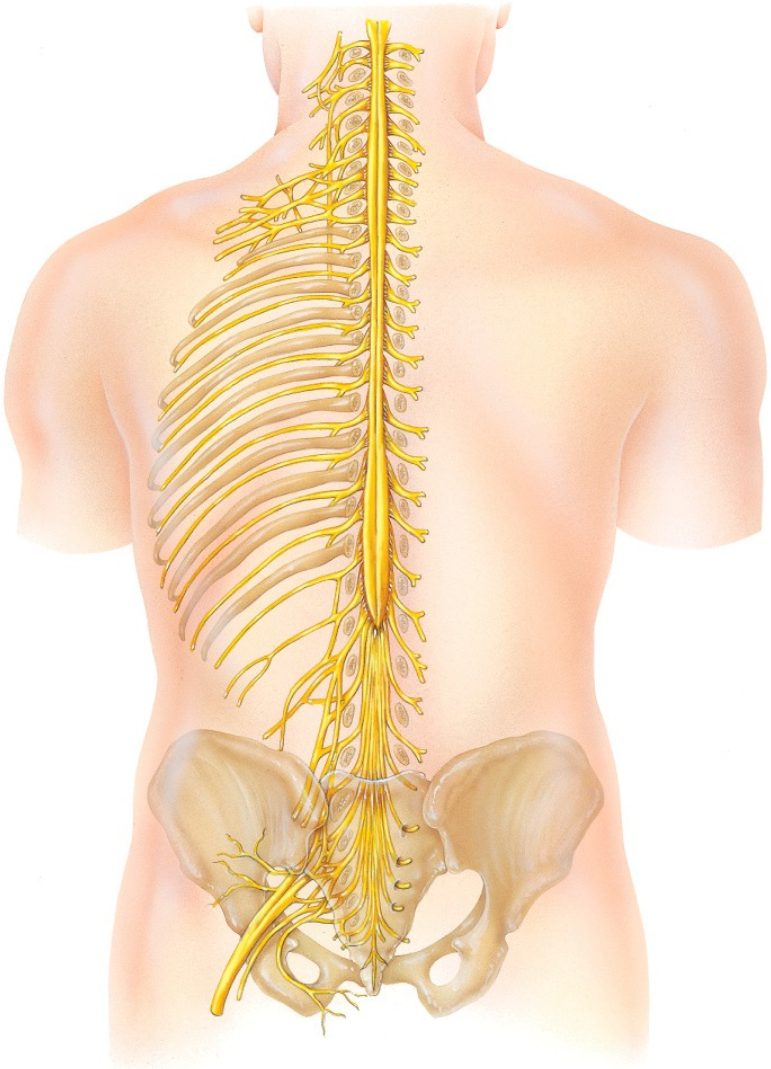
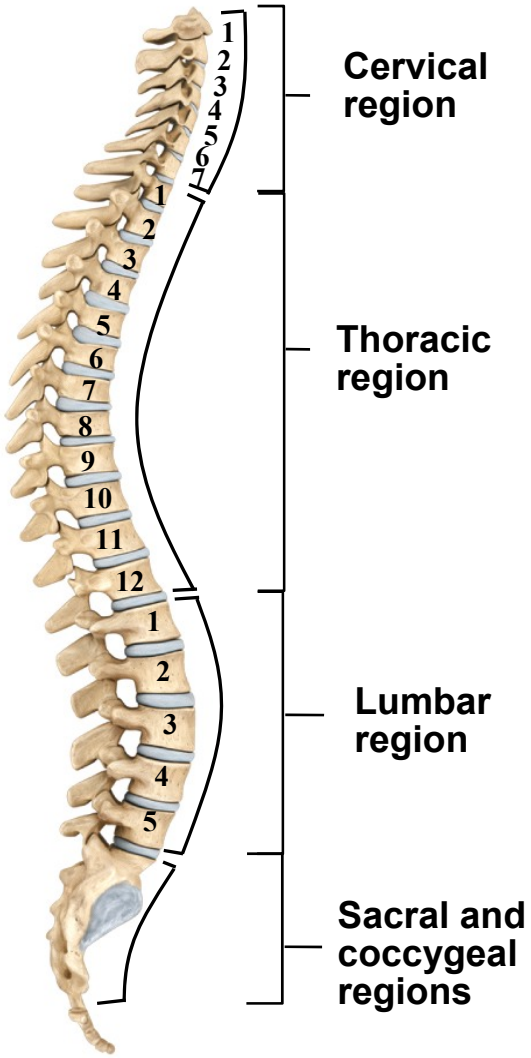
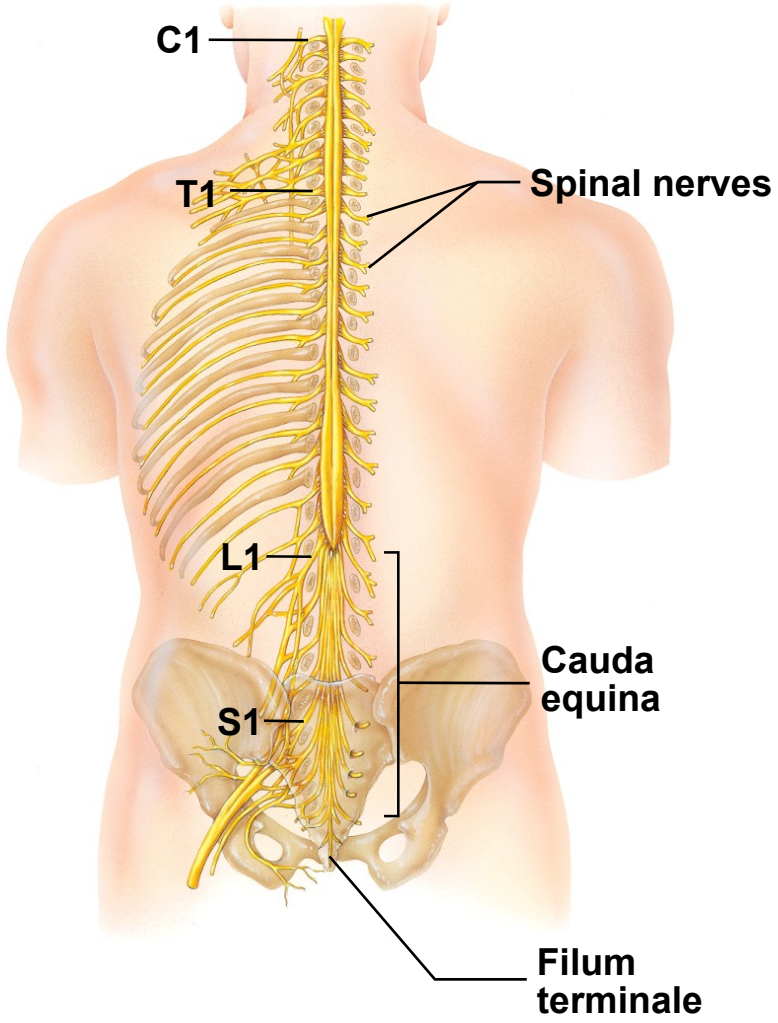
Chapter 13
Spinal Cord and Spinal Nerves



Spinal Cord and Spinal Nerves



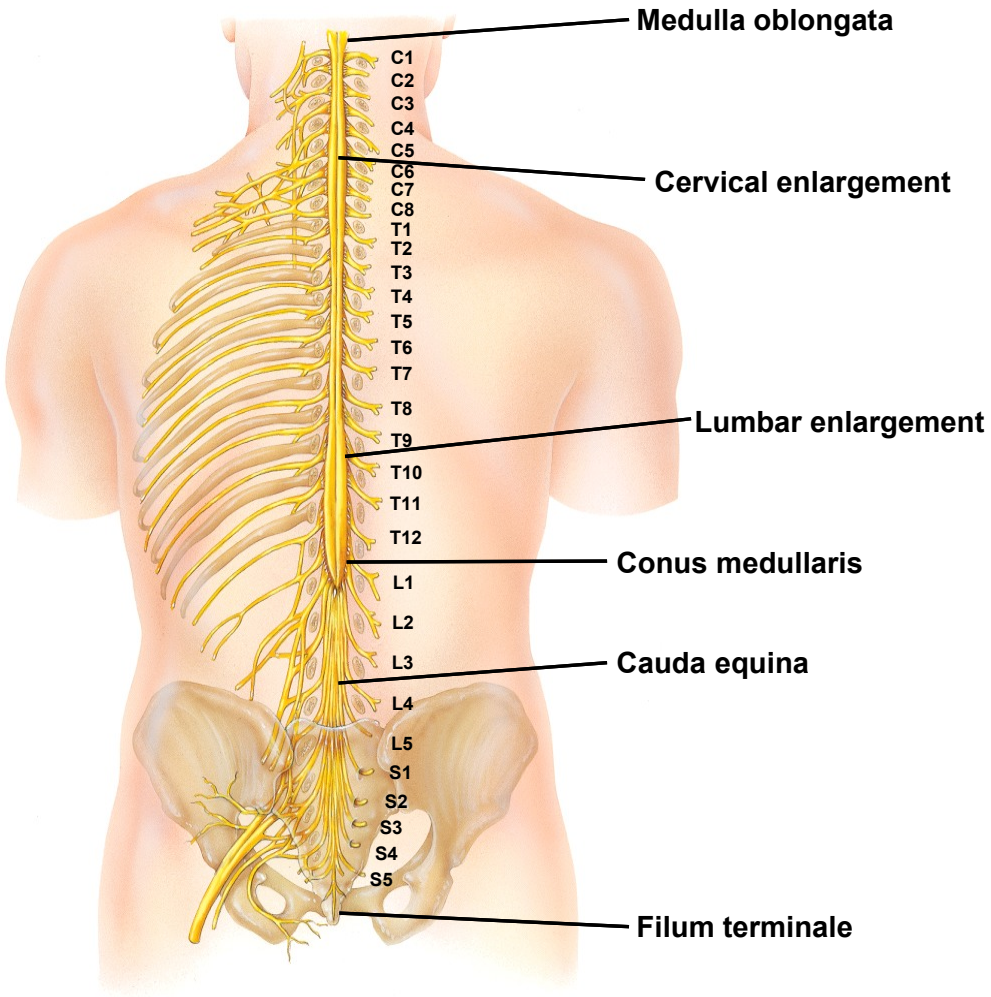


Right lateral view showing four normal curves

Spinal Cord

- **Communication link between the brain and the PNS (below the head)**
- **Integrate information and produce responses**
- **Extends from the foramen magnum to L2**
- **Composed of cervical, thoracic, lumbar, and sacral segments**
- **31 pairs of spinal nerves**

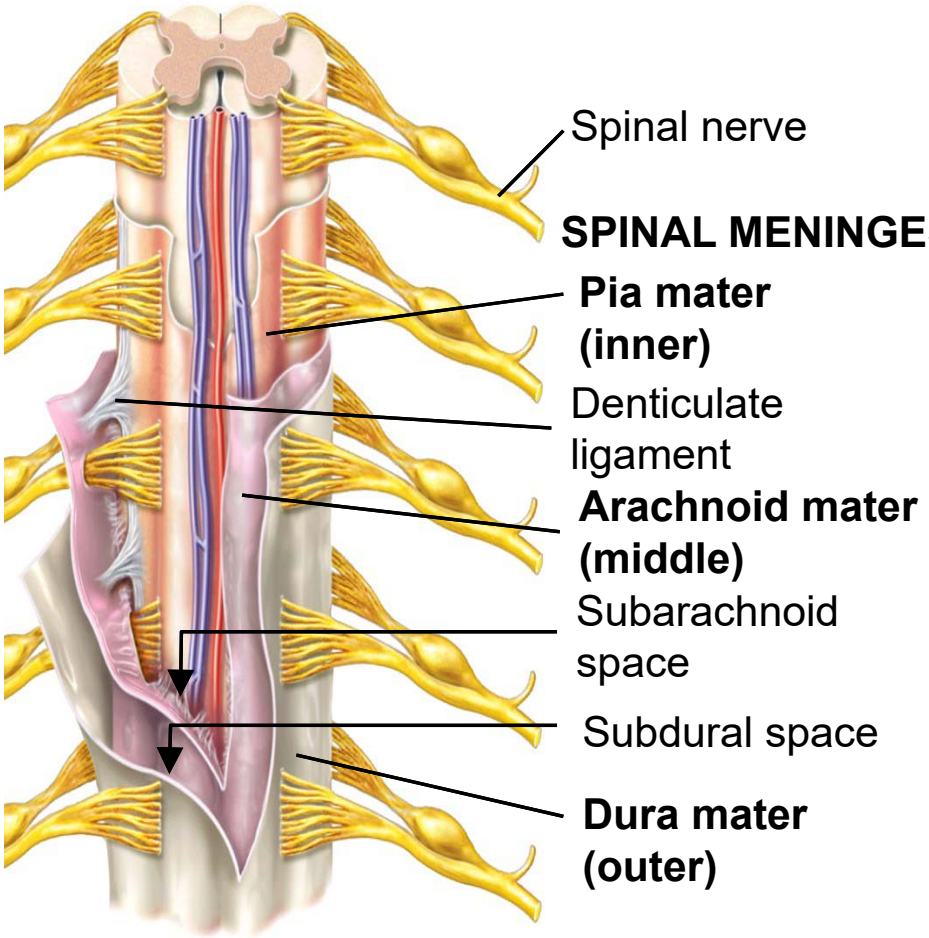
Spinal Cord



Posterior view of entire spinal cord and portions of spinal nerves

- **not uniform in diameter**
- **Two enlargements:**
  1. Cervical enlargement
  2. Lumbosacral enlargement
- **Conus medullaris – the inferior end of the spinal cord**
- **Nerves supplying the lower limbs – exit LS enlargement – course down through vertebral canal – exit via foramina**

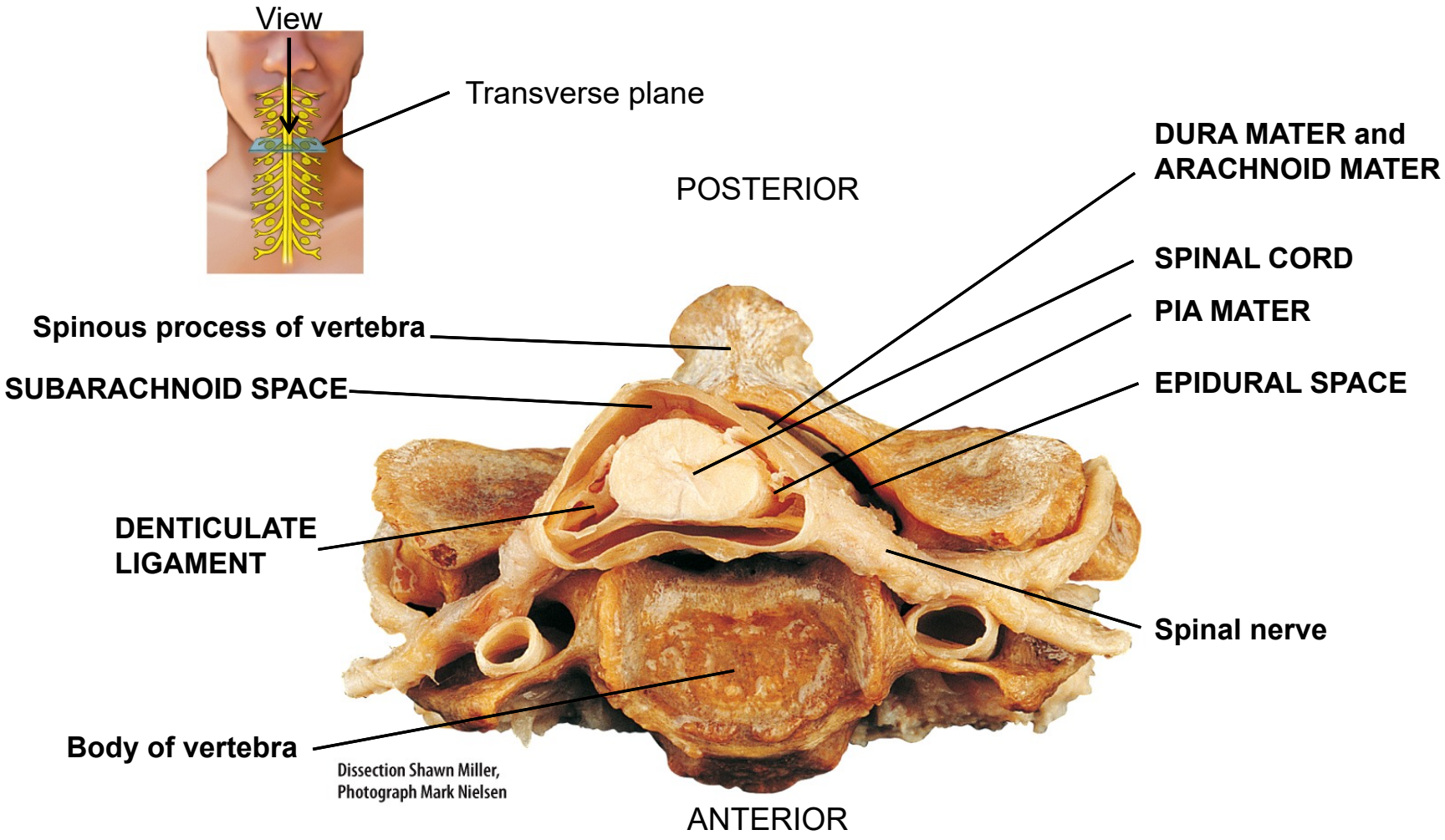
Meninges



(a) Anterior view and transverse section through spinal cord

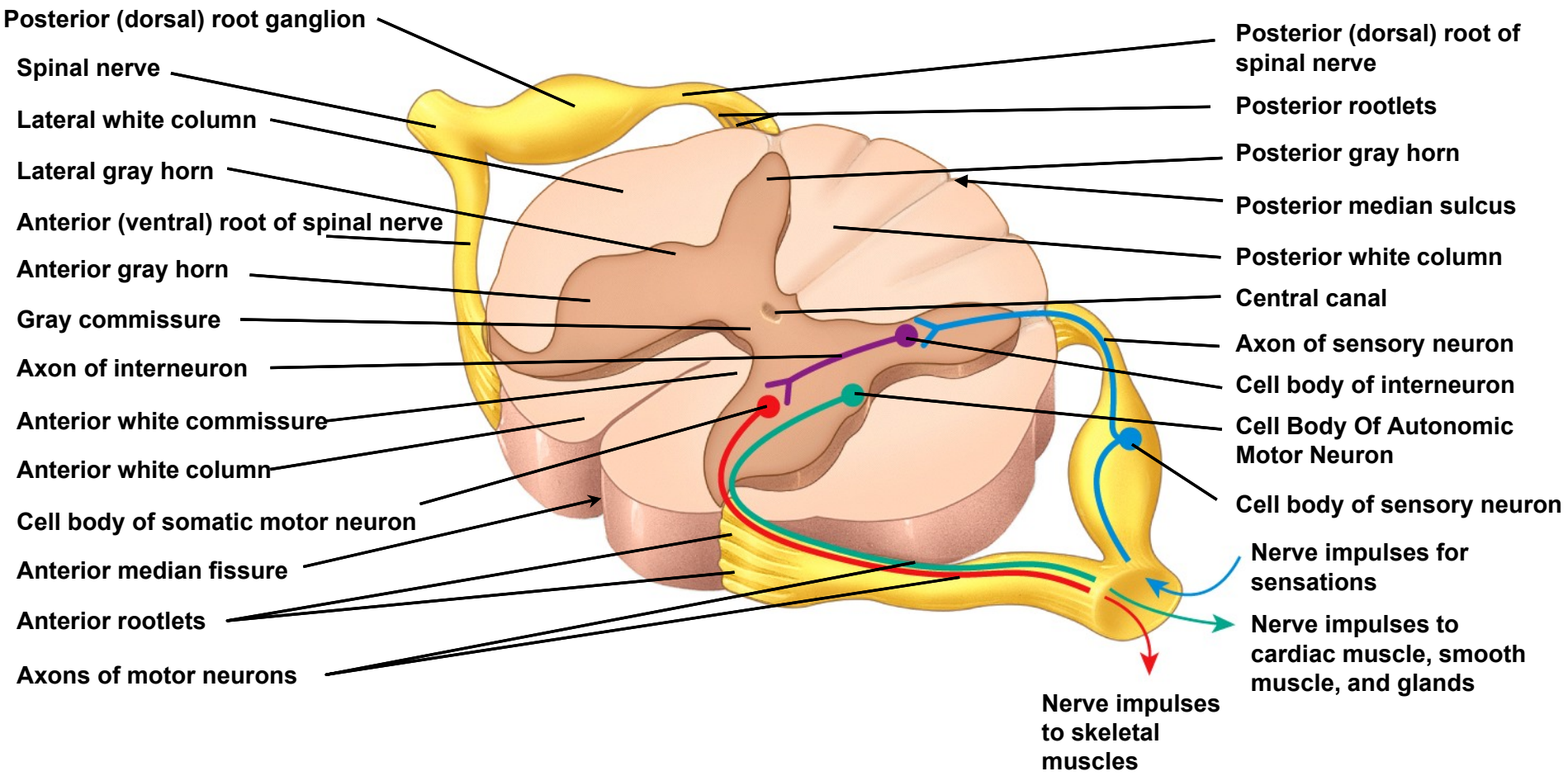
- **Most superficial – Dura mater**
  - **continuous with the brain and epineurium of spinal nerves**
- **Arachnoid mater – thin**
- **Pia mater – deepest layer – tight to the spinal cord**
- **Denticulate ligaments**
- **Filum Terminale**

Meninges



(b) Transverse section of the spinal cord within a cervical vertebra

Internal Anatomy of the Spinal Cord



(a) Transverse section of thoracic spinal cord

Internal Anatomy of the Spinal Cord

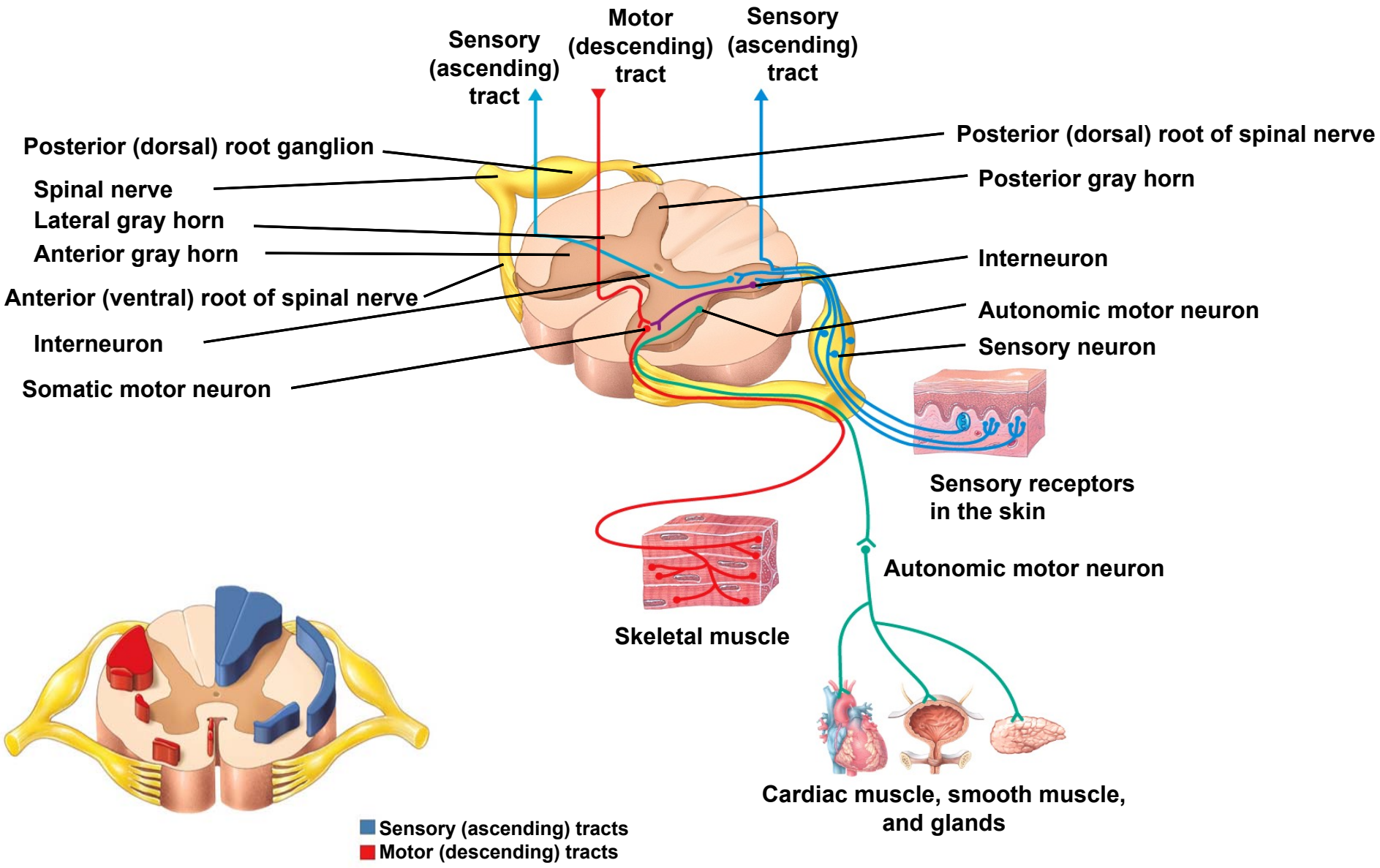
White Matter: **two halves; three columns in each half**

- **Each column subdivided into nerve tracts**
- **Ascending and descending tracts – myelinated axons (white matter)**

Gray Matter **Composed of posterior, anterior and lateral horns**

- **Lateral horns – Autonomic nervous system**
- **Posterior horns – Sensory neurons**
- **Anterior horns (motor horn) – Motor neurons**
- **Gray and white commissures – axons that cross from one side of the spinal cord to the other**
- **Central canal – centre of the gray commissure**

Sensory and Motor Processing



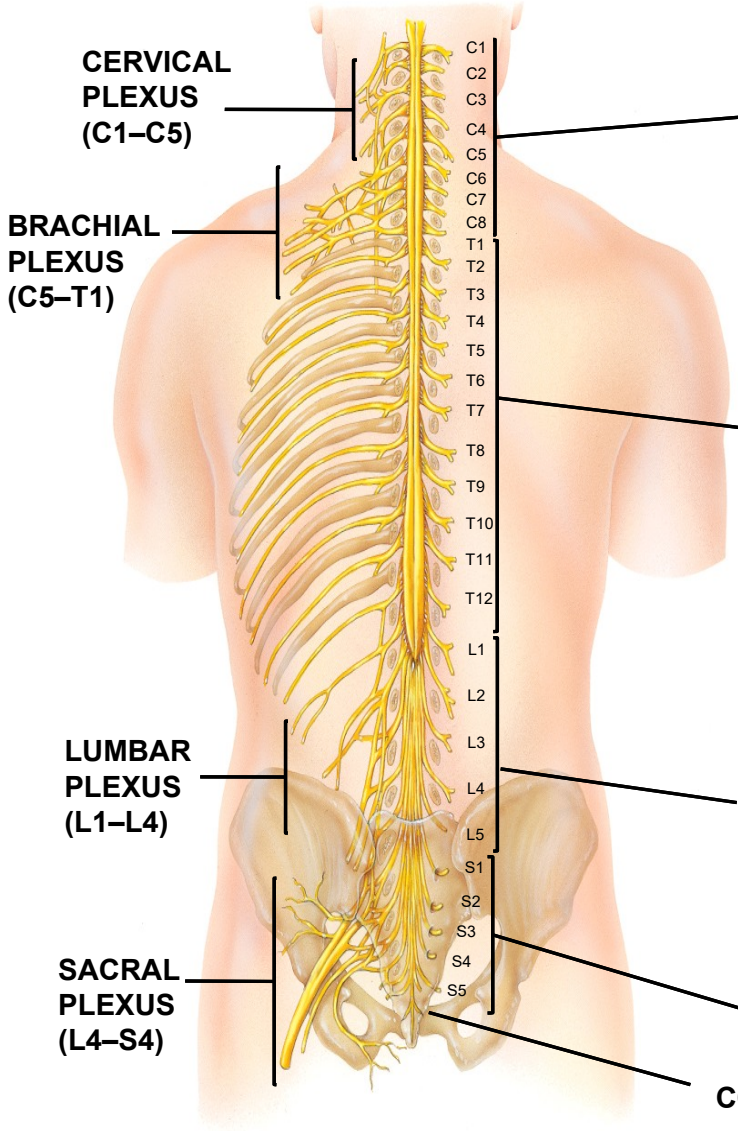
Sensory and Motor Processing

- **The internal anatomy of the spinal cord allows sensory and motor information to be processed in an organized way**
- **sensory neurons pass into the posterior horn through dorsal root**
- **synapse with interneurons or enter white matter and ascend or descend the cord**
- **motor neurons – anterior horn exit the ventral root**

Spinal Nerves

- **Thirty-one pairs of spinal nerves**
- **First pair exit vertebral column between skull and first cervical vertebrae**
- **Four pair exit via the sacral foramina**
- **Others exit through intervertebral foramina**
- **Eight pair cervical, twelve pair thoracic, five pair lumbar, five pair sacral, one pair coccygeal**

Spinal Nerves



Posterior view of entire spinal cord and portions of spinal nerves

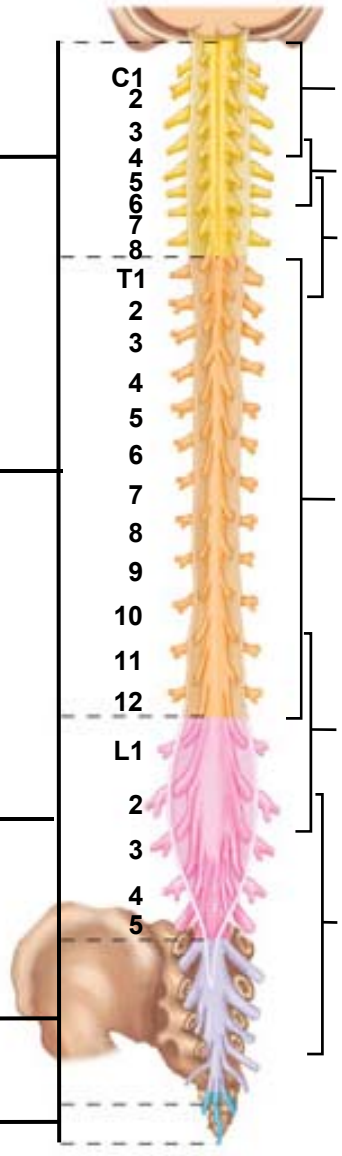
CERVICAL NERVES (8 pairs)

THORACIC NERVES (12 pairs)

LUMBAR NERVES (5 pairs)

SACRAL NERVES (5 pairs)

COCCYGEAL NERVES (1 pair)



Posterior view

Functions

Diaphragm movement

Neck and shoulder movement

Upper limb movement

Rib movement in breathing, vertebral column movement, and tone in postural back muscles

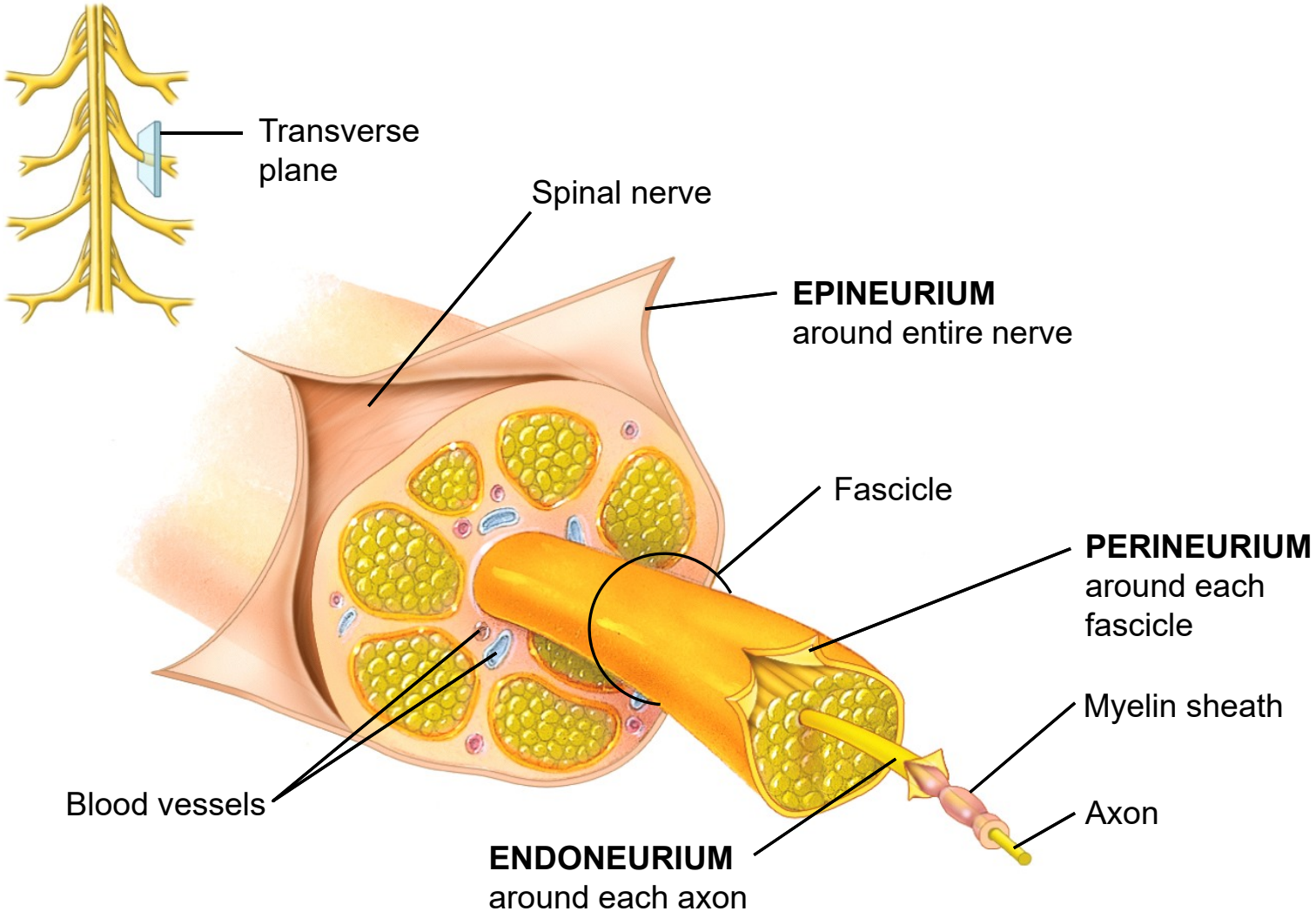
Hip movement

Lower limb movement

Spinal Nerves

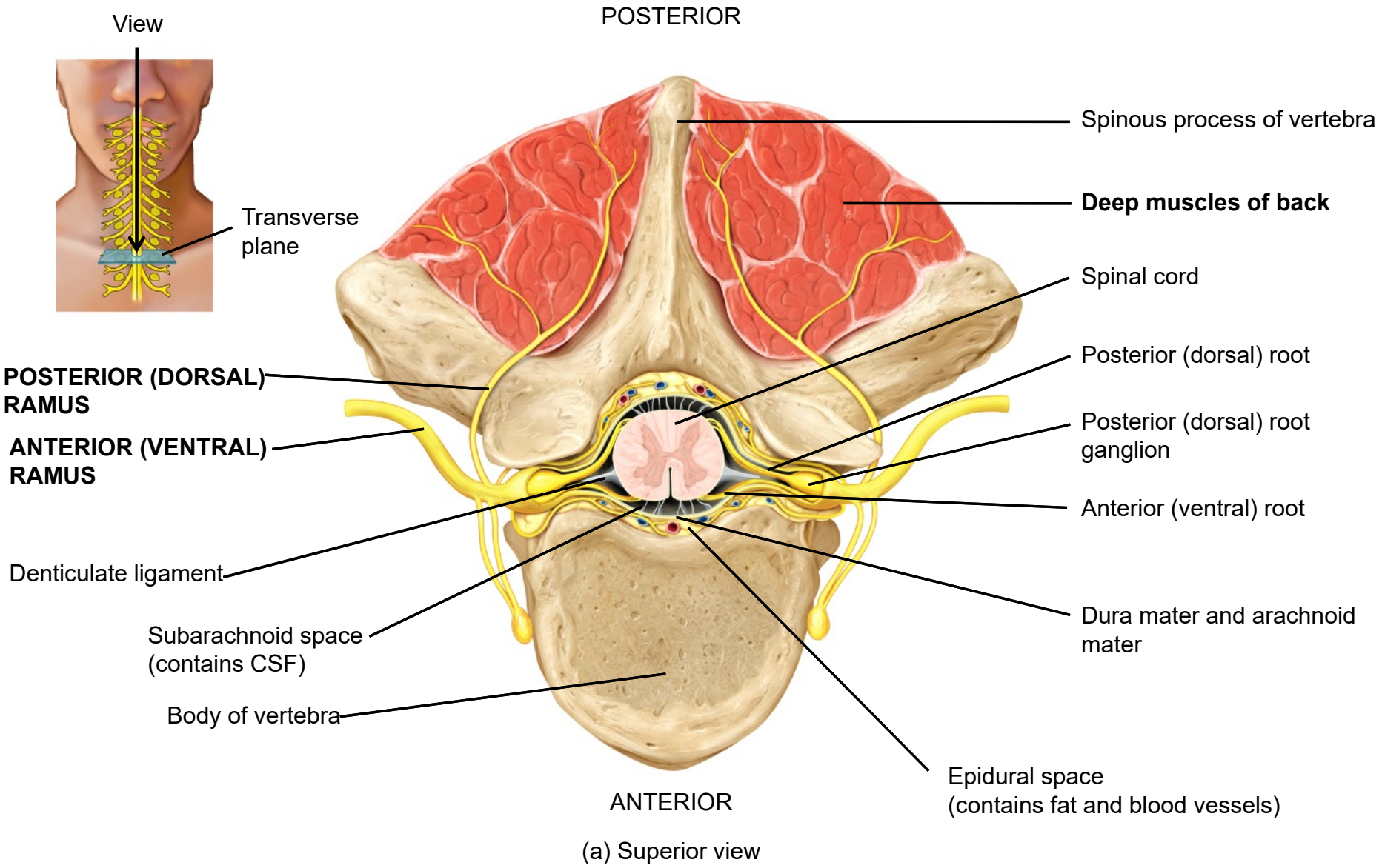
- **arise from rootlets along the dorsal and ventral surfaces of the spinal cord**
- **6-8 rootlets**
- **ventral and dorsal roots – pass through the sub-arachnoid space, pierce the arachnoid and dura mater and join to form a spinal nerve – contains both sensory and motor neurons**
- **each dorsal root contains a ganglion**

Structure of Peripheral Nerves



(a) Transverse section showing the coverings of a spinal nerve

Branches of Spinal Nerves



(a) Superior view

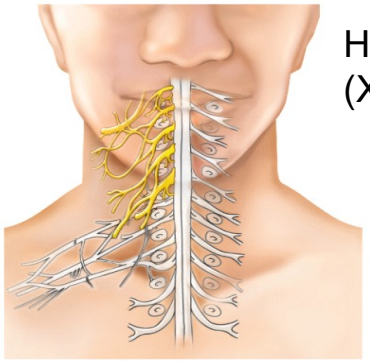
Branches of Spinal Nerves

- **Dorsal Ramus: innervate deep muscles of the trunk responsible for movements of the vertebral column**

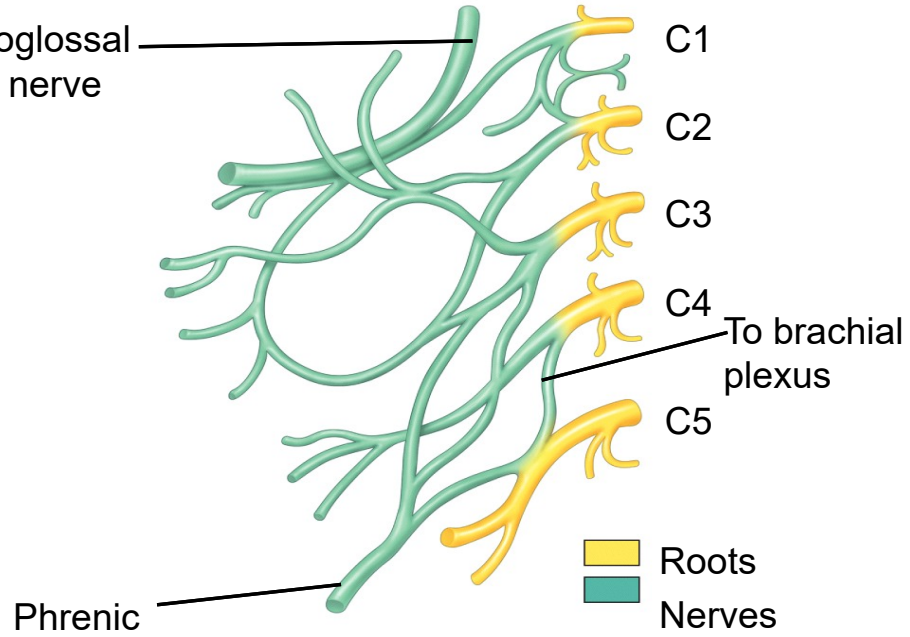
- **Ventral Ramus:**
  - **Thoracic region (T2-T12): form intercostal nerves**
  - **Remaining spinal nerve ventral rami (roots of the plexus): five plexuses (intermingling of nerves).**
    - **Ventral rami of C1-C4 (some C5)= cervical plexus**
    - **Ventral rami of C5-T1= brachial plexus**
    - **Ventral rami of L1-L4= lumbar plexus**
    - **Ventral rami of L4-S4= sacral plexus**
    - **Ventral rami of S4-S5 and Co= coccygeal plexus**

Cervical Plexus

- **Roots: C1-C4 (with some from C5)**
- **Innervates superficial neck structures, skin of neck, posterior portion of head**
- **Phrenic nerve: from C3-C5 (cervical and brachial plexuses)**
  - Innervates diaphragm



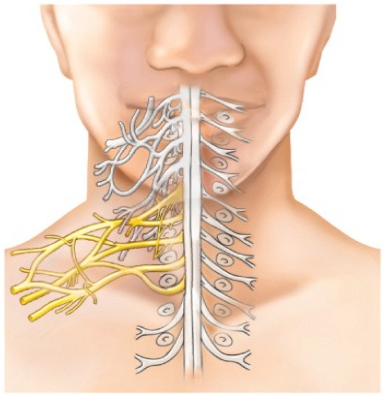
Cervical plexus projected to surface



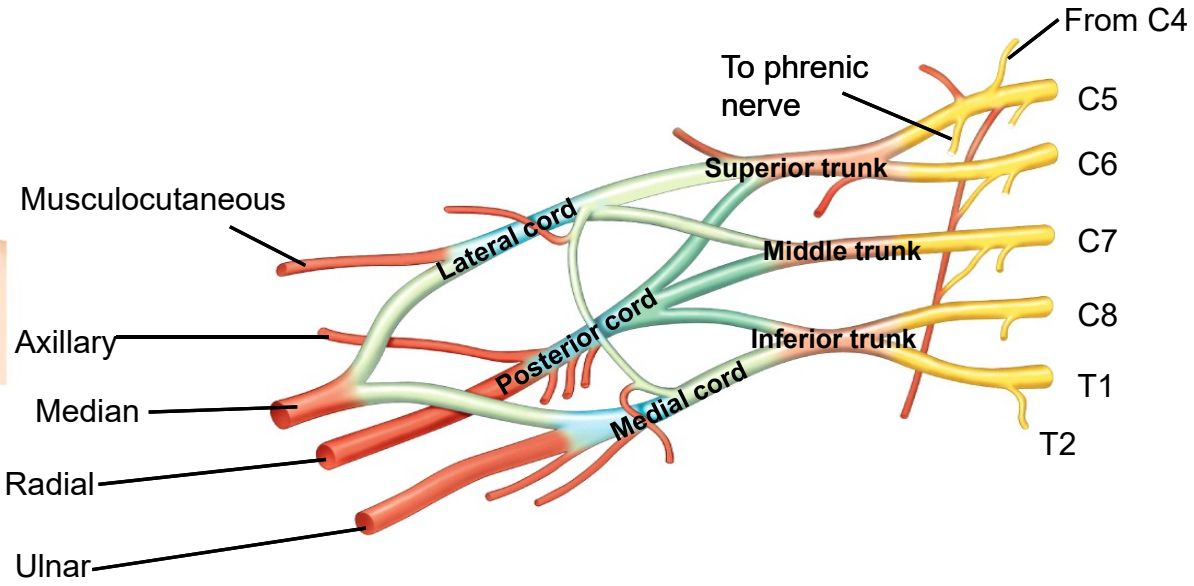
Origin of cervical plexus

Brachial Plexus

- **Roots: C5-T1**
- **3 trunks, 6 divisions, 3 cords, 5 branches: axillary, radial, musculocutaneous, ulnar, median**



Brachial plexus projected to surface

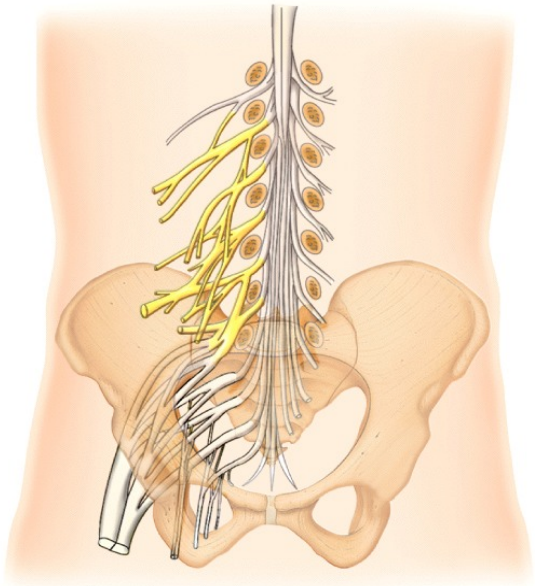


(a) Origin of brachial plexus

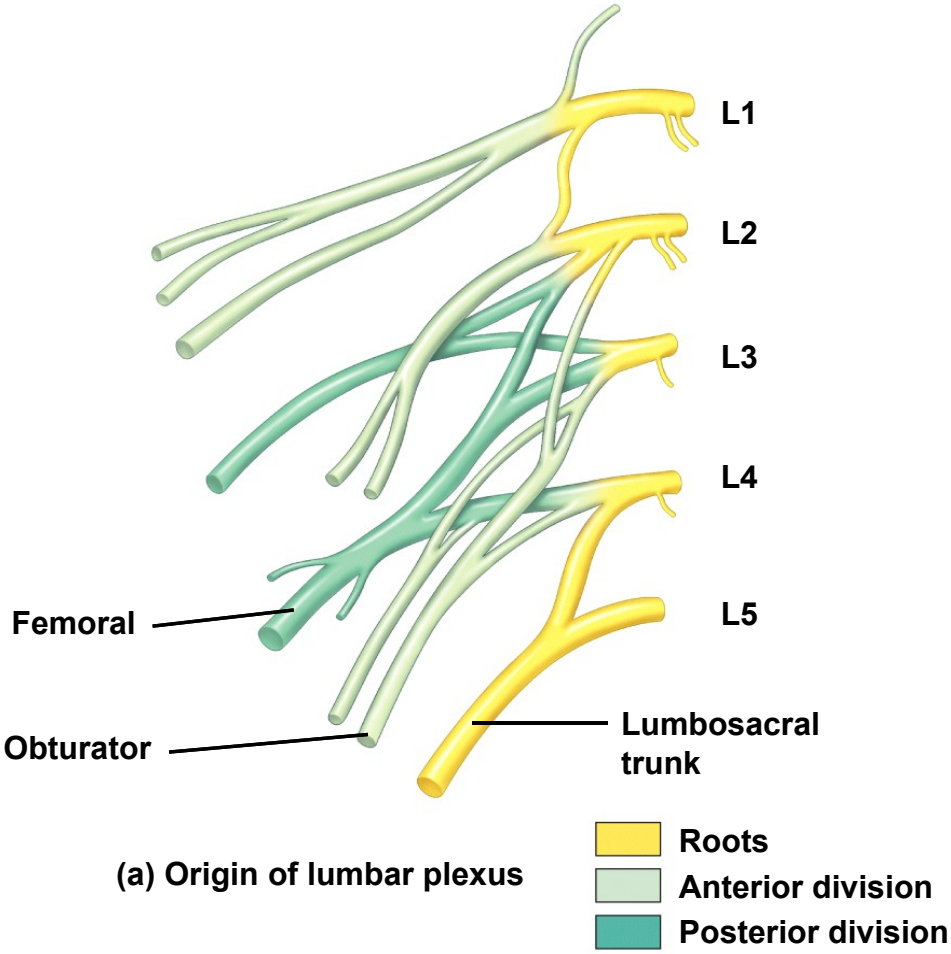
MNEMONIC for subunits of the brachial plexus:
Risk **T**akers **D**on't **C**autiously **B**ehave.
Roots, **T**runks, **D**ivisions, **C**ords, **B**ranches

Lumbar Plexus

- **Roots: L1-L4**
- **Two of the major nerves are obturator & femoral**
  - **supplies part of the lower limbs**



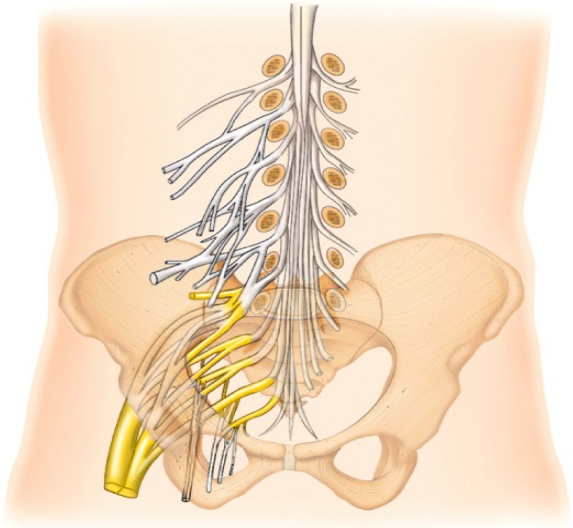
Lumbar plexus projected to surface



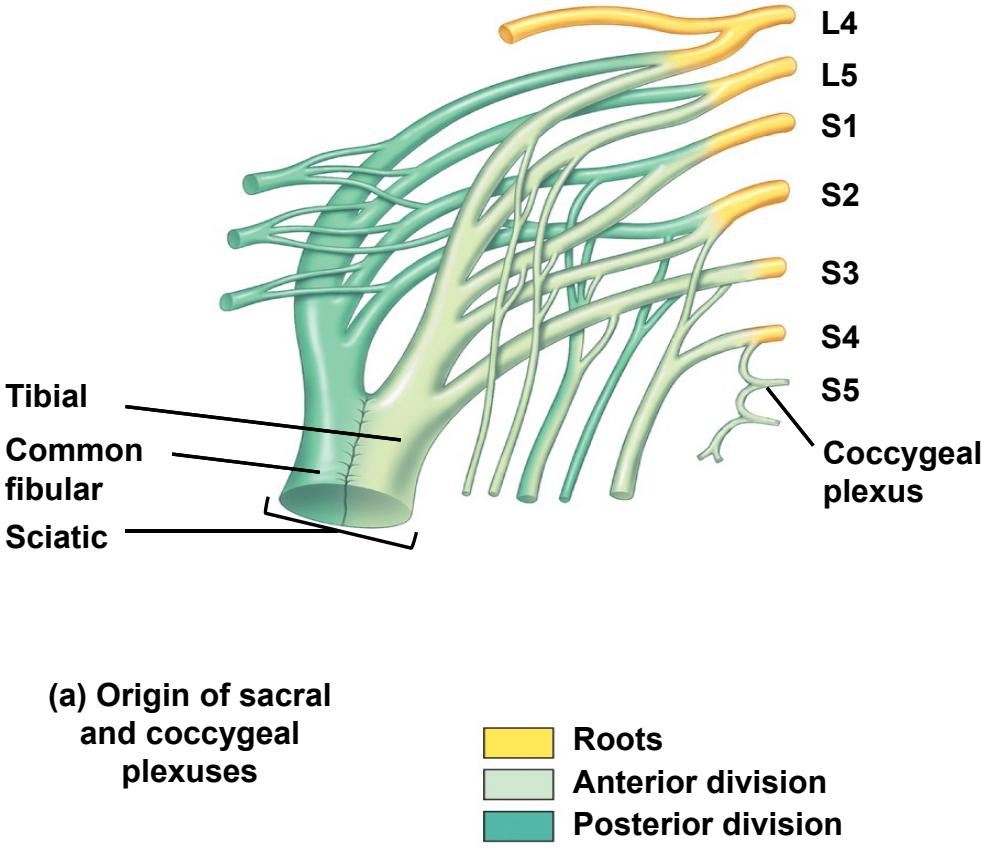
(a) Origin of lumbar plexus

Sacral Plexus

- **Roots: L4-S4**
- **Two of the major nerves are tibial & common fibular which are bound together to form the sciatic nerve**
  - **supplies large portions of the lower limbs**



Sacral and coccygeal plexuses projected to surface



(a) Origin of sacral and coccygeal plexuses

Coccygeal Plexus

- **S4-Co**
- **Muscles of pelvic floor**
- **Sensory information from skin over coccyx**