

**PHYLUM: CHORDATA**

**CLASS: AVES**

**(BIRDS)**

# THE ORIGIN AND EVOLUTION OF AVES

**The ancestor of Aves shows very similarity features to the Pterosaurs (Flying Reptiles) ordo of Reptilia.**

- About 147 million years ago (Upper Jurassic period), a flying animal died and settled at the bottom of a shallow marine lagoon in Bavaria, Germany.
- Later the fossil of this flying animal named as *Archaeopteryx lithographica*.

## **Similarities with Birds**

- The fossil was about the same size as a crow
- The skull and jaw break like birds were resembled.

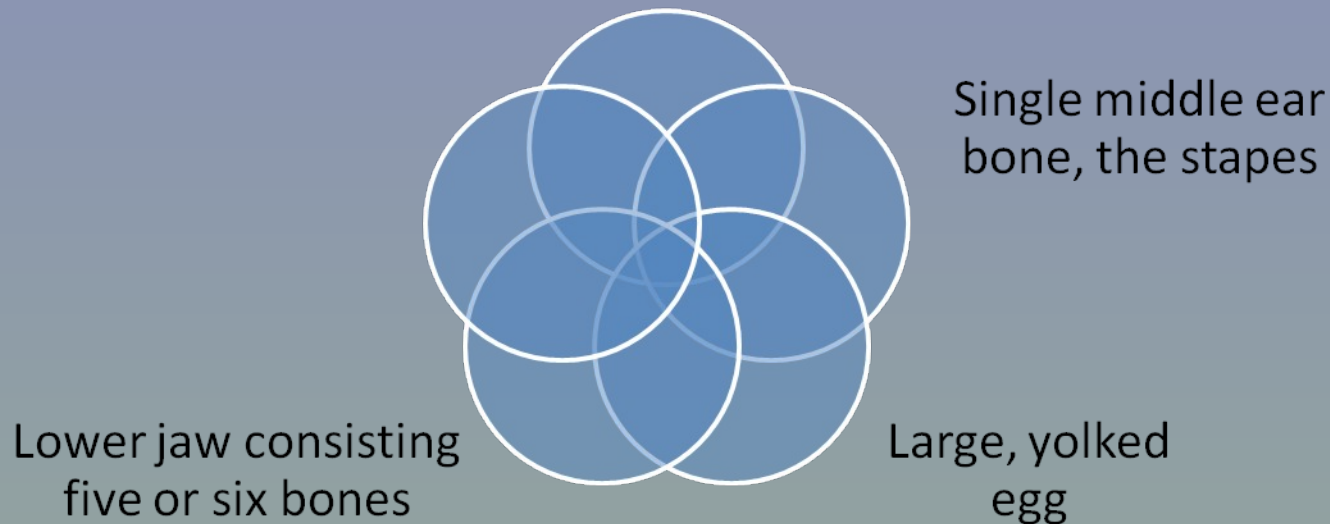
## **Similarities with Theropod Dinosaurs**

- Their jaws have got small bony teeth set in sockets like dinosaurs.
- The skeleton was decidedly reptilian with a long, bony tail, clawed fingers and abdominal ribs.

The finding was very important to put forward the phylogenetic relation of birds and extinct theropod dinosaurs

# SIMILARITIES BETWEEN THE BIRDS AND NON-AVIAN REPTILES

The first neck vertebrae by a  
**single occipital condyle**



According to the findings, theropod dinosaurs and birds share many derived characters especially elongate, mobile, S-shape neck.

## Birds Fossils

### *Hesperornis*

Birds with teeth; It was found among them the Cretaceous period in America. It shows characteristics of living in water and has no flying properties.

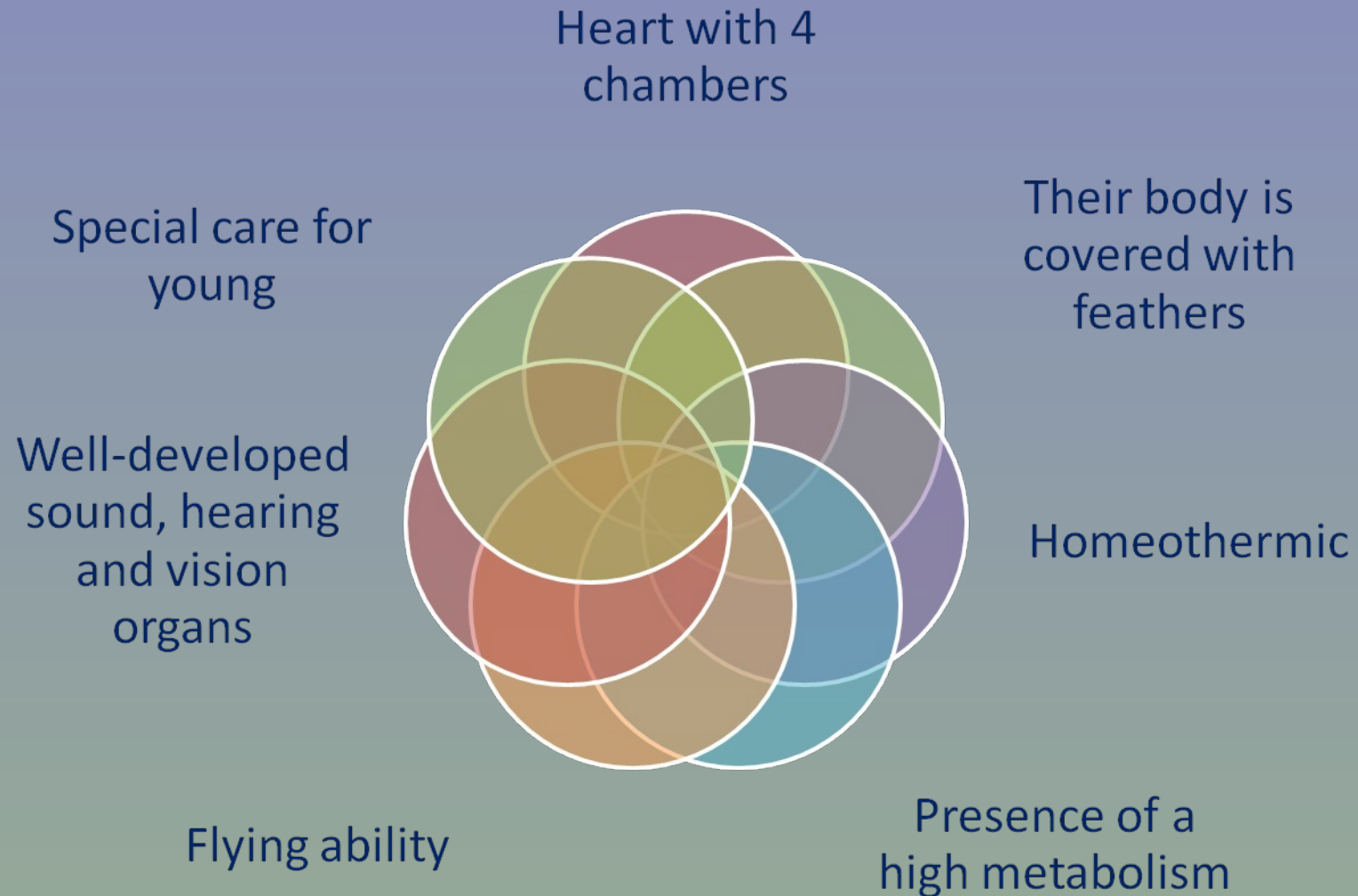
### *Ichthyornis* (Eosen)

Relatively small in size, can fly and shows great resemblance to the birds living today.

### *Diatryma* (Eosen)

More than 2m length; giant beak; blunt wings

# Characters Indicating that Birds are More Developed Animals than Reptiles



# MORPHOLOGY

EAR located in the back part of the eye between special feathers

Mobile eyelids

**NOSTRIL**  
Located on the upper beak

The mouth is located at the end of the beak covered with a keratin  
There are scales on the beak

Forelimbs modified as wings

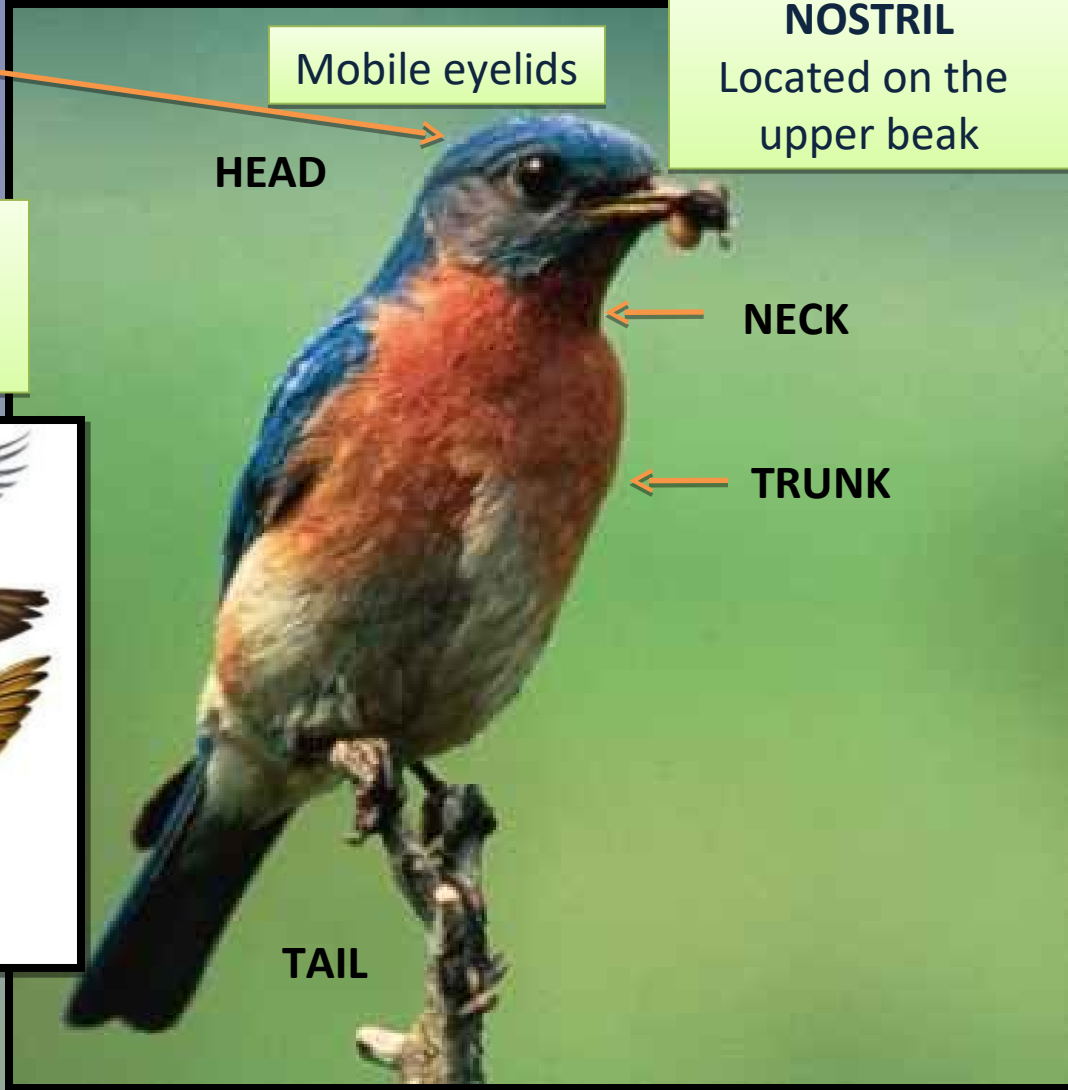
**HEAD**

**NECK**

Neck elongate and S-shaped

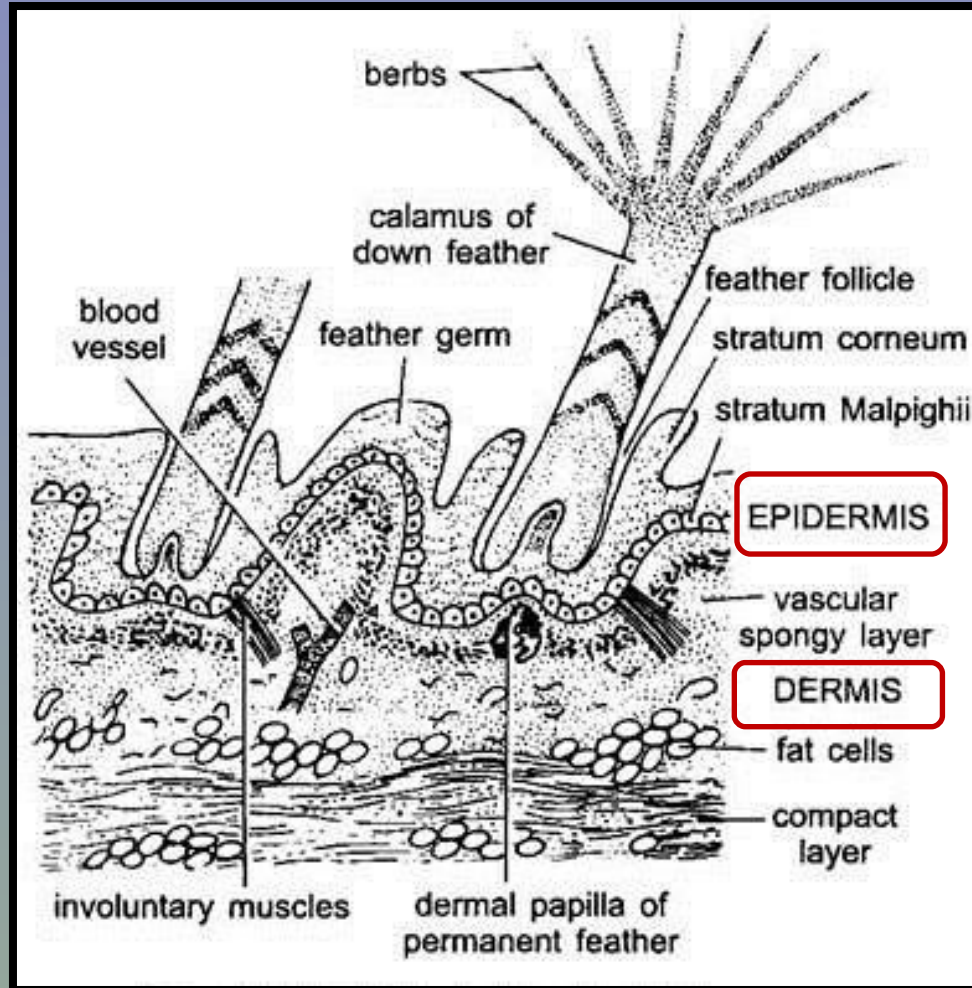
**TRUNK**

**TAIL**



# SKIN AND COLOR

Epidermal covering of feathers and leg scales



No secretory glands on the skin

Oil gland only found at the base of tail

Unlike other vertebrate animals  
**THE EPIDERMIS AND DERMIS ARE QUITE THIN AND LESS KERATINISED**



A large amount of fat is stored in the dermis

## Functions of Stored Fat

Protect the  
body from  
strike

Prevention of  
body  
temperature  
loss

Use as a  
reserve  
nutrient

More  
common in  
water birds  
because of  
easy to stay  
on water

**The smooth muscles in the dermis layer are attached to the feather follicle.**

**Function:** It is possible to increase the temperature loss by adhering the feather to the body in hot weather vice versa and to decrease the temperature loss by bristle up in cold weather.

Air bladder (air sac) under dermis

## **FUNCTIONS OF THE OIL GLAND AT THE BASE OF TAIL**

- Secretion is taken by beak and applied to the feather and nails for given waterproof features to these structure.
- Provide the birds appear bright and vivid color during the breeding season

# STRUCTURE DERIVED FROM INTEGUMENT

- Beak
- Nails
- Feather
- Scales on beak and hindleg

EPIDERMAL  
ORIGIN

**BEAK:** Many different beak shapes are seen depending on the variety of food.

## Functions

- Catching, transporting, chopping and eating food
- Fix feather
- Nesting
- Protection against enemies

**Nails;** special shaped scales for protecting the fingertips. In many nails, as the upper part grows faster, an inwardly curved structure arises.

**Functions:** Used for disinterment; tearing; fighting; cleaning feathers

## The most typical characteristic of birds is their feathers.

It is suggested that the feathers in birds are phylogenetically composed of epidermal structures that form the scales of reptiles. The evidence supporting this finding is that **the keratin flakes on the legs of birds and the scales of reptiles are of the same structure.**

Embryologically, the feathers appear first  
as small papilla  
**Formation of dermal papilla**

Then, the lower part of the feather buds  
covering the skin indent into the holes in  
the skin called **follicle.**  
**Formation of follicle**

Formation of epidermal ridges  
Ridges form into barbs and barbules

Open feather  
Corneal sheath degenerates

A feather is consist of a **Hollow Quill (Calamus) and Shaft (Rachis)**

**Barbs:** Spread diagonally outward from both sides of the central shaft to form a flat, expanse, webbed surface, the **vane**

**Barbule:** Numerous parallel filaments set in the ech side of the barb  
Barbs and barbule form to **Vane**

Different types of bird feathers serve different functions

**1. Pinna (Quill):** Feathers covering the outer part of the body, providing support and shaping.

**2. Plumae (Down Feather)**

- Located under Pinna (Quill)
- Usually white color

**Function:** To conserve heat

**3. Filoplumae:** Hairlike, degenerate feathers; each is a weak shaft with a tuft of a short barbs at the tip

**They have no known function**

## MOLTING OF FEATHER

- When a feather is fully grown, it is a dead structure
  - Molting of feathers is a highly orderly process
- 
- **Except in Penguins**, which molt at once, feathers are discarded gradually to avoid the appearance of bare spots.
  - Flight and tail feathers are lost in exact pairs, one from each side, **maintaining balance**.
  - Replacements emerge before the next pair is lost; **SO the most birds can continue to fly in molting period**.
  - Many water birds (ducks, geese, loons, etc.) lose all their primary feathers at once and grounded during molt.
  - **Nearly all birds molt at least once a year, usually in late summer after nesting season**

# Functions of Feathers

Keeping the  
body  
temperature  
constant

Protection of  
the body from  
external  
factors

Providing  
flight

Increasing the  
ability to stay  
on the water  
surface in  
aquatic birds

# COLOR OF BIRDS

The vivid color of feathers is of two kinds:

Pigmentary

Structural

Red, orange and yellow feathers are colored by **lipochromes pigments**

Black, brown, red-brown, gray colors are form a different pigment, melanin

**Blue color of feathers do not depend on pigment**

Scattering of shorter wavelengths of light by particles within the feathers.

**These are structural colors**

**Green colors** are almost a combination of yellow and blue feather structure.

**These are also structural colors**



Some of the bird species have got a different color in male and female (Sexual dimorphism)

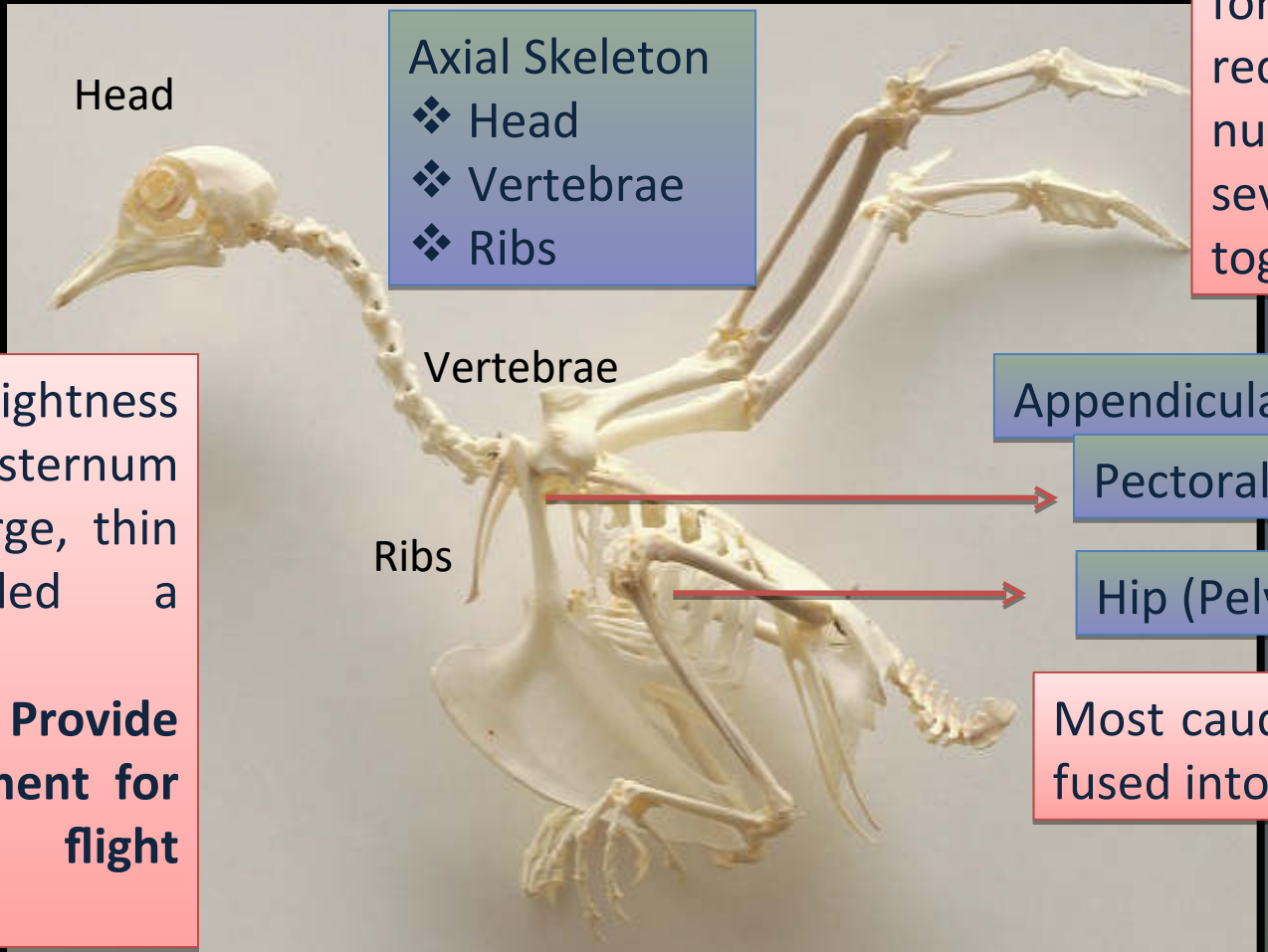
**The color is important for;**

- Adaptation to the environment,
- To know opposite sex each other,
- Courtship of male to the female in the breeding season

# SKELETON SYSTEM

## Pneumatic Bone

Bones of forelimbs are reduced in number and several are fused together for flight



Except in flightless birds, the sternum bears a large, thin keel called a **Carina**.  
**Function: Provide an attachment for powerful flight muscle**

Most caudal vertebrae are fused into a **pygostyle**

Many of the vertebrae in the trunk are fused as the **Synsacrum**

# MUSCULAR SYSTEM and LOCOMOTION

- Muscular system is adapted to fly
- Locomotor muscles of wings are relatively extensive to meet requirements of flight.
- **Supracoracoideus muscle** which is antagonist of pectoral muscle raises the wings.
- Wing movements during flight are provided with large **pectoral muscles** connected to the breastbone.
- Both pectoralis and supracoracoideus are attached to the base (keel) of the sternum
- The leg muscles mass in the thigh, thin but strong tendons extend downward to the toes.
- The **femoral muscles** in the legs are used for walking and straching.
- Movement of the **fingers** is possible due to the tendons attached to the muscles in the upper part of the leg
- The main muscles are located in the ventral side to maintain aerodynamic stability

## The size and shape of the bird's wings vary depending on the habitat's characteristics and life style.

- The birds that live in forests and shrubs such as woodpecker (Picidae family) and have to make short turns are in **elliptical form**.
- The wings are sharp in migratory birds that have to fly at long distances. **The length-width ratio of this type of wings is high** (Falconidae-*Falco*; Hirundinidae-*Hirundo*)
- The wings are slender shape in sea birds that can stay in air for a long time (Diomedidae-*Albatros*). **Quite long and narrow wings and the length-width ratio is high.**
- Birds that are predatory and can stay in the air for a long time have broad wings (Accipitridae-Vulture; Hawk). The feathers (wing slots) at the tip of the wings are elongated as finger shape.

- The movement of birds on the ground is **bipedal (using only two legs for walking)** type.
- **Fifth fingers are lost.**

**Ostrich has got two fingers in hind legs.**



The hind legs (feet) that provide the movement of the birds on the ground are divided into various groups depending on the living habitat (water, land; swamp) and feeding behaviour (predator) Walking, climbing, swimming, scratching, grasping, etc.

# Birds have to reduce their weight and increase their energy (metabolism) to fly

## Properties For Reducing Weight

1. Hollow bones
2. Quite light feathers
3. Lack of many skin glands
4. Lack of teeth and heavy jaws
5. The disappearance of the tail vertebrae and some diarthroses
6. Vertebrae, pelvic girdle and pectoral girdle are fused together to form larger bones
7. Bones with air cavities
8. Oviparous reproduction (Internal fertilization; external development)
9. Gonads active during only part of year. The right ovary is blunted.
10. Feeding with the high nutritional value of food.
11. Fast digestion
12. Uric acid is the main nitrogenous waste

## Properties For Increase Their Energy (Metabolism)

1. Homeothermic animals
2. Presence of feathers that prevent heat loss
3. Feeding with the high nutritional value of food.
4. Fast and effective digestive system
5. Glucose levels in their blood is high.
6. Heart with 4 chambers; pulmonary and systemic circulation are separated.
7. High forced circulation system
8. Highly effective respiratory system
9. Performing breathing movements in accordance with flapping.
10. High metabolism; high metabolic production