

The Skeleton

Outline

PART 1: THE AXIAL SKELETON

- I. The skull consists of 8 cranial bones and 14 facial bones (pp. 200–218; Figs. 7.1–7.18; Table 7.1).
 - A. The cranial and facial bones form the framework of the face, and contain cavities for special sense organs, provide openings for air and food passage, secure the teeth, and anchor muscles of facial expression. (p. 200)
 - B. Except for the mandible, which is joined to the skull by a movable joint, most skull bones are flat bones joined by interlocking joints called sutures. (p. 200)
 - C. Overview of Skull Geography (pp. 200–201)
 1. The anterior aspect of the skull is formed by facial bones, and the remainder is formed by a cranium, which is divided into the cranial vault, or calvaria, and cranial base.
 2. The cavities of the skull include the cranial cavity (houses the brain), ear cavities, nasal cavity, and orbits (house the eyeballs).
 3. The skull has about 85 named openings that provide passageways for the spinal cord, major blood vessels serving the brain, and the cranial nerves.
 - D. Cranium (pp. 201–210; Figs. 7.1–7.10; Table 7.1).
 1. The cranium consists of eight strong, superiorly curved bones. For diagrams, and detailed descriptions of the functions of each bone or structure, refer to pages listed in D, above.

Cranium		
Bone	Location/Part of Cranium Formed	Key Structures
Frontal	Anterior cranium	Supraorbital margins
	Forehead	Glabella
	Superior wall of orbits	Frontal sinus
	Anterior cranial fossa	Coronal suture
Parietal	Superior/lateral cranium	Sagittal suture
	Cranial vault	Lambdoid suture
		Squamous suture
Occipital	Posterior cranium/cranial base	Foramen magnum
	Posterior cranial fossa	Occipital condyles
		External occipital protuberance
		Lambdoid suture

		Occipitomastoid suture
Tempo- ral	Inferior/lateral cranium	Squamous part
		Zygomatic process
		Mandibular fossa
		Tympanic part
		External acoustic meatus
		Petrous part
		Jugular foramen
		Carotid canal
		Foramen lacerum
		Internal acoustic meatus
		Mastoid process
Styloid process		
Sphe- noid	Width of cranial fossa	Body
		Sphenoid sinuses
		Sella turcica
		Greater wings
		Lesser wings
		Pterygoid process
		Optic canals
Superior orbital fissure		
Eth- moid	Bony area between nasal cavity and orbits	Cribriform plate
		Crista galli
		Perpendicular plate
		Superior/middle nasal conchae
		Orbital plates

E. Facial Bones (pp. 210–212; Fig. 7.11; Table 7.1)

The facial skeleton is made up of 14 bones, of which only the mandible and vomer are unpaired. For diagrams, and detailed descriptions of the functions of each bone or structure, refer to pages listed in E, above.

Facial Bones		
Bone	Location	Key Structures
Mandible	Lower jawbone	Ramus Mandibular angle Mandibular notch Coronoid process Condylar process Body Alveolar process Mental foramina
Maxillary bones	Upper jaw, central portion of the facial skeleton	Alveolar process Anterior nasal spine Palatine process Maxillary sinuses Inferior orbital fissure
Zygomatic	Cheekbones	
Nasal	Bridge of nose	
Lacrimal	Part of the medial wall of the orbits	Lacrimal fossa
Palatine	Posterior portion of the hard palate	Horizontal plates Perpendicular plate
Vomer	Forms the nasal septum	
Inferior Nasal Conchae	Form part of the lateral wall of the nasal cavity	

- F. The hyoid bone lies inferior to the mandible in the anterior neck. It is the only bone that does not articulate directly with any other bone (p. 212; Fig. 7.12).
- G. *Special Characteristics of the Orbits and Nasal Cavity* (pp. 212–215; Figs. 7.13–7.15; Table 7.1)
1. The orbits are bony cavities that contain the eyes, muscles that move the eyes, and tear-producing glands.
 2. The nasal cavity is constructed of bone and hyaline cartilage, covered by a mucous membrane that serves to warm and moistened inhaled air, and

trap debris. For diagrams, and detailed descriptions of the functions of each bone or structure, refer to pages listed in *G*, above.

Special Characteristics of the Orbits and Nasal Cavity		
	Location Within Orbit	Bone
Orbits	Roof	Frontal Sphenoid
	Lateral wall	Frontal Sphenoid Zygomatic
	Medial wall	Sphenoid Ethmoid Maxilla Lacrimal
	Floor	Palatine Maxilla Zygomatic

	Location Within Nasal Cavity	Bones/Structures
Nasal Cavity	Roof of cavity	Cribriform plate
	Lateral wall	Cribriform plate Superior, middle, inferior nasal conchae Inferior nasal conchae Perpendicular plate of palatine bones
	Depressions beneath conchae	Superior, middle, and inferior meatuses
	Floor of cavity	Palatine process of the maxilla Palatine process of the palatine bones
	Nasal septum	Vomer Perpendicular plate of ethmoid Septal cartilage

4. Paranasal sinuses, located within the frontal, sphenoid, ethmoid, and maxillary bones, are air-filled spaces, lined with a mucous membrane, that are clustered around the nasal cavity that lighten the skull and enhance resonance of the voice.
- II. The vertebral column is a flexible curved support structure (pp. 218–224; Figs. 7.16–7.22; Table 7.2)
- A. General Characteristics (pp. 218–220; Figs. 7.16–7.18)
1. The vertebral column consists of 26 irregular bones, forming a flexible, curved structure extending from the skull to the pelvis that surrounds and protects the spinal cord and provides attachment for ribs and muscles of the neck and back.
 2. Divisions and Curvatures
 - a. The vertebrae of the spine fall in five major divisions: seven cervical, twelve thoracic, five lumbar, five fused vertebrae of the sacrum, and four fused vertebrae of the coccyx.
 - b. The curvatures of the spine increase resiliency and flexibility of the spine.
 - c. The cervical and lumbar curvatures are concave posteriorly, and the thoracic and sacral curvatures are convex posteriorly.
 3. The major supporting ligaments of the spine are the anterior and posterior longitudinal ligaments, which run as continuous bands down the front and back surfaces of the spine, supporting the spine and preventing hyperflexion and hyperextension.
 4. Intervertebral discs are cushion-like pads that act as shock absorbers and allow the spine to flex, extend, and bend laterally.
- B. General Structure of Vertebrae (p. 220; Fig. 7.19)
1. For diagrams, and detailed descriptions of the functions of each structure, refer to pages listed in B, above.

General Structure of Vertebrae		
Main Features	Composite Features of the Vertebral Arch	Structures Derived from the Vertebral Arch
Body		
Vertebral arch		
	Pedicles	
		Transverse process
		Superior articular process
		Inferior articular process
	Lamina	
		Spinous process
Vertebral foramen		

Intervertebral
foramen

C. Regional Vertebral Characteristics (pp. 221–224; Figs. 7.20–7.22; Table 7.2)

1. For diagrams, and detailed descriptions of the functions of each structure, refer to pages listed in C, above.

Regional Vertebral Characteristics				
Type	Number	Special Features	Special Vertebrae	Special Features
Cervical	7	Small, oval body	Atlas (C1)	No body or spinous process
		Except for C7, short, directly backward-projecting, bifurcate spinous process.	Axis (C2)	Dens
		Large, triangular vertebral foramen		
		Transverse foramen in each transverse process.		
Thoracic	12	Heart-shaped body		
		Circular vertebral foramen		
		Long, downward-pointed spinous process		
		Transverse costal facets on most spinous processes		
		Superior and inferior articular facets face the frontal plane		
Lumbar	5	Massive, kidney-shaped bodies		
		Short, thick pedicles and laminae		
		Short, flat, hatchet-shaped spinous processes		

		Triangular vertebral foramen		
		Superior and inferior articular facets posteromedial and anterolateral		
Sacrum	5 fused	Auricular surfaces articulate with the coxae to form the sacroiliac joint		
		Sacral promontory		
		Anterior and posterior sacral foramina		
		Sacral canal		
		Sacral hiatus		
Coccyx	4 fused			

III. The thoracic cage is the bony structure of the chest (pp. 224-227; Figs. 7.23-7.24)

A. The thoracic cage consists of the thoracic vertebrae dorsally, the ribs laterally, and the sternum and costal cartilages anteriorly, forming a protective cage around the organs of the thoracic cavity, and providing support for the shoulder girdles and upper limbs. For diagrams, and detailed descriptions of the functions of each structure, refer to pages listed in III, above. (p. 225; Fig. 7.23)

Thoracic Cage			
	Bone Parts	Structures	Joints
Sternum	Manubrium	Clavicular notches	
		Jugular notch	
			Sternal angle
	Body		
			Xiphisternal angle
	Xiphoid process		

	Type	Attachment	Structures
Ribs 1-7	True ribs	Sternum	Head
			Neck
			Tubercle
Ribs 8-10	False ribs	Costal cartilage	
Ribs 11-12	False ribs	None	Floating ribs

PART 2: THE APPENDICULAR SKELETON

- IV. Each pectoral girdle consists of a clavicle and a scapula (pp. 227-229; Figs. 7.25-7.27; Table 7.3)
- A. For diagrams, and detailed descriptions of the functions of each structure, refer to pages listed in IV, above.

Pectoral Girdle		
Bone	Location	Key Structures
Clavicle	Collarbone	Sternal end
		Acromial end
Scapula	Shoulder blade	Superior border
		Medial border
		Lateral border
		Superior angle
		Lateral angle
		Inferior angle
		Glenoid cavity
		Spine
		Acromion
		Coracoid process
		Infraspinous fossa
		Supraspinous fossa
		Subscapular fossa

- V. The upper limb consists of the arm, forearm, and hand (pp. 230-236; Figs. 7.28-7.30; Table 7.3)
- A. For diagrams, and detailed descriptions of the functions of each structure, refer to pages listed in V, above.

Upper Limb		
Bone	Location	Key Structures
Humerus	Arm	Head
		Greater tubercle
		Lesser tubercle
		Deltoid tuberosity
		Surgical neck
		Trochlea
		Capitulum
		Medial epicondyle
		Lateral epicondyle
		Coronoid fossa
		Radial fossa
Olecranon fossa		
Ulna	Medial forearm	Olecranon
		Coronoid process
		Trochlear notch
		Radial notch
		Styloid process
Radius	Lateral forearm	Head
		Radial tuberosity
		Ulnar notch
Carpals	Wrist	Styloid process
		Scaphoid
		Lunate
		Triquetrum
		Pisiform
		Trapezium
		Trapezoid
		Capitate
Hamate		
Metacarpals	Hand	Base

	Number 1-5, from thumb to little finger	Head
Phalanges	Digits 1-5	Proximal
	Digits 2-5	Middle
	Digits 1-5	Distal

- VI. The hip bones attach to the sacrum, forming the pelvic girdle (pp. 236-239; Figs. 7.31-7.32; Tables 7.4-7.5)
- A. For diagrams, and detailed descriptions of the functions of each structure, refer to pages listed in VI, above.

Pelvic Girdle			
	Bone	Location	Key Structures
Coxa	Ilium	Superior	Acetabulum
			Body
			Ala Iliac crest Anterior superior iliac spine Anterior inferior iliac spine Greater sciatic notch
			Iliac fossa Auricular surface
	Ischium	Posteroinferior	Body Ramus Ischial spine Lesser sciatic notch Ischial tuberosity
	Pubis	Anteroinferior	Body Superior pubic ramus Inferior pubic ramus Pubic crest Obturator foramen Pubic symphysis

			Pubic arch
			Subpubic angle

E. Pelvic Structure and Childbearing (p. 238; Table 7.4)

1. The female pelvis tends to be wider, shallower, lighter, and rounder than the male pelvis, as a modification for childbearing.
2. The pelvis consists of a false pelvis, which is part of the abdomen and helps support the viscera, and a true pelvis, which is completely surrounded by bone and contains the pelvic organs.

VII. The lower limb consists of the thigh, leg, and foot (pp. 240–245; Figs. 7.33–7.36; Table 7.5)

A. For diagrams, and detailed descriptions of the functions of each structure, refer to pages listed in VII, above.

Lower Limb		
Bone	Location	Key Structures
Femur	Thigh	Head
		Fovea capitis
		Greater trochanter
		Lesser trochanter
		Linea aspera
		Medial condyle
		Lateral condyle
		Medial epicondyle
		Lateral epicondyle
		Patellar surface
		Intercondylar fossa
Patella	Knee	
Tibia	Medial leg	Medial condyle
		Lateral condyle
		Tibial tuberosity
		Anterior border
		Medial malleolus
		Fibular notch
Fibula	Lateral leg	Head
		Lateral malleolus
Tarsals	Ankle	Calcaneus

		Talus
		Cuboid
		Navicular
		Medial cuneiform
		Intermediate cuneiform
		Lateral cuneiform
Metatarsals	Foot	Number 1-5, from hallux to little toe
Phalanges	Digits 1-5	Proximal phalanges
	Digits 2-5	Middle phalanges
	Digits 1-5	Distal phalanges

4. There are three arches of the foot, the medial and lateral longitudinal arches, and the transverse arch, which are maintained by interlocking of the foot bones, and pulling forces of tendons and ligaments.

VIII. Developmental Aspects of the Skeleton (pp. 246-247; Figs. 7.37-7.40)

- A. Membrane bones of the skull begin to ossify late in the second month of development. (p. 244)
- B. At birth, skull bones are connected by fontanelles, unossified remnants of fibrous membranes. (p. 244; Fig. 7.37)
- C. Changes in cranial-facial proportions and fusion of bones occur throughout childhood. (pp. 246-247; Fig. 7.39)
 1. At birth, the cranium is much larger than the face, and several bones are still unfused.
 2. By nine months, the cranium is half the adult size due to rapid brain growth.
 3. By age 8-9, the cranium has reached almost adult proportions.
 4. Between ages 6-13, the jaws, cheekbones, and nose become more prominent, due to expansion of the nose, paranasal sinuses, and development of permanent teeth.
- D. Curvatures of the Spine (pp. 246-247; Figs. 7.38, 740)
 1. The primary curvatures (thoracic and sacral curvatures) are convex posteriorly and are present at birth.
 2. The secondary curvatures (cervical and lumbar curvatures) are convex anteriorly and are associated with the child's development.
 3. The secondary curvatures result from reshaping the intervertebral discs as the baby begins to lift its head and learns to walk.
- E. Changes in body height and proportion occur throughout childhood. (pp. 246-247; Fig. 7.39)
 1. At birth, the head and trunk are roughly $1\frac{1}{2}$ times the length of the lower limbs.
 2. The lower limbs grow more rapidly than the trunk, and by age 10, the head and trunk are about the same length as the lower limbs.

3. During puberty, the female pelvis widens, and the male skeleton becomes more robust.
- F. In old age, the intervertebral discs become thinner, less hydrated, and less elastic, the thorax becomes more rigid as the costal cartilages calcify, and bones lose bone mass with age, becoming more porous. (p. 247).