Student Learning Objectives. Instruction in this lesson should result in students achieving the following objectives:

1. Explain the meaning of anatomy and physiology.
2. Describe how the animal body is organized in terms of cells, tissues, organs, and organ systems.
3. Examine the four basic tissue types (epithelial, connective, muscle, and organ).
4. List and briefly describe the major organ systems found in vertebrate animals.
5. Describe the importance of understanding the anatomy and physiology in livestock and small animal production.

List of Resources. The following resources may be useful in teaching this lesson:

Corresponding E-unit(s). Danville, IL: CAERT, Inc. www.mycaert.com

List of Equipment, Tools, Supplies, and Facilities

- Copies of sample test
- Visuals from accompanying masters
- Copies of student lab sheets
Terms. The following terms are presented in this lesson (shown in italics):

- adipose tissue
- anatomy
- animal well-being
- blood
- bones
- cardiac muscle tissue
- cartilage
- cell
- cell differentiation
- circulatory system
- connective tissue
- dense, irregular connective tissue
- dense, regular connective tissue
- digestive system
- endocrine system
- epithelial tissue
- excretion
- gross anatomy
- hormones
- integumentary system
- ligaments
- loose connective tissue
- microscopic anatomy
- muscle tissue
- muscular system
- nervous system
- nervous tissue
- organs
- organ system
- physiology
- plasma
- platelets
- red blood cells
- reproductive system
- respiratory system
- skeletal muscle tissue
- skeletal system
- smooth muscle tissue
- tendons
- tissue
- urinary system
- white blood cells

Interest Approach. Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here:

Ask students to describe what functions an animal organism must perform to carry out life processes. List these on the writing surface. Examples include respiration, digestion, and elimination. Next, ask students how organisms are able to carry out these functions—they have body parts or organ systems that make it possible for these functions to occur. Have students name and discuss specific examples, such as the mammary system of a dairy cow secretes milk used as food for her calf as well as for human food. Move from this interest approach into the lesson.

SUMMARY OF CONTENT AND TEACHING STRATEGIES

Objective 1: Explain the meaning of anatomy and physiology.

Anticipated Problem: What is anatomy and physiology?

I. Animals are complex organisms with systems and processes that allow them to carry out activities to remain in the living condition.
A. **Anatomy** is the study of the form, shape, and appearance of an animal. Since mammals are among the most common animals, most of the information on anatomy will focus on these animals.

1. **Gross anatomy** deals with the features that can be seen with the unaided eye. Examples include feet, horns, tails, tongues, and teeth.
2. **Microscopic anatomy** deals with the features that can only be seen with magnification. Examples include cells and sperm.

B. **Physiology** is the study of the functions of the cells, tissues, organs, and organ systems of the living organism.

1. Physiology includes relationships among functions by different systems of an organism, such as secretion and digestion.
2. Diseases can cause the systems to fail to work properly.

Many techniques can be used to help students master this objective. Have students research the Internet for subject matter related to this objective. Organize information on the writing surface using student input. Have students keep notes on important issues covered in class. Use VM–A to present definitions of the key terms. Have students give examples of anatomy and physiology in companion animals and in animals used for production.

**Objective 2:** Describe how the animal body is organized in terms of cells, tissues, organs, and organ systems.

**Anticipated Problem:** How is the animal body organized in terms of cells, tissues, organs, and organ systems?

II. Animals are very complex organisms; yet, the structural basis of all animals begins with cells.

A. A **cell** is the most basic structure of an animal and is considered the building block from which an animal’s body is made.

B. All cells of an embryo have the same number and kinds of genes, as they all descended from the same zygote. In the development process, cell differentiation occurs. In **cell differentiation**, cells become specialized in structure and function by activating and suppressing their genes in selective and unique ways. Cell differentiation is very important, because organisms could not exist if all cells were alike.

1. Specialized groups of cells that are organized to perform a specific function are called tissues. A **tissue** could also be defined as a group of cells that are alike in activity and structure. The primary types of tissues are epithelial, connective, muscle, and nervous.

2. **Organs** are groups of tissues that perform specific functions. The tissues work cooperatively so that the organ can carry out its purpose. Examples of organs include the liver, the lungs, the heart, and the brain.
3. An **organ system** is a group of organs that work together to carry out a specific activity. The following are major organ systems: circulatory, digestive, integumentary, endocrine, urinary, muscular, nervous, reproductive, respiratory, and skeletal.

Many techniques can be used to help students master this objective. Lead a lecture-discussion to present information. Use VM–B to illustrate the concept of animal organization and, more specifically, the components of an animal cell. Use VM–C to present definitions of the key terms. Review with students upon completion to assess the students’ understanding.

**Objective 3:** Examine the four basic tissue types (epithelial, connective, muscle, and organ).

**Anticipated Problem:** What are the four basic tissue types?

III. As stated previously, tissue contains a cluster of cells that are alike in structure and activity. Tissue cells work together to perform a specific function. There are four basic tissue types: epithelial, connective, muscle, and nervous.

A. **Epithelial tissue** lines the body’s surface, openings, and tubes in the body, such as blood vessels. Epithelial tissues are groups of cells arranged together in sheets.

1. Epithelial tissues perform several functions.
   a. Skin, which is composed of epithelial tissue, protects the body from things such as the sun’s ultraviolet rays and bacteria.
   b. Epithelial tissues also produce a variety of secretions, such as tears, saliva, sweat, urine, and milk.
   c. In addition, epithelial cells that line the intestines, lungs, and kidneys can absorb materials from surrounding fluids in a highly selective manner.

2. Epithelial tissue is classified by cell shape into three types of tissue: squamous epithelium, cuboidal epithelium, and columnar epithelium.
   a. Squamous epithelium is composed of flat cells.
   b. Cuboidal epithelium is composed of cube-shaped cells.
   c. Columnar epithelium is composed of cells that resemble columns or pillars.

3. Epithelial tissue can also be categorized as simple or stratified.
   a. Simple epithelium consists of a single layer of cells.
   b. Stratified epithelium consists of two or more layers of cells.
B. The primary function of **connective tissue** is to connect one organ or tissue to another. For example, tendons connect muscles to bone. Connective tissue also holds, supports, protects, and insulates body parts. In addition, connective tissue fills space, stores fat, and forms blood cells. Types of connective tissue include soft connective tissues and specialized connective tissues. Cartilage, bone tissue, adipose tissue, and blood are examples of specialized connective tissues.

1. Soft connective tissue is subdivided into three types of tissue: loose connective tissue; dense, irregular connective tissue; and dense, regular connective tissue.
   a. **Loose connective tissue** is found beneath the skin and supports the epithelium. This area is monitored by white blood cells to attack any pathogens that may enter through the skin.
   b. **Dense, irregular connective tissue** is found in the skin and around organs. This tissue provides structural support for the skin and protects internal organs.
   c. Tendons and ligaments are composed of **dense, regular connective tissue**. **Tendons** attach muscles to bone. **Ligaments** connect one bone to another at a joint.

2. **Cartilage** is a firm but pliable tissue that forms portions of a vertebrate’s skeleton. Cartilage is found at the ends of long bones, in the ear, in the nose, within the vertebral column, and elsewhere.

3. Bone tissue—**Bones** are living structures that grow and are able to repair themselves if damaged. They are composed of calcium and small amounts of other minerals. They provide support for the body and protect internal organs. Bones also interact with skeletal muscles to create bodily movement. Some bones are the place for the production of blood cells.

4. **Adipose tissue**, or fat, is a place of energy storage. Adipose tissue, which is composed of cells filled with lipid, also serves as insulation for the body. Adipose tissue is found mainly beneath the skin.

5. **Blood** is a connective tissue whose main functions are to transport nutrients and oxygen to cells and to carry carbon dioxide and other wastes away from cells. Blood is composed of plasma, red blood cells, white blood cells, and platelets.
   a. **Plasma** is the liquid part of the blood.
   b. **Red blood cells** transport nutrients, oxygen, carbon dioxide, and wastes.
   c. **White blood cells** aid in fighting infection.
   d. **Platelets** are important in blood clotting.

C. **Muscle tissue** creates bodily movement and helps the respiratory and digestive systems to function. The three types of muscle tissue are skeletal, smooth, and cardiac.

1. **Skeletal muscle tissue** is under voluntary control, and when it contracts, it creates bodily movement. Skeletal muscle is the largest component of red meat animal products.
2. **Smooth muscle tissue** is involuntary and is found in the intestines, stomach, blood vessels, and other internal organs.

3. **Cardiac muscle tissue** is found only in the heart.

D. **Nervous tissue**, which contains nerve cells called neurons, is found in the brain and spinal cord. Together, the brain and spinal cord compose the central nervous system.

Many techniques can be used to help students master this objective. Use VM–D to illustrate a neuron. Review with students upon completion to assess the students’ understanding.

### Objective 4:

List and briefly describe the major organ systems found in vertebrate animals.

**Anticipated Problem:** What are the major organ systems found in vertebrate animals?

IV. As previously mentioned, an organ system is a group of organs that work together to carry out a specific activity. The following are the major organ systems in vertebrate animals: circulatory, digestive, integumentary, endocrine, urinary, muscular, nervous, reproductive, respiratory, and skeletal.

A. The **circulatory system**, which consists of blood, heart, arteries, capillaries, and veins, is responsible for transporting nutrients and oxygen to, and metabolic wastes away from, cells. The circulatory system also transports hormones and helps stabilize internal pH and temperature.

B. The **digestive system** is responsible for breaking food down into smaller particles that are then absorbed and utilized by the body. Digestive systems vary widely among animal species, but they do have some common components: teeth, stomach, and intestines.

C. The **integumentary system**, which is the skin, protects internal organs by keeping out harmful materials, such as bacteria and dust. The integumentary system also has a role in regulating body temperature.

D. The **endocrine system** consists of ductless glands that release hormones that are transported throughout the body by blood vessels.
   1. **Hormones** are chemical messengers that exert a specific influence on organs and other body tissues. Hormones regulate such things as growth and reproductive development.
   2. Examples of glands that secrete hormones include the pituitary gland, adrenal glands, thyroid gland, parathyroid gland, thymus gland, and gonads.

E. The **urinary system** is chiefly responsible for the **excretion**, or removal, of wastes. It removes wastes from the body through the filtration of blood. The urinary system consists of two kidneys, two ureters, a bladder, and a urethra.
F. The **muscular system** cooperates with the skeletal and nervous systems to create bodily movement. The muscular system also maintains an animal’s posture and produces heat.

G. The **nervous system** controls body activities and perceives and reacts to internal and external stimuli. The nervous system directs all muscular activities, controls learning and memory, and regulates vital processes, such as digestion, circulation, and respiration.

H. The **reproductive system** makes the production of offspring possible. Animals reproduce sexually; the egg of one parent is fertilized by the sperm of another.
   1. The male is responsible for producing viable sperm and delivering them to the female reproductive tract at the appropriate time.
   2. The female not only provides the ovum for fertilization, but she also cares for the young until weaning time.

I. The **respiratory system** governs gas (oxygen and carbon dioxide) exchange. The respiratory system brings in oxygen and delivers it to body cells by way of blood. It also picks up carbon dioxide and releases it back into the air.

J. The **skeletal system** provides a framework for the body and protects internal organs. The skeleton stores minerals, primarily calcium and phosphorus, and bone marrow is the site of blood cell formation. In mammals, the skeletal system consists of bones, cartilage, teeth, and joints.

Many techniques can be used to help students master this objective. Lead a lecture-discussion to present information. Use VM–E and VM–F to further discuss the major organ systems in the body and their specific functions. Review with students upon completion to assess the students’ understanding.

**Objective 5:** Describe the importance of understanding the anatomy and physiology in livestock and small animal production.

**Anticipated Problem:** Why is it important to understand the anatomy and physiology in livestock and small animal production?

V. People who care for animals need to understand the fundamentals of anatomy and physiology.

A. Practicing the correct nature of anatomy and physiology of an organism promotes animal well-being. **Animal well-being** is caring for animals so that their needs are met and they do not suffer. Conditions for raising and keeping animals must be considered for their well-being.
   1. Species have different environmental requirements. Animal producers are more effective in meeting these requirements when they know the unique anatomy and physiology of a species. For example, some breeds of cattle are more resistant to extreme temperatures than others. Producing a breed out-
side its preferred temperature range means that steps need to be taken to provide shade to protect from the heat or housing to protect from the cold.

2. The design of facilities can accommodate the unique anatomy needs of organisms. The size, shape, and form of an animal influence facility arrangement and design. For example, keeping dairy cattle housing clean requires a way to handle animal wastes, including feces and urine. Facility design can help collect and remove wastes from the area.

3. Young animals require different care than older animals. Feed for young animals should be appropriate to its digestive system and nutrient needs. For example, young animals typically require feed with a higher percentage of protein than older animals.

B. Animal productivity is based on animal capacity.
   1. Meat animals are required to have muscling in areas that are used to make the higher-priced cuts. Examples include the loin and hams of hogs.
   2. Dairy animals need to have the capacity for high milk production. For example, a dairy cow needs a well-developed mammary system.
   3. Animals used for other products are required to have the capacity to produce those products, including egg-laying capacity of chickens and wool quality of sheep.
   4. Knowing how animals reproduce helps a producer provide conditions that promote reproduction.

Many techniques can be used to help students master this objective. Ask students to indicate why they feel knowledge of anatomy and physiology is important to animal producers. Have students tell the importance for the production of farm animals as well as the keeping of companion animals in the home. Have students relate animal well-being to having knowledge of the needs of an animal. Students can name examples in the local area where animal well-being is practiced properly and where it is ignored so that the animals are not in a good situation. Use VM–G as a visual aid during the discussion.

■ **Review/Summary** Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. The anticipated problems can be used as student review questions.

■ **Application.** Use the included visual masters and lab sheets to apply the information presented in this lesson.

■ **Evaluation.** Evaluation should focus on student achievement of the objectives of this lesson. Various techniques can be used, such as student performance on the application activities. A sample written test is provided.
Answers to Sample Test:

Part One: Matching
1. i
2. e
3. a
4. f
5. c
6. d
7. b
8. h
9. j
10. g

Part Two: True or False
1. F
2. T
3. F
4. T
5. T
6. F

Part Three: Short Answer
1. plasma, red blood cells, white blood cells, and platelets
2. epithelial, connective, muscle, and nervous
Part One: Matching

Instructions: Match the term with the correct definition.

- a. animal well-being
- b. anatomy
- c. physiology
- d. tissue
- e. organ
- f. organ system
- g. excretion
- h. digestive system
- i. endocrine system
- j. white blood cells

_____1. A system of ductless glands that release hormones in the body
_____2. A group of tissues that work together to perform specific functions
_____3. Caring for animals so that their needs are met and they do not suffer
_____4. A collection of organs that work together to perform a function for an organism
_____5. The study of the functions of cells, tissues, organs, and organ systems of a living organism
_____6. A group of cells that is alike in activity and structure
_____7. The study of the form, shape, and appearance of an animal
_____8. The system responsible for breaking down food into molecules that the body can absorb
_____9. Cells that aid in fighting infection in the body
______10. The process of the body ridding itself of wastes

Part Two: True or False

Instructions: Write T for true or F for false.

_____1. The skeletal system consists of skin and other body covering.
_____2. The muscular system makes movement possible.
_____3. The integumentary system provides a framework to give the body shape.
_____4. The digestive system prepares food for use by the body.
5. The circulatory system moves blood and other materials throughout the body of an animal.

6. Gross anatomy deals with features that can only be seen with magnification.

**Part Three: Short Answer**

*Instructions: Complete the following.*

1. List the four components of blood.

2. List the four tissue types.
ANATOMY AND PHYSIOLOGY OF ANIMALS

♦ Anatomy—study of the form, shape, and appearance of animals
  ■ Gross anatomy—study of the anatomy features that can be seen with the unaided eye
  ■ Microscopic anatomy—study of the anatomy features that require magnification

♦ Physiology—study of the functions of cells, tissues, organs, and organ systems of a living organism
MAJOR PARTS OF AN ANIMAL CELL

Cell membrane → Cytoplasm

Endoplasmic reticulum

Ribosomes

Nucleus

Mitochondrion

Lysosome

Nuclear membrane

Nucleolus

Golgi body

Cytoplasm
Cell—basic structure of a living organism; contains protoplasm which carries out important chemical activities

Cell specialization—differences in cells so that they can perform unique activities

Tissue—a group of cells that are alike in structure and activity

Organ—a group of tissues that work together to perform a specific function

Organ system—a collection of organs that work together to perform a function essential for the living condition
THE NEURON

- Dendrite
- Cell body
- Myelin sheath
- Axon
MAJOR ORGAN SYSTEM PARTS

- Skeletal—bones and cartilage
- Muscular—muscles and connective tissues
- Nervous—brain, spinal cord, and nerves
- Circulatory—heart, arteries, and veins
- Respiratory—lungs
- Excretory—kidneys, bladder, urethra, and skin
- Digestive—mouth, stomach, and intestines
- Lymphatic—lymph nodes and lymph vessels
- Integumentary—skin, hooves, claws, and other exterior parts
- Reproductive—varies by gender (testes in males; ovaries in females)
- Mammary—milk glands and udder
ORGAN SYSTEMS AND FUNCTIONS

♦ Skeletal—framework for body
♦ Muscular—makes movement and locomotion possible
♦ Nervous—coordinates body activities and responds to stimuli
♦ Circulatory—moves blood and its contents in body
♦ Respiratory—moves gases to and from the circulatory system
♦ Excretory—rids body of metabolic wastes
♦ Digestive—prepares food for digestion and eliminates undigested food materials
♦ Lymphatic—produces and circulates lymph
♦ Integumentary—protects and shapes the body exterior
♦ Reproductive—produces offspring; varies by gender
♦ Mammary—present in female mammals; secretes milk
WHY KNOW ANATOMY AND PHYSIOLOGY?

♦ Promotes animal well-being
  ■ Animal well-being—caring for animals so that their needs are met; animals do not suffer

♦ Consider environmental needs of animals

♦ Provide facilities to meet needs

♦ Provide care based on age and condition

♦ Consider animal production capacity in selection
Understanding Tissues in the Animal Body

Purpose

The purpose of this activity is to familiarize students with types of tissues that make up the animal body.

Objectives

1. Identify and describe the four types of tissue.
2. Identify the difference between simple and stratified epithelium.
3. Identify and describe the differences between squamous, cuboidal, and columnar epithelial cells.
4. Identify and describe the differences between the various types of connective tissue.
5. Identify the three types of muscle tissue and describe the differences between them.
6. Identify a nerve cell and describe its components.

Materials

- microscope
- prepared slides of the following epithelial cells: simple squamous, stratified squamous, simple cuboidal, stratified cuboidal, simple columnar, and stratified columnar
- prepared slides of the following connective tissues: loose, dense irregular, dense regular, cartilage, compact bone, adipose, blood smear
- prepared slides of skeletal, smooth, and cardiac muscle tissue
- prepared slides of nerve cells
- lab sheet
- writing utensil

Procedure

1. View each of the prepared epithelial cell slides with full magnification and make sketches of each type of epithelial cell.
2. View each of the prepared connective tissue slides with full magnification and make sketches of each type of connective tissue.
3. View each of the prepared muscle tissue slides with full magnification and make sketches of each type of muscle tissue.
4. View the prepared nerve cell slide with full magnification and make a sketch of the nerve cell.
External Parts of Swine

Purpose

The purpose of this activity is to help students master the external anatomy of swine.

Objective

Identify and understand the major external parts of swine.

Materials

- lab sheet
- research material (lecture notes or Internet)

Procedure

1. Use a research source to identify the major external parts of swine.
2. Label the parts on the drawing provided on the following page.
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