

Lesson # 11

Poultry Anatomy and Physiology

Core Area: Animal Science

Unit: Poultry Industry

Lesson # 11: Poultry Anatomy and Physiology

California CTE Standards (Agriculture):

D3.1 Understand the major systems and the function of the organs within each system.

C6.1 Know the names and locations of the external anatomy of animals.

C6.2 Know the anatomy and major functions of vertebrate systems, including digestive, reproductive, circulatory, nervous, muscular, skeletal, respiratory, and endocrine systems.

FS 4.6 Differentiate among, select, and apply appropriate tools and technology.

FS 6.5 Use tools and machines safely and appropriately.

FS 9.3 Understand how to organize and structure work individually and in teams for effective performance and attainment of goals.

FS 11.0 Demonstration and Application.

California Academic Standards.

Investigation and Experimentation

1a Select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform tests, collect data, analyze relationships, and display data.

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

1. To understand the definitions of anatomy and physiology.
2. To understand anatomical terms to describe areas of the animal body.
3. To define and discuss the functions of major body systems of poultry.

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

Recommended Resources. The following resource should be selected to accompany this lesson:

- ✓ Power Point Presentation
- ✓ Anatomy Worksheet

Other Resources: The following resources will be useful to students and teachers:

List of Equipment, Tools, Supplies, and Facilities.

Lab Option 1: Dissection

- ✓ Scalpel
- ✓ Scissors
- ✓ Pins
- ✓ One euthanized chicken, preferably fully intact.

Lab Option 2: Dissection Video

Terms. The following terms are presented in this lesson (shown in bold italics):

- Bronchi
- Wattle
- Comb
- Larynx
- Pneumatic Bones
- Plumage
- Filoplumes
- Inhalation
- Exhalation
- Air Sacs
- Nares
- Uric Acid
- Medullary
- Shank
- Ductus Deferens
- Rudimentary Phallus
- Vent
- Deglutition
- Crop
- Proventriculus
- Ceca
- Cloaca
- Bile
- Erythrocyte
- Gizzard
- Leukocyte

Interest Approach.

With the guidance from the instructor have students list and discuss anatomical differences between birds and mammals. Have the students explain how these differences relate to unique physiological processes of birds.

SUMMARY OF CONTENT AND TEACHING STRATEGIES

Objective 1: Define Anatomy and Physiology.

Anticipated Problem: What is the difference between the location of an organ and its actual purpose?

I. Anatomy

- A. Anatomy is the science of the structure of animals. The word is derived from the Greek work “to cut up.”

II. Physiology

- A. Physiology is the science that deals with the functions of the living organism and its parts.

III. Anatomical Terms

- A. The following terms are used to describe locations on the animal body.
 1. Dorsal: pertains to the upper surface of the animal.
 2. Ventral: relates to the lower and abdominal surface.
 3. Cranial (or anterior): applies to the front or head.
 4. Caudal (or posterior): pertains to the tail or rear.

Teacher notes: A handout is provided at the end of the lesson plan. Have students complete the handout as you lecture about these terms.

Objective 2: To understand the anatomy and physiology of various avian systems and to understand how they might differ from mammals.

Anticipated Problem: How does avian anatomy and physiology differ from mammals?

I. Integumentary System

- A. The skin, or integumentary system, of poultry is similar to mammals, except for feather production. They have a **wattle**, defined as the red skin underneath the beak, and a **comb**, defined as the red skin located on top of their head. Blood circulates between the wattle and comb and helps to regulate body temperature.

B. Poultry have **plumage** and beaks.

1. Plumage is defined as the outer covering of a bird's body. This includes feathers, scales, and **filoplumes**, which are hair-like structures located at the base of feathers. Scales are located on the legs and feet. The plumage allows for altered shape to facilitate necessary body cooling and heating for maintenance of body temperature. Plumage shape is particularly important for cooling since birds lack sweat glands. Although it is not common for production birds to fly, plumage type and form is an important determinant in flight for aerial species. Plumage protects against abrasions and bruises when birds are in groups or lying on the ground.
2. Birds have beaks as opposed to lips and teeth. The beak is used for eating and drinking, as well as in self-defense and protection from other animals.

II. Respiratory System

- A. The respiratory system of poultry is vastly different than the mammalian respiratory system. Unlike mammals, birds lack a diaphragm to inflate and deflate the lungs. Instead, birds have nine **air sacs** located in the neck region and body cavity that function to inflate the lungs.
 1. Gas exchange occurs in the Avian lung and the air sacs function to move air in and out of the respiratory system.
- B. The breathing process has two phases: inhalation and exhalation.
 1. **Inhalation**: when the bird breathes in, air bypasses the lungs and enters the posterior air sacs. At the same time, air in the lungs from the last exhalation phase exits the lungs and enters the anterior air sacs.
 2. **Exhalation**: the bird releases air from the posterior air sacs, which enters the lungs. The air that filled the anterior air sacs from the inhalation phase is then released from the body through the trachea.
- C. **Nares** are the nostrils located on the beak. Their purpose is the passageway for air to be breathed in and out of the trachea.

III. Skeletal System of Poultry

- A. Pneumatic Bones
 1. Poultry have **pneumatic**, or hollow, bones. These bones connect with the respiratory system and their light weight helps is an adaptation to flight.
- B. Medullary Bone
 1. **Medullary** bone contains high amounts of calcium and this storage source is used by the female hen when developing the egg shell during reproductive periods.
- C. Fused Bones
 1. Bones in the foot, or **shank**, are fused and cause birds to walk upright.
 2. Many vertebrae along the backbone are fused for the purpose of flight.

IV. Digestive System:

- A. The purpose of the poultry digestive system is to use nutrients found in feed through the processes of digestion and absorption.
- B. The digestive system begins at the oral cavity and ends at the **vent**.
 1. Oral cavity
 - a. Tongue: the tongue functions to move food within the oral cavity and initiates **deglutition**, or swallowing, of feed.
 2. Esophagus
 - a. The esophagus is a flexible tube that carries food from the oral cavity to the **crop** and **proventriculus**.
 3. Crop
 - a. The crop is an outcropping, or pouch, of the esophagus.
 - b. The crop functions to store feed. No digestion of food takes place in the crop.
 4. Proventriculus
 - a. The **proventriculus** is the true stomach of the bird, similar to the mammalian stomach.
 - b. The proventriculus uses acid and other digestive enzymes to begin the chemical breakdown of food.
 5. Gizzard
 - a. The gizzard is also called the ventriculus.
 - b. The gizzard contains well-developed musculature and functions by grinding and contacting to aid in the mechanical reduction of food particles.
 - c. The gizzard may contain small pebbles or gravel from foraging to aid in the reduction of food particle size.
 6. Small Intestine
 - a. After passing the gizzard and being reduced to the proper particle size, food enters the small intestine for further digestion and absorption.
 - b. There are three regions of the small intestine:
 1. Duodenum
 2. Jejunum
 3. Ileum
 - c. The small intestine has a very large absorptive area due to many folds and finger-like projections located along its length.
 7. Ceca
 - a. Poultry have two **ceca**, while mammals have one (appendix).
 - b. The ceca are two dead-end pouches that contain microbes.
 - c. The microbes ferment any left over food particles and produce molecules that the bird can use as an energy source.
 8. Colon
 - a. Also referred to as the large intestine.
 - b. This a short section of the digestive tract that starts after the ceca and ends at the **cloaca**.
 - c. The function of the colon is to absorb water.

9. Cloaca
 - a. This is also known as the vent and is the chamber responsible for the expulsion of feces and urine.
10. Liver
 - a. The liver is an accessory organ of the digestive system.
 - b. The liver produces a substance called **bile**, which helps to digest fats. Bile is stored in the gall bladder.
11. Pancreas
 - a. The pancreas is an accessory organ of the digestive system.
 - b. This is a yellow organ located in the loop of the duodenum.
 - c. The pancreas produces digestive enzymes that are released into the small intestine to help digest protein and carbohydrate.
 - d. The pancreas produces the hormones insulin and glucagon, which work together to control blood-sugar level.

V. Circulatory System

- A. The purpose of the circulatory system is to control the flow of blood throughout the body.
- B. There many organs of the circulatory system:
 1. Heart
 - a. A large organ that is located in the chest cavity.
 - b. The poultry heart has four chambers: two atrium and two ventricles.
 - c. The heart pumps blood throughout the body to deliver oxygen and nutrients to tissues and to remove carbon dioxide and metabolic waste from tissues.
 2. Blood Vessels
 - a. Arteries – deliver blood from the heart to tissues.
 - b. Arterioles – smaller branches of arteries that direct blood to certain tissues.
 - c. Capillaries – site of gas, nutrient, and waste exchange between the blood and the body's tissues.
 - d. Veins – deliver blood from the tissues to the heart and lungs for oxygenation.
 3. Blood
 - a. Composed of plasma and blood cells.
 1. Avian red blood cells, also known as **erythrocytes**, are nucleated, unlike non-nucleated mammalian red blood cells. They are produced in the bone marrow and transport oxygen.
 2. White blood cells, or **leukocytes**, are important in fighting disease in the body. They are cells of the immune system.
 3. Plasma makes up the majority of the blood. It contains many different molecules, such as water, glucose, plasma proteins, and plasma enzymes.

VI. Urinary System

- A. Kidneys – two multi-lobular structures located in the rib cage.
 - 1. The kidneys produce urine by removing waste products from the blood.
- B. Ureters
 - 1. Transport kidney filtrate from the kidneys to the cloaca for excretion.
 - 2. Birds do not have a bladder, so urine is not stored, but rather excreted into the cloaca when produced.
- C. Cloaca
 - 1. Feces and urine exit out of the bird's body through this region in the abdominal cavity.
- D. Uric Acid Excretion
 - 1. Poultry excreta contain **uric acid**. Uric acid is very high in nitrogen and due its lowered water content is semi-solid.

VII. Reproductive System

- A. Male Reproductive Tract
 - 1. Two testes located internally in the body.
 - 2. **Ductus Deferens**
 - a. Deliver semen from the testes to the phallus.
 - 3. **Rudimentary phallus**
 - a. Poultry have no external penis, but rather a protuberance termed a **rudimentary phallus**.
- B. Female Reproductive Tract
 - 1. Ovary
 - a. Poultry have only one functioning ovary, usually the left ovary.
 - 2. Oviduct
 - a. Function
 - 1. To produce albumen (egg white), shell membrane, and the shell around the yolk.
 - b. Five regions
 - 1. Infundibulum – receives the follicle and is the location of conception where the male and female gamete come together.
 - 2. Ampulla – produces the albumen.
 - 3. Isthmus – produces the inner and outer shell membranes.
 - 4. Uterus – produces additional albumen, forms the shell and cuticle (seals pores of the egg shell) and determines the shell pigment.
 - 5. Vagina – a holding area of the egg, produces some cuticle, and expels the egg and regulates timing of egg production.
 - 3. Cloaca – the equivalent of a rectum in poultry; egg passes through this part.
 - 4. Ovulation
 - a. The releasing of the egg and formation of the egg and shell which is a process regulated by hormones.

Teacher notes: Have students fill in handout as you lecture. Assign Worksheet: *Anatomy of the Avian System*. More information on the female reproductive tract is available in the “Egg Laying Hens” lesson plan.

Review/Summary. Focus the review of the lesson around the student learning objectives. Ask students to explain the content associated with each objective. Use their responses as the basis for determining any areas that need to be covered again.

Application. Application can involve student activity with the provided labs.

Evaluation. Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as a written test. A sample test is attached.

Answers to Sample Test:

Part One: Terms

Integumentary System	Respiratory System	Skeletal System	Digestive System	Circulatory System	Urinary System	Reproductive System
Wattle	Inhalation	Pneumatic bones	Deglutition	Erythrocyte	Uric acid	Ductus defrens
Comb	Exhalation	Medullary	Crop	Leukocyte	Cloaca	Rudimentary phallus
Plumage	Air sacs	Shank	Proventriculus			
Filoplumes	Nares		Ceca			
			Gizzard			

Part Two: T / F

- | | |
|------|-------|
| 1. T | 9. T |
| 2. T | 10. T |
| 3. F | 11. F |
| 4. T | 12. T |
| 5. T | 13. T |
| 6. T | 14. F |
| 7. T | 15. T |
| 8. F | 16. T |