The Vertebral Column

The Vertebral Column

- Comprised of **33-34** individual bones or **vertebrae**
  - may be differences in resources or fusion

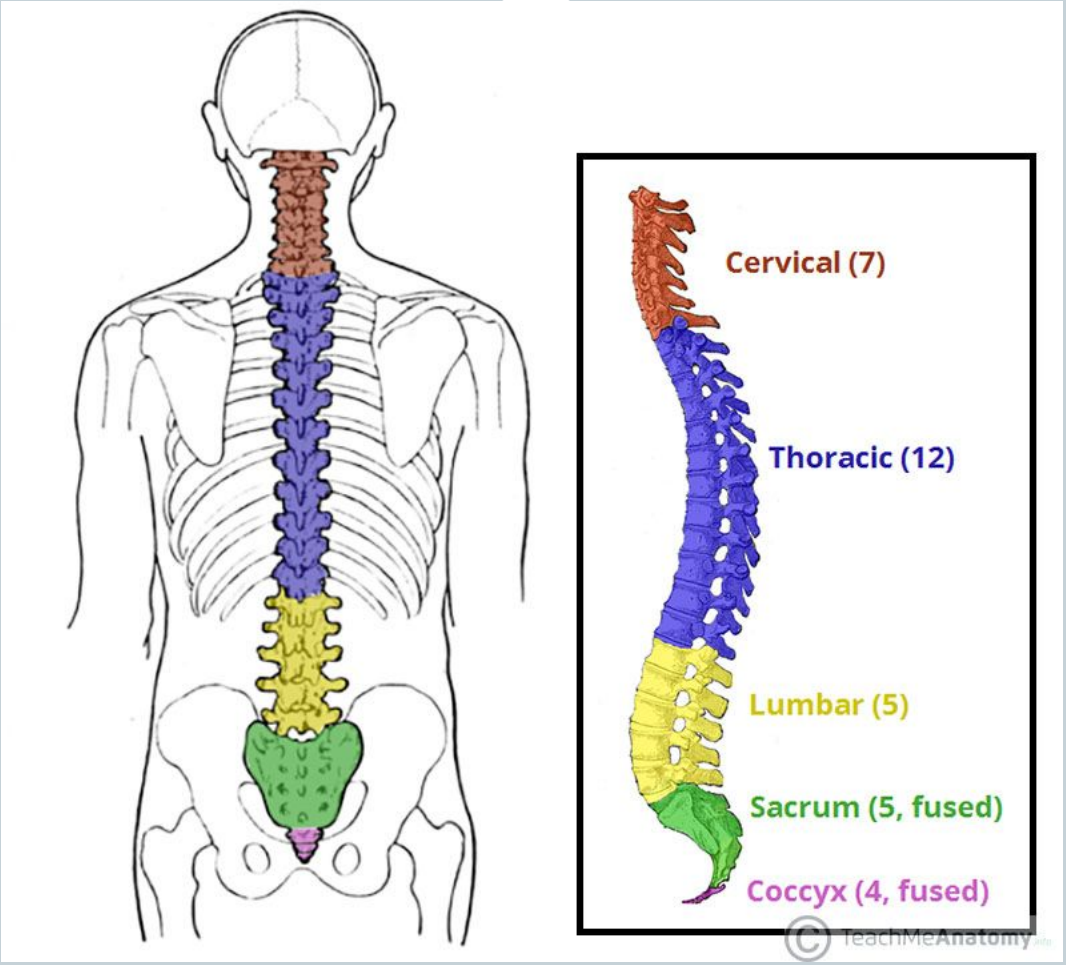
Fun fact:

- sometimes during development bones can fuse resulting in 26 bony segments

Regions

Anatomical Terms	Layman's Terms
Cervical → C1 → C7	Neck → 7
Thoracic → T1 → T12	Chest → 12
Lumbar → L1 → L5	Small Back → 5
Sacral → S1 → S5	Low Back → 5 *fused
Coccygeal → Co1→Co5 (fused)	Tailbone → 4-5 *fused

REGIONS OF THE VERTEBRAL COLUMN

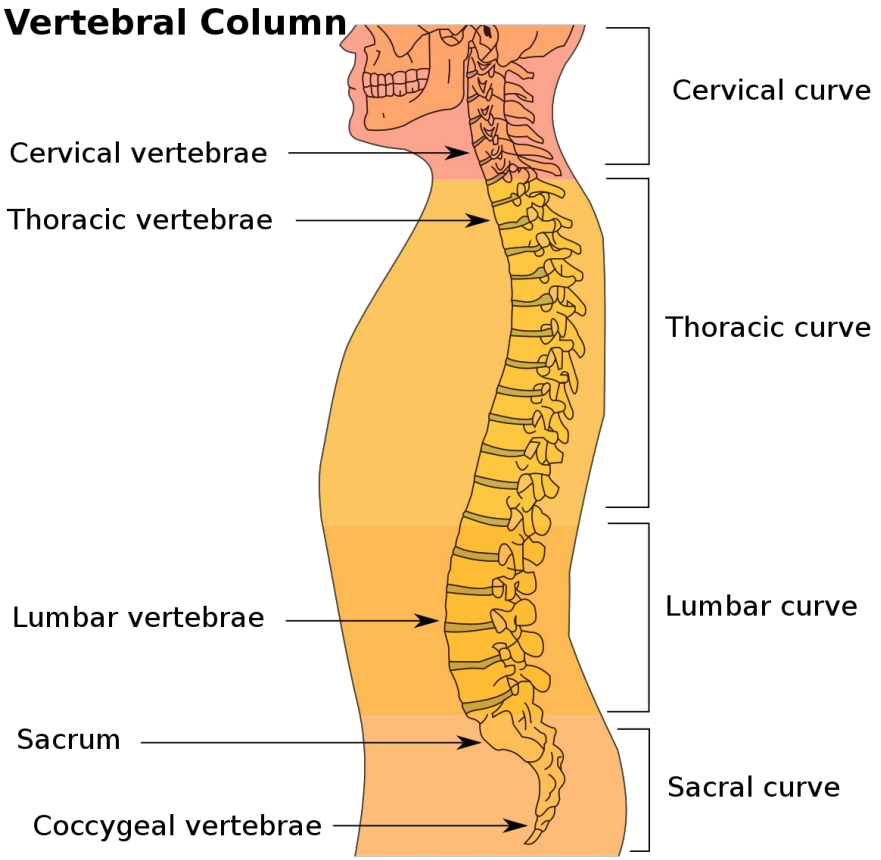


Functions of the Vertebral Column

- Support & upright posture
  - vertebrae become larger & thicker as you progress down the spine
- Protection
  - encases the spinal cord & nerve roots
- Movement
  - flexion & extension
  - side flexion
  - rotation
  - hyperextension
    - movement allowed due the muscular attachments
- Axis
  - central axis of the axial body

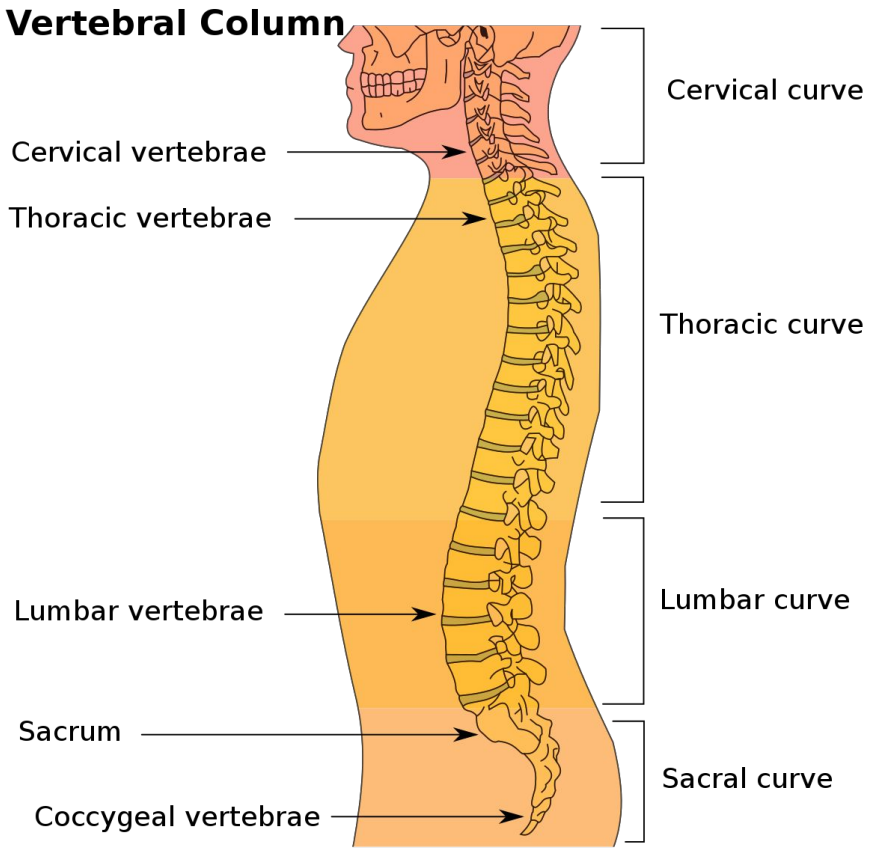
Spinal Curves

Spinal Lordosis



concave spine posteriorly

Spinal Kyphosis



convex spine posteriorly

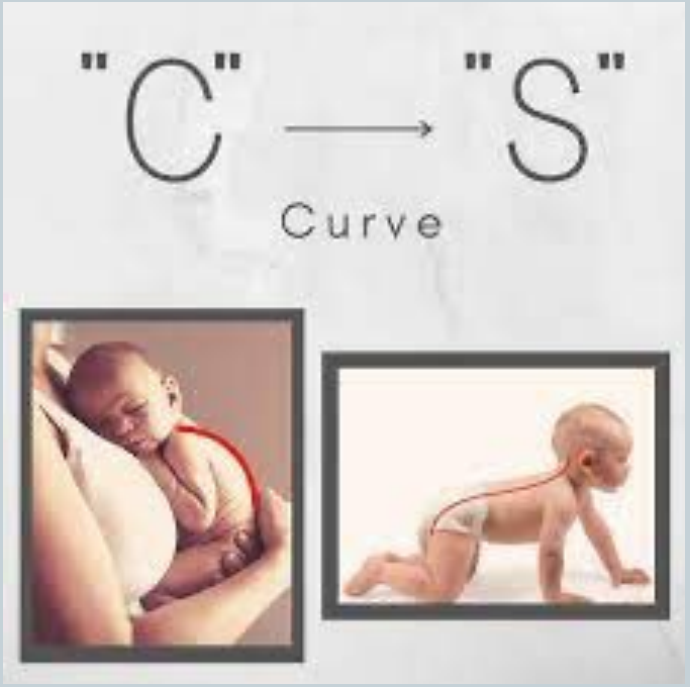
Curves Over Time…

- At birth
  - kyphotic
  - large C-shaped spine
  - **primary** curves are:
    - thoracic & sacral

- 3 months differentiation occurs
  - formation of secondary curves
  - S-shaped from a side view
  - **secondary** curves are:
    - cervical & lumbar

Timeline:

- 3 months (head up)
  - cervical lordosis
- 9 months (sitting up)
  - thoracic kyphosis
- 18 months (walking)
  - lumbar lordosis
- Sacral kyphosis



STAGE 1

Infants are born with only one C-shape curvature in their spine.

STAGE 2

The Cervical Lordosis develops in the first few months as the posterior neck muscles get stronger to hold the head up against gravity.

STAGE 3

The Lumbar Lordosis develops between 6-12 months as babies start cross crawling and cruising.

STAGE 4

Eventually when all four curvatures have developed they can support themselves upright while walking.

Abnormal Spinal Curves

Scoliosis

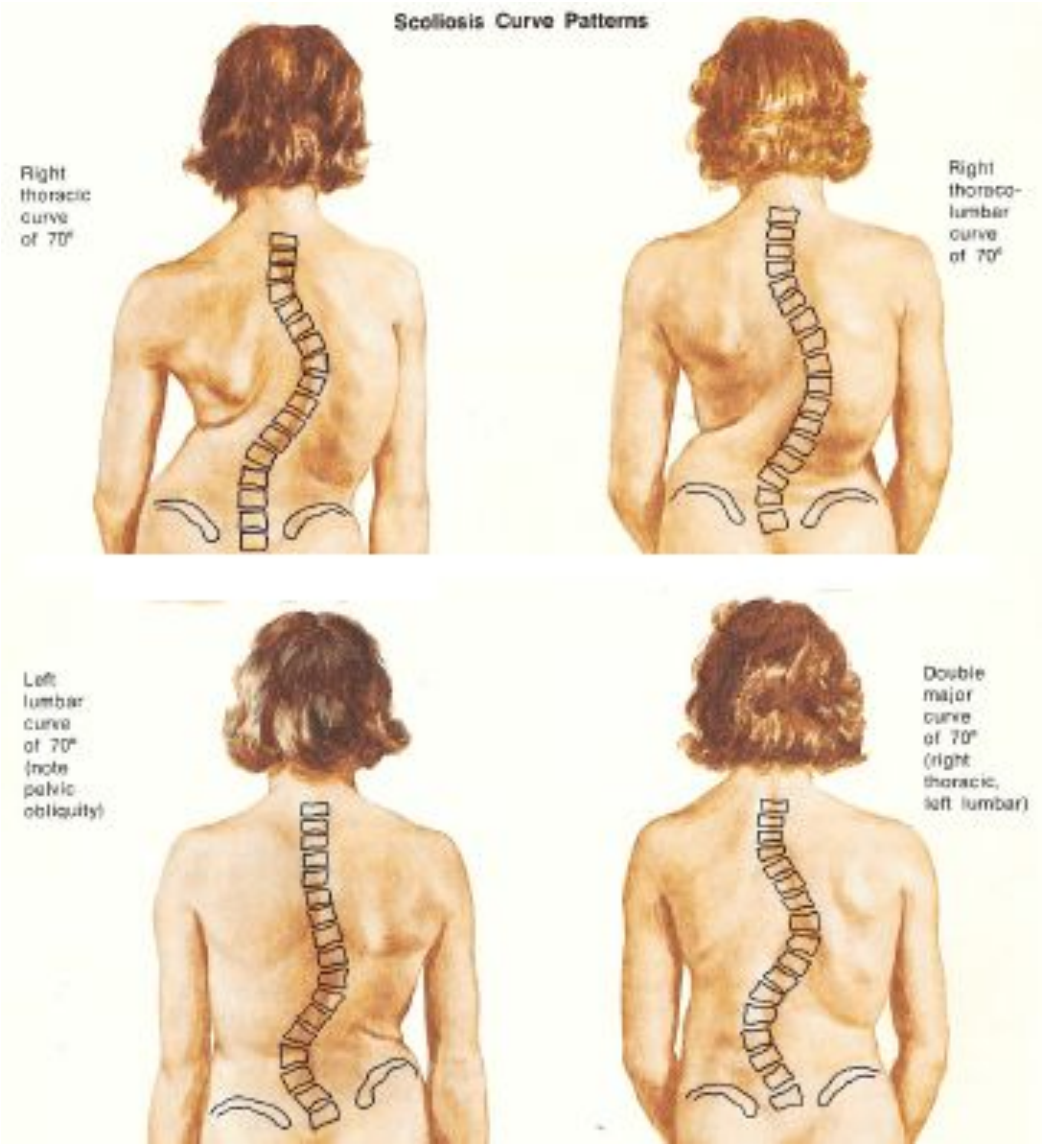
- **lateral curvature of the spine**

Scoliosis

- idiopathic in nature
  - most common in adolescent age group

Types:

- S Curve
  - double curve scoliosis
  - secondary curve may develop to balance the primary curve
  - more dangerous of the two; rotating forces
- C Curve
  - single curve scoliosis
- Structural
  - when the spine itself is curved
- Functional
  - when the curvature is a result of an abnormality somewhere else


Scoliosis Curve Patterns
Right thoracic curve of 70°
Right thoraco-lumbar curve of 70°
Left lumbar curve of 70° (note pelvic obliquity)
Double major curve of 70° (right thoracic, left lumbar)

Hyperlordosis

- **aka: saddleback or sway back**

Hyperlordosis

Definition:

- when the inward curve of the low back is exaggerated
  - can occur at any age, although rare in children
  - typically reversible

Causes:

- obesity
- seen in people who wear high heels for long periods of time
- spinal injuries
- neuromuscular disease
- rickets
- sitting/standing for long periods
- weak abdominal muscles

Symptoms:

- low back or neck pain
- restricted movement
- stiffness
- excessive inward C shape of the low back
- glutes may appear more posteriorly

Hyperkyphosis

aka: hunch back

Hyperkyphosis

Definition:

- when the thoracic spine curvature is over pronounced
  - can be age related, due to malformation (birth), caused by wedging of vertebrae
  - can be mild or severe

Types:

- Postural
  - most common
  - most noticeable during adolescence
  - typically occurs due to poor posture (slouching)

- Congenital
  - Occurs in infants, in utero
  - Spinal column does not form properly

- Scheuermann's
  - structural → more difficult to treat
  - most commonly found in adolescence
  - structural abnormality with the spine or individual vertebrae; unable to maintain normal spinal curvatures

Hyperkyphosis

Causes:

- Fractures
- Disc degeneration
- Osteoporosis
- Ehlers Danlos Syndrome

Symptoms:

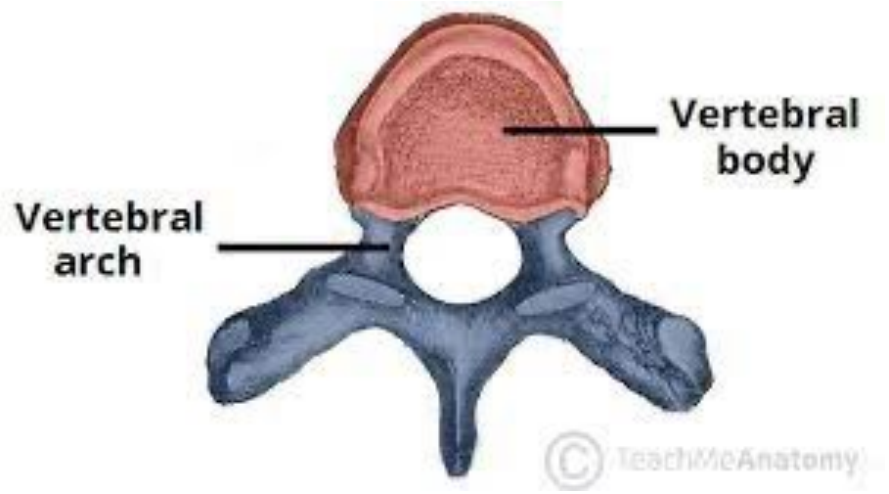
- excessively rounded shoulders
- visible arch on the back
- back pain (adults)
- stiff & rigid spine
- general fatigue
- severe cases → issues with organs (lungs & heart)

SPINAL ABNORMALTIES

Vertebrae

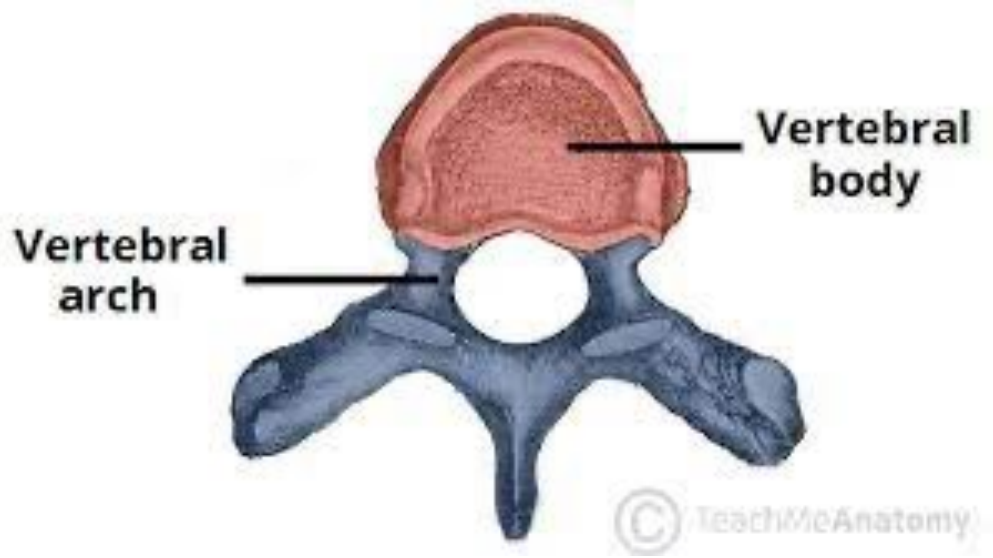
General Structure

Vertebral Body



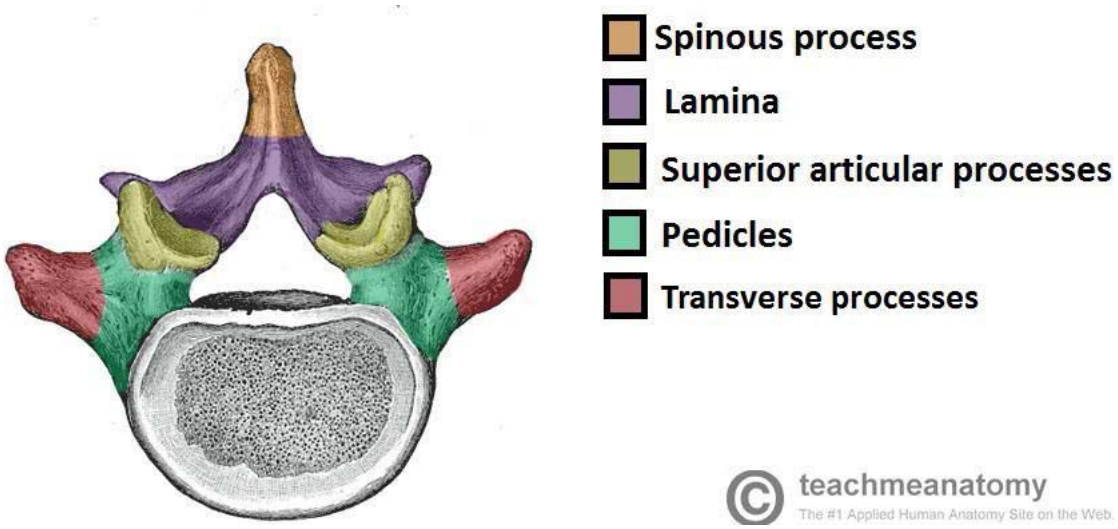
- anterior portion of a vertebrae
- supports body weight
- progressively increases in size further down the spine

Vertebral Arch



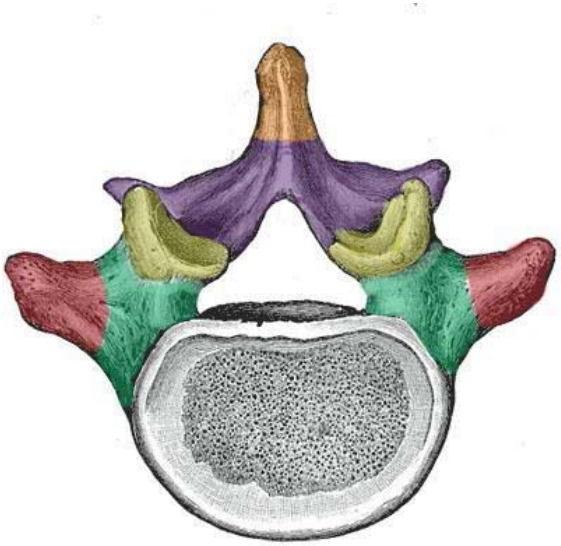
- posterior portion of vertebrae
- comprised of the lamina and pedicle
- serves to protect the spinal cord

Pedicles



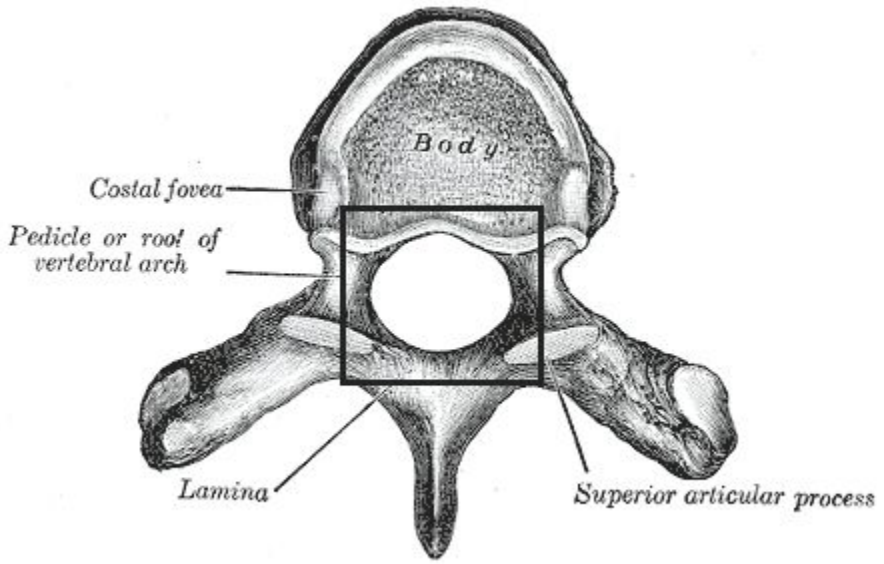
- **2 projections from the posterior aspect of the body**

Lamina



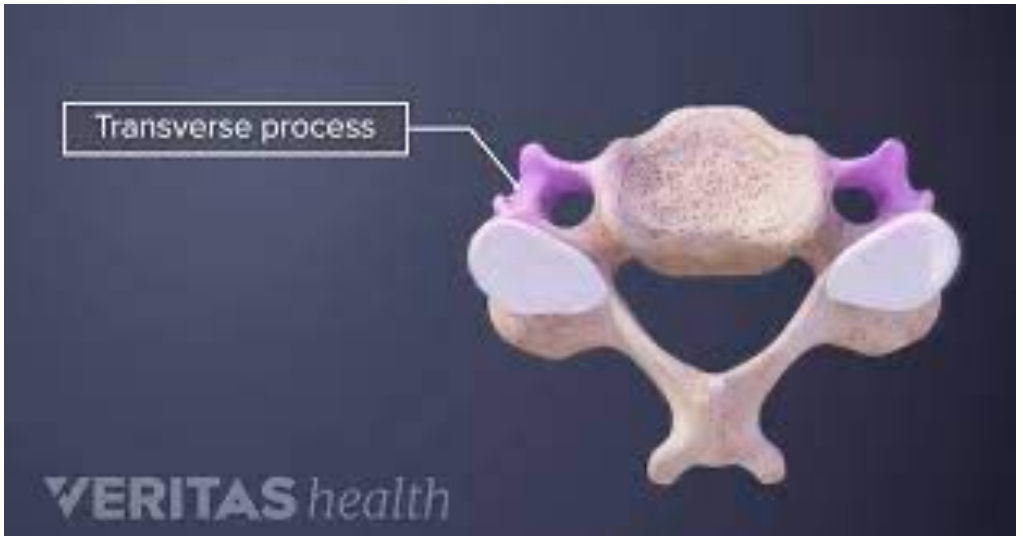
- 2 flat bars
- meet posteriorly at the spinous process

Vertebral Foramen



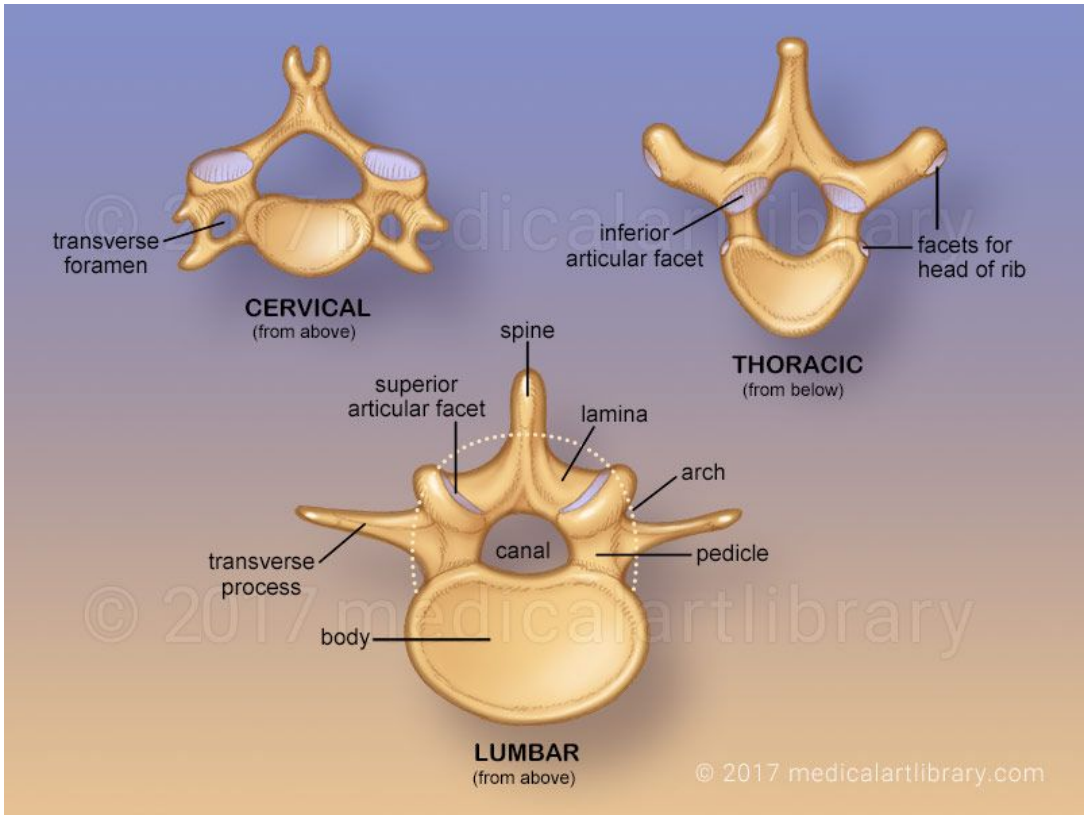
- created by the lamina, pedicle & body
- aka: spinal/vertebral foramen
- home of the spinal cord

Transverse Processes



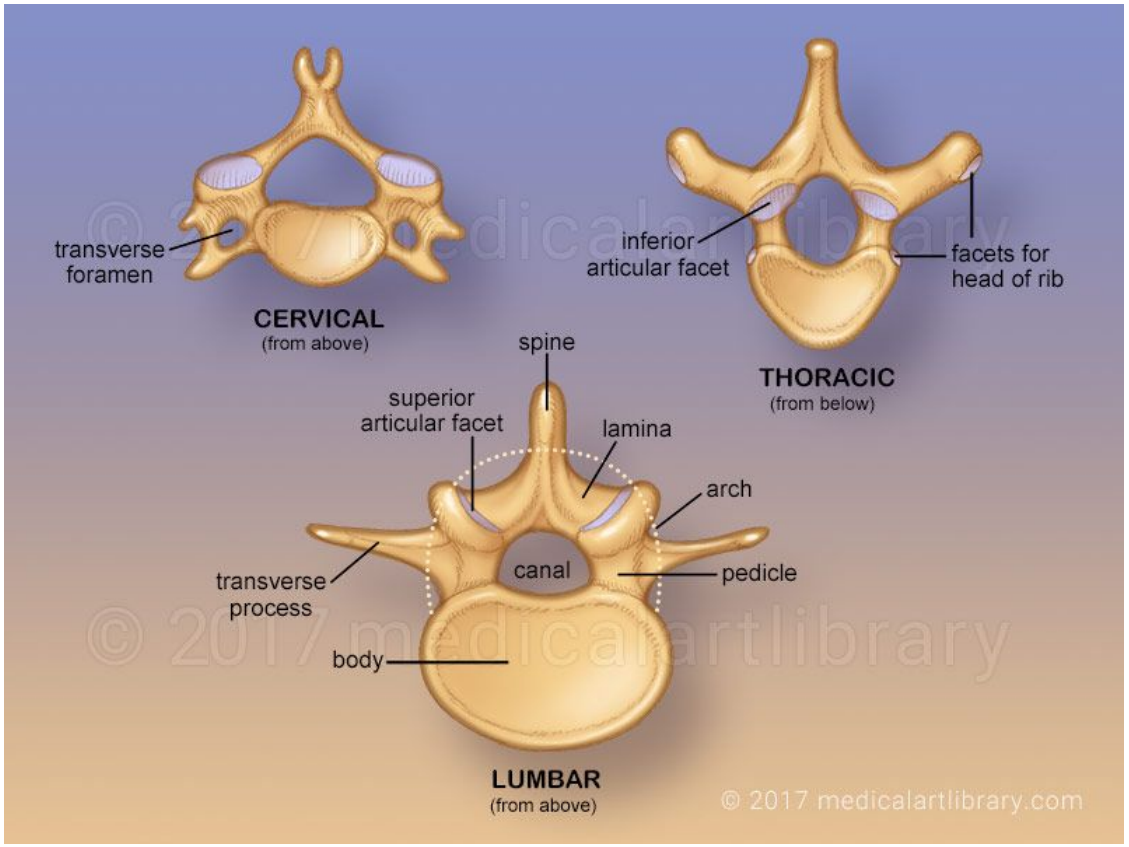
- **2 on either side (transverse)**
- **found at the junction of the lamina & pedicle**
- **important site for ligament & muscle attachment**

Superior Articular Process (Facet)



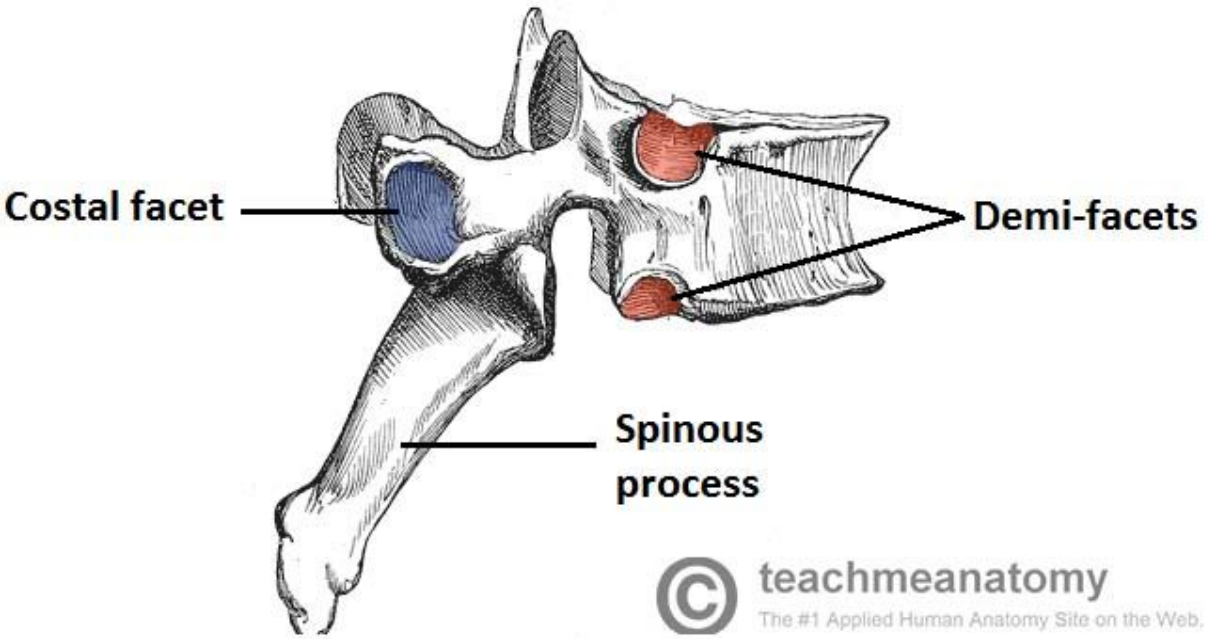
- 2 flat surfaces that project upwards
- articulate with the inferior articular facet of the vertebrae above

Inferior Articular Process (facet)



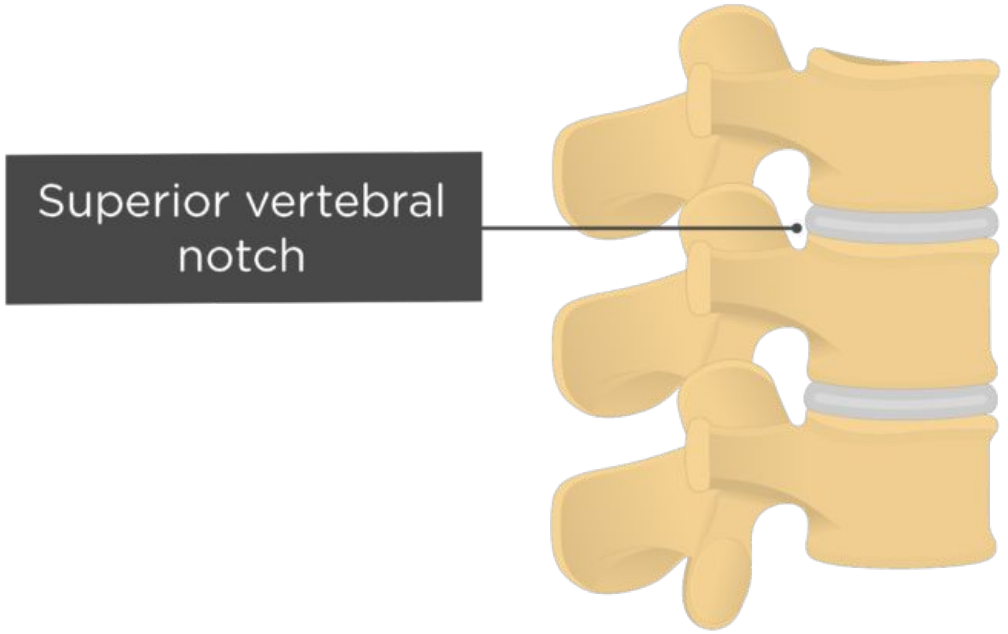
- 2 flat surfaces that project downwards
- articulate with the superior articular facet of the vertebrae below

Spinous Process



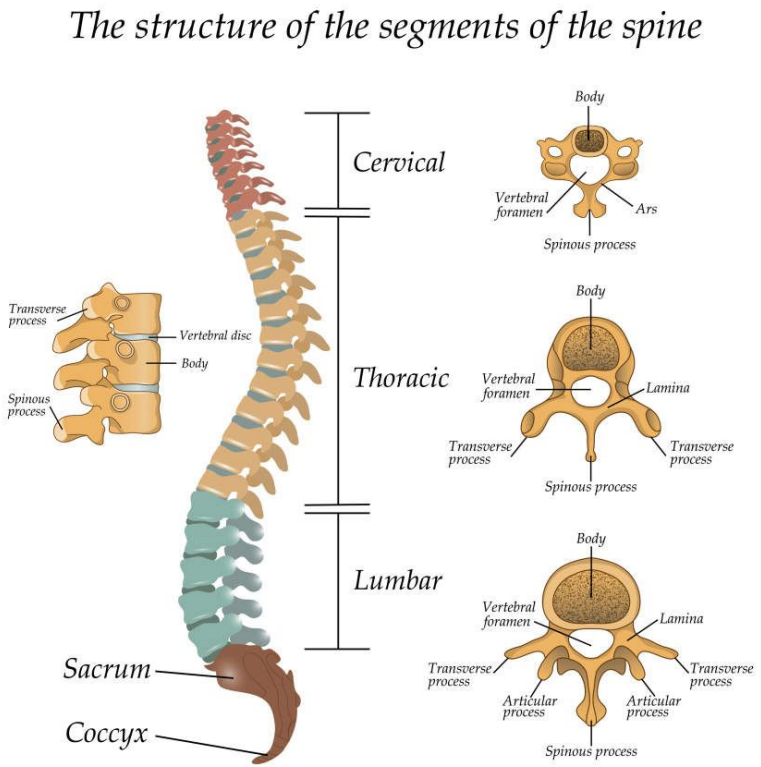
- **projects posteriorly from the junction of the laminae**

Vertebral Notch



- found posterior to the vertebral body & inferior to the pedicle
- creates intervertebral foramen → for spinal nerve roots to exit each side of the vertebral column at each vertebral segment

Vertebral Segment



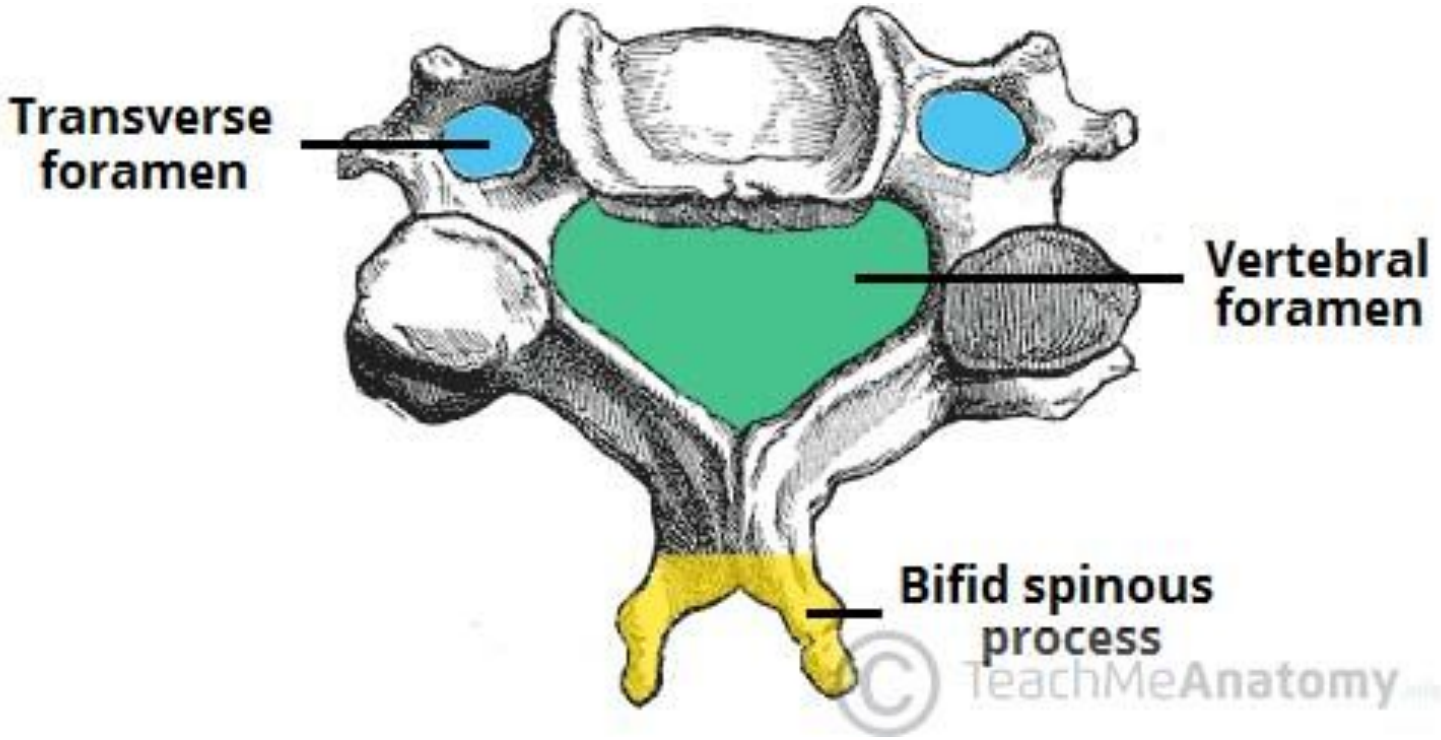
- **made up of two consecutive vertebrae in the vertebral column plus the intervertebral disc in between**

Special Features

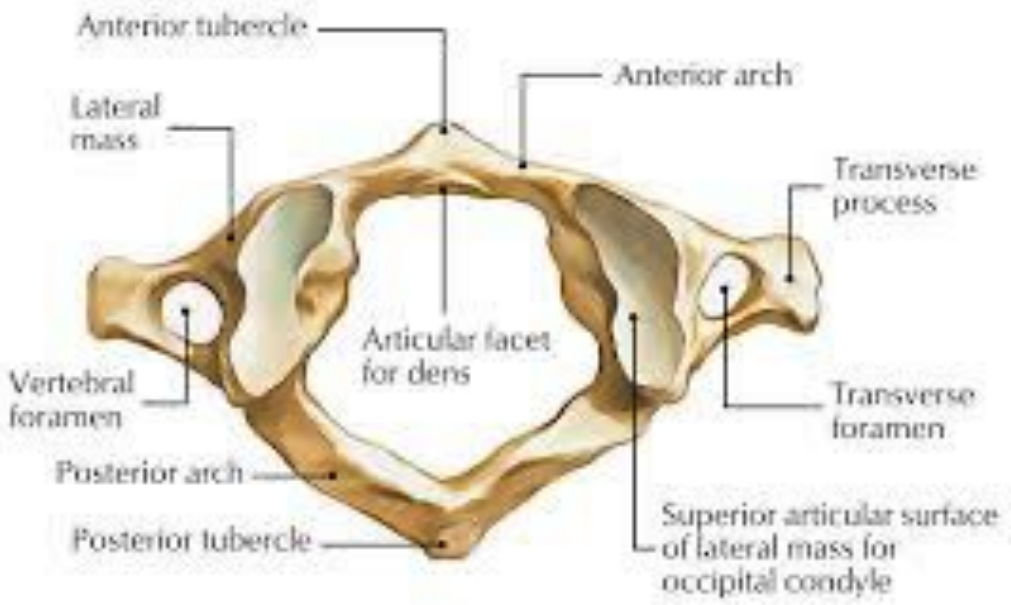
Individual Vertebrae

Cervical Vertebrae

- Small bodies
  - bears less weight
- C1 & C2 are specialized
  - atlas & axis
- Large vertebral foramen
- Bifurcate
  - Bifid spinous process (C2-C6)
- Transverse foramina
  - protects the vertebral artery that supply the brain
- articular processes
  - flat; face superior & inferior
  - allow for rotational movements

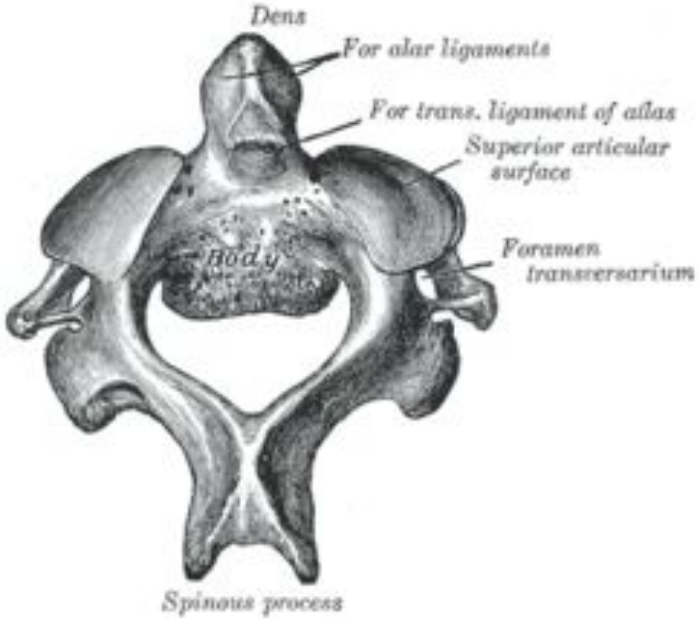

Transverse foramen
Vertebral foramen
Bifid spinous process
© TeachMeAnatomy

Atlas (C1)



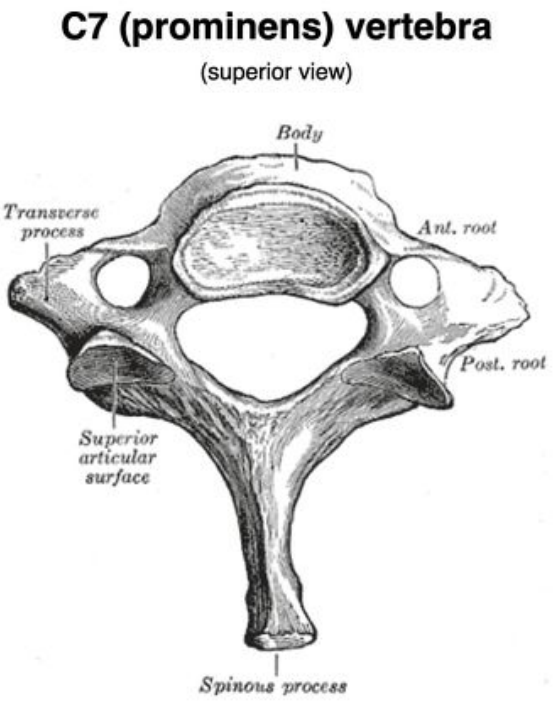
- **supports the head**
- **lacks a body**
- **anterior & posterior arches & tubercles**
- **concave superior & flat inferior articular facets**
  - superior → occipital condyles
    - allows for yes motion of the head
- **large vertebral/spinal canal**
- **anterior foramen for the odontoid process (dens)**

Axis (C2)



- **Dens → body of atlas**
  - creates a pivot
    - allows for no action of the head
- **superior articular process**
  - articulates with atlas
- **bifid spinous process**

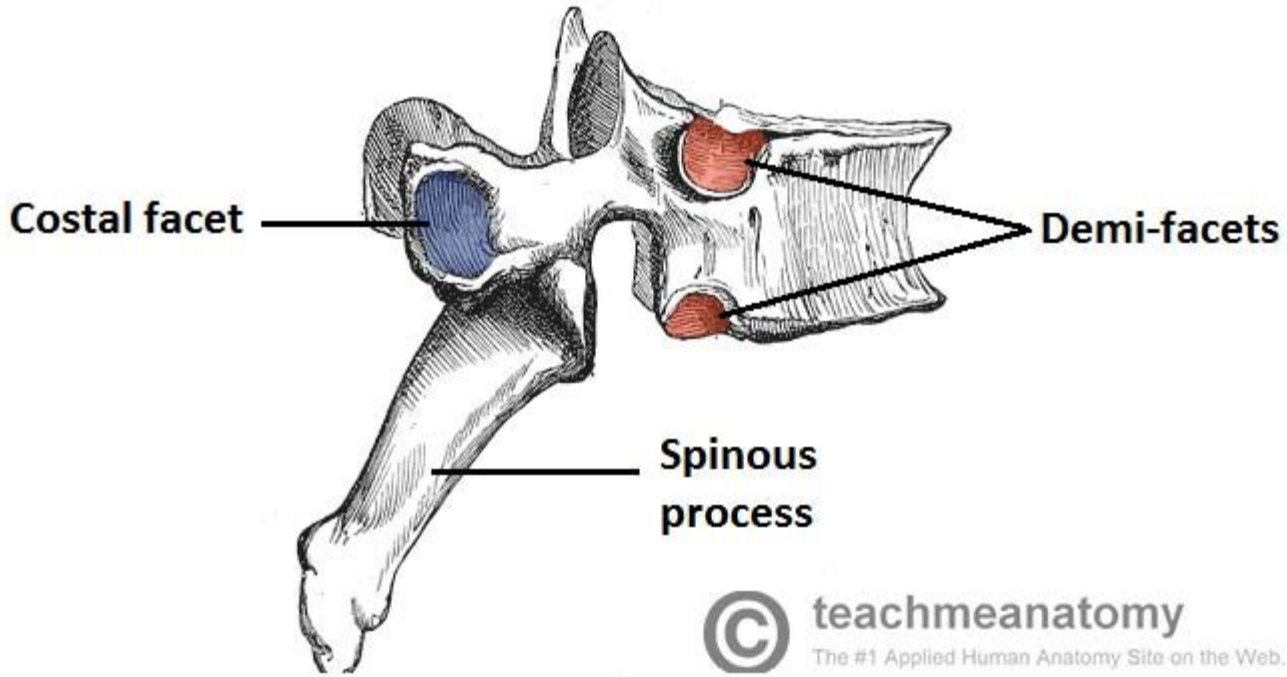
Prominens (C7)



- **characterized by long spinous process**
  - not bifid
- **tubercle on the end of the spinous process**
  - ligamentum nuchae

Thoracic Vertebrae

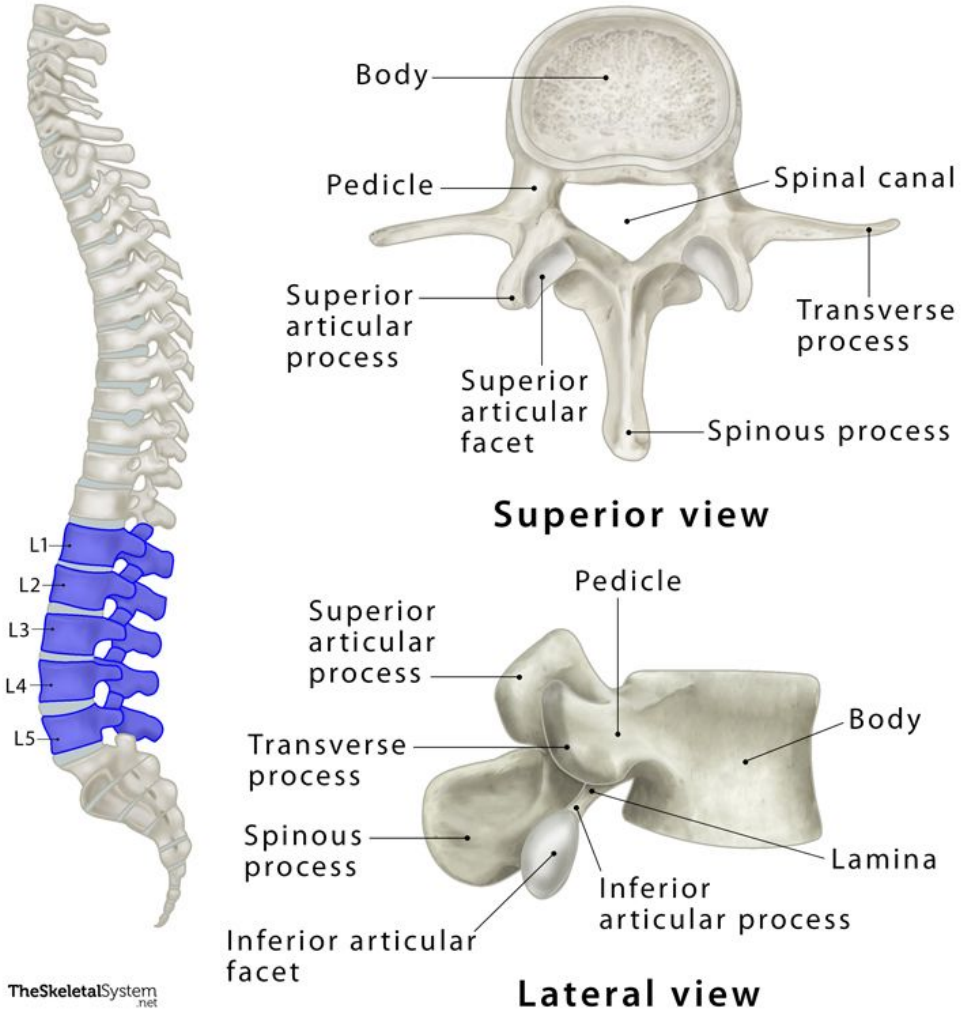
- Long & pointed spinous process
  - overlap like shingles
- Superior & inferior "demifacets"
  - on the sides of the bodies
  - articulate with the head of the ribs
  - ribs 1, 10, 11, 12 have full facets for rib attachment
- Costal facets on transverse processes
  - attachment sites for tubercles of the ribs
- Articular facets are oriented in the frontal plane
  - allow for side flexion


Costal facet
Demi-facets
Spinous process
teachmeanatomy
The #1 Applied Human Anatomy Site on the Web.

Lumbar Vertebrae

- Large & heavy vertebral bodies
  - for weight bearing
- Square cut spinous processes
  - almost straight back
- Articular facets; oriented in the sagittal plane
  - allow for flexion & extension
- Long & slender transverse processes

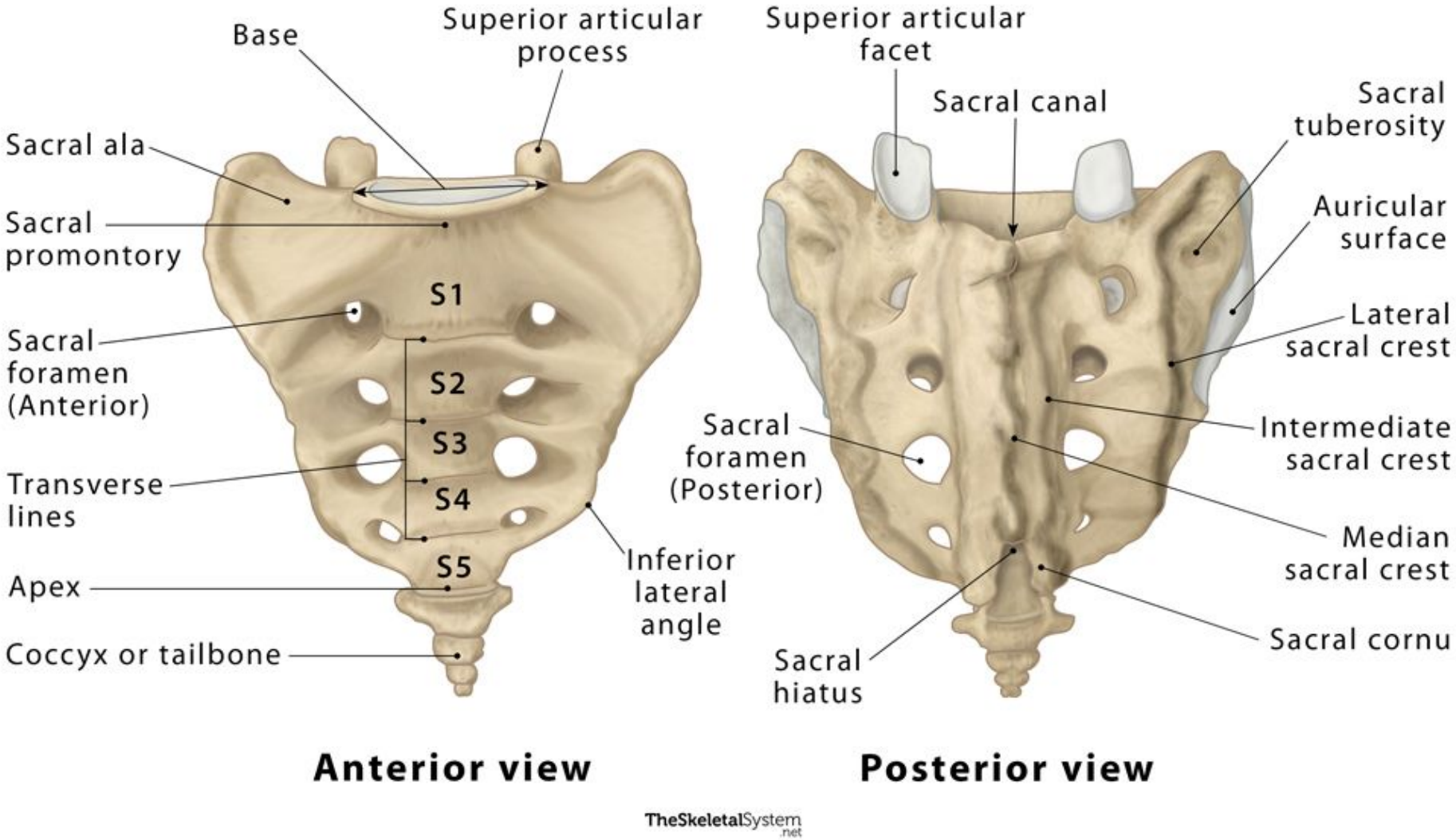
Lumbar Vertebrae



Sacrum

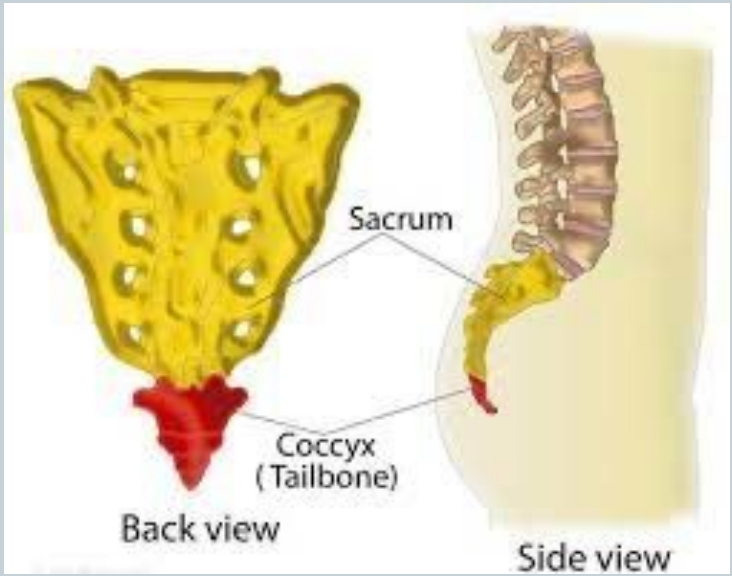
- Anterior surface is concave
  - smooth
  - pelvic contents
- Posterior surface is convex
  - roughened
  - muscles & attachments
- Base
  - sacral promontory
  - 30 degree anterior slope to articulate with the 5th lumbar vertebrae
- Apex
- Median & lateral sacral crests
- Auricular surfaces
  - ear like
  - articulate with the innominate bones (ilium)
- Posterior & anterior sacral foramina
- Sacral canal

Sacrum

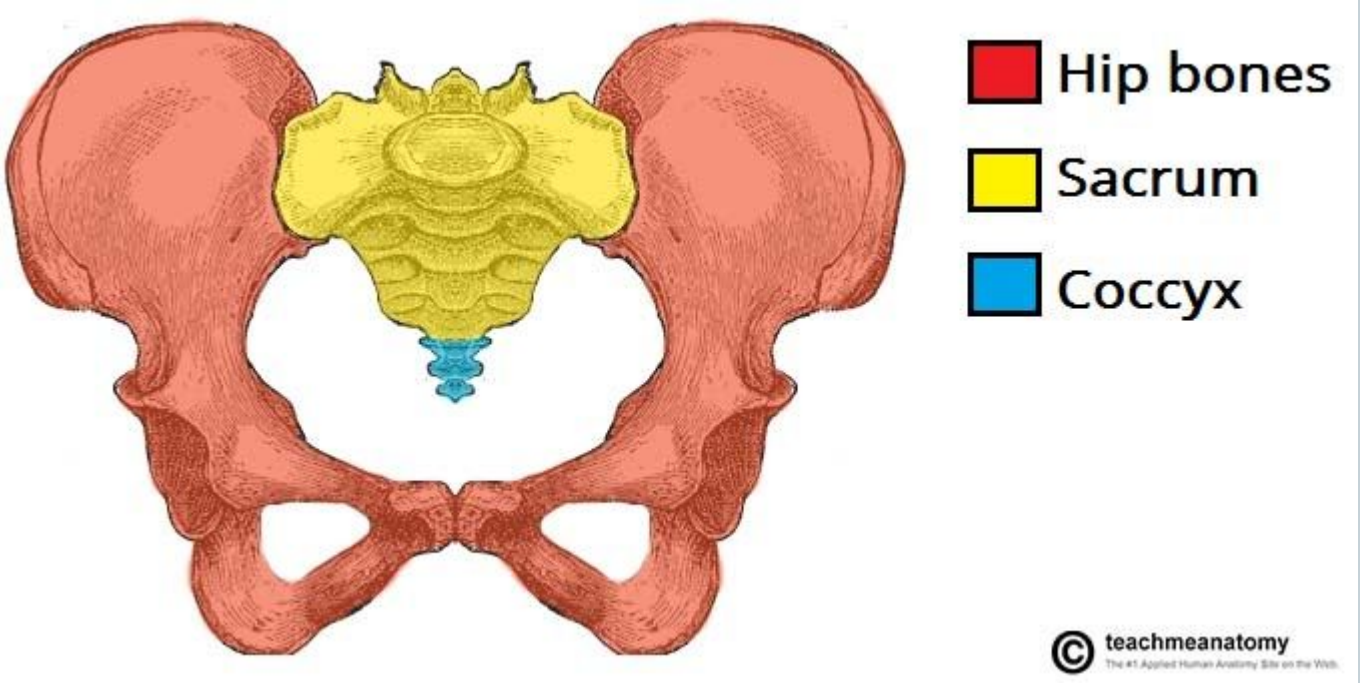

Base
Superior articular process
Sacral ala
Sacral promontory
S1
Sacral foramen (Anterior)
S2
S3
Transverse lines
S4
S5
Apex
Coccyx or tailbone
Inferior lateral angle
Anterior view
Superior articular facet
Sacral canal
Sacral tuberosity
Auricular surface
Lateral sacral crest
Sacral foramen (Posterior)
Intermediate sacral crest
Median sacral crest
Sacral cornu
Sacral hiatus
Posterior view
TheSkeletalSystem.net

Coccyx

- small bone that typically articulates with the apex of the sacrum



Sacrum & Coccyx



Vertebral Movements

Cervical

- **articular facets**
  - horizontal in orientation
- **look like a table top**
- **allow for rotational movements**
- **movements occur:**
  - transverse plane
  - longitudinal axis

Thoracic

- **articular facets**
  - anterior/posterior orientation
- **allow for side flexion movement & some rotation**
- **movements occur:**
  - frontal plane

Lumbar

- **articular facets**
  - side to side orientation
- **allow for flexion & extension**
- **movements occur:**
  - sagittal plane

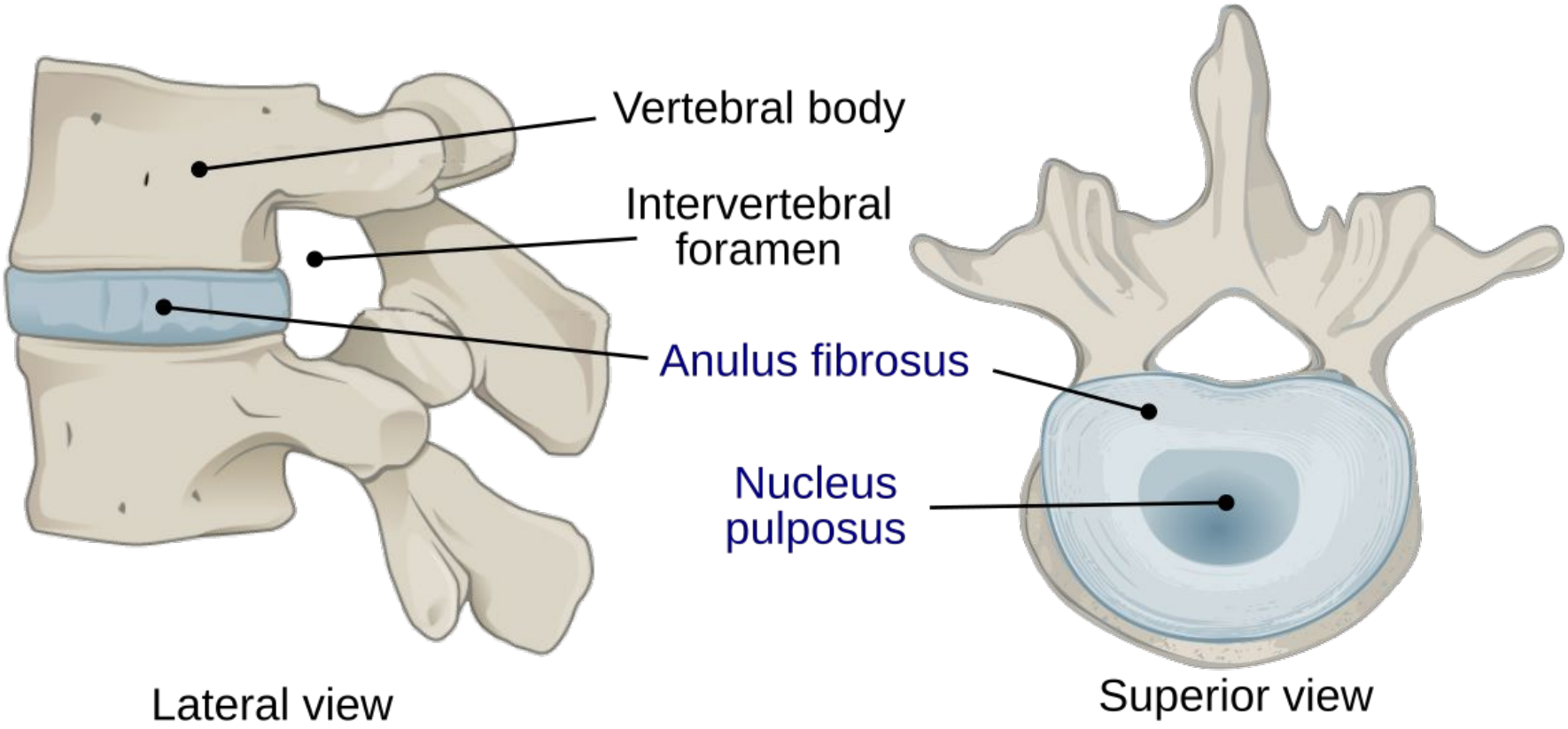
Vertebral Disc

- Thick; made of fibrocartilage
- Location:
  - found between each vertebrae
  - not found between C1 & C2
- Function:
  - allows for some spinal movement
  - shock absorption

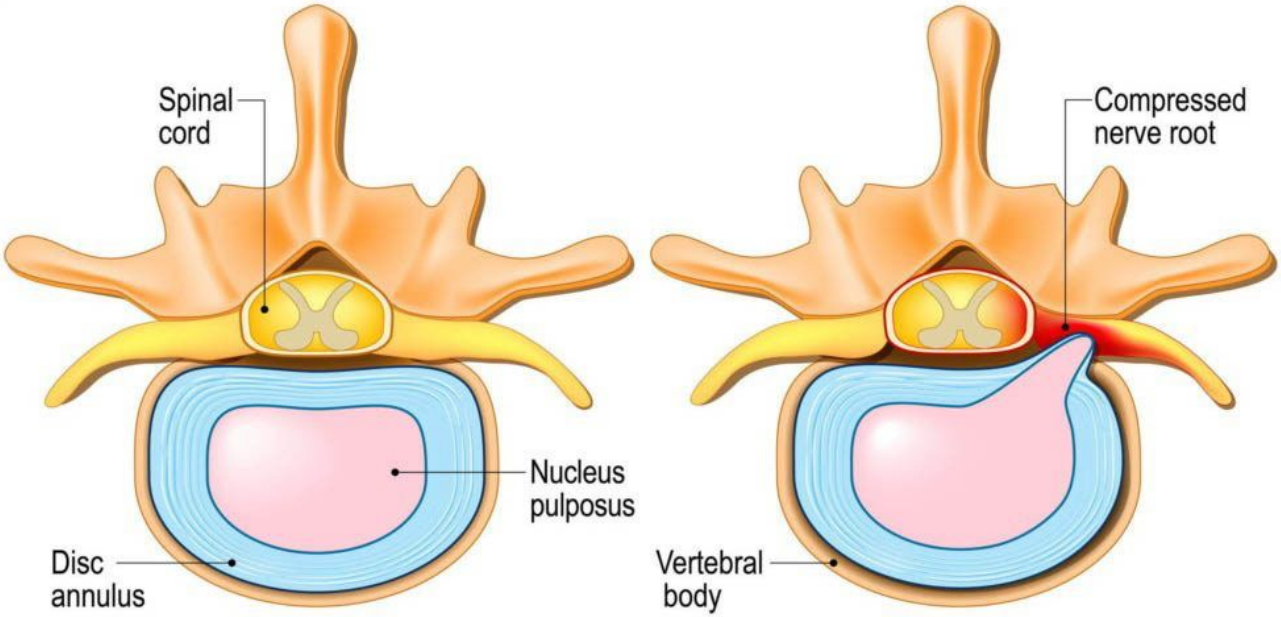
Vertebral Disc

- Components:
  - nucleus pulposus
    - gel-like inner core
  - annulus fibrosus
    - tough outer ring of collagen

- “Slipped disc”

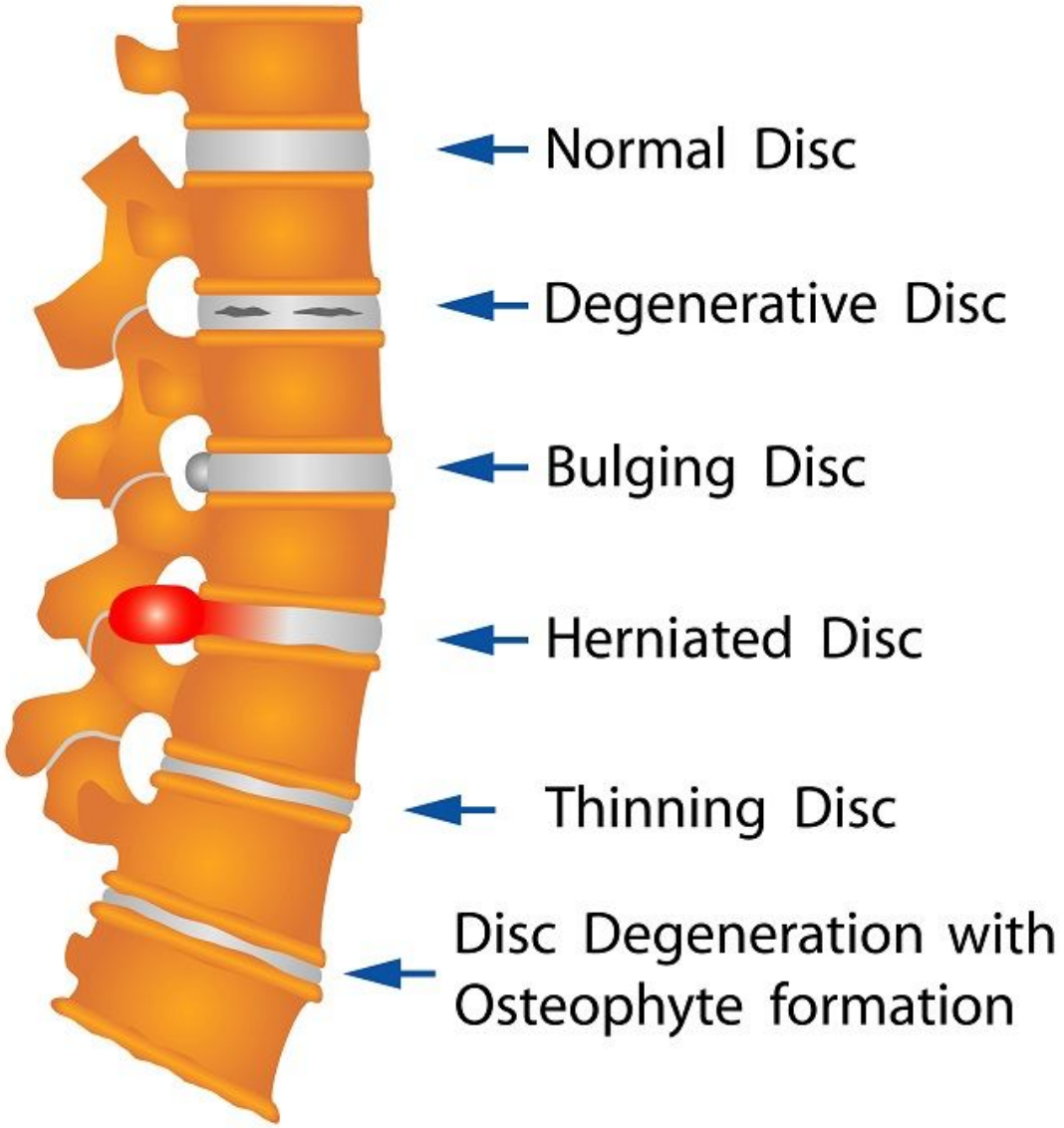

Vertebral body
Intervertebral foramen
Anulus fibrosus
Nucleus pulposus
Lateral view
Superior view

What is a Herniated Disc?



Normal Disc

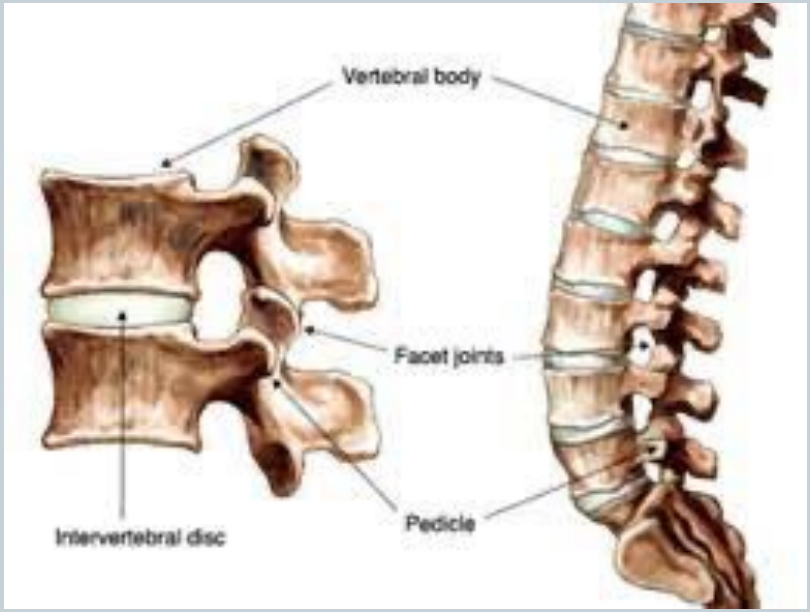
Herniated Disc


Normal Disc
Degenerative Disc
Bulging Disc
Herniated Disc
Thinning Disc
Disc Degeneration with
Osteophyte formation

Joints of the Vertebral Column

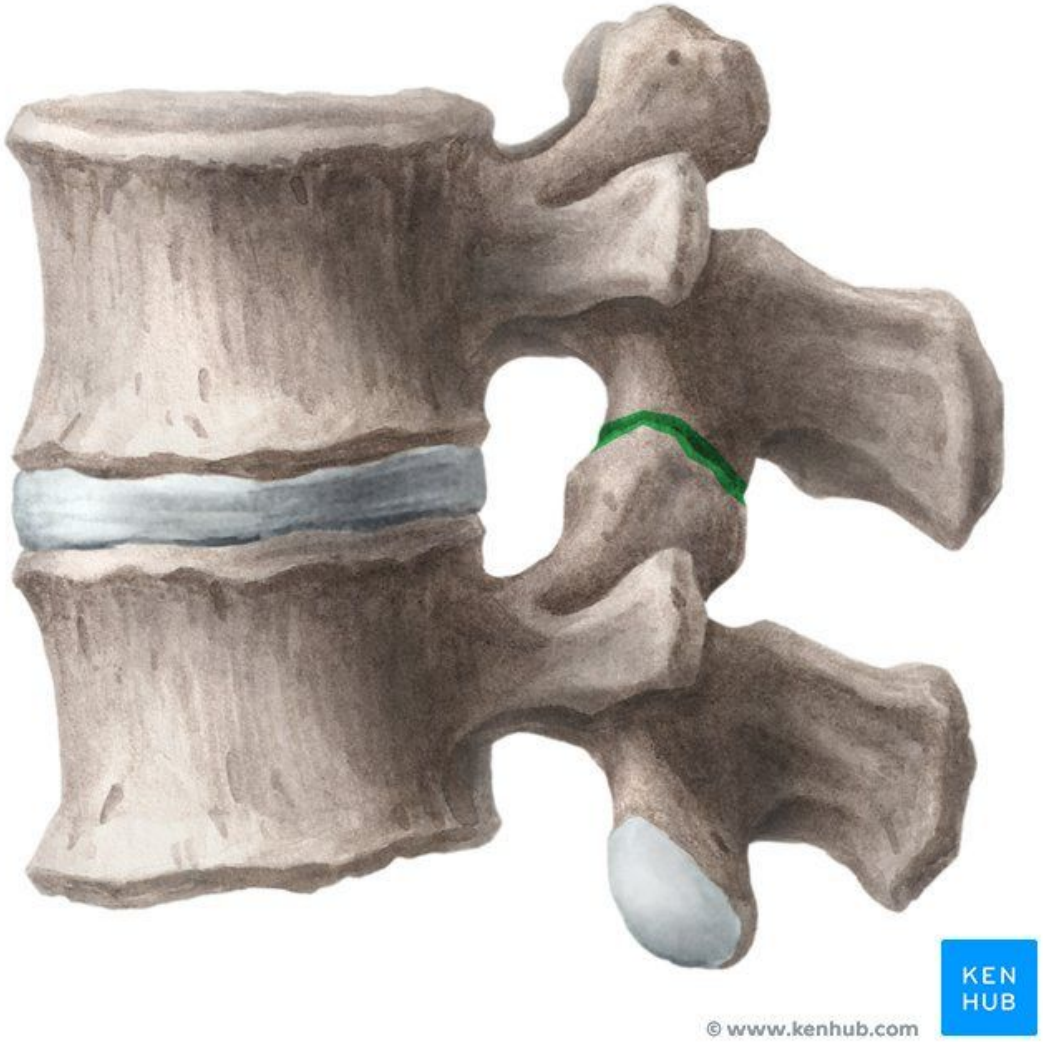
Intervertebral Disc

- Classifications:
  - Functional:
    - amphiarthrotic
  - Structural:
    - cartilaginous
    - symphyseal



Zygapophyseal Joint

- Aka: facet joints
- Articulations:
  - Between the arches & superior/inferior articular processes
- Classifications:
  - Functional:
    - diarthrotic, uniaxial
  - Structural:
    - synovial, plane
- Very little movement
  - movement will be greatest where articular surfaces are largest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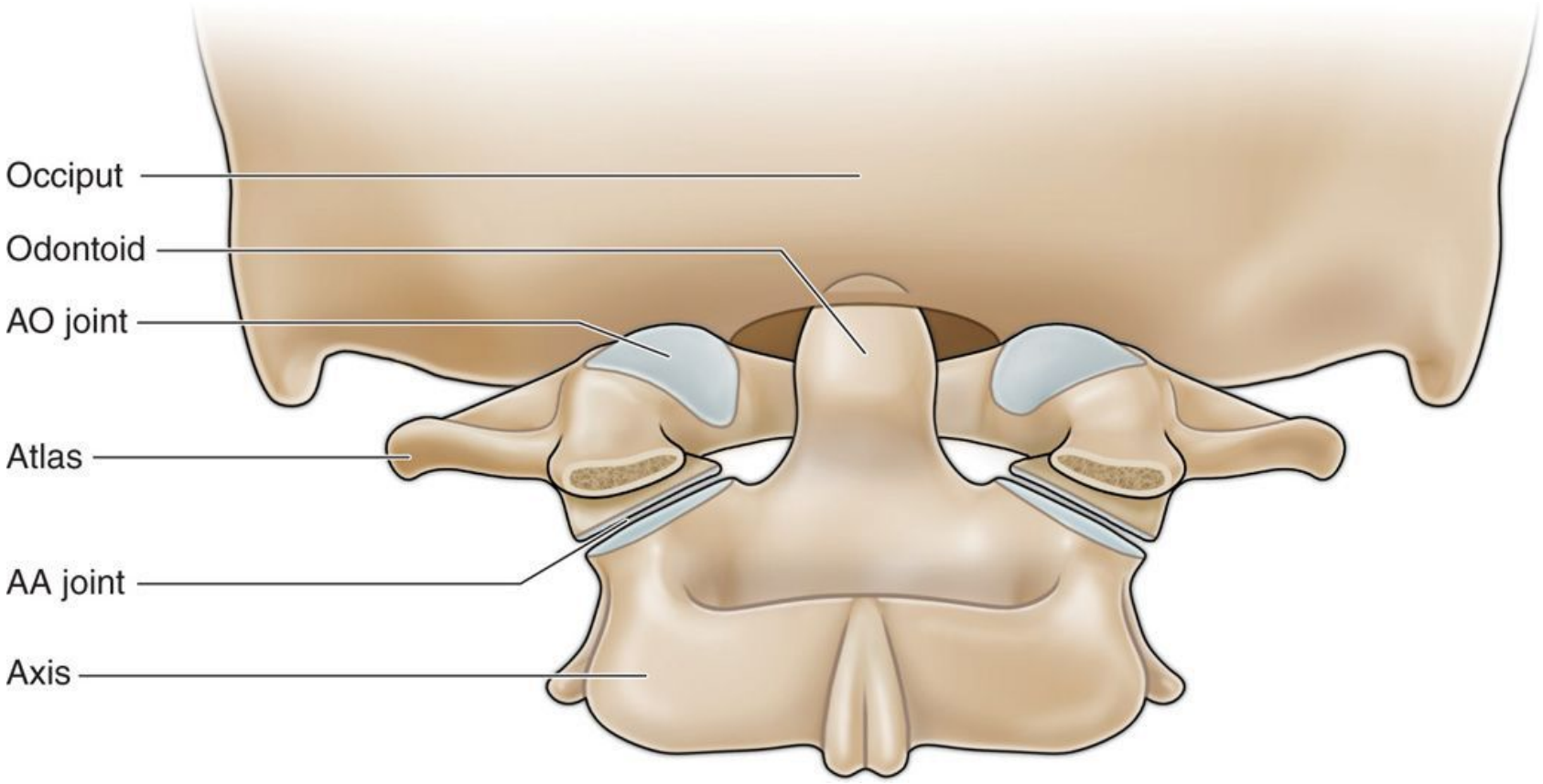
Atlanto-Occipital Joint

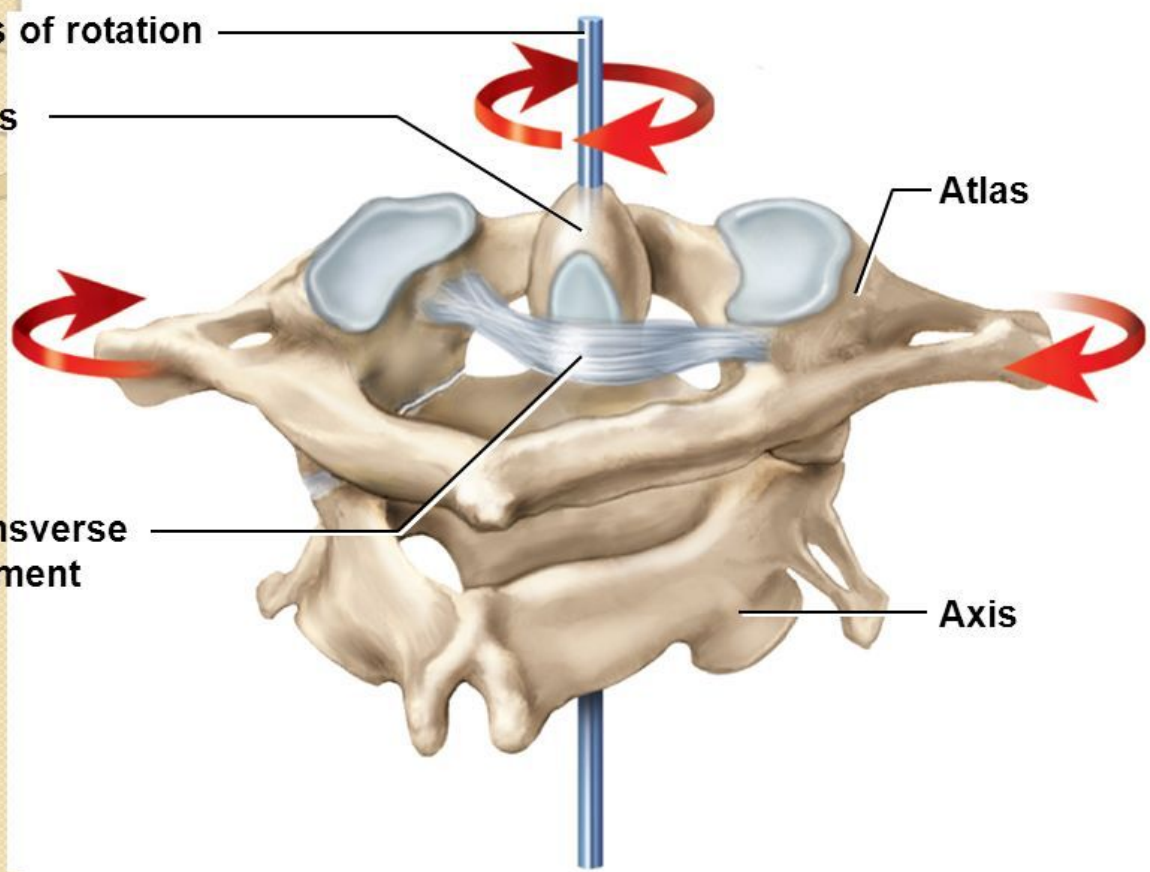
- Articulations:
  - C1 superior articular facets → occipital condyles
- Classifications:
  - Functional
    - diarthrotic, biaxial
  - Structural
    - synovial, ellipsoid
- Nods head → the rocking “yes”motion


Occiput
Odontoid
AO joint
Atlas
AA joint
Axis

Atlantoaxial Joint

- Articulations:
  - Odontoid process (dens) of axis articulates with posterior aspect of the anterior arc of the atlas
- Classifications:
  - functional:
    - Diarthrotic, uniaxial
  - Structural:
    - Synovial, pivot
- Shakes head “no”

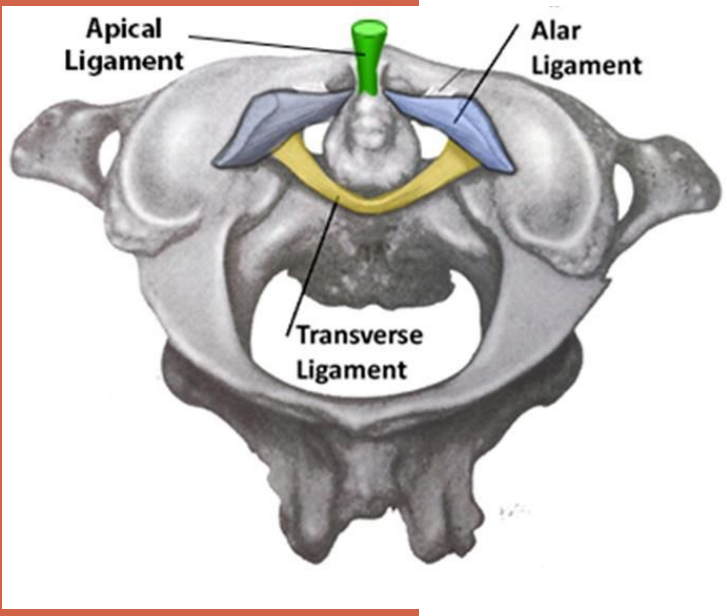
Atlas and Axis Articulation

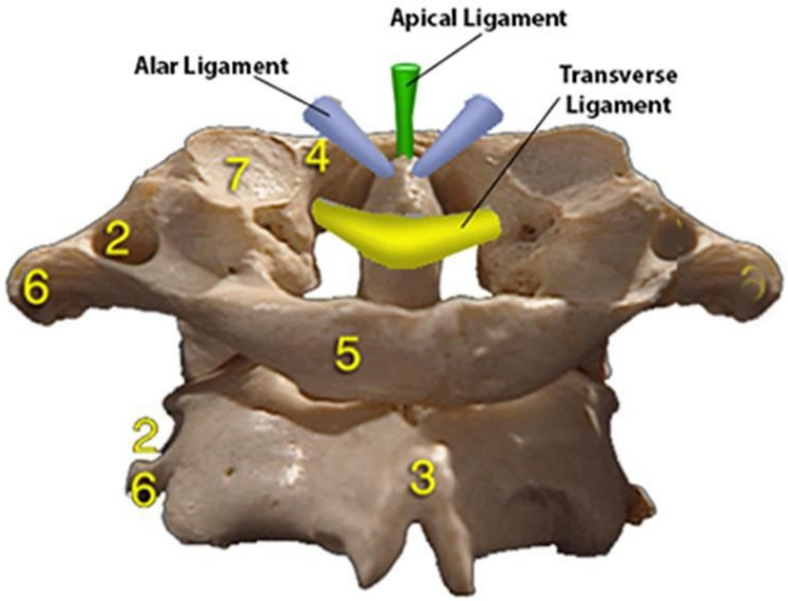


Ligaments of the Vertebral Column

Transverse Atlantal Ligament

- **part of the atlantoaxial joint**
- **divides the foramen into two areas:**
  - ⅓ anterior area allows room for the dens/pivot joint
  - ⅔ posterior area allows room for the spinal cord

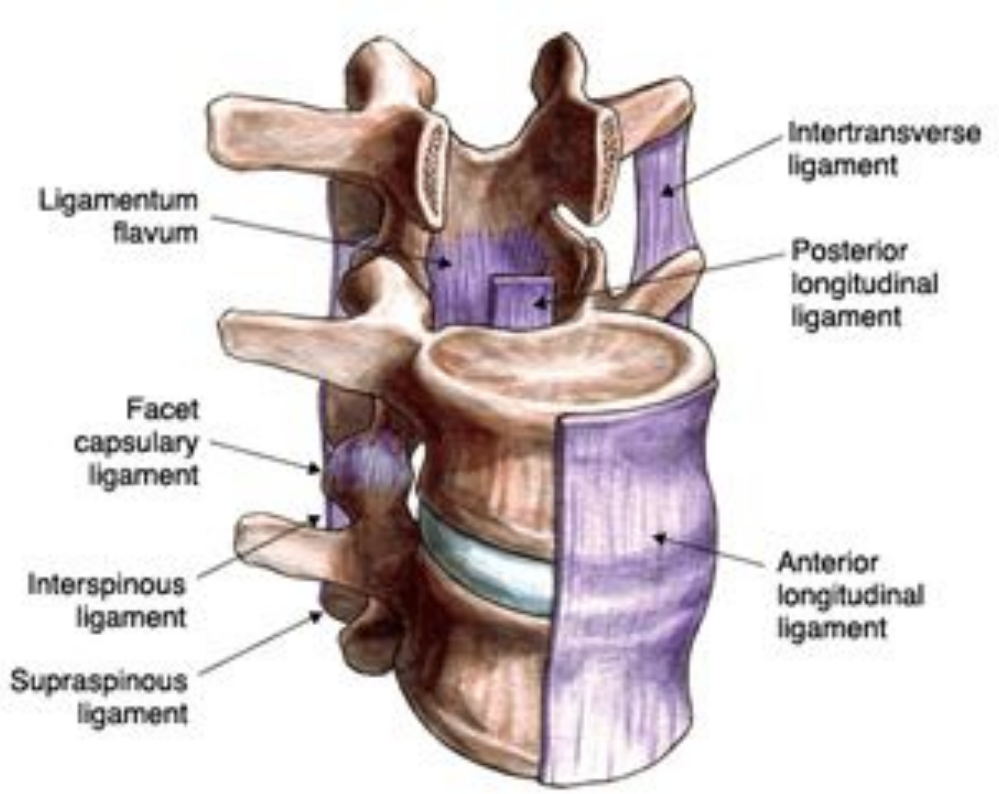




Ligament that supports the vertebral body:

Anterior Longitudinal Ligament

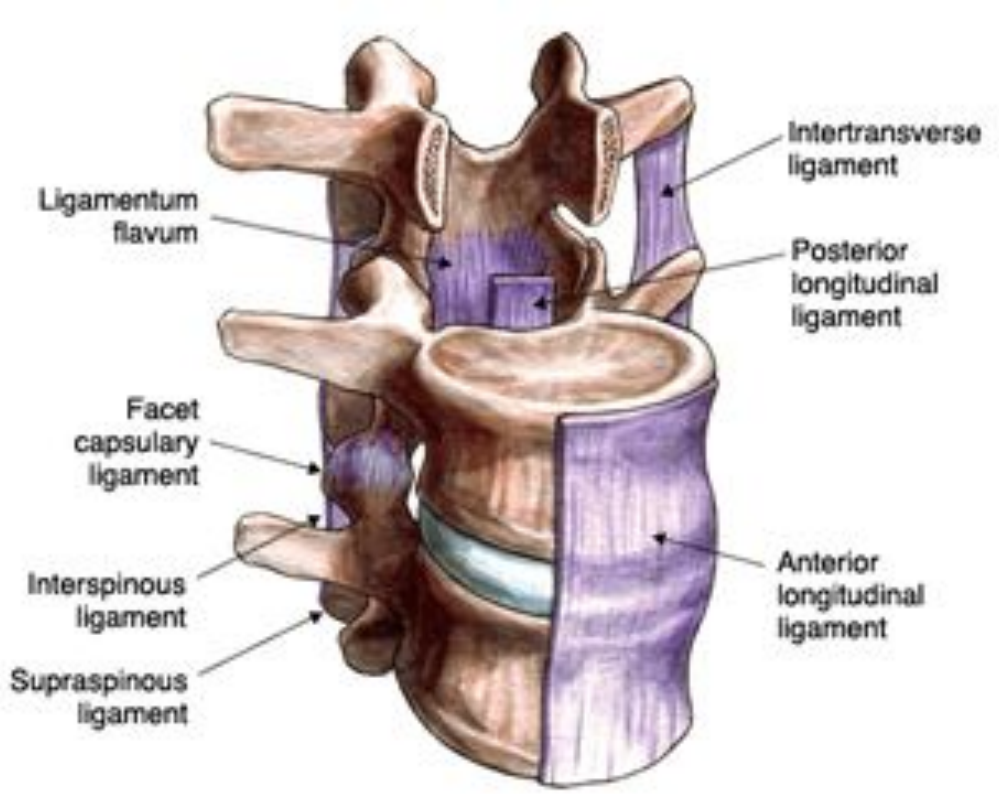
- runs the length of all the vertebral bodies; anteriorly
- C2 → Sacrum
- prevents hyperextension



Ligament that supports the vertebral body

Posterior Longitudinal Ligament

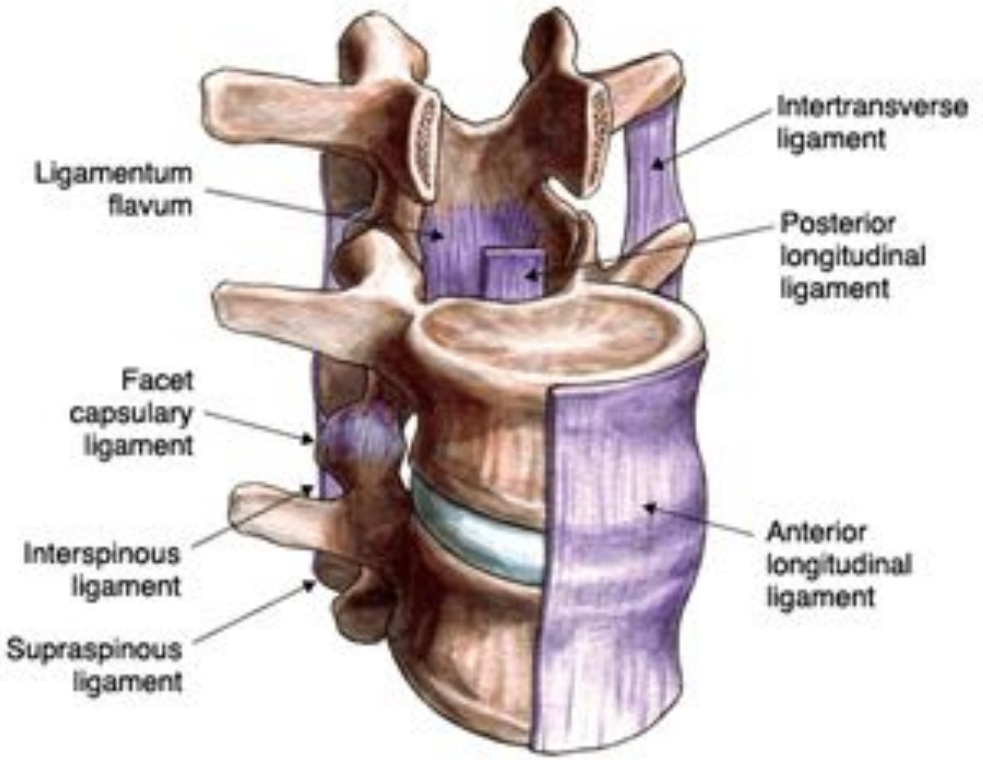
- runs the length of all the vertebral bodies; posteriorly
- C2 → Sacrum
- prevents hyperflexion



Ligament that supports the posterior elements

Ligamentum Flavum

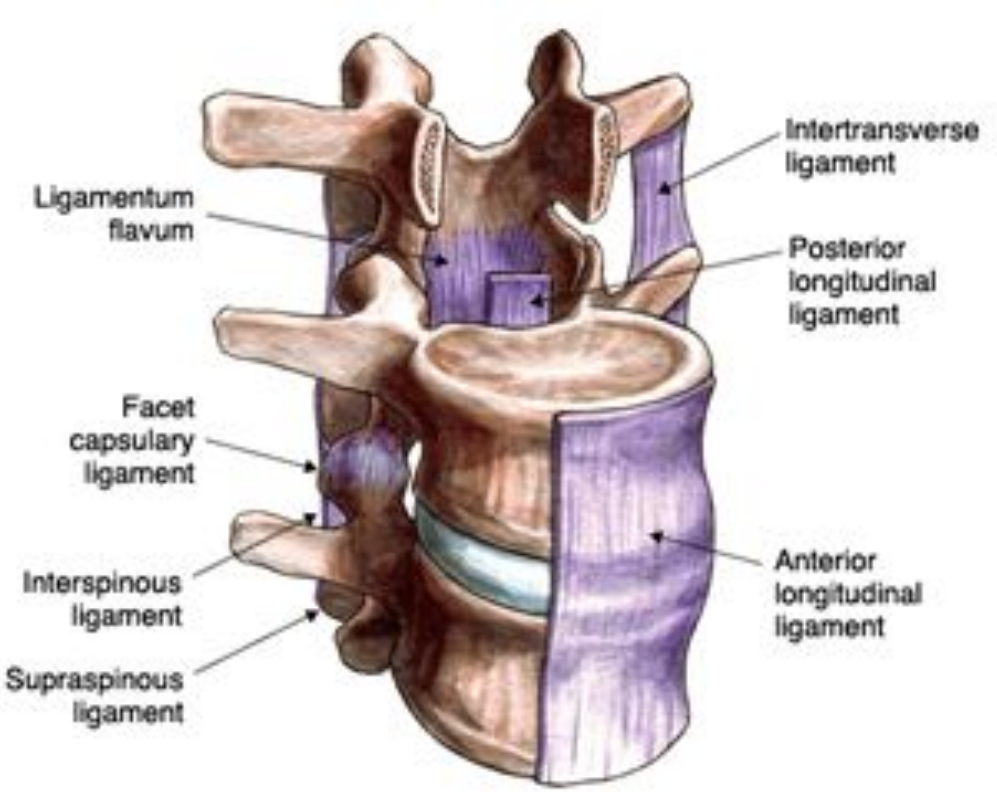
- **elastic fibres between the lamina of each vertebrae**



Ligament that supports the posterior elements

Interspinous Ligament

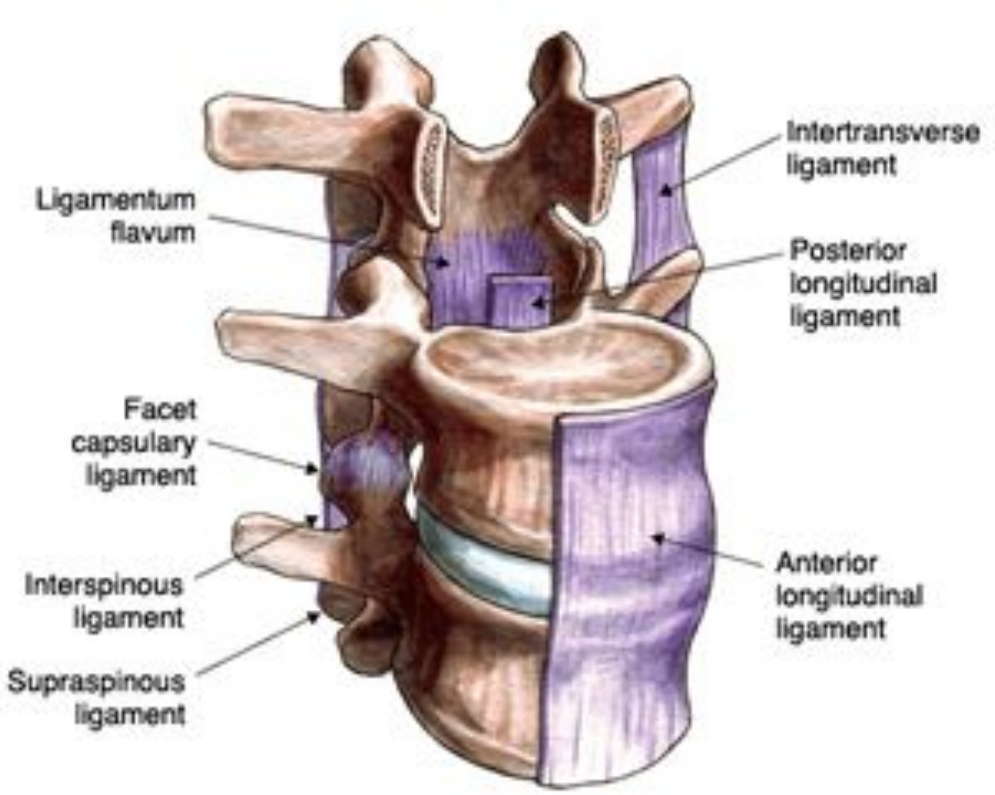
- **Ligament joining each spinous process to the one above and below**
- **C7 → L5**



Ligament that supports the posterior elements

Supraspinous Ligament

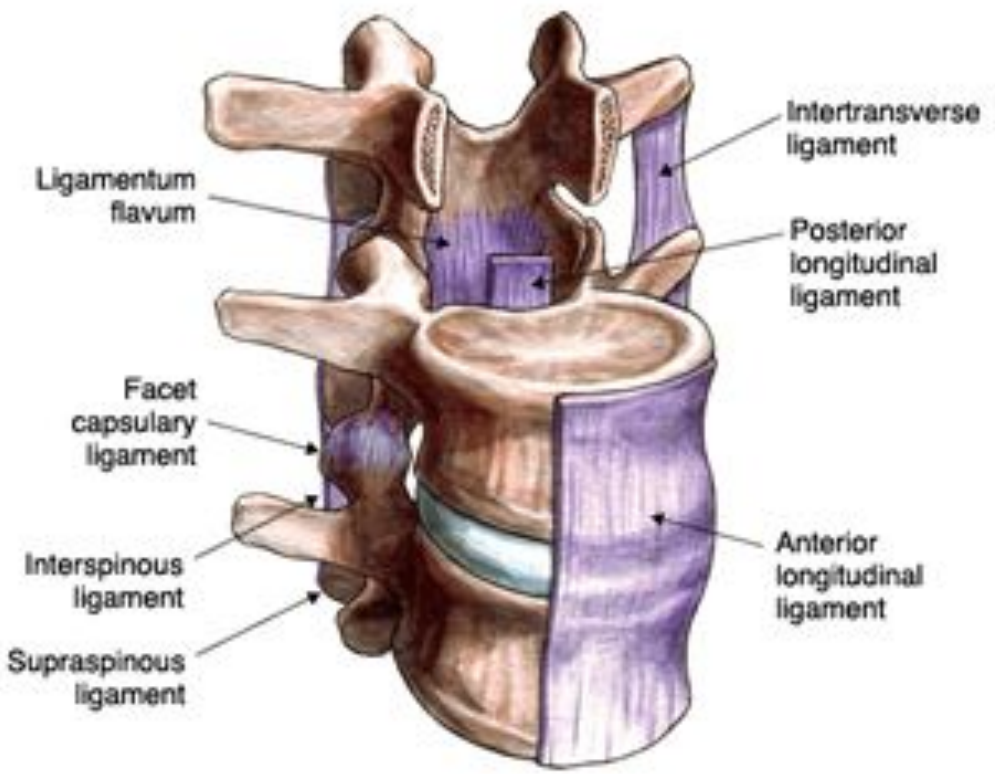
- **A strong fibrous cord that attaches to the most posterior points of each spinous process**
- **C7 → Sacrum**



Ligament that supports the posterior elements

Intertransverse Ligament

❖ Ligaments found between each transverse process



Ligament that supports the posterior elements

Ligamentum Nuchae

- An extension of the supraspinous ligament
- extends from the spinous process of C7 → external occipital protuberance of the skull