

The Digestive System of Ruminators: Animals That Eat Plants and Chew a Cud

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Psalm 115:1

"¹ Not to us, LORD, not to us
but to your name be the glory,
because of your love and faithfulness." (NIV)

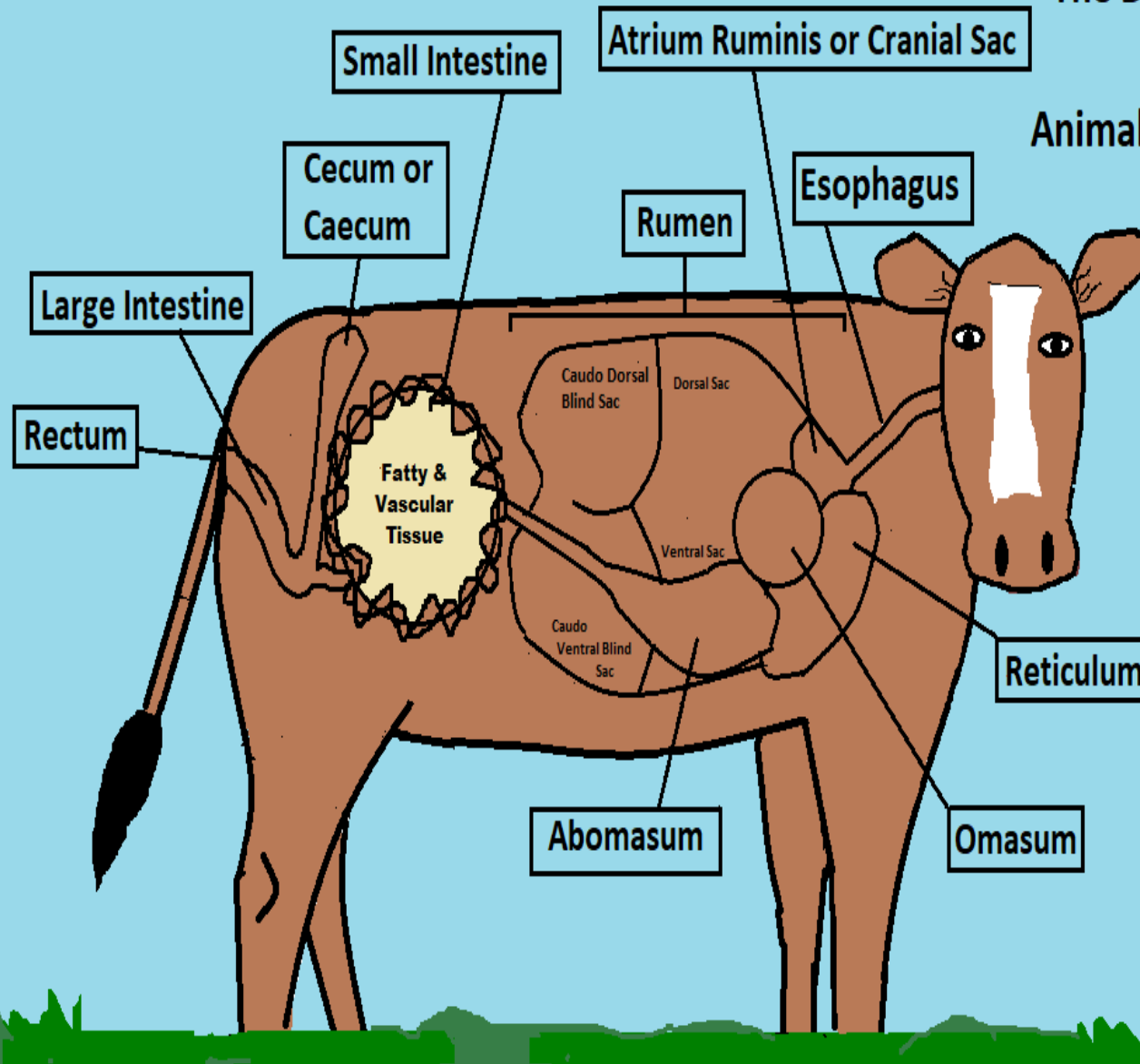
Some animals that are a part of the ruminant family of animals that have 4 stomach compartments are: cattle, deer, antelope, sheep, buffalo, bison, giraffes, and goats.

Some animals like Camelids: camels, alpacas, and llamas have 3 stomach compartments instead. They are referred to as pseudo-ruminants.

Ruminants have 4 stomach parts, because they are grazers (meaning herbivores or plant eaters). The food they eat is tough and requires it to be broken down multiple times before it can be fully absorbed into their systems. Domesticated cattle eat hay, grains, and grasses. WILD ruminants also eat WILD plants. So, the ruminant stomach parts are the same whether they are domesticated animals or not. For this lesson, we are going to use a domesticated steer as an example, so remember the size of these parts is relative to the size of the animal.

Just like humans, ruminant digestion begins in the mouth. Ruminants have no teeth in the top front of their mouths, instead they have a hard dental pad. ADULT cattle have a total of 32 teeth. They use their tongues to grab grasses and then tear them with their 8 incisors located in the front bottom of their mouths. They have 3 premolars (towards the front) and 3 molars (in the far back) on EACH SIDE of the bottom of their mouths. That makes a total of 12 on the bottom. They have another 12 on the top - making a total of 24 combined premolars and molars altogether. Add in their 8 incisors = 32 teeth which they use to tear and grind their food. They chew on one side and then the other. Large ruminants can produce ABOUT 50 LITERS of saliva per day to help this process.

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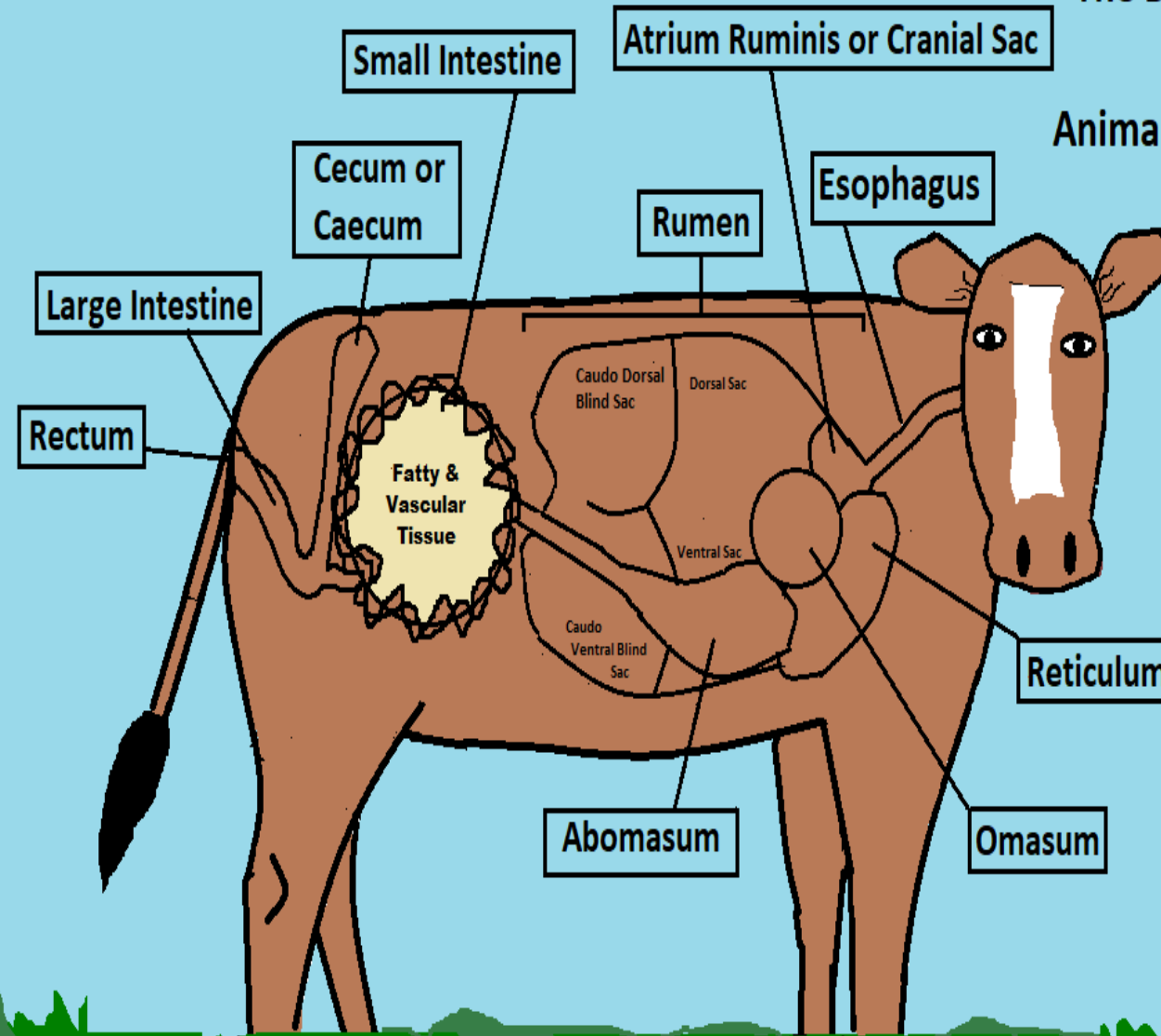


The Esophagus of a ruminant operates 2 ways. It uses muscle contractions to move food to the stomach and also to regurgitate or throw the food back up into the mouth to continue the grinding process. Ruminants first chew their food just enough to mix it with saliva or spit and swallow it. It goes down the Esophagus, then the food enters the Atrium Ruminis or Cranial Sac. The Esophagus and the Atrium Ruminis are linked together. Next, the food moves to the first part of the stomach called the Rumen.

NOW, LET'S TAKE A CLOSER LOOK!

The first part and largest part of a ruminant's stomach is called the Rumen and it is directly connected to the Atrium Ruminis. In an approximately 1100 lb. steer, a Rumen can hold about 30 gallons of food stuff, saliva, and water. The Rumen on the outside looks like a big stuffed elongated heart - the kind we draw on paper. The Rumen itself is divided into multiple parts. We will show only 4 here: 1. the Caudo Ventral Blind Sac 2. the Caudo Dorsal Blind Sac, 3. the Ventral Sac which has a lot of food and fluids, and 4. the Dorsal Sac which is always empty and only contains gases. The many papillae on the inside surface of the Rumen look just like the texture of a bath towel and ironically, IT IS used to absorb nutrients that the animal needs - just like a towel absorbs water from the outside of our bodies. It's not the same thickness throughout though. Some parts look like a worn-out towel instead, with very little length to the papillae. Those thinned out parts are in the Dorsal Sac, because there is only gas in there, so less absorption is needed.

The Rumen IS NOT just a stagnant pool of food, saliva, and water. In a healthy animal, the food stuff within the Rumen is constantly moving because of CONTRACTIONS that occur about twice a minute.



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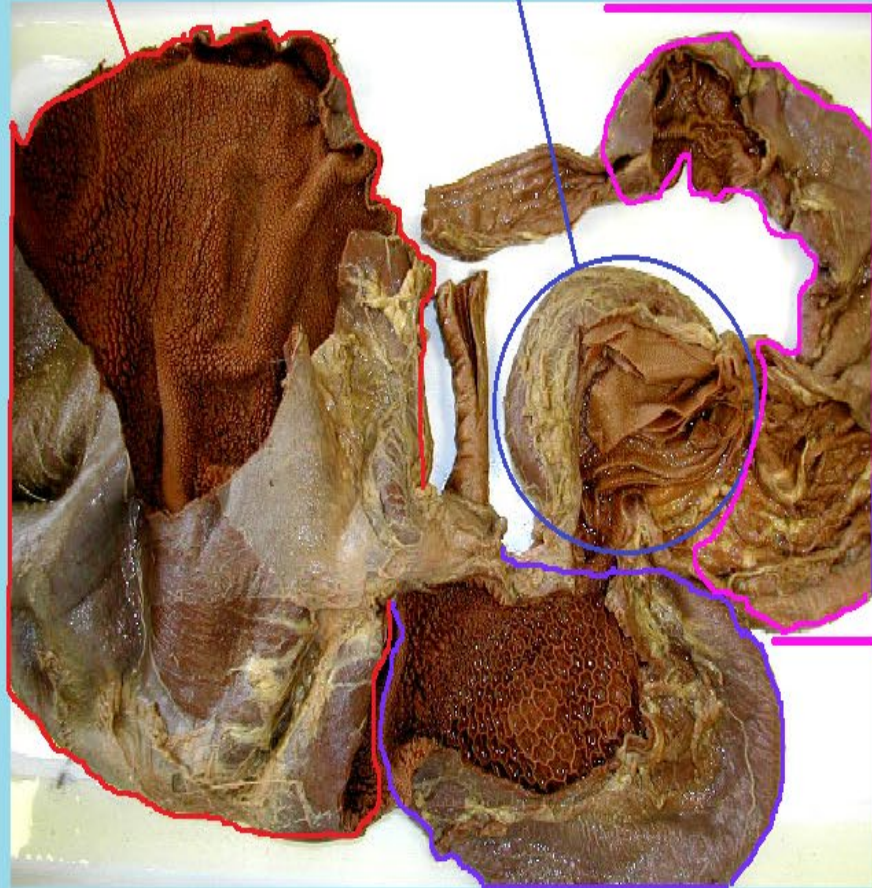
The contractions act like a MIXER. Bacteria and micro-organisms in the Rumen soften the food. MICROBES are constantly forming in the Rumen and the contractions mix MICROBES that have already formed - with NEW food coming in. They also push older material out and send it to the Reticulum. If the contractions DON'T occur, then the cow may be sick. The softened mixture produced in the Rumen is called the cud.

Shown on the next slide are photos of the multiple stomach parts of a steer.

The Multiple Stomach Parts within a Steer's Body

Rumen

Omasum



Abomasum

Reticulum



Close-up of the Interior of a Steer's Reticulum

Close-up of the Interior of a Steer's Omasum



Original photos courtesy of
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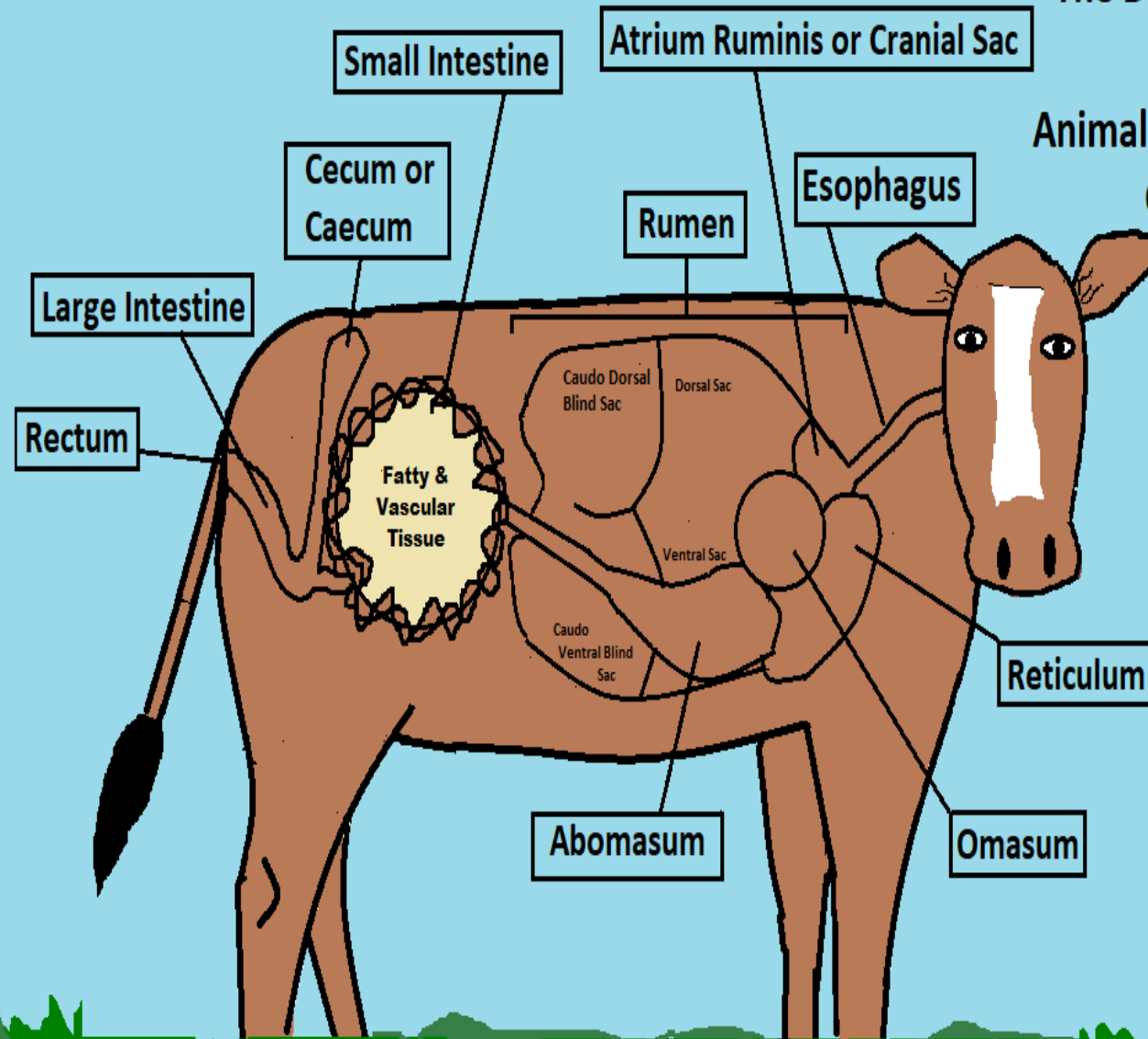
WHAT HAPPENS AFTER THE CUD IS MADE?

The softened food/cud is then sent into the second part of the steer's stomach called the Reticulum. The Rumen is attached to the Reticulum by only a thin piece of tissue. Inside the Reticulum it looks like honeycomb. The Reticulum acts as a sieve to prevent large pieces of feed from being ingested. It helps with regurgitation too. Surprisingly, acid is not produced in the Reticulum, so it will not hurt the steer.



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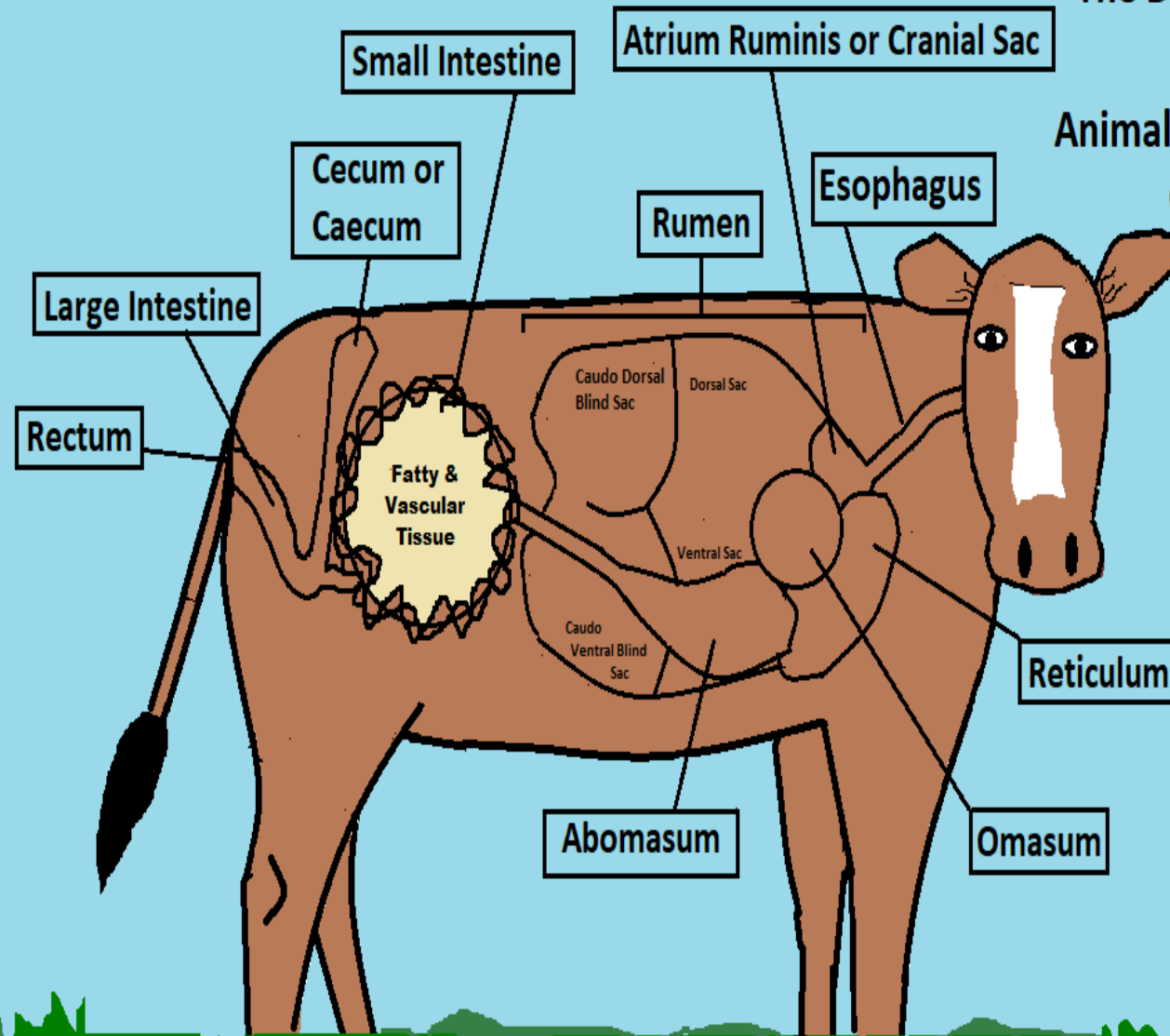


The cud is then regurgitated back up into the animal's mouth to chew the cud some more. More chewing makes it even softer and breaks it down into even smaller parts. Next, the animal swallows it again and it is sent into the third part of a steer's stomach called the Omasum which is round like a ball. The Omasum inside is made up of folds of tissue of varying sizes which also absorbs water and nutrients. The Omasum acts like a filter which allows very fine materials to pass through.



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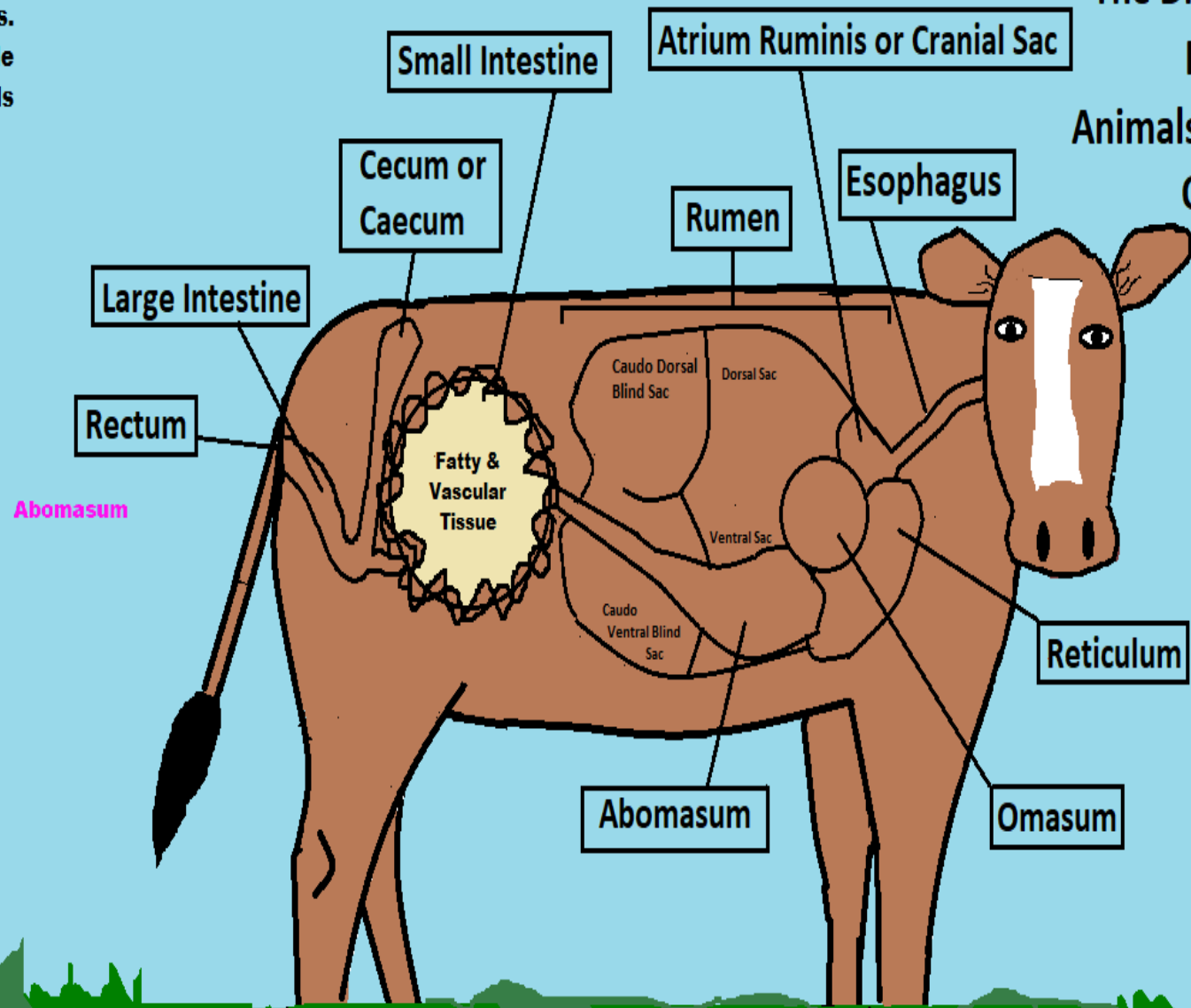


Next, the food is sent to the 4th part of the steer's stomach called the Abomasum. It is lined with glands. On the outside you can see white lines. On the inside these white lines are called Plicae Spirales folds which increase the internal area of the Abomasum.



Original photo of the parts of a Cow's stomach
 Courtesy of Dr. Karen Petersen
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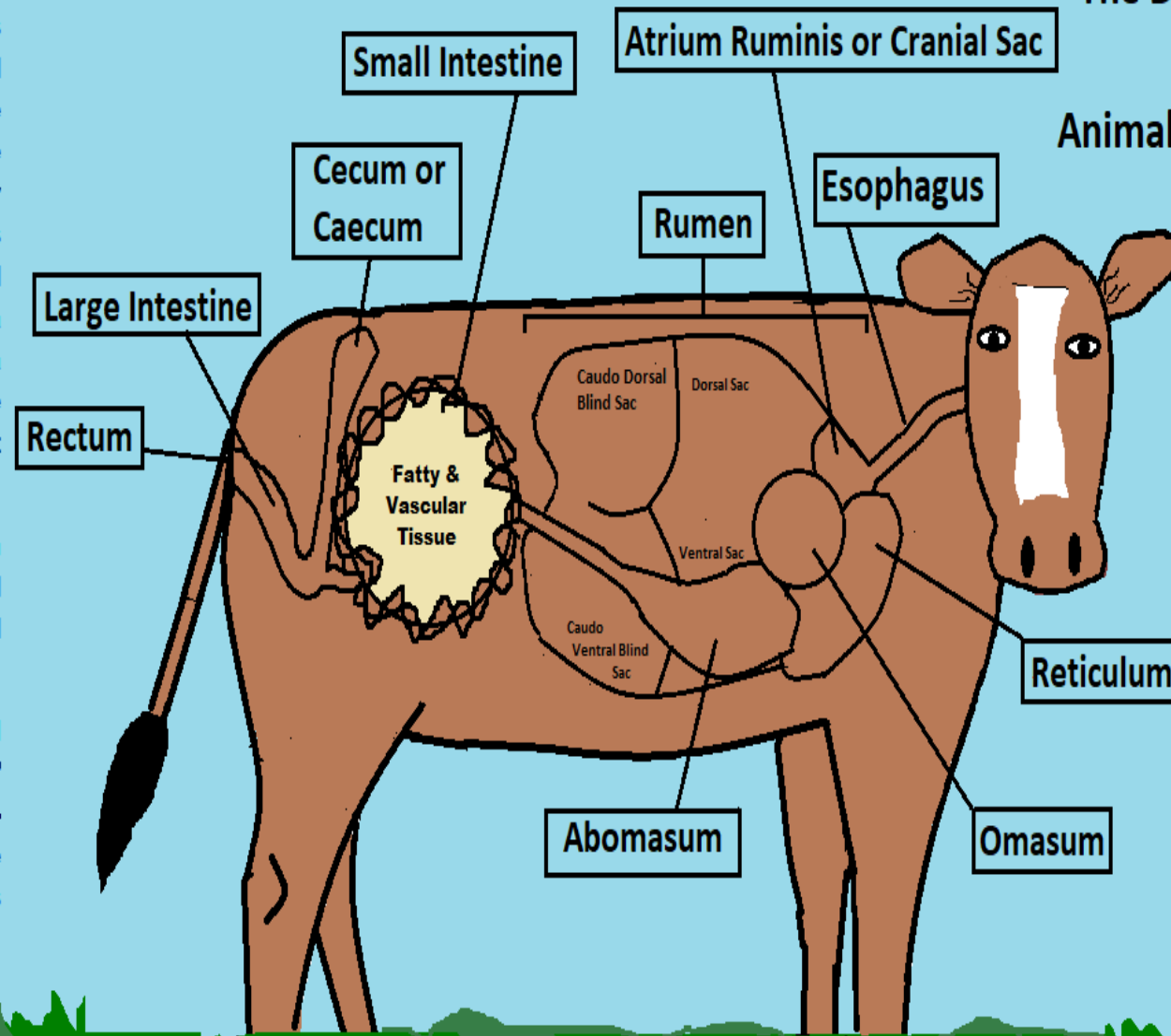


From the Abomasum the food enters the Small Intestine where the vitamins and minerals within the food is absorbed into the animal's body. Think of the Small Intestine like a jelly-like flexible garden hose, the opening to a garden hose is narrow. That's why the Small Intestine is called "Small." It sends very finely broken-down plant materials through more of the steer's digestive system. The actual LENGTH of the Small Intestine CAN be about 150 feet long. It looks like a narrow network of hosing intertwined and wrapped in a CIRCULAR pattern. The fatty tissue and vascular tissue that covers it makes it look like a drumhead, but that tissue protects the Small Intestine from damage.

Then the food goes into a sac called a Cecum or Caecum (pronounced see-cum) which also helps with additional digestion. It is located between the Large and Small Intestine.

Finally, there is a Large Intestine which IS NOT called LARGE because of its length. It is called "Large," because of the diameter of its opening to its also hose-like structure. It breaks the foods down into waste material and the waste exits the animal's body from its Rectum when it lifts its tail.

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Of course there are many more organ parts to a ruminant's body. We have only shown the most important parts used for Digestion.

Question:

Since food within a steer's body is constantly contracting in the Rumen - pushing more food stuff to other parts of its stomach and through the other parts of its digestive system, how often does a steer defecate - meaning to have a bowel movement or to pass feces? Feces is another word for poop or manure.

Answer:

A steer defecates or poops every 1 ½ to 2 hours and poops 100 or more pounds of manure a day!

Question:

What do farmers do with ALL of that manure?

Answer:

Since most farmers raise their own feed, they spread it on their own fields as a natural fertilizer to help their crops grow or they sell it to local nurseries.

**What do the interior parts of a smaller
ruminant's stomach
look like? For example, a Sheep?**

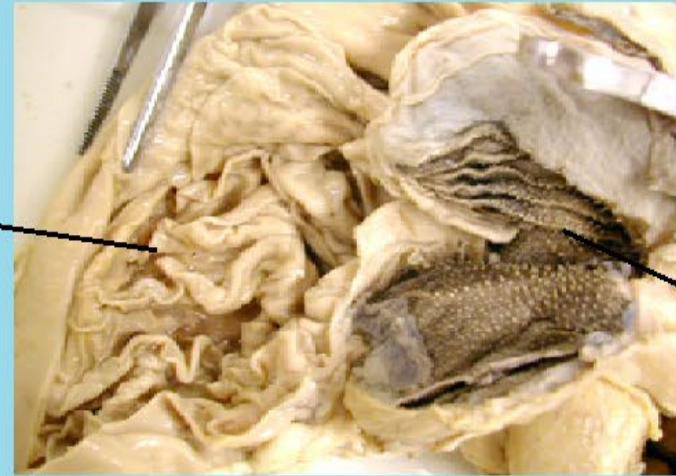
**Close-up
of the
Interior
of a
Sheep's
Rumen**



Longer Papillae

Shorter Papillae

Abomasum



**Close-up of a
Sheep's
Omasum
and
Abomasum**

Omasum

**Close-up of the
interior of a Sheep's
Reticulum and
Omasum**

Reticulum



Omasum

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of Dr. Karen Petersen
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If you need help with learning and reading God CAN help you.
Let us pray.

Just say, Lord Jesus the Christ,
I've made so many mistakes I must confess.
I repent of them now and turn from them.
I no longer want that mess.

Lord Jesus, I believe you are the Son of God
and believe in your resurrection.
I want to be a child of God
and receive your love and affection.

Lord Jesus the Christ, be my Savior.
Come into my heart.
Cleanse me now of all unrighteousness
and give me a brand-new start.

I ask for the baptism of the Holy Spirit
and the baptism by Holy fire too.
I WANT to be changed and to do the RIGHT things.
I need help from you.

Please help me to read, write, and do my math.
I want to start learning today.
I want my life to take a turn
and start in a whole new way.

Thank you Lord Jesus for helping me to learn.
I KNOW you can help make my ability,
greater than anyone ever imagined
and bring back my self-respect and dignity.

I ask this in the name of the Lord Jesus the Christ.
I say "Amen" and make it sure.
Now I'll start learning the RIGHT way.
I KNOW Lord Jesus, YOU are the door.

AMEN!

RESOURCES

All Photos retrieved on 3/10/23 from: the Smithsonian's National Zoo and Conservation Biology Institute's Open Access collection. These images are in the public domain as Creative Commons Zero (CC0), meaning they may be used without permission from the Smithsonian.

https://nationalzoo.si.edu/openaccess/search?edan_local=1&edan_q=&edan_fq%5Bonline_visual_material%3Atrue%5D=online_visual_material%3Atrue

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Joe Alderman, Smithsonian's National Zoo, 2011, Photo of Bison

Skip Brown, Smithsonian's National Zoo, 2018, Photo of Hereford Cattle

Skip Brown, Smithsonian's National Zoo, 2019, Photo of White Tailed Deer

Connor Mallon, Smithsonian's National Zoo, 2018, Photo of Gazelle

Connor Mallon, Smithsonian's National Zoo, 2018, Photo of Oryx

Mehgan Murphy, Smithsonian's National Zoo, 2010, Photo of Eld's Deer

Mehgan Murphy, Smithsonian's National Zoo, 2008, Photo of Nigerian Dwarf Goats

Gil Myers, Smithsonian's National Zoo, 2016, Photo of Lesser Kudu

Gil Myers, Smithsonian's National Zoo, 2012, Photo of a Sitatunga

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All Photos of Cow and Sheep Stomach Parts Courtesy of: Dr. Karen Petersen, University of Washington, Biology Dept., Used with permission received by email on 3/16/23

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Isaiah 61:11

"11 For as the soil makes the
sprout come up and a
garden causes seeds to grow,
so the Sovereign LORD will make
righteousness and praise spring up
before all nations." (NIV)

