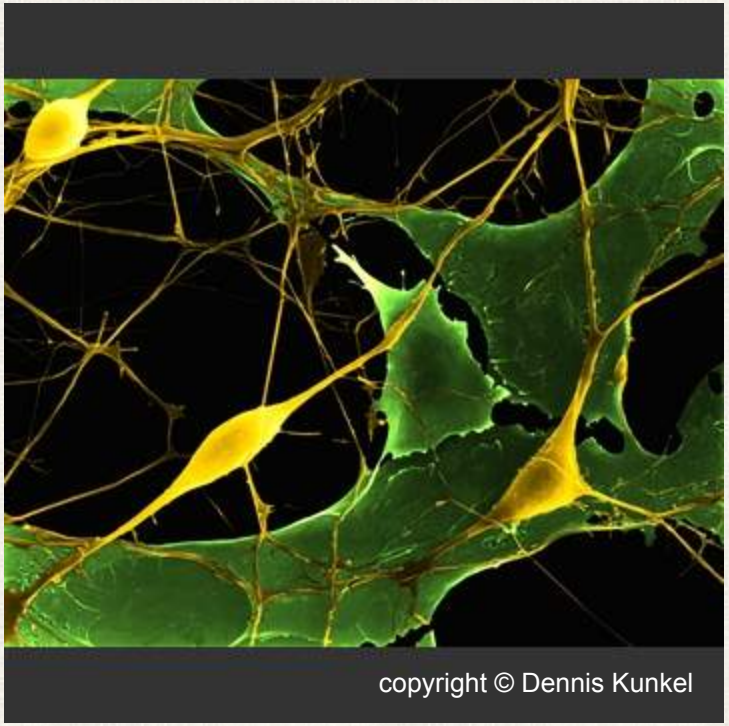
CAPS 301

Components of Peripheral Nervous System



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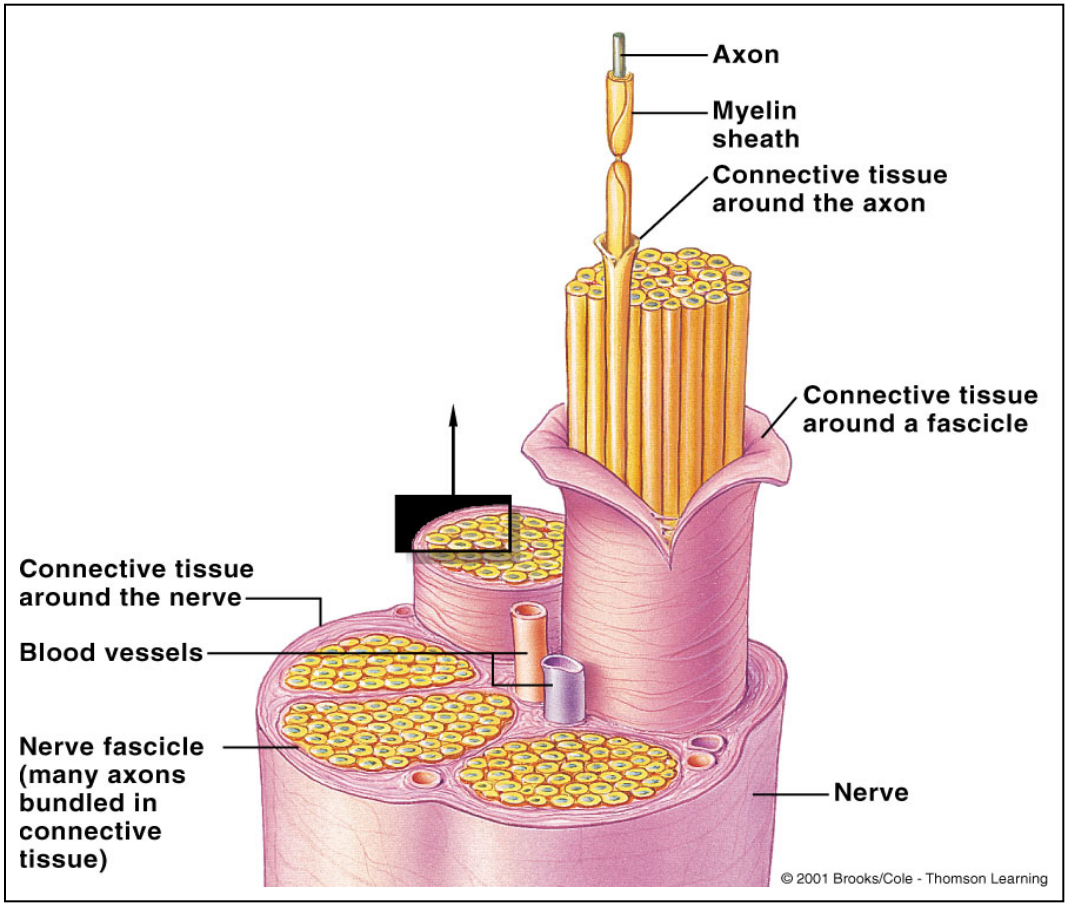
PERIPHERAL NERVOUS SYSTEM

(See Fig 5-1, 5-2 and 7-2)

Peripheral nerves are composed of **bundles** of axons

- **sensory** (afferent)
- **motor** (efferent)
- **autonomic**
  - (also motor, involved in functions that are NOT under voluntary control).



(Fig 5-30)

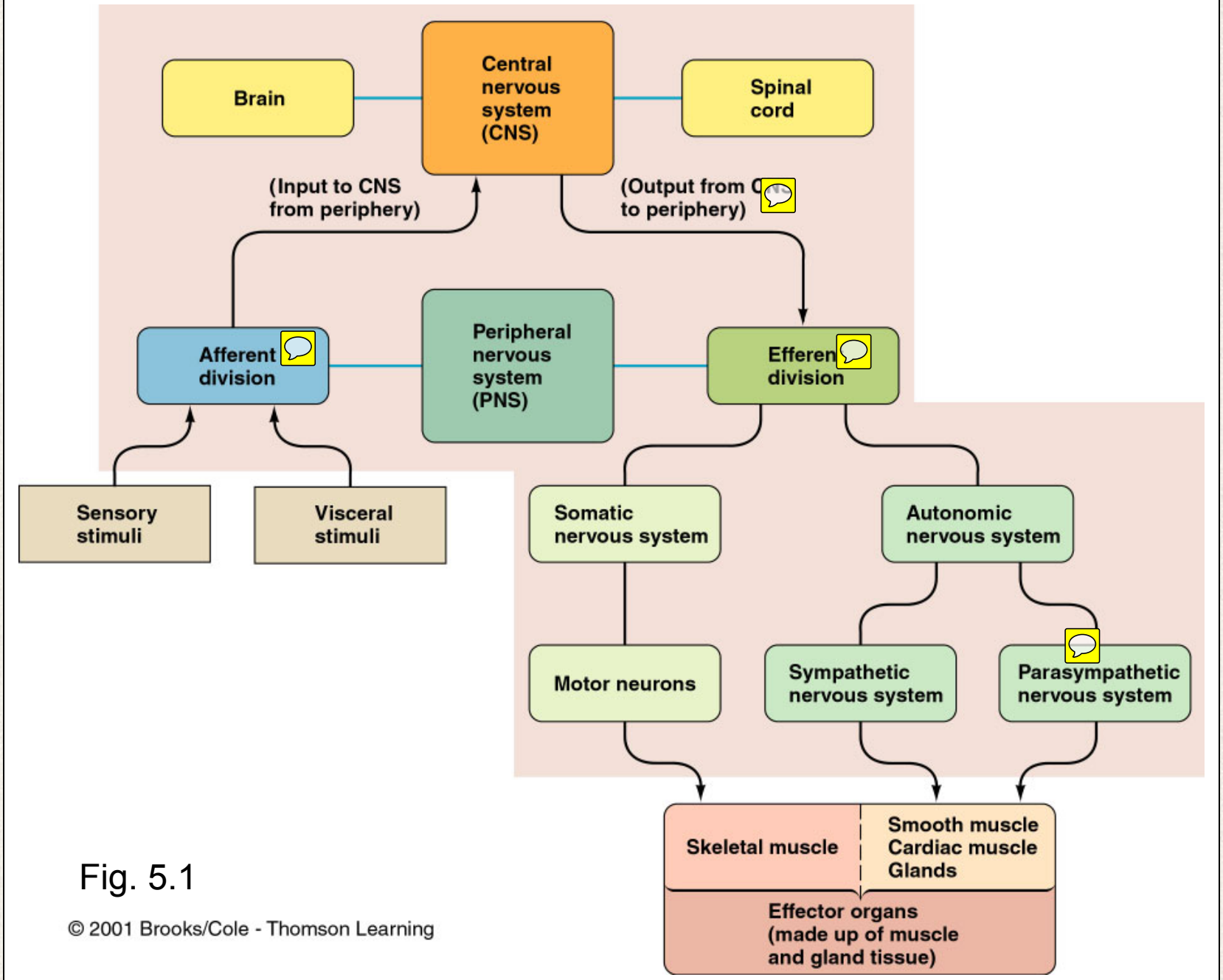
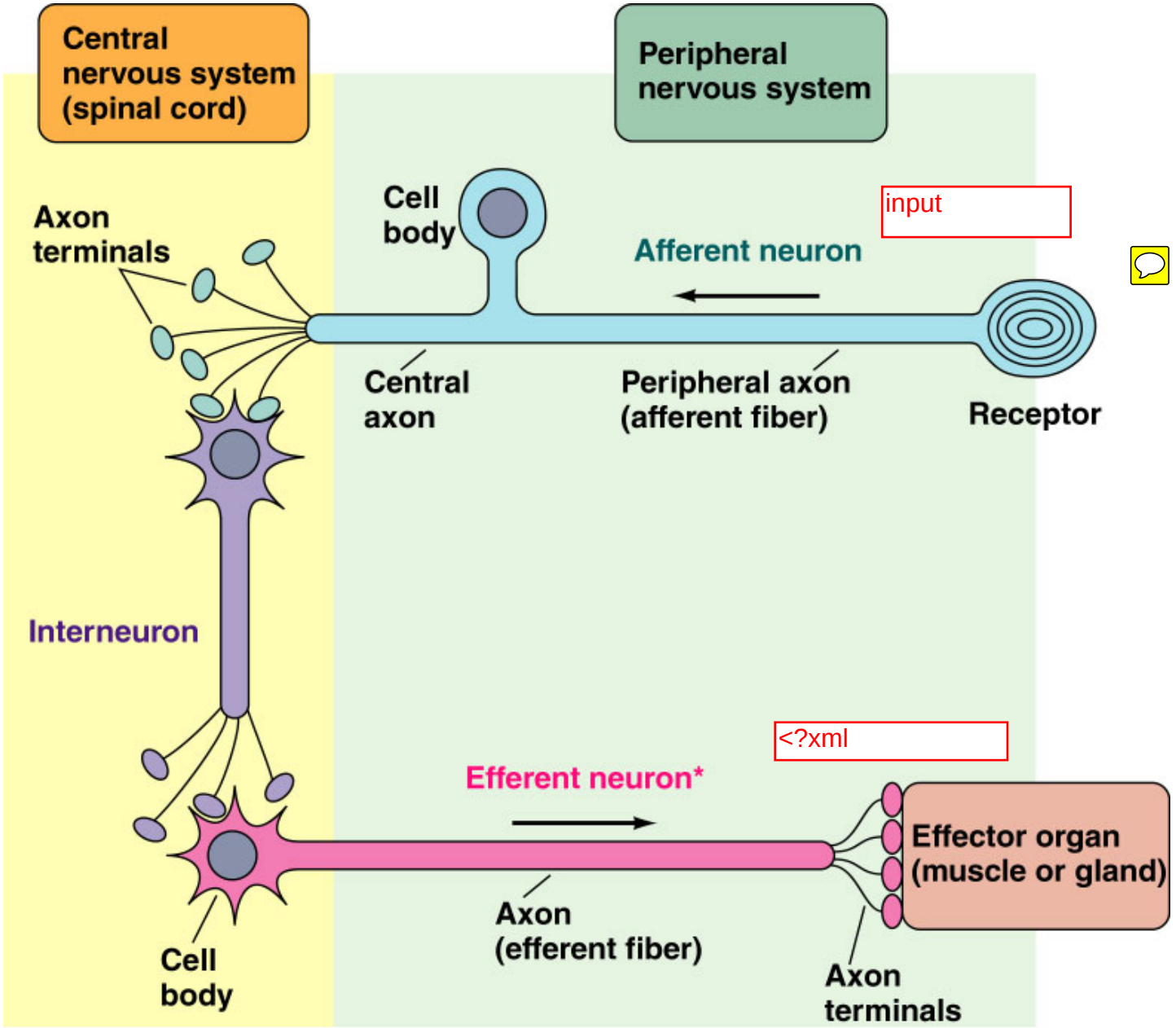


Fig. 5.1



* Efferent autonomic nerve pathways consist of a two-neuron chain between the CNS and the effector organ.

Fig. 5.2

PERIPHERAL NERVOUS SYSTEM

Motor neurons

- innervate striated muscle fibres
- cell body (soma) in the CNS
- release acetylcholine - acts via nicotinic receptors at the neuromuscular junction (NMJ).

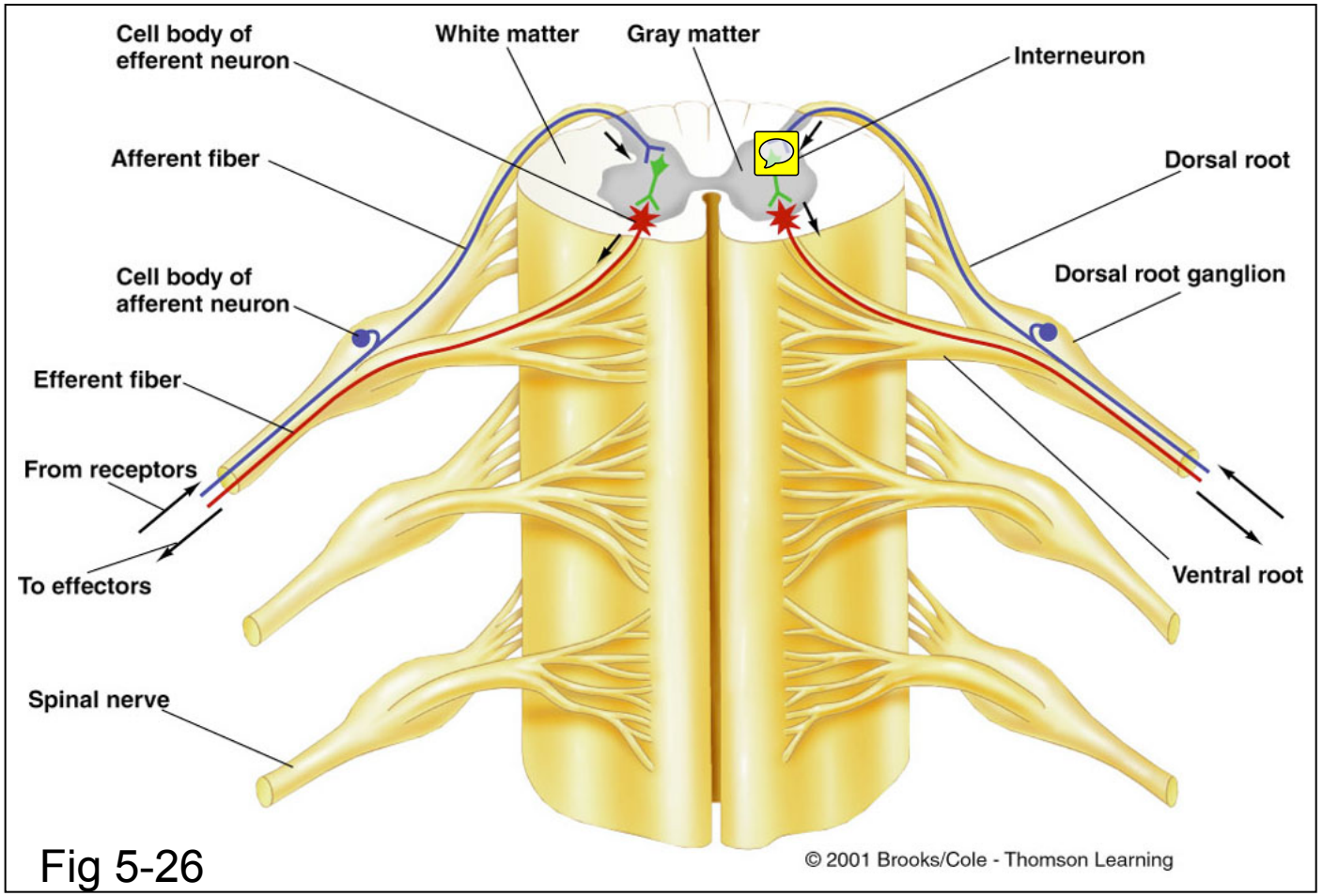
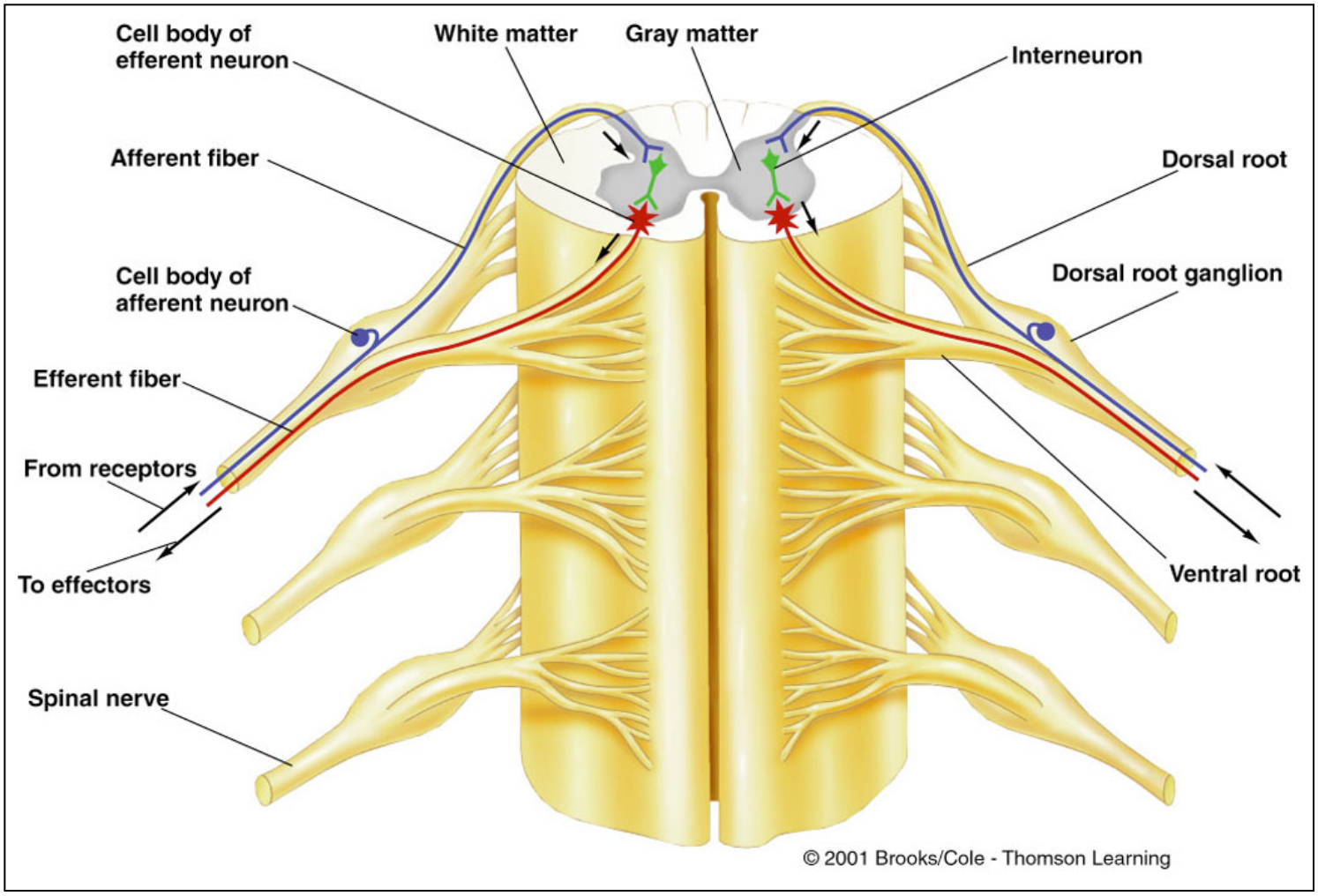


Fig 5-26

PERIPHERAL NERVOUS SYSTEM

Sensory neurons

- cell body outside the CNS in sensory ganglia.
  - "ganglion" denotes a collection of neuronal cell bodies in the PNS.



Autonomic neurons

- In the PNS are either **Sympathetic** or **Parasympathetic**.
- There are **2 neurons** in the pathway from the CNS to the peripheral organ.
  - The 1st neuron (preganglionic) has its cell body in the CNS.
  - The 2nd neuron (postganglionic) in an autonomic ganglion in the periphery.
  - Ganglion is close to the **CNS** in the sympathetic system
  - Ganglion is close to, or actually within, the **target organ** in the parasympathetic system.

ANS Functions

- Homeostasis
  - maintaining a stable internal environment
- Controls vegetative systems (life support)
  - semi-autonomously
  - coordinates with endocrine systems
- Blood pressure
  - HR, Stroke Volume, total peripheral resistance
- GI motility
- Salt/water balance
- Pupillary reflexes
- Sexual function

Control of ANS – Higher Centres

ANS coordinated via:

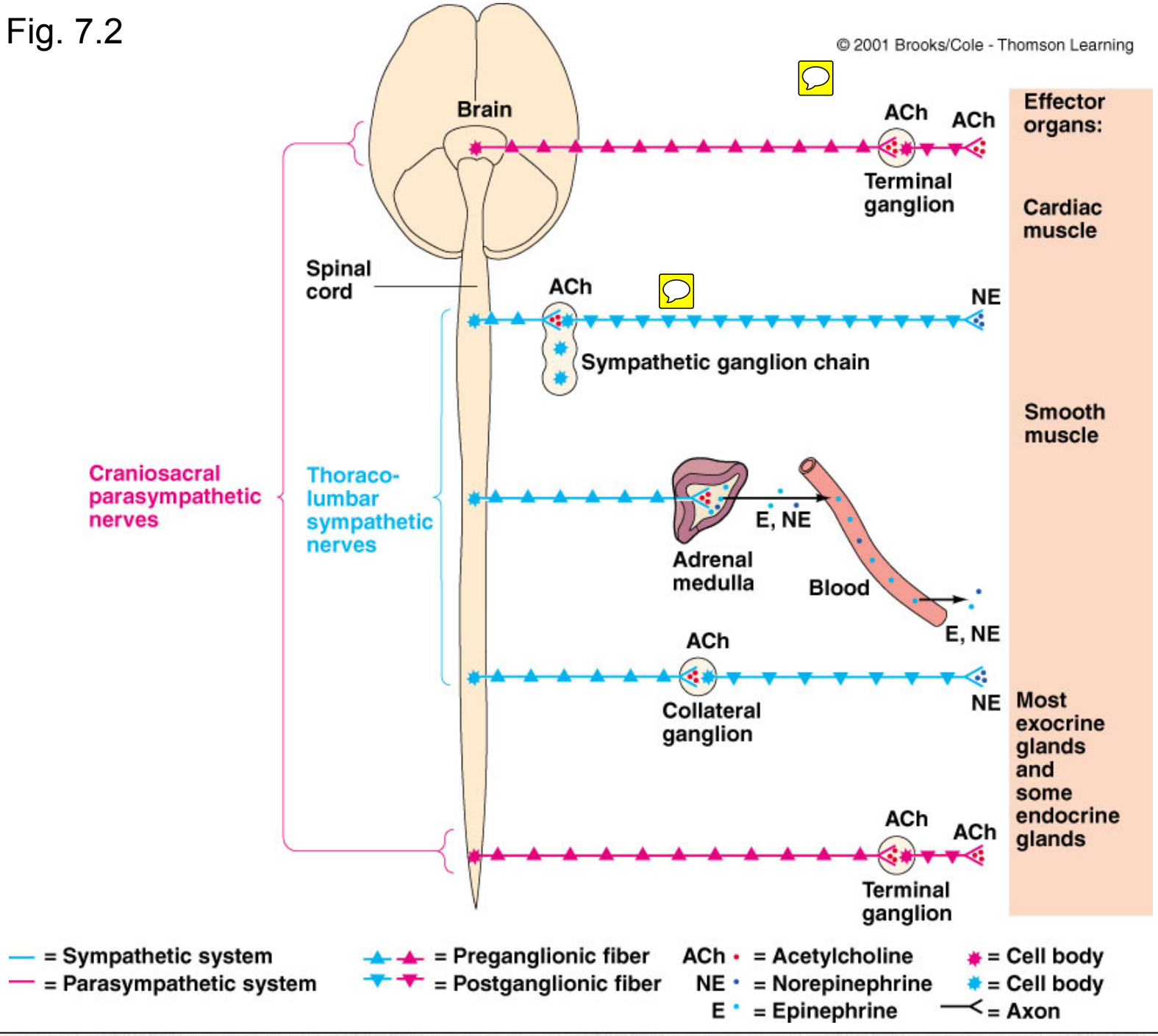
- Some **reflexes** at spinal cord level
- **Medulla** – within the brainstem
- **Hypothalamus**
- **Prefrontal cortex** – emotional states

ANS Afferents

Send information into **control centres**:

- **Baroreceptors** in aortic arch, carotid sinus monitor blood pressure
  - monitor bp
- **Osmoreceptors**-regulation of plasma ions
- **Thermal** (hot and cold) **sensors** in skin, CNS for regulating body temperature.
- **Cutaneous receptors** detect sexual stimuli
- Pain fibres in viscera
- **Stretch receptors** monitor distension in lungs, bladder, stomach, bowel

Fig. 7.2



Autonomic Neurons

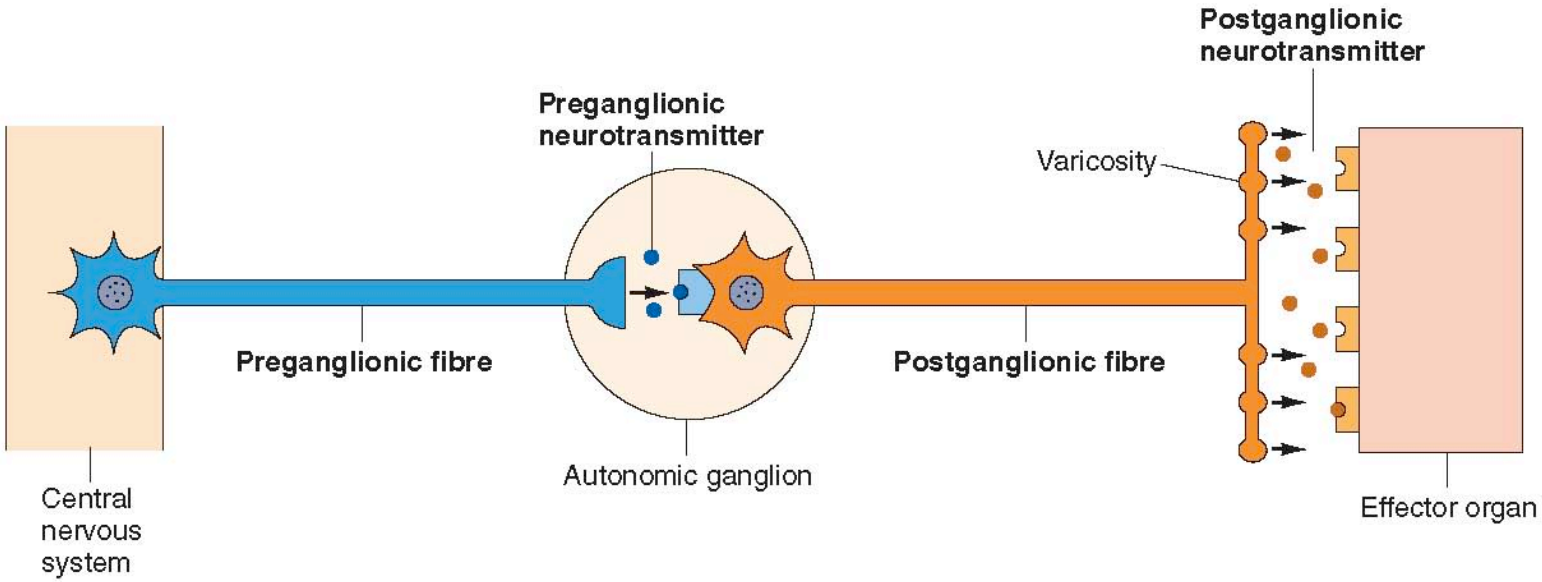


FIGURE 7-1
Autonomic nerve pathway

CATABOLIC Effects of Sympathetic Nervous System

- **Increased** Heart Rate, Stroke Volume and Blood Pressure
- **Increased** blood flow to skeletal muscle
- **Decreased** blood flow to skin
- Fight or Flight response:
  - Release of **epinephrine/norepinephrine** from adrenal medulla stimulates skeletal muscle glycogenolysis

ANABOLIC Effects of Parasympathetic Nervous System

- Decreased Heart Rate, Stroke Volume and Blood Pressure
- Increased G.I. tract motility and secretions
- Relaxation of sphincters in eosphagus, stomach, bladder
- **Paradoxical Co-activation**:
  - Both sympathetic and parasympathetic systems activated during intense conflict situations

PNS Nerves – Cranial Nerves

- Originate inside cranium and proximal spinal cord
- Can carry:
  - Afferent information (fibres)
  - Efferent fibres
  - ANS fibres

CRANIAL NERVES

(See Fig 5-21)

There are 12 pairs (please note Roman numerals)

I. OLFACTORY – **sensory** - sense of smell.

II. OPTIC – **sensory** - vision.

III. OCULOMOTOR

- **motor**, voluntary – moves eyeball medially (towards midline)
- **motor**, **autonomic (parasympathetic)** – constricts pupil and thickens lens.

CRANIAL NERVES

IV. TROCHLEAR

- **motor**, voluntary – moves eyeball.

V. TRIGEMINAL

- **motor**, voluntary – mastication.
- **sensory**, touch, temperature, pain etc from face, head and mouth.

VI. ABDUCENS

- **motor** – moves eyeball laterally.

double vision: when abducens and ocularmotor nervers dont communicatee well- dont shift just enough to keep object in focus.

* Note, opposite to III.
* III and VI must work together when we are looking right or left. This is coordinated by information carried in the MLF (medial longitudinal fasciculus). This is a tract connecting III nerve nucleus to VI nerve nucleus.

CRANIAL NERVES

VII. FACIAL

- **motor**, voluntary – muscles of facial expression.
- **motor**, **autonomic (parasympathetic)** – lacrimal and salivary glands.
  sensory, taste – tastebuds of (anterior 2/3 of the tongue).

VIII. AUDITORY (Vestibulocochlear)

- **sensory**, from cochlea – hearing
- **sensory**, from vestibular apparatus – gravity, motion and position of head.

IX. GLOSSOPHARYNGEAL

- **motor**, voluntary – pharynx swallowing
- **motor**, **autonomic (parasympathetic)** – salivary glands.
- **sensory**, taste – tastebuds (posterior 1/3 of tongue).
- **sensory**, - carotid sinus baroreceptors - monitors pressure of arterial blood - Important in reflex regulation of heart rate and BP.
- **sensory**, - carotid body chemoreceptors – monitors CO_2, O_2 in arterial blood - Important in control of breathing.

CRANIAL NERVES

X. VAGUS (See Fig 7-3)

- **motor**, voluntary – pharynx swallowing; larynx phonation.
- **motor**, **autonomic (parasympathetic)** to heart (slows heart rate), to abdominal organs – controls secretion and motility.
- **sensory**, from aortic baroreceptors and chemoreceptors
- **sensory**, from GI tract.

XI. ACCESSORY

- **motor**, voluntary – swallowing
- **motor**, voluntary – shoulder shrugging

XII. HYPOGLOSSAL

- **motor**, voluntary – tongue.

* Please note, IX, X, and XI all involved in **swallowing**. Vagus (X) is the most important.

SPINAL NERVES

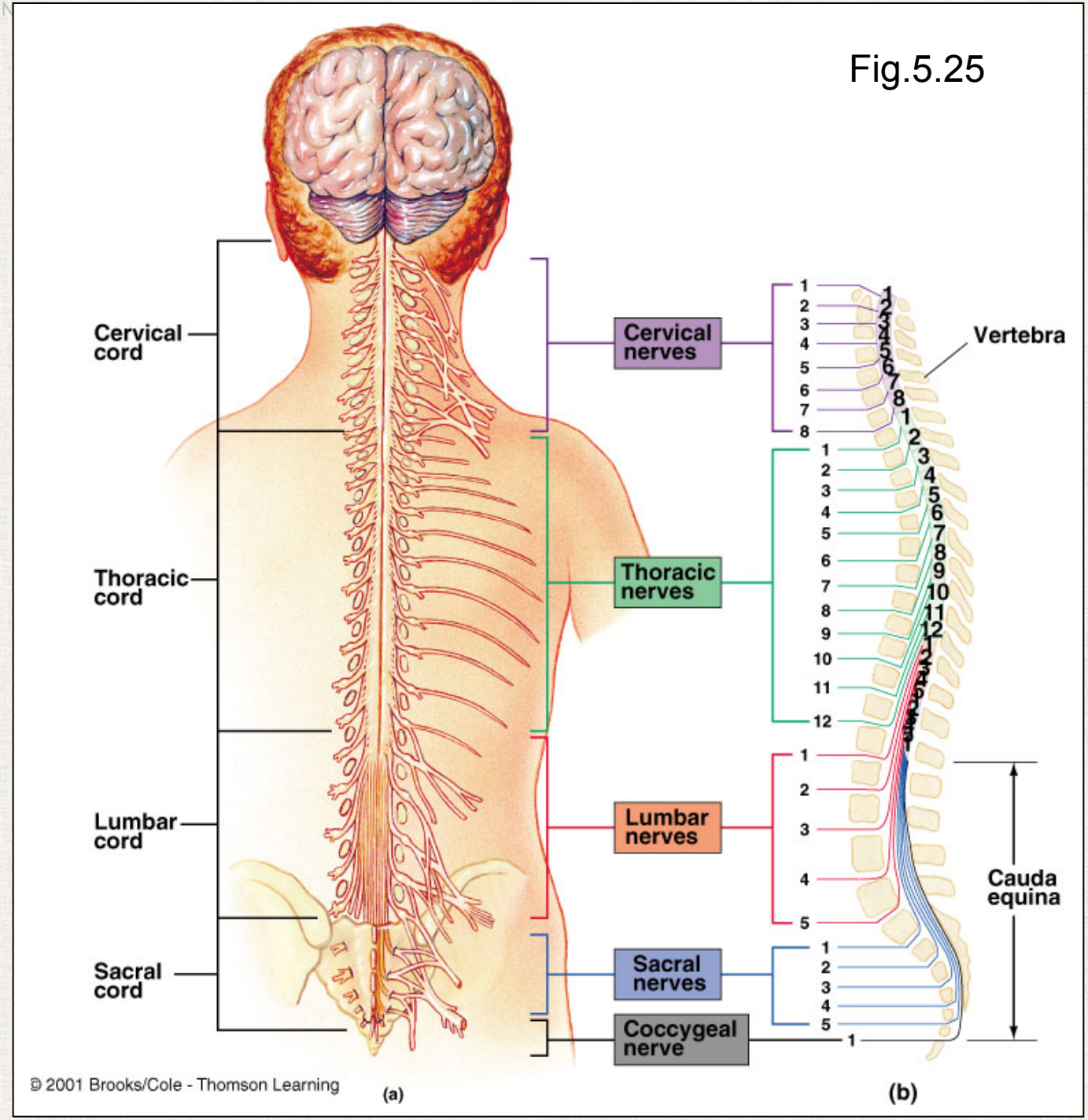
(See Fig 5-25)

31 pairs:

- 8 cervical (C.1 - C.8)
- 12 thoracic (T.1 - T.12)
- 5 lumbar (L.1 – L.5)
- 5 sacral (S.1 – S.5)
- 1 coccygeal

- **All** have voluntary motor function.
- **All** (except C. 1) have sensory fibres.

Fig.5.25



AUTONOMIC SYSTEM

(See Fig 7-3 and Table 7 – 3)

SYMPATHETIC

- Preganglionics arise from all thoracic and the 1st and 2nd lumbar segments. T.1 - L.2 .

PARASYMPATHETIC

- Parasympathetics are carried in Cranial nerves III, VII, IX and X, and Sacral 2, 3 and 4.
  - Preganglionics arise from Sacral segments S.2, S.3 and S.4.

* **Please note**: none of the cranial nerves carry sympathetic fibres.

- The sympathetic innervation of the head comes from the upper thoracic spinal nerves.