1. Skeletal System is formed of bones, cartilages, joints and ligaments. Skeleton is mainly formed of bones. Cartilages form a small fraction and lie in isolated places. Ligaments join bones to bones and help to reinforce joints. Ligaments allow movements in certain directions but restrict them in other directions. Skeletal system accounts for 20% of body mass.

2. **Axial Skeleton** forms the longitudinal axis of body and is formed of Skull, vertebral column and bony thorax. It is formed of 80 bones. It supports head, neck, and trunk. It protects brain, spinal cord, heart, and lungs. **Fig 6.9**

3. **Skull**: is the most complex bony structure in human body. It is formed of Cranium and facial bones.

4. **Cranium** is formed of 8 bones. Frontal – 1, shell-shaped bone covering forehead; Parietal – 2 large rectangular bones form most of the superior and lateral cranial vault; Occipital – 1, forms the posterior wall and base of the skull; Temporal – 2, form inferolateral aspects of skull and parts of cranial floor; Sphenoid – 1 butterfly shaped median bone with wings extended to surface forming part of orbit and also seen in front of temporal; Ethmoid – 1 median bone, forms the deep most part of skull, lies between sphenoid and nasals.

5. **Special Structures associated with cranial bones**: a) Occipital – foramen magnum - spinal cord passes through it; occipital condyles - atlas = C1 articulates with skull b) Temporal -- external acoustic = auditory meatus - leads to tympanum; jugular foramen and carotid canal c) Sphenoid – Sella turcica - a saddle shaped structure that houses pituitary gland d) Ethmoid – Crista galli - a triangular part anchors brain membranes; Cribriform plates - form the roof of nasal cavity and floor of anterior fossa of cranium; superior and middle conchae are formed of ethmoid.

6. **Sinuses** – frontal, ethmoid, sphenoid and maxilla of face **Fig 6.13**

7. 4 major **Sutures** of parietals – Sagittal between 2 parietals; Coronal or frontal between parietals and frontal; Lambdoid between parietals and occipital; Squamous between parietals and temporal **Fig 6.10, 6.11**

8. **Face** is formed of 14 bones – 1 mandible, 2 maxilla, 2 zygomatic, 2 nasal, 2 lacrimal, 2 palatine, 1 vomer and 2 inferior conchae. **Mandible** is the lower jaw. It has mandibular condyles to articulate with temporal bone. It has coronoid processes and sockets for teeth. **Maxilla** is the keystone bone of face-it articulates with most others. It forms upper jaw, most part of hard palate. **Zygomatic** – cheek bones, articulate with zygomatic processes of temporal, frontals and maxilla; **Nasal** – 2 nasal are fused anteriorly to form nose bridge; **Lacrimal** – are delicate bones and form part of medial wall of orbit and articulate with frontal, ethmoid and maxilla; **Palatine** – form posterior part of palate and inferior part of orbits; **Vomer** – plow shaped bone lies in nasal cavity and forms the part of nasal septum, part is formed by ethmoid; **Inferior Nasal Conchae** – are thin curved bones grow medially from the lateral wall of nasal cavity just inferior to superior and middle nasal conchae formed by ethmoid. **Fig 7.10a**

9. **The Orbits** are sockets for eye balls. Each orbit is formed of 7 bones. Superior – frontal; lateral – zygomatic; inferior – zygomatic, maxilla, palatine; medial – lacrimal, sphenoid, ethmoid. Optic canal is part of ethmoid. **Fig 7.9**. The lacrimal glands are lodged superolateral to eye balls. **Fig 15.2**

10. **Nasal cavities** are, like orbits, complex skeletal structures formed of bone and hyaline cartilage.
11. **Hyoid bone (U-shaped)** is the only stand alone bone in body and is present inferior to mandible and superior to larynx. It is fixed to styloid processes of temporal via ligaments. It serves as the base of tongue and has attachments for muscles that move larynx up and down for swallowing.

12. **3 Auditory Ossicles** are small ear bones malleus, stapes and incus. These are tiny bones in each ear and help pass sound waves from tympanum to internal ear.

13. Total # of bones in head: skull 22 + ear bones 6 + hyoid bone 1 = 29

14. **Vertebral Column** is formed of 26 bones. 7 cervical + 12 Thoracic + 5 Lumbar + 1 sacrum + 1 coccyx.

15. **A typical vertebra** has a solid Body or centrum. A neural arch is present superior to it and surrounds vertebral foramen. A median superior neural spine is present. 2 lateral Transverse processes. Spinous process and transverse processes provide surface for muscle attachment. Each vertebra has superior and inferior articular processes. **Fig 6.16** gives a comparison of typical cervical, thoracic and lumbar vertebrae.

16. **Intervertebral discs** are formed of fibrocartilage and are very compressible and help in shock absorption but resist extension.

17. Lumbar vertebrae are stoutest because they carry maximum mass of body.

18. Sacrum articulates with hip girdle and is formed of 5 fused vertebrae. The last 4 vertebrae are fused to form Coccyx that represents tail.

19. **Atlas of C-1** is ring like and lacks a body. Nodding of the head requires the muscles attached to skull and transverse processes of atlas. **Axis (C-2)** vertebra has a knob like Dens projecting anteriorly. During rotation of skull atlas lock with skull but moves around dens and cause rotation of head – a pivot movement. Thoracic vertebrae articulate with ribs at 2 places – head and tubercle. Head of the rib articulates with the body of 2 adjacent vertebrae. Tubercle of the rib articulates with transverse process. **Fig 6.17**

<table>
<thead>
<tr>
<th>Table 7.2</th>
<th>Cervical Vertebrum</th>
<th>Thoracic Vertebrum</th>
<th>Lumbar Vertebrum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body</td>
<td>Small laterally extended</td>
<td>Large, heart shaped</td>
<td>Very large kidney shaped</td>
</tr>
<tr>
<td>Spinous process</td>
<td>Small bifid, posteriorly directed</td>
<td>Long inferiorly directed</td>
<td>Short, blunt, posteriorly directed</td>
</tr>
<tr>
<td>Transverse process</td>
<td>Medium, foramen present</td>
<td>Short, articulate with tubercle of rib</td>
<td>Long, lateral directed</td>
</tr>
</tbody>
</table>

20. **Sacrum**: 5 vertebrae fuse to form Sacrum. The 1st vertebrae had longest and stoutest transverse processes and then transverse processes diminish inferiorly in size. Sacrum articulates via auricular surfaces with the hip bone. It articulates superiorly with L5 and inferiorly with coccyx. It has sacral canal for spinal cord/nerves and a posterior median sacral crest. 4 pairs of anterior foramina are also present in the sacrum. **Fig 6.19**

21. **Coccyx** represents the 4 fused vertebrae of tail.
22. **Bony Thorax or Thoracic Cage** is formed dorsally/posteriorly of 12 thoracic vertebrae, vertebral ribs laterally and anteriorly with sternum and costal cartilages. Fig 6.20

23. **Sternum**: is the breast bone. It has 3 parts – a superior Manubrium, a middle Body and an inferior Xiphoid process. It articulates superiorly with a clavicle = collar bone on each side. Individual costal cartilages fix superior 1-7 pairs of vertebral ribs to sternum. Next 3 pairs join to the costal cartilage superior to it. Last 2 pairs do not attach at all.

24. **True Ribs** = 1-7 pairs, also called Vertebrosternal ribs. **False Ribs** = 8-12 pairs. 8-10 pairs of ribs are called Vertebrochondral ribs. **Floating Ribs** = 11-12 pairs.

25. **Total bones in Axial Skeleton**: 29 (8 cranial +14 facial +6 ear+1 hyoid) + 51 (26 vertebral + 1 sternum + 24 ribs) = 80