

Lesson B3–2

Understanding Animal Digestion

Unit B. Animal Science and the Industry

Problem Area 3. Meeting Nutritional Needs of Animals

Lesson 2. Understanding Animal Digestion

New Mexico Content Standard:

Pathway Strand: Animal Systems

Standard: III: Provide proper nutrition to maintain animal performance.

Benchmark: III-A. Examine animal developmental stages to comprehend why nutrient requirements are different throughout an animal's life cycle.

Performance Standard: 1. Recognize the different phases of an animal's life cycle.

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

1. Identify the various types of digestive systems found in animals.
2. Describe the functions of the major parts of the digestive systems.

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

Recommended Resources. One of the following resources should be selected to accompany the lesson:

Lee, Jasper S., et. al. *Introduction to Livestock and Companion Animals, 2nd Edition.* Danville, Illinois: Interstate Publishers, Inc. 2000. (Chapter 3)

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

Baker, M. and Mikesell, R.E. *Animal Science Biology & Technology.* Danville, Illinois: Interstate Publishers, Inc. 1996. (Chapter 4)

Ensminger, M. E. *Animal Science,* Danville, Illinois: Interstate Publishers, Inc. 1991. (Chapter 4)

Gillespie, James R. *Modern Livestock & Poultry Production, 6th Edition.* Albany, New York: Delmar, 2002. (Unit 5)

List of Equipment, Tools, Supplies, and Facilities

Writing surface
Overhead projector
Transparencies from attached masters

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

Absorption
Amino acids
Anus
Avian
Bile
Cecum
Chyme
Crop
Cud
Digestion
Digestive system
Enzymes
Eructated
Feces
Gizzard
Intestinal juice
Monogastric
Omasum

Pancreatic amylase
Pancreatic juice
Pepsin
Polygastric
Pseudo-ruminant
Reticulum
Rumen
Ruminant
Rumination
Salivary amylase
Salivary maltase
Stomach
Trypsin

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.

Show the students a transparency of one of the digestive systems. Ask the students, “What is this?” When you have gotten the correct answer, ask the students “Why is it important for livestock producers to understand this?” Lead discussion to Objective 1 of the lesson.

Summary of Content and Teaching Strategies

Objective 1: Identify the various types of digestive systems found in animals.

Anticipated Problem: What are the various types of digestive systems found in animals?

- I. Knowledge of the different types of digestive systems is critical in selecting the proper feeds for livestock. Understanding the chemical and physical changes that occur during the digestion process leads to more efficient livestock feeding. **Digestion** is the process of breaking down feed into simple substances that can be absorbed by the body. **Absorption** is taking the digested parts of the feed into the bloodstream. The **digestive system** consists of the parts of the body involved in chewing and digesting feed. This system also moves the digested feed through the animal’s body and absorbs the products of digestion. Different species of animals are better able to digest certain types of feeds better than others. This difference occurs due to the various types of digestive systems found in animals. There are four basic types of digestive systems: monogastric (simple), avian, ruminants (polygastric), and pseudo-ruminants.
 - A. A **monogastric** digestive system has a simple stomach. The **stomach** is a muscular organ that stores ingested feed and moves it into the small intestine. The stomach secretes acid. The acid results in a low pH of 1.5 to 2.5. The low pH destroys most bacteria and begins to break down the feed materials. Animals with this type of digestive system are

better adapted to the use of concentrated feeds, such as grains, than the use of large quantities of roughages. Examples of monogastric animals are dogs, cats, swine and humans.

- B. The **avian** digestive system is found in poultry. This system differs greatly from any other type. Since birds have no teeth, there is no chewing. The esophagus empties directly into the crop. The **crop** is where the food is stored and soaked. From the crop the food makes its way to the gizzard. The **gizzard** is a very muscular organ, which normally contains stones or grit which functions like teeth to grind the food. Digestion in the avian system is very rapid.
- C. The **polygastric** or **ruminant** digestive system has a large stomach divided into compartments. The largest section of the stomach is the **rumen**. The rumen contains bacteria and other microbes that promote fermentation. The rumen is the first compartment of the stomach that food enters. This system is designed for food to be ingested, **eructated** (belched up), chewed, and swallowed again. The **reticulum** is the second segment of the stomach. Next is the omasum, followed by the abomasum. The **omasum** is a small compartment that acts as a filter of materials for the abomasum. The abomasum secretes gastric juices that kill the microbes that have passed with the food materials from the rumen. The juices and other substances in the abomasum digest the microbes. The polygastric system uses feed high in fiber. Thus, these animals make good use of roughage. Some examples of polygastric animals are cattle, sheep, and goats.
- D. A **pseudo-ruminant** is an animal that eats large amounts of roughage but does not have a stomach with several compartments. The digestive system does some of the same functions as those of ruminants. They are able to utilize large amounts of roughages because of the greatly enlarged cecum and large intestine. These animals often eat forages as well as grains and other concentrated feeds. Examples of pseudo-ruminants are horses, rabbits, guinea pigs, and hamsters.

There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in understanding the various types of digestive systems found in animals. Chapter 3 in Introduction to Livestock and Companion Animals is recommended. Use TM: B3–2A thru TM: B3–2D to aid in discussion.

Objective 2: Describe the functions of the major parts of the digestive systems.

Anticipated Problem: What are the major parts of the digestive system and their functions?

- II. The digestive system is made up of a number of parts known as organs. The system begins at the mouth, where food enters the body, and continues until anus, where undigested material exits the body. The digestive systems of most livestock are very similar in terms of the organs they contain. Some of the major parts of the digestive system and their functions are:
 - A. Mouth and esophagus—The chewing action of the mouth and teeth breaks, cuts, and tears up the feed. This increases the surface area of the feed particles which aids in the chewing and swallowing process. Saliva stimulates the taste of the feed but also contains

the enzymes, salivary amylase and salivary maltase. **Enzymes** are substances called organic catalysts that speed up the digestive process. **Salivary amylase** changes starch to maltose or malt sugar. **Salivary maltase** changes maltose to glucose.

- B. Ruminant stomach—The four parts of the ruminant stomach are rumen, reticulum, omasum, and abomasum. Ruminant animals typically eat rapidly. They do not chew much of their food before swallowing. The solid part of food goes into the rumen. The liquid part goes into reticulum, then the omasum and on into the abomasum. In the rumen, the solid feed is mixed and partially broken down by bacteria. When the rumen is full, the animal lies down. The feed is then forced back into the mouth ruminates occurs. **Rumination** is the process of chewing the cud. **Cud** is a ball-like mass of feed that is brought up from the stomach to be rechewed. On average, cattle chew their cud about six to eight times per day. A total of five to seven hours each day are spent in rumination. The rumen and reticulum contain millions of bacteria and protozoa. It is the bacterial action in the rumen that allows ruminants to use large amounts of roughage. These bacteria can change low-quality protein into the amino acids needed by the animal. **Amino acids** are compounds that contain carbon, hydrogen, oxygen, and nitrogen. These are essential for growth and maintenance of cells. Bacteria also produce many of the vitamins needed by the animal.
- C. Monogastric stomach—When feed enters the stomach of monogastrics or the abomasum of ruminants, gastric juices begin to flow. The fluid comes from glands in the wall of the stomach. The juices contain from 0.2 to 0.5 percent hydrochloric acid. This acid stops the action of the amylase from the mouth. These gastric juices also contain the enzymes pepsin, rennin, and gastric lipase. **Pepsin** breaks the proteins in the feed into proteoses and peptones. The muscular walls of the stomach churn and squeeze the feed. Liquids are pushed on into the small intestine. The gastric juice then act on the solids that remain in the stomach.
- D. Small intestine—The partly digested feed that leaves the stomach enters the small intestine. It is an acid, semi-fluid, gray, pulpy mass. This material is called **chyme**.

In the small intestine, the chyme is mixed with three digestive juices: pancreatic juices, bile, and intestinal juice.

Pancreatic juice secreted by the pancreas, contains the enzymes trypsin, pancreatic amylase, pancreatic lipase, and maltase. **Trypsin** breaks down proteins not broken down by pepsin. Some of the proteoses and peptones are broken down by trypsin to peptides. Proteoses, peptones, and peptides are combinations of amino acids. Proteoses are the most complex compounds and peptides are the simplest. **Pancreatic amylase** changes starch in the feed to maltose. Sugar and maltose are then broken down even further by maltase. They are then changed into a simple sugar called glucose. Lipase works on fats in the feed. It changes them into fatty acids and glycerol.

Bile is a yellowish-green, alkaline, bitter liquid produced in the liver. Bile is stored in the gall bladder in all animals except horses. Bile aids in the digestion of fats and fatty acids. It also aids in the action of the enzyme lipase.

Glands in the walls of the small intestine produce **intestinal juice**. This fluid contains peptidase, sucrase, maltase, and lactase, all enzymes used in digestion. Proteoses and peptones are broken down by peptidase into amino acids. Starches and sugars are broken down by sucrase, maltase, and lactase into the simple sugars, glucose, fructose, and galactose.

- E. Cecum—The **cecum** or “blind gut” is found where the small intestine joins the large intestine. It is a small organ and has little function in most animals, except pseudoruminants. In these animals, roughage feeds are digested by bacterial action in the cecum.
- F. Large intestine—The main function of this organ is to absorb water. Material not digested and absorbed in the small intestine passes into the large intestine. Feed materials that are not digested or absorbed are called **feces**. This material is moved through the large intestine by muscles in the intestinal walls. The undigested part of feed is passed out the body through the **anus**, the opening at the end of the large intestine.

There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in understanding the functions of the major parts of the digestive systems. Unit 5 in Modern Livestock and Poultry Production is recommended.

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. Questions at end of chapters in the textbook may also be used in the review/summary.

Application. Do Experiment 1: Starch Digestion by Enzyme Action and Experiment 2: Effects of Physical and Chemical Treatment of Forage Samples on Digestibility of pages 320–322 in *Biological Science Applications in Agriculture*.

Evaluation. Focus the evaluation of student achievement on mastery of the objectives stated in the lesson. Measure student performance on classroom participation, laboratory assignments, and written tests or quizzes.

Answers to Sample Test:

Part One: Matching

1 = h, 2 = e, 3 = j, 4 = f, 5 = b, 6 = i, 7 = d, 8 = a, 9 = g, 10 = c

Part Two: Completion

1. Digestion
2. gastric juices
3. fiber

4. maltose or malt sugar
5. six, eight

Part Three: Short Answer

See Objective 2 in lesson for scoring this question.

Test

Lesson B3–2: Understanding Animal Digestion

Part One: Matching

Instructions. Match the term with the correct response. Write the letter of the term by the definition.

- | | | |
|--------------------|---------------|---------------------|
| a. Pseudo-ruminant | b. Omasum | c. Digestive system |
| d. Reticulum | e. Rumination | f. Amino acids |
| g. Avian | h. Cecum | i. Monogastric |
| j. Ruminant | | |

- _____ 1. Small organ and has little function in most animals, except pseudo-ruminants
- _____ 2. The process of chewing the cud
- _____ 3. Digestive system that has a large stomach divided into compartments
- _____ 4. Compounds that contain carbon, hydrogen, oxygen, and nitrogen
- _____ 5. A small compartment that acts as a filter of materials for the abomasum.
- _____ 6. Digestive system that has a simple stomach
- _____ 7. The second segment of the ruminant stomach
- _____ 8. An animal that eats large amounts of roughage but does not have a stomach with several compartments
- _____ 9. Digestive system found in poultry
- _____ 10. Parts of the body involved in chewing and digesting feed

Part Two: Completion

Instructions. Provide the word or words to complete the following statements.

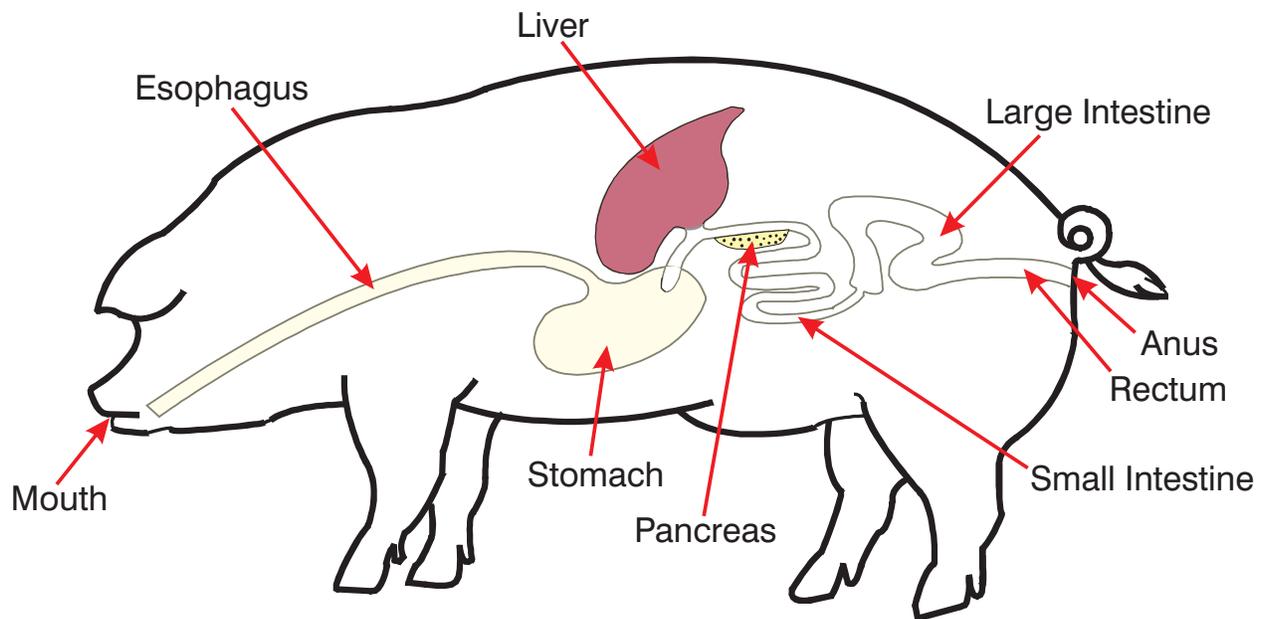
1. _____ is the process of breaking down feed into simple substances that can be absorbed by the body.
2. The abomasum secretes _____ that kill the microbes that have passed with the food materials from the rumen.
3. The polygastric system uses feed high in _____.
4. Salivary amylase changes starch to _____.
5. On average, cattle chew their cud about _____ to _____ times per day.

Part Three: Short Answer

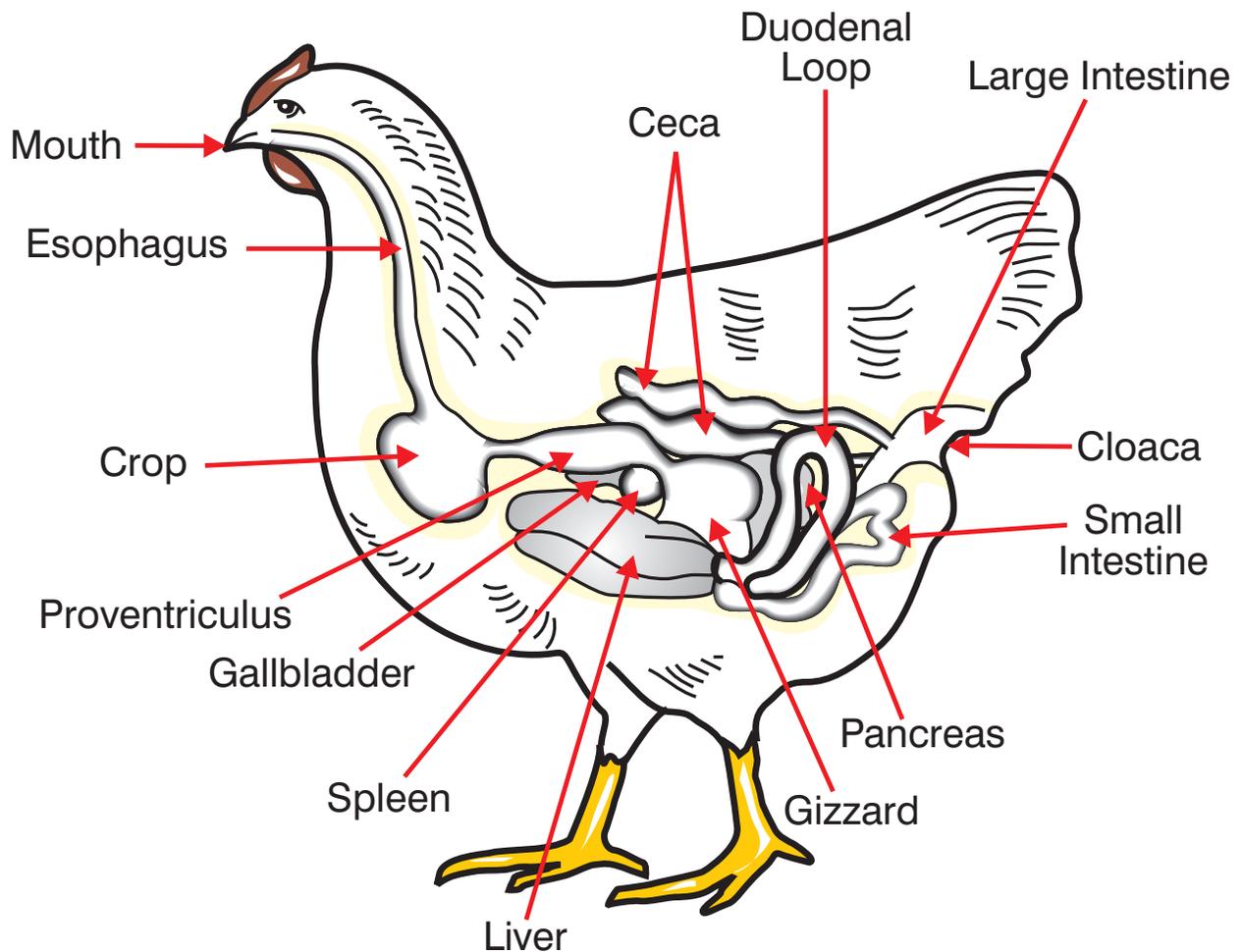
Instructions. Provide information to answer the following question.

Briefly describe digestion in ruminant animals.

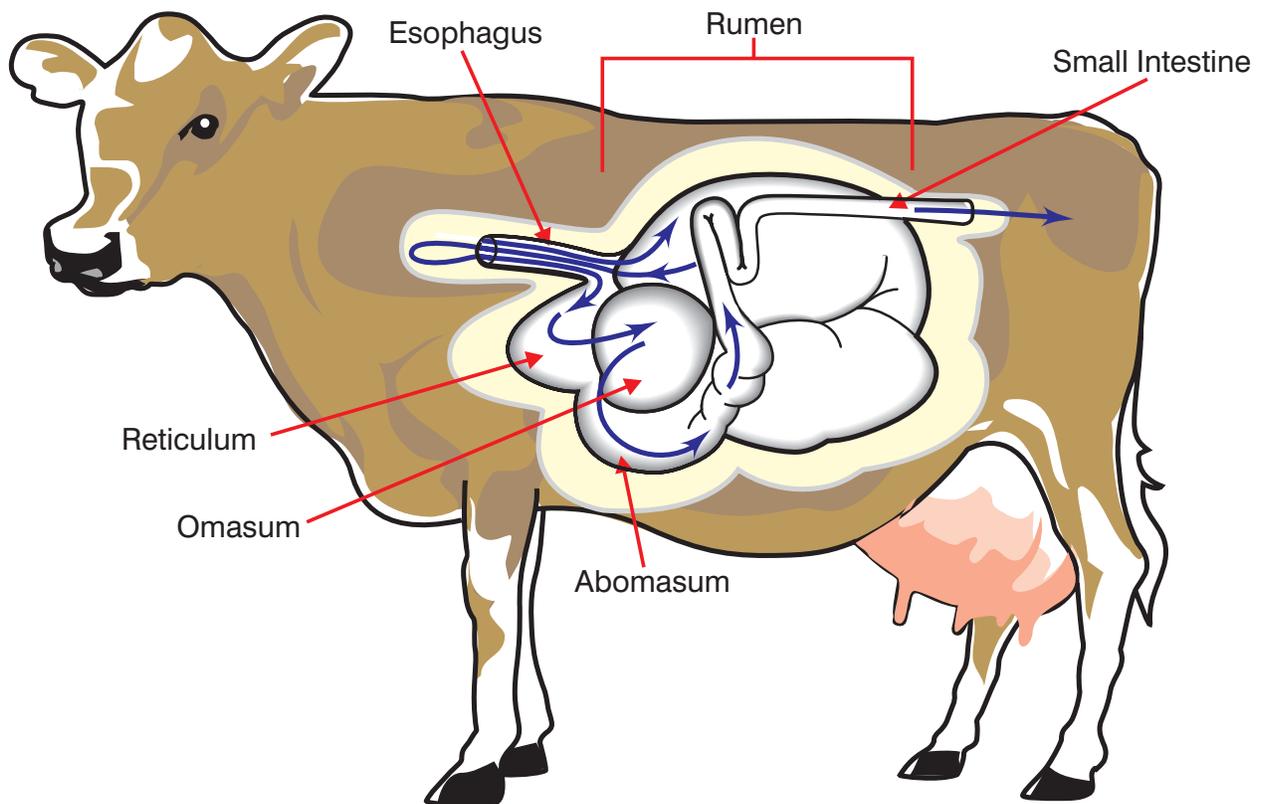
SCHEMATIC DIAGRAM OF PIG DIGESTIVE SYSTEM



SCHEMATIC DIAGRAM OF CHICKEN DIGESTIVE SYSTEM



SCHEMATIC DIAGRAM OF COW DIGESTIVE SYSTEM



SCHEMATIC DIAGRAM OF HORSE DIGESTIVE SYSTEM

