

# **Skeletal System**

## **Lec 3**

### **Comparative Anatomy**

#### **Skeletal system (Part 1)**

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# Objectives

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- ▶ Students should learn the following;
- ▶ Skeletal System functions
- ▶ Skeletal system Components
- ▶ Types of bones
- ▶ Divisions of skeletal system
- ▶ The axis system function and parts
- ▶ The appendicular system functions and parts
- ▶ The skeleton of different vertebrate classes



# Skeletal System functions

- ▶ **Support and assisting in Movement;** support the softer tissues and provides points of attachment for most skeletal muscles.
- ▶ Protect the body's internal organs, ex; skull protect the brain, vertebrae protect spinal cord, the ribcage protect heart and lungs.
- ▶ Store several minerals, ex; calcium (Ca) and phosphorus (P). When required, bone releases minerals into the blood to **balance** the minerals concentration.
- ▶ **Production of Blood Cells**
- ▶ **Storage of Chemical Energy;** some bone marrow changes from 'red bone marrow' to 'yellow bone marrow' with age. Yellow bone marrow consists of adipose cells, and a few blood cells. It is provide chemical energy backup

# Skeletal System

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- ▶ The skeleton is the basic framework of the body
- ▶ Composed of bone and cartilage.
- ▶ There are four types of bone based on shape; long bones, short bones, flat bones, and irregular bones



# Skeleton System

**Axial  
skeleton**

**Skull**

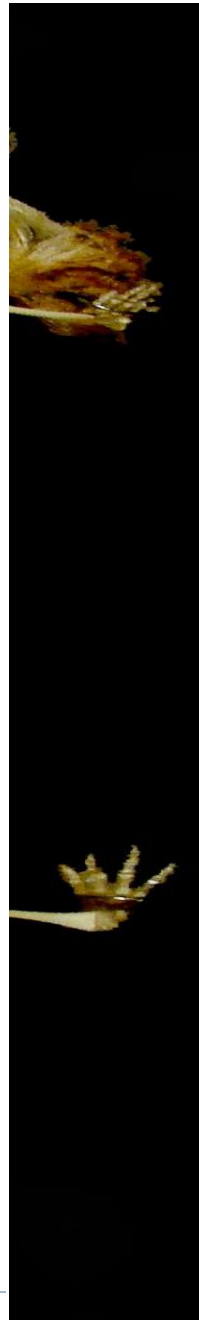
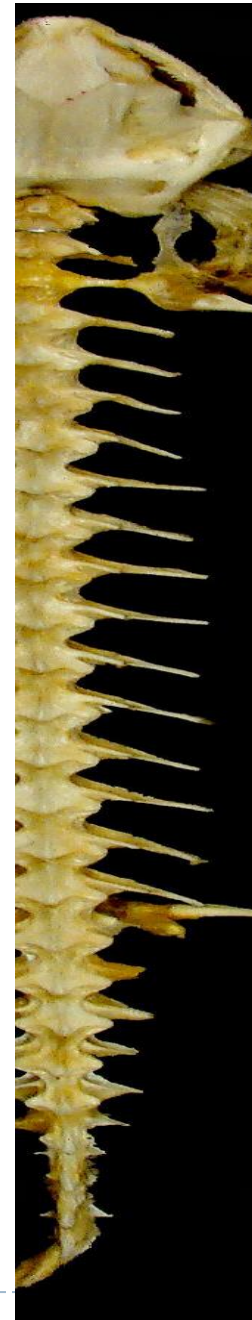
**Vertebral  
column**

**Rib cage**

**Appendicular  
skeleton**

**Limbs**

**Girdles**



# Skull

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graph TD; Skull[Skull] --> Cranial[Cranial skeleton]; Skull --> Visceral[Visceral skeleton]; Cranial --> Neurocranium[Neurocranium  
brain, vision and olfaction]; Cranial --> Dermatocranium[Dermatocranium  
integumentary bones of the head]; Visceral --> Jaw[upper & lower jaw]; Visceral --> Branchial[Branchial & Hyoid, gill arches];
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## Cranial skeleton

### Neurocranium

brain, vision and olfaction

### Dermatocranium

integumentary bones of the head

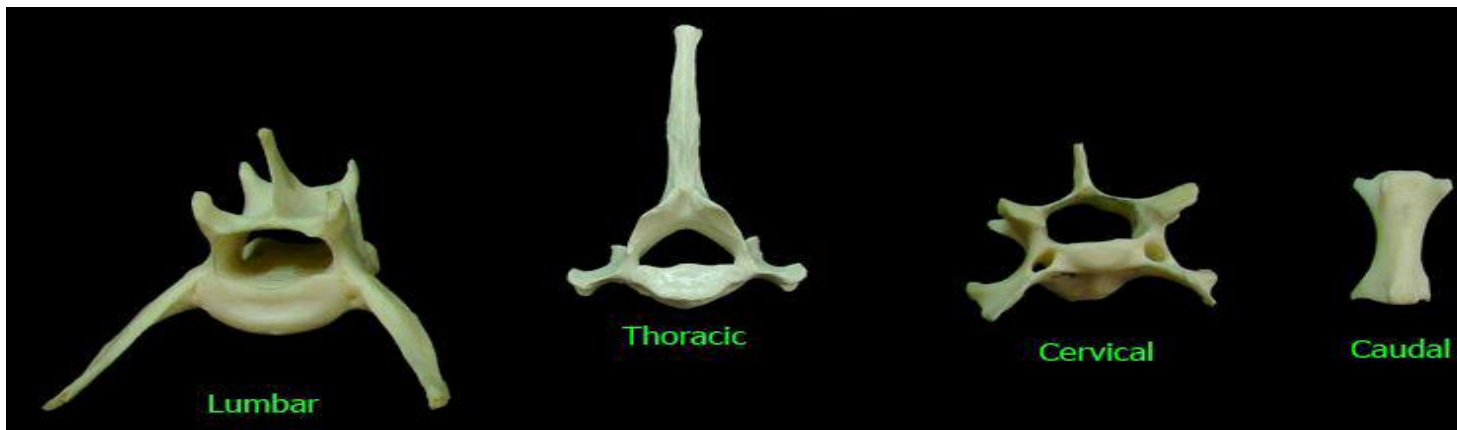
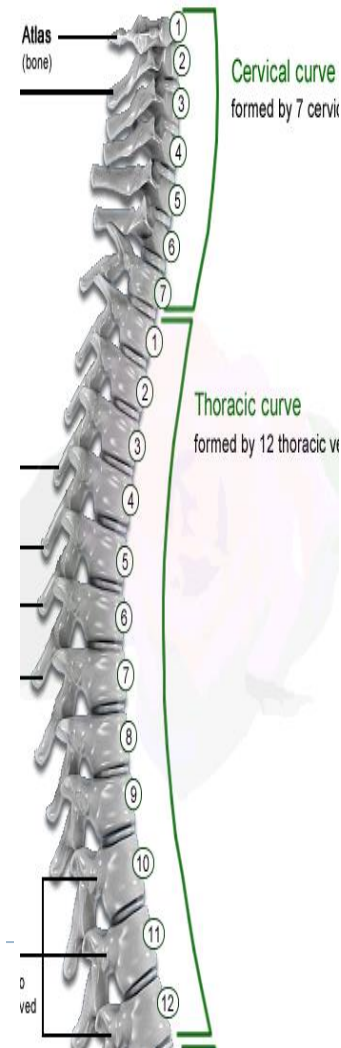
## Visceral skeleton

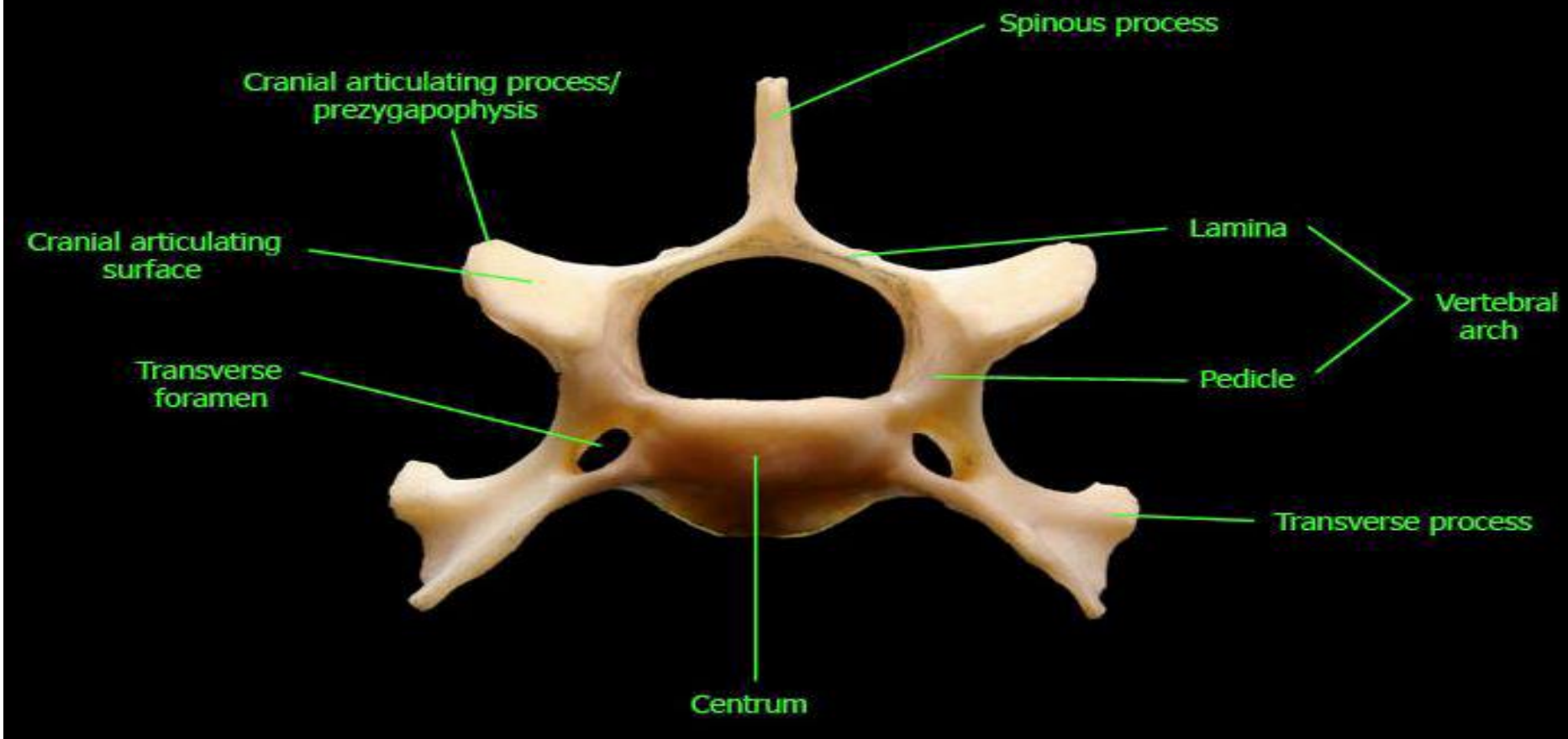
upper & lower jaw

Branchial & Hyoid, gill arches

# 2. Vertebral column

- ▶ Composed of either cartilage or commonly bone vertebrae.
- ▶ The vertebral column functions;
  - ▶ Surrounds and protects the spinal cord,
  - ▶ Point of attachment for ligaments, tendons, and muscles,
  - ▶ Helps to bear the weight of the body.
- ▶ Names of vertebrae based on their position;
  - ▶ Cervical (neck), thoracic (chest), Lumbar (abdomen)  
Sacral and caudal (tail) vertebrae.
  - ▶ First cervical vertebrae called atlas & 2<sup>nd</sup> called axis



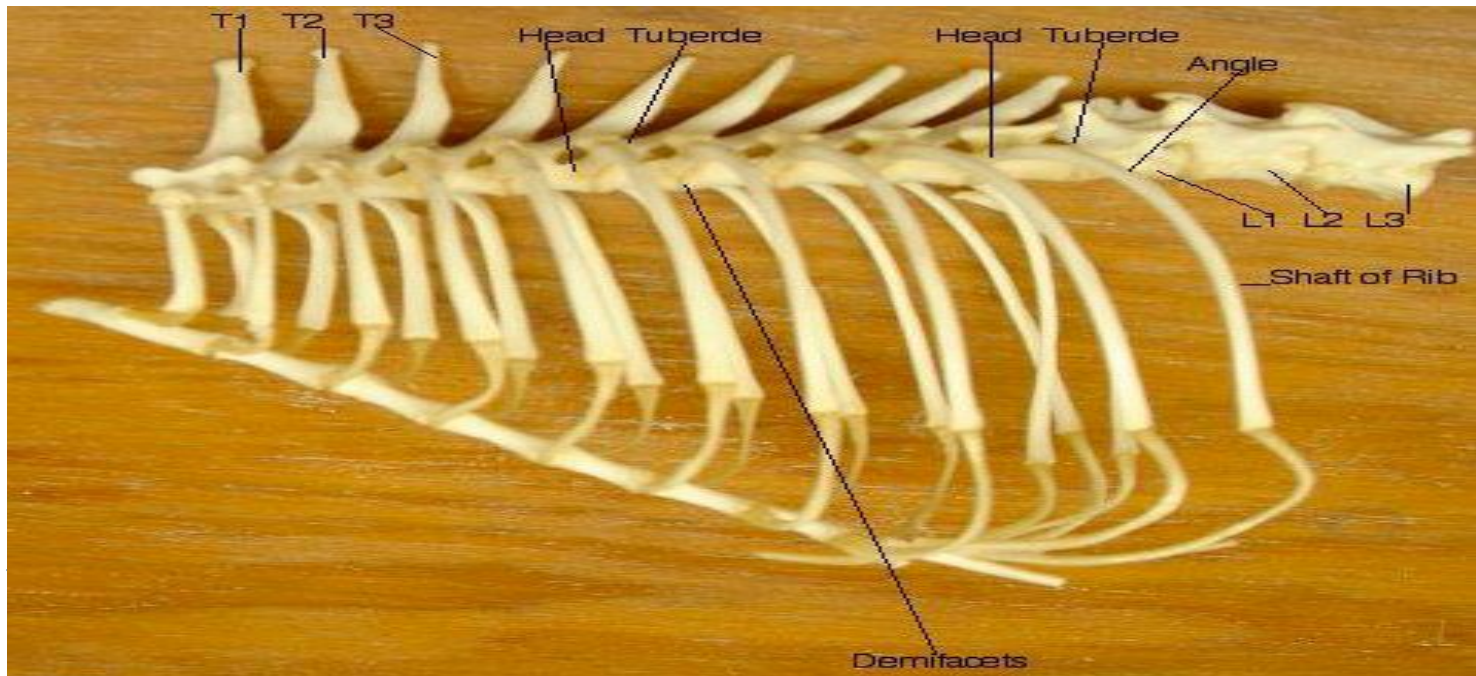


- ▶ Typical vertebra consists of a centrum, (vertebral arch) and one or more process.
- ▶ The centrum occupies the position occupied by the notochord during development.
- ▶ Transverse processes articulate with ribs, articulating processes allow for articulation between successive vertebrae



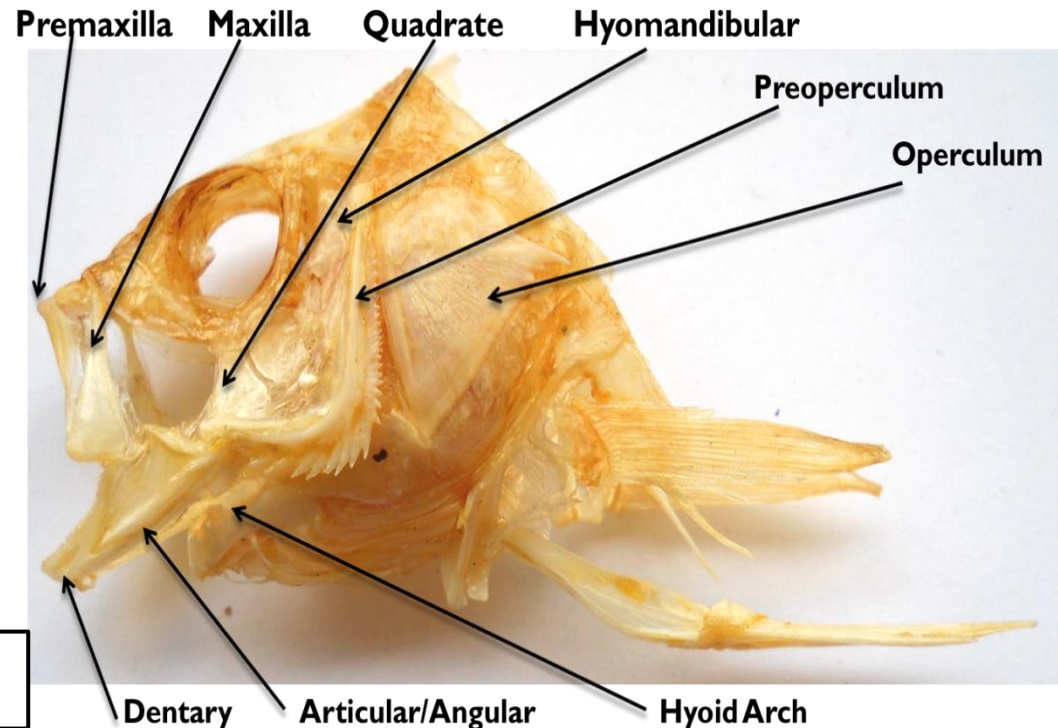
# 3. The Ribs and Sternum

- ▶ Ribs are flat bones that articulate with the vertebrae
- ▶ Some fishes have two sets of ribs, dorsal and ventral ribs, associated with each trunk vertebrae.
- ▶ The sternum (breastbone), is flat bone that articulates with the first seven pairs of ribs and the clavicles, it is found only in tetrapod.



# Fish skeletal system

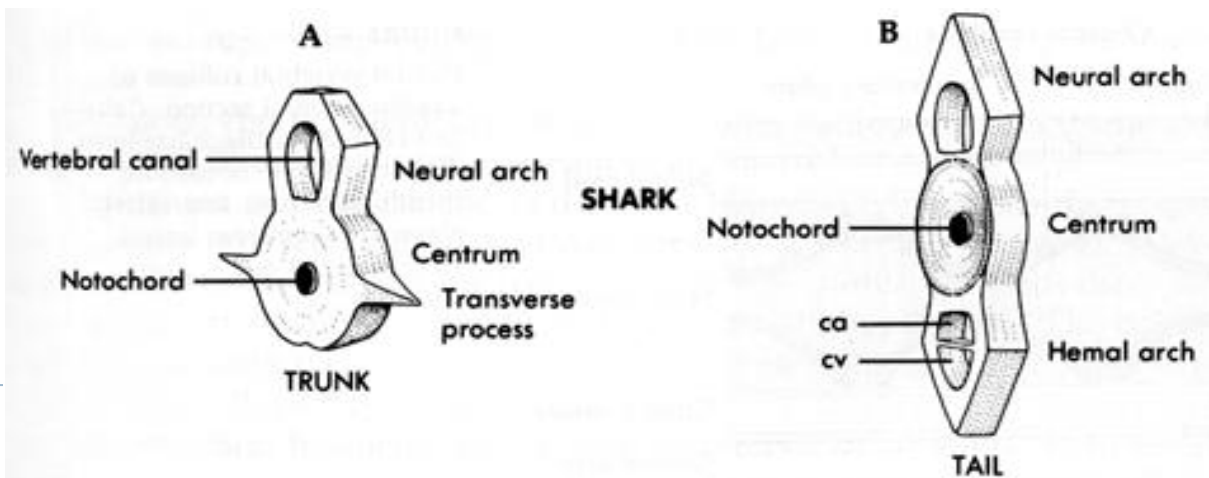
- ▶ Skeleton of the head includes the
- ▶ **Chondrocranium cranium** Supports underside of brain & surrounds sensory organs
- ▶ **Splanchnocranium** (Supports jaws & gills ).
- ▶ Most Teleosts have ventral ribs
- ▶ Sharks - dorsal ribs only



**Skull structure**

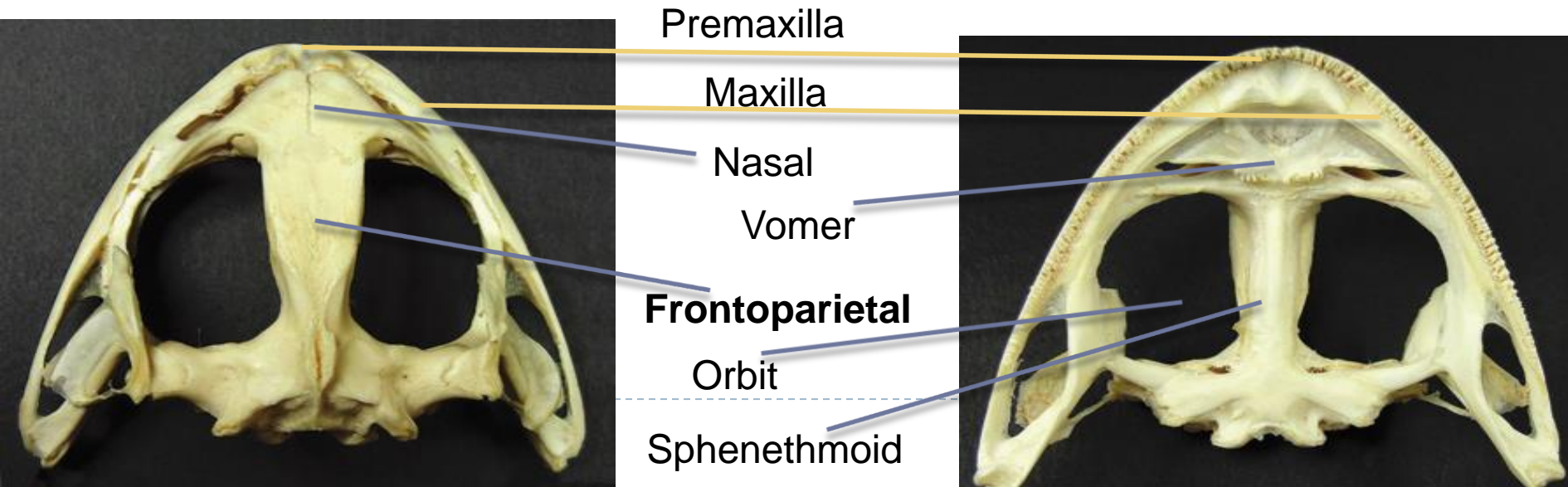
# Fish skeletal system

- ▶ In Osteichthyes, **vertebral column** extends from the skull to the tail.
- ▶ Chondrichthyes don't have a typical vertebral columns.
- ▶ vertebrae well-ossified in Teleosts, notochord persists with each vertebra.
- ▶ A vertebrae consist of a centrum and vertebral arch.
- ▶ The dogfish vertebrae are divided into 2 types:
  - ▶ **Trunk vertebrae (articulate with ribs)**
  - ▶ **Caudal vertebrae**



# Amphibian

- ▶ The premaxilla and maxilla bear a single row of small teeth
- ▶ Vomers lie anteriorly just behind the premaxillae. They bear vomerine teeth
- ▶ The paired nasals are broad and flattened
- ▶ Frontoparietals are elongated, flattened bones form most of the cranial roof.
- ▶ Sphenethmoid form the roof of the dorsal braincase.



# Amphibian skeleton

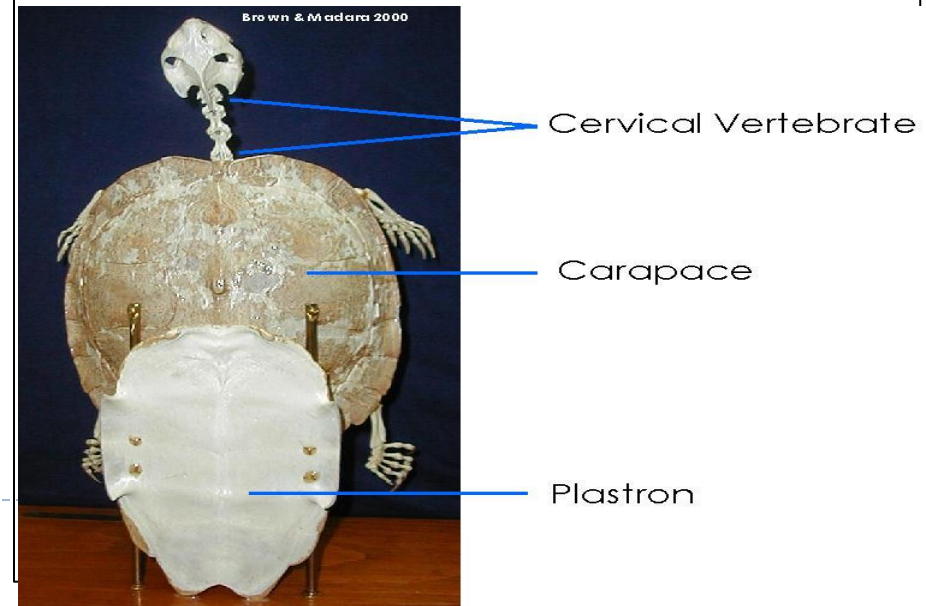
- ▶ The vertebral column is reduced, with only nine free vertebrae
- ▶ 1 cervical = **atlas**, trunk, 1 sacral & the **urostyle** formed by fusion of caudal vertebrae



- ▶ The ribs have fused onto the transverses processes

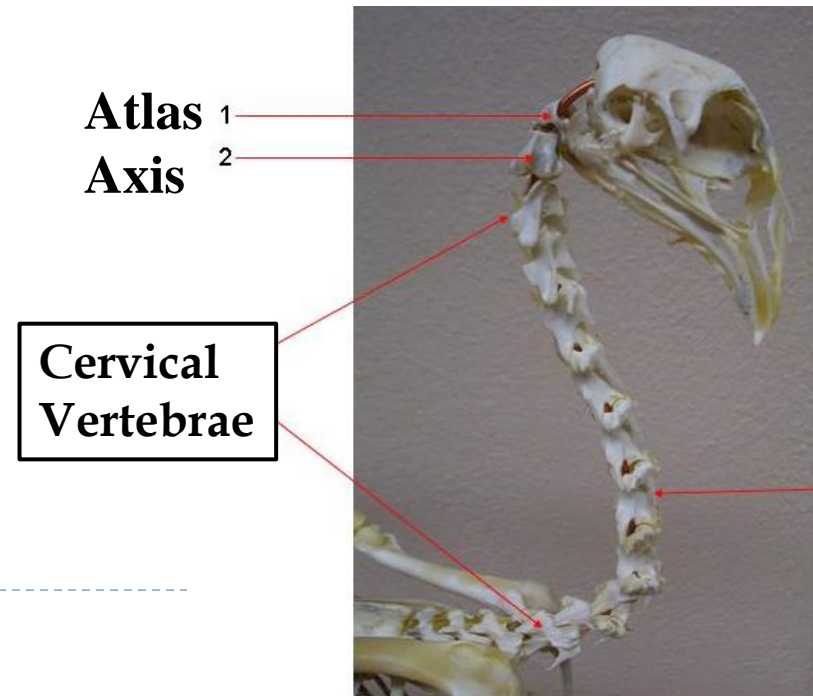
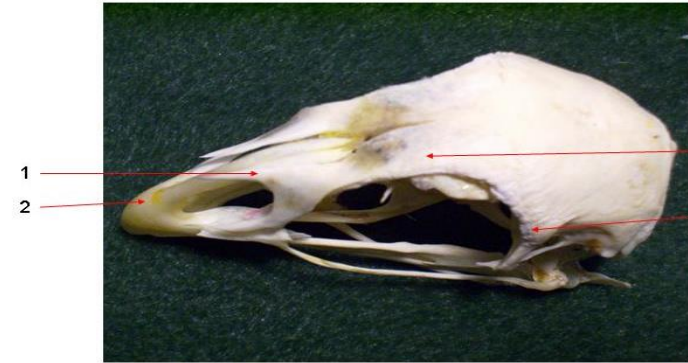
# Reptile skeleton

- ▶ Skull consist of the braincase and the jaws
- ▶ The skull connected with 7 cervical vertebrae, the 8<sup>th</sup> are joined with the carapace.
- ▶ The vertebrae and ribs are fused with the carapace



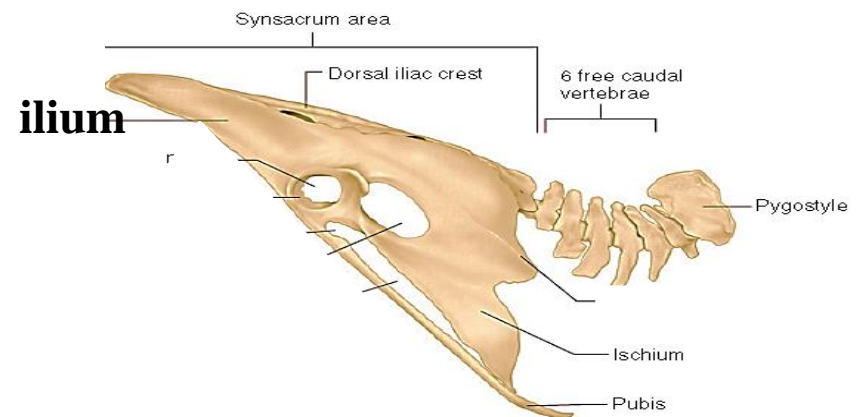
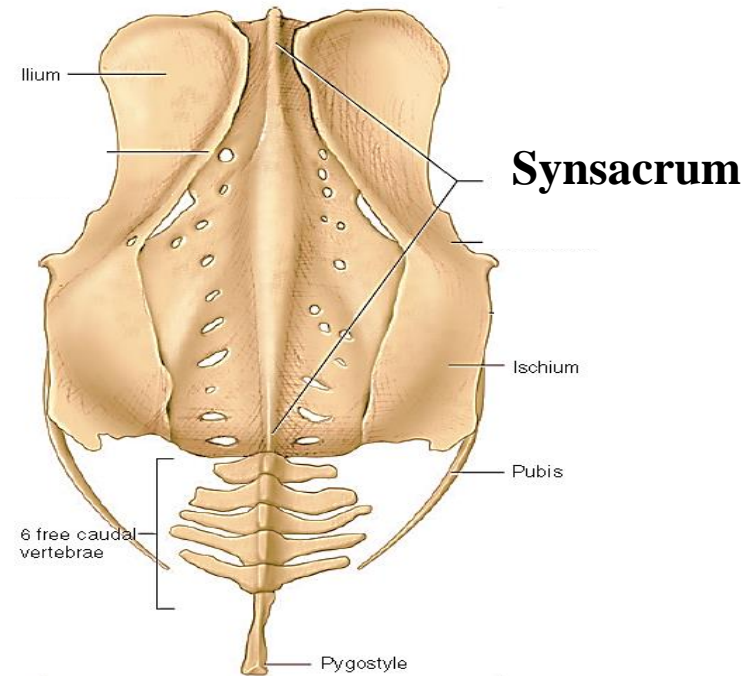
# Bird skeletal System

- ▶ Bones such as the prefrontal, postfrontal, temporal, and postparietal and teeth are lost to reduce weight.
- ▶ The bones of skull fused to provide strength & reduce weight.
- ▶ Cervical vertebrae are 14, atlas and axis articulate with flexibility to enable free movement.
- ▶ 5 thoracic, 6 lumbar, 2 sacral, and 15 caudal vertebrae.



# Bird vertebral column

- ▶ Posterior thoracic, lumbar, and sacral vertebrae fused to form **Synsacrum** to reduce weight
- ▶ **Sternum** (keel) provides strength and control flight.
- ▶ Most flightless birds have a small sternum compared to flying birds
- ▶ **Pygostyle**, several caudal vertebrae fused to provide **stabilization** during flight.
- ▶ Ribs are 5, reduced & fused with the vertebrae

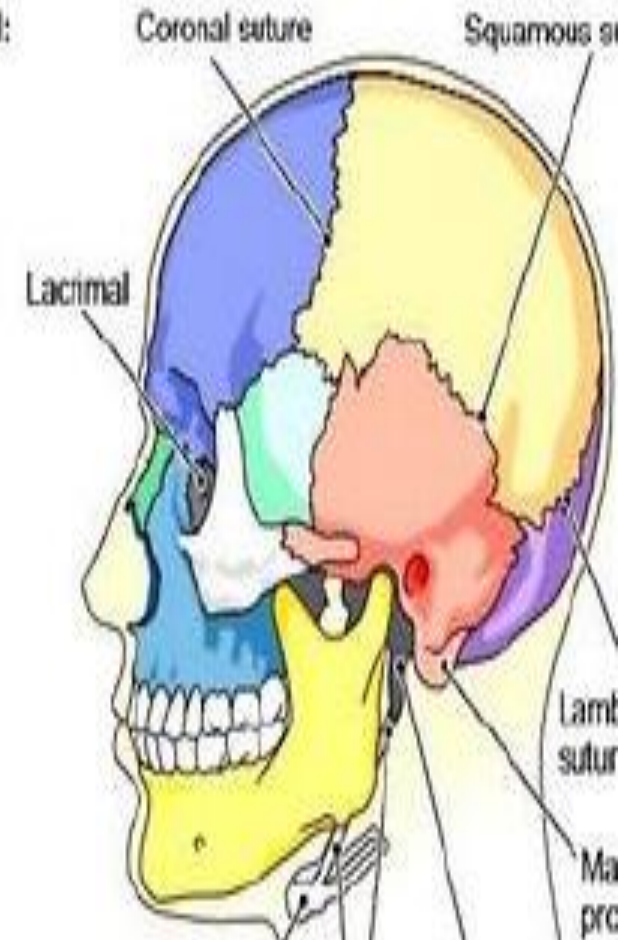


# Mammals

- ▶ Vertebrate skull is a complex mixture of 34 bones.
- ▶ Most of these bones are fused together
- ▶ The skull divided into 3 parts;
  - ▶ Braincase
  - ▶ Rostrum (snout and upper jaw)
  - ▶ Lower Jaw.
- ▶ Some of the skull main bones are
  - ▶ Nasal bones, roof of the nasal cavity
  - ▶ Maxillary bones, main bones of the upper jaw

Bones of the skull:

- Frontal
- Parietal
- Spheroid
- Temporal
- Nasal
- Maxilla
- Occipital
- Zygomatic
- Mandible





# Mammals

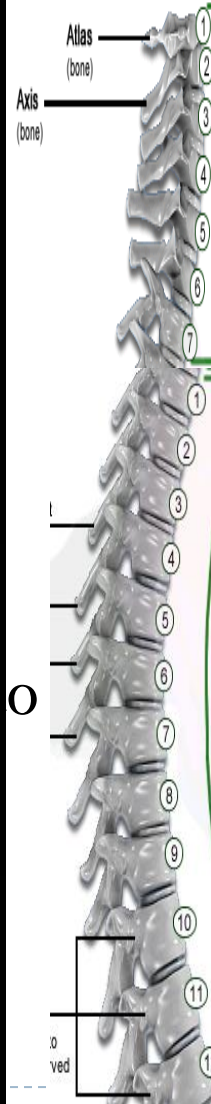
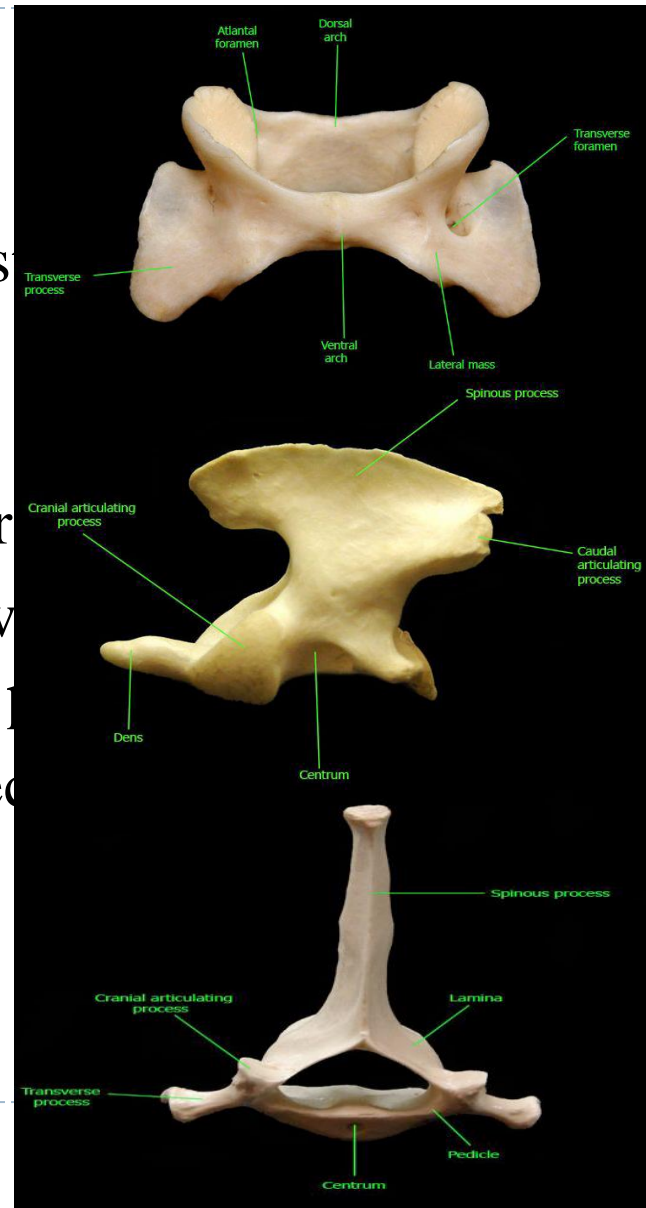
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- ▶ Frontal bones, where the bones that horns and antlers grow
- ▶ Parietal bones, form the roof and back of the Braincase.
- ▶ Occipital bones, the lower back of the Braincase
- ▶ Dentary bones, the lower jaw.
- ▶ Dentition in mammals is mostly Heterodont, teeth are modified in shape and size to serve specialized functions. Such as;
- ▶ Incisors (cutting),
- ▶ canines (piercing),
- ▶ premolars (grinding)
- ▶ carnassials (shearing)
- ▶ molars (crushing).



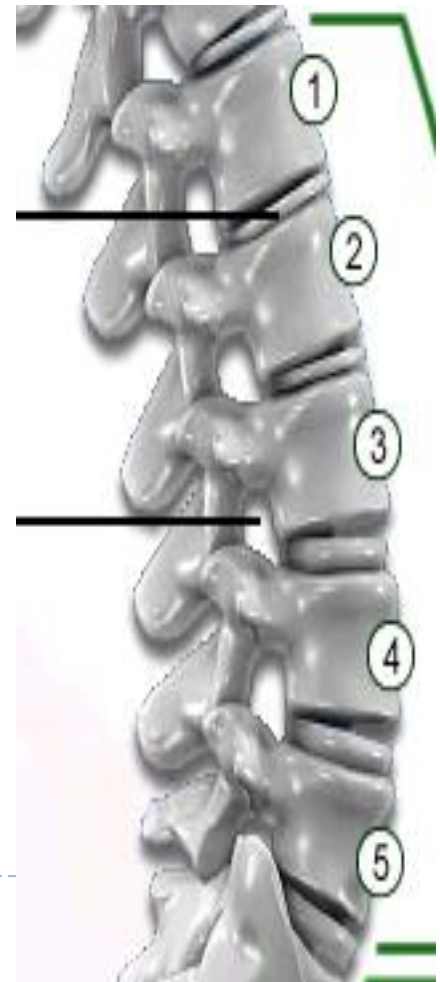
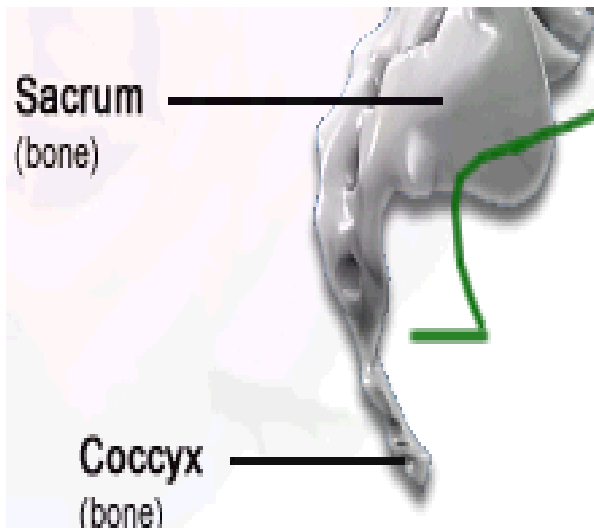
# Vertebral column of mammals

- ▶ Consists of 33 vertebrae,
- ▶ Cervical Vertebrae are 7, the 1<sup>st</sup> is
- ▶ **Atlas** is a ring-shaped lacking most movement of the head on the neck
- ▶ Axis having a cranial projecting process
- ▶ Dens is the centrum of C1, it allows
- ▶ Thoracic Vertebrae usually 12-15, they support the muscles that lift the neck



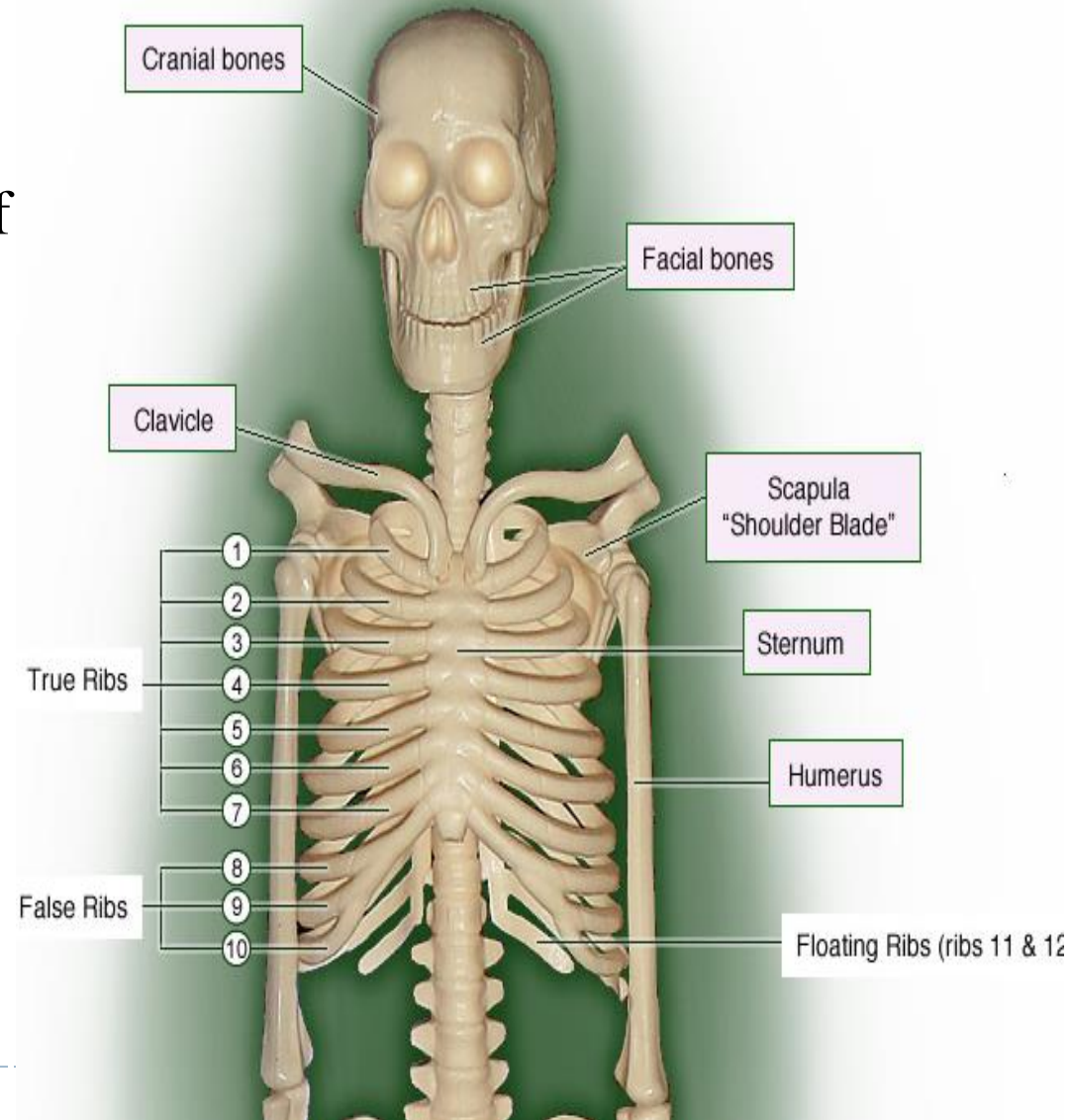
# Mammals

- ▶ Lumbar Vertebrae are only 6 or 7, except in toothed whales (20)
- ▶ Lumbar vertebrae have many spines and processes, so it look complicated.
- ▶ Sacral Vertebrae 3-5 in number.
- ▶ Caudal Vertebrae are simple and smaller
- ▶ In Mankind and Chimpanzees, Caudal vertebrae are reduced to 4 and fused to form the Coccyx.



# Mammals

- ▶ Ribs arise from the thoracic vertebrae
- ▶ Ribs end along each side of the sternum (breastbone).
- ▶ In many species the lower or posterior ribs do not meet the sternum these are called floating ribs.



# References

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- ▶ For further reading please see:
- ▶ **Charles K. Weichert (2017). Elements of chordate anatomy. 3rd edition. The McGraw–Hill Companies, New york.**
- ▶ **Comparative anatomy | Definition, Examples, & Facts | Britannica**<https://www.britannica.com › science › comparative-anatomy>
- ▶ ***Kardong, Kenneth V. (2019). Vertebrates: comparative anatomy, function, evolution (8<sup>th</sup> edition). New York.***
- ▶ **De Iuliis, G., & Pulerà, D. (2019). *The dissection of vertebrates*. 3<sup>rd</sup> edition. Academic press. Elsevier, London.**
- ▶ **Kenneth, S. S. (2017). *The unity of form and function*. 8<sup>th</sup> edition. The McGraw–Hill Companies,. New york.**
- ▶ **Comparative Anatomy. [www.health.zone/](http://www.health.zone/)**

