LESSON ASSIGNMENT

LESSON 2
Anatomy, Physiology, and Pathology Important to Therapeutics.

TEXT ASSIGNMENT
Paragraphs 2-1 through 2-20.

LESSON OBJECTIVES
After completing this lesson, you should be able to:

2-1. Given a term pertaining to anatomy, physiology or pathology and a group of definitions, select the definition of that term.

2-2. Given the name of a system of the body and a group of functions, select the function of that system.

2-3. Given the name of a structural component of a cell and a group of descriptions, select the most appropriate description of that structure.

2-4. Given the name of a type of tissue and a group of descriptions, select the most appropriate description of that type of tissue.

2-5. Select from a list of functions the function of the skin.

2-6. Given the name or type of a disease of the skin and a group of descriptions, select the best description of that particular disease.

2-7. Given a cause of disease and a group of statements discussing various causes of disease, select the statement that best describes that cause.

SUGGESTION
After studying the assignment, complete the exercises at the end of this lesson. These exercises will help you to achieve the lesson objectives.
LESSON 2

ANATOMY, PHYSIOLOGY, AND PATHOLOGY IMPORTANT TO THERAPEUTICS

Section I. PRINCIPLES OF ANATOMY AND PHYSIOLOGY

2-1. ANATOMY AND PHYSIOLOGY

a. Anatomy is the study of the structure of the body. Often, you may be more interested in functions of the body. Functions include digestion, respiration, circulation, and reproduction. Physiology is the study of the functions of the body.

b. The body is a chemical and physical machine. As such, it is subject to certain laws. These are sometimes called natural laws. Each part of the body is engineered to do a particular job. These jobs are functions. For each job or body function, there is a particular structure engineered to do it.

c. In order to read and understand basic concepts in pharmacology, you must be familiar with certain topics in anatomy, physiology, and pathology. It is not the intent of this subcourse to discuss these areas in detail. Instead, the content of this lesson should give you the knowledge required to complete this subcourse. If you want, you can read texts and references that discuss these areas in detail.

2-2. ORGANIZATION OF THE HUMAN BODY

The human body is organized into cells, tissues, organs, organ systems, and the total organism.

a. Cells are the smallest living unit of body construction.

b. A tissue is a grouping of like cells working together. Examples are muscle tissue and nervous tissue.

c. An organ is a structure composed of several different tissues performing a particular function. Examples include the lungs and the heart.

d. Organ systems are groups of organs, which together perform an overall function. Examples are the respiratory system and the digestive system.

e. The total organism is the individual human being. You are a total organism.
2-3. SYSTEMS OF THE BODY

A system is a combination of parts or organs, which, in association, perform some particular function. The systems of the body are as follows:

a. **Integumentary.** Covers and protects the body from drying, injury, and infection, and has functions of sensation, temperature regulation, and excretion.

b. **Skeletal.** Provides a framework for the body, supports the organs, and furnishes a place of attachment for muscles.

c. **Muscular.** Provides the force for the motion and propulsion of the body.

d. **Respiratory.** Absorbs oxygen from the air and gives off the carbon dioxide produced by the body tissues.

e. **Cardiovascular.** Functions in the transportation of blood throughout the body.

f. **Lymphatic (System of Vessels and Glands).** Returns protein and fluid to the blood from the various body tissues; also furnishes the body with protective mechanisms against pathogenic organisms.

g. **Gastrointestinal.** Digests and absorbs food substances and excretes waste products.

h. **Genitourinary.** Excretes and transports urine (urinary), and elaborates and transports reproductive cells and sex hormones (reproductive).

i. **Nervous and Special Senses.** Gives the body awareness of its environment, and enable it to react to that environment.

j. **Endocrine.** Manufactures hormones, which are active in the control of much of the body activity and behavior.

**Section II. CELLS**

2-4. INTRODUCTION

Each of the 100 trillion cells in a human being is a living structure that is capable of surviving indefinitely. In most instances, the cell can reproduce itself provided its surrounding fluids remain intact. To understand the function of the various organs and other structures of the human body, it is essential that you first understand the basic organization of the cell and the functions of its component parts.
2-5. STRUCTURAL COMPONENTS OF A CELL

The cell was once viewed as a bag of fluid, enzymes, and chemicals. Now, we understand that the cell is an extremely complex living entity. With the advent of electron microscopy in the early 1940's, several distinct cellular structures called organelles were clearly recognized. A typical animal cell contains several types of these organelles. Each organelle has an important role in the functioning of the cell. It is important for you to become familiar with these organelles.

a. **Cell Membrane.** Animal cells do not have cell walls; they have cell membranes (figure 2-1) only. Plant cells have both cell walls and cell membranes.

   (1) Practically all the structures within the cell, as well as the cell itself, are lined with a porous, elastic membrane. The cell membrane is composed primarily of lipids (fats) and proteins that are arranged in layers at right angles to each other (figure 2-1).

   ![Diagram of a cell membrane](image)

   **Figure 2-1.** Diagram of a cell membrane.

   (2) The lipids of the cell wall are composed of two portions: a long hydrocarbon chain (that is insoluble in water) and a glycerol-phosphate head (that is soluble in water). The long chains are in the center of the protein and the glycerol-phosphate group is attached to the end of the protein.

   (3) The cell membrane contains many pores. It is through these pores that lipid-insoluble particles, such as water and urea, pass between the interior and the exterior of the cell. Diffusion experiments have shown that particles up to approximately 8-Angstrom units in diameter pass through the pores freely.

   (4) The main function of the cell membrane is to regulate the flow of substances into and out of the cell. This regulation of flow is accomplished by the membrane’s selective permeability. That is, only certain substances may pass through the pores. This is important, since the cell must obtain the nutrients for its growth from the extracellular fluid (fluid outside the cell) and discard waste products back into the extracellular fluid.
b. **Cytoplasm.** Cytoplasm (figure 2-2) is the fluid or semifluid contained inside the cell membrane, but outside the nucleus. The cytoplasm functions as a medium to contain many substances, such as fats, glucose, proteins, water, and electrolytes. The clear portion of the cytoplasm is called hyaloplasm. Located within the cytoplasm are the organelles that perform highly specialized functions in the cell.

c. **Nucleus.** The nucleus (figure 2-2) is the control center for the cell. It controls the reproduction of the cell as well as the chemical reactions that occur within the cell. The nucleus contains large amounts of deoxyribonucleic acid (DNA). The DNA is responsible for controlling the characteristics of the protein enzymes of the cytoplasm, and thus, it controls cytoplasmic activities. The DNA is also responsible for controlling the hereditary characteristics of individuals.

d. **Mitochondria.** The mitochondria (figure 2-2) may be called the power house" of the cell. The mitochondria are the site of cell respiratory activity. The mitochondria are found in the cytoplasm. They are usually located near energy requiring structures (that is, nodes of nerves, contracting ligaments of muscles, active transport mechanisms in membranes and ribosomes). Their numbers depend on the amount of energy required by the cell to perform its function. Several infoldings of the inner unit membrane form shelves on which practically all of the oxidative enzymes of the cell are said to be absorbed. When nutrients and oxygen meet these enzymes, they combine to form carbon dioxide, water, and energy. The liberated energy is used to synthesize ATP (adenosine triphosphate). This ATP then diffuses throughout the cell and releases its energy whenever it is needed for cellular functions.

e. **Lysosomes.** Lysosomes (figure 2-2) may be called the digestive organs of the cell. Lysosomes are surrounded by a membrane and contain digestive (hydrolytic) enzymes. When this membrane ruptures, it releases the digestive enzymes that will break down particles or molecules located near the ruptured area. For example, they surround pinocytic vesicles containing food particles and digest them. If a sufficient number of lysosomes rupture, the entire cell may be digested. When the lysosomes function properly, products of digestion can be used by the cell.

f. **Nucleoli.** In the nucleus of many cells, there may be one or more structures called nucleoli (figure 2-2). The nucleoli do not have a limiting membrane, as do most organelles. These structures are primarily aggregate of loosely bound granules composed mainly of ribonucleic acid (RNA). Hereditary units called genes are thought to synthesize and store in the nucleolus. This stored RNA diffuses into the cytoplasm where it controls cytoplasmic function. Therefore, the main functions of the nucleolus are the synthesis of RNA and the storage of RNA.
**Endoplasmic Reticulum.** The endoplasmic reticulum (figure 2-2) is a network of tubules and vesicles (saclike structures) in the cytoplasm. The inside of the tubules and vesicles is filled with endoplasmic matrix, a fluid medium, which is different from the fluid outside the endoplasmic reticulum. In the matrix, there are enzyme systems. The first function of the endoplasmic reticulum is to use these enzymes to synthesize various substances (that is, lipids). The endoplasmic reticulum is connected to the nuclear membrane and, in some cases, it is connected directly through small openings to the exterior of the cell. A second function of the endoplasmic reticulum is to transport various substances, through the vast network of tubules, from one part of the cell to another area of the cell. A third function of the endoplasmic reticulum is to store various substances within the cell.
h. **Ribosomes.** Ribosomes (figure 2-2) are small particles that are usually attached to the endoplasmic reticulum. Ribosomes are the site of protein synthesis and are referred to as "protein factories" of the cell. Ribosome is composed mainly of ribonucleic acid (RNA).

2-6. **PINOCYTOSIS**

Pinocytosis is the engulfing of small particles or fluids by the cell. That is, when these substances meet the cell membrane, they cause the membrane to form a channel. At the end of this channel, small vesicles form. These vesicles contain the substance and some extracellular fluid. The vesicle then breaks away from the rest of the membrane and migrates toward the center of the cell. Figure 2-3 illustrates the process of pinocytosis.

1. Particles contact cell membrane.

2. Vesicle (saclike structure) is formed.

3. Vesicle containing the particles passes into the cell.

![Figure 2-3. Pinocytosis.](image)

2-7. **PHAGOCYTOSIS**

Phagocytosis is the engulfing of solid particles by a cell. For example, bacteria could be surrounded and ingested by a cell. The mechanism of phagocytosis is similar to that of pinocytosis. However, in phagocytosis, the cell acts to surround the particle with the cell membrane and form a vesicle (sac) containing the particle and cytoplasm. Then, the vesicle breaks away from the cell wall and moves toward the center of the cell. Figure 2-4 illustrates phagocytosis.
2-8. **DEFINITION OF TISSUE**

A tissue is composed of a group of cells, which are the same or similar in nature. For example, liver cells are bound together into a tissue called liver, and bone cells are bound together with a large amount of lime salts to form bony tissue. The various tissues of the body have different characteristics because the cells that make up these tissues are different both in structure and in function.

2-9. **TYPES OF TISSUE**

There are four primary tissues as follows: epithelial, connective, muscular, and nervous.

a. **Epithelial.** Epithelial tissue (figure 2-5) covers the outer surface of the body and forms the lining of the intestinal and respiratory systems. A special form called endothelium lines the heart and blood vessels. As serous membranes, it lines the cavities of the abdomen, the chest, and the heart, and covers the organs that lie in these cavities. Epithelial tissue forms the glands and parts of the sense organs. According to its location, this tissue has different functions. As the skin, it protects underlying structures; in the small intestine, it absorbs; in the lungs, it is a highly permeable membrane; in glands, it secretes; and in the kidneys and liver, it both secretes and excretes. There are three types of epithelial tissue based on the shape of the cells. These are squamous (flat), cuboidal, and columnar. These cells are further designated as simple if they are arranged in a single layer, or stratified if arranged in layers.

![Figure 2-5. Epithelial tissue.](image)
b. **Connective.** Connective tissue (figure 2-6) is widely distributed throughout the body. It binds other tissues together and supports them, forms the framework of the body, and repairs other tissues by replacing dead cells. Principal types of connective tissue are osseous (bony), cartilaginous, fibrous, elastic, and fatty. Areolar tissue, which lies under the skin and serves to fill many of the sharp corners and small spaces of the body, is a mixed type composed of fibrous, elastic, and fatty connective tissue.

![Connective tissue diagram]

Figure 2-6. Connective tissue.

c. **Muscular.** Muscular tissue (figure 2-7) is of three kinds: voluntary (striated), involuntary (smooth), and cardiac.

![Muscle tissue diagram]

Figure 2-7. Muscle tissue.
d. **Nervous.** Nervous tissue (figure 2-8) is made up of nerve cells (neurons) and supporting structure of nervous tissue (neuroglia).

![Figure 2-8. Neuron and neuroglia.](image)

Section IV. **SKIN**

2-10. **DESCRIPTION OF SKIN**

The skin is a tough, elastic structure covering the entire body (figure 2-9). It is made up of two principal layers, the **epidermis** or cuticle and the **dermis** or true skin. The epidermis, which overlies the dermis, is itself composed of a superficial layer and an inner layer. The superficial or horny layer consists of dead cells that are constantly being worn off. These are replaced from the living cells that form the inner layer. The dermis is the thicker part of the skin, and consists of connective tissue containing blood vessels, nerve endings, sweat glands, sebaceous glands, and hair follicles. The dermis is held in place by a layer of areolar connective tissue.
2-11. FUNCTIONS OF THE SKIN

a. **Protection.** The skin protects underlying structures by acting as a mechanical barrier. When the skin is broken, bacteria may invade the body through the opening.

b. **Regulation of Body Temperature.** The skin regulates the body temperature by controlling heat loss in two ways:

   (1) The blood vessels in the skin change in size; they dilate and bring warm blood to the surface to increase heat loss, and they constrict to decrease heat loss.

   (2) The skin produces sweat which, when it evaporates, cools the body surface.

c. **Sensory Perception.** The skin acts as an organ of perception. It contains sensory nerve endings which are specialized to detect heat, cold) pressure (touch), and pain.
d. **Excretion.** The excretion of waste products through the skin is a function of the sweat glands that open by a duct onto the skin surface. The opening is called a pore. These glands are distributed in large numbers over the body and secrete an average of a quart of perspiration each day; although, the amount varies considerably, depending on the temperature and humidity of the atmosphere, and the amount of exercise performed by the individual. Perspiration is continuous, but it may be so slow and the sweat may evaporate so quickly that it is imperceptible. Sweat consists chiefly of water (99 percent), with small quantities of salts and organic materials which are waste products. Skin also secretes a thick substance, sebum. This material is the product of the sebaceous glands, and its purpose is to lubricate the skin and keep it soft and pliable.

e. **Absorption.** Although not one of its normal functions, the skin is capable of absorbing water and other substances. Physicians take advantage of this fact by prescribing local application of certain drugs.

2-12. **APPENDAGES OF THE SKIN**

The appendages of the skin include the glands (sweat and sebaceous), the hair, and the nails. Each hair consists of a shaft (the portion projecting from the surface) and a root (the part implanted in the skin); each hair root is implanted in an involution of the epidermis called the hair follicle. A fingernail or toenail grows from a nail bed. If the bed is destroyed, the nail will no longer grow.

2-13. **DISEASES OF THE SKIN**

a. **General.** Diseases of the skin make up a large portion of the physician's practice, whether in civilian life or in the Army. A specialist in diseases of the skin is called a dermatologist. Descriptive terms used in dermatology are:

1. Bulla--large blister filled with serous fluid.
2. Excoriation--superficial discontinuity or scratch.
3. Induration--hardness.
4. Lesion--any localized abnormality.
5. Macula--small, flat discoloration or freckle.
6. Papule--small, elevated lesion.
7. Pruritis--intense itching.
8. Pustule--vesicle containing pus.
(9) Squamous--scaly.

(10) Vesicle--small blister.

b. **Virus Infections.** Virus infections of the skin include the follows:

(1) **Verruca vulgaris.** Verruca vulgaris is the common wart.

(2) **Herpes simplex.** This is often called a fever blister, or cold sore.

(3) **Herpes zoster.** Herpes zoster is a painful infection commonly known as shingles.

c. **Bacterial Infections.** Bacterial infections of the skin include the following:

(1) **Furuncle (also called "boil.")** This is an acute, inflammatory lesion produced by the infection of a hair follicle or a skin gland by staphylococci bacteria. The lesion begins as a pustule. As the pustule enlarges, the skin becomes reddened, tense, and shiny. Pain and tenderness develop. The furuncle rapidly matures (comes to a head), and usually ruptures spontaneously, discharging pus. The treatment is heat, and incision and drainage. Under certain circumstances, antibiotics, such as penicillin, are indicated.

(2) **Carbuncle.** A lesion that resembles the furuncle, since it has the same cause and early course, but carbuncles are larger, and produce fever and leukocytosis (elevated white cell count in the blood). When a carbuncle ruptures, pus is discharged through several openings in the skin. The treatment consists of surgical drainage of the carbuncle and penicillin.

(3) **Cellulitis.** An acute, deep-spreading inflammation of the skin and subcutaneous tissues. Streptococcic infections tend to spread more than staphylococcic infections, because they produce an enzyme which breaks down the wall the body tries to form around the infection. The skin becomes red, tender, and swollen. The patient has fever. The infection may spread through lymph vessels, producing red streaks on the skin. It may enter the bloodstream and be carried through the body (septicemia or blood poisoning).

d. **Fungal Infections.** Fungal infections are among the most common of all diseases. In order for the fungi to produce skin infection, certain favorable conditions are required. Some of these conditions are: lack of cleanliness; excessive moisture, usually due to perspiration; and irritation of the skin, usually because of tight clothing.

(1) **Dermatophytosis pedis.** Dermatophytosis pedis (also called tinea pedis and athlete's foot) may be recognized by the presence of superficial fissures between and toes, and vesicles on the sides and beneath under the toes. If secondary bacterial infection occurs, pustules appear, and ulceration may result.
(2) **Dermatophytosis (tinea) corporis, capitis, and cruris.** These fungous infections are commonly called ringworm. Dermatophytosis (or tinea) cruris is also called "jock itch." The diagnosis of ringworm is made by the presence of a few (usually not over two or three) circular, ring-like, red, scaling lesions, clearing at the center, with advancing vesicular margins. Tinea cruris is distinguished by its location on the upper surface of the thighs. Excessive perspiration and friction from clothing are important contributing factors. Therefore, an important part of the treatment consists of exposing the involved parts to the air as much as possible.

e. **Arthropod Infestations and Infections.** The arthropods are many-celled animals with outer skeletons but without backbones, and include such organisms as crayfish, spiders, mites, ticks, centipedes, and insects (lice, mosquitoes).

(1) **Pediculosis.** Pediculosis is an infestation of the skin with lice.

(a) Diagnosis of louse infestation. Lice have a habit of living in the clothes and bedding of patients and coming out only at the night to feed. This fact must be taken into account when examining a patient suspected of being infested. The small louse bites may be quite difficult to locate in the absence of the louse, although the patient has usually scratched the skin in the area very vigorously, leaving scratch marks.

(b) Treatment. Pediculosis is treated by application of gamma benzene hexachloride (Lindane®).

(2) **Scabies.** Scabies is a disease caused by a very small mite that burrows into the skin. The infection often begins between the fingers, and spreads to the body, especially the lower abdomen, buttocks, and genitalia. The mite causes much itching (especially at night), and there is abrasion of the skin from scratching. Secondary infection by bacteria may occur, with the formation of pustules. The abrasions and pustules often obscure the typical lesions of scabies, which are threadlike, twisted lesions with a small raised area at one end. All washable clothing should be thoroughly laundered, and other clothing dry-cleaned.

f. **Allergic Conditions.** In allergic conditions, the patient is sensitive to certain foreign substances that may contact his skin, or be introduced into his body in the food he eats or the air he breathes. A first contact is necessary to produce the sensitization, following which the patient reacts to contact with the foreign substances in an abnormal manner. Some substances can provoke an allergic reaction in anyone contacting them. Others appear to produce allergy only in certain individuals who have a constitutional or inherited predisposition to allergy.
(1) **Urticaria.** Urticaria (commonly called hives) is an allergic condition which results in the formation of wheals (rounded or irregular shaped, transitory elevations of the skin). Urticaria is usually caused by eating a substance to which the patient has been sensitized, but may also be caused by a local allergen such as poison ivy; or it might have a psychogenic origin. It is usually associated with much itching and may cover the whole body. Often it is difficult to determine the cause, and the disease may constantly reoccur.

(2) **Contact dermatitis.** Contact dermatitis (dermatitis venenata) is due to sensitization of the skin by direct contact with a sensitizing substance. The development depends on how much of the substance is contacted, and how often. Why sensitivity occurs is not known. At the beginning, the skin is reddened in the contacted area, then raised lesions appear, and then blisters. The lesions may spread over the body. The vesicles may become infected by bacteria, and pustules appear. There is marked itching. The patient may carry the sensitizing substance to other skin areas by his hands. The sensitizing substance may be almost anything. Examples include: poison ivy, medicines, clothes, and soaps. A painstaking and thorough search is necessary to find and remove the allergen. Treatment includes removal of the allergen, mild bland applications, and antihistaminics in some cases.

g. **Other Conditions.**

(1) **Psoriasis.** Psoriasis is a chronic, recurrent disease of the skin, characterized by reddish, rounded lesions that are covered by silvery scales. When a scale is removed, it leaves a small bleeding point. The disease tends to begin on the elbows, knees, or scalp, and to spread over the whole body.

(2) **Acne vulgaris.** Acne vulgaris is a chronic inflammation of the sebaceous glands (oil glands) of the skin, which usually develops during adolescence. Lesions develop rapidly and in crops, located mostly on the face, sometimes on the sternal region, the shoulders, and the back. The lesions may cause considerable scarring on healing. Treatment includes good personal hygiene to help prevent secondary infections, dietary measures, antibiotics, and various skin lotions.

2-14. **SIGNS AND SYMPTOMS OF SKIN DISEASE**

a. **Pruritis (Itching).** The most common, most annoying, and least specific symptom encountered in dermatologic conditions is pruritis. Among the causes of itching may be included infectious agents, allergic conditions, neuroses, parasitic infestations, dryness of the skin, anoxia of the skin, and chronic irritation of the skin. The actual pathological change responsible for this symptom takes place in minute nerve endings in the skin. The exact change is not known, but these endings become increasingly sensitive to the various causative agents, and itching will appear more easily.
b. **Pain.** Pain is not seen very often in skin disorders, although there may be a burning sensation associated with indurating lesions.

c. **Edema.** Edema is the collection of fluid in the tissues of the dermis. This is usually localized at least to a particular area of the body. When individual lesions take the form of a small area of swelling with associated pruritis, the eruption is called urticaria. The edema may be extensive, involving either the face or part of an extremity. When the edema involves the face, the eyes may be forced shut by the swollen tissues. Edema is seen in numerous systemic disorders, but there are usually enough other symptoms of the underlying disease to prevent confusion with a skin reaction to an allergen.

d. **Scales.** The upper layer of the epidermis may accelerate the production of keratinized (horny) cells, and these will begin to flake off following minimal trauma. These flakes of dry, dead tissue are called scales. Many lesions show scaling as the disease kills additional layers of the epidermis. Occasionally the scales may take characteristic shapes because of plugging pores in the skin.

e. **Weeping.** Weeping is the oozing of fluid from the surface of a lesion. This occurs whenever sufficient layers of epidermis have been destroyed and removed so that the capillary beds of the dermis are near the surface. Weeping is serious because of its tendency to macerate (soften) the lesions and the surrounding skin. As the healthy tissue breaks down, the disease spreads more easily. Weeping is frequently seen in body creases and must be guarded against. The use of powders to dry weeping lesions is the first step in the successful therapy of such conditions.

f. **Scaling and Weeping.** There may be a combination of scaling and weeping. This will result in the formation of a crust over the lesion. Any blood, pus, or other exudate from the lesion may add to this crust. The raw surface of the lesion will be protected by this crust, but the fluid collecting under it will be an excellent growth medium for bacteria, thus adding infection to the existing problems. Crusts may be a cause of itching, and frequently they will be ripped off by the patient, either on purpose or accidentally while scratching.

g. **Fissures.** Fissures are small cracks in the skin. These are very common and occur when there is an excessive drying of the skin. The corners of the mouth are common sites for this condition. Fissure may also be seen in areas of lichenification (places where the tissue has become thickened from continuous irritation). Fissures are open portals of entry for bacteria.

h. **Fever.** Fever is usually seen in infectious diseases, but it may also be present in cases of allergy. This is not a common concern to the dermatologist, because disease limited to the skin will not cause fever.
2-15. TREATMENT

a. Symptomatic. Many forms of treatment are available for disorders of the skin. Frequently, treatment is instituted merely to relieve the distressing symptoms and may have no effect on the course of the disease. The antipruritic (anti-itch) medications are of this type. Both lotions and powders are used and are effective in a fair percentage of cases. Systemic antipruritics are not very effective but are of some use in systemic diseases that have itching at some stage. Antihistamines are used primarily in allergic reactions, and they are extremely effective in relieving the itching as well as in suppressing the skin lesions.

b. Drugs.

(1) Antibiotics. Antibiotics may be used topically when there is an infection in the skin, either primary or secondary. The infection should always be present before the antibiotic is used. The prophylactic (preventive) use of topical antibiotics is dangerous because these drugs have a higher than usual incidence of sensitivity reactions when used in this manner.

(2) Steroids. The numerous synthetic steroid preparations have been of great assistance to the dermatologist. Many diseases will be controlled by steroids after all other means of treatment have failed. Steroids usually are given systemically, and they may cause serious consequences; therefore, steroids are normally used only after other means of therapy have failed. The topical use of steroids, however, is effective and safe because negligible quantities are absorbed, even through raw lesions.

(3) Antipyretics. Aspirin and acetaminophen are the most effective agents available for reducing temperatures.

Section V. NATURE AND CAUSES OF DISEASE

2-16. DEFINITION OF DISEASE

Disease can be defined as a derangement of the normal functioning of one or more of the body processes. This interference with the normal body functions either prevents them from taking place, or causes them to act in an abnormal manner. For example, a tumor may obstruct the flow of intestinal contents, or bacteria may cause irritation or inflammation. In the following text, consideration will be given to those factors which are responsible for interference with the normal body functions, in other words, the etiology (causes) of disease.
2-17. CAUSES OF DISEASE

There are nine major causes of disease (a through i below). Frequently a disease may be produced by a combination of these causes, or the same disease may be caused by different factors in different patients, or the cause may be unknown (see paragraph j below).

a. Prenatal Influences. By this is meant those factors which may operate before birth to produce disease in the offspring; factors may be manifested at birth (congenital disease) or may not become obvious until later in life.

(1) Heredity. Among prenatal factors, one influence is heredity. A disease may be genetically transmitted from a parent to offspring. The parents who transmit the disease to their offspring may or may not have the disease themselves. Examples of some hereditary diseases are hemophilia and congenital dislocation of the hip.

(2) Congenital influence. Diseases affecting the mother while she is pregnant with the baby may adversely affect the offspring. For example, some diseases may be transmitted directly to the baby via the bloodstream, as is often seen in the case of syphilis in the mother. Alternatively, the pregnant woman may have a disease such as German measles, which interferes with the normal development of the child in the uterus (in utero), although, the child does not acquire the disease. Malnutrition in the mother could result in a poorly nourished baby, which could also interfere with the normal development of the child.

(3) Mechanical. Purely mechanical factors are also felt to be responsible for some abnormalities present at birth. Abnormal positioning of the baby in utero is felt to be occasionally responsible for wryneck; torsion or twisting of the umbilical cord would limit the blood and food supply to the baby, and dire results could occur. Any defect or disease present at the time of birth is called a congenital disease or condition. Injuries or effects sustained during the process of being born may be included here.

b. Parasites. Parasites are organisms that live on or within the body of the man or any other living organism, and at the expense of the one parasitized. Parasites may live on the surface of the skin (ectoparasites), or they may enter the body through the skin, the respiratory tract, the gastrointestinal tract, or the genitourinary tract where they may enter the bloodstream and be carried to distant parts of the body. If they live inside the body, but outside the cells, they are called extracellular endoparasites; if they enter the body's cells, they are called intracellular endoparasites. They all cause disease by interfering with the tissue and organ functions; they accomplish this by elaborating toxins, or poisons; by causing inflammation, or irritation; by producing enzymes which destroy tissue; and by causing mechanical blockage of function.
(1) **Viruses.** These are the smallest agents known to produce disease; whether they are living organisms or complex chemical compounds is not known. They are known to be intracellular endoparasites that cause such common diseases in man as poliomyelitis, common cold, influenza, measles, mumps, chickenpox, smallpox, hepatitis, encephalitis, warts, rabies, yellow fever, and lymphogranuloma venereum.

(2) **Rickettsiae.** These organisms are larger than viruses, but are still very small intracellular endoparasites. These organisms are transmitted to man by mites, ticks, fleas or lice, and they produce Rocky Mountain spotted fever, typhus (epidemic and endemic), scrub typhus (tsutsugamushi fever), Q fever, and Rickettsialpox.

(3) **Bacteria.** Bacteria are minute, one-celled, organisms that may occur alone or in large groups called colonies. Significant bacteria can be divided by their shape into three main groups.

   (a) **Cocci.** Cocci are round, one-celled bacteria. The primary members of this group are staphylococci, which group themselves in clusters; streptococci, which arrange themselves in chains; and diplococci, which arrange themselves in pairs. All are pyogenic (produce pus).

   (b) **Bacilli.** Bacilli are rod-shaped; however, they vary from straight to irregular-curved and branched shapes. They cause such common diseases as typhoid fever, diphtheria, tuberculosis, and leprosy.

   (c) **Spirochetes.** Spirochetes are spiral-shaped and can move or twist. Spirilla and Treponema pallidum are examples. The latter causes syphilis.

(4) **Fungi.** These extracellular endoparasites or ectoparasites are larger and higher in the scale of plant life than are the bacteria. They include the yeast and molds, and produce infections of the skin such as ringworm, and infections of the mucous membranes such as thrush. Some attack internal organs, especially the lungs and central nervous system, very often with disastrous results.

(5) **Protozoa.** These are one-celled animal parasites (either extracellular or intracellular) that cause such common diseases as malaria and amoebic dysentery.

(6) **Metazoa.** These many-celled, larger animals include the helminthes (worms) such as the ascaris, the hookworm, the pinworm, the tapeworms, and the flukes, as well as the arthropods (mites, lice, and so forth.).

   c. **Intoxicants.** Intoxication is the process of taking any chemical substance that causes disease or injury into the body. Many substances are very useful in small amounts, and do not cause intoxication; but the same substances may be very toxic in larger amounts, and result in severe illness or death.
d. **Trauma.** Trauma may be defined as injury sustained by the body as the result of a physical agent or force. The physical agents that may produce trauma or injury of the body are:

1. **Light.** In excessive amounts, light can cause temporary blindness.
2. **Heat.** Excessive heat can cause burns of the body, heat cramps, heat exhaustion, or heatstroke.
3. **Cold.** Cold is absence or deficiency of heat. Exposure to low temperatures can result in frostbite and other cold injury.
4. **Electricity.** One can sustain burns, electric shock, or both when exposed to this agent.
5. **Ionizing radiation.** Excessive exposure to x-rays or to radioactive elements can produce burns, radiation sickness, malignancies, cataracts of the eye, and genetic changes.
6. **Mechanical forces.** These agents produce contusions, abrasions, lacerations, fractures, sprains, and strains.
7. **Sound.** Exposure to excessive noise can cause temporary or permanent deafness to certain wavelengths.

e. **Circulatory Disturbances.** Any interference with the blood flow to a portion of the body results in a circulatory disturbance.

1. **Ischemia.** A decrease in the normal diameter of an artery supplying a portion of the body results in a decrease in the amount of blood that flows to the part. The area becomes more pale and colder than normal, and is said to be ischemic.
2. **Thrombosis.** Whenever a vessel wall becomes diseased, the blood tends to collect at the diseased or injured site and form a thrombus (clot). The presence of an intravascular blood clot is called thrombosis.
3. **Embolism.** Portions of a thrombus may break loose, and then travel freely in the bloodstream until stopped by a vessel too small for the particle to pass through; or foreign particles, such as air bubbles or fat globules, may be introduced into the bloodstream and travel freely until stopped by a smaller vessel. These foreign particles are known as emboli. The process of obstruction or occlusion of a blood vessel by a transported foreign material is known as embolism.
(4) **Gangrene.** When an extremity or portion thereof loses its arterial blood supply as the result of thrombosis, embolism, trauma, or from any other cause, a massive area of the tissue dies, and is said to have undergone gangrene, or to have become gangrenous.

(5) **Infarction.** Death of the tissue of an organ or portion thereof as the result of the loss of its blood supply is known as infarction. The necrotic (dead) area itself is called an infarct.

(6) **Hemorrhage.** This is the loss of blood.

f. **Neuropsychiatric Disturbances.**

(1) **Organic disorders.** Injury or disease of the nervous system tissue may result in the loss of the nerve supply to a particular part of the body. Therefore, because of loss of enervation, secondary changes in the tissue occur, such as atrophy. In addition, the normal functions may become paralyzed, and there may be loss of sensation and other changes.

(2) **Functional disorders.** Disturbances of the mind or psyche may produce neuroses, psychoses, or character and behavior disorders. Such disturbances may or may not be inherited; the environment, childhood experiences, and many other factors have a bearing on the production of psychiatric disturbances.

g. **Mechanical Disturbances.** Certain static mechanical abnormalities may result in disease within the body. For example, volvulus or twisting of the intestine on itself, torsion of the spermatic cord, strangulation of a hernia, and intussusception, are all often on a purely mechanical basis.

h. **Disorders of Metabolism, Growth, or Nutrition.** Metabolism has to do with the total chemical cycle of converting substances into forms that are usable to the body. Metabolism occurs in two phases.

(1) **Anabolism.** In anabolism, foodstuffs are broke down (digested) and reconverted into compounds which can be utilized as energy, or as building blocks for new tissue cells and substances. In anabolism, living tissue is manufactured from nonliving substances. This results in growth or replenishment.
(2) **Catabolism.** Catabolism is the breaking down of the body’s complex substances by wear, tear, and age into waste products of simpler composition for elimination. Metabolism and growth then are dependent on the body’s receiving enough of the proper foodstuffs in order to supply its needs, in other words, on proper nutrition. Metabolism and growth are further regulated by the vitamins and hormones. The hormones are supplied by the ductless glands of the body (the pituitary, thyroid, parathyroid, pancreas, adrenals, and gonads), and any disorder of these glands will profoundly disturb growth and metabolism. The vitamins are supplied by the diet; if the diet or nutrition is unsatisfactory, disturbances in growth and metabolism can result also. Therefore, metabolism, growth, and nutrition are closely related to one another.

i. **Neoplasms.** Normally, the body grows by multiplication of its cells. At first, in the embryo, these cells are all alike or undifferentiated. However, as they multiply, they come under the influence of certain factors and take on different forms and different functions to make up the different tissues, organs, and systems of the body (that is, they become differentiated). This growth and differentiation is a slow, methodical, controlled process. However, some cells may not differentiate entirely, but for some unknown reasons, retain varying degrees of undifferentiation, break free of their growth control, and form a new growth (neoplasm) or tumor. Tumors cause disease by interfering with the function of normal cells, tissues, and organs. They may cause pressure on an organ so that its normal cells are destroyed or its blood supply is shut off. A tumor may fill the cavity of an organ so that the organ wall cannot contract properly. The tumor may also use up the nutritive materials taken into the body so that there is not enough for the normal tissues. Tumors are of two types: benign and malignant.

(1) **Benign.** These are more slowly growing, the cells are more differentiated, the tumor is well separated from the surrounding tissues by its capsule, and can usually be completely removed surgically.

(2) **Malignant.** These are more rapidly growing with very little growth control, and the cells are more primitive or undifferentiated. The cells of the tumor infiltrate or grow between the normal tissue cells, and are much more difficult to remove surgically. Because of this, the malignant tumor tends to recur and tends to metastasize or spread via the blood and the lymph vessels. The common term for malignant tumors is cancer. The medical profession speaks of carcinoma when the malignant tumor arises from tissue that covers the surface of the body, lines a hollow structure, or forms glands, and sarcoma when the malignant tumor arises from any other tissue in the body such as fatty, muscular, bony, or fibrous tissue.

j. **Idiopathic (Unknown) Causes.** There are many diseases of known etiology. The affected organ and effective treatment are often known, however, the cause and the mechanism through which the disease disrupts the body’s functions remain unknown.
Section VI. TREATMENT OF DISEASE AND INJURY

2-18. INTRODUCTION

Patients who have disease or injury must be properly diagnosed and treated. The physician is responsible for these functions; however, the physician may delegate the accomplishment of some of the treatments to other members of the Army Medical Department (that is, physicians' assistants and physical therapists). In general, all types of treatment may be classified as either preventive or corrective.

2-19. PREVENTIVE TREATMENT

Preventive treatment includes all measures used to prevent disease.

a. Preventive procedures include sanitary measures such as cleanliness, proper waste disposal, inspection of food and food handlers, isolation diseased individuals, aseptic surgical technique, and the use insecticides of and rodenticides to control vectors of disease.

b. Another preventive measure is immunization. Active immunity is the result of a direct introduction into the individual's body of an antigenic preparation (frequently bacteria or viruses) so that an individual produces his own antibodies that defend him against the particular antigen introduced. Passive immunity is produced by injecting serum-containing antibodies into an individual. This blood serum may be from animals or humans in which the antibodies were produced by an active immunity process.

c. A third preventive measure consists of preventive psychiatry and mental health work, in which the individual or his environment is manipulated in a manner to prevent excessive mental stress.

2-20. CORRECTIVE / SYMPTOMATIC TREATMENT

People who have some disease or condition want to receive prompt medical treatment. Many people believe that the use of prescribed medications is the only way to ensure that a disease or condition will be cured or improved. The use of drugs does have an important role in the treatment of disease; however, other treatment methods are available. For example, rest, radiotherapy, and physical therapy are very useful in the treatment of certain conditions. In many cases, various treatment methods are used to benefit the patient.

a. Rest prevents overwork of a diseased organ and includes more than freedom from physical work; a patient must have mental rest also.
b. Diet is of extreme importance both in the prevention of disease and in medical care. An adequate intake of proteins, carbohydrates, fats, vitamins, and minerals is necessary in the treatment of all patients. Patients with fever generally require increased amounts of all dietary constituents. Patients with certain diseases require diets in which the various dietary constituents are carefully controlled. One example of a special diet of this type is that for diabetes mellitus, in which the amounts of protein, fat, and carbohydrates must be individually regulated.

c. Nursing care is another essential part of medical care. In addition to doing technical procedures such as administering drugs, nursing service personnel watch for the appearance of changes in the patient's condition. Frequently the personalities of such personnel will be an important factor in promoting the patient's morale, securing his cooperation, and fostering in him a desire to get well.

d. Drugs are substances used in the treatment of disease. They are used to relieve the unpleasant effects of disease and to eradicate the disease. Drugs may be administered externally and internally.

e. Radiotherapy is the use of x-rays, radium, and radioactive isotopes in the treatment of disease.

f. Occupational therapy is treatment that provides a patient with activity to keep his mind and body occupied. It is also used to help the patient regain muscular coordination and control of specific parts of the body.

g. Physical therapy is the treatment of disease by physical means. Various agents used in physical therapy are light, heat, cold, electricity, water, massage, and exercise.

h. Psychotherapy is treatment by various means, which may include the use of drugs, to lessen or rectify abnormal mental conditions. Surgery performed for the same purpose is called psychosurgery.

i. Surgery is the treatment of disease by manual operation or corrective apparatus. It includes the removal of diseased tissue or organs and the repair of injured structures.
EXERCISES, LESSON 2

INSTRUCTIONS: Answer the following exercises by marking the lettered response that best answers the exercise, by completing the incomplete statement, or by writing the answer in the space provided at the end of the exercise.

After you have completed all of these exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers. For each exercise answered incorrectly, reread the material referenced with the solution.

1. From the definition below, select the definition of the term anatomy.
   a. The study of the functions of the body.
   b. The study of the chemical substances in the body.
   c. The study of the structures of the body.
   d. The study of the systems of the body.

2. From the definitions below, select the definition of the term tissue.
   a. A grouping of like cells working together.
   b. The smallest living unit of body construction.
   c. A group of organs working together.
   d. A group of cells that have nothing in common.

3. From the functions below, select the function of the lymphatic system.
   a. Protects the body from drying.
   b. Returns proteins and fluid from the various body tissues to the blood.
   c. Manufactures hormones.
   d. Provides nutrients to the various limbs of the body.
4. From the descriptions below, select the best description of the cytoplasm.
   a. Organelles that perform highly specialized functions in the cell.
   b. A jelly-like substance that coats the outside of the cell membrane.
   c. The part of the cell which manufactures RNA and DNA.
   d. The fluid or semifluid contained inside the cell membrane, but outside the nucleus.

5. From the descriptions below, select the best description of the mitochondria.
   a. The organelle of the cell responsible for producing DNA.
   b. The site of cell respiratory activity.
   c. The part of the cell which is responsible for producing RNA.
   d. The organelle responsible for monitoring the flow of water into the cell.

6. From the definitions below, select the definition of pinocytosis.
   a. A vesicle which engulfs and destroys the cell.
   b. The organelle responsible for producing extracellular fluid.
   c. The production of fluids by the cell.
   d. The engulfing of small particles or fluids by the cell.

7. From the descriptions below, select the description of connective tissue.
   a. The tissue that binds other tissues together and supports other tissues.
   b. The tissue that covers the outer layer of the body.
   c. The tissue that forms the glands and the sense organs of the body.
   d. The tissue that covers the organs in the abdomen.
8. From the list of function below, select the function of the skin.
   a. Controls the size of the patient.
   b. Produces chemicals for body growth.
   c. Prevents perspiration on hot days.
   d. Detects heat, cold, pressure, and pain.

9. Select, from the group of descriptions below, the best description of pediculosis.
   a. An infestation of the skin with fungus.
   b. An infection of the skin with bacteria.
   c. An infestation of the skin with lice.
   d. An infection of the skin with ringworm.

10. Select, from the group of descriptions below, the best description of scabies.
   a. A disease caused by a very small mite, which burrows into the skin.
   b. A disease caused by small bacteria, which includes the skin.
   c. A disease characterized by itching and fungal growth.
   d. A disease characterized by the growth of bacteria on the skin.

11. Select, from the descriptions below, the best description of a furuncle.
   a. An acute inflammatory lesion produced by the infection of a hair follicle or skin gland by streptococci bacteria.
   b. An acute, inflammatory lesion produced by the infection of a hair follicle or skin gland by staphylococci bacteria.
   c. An acute lesion produced by an infection of a hair follicle by fungal organisms.
   d. An acute, inflammatory lesion produced by the infection of a hair follicle by allergens.
12. Select, from the definitions below, the meaning of the term pruritis.
   a. A chronic, recurrent disease characterized by reddish, rounded lesions.
   b. A chronic inflammation of the sebaceous glands of the skin.
   c. A parasitic infestation of the skin caused by lice.
   d. Itching.

13. Select, from the descriptions below, a description of edema.
   a. A collection of fluid in the tissues, resulting in swelling.
   b. A raised area of the skin characterized by cellulitis.
   c. A collection of protein in injured tissues resulting in bleeding.
   d. A collection of raised swellings on the skin characterized by itching and discoloration.

14. From the definitions below, select the definition of the term disease.
   a. A condition characterized by functioning of certain glands.
   b. A derangement of the normal functioning of one or more body processes.
   c. A dysfunction of the body caused by lack of exercise.
   d. A dysfunction of the systems of the body characterized by lowered blood sugar.

15. Select, from the descriptions below, the description of physical therapy.
   a. The use of drugs to treat disease of mental origin.
   b. The treatment of disease by the administration of antibodies.
   c. The treatment of disease by such methods of heat, light, and cold.
   d. The treatment of disease by the removal of diseased organs or tissues.

   Check Your Answers on Next Page
SOLUTIONS TO EXERCISES, LESSON 2

1. c (para 2-1)
2. a (para 2-2b)
3. b (para 2-3f)
4. d (para 2-5b)
5. b (para 2-5d)
6. d (para 2-6)
7. a (para 2-9b)
8. d (para 2-11c)
9. c An infestation of the skin with lice. (para 2-13e(1))
10. a (para 2-13e(2))
11. b (para 2-13c(1))
12. d (para 2-14a)
13. a (para 2-14c)
14. b (para 2-16)
15. c (para 2-20g)

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