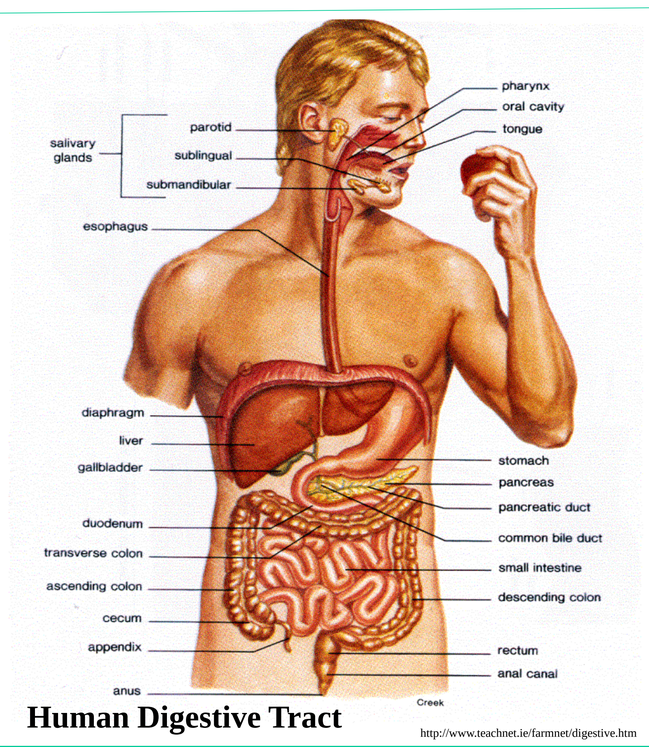
Digestive Tract Comparison



Human Digestive Tract

http://www.teachnet.ie/farmnet/digestive.htm

Human/Dog Digestive system or Simple Monogastric Digestion

Mouth
- A specialized region of the digestive tract designed to break up large particles of food into smaller, more manageable particles
- Saliva is added to moisten food and begin carbohydrate breakdown by amylase in humans.
- There are four main types of teeth in the human or dog: incisors, canines, premolars and molars.
- One reason dog and cat canines are much larger than ours is that they need to be able to rip and tear through tough raw meat. Humans have evolved to eat easier to chew, cooked meat.
- While chewing, food is transformed into what is called a bolus, a food ball, and then forced down the throat by the tongue.

Pharynx
- The pharynx is the shared tube of the respiratory and digestive tracts.
- It houses the epiglottis, a flap that closes off the tracheal opening while swallowing so food does not enter the respiratory tract while swallowing.

Esophagus
- An thick and muscular organ of transport.
- Contracts rhythmically to transfer the bolus from the mouth and pharynx to the stomach through peristalsis

Stomach
- The bolus enters the stomach by passing through a valve-like cardiac sphincter.
- The stomach is highly elastic, able to stretch to many times its original empty volume in order to hold great volumes of digesting food.
- Sphincters let controlled amounts of food in and out of the stomach and help to contain the corrosive compounds in the stomach.
- The stomach is protected from its own acids by mucus secreted by cells in the stomach lining.
- Stomach muscles churn the bolus and mix it with gastric juices to form a liquid that is now called chyme and is into the small intestines.
- Protein digestion by pepsin begins in the stomach.

• Small Intestine
- The small intestine is a tube roughly twenty feet long deided into the duodenum, jejunum and ileum.
- The first part of the small intestine is the duodenum, the site of most chemical digestive reactions and is smoother than the rest of the small intestine
- Bile, bicarbonate and pancreatic enzymes are secreted into the duodenum to breakdown nutrients in the chyme so that they can be readily absorbed.
- Bicarbonate from the pancreas neutralizes corrosive stomach acid from 3.5 in the stomach to 8.5 in the small intestine.
- Pancreatic enzymes include lipases, peptidases and amylases.
  - Lipases break down fats. Peptidases break down proteins. Amylases break down carbohydrates.
- Bile from the liver is stored in the gall bladder and secreted into the duodenum to emulsify fat.
- The jejunum and ileum are next in the small intestine and are covered in villi, finger-like projections.
- Each individual villi is covered in microvilli that greatly expand the surface area of the small intestine to maximizes the ability to absorb nutrients.
- Most absorption in the simple monogastric digestive system happens in the jejunum.
- Fats are passed into the lymphatic system. Glucose, amino acids and other nutrients are absorbed into the blood stream

•Large Intestine
- The ileocecal valve opens into a length of digestive tract composed of the cecum, colon and rectum.
- The cecum is a blind sac at the end of the large intestine.
- A finger shaped appendix with no functional role today, extents from the cecum.
- The colon is the site of bacterial fermentation.
- The rectum is the tube extending from the colon.
- Fecal matter that has had all the water removed is now called feces and is stored in the rectum till it can be eliminated via the anus.
- The large intestine is filled with a huge amount of bacteria that ferment undigested carbohydrate.
  - For example, a one hundred fifty pound human would have fifteen pounds of bacteria in their gut. These bacteria are essential to the health of the animal.
- By fermenting undigested carbohydrate these bacteria create products that can be used by the animal for energy.
- Methane and other unusable gaseous products made by the bacteria are released as flatus.
- Water and salt reabsorption also occurs in the large intestine.

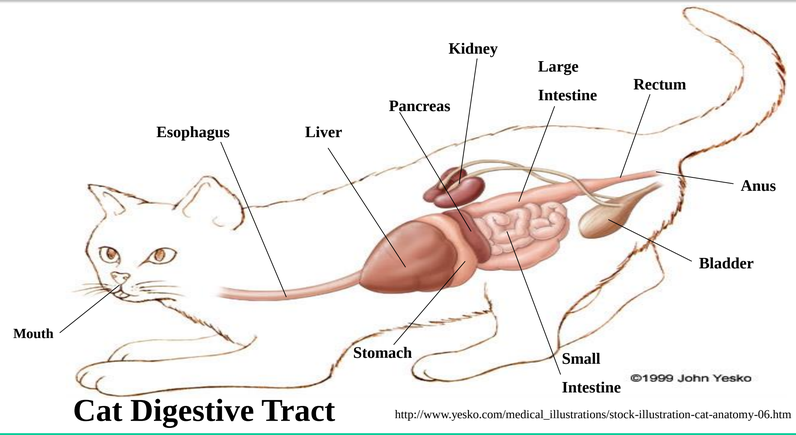
Cat Digestive System or Obligatory Carnivore Digestion

Mouth
- As an obligatory carnivore is an animal that must eat meat and bone material to survive.
- The cat has the same four types of teeth that the omnivore has but its teeth are all pointed for puncturing and gripping.
- The canine teeth are designed for puncturing, holding and tearing food and are much larger proportionally than even the primarily carnivorous dog.
- Additionally, the last upper premolars and first lower molars are modified into specialized carnassials that provide slashing and cutting ability to the animal.
- Their tongue is also specialized for use by the obligatory carnivore.
- It is covered in fine hook like projections that allow the cat to more easily scrape fine tissue from bone to get as much from a meal as it can.

Stomach
- The cat's stomach is a sac-like organ with all the characteristics of the omnivore's stomach
- Enzymatic digestion of protein is started in the stomach.

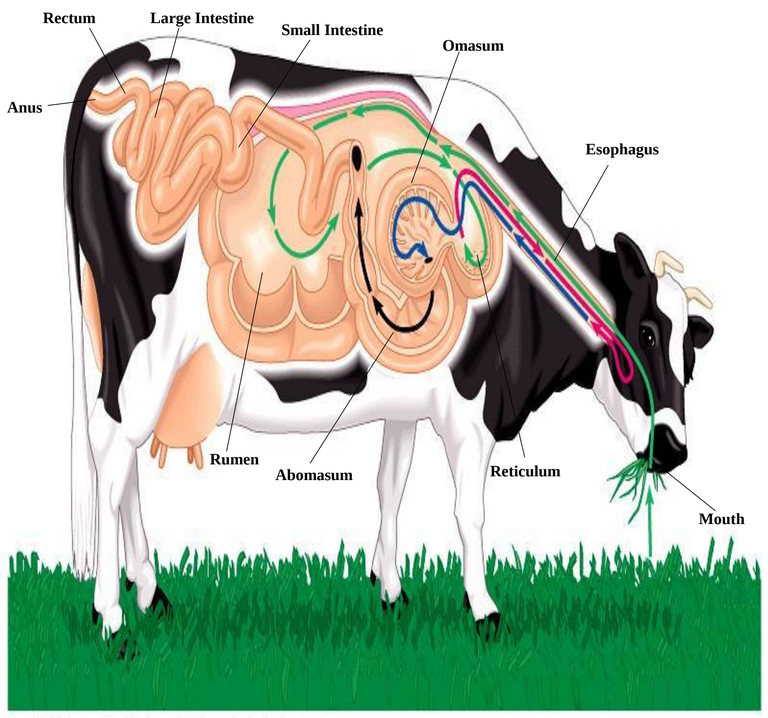
Small Intestine
- The small intestine in the cat is notably shorter than the small intestine of other species.
- As an obligatory carnivore means that the cat is taking in very highly digestible foods.
- Since the food it eats does not take much time to break down the cat can afford to have a shorter digestive tract.
- This conserves energy and conveys an evolutionary advantage to the cat making it lighter and better able to catch prey.

Liver and Gall Bladder
- The meat that cats survive on is not only high in protein but also fat.
- A working liver and gall bladder to supply bile are essential to cat digestion.
- The low carbohydrate consumption by the cat means little glucose is available for absorption via the digestive tract.
- Glucose production via Gluconeogenesis in the liver and is important for obtaining the absolute requirement for glucose
  - Gluconeogenesis is the breakdown of amino acids from protein to form glucose.



Cat Digestive Tract

http://www.yesko.com/medical_illustrations/stock-illustration-cat-anatomy-06.htm



Cow Digestive Tract

http://faculty.irsc.edu/FACULTY/TFischer/bio%202%20files/Bio%202%20resources.htm

Cow Digestive System or Foregut Fermenter Digestion

Mouth
- The cow has thirty-two teeth, eight incisors and twenty-four molars and premolars
- The top jaw has no teeth in the front but instead has a hard pad of skin for the bottom incisors to clamp against.
- When a cow is grazing it is actually just ripping up sections of plant material, chewing a few times to mix them with saliva, and then swallowing the bolus whole.

Esophagus
- Unlike the simple monogastric, the cow's esophagus can bring food from the pharynx to the stomach and also easily work in the other direction, bringing material from the stomach to the mouth for remastication.
- This process is called antiperistalsis.

Stomach
- The cow's stomach resembles one stomach split into four separate compartments each of which has a separate function.
- Only one compartment carries out the roles associated with the monogastric stomach.
- **Reticulorumen**
  - The reticulorumen is comprised of two sacs, the reticulum and rumen.
  - The two compartments are closely associated and are separated by a reticular fold.
  - **Rumen**
  - The rumen is muscular and covered in papillae, the finger-like projections.
  - When ruminants like the cow are not grazing they are likely resting and 'chewing their cud'. Cud chewing is where food is returned to the mouth for continuous rechewing and addition of more saliva.
  - Muscle contractions mix a dense microorganism slurry composed of symbiotic bacteria, protozoa and fungi.
  - These microorganisms work to break down the animal's food and release nutrients via fermentation.
  - Through the papillae, products of microbial fermentation (volatile fatty acids) are absorbed directly into the blood stream.
  - In essence the rumen is one giant fermentation vat that can hold up to fifty gallons of partially digested material.
  - The micro flora growing in the rumen are a source of protein for the cow. The bacteria 'eat' the grass and the cow 'eats' the bacteria. This allows the cow to eat grass and turn it into a viable source of energy.
- **Reticulum**
  - The reticulum is rough and honeycomb-like.
  - The reticulum is a smaller pouch that acts as a sort of trap for large objects leaving the rumen.
  - They essentially have a built in filter to allow them to take in huge amounts of low digestibility feed very fast and ferment it into useable energy while not taking in dangerous objects in their haste.

Omasum
- After the food material has been sufficiently broken down go through the rumenoreticulo-omasal orifice and into the omasum.
- The omasum is a highly folded organ that holds about two and a half gallons of material.
- It has small projections on its surface that allow it to act as a sort of sieve.
- It allows water and minerals such as sodium and phosphorus to be reabsorbed from the food
- It also acts as a pump from the reticulum to the abomasum for the solid portion of foods.

Abomasum
- Once food is pumped into this stomach compartment from the omasum, the acid digestion that we traditionally think of as happening in the stomach begins.
- Ruminants almost always have something coming into their abomasum.
- They differ from monogastrics who tend to only eat and release food into their stomachs in a rhythm at different times throughout the day.
- Chyme is, therefor, created and deposited into the small intestine throughout the day.

Small Intestine
- The small intestine in the cow is proportionally longer.
- The cow needs more area so that it has more time to absorb nutrients from the food it is digesting.

Liver and Gall Bladder
- The carbohydrates eaten by the cow are actually mostly consumed by the rumen bacteria.
- To obtain the absolute requirement of glucose the forgut fermenter must break down protein and propionate from microorganisms through gluconeogenesis in the liver.

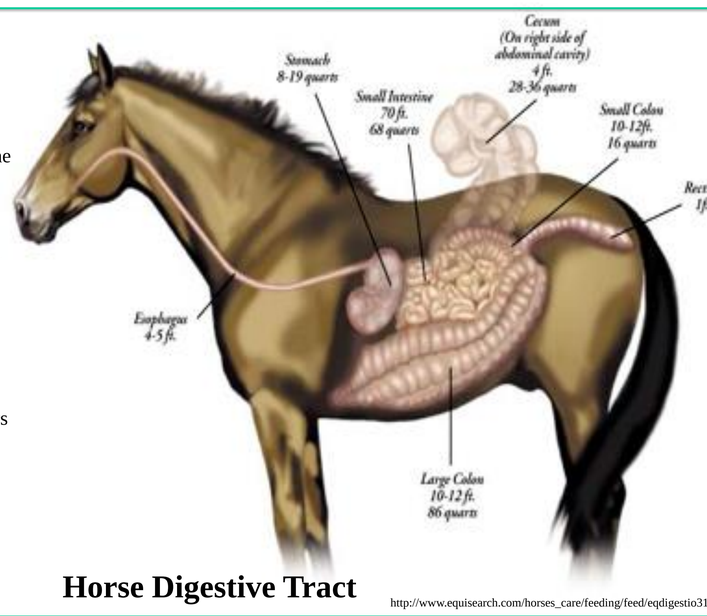
Horse Digestive System or Hindgut Fermenter Digestion

Mouth
- The horse's teeth grow continuously throughout the animal's life.
- Horses have incisors in the fronts of their mouths, a gap on each side, both top and bottom, where a carnivore's canines would be, then premolars and molars.
- A horse often has a wider upper jaw than lower jaw.
  - This is no problem in the wild where they eat mainly plants and use the traditional circular chewing method, which wears their continually growing teeth evenly.
  - In captivity they are often fed pelleted diets which they are more inclined to chew up and down.
  - This creates a ridge in their teeth that can hinder further normal chewing.
  - Not surprisingly, horse dentistry is very popular.

Stomach
- The stomach of the horse is proportionally very small.
- The horse evolved grazing, eating small meals throughout the day of less digestible foods.
- Digestion of these less digestible foods does not take place in the stomach.
- An organ that is not being used is smaller to take up less energy and keep the horse light so it can run from predators.
- In normal digestion chyme is created and deposited into the small intestine in intervals through the pyloric sphincter.
- The main reason for colic is because horses in captivity are fed twice daily with highly digestible feeds so their small stomach is overloaded.
- Colic is an extreme, deadly condition of abdominal pain in horses. It can require an expensive, major surgery to correct and so is of veterinary importance.
- Making sure horses get enough roughage in captivity can help prevent colic.
- Unlike the monogastric, the horse cannot vomit!

Liver and Gall Bladder
- Horses have no gall bladder, the liver alone controls

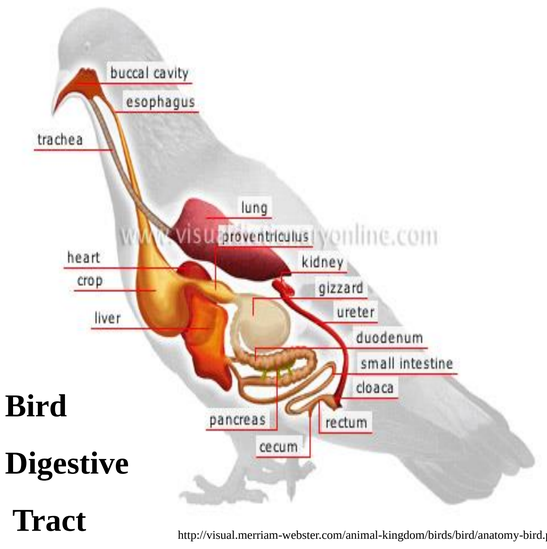
Large Intestine:
- The large intestine of the horse is more specialized than that of the monogastric.
- The large intestine is divided into two major sections in the hindgut fermenter, the cecum and the colon.
- **Cecum**
- Food from the small intestine enters the cecum, a blind sac.
- The cecum can hold up to ten gallons of food and acts similarl to the rumen in the cow in that it is the site of microbial fermentation
- Thus, the main difference between horses and cows is that horses are hindgut fermenters, after the stomach, and cows are forgut fermenters, before the stomach (abomasum).
- Food is mixed with the micro flora in the cecum using smooth muscles and is expelled into the colon.
- **Colon**
- Food reaches the colon and spends most of its time there, a few days as compared to a few hours in the rest of the tract.
- A huge amount of mixing occurs here that allows the horse to absorb not only water and vitamins made by bacteria but large amounts of volatile fatty acids made by microbial fermentation.
- As with the cow this allows the horse to utilize grass as a viable source of energy.
- Fecal matter is turned into feces in the last section of the colon to be stored in the rectum till it can be excreted out the rectum through the anus.



Horse Digestive Tract

http://www.equisearch.com/horses_care/feeding/feed/eqdigestio3120/

Bird Digestive System



Bird Digestive Tract

http://visual.merriam-webster.com/animal-kingdom/birds/bird/anatomy-bird.php

Mouth
- Instead of teeth, birds have a wide variety of beaks.
- The beak is a thick, keratinized structure.
- The beak continues to grow throughout the bird's life and wears off as it is used.

Esophagus
- The bird's esophagus is a fairly wide diameter tube.
- It is muscular to move food from the mouth toward the crop via peristalsis.
- A crop exists in most, but not all, birds and is a pouch that expands to hold huge amounts of food material.
- This allow the bird to take in a very large amount of food without stopping, and then begin digestion later when it is able.
- Birds are one of two warm-blooded groups (the other being bats) that have evolved flight.
- Most of the bird's digestive adaptations are centered around this idea of increased energy input and decreased energy output to save that energy for flight.
- Both parents are equally suited to take care of young as they bring food home to the chicks via their crops.

Stomach
- The bird actually has two stomachs, the proventriculus and the ventriculus.
- **Proventriculus**
- The proventriculus or glandular stomach is much the same as the monogastric stomach.
- It is smooth and muscular and coated with a protective lining and is the site of protein hydrolysis.

Ventriculus:
- The ventriculus, or gizzard, is the muscular stomach made of a disk shape of heavy musculature that uses stones , or grit, to grind food into smaller particles.
- The gizzard is covered by a protective cuticle of hardened material that ensures that stomach acids from the proventriculus and the stones in the gizzard do not harm the animal.
- Food from the proventriculus enters the ventriculus and is ground down into fine particles by the stones through the muscular contractions in the ventriculus taking the place of teeth 'chewing'.
- Food then typically returns to the proventriculus for further chemical digestion.

Small Intestine
- The small intestine sections of the bird are not histologically different as they are with mammals where the jejunum has longer villi.
- A bird's small intestine are very uniform throughout the three segments.

Liver and Gall Bladder
- Some species of birds such as pigeons and parrots do not have a gall bladder, much like the horse.
- In these species bile is released into the duodenum directly from the liver.

Large Intestine
- The large intestine is made of a pair of caeca which can be developed or undeveloped depending on the species of bird.
- Birds with well-developed caeca such as chickens use their caeca as a sites of cellulose breakdown and volatile fatty acid formation that contribute to the energy supply of the bird.
- There is then a short colon that acts very much the same as it does in the monogastric.
- Short villi may be observed extending into large intestine.
- Unlike other animals however, the bird has only one opening for the digestive, urinary and reproductive tracts called the vent.

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