

Avian digestive system

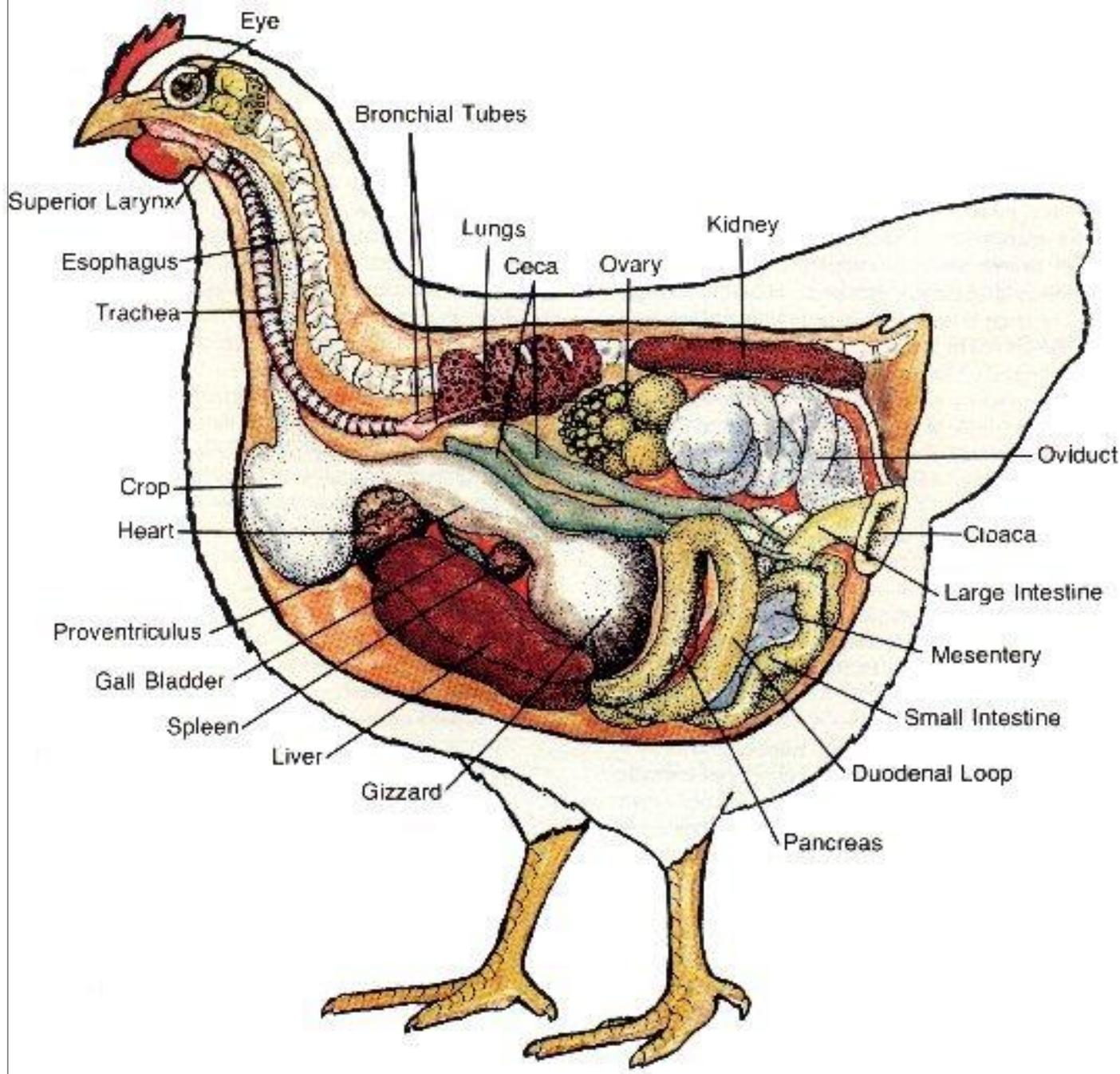
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An understanding of the avian digestive system is essential to developing an effective and economical feeding program for your poultry flock. A knowledge of chicken anatomy, and what the parts normally look like, will also help you to recognize when something is wrong and

take the necessary actions to correct the problem.

The digestive tract of any animal, including chickens, is important in converting the food the animal eats into the nutrients their body

Figure 1. Model showing the internal organs of the female chicken



needs for maintenance, growth, and production (such as eggs). Once food is eaten, it must be broken down into its basic components. This is done through both mechanical and chemical means.

- **Mechanical action** typically involves chewing, but since birds don't have teeth other mechanical methods are used and will be discussed later in this publication.
- **Chemical action** includes the release of digestive enzymes and fluids from the stomach, pancreas and liver.

Once the nutrients have been released from food during digestion, they can be absorbed and distributed throughout the animal's body.

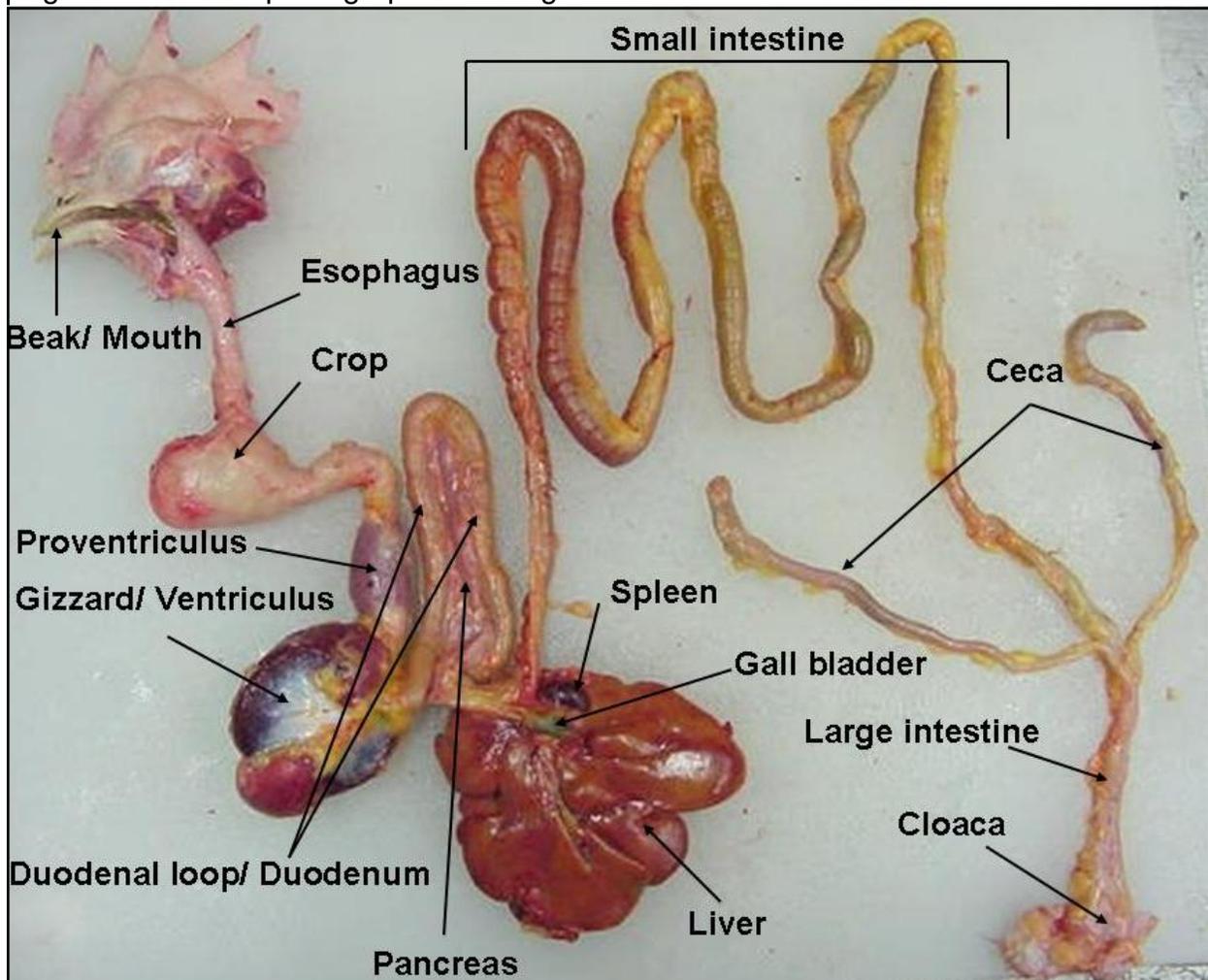
The digestive tract is also referred to as the gastro-intestinal or GI tract. Which ever term is used, in chickens it begins at the **mouth** and

ends at the **cloaca** and has several important organs in between (see the Figure 2 below).

Beak / Mouth: Chickens, as with most birds, obtain feed with the use of their **beak**. Food picked up by the beak enters the mouth. As previously mentioned, chickens do not have teeth so they are not able to chew their food. The mouth does contain glands which secrete saliva which wets the feed to make it easier to swallow. The saliva also contains some enzymes which start the digestion of the food eaten. The chicken's **tongue** is then used to push the feed to the back of the mouth so that it can be swallowed.

Esophagus: The esophagus is a flexible tube that connects the mouth with the rest of the digestive tract. It carries food from the mouth to the crop and from the crop to the proventriculus.

Figure 2. Labeled photograph of the digestive tract of a chicken



Did you know: Chickens swallow water differently than we do. While they use their tongue to push food to the back of the throat this is not very effective when swallowing water. We close our mouths and let our throats do the swallowing. Chickens, however open and close their mouths rapidly while tilting their heads up, since they



Crop: The crop is an out-pocketing of the esophagus and is located just outside the body cavity in the neck region (see Figure 3 below). Any swallowed feed and water is stored in the crop until it is time to pass it on to the rest of the digestive tract. When the crop is empty, or nearly empty, it sends hunger signals to the brain so that the chicken will eat more.

Although salivary glands of the mouth secrete the **digestive enzyme** amylase very little digestion actually takes place in the crop – it is simply a temporary storage pouch. The crop evolved for birds that are typically hunted by other animals but which need to move to the open to find feed. These birds are able to consume relatively large amounts of food quickly and then move to a more secure location to digest the food they consumed.

Occasionally the crop becomes impacted or 'backed up' (**crop impaction**, also referred to as **crop binding** or **pendulous crop**). This may occur when chickens go a long time without feed. This will cause the chickens to eat too much too fast when the feed becomes available again. A crop may also become impacted in a chicken that is free-ranged on a pasture of tough, fibrous vegetation. Crop impaction can also result when the chickens eat a long piece of string. With a crop impaction, even if a chicken continues to eat, the feed can not get past the impacted crop. The swollen crop may also cut off the windpipe, suffocating the chicken.

Proventriculus: The esophagus continues past the crop to connect the crop to the proventriculus. The proventriculus (also known as the '**true stomach**') is the **glandular stomach** where digestion begins. As with human stomachs, hydrochloric acid and digestive enzymes (e.g., pepsin) are added to the feed here and digestion begins. At this point, how-

Figure 3. Location of the crop in a chicken. The crop is located just outside the body cavity in the neck region.

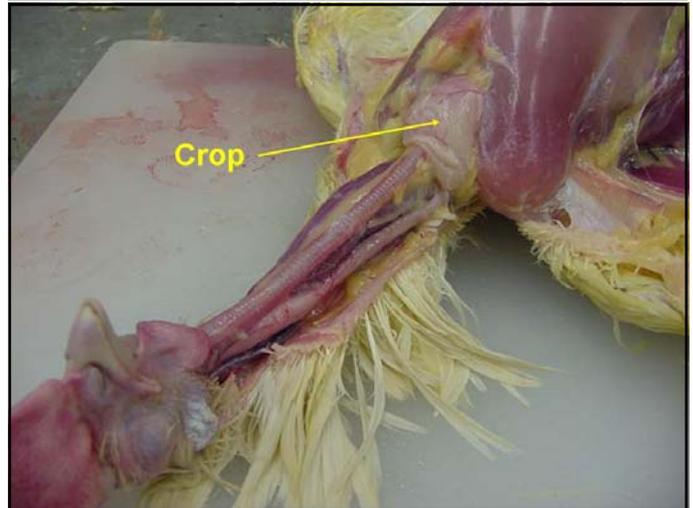
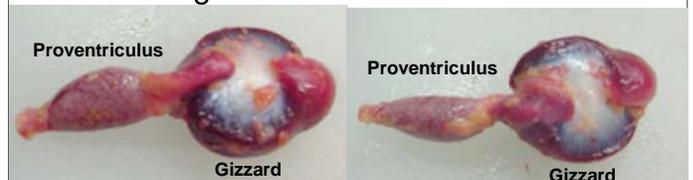


Figure 4. Front and back views of the proventriculus and gizzard



ever, the food has not yet been ground up. The term 'proventriculus' is used since it comes before the 'ventriculus' or gizzard, with 'pro' being a Latin term meaning before.

Gizzard / Ventriculus: The gizzard, or ventriculus, is a part of the digestive tract unique to birds. It is often referred to as the '**mechanical stomach**'. It is made up of two sets of strong muscles which act as the bird's teeth (see Figure 4 above). Consumed feed and the digestive juices from the salivary glands and the proventriculus pass into the gizzard for grinding, mixing, and mashing.

When allowed to free-range, chickens will typically eat small stones. These stones remain in the gizzard until they become ground into

Warning: Do NOT give chicks oyster shell or limestone. These are NOT grit. Oyster shell and/or limestone are often given to laying hens to provide the extra calcium they need for egg shell formation. This extra calcium, however, will cause bone development problems in chicks. The kidneys can be damaged as well.

pieces small enough to pass through to the rest of the digestive tract. The stones/pebbles are weakened by the acidic environment created in the proventriculus and then are ground into tiny pieces by the strong muscles of the gizzard.

Chickens fed only commercially prepared feed do not need stones. If, however, **whole grains** are fed, it is necessary to provide small pebbles, typically given as **grit**. Grit is a commercial product made up of small stones. It should not be confused with limestone or oyster shell which are given to laying hens as a source of calcium for their egg shells.

Chickens kept on pasture will also require supplementation with grit, though many of them may consume enough pebbles when they forage.

Gizzards have a thick lining which protects their muscles (see Figures 5 and 6 below). When chickens are slaughtered, the gizzards are often saved, the lining removed, and the gizzard consumed by the family or sold as a food item. While many people use chicken gizzards in home-made pet food (typically dogs and cats) they can also be a human food item, eaten alone or as part of a recipe.

When a chicken eats a small, sharp object such as a tack or staple, the object is likely to get stuck in the gizzard. Because of the strong

grinding motion of the gizzard's muscles, these sharp objects may eventually put a hole in the gizzard wall. Chickens with damaged gizzards will grow thin and eventually die – a very good reason to keep your poultry houses free of nails, glass shards, bits of wire and the like.

Small intestine: The small intestine is made up of the duodenum (also referred to as the duodenal loop) and the lower small intestine. The **duodenum** receives digestive enzymes and bicarbonate (to counter the hydrochloric acid from the proventriculus) from the **pancreas** and bile from the **liver** via the **gall bladder**. The digestive enzymes produced by the pancreas are primarily involved in protein digestion. **Bile** is a detergent that is important in the digestion of lipids and absorption of fat-soluble vitamins (vitamins A, D, E and K). The remainder of the digestion occurs in the duodenum and the released nutrients are absorbed mainly in the **lower small intestine**. The lower small intestine is composed of two parts, the jejunum and ileum. The Merkel's Diverticulum marks the end of the jejunum and the start of the ileum.

The **pancreas** plays important roles in both the digestive and hormonal systems. It secretes hormones into the blood system that are important in the regulation of blood sugar.

In the developing embryo the yolk sac supplies the nutrients needed for it to develop and grow. Right before hatch, the yolk sac is taken into the navel cavity of the embryo. The residual tiny sac is the Merkel's Diverticulum (see

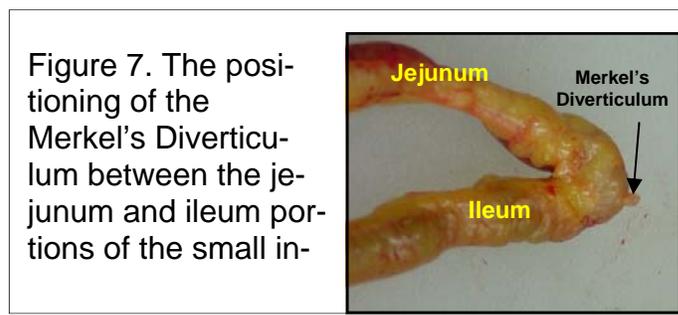
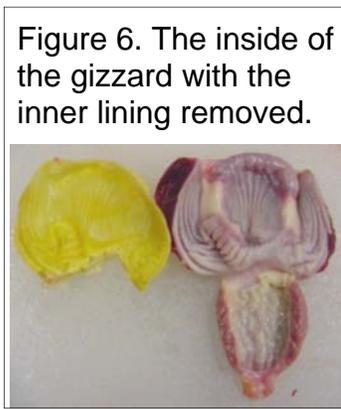


Figure 7 below).

The material remaining in the yolk immediately after hatch is able to supply the feed and water needs of the newly hatched chicken. This is why it is possible to ship chicks long distances without adverse affects, as is done when chicks are purchased online and shipped via the postal service.

Omphalitis is a condition characterized by infected yolk sacs, often accompanied by unhealed navels in recently hatched chicks. It is infectious but not contagious. It is often associated with excessive humidity and contamination of the hatching eggs or incubator. The affected chicks usually appear normal until a few hours before death. Being lethargic, drooping of the head, and huddling near the heat source usually are the only signs. The navel may be inflamed and fail to close, producing a wet spot on the abdomen; a scab may be present.

Ceca (plural form; singular = **cecum**): The ceca are two blind pouches located where the small and large intestines join. Some of the water remaining in the fecal material is reabsorbed here. Another important function of the ceca is the fermentation of any remaining coarse materials. In doing so they produce several fatty acids as well as the eight B vitamins (Thiamine, riboflavin, niacin, pantothenic acid, pyridoxine, biotin, folic acid and vitamin B₁₂). Because the ceca are located so close to the end of the digestive tract, however, very little of the produced nutrients are absorbed and available to the chicken.

The ceca empty their contents two or three times a day, producing pasty droppings that often smell worse than regular droppings. Cecal droppings typically have a mustard to dark brown in color. The number of times **cecal droppings** are 'pooped', as well as their color and texture, tell you that the chicken's digestive tract is functionally normally.

Large intestine (also known as the **colon**): Despite the name, the large intestine is actually shorter than the small intestine. The large intestine is where the last of the water re-

absorption occurs.

Cloaca: In the cloaca there is a mixing of the digestive wastes together with wastes from the urinary system (urates). Fecal material is usually voided as digestive waste with white uric acid crystals on the outer surface (i.e., chickens do not urinate/pee). The reproductive tract also exits through this area but when a hen lays an egg the vagina folds over to allow the egg to leave through the vent without coming into contact with the feces or urine.

The color and texture of chicken fecal material can indicate the health status of the chicken's digestive tract. The white pasty material that commonly coats chicken fecal material is **uric acid**, the avian form of urine, and is normal (see Figure 8 below).



Some of the possible abnormal color and texture changes that can occur, together with possible causes, are shown below. These are just possible causes—any sick birds should be diagnosed by a veterinarian.

Appearance of Feces

- Droppings with blood = coccidiosis
- Greenish droppings = late stages of worms (or has eaten a lot of green vegetables if free-ranged)
- White, milky runny droppings = worms, coccidiosis, Gumboro disease (Infectious Bursal Disease)
- Brown runny droppings = *E. coli* infection
- Clear or watery runny droppings = stress, Infectious Bronchitis
- Yellow & foamy droppings = coccidiosis
- Grayish white & running continuously = vent gleet (a chronic disease of the cloaca of domestic birds)

Intestinal Microflora

Both the small and large intestine are normally populated by beneficial bacteria, referred to as **microflora** ('micro' meaning small and 'flora' meaning plants). This population of microflora are important since they aid in digestion. Intestinal disease normally occurs when the balance of normal microflora is upset or the normal microflora is overrun by too many foreign organisms. The result is **enteritis** or inflammation of the intestines, producing symptoms that include diarrhea, increased thirst, dehydration, loss of appetite, weakness, and weight loss or slow growth.

When the damage to the intestinal tract is severe it is typically referred to as **necrotic enteritis**. 'Necrotic' means 'dead tissue' while

'enteritis' refers to an inflammation of the intestinal tract. Necrotic enteritis is a problem in many different types of production systems.

So where do these 'beneficial' bacteria come from? When chicks hatch their digestive tracts are virtually sterile. If raised by a mother hen, they would obtain the beneficial microflora by consuming some of their mother's fecal material. This is not possible in artificial incubation and brooding. Probiotics are a collection of the normal beneficial microflora that would inhabit a chicken's digestive tract. By spraying it in the shipping boxes or supplying it in the first feed the chicks receive the 'good' bacteria that they need to fight off infection by pathogenic bacteria, such as salmonella.