Module 7
THE HUMAN BODY:
STRUCTURE, FUNCTION, ASSESSMENT

Purpose
The purpose of this module is to present a basic review of the human body, its major systems, their primary functions, and basic assessment techniques.

The module contains eight units, each with terms, introduction to the structures and functions of that system, and basic assessment techniques. At the end of each unit is a self-test to help you check your understanding of the material you have just studied. Try to master one unit before moving on to the next.

General Objectives
Upon completion of this module, you should be able to:

- Name each major body system.
- Describe the anatomy and physiology of each major body system.
- Describe basic physical assessment techniques used for each body system.
- Identify common data gathered in physical assessment of each body system.
- Define common terminology related to anatomy, physiology, and assessment of each body system.

Introduction
The human body can be viewed as a complex society of cells. Many different types of cells are structurally and functionally combined and interrelated in a variety of ways to carry on the functions essential to the survival of the organism as a whole. Several major systems functioning together comprise the human body.

In this module, those systems are briefly described in the text and illustrated in graphic form. In addition to the anatomy and physiology of each body system, an overview of assessment techniques for each system is discussed. Terms commonly used for each system introduce each unit.

The body systems discussed in this module include:

- Integumentary
- Musculoskeletal
- Circulatory (blood & lymph)
- Respiratory
- Neurological, including ear & eye
- Digestive
- Urinary
- Endocrine
- Reproductive (male & female)

Each system is described and illustrated individually; however, they are interdependent for survival of human life. As you proceed through the module, it will become more evident that no one system can or would survive without the others.
General Terms

**Inspection:** the visual examination, that is, assessment by using the sense of sight

**Palpation:** the examination of the body by using the sense of touch

**Percussion:** a method in which the body surface is struck to elicit sounds that can be heard or vibrations that can be felt

**Auscultation:** the process of listening to sounds produced within the body

**Cell:** the basic biological and structural unit of the body consisting of a nucleus surrounded by cytoplasm and enclosed by a membrane

**Tissue:** group of similar cells that perform a common function

**Organ:** group of several tissue types that perform a special function

**Organ System:** a collection of organs that together perform an overall function

**Base:** the part of an organ nearest its point of attachment

**Duct:** a canal-like structure that transports fluid or air from one part to another

**Foramen:** an opening or hole in an organ or part of an organ

**Meatus:** an opening or channel

**Orifice:** a mouth-like opening

**Sinus:** a space or cavity inside some of the cranial bones

**Tract:** a definite region or area of the body, especially a group, series, or system of related parts or organs

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**Unit 1**

**Integumentary System**

Terms

**Apocrine Glands:** sweat glands located in the axilla and genital regions

**Axilla:** armpit

**Cuticle:** skin fold covering the root of the nail
**Dermis:** the deeper of the two major layers of the skin, sometimes called “true skin”

**Dilate:** expand

**Eccrine Glands:** small sweat glands distributed over the total body surface

**Epidermis:** outermost layer of the skin, sometimes called “false skin”

**Evaporation:** heat being lost from the skin by sweat being vaporized

**Hair Follicles:** small tube where hair growth occurs

**Hives:** condition of the skin characterized by the appearance of very itchy raised areas

**Impetigo:** highly contagious bacterial skin infection that occurs most often in children

**Integumentary System:** the skin; the largest and most important organ in the body

**Lanula:** moon-shaped white area at the base of the nail

**Perspiration:** sweating; helps maintain body temperature

**Pruritus:** severe itching

**Sebaceous Glands:** oil-producing glands found in the skin

**Sebum:** oily substance secreted by sebaceous glands

**Sensory Perception:** recognition of a sensation such as pain, touch pressure, and heat

**Skin Appendages:** hair, nails, sweat glands, oil glands, and ducts

**Stratified Epithelial Tissue:** tissue in which cells are arranged in layers

**Structures and Functions**

The major structures of the integumentary system include the skin and its appendages, which include hair, nails, and specialized sweat- and oil- producing glands.

The skin has many important functions including:
- Protection of underlying tissue against invasion of harmful bacteria
- Bars entry of most chemicals
- Minimizes the chances of mechanical injury to underlying structures
- Regulates body temperature
-Synthesizes important chemicals
- Sense organ
The skin is divided into three layers:
1. the epidermis,
2. the dermis,
3. and the subcutaneous tissues.

**Epidermis**

The epidermis is an avascular, cornified, cellular structure. It is stratified into several layers and is composed chiefly of keratinocytes, cells that produce keratin. Keratin is a tough, waterproof material that provides cells in the outer layer of the skin with a horny, abrasion-resistant, and protective quality. The stratum corneum is the tough outer layer of the epidermis. Cells filled with keratin are pushed to the surface of the epidermis. The dry, dead cells become dislodged by the thousands and “flake off” onto our clothes, our bathwater, and things we handle. The innermost layer of the epidermis contains melanocytes, the source of melanin, the pigment that gives color to the skin and hair.

Epidermal appendages include the hair, nails, eccrine sweat glands, apocrine sweat glands, and sebaceous glands. These are formed by growth of the epidermis into the underlying dermis. The hair and nails are keratinized appendages and have no significant function in human beings. The eccrine, sebaceous, and apocrine appendages are glandular. The sebaceous glands usually arise from the hair follicles and produce sebum, which has a lubricating effect on the horny outer layer of the epidermis. The eccrine sweat glands are widely distributed and have an important function in the dissipation of body heat as sweat is produced and evaporated. The apocrine sweat glands are found in the axillary and genital areas and usually open into the hair follicles. The sweat produced by the apocrine glands decomposes when contaminated by bacteria, resulting in the characteristic body odor.

**Dermis**

The dermis is the deeper of the two primary skin layers and is much thicker than the epidermis. It is a tough connective tissue that contains lymphatics and nerves and is highly vascular. It supports and nourishes the epidermis. The upper region of the dermis is characterized by parallel rows of peg-like projections called dermal papillae. They help bind the skin levels together and form the ridges and groves that make fingerprinting possible.

**Subcutaneous**

The subcutaneous layer immediately under the dermis is distinguished by the storage of fat and is important in temperature insulation. It also serves as a stored source of energy for the body and can be used as a food source, if required. The subcutaneous tissue also acts as a buffer or shock-absorbing pad and helps protect underlying tissues from injury caused by impact to the body surface.

**Summary**

The skin and its appendages—hair, nails, oil and sweat glands—make up the integumentary system. Protection of body tissues against infection, injury, and loss of fluids is a major function of this system. Skin also plays a vital role in maintaining normal body temperature. Sensory receptors in the skin enable
humans to perceive pain, heat, touch, and pressure, while motor fibers produce a required reaction to these sensations.

**Assessment**

Assessment of the skin involves inspection and palpation. Examination of the skin and appendages begins with a general inspection followed by a detailed examination. A good light source is necessary. Indirect natural daylight is preferred. Observation of the entire integumentary system, which includes skin, hair, and nails is performed with the client wearing a hospital gown. Comparison of symmetrical anatomical areas is made throughout the examination.

The skin is inspected for color and vascularity, and for evidence of perspiration, edema, injuries, or skin lesions. During the examination, the practitioner should think about the underlying structures, the thinness of the skin, and the particular kind of exposure of a body part.

Skin color varies from person to person and from one part of the body to another. Skin color varies from light to deep brown; from ruddy pink to light pink; from yellow overtones to olive, depending upon ethnicity. The exposed areas of the body, including the face, ears, back of neck, and backs of hands and arms are noticeably different and may be more damaged after long exposure to the sun and weather.

Palpation of the skin is used to amplify the findings observed on inspection and is usually carried out simultaneously as each body part is examined. Changes in temperature, moisture, texture, and turgor are detected by palpation. Texture refers to the fineness or coarseness of the skin, and changes may indicate local irritation or trauma to defined skin areas or may be associated with problems of other systems. Turgor refers to the elasticity of the skin and is most easily determined by picking up a fold of skin of an extremity and observing how quickly it returns to its normal shape.

The assessment of the nails is important to determine not only their condition, but also possible evidence of systemic diseases. The condition of the nail can reflect an individual’s general state of health, state of nutrition, occupation and level of self-care. The nails are examined for shape, normal dorsal curvature, adhesion to the nail bed, regularity of the nail surface, color, and thickness. The skin folds around the nails are examined for any color changes, swelling, increased temperature, and tenderness. (Figure 2)

When assessing an individual’s hair, consider developmental changes, hair care practices, and ethnicity differences. The hair over the entire body is examined to determine the color, distribution, quantity, thickness, texture, and lubrication of hair. There is a normal male and female hair pattern that evolves after puberty. Note any unusual distribution and growth that may be related to a hormonal disorder.

**Summary**

Assessment of the integumentary system includes examination of the hair, skin, and nails. Inspection and palpation are the means of gathering the assessment data.
Unit 1
Self-Test

1. The major structure of the integumentary system are
   a. _____________________________
   b. _____________________________
   c. _____________________________

2. The three layers of the skin include
   a. _____________________________
   b. _____________________________
   c. _____________________________

3. One function of the integument includes maintaining body _____________________.

4. Turgor refers to the _________________________ of the integument.

5. Two methods of gathering data for assessment of the integument include
   a. _____________________________
   b. _____________________________
Unit 2
Musculoskeletal System

TERMS

**Abduction:** movement of a limb away from the midline of the body or one of the parts

**Adduction:** movement of a limb toward the central axis of the body or beyond it

**Articular cartilage:** a special type of dense connective tissue which covers bone surfaces in a joint

**Articulation:** junction of two or more bones; a joint

**Bone:** an individual part of the skeleton; osseous tissue

**Bone marrow:** a vital substance found in the medullary canal of long bones and in the porosities of cancellous bone

**Bone shaft:** the body (diaphysis) of a long bone

**Cancellous bone:** spongy, lightweight, porous bone

**Cartilage:** relatively hard, dense connective tissue which serves to cushion jolts and bumps

**Circumduction:** movement of a body part in a circular pattern

**Compact bone:** hard, dense bone which composes the shaft or diaphysis; compact and cancellous bones differ mainly in degree of porosity

**Cranium:** skull bones which encase the brain

**Diaphysis:** shaft of long bone

**Endosteum:** lining inside bones (medullary or marrow cavity) which makes new bone

**Epiphysis:** two ends of a long bone

**Extension:** straightening of a limb so that the joint angle is increased, the placement of the distal segment of a limb in such a position that its axis is continuous with that of the proximal segment, or the pulling or dragging force exerted on a limb in a direction away from the body

**External rotation:** turning the body part away from the midline

**Femur:** long bone of the thigh which extends from hip to knee

**Flexion:** bending of the joint to approximate the bones it connects, thereby decreasing the joint angle
**Internal rotation:** turning the body part inward toward the central axis of the body

**Involuntary muscle:** a muscle not subject to control by human will

**Joint:** articulation

**Joint capsule:** the fibrous sheath which encloses articular bone surfaces

**Ligament:** band of exceptionally strong, flexible connective tissue which joins articular bone surfaces

**Locomotion:** process of moving about

**Medullary canal:** hallow in the center of a long bone; contains bone marrow

**Metaphysis:** flaring portion of bone between epiphysis and diaphysis

**Muscle:** groups of special cells (muscle fibers) with the ability to contract or shorten

**Muscle insertion:** point of attachment of skeletal muscle to bone most moved by its contraction

**Muscle origin:** site of attachment of skeletal muscle to bone which remains most stationary during its contraction

**Musculoskeletal system:** the organs and structures which function to support, stabilize, and shape the body, protect internal organs, and aid in locomotion

**Patella:** kneecap

**Patellar tendon:** strong cord of fibrous tissue which connects the rectus femoris muscle to the kneecap

**Pelvis:** bony structure surrounding the pelvic cavity

**Periosteum:** double layer of connective tissue which covers bone except at joints; inner layer can make new bone

**Rectus femoris muscle:** a major muscle of the front of the thigh

**Skeletal muscle:** muscle which is connected to bone

**Skeleton:** bony framework of the body

**Smooth muscle:** involuntary muscle tissue which lacks cross-striations on microscopic exam; found in areas such as the gastrointestinal tract, respiratory tract, and uterus

**Sternum:** breastbone
Striated muscle: muscle which has cross-striations on microscopic exam; found in skeletal muscles

Synovial membrane: lining of the joint capsule

Tendon: fibrous tissue structure which serves to connect muscle to bone and other parts

Voluntary muscle: muscle under control of the conscious will

Xiphoid cartilage: lower tip of the sternum; composed of cartilage

STRUCTURES AND FUNCTIONS

The structures which make up the musculoskeletal system are the bones, joints between bones, muscles, tendons, ligaments, and cartilage. This system as a whole is responsible for these important functions:

- Body shape and support
- Protection of vital internal organs
- Locomotion (ability to move about)

In addition, the marrow found in the depths of many bones produces essential blood cells. Bones also are chemical reservoirs of calcium and other minerals.

BONES AND JOINTS

The skeletal system is made up of 206 bones and the joints by which they articulate. Figure 3 shows that the body shape closely follows skeletal shape. Enclosed spaces (cavities) are formed by the ribs, cranium, and pelvis. Nature provides protection for vital structures such as the brain, heart, liver, and internal reproductive organs by enclosing them within the cranium, rib cage, and pelvis.

Bone hardness is essential to stability and locomotion, yet the human body must bend and flex in order to move. Provision for locomotion is made by the manner in which bones come together at joints. The construction of a movable joint prevents the two ends of bone from scraping against each other. The outside layer of the joint is tough fibrous connective tissue called the capsule. The next layer is the lining of the joint cavity, the synovial membrane. This smooth, slippery tissue secretes a fluid to lubricate the joint. Covering the two ends of bone is tissue called articular cartilage. Its purpose is to cushion and absorb jolts. The bone ends are held securely in place by the joint capsule attached to both bone shafts and by ligaments, bands of strong fibrous tissue.

Bones can be classified according to shape: long, short, flat, and irregular. The femur, or thighbone, is an example of a long bone. The shaft of a long bone is called the diaphysis; the two ends of a long bone are the epiphysis, and the flanged areas which support the epiphyses are called metaphyses.

Bones are covered (except at joints) by periostea, a strong fibrous membrane. The blood supply to the bone pierces the periostea to provide nutrition to the bone. The next layer is compact bone which makes up the shaft or diaphysis. Compact bone is very hard and strong. In the center of the shaft is a small cavity, the medullary canal. Lined by the endosteum, the medullary canal contains yellow bone
marrow. The type of bone which forms the epiphysis differs from the bone of the shaft. It is called cancellous bone and is more spongy, porous, and lightweight than compact bone. Red bone marrow, found inside the cavities of cancellous bone, is vital for producing, maintaining, and disposing blood cells in the adults.

MUSCLES

Muscles are organs composed of many separate fibers which are able to contract (shorten). There are hundreds of muscles in the human body. Depending on its appearance under the microscope, a muscle may be classified as smooth or striated. Skeletal muscles are striated (See Figure 5).

Muscles are also classified as voluntary or involuntary, depending on their nerve supply. The human heart, for example, is an involuntary muscle because its nerve stimulus does not depend on the conscious will.

Skeletal muscles are attached to bones and are essential to locomotion. The origin of a muscle is its point of attachment to the bone which remains most stationary during muscle contraction. The insertion of the same muscle is its point of attachment at the other end to the bone which is moved by muscle contraction. For instance, the origin of the rectus femoris muscle is on the femur and its insertion is on the kneecap. When the leg is flexed at the knee (as in sitting position) this muscle is relaxed. When the rectus femoris contracts or shortens, it pulls the lower leg upward to a straight-out position by force of the patellar tendon.

One single muscle does not work alone. Groups of muscles must contract simultaneously to bring about body movement. Nerve impulses transmitted from the brain to the skeletal muscles serve to stimulate their contraction. When the nerve pathway is interrupted by disease or injury, such as polio or severed spinal cord, skeletal muscles beyond the point of interruption no longer receive their stimuli and are paralyzed.

Because muscles require oxygen and a blood supply to perform their functions, the musculoskeletal system is dependent on the circulatory, respiratory, nervous, and other systems.

TENDONS, LIGAMENTS AND CARTILAGE

Three other types of structures are intimately related parts of the musculoskeletal system. Tendons are cords of strong, elastic, fibrous tissue which attach muscles to bones. When tendons cross movable joints as they do at wrists, ankles, and fingers, they are encased in a synovial membrane sheath for smooth gliding action.

Ligaments are bands of tough, flexible connective tissue which join the articular surfaces of bones. Ligaments are made exceptionally strong by the manner in which their collagen fibers are oriented against the forces applied to them.

Cartilage, another type of connective tissue, is relatively hard, has a very smooth surface, and no direct blood supply. Its nutrition is derived from joint fluid. Cartilage is compressible tissue which acts to cushion jolts and bumps. Thus, it is found in many areas of the musculoskeletal system. The
lower tip of the breastbone (sternum) is the xiphoid cartilage; there is cartilage at most articular bone surfaces, and the ribs are connected to the sternum by cartilage.

Summary: The musculoskeletal system is made up of bones, joints, muscles, tendons, ligaments, and cartilage. The chief functions of this important system are the provision of body shape, support, and stability; protection of vital internal organs; locomotion; production of essential blood cells; and storage of calcium plus other minerals.

ASSESSMENT

The cephalocaudal (head to toe) organization for examination is used in the assessment of the bones, joints, and muscles. This organization provides order and aids in avoiding omissions.

Thorough assessment of the musculoskeletal system can be accomplished only through the appropriate exposure of the client. The ambulatory individual can best be examined in shorts or swimming trunks.

For each examination, the client should be in the position that provides the greatest stability of joints. General inspection of the musculoskeletal system includes a visual scanning for symmetry, contour, size, involuntary movement of the two sides of the body, gross deformities, areas of swelling or edema, and ecchymoses or other discoloration.

The posture, or stance, and body alignment are viewed from both in front of and behind the client. The structural relationships of the feet to the legs and the hips to the pelvis are noted, as are those of the upper extremities, shoulder girdle, and upper trunk. The shape of the spine is assessed, and its structural apposition to the shoulder girdle, thorax, and pelvis are ascertained.

The musculoskeletal examination frequently includes the measurement of the extremities for length and circumference. Measurements of length are made when the symmetry of two limbs is questioned or to determine whether limbs are in normal range.

The muscles are examined for gross hypertrophy or atrophy. Measurements taken of limbs at their maximum circumference may provide a baseline for comparison when swelling or atrophy are suspected or in subsequent routine examinations. The limbs should be in the same position and the muscles in the same state of tension each time measurements are performed. Palpation is used in the examination of the musculoskeletal system to detect swelling, localized temperature changes, and marked changes in shape.

The consistency of the muscle on palpation is noted. Muscle tone, or tonus, is the tension that is present in the resting muscle. It is also seen in the slight resistance felt when the relaxed limb is passively moved. While palpating the muscle, the examiner should be alert to fasciculations, which are involuntary contractions or twichings of groups of muscle fibers or tremors which are involuntary tremblings of a limb or body part. Muscle strength may be assessed throughout the full range of motion for each muscle or group of muscles. Assess for equal strength on each body side.
Summary. Assessment of the musculoskeletal system is carried out in an organized manner. Inspection and palpation are used to assess symmetry and strength of bones and muscles, as well as joint range of motion, proceeding from head to toe.
Unit 2
Self-Test

1. One function of the musculoskeletal system is to provide ________________ and ________________ for the body.

2. Muscles are classified as ________________ or ________________.

3. ________________ are bands of tough flexible connective tissue which join the articular surfaces of bones.

4. During assessment of the musculoskeletal system, muscles are assessed for ________________ or ________________.

5. ________________ and ________________ are methods of gathering data for musculoskeletal assessment.

Unit 3
The Circulatory System:
Blood and Lymph

TERMS

**Antibodies:** substance built up by lymphoid tissue as defensive response to invasion by organisms, foreign proteins, etc.

**Aorta:** largest artery in the body; arises from the heart and courses down the body trunk

**Aortic arch:** curved portion of the aorta which courses upward and then turns downward to form an arch

**Aortic bifurcation:** distal end of the aorta at which point the artery divides into the two common iliac arteries

**Aortic valve:** fibrous tissue flaps or leaflets which open and close between the left ventricle and the aorta; valve closure prevents backflow (reflux) of blood

**Arteriole:** a very small artery

**Arteries:** elastic, extensible vessels which carry blood in the direction away from the heart

**Atrium:** one of the two upper chambers of the heart (right and left)

**Bicuspid valve:** one of the two-leaflet heart valve between the left upper and left lower heart chambers; the bicuspid valve is also called the mitral valve
Blood capillary: a microscopic vessel through which blood travels from arteriole to venule; oxygen/carbon dioxide exchange occurs across capillary walls

Carotid arteries: vessels which provide the major blood supply to the head and neck

Circulatory: pertaining to movement through a circuitous route with return to origin

Cisterna chyli: dilated portion at the origin of the thoracic duct into which several lymph-collecting vessels empty

Heart: powerful, muscular organ which pumps blood to all parts of the body

Iliac artery, common: vessel which carries major blood supply to each leg

Lymph: substance continuously formed by filtratin from tissue fluids

Lymphadenitis: inflammation of lymph glands

Lymphadenopathy: general term meaning disease of the lymph glands

Lymphatic duct: one of two large vessels which empty lymph collected in various parts of the body into the venous bloodstream

Lymphatics: channels of the lymph circulatory system

Lymph capillary: microscopic channel of the lymph system; tissue fluids filter through its walls

Lymph gland: a structure composed of lymphoid tissue, at least in part

Lymph nodes: small bodies of lymphoid tissue arranged in chains to filter lymph and help prevent the spread of infection

Lymphocyte: a particular type of white blood cell which is formed in the reticular (net-like) tissue of lymph glands

Lymphoid tissue: tissue which appears microscopically similar to a network of mesh; lymph cells occupy the meshes or spaces in the network

Lymph circulatory system: a “one-way” drainage system which picks up fluids from tissues and returns them to the bloodstream

Mitral valve: fibrous tissue leaflets which open and close between the left upper and left lower heart chambers; closure prevents reflux of blood

Oxygenated: saturated with oxygen
**Plasma:** fluid portion of blood in which cells are suspended

**Pulmonary artery:** vessel which carries venous blood from right lower heart chamber to the lung for oxygenation

**Pulmonary vein:** vessel which returns oxygenated blood from the lung to the left upper heart chamber

**Red blood cells:** erythrocytes which are the iron and oxygen-bearing cells of the blood

**Renal artery:** vessel which provides major arterial blood supply to the kidneys

**Semi-permeable membrane:** a cell wall which permits passage of small molecules but prevents passage of larger ones

**Serum globulin:** a protein constituent of blood plasma associated with antibodies and immune substances

**Splenomegaly:** enlargement of the spleen

**Spleen:** a large lymphoid organ located in the left upper abdomen behind the stomach; the spleen plays a role in the production, storage, and destruction of blood cells, and in the lymphocyte production

**Subclavian artery:** large vessel which branches off the aortic arch on the left and off the innominate artery on the right to supply blood to areas of the trunk, head, and upper extremities

**Systemic circulation:** blood supply to the body as a whole

**Thoracic:** pertaining to the chest

**Thymus:** a gland located in the neck and upper chest which is thought to play a role in the immune mechanism of the body

**Tricuspid valve:** valve with three fibrous tissue leaflets which open and close between the right upper and right lower chambers of the heart to prevent backflow of blood

**Vascular:** pertaining to vessels

**Vein:** vessel which carries blood in the direction toward the heart

**Venae cavae:** two large veins, inferior and superior, which empty into the right upper chamber of the heart

**Venous:** pertaining to veins

**Ventricle:** one of the two (right and left) lower chambers of the heart
**Venule:** a very small vein

**White blood cells:** principally three types of corpuscles (cells) normally present in blood: lymphocytes, monocytes, and granulocytes

**Blood**

The circulatory system is responsible for uninterrupted delivery of oxygenated blood and its nutrients to all tissue cells, their exchange for waste products of metabolism, and transportation of wastes to points of elimination.

The center of the vascular system is the heart, which lies in the thoracic cavity within the mediastinum. The upper portion, consisting of both atria, lies at the top behind the upper portion, composed of both ventricles, and is directed downward and toward the left. The upper portion is referred to as the base of the heart, and the lower left portion is referred to as the apex. The aorta, pulmonary arteries, and the great veins are located around the upper portion, or base, of the heart.

Most of the anterior cardiac surface consists of the right ventricle, which lies behind the sternum and extends to the left of it. The left ventricle lies posterior to the right ventricle and extends further to the left, thus forming the left border of the heart and making up a small portion of the anterior cardiac surface. The right ventricle and left atrium occupy a posterior portion of the heart. It is the contraction and thrust of the left ventricle that produces the normal apical impulse, sometimes referred to as the point of maximum impulse, that is located at or just medial to the midclavicular line in the fifth left intercostals space.

The atrioventribular valves lie between the atria and ventricles; the right atrioventricular valve is the tricuspid valve and the left is the mitral valve. The semilunar valves separate the ventricles from the great vessels, the aorta, and the pulmonary artery. On the right, the pulmonic valve separates the right ventricle from the pulmonary artery, and on the left the aortic valve separates the left ventricle from the aorta. It is basically the closure of the heart valves that produces the normal heart sounds.

Although the four valves are actually located rather close to each other in a small area behind the sternum, the areas on the chest wall where their closure is best heard are not located directly over the valves but rather more in the direction of the flow of blood. The sound produced by closure of the mitral valve is best heard at the apex, at the fifth left intercostal space in the midclavicular line; the sound produced by closure of the tricuspid valve is best heard along the lower left sternal border at the fourth left intercostals space; the sound produced by the aortic valve is heard best at the second right intercostals space at the sternal border; and the sound produced by the pulmonic valve is best heard at the second left intercostal space at the sternal border.

The great vessels lie at the top, or base, of the heart. The pulmonary artery extending from the right ventricle bifurcates quickly into its left and right branches. The aorta, extending from the left ventricle, curves upward over the heart, then backward and down. The superior and inferior venae cavae empty into the right atrium and the pulmonary veins return blood to the left atrium.
The pericardium is a tough, double-walled, fibrous sac encasing and protecting the heart. Several cubic centimeters of fluid are present between the inner and outer layers of the pericardium, providing for easy, low-friction movement. The outer layer of the pericardium is firmly attached to the diaphragm, sternum, pleura, esophagus, and aorta.

The position of the heart in the thorax has a large range of what is considered normal and varies considerably with different body builds, chest configurations, and diaphragm levels. In an average-sized person, the heart lies obliquely; one third of it lies to the right of the midsternal line, two thirds lies to the left of it. In short, stocky persons the heart may tend to lie more vertically.

**ROUTE OF BLOOD FLOW THROUGH THE HEART**

Circulation of blood through the heart is illustrated in Figure 6. Venous blood, with a high concentration of carbon dioxide enters the heart via the inferior and superior vena cavae (1), flows into the right atrium (2), through the tricuspid valve (3), and into the right ventricle (4). From the right ventricle, blood flows through the pulmonary valve (5) into the pulmonary artery (6), which carries the non-oxygenated, venous blood to the pulmonary capillary bed of the lung. In the alveoli (air sacs) of the lungs, carbon dioxide is exchanged for oxygen. Oxygenated blood then flows through the pulmonary veins (7) into the left atrium (8), past the mitral valve (9) into the left ventricle (10). From the left ventricle, blood is ejected through the aortic valve (11) into the aorta (12) for circulation to the entire body. From the aorta, blood flows to the head and upper extremities via the innominate (13), common carotid (14), and subclavian arteries (15). As the downward course of the aorta divides into two major common iliac arteries which supply blood to each leg (see the common iliac arteries, in turn, branch off into smaller units and eventually become arterioles.

Blood reaches the capillaries from arterioles and much of its oxygen content is given up across the semi-permeable wall of the capillary. Carbon dioxide crosses the membrane in the opposite direction and enters the bloodstream. As a result, blood becomes non-oxygenated venous blood.

Venous blood flows back toward the heart through venules which become veins. It is emptied into the right upper heart chamber or atrium (2) through the inferior and superior venae cavae (1), then passes through the tricuspid valve (3) into the right ventricle (4). Another round trip begins at this point.

**Summary:** The primary function of the blood vascular system is to carry oxygen and nutrients to cells, exchange them for wastes, and carry the wastes to points of elimination. This system is equipped to adjust flow rate and blood composition to meet varying body needs. Major organs of the blood circulatory system are the heart, aorta, arteries, arterioles, capillaries, venules, and veins.

**ASSESSMENT**

Dividing the cardiac examination into the techniques of inspection, palpation, and auscultation is useful. Several environmental considerations are basic to the cardiac examination. A quiet room is essential because cardiac sounds are, for the most part, subtle and low pitched and are thus easily missed if outside noises prevail. A good light source that can be directed tangentially across the chest wall is important for adequate observation.
It is important to remember that examination of the peripheral pulses, including the radial, brachial, femoral, popliteal, dorsalis pedis, and posterior tibial, is an essential component in assessing the cardiovascular system.

Inspection and palpation of the precordium should be performed before the stethoscope is applied to the chest wall. The purpose of both inspection and palpation is to determine the presence and extent of normal and abnormal pulsations over the precordium.

Inspection and palpation of the precordium should be performed before the stethoscope is applied to the chest wall. The purpose of both inspection and palpation is to determine the presence and extent of normal and abnormal pulsations over the precordium.

The chest wall and epigastrium are inspected while the client is in the supine position. The thrust of the contracting left ventricle may produce a visible pulsation in the area of the midclavicular line in the fifth left intercostals space.

The technique of palpation builds on and expands the findings gleaned from inspection. The anterior precordium is palpated methodically, beginning at the apex, moving to the left sternal border, and then to the base of the heart. Other areas may also be included if indicated, including the left axillary area, the epigastrium and the right sternal border.

The technique of percussion is of limited value in cardiac assessment. In the past, percussion was used to determine the borders of cardiac dullness, but the actual size of the heart is much more accurately determined by a chest X-ray. Auscultation includes using both the bell and diaphragm of the stethoscope. Satisfactory auscultation requires a quiet room; mechanical and conversational noises must be minimized. The room should be comfortably warm for the client so that shivering and subsequent muscular noises are avoided. A systematic method of auscultation is essential. All precordial areas and each sound and phase must be assessed.

In each area examined, the examiner listens selectively to each component of the cardiac cycle; as with palpation, this usually requires a period of “tuning in” to the various cardiac events. Note the rate and rhythm of the heartbeat.

The vascular structures of the neck assessable for and included in the cardiovascular examination are the jugular veins and carotid arteries. Examination of these vessels provides information on local states and also reflects the activity of the heart. The jugular veins are observed for pulse waves and pressure level; the carotid arteries are examined by inspection, palpation, and auscultation to assess the characteristics of their pulsations.

Summary: Assessment of the circulatory system includes inspection of the precordium, palpation of all areas on the anterior chest, and auscultation for heart sounds by use of a stethoscope. Using percussion for circulatory assessment is of limited value; X-ray is much more accurate.

LYMPH
The system of lymphatics is composed of collecting ducts, the lymph fluid, and tissues. This tissue makes up the lymph nodes, the thymus, the tonsils, and Peyers patches in the intestinal tract (see Figure 8). Lymphoid aggregates are also found in bone marrow, the lungs, and in gastric and appendiceal mucosa. Lymphatic vessels originate as microscopic open-ended tubules called capillaries. These capillaries merge to form larger collecting ducts which drain to specific lymphatic tissue centers.

The specific functions and properties of the lymphatic system are still imperfectly understood. The lymphatic tissue has been given responsibility for the immunological and various metabolic processes of the body, and is implicated in formation of corpuscular elements of the blood and in extension of malignant disease. The functions of the lymphatic system include:

- Transporting lymph fluids, protein, and microorganisms for return to the cardiovascular system
- Producing lymphocytes in terminal centers of lymph nodes
- Producing antibodies
- Phagocytosis by the reticuloendothelial cells lining the sinuses of the lymph nodes, the spleen, and the liver
- Hemopoiesis in some pathological states
- Absorbing fat and fat-soluble materials from the intestine

In humans lymphatic tissue is estimated to be 2 to 3 percent of the total body weight. The lymph channel section of the lymphatic system consists of lymphatic capillaries, lymph node precollecting ducts, lymph node, and main lymphatic trunks.

Summary: Motor functions of the lymph vascular system are to supplement the action of the veins by helping return tissue fluids to blood, to play a defensive role against spread of infection by filtering action of lymph nodes, and to produce and add defensive elements such as antibodies to the bloodstream. Major structures of the lymph lymphatics and ducts, lymph fluid, lymph nodes, and spaces. The spleen and the thymus are glands which assist in the function of the lymph system.

**ASSESSMENT**

Lymph nodes are usually arranged in chains or clusters called lymph centers. The lymph nodes are found either in the subcutaneous connective tissue or beneath the muscular fascia, and in the cavities of the body (see Figure 8).

Examination of the lymphatic system is carried out by using the assessment techniques of inspection and palpation, and is accomplished by incorporating the examination techniques into the regimen for each part of the body where lymph nodes are palpable. The information gained in these localized efforts must be integrated so that a general lymphadenopathy is not overlooked.

Inspection is the first step in regional lymph node examination. This is followed by palpation of the specific nodal regions for prominent nodes. Palpation of the lymph nodes is best accomplished through a gentle rotary motion of the palmar surface of the index and middle fingertips. Enough pressure should be exerted so the skin moves in concert with the fingers, but not so much that underlying nodes are obscured in the deeper soft tissue. Detected nodes are described according to location, size, regularity, consistency, tenderness, fixation to surrounding tissues, and discreetness as opposed to matting. There may be no
significance in a few discrete, mobile lymph nodes that measure less than one centimeter in diameter in any of the nodal sites; however, these nodes ought to move easily beneath the fingers. The fixed, immobile node may signify malignancy, whereas nodes that have coalesced may indicate infection. On judging a node to be normal, one must examine the regions drained by this node for indications of infection or neoplasm.
Unit 3
Self-Test

1. The chambers of the heart are the ________________ and ________________.

2. Most of the anterior cardiac surface consists of the ________________.

3. The apical pulse is caused by the contraction and thrust of the ________________ and ________________.

4. The valves that separate the atria from the ventricles are the ________________ and ________________.

5. The great vessels lie at the ________________ or ________________ of the heart.

6. The primary function of the circulatory system is to carry ________________ and ________________ to cells and to exchange them for ________________.

7. Examination of the lymph system is carried out by ________________ and ________________.

8. Detected lymph nodes can be described according to the five characteristics of

a. ________________

b. ________________

c. ________________

d. ________________

e. ________________
UNIT 4
Respiratory System

TERMS

**Alveoli:** very small air sacs in the lung tissue through which oxygen and carbon dioxide are exchanged

**Blood:** fluid which circulates through the body carrying nutrients to cells and removing wastes from cells; arterial blood contains a heavy concentration of oxygen while venous blood contains carbon dioxide in large amounts

**Bronchial:** breath sounds heard over the trachea

**Bronchial tubes, bronchi:** branches of the right and left mainstream passageways extending from the trachea

**Bronchovesicular:** breath sounds normally heard in the areas of the major bronchi

**Carbon dioxide:** odorless, colorless gas produced in tissue cells as a by-product of metabolism; carbon dioxide is excreted by the lungs

**Diaphragm:** the musculomembranous “partition” between the chest cavity and abdominal cavity which acts as a bellows in breathing

**Diffusion:** exchange of gases through a semi-permeable membrane

**Exhale:** to expel air from the lungs

**Fremitus:** vibration perceptible on palpation

**Inhale:** to take air into the lungs

**Larynx:** the organ of voice

**Lobe:** the major divisions of a lung

**Lung:** major organ of respiration; consists of spongy, porous, elastic tissue

**Medulla oblongata:** an area of the brain which shares concern for respiratory function with the pons

**Mucous membrane:** thin layer of smooth tissue which lines many cavities and has special ability to secrete a slimy fluid called mucous

**Nasopharynx:** upper part of the back of the throat where the nasal cavity opens into the pharynx
Olfactory receptors: nerves in the upper part of the nasal cavity concerned with the sense of smell

Oxygen: gaseous element found in free air; essential to life of human tissue cells

Pharynx: area in the back of the throat located between mouth and nose and upper end of the esophagus

Pleura: membranous sac which encloses the lungs and lines the chest cavity; parietal pleura lines the chest cavity and visceral pleura adheres closely to the lungs

Pons: an area of the brain which shares concern for respiratory function with the medulla oblongata

Respiration: inspiration and expiration of air via the lungs

Respiratory system: the organs and structures with primary responsibility for providing tissues with oxygen and eliminating carbon dioxide

Trachea: passageway for air between larynx and bronchi

Vesicular: breath sounds heard over normal lung tissue

Vocal cords: fibrous, elastic ligaments in the larynx which function to produce voice

ORGANS, STRUCTURES, AND FUNCTIONS

The respiratory system serves the major purpose of supplying the body with oxygen and eliminating carbon dioxide. This is accomplished through complex cooperation of many body systems that, in wellness, act in harmony. The teacher of oxygen and carbon dioxide between environmental gas and body liquid occurs in the alveoli, which are obviously not accessible to clinical examination. Assessment of respiratory efficiency is accomplished by direct and indirect appraisal of structures supporting alveolar function. (Refer to Figures 9 and 10 for anatomical structures.)

Twelve thoracic vertebrae, twelve pairs of ribs, the sternum, the diaphragm, and the intercostals muscles make up the thoracic cage. The skeletal parts of the thoracic cage consist of the ribs, the sternum, and the vertebrae. The ribs are paired. Anteriorly, the costal cartilages of the first seven ribs articulate with the body of the sternum, and the costal cartilages of the eighth to tenth ribs are attached to costal cartilages just above the ribs. The eleventh and twelfth ribs are termed “floating ribs” and are unattached anteriorly. The tip of the eleventh rib is located in the lateral thorax, and the tip of the twelfth rib is located in the posterior thorax. Posteriorly, all ribs articulate with the thoracic vertebrae.

The adult sternum measures approximately 17 centimeters in length and consists of three parts: the manubrium, the body, and the Xiphoid process. An anatomical landmark, the angle of Louis, is the junction of the manubrium and the body of the sternum. The second rib attaches to the sternum at the angle of Louis. The spaces between the ribs are termed intercostals spaces. The thoracic cage is perpetually moving in the inspiratory and expiratory phases of respiration. During inspiration, the diaphragm descends and flattens the intercostals muscles contract. These maneuvers produce differences in pressure among the areas of the mouth, the alveoli, and pleural areas, and air moves into the lungs. The
intrathoracic pressure is decreased, the lungs are expended, and the ribs flare, increasing the diameter of the thorax.

**ASSESSMENT**

For adequate inspection of the thorax, the client should be sitting upright without support and uncovered to the waist. It is essential that the room lighting be adequate and that a mechanism for supplementary lighting be available for close inspection of small areas.

The examiner first observes the general shape of the thorax and its symmetry. No individual is absolutely symmetrical in both body hemispheres; most individuals are reasonably similar side to side.

The anteroposterior diameter of the thorax in the normal adult is less than the transverse diameter at approximately a ratio of 1:2 to 5:7. Normally, men and children breathe diaphragmatically and women breathe thoracically or costally. The normal adult resting respiratory rate is 12 to 20 breaths per minute and is regular. The ratio of respiratory rate to pulse rate is normally 1:4.

Palpation is performed to further assess abnormalities suggested by the history or observation such as tenderness, pulsation, masses, or skin lesions. The examiner should specifically palpate any areas of abnormality. The temperature and turgor of the skin should be generally assessed. The examiner should then palpate the muscle mass and the thoracic skeleton. The trachea should be assessed by palpation for lateral deviation.

Percussion is used in the thoracic examination to determine the relative amounts of air, liquid, or solid material in the underlying lung and to determine the positions and boundaries of organs.

Through auscultation, the practitioner obtains information about the presence of any obstruction in the passages. Auscultation of the lungs is accomplished by the use of stethoscope. Before beginning auscultation, the examiner should instruct the client to breathe through the mouth and more deeply and slowly than in usual respiration. The examiner systematically auscultates the apices and the posterior, lateral, and anterior chest.

**Summary:** Assessment of the respiratory system is carried out by inspection, percussion, palpation, and auscultation. Inspection of skin is followed by palpation of skin and lung vibrations upon spoken voice of client. The stethoscope is used for listening for breath sounds in the lung area.
1. Two major purposes of the respiratory system are to supply the body with ________________ and eliminate ________________.

2. On the right side of the chest, there are ________________ lobes of lung and on the left are ________________ lobes.

3. The eleventh and twelfth ribs are called ________________ ribs.

4. Normally men and children breathe ________________ while women breathe ________________.

5. ________________ is performed to assess tenderness, pulsation, and masses.
INTRODUCTION

The neurological system provides integration for all functions of the body, but the system also derives its homeostatic balance from the appropriate functioning of the peripheral organs. The cells of the central nervous system, for example, depend on an adequate supply of glucose for their metabolic process, and this supply can be maintained only when those tissues that play a role in intermediary metabolism function well.

The brain and spinal cord are the major organs of the central nervous system, and the many major nerve branches seen leaving the cord are essential to its function. Nature affords a measure of protection to the brain and spinal cord since a number of their functions are essential to life. The brain is encased within the skull so that hardness of bone helps shield it from damage. Cerebrospinal fluid and membranes called “meninges” surround the brain and spinal cord to give added protection by cushioning these delicate structures.

This unit includes the structure, function, and assessment of the central nervous system as well as the structure, function, and assessment of the ear and eye.

TERMS: Central Nervous System

Anesthesia: absence of touch sensation

Autonomic nervous system: involuntary nervous system not subject to control by human will

- **Parasympathetic**: portion of the autonomic system which leaves the central nervous system in the cranial and sacral regions, stimulating muscular activity of the organs and secretion by the glands of the body

- **Sympathetic**: portion of the autonomic system which leaves the central nervous system at the thoraco-lumbar region, producing, in general, the opposite effects of those cited for the parasympathetics, but also stimulating heart action, constriction of blood vessels, and sweating

**Brain**: extremely complex mass of nervous tissue organized in five distinct sections: (1) cerebrum, (2) midbrain, (3) cerebellum, (4) pons, and (5) medulla oblongata

**Central nervous system**: brain and spinal cord

**Cerebrospinal fluid**: watery fluid which surrounds the brain and spinal cord to cushion and protect these vital organs
Cranium: skull bones which encase the brain

Extinction: normal client, when touched in corresponding areas on both sides of the body, perceives touch in both areas

Graphesthesia: identification of letters or number inscribed on the palm of the hand, back or other areas with a blunt object

Meninges: three membranes which cover and protect the brain and spinal cord; the innermost membrane is pia mater; the middle membrane is arachnoid mater; and the outermost membrane is dura mater.

Nerve: highly specialized cord of tissue with the power to respond to stimuli and the ability to transmit impulses to other cells

Nerve impulse: the activity or excitability initiated by a stimulus applied to a nerve and conveyed along nerve fibers

Nerve plexus: the activity or excitability initiated by a stimulus applied to a nerve and conveyed along nerve fibers

Peripheral nerve: an outlying nerve, distal from its origin at the spinal cord:

- Motor nerve: a nerve which conducts away from a center and causes contraction of muscle or secretion of glands; an efferent nerve

- Sensory nerve: a nerve which perceives sensations such as pain, touch, and pressure and conducts them toward a center; an afferent nerve

Sacrum: broad, flat, triangular-shaped plate of bone formed by five fused vertebrae; the sacrum is located between the pelvic bones with the lumbar vertebrae above and the coccyx below

Spinal cord: the major pathway for transmission of nerve impulses between the brain and all parts of the body; the spinal cord extends about 18 inches from the base of the brain down the spinal canal

Stereognosis: the act of recognizing objects on the basis of touching and manipulating them

Thoraco-lumbar region: chest (thorax) and midback

Two-point discrimination: the ability to sense whether one or two areas of the skin are being stimulated by pressure

Vertebral column: a series of bones or vertebrae which make up the bony spine

Voluntary nervous system: nerves which act in response to human will
FUNCTIONS

Among the major functions of the central nervous system are:

- Control of consciousness
- Control of all mental processes
- Regulation of body movements and functions
- Dispatch and reception of nerve impulses involving all areas of the body

A relatively simple example of central nervous system function is illustrated by the sequence of events which occur when a person touches a hot surface with a finger. Sensory nerve endings in the fingertip pick up a sensation which is transmitted at lightning speed, via nerve pathways and relay stations in the spinal cord, to the brain. Once the sensory impulse reaches its destination, the brain interprets the signal, “The surface is hot.” Instantaneously, an action reply is sent via motor nerves, “Lift your finger!” In similar circumstances, you may have noticed that there is a split-second delay between contact with the hot surface and removal of your finger. In this momentary interval, a sensation is received, transmitted, registered, interpreted; a response is sent and action is taken. This is an oversimplified example of the work of the central nervous system in controlling our actions.

Far more complicated than the most advanced computer, the central nervous system has two distinctly different sets of nerve pathways. The autonomic, or involuntary, nervous system works “automatically” as it conducts impulses to the heart, smooth muscle, and glands to control and regulate their activities. For instance, nerves which stimulate the heartbeat are involuntary because they do not respond to human will. For this reason, humans cannot cause their heart to stop beating through use of will. The second system of nerves within the central nervous system is voluntary and does respond to conscious will. When you decide to rise from a seated position, for example, your voluntary nervous system is triggered into action. Impulses stimulated by your decision are sent along voluntary nerve pathways to your skeletal muscles which respond by contracting and moving you out of your chair. (Refer to Figure 12.)

A subdivision exists within the involuntary (autonomic) nervous system: the sympathetic and parasympathetic nerves. The sympathetic portion of the autonomic system leaves the central nervous system at the thoraco-lumbar (middle) region of the spinal cord. The parasympathetic portion leaves the central nervous system at the cranium and sacrum. Both systems are distributed to the organs of the body where they regulate function by a kind of balanced opposition. Major nerve bundles are relatively large as they branch off the spinal cord. The nerves divide and subdivide into progressively smaller structures as their course takes them ever more distant from their point of origin at the cord (see Figure 12). These are peripheral (outlying) nerves.

Summary: The central nervous system and many of its functions are essential to life. All that humans are and everything they do are controlled by their brains, spinal cord, and nerves. Other body systems are dependent upon the central nervous system and are subordinate to its control.

ASSESSMENT

When assessing the nervous system, mental status examination is integral. This examination occurs early in the exam during the time the client’s history is taken. During the interview make inquiries within the
framework of interviewing that will give you information about the client’s orientation, memory, intellectual performance and judgment; note the client’s dress, grooming, personal hygiene, facial expressions, manners and affect, manner of speech, and state of awareness or consciousness.

The twelve cranial nerves, outlined below, are examined.

I. Olfactory
II. Optic
III. Oculomotor
IV. Trochlear
V. Trigeminal
VI. Abducens
VII. Facial
VIII. Vestibulocochlear
IX. Glossopharyngeal
X. Vagus
XI. Spinal Accessory
XII. Hypoglossal
# Table 1

<table>
<thead>
<tr>
<th>CRANIAL NERVE</th>
<th>FUNCTION</th>
<th>CLINICAL FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CN I Olfactory</td>
<td>Sense of Smell</td>
<td>Have patient close eyes, ask the patient to identify familiar odors (coffee, tobacco). Test each nostril separately.</td>
</tr>
<tr>
<td>CN III Oculomotor</td>
<td>Movement of eye muscles, upper lid opening, papillary reflexes</td>
<td>Test for ocular rotations, conjugate movements, nystagmus. Test for papillary reflexes and inspect eyelids for ptosis.</td>
</tr>
<tr>
<td>CN IV Trochlear</td>
<td>Movement of superior eye oblique eye muscles</td>
<td>Test for ocular rotation, conjugate movements, nystagmus.</td>
</tr>
<tr>
<td>CN V Trigeminal</td>
<td>Facial sensation</td>
<td>Have patient close eyes. Touch cotton to forehead, cheeks, and jaw. Opposite sides of face are compared. Sensitivity to superficial pain is tested by using a safety pin. Alternate between the sharp point and dull end. Patient reports “sharp” or “dull” with each movement. If responses are incorrect, test for temperature sensation. Use test tubes of cold and hot water alternately.</td>
</tr>
<tr>
<td></td>
<td>Corneal reflex</td>
<td>While the patient looks up, lightly touch a wisp of cotton against the temporal surface of cornea. A blink or tearing is normal.</td>
</tr>
<tr>
<td>CRANIAL NERVE</td>
<td>FUNCTION</td>
<td>CLINICAL FUNCTION</td>
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<tr>
<td></td>
<td>Mastication</td>
<td>Have patient clench jaw and move it from side to side. Palpate the masseter and temples.</td>
</tr>
<tr>
<td>CN VI Abducens</td>
<td>Movement of lateral rectus</td>
<td>Test of ocular rotations, conjugate movements, nystagmus. Test for papillary reflexes and inspect eyelids for ptosis.</td>
</tr>
<tr>
<td>eye muscle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CN VII Facial</td>
<td>Facial muscle movement</td>
<td>Observe for symmetry while the patient performs facial movements: smiles, whistles, elevates eyebrows, frowns, tightly closes eyelids against resistance (examiner attempts to open them). Observe face for flaccid paralysis (shallow nasolabial folds).</td>
</tr>
<tr>
<td></td>
<td>Taste: anterior two thirds of tongue</td>
<td>Ask patient to extend tongue. Test ability to discriminate between sugar and salt.</td>
</tr>
<tr>
<td>CN VII Vestibulocochlear</td>
<td>Hearing and equilibrium</td>
<td>Administer whisper or watch-tick test. Test for lateralization (Weber). Test for air and bone conduction (Rinne).</td>
</tr>
<tr>
<td>CN IX Glossopharyngeal</td>
<td>Taste: posterior third of tongue</td>
<td>Assess patient’s ability to discriminate between sugar and salt on posterior third of tongue.</td>
</tr>
<tr>
<td>CRANIAL NERVE</td>
<td>FUNCTION</td>
<td>CLINICAL FUNCTION</td>
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</tr>
<tr>
<td>CN X Vagus</td>
<td>Pharyngeal contraction</td>
<td>Depress a tongue blade on posterior tongue, or stimulate posterior pharynx to elicit gag reflex.</td>
</tr>
<tr>
<td></td>
<td>Symmetrical movement of vocal cords</td>
<td>Note any hoarseness of voice.</td>
</tr>
<tr>
<td></td>
<td>Symmetrical movement of soft palate</td>
<td>Have patient say “ah”. Observe symmetrical rise of uvula and soft palate.</td>
</tr>
<tr>
<td>CN XI Spinal Accessory</td>
<td>Movement of sternocleidomastoid and trapezius muscles</td>
<td>Palpate and note the strength of the trapezius muscles while the patient shrugs shoulders against resistance.</td>
</tr>
<tr>
<td></td>
<td>Palpate and note the strength of each sternocleidomastoid muscle as the patient turns shoulders against resistance.</td>
<td></td>
</tr>
<tr>
<td>CN XII Hypoglossal</td>
<td>Movement of the tongue</td>
<td>While the patient protrudes tongue, any deviation or tremors are noted. The strength of the tongue is tested by having the patient move the protruded tongue from side to side against a tongue depressor.</td>
</tr>
</tbody>
</table>
Cranial Nerves

1. Cranial nerve I – olfactory (sensory)
2. Cranial nerve II – optic (sensory)
3. Cranial nerve III – oculomotor (sensory and motor)
4. Cranial nerve IV – trochlear (motor)
5. Cranial nerve V – trigeminal (sensory and motor)
6. Cranial nerve VI – abducent (motor)
7. Cranial nerve VII – facial (sensory and motor)
8. Cranial nerve VIII – vestibulo cochlear (sensory)
9. Cranial nerve IX – glossopharyngeal (sensory and motor)
10. Cranial nerve X – vagus (sensory and motor)
11. Cranial nerve XI – accessory (motor)
12. Cranial nerve XII – hypoglossal (motor)

PROPRIOCEPTION AND CEREBELLAR FUNCTION

The proprioceptive system of the nervous system maintains posture, balance, and other acts of coordination. The cerebellum functions primarily in the integration of muscle contractions for the maintenance of posture. The client is asked to pat his or her knees with the palms of the hands followed by the backs of the hands at an ever-increasing rate. The client with cerebellar disease has difficulty with rapid patting and supination-pronation alterations, and performing other acts of coordination.

Sensory function is tested by light touch, pain, temperature, vibration, and tactile discrimination over the entire system.

Assessment of reflexes is also carried out during neurological examination.

Summary: During assessment of the central nervous system, mental status as well as functions of all cranial nerves are assessed. The proprioceptive system and cerebellar functions are observed as well as sensory functions and reflexes.

TERMS: THE EAR

**Auditory canal:** channel for entry of sound from outside; extends to the eardrum

**Auditory ossicles:** three small bones of the middle ear which vibrate and conduct sound

**Basilar membrane:** membrane inside the cochlea in which the hair cells (organ of Corti) are located

**Cochlea:** spiral canal hollowed out of the temporal bone; shaped like a snail shell and located in the anterior portion of the inner ear

**Cochlear nerve:** major sensory nerve of hearing
Equilibrium: balance

Eustachian tube: conduit 3-4 cm long from middle ear to pharynx

External ear: pinna and external receptors of sound

Incus: one of the three auditory ossicles; also called anvil due to its shape

Internal ear: vestibule, semicircular canals, and cochlea: contains end organs of sound perception and equilibrium

Malleus: one of three auditory ossicles: hammer-shaped
Middle ear: extends from eardrum to oval window; contains auditory ossicles

Organ of Corti: the hair cells (final sensory receptors of sound) located in the inner ear

Oval window: division between middle and inner ear

Pinna: auricular appendage; portion of external ear visible at sides of the head

Round window: membrane through which sound waves escape after passing hair cells

Semicircular canals: three bony canals of the inner ear

Stapes: one of the three auditory ossicles; stirrup-shaped

Tympanic membrane: eardrum

Vestibule: central cavity of the inner ear

STRUCTURES AND FUNCTIONS

The ear is a sensory organ that functions both in hearing and equilibrium. It has three parts: the external ear, the middle ear, and the inner ear. (Refer to Figure 14 for structures of the ear.)

The external ear has two divisions: the flap, called the auricle or pinna, and the canal, called the external auditory canal or meatus. The external auditory canal is about one inch in length, has a skeleton of cartilage in its outer third, and a skeleton of bone in its inner two thirds. The tympanic membrane, which covers the proximal end of the auditory canal, is made up of layers of skin fibrous tissue, and mucous membrane.

The middle ear is a small, air-filled cavity located in the temporal bone. It contains three small bones called the auditory ossicles: the malleus, incus, and stapes.
The inner ear is made up of two parts, the bony labyrinth and, inside this structure, a membranous labyrinth. The bony labyrinth consists of three parts: the vestibule, the semicircular canals, and the cochlea. The vestibule and the semicircular canals comprise the organs of equilibrium. The cochlea is the organ of hearing.

**Summary:** The ears are sensory organs which enable people to hear and maintain their physical balance. The ear has three divisions. The external ear is divided from the middle ear by the tympanic membrane or eardrum. In the middle ear are three small bones that assist humans to hear. The organs of the inner ear include those which help in hearing and balance.

**ASSESSMENT**

Examination of the external ear begins with an inspection of both auricles to determine their position, size, and symmetry (see Figure 15). Then the lateral and medical surfaces of each auricle and the surrounding medical surfaces of each auricle and the surrounding tissues are inspected to determine the skin color and the presence of deformities, lesions or nodules. The auricles and mastoid areas are palpated for evidence of swelling, tenderness, or nodules. In addition to examination of the external ear, an otoscope is used to inspect the inner ear. During examination of the ear, several hearing tests are conducted to determine the accuracy of auditory function. A precise measurement of hearing requires using the audiometer, but a good estimate of hearing can be made during the physical examination with the use of several tests. Voice tests as well as the watch tick tests are useful in testing but should not be used exclusively because they provide only a high-frequency sound.

Tuning fork tests are useful in determining whether the client has a conductive or perceptive hearing loss. The Rinne test makes use of air conduction and bone conduction. The tuning fork is used to compare the conduction of sound through the mastoid bone and the conduction of sound through the auditory meatus. The Weber test makes use of bone conduction by placing the base of the vibrating tuning fork on the vertex of the skull, on the forehead, or on the front teeth and asking the client if she or he hears the sound better in one ear or in the other.

**Summary:** Assessment of the ear includes inspection and palpation of the external ear before the inner ear canal and eardrum are examined with otoscope. Hearing tests are used to determine auditory acuity.

**TERMS: EYE**

**Abrasion:** a scraping injury in which skin or membrane is denuded

**Anterior chamber:** frontal space in the eyeball; bounded by cornea, iris, and lens

**Aqueous humor:** watery, transparent fluid found in the anterior and posterior chambers of the eye; helps maintain conical shape of the front of the globe and assists in focusing light rays on the retina

**Bony orbit:** rounded socket in the cranium in which the eyeball is partially sunk

**Conjunctiva:** mucous membrane which lines the eyelids and covers the anterior surface of the globe except for the cornea
Cornea: transparent frontal layer of the eyeball

Crystalline lens: that part of the eye which, in addition to the cornea, refracts light rays and focuses them on the retina

Extraocular: outside the glove of the eye

Iris: colored membrane of the eye which separates the anterior and posterior chambers; contracts and dilates to regulate entrance of light rays

Lacrimal ducts and glands: system of ducts and glands which secrete and conduct tears

Occipital lobe: posterior section of the brain

Optic nerve: second cranial nerve with special sense of sight

Posterior chamber: space between iris and lens which is filled with aqueous humor

Pupil: opening at the center of the iris

Retina: the “seeing” membrane lining the inside of the posterior eye where images are focused by the lens and cornea, then transmitted to the brain via the optic nerve

Sclera: the white outer coat of the eye which extends from the optic nerve to the cornea

Sensory receptors: rods and cones in the retinal layer which are stimulated by light rays to conduct nerve impulses to the brain via the optic nerve

Vitreous humor: transparent substance of raw eggwhite consistency which fills the posterior cavity of the eyeball; vitreous also is called the hyaloid

STRUCTURES AND FUNCTIONS

The structures of the eye enable man to see. The eyelashes are evenly distributed along the margin of the eyelids and curve outward. The eyelids protect the anterior aspect of the eye and lubricate its surface. (Refer to Figure 16.) Lining of the lids and covering the anterior portion of the eyeball is the conjunctiva. The sclera is the white portion of the eye visible anteriorly. Normally, several small, distinct conjunctival vessels are visible over the sclera, particularly around the periphery. The cornea, like the bulbar conjunctiva, is a smooth, moist, transparent tissue. It covers the area over the pupil and iris, and merges with the conjunctiva at the limbus. The anterior chamber is bounded anteriorly by the cornea, laterally by the sclera and the ciliary body, and posteriorly by the iris and that portion of the lens within the papillary opening. The iris is a circular, pigmented structure containing two involuntary muscles. The pupils are normally round and of equal size. The vitreous is a normally transparent material occupying the area posterior to the lens. The eyeball is a spherical structure lined from the inside toward the outside by the retina, the choroids, and the sclera.
For a clear visual image to be perceived, light reflected from an object must pass through the cornea, the anterior chamber, the lens, and the vitreous fluid and then be focused on the retina. The images formed on the retina are reversed right to left and are upside down; thus, an object in the upper nasal field of vision will be formed on the lower temporal quadrant of the retina.

Six muscles of each eye, working in a coordinated, yoked fashion with the other eye, control eye movement which normally occurs in conjugate, parallel fashion except during convergence when a very close object is visualized.

Summary: The eyes are sensory organs which function to give sight. Structures which are part of normal eye function are the globe, or eyeball, and its contents, the bony orbit, muscles and tendons, conjunctiva, eyelids, tear ducts and glands, the optic nerve, and that portion of the occipital lobe of the brain which is concerned with vision.

ASSESSMENT

Examination of the functions and structure of the eyes involves multiple procedures and should be performed in a manner that provides efficient access to physical findings while maintaining the greatest degree of comfort for the client.

The assessment of visual acuity is done using the Snellen Chart. The numerator is 20, the distance in feet between the chart and the client, or the standard testing distance. The denominator is the distance from which the normal eye can read the lettering; therefore, the larger the denominator, the poorer the vision. The assessment of visual acuity is indicative of the functioning of the muscular area, the area of central vision, and thus provides only a crude estimate of visual fields.

There are three aspects to the assessment of extraocular muscle function: the corneal light reflex, the six cardinal positions of gaze, and the cover-uncover test. Basic to each of these is the observation of the parallelism of the eyes and ocular movements. The lids are inspected for the ability to close completely, position and color, any lesions, infection, or edema. The bulbar and palpebral portions of the conjunctiva are examined by separating the lids widely and having the client look up, down, and to each side. The cornea is best observed by directing the light of a penlight at it obliquely from several positions. The sclera is easily observed during assessment of the conjunctiva. It is normally white, though some pigmented deposits are within the range of normal. Of the various components of the lacrimal apparatus, including the lacrimal gland, the puncta, the lacrimal sac, and the nasolacrimal duct, only the puncta can normally be observed.

Examination of the pupils involves several observations including assessment of their size, shape, reaction to light, and accommodation. The notation PERRLA stands for pupils equal, round, react to light, and accommodate. Examination of other ocular structures includes observation of the lens, vitreous body, and the retinal structures, and is performed with an ophthalmoscope.

Summary: Assessment of the eye includes several procedures and tests. All of the external structures are inspected for normal functioning. Tests for visual acuity are performed as well as procedures to examine all anatomical structures of the eye.
Unit 5
Self-Test

1. The major organs of the nervous system are the ______________ and
   ________________.

2. The autonomic nervous system works ______________ as it conducts impulses to the heart,
   smooth muscle, and glands.

3. The proprioceptive system of the nervous system maintains ________________,
   ________________, and ________________.

4. The ear is a sensory organ that assists in hearing and ________________
   ________________.

5. The ear includes three parts.
   a. ________________
   b. ________________
   c. ________________

6. The ________________ is the organ of hearing.

7. The ________________ lines the eyelids and covers the anterior surface of the eyeball.

8. Visual acuity is assessed by using the ________________.

9. PERRLA means ________________ and ________________.

10. The internal structures of the eye are examined with a ________________.
Unit 6
Digestive System

TERMS

Accessory organs: structures which aid in the digestive process: tongue, teeth, salivary glands, pancreas, liver, and gallbladder

Alimentary canal: the continuous tract from mouth to anus through which food moves during the process of digestion

Anus: terminal portion of the intestinal tract, about 1 to 1 ½ inches long

Appendix: blind, worm-like pouch normally found at the cecum; has no known role in digestion

Bile: fluid secreted by the liver, stored in the gallbladder, and emptied into the small intestine where it assists in absorption of fats

Cecum: first portion of the large intestine; the ileum joins the cecum at a right angle, and the appendix is attached to the cecum

Chyme: semiliquid material resulting from action of digestive juices on food in the stomach

Colon: second portion of the large intestine which is subdivided into four sections: ascending colon, transverse colon, descending colon, and sigmoid colon

Convoluted: tortuously structured with multiple folds

Digestion: process by which ingested food is converted for absorption and used as nutrients for body cells

Digestive system: the group of structures concerned with the process of digestion (alimentary canal and accessory organs)

Dullness: thud-like sound produced by percussion

Duodenum: first portion of small intestine about ten inches long, extending from the stomach to the jejunum

Elimination: movement of bowels to expel waste products from the body

Epiglottis: “lid” which covers and closes the larynx during swallowing to prevent entry of food into lungs

Esophagus: tube-like passageway which connects pharynx to stomach
**Gallbladder:** small sac in which bile made by the liver is stored until needed in the duodenum for fat digestion.

**Gastric:** pertaining to the stomach

**Gastric fluid:** digestive juices produced by glands in the stomach wall to convert solid food to a semiliquid state

**Gastrointestinal:** pertaining to the stomach and intestines

**Ileum:** the third portion of the small intestine which joins the cecum at a right angle

**Ingestion:** act of taking food into the body via the mouth

**Intestine, large:** lower portion of the intestinal tract; extends from the cecum to the anus and is about five feel long

**Intestine, small:** upper portion of the intestinal tract; extends from the stomach to the cecum and is about 23 feet long; most of the process of digestion and absorption takes place in the small intestine

**Jejunum:** second portion of the small intestine extending from the duodenum to the ileum

**Liver:** large organ located in the upper right portion of the abdominal cavity; the liver produces bile for fat digestion and plays other important roles in digestion

**Lymph circulatory system:** network which assists in distributing nutrients to cells and removing wastes

**Mastication:** the act of chewing

**Nutrient:** a substance which provides nourishment to body cells

**Orifice:** an opening

**Pancreas:** a gland which is both endocrine and exocrine; located behind the stomach, the pancreas produces secretions concerned with digestion

**Pharynx:** cavity by which food passes from mouth to esophagus

**Rectum:** portion of the intestinal tract which connects the sigmoid colon to the anus; the rectum is about five inches long

**Salivary glands:** oral glands which secrete saliva to moisten food and assist in swallowing

**Tympany:** drum-like sound produced by percussion
FUNCTIONS

It is common knowledge that the human body cannot long survive without nourishment and fluids. Responsibility for this extremely important function belongs to the organs of the digestive system.

The function of supplying essential nutrients to body cells encompasses three major phases:

1. **Ingestion**: bringing food and fluids into the body

2. **Digestion**: converting nutrients by physical and chemical means to a state that can be absorbed for distribution and use by the tissue cells.

3. **Elimination**: removing from the body unusable by-products of digestion.

The complicated process of digestion requires the assistance and participation of several body systems. Just a few examples are:

- Appetite, which prompts a person to eat, supplied partially by the nervous system
- Flow of digestive juices stimulated by the central nervous system and chemical substances furnished by the endocrine system
- Circulatory system delivery of nutrients to tissue cells and pick-up of waste products of metabolism.

STRUCTURES

As food is taken into the mouth, it is broken up by chewing. The teeth and tongue, accessory organs of digestion, start the physical breakdown of food particles to smaller sizes and smoother consistency. Salivary glands in the oral region supply moisture to aid in mastication and swallowing, and they furnish some digestive enzymes.

From the mouth, food enters the pharynx, the common cavity for food and air before each goes its separate way. Air goes to the larynx and food to the esophagus (see Figure 17). As food is swallowed, muscles draw the pharynx upward and dilate it for reception of the particles. These muscles then relax while other muscles contract to force the food down into the esophagus. A small “lid”, the epiglottis, closes the trachea during the act of swallowing to prevent food from reaching the lungs.

The esophagus is a tube, approximately ten inches long, which connects the pharynx with the stomach. The esophagus has both circular and longitudinal muscle fibers in its wall to produce waves of contraction, which move food down the passageway.

Food enters the stomach through the esophageal opening and it remains temporarily in the stomach while it is being reduced to a digestible state. Hydrochloric acid, secreted by small glands in the stomach lining, and other components make up the gastric fluid. The ingested food is converted to a semiliquid state by the chemical action of gastric fluid. At frequent intervals, the stomach releases small amounts of this semiliquid (called chyme) into the small intestine.
Digestion and absorption take place chiefly in the small intestine, a convoluted tube about 1 to 1 ½ inches in circumference and about 23 feet long. The first portion of the small intestine is called the duodenum. Digestive juices and bile are emptied into the duodenum from the pancreas and gallbladder while glands in the intestinal mucosa add other juices. All these fluids act to digest chyme. The nutrients then are absorbed into tiny capillaries and lymph vessels in the walls of the small intestine. The blood and lymph circulatory systems distribute nutrients to the body cells for energy or storage.

The second and third sections of small intestine are called the jejunum and ileum, respectively. The latter, ileum, extends to the large intestine which it joins at a right angle. Ingested food remaining after the major portion of digestion and absorption has taken place moves on into the large intestine.

The cecum, the colon (divided into ascending, transverse, descending, and sigmoid), the rectum, and the anus comprise the large intestine. The appendix, a worm-like pouch which has no recognized role in digestion, is attached to the cecum. Within the large intestine, digestion and absorption continue, but on a reduced scale. Finally, waste products of digestion are eliminated from the body via the rectum and anus.

Summary: The digestive system is responsible for making available to the body cells the nourishment required for survival in a form in which it can be used for energy or storage. This system must also eliminate from the body the wastes resulting from the digestive process. Thus, organs of this system ingest food, chew it, swallow, and propel food downward to the stomach. Here, gastric fluids begin to change the nature of food from solid of semiliquid. Most digestion and absorption occur in the small intestine through capillaries and lymph vessels in the intestinal lining.

Organs and structures of the digestive system include:

<table>
<thead>
<tr>
<th>Alimentary Canal</th>
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<tbody>
<tr>
<td>Mouth</td>
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<tr>
<td>Pharynx</td>
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<tr>
<td>Esophagus</td>
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<tr>
<td>Stomach</td>
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<td>Small intestine</td>
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<td>Duodenum</td>
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<tr>
<td>Jejunum</td>
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<td>Ileum</td>
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<td>Large intestine</td>
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<td>Rectum</td>
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<td>Anus</td>
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<td>Teeth</td>
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<table>
<thead>
<tr>
<th>Accessory Organs</th>
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Salivary Glands
Pancreas
Liver
Gallbladder
ASSESSMENT

Physical assessment of the abdomen includes all four methods of examination. Inspection is done first, followed by auscultation, since the movement or stimulation by pressure on the bowel occasioned by palpation and percussion is known to alter the motility of the bowel and generally to heighten sounds. (See Figure 18 for abdominal assessment areas.)

The supine position is the best choice for the client when performing an abdominal assessment. Environment should be warm and as comfortable as possible. During inspection, the examiner should note the presence or absence of symmetry, distention, masses, visible peristaltic waves, and respiratory movements. The skin of the abdomen should also be inspected for pigmentation, lesions, striae, scars, dehydration, general nutritional status, venous patterns, and the condition of the umbilicus. Visible peristalsis may be noted, and sometimes pulsation of the abdominal aorta is visible.

Auscultation of the abdomen precedes percussion because bowel motility, and thus bowel sounds, may be increased by palpation and percussion. The use of the diaphragm of the stethoscope to hear the sounds of air and fluids as they move through the gastrointestinal tract can provide valuable diagnostic clues relevant to the motility of the bowel. Normal bowel sounds are high-pitched, gurgling noises that occur approximately every 5 to 15 seconds.

Percussion of the abdomen is used for detecting fluid, gaseous distention, and masses and in assessing solid structures within the abdomen. The entire abdomen should be percussed lightly for a general examination of the areas of tympany and dullness. The position and size of the liver and spleen are determined by percussion.

Following careful visual scrutiny, auscultation, and percussion, palpation is used to substantiate findings and to further explore the abdomen. The organs are examined with respect to shape, position and mobility, size, consistency, and tension. Thorough and systematic screening is performed to detect areas of tenderness, muscular spasm, masses, or fluid.

Summary: In abdominal assessment, inspection is followed by auscultation for bowel sounds. Through percussion and palpation, the spleen and liver are evaluated as well as areas of the abdomen for tympany, dullness, and size and consistency of organs.
## Four Quadrants of the Abdomen

**Right Upper Quadrant**
- Liver and gallbladder
- Pylorus
- Duodenum
- Head of pancreas
- Right adrenal gland
- Portion of right kidney
- Hepatic flexure of colon
- Portions of ascending and transverse

**Left Upper Quadrant**
- Left lobe of liver
- Spleen
- Body of pancreas
- Stomach
- Left adrenal gland
- Portion of left kidney
- Splenic flexure of colon
- Portions of transverse and descending colon

**Right Lower Quadrant**
- Lower pole of right kidney
- Cecum and appendix
- Portion of ascending colon
- Bladder (if distended)
- Ovary and salpinx
- Uterus (if enlarged)
- Right spermatic cord
- Right ureter

**Left Lower Quadrant**
- Lower pole of left kidney
- Sigmoid colon
- Portion of descending colon
- Bladder (if distended)
- Ovary and salpinx
- Uterus (if enlarged)
- Left spermatic cord
- Left ureter
1. Digestion and absorption take place in the _________________ intestine.

2. The second and third sections of the small intestine are called the _________________ and _________________.

3. Accessory organs to the digestive system include
   a. ___________________________________
   b. ___________________________________
   c. ___________________________________
   d. ___________________________________
   e. ___________________________________
   f. ___________________________________

4. During assessment of the abdomen, __________________________ is always performed before ____________________ and ____________________.

5. ____________________ is used to determine the size and shape of the spleen and liver.
Unit 7
Urinary and Endocrine Systems

TERMS: Urinary Bladder

**Bladder**: hollow muscular organ which serves as the reservoir for urine

**Distention**: enlargement

**Excretory**: pertaining to discharge of waste products from the body

**Kidney**: large, bean-shaped gland located at each upper side of the posterior abdominal cavity; kidneys extract wastes from blood, from urine, and discharge it continuously into the ureters

**Meatus**: an opening or orifice to a passageway

**Micturition**: act of urinating

**Nitrogenous wastes**: by-products of metabolism containing nitrogen

**Penis**: male organ of sexual intercourse through which the urethra passes

**Prostate**: a gland in the male which surrounds the bladder neck and urethra; prostatic fluid is secreted by the prostate

**Spermatozoa**: male germ cells of reproduction

**Toxin**: a “poisonous” substance; one capable of damaging body cells

**Trigone of bladder**: a triangular area at the base of the urinary bladder

**Upper vaginal wall**: anterior surface of the vagina in the female

**Ureter**: one or two small-diameter tubes extending from the kidney to the bladder; conveys urine

**Urethra**: passageway for urine from the bladder to body exterior

**Urinary system**: organs concerned with the common function of ridding the body of certain types of wastes

**Urinate**: to empty the urinary bladder

**Organs and Functions: Urinary System**
The urinary system has an excretory function: elimination of a portion of body wastes. Organs of the urinary system include two kidneys, two ureters, the bladder, and the urethra. (Refer to Figure 19.)

The kidneys are large, bean-shaped glands located in the thoraco-lumbar region, in the space behind the abdominal cavity (retroperitoneal). The kidneys extract nitrogenous wastes, salts, water, and toxins from the bloodstream and turn the wastes into urine. The formation of urine is a continuous process, with droplets constantly flowing out of the kidneys into the ureters.

The two ureters are very small-diameter tubes about 12 inches long which convey urine from the kidneys to the urinary bladder. The upper end of each ureter is connected to a kidney. The lower ends of the two ureters are attached to the reservoir for urine, the bladder. This is a hollow, muscular organ with considerable capacity for distention. Urine is collected in the bladder until there is a nerve stimulus to urinate (empty the bladder).

During urination (or micturition, as it is called), urine leaves the body via a tube called the urethra. The female urethra is short (about 1 ½ inches) and it is embedded in the upper vaginal wall. The external opening of the urethra is called the meatus. The male urethra is about eight inches long. From its attachment to the bladder, the male urethra courses through the prostate gland and penis. The urethra in the male also serves as the passageway for emission of spermatozoa, the male reproductive cells.

Summary: The urinary system serves an excretory function by filtering certain waste products from the bloodstream, by forming urine, and by mechanically removing urine from the body. The organs of this system are two kidneys, two ureters, a bladder, and a urethra.

**TERMS: Endocrine System**

- **Adrenal glands:** two small endocrine glands located one above each kidney
- **Calcium:** an element which occurs naturally in all body tissues and fluids such as bones, teeth, and blood
- **Diabetes:** a condition in which cells of the pancreas, called islets of Langerhans, fail to produce enough insulin for proper metabolism of sugars and starches
- **Ductless gland:** a gland without excretory ducts or channels
- **Electrolyte:** an acid, base, or salt which is capable of conducting electrical current
- **Electrolyte balance:** distribution of acids, bases, and salts in tissue cells, fluids, and blood plasma which helps maintain normal pH and control the passage of water between cell membranes
- **Endocrine:** capable of secreting internally
- **Endocrine gland:** an organ which secretes hormones directly into the circulatory systems to influence and regulate numerous body processes
**Endocrine system:** all the glands of internal secretion concerned with regulating and influencing organs and processes by which the hormones are produced

**Exocrine:** capable of external secretion

**Gastric:** pertaining to the stomach

**Glucose:** one form of sugar, a product of starch metabolism in the body

**Gonads:** gland which produces sex hormones and germ cells necessary for reproduction

**Hormone:** chemical substance produced and secreted by an endocrine gland

**Hypophyseal gland:** the pituitary or “master” gland

**Insulin:** substance produced by an area of the pancreas; insulin is vital to normal glucose metabolism

**Islets of Langerhans:** a group of cells of the pancreas which secrete insulin

**Lymph system:** a drainage network which assists the blood circulatory system in returning tissue fluids to the bloodstream

**Menstruation:** cyclic shedding of the uterine lining

**Metabolism:** the physical and chemical processes by which ingested food and fluids are converted to energy or body tissues

**Mucosa:** mucous membrane

**Ovarian follicles:** blister-like formations on the ovary which rupture when they ripen and release the egg cell of reproduction in the female

**Ovaries:** the two sex glands in the female which produce egg cells for reproduction

**Ovum:** egg cell

**Pancreas:** a gland which is both endocrine and exocrine, located behind the stomach, the pancreas produces secretions concerned with digestion

**Parathyroid glands:** two pair of small endocrine glands usually attached to the back of the thyroid gland

**Phosphorus:** a nonmetallic element normally found in the body

**Pituitary gland:** the “master” gland of the body, so-called because of the many ways it controls and influences organs and body processes
**Puberty:** onset of sexual maturity; appearance of adult secondary sex characteristics

**Scrotum:** pouch which contains testes and accessory structures

**Testes:** the two male gonads in the scrotum which produce sex cells called spermatozoa

**Thyroid gland:** an endocrine gland located in the anterior neck at the trachea; secretions of the thyroid gland are important in certain metabolic processes

**Uterus:** the womb, a muscular organ in which the fertilized ovum is implanted and develops

**Viscera:** internal organs within the chest, abdominal and pelvic cavities

**Structures: Endocrine System**

The endocrine system is one of the most complicated of the body systems. Many of its functions are understood but others remain to be unraveled by scientists. It has long been recognized that this system of ductless glands exerts a profound influence on humans, their bodies, their activities, and their metabolic processes. Some of the endocrine glands are essential to life.

The word “endocrine” means to secrete internally. Thus, the endocrine glands extract substances from the blood stream and from tissue fluids and manufacture entirely new substances called hormones. The glands secrete these hormones directly into the blood and lymph systems for transport to various organs.

Hormones influence organs in many ways. The common condition called diabetes can be used as an illustration. Groups of cells in the pancreas (called the islets of Langerhans) produce and secrete a substance called insulin. The body must have insulin to properly use sugars and starches. When, for unknown reasons, the pancreas fails to secrete enough insulin, the patient is said to have diabetes. As yet, no method of restoring function to this area of the pancreas has been discovered, but diabetes can be controlled by diet restrictions or medication. Besides its endocrine function, the pancreas also is an exocrine gland since it produces an external secretion. Pancreatic juice passes from the pancreas into the duodenum where it plays an important role in digestion.

The major glands of the endocrine system are:

- The pituitary
- The thyroid and parathyroids
- The adrenals
- Islets of Langerhans
- The gonads (testes in the male and ovaries in the female). (See Figure 20 and 21.)

**Functions: Endocrine System**

The pituitary is also called the hypophyseal or “master” gland, and for good reason. Substances produced and secreted by the pituitary act directly and indirectly.
Pituitary

**Direct Functions.** Direct functions of the pituitary include:

- Regulation of growth, development, and sexual maturation of the young.
- Regulation of water excretion and retention.
- Regulation of electrolyte (salt) balance in the blood and tissues.
- Regulation of lactation in the new mother.

**Indirect Functions.** By regulating all other endocrine glands, the pituitary is involved in:

- Regulation of assimilation and metabolism of foods by hydration on the thyroid.
- Regulation of body composition, adaptation, and resistance to stress by action on the adrenals and parathyroid glands.
- Regulation of sexual development, activity, and reproduction by action on the gonads.
- Regulation of respiration, circulation, digestion, urinary excretion, and muscular activity by combined actions of many hormones.

**Thyroid**

The thyroid gland produces and secretes substances important in controlling certain metabolic processes and their rate, plus the normal growth and development of the young. Iodine also is stored in the thyroid gland. Hormones secreted by parathyroids help maintain the normal calcium level in the blood, regulate phosphorus metabolism, and help control irritability of the nervous system and muscles.

**Endocrine System: Male**

1. Hypothalamus
2. Pituitary gland (hypophysis)
3. Pineal gland (epiphysis)
4. Thyroid gland
5. Parathyroid glands
6. Thymus
7. Adrenal
8. Pancreas
9. Gonads
   (males-testes
female-ovaries)

**Endocrine System: Female**
1. Hypothalamus
2. Pituitary gland (hypophysis)
3. Pineal gland (epiphysis)
4. Thyroid gland
5. Parathyroid glands
6. Thymus
7. Adrenal
8. Pancreas
9. Gonads (males-testes, female-ovaries)

Adrenal

The adrenal glands secrete substances, which help regulate fluid and electrolyte balance, influence metabolism and sexual organs, and assist the body in coping with stress.

Gonads

Portions of the ovaries in the female make secretions, which are essential to the normal cyclic changes of menstruation and preparation of the uterine lining for pregnancy. The male testes, located in the scrotum, produce hormones essential to development of secondary sex characteristics.

Summary: The endocrine system is made up of a group of glands, which exert profound influences on the growth and development, as well as the activities of people. Endocrine glands perform their functions by extracting “raw materials” from blood and tissue fluids. Entirely new substances called hormones are created from raw materials by this system. Hormones are secreted into the blood and lymph circulation to be transported to the specific organs and structures upon which the substances exert influence and control.

The major glands of the endocrine system include the pituitary, thyroid and parathyroids, adrenals, islets of Langerhans, and the gonads.
Unit 7
Self-Test

1. Two large, bean-shaped glands located in the thoraco-lumbar region which excrete wastes from the body are the ________________________.

2. Structures which convey urine from the kidneys to the bladder are the _________________________.

3. The ________________________ in both the female and male allows the urine to leave the body.

4. The word ________________________ means to excrete internally.

5. The pancreas secretes _________________________.


Unit 8
Reproductive Systems: Female and Male

Terms

Axillary: pertaining to the armpit

Cervical os: opening in the cervix (lower end) of the uterus

Clitoris: erectile organ of sexual stimulation in the female

Ejaculatory duct: passage from which semen is discharged into the male urethra

Endometrium: lining of the uterus

Epididymis: small but lengthy convoluted tube which begins at its attachment to the testes and ends in the vas deferens

Fallopian tube: tubal passageway in which the egg travels from the ovary to the uterus

Fertilization: union of ovum and spermatozoon

Genitals, genitalia: organs of reproduction

Hormones: complex chemical substances which profoundly affect organ and body growth, development, and activities; the ovaries and testes produce hormones

Hymen: membranous tissue fold which partially covers the external opening of the vagina

Labia majora: two outer borders of raised, fleshy tissue extending from the mons pubis down past the vaginal opening

Labia minora: two inner borders of tissue between the labia majora and the vaginal opening

Mammary glands: breasts

Menstrual cycle: rhythmic hormonal stimulation of the female organs to prepare for pregnancy and withdrawal of hormones, with subsequent bleeding if the egg is not fertilized

Menstruation: normal uterine bleeding which usually occurs monthly as the endometrium is shed by the non-pregnant female

Mons pubis: rounded, hairy mound of tissue covering the pubic bone

Ovary: one of the female glands which produce the ovum for reproduction
Ovulation: discharge of the egg from the ovary

Ovum: female egg cell of reproduction

Penis: male organ of sexual union

Perineum: space between the vagina and rectum or between the scrotum and rectum

Pregnancy: condition in which the fertilized egg normally is implanted into the uterine lining, grows and develops for about 40 weeks until the infant is capable of living in the outside environment

Procreation: entire process of creating new life

Prostate: gland in the male which surrounds the bladder neck and contributes secretions to seminal fluid

Puberty: time of appearance of adult secondary sex characteristics (breast and body development, ovulation, and menstruation in the female; voice change, hair distribution, and functional spermatozoa in the male)

Pubic: pertaining to the bone beneath the mons pubis

Quiescent: at rest; inactive

Reproduction: process of new life by fusion of the male spermatozoon with female ovum

Scrotum: two-compartment pouch of tissue located externally on the male body; contains the testes

Semen: thick white fluid which contains sperm and other secretions; discharged by the male during sexual intercourse

Seminal duct: two channels which convey semen

Seminal vesicle: two small pouches attached to the bladder which join with the seminal ducts to form the ejaculatory ducts

Sperm, spermatozoon (pl. –zoa): male germ cell

Spermatic cord: tubal passageway by which the testis is suspended in the scrotum

Sperm motility: ability of male germ cells to move about

Testes (sing. –is): the two glands situated in the male scrotum which produce sperm

Urethra: passageway, which extends from the urinary bladder to the body exterior for the elimination of urine
Urine: waste-containing liquid produced by the kidneys, stored in the bladder, and eliminated through the urethra

Uterus: hollow, muscular organ in the female which houses and nourishes the fertilized ovum until it becomes a viable infant; also called the womb

Vagina: passageway for infant birth and reception of the male penis during the sexual act

Vas deferens: the excretory duct of the testis; also called ductus deferens

Vestibule: entrance to the vagina

Viable: capable of living in the environment outside the mother’s body

Vulva: external genitalia of the female

**Structures and Functions: Female**

Continuation of human life is the primary function of the reproductive system. Sexual gratification is also a function of some of the organs of this system. Another extremely important task given to some of the reproductive organs is the secretion of hormones which help simulate body development and feminine characteristics, regulate the menstrual cycle, and make pregnancy possible.

The internal reproductive organs of the female include the uterus (womb), two Fallopian tubes, two ovaries, and the vagina (refer to Figure 22). External genitals are the mons pubis, labia majora and minora, clitoris, vestibule, hymen and several glands. Collectively, the external organs are referred to as the vulva. The breasts, or mammary glands, also may be considered a part of the reproductive system.

**Puberty**

The normal female infant is born with diminutive reproductive organs. During her first 10 or 11 years of life, these organs grow slowly in proportion to total body growth, but they remain quiescent. Around age 12, hormonal stimuli gradually convert the female body contour from the stolid squareness of childhood to curves suggestive of approaching womanhood. Simultaneously, hair begins to grow in the axillae and on the pubis; the breasts develop; and menstruation appears. The internal organs of reproduction enlarge, mature, and become functional during the period called puberty.

**Menstruation and pregnancy**

The menstrual cycle is an integral part of the female reproductive mechanism. Under cyclic hormonal influence, one of the two ovaries is stimulated to produce an egg (ovum) about once a month. A blister-like projection (follicle) appears on the surface of the ovary. When the egg cell inside is mature, the follicle ruptures and the egg is released. This is called ovulation.
Normally, the egg enters the nearby open end of the Fallopian tube and is moved along the tube toward the uterus. The ovum may be met and penetrated by a male sperm in the tubal passageway. If this happens, the egg is fertilized. The fertilized ovum normally continues its journey through the tube and enters the womb.

Meanwhile, hormones have stimulated a thickening of the uterine lining (endometrium) and an increase in its blood supply. The womb is prepared in this manner to receive and implant the fertilized ovum in its lining and to nourish the embryo in the months ahead. Thus, the female becomes pregnant. After about nine months of intrauterine life, the infant is capable of surviving in the outside world. Labor begins, and a new life emerges through the birth canal.

If the ovum is not fertilized within about 48 hours after its release from the ovary, the uterine preparation for pregnancy (signified by the thick lining and greater blood supply) is not needed. Hormonal stimuli begin to be withdrawn, resulting in the disintegration of the endometrium within a few days. As the womb lining separates from the wall to which it is attached, some bleeding occurs. This is called menstruation or the menstrual period. After about five days, bleeding ceases. The remaining endometrium is very thin but soon again, the rhythmic cycle of hormone production and stimulation will rebuild it to be ready for pregnancy once more.

**Female Internal Reproductive Organs**

A: Median section through the female pelvis  
B: Anterior view of female reproductive tract

1. Ovary  6. Labia majora  
2. Fallopian tube  7. Labia minora  
3. Uterus  8. Pubic symphysis  
4. Vagina  10. Anus  
5. Clitoris  11. Perineum  
5a. Prepuce

**Structures and Functions: Male**

The primary functions of male organs of reproduction are procreation, sexual gratification, and hormone secretion. The internal organs include two testes, two epididymides, two seminal ducts and vesicles, two ejaculatory ducts, two spermatic cords, the urethra, the prostate, and other glands. The scrotum and penis are external reproductive organs. (Refer to Figure 23.)

**Puberty**

The normal male infant is born with his full complement of reproductive organs. They grow slowly, along with the rest of his body, until the child reaches his early teens.
In the young male, puberty is marked by the appearance of functional spermatozoa (germ cells of reproduction). Hormonal influences also stimulate rapid body development during the teens, the growth of hair on the face, axillae, pubis and other body areas, and deepening of the voice.

**The organs and their functions**

The testes are two glandular organs suspended on each side of the scrotum by a spermatic cord composed of the vas deferens, blood vessels, and supportive tissues. The testes produce the male germ cells (spermatozoa or sperm) and hormones which influence growth and development in the male. Lying along the upper portion of each testis is the epididymis, a long narrow body which connects the testis with the excretory seminal duct (vas deferens). The two seminal ducts course upward within the spermatic cords until they reach the prostate gland in front of the urinary bladder neck. Here the seminal ducts join seminal vesicles, two pouch-like glands, to form ejaculatory ducts. Secretions which aid sperm motility are added to semen by the seminal vesicles and the prostate gland (see Figure 23).

The ejaculatory ducts discharge seminal fluid containing sperm into the urethra, the same passageway by which urine is empties from the bladder. During the sexual act, an average of 3-5 cc of seminal fluid is ejected at the upper end of the vagina near the uterine opening called the cervical os. Nature appears over-abundant since only one spermatozoan is required for fertilization of the ovum and 3-5 cc of ejaculate normally may contain as many as 250 million sperm.

**Male Reproductive Structures**

A: median section through the male pelvis  
B: Anterior view of the male reproductive tract

1. Vas deferens  
2. Seminal vesicle  
3. Prostate gland  
4. Cowper’s glands  
5. Epididymis  
6. Testis  
7. Scrotum  
8. Penis  
9. Pubic symphysis  
10. Bladder  
11. Urethra

**Summary:** Although the organs of reproduction in the male and female are very different, their primary functions are identical:

1. Continuation of human life through procreation.
2. Achievement of sexual gratification.
3. Secretion of hormones which influence growth and development, sexual activity, and secondary sex characteristics.

**Assessment: Female**
The external genitalia are inspected. The skin and hair distribution are observed. The total skin area is inspected. The clitoris is examined for size. Next observed is the area of Bartholin’s glands and their ducts. The perineum is inspected for evidence of episiotomy and its healing. The anus is also inspected at this time. Palpation of the external genitalia is done for size, shape, consistency, and tenderness. An examination of the cervix is carried out with a speculum. In addition, a rectal exam is done as well as bimanual palpation of the uterus.

**Assessment: Male**

The techniques of inspection and palpation are used to examine the male genitalia. The examination occurs with the client standing facing the examiner who is seated. After exposure, the skin, hair, and appearance of the penis and scrotum are inspected. The size of the penis and the secondary sex characteristics are assessed in relation to the client’s age and general development. The penis is observed for lesions, nodules, swelling, inflammation, and discharge. The scrotum is also observed for general size, superficial appearance, and symmetry. When the scrotal skin is being observed, its rugated surface should be spread. Both testes are palpated simultaneously between the thumb and the first two fingers. Each epididymis is palpated. The rectal examination is performed first, then the prostate gland and seminal vesicles are palpated. Following examination of genitalia the client is examined for inguinal and femoral hernias.

Summary: Male and female genitalia assessment is carried out by carefully inspecting all areas. Palpation is used where appropriate.

**BIBLIOGRAPHY**


Unit 8
Self-Test

1. The _________________ is an organ of reproduction which carries the fetus in the female.

2. The _________________ from the male fertilizes the ovum of the female.

3. The _________________ produce the sperm in the male.

4. _________________ produce the ova in the female.

5. The primary functions of the organs of reproduction in both the male and female are
   a. _____________________________________________________________________
   b. _____________________________________________________________________
   c. _____________________________________________________________________
Module 7
Answers to Self-Tests

Unit 1  Integumentary System

1. a. skin
   b. hair
   c. nails
2. a. epidermis
   b. dermis
   c. subcutaneous
3. temperature
4. elasticity
5. a. inspection
   b. palpitation

Unit 2  Musculoskeletal System

1. shape
   support
2. voluntary
   involuntary
3. ligaments
4. hypertrophy
   atrophy
5. inspection
   palpation

Unit 3  Circulatory System

1. Atria
   ventricles
2. right
   ventricle
3. left
   ventricle
4. mitral
   tricuspid
5. top
   base
6. oxygen
   nutrients
   wastes
7. inspection
   palpation
8. a. location
   b. size
   c. regularity
   d. tenderness
   e. consistency

Unit 4  Respiratory System

1. oxygen
   carbon dioxide
2. three
   two
3. floating
4. diaphragmatically
   thoracically
5. palpation

Unit 5  Neurological/Ear/Eye

1. brain
   spinal cord
2. automatically
3. posture
   balance
   coordination
4. equilibrium
   palpation
5. a. external
   b. middle
   c. inner
6. cochlea
7. conjunctiva
8. Snellen Eye Chart
9. pupils
   equal
   round
   react to light
   accommodation
10. Ophtalmoscope

Unit 6  Digestive System

1. small
2. jejunum
   ileum
3. a. tongue
b. teeth
c. salivary glands
d. pancreas
e. liver
f. gallbladder
4. auscultation
   percussion
   palpation
5. percussion

Unit 7  Urinary and Endocrine Systems

1. Kidneys
2. Ureters
3. Urethra
4. Endocrine
5. Insulin

Unit 8  Reproductive System

1. Uterus
2. Sperm
3. Testes
4. Ovaries
   a. procreation
   b. sexual gratification
   c. secretion of hormones