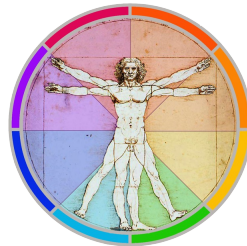


HUBS191 Lecture Material

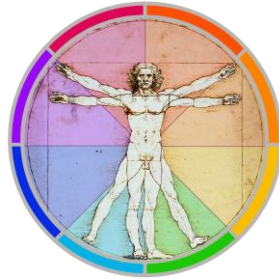
This pre-lecture material is to help you prepare for the lecture and to assist your note-taking within the lecture, it is NOT a substitute for the lecture !



Please note that although every effort is made to ensure this pre-lecture material corresponds to the live-lecture there may be differences / additions.



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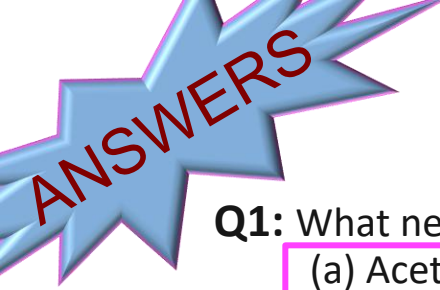
HUBS 191

Human Movement and Sensation

Theme 2: Integrating and coordinating roles of the nervous system

Lecture 20: Anatomy and Function of the Spinal Cord and Spinal Nerves

Dr Rob Munn, Director of Neuroscience
Department of Anatomy



Lecture 17: Post-lecture quiz

Q1: What neurotransmitter is used by a somatic efferent neuron?

- (a) Acetylcholine (b) Norepinephrine (c) Both (d) Neither

Q2: Which of the following is true about the *sympathetic chain ganglia*.

- (a) The preganglionic neurons are unmyelinated
(b) They contain the axons of postganglionic neurons
(c) They contain cell bodies that contain norepinephrine
(d) They contain cell bodies that give rise to myelinated axons

Q3: If you were told that your craniosacral nervous system were activated, does that mean that you are:

- (a) Relaxed (b) Thoughtful (c) Hyperactive (d) Sympathetic

Q4: Which statement is true of a post-ganglionic parasympathetic neuron

- (a) It is myelinated (b) It receives input from an unmyelinated axon;
(c) Its cell body resides distant from the CNS
(d) Its cell body can be found in the collateral ganglion

Lecture 20: Learning objectives

After reviewing and studying this lecture you should know and be able to describe:

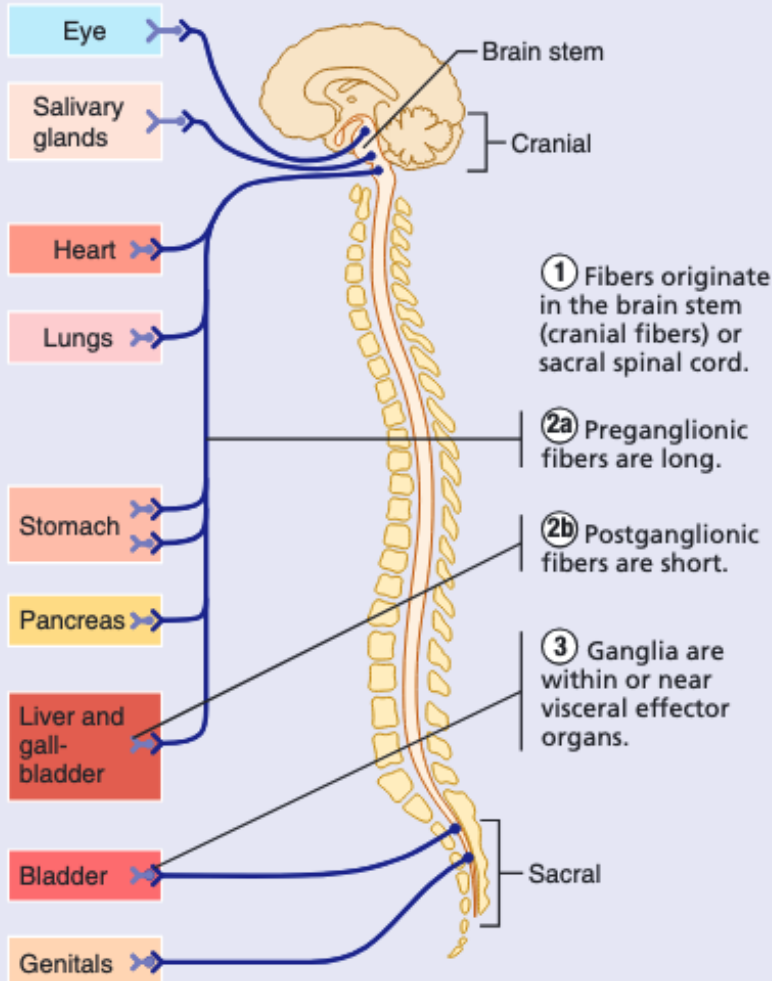
1. The external anatomy of the spinal cord and its associated structures
2. The internal anatomy of the spinal cord
3. How neural information is organised within the spinal cord and the direction of information flow
4. How neural information enters and exits the spinal cord
5. The spinal nerves and how neural information travels in them between the body and the CNS
6. The structure of a peripheral nerve

Autonomic nervous system recap



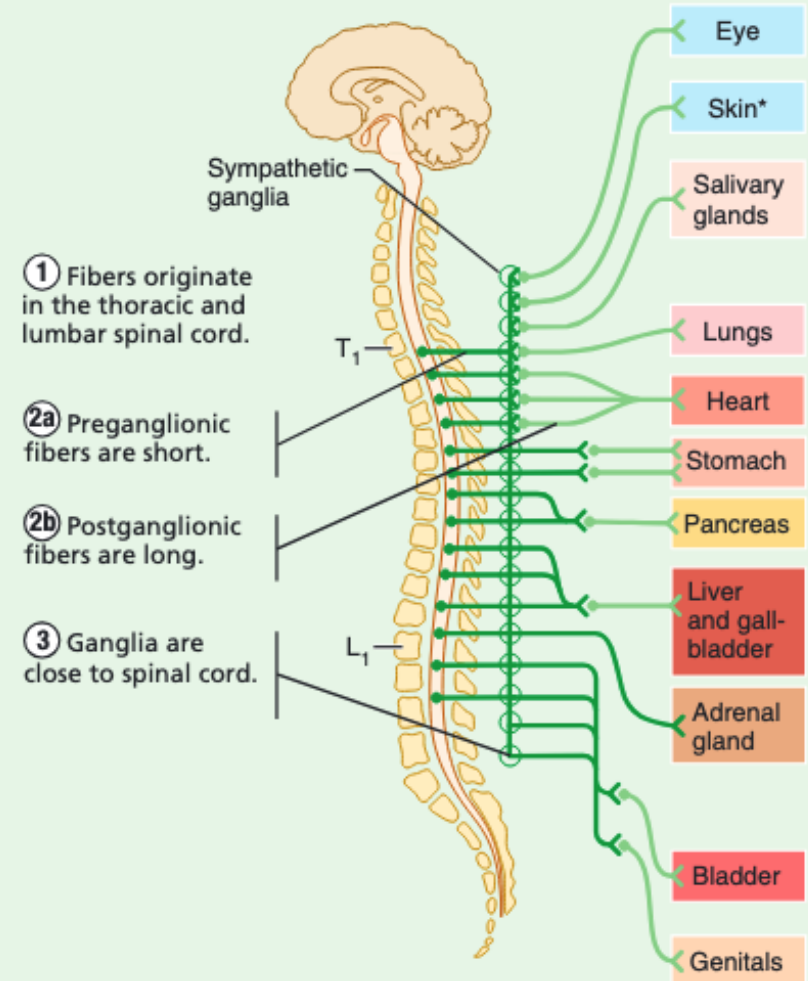
Craniosacral

Parasympathetic

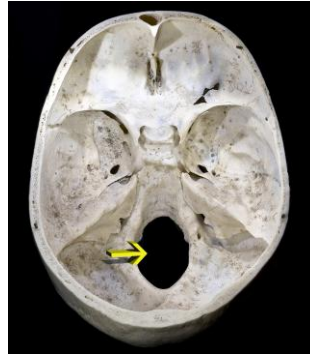


Thoracolumbar

Sympathetic



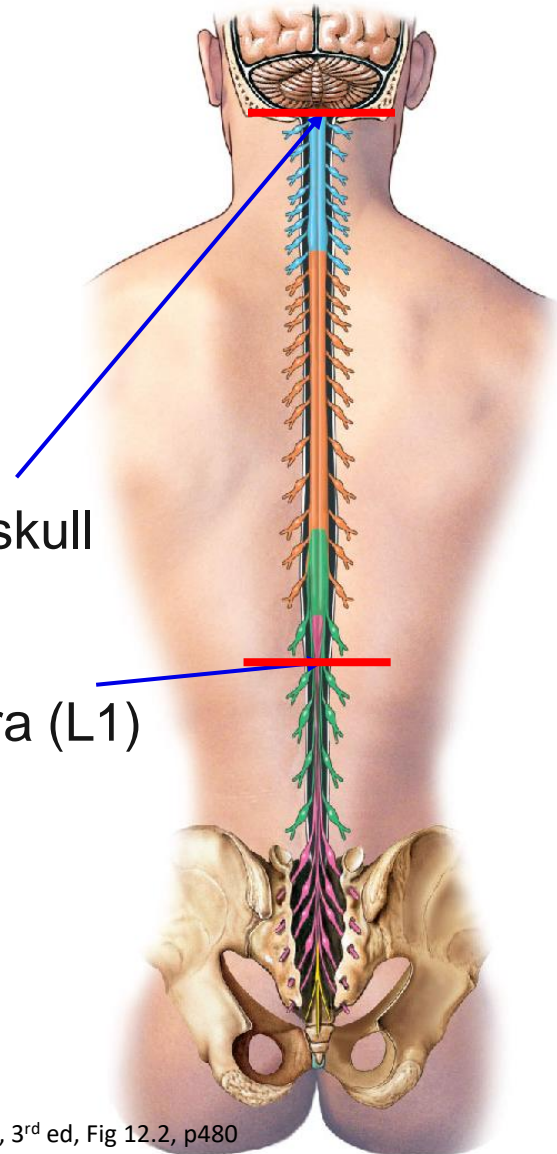
External anatomy of the spinal cord



Starts at: **Foramen magnum**

“big hole”, the opening at the base of the skull

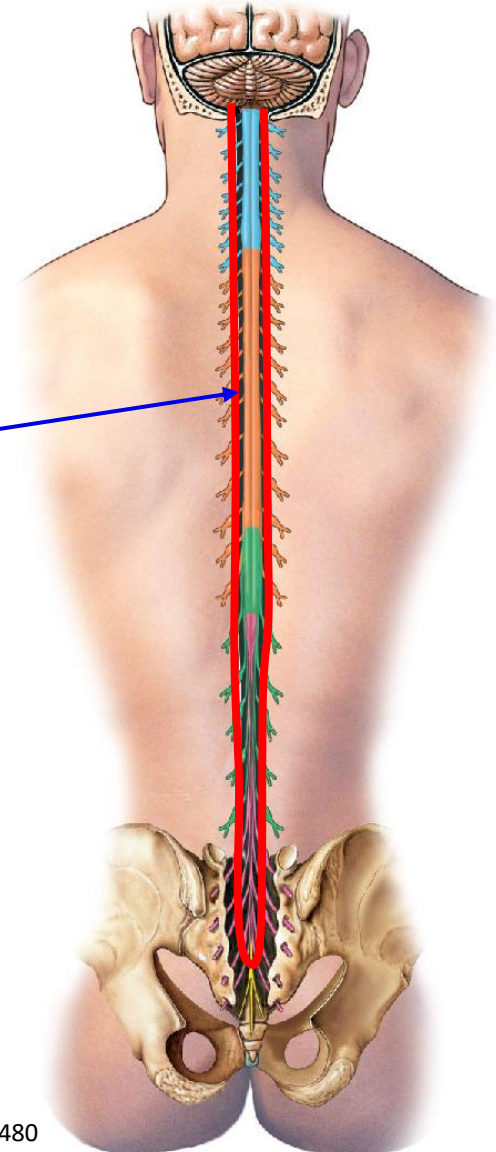
Ends at: inferior border of 1st lumbar vertebra (L1)



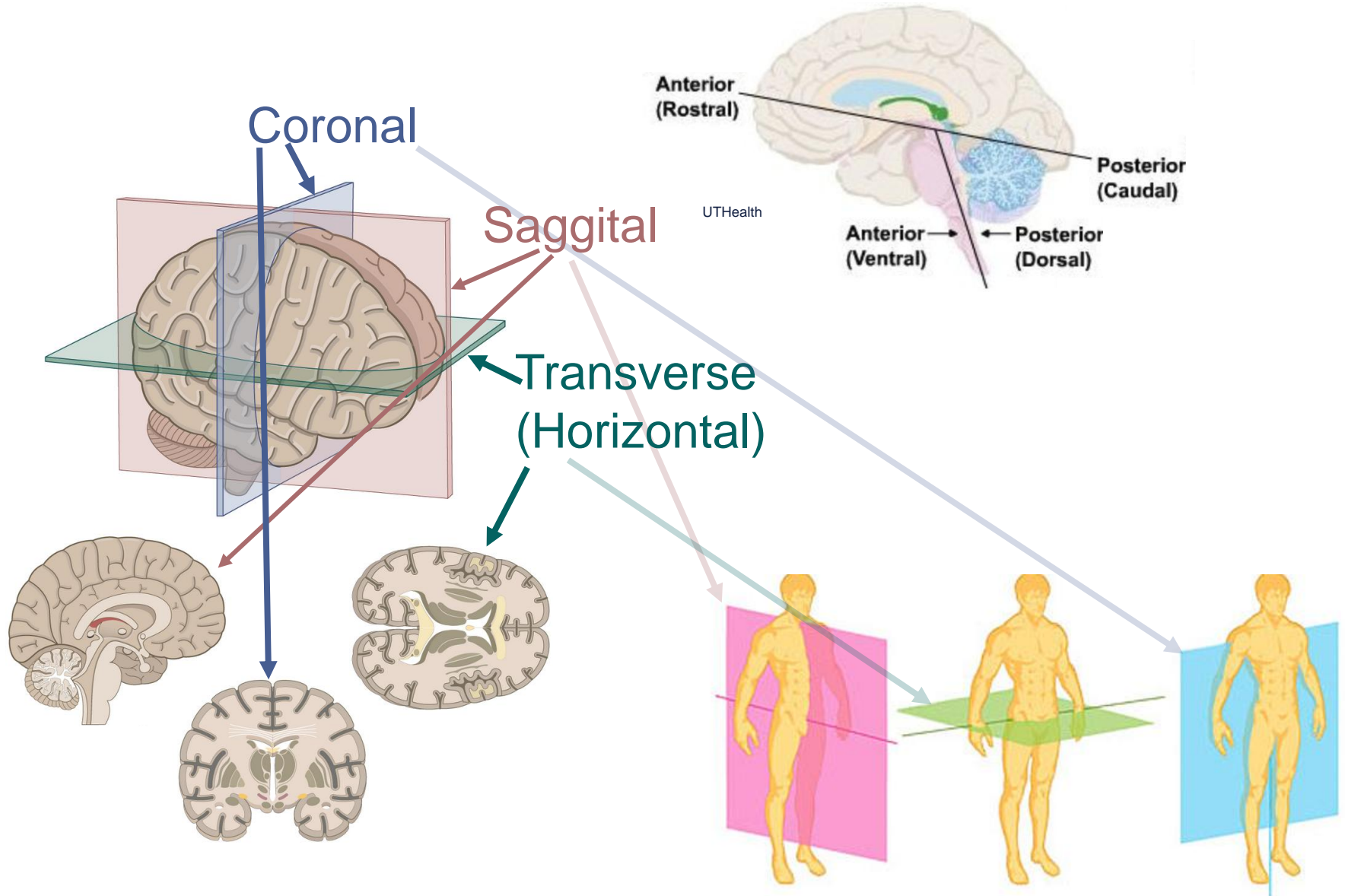
External anatomy of the spinal cord

Within a sac, made of **meninges**,
that fits inside the **spinal cavity**

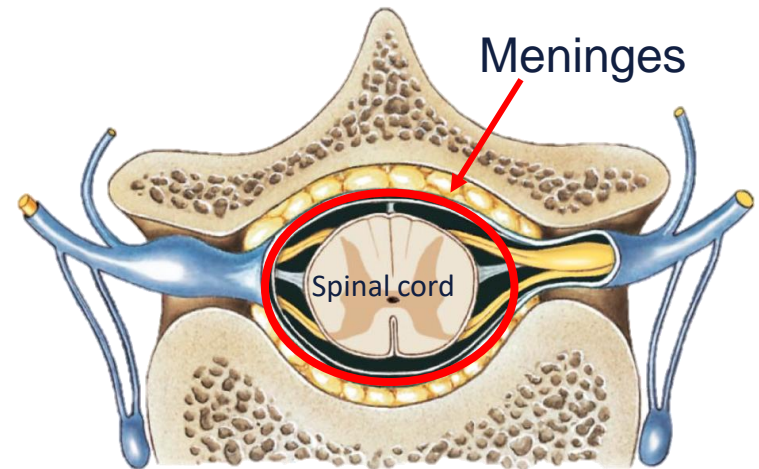
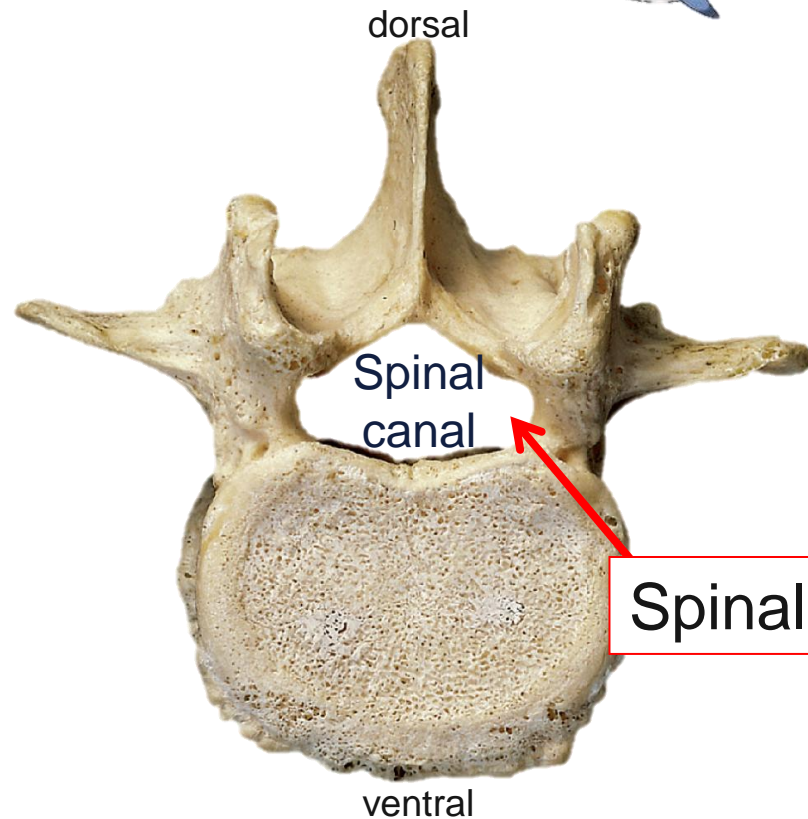
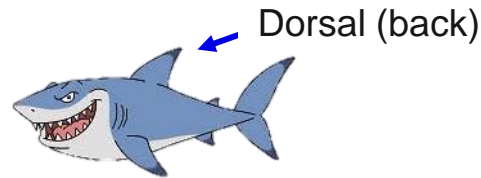
Spinal cavity **within vertebrae**



Anatomical planes revision



Spinal cavity & position within the vertebral column



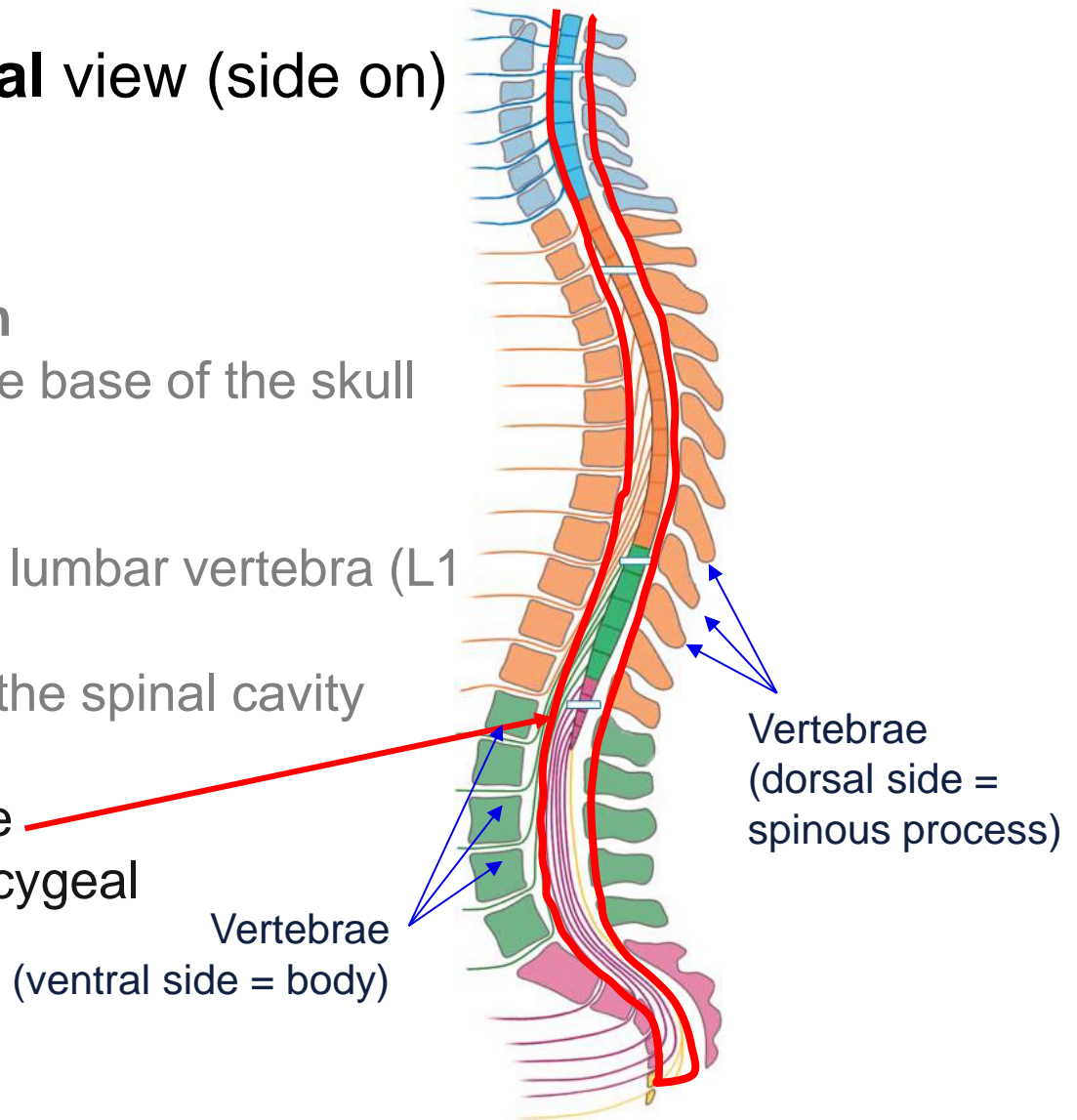
Spinal cord goes here!!!

Martini, 3rd ed, Fig. 12.3.2, p482

External anatomy of the spinal cord

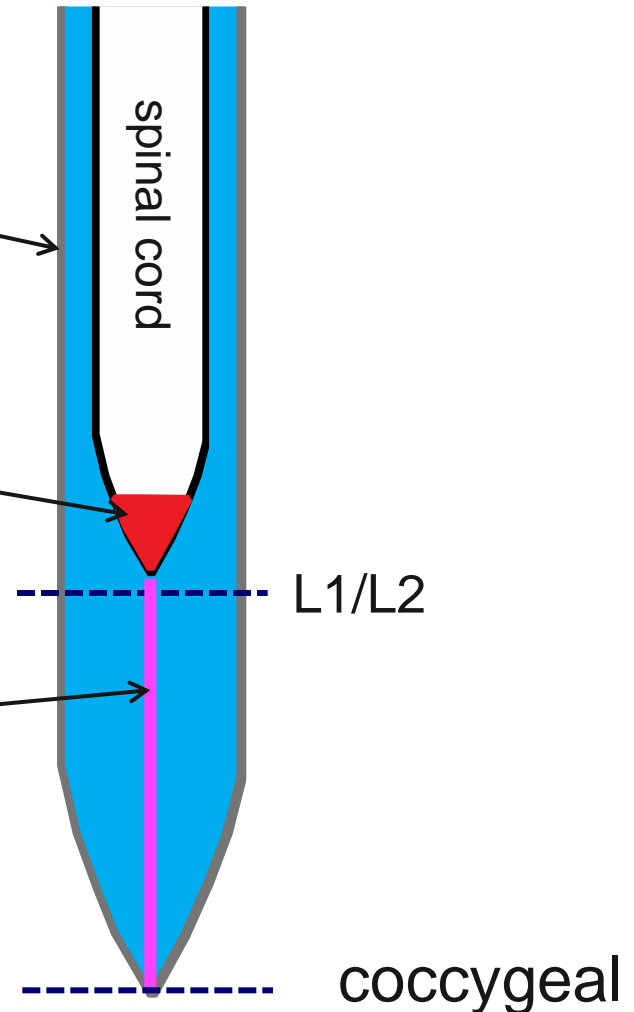
Sagittal view (side on)

- Starts at: **Foramen magnum**
“big hole”, the opening at the base of the skull
- Ends at: inferior border of 1st lumbar vertebra (L1)
- Within a sack that fits inside the spinal cavity
- Spinal cavity within vertebrae extends all the way to the coccygeal vertebrae



Non-neural structures associated with the spinal cord

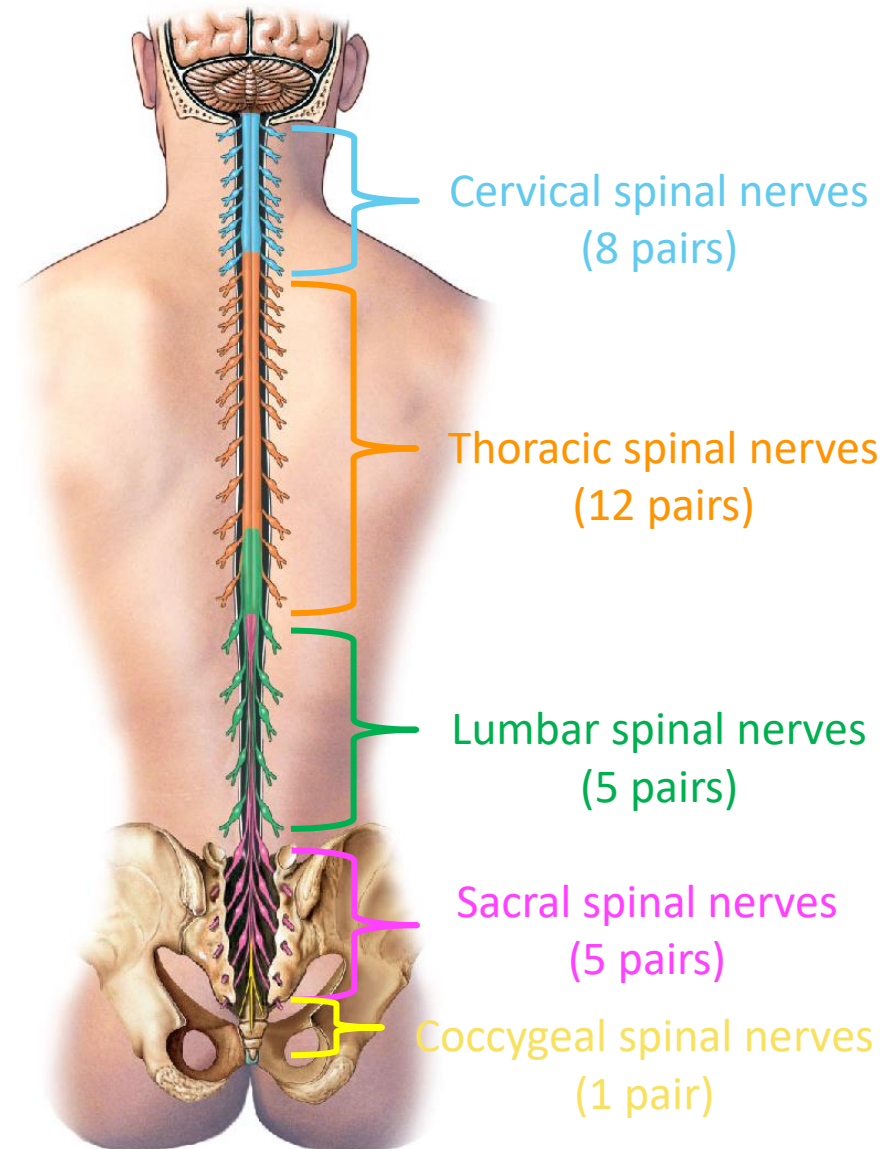
- Extends within a meningeal sac
 - filled with cerebrospinal fluid (CSF)
- End is a tapered cone called the **conus medularis**
 - Non-neural tissue
 - Attachment point for filum terminale
- **Filum terminale** extends from conus medularis to end of spinal cavity
 - Anchors the spinal cord
 - Fibrous, non-neural tissue



Spinal nerves

The spinal cord has 31 segments

One pair (left and right) of spinal nerves associated with each segment



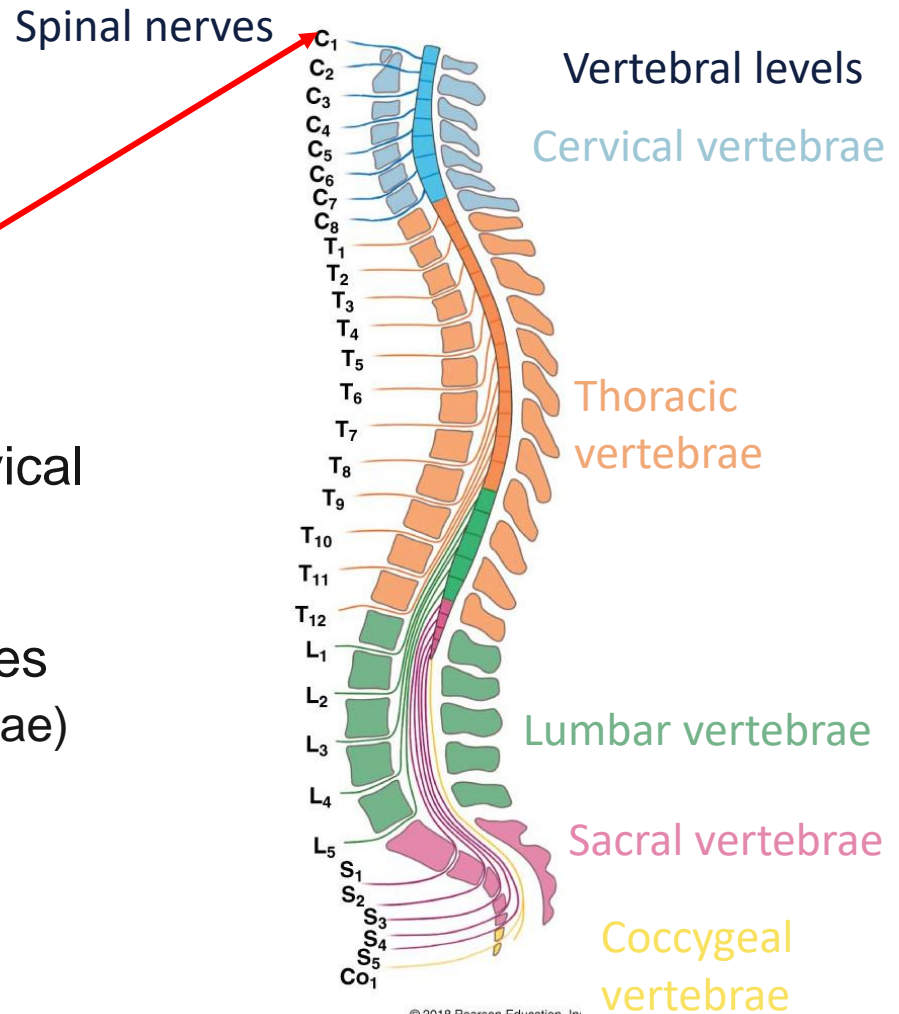
Spinal Nerves: Exit points

Spinal nerves are named by the vertebra they exit below

ONE EXCEPTION

The first cervical spinal nerve exits between the skull and the first cervical vertebra.

→ There are 8 cervical spinal nerves (even though only 7 cervical vertebrae)



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Spinal nerves: Exit points

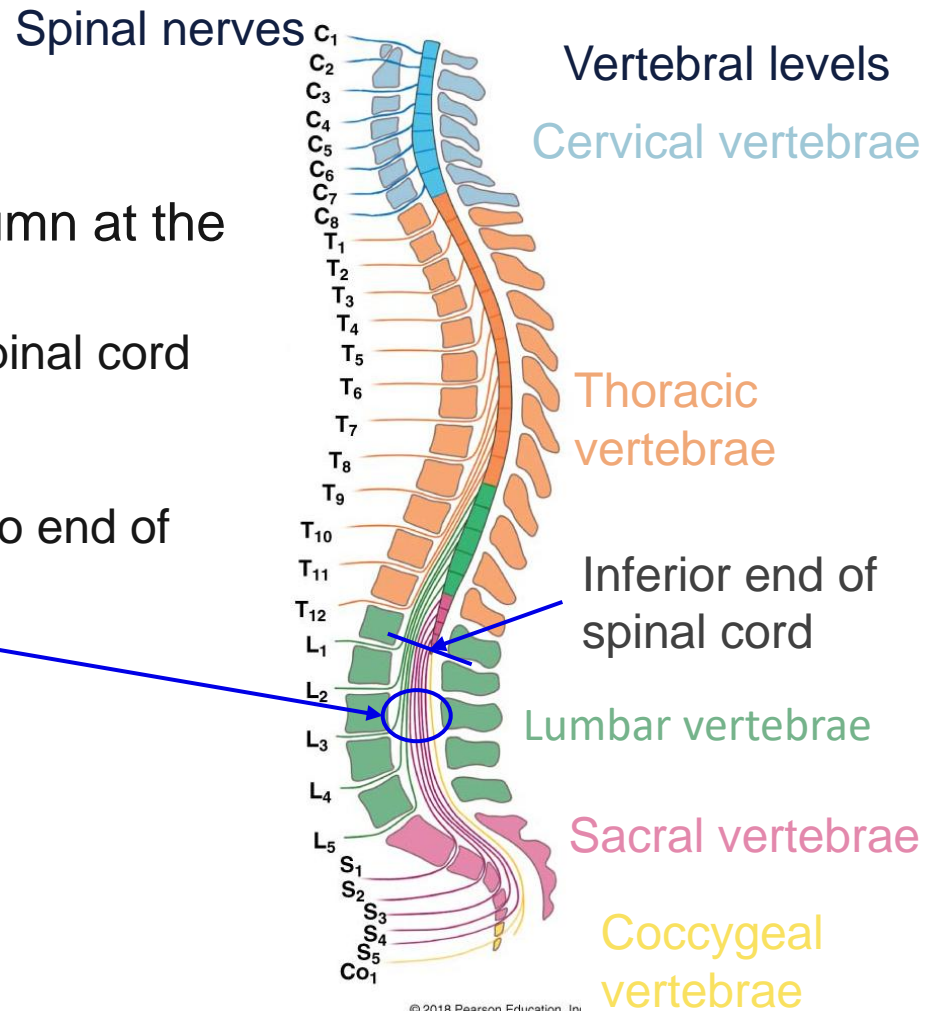


Spinal nerves exit the vertebral column at the level appropriate to their origin

- e.g. nerves originating in lumbar spinal cord exit between lumbar vertebrae

Large collection of long nerves inferior to end of spinal cord

= Cauda Equina ('horses tail')



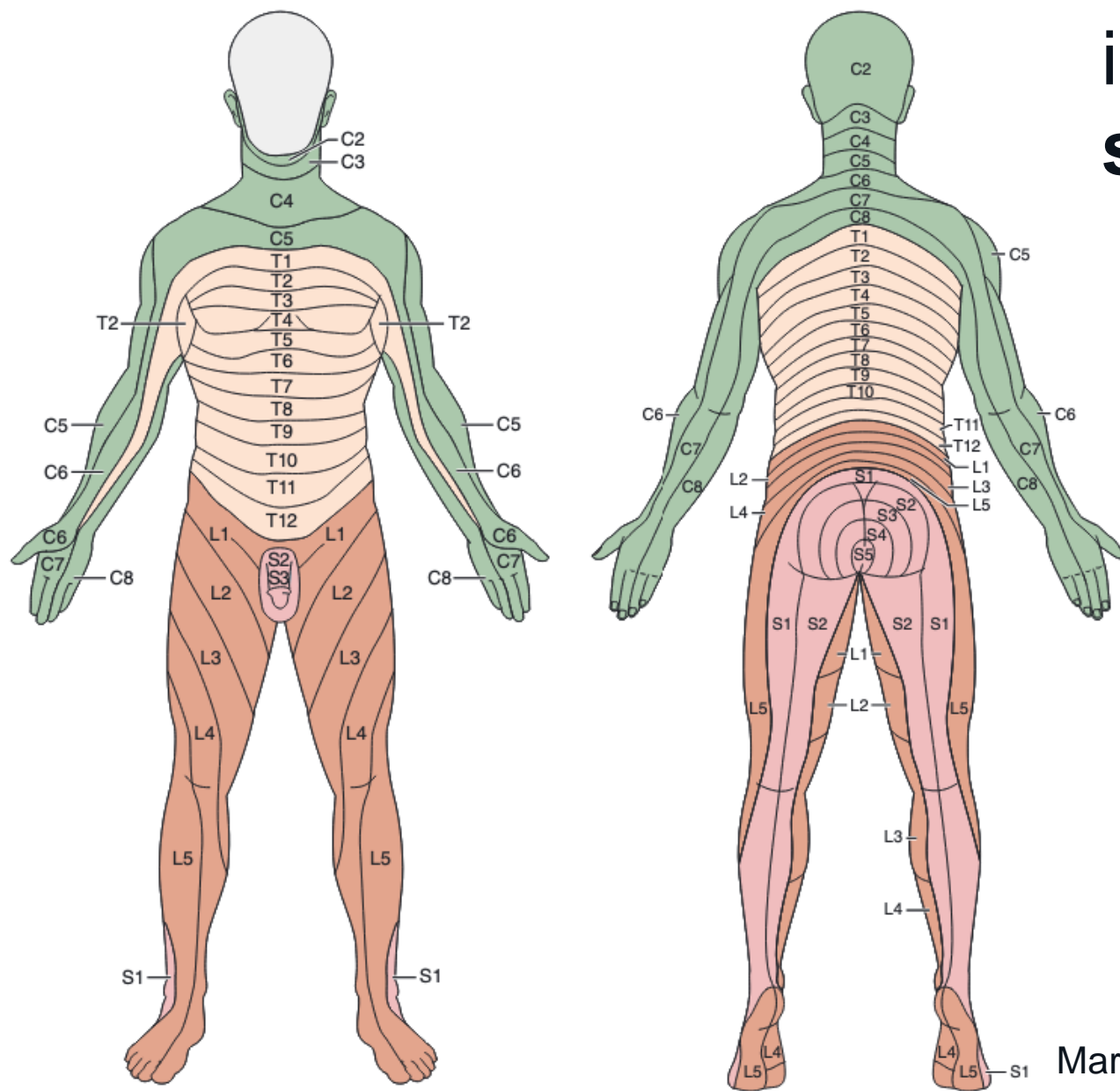
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The *Dermatome*



Areas of **skin**
innervated by
spinal nerves

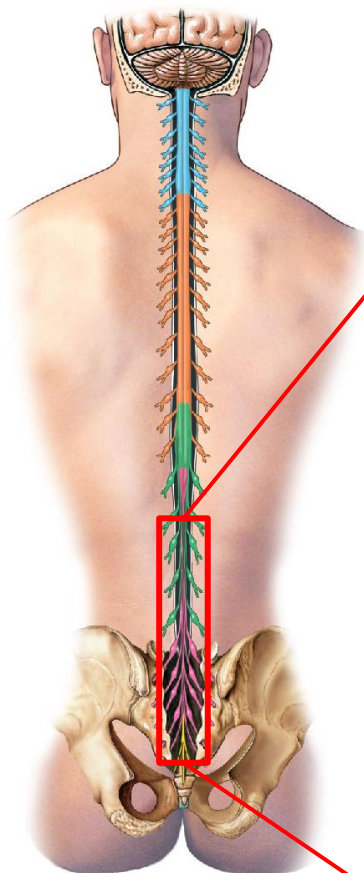
All spinal nerves
except C1



Marieb & Hoehn pg 532

External anatomy of the spinal cord:

Cauda equina



Martini, 3rd ed, Fig 12.2, p480



Conus medullaris
(end of spinal cord)

Cauda equina

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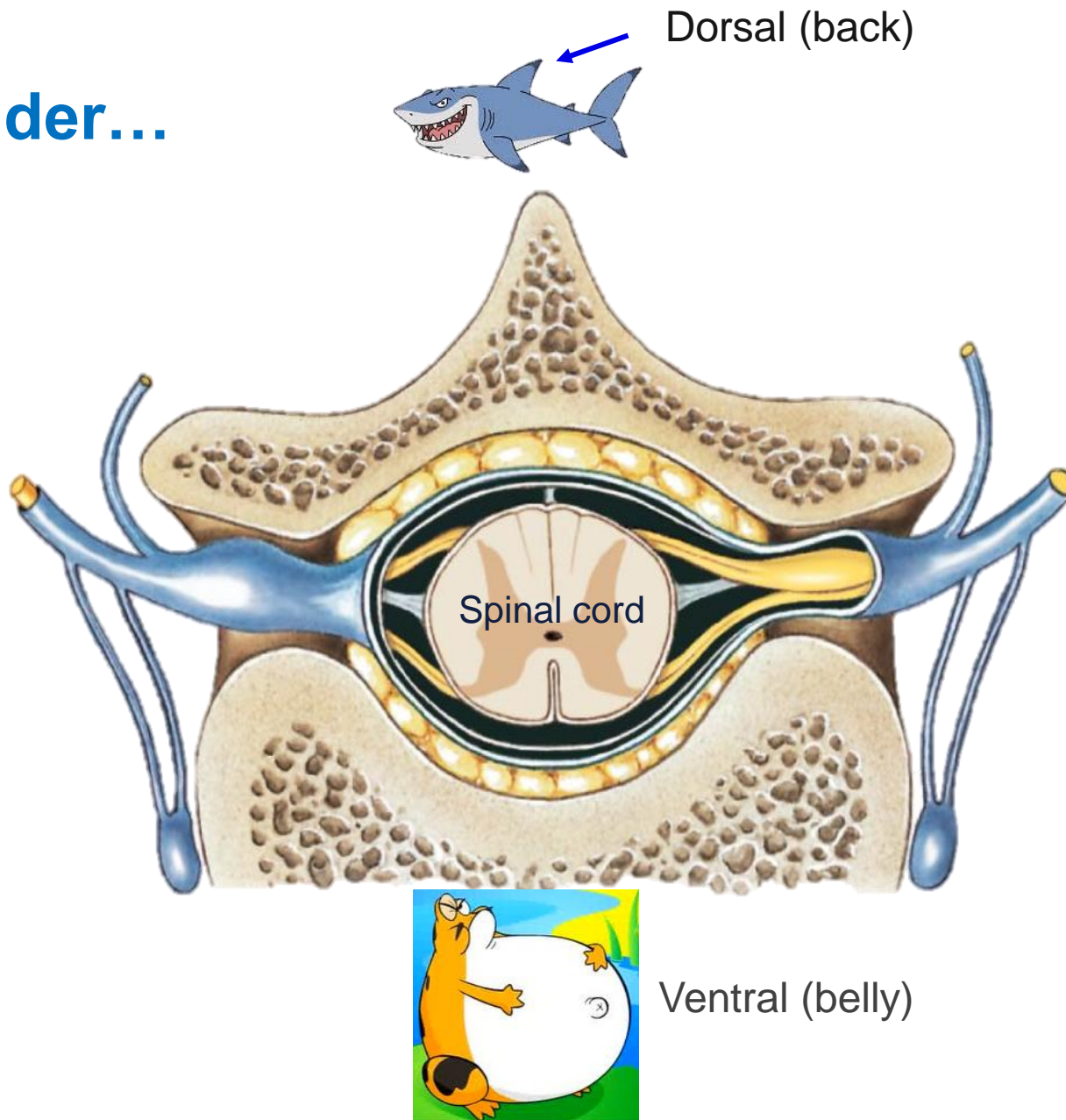
Martini, Atlas of the Human Body, plate 24a, p34



<http://vaquerofeed.com/?p=290>

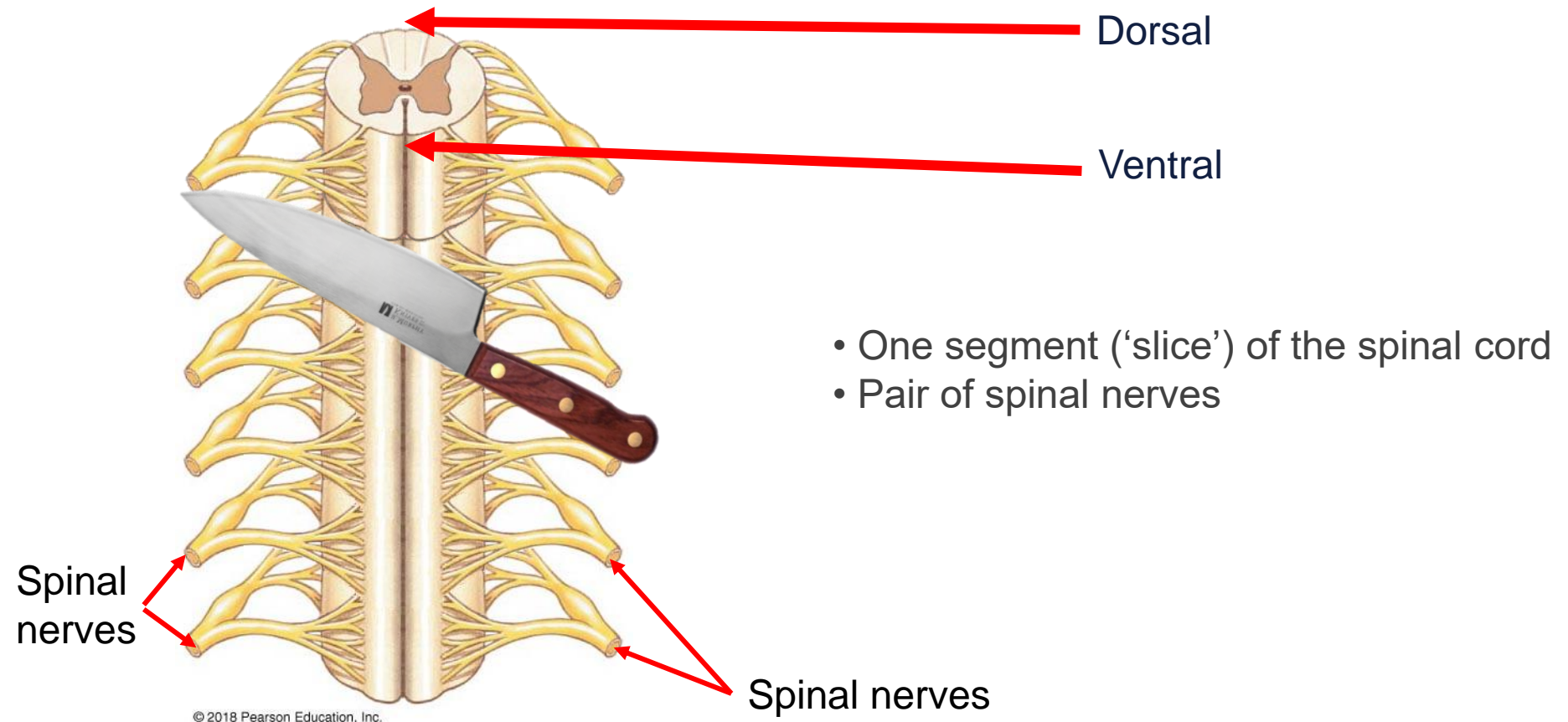


Reminder...

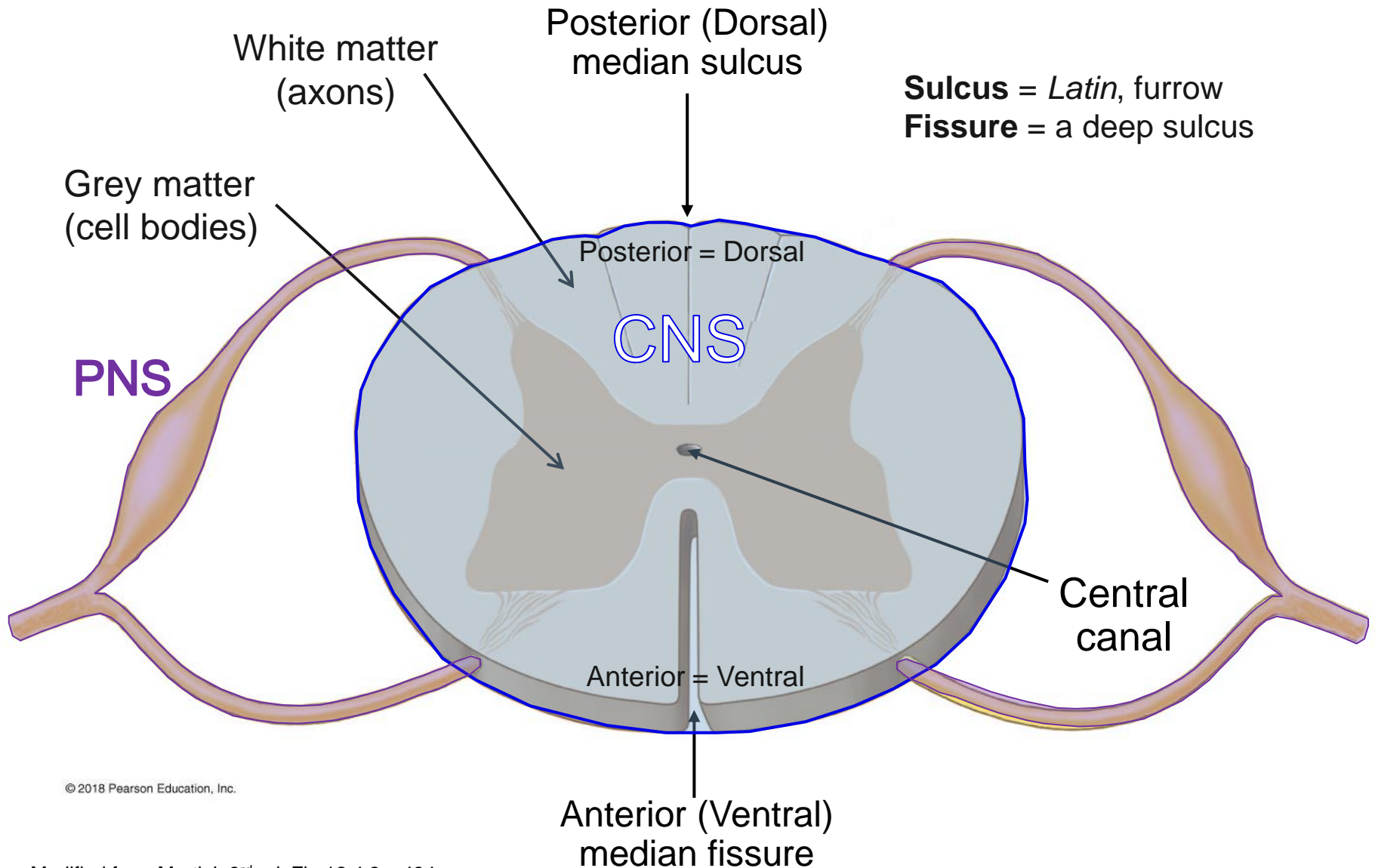


Another reminder...

The spinal cord is one long continuous structure

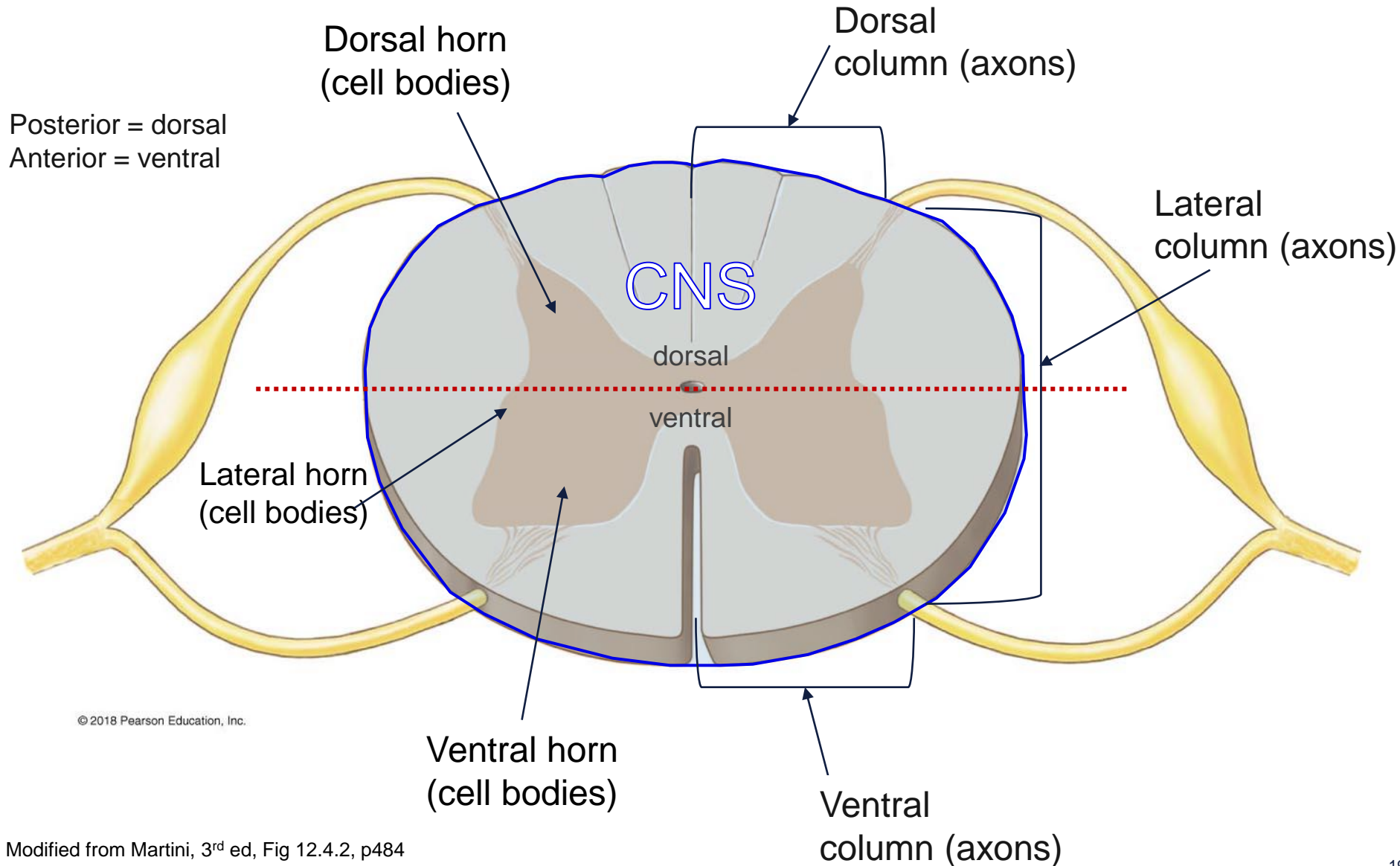


Internal anatomy of the spinal cord

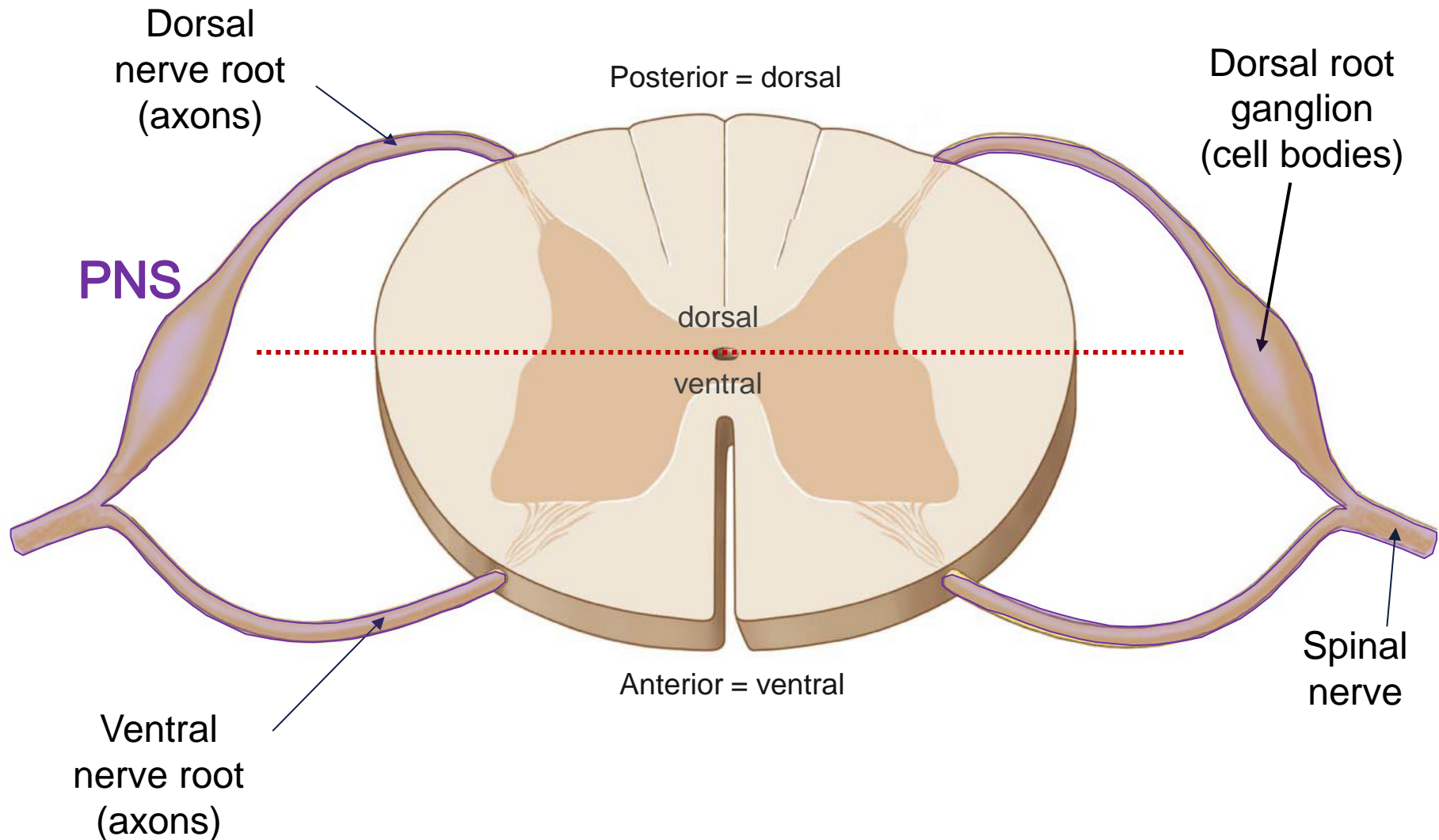


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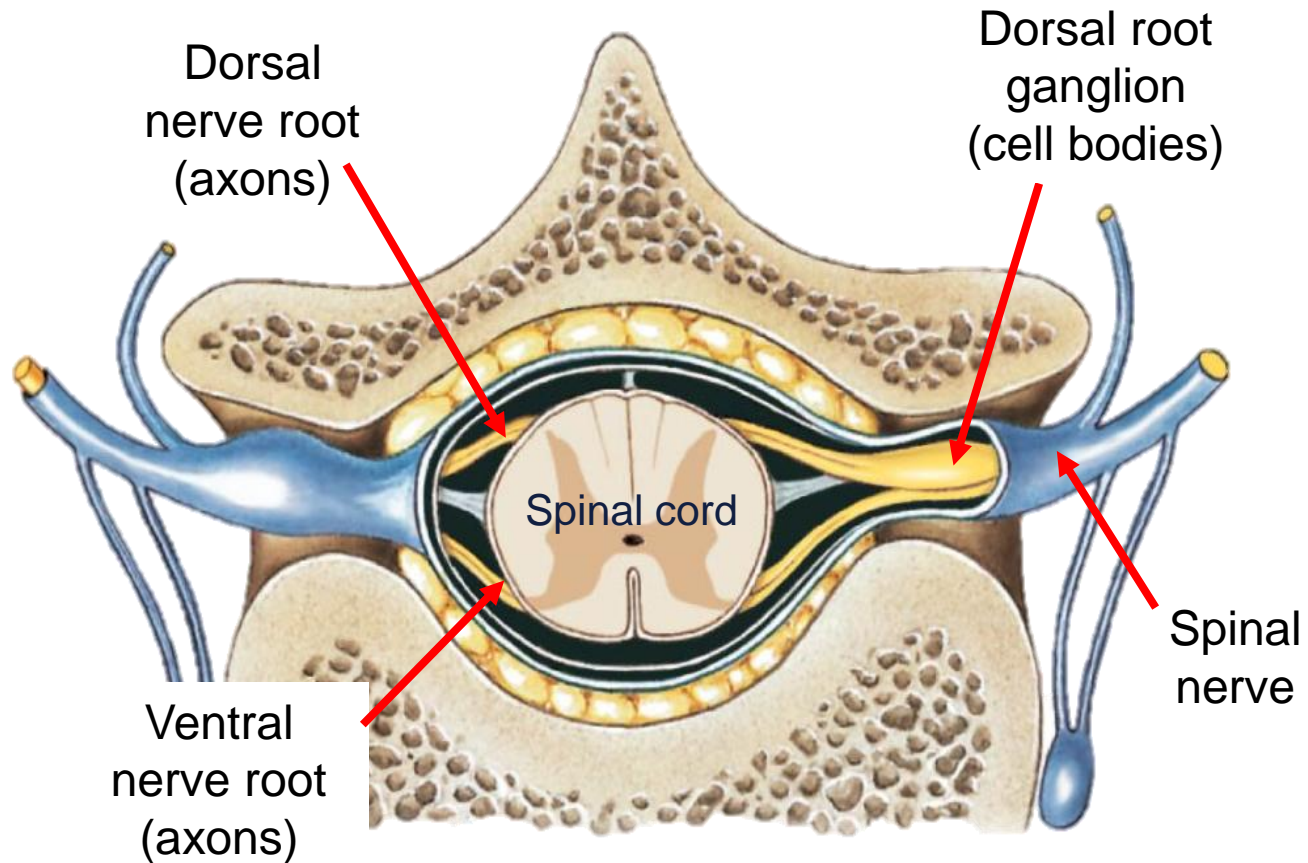
Internal anatomy of the spinal cord



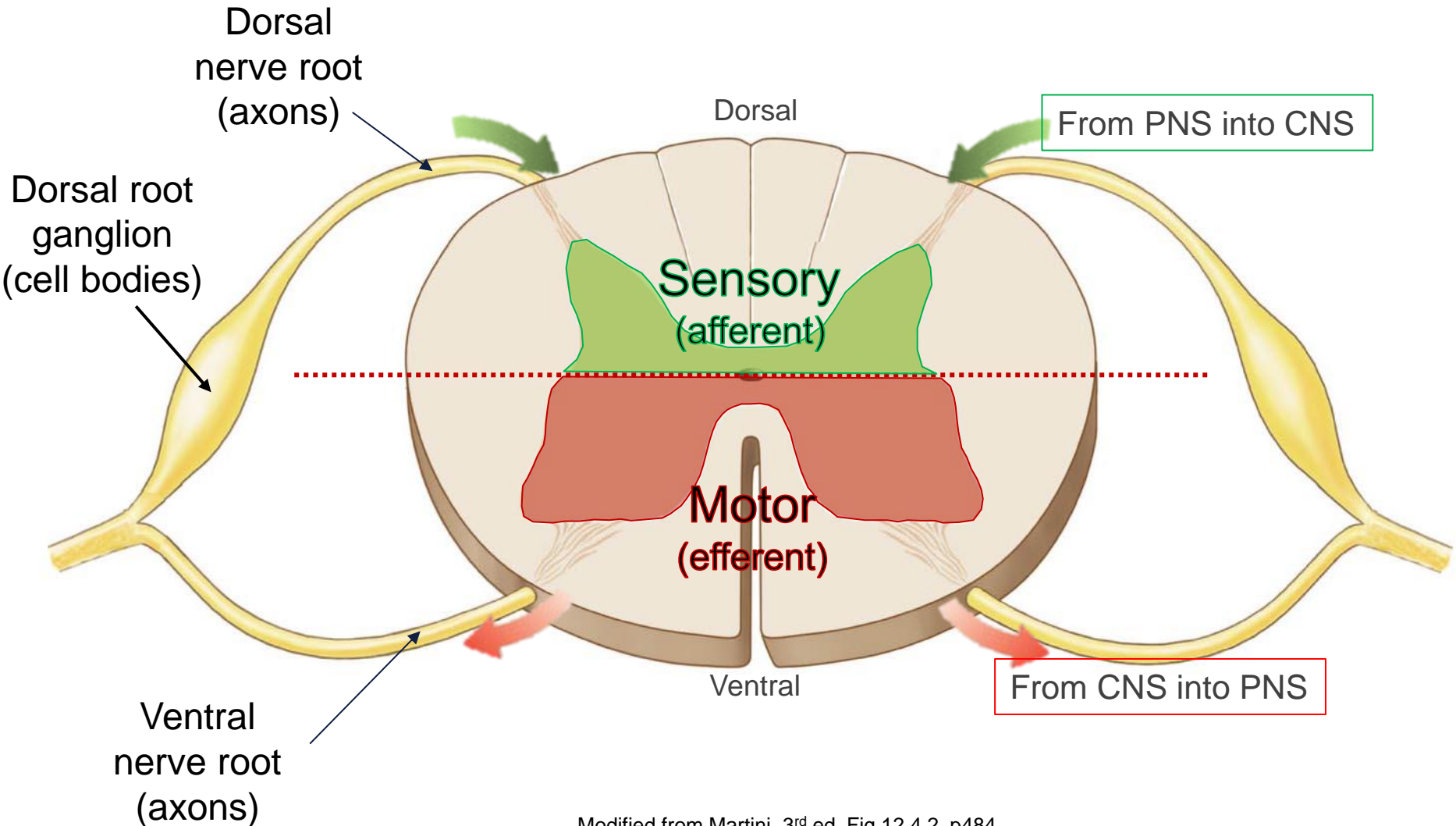
Internal anatomy of the spinal cord



In context...



Organisation and flow of information in the spinal cord

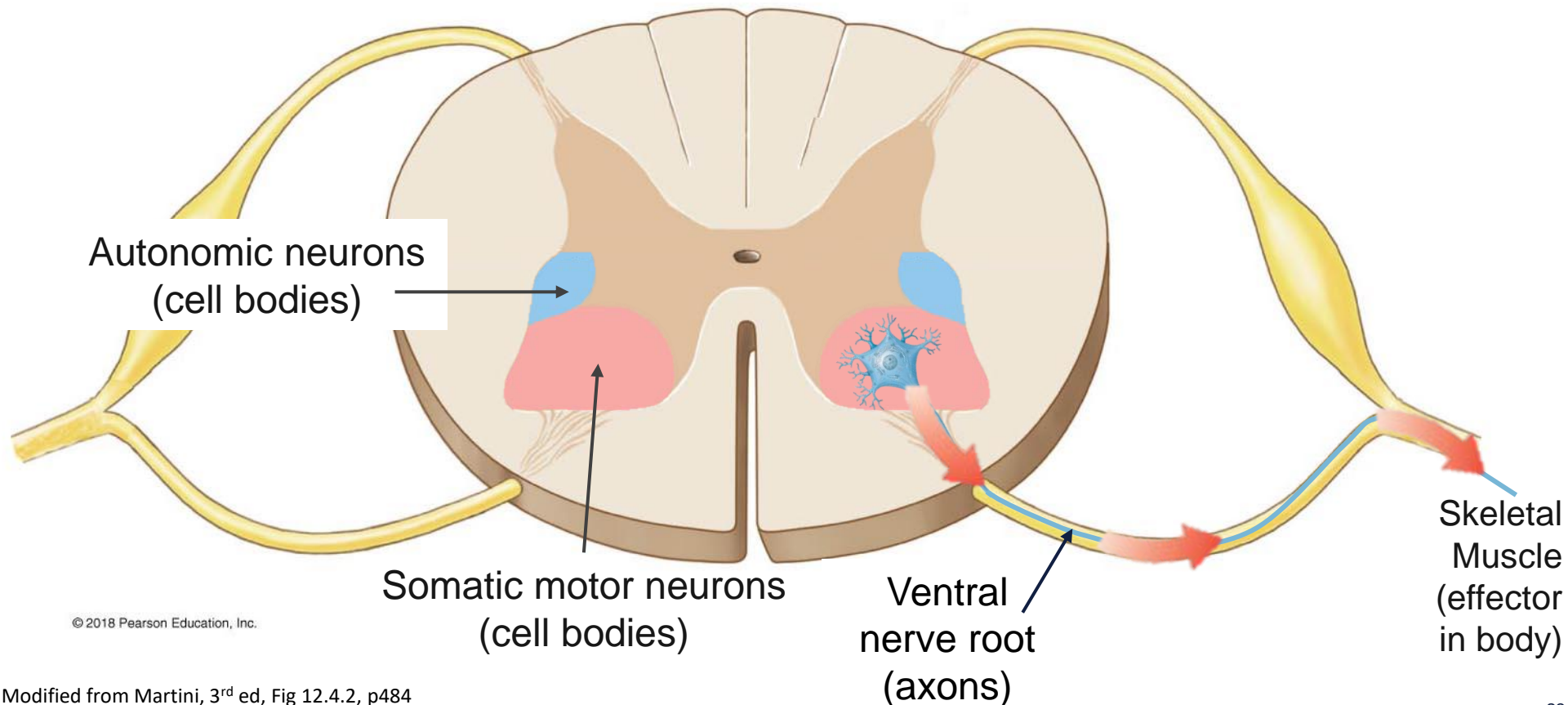


Flow of efferent information - out of the spinal cord



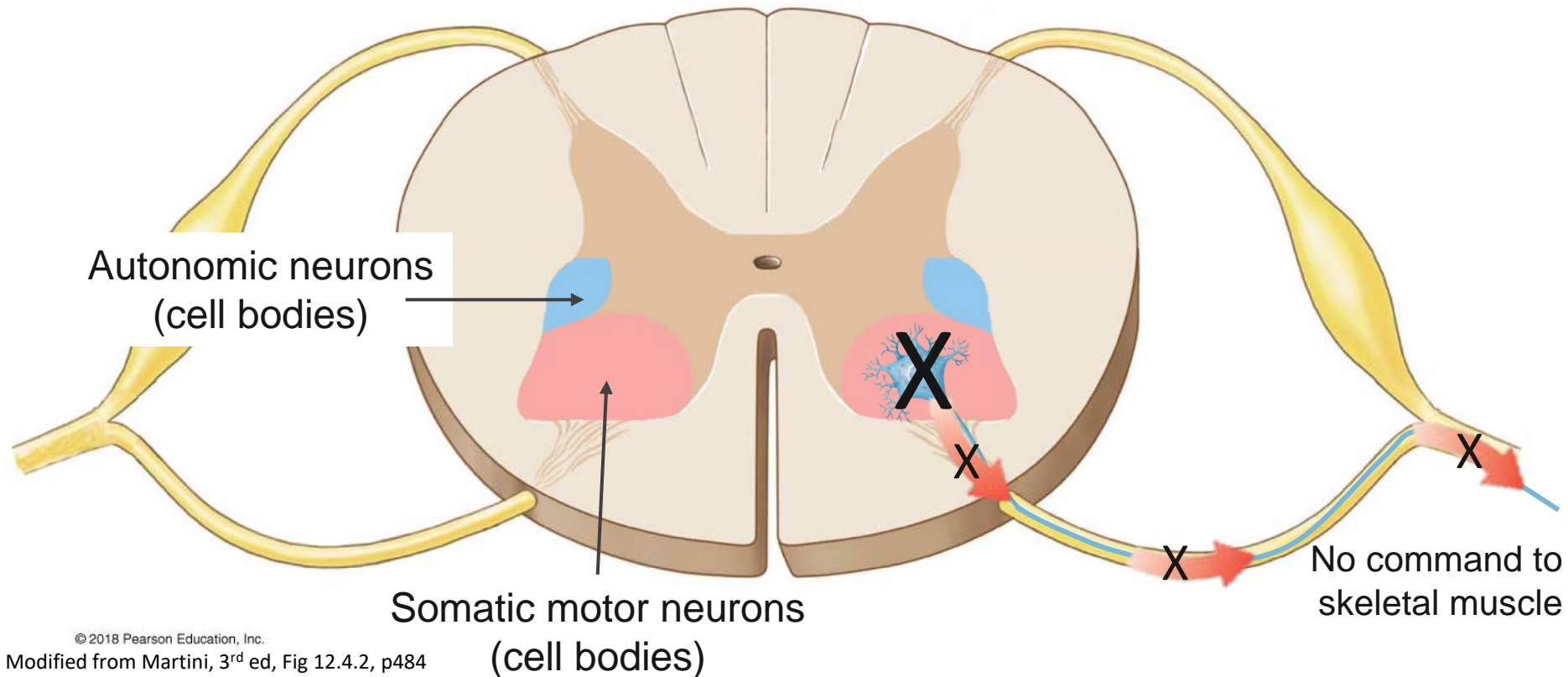
Reminder. Efferent (motor) information leaves through *ventral roots*

→ Motor commands to effectors in the body



Flow of efferent information - out of the spinal cord

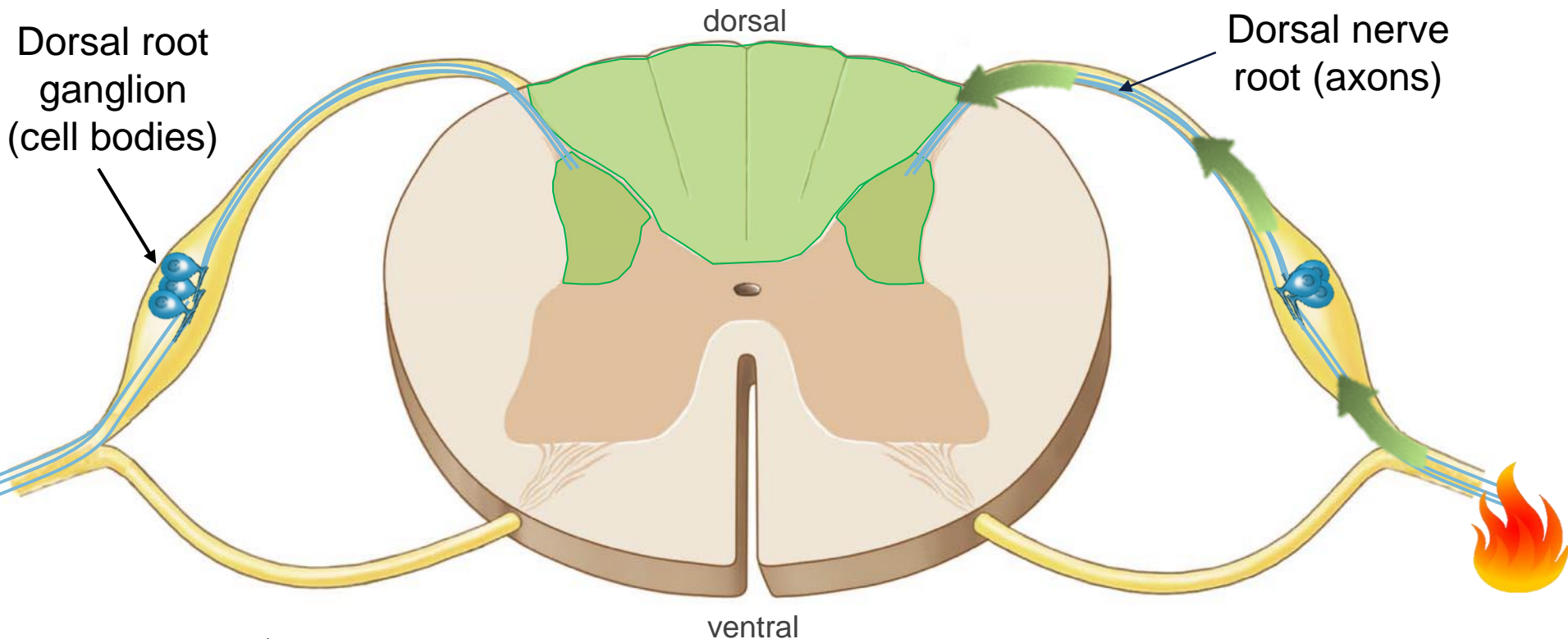
What would happen if there was damage to ventral horn (X)?



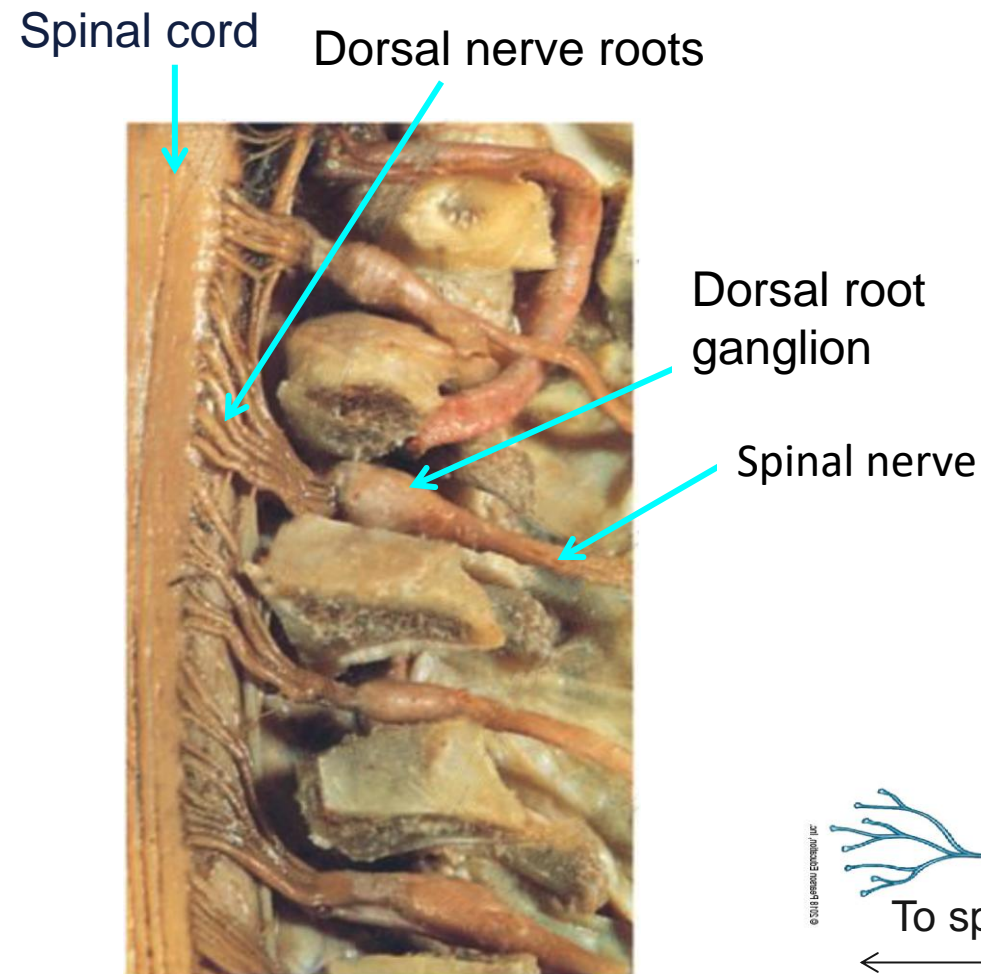
Paralysis of muscles supplied by somatic motor neurons from this spinal cord segment, on same side only

Flow of afferent information - into the spinal cord

- Cell bodies of sensory neurons are in dorsal root ganglion
- Input zone in body associates with receptors for sensory stimulus
- Output zone enters the spinal cord through dorsal roots



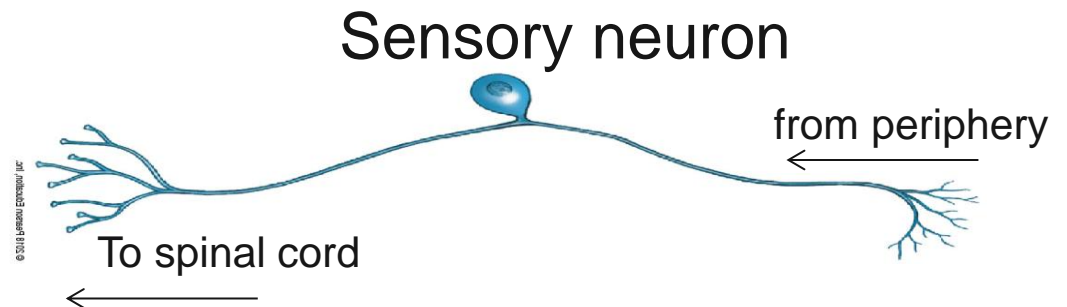
Flow of afferent information - into the spinal cord



Credit: Anatomy Museum @Otago

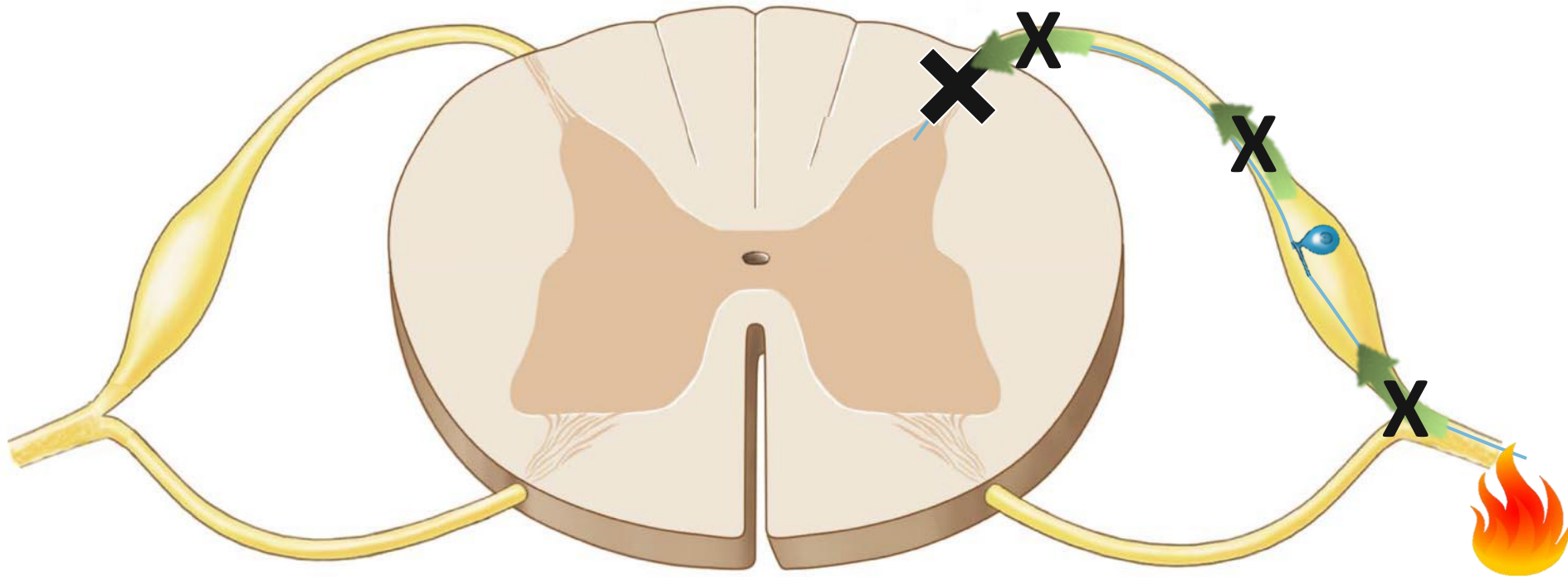


- Dorsal root ganglion contains cell bodies of sensory neurons



Flow of afferent information - into the spinal cord

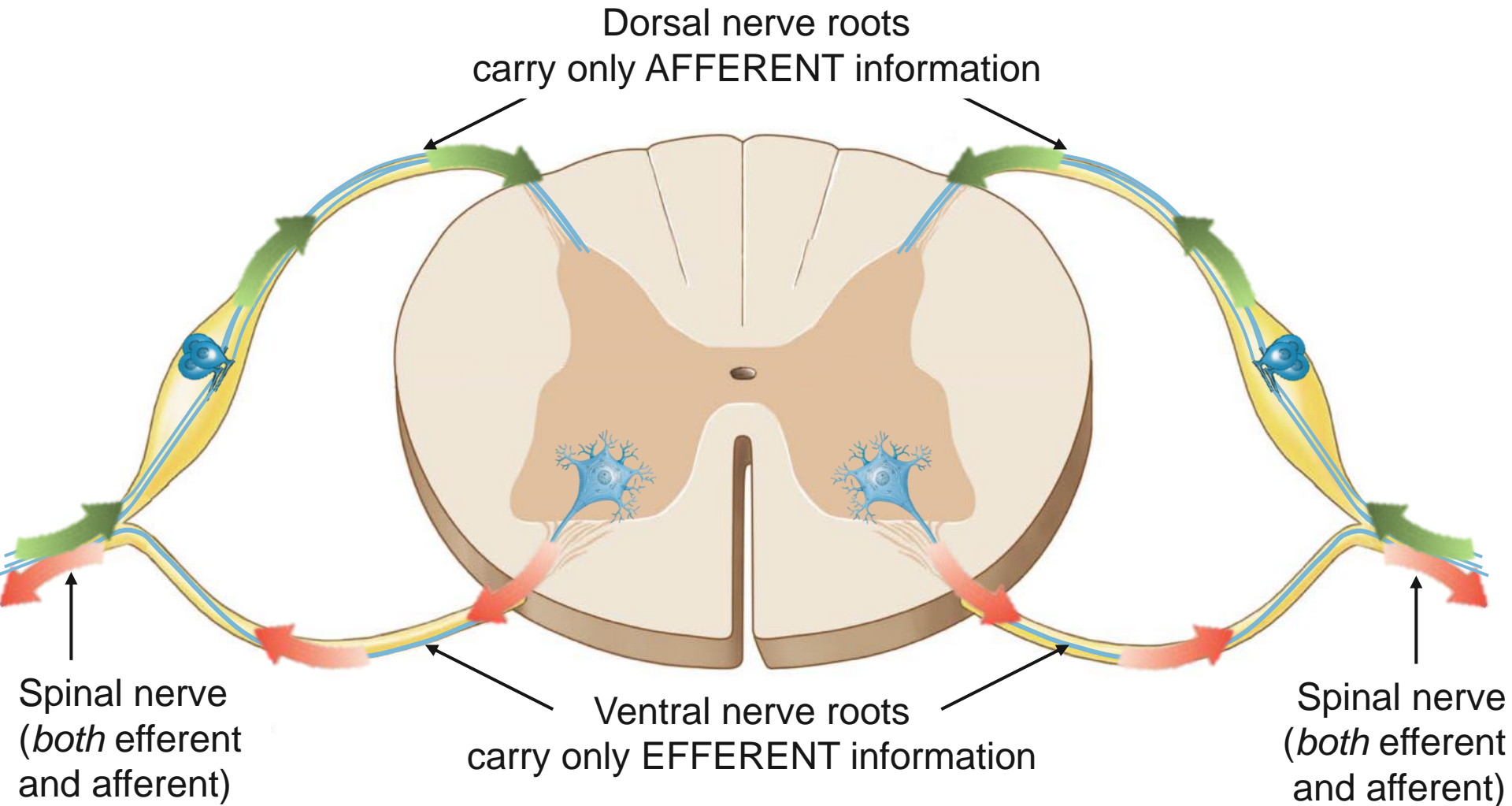
What would happen if there was damage here (X)?



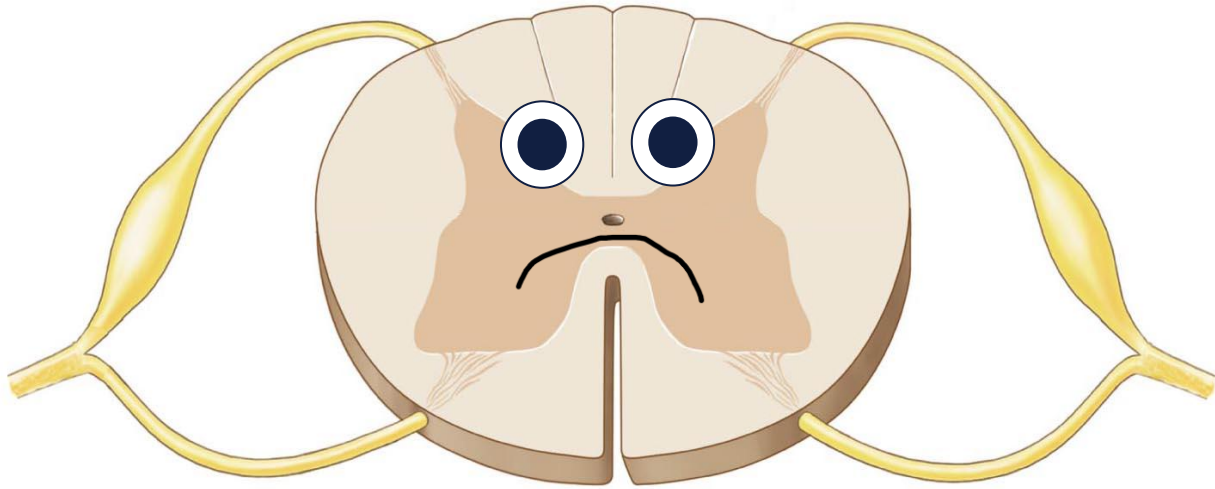
Modified from Martini, 3rd ed, Fig 12.4.2, p484

Loss of sensation from regions of the body supplied by sensory neurons from this spinal cord segment, on same side only.

Spinal nerves: Carry information into and out of the spinal cord



SAD DAVE

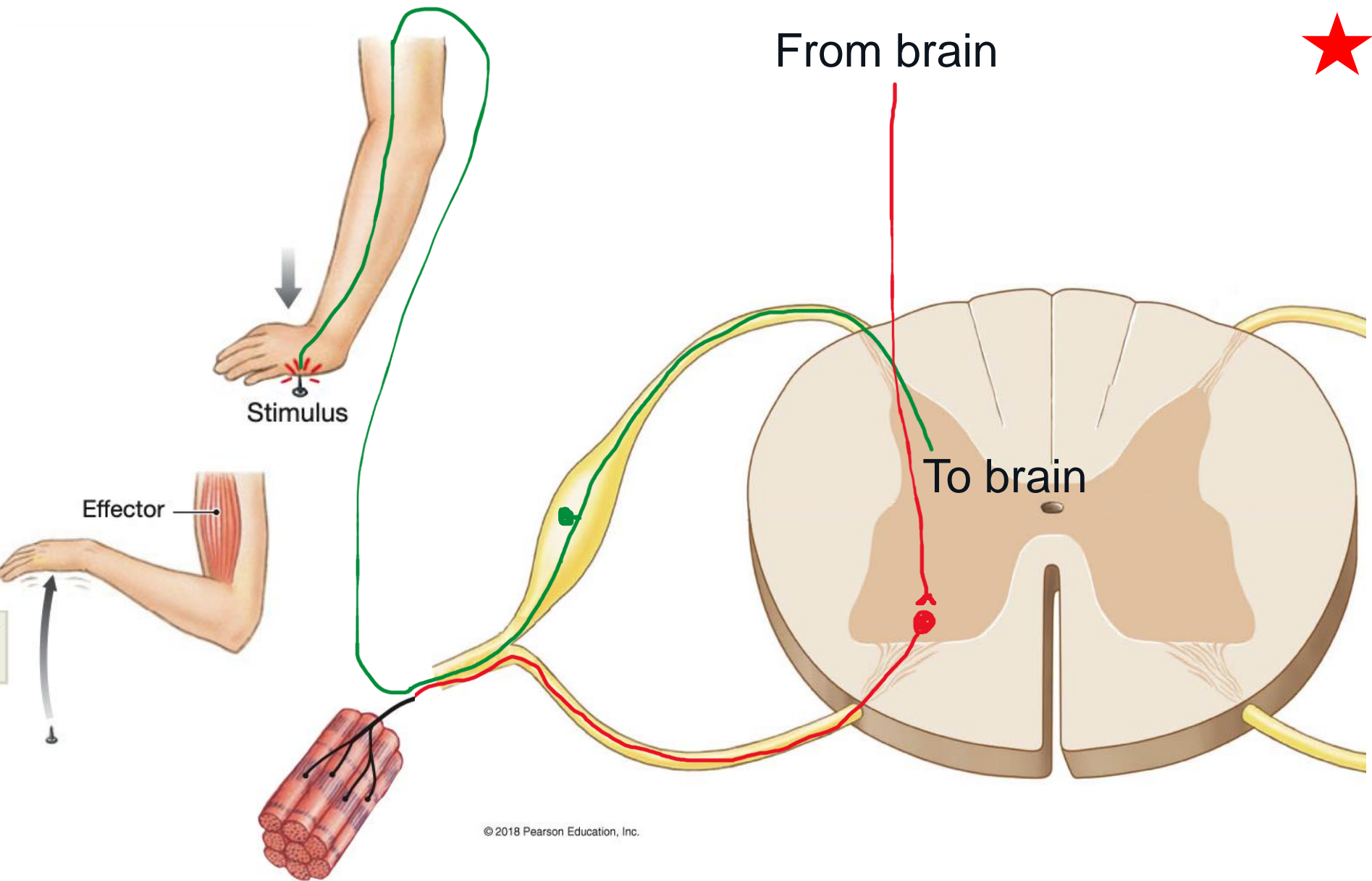


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Sensory = Afferent = Dorsal

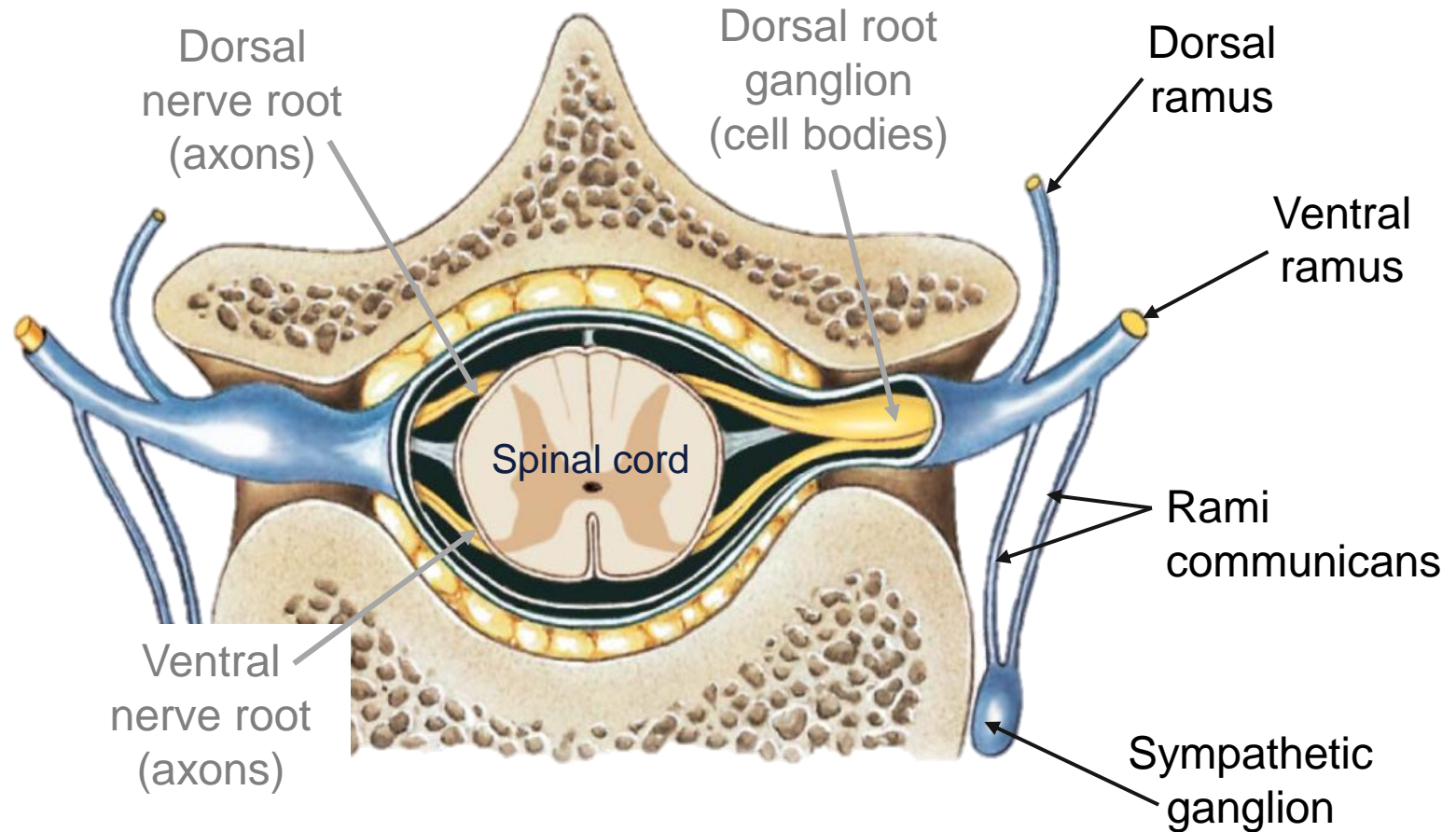
Dorsal = Afferent

Ventral = Efferent

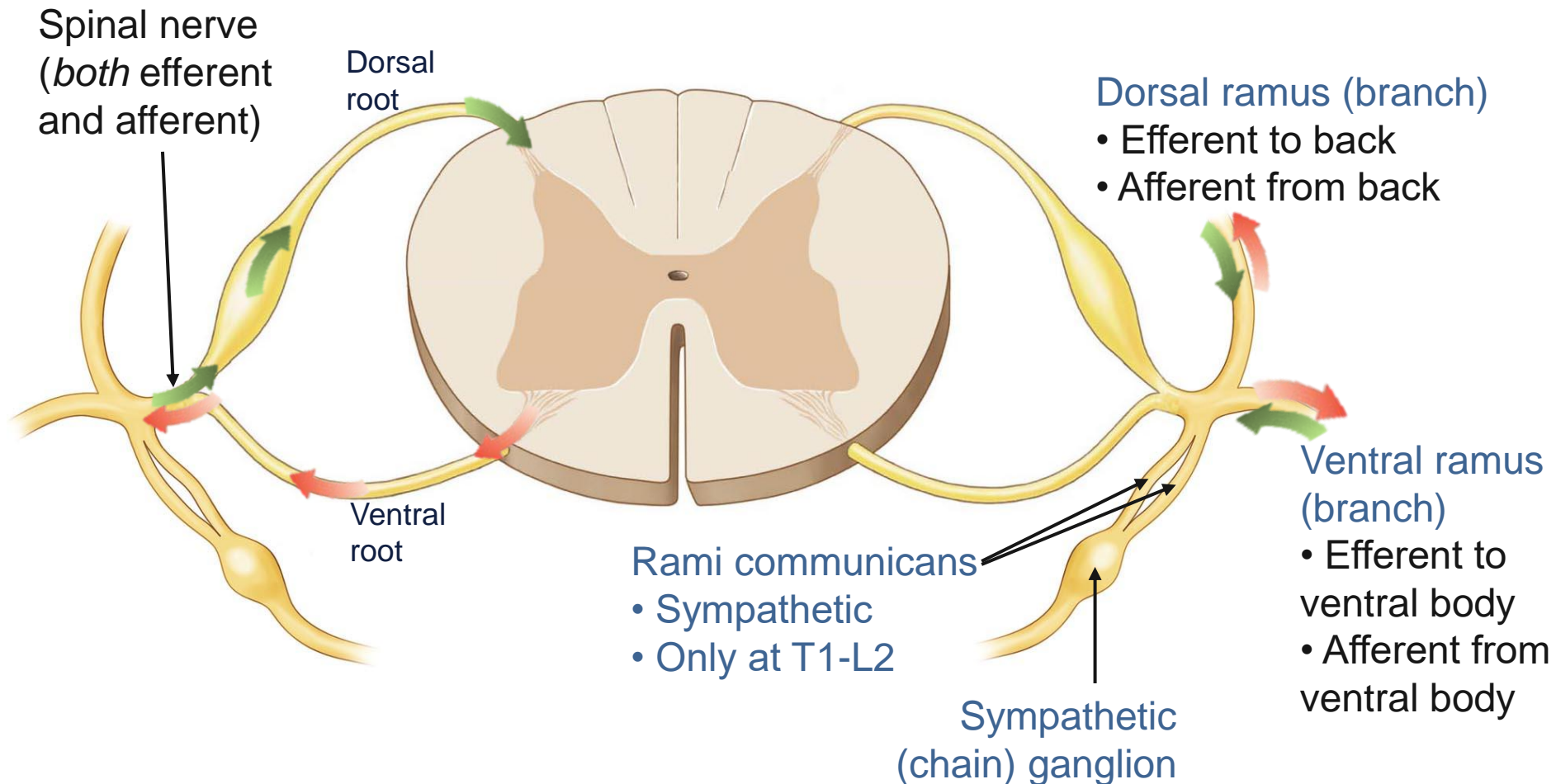


Voluntary response to a painful stimulus

What happens to the spinal nerves once they leave the spinal column?



What happens to the spinal nerves once they leave the vertebral column?

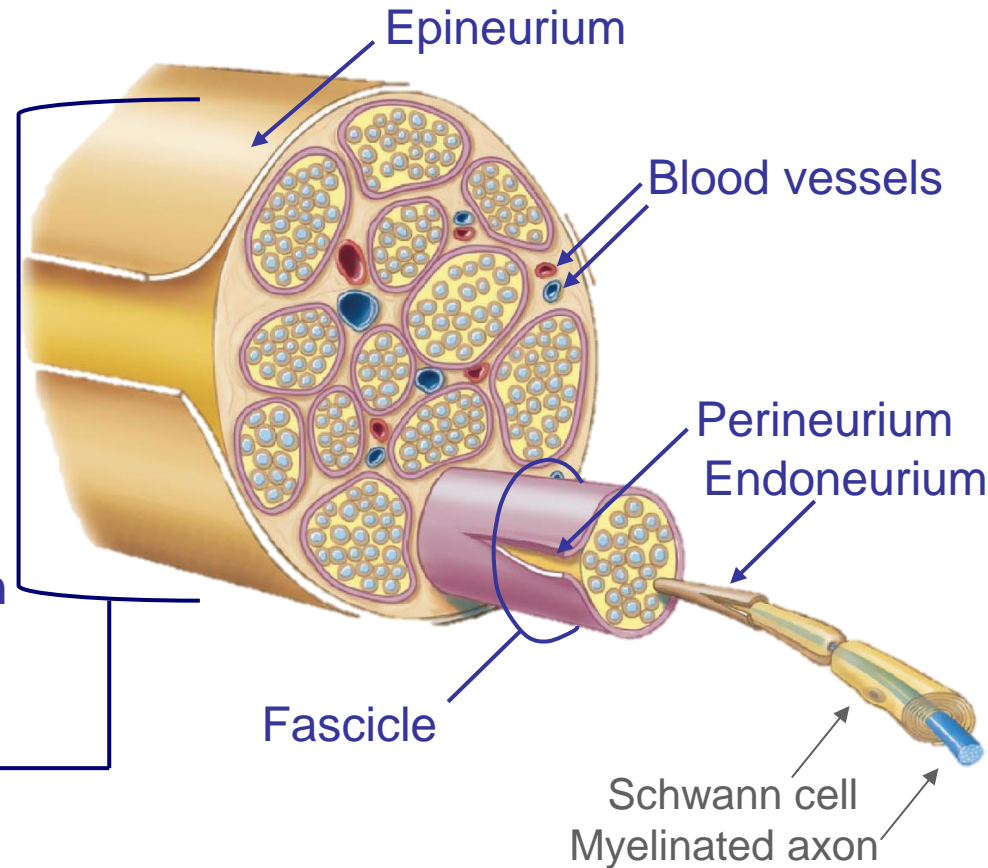


Structure of a peripheral nerve



[Review from lecture 16: Bundles of axons in the PNS are called a nerve.]

- Individual axons may be myelinated (shown) or unmyelinated (not shown)
- Axons are covered with **endoneurium**
- Endoneurium-covered axons are bundled together to form a **fascicle**
- Fascicles are covered with **perineurium**
- Fascicles bundle with each other and with blood vessels to form a **nerve**
- Nerves are covered by **epineurium**



Bundles of axons in the CNS are called a tract ?

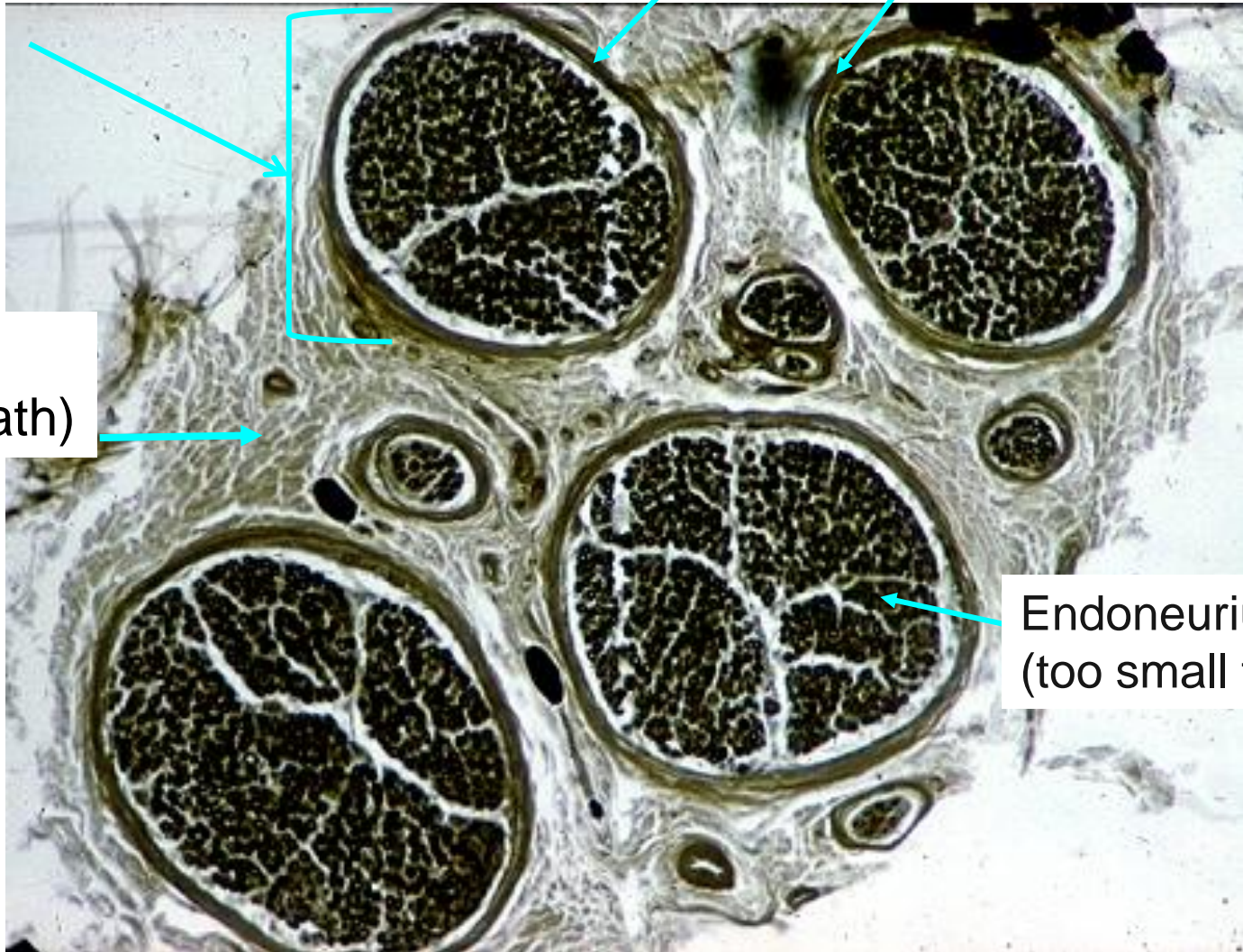
Structure of a peripheral nerve

Fascicle

Perineurium

Epineurium
(nerve sheath)

Endoneurium
(too small to see)



Lecture 20: Post-lecture Quiz

- The dorsal white columns are part of:
(a) PNS; (b) spinal nerves; (c) sensory system; (d) efferent system.
- Spinal nerves contain all of the following except:
(a) Myelinated axons; (b) Sensory axons; (c) Motor axons; (d) filum terminale
- Which of the following is true of the spinal cord
(a) it is part of the PNS; (b) contains spinal nerves; (c) it contains sympathetic nerve fibers; (d) it contains perineurium.
- A peripheral nerve contains _____.
(a) Fascicles; (b) Conus medullaris; (c) Filum terminale; (d) Oligodendrocytes

HUBS191

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