

Principles of Anatomy and Physiology
14th Edition
Gerard J. Tortora / Bryan Derrickson
WILEY

CHAPTER 7
The Skeletal System:
The Axial Skeleton

Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

Divisions of the Skeletal System

The human skeleton consists of 206 named bones grouped into two principal divisions:

- **Axial skeleton** (80 bones)
- **Appendicular skeleton** (126 bones)

Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

Divisions of the Skeletal System

The axial skeleton:

- Skull bones, auditory ossicles (ear bones), hyoid bone, ribs, sternum (breastbone), and bones of the vertebral column.

The appendicular skeleton:

- Bones of the upper and lower limbs (extremities) and the bones forming the girdles that connect the limbs to the axial skeleton.

Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

Divisions of the Skeletal System

Anatomy Overview:

The Skeletal System

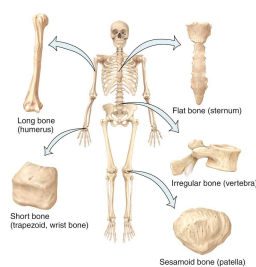
You must be connected to the Internet and in Slideshow Mode to run this animation.

Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

Types of Bones

Almost all bones are classified into 5 main types based on shape:

- Long (greater length than width)
- Short (cube shaped)
- Flat (thin layers of parallel plates)
- Irregular (complex shapes)
- Sesamoid (shaped like a sesame seed)

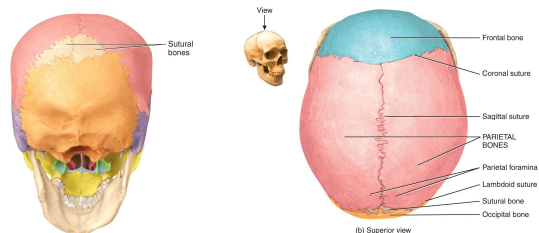


Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

Types of Bones

Sutural bones are small, extra bone plates located within the sutures of cranial bones.

Sutures are the jointed areas where flat bones come together.



Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

Bone Surface Markings

Bones have characteristic surface markings – structural features adapted for specific functions.

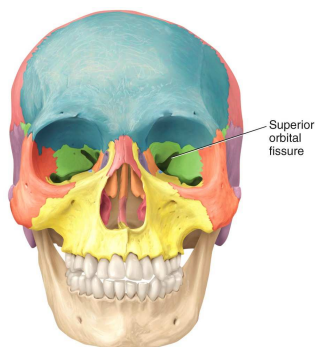
There are two major types of surface markings:

- Depressions and openings
 - Allow the passage of soft tissues
 - Form joints
- Processes
 - Projections or outgrowths that form joints
 - Serve as attachment points for ligaments and tendons

Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

Bone Surface Markings

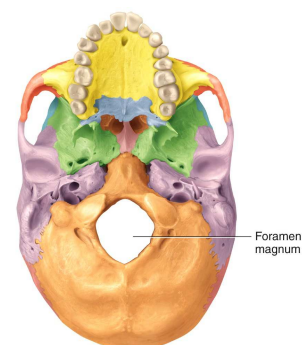
Fissure: Narrow slit between bones for passage of blood vessels or nerves.



Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

Bone Surface Markings

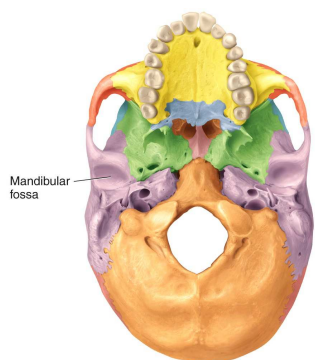
Foramen: Hole for passage of blood vessels, nerves or ligaments.



Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

Bone Surface Markings

Fossa: Shallow depression.

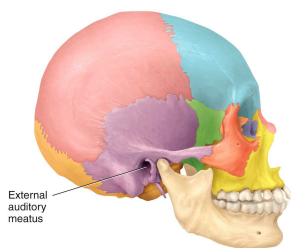


Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

Bone Surface Markings

Sulcus: Furrow on a bone for passage of blood vessel, nerve or tendon.

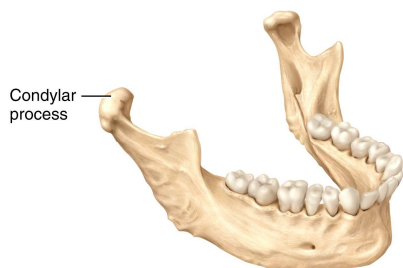
Meatus: Tubelike opening



Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

Bone Surface Markings

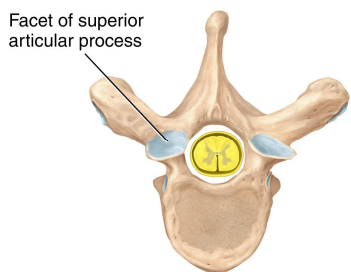
Condyle: Rounded projection with a smooth articular surface.



Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

Bone Surface Markings

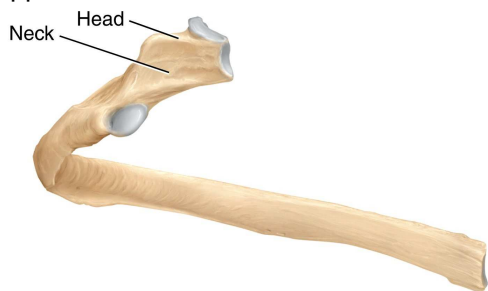
Facet: Smooth, flat, slightly concave articular surface.



Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

Bone Surface Markings

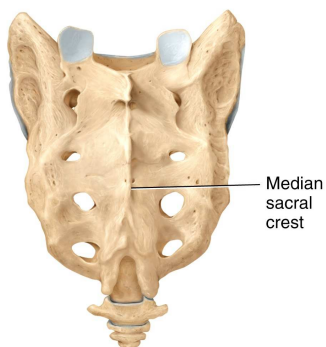
Head: Usually rounded articular process supported on a neck.



Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

Bone Surface Markings

Crest: Prominent ridge or elongated process.

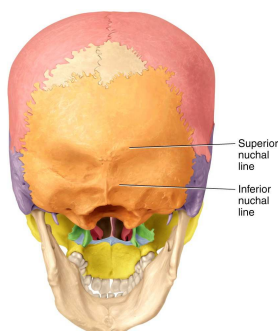


Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

Bone Surface Markings

Epicondyle:
Usually roughened projection on a condyle.

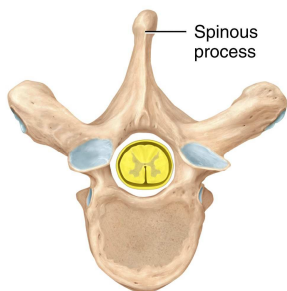
Line: Long, narrow ridge or border (less prominent than a crest)



Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

Bone Surface Markings

Spinous process: Sharp, slender projection.

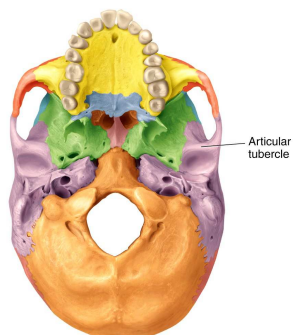


Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

Bone Surface Markings

Trochanter: Very large projection found ONLY on the femur.

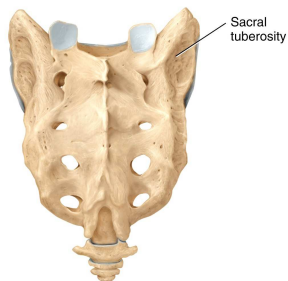
Tubercle: Variably sized rounded projection.



Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

Bone Surface Markings

Tuberosity: Variably sized projection with rough, bumpy surface.



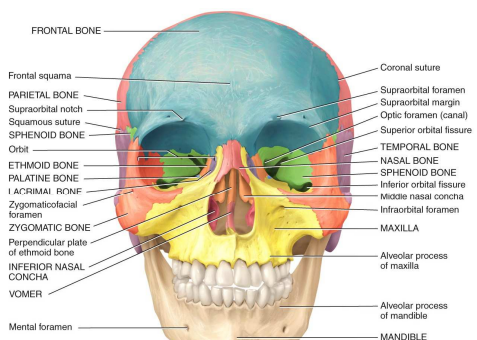
Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

Skull

The skull contains 22 bones, not including the 3 middle ear bones in both ears. Associated with these bones are a number of processes, ridges, lines, depressions and foramen.

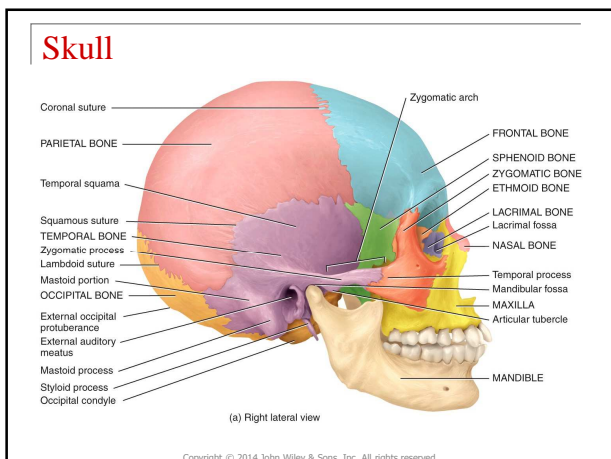
Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

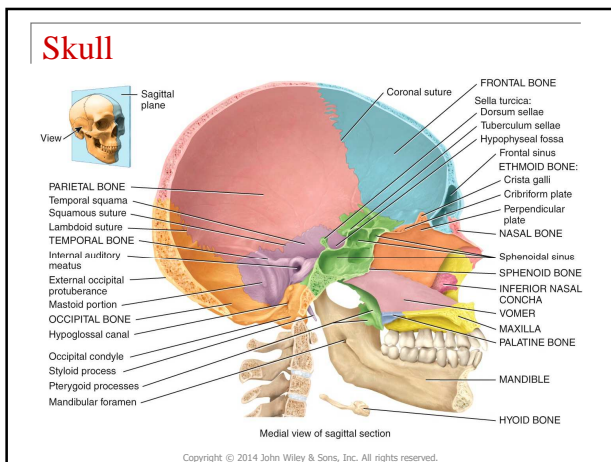
Skull

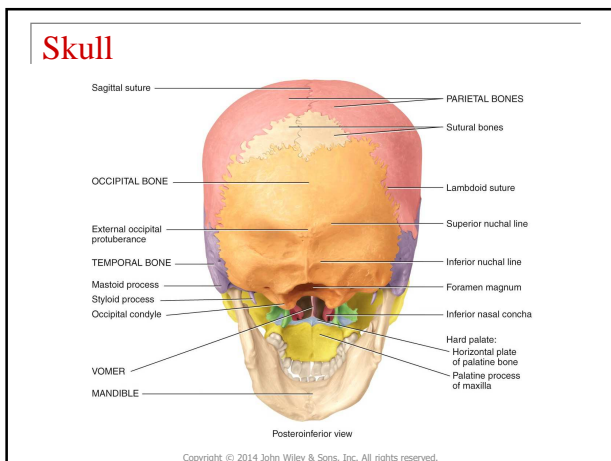


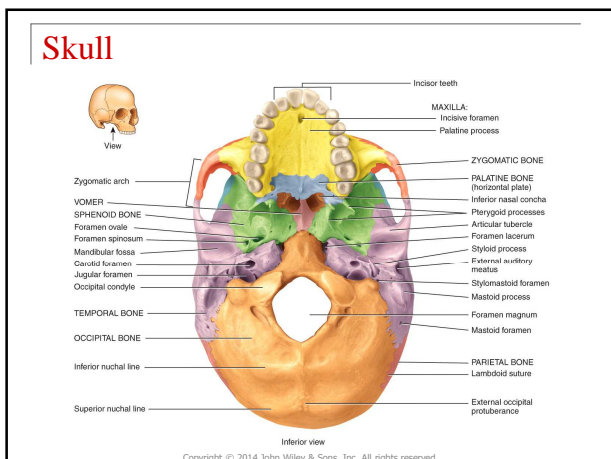
Anterior view

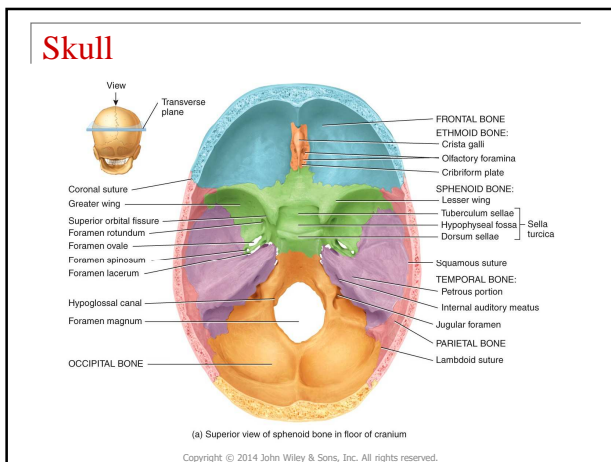
Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

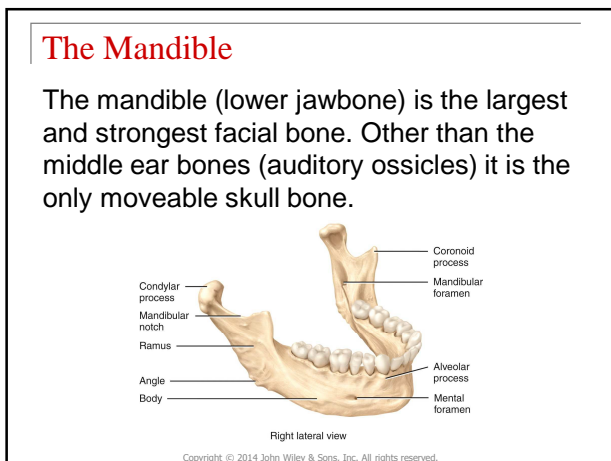










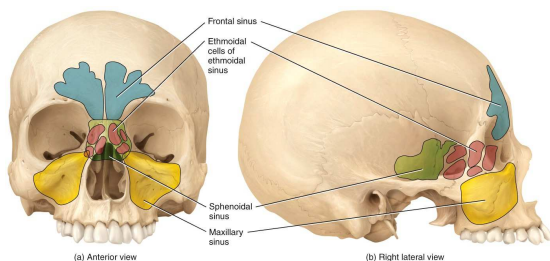


The Paranasal Sinuses

The **paranasal sinuses** are mucous membrane-lined cavities in the frontal, maxillary, sphenoid and ethmoid bones. They are used as resonating (echo) chambers to enhance the voice as well as structures that increase the surface area of the nasal mucosa and help to moisten it as well.

Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

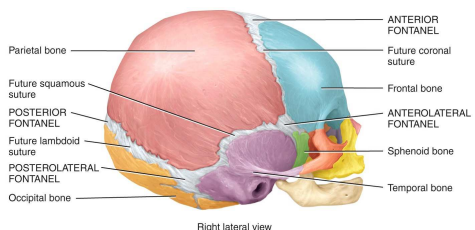
The Paranasal Sinuses



Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

Fontanels

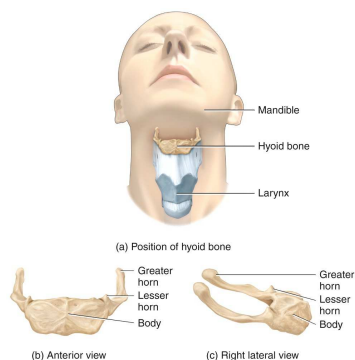
Fontanels are mesenchyme-filled spaces between cranial bones present at birth. They close up beginning at 6 months of age through 2 years (depending on the fontanel).



Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

Hyoid Bone

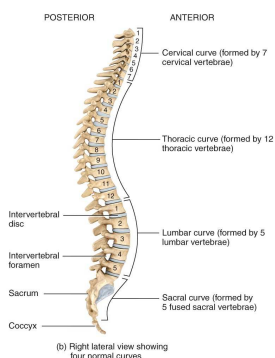
The **hyoid bone** supports the tongue by attaching to muscles. It is situated at the top of the larynx.



Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

The Vertebral Column

The **vertebral column** is also known as the spinal column, backbone and spine. It is made up of 26 vertebrae divided into 5 regions. The lower regions, the sacrum (made up of 5 fused vertebrae) and the coccyx (made up of 4 fused vertebrae) are not individual bones as are the other 24 vertebrae. The column protects the spinal cord.



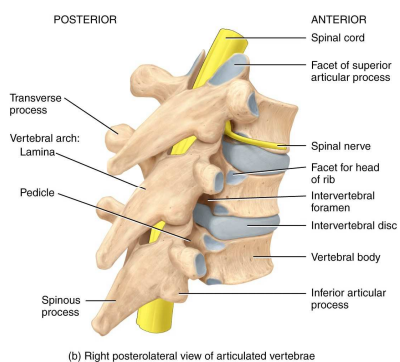
Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

The Vertebral Column

Intervertebral discs separate the vertebrae from one another. They are located between the bodies of the vertebrae from the second cervical to the sacrum. Each disc has an outer ring of fibrocartilage (*annulus fibrosus*) which surrounds soft, pulpy nucleus (*nucleus pulposus*). The top and bottom of each disc has a layer of hyaline cartilage. They are used to absorb shock and create spaces between vertebrae.

Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

The Vertebral Column



(b) Right posterolateral view of articulated vertebrae

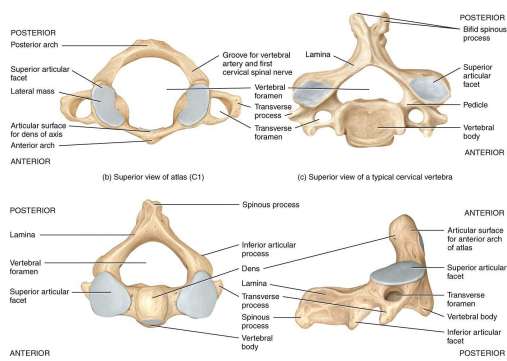
Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

The Vertebral Column

A typical vertebra is composed of several parts. Vertebrae from each region, in addition to containing common structures, have unique structures that help to identify which type they are. In addition, the first 2 **cervical vertebrae** are different from the others in shape and function.

Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

The Vertebral Column



(b) Superior view of atlas (C1)

(c) Superior view of a typical cervical vertebra

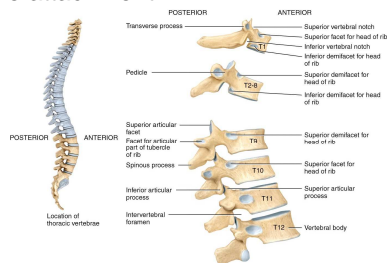
(d) Superior view of axis (C2)

(e) Right lateral view of axis (C2)

Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

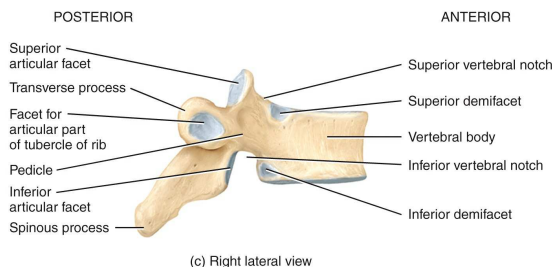
The Vertebral Column

The **thoracic vertebrae** support the ribs and have special structures for rib head and tubercle attachment.



(b) Right lateral view of several articulated thoracic vertebrae
Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

The Vertebral Column

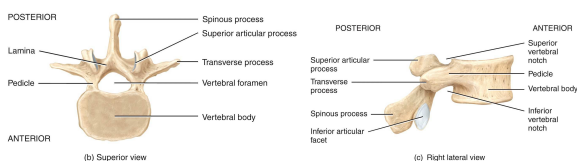


(c) Right lateral view

Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

The Vertebral Column

The **lumbar vertebrae** are the largest and strongest in the vertebral column. They support the body's weight. There are no special structures that are specifically associated with these vertebrae.



(b) Superior view

(c) Right lateral view

Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

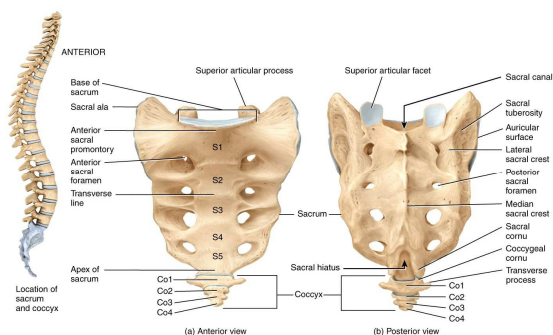
The Vertebral Column

The triangular-shaped **sacrum** is composed of 5 vertebrae that begin to fuse together between 16 and 18 years of age. The process ends at around 30 years of age. It is part of the pelvic girdle.

The **coccyx** is also triangular in shape and is composed of 4 vertebrae that fuse together between 20 and 30 years of age.

Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

The Vertebral Column

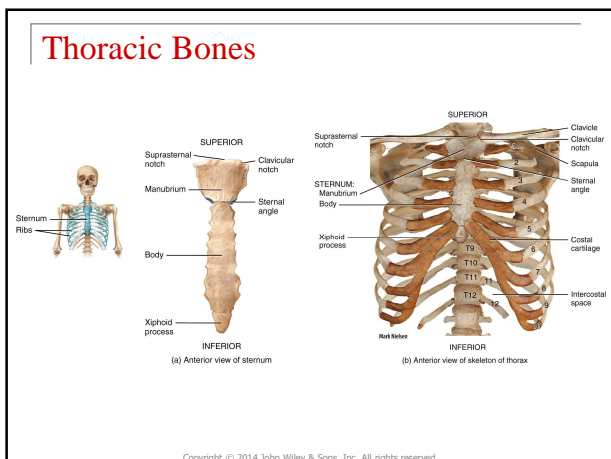


Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

Thoracic Bones

The **sternum**, or **breastbone**, is flat and is located in the center of the anterior thoracic wall. It is divided into three segments: The upper **manubrium**, the middle **body** and the lower **xiphoid process**. The three bones usually fuse by 25 years of age. The sternum articulates with the clavicles and the costal cartilages from the ribs.

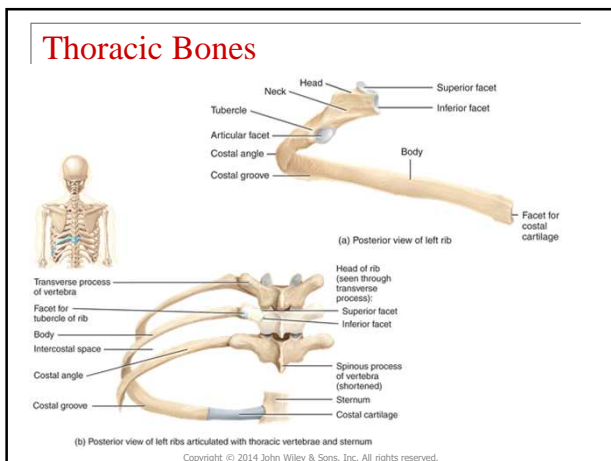
Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.



Thoracic Bones

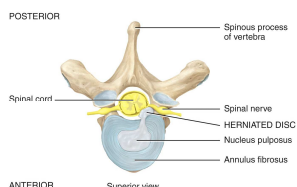
The **ribs** provide support to the thoracic cavity. There are twelve pairs that extend from the thoracic vertebrae to the sternum. The bony portion ends a few inches from the sternum and is connected to costal (hyaline) cartilage which attaches to the sternum. The first 7 pairs are called the **true ribs** because their cartilage is directly connected to the sternum. The next 5 pairs are called false ribs because their cartilage is indirectly connected to the sternum (pairs 8–10) or not connected at all (pairs 11 and 12)

Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.



Disorders

Many disorders may occur that affect the skeleton in one form or another. In the vertebral column, a **herniated disc** may occur due to trauma or, sometimes, simply associated with aging. In these cases, the *nucleus pulposus* is able to leak out due to a tear in the *annulus fibrosus*.



Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

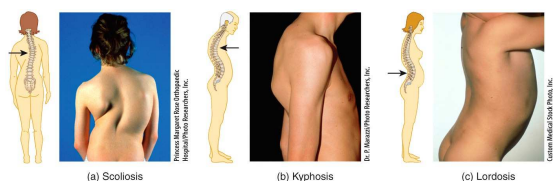
Disorders

At times, the normal curves of the spinal column may become exaggerated. There are many causes for these changes. These curve-related pathologies include:

- **Scoliosis** (increased lateral curvature)
- **Kyphosis** (increased thoracic curve-bent forward)
- **Lordosis** (increased lumbar curve-bent backwards)

Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

Disorders



Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

Disorders

Spina bifida is a congenital defect of the vertebral column where the laminae do not develop normally. The degrees of this deformity vary from minor (*spina bifida occulta*) to severe (*spina bifida with meningocele*). In the latter case, a cystlike sac containing the meninges, cerebrospinal fluid and the spinal cord and/or its nerve roots protrudes from the spinal column.

Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

Disorders



Center for Human Growth/Robert M. Maize, Inc.

Spina bifida with meningocele

Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.

End of Chapter 7

Copyright 2014 John Wiley & Sons, Inc.
All rights reserved. Reproduction or translation of this work beyond that permitted in section 117 of the 1976 United States Copyright Act without express permission of the copyright owner is unlawful. Request for further information should be addressed to the Permission Department, John Wiley & Sons, Inc. The purchaser may make back-up copies for his/her own use only and not for distribution or resale. The Publisher assumes no responsibility for errors, omissions, or damages caused by the use of these programs or from the use of the information herein.

Copyright © 2014 John Wiley & Sons, Inc. All rights reserved.
