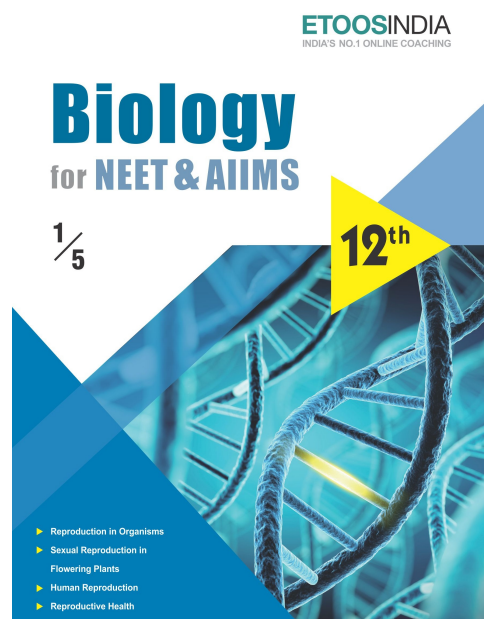
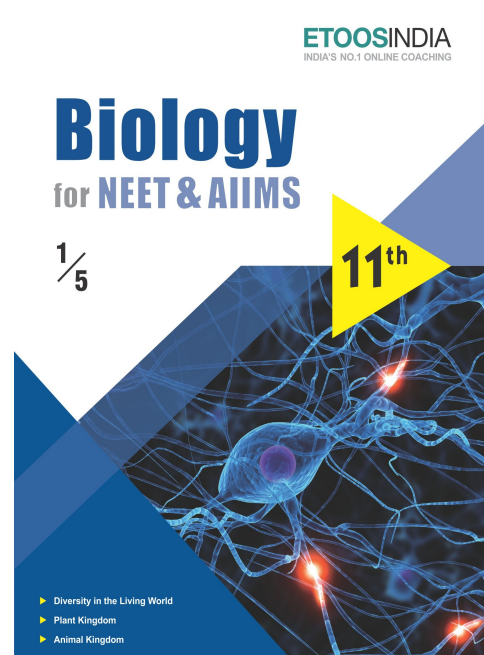
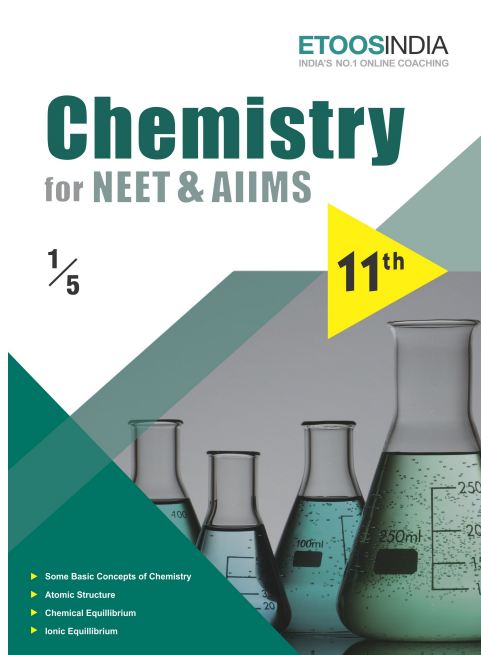
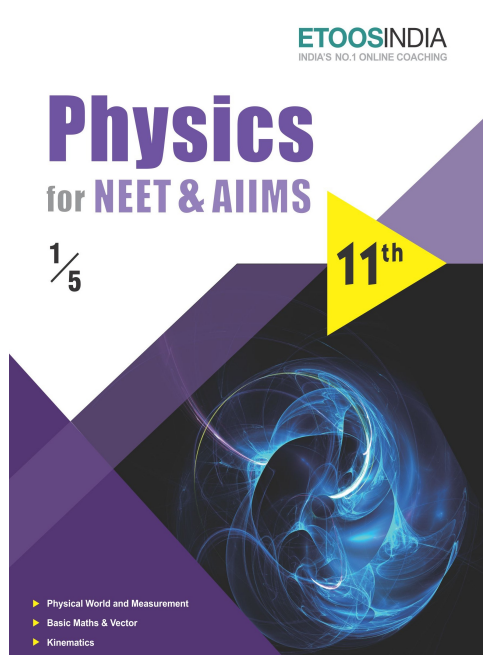


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# LOCOMOTION AND ITS MOVEMENT

*“I am very conscious that there is no scientific explanation for the fact that we are conscious.”*

“SIR ANDREW FIELDING HUXLEY (1917-2012)”

## INTRODUCTION

**M**ovement is a change in posture or position. It is the significant feature of living beings. Animals and plants both exhibit wide range of movements. Also, unicellular and multicellular organisms show movement. For example, unicellular organism such as Amoeba is a simple form of movement. Movement of cilia, flagella tentacles, limbs, jaws etc are shown by many organisms. Such voluntary movements are called **Locomotion**.

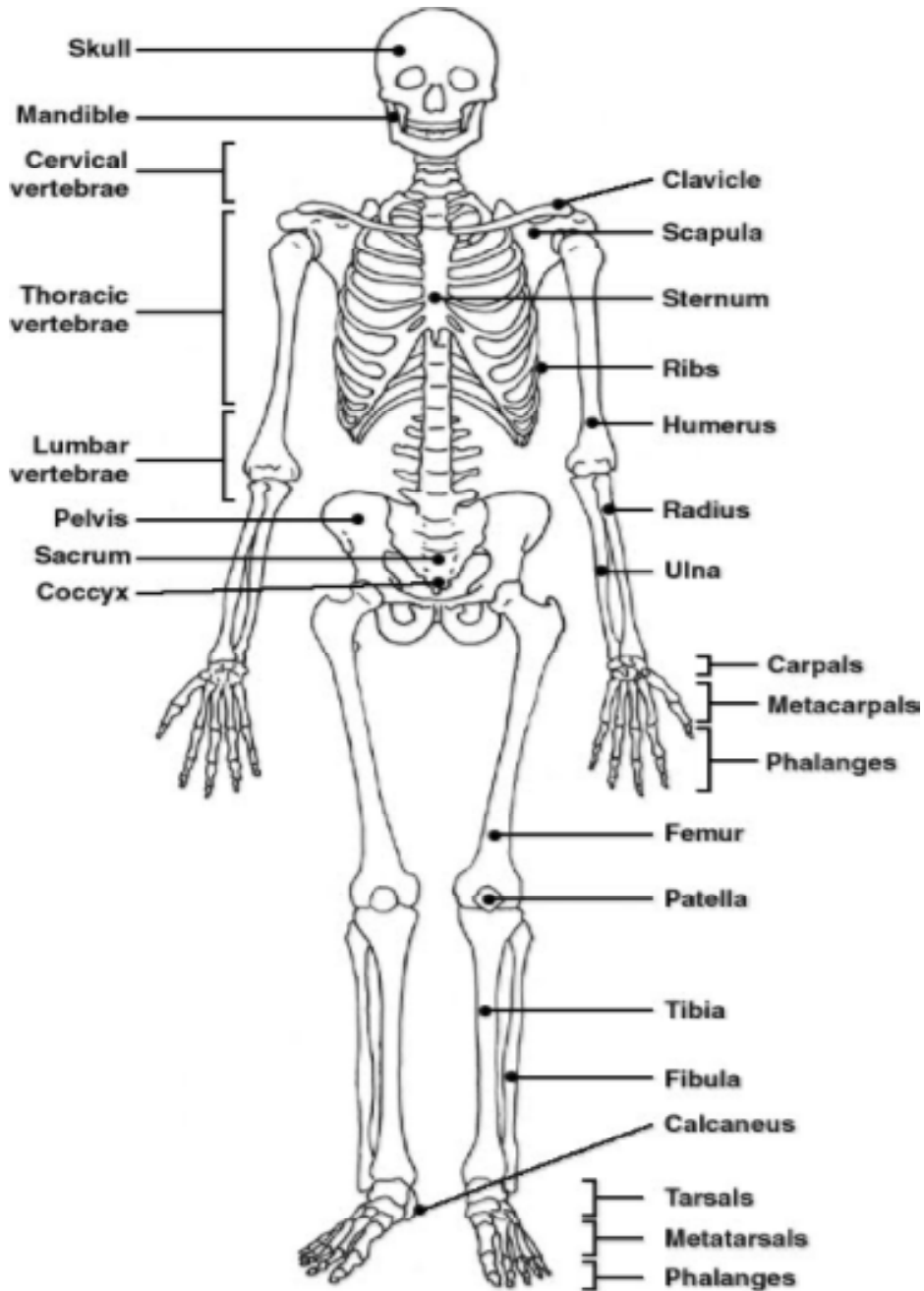
Hydra uses its tentacles for capturing its prey and also use them for locomotion. We use limbs for changes in body postures and locomotion as well.

Methods of locomotion performed by animals vary with their habitats and the demand of the situation.

**LOCOMOTION AND MOVEMENT**

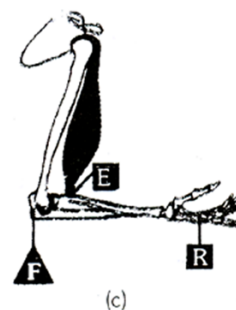
**DEFINITION AND INTRODUCTION**

- The hard protective or supportive part of the animal constitute skeletal system.
- Study of skeleton is called **Osteology** or **Skeletology**.
- Skeleton of different design are needed for the aquatic or terrestrial animals.



### TYPES OF BONES (ON BASIS OF SHAPE AND SIZE)

- (i) Long bones  
e.g. Humerus, Radius, Ulna, Tibia fibula, Femur.
- (ii) Short bones  
e.g. Carpals and tarsals.
- (iii) Flat bones  
e.g. Skull bone, sternum and ribs.
- (iv) Irregular bones  
e.g. Ear ossicles and vertebrae.
- (v) Sesamoid bones  
e.g. Patella (knee cap), pisiform



### ETOOS KEY POINTS

- (i) A small sesamoid bone Fabella often develops in the tendon of lateral head of gastrocnemius muscles behind the knee joint.
- (ii) In frog tibiofibula is the longest bone.
- (iii) Bones formed by ossification in cartilages is called **replacing bone** e.g. Humerus, femur. (cartilagenous bones)
- (iv) The bones of a children have large amount of organic matter, so, their bones are very flexible and less likely to break. (hence they may undergo green stick fracture)
- (v) Bones formed by ossification in the dermis and sink to get attached over the cartilages. e.g. Frontals and parietals is called **investing bone** of the skull. (Dermal bones or membranous bones)
- (vi) Skull of reptiles and birds possess one occipital condyles so the skull is called **monocondylic**, skull of amphibians and mammals possess two occipital condyles, so the skull is called **dicondylic**.
- (vii) Os penis : A bone supporting the penis of bats is called os penis.
- (viii) Os cordis : A bone supporting the heart of cattle is called oscordis.
- (ix) The end of two bones are connected by ligaments. While a muscle attaches with bone through tendon.
- (x) **Procoelous** - Centrum concave anteriorly but convex posteriorly 2<sup>nd</sup> to 7<sup>th</sup> vertebrae of frog. All reptilian vertebrae are procoelous.  
**Amphicoelous** - Centrum concave on both sides. 8<sup>th</sup> vertebrae of frog is amphicoelous.  
**Acoelous** - Centrum remain flat. 9<sup>th</sup> vertebra of frog is acoelous.  
**Heterocoelous** - Centrum partly convex and partly concave on both sides.  
 Vertebrae of birds are heterocoelous.  
**Ceoloplatyn vertebrae** - Centrum concave anteriorly but flat posteriorly.  
**Platycoelous vertebrae** - Centrum flat anteriorly but concave posteriorly.
- (xi) Bones formed by ossification in the tendons at the joint is called **sesamoid bones** e.g. Patella.
- (xii) In Avian skull sutures remains absent.
- (xiii) **Weberian ossicles** - These are modified in vertebrae in cat and fishes. These help in sound production by connecting air bladder and internal ear.
- (xiv) Like mammals amphibian skull is also **dicondylic**.  
Skull of reptiles and aves are **monocondylic**.
- (xv) The pelvic girdle of birds is attached to a complex structure formed by the fusion of last thoracic all lumbar and first five caudal vertebra this structure is called **synsacrum**.
- (xvi) Talus in Rabbit is called as Astragalus.

- Human endoskeleton is made up of 206 bones. It is grouped into two parts -
- Appendicular skeleton - 126 bones.
- Axial Skeleton - 80 bones.
- Axial Skeleton
  - It consist skull, vertebral column, sternum and ribs.
- Skull is composed of cranial and facial bones. Total - 22 bones
- Cranial bones are 8 in number. Frontal(1), parietal(2), occipital(1), temporal(2), sphenoid(1), ethmoid(1).
- Facial bones are 14 in number. Mandible(1), maxilla(2), palatine(2), nasal, vomer(1), inferior turbinals(2), zygomatic(2), lacrimal bones(2).
- Each middle ear contains three tiny bones malleus, incus and stapes, collectively called ear ossicles.
- Hyoid bone:- A single U-shaped bone which is present at the base of the buccal cavity.
- Vertebral column:- Formed by 26 serially arranged vertebrae. Cervical (7) Thoracic (12) Lumber (5) Sacral (1 fused), coccygeal (1 fused)
- The number of cervical vertebrae are seven in almost all mammals including human beings.
- First vertebra is the atlas and it articulates with the occipital condyles of skull.
- Sternum:- A flat bone on the midventral line of thorax.
  - Ribs - 12 pairs
    - Ist 7 pairs - True ribs (vertebra-sternal ribs)
    - 8, 9, 10th pairs - vertebro-chondral ribs.
    - 11, 12th pairs - vertebral ribs (floating ribs)
- Each rib is a thin flat bone. It has two articulation surfaces on its dorsal end and is hence called bicephalic.
- Thoracic vertebrae, ribs and sternum together form the rib cage.
- Appendicular Skeleton
  - The bones of limbs along with their girdles.
  - Fore Limb - 30 bones. Humerus, radius, ulna, carpals (wrist bones-8) metacarpals (palm-5) phalanges (digits-14)
  - Hind Limb - 30 bones. Femur, Patella, Tibia, Fibula, Tarsals (Ankle-7), metatarsals (sole-5), Phalanges (digits-14)
  - Femur is the longest bone of body .
  - Pectoral girdle - Each half is made up of a clavicle (collar bone) and a scapula bones.
  - Glenoid cavity is a depression in the scapula bone in which the head of the humerus bone articulate and form the shoulder joint.
  - Pelvic girdle - It consists of two coxal bones.
  - Each coxal bone is formed by fusion of ilium, ischium and pubis. At the point of fusion of the above bones acetabulum cavity is present in which head of femur articulates. The two halves of the pelvic girdle meet ventrally to form the pubic symphysis containing fibrous cartilage.

## 1. JOINTS

1. Fibrous joint - Do not allow any movement e.g.: Sutures (between skull bones)
2. Cartilaginous Joint - The bones involved are joined together with the help of cartilage e.g.: Intervertebral disc, pubic symphysis.
3. Synovial joint - Characterised by the presence of a fluid filled synovial cavity between the articulating surface of two bones. e.g.: Ball and Socket, Hinge, Pivot, Gliding, Saddle joints.
  - Ball and socket joint (between Humerus and Pectorial girdle)
  - Hinge Joint (Knee Joint, Elbow Joint)
  - Pivot Joint (between atlas and axis)
  - Gliding Joint (between the carpals, between the adjacent vertebrae).
  - Saddle Joint (between carpal and metacarpal of thumb)

**SOLVED EXAMPLE**

**Ex.1** The collar bone is known is  
 (A) Scapula (B) Coracoid  
 (C) Stapes (D) Clavicle

**Sol.** (D)

**Ex.2** Number of cranial nerves in mammal are  
 (A) 10 pairs (B) 8 pairs  
 (C) 12 pairs (D) 16 pairs

**Sol.** (C)

**Ex.3** The number of vertebrae present in cervical, thoracic, lumbar, sacral and coccyx regions respectively are  
 (A) 12, 7, 5, 1, 1 (B) 1, 7, 5, 12, 1  
 (C) 7, 5, 1, 12, 1 (D) 7, 12, 5, 1, 1  
 (E) 5, 12, 7, 1, 1

**Sol.** (D)

**Ex.4** Find out the correct order of number of bones in the parts of skull such as cranial bone, facial bone, hyoid bone and middle ear bone respectively  
 (A) 14, 8, 1 and 6 (B) 6, 8, 14 and 1  
 (C) 14, 8, 6 and 1 (D) 8, 6, 14 and 1  
 (E) 8, 14, 1 and 6

**Sol.** (E)

**Ex.5** Which one is not cranial bone  
 (A) Frontal (B) Zygomatic  
 (C) Temporal (D) Sphenoid

**Sol.** (B)

**Ex.6** In the pelvic girdle of man A, B, C, D and E respectively represents



- (A) A - pubis, B - acetabulum, C - ilium, D - ischium, E - pubic symphysis
- (B) A - ilium, B - acetabulum, C - pubis, D - ischium, E - pubic symphysis
- (C) A - ischium, B - acetabulum, C - pubis, D - ilium, E - pubic symphysis
- (D) A - ilium, B - pubis, C - acetabulum, D - pubic symphysis, E - ischium
- (E) A - ilium, B - acetabulum, C - pubic symphysis, D - ischium, E - pubis

**Sol.** (B)

**Ex.7** A vertebra has a convexity both in front and behind it. It is called  
 (A) Procoelous (B) Amphicoelous  
 (C) Acoelous (D) Amphiplatyon

**Sol.** (C) : Acoelous means without cavity on either of its ends It can be amphiplatyon with both ends flats or amphidicondylar with both ends convex. Procoelous have anterior concavity, amphicoelous has both sides concave.

**Ex.8** Number of bones in skull is  
 (A) 26 (B) 28  
 (C) 107 (D) 29

**Sol.** (B) : Number of Cranium = 8  
 Facial bones = 14  
 Ear ossicles = 6  
 Total = 28

**Ex.9** In human beings the cranium is formed by  
 (A) Eight bones of which two are paired  
 (B) Fourteen bones of which six are paired  
 (C) Ten bones of which two are paired  
 (D) Twelve bones of which four are paired

**Sol.** (A) : The cranium is formed by 8 bones. (1 frontal bone, 2 parietal, 2 temporal, 1 occipital, 1 sphenoid, 1 ethmoid).

**Ex.10** Human vertebral column consists of 33 vertebrae and bones  
 (A) 33 (B) 26  
 (C) 27 (D) 29

**Sol.** (B)

**Ex.11** The major function of the intervertebral discs is to  
 (A) Absorb shock  
 (B) String the vertebrae together  
 (C) Prevent injuries  
 (D) Prevent hyperextension

**Sol.** (A)

**Ex.12** A shallow depression in the scapula which receives the head of the upper arm bone is known as the  
 (A) Acetabulum (B) Neural arch  
 (C) Glenoid cavity (D) None of the above

**Sol.** (C) : Glenoid cavity articulates humerus with scapula.

**Ex.13** Symphysis contains  
 (A) Hyaline cartilage (B) Fibrous cartilage  
 (C) Calcified cartilage (D) None of these

**Sol.** (B)

**Exercise # 1**

**SINGLE OBJECTIVE**

**NEET LEVEL**

1. Number of bones in the adult human body is-  
(A) 206 (B) 406 (C) 106 (D) 306
2. Comparative study of skulls is-  
(A) Craniology (B) Conchology  
(C) Malacology (D) Osteology
3. Extremities of long bones possess-  
(A) Calcified cartilage (B) Fibrous cartilage  
(C) Hyaline cartilage (D) Elastic cartilage
4. Number of bones in human axial skeleton is-  
(A) 120 (B) 142 (C) 80 (D) 206
5. Patella, the knee cap is an example of-  
(A) Cartilaginous bone (B) Sesamoid bone  
(C) Membrane bone (D) Investing bone
6. Human vertebra is an example of-  
(A) Long bone (B) Flat bone  
(C) Sesamoid bone (D) Irregular bone
7. The number of bone in the skull of man is-  
(A) 14 (B) 29  
(C) 8 (D) 20
8. The only movable bone in the skull is-  
(A) Mandible (B) Maxilla  
(C) Ethmoid (D) None
9. In man coccygeal bone is formed by the fusion of-  
(A) 3 vertebrae (B) 4 vertebrae  
(C) 5 vertebrae (D) 6 vertebrae
10. The total number of vertebrae in man is-  
(A) 33 (B) 32 (C) 35 (D) 45
11. In man, the ribs are attached to-  
(A) Clavicle (B) Sternum  
(C) Scapula (D) Coracoid
12. Movable joints are called-  
(A) Synovial joints (B) Fibrous joints  
(C) Symphysis (D) Cartilaginous joint
13. Articulation of ulna with humerus at the elbow joint is-  
(A) Hinge (B) Ball and socket  
(C) Pivotal (D) Gliding
14. Pivot joint occurs at-  
(A) The hip and shoulder joints  
(B) Between the atlas and the odontoid process of the axis  
(C) Sternoclavicular joints  
(D) Temporomandibular joint
15. Stiffness of joints can be due to the -  
(A) Decrease in synovial fluid  
(B) Increase in synovial fluid  
(C) Higher viscosity of synovial fluid  
(D) None of these
16. A disease associated with joint is-  
(A) Glaucoma (B) Arthritis  
(C) Paget's disease (D) Horner's syndrome
17. Ilium is a bone of-  
(A) Cranium (B) Pectoral girdle  
(C) Pelvic girdle (D) Fore arm
18. Ankle joint is-  
(A) Pivot joint  
(B) Ball and socket joint  
(C) Hinge joint  
(D) Gliding joint
19. Avian (bird) skull is-  
(A) Monocondylic (B) Dicondylic  
(C) Acondylic (D) None of these
20. Coronary process is a part of-  
(A) Upper jaw (B) Lower jaw  
(C) Hyoid apparatus (D) Cranium
21. The only movable bone in the skull is-  
(A) Maxilla (B) Frontoparietal  
(C) Mandible (D) Nasal
22. Which one is bone of fore limb  
(A) Humerus (B) Femur  
(C) Tibia (D) Fibula
23. Number of bones present in human cranium is  
(A) 8 (B) 10  
(C) 12 (D) 16

**Exercise # 2****SINGLE OBJECTIVE****AIIMS LEVEL**

1. Immovable joints are called-  
(A) Sutures (B) Amphiarthroses  
(C) Diarthroses (D) None of the above
2. Glenoid cavity is found in-  
(A) Humerus (B) Pectoral girdle  
(C) Pelvic girdle (D) Skull
3. The number of pairs of true ribs in man is -  
(A) 6 (B) 7  
(C) 9 (D) 10
4. Deltoid ridge of humerus is meant for-  
(A) Articulation  
(B) Attachment of muscles  
(C) Protection  
(D) None of the above
5. Long neck of Camel or Giraffe has-  
(A) Numerous cervical vertebrae  
(B) Development of extra large intervertebral pads  
(C) Longer vertebrae  
(D) Development of extra bony plates between adjacent cervical vertebrae
6. Human vertebral formula is known as-  
(A)  $C_4T_8L_4S_8C_8$  (B)  $C_7T_8L_5S_6C_7$   
(C)  $C_7T_{12}L_5S_4C_5$  (D)  $C_7T_{12}L_5S_{(5)}C$
7. The number of carpals in each fore arm of human beings is-  
(A) 5 (B) 6 (C) 7 (D) 8
8. Patella, the knee cap is the example of-  
(A) Cartilage gland (B) Replacing bone  
(C) Sesamoid bone (D) None of these
9. The joint present in the human neck is-  
(A) Angular (B) Pivot  
(C) Hinge (D) Fibrous
10. Coccygeal bone is formed by the fusion of bones in man-  
(A) 3 vertebrae (B) 6 vertebrae  
(C) 5 vertebrae (D) 4 vertebrae
11. In body membrane surrounding the bone is known as-  
(A) Periosteum (B) Endo-osteum  
(C) Perichondrium (D) Chondriocytes
12. The hardest substance in human body is present in-  
(A) Bone-Ossein (B) Chitin - Protein  
(C) Tooth - Enamel (D) Muscle - Myosin
13. In mammals, the largest vertebra is-  
(A) Cervical (B) Lumbar  
(C) Caudal (D) Sacral
14. Presence of furcula is a characteristics feature of  
(A) Frogs (B) Reptiles  
(C) Birds (D) Mammals
15. Obturator foramen in pelvic girdle of mammals is formed by-  
(A) Pubis and ischium  
(B) Pubis and ilium  
(C) Ilium and ischium  
(D) Ilium, ischium and pubis
16. When joint becomes inflamed and painful, condition is not called-  
(A) Rheumatism (B) Sprain  
(C) Osteoarthritis (D) Gouty arthritis
17. In the ball and socket joint the friction of two bones is lessened by-  
(A) Pericardial fluid (B) Pleural fluid  
(C) Synovial fluid (D) Coelomic fluid
18. Incus is modified-  
(A) Parietal bone (B) Jugal bone  
(C) Quadrate bone (D) Premaxilla bone
19. Heaviest vertebra in man is-  
(A) Atlas (B) Axis  
(C) Thoracic (D) Lumbar
20. Skull is formed of-  
(A) 58 bones (B) 28 bones  
(C) 29 bones (D) None
21. Number of floating ribs in man is-  
(A) 7 pairs (B) 3 pairs  
(C) 1 pair (D) 2 pairs



**Exercise # 3**

**PART - 1**

**MATRIX MATCH COLUMN**

1. Match Column - I with Column - II and select the correct option from the codes given below.

**Column I**

- A. Amoeboid movement
- B. Ciliary movement
- C. Flagellar movement
- D. Muscular movement

**Column II**

- i. Limbs
- ii. Leucocytes
- iii. Trachea
- iv. Spermatozoa

| A       | B   | C   | D   |
|---------|-----|-----|-----|
| (A) iii | ii  | i   | iv  |
| (B) ii  | iii | iv  | i   |
| (C) i   | ii  | iii | iv  |
| (D) iv  | ii  | i   | iii |

2. Match Column - I with Column - II and select the correct option from the codes given below.

**Column - I**

- A. Structural and functional unit of a myofibril
- B. Protein of thin filament
- C. Protein of thick filament
- D. The central part of thick filament not overlapped by thin filament

**Column - II**

- i. H-zone
- ii. Myosin
- iii. Sarcomere
- iv. Actin

|                            |                            |
|----------------------------|----------------------------|
| (A) A-i, B-ii, C-iii, D-iv | (B) A-i, B-iii, C-ii, D-iv |
| (C) A-i, B-iv, C-iii, D-ii | (D) A-iii, B-iv, C-ii, D-i |

3. Match Column - I with Column - II and select the correct option from the codes given below.

**Column - I**

- A. Humerus
- B. Hydrostatic skeleton
- C. Femur

**Column - II**

- i. Thigh
- ii. Upper arm
- iii. Flatworms
- iv. Acetabulum
- v. Glenoid cavity
- vi. Hydra

|                                 |                                 |
|---------------------------------|---------------------------------|
| (A) A-ii, v, B-iii, vi, C-i, iv | (B) A-ii, iv, B-iii, vi, C-i, v |
| (C) A-i, v, B-ii, iv, C-iii, vi | (D) A-iii, vi, B-i, v, C-ii, iv |

4. Match Column - I with Column - II and select the correct option from the codes given below.

**Column I**

- A. Smooth muscle
- B. Tropomyosin
- C. Red muscle
- D. Skull

**Column II**

- i. Myoglobin
- ii. Thin filament
- iii. Sutures
- iv. Involuntary

|                            |                            |
|----------------------------|----------------------------|
| (A) A-iv, B-ii, C-i, D-iii | (B) A-ii, B-iv, C-iii, D-i |
| (C) A-iii, B-i, C-iv, D-ii | (D) A-i, B-iv, C-ii, D-iii |

**Exercise # 4****PART - 1****PREVIOUS YEAR (NEET/AIPMT)**

1. The joint found between sternum and the ribs in humans is [CBSE AIPMT-2000]  
(A) angular joint (B) fibrous joint  
(C) cartilaginous joint (D) gliding joint
2. Which one of the following is a skull bone ? [CBSE AIPMT-2000]  
(A) Atlas (B) Coracoid  
(C) Arytenoid (D) Pterygoid
3. What is sarcomere ? [CBSE AIPMT-2001]  
(A) Part between two H-lines  
(B) Part between two A-lines  
(C) Part between two I-bands  
(D) Part between two Z-lines
4. Which statement is correct for muscle contraction ? [CBSE AIPMT-2001]  
(A) Length of H-zone decrease  
(B) length of A band remains constant  
(C) Length of I-band increases  
(D) Length of two Z--lines
5. What will happen if ligaments are cut or broken ? [CBSE AIPMT-2002]  
(A) Bones will move freely at joints  
(B) No movement at joint  
(C) Bone will become unfixed  
(D) Bone will become fixed
6. ATPase enzyme needed for muscle contraction is located in [CBSE AIPMT-2004]  
(A) actinin (B) troponin  
(C) myosin (D) actin
7. An acromion process is characteristically found in the [CBSE AIPMT-2004]  
(A) pelvic girdle of mammals  
(B) pectoral girdle of mammals  
(C) skull of frog  
(D) sperm of mammals
8. Which of the following pairs, is correctly matched? [CBSE AIPMT-2005]  
(A) Hinge joint - Between vertebrae  
(B) Gliding joint - Between zygapophyses of the successive vertebrae  
(C) Cartilaginous joint - Skull bones  
(D) Fibrous joint - Between phalanges
9. The contractile protein of skeletal muscle involving ATPase activity is [CBSE AIPMT-2006]  
(A) myosin (B) a-actinin  
(C) troponin (D) tropomyosin
10. Which one of the following is the correct pairing of a body part and the kind of muscle tissue that moves it ? [CBSE AIPMT-2009]  
(A) Heart wall - Involuntary unstriated muscle  
(B) Biceps of upper arm - Smooth muscle fibres  
(C) Abdominal wall - Smooth muscle  
(D) Iris - Involuntary smooth muscle
11. Elbow joint is an example of [CBSE AIPMT-2009]  
(A) pivot joint (B) hinge joint  
(C) gliding joint (D) ball and socket joint
12. Select the correct statement regarding the specific disorder of muscular or skeletal system [CBSE AIPMT-2012]  
(A) Muscular dystrophy - Age related shortening of muscles  
(B) Osteoporosis- Decrease in bone mass and higher chances of fractures with advancing age  
(C) Myasthenia gravis - Autoimmune disorder which inhibits sliding of myosin filaments  
(D) Gout - Inflammation of joints due to extra deposition of calcium
13. Select the correct statement with respect to locomotion in humans [CBSE AIPMT-2013]  
(A) A decreased level of progesterone causes osteoporosis in old people  
(B) Accumulation of uric acid crystals in joints causes their inflammation  
(C) The vertebral column has 10 thoracic vertebrae  
(D) The joint between adjacent vertebrae is a fibrous joint

**MOCK TEST**

1. The amoeboid movement results from
  - (A) interactions among actin, myosin and ATP etc
  - (B) coordinated beats of cilia
  - (C) whip like action of flagella
  - (D) action by the mitotic spindle, similar to what happens during mitosis and meiosis.
  
2. The H-zone in the skeletal muscle fibre is due to
  - (A) the central gap between actin filaments extending through myosin filaments in the A-band
  - (B) extension of myosin filaments in the central portion of the A-band.
  - (C) extension of myosin filaments in the central portion of the A-band
  - (D) the central gap between myosin filaments in the A-band.
  
3. Sarcomere is the functional unit of contraction in a muscle fibre. Identify the portion of myofibril that constitute a sarcomere.
  - (A) The portion of myofibril between two successive 'A' band.
  - (B) The portion of myofibril between two successive 'Z' line.
  - (C) The portion of myofibril between two successive 'M' line.
  - (D) The portion of myofibril between two successive 'I' band.
  
4. Muscles of the heart are
 

|  |                                  |
|--|----------------------------------|
| (A) striated and voluntary               | (B) non-striated and voluntary   |
| (C) striated, unbranched and involuntary | (D) non-striated and involuntary |
| (E) striated, branched and involuntary.  |                                  |
  
5. Name the ion responsible for unmasking of active sites for myosin for cross-bridge activity during muscle contraction.
 

|             |               |            |               |
|-------------|---------------|------------|---------------|
| (A) Calcium | (B) Magnesium | (C) Sodium | (D) Potassium |
|-------------|---------------|------------|---------------|
  
6. Anaerobic breakdown of glycogen due to repeated activation of muscles leads to the accumulation of
 

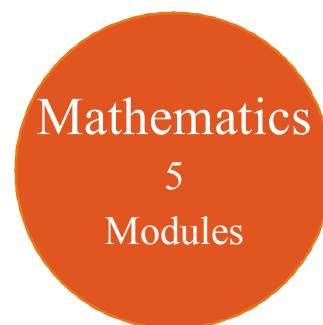
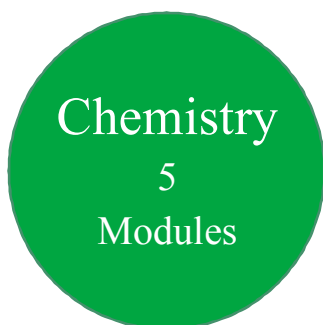
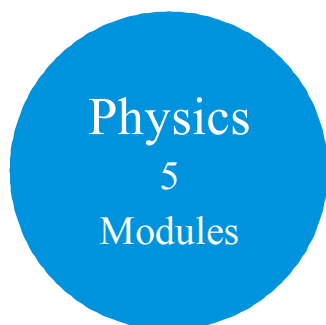
|                |                   |                 |                   |
|----------------|-------------------|-----------------|-------------------|
| (A) uric acid  | (B) phenylalanine | (C) lactic acid | (D) glutamic acid |
| (E) sarcoplasm |                   |                 |                   |
  
7. The collagenous connective tissue layer holding the muscle bundles together is.
 

|                |                 |                |            |
|----------------|-----------------|----------------|------------|
| (A) pleura     | (B) pericardium | (C) sarcolemma | (D) fascia |
| (E) sarcoplasm |                 |                |            |
  
8. Which of the statements about the mechanism of muscle contraction are correct?
  - I. Acetylcholine is released when the neural signal reaches the motor end plate.
  - II. Muscle contraction is initiated by a signal sent by CNS *via* a sensory neuron.
  - III. During muscle contraction, isotropic band gets elongated.
  - IV. Repeated activation of the muscles can lead to lactic acid accumulation.

|                          |                           |                            |                               |
|--------------------------|---------------------------|----------------------------|-------------------------------|
| (A) I and IV are correct | (B) I and III are correct | (C) II and III are correct | (D) I, II and III are correct |
| (E) I and II are correct |                           |                            |                               |
  
9. Which of the following is not a function of the skeletal system?
 

|                                |                         |
|--------------------------------|-------------------------|
| (A) Production of body heat    | (B) Locomotion          |
| (C) Production of erythrocytes | (D) Storage of minerals |

# 11<sup>th</sup> Class Modules Chapter Details



| PHYSICS  | CHEMISTRY   | BIOLOGY  |
|--|---|--|
| <p><b>Module-1</b></p> <ol style="list-style-type: none"> <li>1. Physical World &amp; Measurements</li> <li>2. Basic Maths &amp; Vector</li> <li>3. Kinematics</li> </ol> <p><b>Module-2</b></p> <ol style="list-style-type: none"> <li>1. Law of Motion &amp; Friction</li> <li>2. Work, Energy &amp; Power</li> </ol> <p><b>Module-3</b></p> <ol style="list-style-type: none"> <li>1. Motion of system of particles &amp; Rigid Body</li> <li>2. Gravitation</li> </ol> <p><b>Module-4</b></p> <ol style="list-style-type: none"> <li>1. Mechanical Properties of Matter</li> <li>2. Thermal Properties of Matter</li> </ol> <p><b>Module-5</b></p> <ol style="list-style-type: none"> <li>1. Oscillations</li> <li>2. Waves</li> </ol> | <p><b>Module-1(PC)</b></p> <ol style="list-style-type: none"> <li>1. Some Basic Concepts of Chemistry</li> <li>2. Atomic Structure</li> <li>3. Chemical Equilibrium</li> <li>4. Ionic Equilibrium</li> </ol> <p><b>Module-2(PC)</b></p> <ol style="list-style-type: none"> <li>1. Thermodynamics &amp; Thermochemistry</li> <li>2. Redox Reaction</li> <li>3. States Of Matter (Gaseous &amp; Liquid)</li> </ol> <p><b>Module-3(IC)</b></p> <ol style="list-style-type: none"> <li>1. Periodic Table</li> <li>2. Chemical Bonding</li> <li>3. Hydrogen &amp; Its Compounds</li> <li>4. S-Block</li> </ol> <p><b>Module-4(OC)</b></p> <ol style="list-style-type: none"> <li>1. Nomenclature of Organic Compounds</li> <li>2. Isomerism</li> <li>3. General Organic Chemistry</li> </ol> <p><b>Module-5(OC)</b></p> <ol style="list-style-type: none"> <li>1. Reaction Mechanism</li> <li>2. Hydrocarbon</li> <li>3. Aromatic Hydrocarbon</li> <li>4. Environmental Chemistry &amp; Analysis Of Organic Compounds</li> </ol> | <p><b>Module-1</b></p> <ol style="list-style-type: none"> <li>1. Diversity in the Living World</li> <li>2. Plant Kingdom</li> <li>3. Animal Kingdom</li> </ol> <p><b>Module-2</b></p> <ol style="list-style-type: none"> <li>1. Morphology in Flowering Plants</li> <li>2. Anatomy of Flowering Plants</li> <li>3. Structural Organization in Animals</li> </ol> <p><b>Module-3</b></p> <ol style="list-style-type: none"> <li>1. Cell: The Unit of Life</li> <li>2. Biomolecules</li> <li>3. Cell Cycle &amp; Cell Division</li> <li>4. Transport in Plants</li> <li>5. Mineral Nutrition</li> </ol> <p><b>Module-4</b></p> <ol style="list-style-type: none"> <li>1. Photosynthesis in Higher Plants</li> <li>2. Respiration in Plants</li> <li>3. Plant Growth and Development</li> <li>4. Digestion &amp; Absorption</li> <li>5. Breathing &amp; Exchange of Gases</li> </ol> <p><b>Module-5</b></p> <ol style="list-style-type: none"> <li>1. Body Fluids &amp; Its Circulation</li> <li>2. Excretory Products &amp; Their Elimination</li> <li>3. Locomotion &amp; Its Movement</li> <li>4. Neural Control &amp; Coordination</li> <li>5. Chemical Coordination and Integration</li> </ol> |

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# 12<sup>th</sup> Class Modules Chapter Details

Physics  
5  
Modules

Chemistry  
5  
Modules

Mathematics  
5  
Modules

| PHYSICS  | CHEMISTRY  | BIOLOGY  |
|--|--|--|
| <p><b>Module-1</b></p> <ol style="list-style-type: none"> <li>1. Electrostatics</li> <li>2. Capacitance</li> </ol> <p><b>Module-2</b></p> <ol style="list-style-type: none"> <li>1. Current Electricity</li> <li>2. Magnetic Effect of Current and Magnetism</li> </ol> <p><b>Module-3</b></p> <ol style="list-style-type: none"> <li>1. Electromagnetic Induction</li> <li>2. Alternating Current</li> </ol> <p><b>Module-4</b></p> <ol style="list-style-type: none"> <li>1. Geometrical Optics</li> <li>2. Wave Optics</li> </ol> <p><b>Module-5</b></p> <ol style="list-style-type: none"> <li>1. Modern Physics</li> <li>2. Nuclear Physics</li> <li>3. Solids &amp; Semiconductor Devices</li> <li>4. Electromagnetic Waves</li> </ol> | <p><b>Module-1(PC)</b></p> <ol style="list-style-type: none"> <li>1. Solid State</li> <li>2. Chemical Kinetics</li> <li>3. Solutions and Colligative Properties</li> </ol> <p><b>Module-2(PC)</b></p> <ol style="list-style-type: none"> <li>1. Electrochemistry</li> <li>2. Surface Chemistry</li> </ol> <p><b>Module-3(IC)</b></p> <ol style="list-style-type: none"> <li>1. P-Block Elements</li> <li>2. Transition Elements (d &amp; f block)</li> <li>3. Co-ordination Compound</li> <li>4. Metallurgy</li> </ol> <p><b>Module-4(OC)</b></p> <ol style="list-style-type: none"> <li>1. HaloAlkanes &amp; HaloArenes</li> <li>2. Alcohol, Phenol &amp; Ether</li> <li>3. Aldehyde, Ketone &amp; Carboxylic Acid</li> </ol> <p><b>Module-5(OC)</b></p> <ol style="list-style-type: none"> <li>1. Nitrogen &amp; Its Derivatives</li> <li>2. Biomolecules &amp; Polymers</li> <li>3. Chemistry in Everyday Life</li> </ol> | <p><b>Module-1</b></p> <ol style="list-style-type: none"> <li>1. Reproduction in Organisms</li> <li>2. Sexual Reproduction in Flowering Plants</li> <li>3. Human Reproduction</li> <li>4. Reproductive Health</li> </ol> <p><b>Module-2</b></p> <ol style="list-style-type: none"> <li>1. Principles of Inheritance and Variation</li> <li>2. Molecular Basis of Inheritance</li> <li>3. Evolution</li> </ol> <p><b>Module-3</b></p> <ol style="list-style-type: none"> <li>1. Human Health and Disease</li> <li>2. Strategies for Enhancement in Food Production</li> <li>3. Microbes in Human Welfare</li> </ol> <p><b>Module-4</b></p> <ol style="list-style-type: none"> <li>1. Biotechnology: Principles and Processes</li> <li>2. Biotechnology and Its Applications</li> <li>3. Organisms and Populations</li> </ol> <p><b>Module-5</b></p> <ol style="list-style-type: none"> <li>1. Ecosystem</li> <li>2. Biodiversity and Conservation</li> <li>3. Environmental Issues</li> </ol> |

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