AVES - FEATHERED BIPEDS

- Birds arose in the Jurassic period
- Ancestors of Birds are Therapod dinosaurs, such as bipedal *Igaunodon* and *Camptosaurus.*
- They share many characters with reptiles.
- Consequently the two classes are put together in **Sauropsida**, a division of vertebrates.
- T.H. Huxley aptly called birds "**glorified reptiles**".
- Birds became modernised in the Cretaceous period involving both physiological and morphological changes.
- J.Z. Young described birds as **'Masters of air'**.
- Birds exhibit less diversity due to their adaptation for aerial mode of life.
- Present day living birds number 8590 species.
- Aves are advanced over reptiles in having insulated body, homeothermy, high metabolic rate, and complete separation of venous and arterial blood.
- Flight adaptations of birds are high metabolic rate and high body temperature
- Success of birds and mammals is **Endothermy**
- They inhabit both terrestrial and aquatic environments.

GENERAL CHARACTERS:

- Birds are **endothermic** or **warm blooded** animals.
- Body is streamlined and compactly arranged to suit their adaptation for flight. It is normally spindle shaped and light due to the presence of air sacs.
- Fore limbs are modified as wings. Hind limbs are large and bear the weight of the whole animal. They are variously helpful for capture of food, swimming, perching etc.
- Body is covered by feathers. They form a part of the exoskeleton. The feathers are of 4 types.
- The feathers are arranged in regular tracts called **pterylae**. Featherless tracts are called **apteria**.
- The arrangement of feathers is called **pterylation**.

a) Contour feathers: They form the general covering of the body.

- Each contour feather has a central axis and a vane.
- The barbs are free and there is no inter locking mechanism.

b) Filoplumes: These are small delicate feathers with short calamus and weak barbs.

- They are sparsely distributed, covering the interspaces.

c) Quill feathers: The axis of the quill feathers is divided into a proximal hollow quill or calamus and an expanded portion, the vane or vexillum.

- The vane has a central axis or rachis.
- Expanded part of the feather is composed of barbs, barbules and barbicels with an interlocking arrangement.
- The lower end of the quill has a small opening, the **inferior umbilicus** through which nutrients are supplied.
- A second opening, the **superior umbilicus** occurs at the junction of the Quill and rachis.
- A small tuft of soft feathers called the **after shaft** arises near the superior umbilicus.
- The quill feathers on the wing are called **remiges** and on the tail **rectrices**.

d) Down Feathers: These are small, soft and wooly feathers which differ from contour feathers in the absence of rachis.

- The barbs are long and flexible with sharp barbules.
- They form the natal covering of the newly hatched birds and provide excellent insulation.
- Feathers apart from helping in heat retention provide protection. They are helpful in flight, sex determination and formation of nest.
- Other exoskeletal structures are scales on the legs, claws on the toes and rhamphotheca on the beaks.
- There is a single oil gland or preen gland on the tail. It provides a waxy coating on the quill feather.
- Endoskeleton of the birds exhibits many peculiarities.

a) Bones of birds are **pneumatic** without bone marrow.
b) Skull is **monocondylic.**
c) Vertebrae are **heterocoelous;** vertebral ribs are **double headed.**
d) **Last thoracic, lumbar, sacral and a few caudal vertebrae** fuse to form a **synsacrum.**
e) Synsacrum fuses with pelvic girdle and supports **Hind limbs**
f) Last caudal vertebrae fuse to form **Plowshare** or **pygostyle. It supports tail feathers**
g) Sternum is with a mid ventral **keel** or **carina** for accommodation of large flight muscles.
h) The scapula is sabre shaped. Clavicles on either side join to form **'furcula'**. Furcula is called **'wish bone'**.

- The muscular system is modified to meet the aerial mode of life. The muscles concerned with the activity of the wings are called flight muscles.

- Foramen triosseum is seen in junction of the Clavicle, scapula and coracoids.
- **Tendon of Pectoralis minor passes through Foramen triosseum and acts as a pulley**
- **Pectoralis major:** These constitute about 1/5 of the total weight of the body.
- They are the main muscles and cause powerful **down stroke.**
- **Pectoralis minor:** Situated on the dorsal side of the Pectoralis major.
- They help in **elevating** the wings.
- **Coracobrachialis longus** and **Coracobrachialis brevis.** They **rotate the wing** in the glenoid cavity.
- **Oesophagus** is frequently dilated into a crop for storage.
- Stomach is divided into a glandular **Proventriculus** and muscular **gizzard.**
- At the junction of small intestine and rectum, there is a pair of rectal caeca.
- Heart is 4 chambered.
- Sinus venosus and truncus arteriosus are absent.
- Only right aortic arch present.
- The wall of the right auricle contains SA node, interauricular septum contains AV node.
- Renal portal system is reduced.
- Lungs are spongy.
- A total of nine air sacs are present. They are four pairs: 1. abdominal, 2. posterior thoracic, 3. anterior thoracic, 4. cervical, and one unpaired interclavicular.
- In birds larynx does not function as voice box. The swollen part of trachea near its junction with bronchi acts as the voice box. It is called **syrynx.**
- Brain is large and smooth.
- Cranial nerves are 12 pairs.
- Cerebrum, cerebellum and optic lobes are greatly developed.
- Olfactory sense is poorly developed in birds - exception is Kiwi.
- Eyes are large and possess a well developed nictitating membrane.
- **Sclerotic plates** are found in the sclerotic layer and help maintain the shape of the eye.
- A vascular pleated projection into the cavity of the eye called **pecten**
- It nourishes the retina and removes nitrogenous waste from eyes.
- Kidneys are metanephric and 3 lobed.
- Urinary bladder is absent. It is an adaptation for flight as it disturbs the balance of the animal.
- Excretory substance is uric acid and eliminated along with faeces.
- Sexes are separate.
- A copulatory organ is absent in male except in ducks, geese and flightless birds.
- Female has a single functional left ovary and oviduct.
- Right ovary and oviduct are rudimentary.
- Fertilisation is internal.
- All birds are oviparous. Eggs are megalecithal with large amounts of yolk protected by calcareous shell.
- Eggs developed by external incubation.
- Cleavage is meroblastic. Extra embryonic membranes are present.

CLASSIFICATION:

- About 8590 living species are known at present.
- Class Aves is divided into two subclasses :

Subclass 1: Archaeornithes (Gr: archios - ancient, ornithes - bird)

- **Extinct Jurassic birds of Mesozoic age.**
- Wings primitive with little power of Flight.
- Tail long, lizard like with rectrices arranged on either side.
- Wing bears three clawed fingers.
- **Teeth are present in both the jaws.**
- Bones are not pneumatic.
- **Vertebrae are amphicoelous and sternum has no keel.**
- Cranial cavity is more like that of birds.
  e.g.: ***Archaeopteryx lithographica****.*
- The fossil of Archaeopteryx was discovered in **slate quarry, Bavaria** (Germany), in 1861 by ***Andreas Wagner****.*
- *Archaeopteryx* exhibits reptilian and avian characters and hence considered as a transitional stage between reptiles and birds and forms a **'connecting link'.**

Subclass: II: Neornithes
***(Gr.Neo-Modern, Ornithes* - Birds)**

- Post-Jurassic, modern birds.
- Fingers of the wings are without claws.
- Vertebrae are heterocoelous.
- Thoracic ribs with uncinate process.

The sub class is divided into 4 super orders.

Superorder 1: Odontognathae

- Extinct upper cretaceous marine birds.
- Jaws bear teeth for catching fish.

E.g: ***Hesperornis, Ichthyornis*.**

Superorder: 2: Palaeognathae or Ratitae

- Modern, flightless, running birds without teeth.
- Wings vestigial or rudimentary, feathers without any interlocking mechanism.
- Irregular Pterylae.
- Oil gland is absent except in *Tinamus* and *Kiwi.*
- Sternal keel is vestigeal, flat or raft like,
- Pygostyle is absent or reduced.
- Syrynx is absent. Male has a penis.
- Young ones are precocious.
- Distribution restricted only to certain places. Thus they exhibit **discontinuous distribution.**
- e.g.: ***Struthio camelus:*** (African Ostrich) found in the arid regions of Africa and Arabia.
- This is the largest living bird.
- Strong and long legs make it a fastest running bird.
- The egg of ostrich is very large.
- Male exhibits Polygamy.
- ***Rhea americana:*** (American ostrich) inhabiting plains of S. America.
- They are smaller than the true Ostrich.
- Rudimentary wings are better developed than African Ostrich.
- Head and neck are feathered unlike the true ostrich. Male is polygamous. **Syrynx is present.**
- ***Dromaeus (Emu):*** The second largest living bird found in sandy plains or open forests of Australia.
- It is monogamous.
- After shaft is as long as main shaft.
- The bird's fat is used as a lubricant.
- ***Casuarius (Cassowary):*** Worlds 3rd largest bird found in Australia, New Guinea and other adjacent islands.
- They are shy nocturnal animals and rarely seen.
- It is distinguished from the Emu by a **Horny helmet** on the head.
- The after shaft of this bird is as along as the main shaft.
- These are quarrelsome and vicious birds.
- ***Apteryx (Kiwi):*** Found in New Zealand and commonly known as 'Kiwi' by the native 'Maori' tribe.
- This is the smallest living flightless bird.
- Wings are rudimentary and tail feathers lacking.
- They possess a keen sense of smell.
- They are nocturnal and burrowing animals.
- Pecten is absent.
- ***Tinamus (Tinamou):*** It is a small Mexican terrestrial bird, not flightless but essentially a great runner.
- Sternum is with a keel.
- The flightless birds are not represented in India.

Superorder 3: Impennae

- The superorder includes modern, aquatic flightless birds with paddle like wings or flippers.
- Feet are webbed.
- Commonly referred to as ***penguins.***
- They are mainly confined to the southern hemisphere.
- The skeleton is solid, air sacs are absent.
- The integument is a fatty insulating layer.

E.g. *Aptenodytes* (Emperor penguin)
Eudyptes (Rock hopper penguin)

Speniscus (Jackons Penguin)

Superorder 4: Neognathae or Carinatae

- Modern flying birds, with well developed wings and feathers with interlocking mechanism.
- Pterylae are regular.
- Sternum with well developed keel.
- Males have no copulatory organ.
- Young are altricious. (dependent on parents)

  E.g. *Passer domesticus* (House sparrow)
  Corvus splendens (Crow)
  Eudynomis (Koel)
  Psittacula (Parrot)
  Bubo (Owl)
  Pavo cristatus (Peacock) - National Bird of India.
  Coracious bengalensis - blue jay - State Bird
  Apus (Swift) - fastest flying bird
  Archilochus (Humming bird): smallest bird, the bird which can fly backwards and the bird that is useful in pollination.