



Science



Literacy

MOOVIN' ON THROUGH

INTRODUCTION TO RUMINATION

Introduction

You might have heard that a cow has four stomachs, but that's not *exactly* true. You see, cows have just one stomach, but it's divided into four different compartments, or chambers, that all play a different role in digestion. This is because cows are herbivores and eat plants that are harder to break down and digest. Cows are considered "ruminants," which are hooved mammals that re-chew partially digested food. The digestive system in ruminant animals is a lot different than our human digestive systems!

To summarize, the digestive system is responsible for breaking down food as much as it can, taking all the healthy, nutritious stuff from the food to share with the body (kind of like fuel for the body), and then discarding anything it doesn't need from the food (yep, that's the poop).

Let's learn about the function of the four stomach compartments and the other parts of a cow's digestive system.

Mouth and Esophagus

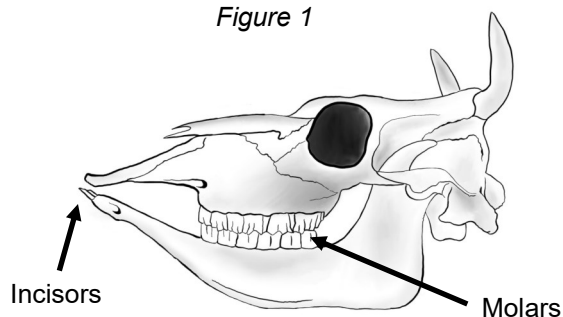
The first part of the digestive system is, of course, the mouth! The mouth is responsible for chewing the food. Cows use their teeth and tongue to begin the breakdown process.

Cows only have 32 teeth and don't have any top, front teeth! They have 6 front, bottom teeth which are called **incisors** which are used for cutting the grass from the ground. The rest of their teeth are **molars** which are more flat and used for grinding the food. Check out *Figure 1* to see what this looks like!

Cows chew from side to side, using their **tongue** to move the food! Just like us, **saliva** (a.k.a. spit) will form as the cow is eating. Saliva helps break down the food too. This movement causes the food to form a **bolus**, a small wad of food.

The cow will then swallow the bolus, or wad of food, which will go through a tube down to the first compartment of the stomach. This tube is called the **esophagus**!

Figure 1



Rumen

The **rumen** is the first compartment of the stomach and is the destination for the food after traveling down the esophagus. It's basically a large storage bin! The rumen is the largest of the compartments and can hold up to 50 gallons! Inside the rumen, you will find stomach liquids, partially digested food, and millions of microorganisms.

As you see in *Figure 2*, the bottom part of the rumen is filled with stomach liquids and the top is filled with gas. These gases come from a process called fermentation. **Fermentation** is a fancy word for the chemical breakdown of a substance by microorganisms. The microorganisms eat the food that the cow swallowed and change, or convert, the food into gases and other chemical compounds. These gases can fill up the cow's rumen like a balloon and have to leave the rumen back up through the esophagus and out of the mouth. That's what we call burping!

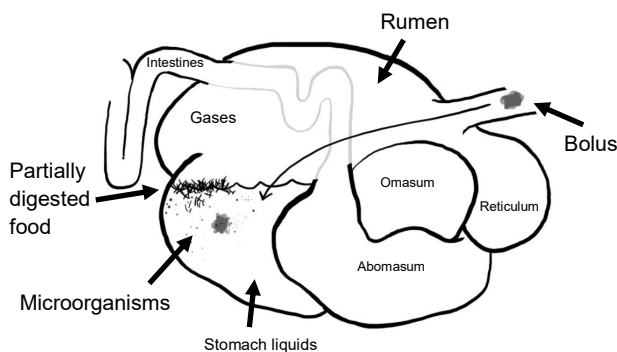
As the bolus is being broken down by the microorganisms, fibers from the food separate and float to the top of the liquid, creating a sort of 'raft.' This 'fiber raft' tickles the rumen walls, causing part of the rumen walls to contract (getting tighter and shorter)! A cow's stomach contracts 1-2 times per minute. These contractions are important for the rumen. One reason it is important is because the contractions mix everything around, ensuring that all the food comes in contact with the microorganisms. Another reason it is important is because the movements also cause the stomach liquids with some microorganisms and broken down food, and non-broken down food, to overflow into the reticulum.

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The entire digestive system relies on the rumen and so it is extremely important that it is healthy at all times! Nutritionists are often hired to formulate special diets for beef and dairy cows. Sometimes this is for the entire herd and sometimes it's case-by-case. Farmers and ranchers also have veterinarians come to their farms for regular check-ups, done to the entire herd to prevent illness.

Figure 2



Reticulum

The **reticulum** is the next compartment of the cow's stomach and is much smaller than the rumen, holding only about 5 gallons. Technically the reticulum is a part of the rumen (sometimes combined and called the rumino-reticulum) but there is a small flap in between that divides them. As you read in the previous section, when the rumen contracts, stomach liquids overflow into the reticulum. Remember, the stomach liquids contain microorganisms and both broken down and non-broken down food! Any food that isn't small enough to be digested is held in the reticulum and everything else will move forward to the next stomach compartment.

But let's back up for a minute. Cows must eat a large amount of food to get the energy they need, not only to be healthy, but for their bodies to work properly! Remember, they don't always chew their food completely. Luckily, if a bolus isn't broken down that much and overflows into the reticulum from the rumen contractions, it will be caught and held by the reticulum. These wads of food are then **regurgitated** (which means it goes back up the esophagus and into the mouth) and re-chewed by the cow! This is the process of **rumination** and is called "chewing the cud."

Cows spend nearly 8 hours a day chewing their cud!

Omasum

The **Omasum** is the next compartment of the cow's stomach and can hold around 15 gallons. This is where a majority of the water from the food is absorbed. You can think of it like a filter; the water will go through the filter and everything else is left in the filter. After the water is absorbed, anything left will move to the next stomach compartment.

Abomasum

The final compartment of the cow's stomach is called the **abomasum** and can hold up to 7 gallons. This compartment is often called the 'true stomach' because it is very similar to our human stomachs. In the abomasum, stomach acids and other enzymes break down the food even further. Any of the microorganisms that traveled along with the food (after overflowing from the rumen into the reticulum) die here and the protein from them, and any in the food, are absorbed!

Intestines

After leaving the abomasum, the food moves through the long stretch of the small and large intestines. Together, the intestines can be as long as 150 feet! The **small intestine** is the part of the digestive system where most of the nutrients and fats from the food are actually absorbed into the blood and carried throughout the body, delivering the nutrients, fats, fibers, proteins, and much more to where they are needed! Blood is a part of the **circulatory system**, which is kind of like a mail delivery system! The **large intestine** is the last part of the digestive system. At this point, the food moving through is considered undigested. There are some microorganisms that live in the large intestine and help the large intestine absorb any nutrients that are left in the undigested food. Remember, the microorganisms' fermentation process creates gases that have to be released somewhere and thus causes what we call 'toots.' When the undigested food has moved completely through the large intestine, it leaves the body through the rectum and falls to the ground. I know what you're thinking, and you're right! The waste material would be the poop, the manure, or as some call it, the 'cow pie.'



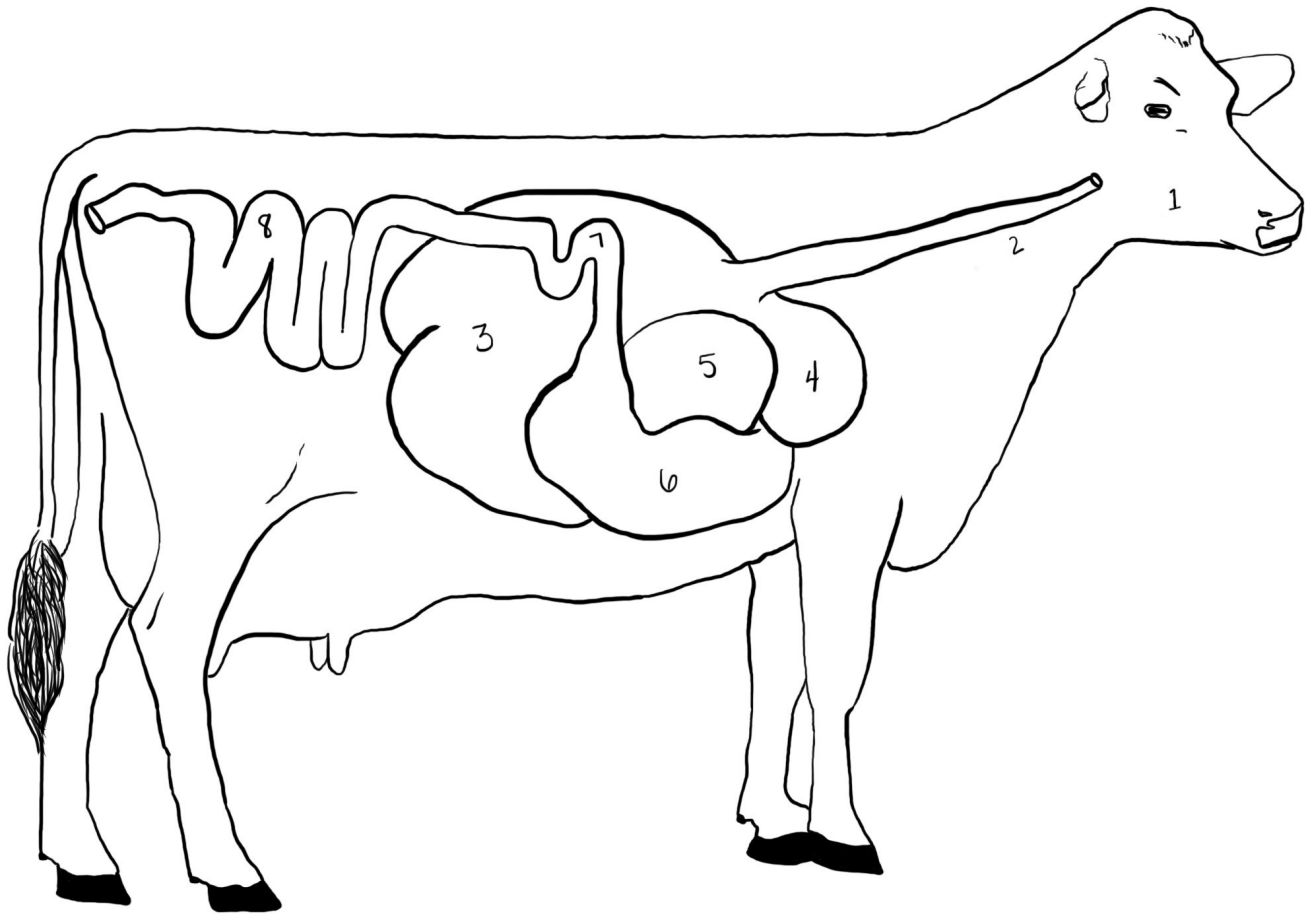
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STUDENT WORKSHEET



Each part of the ruminant digestive system is numbered in the diagram. After you finish reading, fill in the blanks with the matching digestive part!

1. _____

5. _____

2. _____

6. _____

3. _____

7. _____

4. _____

8. _____