10. POULTRY ANATOMY AND PHYSIOLOGY

Can you recall ?

Functions of Skeletal system, Digestive system, Respiratory system, Reproductive system and Endocrine system.

10.1 SKELETAL SYSTEM

The skeletal system of fowl consists of axial and appendicular skeleton

10.1.1 Axial Skeleton

It consist of skull, vertebral column, ribs and sternum

1. **Skull :** Skull is small and conical. The anterior extremity is elongated and ends into a pointed beak. The posterior extremity articulates with atlas.

Do you know ?

- **Teeth and paranasal sinuses are absent in fowl/poultry**
- **Orbital fossa is very large**
- **Upper jaw is movable**

2. **Vertebral Column :** The vertebral column of fowl consists of - a) Cervical vertebrae, b) Thoracic vertebrae , c) Lumbar and sacral vertebrae and d) Coccygeal vertebrae.

Remember...

The vertebral formula for the fowl is C14 T7 L+ S14 Cy6.

a. **Cervical vertebrae :** They are 14 in number. ***Atlas*** is the first cervical vertebra which is thin and ring like. ***Axis***, second vertebra, is short.

b. **Thoracic vertebrae :** They are seven in number. The first and sixth vertebrae are free where as second to fifth are fused with first lumbr vertebra.

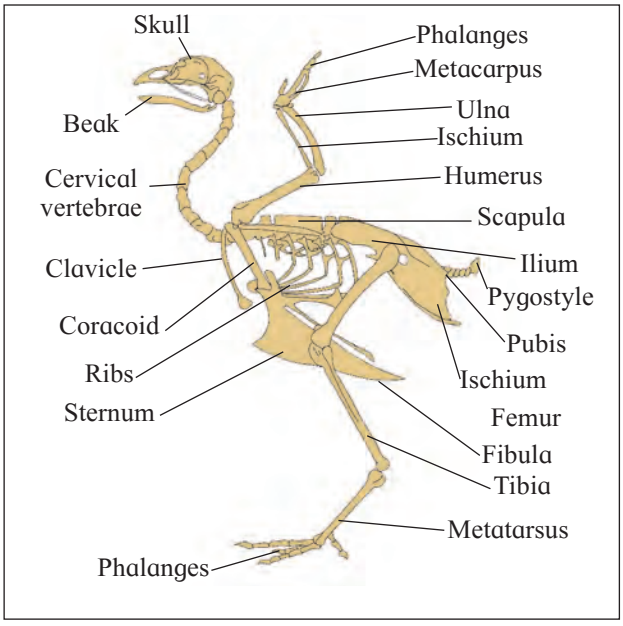


Fig. 10.1 Skeletal system of fowl

c. **Lumbar and Sacral vertebrae :** They are 14 in number. They fuse to form lumbo-sacral mass.

d. **Coccygeal Vertebrae :** They are six in number. The first coccygeal vertebra is fused with lumbo sacral mass. The last two or more vertebrae unite to form a three sided pyramid like structure called as ***' Pygostyle'.***

Can you tell ?

1. **Why birds can fly?**
2. **Why the body temperature in birds is more than other animals species?**

3. **Ribs :** There are seven pairs of ribs. They form lateral wall of thoracic cavity. They articulate above to the thoracic vertebrae and below to the sternum.

4. **Sternum :**It is also called as ***'breast bone'***. It is quadrilateral curved plate of bone. It forms the floor of thoracic cavity and part of the abdominal cavity.

10.1.2 Appendicular Skeleton

Appendicular skeleton of fowl consists of bones of pectoral and pelvic limbs.

1. **Bones of Pectoral Limb**

   a. **Pectoral girdle :** It comprises Clavicle , Coracoid and Scapula. ***Clavicle*** is slightly bent, thin rod of bone. ***Coracoid*** is long, three sided, rod shaped bone. ***Scapula*** is thin elongated bone.

   b. **Humerus:** The bone articulates with the scapula and the coracoids proximally and with the radius and the ulna distally.

   c. **Radius and Ulna :** The radius is placed external to the ulna. Radius and ulna are separated by a wide inter osseous space. These bones articulate with the humerus proximally and with carpus distally.

   d. **Carpals :** There are two bones, namely radial carpal and ulnar carpal in the proximal row. The distal row bones are fused with the metacarpal bones.

   e. **Metacarpals :** There are three metacarpal bones. The first metacarpal is a small projection while the second and third are fused at both extremities.

   f. **Digits :** There are three digits in fowl. The first and second digits have two phalanges while the third digit has one.

2. **Bones of Pelvic Limb**

   a. **Pelvic girdle :** It comprises of ilium, ischium and pubis or ***'lay bone'.*** The ***ilium*** is the largest pelvic bone and is fused with sacrum. The ***ischium*** is smaller than ilium. The ***pubis*** is thin bone and has a tendency to straighten out when a bird is in production. The ***acetabulum*** is large, deep and perforated.

   b. **Femur :**This long bone articulates with pelvic girdle proximally and with tibia- fibula distally.

   c. **Patella :** It is thin triangular bone.

Do you know ?

Tibia is the largest bone of the limb.

   d. **Tibia :** The proximal end is attached to fibula. The distal end is fused with proximal row of the tarsus.

   e. **Fibula :** It is thin, rod shaped bone. The proximal end has a massive head for articulation with femur. The distal end is pointed and extends up to lower third of the tarsus.

   f. **Tarsals:** They are not found separately in the adult birds. The tarsal bones of the proximal row are fused with the tibia to form ***tibio-tarsus.*** The tarsal bones of distal row are fused with metatarsal bone to form ***'tarso-metatarsus'.***

   g. **Metatarsal :** It is a single large bone in adult fowl. The proximal end is irregular and fused with tarsus. The distal end articulates with second, third and fourth digits .

   h. **Digits :** There are four digits (toes) in fowl. The first and second digits have three phalanges. The third has four phalanges and the fourth has five phalanges.

10.2 DIGESTIVE SYSTEM

The digestive system of fowl consists of mouth, oesophagus, stomach, small intestine, large intestine, cloaca and associated glands viz. liver and pancreas.

10.2.1 Alimentary Canal

1 **Mouth :** It is triangular in shape closed by upper and lower jaw forming the beak. The shape of tongue is like the barbed head of an arrow. Mouth is directly continuous with the pharynx. The main functions of mouth are prehension and deglutition.

Do you know ?

Mouth in birds is characterised by absence of cheeks, lips and teeth.

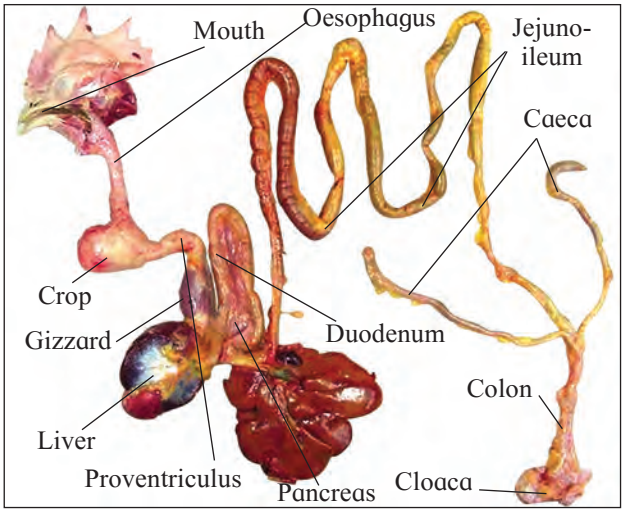


Fig. 10.2 Digestive system of fowl

2 **Oesophagus :** It is thin walled elastic tube. It begins at pharynx and terminates at proventriculus. It is a passage for food.

3 **Crop:** It is an enlargement of the oesophagus. It is simple, oval, musculo-membranous pouch.It stores food material. It also secretes mucus which lubricates and softens food material. It sends food to the proventriculus.

4 **Stomach :** It consists of two parts viz. proventriculus and gizzard.

a. **Proventriculus :** It is also called as ***glandular stomach.*** It is located 2-3 inch beyond the crop .It is an oval thick walled tube.It passes food from the crop to gizzard. It secretes gastric juice and some acids. It helps in further softening of the food material.

Remember...

- **Very little digestion take place in poultry through bacterial action**
- **They can digest small amount of fibre than any other class of farm livestock.**

b. **Gizzard :** It is also called as ***muscular stomach.*** It is located just behind the proventrilculus. It is larger than proventriculus. It is reddish green in colour. It is composed of two thick, powerful muscles. Its main function is crushing or grinding of ingested food. It acts as a filter for food material.

Do you know ?

Gizzard is the largest single organ of the body.

5 **Small Intestine :** It extends from the gizzard to the caeca and about 2½ ft long in mature bird. It consists of three parts namely duodenum, jejunum and ileum. The duodenum begins from gizzard and forms a loop. The bile and pancreatic ducts open near each other at the termination of duodenum. The jejuno-ileum is arranged in the form of coils. Gastric digestion together with some pancreatic digestion takes place in duodenum. It secretes intestinal juice which helps in digestion

of food material. It acts as an organ for absorption of the digested food material.

6 **Large Intestine :** It extends from ileo-caecal junction to cloaca and consists of two caeca and a colon. ***Caeca*** are two blind sacs about 5 - 7 inch in length and are present at the junction of small and large intestine.They help in digestion of fibre. They act as temporary storage organs for faecal material. The absorption of some digested food material may take place in caeca. ***Colon*** is a small straight tube which lies between the caeca and the cloaca. It helps in absorption of water.

7 **Cloaca :** It is a tubular common cavity for digestive, urinary and genital tracts. The ***vent*** is an external opening of cloaca. The faecal material and urine are mixed and excreted through vent.

10.2.2 Associated Glands

Do you know ?

In birds faeces and urine are voided through one opening.

1 **Pancreas :** It lies between the folds of the duodenum. It is a thin, narrow and lobulated gland. It is pale yellow or reddish in colour. Two ***pancreatic ducts*** carry pancreatic juice from pancreas to duodenum.It secretes ***pancreatic juice*** which contains digestive enzymes viz. trypsin, amylopsin and steapsin.

2 **Liver :** It lies on the floor of the abdominal cavity. It is dark red in colour. It consists of two lobes i.e right and left. A sac is situated on visceral surface of the right lobe of liver called as ***'gall bladder'*** which stores bile. There are two ***bile ducts*** which carry ***bile*** from liver to the duodenum. It secretes the bile which helps in digestion of fats. It helps in protein, carbohydrate and fat metabolism.

3. **Salivary Gland :** It secretes saliva in very small amount which helps in lubrication of food .

Remember...

Do you know, liver is the largest gland in the body.

10.3 RESPIRATORY SYSTEM

The respiratory system of fowl consist of nasal cavities, larynx, trachea, syrinx (Voice box), bronchi, lungs and air sacs.

1. Nasal cavity is narrow and comprises of three compartments viz. vestibule, respiratory and olfactory. Nostrils are slit like openings in the upper beak.
2. Larynx consists of four cartilages- a cricoids, a precricoid and two arytenoids.
3. Trachea is formed by about 115 complete cartilagenous rings
4. The syrinx is a sound producing vocal organ of birds. It is dilated cartilaginous compartment located at the point of bifurcation of trachea into two primary bronchi.
5. The bronchi end at the entrance of the air sacs.
6. Lungs are flat and rectangular in shape.
7. Birds have 8 air sacs viz. cervical (1), clavicular (1), anterior thoracic (2), posterior thoracic (2) and abdominal (2).

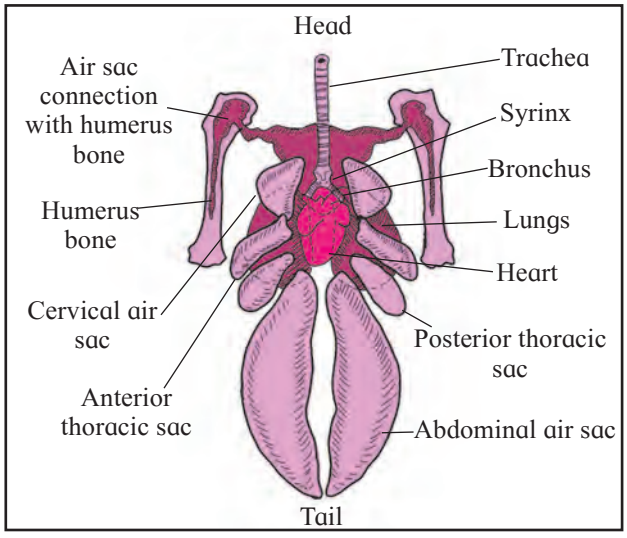


Fig. 10.3 Respiratory system of fowl

8. Birds ventilates their lungs by means of air sacs. These sacs do not play a direct role in gas exchange, but store air and act like bellows, allowing the lungs to maintain a fixed volume with fresh air constantly flowing through them. Air moves in and out of the lungs and the air sacs freely, but the lungs are responsible for most of the respiration. They also function as a cooling mechanism by exhaling water in the form of water vapor.

Do you know ?

The main differentiating features of respiratory system between poultry and mammals –

- **Syrinx is a sound producing vocal organ in fowl.**
- **Lungs of chicken are supplemented by air sacs.**
- **Avian lungs do not have alveoli.**

10.4 REPRODUCTIVE SYSTEM

10.4.1 Male Reproductive System

The male reproductive system of fowl consists of testes, vas deferens and papillae.

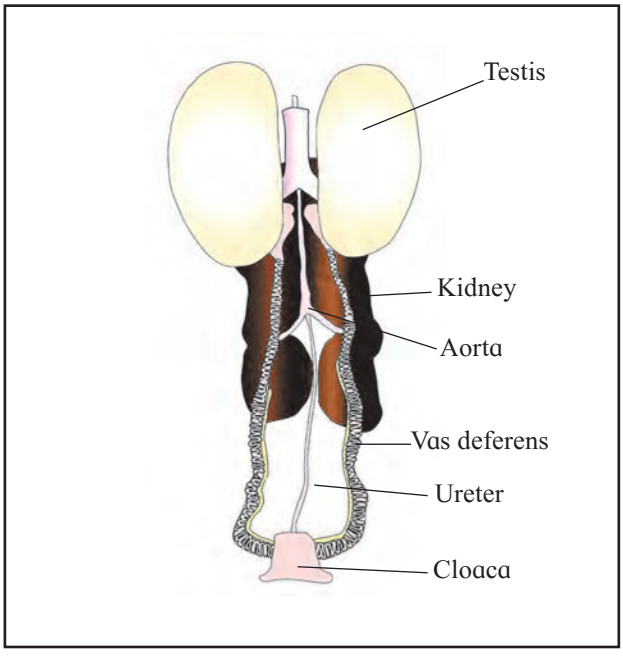


Fig. 10.4 Male reproductive system of fowl

1. Testes

1. They are two in number and situated in sublumbar region.
2. They are bean shaped or oval in shape and pale yellow in colour.
3. The left testis is usually larger than right.
4. They consist of large number of slender convoluted tubes known as seminiferous tubule.
5. They produce sperms, seminal fluid and male sex hormone i.e. ***testosterone.***

2. Vas deferens

1. These are two tortuous tubes which extend from testes to the cloaca.
2. They are narrow at their origin but becomes gradually wider towards the cloaca.
3. They carry sperms and seminal fluid from testis to the cloaca.

Do you know ?

The male reproductive system of fowl differs from that of mammals on following aspects-

1. **Testes are intra-abdominal and sperms are produced at body temperature .**
2. **Sperms remain alive for several days in female genital tract.**
3. **Epididymis is very short.**
4. **The accessory glands like seminal vesicles, prostate and Cowper's glands are absent.**

3. Papillae

1. They are located on the median ventral portion of the cloaca.
2. They are rudimentary copulatory organs of the male.

3. They introduce sperms into the oviduct during coitus.

10.4.2 Female Reproductive System

The reproductive system of the female consist of ovary, oviduct, uterus and vagina

1. Ovary

1. There are two ovaries in early life, but only left ovary is functional in adult.
2. The left ovary is situated in the upper part of the abdominal cavity opposite to the last two ribs.
3. The functional ovary appears as a cluster of ***ova or yolks.***
4. The ovum or yolk is enclosed in a thin membrance called as ***vitelline membrane.*** The yolk is pale straw or yellow or orange coloured. The yolk and vitelline membrane is enclosed by ***follicle,*** which helds the ovary by ***follicle stalk.***
5. The functions of ovary are formation of ova and secretion of female sex hormones viz. oestrogen and progesterone.

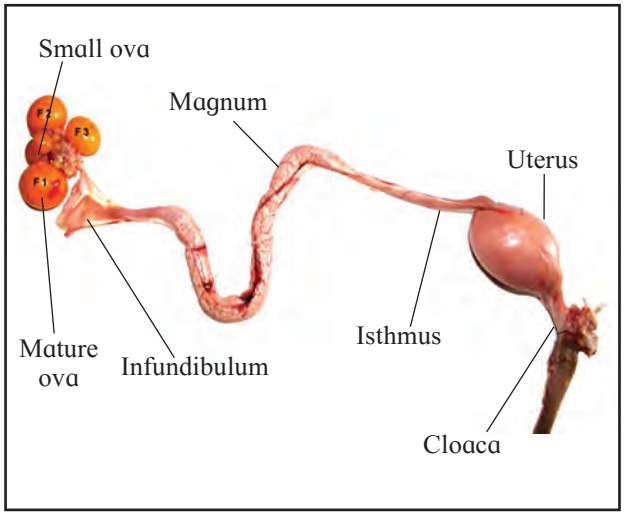


Fig. 10.5 Female reproductive system of fowl

2. Oviduct

1. There are two oviducts during early life, but only left oviduct is developed in adult.
2. It is a long coiled tube which occupies much of the left side of the abdominal cavity.
3. It is divided into five parts viz. infundibulum, magnum, isthmus, uterus and vagina
4. **Infundibulum :** It is located just below and behind the ovary. It is funnel shaped, delicate, membranous structure. Its anterior end is expanded and presents opening. It measures about 9 cm in laying bird. It receives ova or yolk from the ovary.

Remember...
Infundibulum is the site of fertilization.

5. **Magnum :** It is the second portion of oviduct. It forms more than half of the total length (33 cm)of oviduct. It secretes thick albumin or egg white .
6. **Isthmus :** It is third part of the oviduct. It is narrow and some what constricted portion. It is about 10 cm in length. It secretes the shell membranes.
7. **Uterus :** It is also known as *shell gland.* It is thick walled, pouch like structure and is placed next to the isthmus. It is 10 - 12 cm in length. It secretes thin egg white, the shell and the shell pigment.
8. **Vagina :** It is short, narrow terminal portion of oviduct which opens into cloaca. It holds the egg until it is laid.

Do you know ?

The female reproductive system of fowl differs from that of mammals on following aspects -

1. **Only left ovary and left oviduct are functional in adult fowl.**
2. **Egg or ovum is an article of food.**
3. **Egg is large and enclosed with food supply for nourishment of embryo.**

10.4.3 Formation of egg :

Can you think ?

1. **Egg is a vegetarian food.**
2. **Testis are inside the body of birds**

1. When ovary becomes functional, few ova increases in size due to deposition of yolk.
2. The ovum with yolk is enclosed in a ***vitelline membrane***.
3. The yolk and vitelline membrane are enclosed into the highly vascular connective tissue called ***follicle***.
4. The ovum with yolk when grows in size gets suspended in its follicle and held to the ovary by a ***stalk***.
5. The ovum grows rapidly with the formation of concentric layers of light and dark yolk.
6. At maturity, ovum released from follicle (ovulation) is engulfed by the **infundibulum**. If hen is mated with cock then fertilization takes place in infundibulum. The fertilized or unfertilized ova remains for about 18 minutes in infundibulum.
7. Then it moves to magnum where goblet cells secretes ***egg albumen***. The ovum remains in magnum for about 3 hours.
8. The peristaltic movement of the magnum propels ovum to isthmus where inner and outer ***shell membranes*** are formed and also shape of egg is determined. Egg remains in isthmus for about 1 hour 14 minutes.
9. The egg then reaches uterus where watery fluid secreted by the tubular glands of uterus forms inner as well as outer layers of ***thin white***. The uterine secretion also contains material (mainly calcium carbonate) for ***egg shell*** formation. The shell pigments are also formed in uterus during last 5 hours before laying. The egg remains in uterus for about 21 hours.
10. The contractions of uterus propels the fully developed egg to cloaca through vagina during the act of laying.

10.4.4 Structure of egg

1. The egg consists of shell, shell membrane, albumen and yolk.
2. The shell is the hard outermost covering composed of calcium carbonate mainly and is 8 to 11% of total egg.
3. Next to the shell are the outer and inner shell membranes.

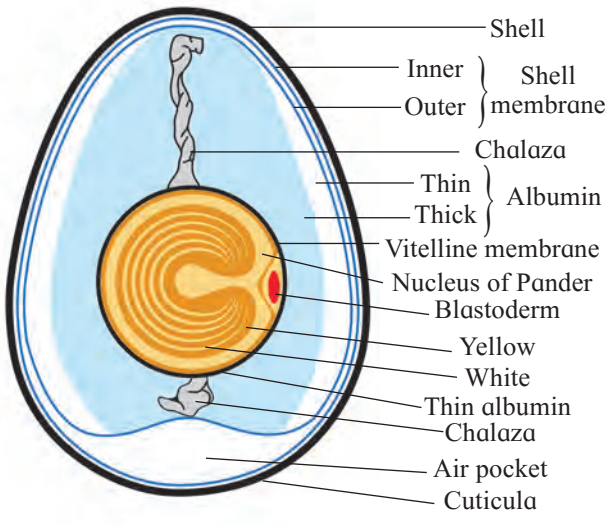


Fig. 10.6 Vertical section of fresh egg

4. The albumen or the egg white is made up of outer thin white (24%) and innermost thick white (34%) .

5. Inner thick white is also known as chalaziferous layer.

6. Albumen accounts for 58-61% of the total egg.

7. The egg yolk is arranged in concentric layers, is almost spherical and is enclosed in thin vitelline membrane. The germinal disc is very clear in a fertile egg. Yolk is 27-32 percent of the total egg.

10.5 ENDOCRINE SYSTEM

Endocrine glands of fowl includes pituitary, thyroid, parathyroid, ovary, adrenal and pancreas.

Table 10.1 Endocrine glands, hormones and their functions

Sr. No.	Endocrine gland	Hormone	Tissues influenced	Functions/Physiological actions
1	Anterior pituitary	Follicle stimulating hormone (FSH)	Ovary	1. Stimulates the growth and maturity of Graffian follicle in female 2. Maturity of sperm in male
		Luteinizing hormone (LH)	Ovary	Releases ovum by rupture of Graffian follicle (Ovulation)
2	Thyroid gland	Thyroxine	All tissues	Affects feather growth and colour
3	Parathyroid	Parathormone	Bone, kidney and intestine	Increases calcium and phosphorous metabolism.
4	Ovary	Estrogens	Oviduct	1. Growth and development of oviduct 2. Secondary sex characteristics 3. Eggs production
5	Adrenal	Adrenaline	Liver, bone, kidney	Helps in carbohydrate, fat and mineral metabolism, breakdown of protein and important in the birds reaction to stress.
6	Pancreas	Insulin	Liver, muscle and adipose tissue	1. Controls blood sugar level. 2. Helps in fat and protein metabolism

EXERCISES

Q.1 Fill in the blanks

1. The main function of gizzard is .....
2. ..... is a common cavity for digestive, urinary and genital tracts.
3. ..... portion of oviduct secretes thick egg white.
4. ..... hormones releases ovum by rupture of graffian follicle.
5. ..... bone of fowl consists of ileum, ischium and pubis

Q.2 Match the pair.

Group A		Group B	
1.	Pancreas	a)	Gastric Juice
2.	Salivary gland	b)	Saliva
3.	Liver	c)	Trypsin
4.	Proventriculus	d)	Grinding of food
5.	Gizzard	e)	Bile

Q.3 Identify the odd one out

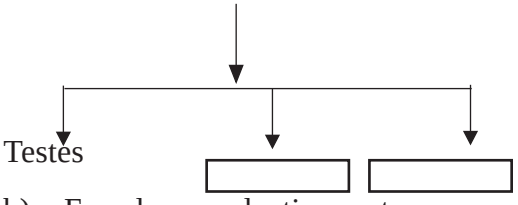
1. Infundibulum, Magnum, Isthmus, Ureter, Vagina
2. Tarsals, Pectoral Girdle, Humerus, Radius and Ulna, Metacarpals
3. Pelvic Girdle, Femur, Patella, Tibia and Fibula, Carpals
4. Larynx, Trachea, Liver, Syrinx, Lungs
5. Estrogens, Saliva, Adrenaline, Insulin, Thyroxine

Q.4 State True or False.

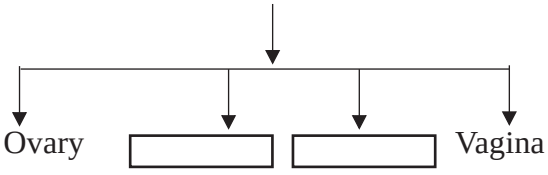
1. Gizzard is the largest single organ of the body.
2. Larynx is a sound producing vocal organ in fowl.
3. Liver is the largest gland in the body.
4. Proventriculus is called as muscular stomach.
5. Lungs of chicken are not supplemented by air sacs.

Q. 5 Answer the following questions in brief.

1. Differentiate between male reproductive system of birds and mammals.
2. a. Male reproductive system



b) Female reproductive system



3. Write note on gizzard.
4. Write short note on structure of egg.

Q.6. Answer the following questions.

1. Draw neat diagram of male reproductive system of fowl.
2. Describe in brief anatomy of pectoral girdle of fowl.
3. Write functions of small intestine in fowl.
4. Enlist organs of respiratory system. Write differentiating features of respiratory system between poultry and mammals.

5. Write in tabular form, hormones secreted by Anterior pituitary, Thyroid gland with tissue influenced and major functions/physiological actions.

6. Draw neat diagram of vertical section of egg.

Q.7 Answer the following questions in detail

1. Describe in detail digestive system of fowl with neat diagram.

2. Explain in detail female reproductive system of fowl with well labeled diagram.