

Unit C: Meeting Nutritional Needs of Animals

Lesson 2: Understanding Animal Digestion

Student Learning Objectives:

Instruction in this lesson should result in students achieving the following objectives:

1. Identify the type of digestive system found in cattle.
2. Describe the functions of the major parts of the digestive system.

Recommended Teaching Time: 1 hour

Recommended Resources: The following resources may be useful in teaching this lesson:

Baker, M & Mikesell, R.E. *Animal Science Biology and Technology*. Danville, IL: Interstate Publishers, Inc. 1996.

Ensminger, M.E. *Animal Science*. Danville, IL: Interstate Publishers, Inc: 1991.

Gillespie, J.R. *Modern Livestock and Poultry Production, 6th Edition*. Albany, NY: Delmar. 2002.

Lee, Jasper S., Hutter, J., Rudd R., Westrom, L., Bull, A.M., Embry Mohr, C. & Pollock, J. *Introduction to Livestock and Companion Animals 2nd Edition*. Danville, Illinois: Interstate Publishers, Inc., 2000.

List of Equipment, Tools, Supplies, and Facilities:

- Writing surface
- PowerPoint Projector
- PowerPoint Slides
- Transparency Masters

Terms: The following terms are presented in this lesson (shown in bold italics and on PowerPoint Slides 2 and 3):

- Absorption
- Amino acids
- Anus
- Bile
- Cecum
- Chyme
- Cud
- Digestion
- Digestive system
- Enzymes
- Eructated
- Feces
- Intestinal juice
- Omasum
- Pancreatic amylase
- Pancreatic juice
- Polygagastic
- Reticulum
- Rumen
- Ruminant
- Rumination
- Salivary amylase
- Salivary maltase
- Trypsin

Interest Approach:

Show the students a picture of the ruminant digestive system. Ask the students, “What is this?” When you have gotten the correct answer, ask the students, “Why is it important for livestock producers to have an understanding of the digestive system of cattle?” Lead discussion to Objective 1 of the lesson.

SUMMARY OF CONTENT AND TEACHING STRATEGIES

Objective 1: Identify the type of digestive system found in cattle.

Anticipated Problem: What is the type of digestive system in cattle?

(PowerPoint Slides 4, 5, and 6)

- I. Knowledge of the digestive system is critical in selecting the proper feeds for cattle. 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. Cattle belong to the ruminant group.

(PowerPoint Slide 7)

- A. The **polygastric** or **ruminant** digestive system has a large stomach divided into compartments.
 1. 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.

(PowerPoint Slides 8 and 9)

2. The **reticulum** is the second segment of the stomach. The reticulum is sometimes called the “honeycomb” due to the structure of its wall and location.
3. Next is the omasum, followed by the abomasum. The **omasum** is a small compartment that acts as a filter of materials for the abomasum.

(PowerPoint Slides 10, 11, and 12)

4. The **abomasum** is the fourth and final compartment to the ruminant digestive system. The Abomasum is often considered the true stomach. It functions just like that of the simple-stomached animals. 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 abomasums digest the microbes. The abomasum also contains

hydrochloric acid and enzymes that break down feed materials into simple compounds. These simple compounds can be absorbed by the stomach wall and the intestines.

5. The polygastric system uses feed high in fiber. Thus, these animals make good use of roughage. Cattle are an example of polygastric animals, plus sheep and goats.

Use TM: 2-1 (PowerPoint Slide 12) to summarize the discussion of the four major compartments of the stomach of a cow. Point to the specific parts of the stomach and have the students explain what happens in each.

Objective 2: Describe the functions of the major parts of the digestive system.
Anticipated Problem: What are the major parts of the digestive system and their functions?

(PowerPoint Slide 13)

- 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 livestock are very similar in terms of the organs they contain. Some of the major parts of the digestive system and their functions are:

(PowerPoint Slides 14 and 15)

- 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.

(PowerPoint Slides 16, 17, and 18)

- 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 where rumination 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.

(PowerPoint Slides 19, 20, and 21)

C. 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**.

1. In the small intestine, the chyme is mixed with three digestive juices: pancreatic juices, bile, and intestinal juice.
 - a. **Pancreatic juice** is 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 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.

(PowerPoint Slide 22)

- b. **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 acids in the digestion of fats and fatty acids. It also aids in the action of enzyme lipase.

(PowerPoint Slide 23)

- c. Glands in the walls of the small intestine produce **intestinal juice**. This fluid contains peptidase, sucrose, 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 sucrose, maltase, and lactase into the simple sugars, glucose, fructose, and galactose.

(PowerPoint Slide 24)

D. 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 pseudo-ruminants. In these animals, roughage feeds are digested by bacterial action in the cecum.

(PowerPoint Slide 25)

E. 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 of the body through the **anus**, the opening at the end of the large intestine.

Use TM: 2-2 to summarize the discussion of the parts of the Digestive System for a ruminant animal. Be sure students can explain what takes place as food travels through each part.

Review/Summary: Focus the review and summary of the lesson around the student learning objectives (**PowerPoint Slide 26**). Call on students to explain the content associated with the objectives.

Application: Application can involve the securing of an actual digestive system from a local slaughter facility or a veterinarian so students can see the different components of the digestive system in cattle or search the internet for actual pictures of the parts.

Evaluation: Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as student performance on the application activity. A sample written test is included.

Answers to Sample Test:

Matching

1. E
2. D
3. B
4. G
5. C
6. A
7. F

Fill-in-the-blank

1. Digestion
2. Gastric juices
3. Fiber
4. Maltose or malt sugar
5. Six, eight

Short Answer

See Objective 2 for scoring this question.

Understanding Animal Digestion

Name: _____

Matching: Match each word with the correct definition.

- | | |
|---------------|---------------------|
| a. Reticulum | e. Cecum |
| b. Ruminant | f. Digestive system |
| c. Omasum | g. Amino acids |
| d. Rumination | |

- _____ 1. Small organ that 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. The second segment of the ruminant stomach.
- _____ 7. Parts of the body involved in chewing and digesting feed.

Fill-in-the-blank: Complete the following statements.

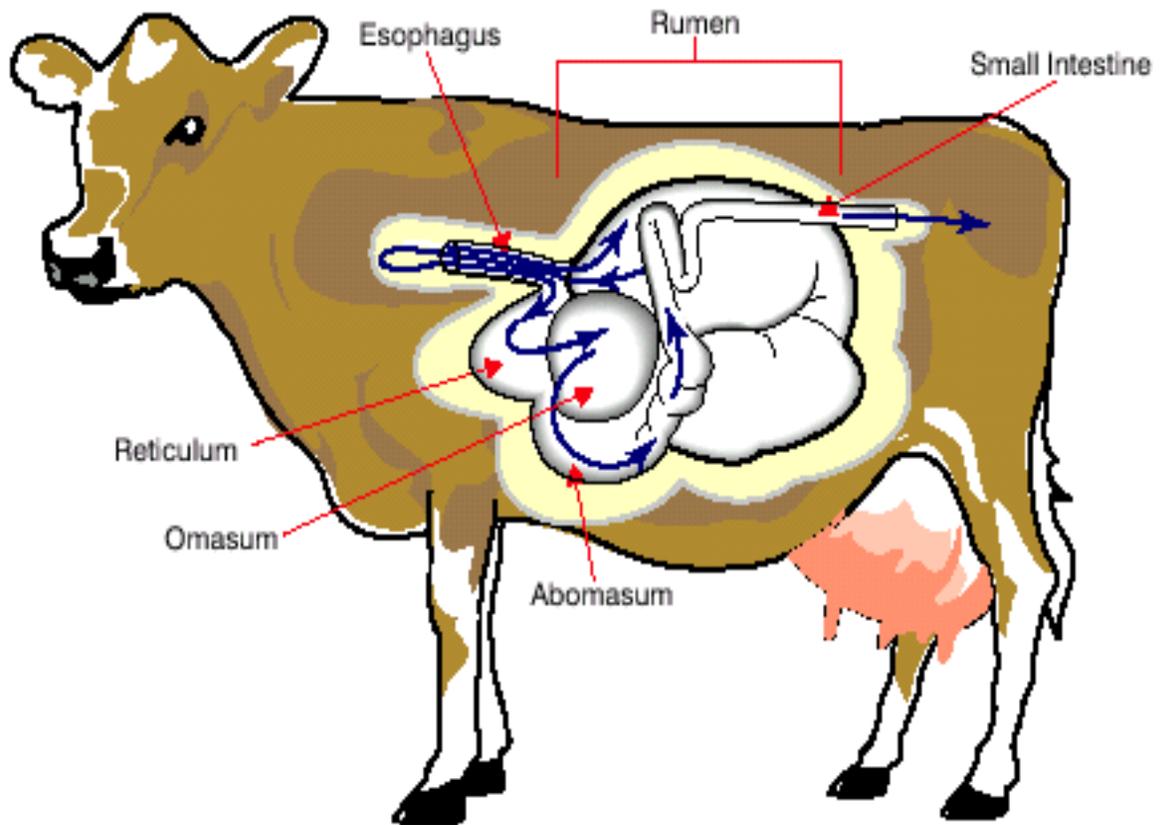
- _____ is the process of breaking down feed into simple substances that can be absorbed by the body.
- The abomasum secretes _____ that kill the microbes that have passed with the food materials from the rumen.
- The polygastric system uses feed high in _____.
- Salivary amylase changes starch to _____.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

Short Answer: Answer the following question.

Briefly describe digestion in ruminant animals.

TM: 2-1

COW DIGESTIVE SYSTEM



TM: 2-2

DIGESTIVE SYSTEM PARTS

- Mouth and esophagus
- Ruminant stomach
- Small intestine
- Cecum
- Large intestine