# **Quadrant II – Transcript and Related Materials**

**Programme: Bachelor of Science (Second Year)** 

Subject: Zoology

Paper Code: ZOC 103

Paper Title: Anatomy of animal body systems

Unit: II

Module Name: Introduction to Skeletal System

Module No: 16

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#### Skeletal system:

Skeleton is a hardened structure or group of structure, external or internal, living or dead which provides support and protection to the body. Skeletal system is divided into 2 types in vertebrates- Exoskeleton and Endoskeleton.

**Exoskeleton**- "Exo" means "outside". It is an external skeleton that consists of a hard encasement on the surface of an organism. It is found in invertebrates as well as vertebrates. This skeleton type provides defence against predators, supports the body, and allows for movement through the contraction of attached muscles. As with vertebrates, muscles must cross a joint inside the exoskeleton.

It is formed from or within the integument. Dermis give rise to bones and epidermis give rise to Keratin. Chitin is secreted by the epidermal cells and it does not grow with the body of organism. Shells of crabs, lobsters, snails and chitinous plates of insects are examples in invertebrates. Dermal scales, feathers, hair, nails, bony armour, horns etc. are examples in vertebrates.

**Endoskeleton-** "Endo" means "inside". It consists of hard, mineralized structures located within the soft tissue of organisms. It is a characteristic of vertebrates. It forms deep within the body from mesoderm and not directly from the integument. It grows with the body of organism.

The tissues contributing to the endoskeleton includes: Bones, Cartilages and Ligaments.

Bones are ossified hard rigid connective tissues consisting of cells embedded in an abundant hard intercellular material. Cartilages are relatively soft elastic connective tissues made up of cells and matrix and the ligaments are fibrous connective tissue that connects bones to other bones.

#### Functions of Skeletal system:

The skeletal system has several key functions, including:

1) **Support and movement:** Bones are a site of attachment for ligaments and tendons, providing a skeletal framework that can produce movement through the coordinated use of levers, muscles, tendons and ligaments. The bones act as levers, while the muscles generate the forces responsible for moving the bones.

2) **Protection:** Bones provide protective boundaries for soft organs: the cranium around the brain, the vertebral column surrounding the spinal cord, the ribcage containing the heart and lungs, and the pelvis protecting the urogenital organs.

3) **Blood-cell formation:** Blood cells are formed from haemopoietic stem cells present in red bone marrow.

4) **Storage of minerals:** As the main reservoirs for minerals in the body, bones contain approximately 99% of the body's calcium, 85% of its phosphate and 50% of its magnesium.

## Types of bones:

Bones can be classified into different types based on various factors:

1) Nature of bones.

2) Origin of bones.

3) Structure and function of bones.

#### Types of bones based on nature:

**1) Spongy or Cancellous bone:** It is very porous, highly vascularized and consists of small pieces joined together irregularly. The small spaces between the pieces contain bone marrow.

**2)** Compact or Periosteal bone: It surrounds spongy bone and is a hard, solid mass of bone without any apparent spaces. The broad ends of long bones are made of spongy bone underlying a layer of compact bone. The shafts of long bones are made of compact bone enclosing a marrow cavity.

# Types of bones based on their origin:

1) Cartilage/ Replacing/ Endochondral bones.

- 2) Dermal/ Investing/ Membrane bones.
- 3) Sesamoid bones.

**1)** Cartilage/ Replacing/ Endochondral bones: These are formed due to the ossification of preexisting cartilaginous endoskeleton. This type of ossification is known as endochondral ossification. Some bones such as Femur, Tibia, Humerus, Vertebrae, Ribs etc. are called endochondral bones.

**2) Dermal/ Investing/ Membrane bones:** These are formed by the direct ossification in the dermis of skin as thin plates and sink to get attached over the original cartilaginous endoskeleton. Some bones, such as the clavicle, some of the facial and cranial bones of the skull, develop directly from mesenchyme, thereby bypassing the cartilaginous stage. These types of bones are called membrane bones.

**3)** Sesamoid bones: These are round or oval bones formed by the ossification in the tendons at the joints where additional strength is needed. Patella (knee cap) is an example of sesamoid bones.

#### Types of bones based on Structure and function:

**1)** Long bones: typically longer than they are wide. Most long bones are located in the appendicular skeleton and function as levers to produce movement.e.g. Humerus, radius, tibia, Femur etc.

**2)** Short bones: small and roughly cube-shaped, these contain mainly cancellous bone, with a thin outer layer of cortical bone. e.g. Wrist, Tarsals etc.

**3)** Flat bones: thin and usually slightly curved, typically containing a thin layer of cancellous bone surrounded by cortical bone. Most are located in the axial skeleton and offer protection to underlying structures. e.g. Ribs, Skull, Sternum etc.

**4) Irregular bones:** bones that do not fit in other categories because they have a range of different characteristics. They are formed of cancellous bone, with an outer layer of cortical bone. e.g. Vertebrae etc.

## Division of endoskeleton:

The skeletal system in vertebrates is divided into the axial skeleton (which consists of the skull, vertebral column, ribs and sternum), and the appendicular skeleton (which consists of the shoulders, limb bones, the pectoral girdle, and the pelvic girdle).