Introduction

- The axial skeleton:
  - Functions as a framework that supports and protects organs in the dorsal and ventral body cavities
  - Contains the special sense organs for taste, smell, hearing, balance, and vision
  - Attachment sites for muscles that
    - Adjust the posture of the head, neck, and trunk
    - Move the thoracic cage for respiration
    - Stabilize the appendicular skeleton
Figure 6.1  The Axial Skeleton

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Figure 6.2  Cranial and Facial Subdivisions of the Skull

The Skull and Associated Bones

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The Skull and Associated Bones

Figure 6.3a  The Adult Skull (Posterior View)
Figure 6.3a  The Adult Skull (Posterior View)
Figure 6.3a  The Adult Skull (Posterior View)
The Skull and Associated Bones

Figure 6.3b  The Adult Skull (Superior View)
Figure 6.3c  The Adult Skull (Lateral View)
Figure 6.3c  The Adult Skull (Lateral View)
Figure 6.3d The Adult Skull (Anterior View)
Figure 6.3d  The Adult Skull (Anterior View)
Figure 6.4    Sectional Anatomy of the Skull, Part I
Figure 6.4  Sectional Anatomy of the Skull, Part I
Bones of the Cranium

- The cranial cavity is a fluid-filled chamber that supports and protects the brain. It is made up of the
  - Occipital
  - Parietal (2)
  - Frontal
  - Temporal (2)
  - Sphenoid
  - Ethmoid
Figure 6.6a  The Occipital Bones
Figure 6.6b  The Occipital Bones
Figure 6.3e  The Adult Skull (Inferior View)
Figure 6.3e  The Adult Skull (Inferior View)
The Parietal Bones

Border of sagittal suture

Parietal eminence

Superior temporal line

Inferior temporal line

Border of squamous suture

(c) Parietal bone, external surface

Figure 6.6 The Parietal Bones
The Skull and Associated Bones

Figure 6.7a  The Frontal Bone

(a) External surface

- Squamous part (squamous surface)
- Frontal (metopic) suture
- Superior temporal line
- Superciliary arch
- Supra-orbital margin
- Supra-orbital notch
Figure 6.7b  The Frontal Bone

- Supra-orbital foramen
- Supra-orbital margin
- Frontal air cells
- Lacrimal fossa
- Orbital part (orbital surface)

(b) Inferior surface
Figure 6.7c  The Frontal Bone
Figure 6.8a,b  The Temporal Bone

(a) Right temporal bone, lateral view

- External acoustic meatus
- Mastoid process
- Styloid process

(b) The mastoid air cells

- External acoustic meatus
- Tympanic part
- Mastoid process, cut to show mastoid air cells

Squamous part (squama)

Mandibular fossa

Articular tubercle

Zygomatic process

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Figure 6.8c  The Temporal Bone

Articular tubercle
Mandibular fossa
External acoustic meatus
Mastoid process
Mastoid foramen
Zygomatic process
Styloid process
Carotid canal
Jugular fossa
Stylomastoid foramen

(c) Right temporal bone, inferior view
Figure 6.8d  The Temporal Bone

(d) Right temporal bone, medial view
Figure 6.9a  The Sphenoid
Figure 6.9b  The Sphenoid
Figure 6.10  The Ethmoid
Figure 6.11a  The Cranial Fossae
Figure 6.11b  The Cranial Fossae
The Skull and Associated Bones

- Bones of the Face
  - The skull contains 14 total facial bones.
    - The facial bones included the paired bones named the
      - Maxillae
      - Palatine
      - Nasal
      - Zygomatic
      - Lacrimal
      - Inferior nasal conchae
  - Single bones of the face are the
    - Vomer
    - Mandible
The Skull and Associated Bones

Figure 6.12a,b The Maxillae
Figure 6.12c  The Maxillae
Figure 6.13a  The Palatine Bones
Figure 6.13b,c  The Palatine Bones

- Orbital process
- Ethmoidal crest
- Perpendicular plate
- Conchal crest
- Horizontal plate

(b) Palatine bone, medial view

(c) Palatine bone, lateral view
Figure 6.15  The Orbital Complex
The Skull and Associated Bones

Figure 6.5  Sectional Anatomy of the Skull, Part II
Figure 6.5  Sectional Anatomy of the Skull, Part II
Figure 6.14a  The Mandible
Figure 6.14b  The Mandible
The Skull and Associated Bones

Figure 6.16a,b The Nasal Complex

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Figure 6.16c    The Nasal Complex
Figure 6.16d  The Nasal Complex
The Skull and Associated Bones

- The Nasal Complex
  - *Paranasal sinuses* are the interconnected hollow spaces inside the frontal, ethmoid, sphenoid, and maxillary bones.
  - These spaces reduce the weight of the skull, produce mucus, and allow air to resonate for voice production.
  - These paranasal sinuses are called the frontal sinus, maxillary sinus, sphenoidal sinus, and the ethmoidal air cells.
The Hyoid Bone

Figure 6.17 The Hyoid Bone

Stylohyoid ligament
Stylohyoid muscle
Digastric muscle (posterior belly)
Thyrohyoid ligament
Greater horn
Lesser horn
Mandible
Styloid process (temporal bone)
Mastoid process (temporal bone)

(a) Anterior view

Greater horn
Lesser horn
Body

(b) Hyoid bone, anterosuperior view
Review of the Skull

22 Bones of the Skull

- 8 form the cranium:
  - Occipital
  - Parietal (2)
  - Frontal
  - Temporal (2)
  - Sphenoid
  - Ethmoid

- 14 total facial bones:
  - Paired bones
    - Maxillae
    - Palatine
    - Nasal
    - Zygomatic
    - Lacrimal
    - Inferior nasal conchae
  - Single bones
    - Vomer
    - Mandible
Figure 6.18a  The Skull of an Infant
Figure 6.18b  The Skull of an Infant
Figure 6.18c  The Skull of an Infant
Figure 6.18d  The Skull of an Infant

Sagittal suture
Parietal bone
Posterior fontanel
Lambdoid suture
Occipital bone

(d) Posterior view
The Vertebral Column

- The adult vertebral column is made up of 26 bones:
  - 24 vertebra, 1 sacrum, and 1 coccyx
- The vertebral column performs several functions:
  - Encloses and protects the spinal cord
  - Supports the skull
  - Supports the weight of the head, neck, and trunk
  - Transfers weight to the lower limbs
  - Helps maintain the upright position of the body
The vertebral column is divided into regions. From superior to inferior, they are:

- Cervical (7)
- Thoracic (12)
- Lumbar (5)
- Sacral (1) 5 fused vertebrae
- Coccygeal (1) 3–5 fused vertebrae
Spinal curves are weight-transferring anterior and posterior curves. The spinal curves are named for the region of the vertebral column they occur in.

- Cervical curve
- Thoracic curve
- Lumbar curve

Sacral curve
The Vertebral Column

- **Spinal Curves**
  - *Primary curves* / accommodation curves are the posteriorly sweeping curves of the thoracic and sacral regions.
    - These curves develop before birth to allow the abdominopelvic viscera more room.
  - *Secondary curves* / compensation curves develop in the infant and toddler as anteriorly sweeping curves of the cervical and lumbar regions.
    - These curves develop as the infant learns to hold up his or her head (cervical) and begins to walk (lumbar).
The Vertebral Column

Figure 6.19a,b  The Vertebral Column

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Figure 6.19c  The Vertebral Column

(c) MRI scan (sagittal section)

Thoracic vertebrae
Lumbar vertebrae
Intervertebral disc
Sacral vertebrae

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Figure 6.19d  The Vertebral Column

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(a) Kyphosis  (b) Lordosis  (c) Scoliosis

Figure 6.20  Abnormal Curves of the Vertebral Column
The Vertebral Column

Figure 6.21a-c  Vertebral Anatomy
Figure 6.21d,e Vertebral Anatomy
Cervical Vertebrae

- 7 total cervical vertebrae are the smallest, most superior vertebrae.
- The spinous processes are relatively stumpy and may be split, resulting in a bifid process.
- Costal processes are extra extensions of bone from the ventrolateral body that attach to the transverse processes.
- Transverse foramina result from the hole between the costal process and the transverse process.

PLAY Typical Cervical Vertebrae
Figure 6.22a,b  Cervical Vertebrae

Vertebral Column
Figure 6.22c  Cervical Vertebrae
The Vertebral Column

Figure 6.22d  Cervical Vertebrae

(d) X-ray of superior cervical vertebrae, anterior-posterior view
The Vertebral Column

- The Atlas (C₁)
  - The *atlas* has no body and articulates cranially with the *occipital condyles*.
    - The articulations with the occipital condyles allow one to shake his or her head “yes.”
  - The atlas has two arches—the anterior and posterior *vertebral arches*.
  - Superior and inferior *articular facets* do not extend beyond the arches.
Figure 6.23a  Atlas (Superior view) and 6.23b Atlas (Inferior View)
The Vertebral Column

- The Axis ($C_2$)
  - The body of the atlas fuses with the body of the axis during development to form the *dens* (odontoid process).
    - Because of the dens, there is no intervertebral disc.
  - The articulation between the atlas and axis allows one to shake his or her head “no.”
Figure 6.23a  Axis (Superior View) and 6.23b Axis (Inferior View)
The Vertebral Column

Figure 6.23e  The Articulated Atlas (Superior and Posterior Views)

(e) Articulated atlas and axis, superior and posterior view

(f) The articulated atlas and axis; note the location and orientation of the transverse ligament
Vertebra Prominens (C₇)

- The last cervical vertebrae, and therefore resembles the thoracic vertebra in structure
- This vertebra has a long, slender spinous process, and enlarged transverse processes that may or may not contain a transverse foramen.
- An elastic ligament called the ligamentum nuchae extends from the spinous process cranially to the occipital crest.
The Vertebral Column

- **Thoracic Vertebrae**
  - 12 total *thoracic vertebrae* make up the posterior of the rib cage.
  - The bodies of the thoracic vertebrae have a heart shape.
  - The spinous process is long and slender and points on a posterocaudal angle.
  - The transverse processes point dorsolateral.
  - The thoracic vertebrae articulate with ribs and therefore contain extra facets.
Figure 6.24a,b  Thoracic Vertebrae
Figure 6.24c  Thoracic Vertebrae
Figure 6.24d  Thoracic Vertebrae
The Vertebral Column

- **Lumbar Vertebrae**
  - 5 total *lumbar vertebrae* are the largest vertebrae, and they make up the lower back region.
  - The body of lumbar vertebrae is very thick and oval shaped.
  - The relatively small vertebral foramen is triangular.
  - The transverse processes point more laterally than the thoracic vertebrae.
  - The spinous process resembles a tail fin of a fish, stumpy and flattened.

Typical Lumbar Vertebrae
Figure 6.25a  Lumbar Vertebrae

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Figure 6.25b  Lumbar Vertebrae

Superior articular facet, Spinous process, Lamina, Superior articular process, Transverse process, Pedicle, Vertebral foramen, Vertebral body.
Figure 6.26  The Sacrum and Coccyx
The Thoracic Cage

- The **thoracic cage** has two functions:
  - It protects the heart, lungs, thymus, and other structures within the cavity.
  - It serves as the attachment site for muscles involved in
    - Respiration
    - Positioning the vertebral column
    - Movements of the pectoral girdle and upper limb
The Thoracic Cage

Figure 6.27a  The Thoracic Cage

(a) Anterior view
Figure 6.27b  The Thoracic Cage
Figure 6.27c  The Thoracic Cage
(d) Posterior view

Figure 6.27d   The Thoracic Cage

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Figure 6.27  The Thoracic Cage