Fak. Farmasi Univ.Pancasila
Kuliah Faal (2 SKS); Sm I / TA. 2021-2022

SISTIM SARAF PERIFER (PNS)
DAN
SISTEM SARAF OTONOM (ANS)

Ros Sumarny

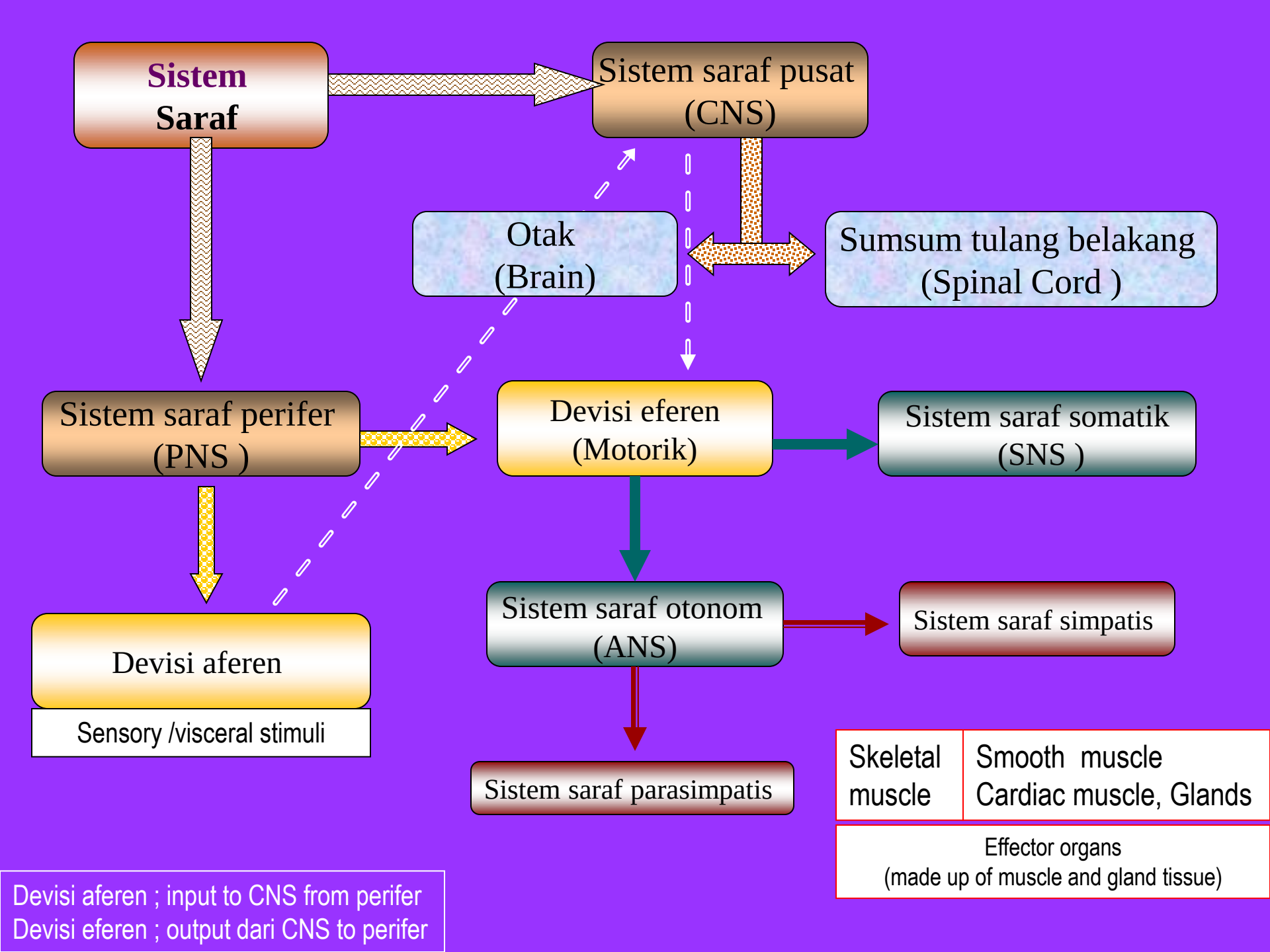
PENDAHULUAN

Sistem saraf

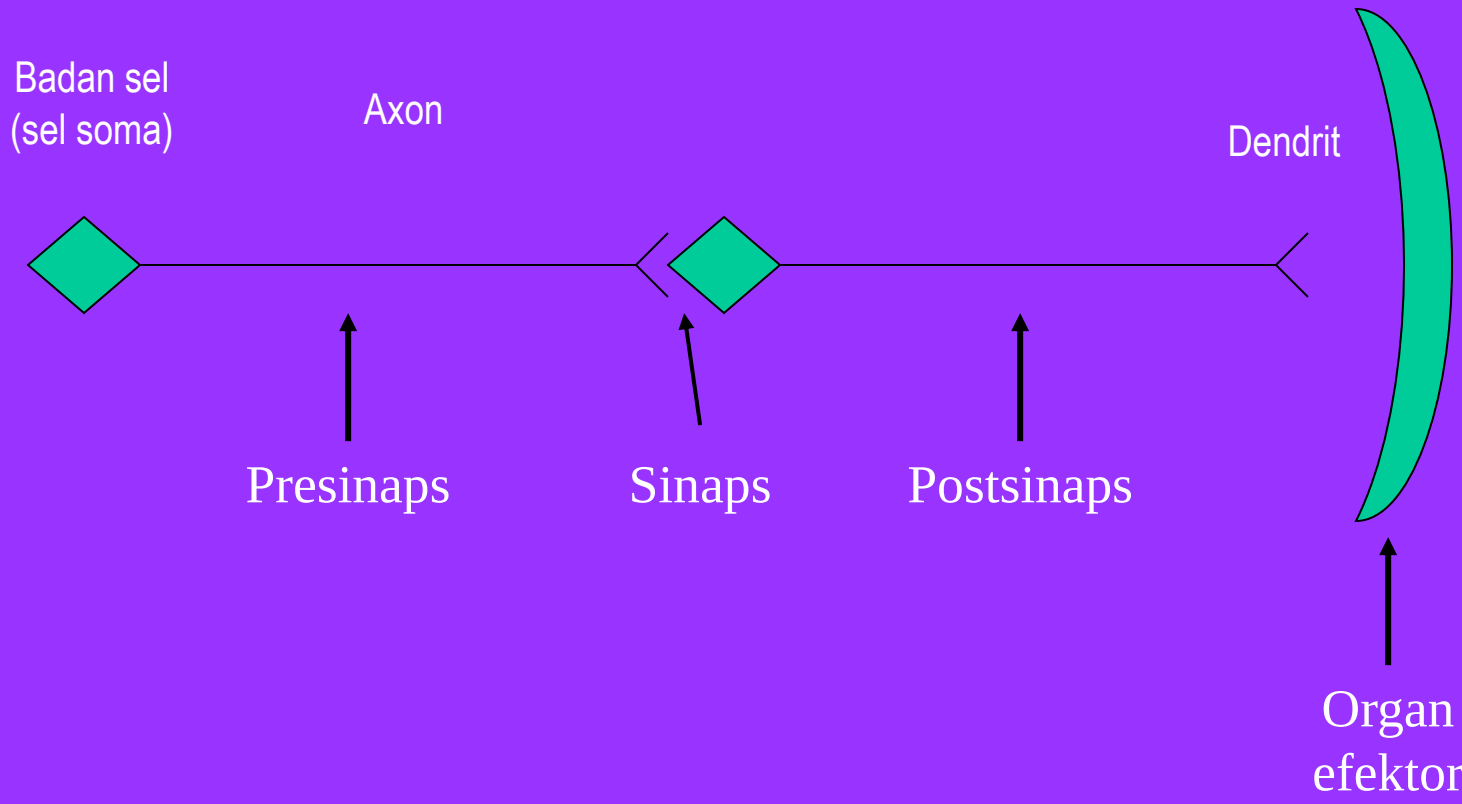
- adalah kumpulan sel yang khusus menghantarkan dan mengintegrasikan informasi (Bray, 1988)
- mengkoordinasikan respon cepat
- sistem kontrol tubuh yang lain → sistem endokrin; mengatur akttivitas tubuh lebih lama

Klasifikasi :

a. Sistim saraf pusat (SSP=CNS), terdiri dari: otak dan medula spinalis
b. Sistem saraf perifer (PNS), mencakup:
   - divisi aferen : serat saraf yang membawa informasi / stimuli sensori/visceral ke SSP
   - divisi eferen: serat saraf yang membawa informasi dari SSP(=CNS) ke saraf perifer (=PNS)


Sistem Saraf
Sistem saraf pusat (CNS)
Otak (Brain)
Sumsum tulang belakang (Spinal Cord)
Sistem saraf perifer (PNS)
Devisi eferen (Motorik)
Sistem saraf somatik (SNS)
Sistem saraf otonom (ANS)
Sistem saraf simpatis
Devisi aferen
Sensory /visceral stimuli
Sistem saraf parasimpatis
Skeletal muscle
Smooth muscle
Cardiac muscle, Glands
Effector organs
(made up of muscle and gland tissue)
Devisi aferen ; input to CNS from perifer
Devisi eferen ; output dari CNS to perifer

Neuron = Sel saraf



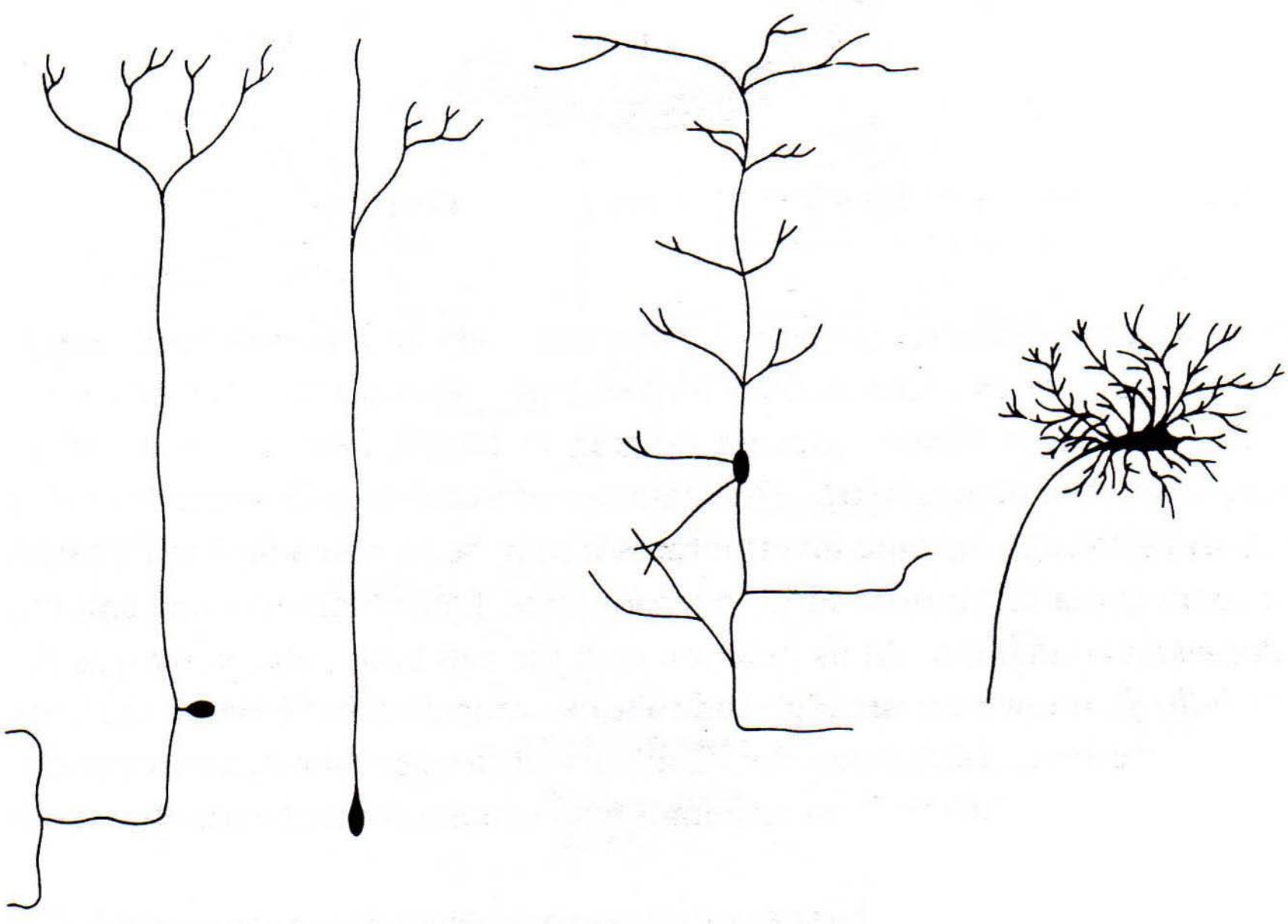
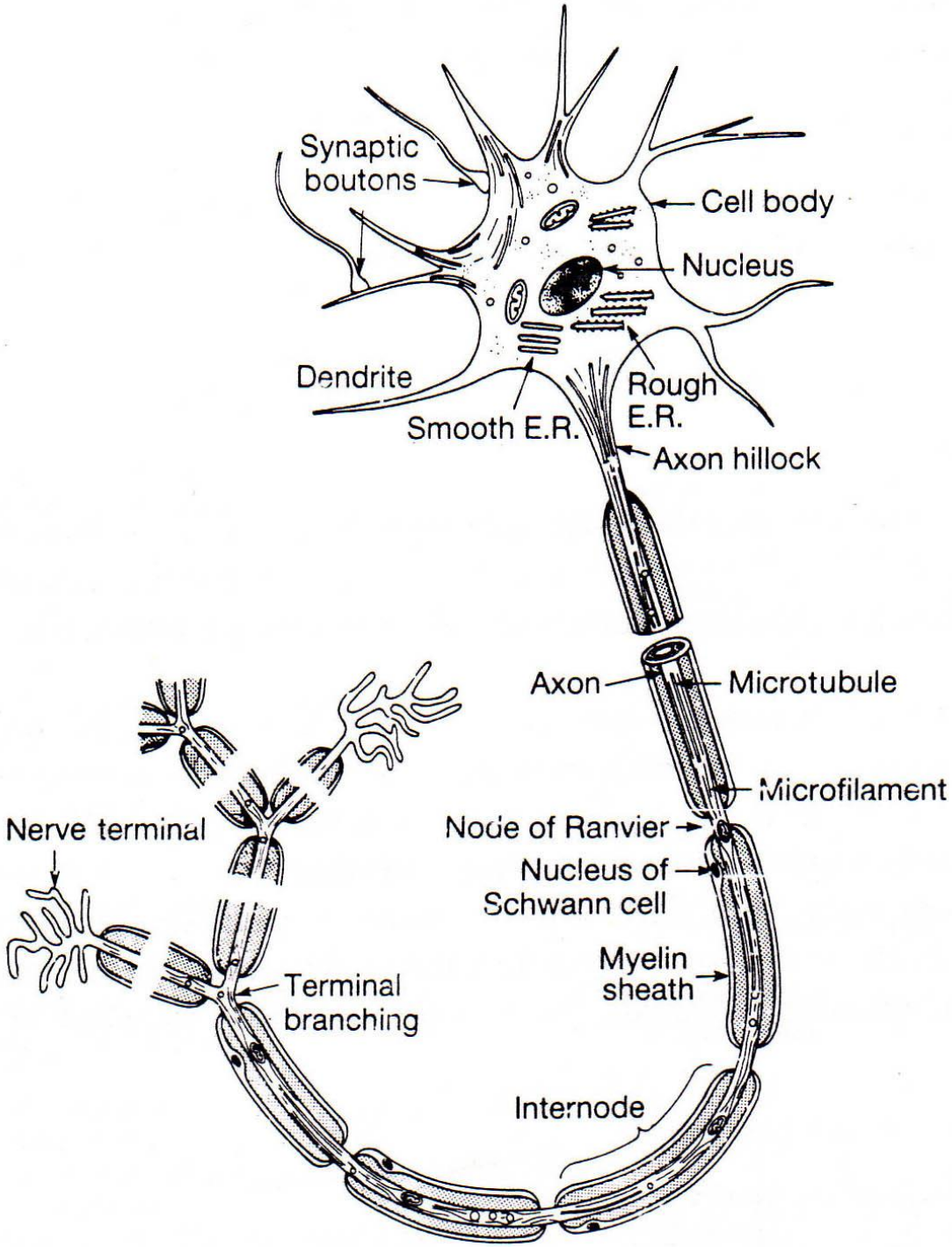


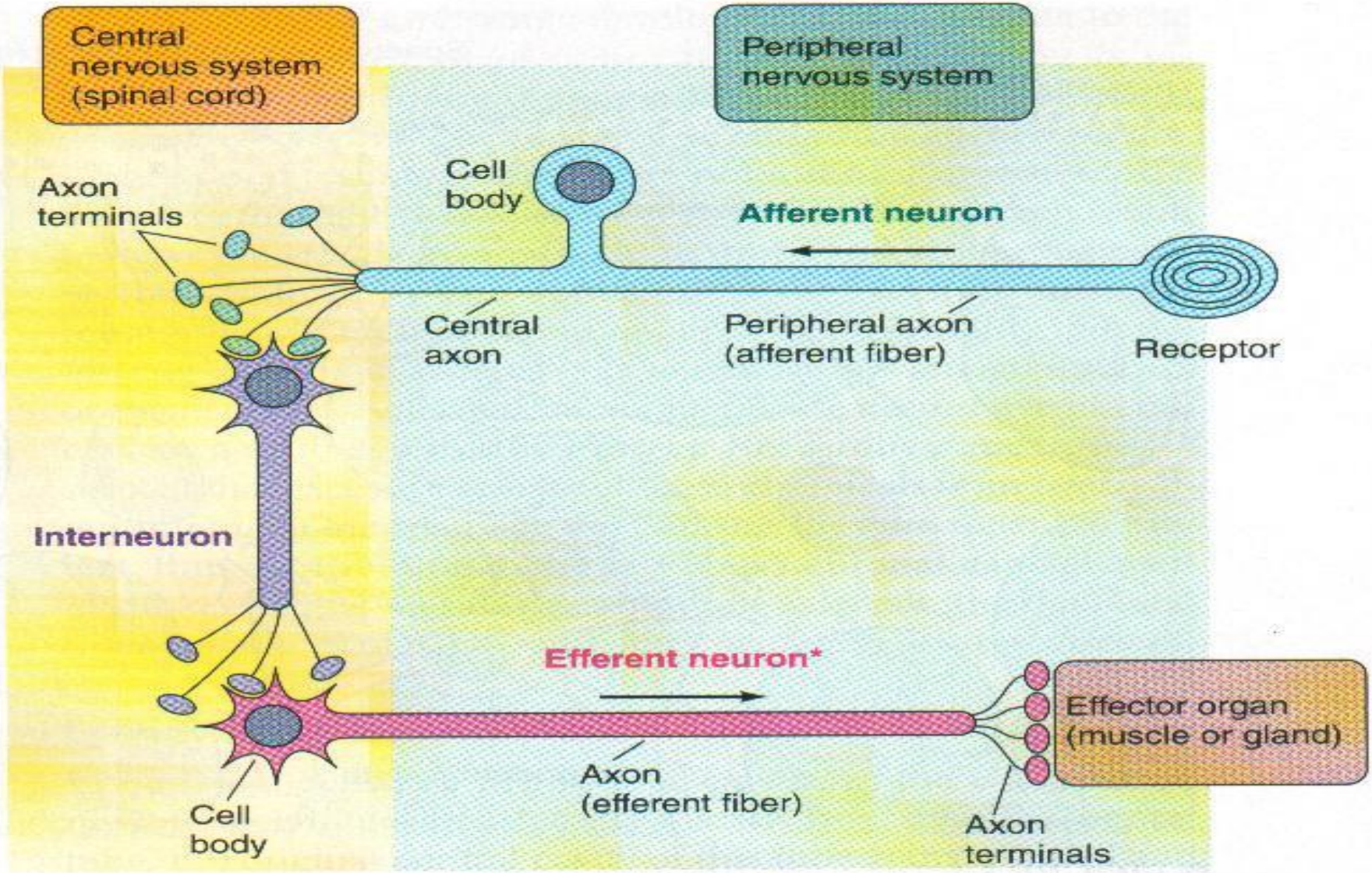
Figure.2.1. Various types of neurones

Fig.2.2. Diagram of a motor neurone (E.R= endoplasmic reticulum)



Jenis neuron

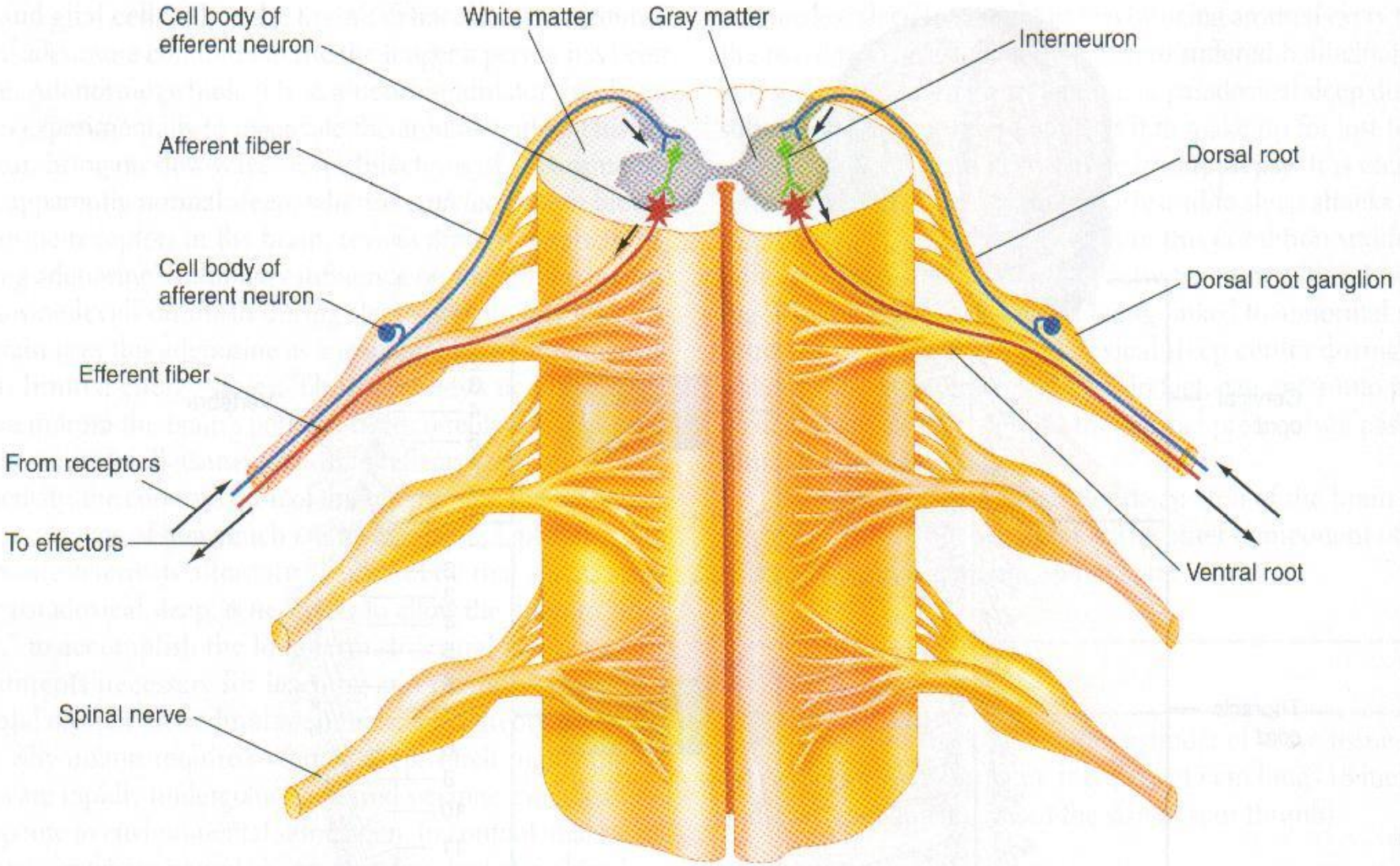
1. Neuron aferen, memberitahu SSP mengenai kondisi lingkungan eksternal dan internal
2. Neuron eferen, membawa instruksi dari SSP ke organ efektor (otot dan kelenjar)
3. Antarneuron, mengintegrasikan informasi aferen dan memformulasikan respon eferen



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

FIGURE 5-2

Structure and location of the three classes of neurons



● FIGURE 5-29

Spinal cord in cross section

Schematic representation of the spinal cord in cross section showing the relationship between the spinal cord and spinal nerves. The afferent fibers enter through the dorsal root, and the efferent fibers exit through the ventral root. Afferent and efferent fibers are enclosed together within a spinal nerve.

Traktus

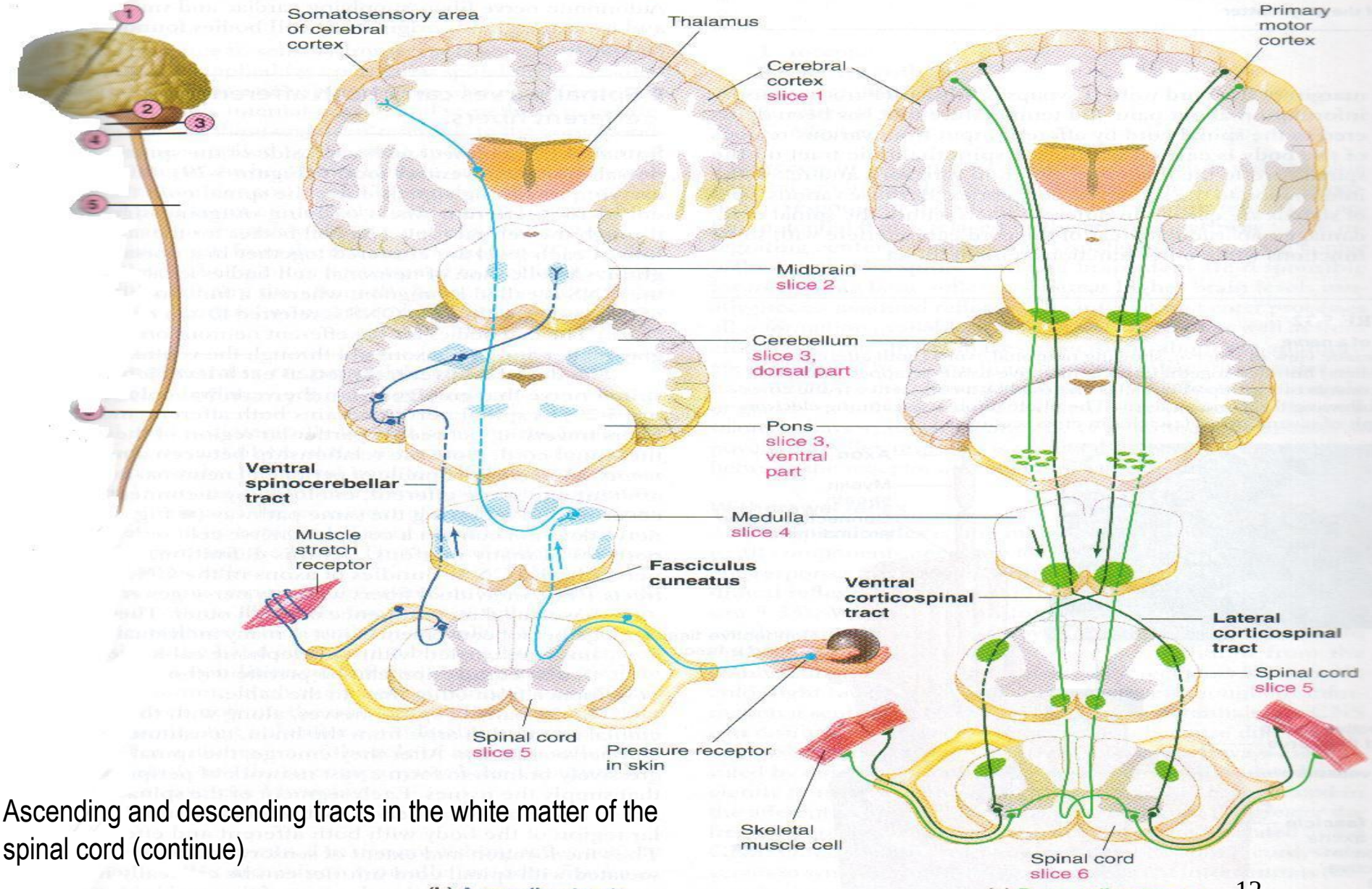
Traktus asendens

Menyalurkan sinyal dari masukan aferen ke otak. Contoh: Traktus spinothalamikus

Traktus desendens

menyampaikan pesan dari otak ke neuron eferen. Contoh: Traktus kortikospinalis

ding and descending tracts in the white matter of the spinal cord *(continued)*
Cord-to-brain pathways of several ascending tracts (fasciculus cuneatus and ventral spinocerebellar tract).
Brain-to-cord pathways of several descending tracts (lateral corticospinal and ventral corticospinal tracts).



Ascending and descending tracts in the white matter of the spinal cord (continue)

Refleks

- adalah respon apapun yang terjadi secara otomatis tanpa usaha sadar.
- Jalur-jalur saraf yang berperan dalam aktivitas refleks disebut lengkung refleks, yang mencakup 5 komponen dasar, yaitu:

1. Reseptor
2. Jalur aferen
3. Pusat integrasi
4. Jalur eferen
5. Efektor

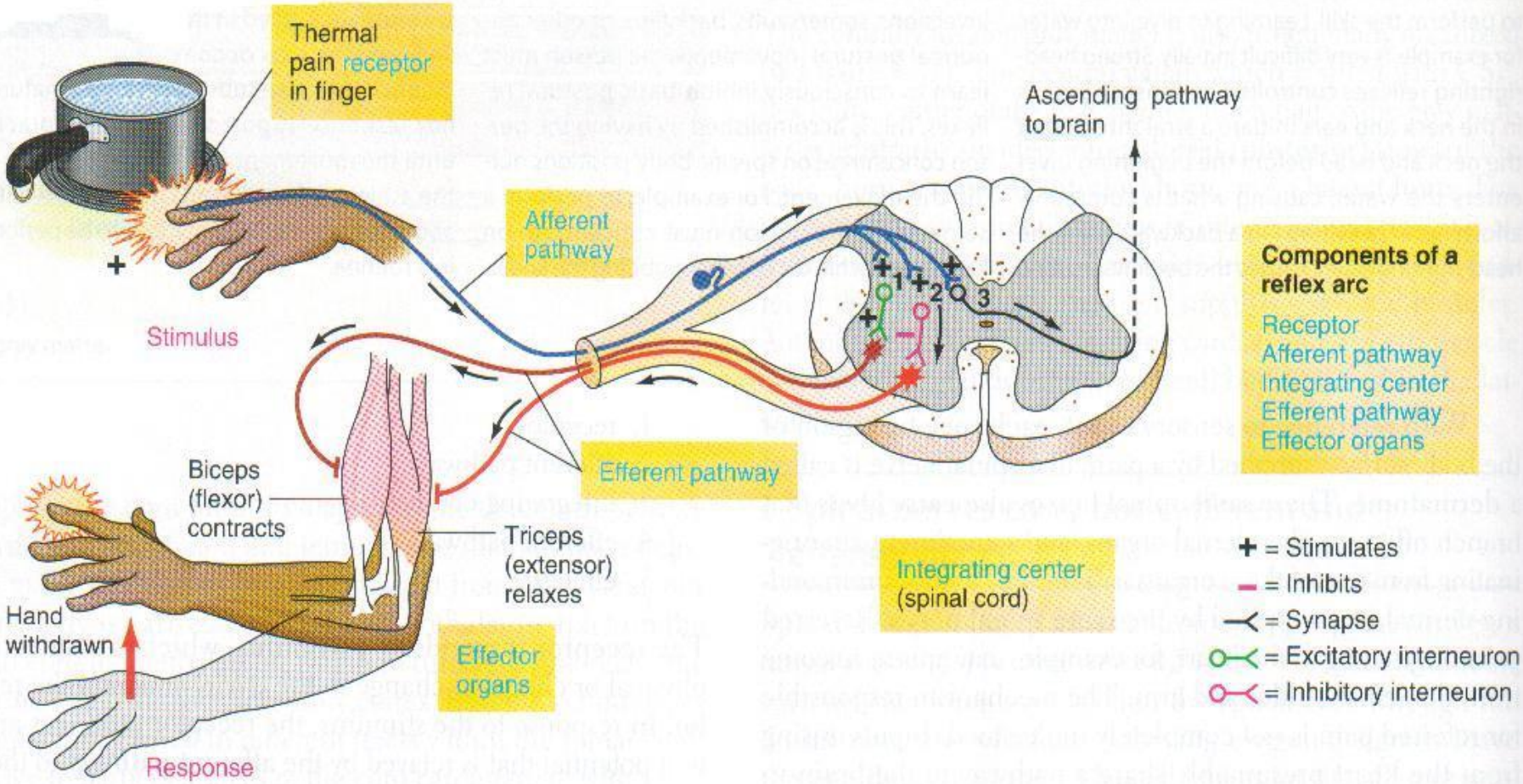


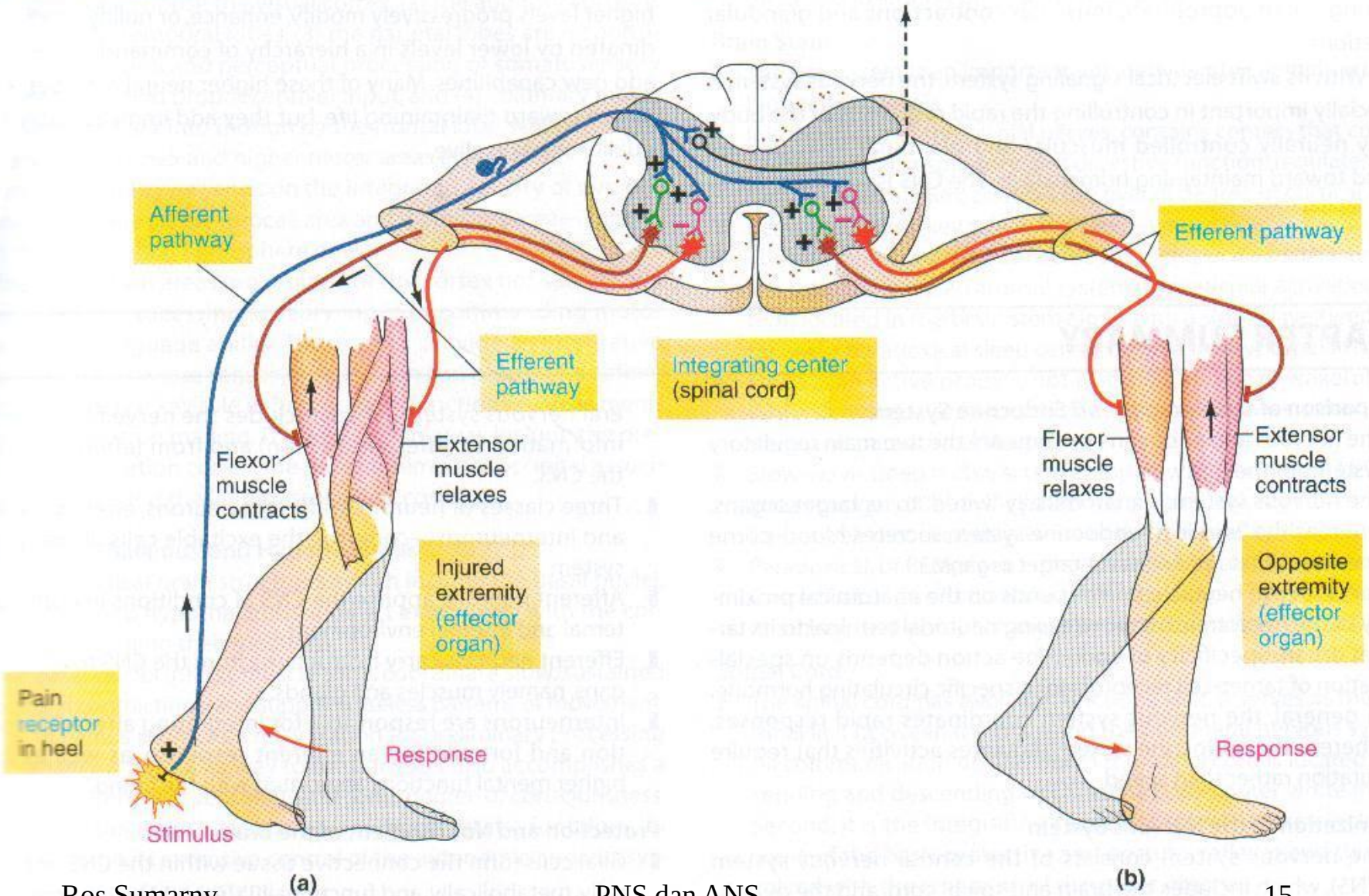
FIGURE 5-33

The withdrawal reflex

When a painful stimulus activates a receptor in the finger, action potentials are generated in the corresponding afferent pathway, which propagates the electrical signals to the CNS. Once the afferent neuron enters the spinal cord, it diverges and terminates on three different types of interneurons (only one of each type is depicted): (1) excitatory interneurons, which in turn stimulate the efferent motor neurons to the biceps, causing the arm to flex and pull the hand away from the painful stimulus; (2) inhibitory interneurons, which inhibit the efferent motor neurons to the triceps, thus preventing counterproductive contraction of this antagonistic muscle; and (3) interneurons that carry the signal up the spinal cord via an ascending pathway to the brain for awareness of pain, memory storage, and so on.

The crossed extensor reflex coupled with the withdrawal reflex

(a) The withdrawal reflex, which causes flexion of the injured extremity to withdraw from a painful stimulus. (b) The crossed extensor reflex, which extends the opposite limb to support the full weight of the body.



SISTEM SARAF OTONOM (ANS)

- SISTEM SARAF YANG MENGATUR FUNGSI VISERAL TUBUH (TEK. DARAH, MOTILITAS DAN SEKRESI GASTROINTESTINAL, OUTPUT URIN, BERKERINGAT, SUHU TUBUH, DLL).
- DISEBUT JUGA SISTEM SARAF TAK SADAR.
- MENURUT FUNGSINYA, DIBEDAKAN ATAS:
  - SISTEM SARAF SIMPATIS
  - SISTEM SARAF PARASIMPATIS.

Outflow Sistim Saraf Otonom

- Sistim saraf parasimpatis → Kraniosakral
  Segment cranial : N. III, VII, IX, X
  Segement sacral : S2,3,4
- Sistim saraf simpatis → Torakolumbal
  Segment Toraks 1 s/d 12
  Segment Lumbal 1 dan 2

Outflow Sistim Saraf otonom

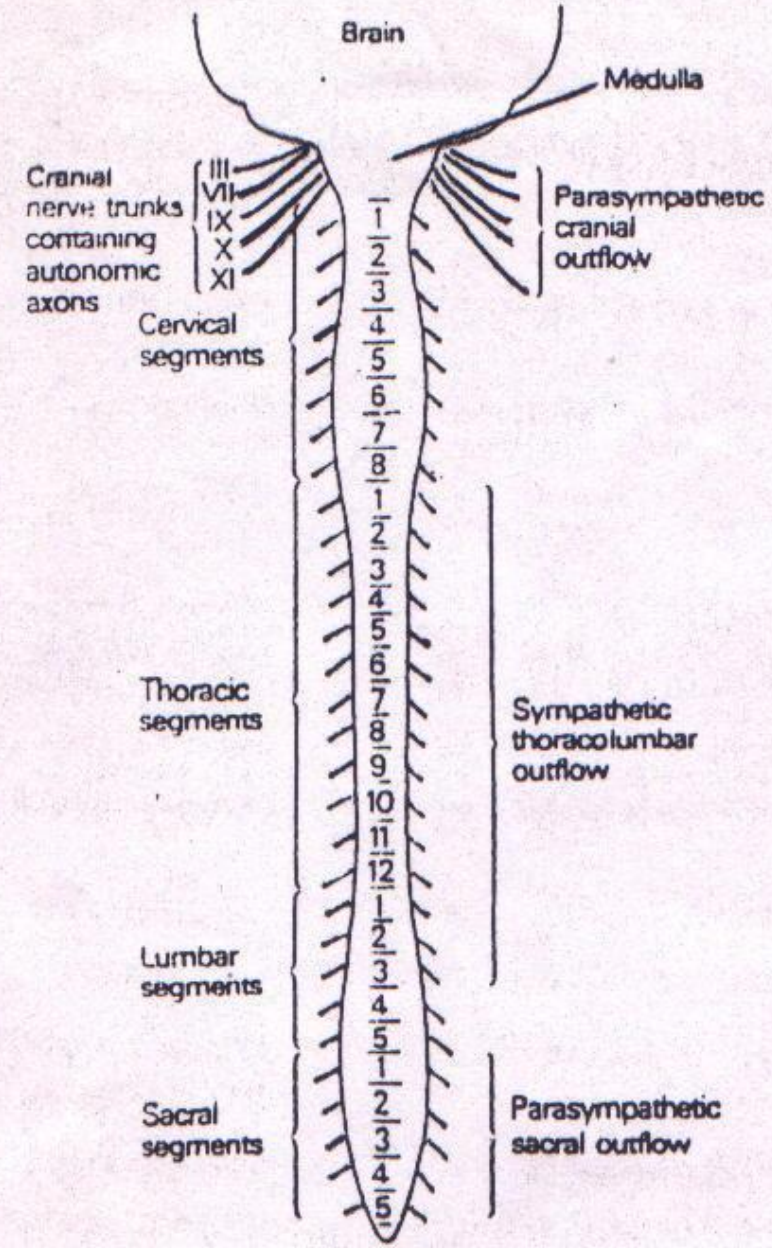


Fig. 9.1. The preganglionic autonomic nervous outflow from the central nervous system (brain and spinal cord) showing the sympathetic (thoracolumbar) and parasympathetic (cranial and sacral) divisions.

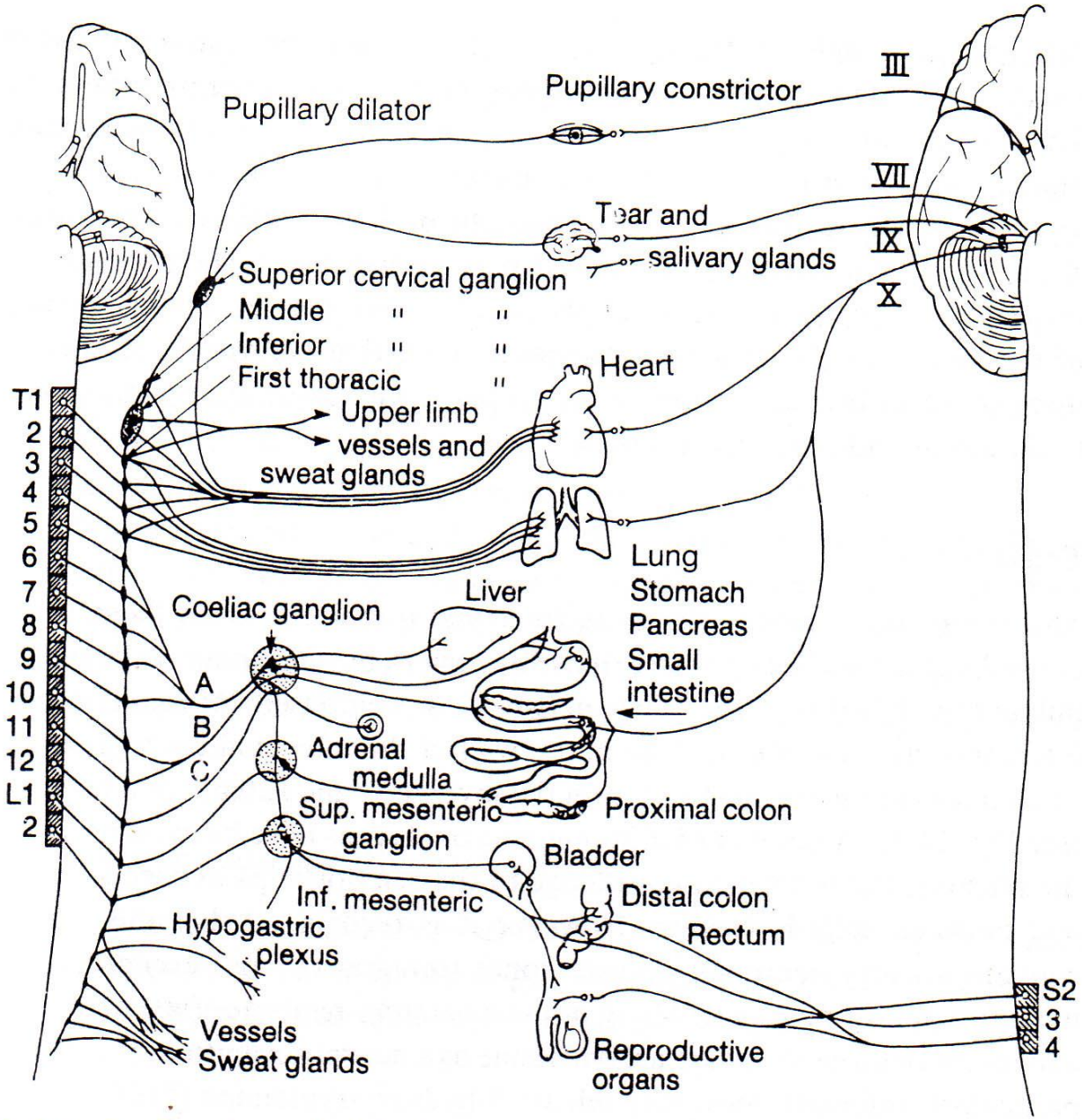


Fig. 2.21. Outflow of sympathetic (left) and parasympathetic (right) fibres.

SISTEM SARAF SIMPATIS

- SARAF SIMPATIS BERASAL DARI DALAM MED. SPINALIS DI ANTARA SEGMEN T-1 SAMPAI L-2 YAITU MOTONEURON SIMPATIS KORNU INTERMEDIOLATERAL SUBSTANSIA GRISEA MEDULLA SPINALIS.
- TIAP LINTASAN SIMPATIS TERDIRI ATAS:
  - NEURON PRA GANGLION
  - NEURON PASCA GANGLION
- BADAN SEL NEURON PRA GANGLION DI KORNU INTERMEDIOLATERAL, SEDANGKAN SERABUTNYA BERJALAN MEL. RADIKS ANTERIOR MED. SPIN BERSAMA SARAF SPINALIS.

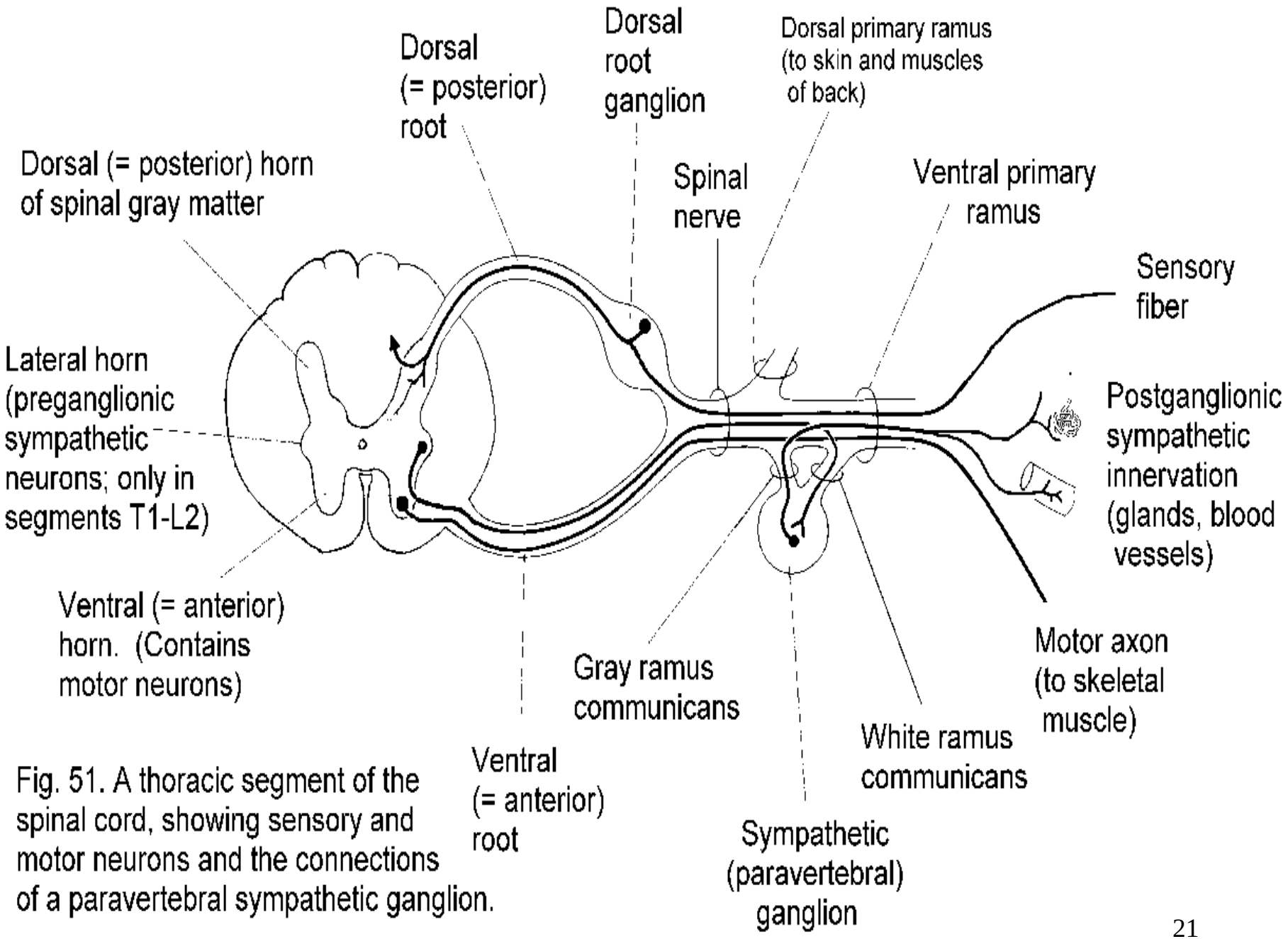
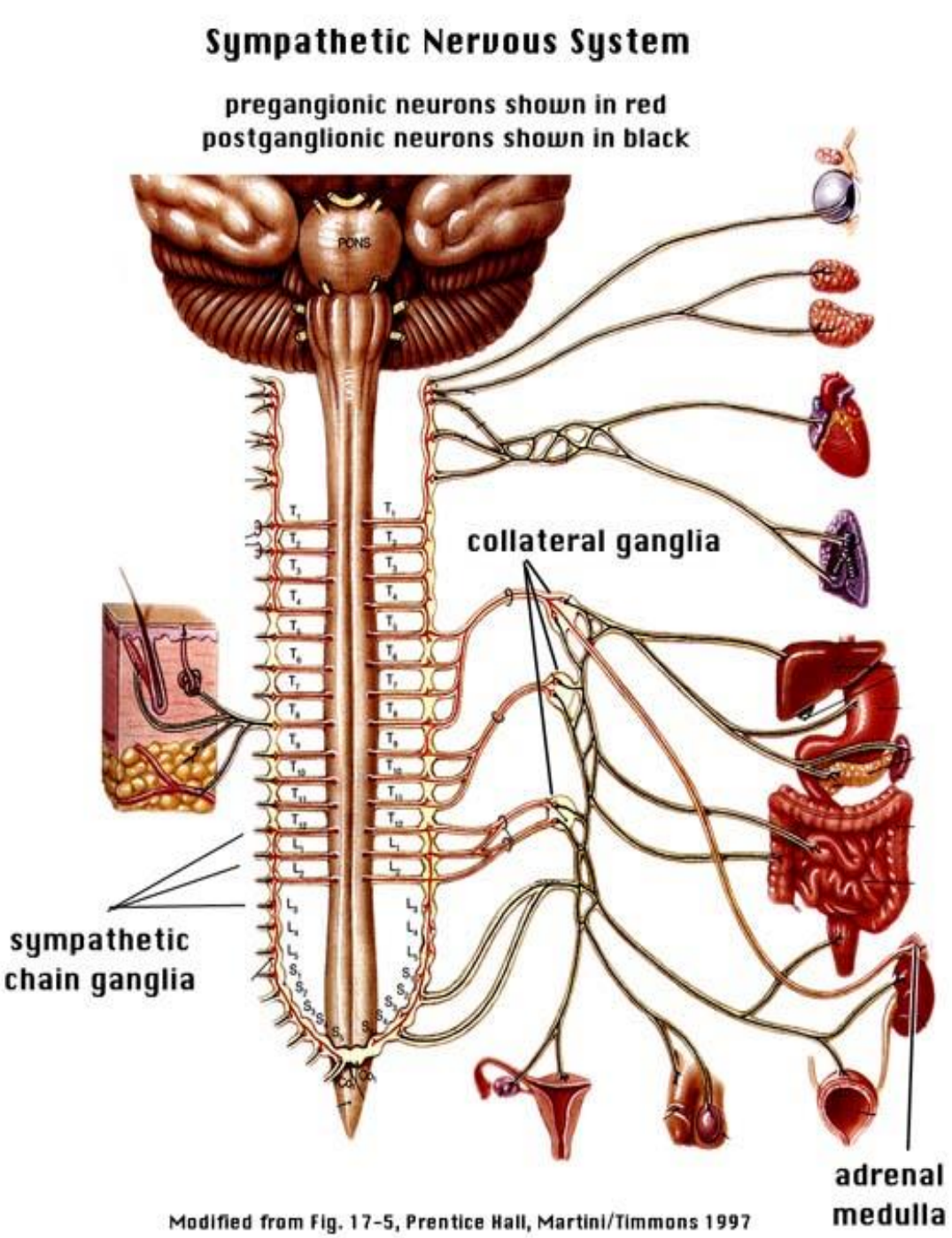


Fig. 51. A thoracic segment of the spinal cord, showing sensory and motor neurons and the connections of a paravertebral sympathetic ganglion.



Organ

Efektor

Sistem

Saraf

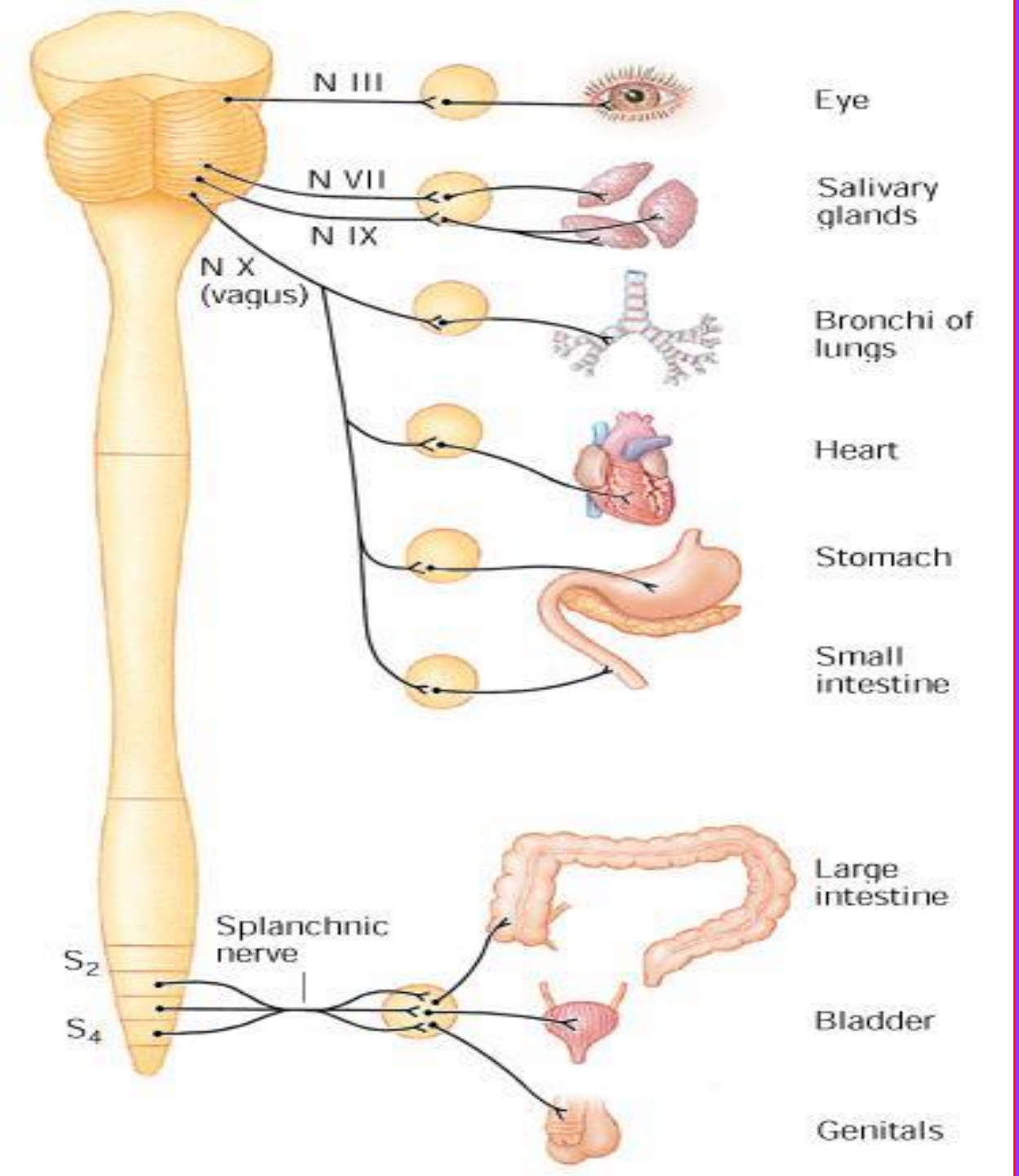
Simpatis

SISTEM SARAF SIMPATIS (2)

- SERABUT PRA GANGLION MENINGGALKAN SARAF SPINAL DAN BERJALAN MELALUI RAMUS ALBA GANGLION RANTAI SIMPATIS (TRUNKUS SIMPATIKUS).
- DI TRUNKUS INI BERSINAPS DENGAN NEURON PASCA GANGLION

SARAF PARASIMPATIS

- DISUSUN OLEH SERABUT SARAF KRANIAL III,VII, IX, X DAN SARAF SPINAL SAKRAL 2,3,4
- NEURON PRA GANGLIONIK DAN PASCA GANGLIONIK SEPERTI PADA SARAF SIMPATIS.



Organ Efektor Sistem Saraf Parasimpatis

Respon fisiologis organ efektor

Organ efektor	Aktivasi Saraf	
	Simpatis	Parasimpatis
Denyut Jantung	Dipercepat	Diperlambat
Arteri koronari	Dilatasi	Konstriksi
Pembuluh darah perifer	Vasokonstriksi	Vasodilatasi
Tekanan Darah	Naik	Turun
Bronkus	Dilatasi	Kontsriksi
Kelenjar saliva	Sekresi ↓	Sekresi ↑
Kelenjar air mata	Sekresi ↓	Sekresi ↑
Pupil mata	Dilatasi	Kontraksi
Kelenjar keringat	Ekskresi ↓	Ekskresi ↑
Saluran cerna	Peristaltik ↓/ relaksasi	Peristaltik ↑/ kontraksi
Kelenjar saluran cerna	Sekresi ↓	Sekresi ↑

Neurotransmitor

- Nama lain: Transmitor kimia, neurohumoral
- Senyawa kimia yang berfungsi menghantarkan impuls saraf pada daerah sinaps
- Contoh: Asetilkolin (ACh) & Adrenalin = Epinefrin (Epi)

Saraf kolinergik dan adrenergik

- Saraf kolinergik: sistim saraf yang mensintesa dan menggunakan asetilkolin sebagai neurotransmiternya
- Saraf adrenergik : sistim saraf yang mensintesa dan menggunakan epinefrin sebagai neurotransmiternya

Saraf simpatis

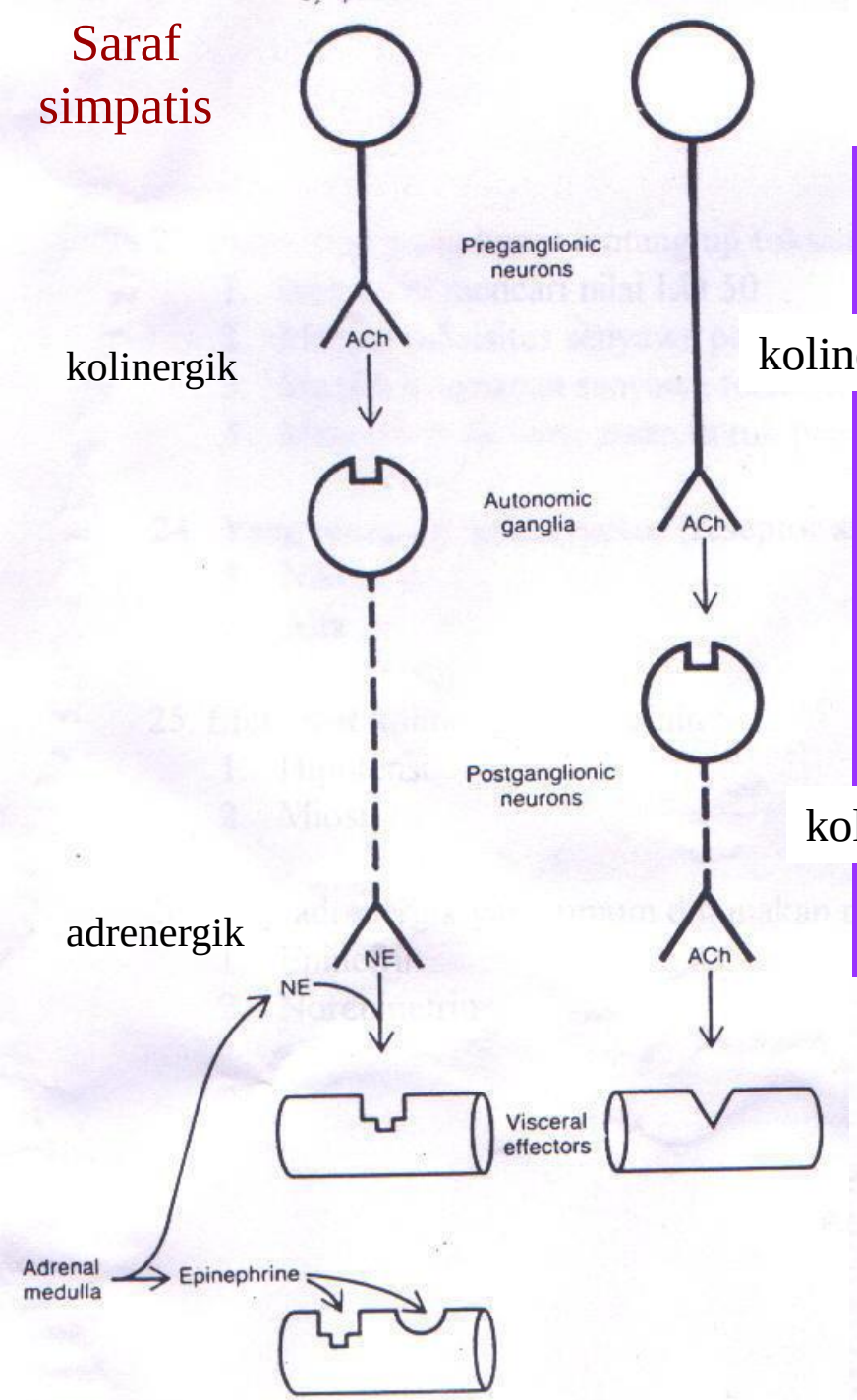
Saraf parasimpatis

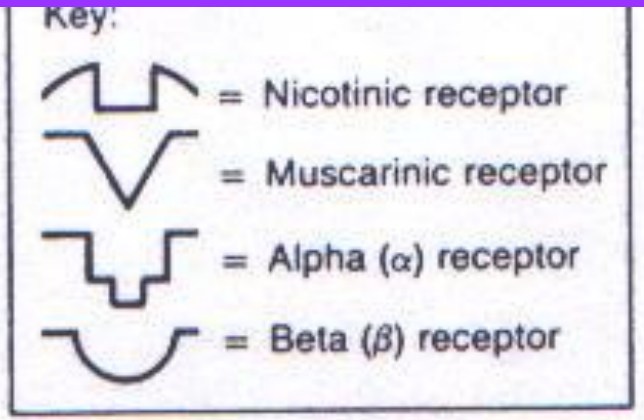
kolinergik

kolinergik

kolinergik

adrenergik





Reseptor Saraf Otonom

Saraf Kolinergik

- Muskarinik reseptor
- Nikotinik reseptor

Saraf adrenergik

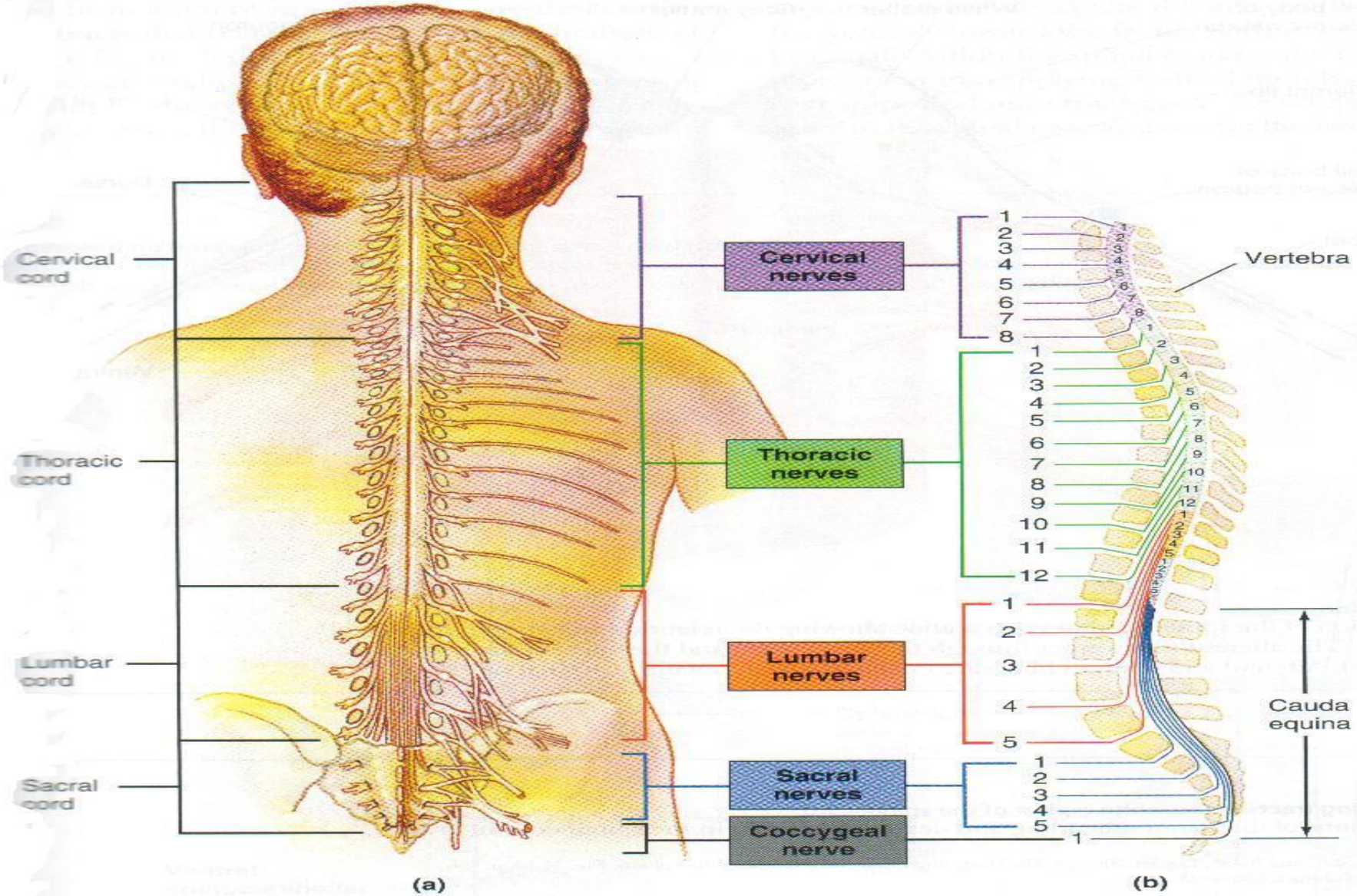
- Alfa reseptor : α_1 , α_2
- Beta reseptor : β_1 , β_2

Manfaat Mempelajari Sistim Saraf Otonom

- Dengan mengetahui efek hambatan atau stimulasi neurotransmitor pada organ efektor ----> target terapi suatu obat

SERABUT KOLINERGIK DAN ADRENERGIK

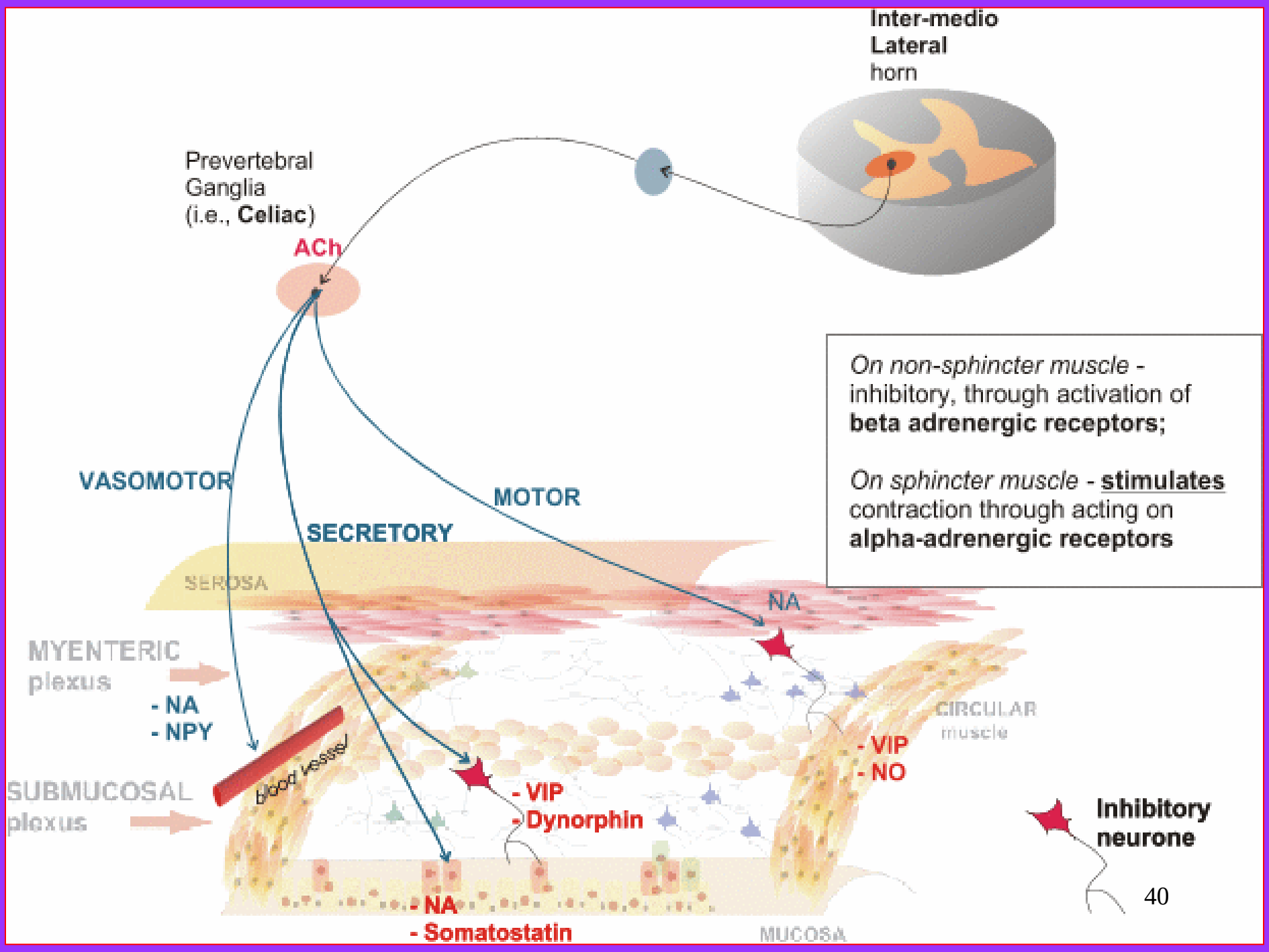
- NEURON PRA GANGLION SISTEM SIMPATIS DAN PARASIMPATIS SERTA NEURON PASCA GANGLION PARASIMPATIS MENSEKRESIKAN ASETIL KOLIN → KOLINERGIK
- SEBAGIAN BESAR NEURON PASCA GANGLION SIMPATIS MENSEKRESIKAN ADRENALIN → ADRENERGIK.
- RESEPTOR KOLINERGIK: MUSKARINIK (M) DAN NIKOTINIK (N).
- RESEPTOR ADRENERGIK: ALFA DAN BETA.
- HAMBATAN, STIMULASI NEUROTRANSMITER DPT DIMANFAATKAN SEBAGAI TARGET TERAPI



● FIGURE 5-28

Spinal nerves

There are 31 pairs of spinal nerves named according to the region of the vertebral column from which they emerge. Because the spinal cord is shorter than the vertebral column, spinal nerve roots must descend along the cord before emerging from the vertebral column at the corresponding intervertebral space, especially those beyond the level of the first lumbar vertebra (L1). Collectively these rootlets are called the cauda equina, literally "horse's tail." (a) Posterior view of the brain, spinal cord, and spinal nerves (on the right side only). (b) Lateral view of the spinal cord and spinal nerves emerging from the vertebral column.


Inter-medio
Lateral
horn
Prevertebral
Ganglia
(i.e., Celiac)
ACh
VASOMOTOR
MOTOR
SECRETORY
SEROSA
NA
MYENTERIC
plexus
- NA
- NPY
blood vessel
SUBMUCOSAL
plexus
- VIP
- Dynorphin
- VIP
- NO
CIRCULAR
muscle
- NA
- Somatostatin
MUCOSA
On non-sphincter muscle - inhibitory, through activation of beta adrenergic receptors;
On sphincter muscle - stimulates contraction through acting on alpha-adrenergic receptors
Inhibitory neurone

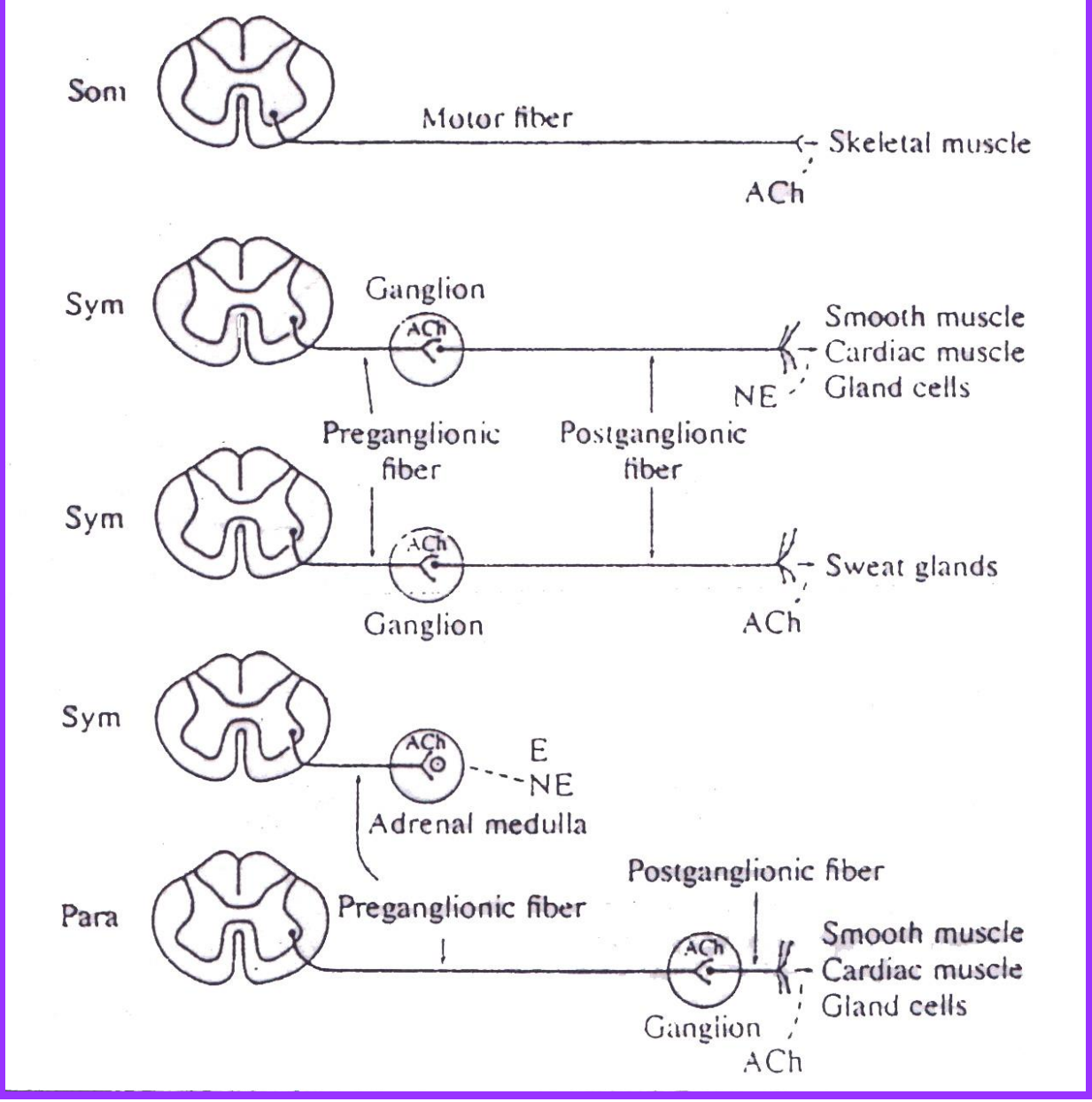


Figure 9-1. Anatomical and pharmacological characteristics of the somatic (Som), symphathetic (Sym), and parasympathetic (Para) divisions of the peripheral nervous systems. Ach = acetylcholine; E = epinephrine; NE = norepinephrine.

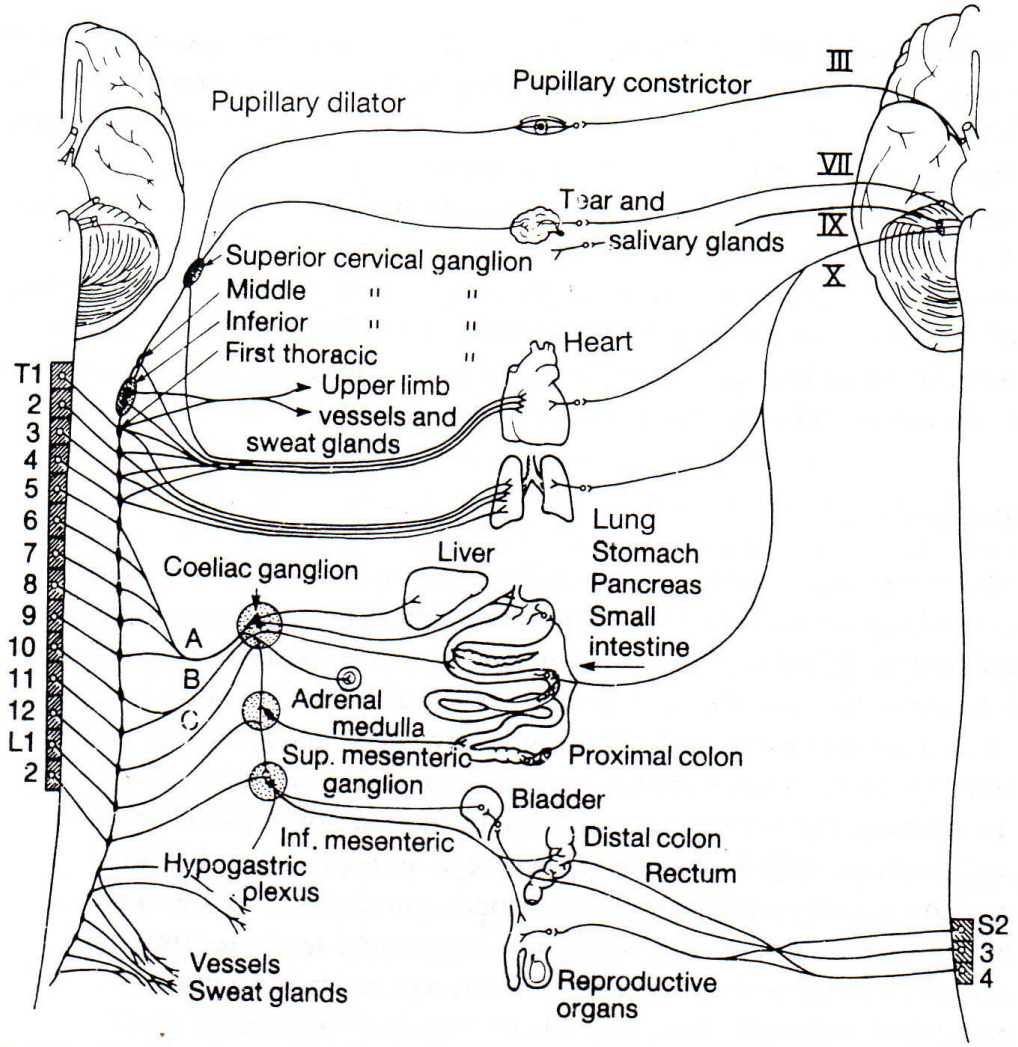
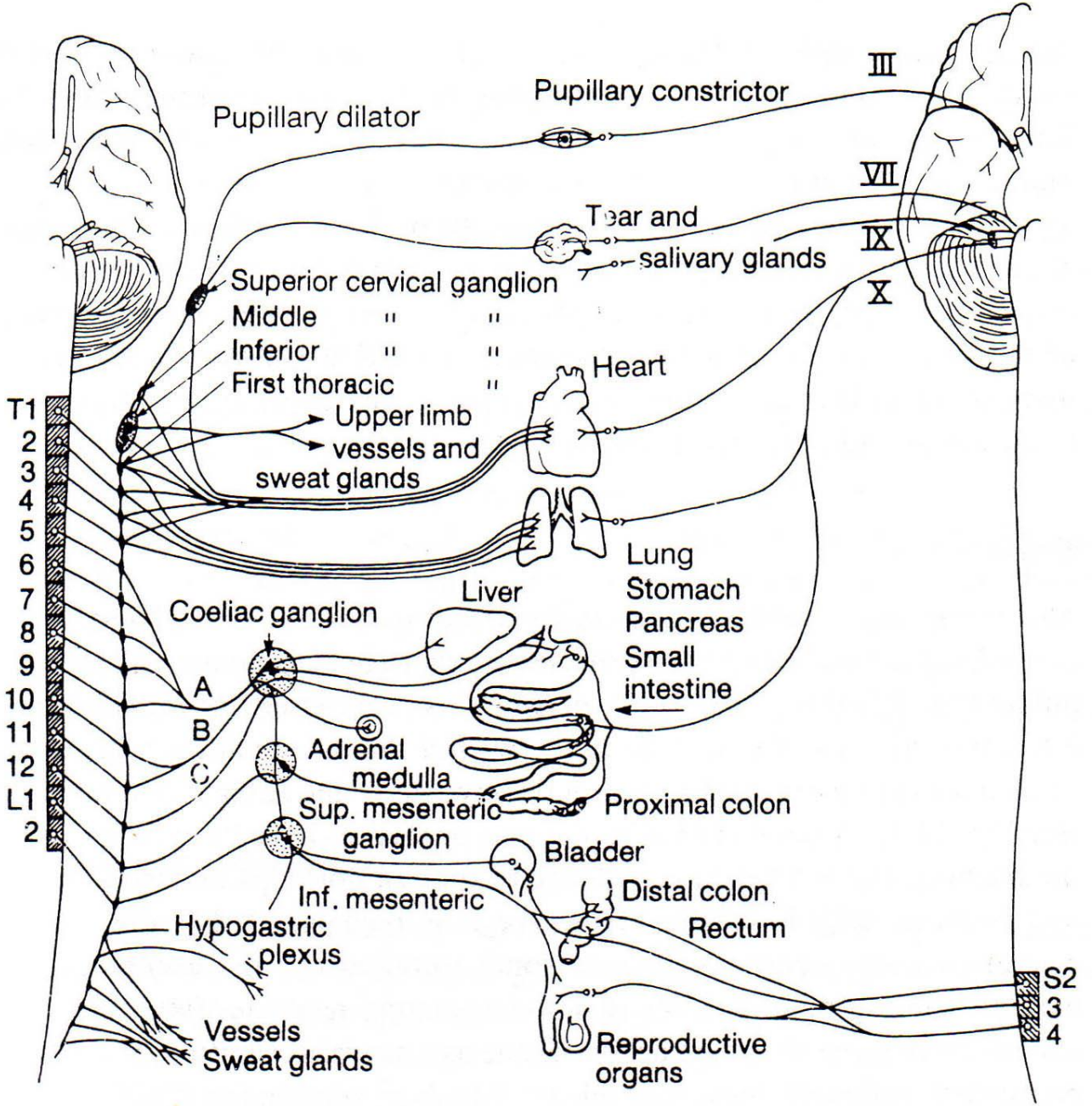


Fig. 2.21. Outflow of sympathetic (left) and parasympathetic (right) fibres.

Figure 2.21. Outflow of sympathetic (left) and parasumphatetic (right) fibers.



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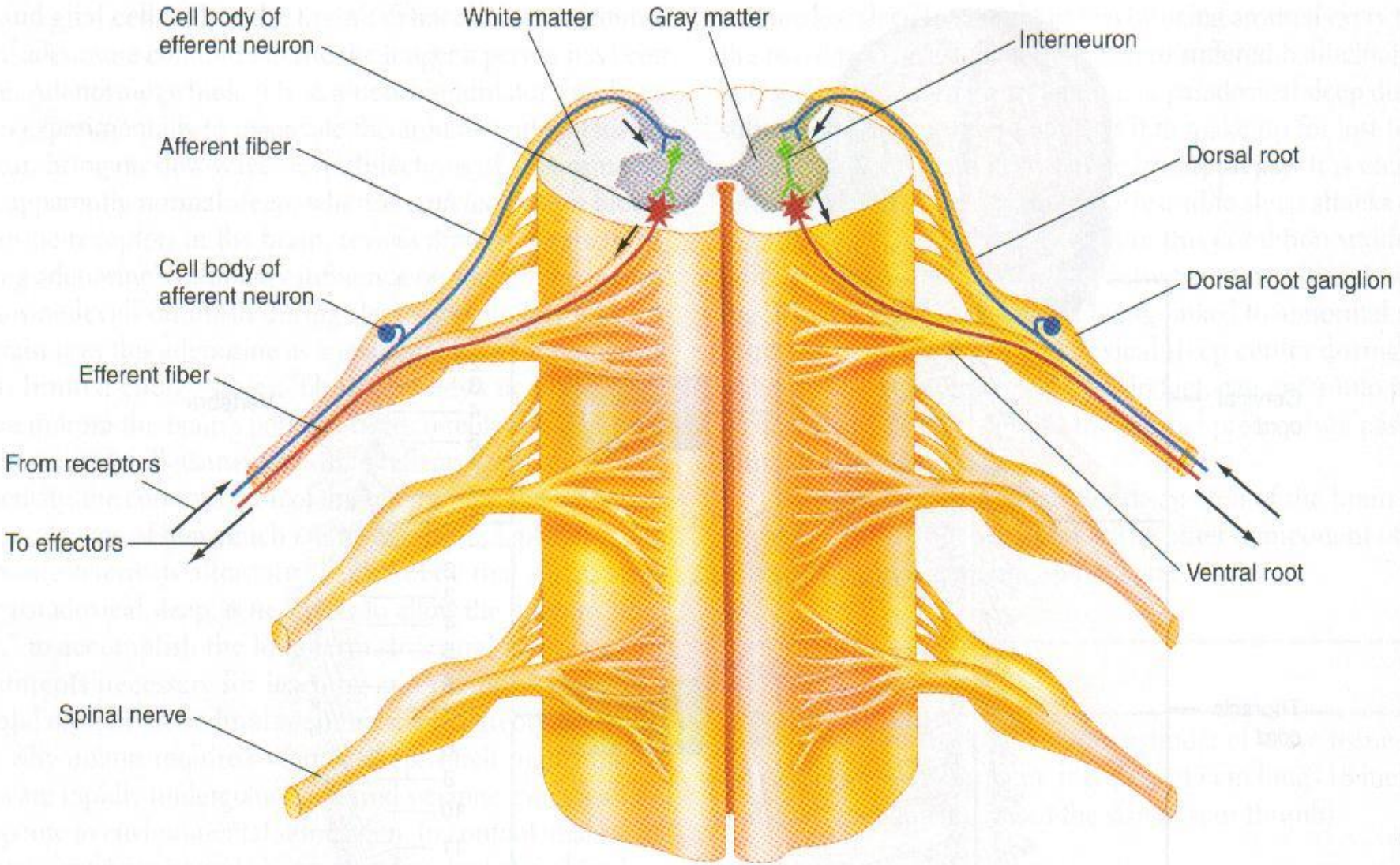

● FIGURE 5-29

Spinal cord in cross section

Schematic representation of the spinal cord in cross section showing the relationship between the spinal cord and spinal nerves. The afferent fibers enter through the dorsal root, and the efferent fibers exit through the ventral root. Afferent and efferent fibers are enclosed together within a spinal nerve.