University of Idaho Extension
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Digestive Systems

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Goal (learning objective)

Youth will learn about the differences, parts and functions between ruminant and monogastric digestive systems.

Supplies

- Copies of Handout 1 "Ruminant vs Monogastric Digestive System" make enough copies for group
- Copies of Handout 2 "Ruminant Digestive System – Parts and Functions" make enough copies for group
- Copies of Handout 3 "Monogastric Digestive System – Parts and Functions" make enough copies for group
- Computer (may need speakers depending on facility and group size)
- Internet connection to view YouTube video
- Slices of bread cut into 4 squares (each member will need one square of bread)
- Sandwich size Ziploc baggies (one bag for each member)
- One, three-ounce cup for holding liquid (one cup for each member)
- 1 Liter of bottle of soda
- 1 Quart of orange juice
- 1 Pitcher of water

Pre-lesson preparation

- Purchase supplies (bread, soda, orange juice, Ziploc baggies)
- Make copies of Handouts 1, 2, and 3 for group
- Prepare bread slices
- Make arrangements to do the meeting in a location that has internet connection, tables, and chairs
- Read/review lesson
- Watch video
- Test computer/internet connection and video before meeting https://youtu.be/JSlZjgpF_7g

Lesson directions and outline

Share the following information with the youth:

The definition of digestion is the process of breaking down food by mechanical and enzymatic action in the stomach and intestines into substances that can be used by the body. The digestive system performs five major functions:

1. Food intake
2. Storage
3. Digestion
4. Absorption
5. Elimination of waste

These functions take place in a special system called the digestive tract. Each feedstuff is broken down into smaller units so it can be utilized by the body, or eliminated from the body. The digestion process prepares food for absorption and use by the animal's body.

There are two main digestive systems in livestock:

1. Ruminant

2. Monogastric

The main differences between ruminants and monogastrics are monogastrics only have one compartment to their stomach, whereas ruminants have four compartments: rumen, reticulum, omasum, and abomasum.

Ruminants chew their food numerous times through a process called regurgitation or rumination. That means their food travels first from their mouth to the esophagus, then down to the rumen. From the rumen, the food travels to the reticulum where it can them come back up the esophagus into the mouth. It is then chewed again and the process is repeated. The rumen is a big fermentation vat that allows ruminants to digest cellulose (found in plants). Microorganisms, such as bacteria, are found inside the rumen and digest feed. The reticulum is a part of the rumen and works to help digest foods. It is also called the honeycomb because it looks like a honeycomb made by bees. The omasum also helps digest feed and squeezes water from the feed. It is called "many plies" because it has many folds. The abomasum, also called the true stomach, is the fourth compartment and is similar to the human stomach. Here digestive juices are produced and help pass the feed into the small intestine and then into the large intestine.

Sheep, goats, and deer are examples of other ruminant animals.

Monogastric digestive systems begin with the ingestion of food into their mouth. The tongue and the teeth gather feed and break it down into smaller pieces in order to make it easier for the animal to digest. Food travels down the esophagus, which is a long tube that carries the feed from the mouth to the stomach. The stomach serves as a reservoir for short term storage and digestion where enzymes break down the feed components so that they may enter and be absorbed into the blood stream. Any remaining undigested food travels into the small intestine, where it is broken down further. After the small intestine has removed all available nutrients from the feed, the remaining material is passed into the large intestine and finally excreted from the body through the rectum or anus.

Hogs, horses, and humans are all examples of monogastrics.

Conducting the activity (DO)

1. Ask for volunteers to distribute Handouts 1, 2, and 3 to the group.
2. Review the background information with the group.
3. Share the video that will be of most interest to the youth: *CEV Multimedia: Ruminant Digestive Systems: A Closer Look DVD Lesson Preview (*available at: https://www.youtube.com/watch?v=M8EF-267Z1wM) or Digestive Physiology of the Ruminant available at https://www.youtube.com/watch?v=3xQ83mbfn5s
4. Discuss whichever video you chose to view with the group.
5. Discuss the differences between monogastric and ruminant digestive systems.
6. Ask the following questions:
   a. What does the esophagus do?
   b. Name the four parts of the ruminant stomach.
   c. What happens to food in the reticulum?
   d. What is the function of the small intestine?
7. Divide class into 3 groups.
8. One group will get water, one group will get orange juice and one group will get soda.
9. Pour 3 ounces of specified liquid for your group into small cups and distribute to appropriate group.
10. Place a piece of bread into a small Ziploc bag.
11. Add three ounces of specified liquid into Ziploc bag with bread.
12. Discussion:
    a. What is the function of the Ziploc bag? The Ziploc bag acts as the stomach or rumen of the animal.
    b. What does the liquid represent? The liquid acts as the enzymes or bacteria inside the stomach or rumen
    c. Once the liquid is added to the bag, observe what happens to the bread.

d. Have one person from each liquid group share:

- Orange Juice (OJ)
- Soda
- Water

13. Have members massage or gently squeeze their bag. Have each group shared what happened after this.

a. Discuss the mechanical action of the squeezing, what does that represent? (Muscles in the stomach or rumen). What is the liquid doing to the bread? (Liquid is acting like acid and breaking down the food, in this case the bread).

b. Discuss the differences in rate of breakdown of the bread based on the type of liquid used.

c. Discuss the differences in rate of breakdown of bread based on the amount of massaging/ squeezing.

14. Following observation of what bread is most dissolved or digested, discuss the differences among the groups.

15. After discussion, discard baggies and contents into trash.

What did we learn? (REFLECT)

- Ask: Name the five basic functions that the digestive system performs. (Food intake, storage, digestion, absorption, elimination of waste)
- Ask: What type of digestive system do humans have? (Monogastric)
- Ask: What is a livestock species that has a similar stomach to humans? (Horses and hogs)
- Ask: What type of digestive system do sheep and beef have? (Ruminant)
- Ask: What is the difference between a ruminant and monogastric digestive system? (The number of stomach compartments - ruminant has four; monogastrics have one).

Why is that important? (APPLY)

- Ask: Are there foods that are harder to breakdown than others? Why? (Yes, plant matter is more difficult to digest compared to meat. Cellulose is hard to break down)
- Ask: Why do ruminants have four stomach compartments and monogastrics have only one? (There are four compartments to help digest and use the cellulose-rich plant material the animal consumes)
- Ask: Which has more complex food to breakdown? (Ruminant)

Resources

CEV Multimedia. (n.d.). *Ruminant digestive systems: a closer look*. Retrieved from: https://www.youtube.com/watch?v=M8EF267Z1wM

Ohio State University Extension. (2011). Nutrition and Feeding. *Beef resource handbook* (pages 7-1 through 7-7).

Ohio State University Extension. (2008). Nutrition. *Goat resource handbook* (pages 49-55).

Ohio State University Extension. (2011). Nutrition. *Sheep resource handbook for market and breeding projects* (pages 49-55).

Ohio State University Extension. (2000). Digestive System. *Swine resource handbook for market and breeding projects* (page 7-1).

Thelen, J. (2016). A Stomach At Work. *Animal science anywhere*. Michigan State University Extension. Retrieved from: msue.anr.msu.edu/uploads/236/65684/4H1659_ASA-DigestiveSystem_2016.pdf

NUTRITION: DIGESTIVE SYSTEMS – HANDOUT 1

Ruminant vs Monogastric Digestive System

RUMINANT

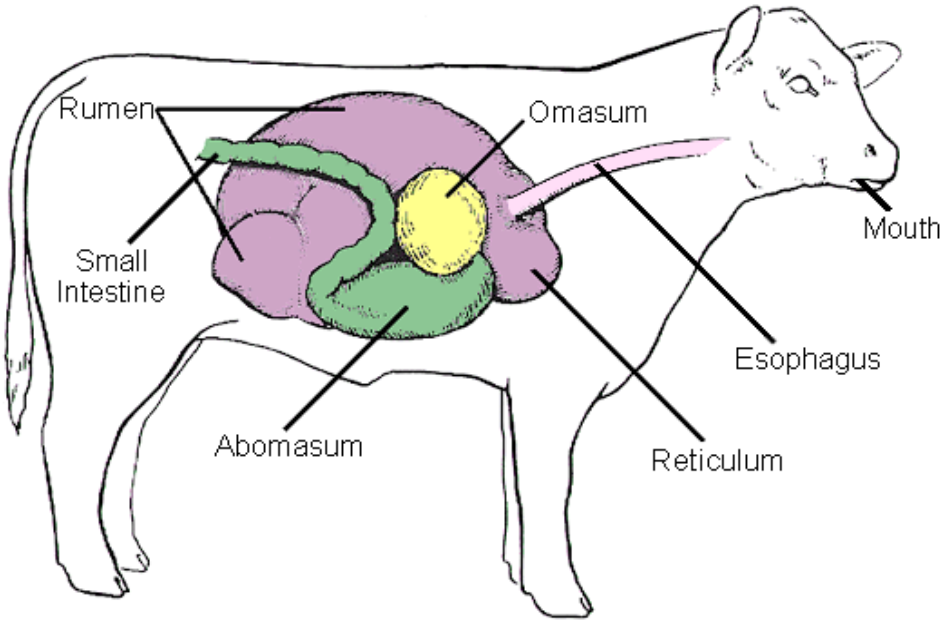

Image from: http://www2.ca.uky.edu/agripedia/agmania/ias/asc106/girumin.asp

MONOGASTRIC

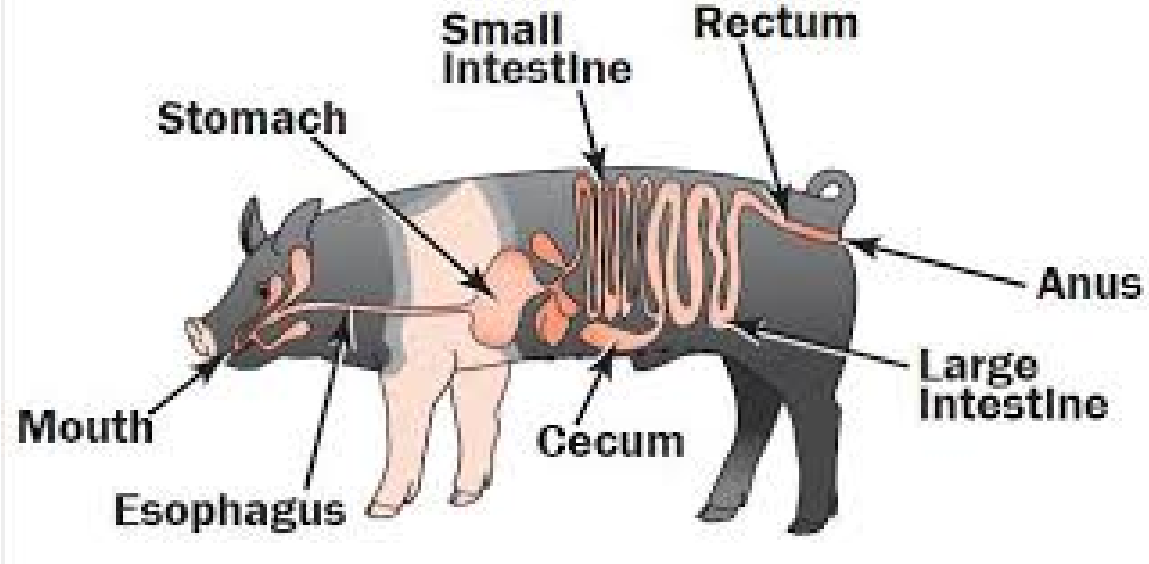

Image from: http://4h.msue.msu.edu/uploads/files/Livestock/Animal_Digestion_-_A_Stomach_at_Work.pdf

NUTRITION: DIGESTIVE SYSTEMS – HANDOUT 2

Ruminant Digestive System Parts and Functions

Adapted from: Ruminant Digestive System (n.d.). Jimmy L. Rodgers. University of Idaho 4-H Beef Curriculum

Parts of the Ruminant Stomach

1. Rumen
2. Reticulum
3. Omasum
4. Abomasum

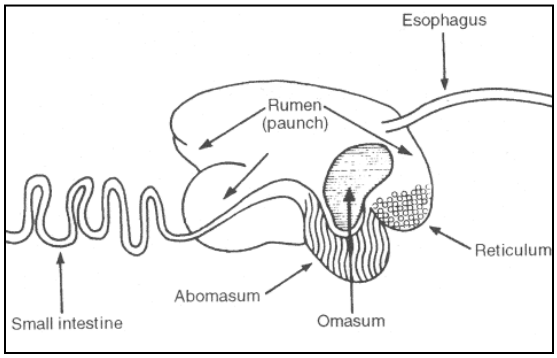

Image from: http://ag.ansc.purdue.edu/sheep/ansc442/semprojs/nutrition/digest.htm

Functions of the Ruminant Stomach

1. Rumen: Functions as a storage area for food; aids in the breakdown of coarse particles through bacterial action.
2. Reticulum (honeycomb): Honeycomb-like walls retain foreign materials that could injure the digestive system; sorts feed particles by detecting large particles that need to be further digested; regurgitates food particles back to the mouth to be re-chewed.
3. Omasum: Acts as a filter by removing water from feed through muscle contractions; many folds or layers of muscle squeeze the moisture away from the feed particles, while also continuing to break down particle size.
4. Abomasum (true stomach): Acids and enzymes further digest feed and get them ready to travel to the small and large intestines.

NUTRITION: DIGESTIVE SYSTEMS – HANDOUT 3

Monogastric Digestive System Parts and Functions

Parts of the Monogastric Digestive System

1. Esophagus
2. Stomach
3. Small Intestine
4. Cecum
5. Large Intestine
6. Rectum

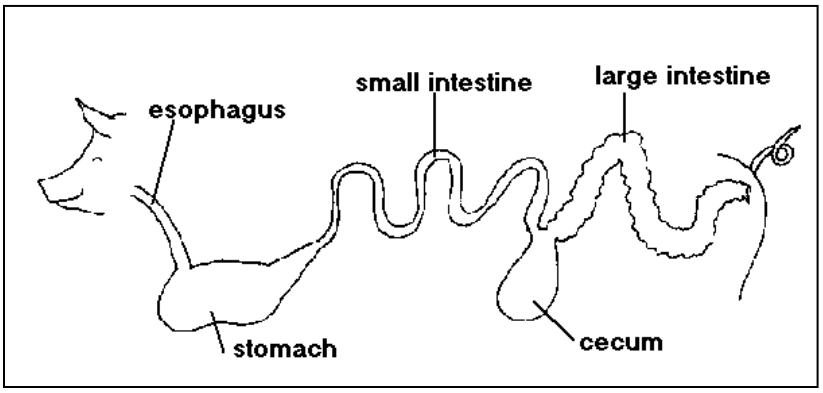

Image from: *https://www.ncsu.edu/project/ansci_feeds/gi_tract/gi_tract.htm*

Functions of the Monogastric Digestive System

1. Esophagus: Transports feed from the mouth to the stomach.
2. Stomach: Secretes acids and enzymes that begin digestion of food.
3. Small Intestine: Where most digestion occurs. Enzymes secreted by the small intestine breakdown food and nutrients are absorbed into the blood stream.
4. Cecum: Where fiber is digested by microbes.
5. Large Intestine: As material passes through the large intestine, water is absorbed back into the animal's body.
6. Rectum: Waste is removed from the animal's body via the rectum and anus.