

**ANIMAL DIVERSITY AND
ECOLOGY
(MZO501)
PART II**

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TOPICS DISCUSSED

- Digestive System in Chick.
- Circulatory System in Chick.
- Urogenital System in Chick.
- Respiratory System in Chick.

DIGESTIVE SYSTEM IN CHICK

OVERVIEW

Mouth: It all starts here.

Esophagus (Gullet): Transports food from the mouth to the stomach.

Crop: A pouch in the esophagus used to store food temporarily before moving it on to the stomach.

Stomach (Proventriculus/Gizzard): Principally the organ where food is broken into smaller units. It has two parts: the proventriculus for storage and the gizzard. The gizzard is a muscular part of the stomach that uses grit to grind grains and fiber into smaller particles.

Small Intestine: Aids in digestion and nutrient absorption. Composed of the duodenum, jejunum and ileum.

Liver: The largest glandular organ in the body. Aids in the metabolism of carbohydrates, fats and proteins.

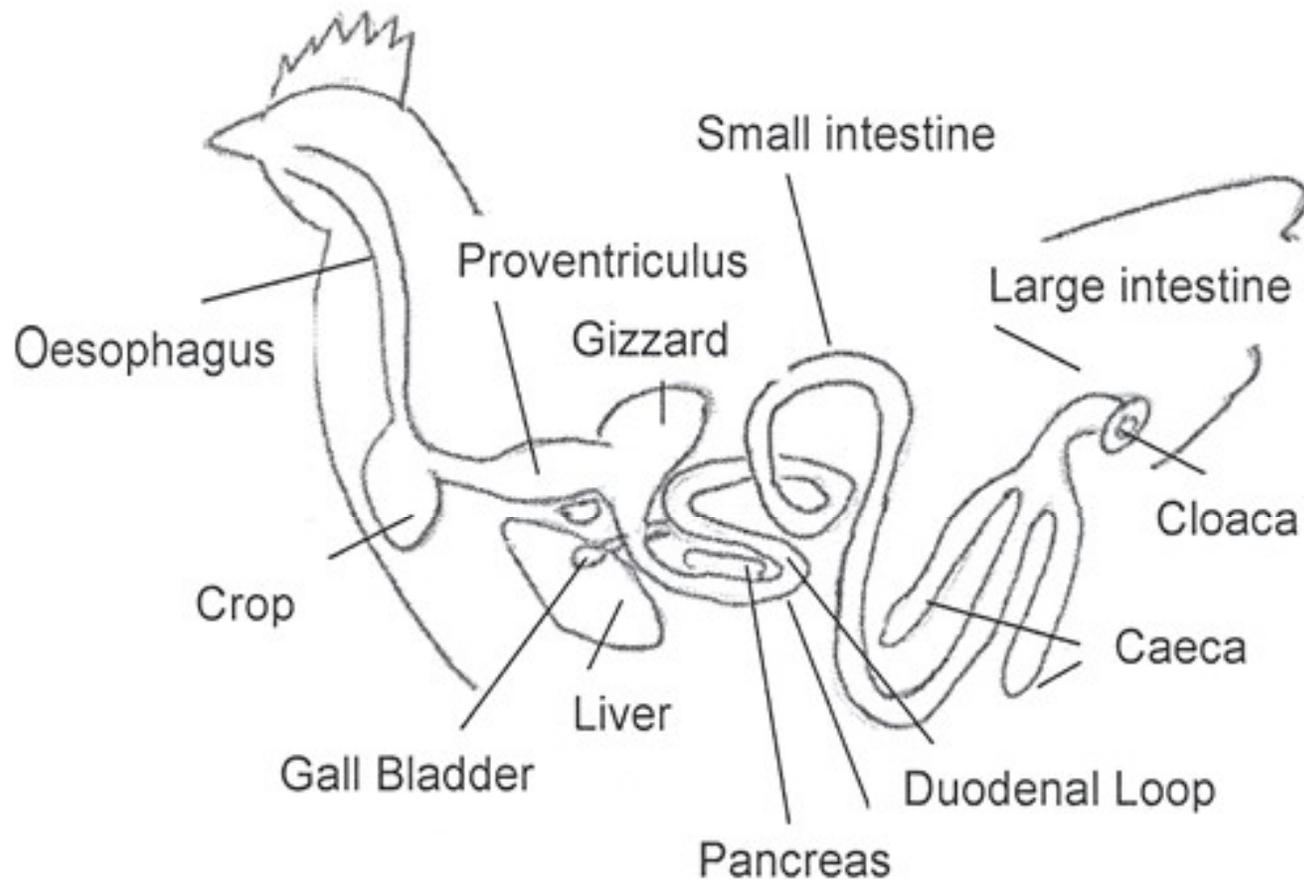
Ceca: Bacterial action in the ceca helps break down undigested food passing through the intestine. The ceca turns into the large intestine, which connects with the cloaca.

Large Intestine: Functions primarily to absorb water, dry out indigestible foods and eliminate waste products.

Cloaca: Where the digestive, urinary and reproductive systems meet.

Urinary System: Consists of two kidneys and two ureters. The kidneys are located in the pelvic bones. They filter waste from the blood and pass it through the ureter to the outside via the cloaca/vent.

Vent: The external opening of the cloaca that passes waste to the outside.



Simplified diagram of Chick Digestive System

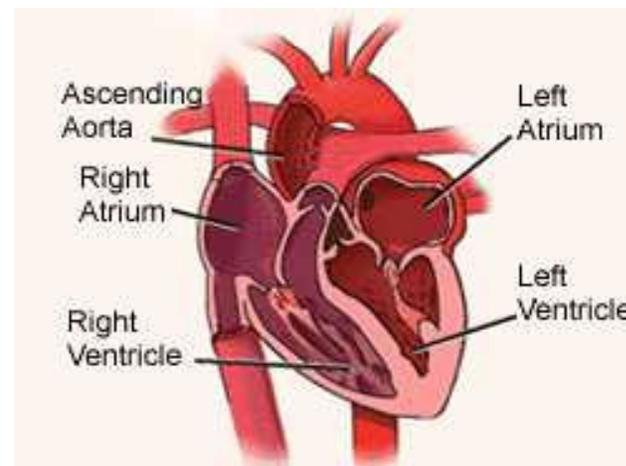
- Food is taken in with the beak, which is the perfect tool for pecking feed in crumble or pellet form, small grains, grass or insects.
- Chickens are omnivores meaning that, in addition to a commercial feed, they can eat meat (grubs, worms, the occasional mouse) and vegetation (grass, weeds and other plants). A small bit of saliva and digestive enzymes are added as the food moves from the mouth into the esophagus.
- From the esophagus food moves to the crop, an expandable storage compartment located at the base of the chicken's neck, where it can remain for up to 12 hours.
- The food trickles from the crop into the bird's stomach (proventriculus or gizzard) where digestive enzymes are added to the mix and physical grinding of the food occurs.
- The gizzard is why chickens do not need teeth. It is a muscular part of the stomach and uses grit (small, hard particles of pebbles or sand) to grind grains and fiber into smaller, more digestible, particles.

- From the gizzard, food passes into the small intestine, where nutrients are absorbed. The residue then passes through the ceca, a blind sack along the lower intestinal tract, where bacteria help break down undigested food.
- From the ceca, food moves to the large intestine, which absorbs water and dries out indigestible foods.
- This remaining residue passes through the cloaca where the chicken's urine (the white in chicken droppings) mixes with the waste. Both exit the chicken at the vent, the external opening of the cloaca.
- Chicken waste is high in nitrogen, it is recommended to let it age for a bit in a compost pile before adding it to gardens.

Circulatory System in Chick

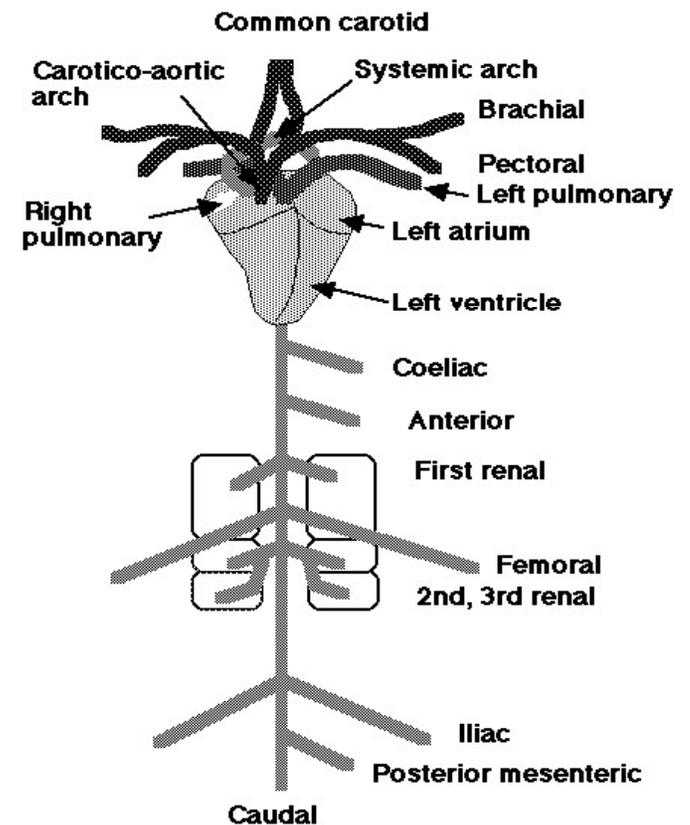
- Birds have very efficient cardiovascular systems that permit them to meet the metabolic demands of flight (and running, swimming, or diving).
- The cardiovascular system not only delivers oxygen to body cells (and removes metabolic wastes) but also plays an important role in maintaining a bird's body temperature.
- The avian circulatory system consists of a heart plus vessels that transport:
 - Nutrients
 - Oxygen and carbon dioxide
 - Waste products
 - Hormones
 - Heat
- Birds, like mammals, have a 4-chambered heart (2 atria and 2 ventricles), with complete separation of oxygenated and de-oxygenated blood. The right ventricle pumps blood to the lungs, while the left ventricle pumps blood to the rest of the body.
- Because the left ventricle must generate greater pressure to pump blood throughout the body (in contrast to the right ventricle that pumps blood to the lungs), the walls of the left ventricle are much thicker & more muscular.

- Birds tend to have larger hearts than mammals (relative to body size and mass). The relatively large hearts of birds may be necessary to meet the high metabolic demands of flight.
- Among birds, smaller birds have relatively larger hearts (again relative to body mass) than larger birds. Hummingbirds have the largest hearts (relative to body mass) of all birds, probably because hovering takes so much energy.
- Avian hearts also tend to pump more blood per unit time than mammalian hearts. In other words, cardiac output (amount of blood pumped per minute) for birds is typically greater than that for mammals of the same body mass.
- Cardiac output is influenced by both heart rate (beats per minute) and stroke volume (blood pumped with each beat). 'Active' birds increase cardiac output primarily by increasing heart rate.



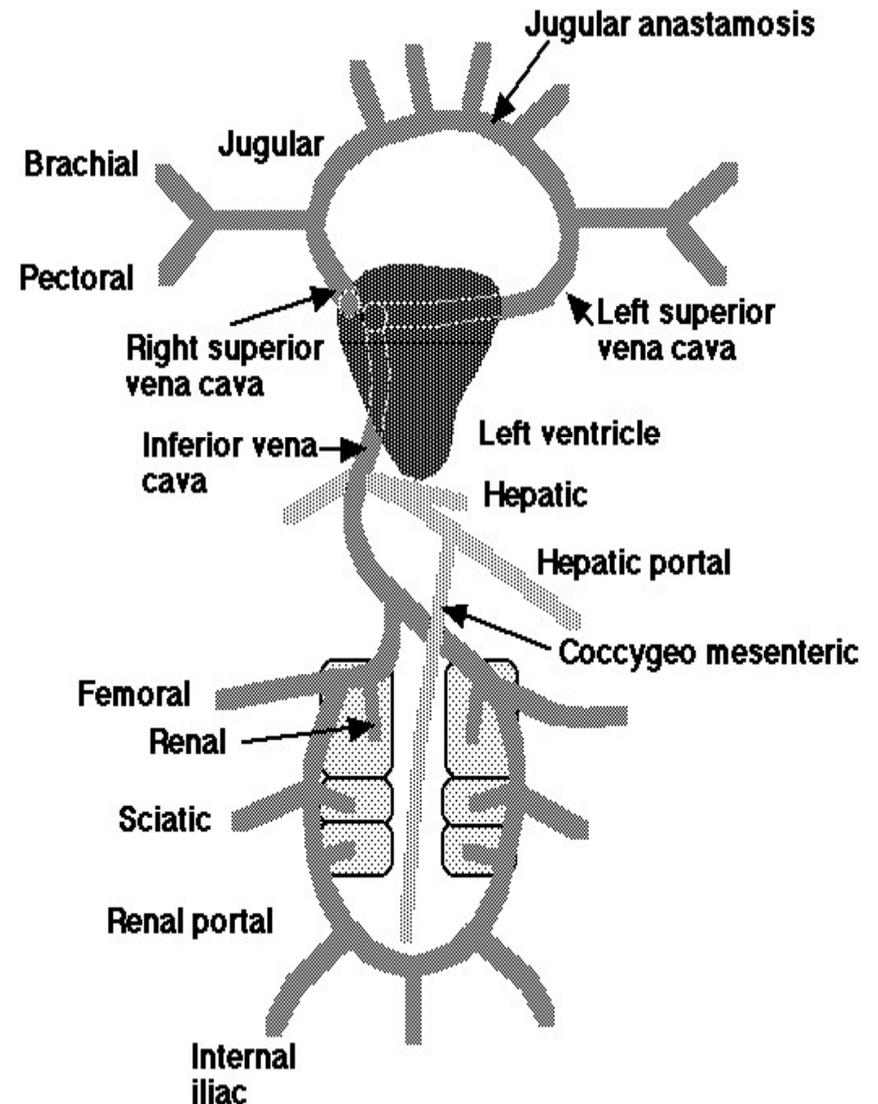
Some of the major arteries in the avian circulatory system

- **Carotids** deliver blood to the head (and brain).
- **Brachials** take blood to the wings.
- **Pectorals** deliver blood to the flight muscles (pectoralis).
- The **systemic arch** is also called the aorta and delivers blood to all areas of the body except the lungs.
- The **pulmonary** arteries deliver blood to the lungs.
- The **celiac (or coeliac)** is the first major branch of the descending aorta and delivers blood to organs and tissues in the upper abdominal area.
- **Renal** arteries deliver blood to the kidneys.
- **Femorals** deliver blood to the legs and the **caudal** artery takes blood to the tail.
- The **posterior mesenteric** delivers blood to many organs and tissues in the lower abdominal area.



Some major veins in the avian circulatory system

- The **jugular anastomosis** allows blood to flow from right to left side when the birds head is turned & one of the jugulars constricted.
- The **jugular veins** drain the head and neck.
- The **brachial veins** drain the wings.
- The **pectoral veins** drain the pectoral muscles and anterior thorax.
- The **superior vena cavae** (or precavae) drain the anterior regions of the body.
- The **inferior vena cava** (or postcava) drains the posterior portion of the body.
- The **hepatic vein** drains the liver.
- The **hepatic portal vein** drains the digestive system.
- The **coccygomesenteric vein** drains the posterior digestive system and empties in the hepatic portal vein.
- The **femoral veins** drain the legs.
- The **sciatic veins** drain the hip or thigh regions.
- The **renal and renal portal veins** drain the kidneys.



Urogenital System in Chick

Male reproductive system

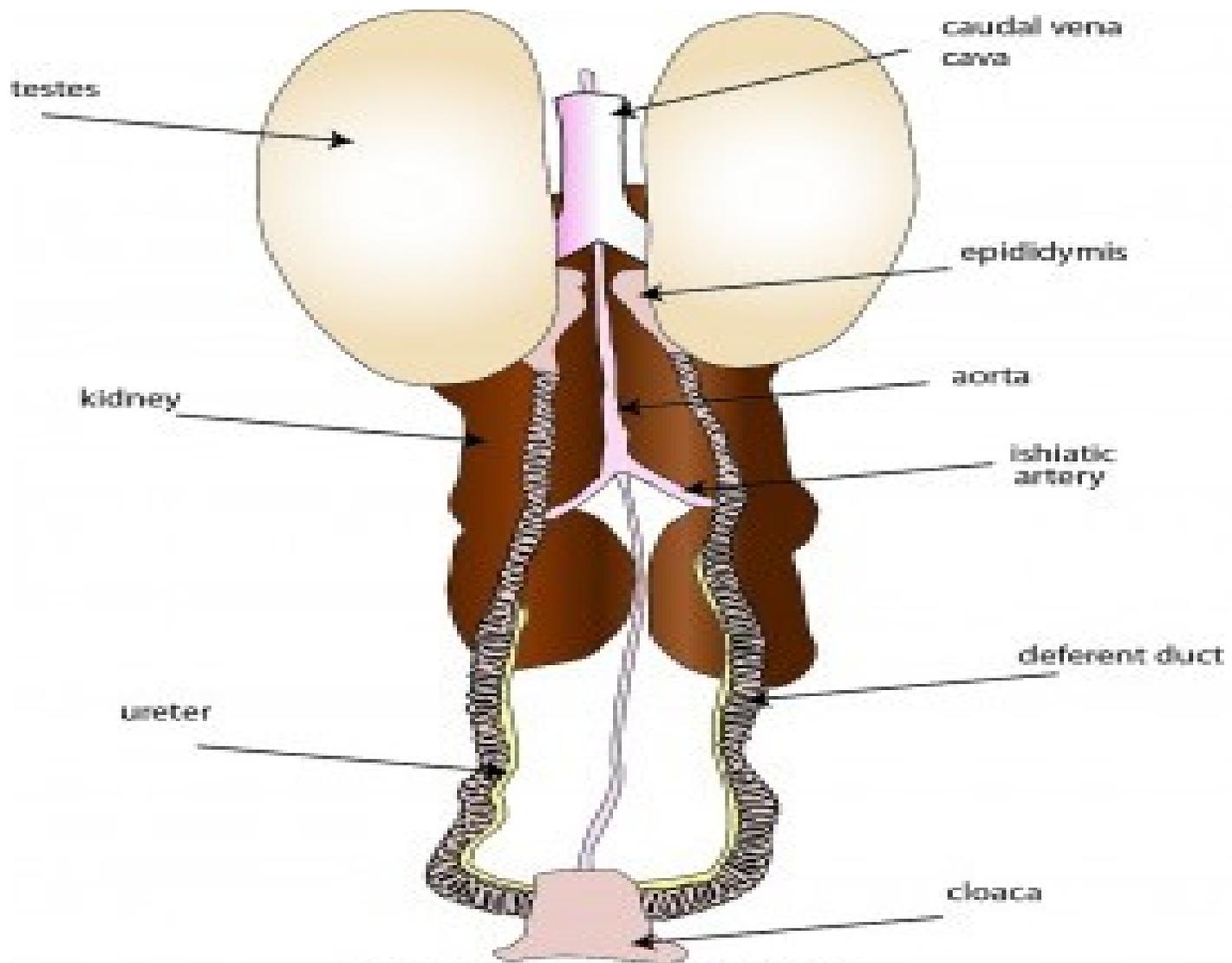
- The male reproductive organs consist of two testes, each with a deferent duct that leads from the testes to the cloaca.
- Fowls do not have a penis such as is found in other animals. The testes are bean shaped bodies located against the backbone at the front of the kidney.
- Their size is not constant and they become larger when the birds are actively mating. The left testes is often larger than the right.
- On the inside of each is a small, flattened area that is believed to correspond to the epididymis of mammals.
- The deferent duct starts at this flattened area.

Deferent duct

- The deferent duct transports the sperm from the testes where they are formed to the cloaca from which they enter the oviduct of the female when mating.
- The deferent duct enters a small pimple-like structure in the cloaca. This structure equates to the mammalian penis and is much larger in ducks to form a penis like organ. The deferent duct is quite narrow at first but widens as it approaches the cloaca.

Testes and sperm

- In the testes very twisted tubes called seminiferous tubules are found. It is in these tubules that a special process of cell division called meiosis and transformation produces the sperm.
- The sperm carry half of the total chromosomes required to produce an embryo. The mother provides the other half.
- One cubic millimetre of the fluid called semen produced by the male contains on average 3-5 million sperm.
- Under a microscope the sperm of the fowl will be seen to have a long pointed head with a long tail.
- The testes also produce hormones called **androgens** that influence the development of what are called secondary sex characteristics such as comb growth and condition, male behaviour and mating.



Urinary and Reproductive Organs of the Male

Female reproductive system

- The female reproductive system in the domestic fowl consists of the ovary and the accompanying oviduct.
- While the female embryo in chicken has two sets of reproductive organs, only one of these, the left survives and reaches maturity to produce eggs.
- The single surviving ovary is located in the laying hen just in front of the kidneys in the abdominal cavity and is firmly attached to the wall of the cavity.
- The ovary is well endowed with blood vessels to ensure there is no hindrance to the transport of nutrients to the developing yolk.

Ovary

- The ovary consists of a mass of yellowish, rounded objects called follicles, each containing an ovum or yolk. There are many such follicles but only a small number in comparison, will ever reach maturity to produce an egg.
- The size of the follicles will vary from very small to those approaching the normal yolk size in the egg which can be up to 40 millimetres in diameter, and will contain a fully matured yolk ready for release into the oviduct.

It is possible to find five stages of development in the active ovary:

Primary follicles – follicles that have not yet commenced to grow

Growing follicles

Mature follicles – follicles ready or nearly so for release

Discharged follicles – where the yolk has just been released

Atretic follicles – those from which the yolk has been released some time ago

Yolk

- It takes approximately 10 days for a yolk to develop from the very small to the normal size found in eggs and during this time it is contained in the follicle.
- The follicle acts as a sack during this period of development supplying it with the nutrients required for its growth. When a mature follicle is examined an elongated area virtually free of blood vessels will be found on the distal surface of it.
- This area, called the **stigma**, is where the follicle normally splits to release the yolk into the oviduct. If, for some reason, the follicle splits at other than the stigma, the numerous blood vessels that rupture will result in free blood being found in the egg i.e. a blood spot will form.
- The function of the oviduct is to produce the albumen, shell membranes and the shell around the yolk to complete the egg. It is a long tube well supplied with blood via numerous blood vessels.
- There are many glands found in its walls that produce the albumen, the shell membranes and the shell. In the non-layer the oviduct is quite short and small in diameter.
- However, once the reproductive system becomes active, it grows to a length of 70-80 centimetres with a variable diameter depending on the function of the section being examined.

The oviduct consists of five distinct parts or sections, each having different functions:

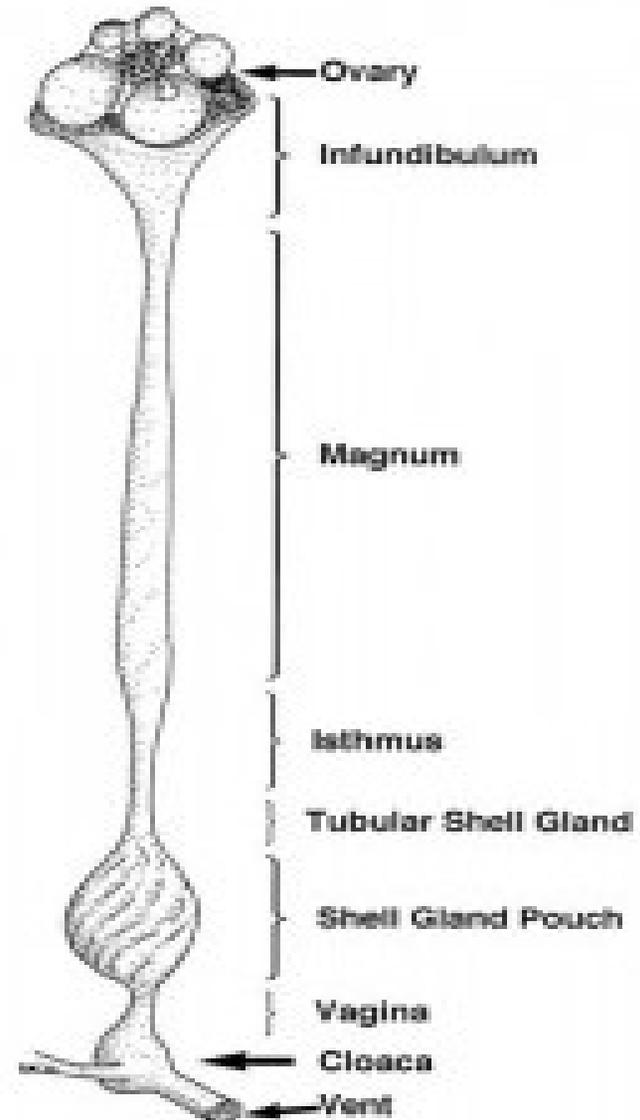
➤ **Infundibulum (or funnel):** located adjacent to the ovary and with long segments enclosing the ovary, the infundibulum collects the yolk after its release from the follicle as a funnel and directs it into the oviduct. This section has very thin walls and is 6-9 centimetres long. Fertilisation of the ovum by the male sperm occurs here.

➤ **Ampulla or magnum:** at approximately 40 centimetres long it secretes more than 40% of the albumen.

➤ **Isthmus:** at about 12 centimetres in length, it secretes some albumen and the shell membranes.

➤ **Uterus or shell gland:** at approximately 12 centimetres in length it secretes about 40% of the albumen and the egg's shell.

➤ **Vagina:** at approximately 12 centimetres in length, it secretes the egg's outer cuticle and possibly the shell pigment.



Respiratory System in Chick

The avian respiratory system is involved in the following functions:

- Absorption of oxygen (O₂)
- Release of carbon dioxide (CO₂)
- Release of heat (temperature regulation)
- Detoxification of certain chemicals
- Rapid adjustments of acid/base balance
- Vocalization

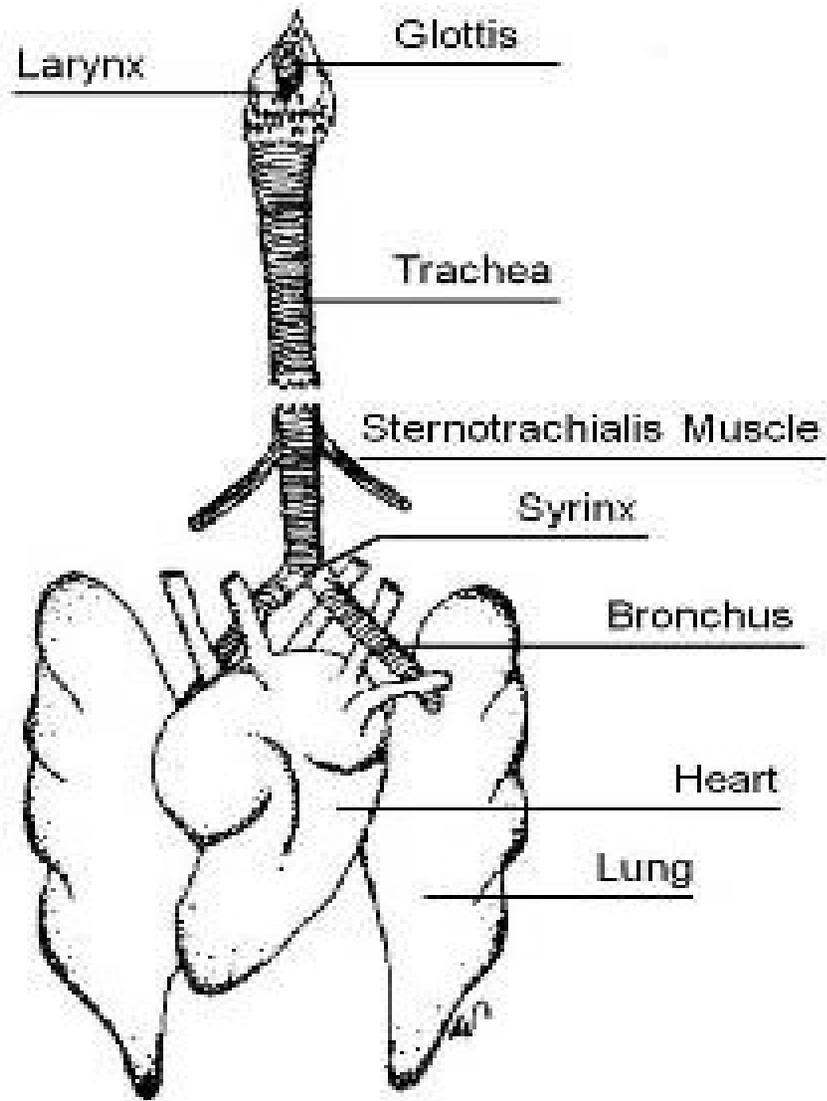
➤ In chick respiratory system begins at the head region. Parts of the respiratory system in this region include the nasal openings and nasal cavities and the pharyngeal region of the mouth.

➤ The **cranial larynx** (sometimes referred to as the **superior larynx** or **glottis**), located in this pharyngeal region, is the opening to the **trachea** (windpipe). The pharyngeal region also has the openings of the esophagus.

➤ The cranial larynx is normally open to allow air passage, but it closes when feed is passing down the throat so that the feed goes down the esophagus and does not enter the trachea.

- After air passes through the cranial larynx, it continues through the trachea. The trachea is made up of cartilaginous rings that keep it from collapsing due to the negative pressure present when a chicken breathes in air.
- After the syrinx, the trachea divides into two much narrower tubes called **bronchi**. In some respiratory diseases, tracheal plugs form and physically block the respiratory tract at the junction of the bronchi, thus suffocating the chicken.
- Each bronchus (singular of *bronchi*) enters a **lung**. Chicken lungs are relatively small, are firmly attached to the ribs, and do not expand. Birds have an incomplete diaphragm and chest muscles and a sternum (keel) that do not lend themselves to expansion in the way that a mammal's chest muscles and sternum do.
- Consequently, a bird's lungs operate differently from those of a mammal. Mammalian lungs contain many bronchi that lead to small sacs called alveoli. Because an alveolus (singular of *alveoli*) has only one opening, air flows into and out of the alveolus but not through it to the outside of the lung.
- In comparison, air passes through a bird's lungs in one direction. (In fact, the mammalian respiratory system is described as tidal because air goes in and out like the tide, whereas the avian respiratory system is described as nontidal.)

- A bird's lungs contain **parabronchi**, which are continuous tubes that allow air to pass through the lung in one direction, and **air sacs**.
- The parabronchi are laced with blood capillaries, and it is here that gas exchange occurs. The air sacs, which fill a large proportion of the chest and abdominal cavity of a bird, are balloon-like structures at the ends of the airway system.
- The key to the avian respiratory system is that air moves in and out through distention and compression of the air sacs, not the lungs. The air sacs act as bellows to suck air in and blow it out and to hold part of the total air volume.
- At any given moment, air may be flowing into and out of the lung and being “parked” in the air sacs.
- Air sacs are somewhat unique to avian species, found elsewhere only in certain reptiles. In the chicken, there are nine such sacs: an unpaired one in the cervical area, two interclavicular air sacs, two abdominal air sacs, two anterior thoracic air sacs, and two posterior thoracic air sacs.
- Another important feature of the avian respiratory system is also part of the avian skeletal system. Some of a bird's bones are hollow. The air sacs in a bird's lungs connect to the air spaces in these bones, and the bones then act as part of the avian respiratory system.
- They are called **pneumatic bones** and include the skull, humerus, clavicle, keel, pelvic girdle, and lumbar and sacral vertebrae. A broken pneumatic bone can cause a bird to have difficulty breathing.



Chicken Respiratory System

A yellow sticky note is pinned to a corkboard with a single red pushpin. The words "Thank you" are written on the note in a red, cursive-style font.

Thank you