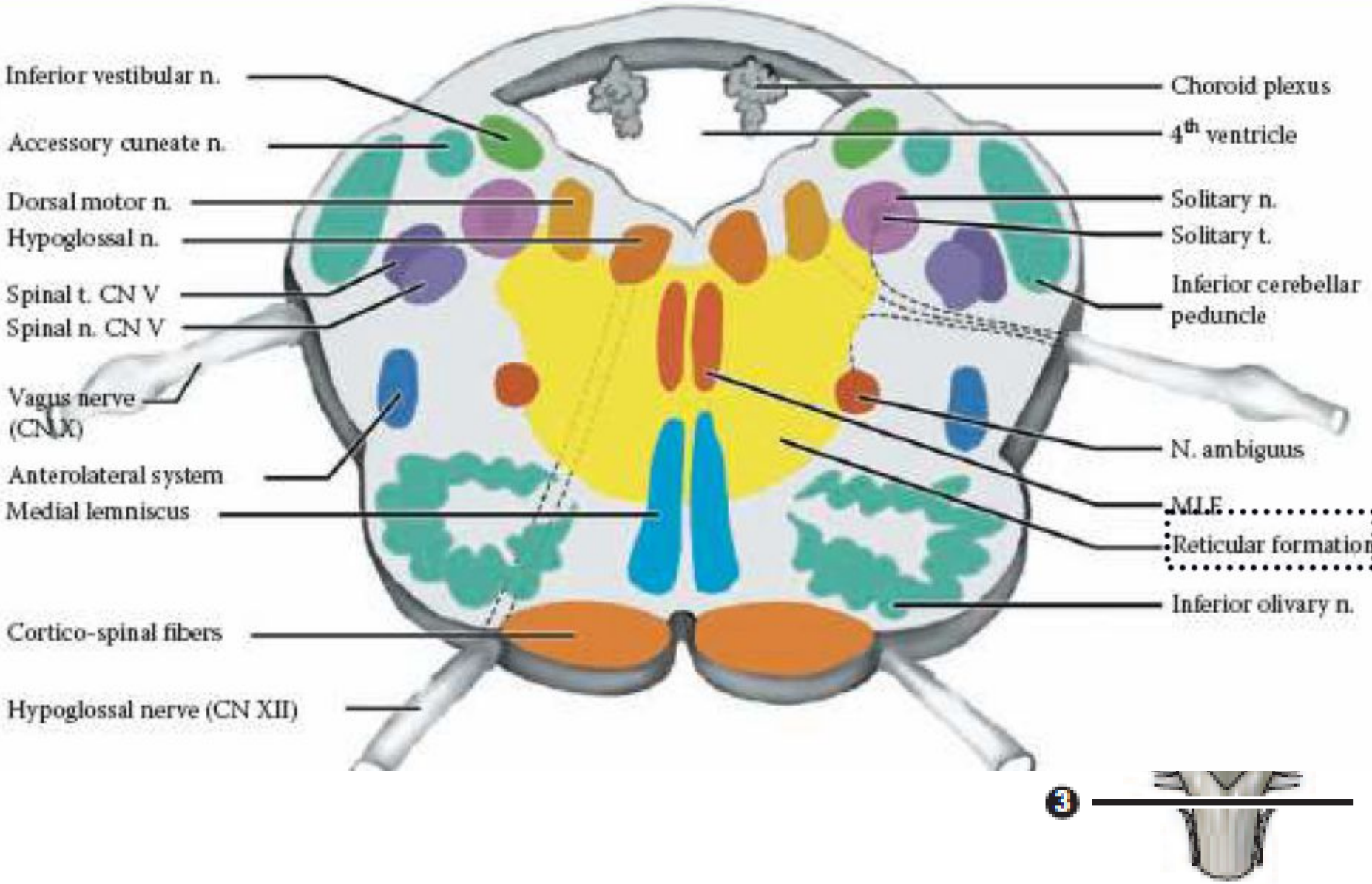
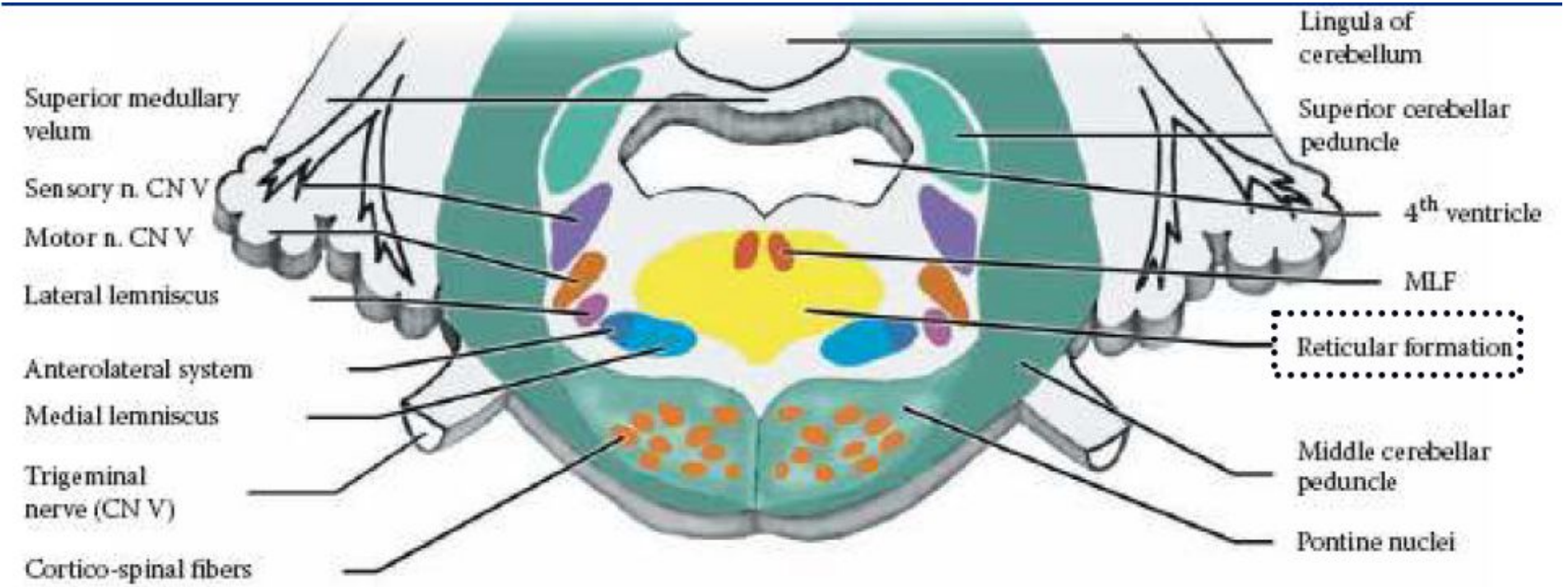
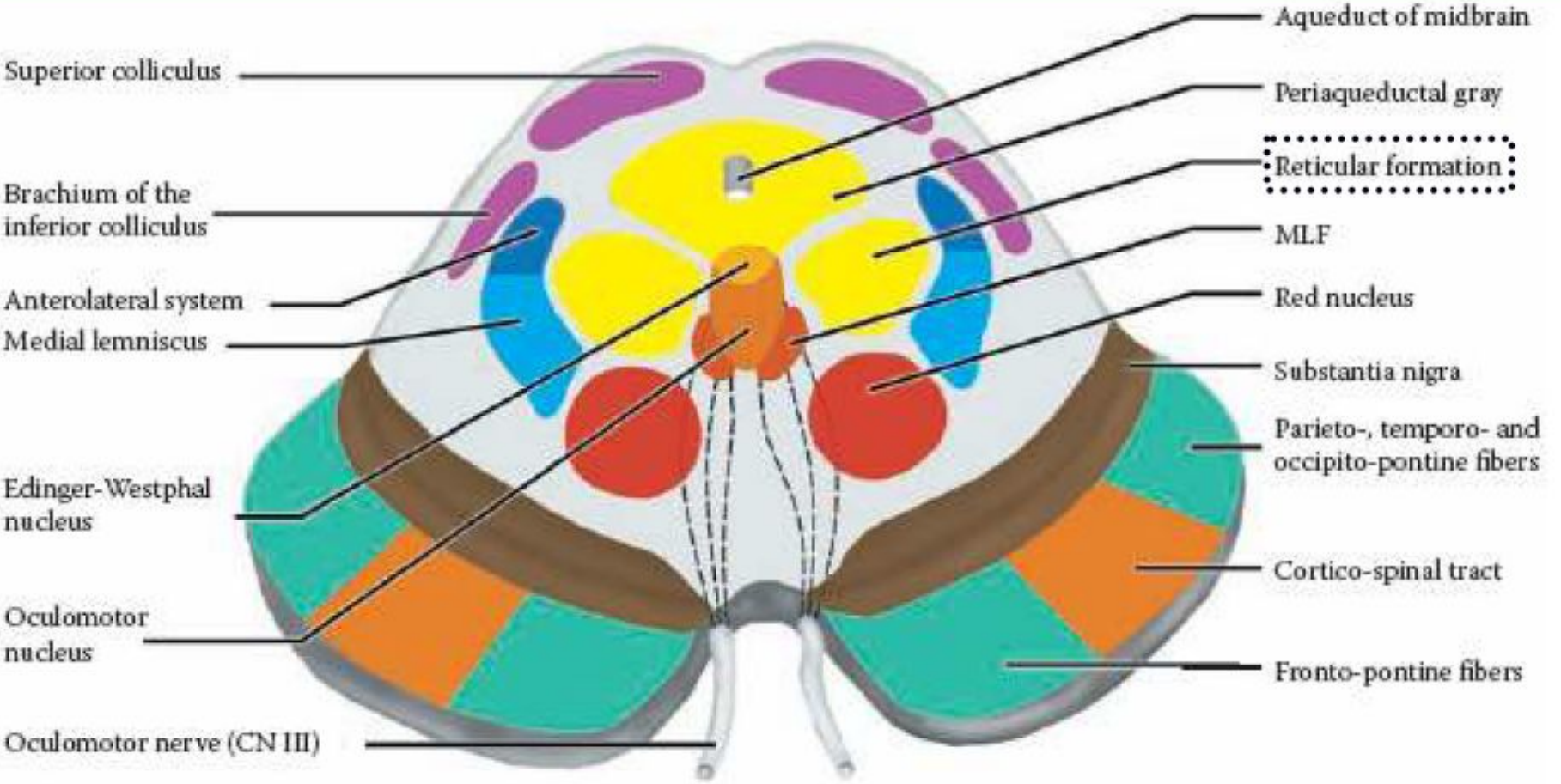
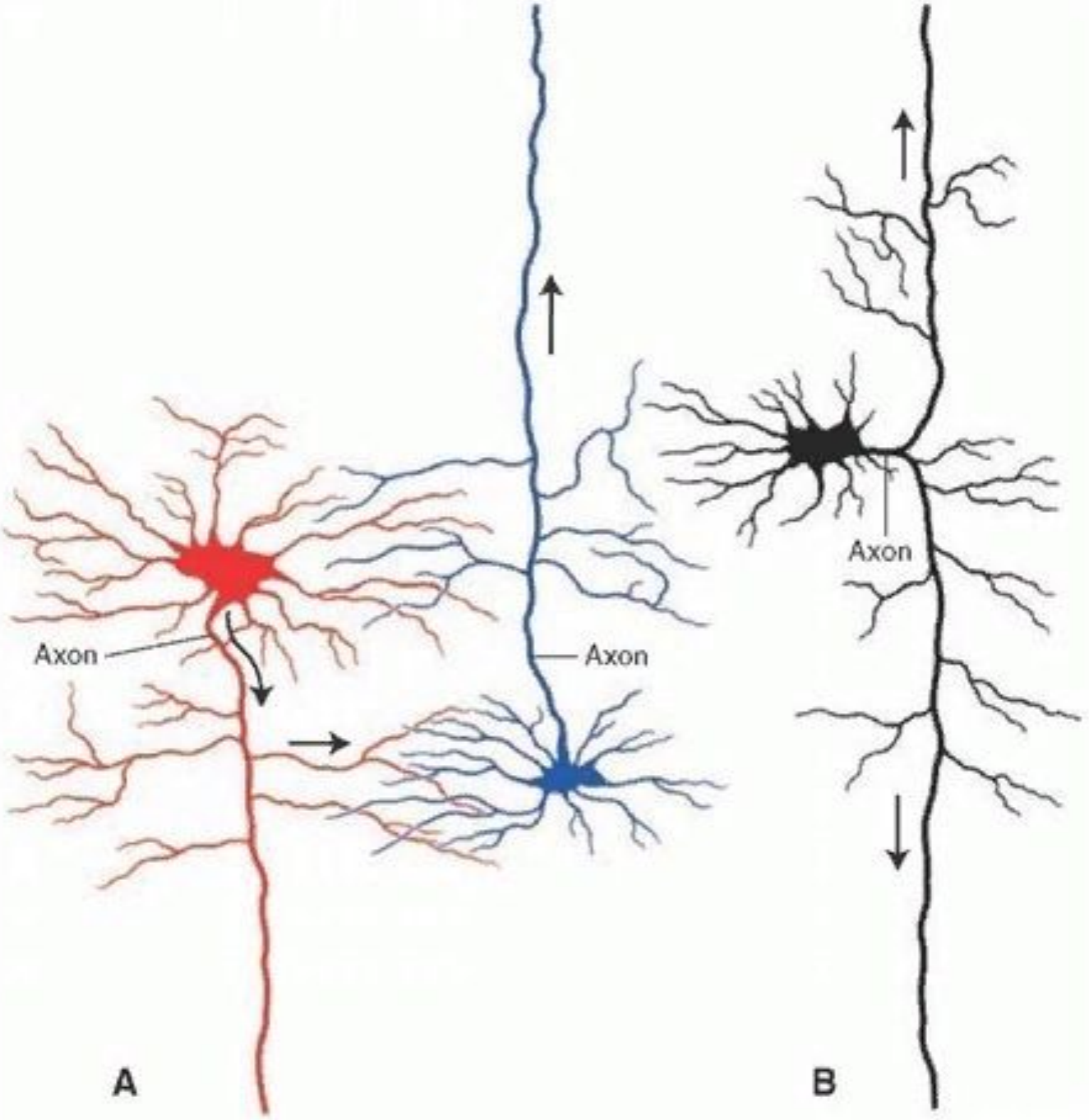
Физиология ретикулярной формации. Мозжечок, базальные ядра

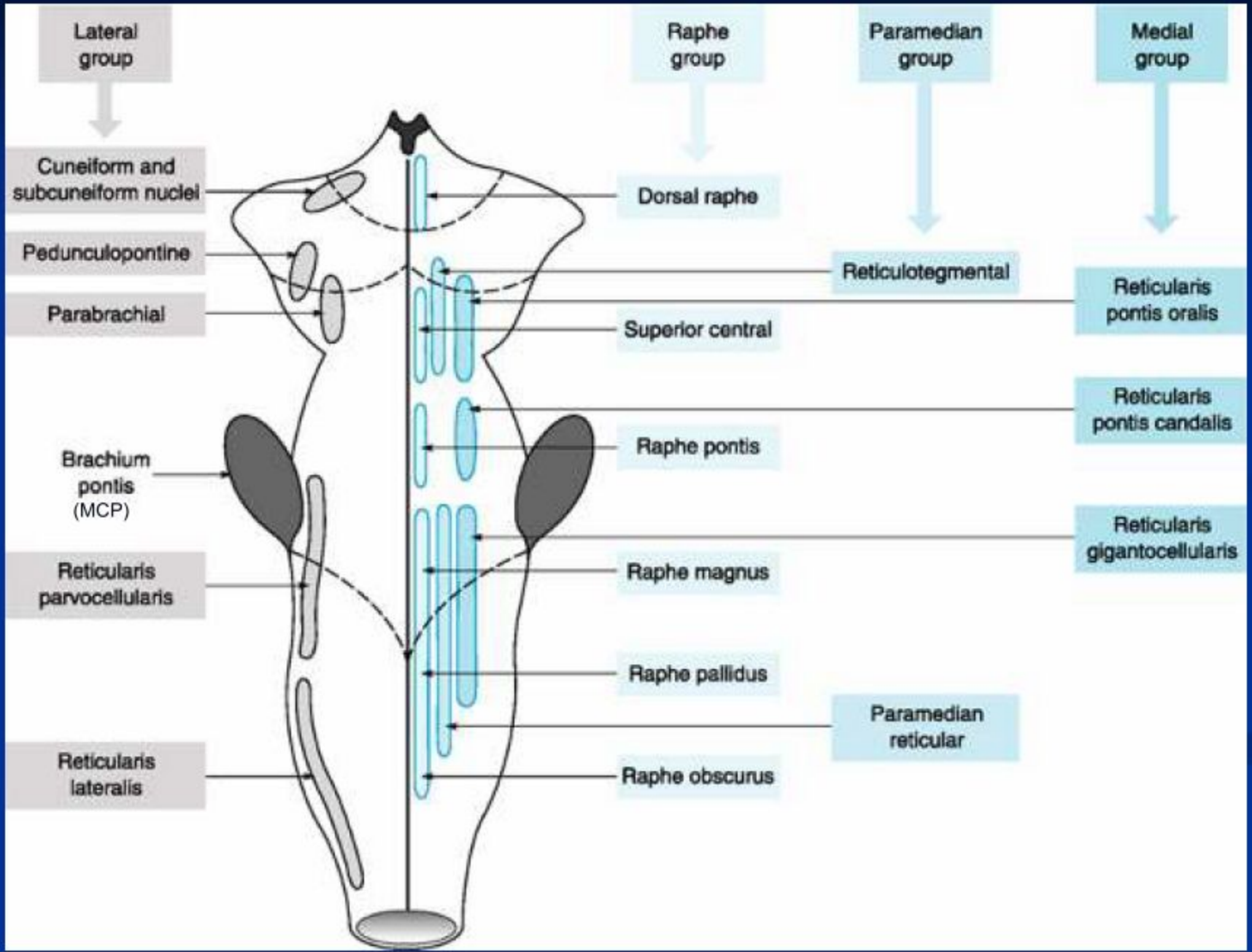

Inferior vestibular n.
Accessory cuneate n.
Dorsal motor n.
Hypoglossal n.
Spinal t. CN V
Spinal n. CN V
Vagus nerve (CN X)
Anterolateral system
Medial lemniscus
Cortico-spinal fibers
Hypoglossal nerve (CN XII)
Choroid plexus
4th ventricle
Solitary n.
Solitary t.
Inferior cerebellar peduncle
N. ambiguus
M.L.F.
Reticular formation
Inferior olivary n.
3


Lingula of cerebellum
Superior medullary velum
Superior cerebellar peduncle
Sensory n. CN V
4th ventricle
Motor n. CN V
MLF
Lateral lemniscus
Reticular formation
Anterolateral system
Medial lemniscus
Middle cerebellar peduncle
Trigeminal nerve (CN V)
Pontine nuclei
Cortico-spinal fibers

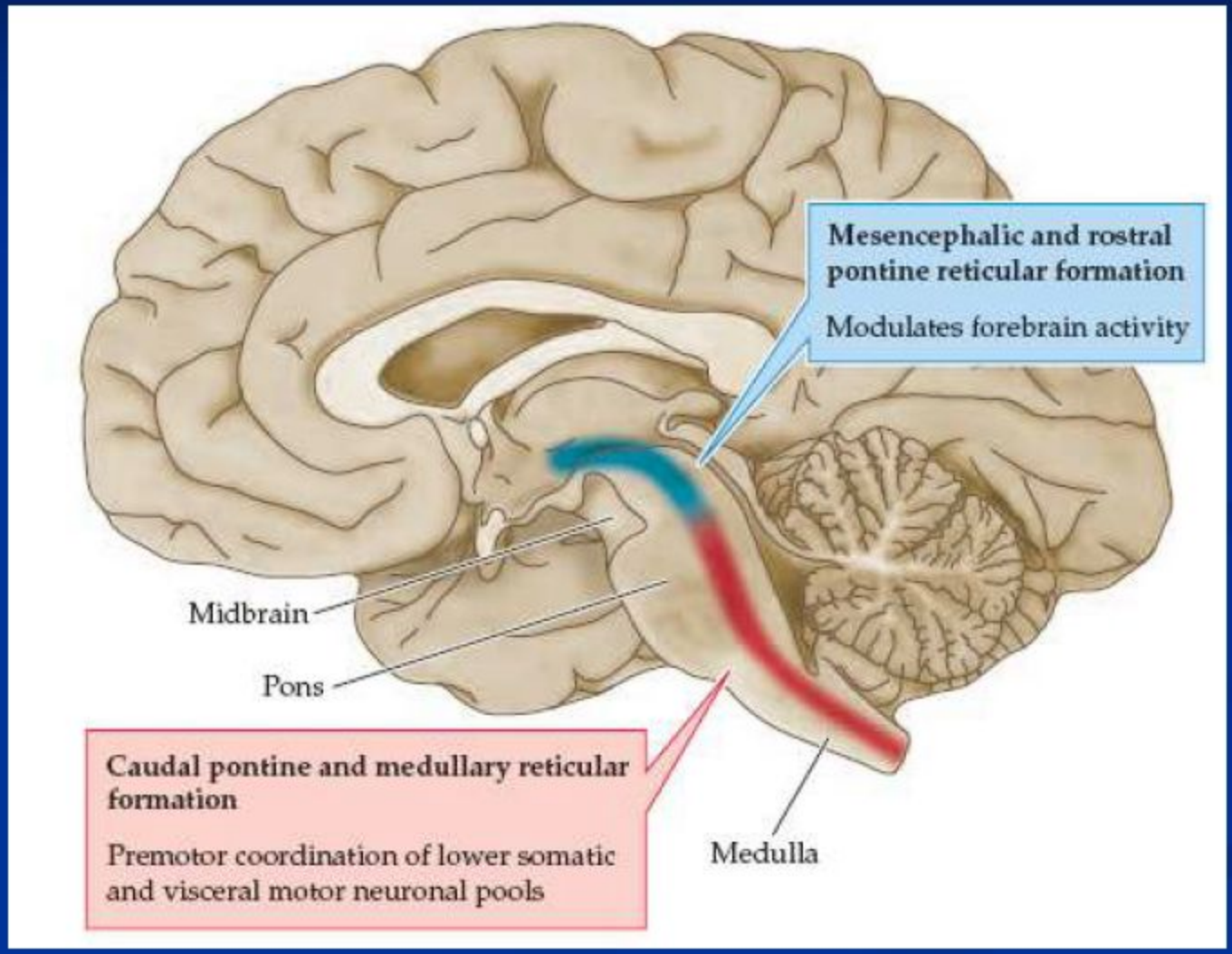

Superior colliculus
Brachium of the inferior colliculus
Anterolateral system
Medial lemniscus
Edinger-Westphal nucleus
Oculomotor nucleus
Oculomotor nerve (CN III)
Aqueduct of midbrain
Periaqueductal gray
Reticular formation
MLF
Red nucleus
Substantia nigra
Parieto-, temporo- and occipito-pontine fibers
Cortico-spinal tract
Fronto-pontine fibers


Axon
Axon
Axon
A
B

Reticular nuclei

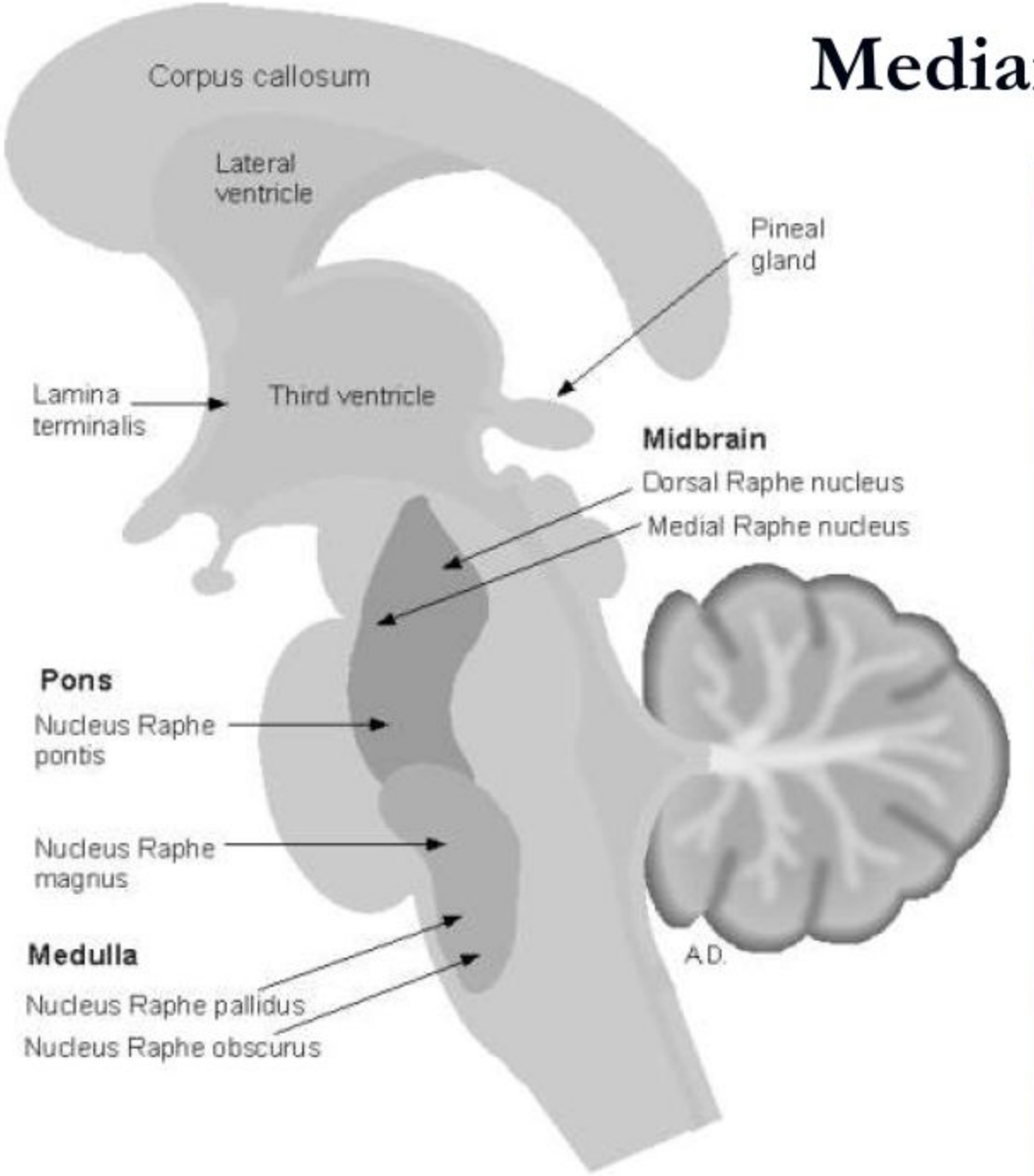


Reticular formation – summary of functions



Purves, et al, Neuroscience, 3rd ed.

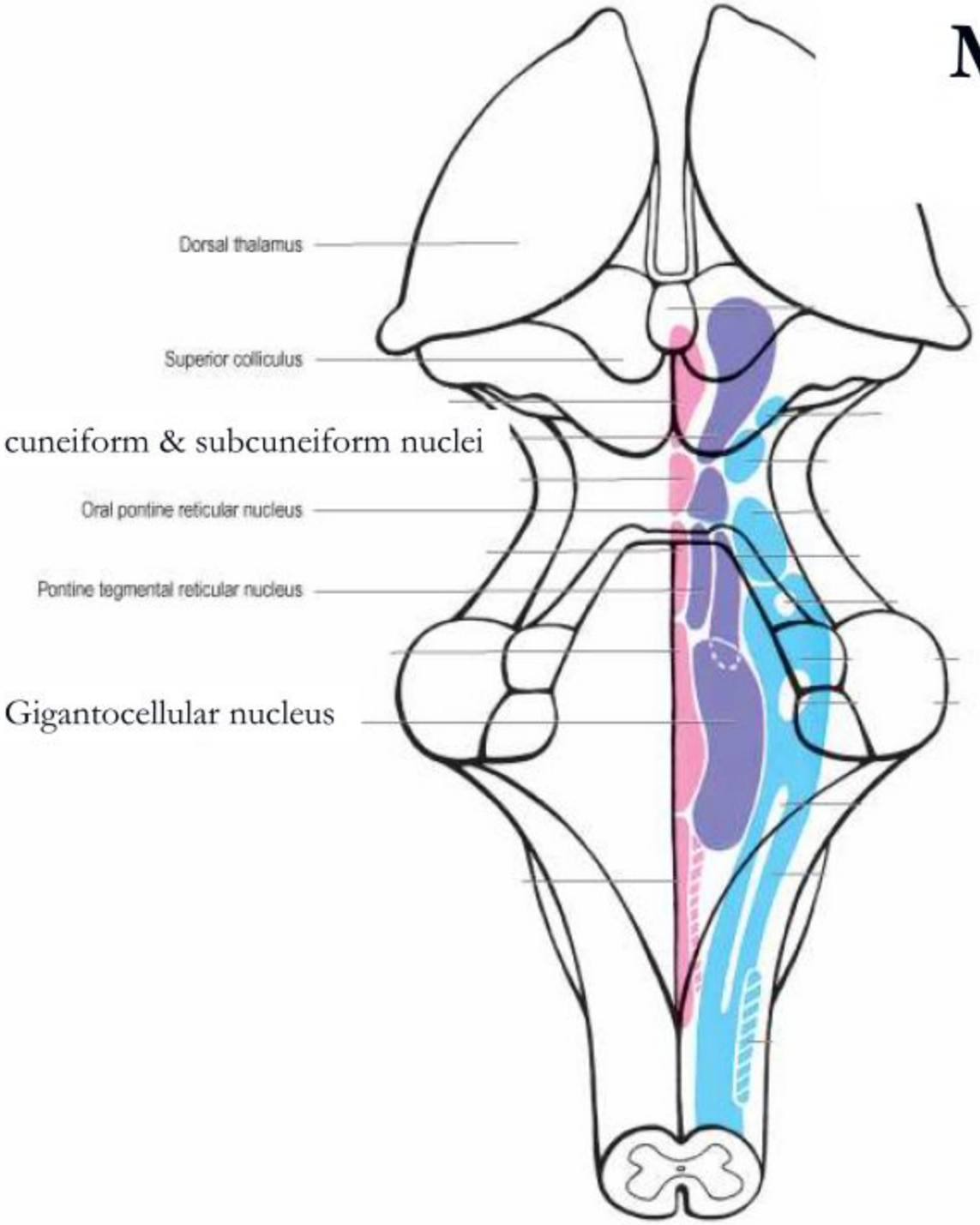
Median raphe nuclei



rostral raphe nuclei → reticular activating system (wakefulness, alertness, and sleep)

caudal raphe nuclei → pain mechanisms

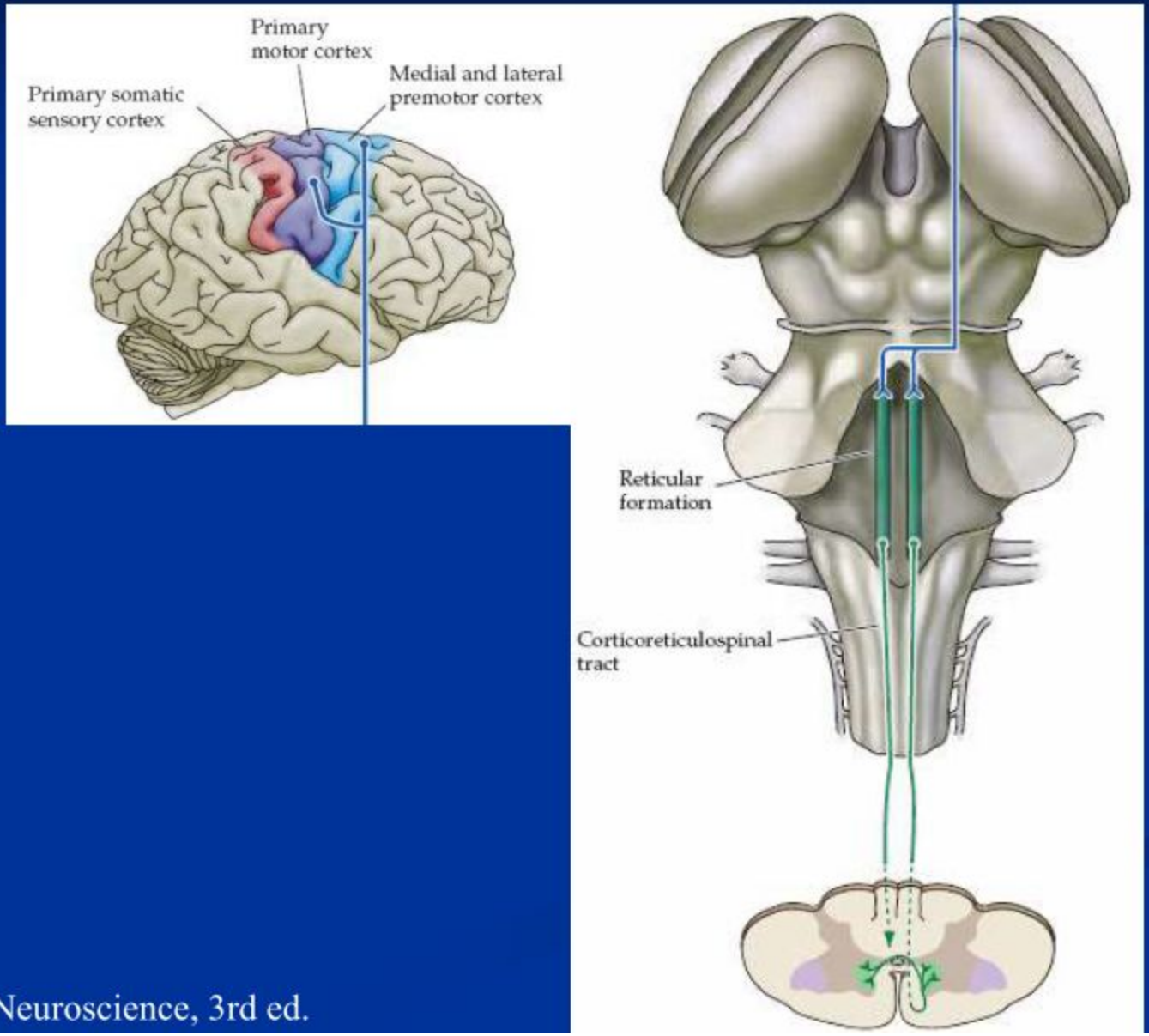
Medial reticular nuclei



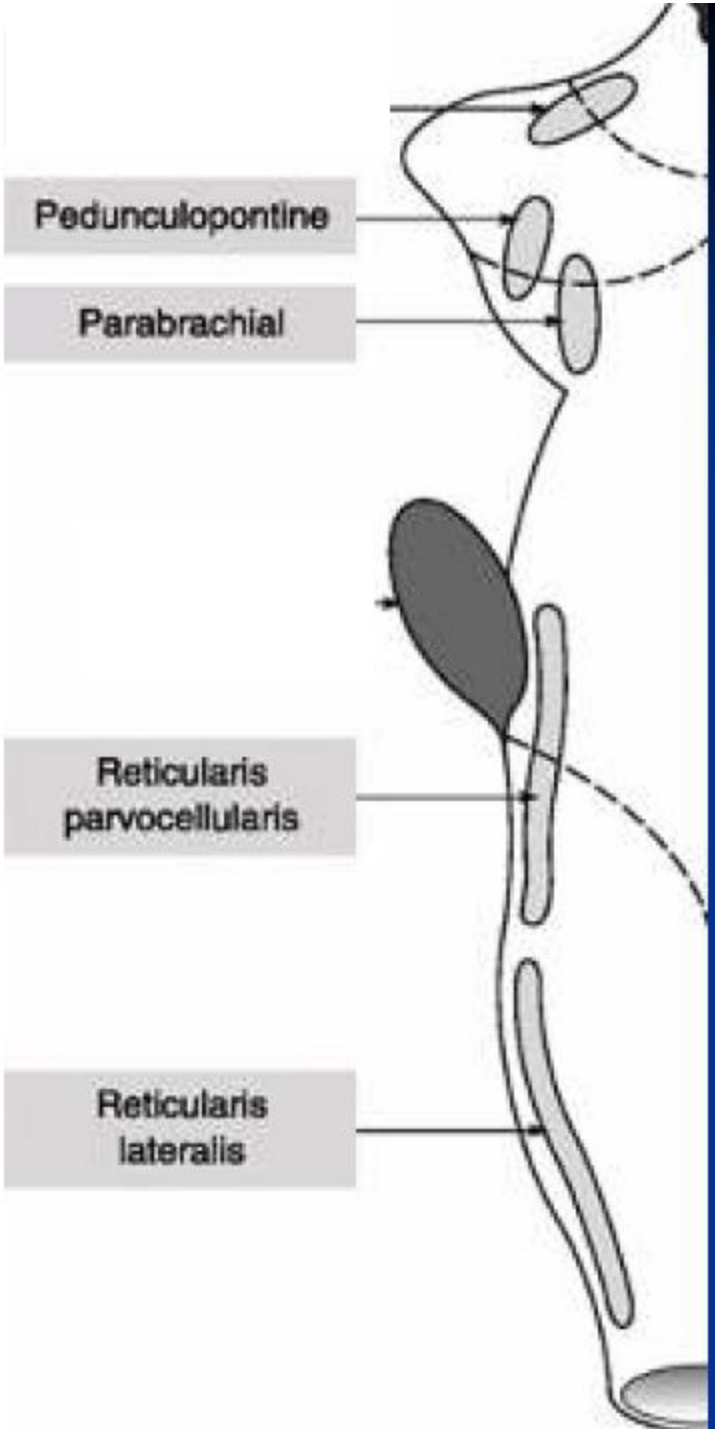
ascending projections → consciousness and alertness

descending projections → motor control

Premotor cortex regulates posture via the reticular formation



Purves, et al, Neuroscience, 3rd ed.

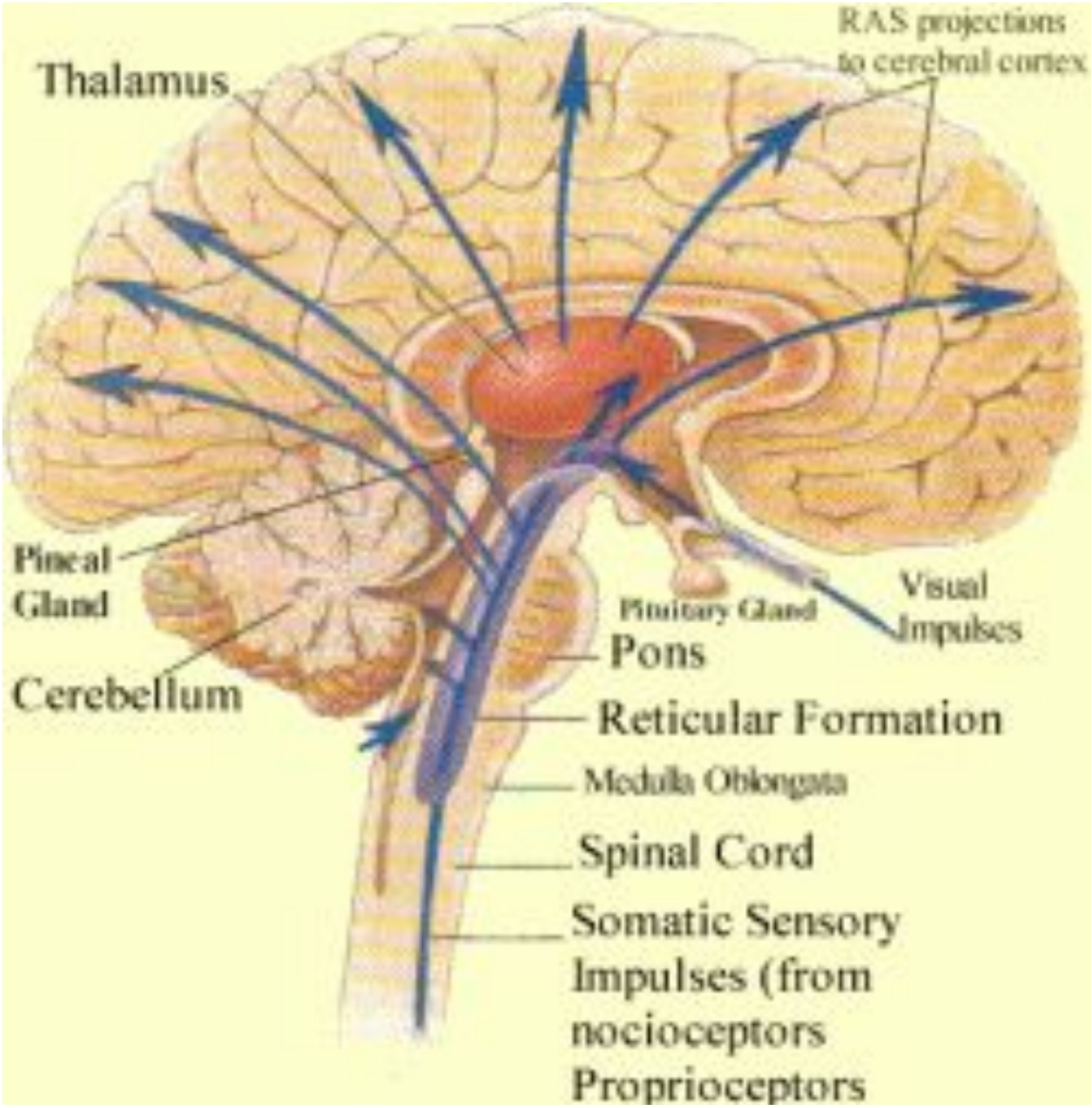


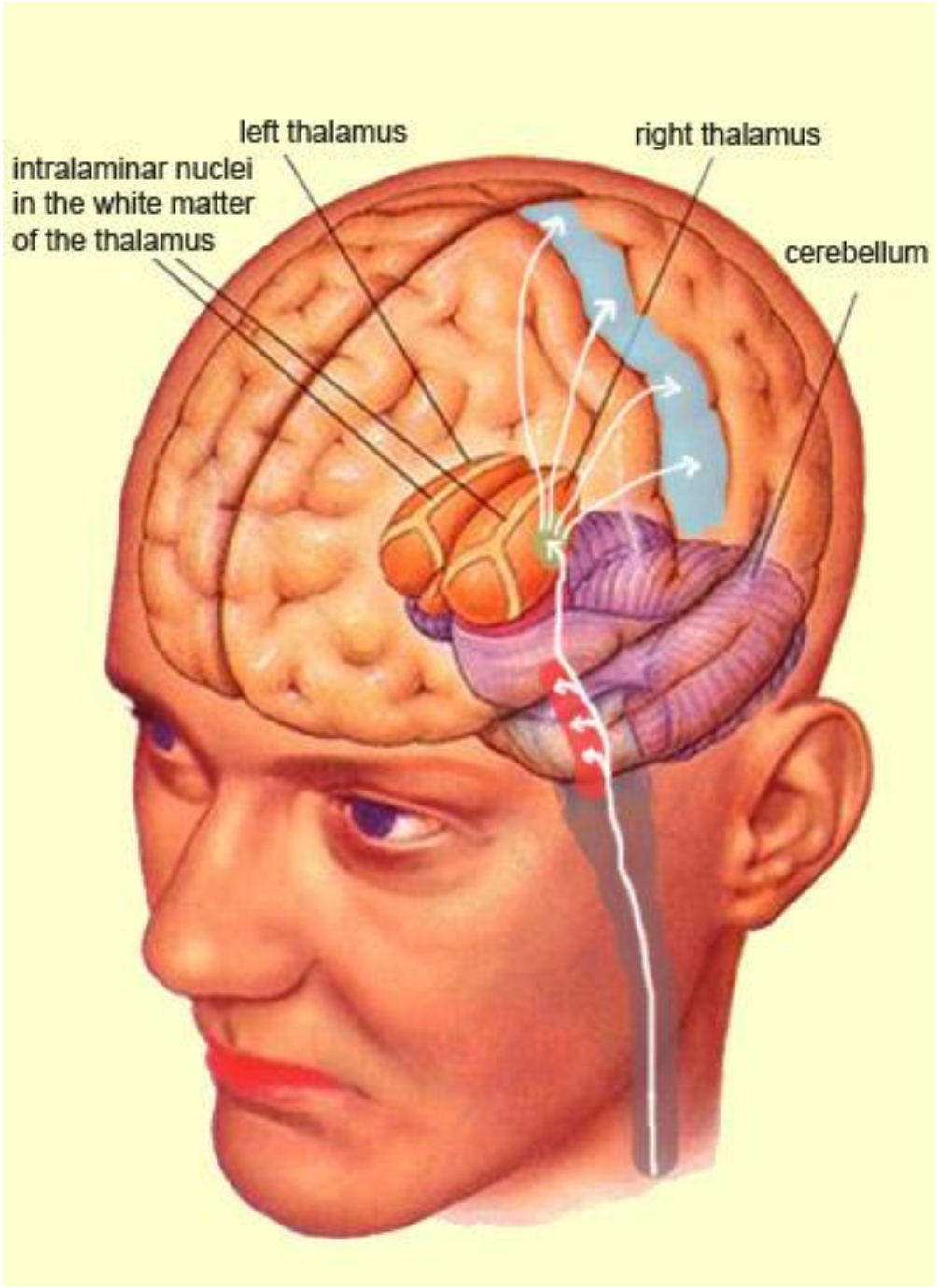
Lateral reticular nuclei

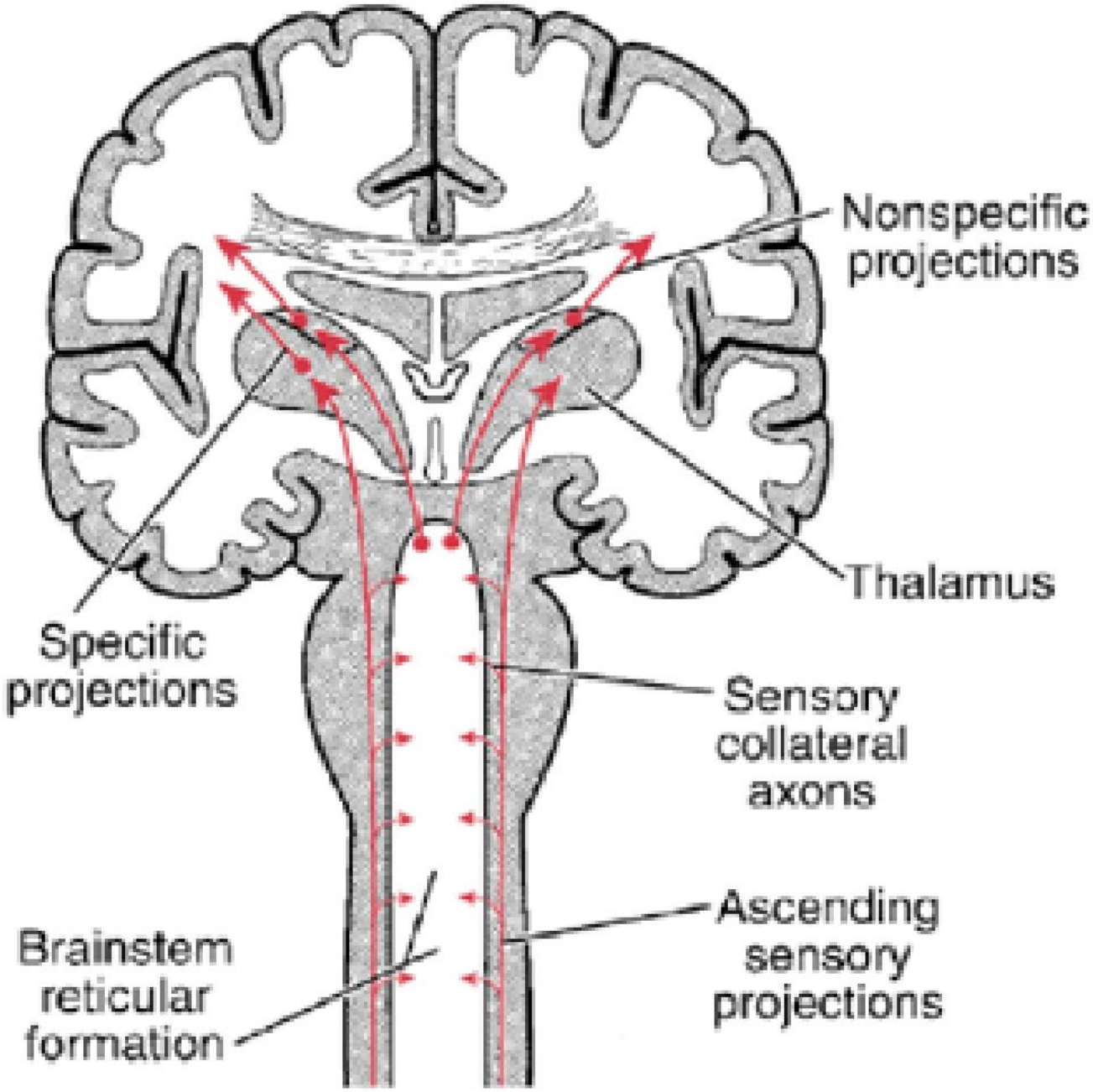
- Pedunculopontine – connections with cortex & substantia nigra → locomotor center
- Parabrachial nucleus – connections with amygdala, nucleus solitarius, hypothalamus → autonomic function
- N. parvocellularis and lateralis constitute the receptive component of reticular nuclei – receive from ascending sensory systems, project to cortex & medial reticular group

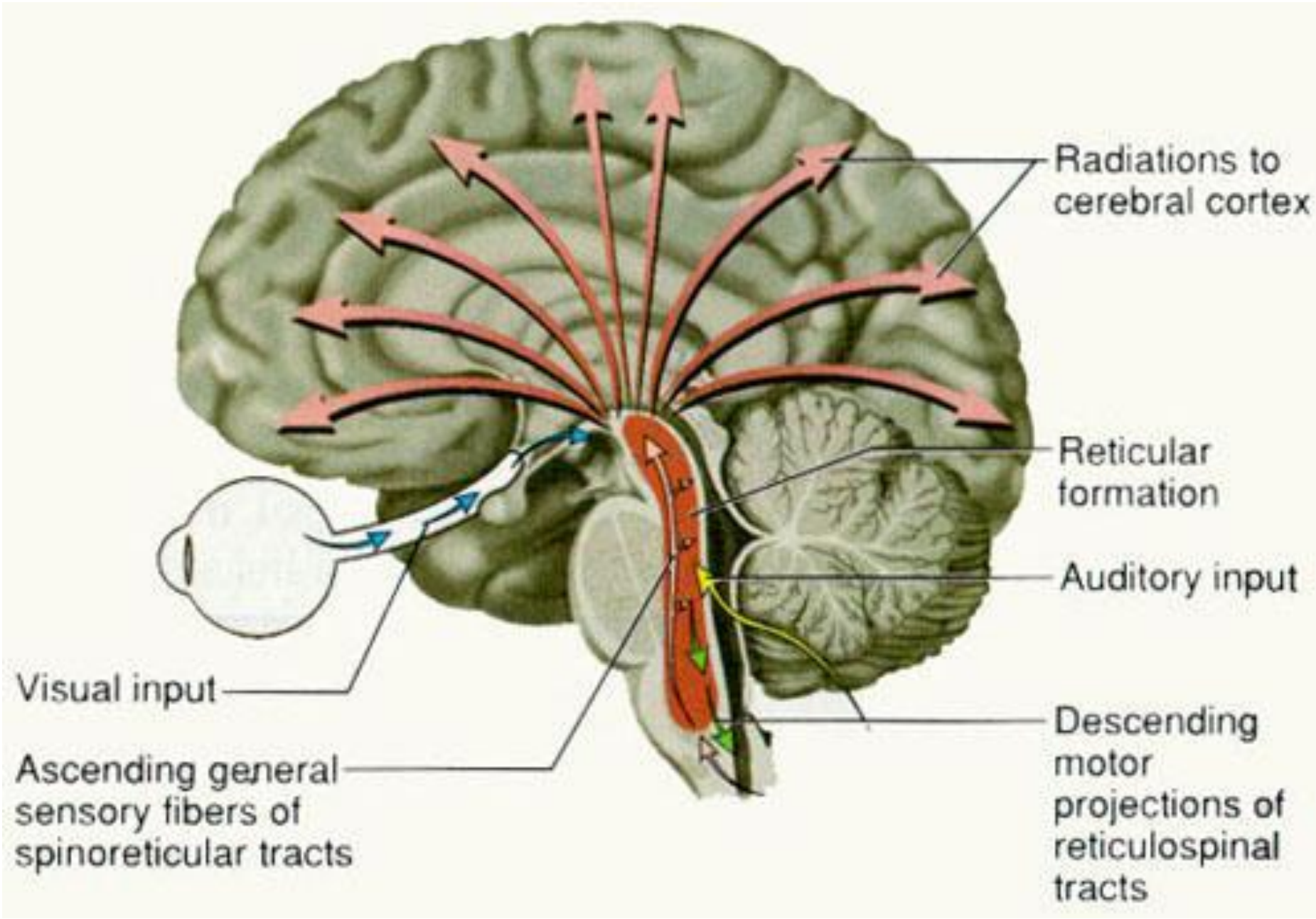
Chemically specified systems of the reticular formation

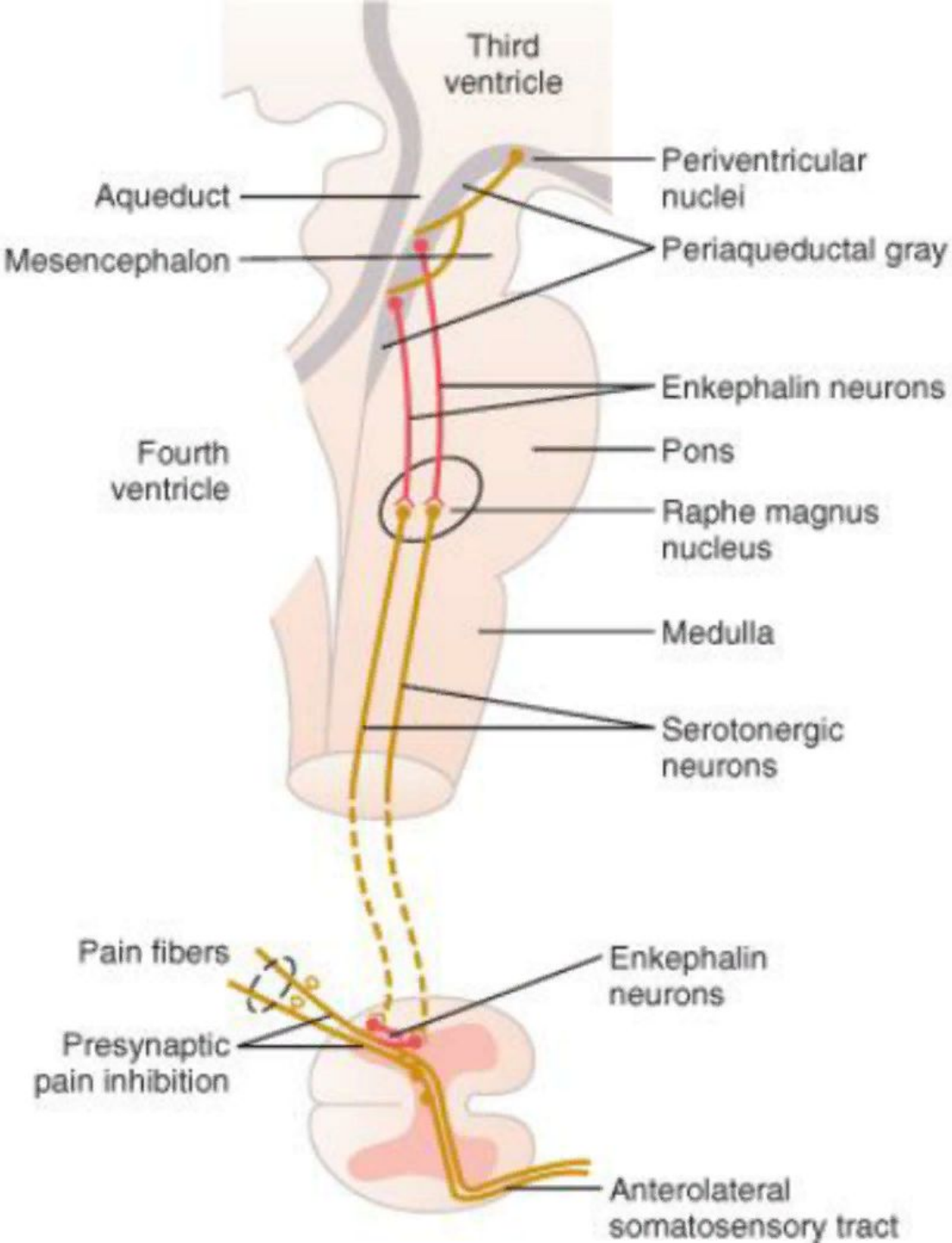
- **Cholinergic** system (groups Ch1-Ch6) - Ach
  - Locations
    - ✓ pontomesencephalic junction – e.g. pedunculopontine nucleus
    - ✓ basal forebrain - nucleus basalis of Meynert
  - Function - cortical arousal - wakefulness and REM sleep
- **Monoaminergic** System – NE, E, Ser, Dop
  - Serotonergic neurons (groups B1 to B9) – most median raphe nuclei → destruction of these neurons leads to insomnia; mood regulation
  - Noradrenergic neurons - attention, sleep-wake state and mood
    - ✓ locus ceruleus (group A6); (Latin, "dark blue place")
    - ✓ lateral tegmental norepinephrine system (groups A1 to A7)
  - Adrenergic neurons (groups C1-C2)- a minor component of the monoaminergic system
  - Dopaminergic neurons – most are in the midbran (ventral tegmental area)
    - ✓ mesostriatal (= nigrostriatal) pathway – to substantia nigra → PD!!!
    - ✓ mesolimbic pathway – to the limbic system → overactivity in schizophrenia
    - ✓ mesocortical – to prefrontal cortex → cognitive deficits in PD

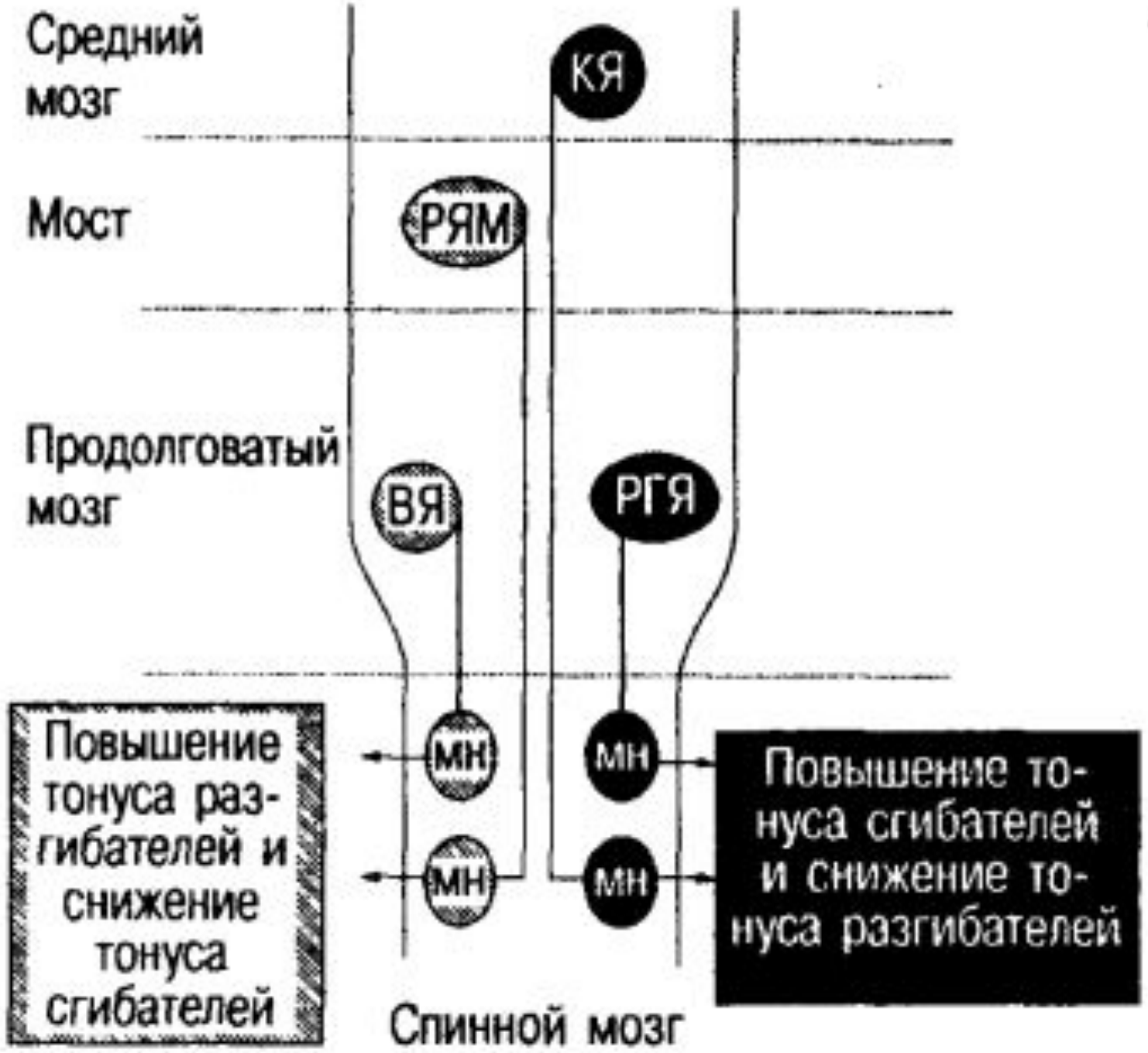

RAS projections
to cerebral cortex
Thalamus
Pineal
Gland
Cerebellum
Pituitary Gland
Visual
Impulses
Pons
Reticular Formation
Medulla Oblongata
Spinal Cord
Somatic Sensory
Impulses (from
nocioceptors
Proprioceptors

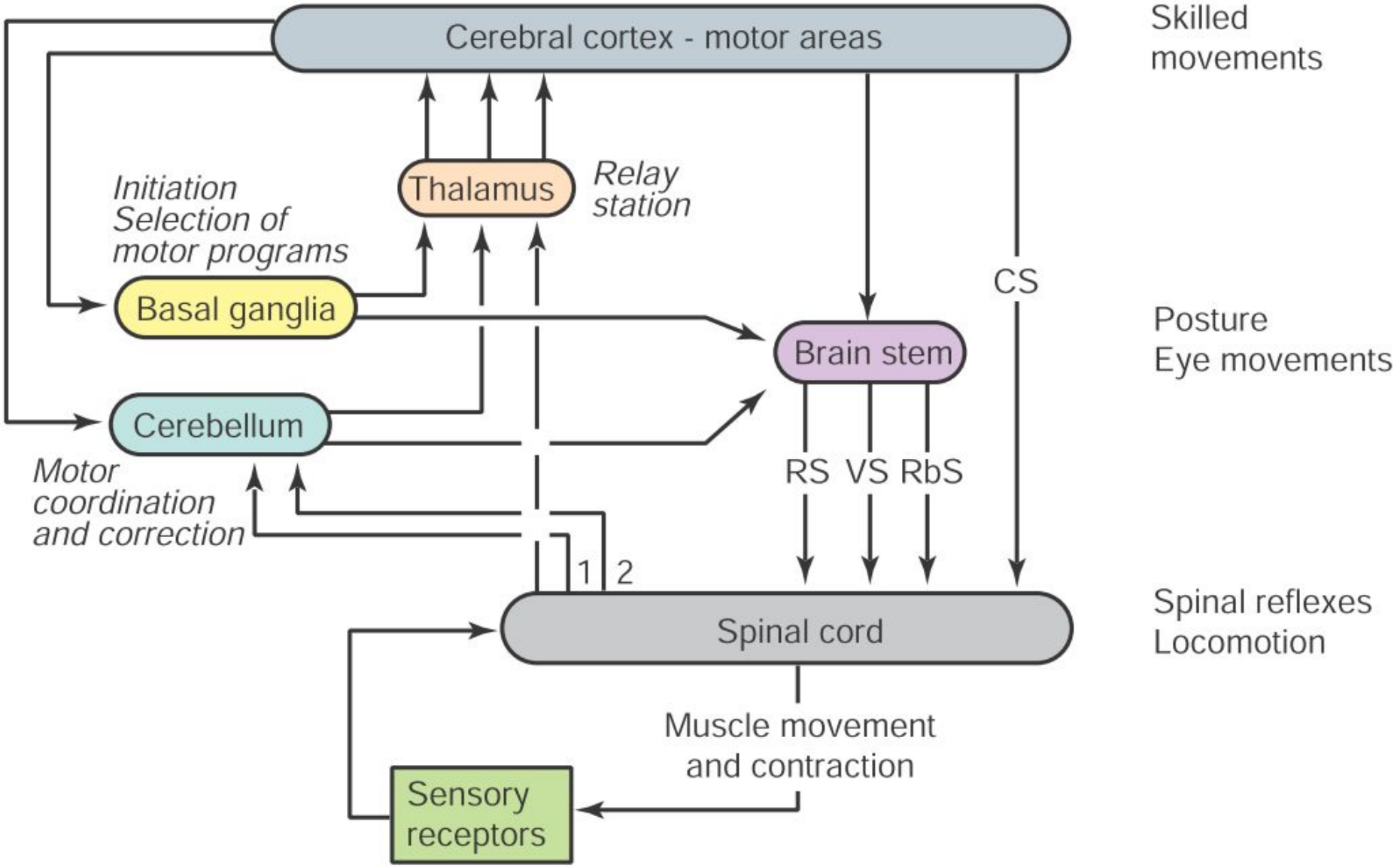

left thalamus
right thalamus
intralaminar nuclei
in the white matter
of the thalamus
cerebellum

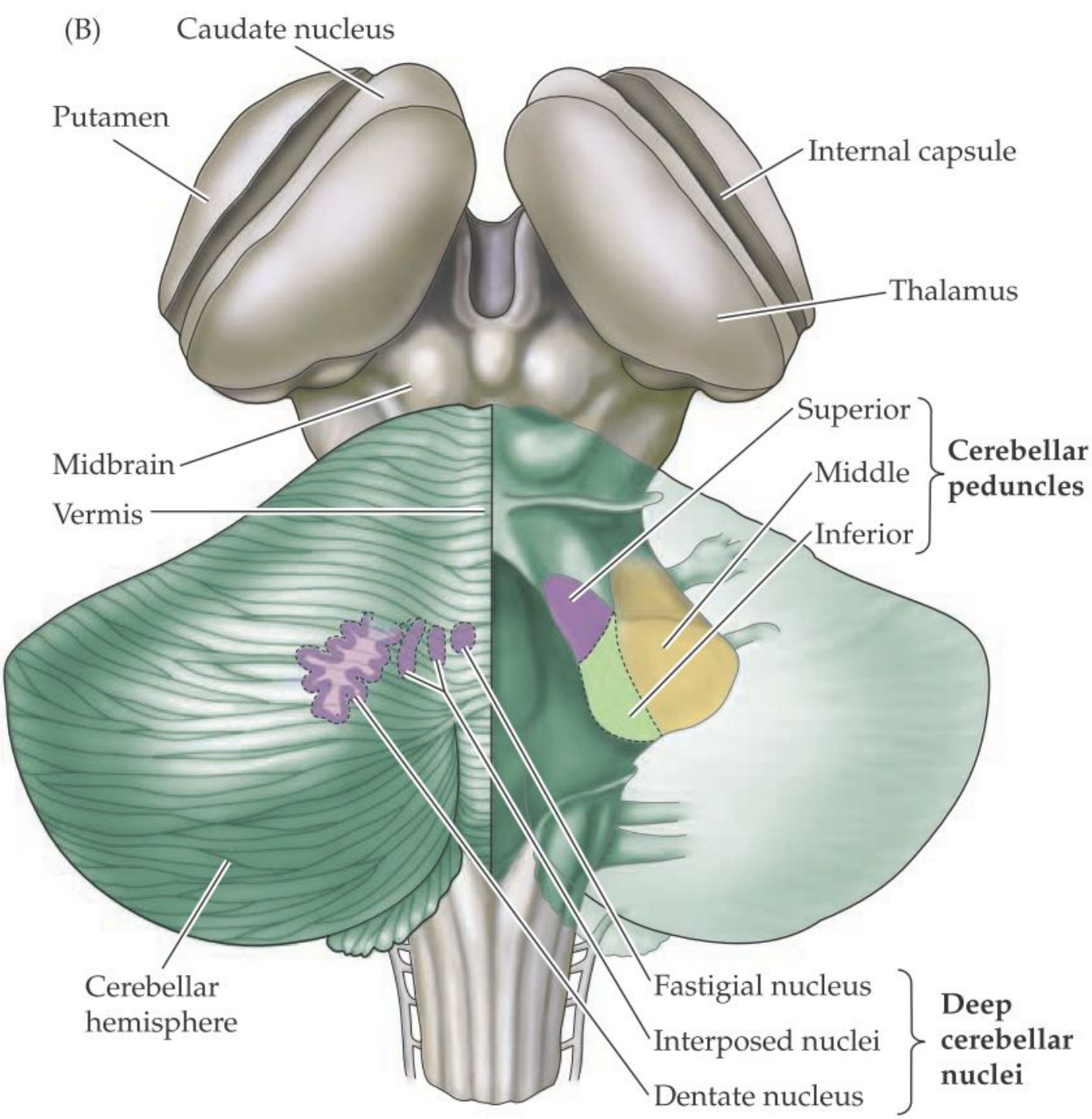

Nonspecific projections
Thalamus
Specific projections
Sensory collateral axons
Ascending sensory projections
Brainstem reticular formation

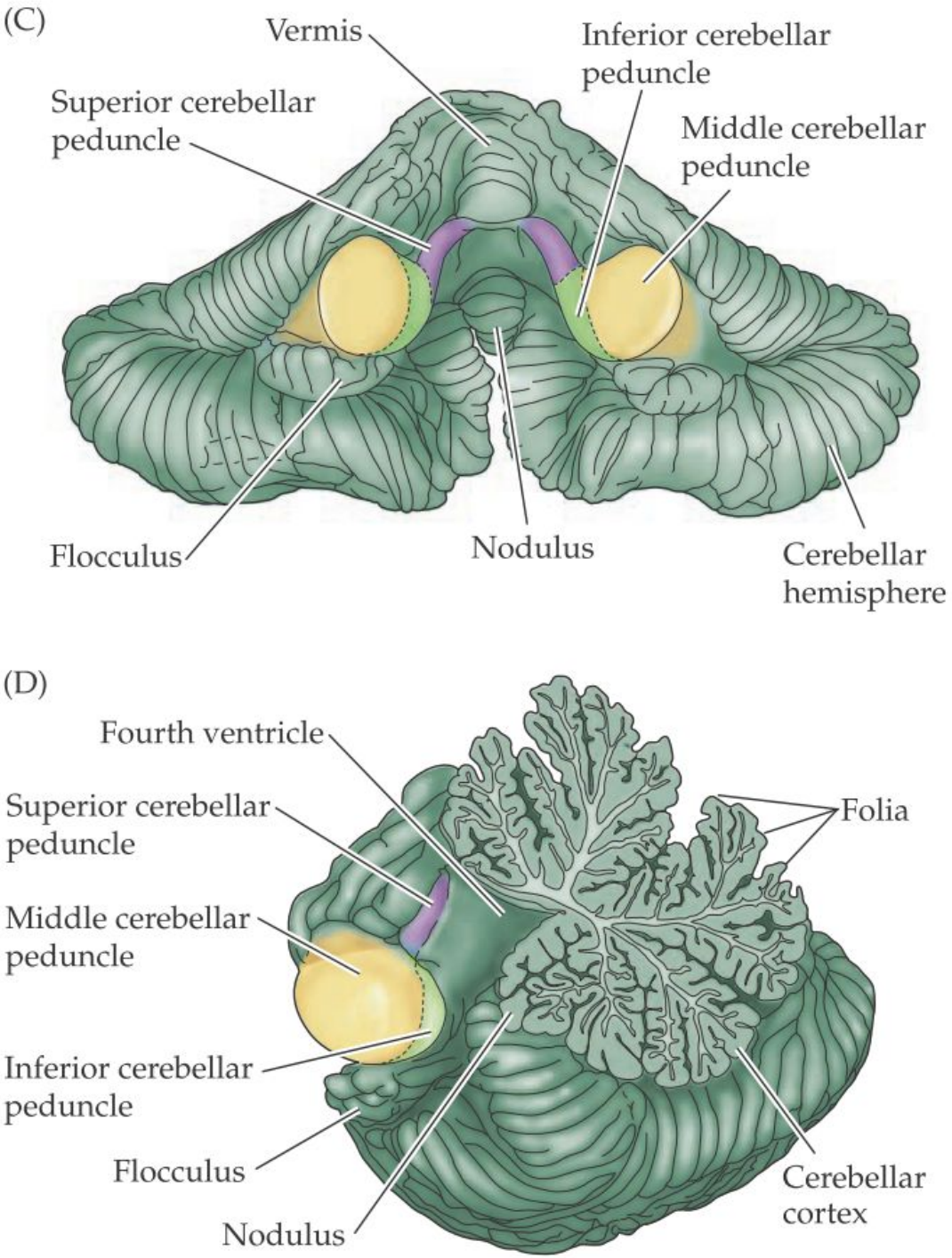

Radiations to cerebral cortex
Reticular formation
Auditory input
Visual input
Descending motor projections of reticulospinal tracts
Ascending general sensory fibers of spinoreticular tracts

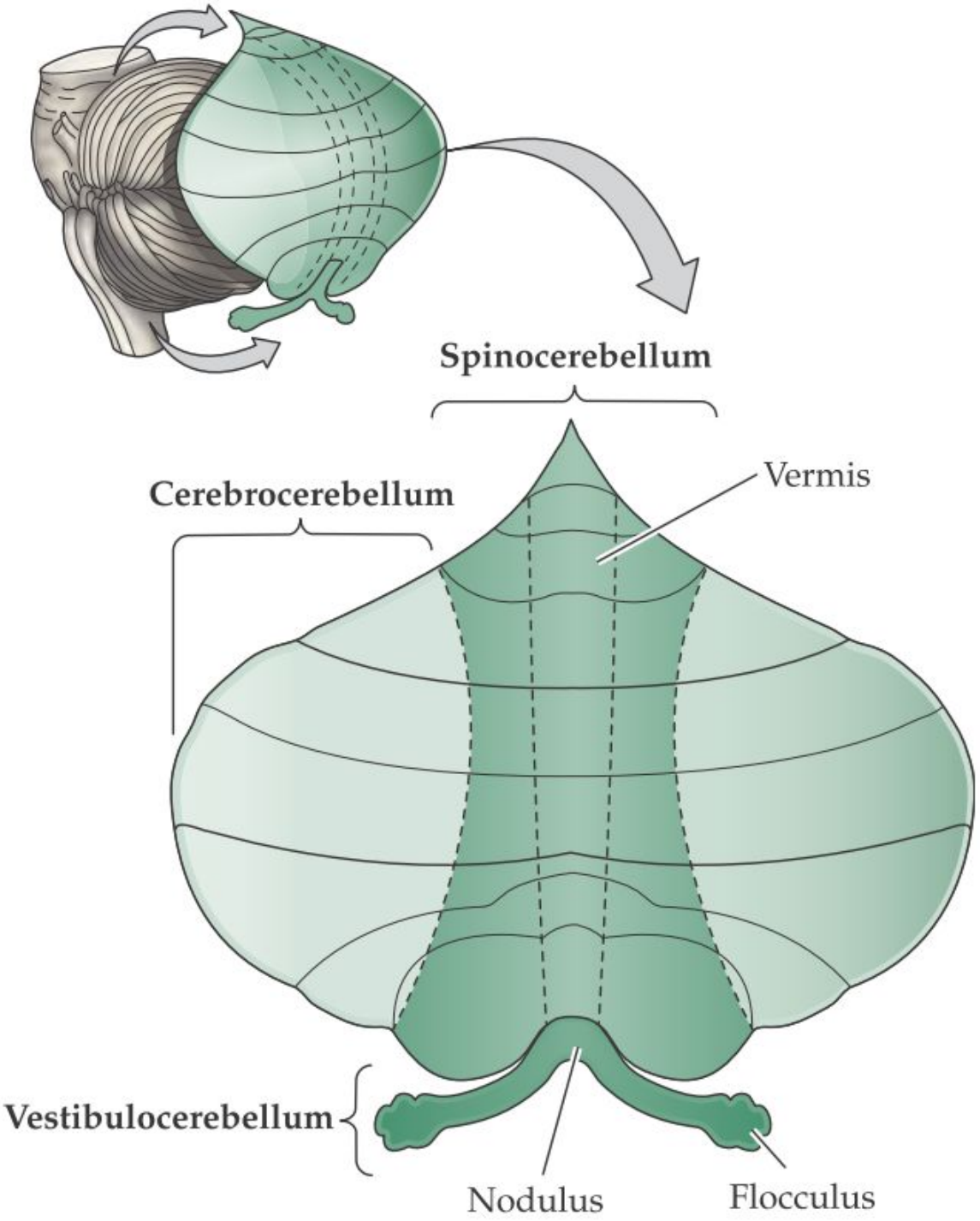

Third ventricle
Periventricular nuclei
Aqueduct
Mesencephalon
Periaqueductal gray
Enkephalin neurons
Fourth ventricle
Pons
Raphe magnus nucleus
Medulla
Serotonergic neurons
Pain fibers
Enkephalin neurons
Presynaptic pain inhibition
Anterolateral somatosensory tract

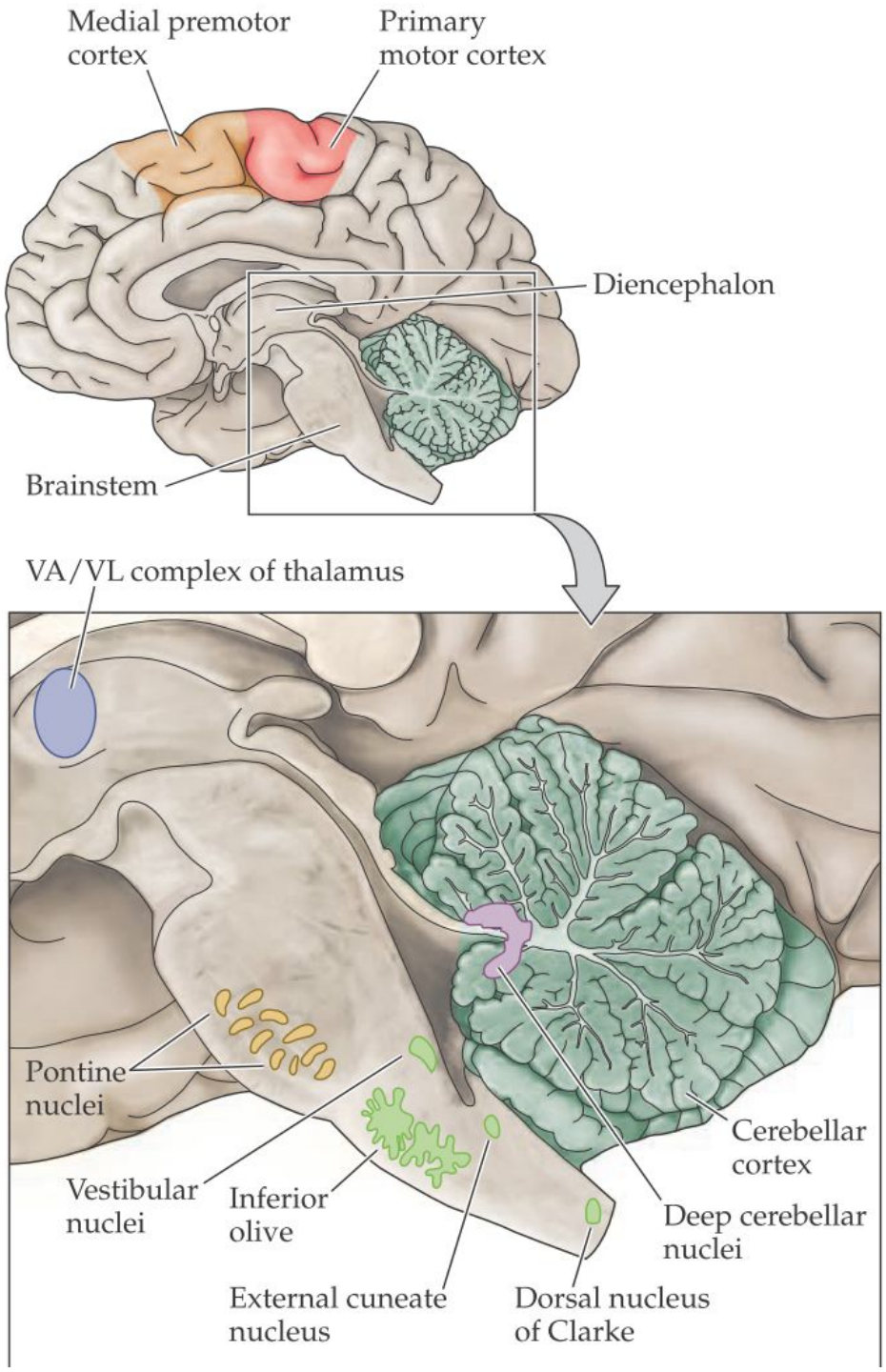

Средний мозг
Мост
Продолговатый мозг
КЯ
РЯМ
ВЯ
РГЯ
МН
МН
МН
МН
Повышение тонуса разгибателей и снижение тонуса сгибателей
Повышение тонуса сгибателей и снижение тонуса разгибателей
Спинной мозг

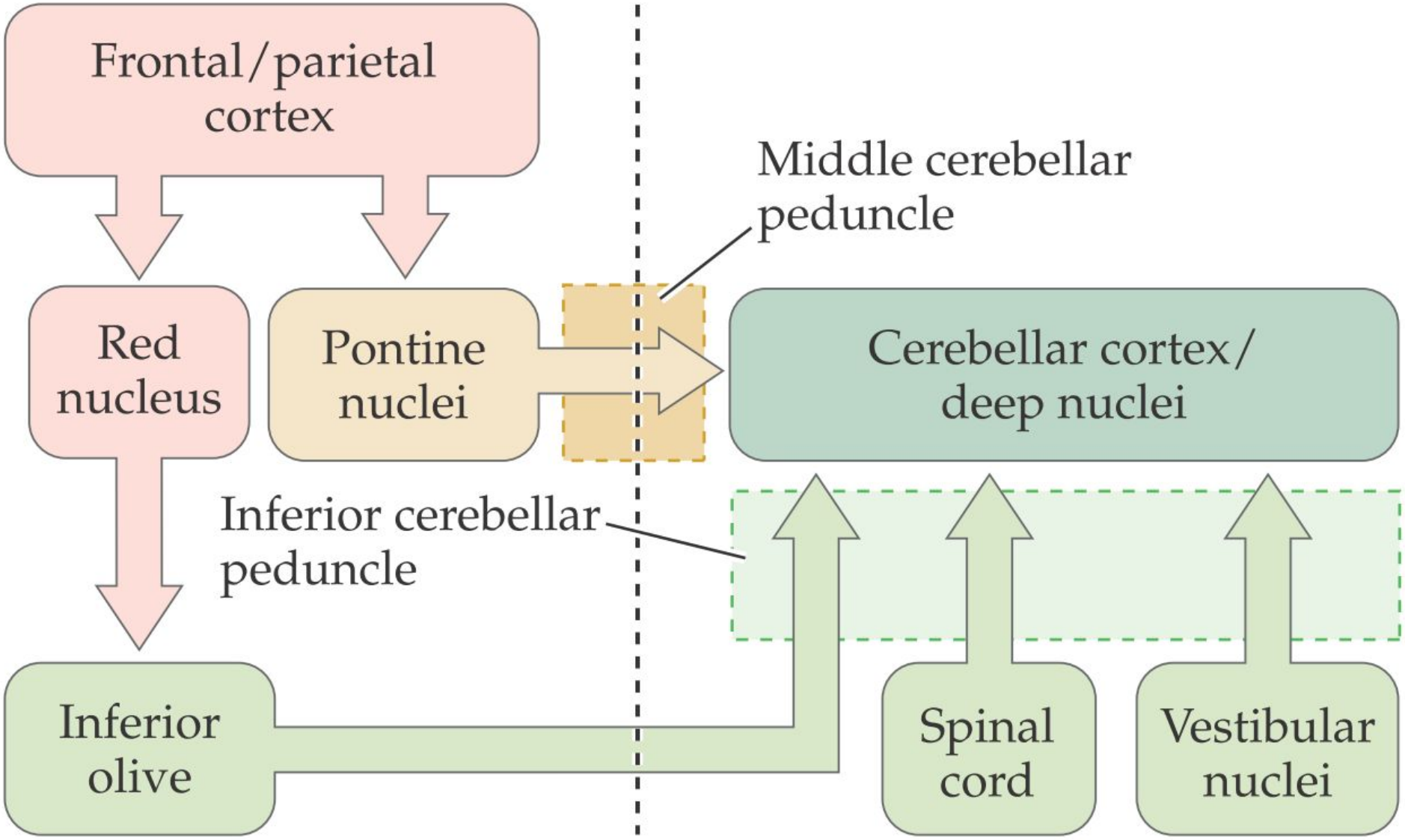

Cerebral cortex - motor areas
Skilled movements
Thalamus
Relay station
Initiation
Selection of motor programs
Basal ganglia
CS
Brain stem
Posture
Eye movements
Cerebellum
RS VS RbS
Motor coordination and correction
1 2
Spinal cord
Spinal reflexes
Locomotion
Muscle movement and contraction
Sensory receptors

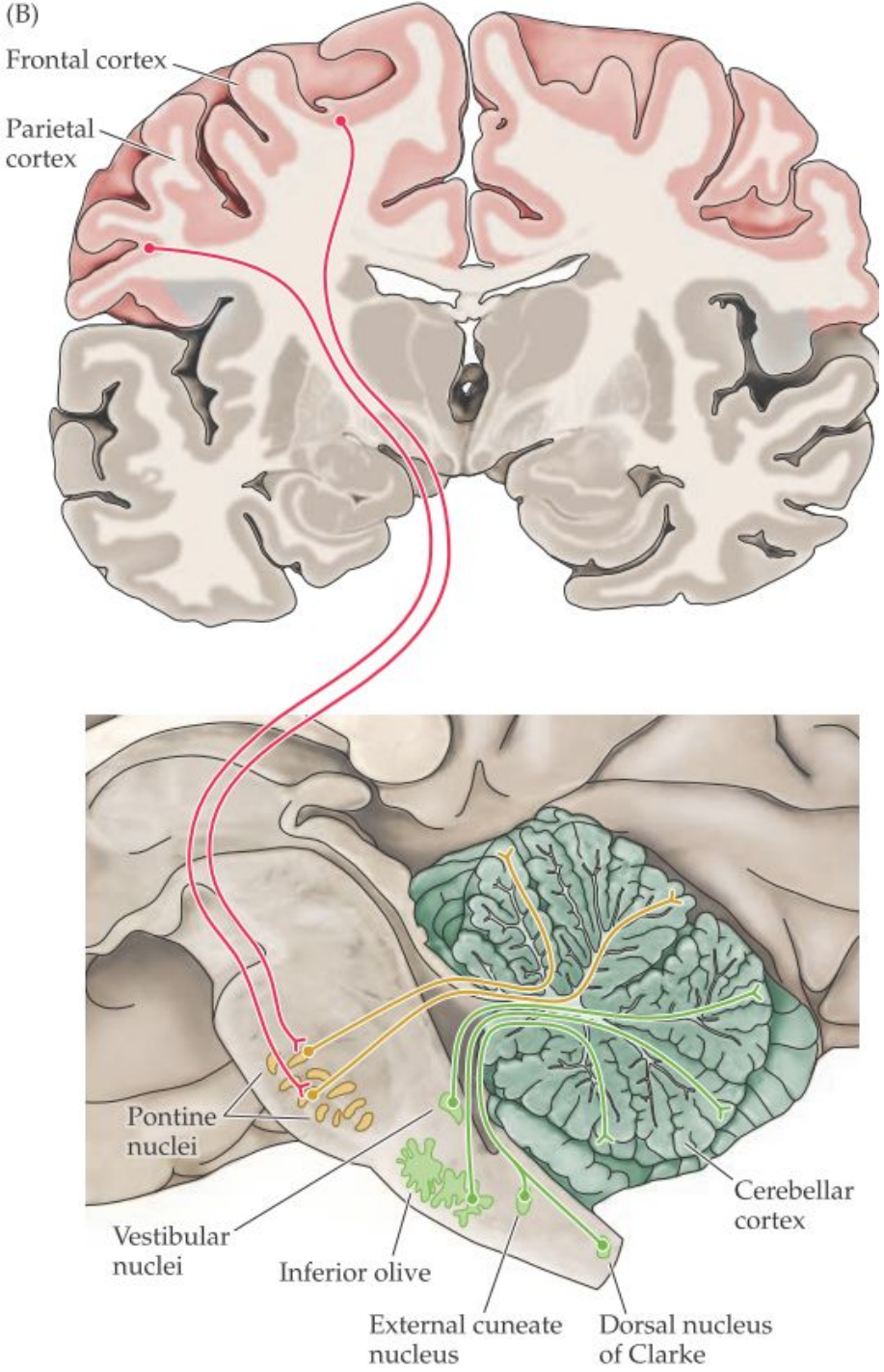

(B)
Caudate nucleus
Putamen
Internal capsule
Thalamus
Midbrain
Vermis
Superior
Middle
Inferior
Cerebellar peduncles
Cerebellar hemisphere
Fastigial nucleus
Interposed nuclei
Dentate nucleus
Deep cerebellar nuclei

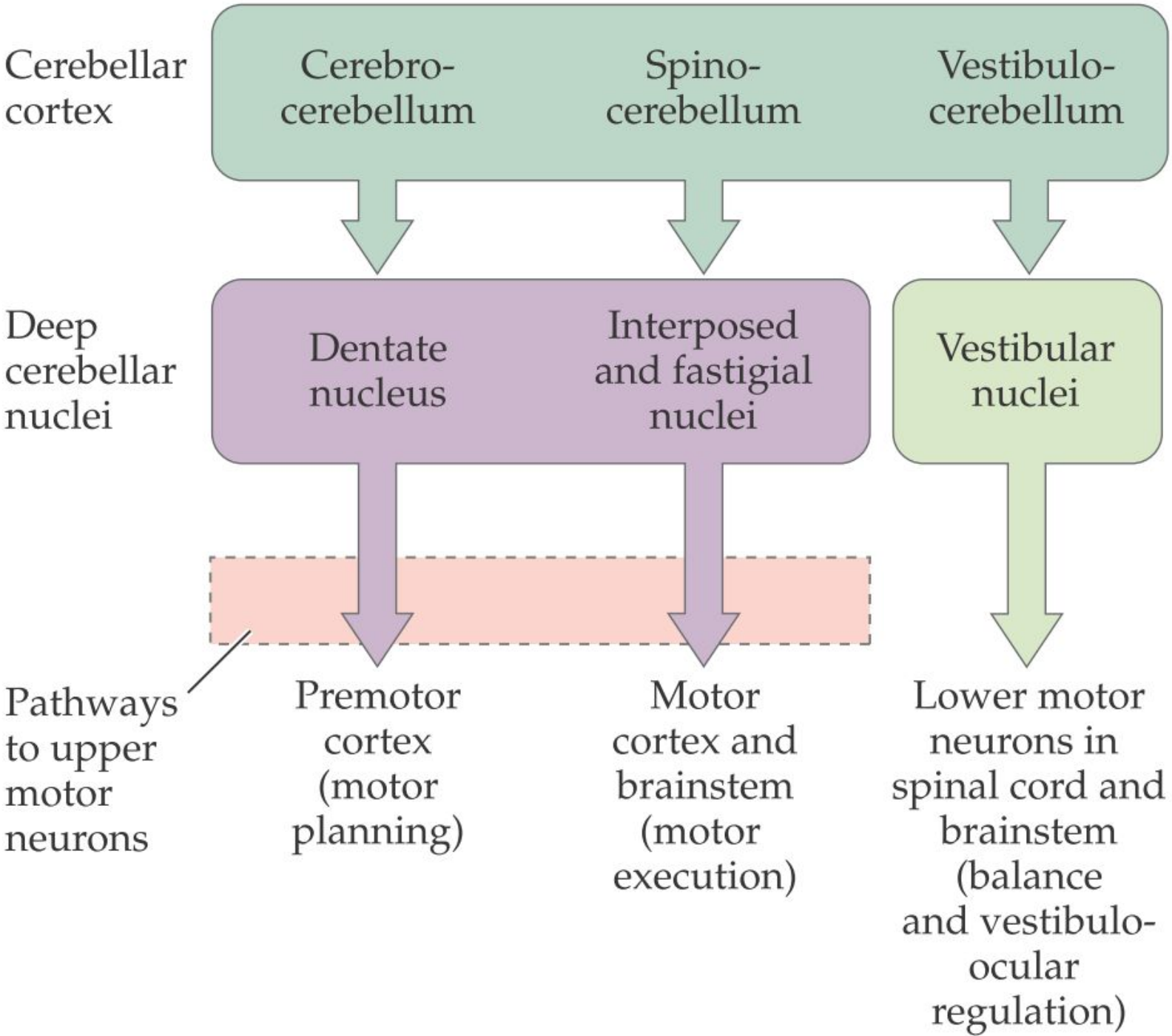

(C)
Vermis
Inferior cerebellar peduncle
Superior cerebellar peduncle
Middle cerebellar peduncle
Flocculus
Nodulus
Cerebellar hemisphere
(D)
Fourth ventricle
Superior cerebellar peduncle
Folia
Middle cerebellar peduncle
Inferior cerebellar peduncle
Flocculus
Nodulus
Cerebellar cortex


Spinocerebellum
Cerebrocerebellum
Vermis
Vestibulocerebellum
Nodulus
Flocculus

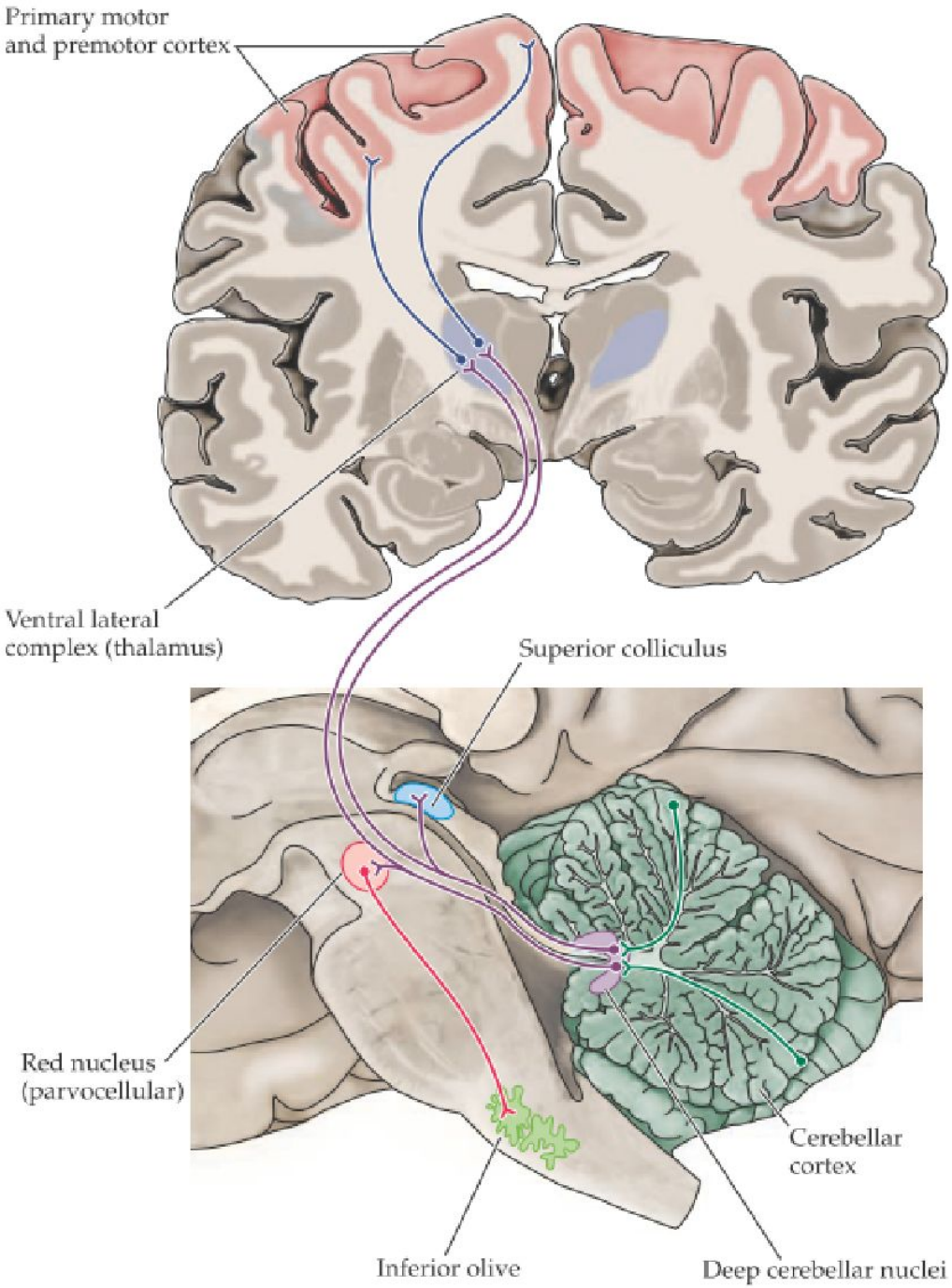

Medial premotor cortex
Primary motor cortex
Diencephalon
Brainstem
VA/VL complex of thalamus
Pontine nuclei
Vestibular nuclei
Inferior olive
External cuneate nucleus
Dorsal nucleus of Clarke
Deep cerebellar nuclei
Cerebellar cortex

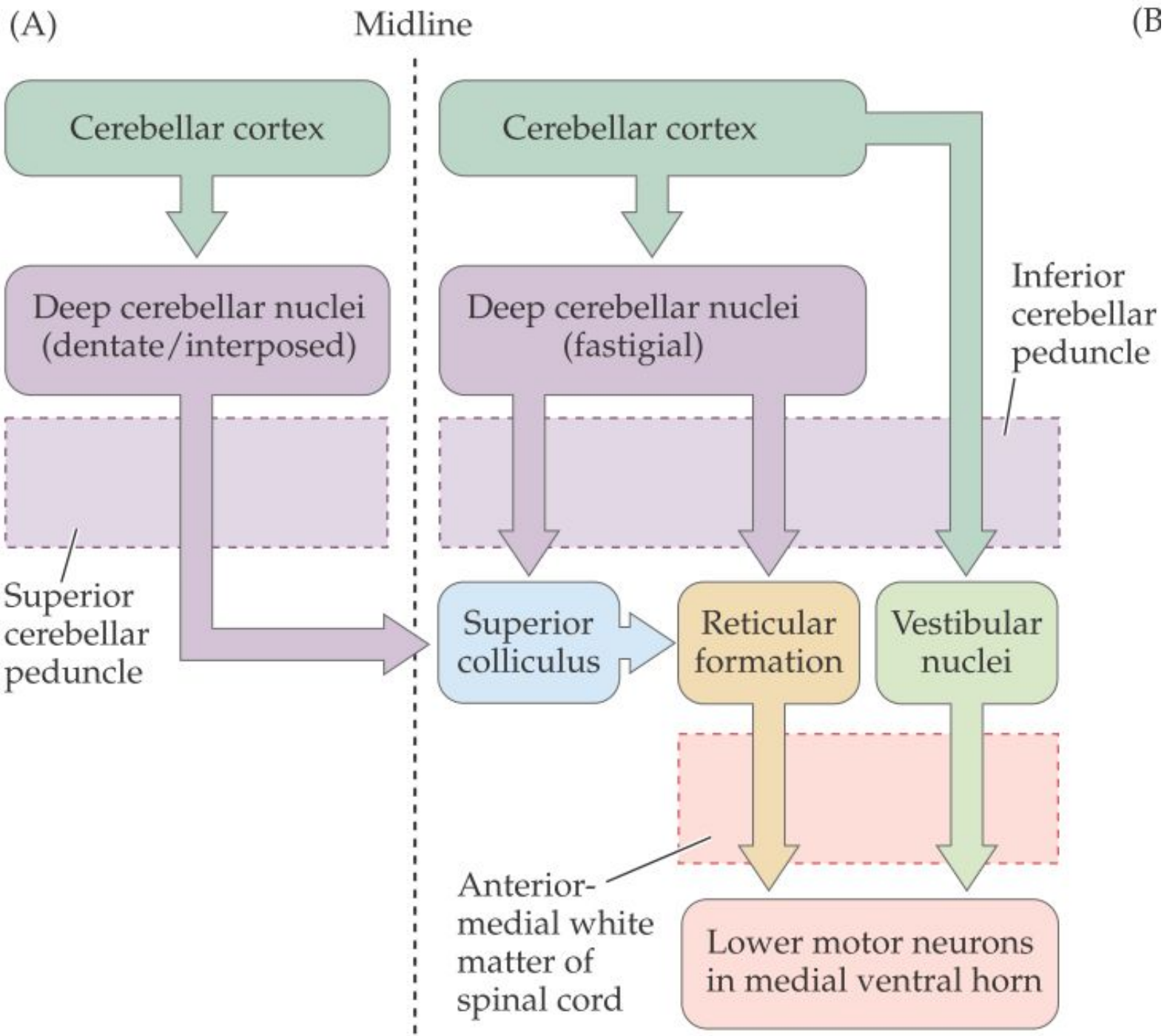

Frontal/parietal cortex
Middle cerebellar peduncle
Red nucleus
Pontine nuclei
Cerebellar cortex/ deep nuclei
Inferior cerebellar peduncle
Inferior olive
Spinal cord
Vestibular nuclei

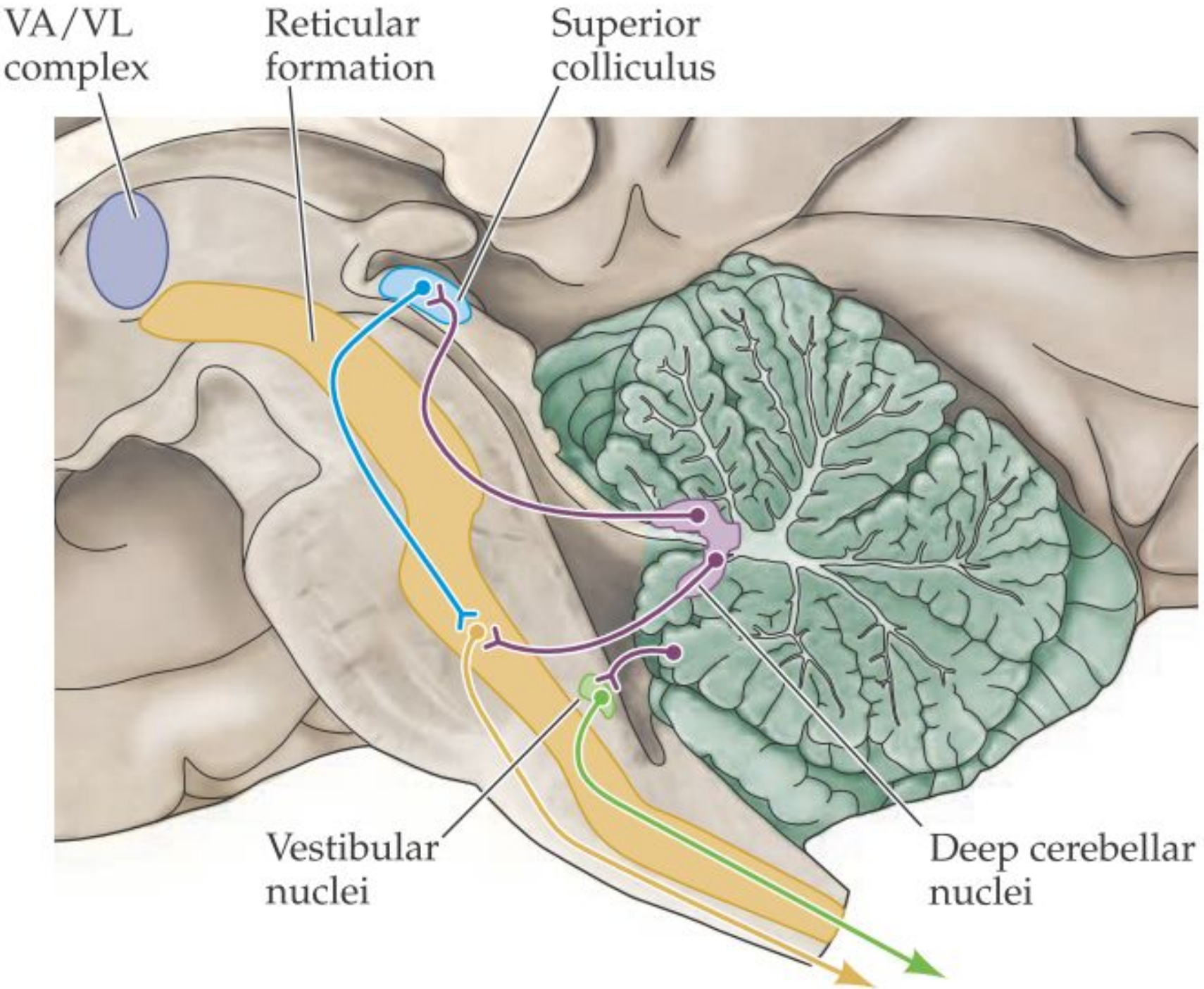

(B)
Frontal cortex
Parietal cortex
Pontine nuclei
Vestibular nuclei
Inferior olive
External cuneate nucleus
Dorsal nucleus of Clarke
Cerebellar cortex

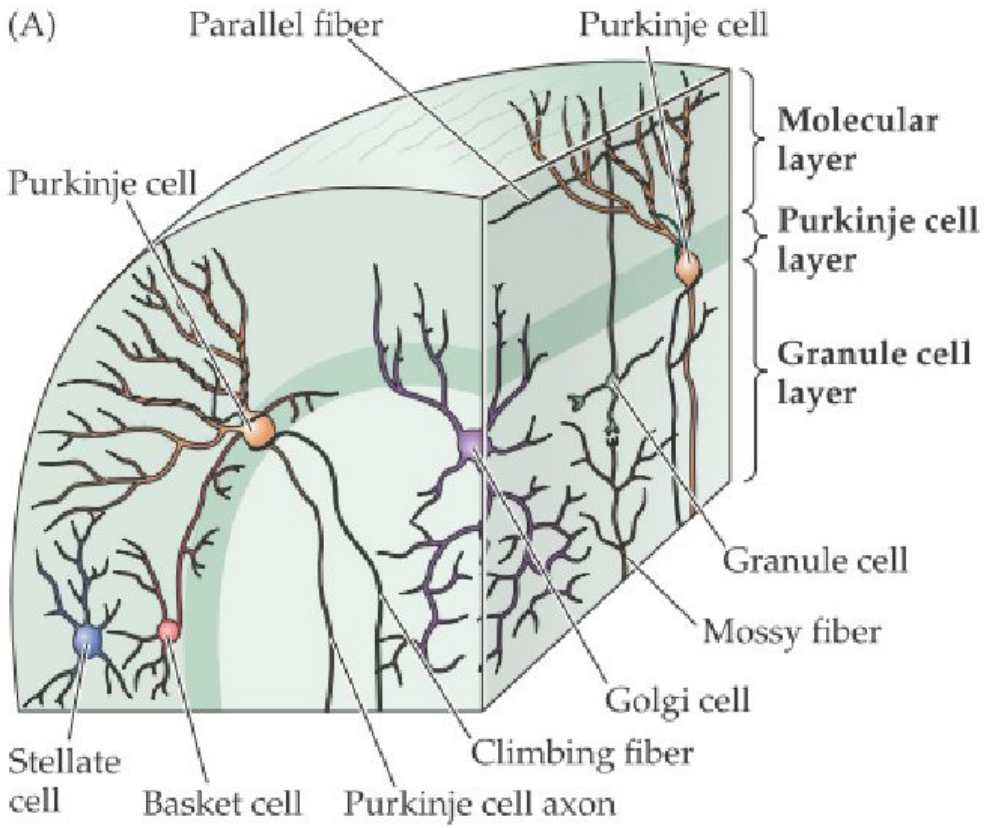

Cerebellar cortex
Cerebro-cerebellum
Spino-cerebellum
Vestibulo-cerebellum
Deep cerebellar nuclei
Dentate nucleus
Interposed and fastigial nuclei
Vestibular nuclei
Pathways to upper motor neurons
Premotor cortex (motor planning)
Motor cortex and brainstem (motor execution)
Lower motor neurons in spinal cord and brainstem (balance and vestibulo-ocular regulation)

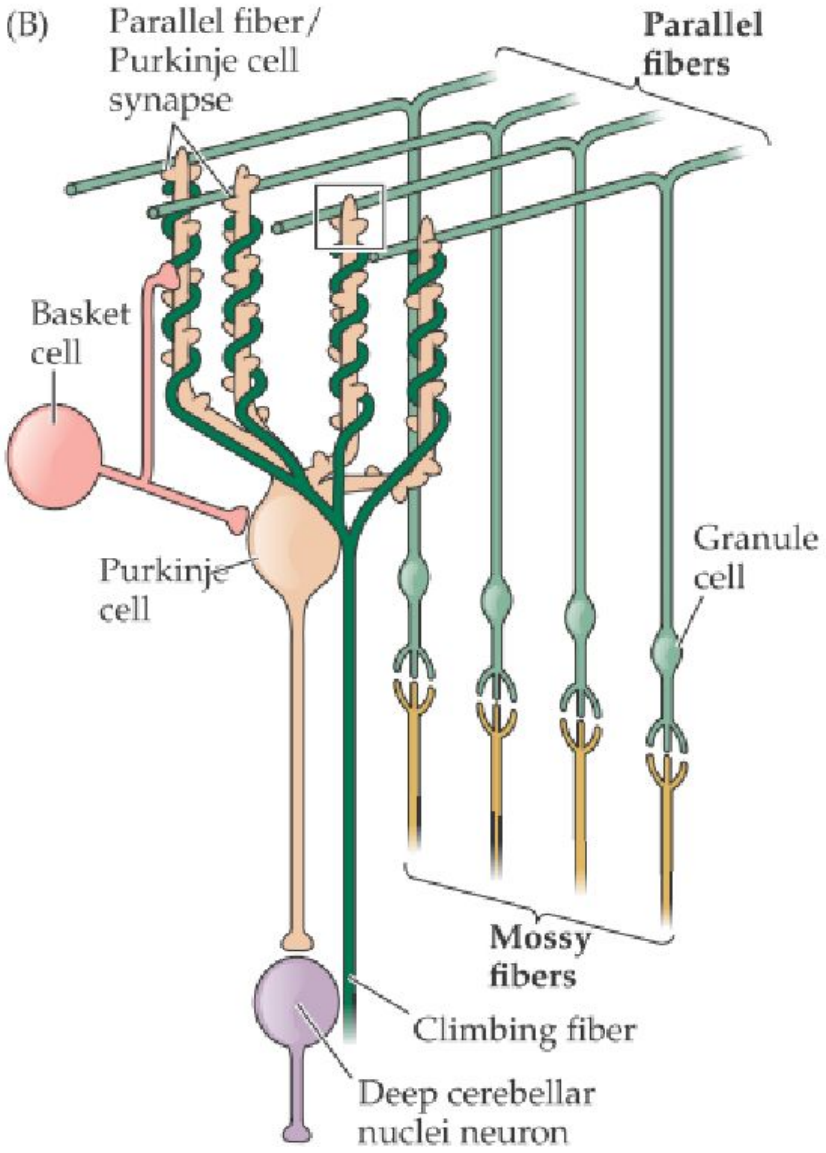
(B)

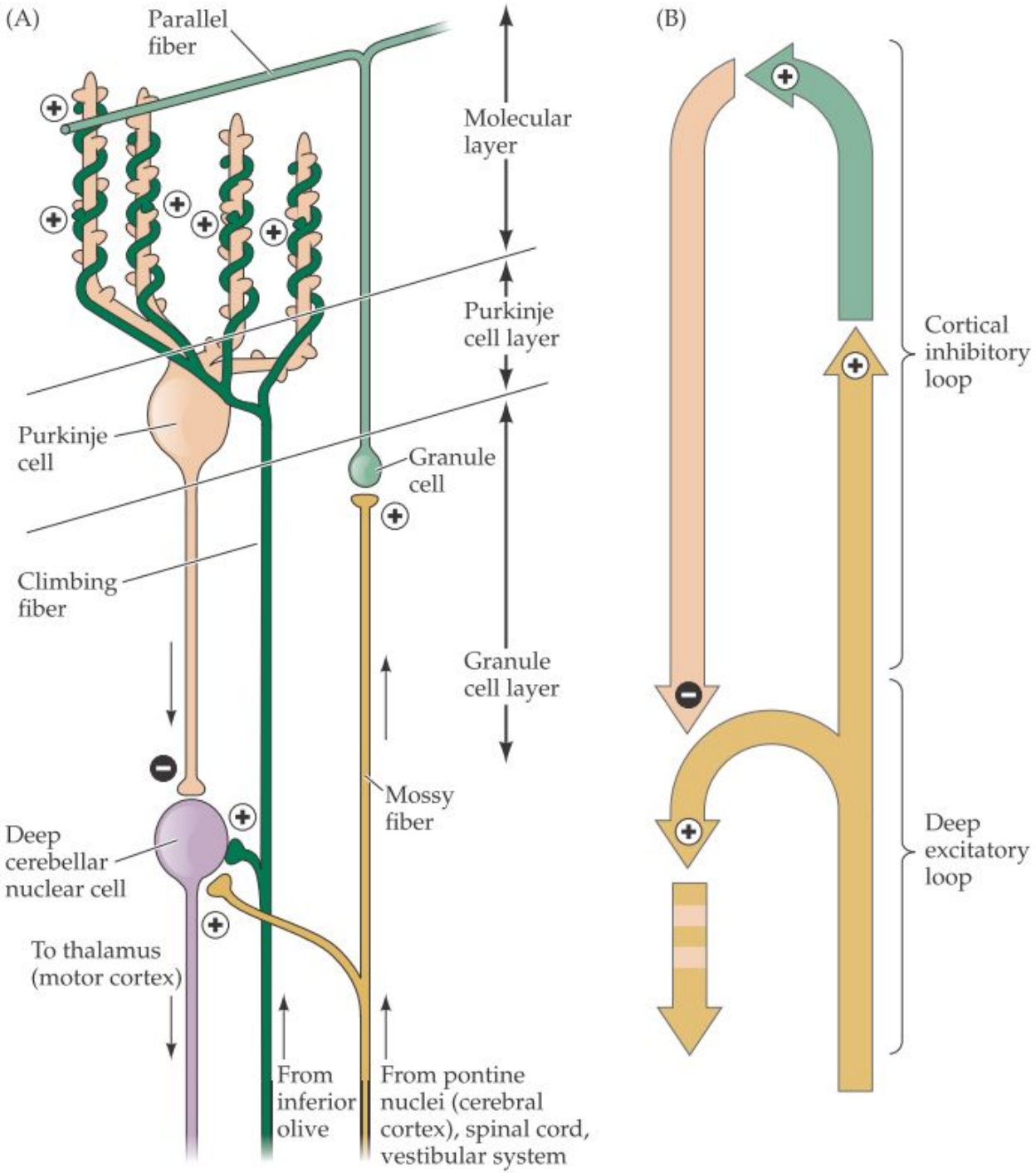

Primary motor
and premotor cortex
Ventral lateral
complex (thalamus)
Superior colliculus
Red nucleus
(parvocellular)
Cerebellar
cortex
Inferior olive
Deep cerebellar nuclei

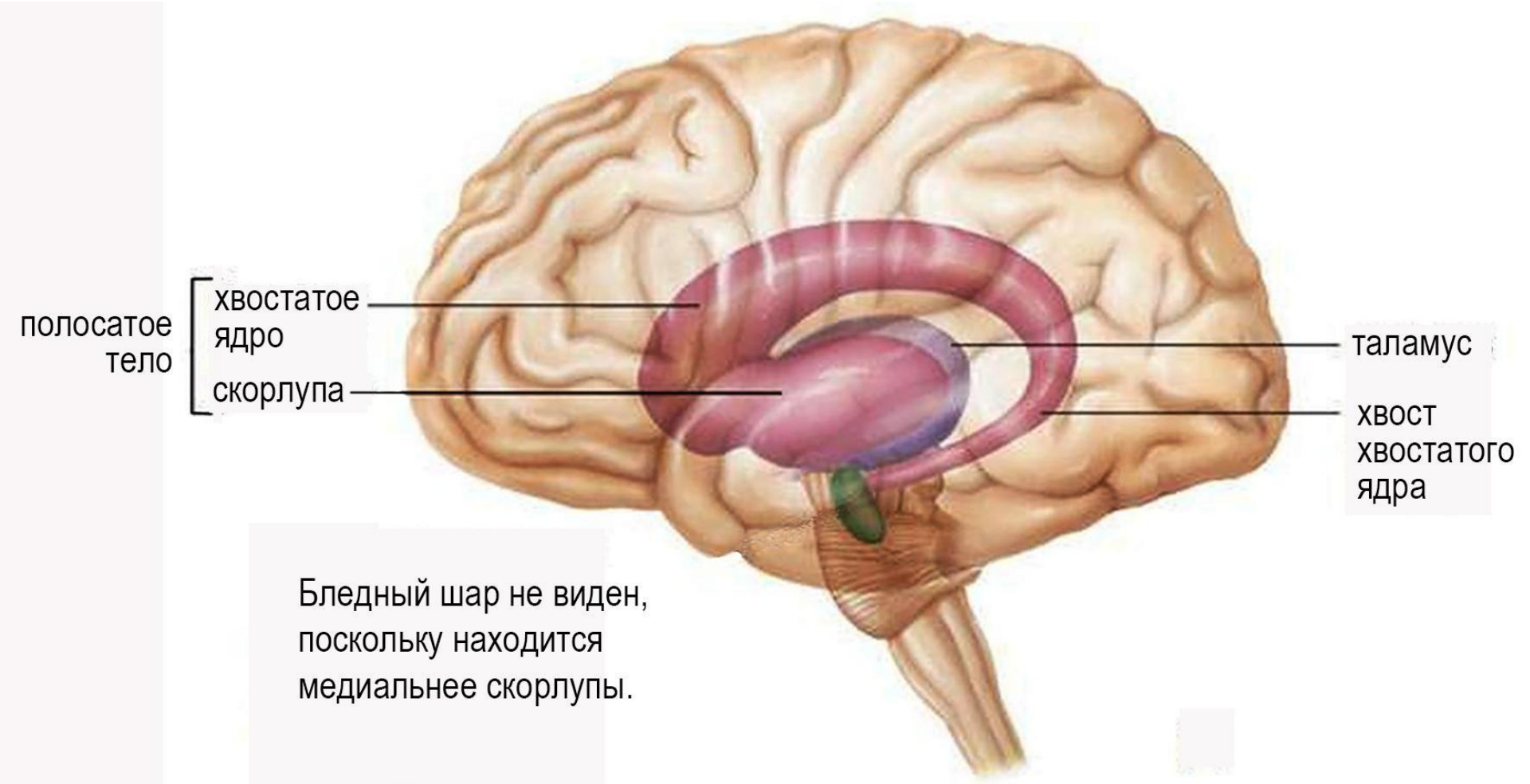

(A)
Midline
(B
Cerebellar cortex
Deep cerebellar nuclei (dentate/interposed)
Superior cerebellar peduncle
Cerebellar cortex
Deep cerebellar nuclei (fastigial)
Inferior cerebellar peduncle
Superior colliculus
Reticular formation
Vestibular nuclei
Anterior-medial white matter of spinal cord
Lower motor neurons in medial ventral horn


VA/VL complex
Reticular formation
Superior colliculus
Vestibular nuclei
Deep cerebellar nuclei

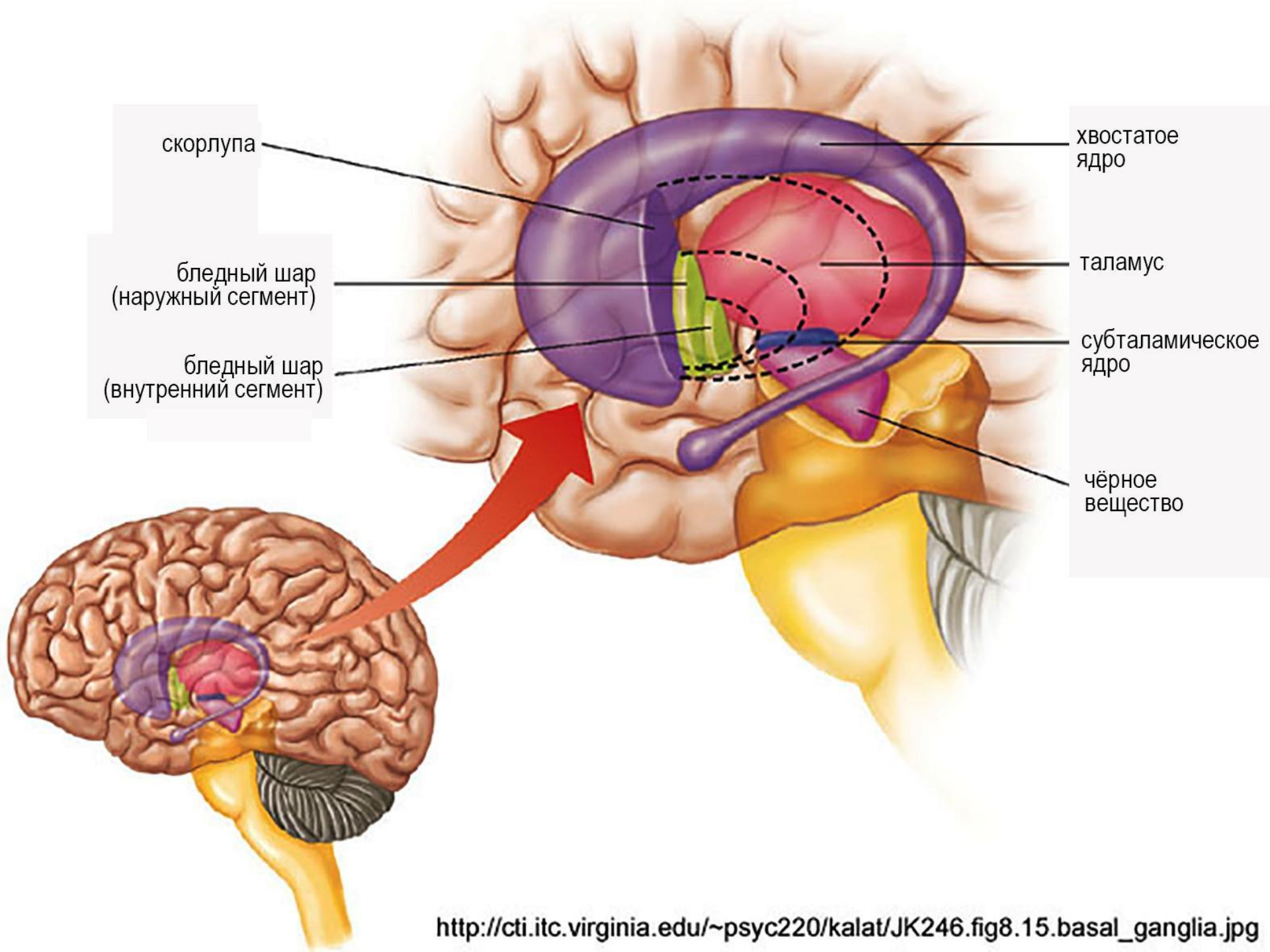

(A)
Parallel fiber
Purkinje cell
Molecular layer
Purkinje cell layer
Granule cell layer
Purkinje cell
Granule cell
Mossy fiber
Golgi cell
Climbing fiber
Stellate cell
Basket cell
Purkinje cell axon


(B)
Parallel fiber/ Purkinje cell synapse
Parallel fibers
Basket cell
Purkinje cell
Granule cell
Mossy fibers
Climbing fiber
Deep cerebellar nuclei neuron

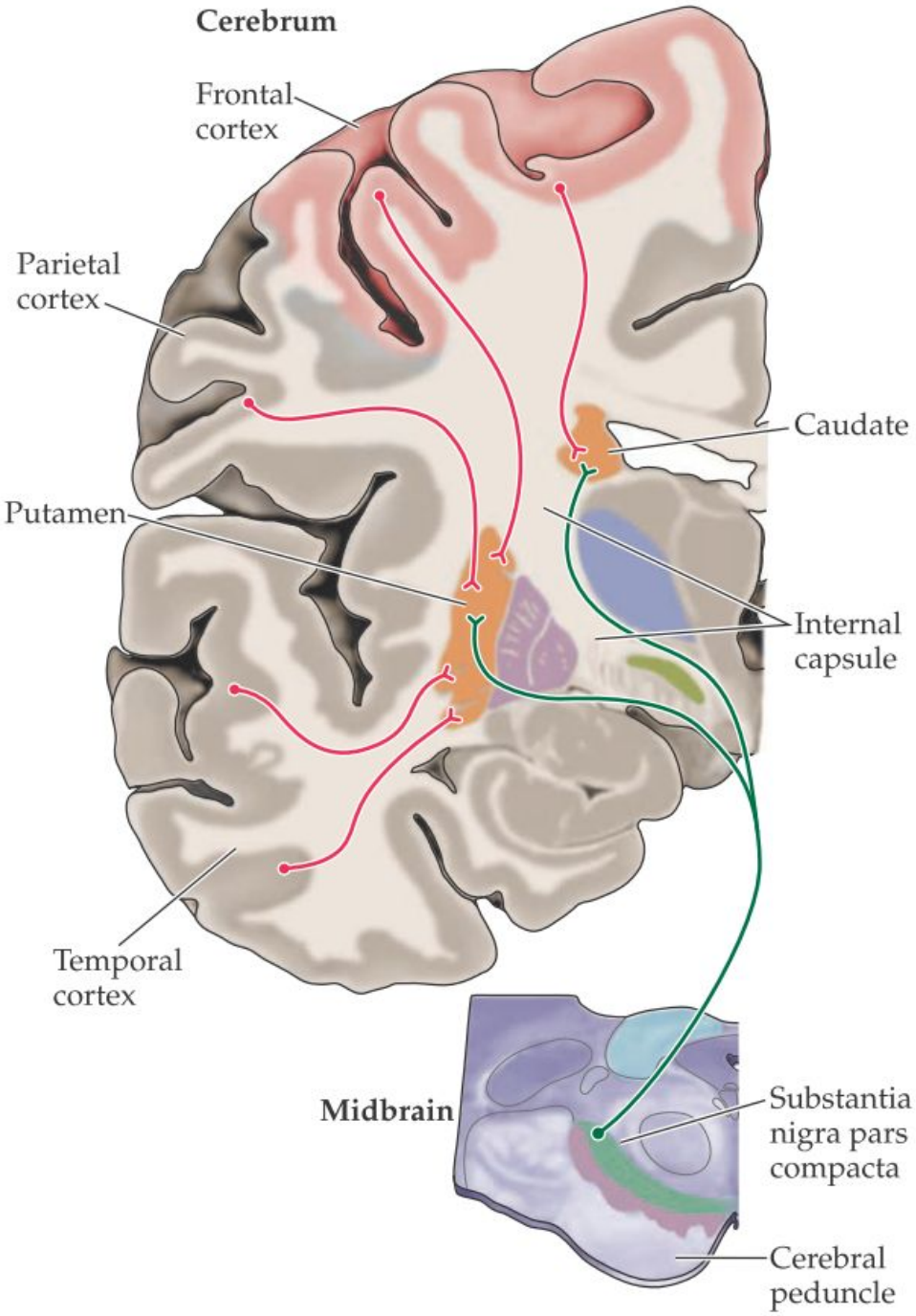

(A)
Parallel fiber
Molecular layer
Purkinje cell layer
Granule cell layer
Purkinje cell
Granule cell
Climbing fiber
Mossy fiber
Deep cerebellar nuclear cell
To thalamus (motor cortex)
From inferior olive
From pontine nuclei (cerebral cortex), spinal cord, vestibular system
(B)
Cortical inhibitory loop
Deep excitatory loop

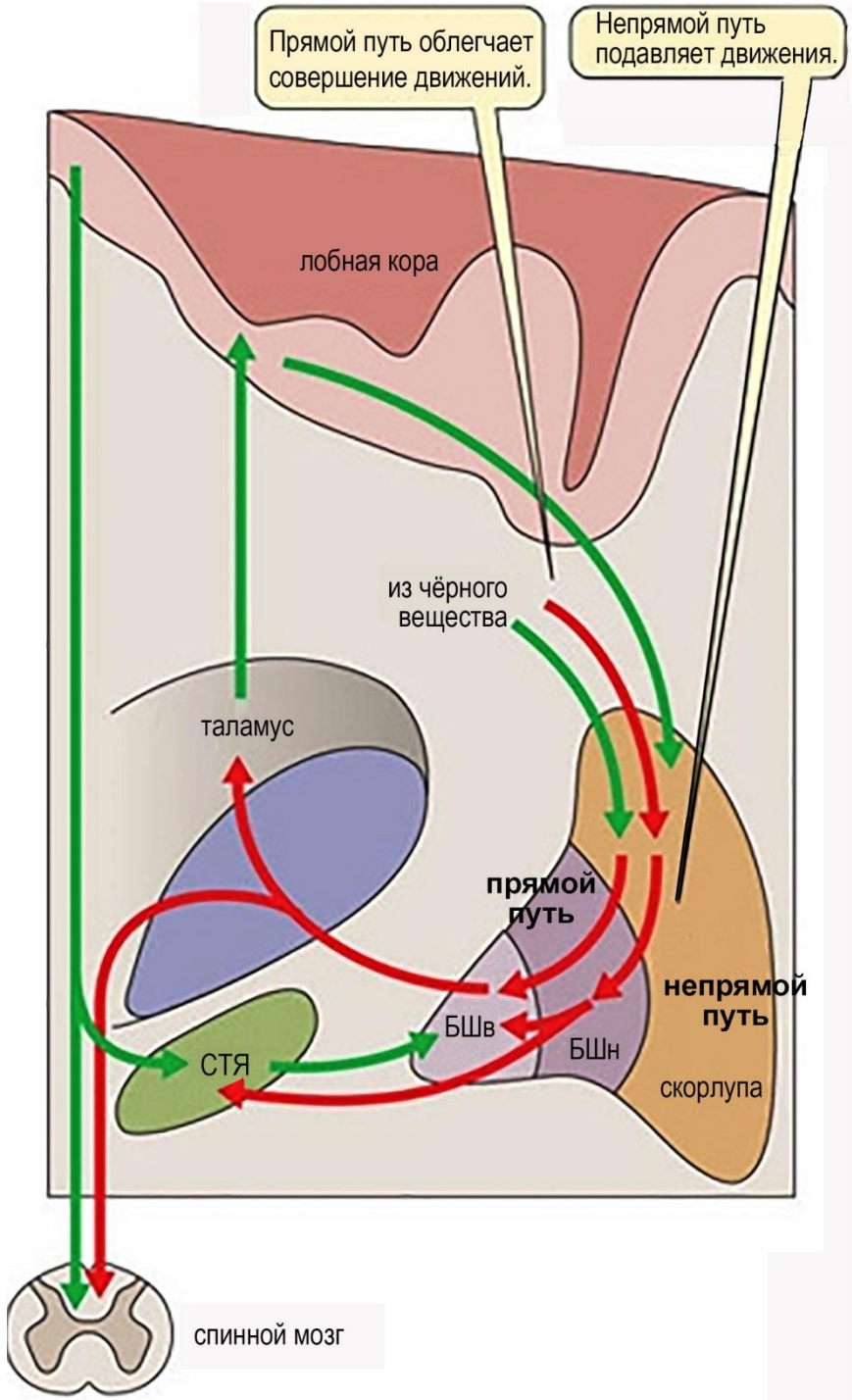


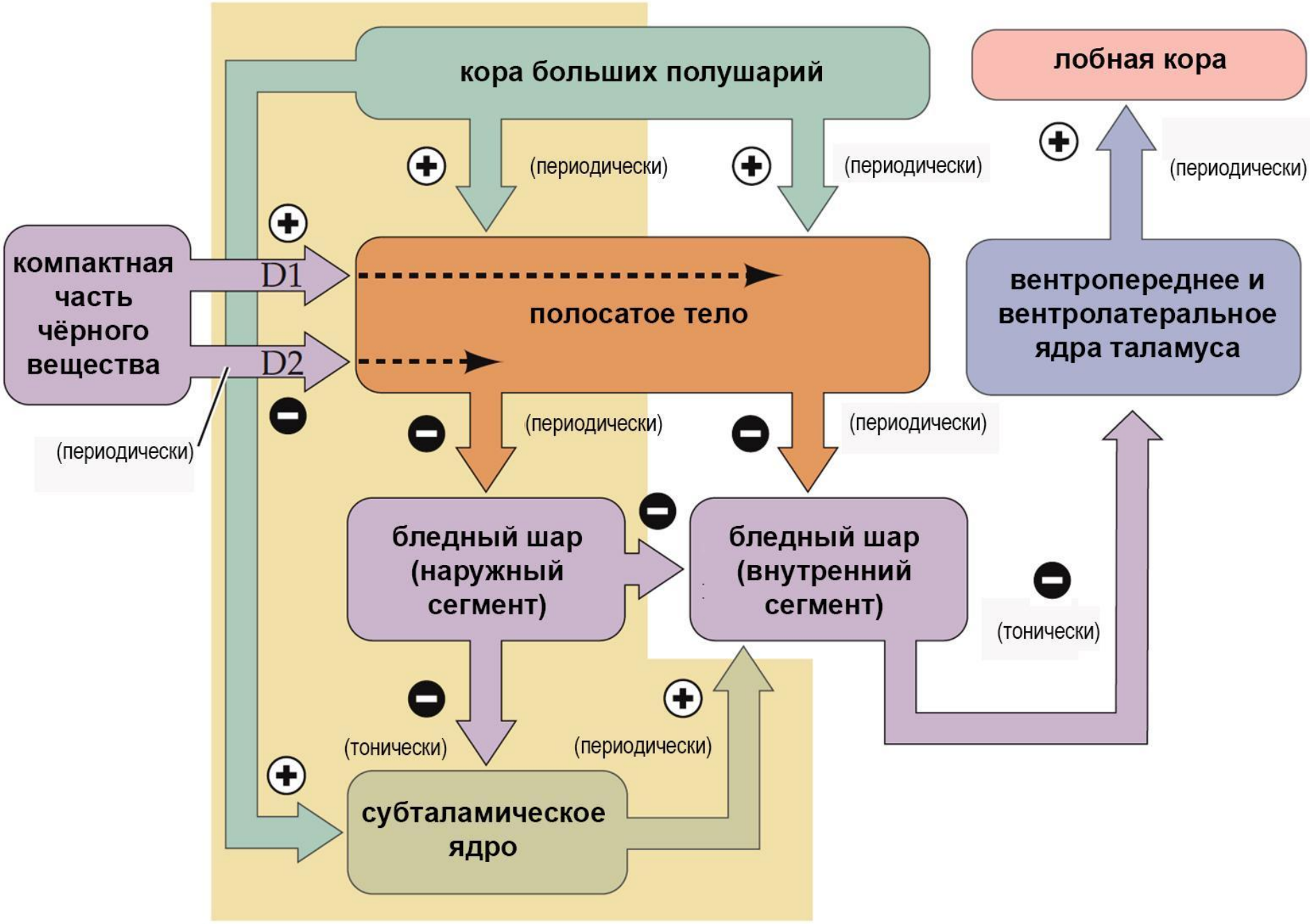
Бледный шар не виден, поскольку находится медиальнее скорлупы.

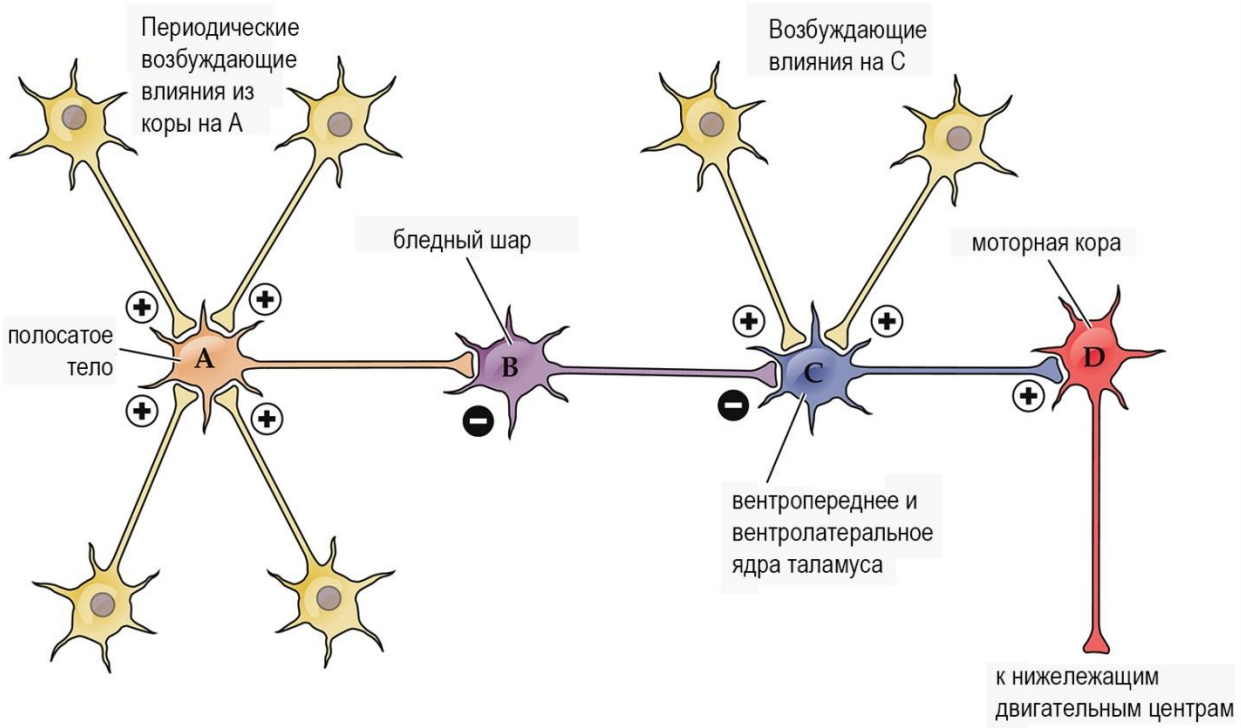


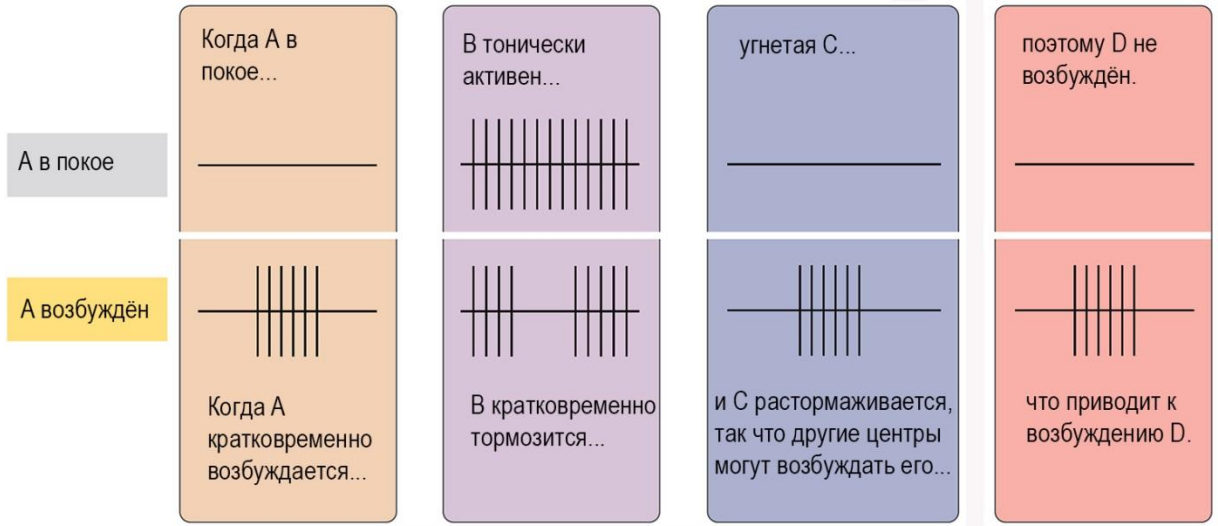
http://cti.itc.virginia.edu/~psyc220/kalat/JK246.fig8.15.basal_ganglia.jpg


Cerebrum
Frontal cortex
Parietal cortex
Caudate
Putamen
Internal capsule
Temporal cortex
Midbrain
Substantia nigra pars compacta
Cerebral peduncle

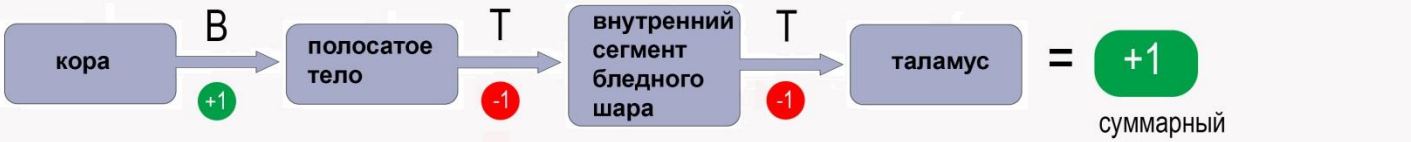

Прямой путь облегчает совершение движений.
Непрямой путь подавляет движения.
лобная кора
из чёрного вещества
таламус
прямой путь
непрямой путь
БШв
БШн
СТЯ
скорлупа
спинной мозг


кора больших полушарий
лобная кора
(периодически)
(периодически)
(периодически)
компактная часть чёрного вещества
D1
D2
полосатое тело
вентропереднее и вентролатеральное ядра таламуса
(периодически)
(периодически)
(периодически)
бледный шар (наружный сегмент)
бледный шар (внутренний сегмент)
(тонически)
(тонически)
(периодически)
субталамическое ядро


Периодические возбуждающие влияния из коры на А
Возбуждающие влияния на С
бледный шар
моторная кора
полосатое тело
A
B
C
D
вентропереднее и вентролатеральное ядра таламуса
к нижележащим двигательным центрам


А в покое
А возбуждён
Когда А в покое...
Когда А кратковременно возбуждается...
В тонически активен...
В кратковременно тормозится...
угнетая С...
и С растормаживается, так что другие центры могут возбуждать его...
поэтому D не возбуждён.
что приводит к возбуждению D.
полосатое тело
бледный шар
вентропереднее и вентролатеральное ядра таламуса
моторная кора

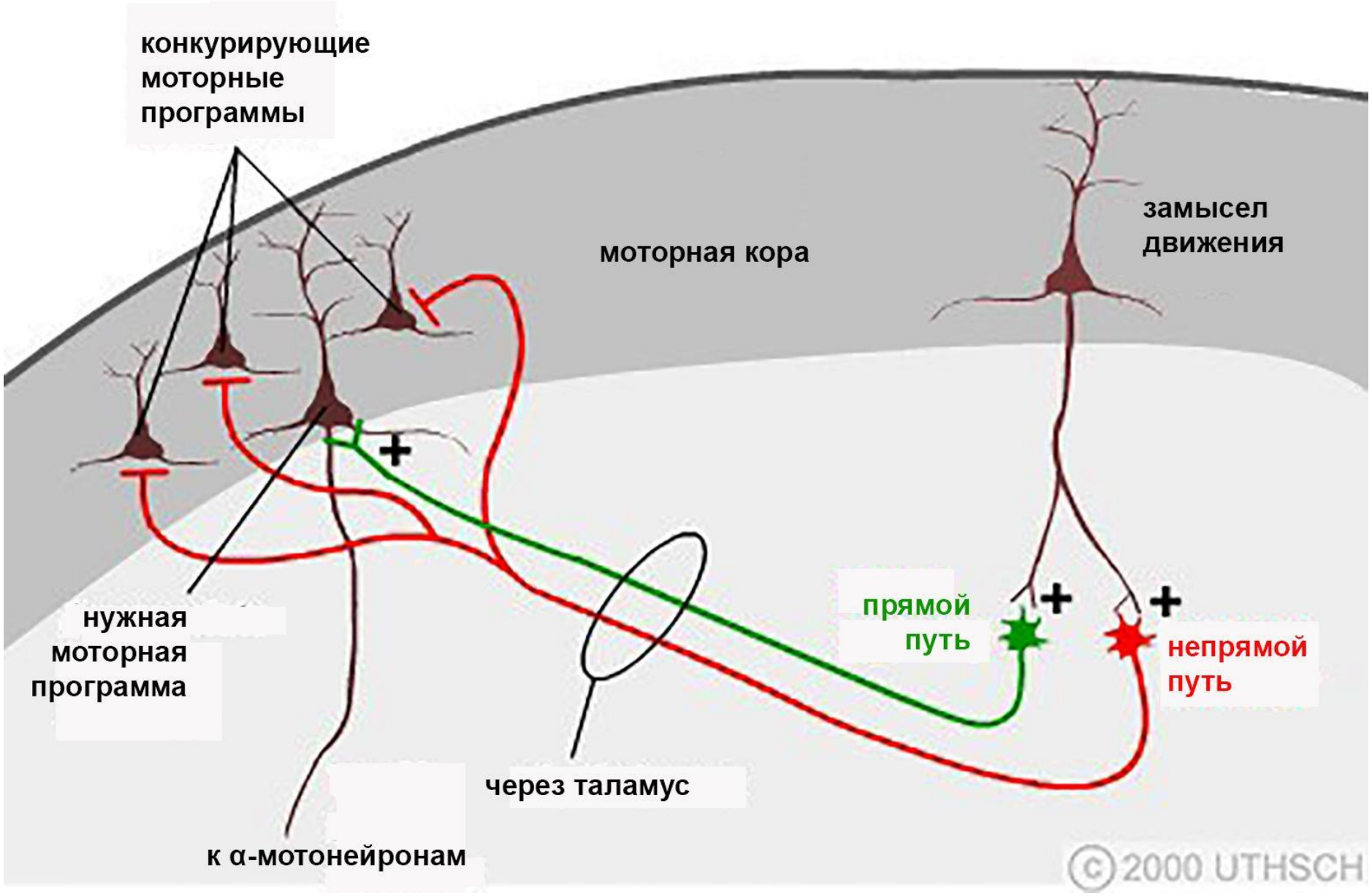
ПРЯМОЙ ПУТЬ

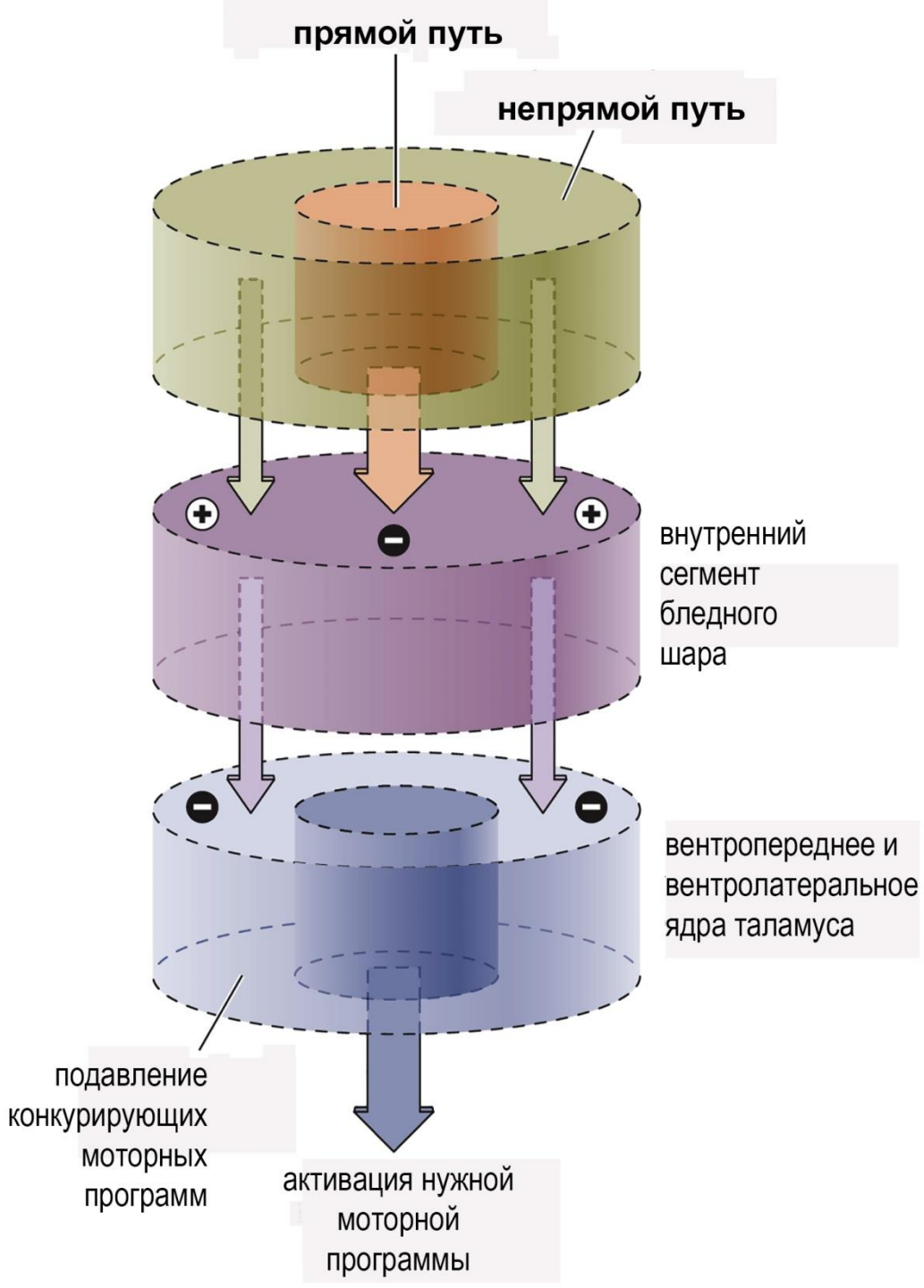


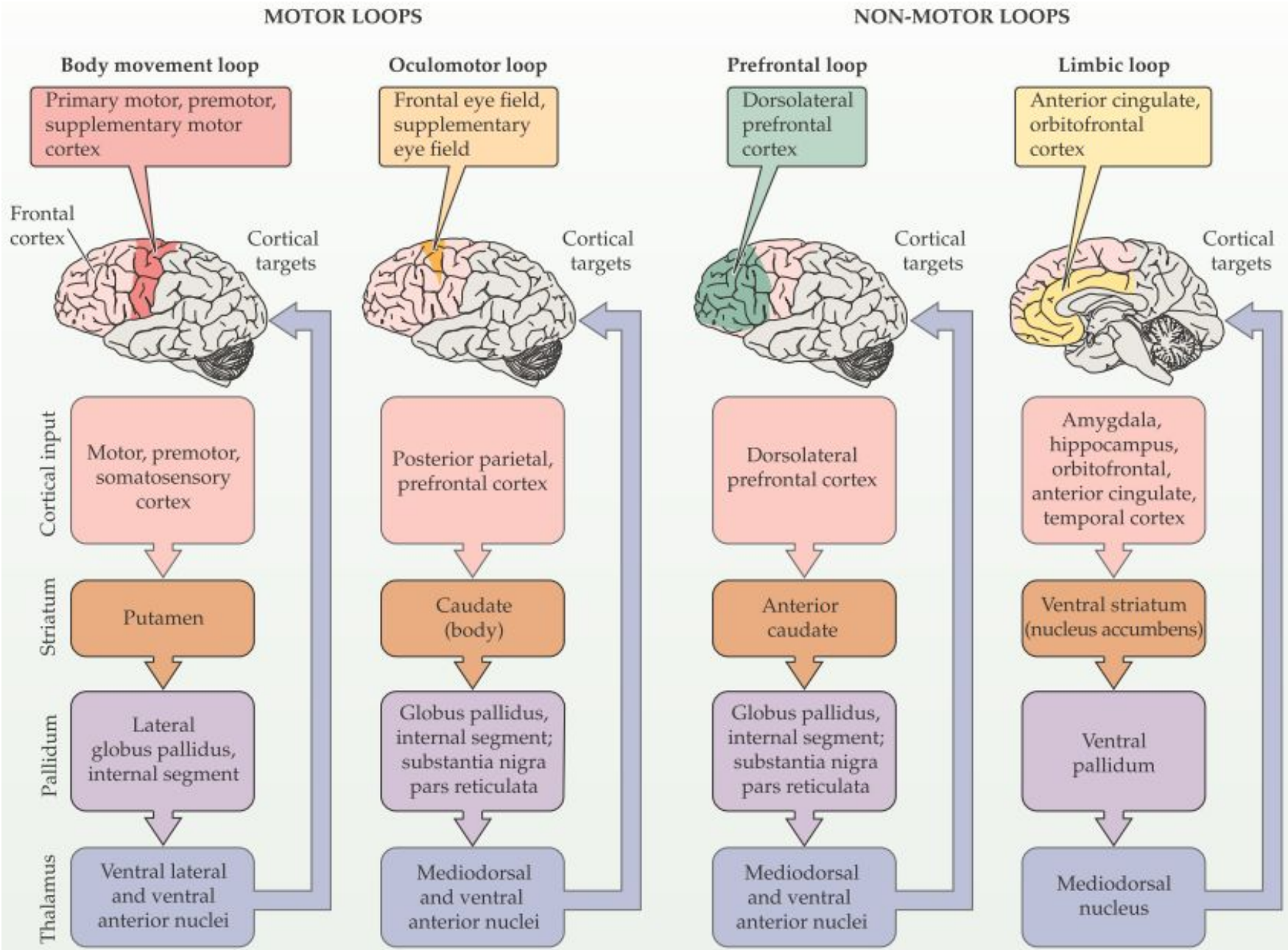
суммарный
эффект - растормаживание

НЕПРЯМОЙ ПУТЬ

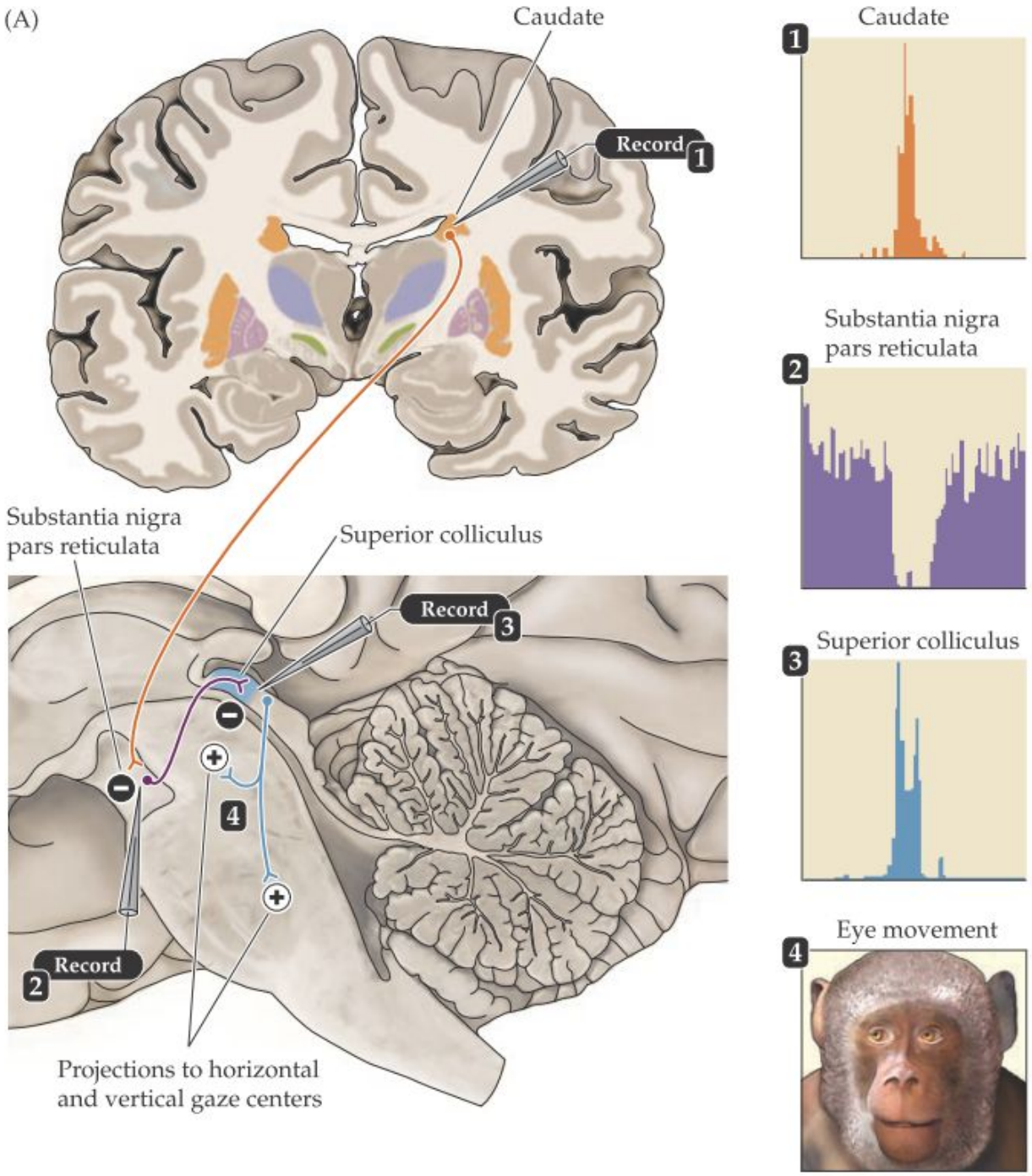
суммарный
эффект - торможение

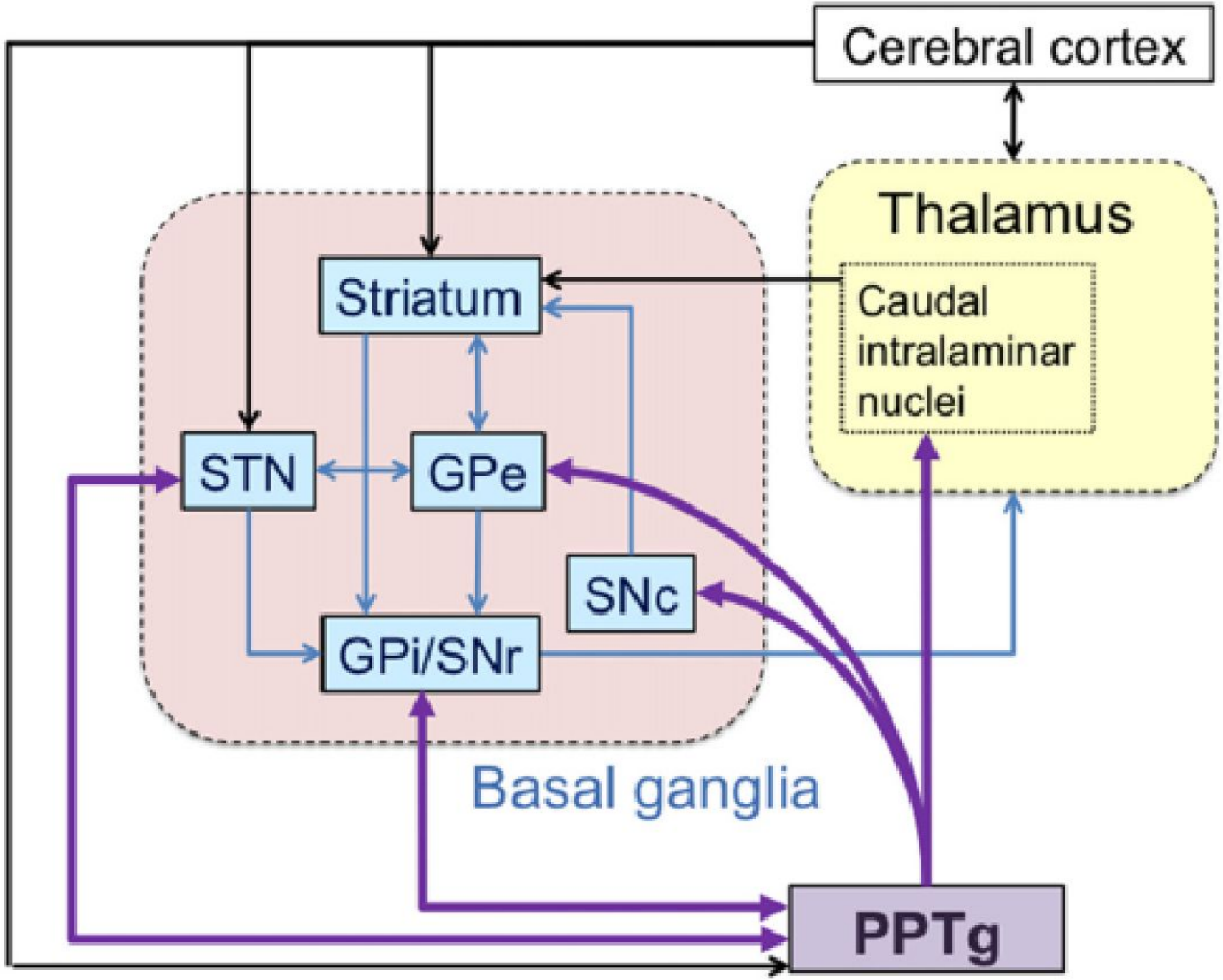

конкурирующие моторные программы
моторная кора
замысел движения
нужная моторная программа
прямой путь
непрямой путь
через таламус
к α-мотонейронам
© 2000 UTHSCH

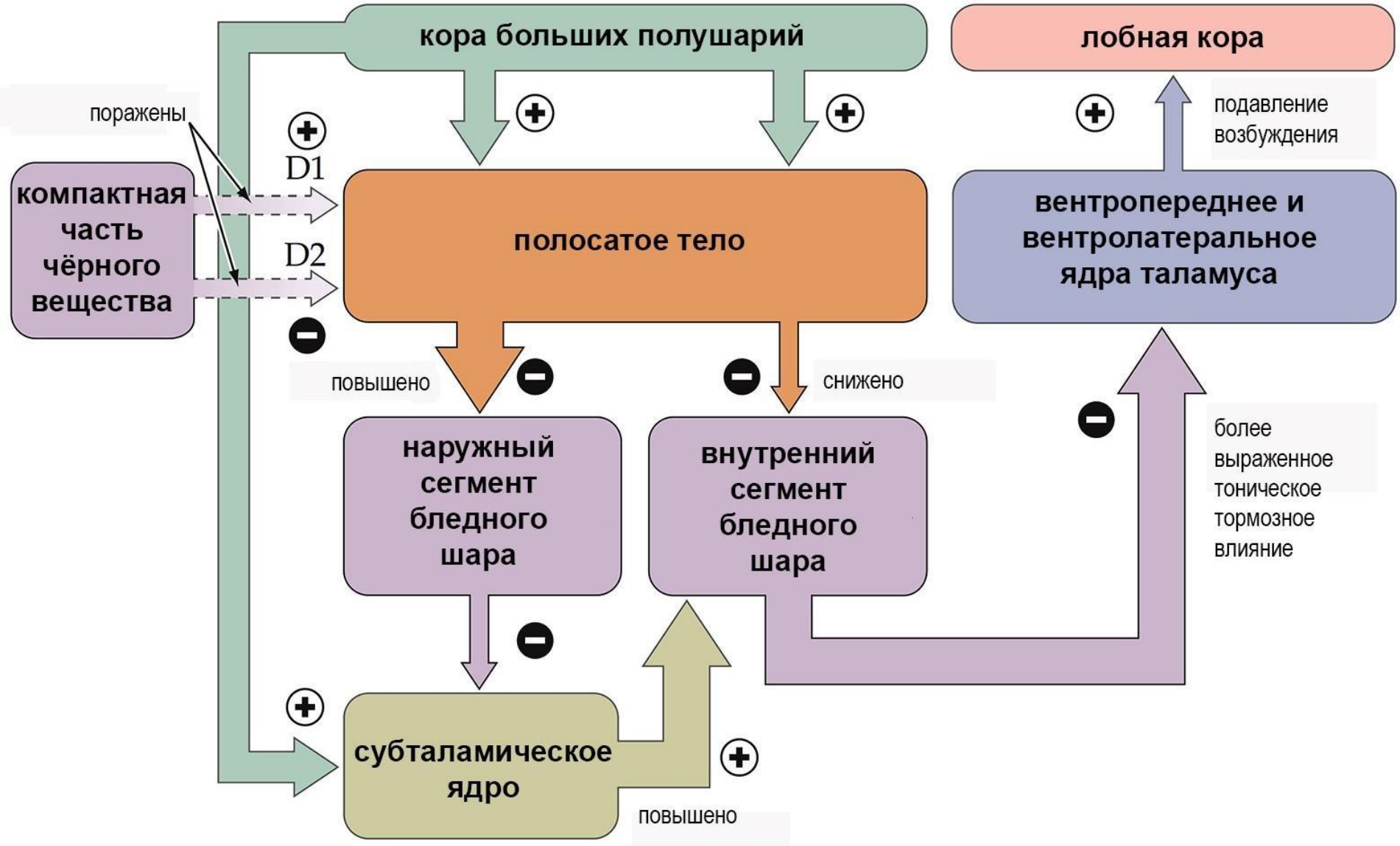

прямой путь
непрямой путь
внутренний сегмент бледного шара
вентропереднее и вентролатеральное ядра таламуса
подавление конкурирующих моторных программ
активация нужной моторной программы

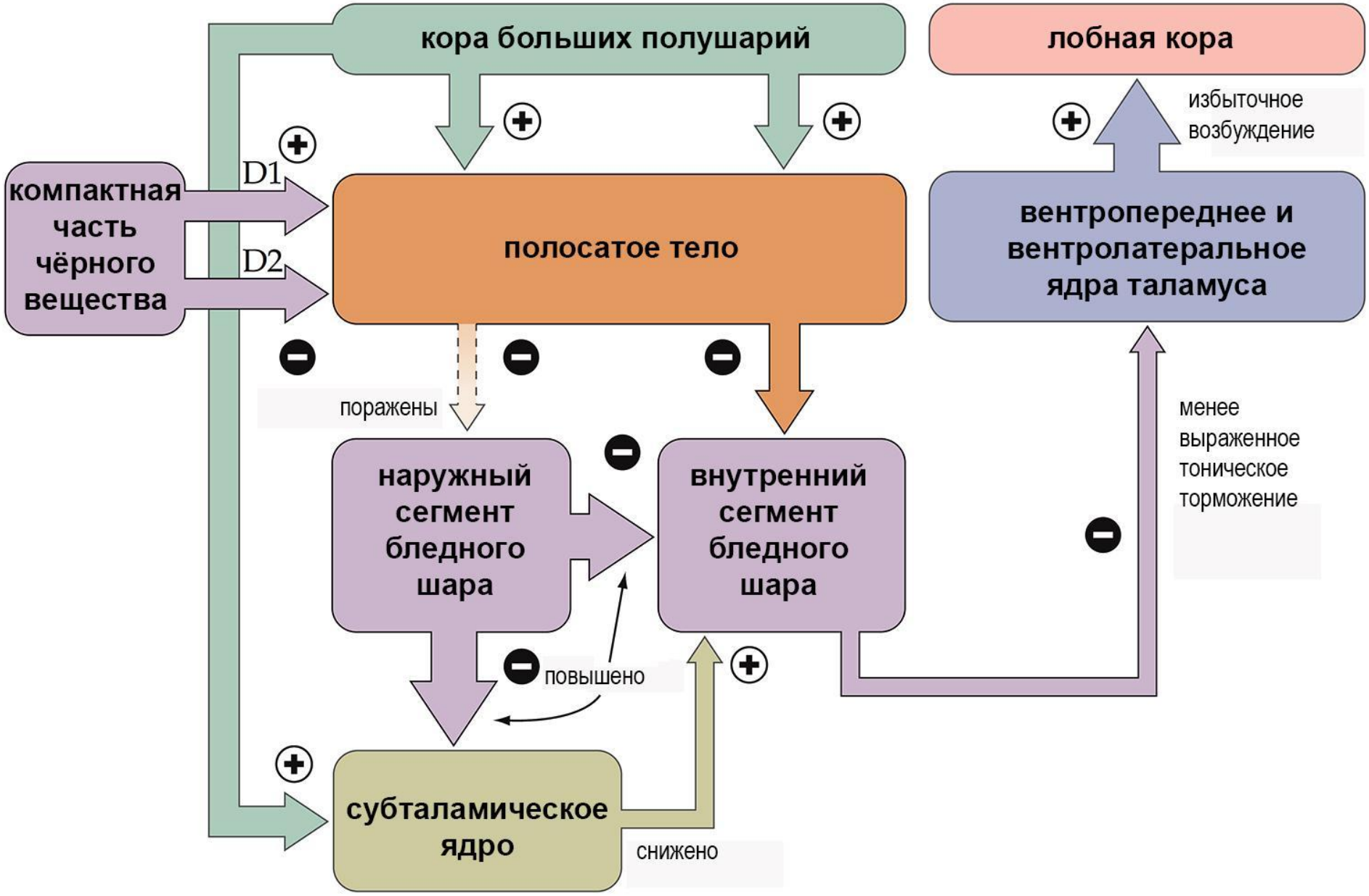


Comparison of motor and non-motor basal ganglia loops.


(A)
Caudate
Record 1
Substantia nigra pars reticulata
Superior colliculus
Record 3
4
Record 2
Projections to horizontal and vertical gaze centers
1
Caudate
2
Substantia nigra pars reticulata
3
Superior colliculus
4
Eye movement


Cerebral cortex
Thalamus
Caudal intralaminar nuclei
Striatum
STN
GPe
SNc
GPi/SNr
Basal ganglia
PPTg


кора больших полушарий
лобная кора
поражены
D1
D2
компактная часть чёрного вещества
полосатое тело
вентропереднее и вентролатеральное ядра таламуса
подавление возбуждения
повышено
снижено
наружный сегмент бледного шара
внутренний сегмент бледного шара
более выраженное тоническое тормозное влияние
субталамическое ядро
повышено


кора больших полушарий
лобная кора
избыточное возбуждение
компактная часть чёрного вещества
D1
D2
полосатое тело
вентропереднее и вентролатеральное ядра таламуса
поражены
менее выраженное тоническое торможение
наружный сегмент бледного шара
внутренний сегмент бледного шара
повышено
субталамическое ядро
снижено

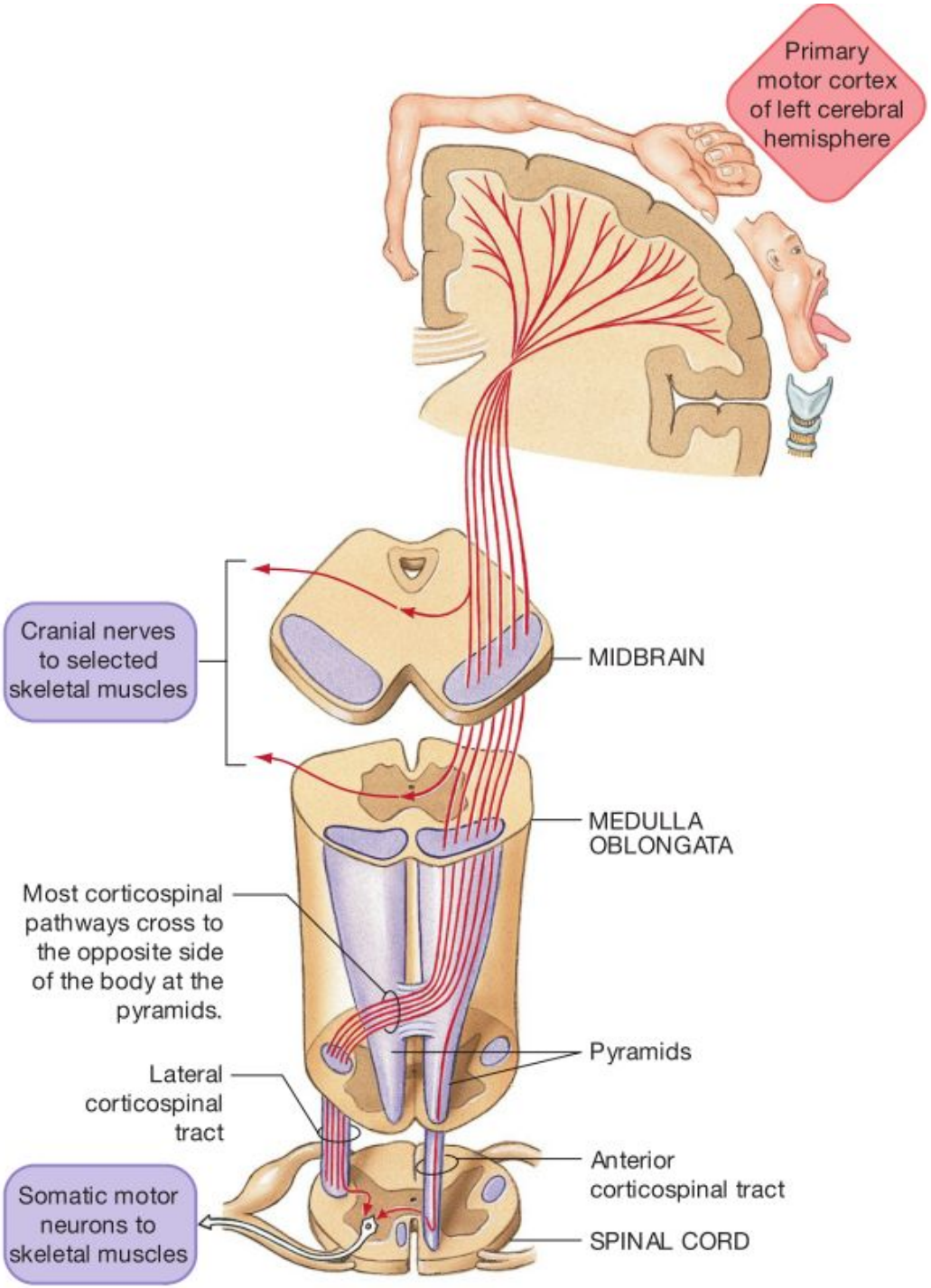

Primary motor cortex of left cerebral hemisphere
Cranial nerves to selected skeletal muscles
MIDBRAIN
MEDULLA OBLONGATA
Most corticospinal pathways cross to the opposite side of the body at the pyramids.
Pyramids
Lateral corticospinal tract
Anterior corticospinal tract
Somatic motor neurons to skeletal muscles
SPINAL CORD

TABLE 17.1 ■ Signs and Symptoms of Lower and Upper Motor Neuron Lesions

	Lower motor neuron syndrome	Upper motor neuron syndrome
Strength	Weakness or paralysis	Weakness
Muscle bulk	Severe atrophy develops	Mild or no atrophy develops
Reflexes	Hypoactive superficial and deep reflexes	Hyperactive deep reflexes after initial period of spinal shock
Special signs and symptoms	Initial signs and symptoms persist	Initial period of spinal shock, then spasticity ensues
	Fasciculations and fibrillations	Babinski's sign and clonus
	Geographic distribution of impairment (reflecting distribution of affected spinal segments, cranial nuclei, or spinal/cranial nerves)	More widespread (nongeographic) distribution of impairment in body regions
	Impairments of reflexive and gross and/or fine voluntary movements	Impairment of fine voluntary movements; gross movements relatively unimpaired