

**New Material
for Test 2**

**The
Gastrointestinal
Tract and
Nutrition**

Anatomy of Digestive System

- **Terminology:**

- **Hypothalamic: control of appetite**

- **Hunger:** is the *physiological* desire for feed following a period of fasting.
 - **Appetite:** is a *learned* or habitual response to the presence of feed.
 - **Feeding center :** **Lateral hypothalamus**
 - **Satiety center :** **Ventro-medial area of the hypothalamus**

Anatomy of Digestive System

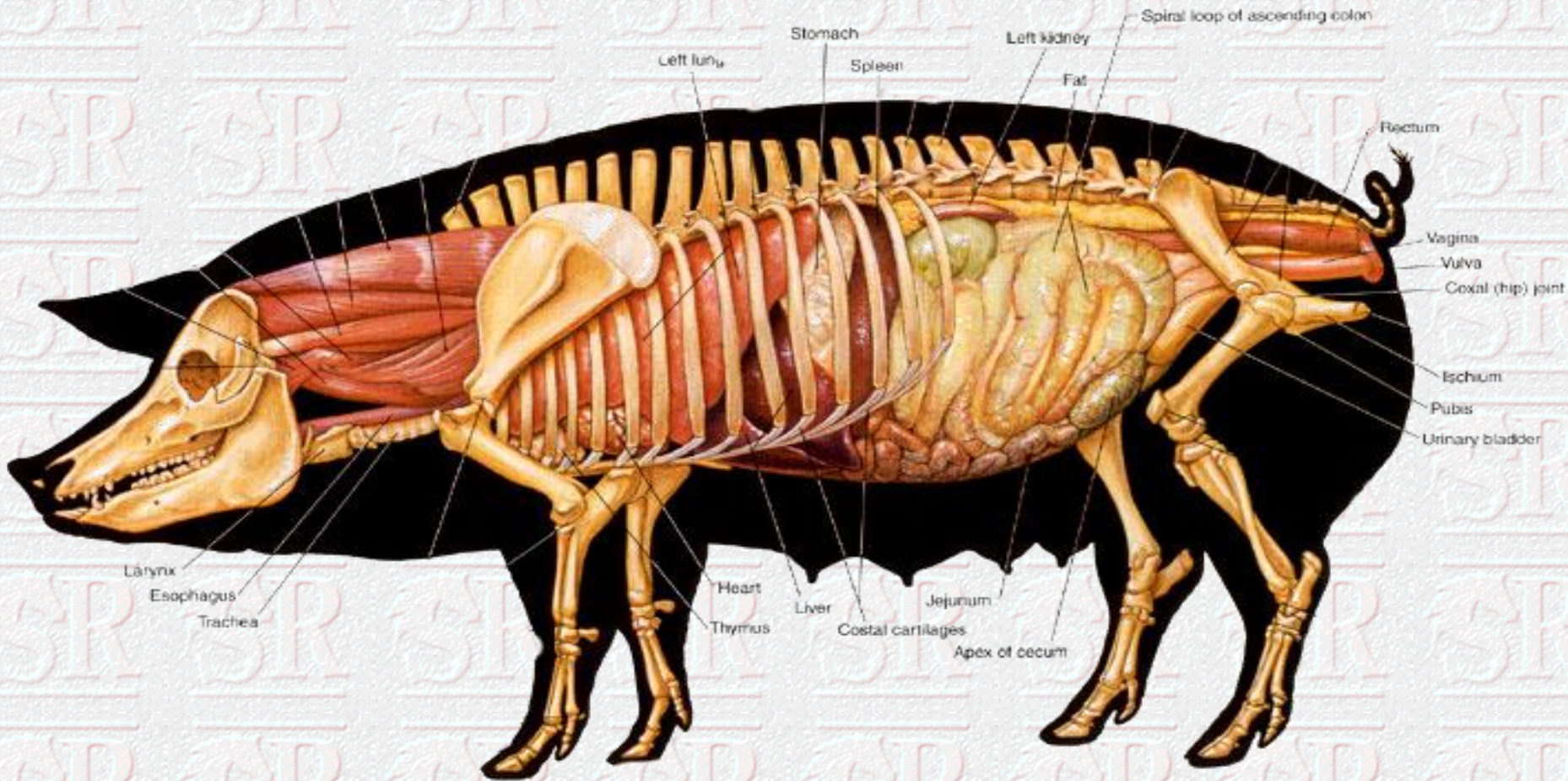
- **Classification of various digestive systems**
 - **Carnivores:** flesh eaters; eat other animals
 - **Herbivores:** vegetarians; consume primarily plant material
 - **Omnivores:** consume both plant and animal matter

Anatomy of Digestive System

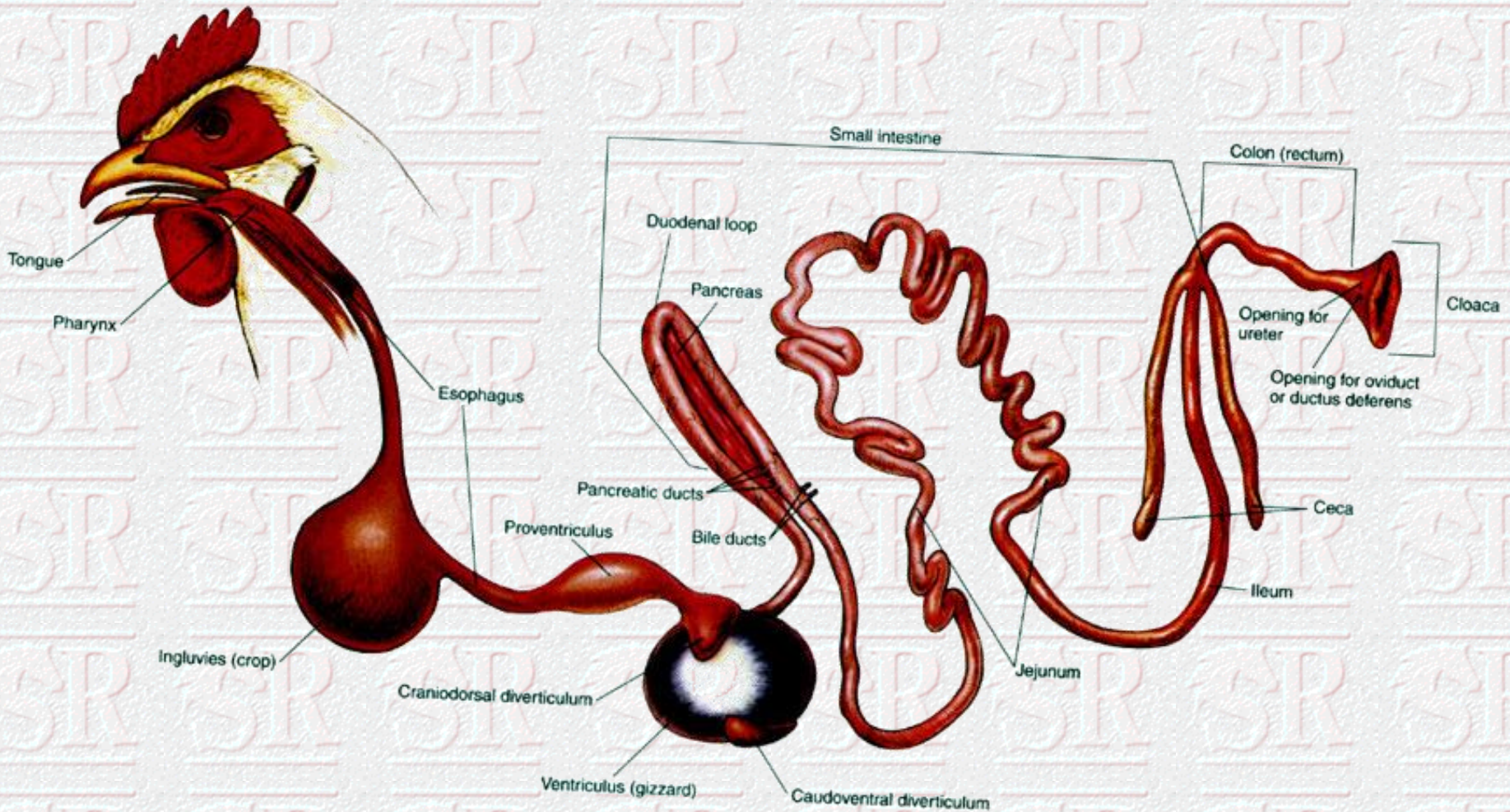
- **Animals are classified based on their digestive physiology.**
 - **Monogastric: simple stomach, nonruminant**
 - **swine, dogs and cats, horses and mules, & rabbits**
 - **Ruminant : multi-chambered stomach; fermentation occurs**
 - **cattle, sheep, goats, deer, elk, & wild animals**

Anatomy of Digestive System

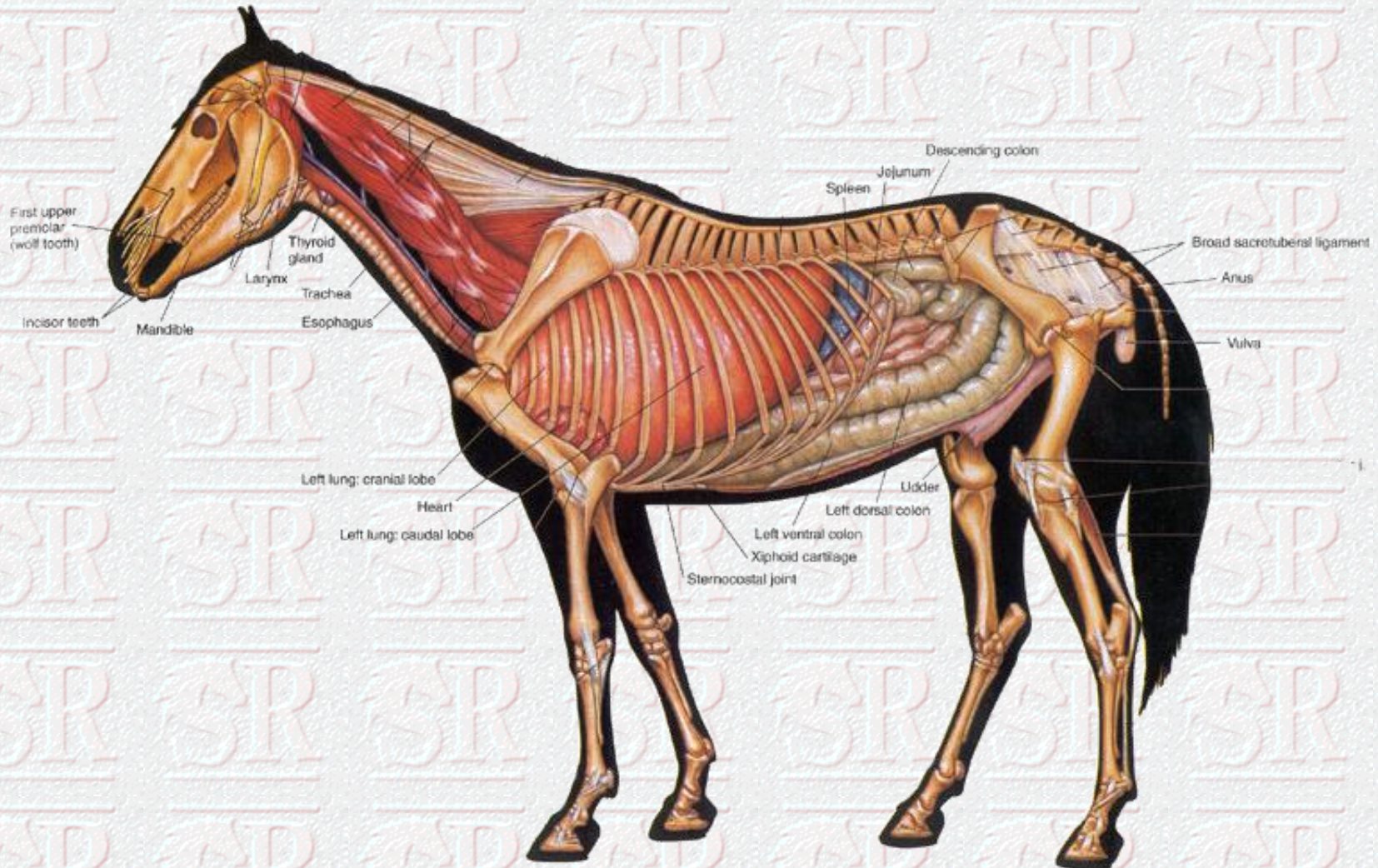
- The digestive system of monogastric animals



Anatomy of Digestive System

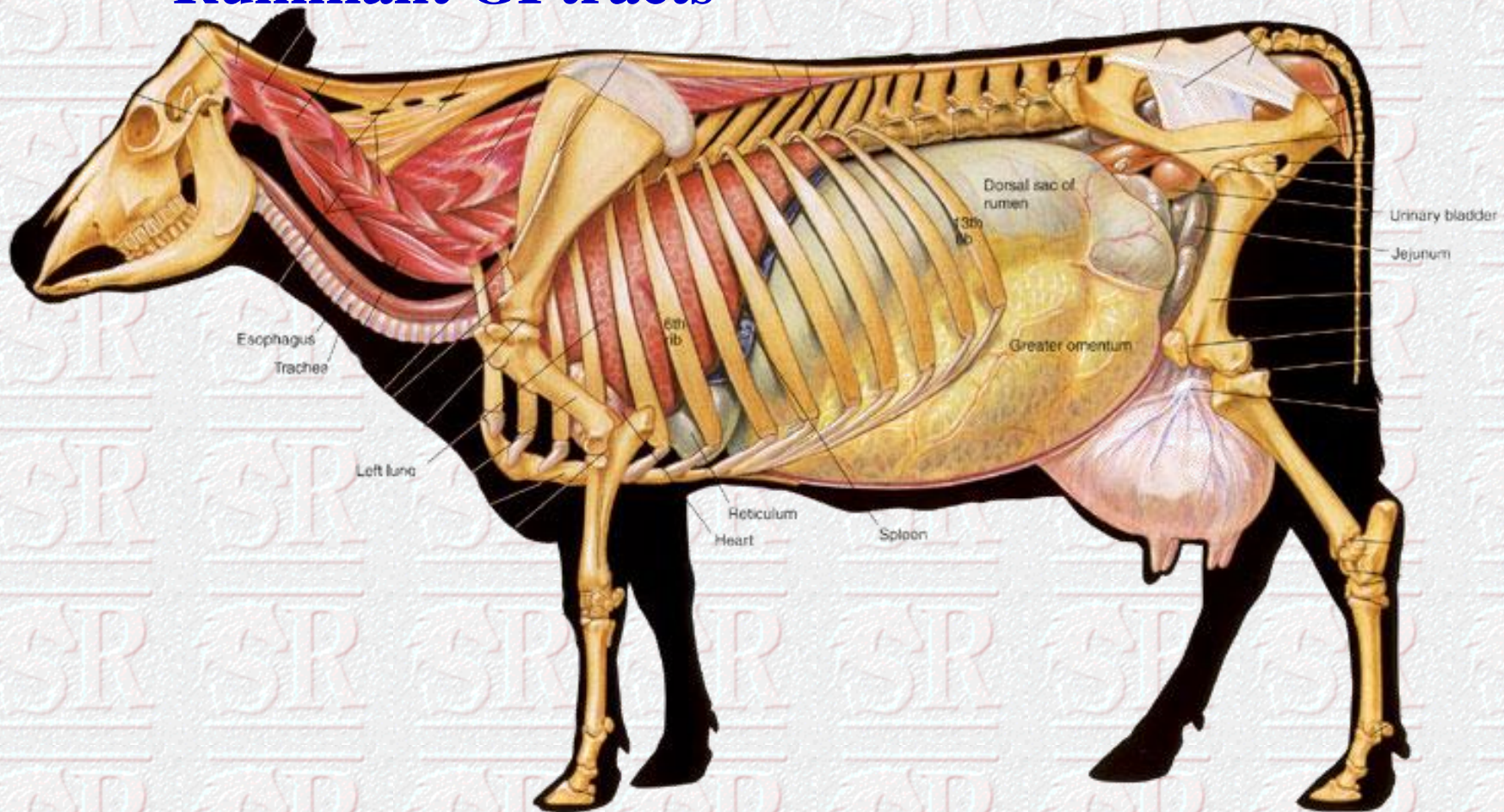


Anatomy of Digestive System

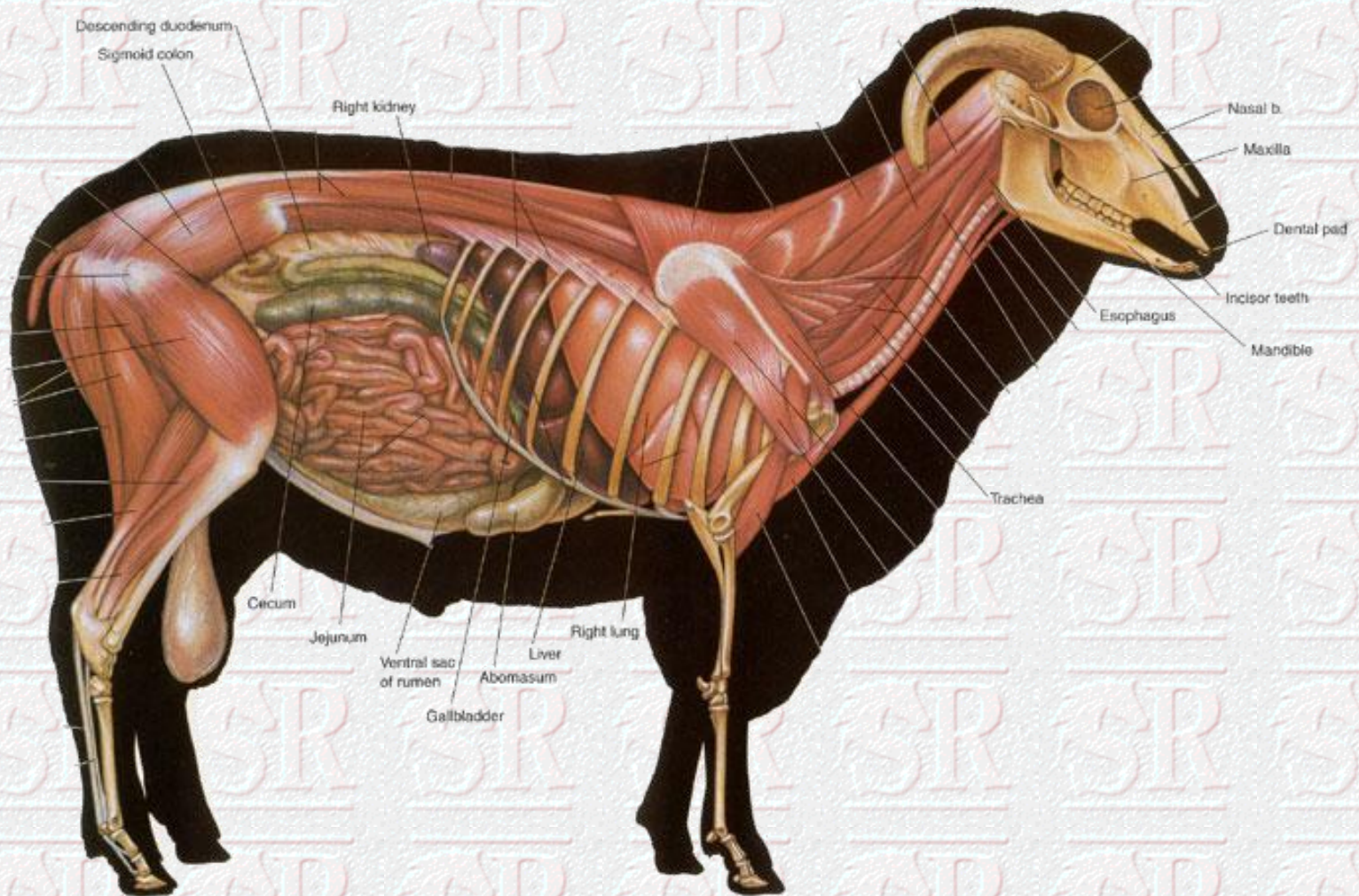


Anatomy of Digestive System

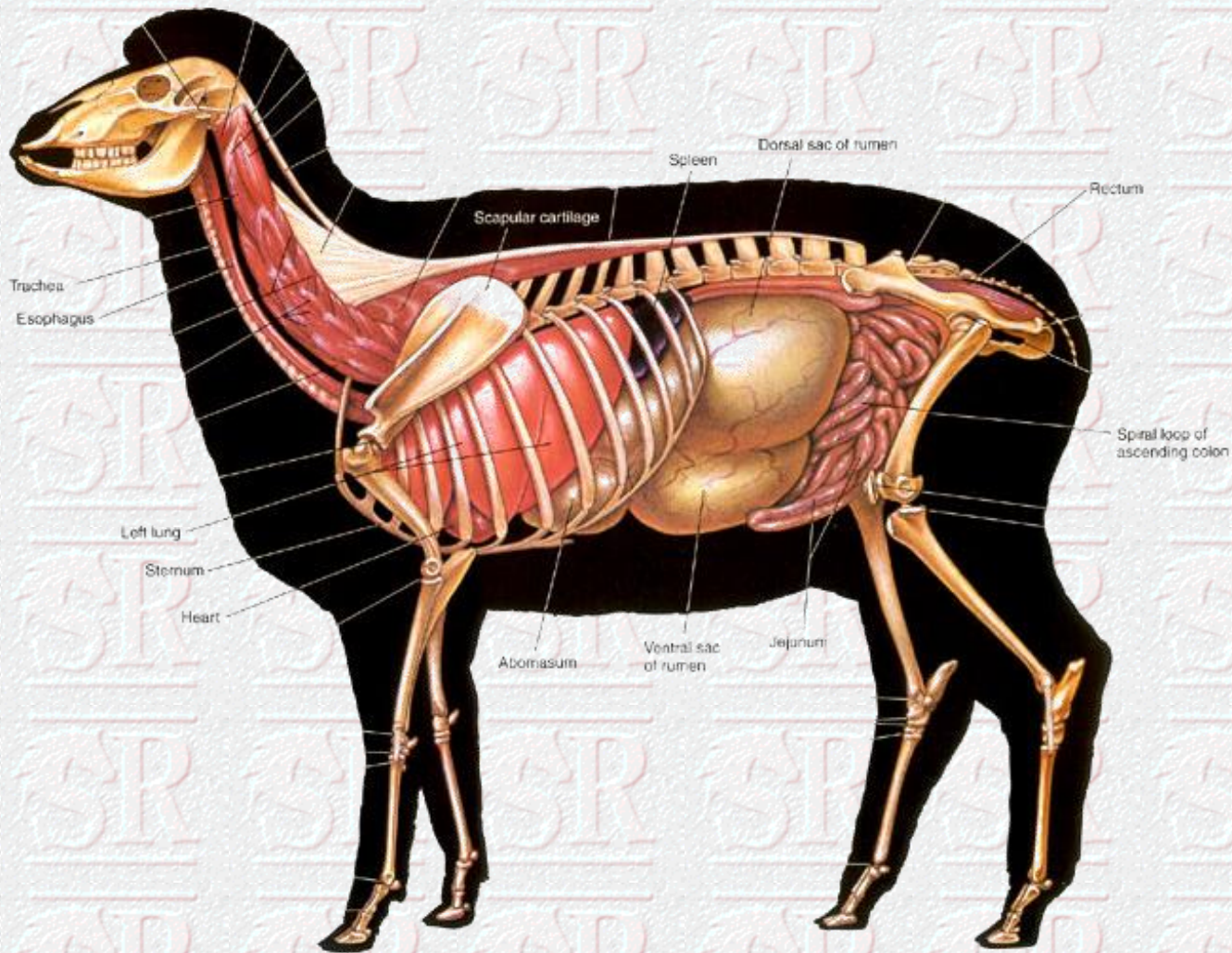
- Ruminant GI tracts



Anatomy of Digestive System



Anatomy of Digestive System



Anatomy of Digestive System

Oral cavity lies between the teeth, the tongue and the hard and soft palates.

Mouth

- prehension of food
- mastication of food
- rumination of food
- eructation
- insalivation of food
- communication
- aggression
- grooming
- thermoregulation

Tongue

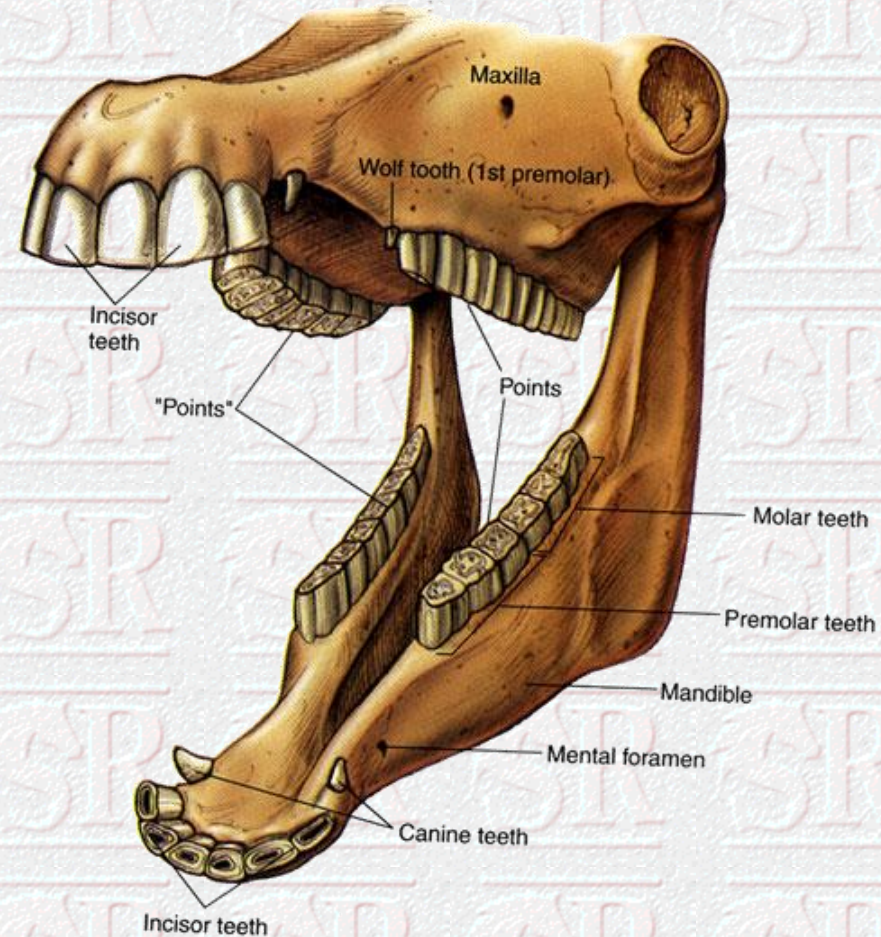
- tactile
- used for mastication
- used for swallowing
- drives food (bolus) into pharynx

Anatomy of Digestive System

Teeth - ruminant vs monogastric

Dentition Pattern of Adult Domestic Animals.

	Incisors	Canines	Premolars	Molars
Sheep	<u>0</u> 8	<u>0</u> 0	<u>6</u> 6	<u>6</u> 6
Goats	<u>0</u> 8	<u>0</u> 0	<u>6</u> 6	<u>6</u> 6
Cattle	<u>0</u> 8	<u>0</u> 0	<u>6</u> 6	<u>6</u> 6
Horses	<u>6</u> 6	<u>2</u> 2	<u>6-8</u> 6	<u>6</u> 6
Swine	<u>6</u> 6	<u>2</u> 2	<u>8</u> 8	<u>6</u> 6

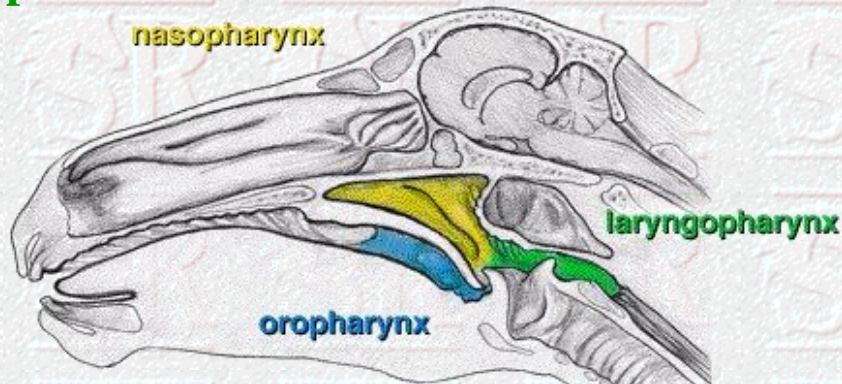


Anatomy of Digestive System

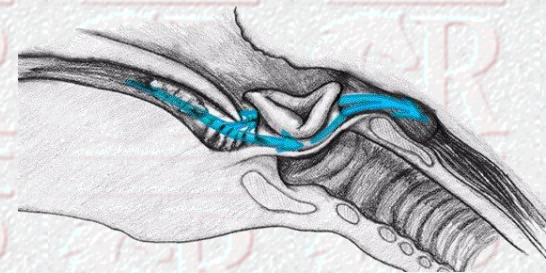
Pharynx - connects mouth w/ esophagus and nasal cavity w/ larynx

- muscular passage
- common passage for the respiratory and digestive systems.

Three major components:



- **Laryngopharynx** : is positioned dorsal to the larynx



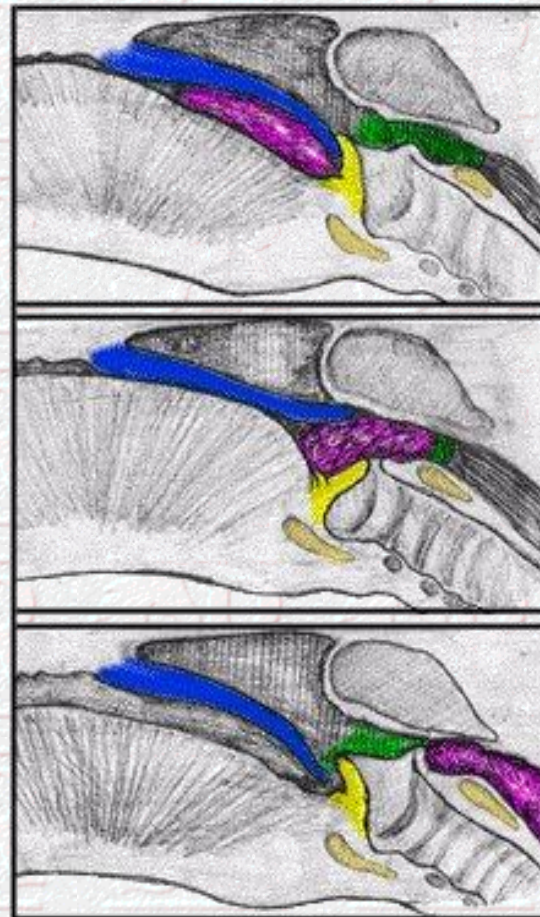
- Food must travel through the oropharynx and the laryngopharynx

Anatomy of Digestive System

Epiglottis - passively covers the laryngeal opening during swallowing.

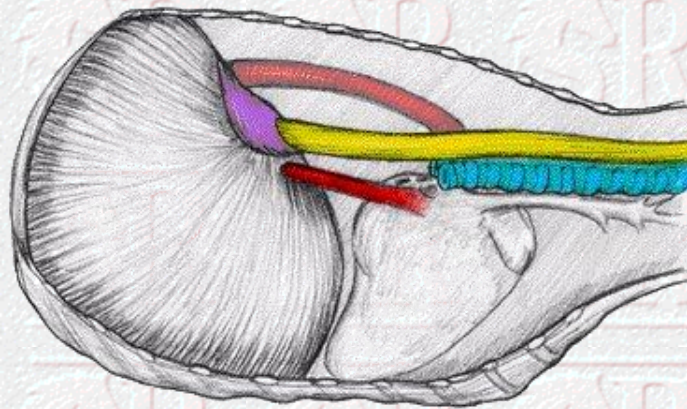
Esophagus






- connects pharynx w/ stomach
- has circular muscles which force food & water down by peristalsis
- gasses in the stomach closes the cardiac opening, preventing vomiting (horses)



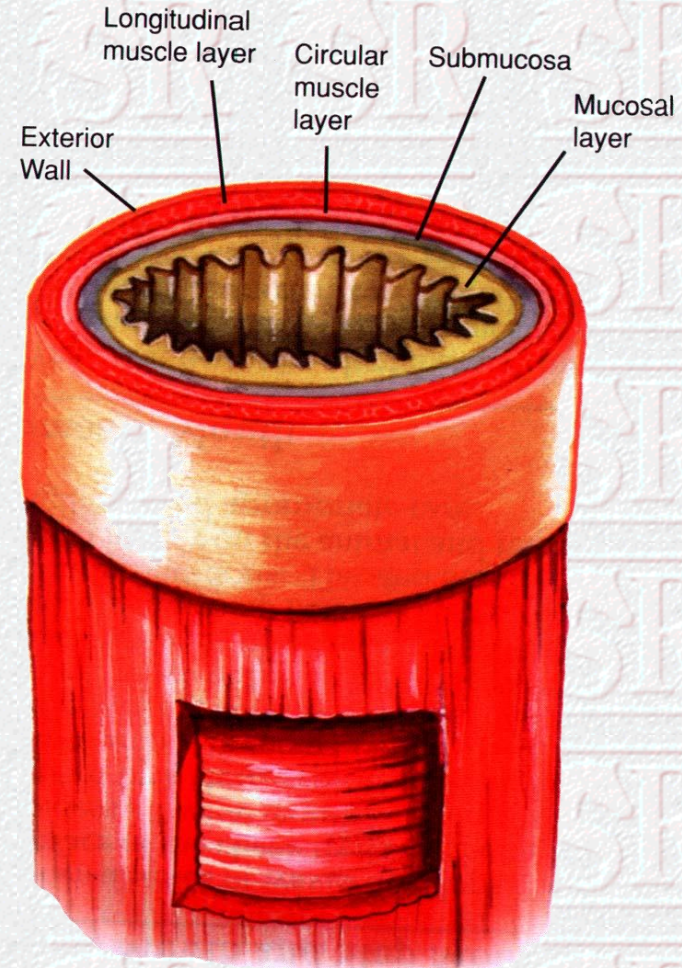
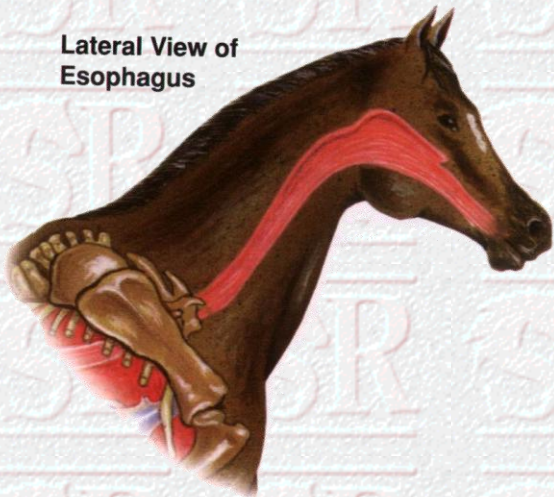
- laryngopharynx
- bolus
- soft palate
- epiglottis
- cricoid

Esophagus

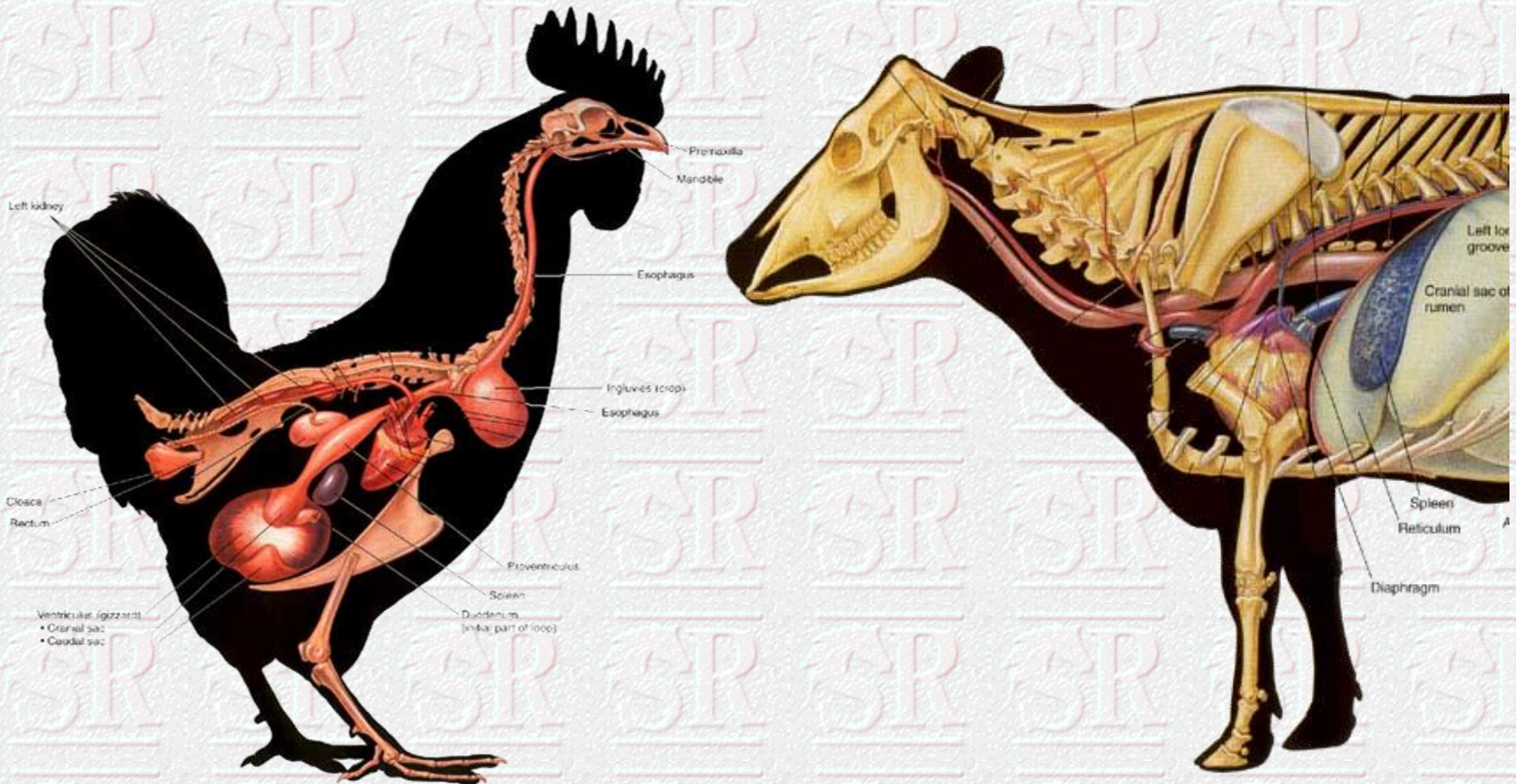


-  **Esophagus**
-  **Aorta**
-  **Caudal vena cava**
-  **Trachea**
-  **Esophageal hiatus**

Lateral View of Esophagus



Esophagus



Anatomy of Digestive System

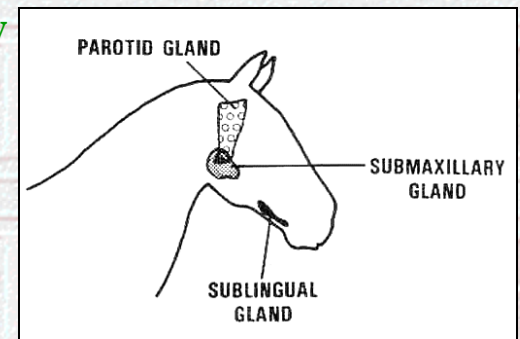
Salivary Glands

- essential for digestion
- secretion from these glands are highly variable in chemical composition.
 - 2 basic types of saliva:
 - *extremely thick, rich in glycoprotein mucin
 - *serous in composition; watery and thin, containing various proteins and enzymes, but little mucin.
- regulated by the parasympathetic nervous system
- produce up to 35 to 190 l saliva/d

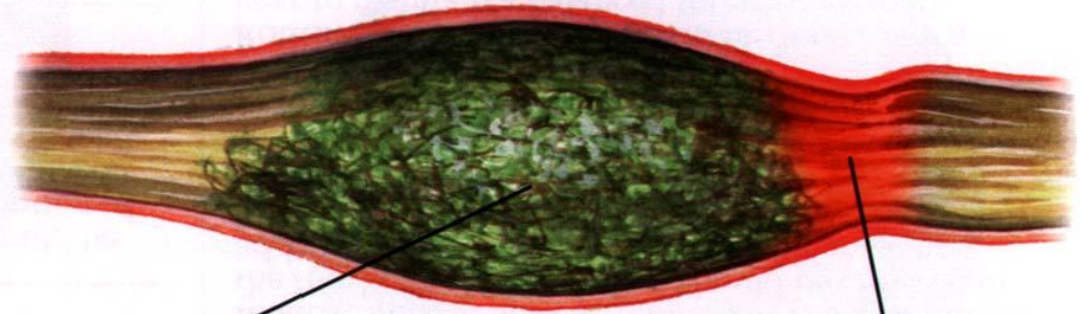
Anatomy of Digestive System

Salivary glands

- Saliva is produced by three pairs of glands in most livestock.
 1. Parotid glands
 - largest; located below the ear & behind the jaw
 - tends to be serous in composition
 2. Submaxillary glands
 - are long and narrow; tends to secrete both
 3. Sublingual gland
 - located beneath the oral mucous membrane, between the tongue and the mandible; tends to secrete both



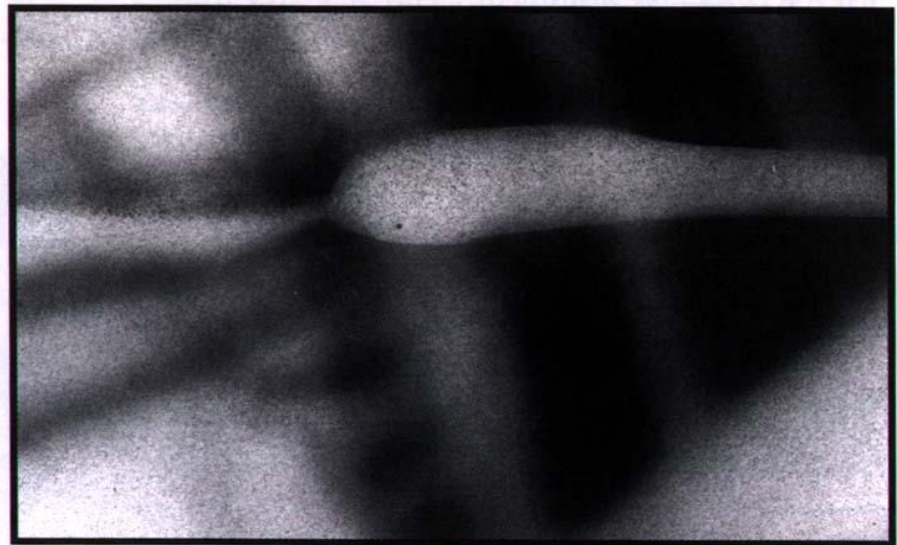
Esophageal impactions



Esophageal Obstruction

Sticture

Esophageal Obstruction



Contrast radiograph of esophageal stricture

Anatomy of Digestive System

Uses of Saliva:

lubricant

enzymatic activity

buffering capacity

nutrients for rumen microorganisms

prevention of frothing

taste

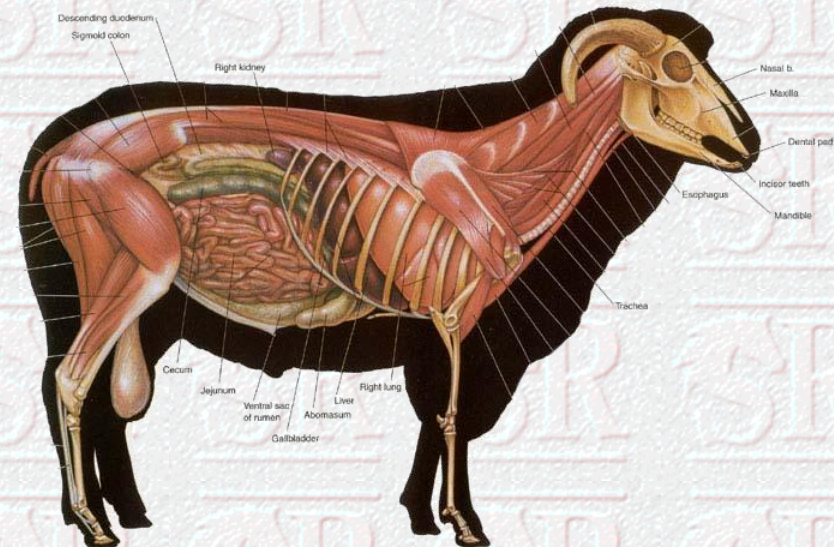
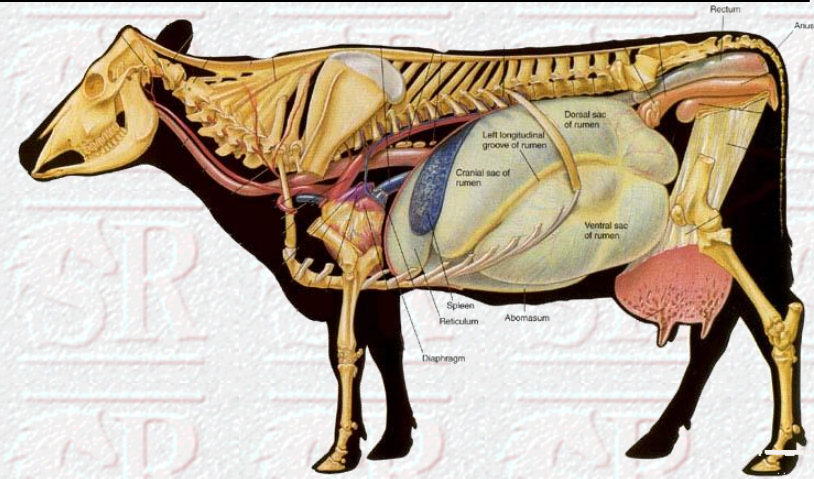
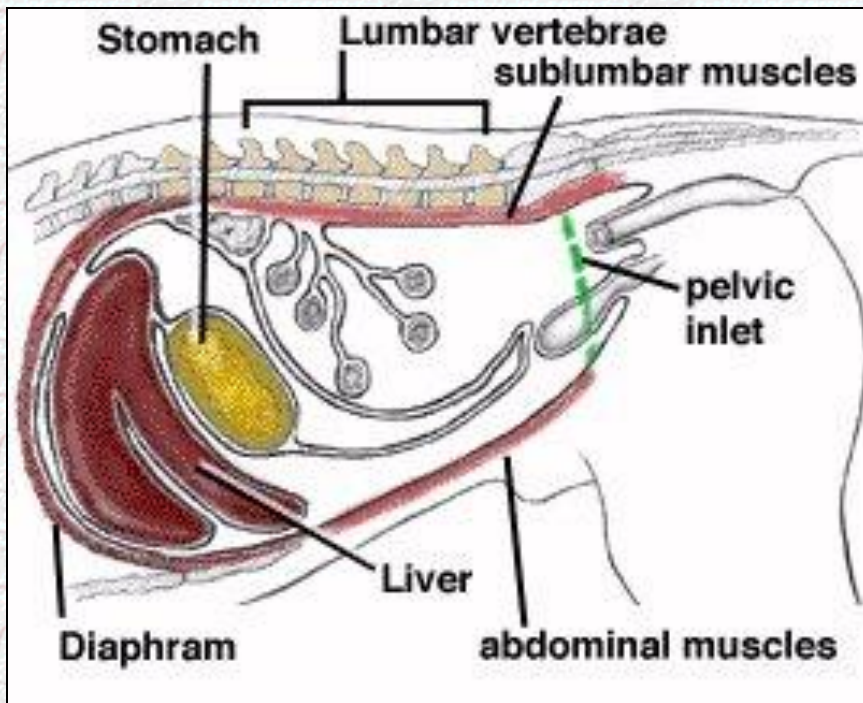
protection

Anatomy of Digestive System

- **Factors affecting salivary production:**
 - **Animal - genetic control; some animals prod. more saliva than others.**
 - **Diet**
 - **Roughage** - increase roughage will increase saliva
 - **Grain** - vise versa
 - **Anything that decreases rumination will decrease saliva production.**
 - moisture content
 - particle size

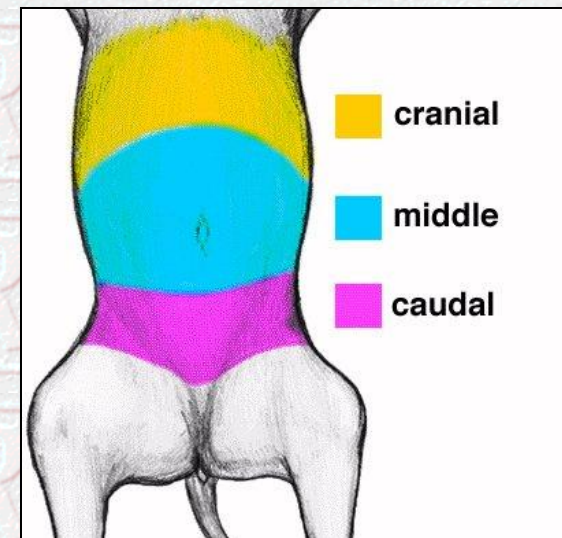
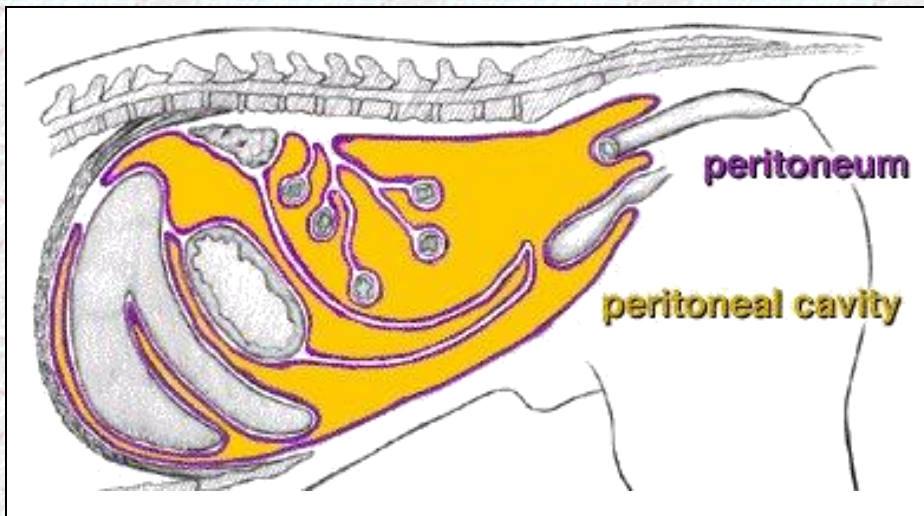
Anatomy of Digestive System

- Abdominal Cavity



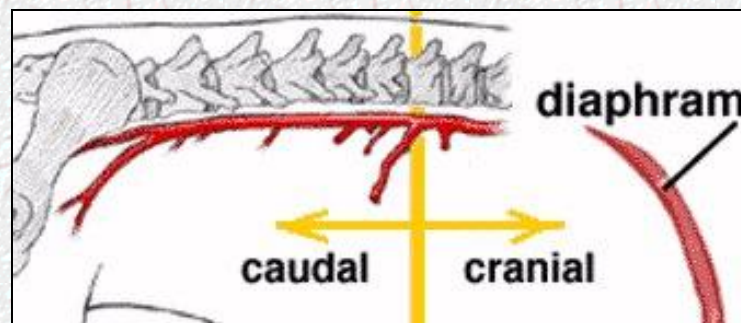
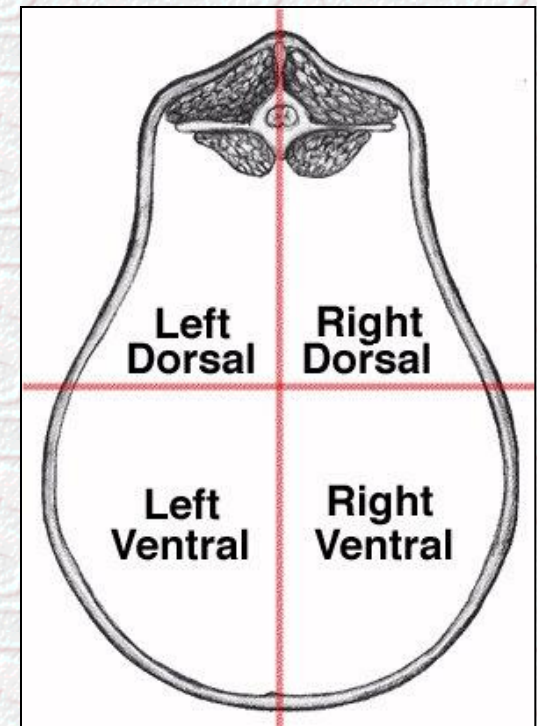
Anatomy of Digestive System

- **Peritoneum** is a serous membrane which lines the abdominal cavity.
- Forms the peritoneal cavity
- Some points of reference for describing the location of structures in the abdominal cavity.



Anatomy of Digestive System

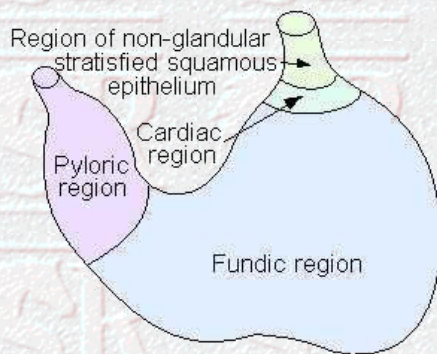
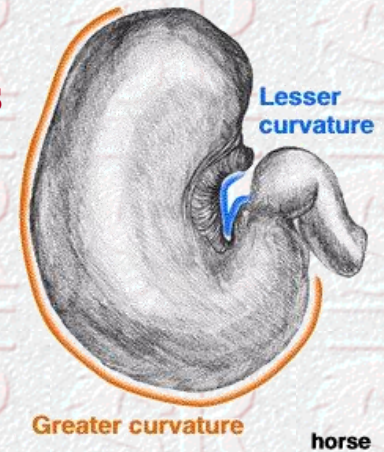
- **Transverse** section of the abdominal cavity is divided into quadrants.
 - Dorsal
 - ventral
 - Left
 - Right
- Cranial and caudal halves
 - mesenteric artery being the point of division



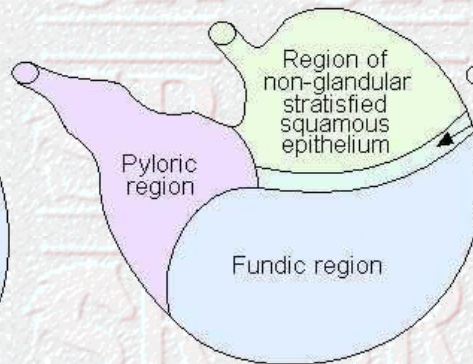
Anatomy of Digestive System

- **Stomach**

- is a dilatation of the digestive tract between **esophagus** and **SI**
- variation between species in size and shape
 - consequence of differing diets
- **horse, dog, cat, and pig, and the abomasum or “true stomach”** look like a kidney bean.

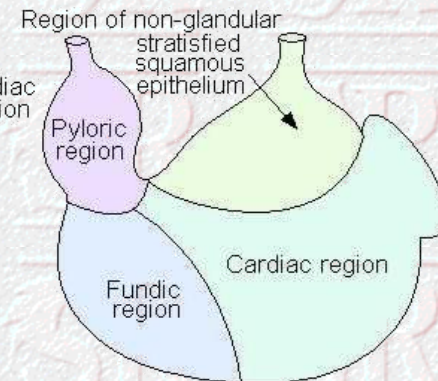


DOG



HORSE

Right ← → Left



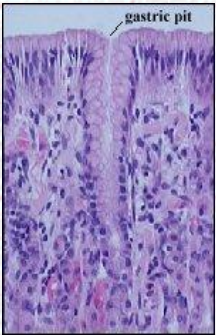
PIG

Anatomy of Digestive System

- **Stomach (monogastrics)**
 - resembles the shape of a kidney bean
 - has many regions:
 - **Cardia:** sphincter at the junction of the esophagus and stomach
 - **Esophageal region:** nonglandular area surrounding the cardia
 - **Cardiac gland region:** contains cells that produce primarily mucus

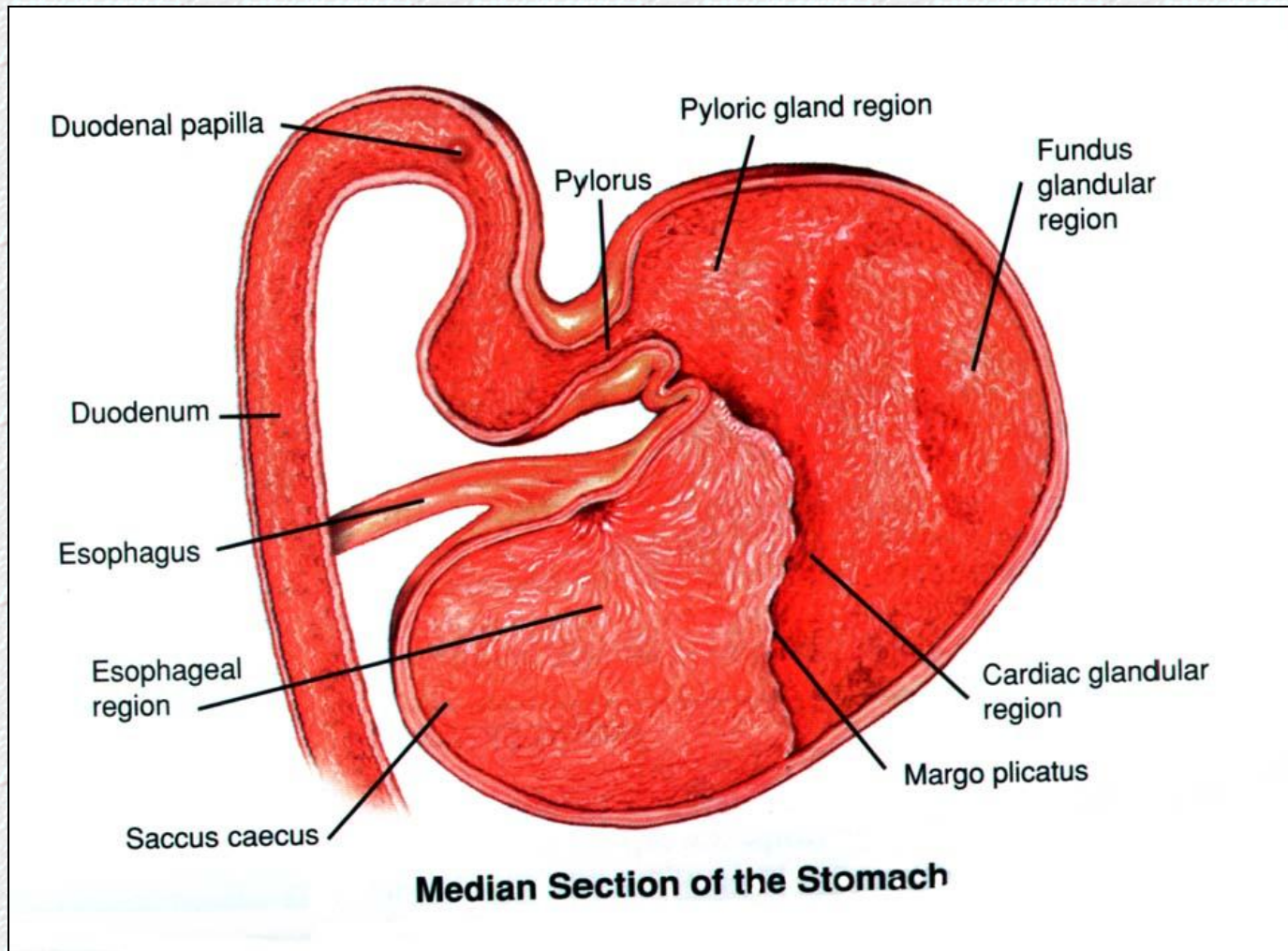
Anatomy of Digestive System

- **Fundic gland region:** contains cells that provide the gastric secretions



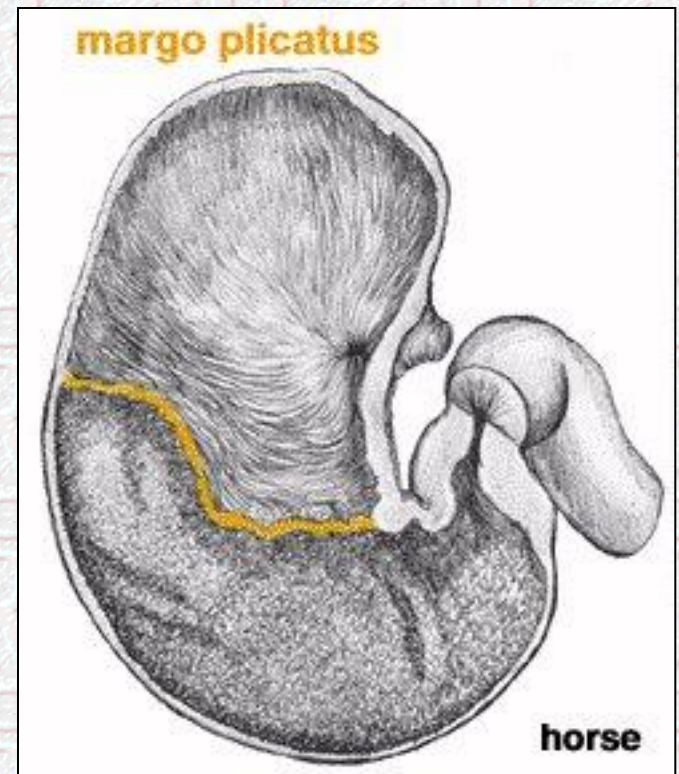
- **Parietal cells:** produce HCL acid
 - **Neck Chief cells:** produce mucin
 - **Body Chief cells:** produce enzymes and precursors of enzymes (pepsinogen, rennin, & lipase).
- **Pyloric gland region:** contains cells that produce mucus and some proteolytic enzymes
 - **Pylorus:** sphincter at the beginning of the small intestine.

Stomach



Stomach

- **Margo plicatus: div the two regions**
- **Functions:**
 - **Storage**
 - **Muscular movement for movement & breakdown**
 - **Secretions**



Anatomy of Digestive System

- “Gastric Juices”
 - Acid (HCL; pH ~ 2)
 - Produced by **fundic** parietal cells
 - Kills bacteria
 - Activates digestive enzyme
 - Denatures (unfolds) protein
 - Pepsinogen
 - Produced by **fundic** chief cells
 - Inactive proteolytic enzyme
 - Conversion to **pepsin** requires **HCL**
 - Initiates protein digestion

Anatomy of Digestive System

- “Gastric Juices”

- Mucus

- Produced by cardiac and pyloric cells
 - Protects stomach wall from acid and pepsin
 - Lubricant

- Rennin

- Produced by cells in fundic region
 - Proteolytic enzyme
 - Only produced in young animals
 - Coagulates milk to slow passage

Anatomy of Digestive System

- **Regulation of gastric secretions**
 - **Cephalic phase**
 - Impulses from the brain
 - Sight, smell, taste, thought
 - Accounts for 25 to 30% of secretions
 - **Gastric phase**
 - Presence of food in stomach
 - Accounts for 70 to 75% of secretions
 - **Intestinal phase**
 - Presence of **chyme** and/or low pH in the small intestinal duodenum causes reduced gastric secretion

Anatomy of Digestive System

Rate of Passage within the Stomach

- **esophagus enters stomach**
 - horse has a sharp angle of entry**
- **water passes quickly**
- **rate of passage depends largely on the nutrient composition of the ration**
- **initial stage of digestion is provided by gastric secretions**

Anatomy of Digestive System

- **Stomach hormones**
 - **Gastrin release from pyloric cells**
 - **Release caused by**
 - **stomach distension**
and/or
 - **presence of protein**
 - **Stimulates acid and pepsinogen secretion and gastric motility**

Anatomy of Digestive System

Digestion is more complete when stomach is not completely full

- two types of motility:

- 1. peristalsis**
- 2. tonic contraction**

Feed small quantities more often and feed hay before grain.

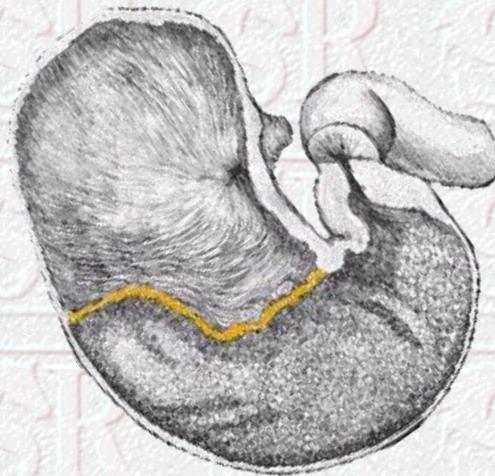
Water before feeding (if not free choice)

Anatomy of Digestive System

- Monogastric animals need high quality feedstuff.

– Why?

- CHO~ starch
- CF~ cell wall
- CHON~ CP



CHO & CF



SI

CHON

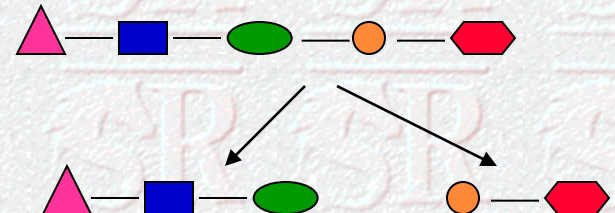


Pepsinogen



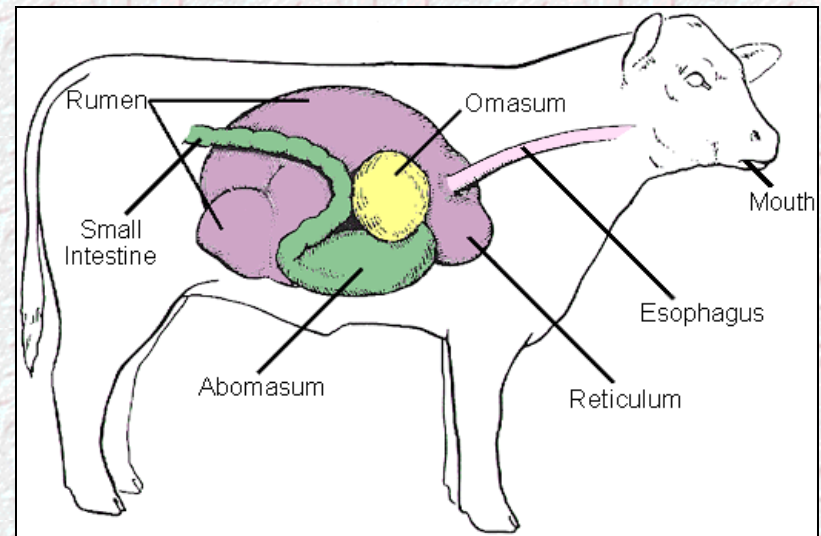
HCL

Pepsin



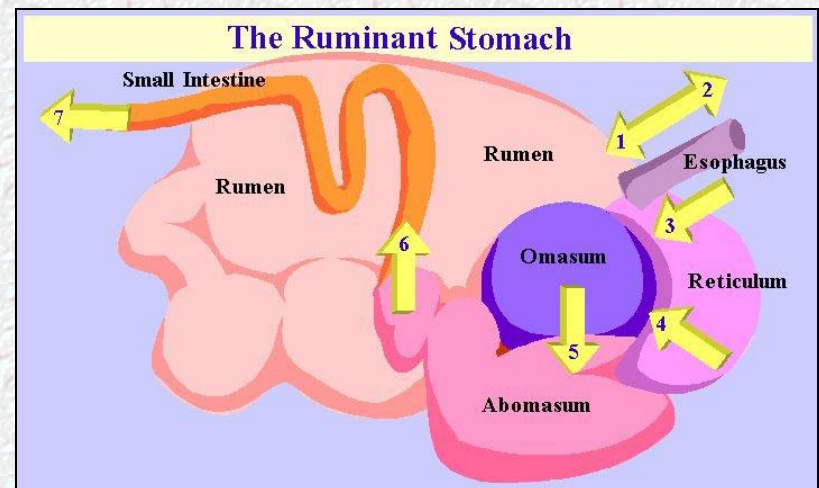
Anatomy of Digestive System

- Ruminants differ from other mammals in having a greatly enlarged forestomach consisting of **3 additional compartments**.
- This large capacity is essential in allowing feed retention, so **microorganisms** can break down cellulose and other complex CHO.

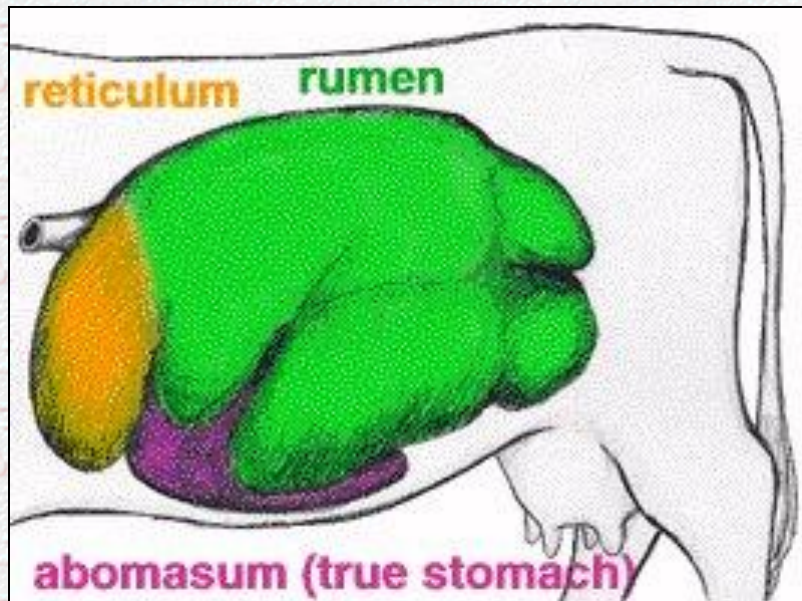


Anatomy of Digestive System

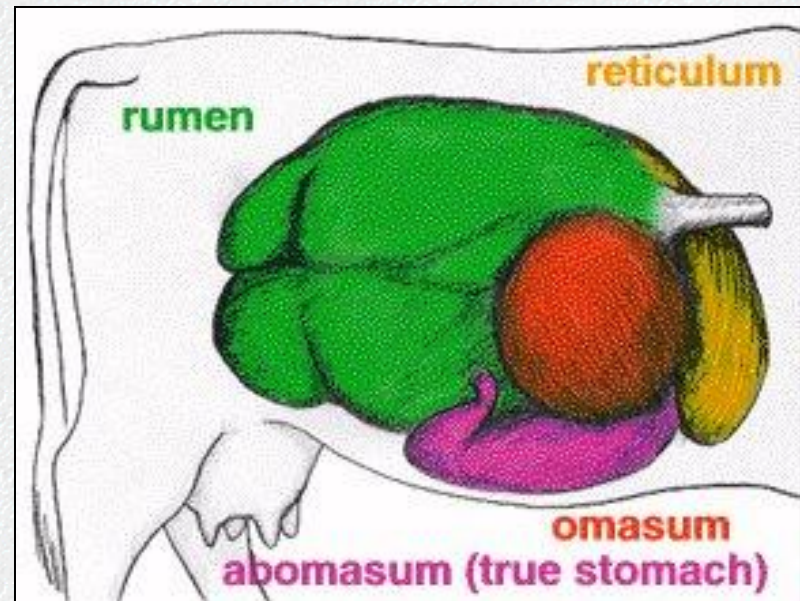
- **The four compartments :**
 - reticulum, rumen, omasum and abomasum
 - the first 3 compartments are lined with **non-glandular mucous membrane**. (papillae)
 - the **abomasum** is lined with a **glandular mucosa**.
 - **The forestomach compartments function to store and delay passage of ingested food.**
 - Sites of **anaerobic microbial fermentation**



Anatomy of Digestive System

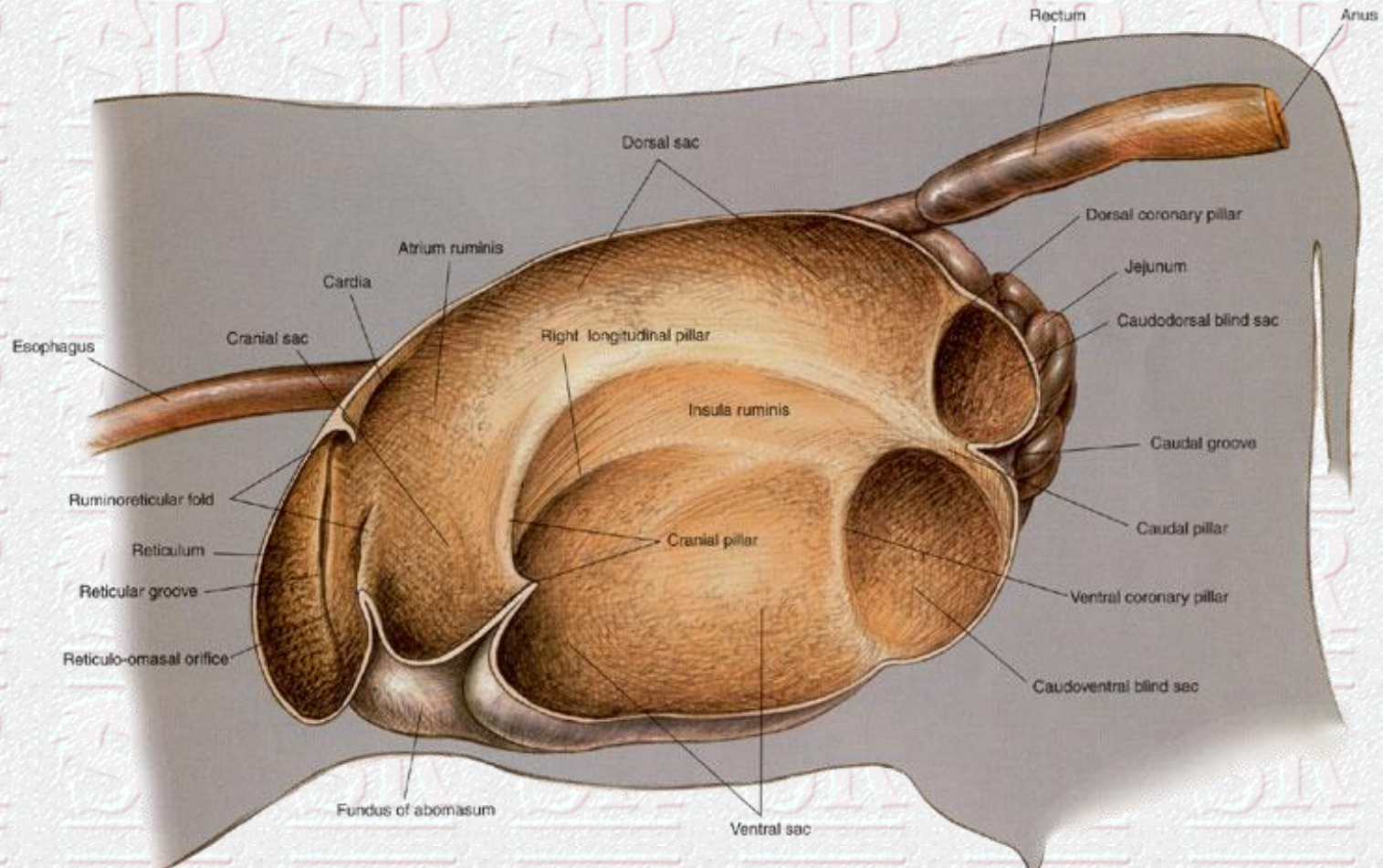


Left side



Right side

Anatomy of Digestive System

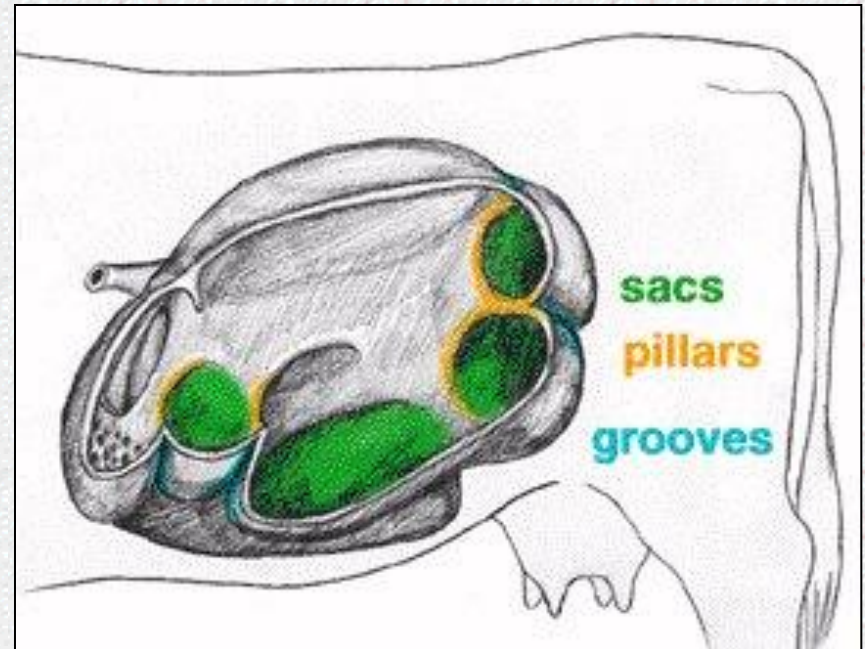


Anatomy of Digestive System

Animal	Stomach	Sm Int.	Cecum	Lg Int.
	-----% of total capacity-----			
Cat	69.5	14.0	1.5	15.0
Dog	62.3	23.3	1.3	13.1
Pig	29.2	33.5	5.6	31.7
Man	17.0	66.0		17.0
Horse	8.5	30.2	15.9	45.4
Cattle	70.8	18.5	2.8	7.9
Sheep	66.9	20.4	2.3	10.4

Anatomy of Digestive System

- Rumen is subdivided into various compartments called **sacs**, by muscular protrusions called **pillar**.
- Externally, the locations of the pillars are marked by **grooves**.



Anatomy of Digestive System

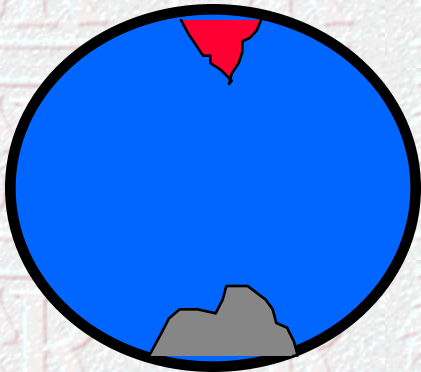


- The reticular epithelium is raised into folds forming cells with 4, 5, or 6 sides.
- “Honeycomb”
- “Hardware Disease”
- Magnified to show the secondary cells w/in the larger cells.
- The bottom of the cells have numerous pointed horny papillae.

Anatomy of Digestive System

- **Papillae line the rumen epithelium**
 - **papillae: are projections of epithelium which increase surface area.**

1 mm



1-3 mm

- the largest papillae are found on the floor of the rumen

(cranial and ventral sac).

- the dorsal sac has the smallest papillae; color changes from top to bottom.



Anatomy of Digestive System

- For normal development of papillae:

1. Physical factor : “Scratch factor”

Forage provides the scratching factor

Increase grain content - decrease scratch factor

2. Chemical factor : “VFA”; they need VFA to metabolize for energy.

Butyric acid is the major promoter of papillae growth.

Anatomy of Digestive System

