Anatomy and Physiology
Unit III

OBJECTIVES/RATIONALE

Veterinary technicians must possess a basic understanding of the principles of Anatomy and Physiology. The student will relate anatomical structure to physiological functions.

TEKS 121.5 1A, 1E, 1F

TAKS ELA 1, 4
Science 1, 2

KEY POINTS

I. Anatomical Terminology
   A. Cranial – directional term, meaning toward the head
   B. Caudal – directional term, meaning toward the tail
   C. Rostral – within the head; directional term, meaning toward the muzzle
   D. Median Plane – imaginary line that divides the body symmetrically into right and left halves
   E. Medial – directional term, meaning toward the medial plane
   F. Lateral – directional term, meaning away from the medical plane
   G. Proximal – within the limbs; directional terms, meaning toward the body
   H. Distal – within the limbs; directional term, meaning away from the body
   I. Dorsal – directional term, meaning toward the backbone
   J. Ventral – directional term, meaning away from the backbone or toward the abdominal wall
   K. Superficial – refers to the nearness to the skin or surface of the body
   L. Deep – refers to the nearness to the center of gravity

II. Gross Anatomical Structures of Common Domestic Animals
   A. All domestic animals
      1. forelegs – the two front legs
      2. rear legs or hind legs – the two back legs
      3. elbows and shoulders are located on and above the forelegs
      4. the back is followed by the rump
   B. Gross anatomy is that part of an animal's anatomy visible to the naked eye

III. The Skeletal System - is composed of bones, cartilage, and the ligaments that hold them together.
   A. The study of the bones and the skeleton is called **osteology**
   B. **Bones** are a form of connective tissue and are living structures. They have blood vessels and nerves, and are subject to disease. Bones serve as the framework for the body. They provide protection by giving the body rigidity and store minerals, such as magnesium and calcium. Most importantly, bones serve as the body's center for blood production. Blood cells are produced in the bone marrow, which is the soft, organic material found in the cavities of bones.
   C. **Cartilage** is a translucent, elastic substance found in and around bones.

D. **Ligaments** are bands of fibrous connective tissues that hold bones together.
E. **Main functions of the skeletal system**
    1. Support
    2. Mineral/energy storage
    3. Blood cell formation
    4. Protection
    5. Leverage
F. Divisions of the Skeleton
    1. The **axial skeleton** consists of the bones of the skeleton other than those associated with the limbs or appendages.
        a. skull (bones of the head)
            (1) The bones of the head form the skull or cranium
            (2) houses the brain inside, and sense organs outside
            (3) attaches two jaw bones
            (4) space in the skull is called the cranial cavity
            (5) immovable bone that is the upper jaw is called the maxilla, the movable, lower jaw is the mandible. Teeth are attached to both of these bones.
        b. vertebrae (bones of the back)
            (1) The head is connected to the trunk (body) by the neck.
            (2) There are seven cervical vertebrae in this region plus the esophagus, larynx (voice box), and trachea.
            (3) The atlas and the axis are the names for the first and second cervical vertebrae, respectively.
            (4)
        c. thoracic bones (the sternum and ribs).
            (1) The trunk is further divided into three areas—the thorax, the abdomen, and the pubic region. Each region contains a cavity.
            (2) The thorax is composed of bones that form a cage for the lungs and heart.
            (3) Thoracic bones include the sternum (on the ventral side), the ribs (laterally), and the thoracic vertebrae (on the dorsal side).
            (4) Thoracic vertebrae are identified by the attachment of a rib to each.
            (5) The thoracic cavity is separated from the abdominal cavity by a thin sheet of muscle called the diaphragm.
            (6) The only bones in the abdomen are the seven lumbar vertebrae of the spinal column.
            (7) Viscera fill the abdominal cavity.
            (8) Organs of the digestive system include the stomach, small intestine, and most of the large intestine.
            (9) Accessory organs are the liver, gall bladder, and pancreas.
            (10) Urinary system organs are two kidneys and two ureters.
    2. **appendicular skeleton** is made up of the bones of the limbs.
        a. pectoral (front) pelvic (rear) limbs
            (1) The animal's extremities are four legs and a tail
            (2) The forelegs are comparable to human arms.

(a) scapula, humerus, radius, ulna, carpals, and metacarpals
(3) hind leg bones
(a) femur, tibia, fibula, tarsals, and metatarsals
(4) There is a kneecap called the patella
(5) All four legs end in small bones termed phalanges or digits
(6) The bones of the tail are coccygeal or caudal vertebrae

b. pubic (pelvic) region is the third region of the trunk
(1) The sacrum, ilium, ischium, and pubis form a bony, basin-shaped cavity (pelvic) to house the bladder, urethra, and rectum together with the female reproductive organs (two ovaries, fallopian tubes, uterus, vagina, and the external vulva).
(2) The male genital organs (two testes, epididymis, and vas deferens) are housed outside the body in the saclike structure called a scrotum. The penis is suspended from the pubic region and contains the urethra and blood vessels.

IV. The Muscular System - makes and restrains motion. It supplies force for movement as well as for holding bodies in position

A. Attached to the bones of the skeleton by tendons (fibrous, connective tissue), muscles work in conjunction with the skeletal system to produce gross body movement.

B. Functions of the muscular system
1. the transport of ingest (food matter) within the intestines
2. the generation of heat
3. the circulation of blood throughout the body
4. respiratory function

C. Muscles can be either voluntary or involuntary
1. **Voluntary muscles** are those controlled by the animal from the animal
2. **Involuntary muscles** operate automatically, without conscious thought
3. Some muscles, like the diaphragm—the muscle that separates the thoracic cavity from the abdominal cavity—can be both voluntary and involuntary

D. There are three types of muscle tissue in the body
1. **Skeletal muscle** is the type normally thought of when muscle is mentioned.
a. striated (or striped)
b. generally considered to be voluntary.
c. Skeletal muscle has the primary function of controlling locomotion and movement.
d. It is usually attached to bones
2. **Cardiac muscle**
a. striated
b. involuntary muscle
c. found within the walls of the heart
d. primary function is the circulation of blood
3. **Smooth muscle**
a. Nonstriated
b. involuntary muscle
c. primarily operates to control the function of the body

d. can be found in the intestines, the blood vessels, and other organs

V. The Nervous System – serves as the control center for the body by monitoring changes in the internal and external environment and initiating changes within the body
   A. Works somewhat like a computer for the body
      1. collects, processes and stores information
      2. analyzes the information and generates output
      3. uses electrical impulses, which travel along the neurins (nerve cells) to the spinal cord and brain
   B. The Central Nervous System (CNS)
      1. consists of the brain and spinal cord
      2. responsible for coordination of movement and responding to stimuli from the sense organs
   C. The Peripheral Nervous System (PNS)
      1. includes all the nerve processes connecting the CNS
      2. function is the transmission of nerve impulses
      3. divided into
         a. somatic nervous system (SNS)
            (1) transmits information from the CNS to the skeletal muscles
            (2) function is to keep the body in balance with its external environment
         b. automatic nervous system (ANS)
            (1) carries information to and from the smooth muscle, the cardiac muscle and the glands of the body
            (2) functions to regulate the body's internal balance

VI. The Digestive System
   A. consists of those organs that carry out the function of ingesting, digesting, absorbing, and eliminating food, water, and nutrients
   B. provides the body with fuel and performs many other chemical exchanges
   C. Parts of the Digestive System
      1. a muscular tube that stretches from an animal's mouth to the anus
         a. mouth
         b. teeth
         c. tongue
         d. pharynx
         e. esophagus
         f. stomach
         g. intestines
         h. Also included in this system are the organs that contribute to digestion
            (1) salivary glands
            (2) pancreas
            (3) liver
            (4) gall bladder
      2. Food and water is transported through the digestive system by the process of **peristalsis,** or wavelike contraction and relaxation of the rings of muscles within the walls of the digestive system
      3. Types of Animal Digestive Systems

a. **Ruminants** are animals that have stomachs made up of four chambers: the reticulum, rumen, omasum, and abomasums
   (1) These animals chew their cud or ruminate, which means they can graze quickly and then regurgitate the undigested food from the rumen and masticate (chew) it later while at rest.
   (2) Ruminants include cows, goats, and sheep
b. Animals such as dogs, pigs, and horses are **nonruminants**. Nonruminants have a single-chambered or simple stomach. They do not ruminate their food

VII. The Circulatory System - controls the movement of blood through all parts of the body

A. made up of the heart and a system of vessels responsible for transporting blood and lymph (tissue fluid).

B. Functions
   1. transporting oxygen and nutrients to the body's tissues
   2. transporting immune substances to the areas where they are needed
   3. transporting hormones and chemicals necessary for normal function to the organs
   4. carrying away waste products and carbon dioxide
   5. helping to maintain normal hydration and electro-lyte balance. Electrolytes are chemical substances that, when dissolved in water, become electrically charged particles or ions.
   6. helping to equalize the body's temperature

C. Blood and Blood Cells
   1. Blood is composed of blood cells and **plasma**—the liquid in which the blood cells are suspended.
   2. There are three types of cells found in blood
      a. Erythrocytes or red blood cells (RBC), contain **hemoglobin**—a protein that carries oxygen and gives erythrocytes their red color. Transporting oxygen to the body's tissues is their main function.
      b. Leukocytes or white blood cells (WBC), are colorless blood cells whose chief function is to protect the body from microorganisms that cause disease
      c. Platelets often called thrombocytes, are small disklike structures whose function is the coagulation (clotting). of blood. They serve to stop bleeding when blood vessels are damaged or severed

D. Blood Vessels
   1. **Arteries** are vessels that carry oxygenated blood from the heart to the body
   2. **Veins** carry unoxygenated blood from the body to the heart
   3. **Lymphatic vessels** carry lymph (tissue fluid) to the veins

E. The Heart
   1. heart pumps or propels blood throughout the circulatory system
   2. It is divided into four chambers
      a. right atrium
      b. right ventricle
      c. left atrium

d. left ventricle

3. **Pulmonic circulation**
    a. associated with the right side of the heart, functions to send the blood from veins through the heart to the lungs.
    b. Unoxygenated blood, brought to the heart by veins, enters the right atrium and is pumped into the right ventricle.
    c. It is then pumped into the lungs where it is oxygenated
4. **systemic circulation**
    a. After the blood is oxygenated in the lungs, it then returns to the heart and enters the left atrium.
    b. From there it empties into the left ventricle, where it is pumped into the arteries, which carry it to the body's tissues.
    c. This process is associated with the left side of the heart
5. Capillaries are tiny vessels dispersed throughout the body's tissues in which oxygen, water, and nutrients are exchanged between the blood and tissue cells.
    a. There is not one cell in the entire body that is more than three or four cells away from a capillary.
    b. This is very important because every cell needs to be able to absorb oxygen and nutrients, and get rid of wastes
    c. The capillaries eventually unite to form the veins, which will carry the unoxygenated blood back to the heart to begin the continuous process again

VIII. The Respiratory System - controls the transport and exchange of oxygen for carbon dioxide throughout the body

A. Functions
    1. exchanging gases
    2. assisting with temperature control
    3. voice production
    4. elimination of water

B. Consists of the Respiratory System
    1. nostrils (external openings of the nasal cavity)
    2. the nasal cavity
    3. the pharynx
    4. the larynx
    5. the trachea
    6. the lungs

C. Breathing
    1. The lungs fill with air during **inspiration**
    2. process allows the thorax to expand and enlarge, thereby allowing air to rush into the lungs
    3. Inspiration is caused by the contraction of the diaphragm (a musculotendinous separation between the abdominal wall and thorax) and some of the intercostal muscles (muscles between the ribs)
    4. Expiration - when an animal breathes out, a different set of intercostal muscles contract, causing the thorax to decrease in size, pushing air out of the lungs.
    5. Variations in breathing

a. **Eupnea** refers to normal, quiet breathing in which very little movement of the abdomen and thorax is noticed
b. **Dyspnea** refers to difficult breathing in which a visible effort is required to breathe
c. **Polypnea** refers to rapid, shallow breathing similar to panting
d. **Apnea** refers to a pause or cessation of breathing

IX. **The Urinary System**
A. Primary Function of the urinary system is to filter the blood and excrete urine
B. urinary system is composed of
1. two **kidneys** (organs that filter blood and produce urine)
2. two **ureters** (tubes that connect the kidneys to the bladder)
3. the **bladder** (an expandable muscular sac that receives and stores urine)
4. the **urethra** (the tubular passage through which urine is expelled from the body)

X. The Reproductive System
A. consists of those organs that function in the sexual reproduction of the species
B. The anatomy of reproductive systems varies widely between species
C. Male Reproductive Organs
1. **gonads** or **testes**, which are the organs that produce sperm and testosterone (the male sex hormone)
2. **external genital**, which deposits the sperm into the female
D. **Female Reproductive Organs**
1. ovaries, which produce the ova or egg, and the female sex hormones: estrogen (regulates estrus or the heat cycle) and progesterone (prevents estrus during pregnancy)
2. uterus
3. vagina
4. vulva
5. mammary gland

ACTIVITIES

I. Complete Anatomy and Physiology Labeling and Exploration Exercise.

MATERIALS NEEDED

Labeled Structures
Test - Key

ASSESSMENT

Test

ACCOMMODATIONS

For reinforcement, the student will define Key Terms.

For enrichment, the student will dissect a cat and identify anatomical structures.

REFLECTIONS

Key Terms

Directions: Define the following terms.

1. Anatomy

2. Physiology

3. Cranial

4. Caudal

5. Medial

6. Lateral

7. Proximal

8. Distal

9. Rostral

Test /Anatomy and Physiology—Part A

Directions: Complete these questions using brief answers.

1. **Differentiate between the terms anatomy and physiology.**

2. **List the eight body systems Chapter 3 focused on.**

3. **List and define four descriptive terms used in anatomy.**

4. **What is the study of bones called?**

5. **Differentiate between cartilage and ligaments.**

6. **List the five functions of the skeletal system.**

7. **What does the axial skeleton consist of?**

8. **What is the appendicular skeleton made of?**

9. **What are the five functions of the muscular system?**

10. **Differentiate between the voluntary muscles and involuntary muscles.**

11. **List and describe the three types of muscle tissue.**

Test / Anatomy and Physiology—Part B

Directions: Complete these questions using brief answers.

1. **What does the nervous system serve as?**

2. **What are the differences between the CNS and the PNS?**

3. **List the organs that primarily make up the digestive system.**

4. **List and define the two types of digestive systems found in domestic animals.**

5. **What does the circulatory system control?**

6. **What is the circulatory system made up of?**

7. **List the roles of the circulatory system.**

8. **Differentiate between erythrocytes and leukocytes.**

9. **Differentiate between pulmonic circulation and systemic circulation.**

Test / Anatomy and Physiology—Part C

Directions: Complete these questions using brief answers.

1. **What does the respiratory system control?**

2. **What does the respiratory system consist of?**

3. **Differentiate between inspiration and expiration.**

4. **What is the primary function of the urinary system?**

5. What are the primary parts of the male reproductive system?

6. **What are the primary parts of the female reproductive system?**

Test / Anatomy and Physiology—Part A

Directions: Complete these questions using brief answers.

1. **Differentiate between the terms anatomy and physiology.**
   Anatomy is the study of an organism's form and structure. Physiology is the study of the function of the body's parts and systems, or "how living systems work."
2. **List the eight body systems Chapter 3 focused on.**
   Skeletal, muscular, nervous, digestive, circulatory, respiratory, urinary, reproductive
3. **List and define four descriptive terms used in anatomy.**
   (Any four)
   Cranial—directional term, meaning toward the head
   Caudal—directional term, meaning toward the tail
   Rostral—within the head; directional term, meaning toward the muzzle
   Median Plane—imaginary line that divides the body symmetrically into right and left halves
   Medial—directional term, meaning toward the median plane
   Lateral—directional term, meaning away from the median plane
   Proximal—within the limbs; directional term, meaning toward the body
   Distal—within the limbs; directional term, meaning away from the body
   Dorsal—directional term, meaning toward the backbone
   Ventral—directional term, meaning away from the backbone or toward the abdominal wall
   Superficial—refers to the nearness to the skin or surface of the body
   Deep—refers to the nearness to the center of gravity
4. **What is the study of bones called?**
   Osteology
5. **Differentiate between cartilage and ligaments.**
   Cartilage is a translucent, elastic substance found in and around bones. Ligaments are bands of fibrous connective tissues that hold bones together.
6. **List the five functions of the skeletal system.**
   Support, mineral/energy storage, blood cell formation, protection, leverage
7. **What does the axial skeleton consist of?**
   Bones of the skeleton other than those associated with the limbs or appendages. It includes the skull (bones of the head), the vertebrae (bones of the back), and the thoracic bones (the sternum and ribs).
8. **What is the appendicular skeleton made of?**
   Bones of the limbs. It includes the pectoral (front) and pelvic (rear) limbs.
9. **What are the five functions of the muscular system?**
   Make and restrain motion, transport ingest (food matter) within the intestines, generation of heat, circulation of blood throughout the body, respiratory function
10. **Differentiate between the voluntary muscles and involuntary muscles.**
    Voluntary muscles are those that are controlled by the animal. Involuntary muscles operate automatically, without conscious thought from the animal.

11. List and describe the three types of muscle tissue.

Skeletal muscle is the type normally thought of when muscle is mentioned. It is characterized as being striated (or striped) and is generally considered to be voluntary. Skeletal muscle has the primary function of controlling locomotion and movement. It is usually attached to bones. Cardiac muscle is also striated but is involuntary muscle. It is found within the walls of the heart. Its primary function is the circulation of blood. Smooth muscle is nonstriated, involuntary muscle. It primarily functions to control the operation of the body. Smooth muscle can be found in the intestines, the blood vessels, and other organs.

Test / Anatomy and Physiology—Part B

Directions: Complete these questions using brief answers.

1. **What does the nervous system serve as?**
   The control center for the body by monitoring changes in the internal and external environment and initiating changes within the body.
2. **What are the differences between the CNS and the PNS?**
   The Central Nervous System (CNS) consists of the brain and spinal cord. It is responsible for coordination of movement and responding to stimuli from the sense organs. The Peripheral Nervous System (PNS) includes all the nerve processes connecting to the CNS. Its function is the transmission of nerve impulses. It is divided into the somatic and autonomic nervous systems.
3. **List the organs that primarily make up the digestive stystem.**
   Mouth, teeth, tongue, pharynx, esophagus, stomach, and intestines
4. **List and define the two types of digestive systems found in domestic animals.**
   Ruminants are animals that have stomachs made up of four chambers (the reticulum, rumen, omasum, and abomasum). Animals like dogs, pigs, and horses are nonruminants. Nonruminants have a single chambered or simple stomach. They do not ruminate their food.
5. **What does the circulatory system control?**
   The movement of blood through all parts of the body
6. **What is the circulatory system made up of?**
   The heart and a system of vessels responsible for transporting blood and lymph (tissue fluid)
7. **List the roles of the circulatory system.**
   - transporting oxygen and nutrients to the body's tissues,
   - transporting immune substances to the needed areas,
   - transporting hormones and chemicals necessary for normal function to the organs,
   - carrying away waste products and carbon dioxide,
   - helping to maintain normal hydration and electrolyte balance, and
   - helping to equalize the body's temperature.
8. **Differentiate between erythrocytes and leukocytes.**
   Erythrocytes are red blood cells that contain hemoglobin—a protein that carries oxygen and give erythrocytes their red color. Transporting oxygen to the body's tissues is their main function. Leukocytes are white blood cells whose chief function is to protect the body from microorganisms that cause disease.
9. **Differentiate between pulmonic circulation and systemic circulation.**
   Pulmonic circulation, associated with the right side of the heart, functions to send the blood from veins through the heart to the lungs. Unoxygenated blood, brought to the heart by veins, enters the right atrium and is pumped into the right ventricle. It is then pumped into the lungs, where it is oxygenated. When the blood is oxygenated in the lungs, it then returns to the heart and enters the left atrium. From there it empties into the left ventricle, where it is pumped into the arteries, which carry it to the body tissues. This process, known as systemic circulation, is associated with the left side of the heart.

Test / Anatomy and Physiology—Part C

Directions: Complete these questions using brief answers.

1. **What does the respiratory system control?**
   The transport and exchange of oxygen for carbon dioxide throughout the body. Besides exchanging gases, the respiratory system also assists with temperature control, voice production, and the elimination of water.
2. **What does the respiratory system consist of?**
   Lungs and those passages that allow air to enter and leave the lungs. Components of the respiratory system are the nostrils (external openings of the nasal cavity), the nasal cavity, the pharynx, the larynx, the trachea, and the lungs.
3. **Differentiate between inspiration and expiration.**
   Inspiration: The process that allows the thorax to expand and enlarge, thereby allowing air to rush into the lungs. Inspiration is caused by the contraction of the diaphragm (a musculotendinous separation between the abdominal wall and thorax) and contraction of some of the intercostal muscles (muscles between the ribs). Expiration: When an animal breathes out, a different set of intercostal muscles contract, causing the thorax to decrease in size, pushing air out of the lungs.
4. **What is the primary function of the urinary system?**
   The urinary system is comprised of the two kidneys (organs that filter blood and produce urine); two ureters (tubes that connect the kidneys to the bladder); the bladder (an expandable muscular sac that receives and stores urine); and the urethra (the tubular passage through which urine is expelled from the body).

5. What are the primary parts of the male reproductive system?
   The gonads**,** or testes, which are the organs that produce sperm and testosterone (the male sex hormone), and the external genitals, which deposit the sperm into the female.
6. **What are the primary parts of the female reproductive system?**
   The ovaries, which produce the ova or egg; the female sex hormones, estrogen (regulates estrus or the heat cycle) and progesterone (prevents estrus during pregnancy); the uterus; the vagina; the vulva; and the mammary glands.