cell. Name 4 main components of a typical cell.
3. Define: tissue, organ, body system.
4. List the body systems, including a brief description of each with respect to its function.
5. Match the following with their opposites: superior, ventral, anterior, cranial, medial, proximal. Define each item in the complete list.
6. What are the 3 main body planes? Explain the division of each.
7. Make a rough sketch of the 2 principal groups of body cavities, indicating the 3 smaller central divisions of the largest cavity.

2 Disease and Disease-Producing Organisms

The nature of disease · The study of disease · Disease terminology · Diagnosis, treatment and prevention · Infection · The microorganisms · Bacteria · Fungi · Rickettsiae · Viruses · Protozoa · Parasitic worms · Microbial control · Aseptic methods · Chemotherapy.

WHAT IS DISEASE?

Disease may be defined as the abnormal state in which part or all of the body is not properly adjusted or is not capable of carrying on all the required functions. There are marked variations in the extent of the disease and in its effect on the person. Disease can have a number of direct causes such as the following:

1. **Disease-producing Organisms.** Certain of these will be discussed in this chapter. These are believed to play a part in at least one half of the human illnesses in the world.

2. **Malnutrition.** This means a lack of essential vitamins, minerals, proteins, or other substances required for normal life processes to take place.

3. **Physical Agents.** These include excessive heat or cold, or injuries that cause cuts, fractures, or crushing damage to tissues.

4. **Chemicals.** Certain ones may be poisonous or otherwise injurious if present in excess, such as lead compounds (in paints), carbolic acid (in certain antiseptic solutions), certain laundry aids, etc.

5. **Birth Defects.** Those abnormalities of structure and function which are present at birth are termed either **inherited** or **congenital** (kon-jen'i-tal). An inherited abnormality (such as the blood disease hemophilia) is one which has been passed on by the parents through their reproductive cells. A congenital abnormality (such as a harelip) is one which has been acquired during the process of development within the mother's womb (uterus), but which probably has nothing to do with inheritance.