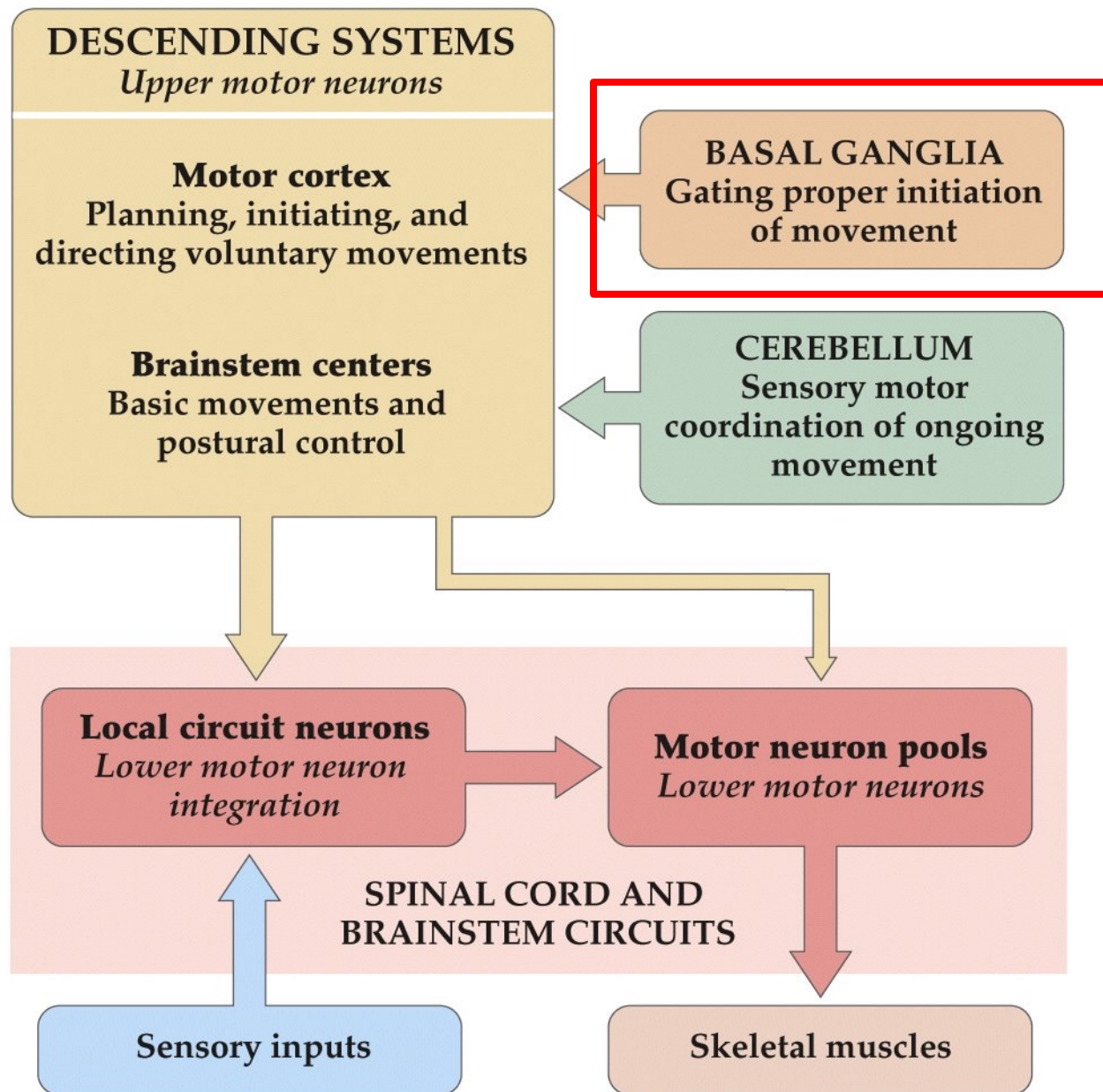


BMD ENG 301
Quantitative Systems Physiology
(Nervous System)

Basal Ganglia
2022_v1

Professor Malcolm MacIver

Organization of neural structures involved in the control of movement



Motor components of the basal ganglia

Cerebrum

Frontal cortex

Caudate

Internal capsule

Putamen

Globus pallidus,
external and internal segments

VA/VL complex
of thalamus

Subthalamic nuclei

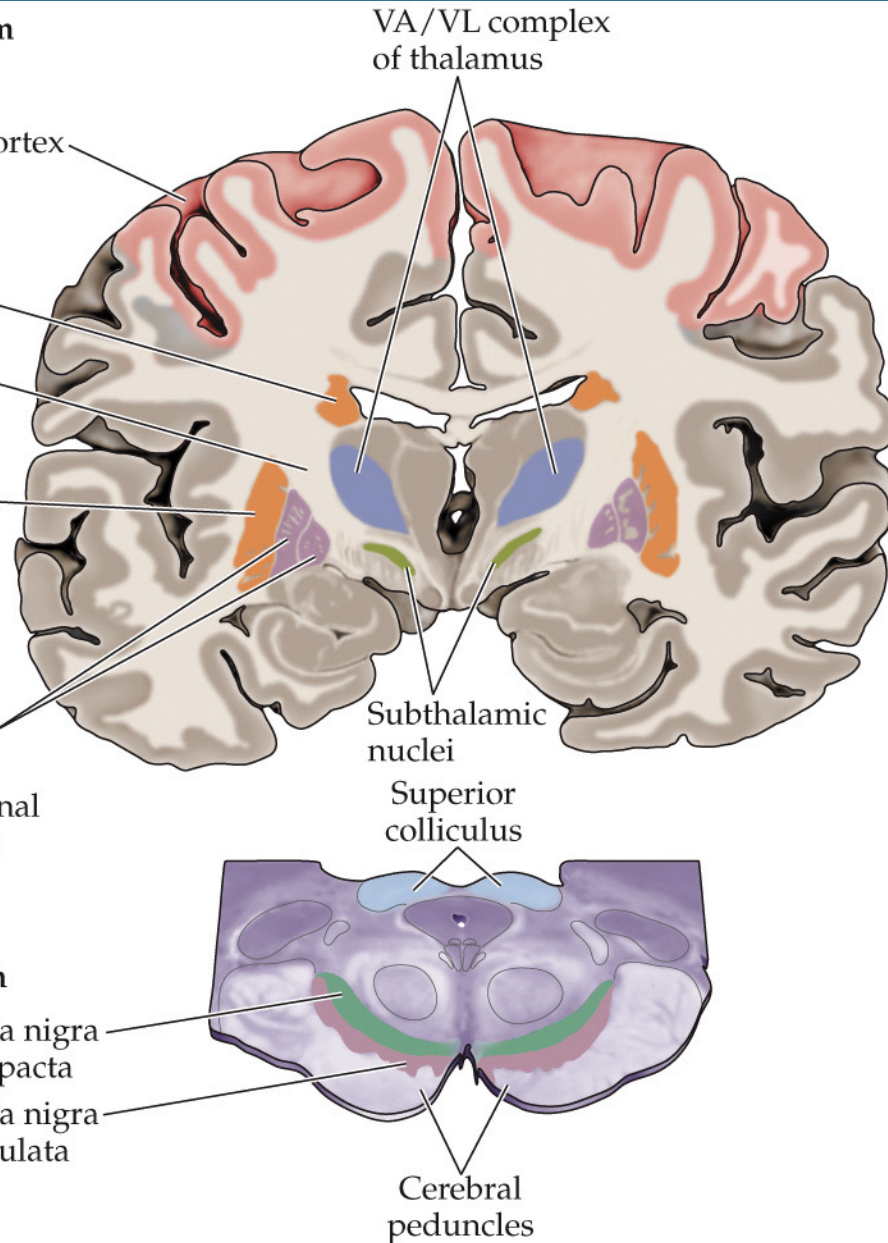
Superior colliculus

Midbrain

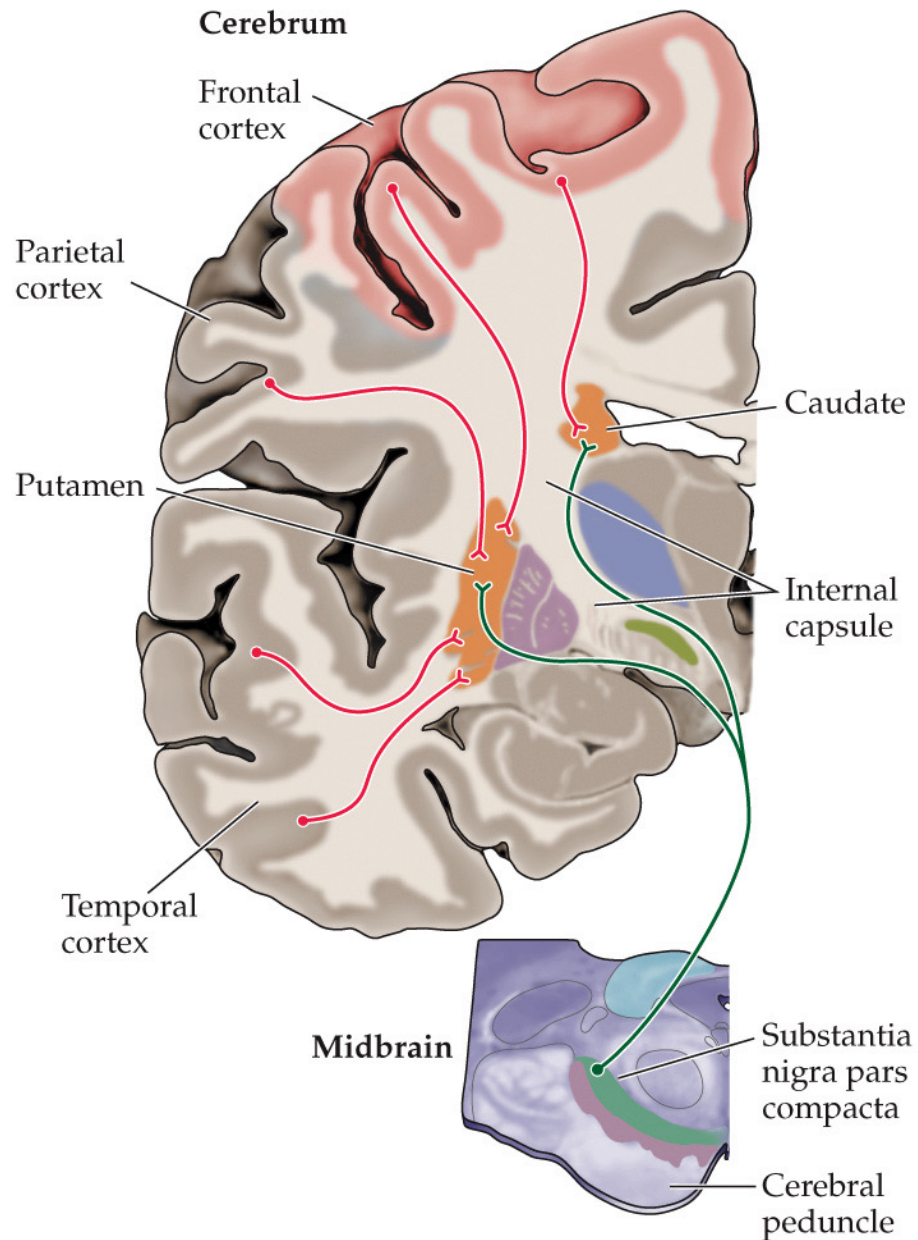
Substantia nigra
pars compacta

Substantia nigra
pars reticulata

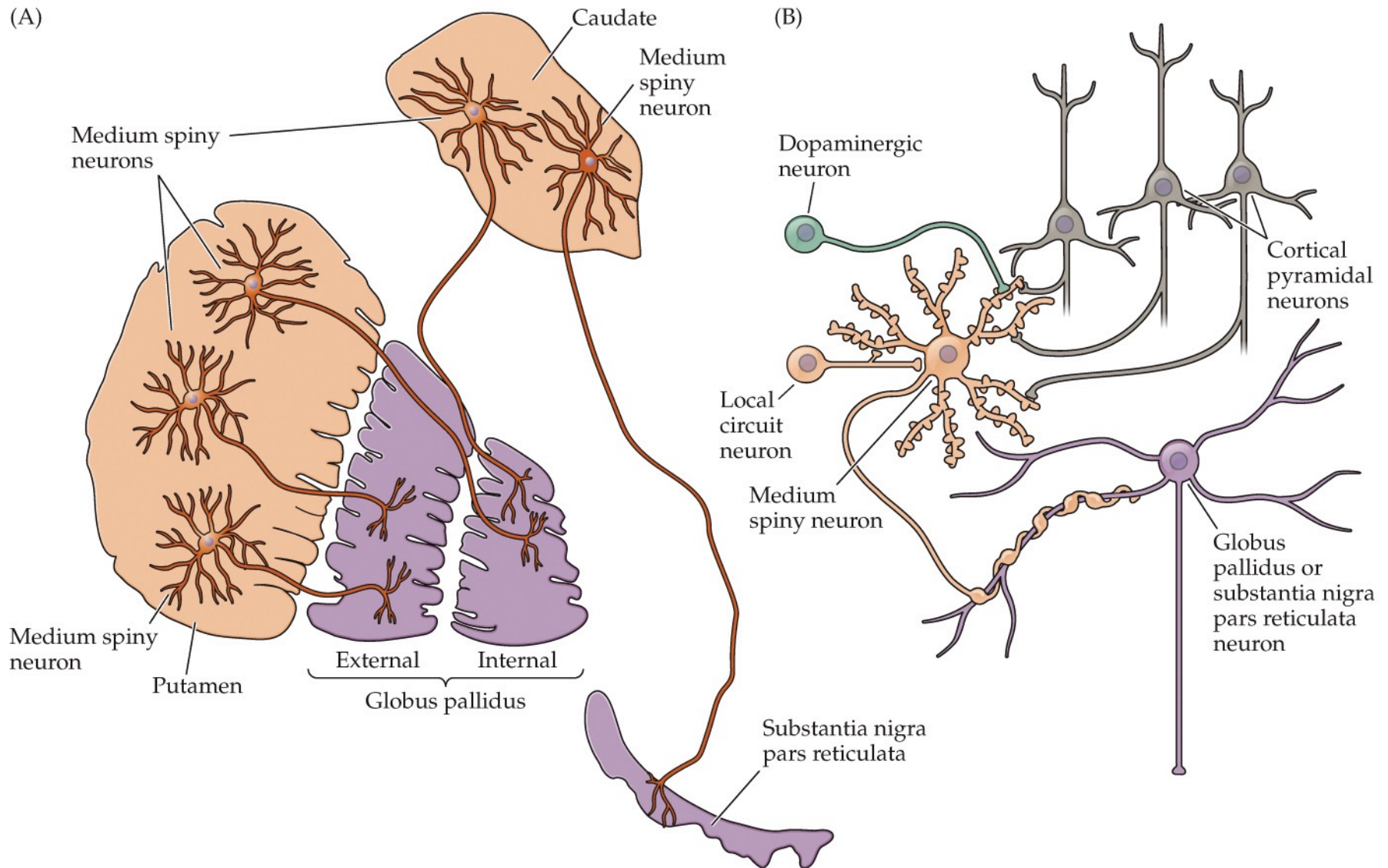
Cerebral
peduncles



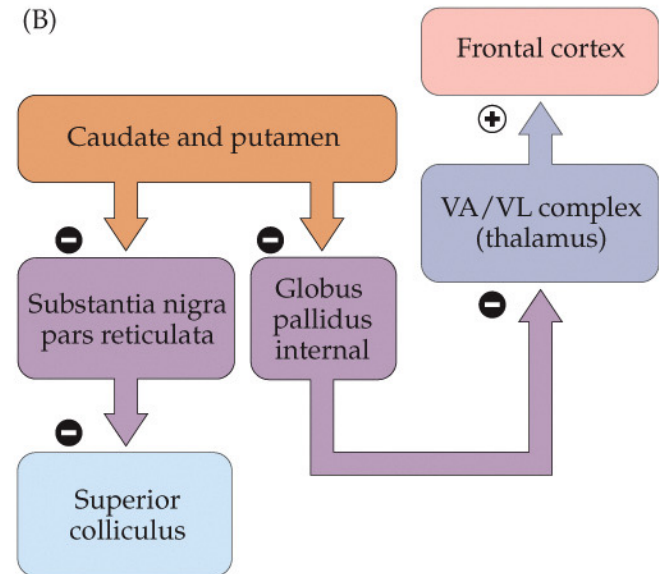
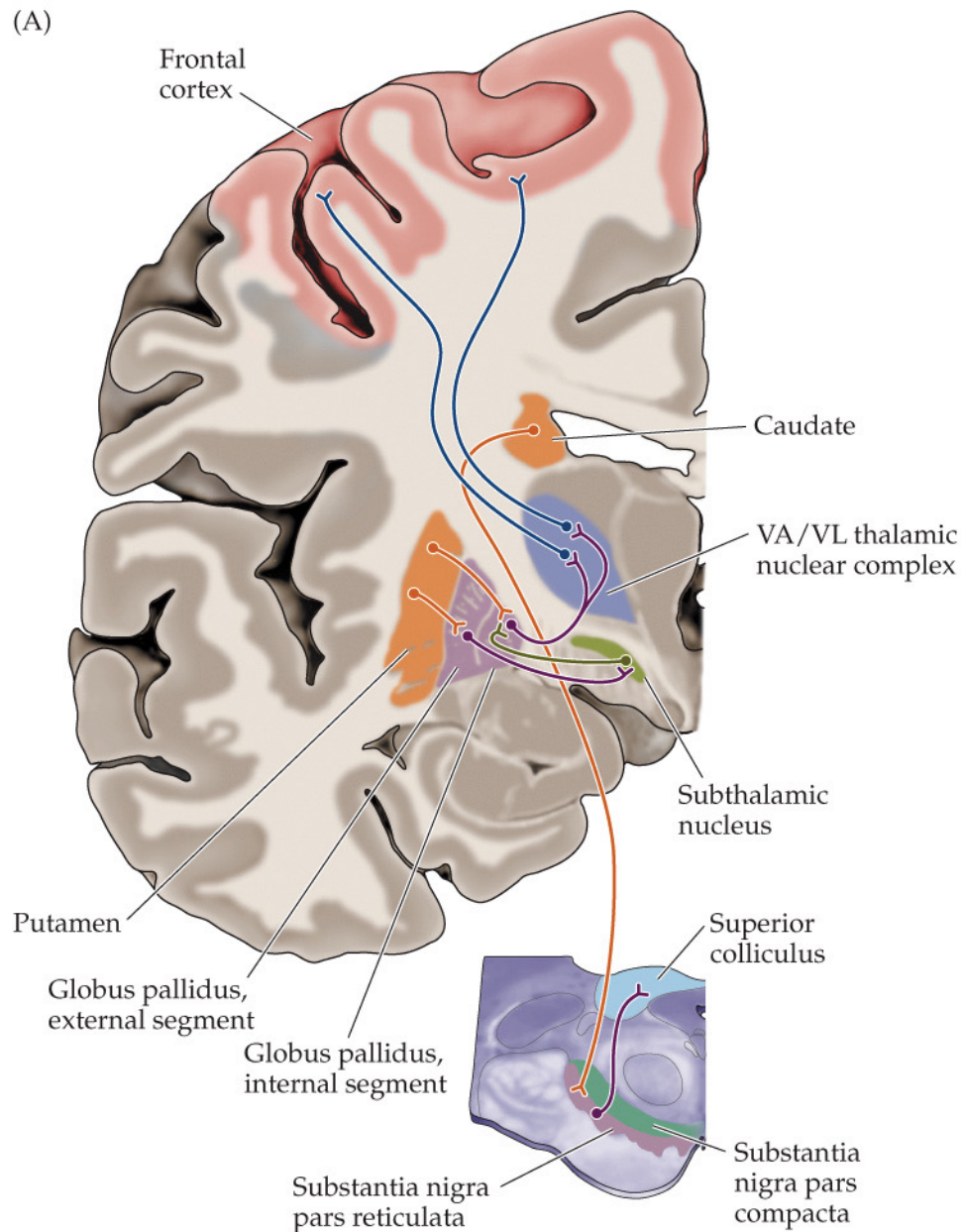
Anatomical organization of the inputs to the basal ganglia



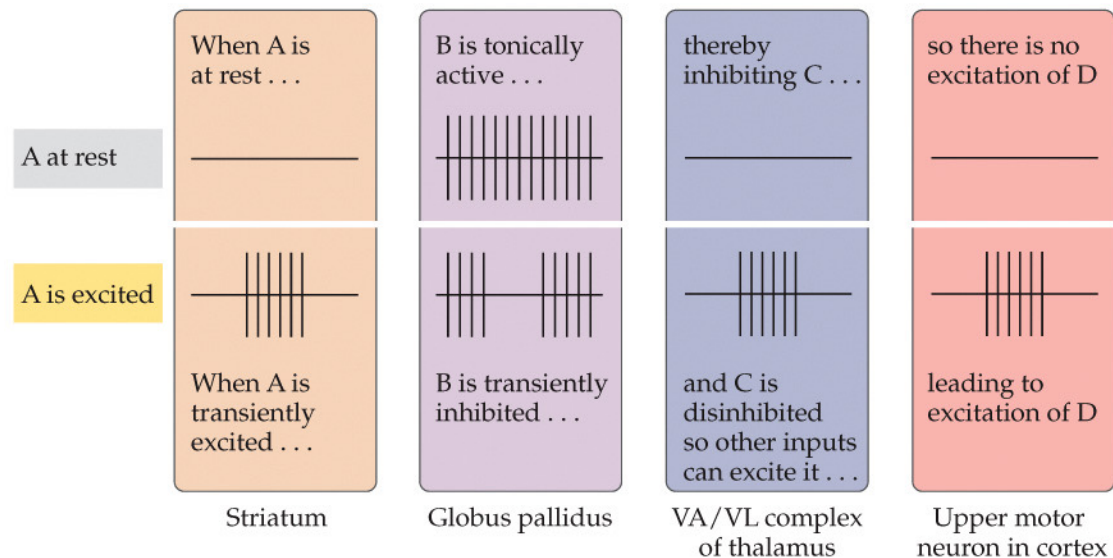
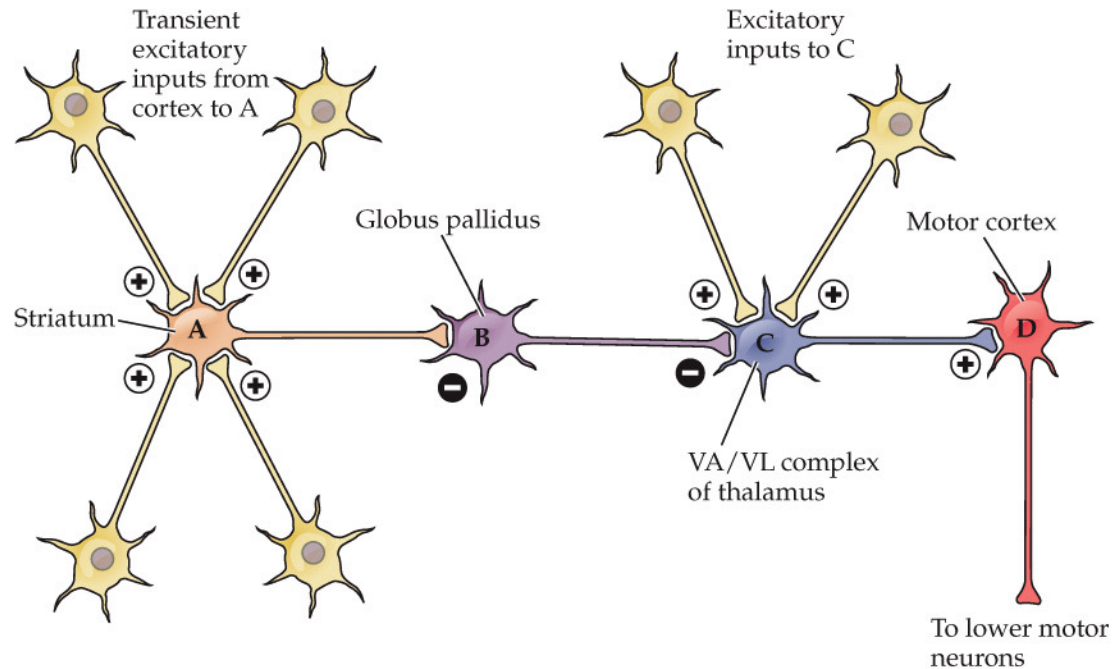
Neurons and circuits of the basal ganglia



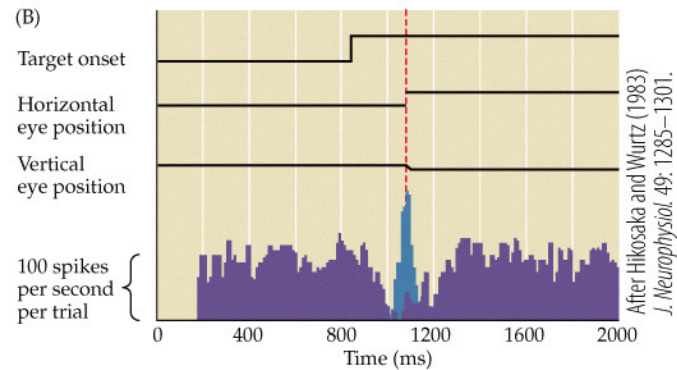
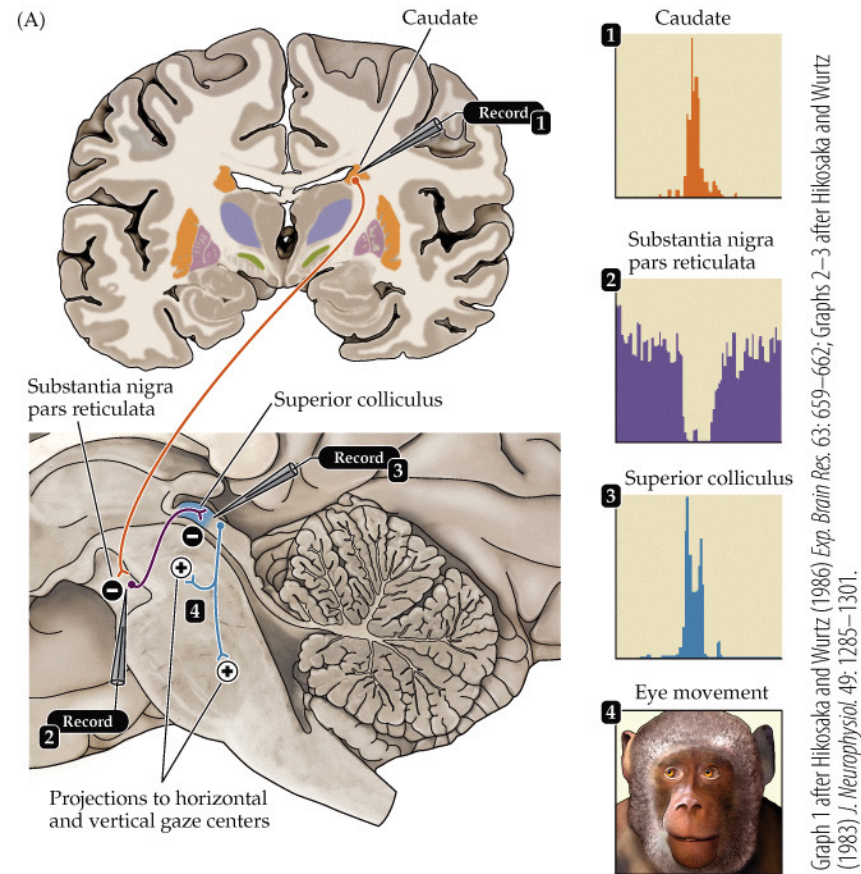
Functional organization of the intrinsic circuitry and outputs of the basal ganglia



A chain of nerve cells arranged in a disinhibitory circuit

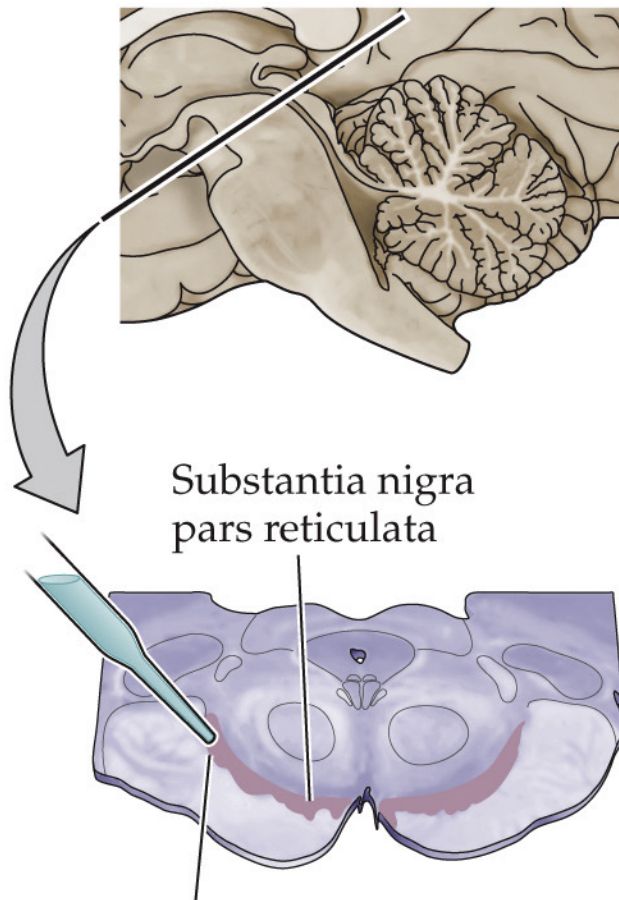


The role of basal ganglia disinhibition in the generation of saccadic eye movements



A GABA agonist produces involuntary movements resembling hyperkinesia

(A)

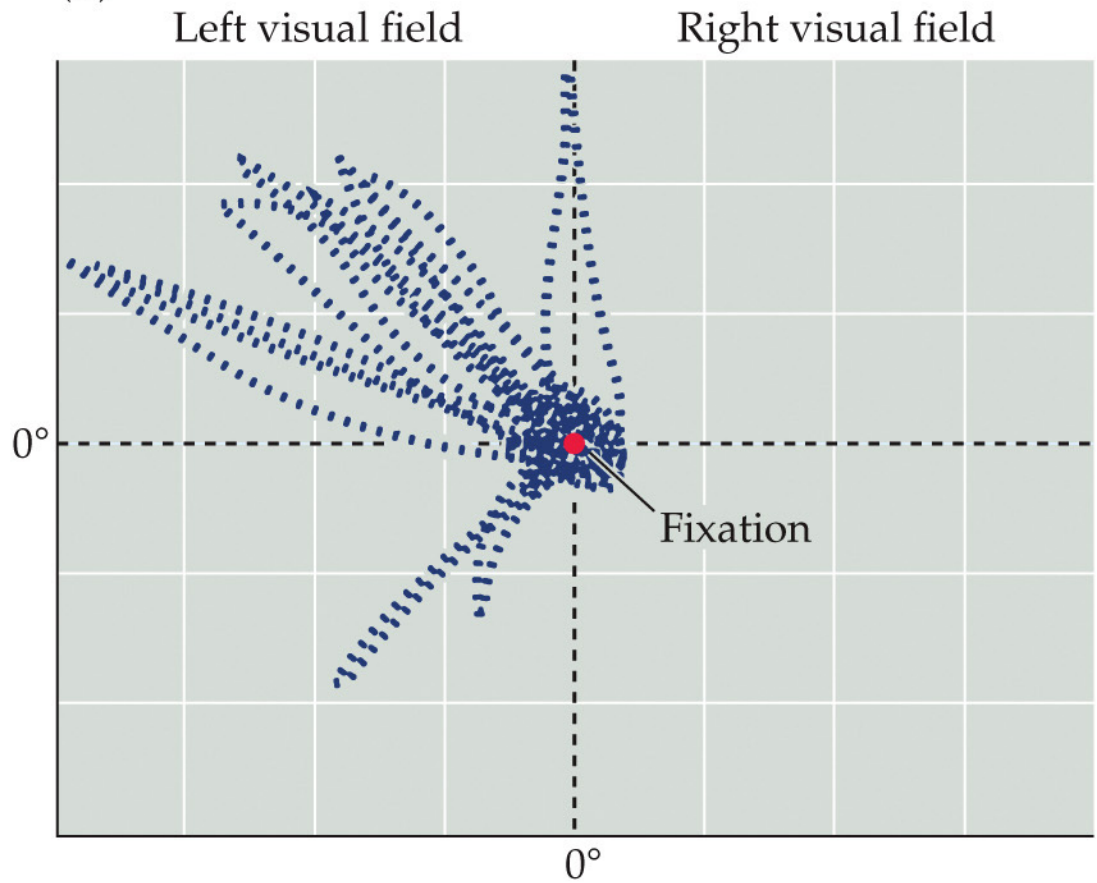


Muscimol injection

NEUROSCIENCE 6e, Figure 18.11

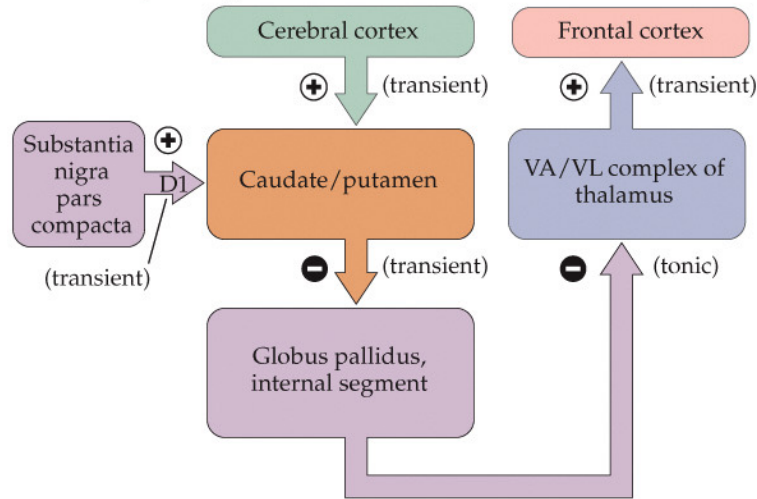
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(B)

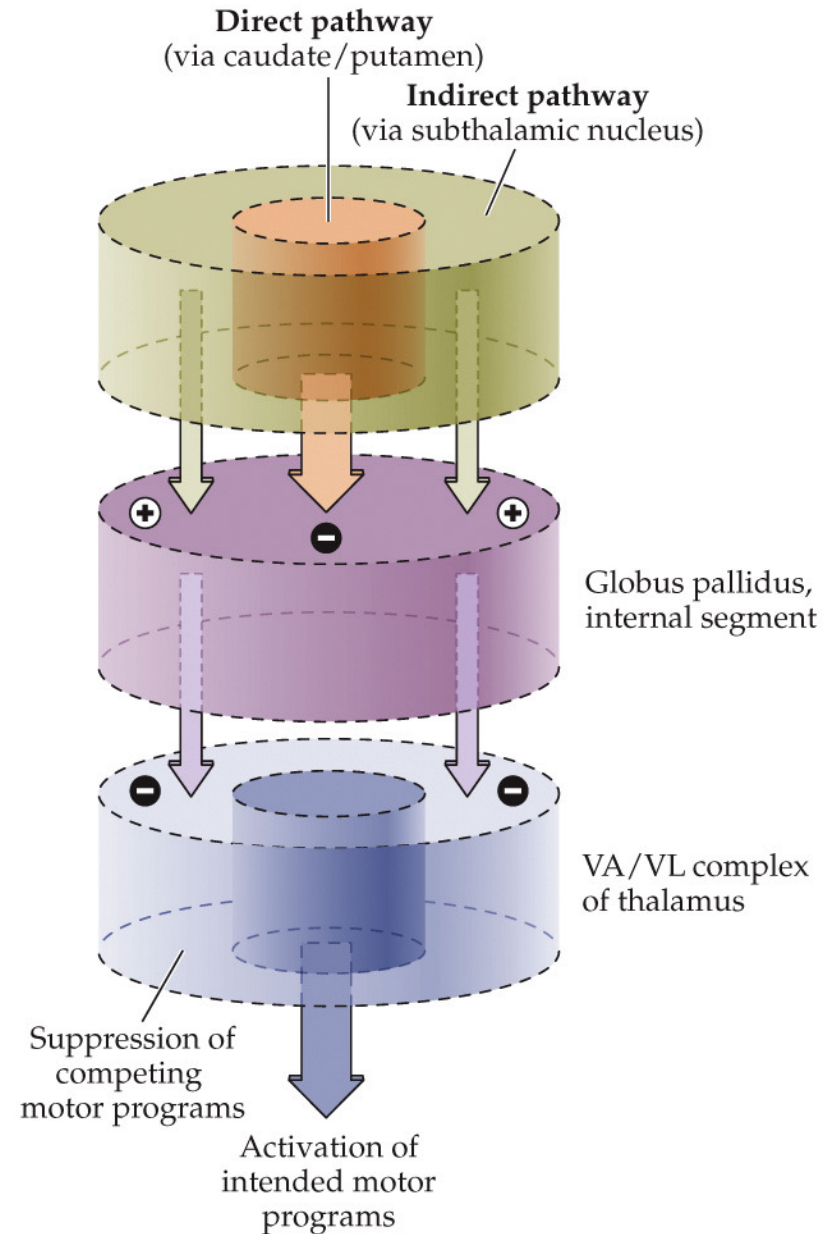
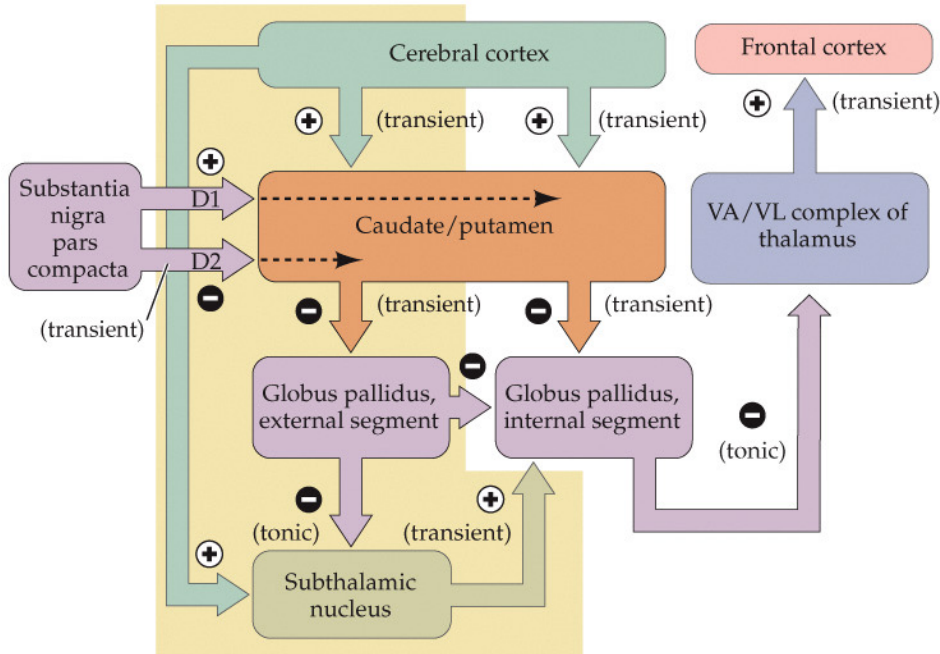


Disinhibition in the direct and indirect pathways through the basal ganglia

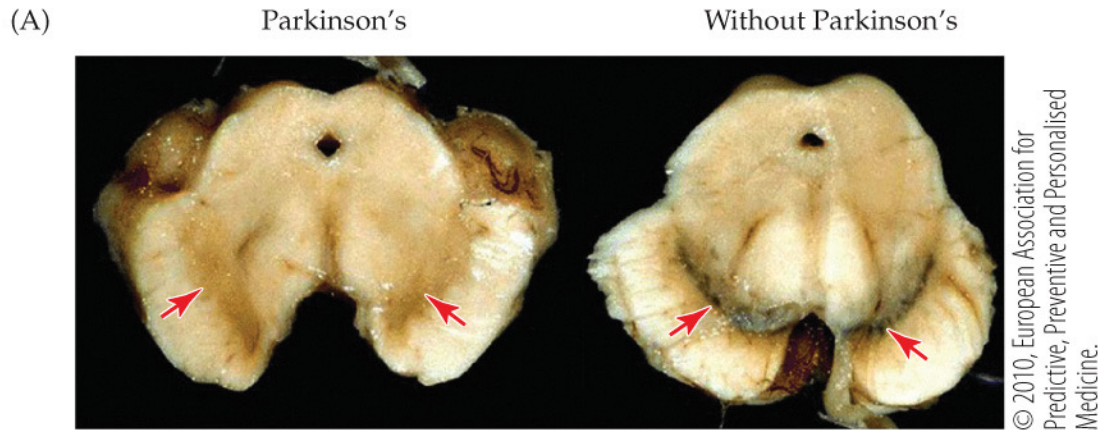
(A) Direct pathway



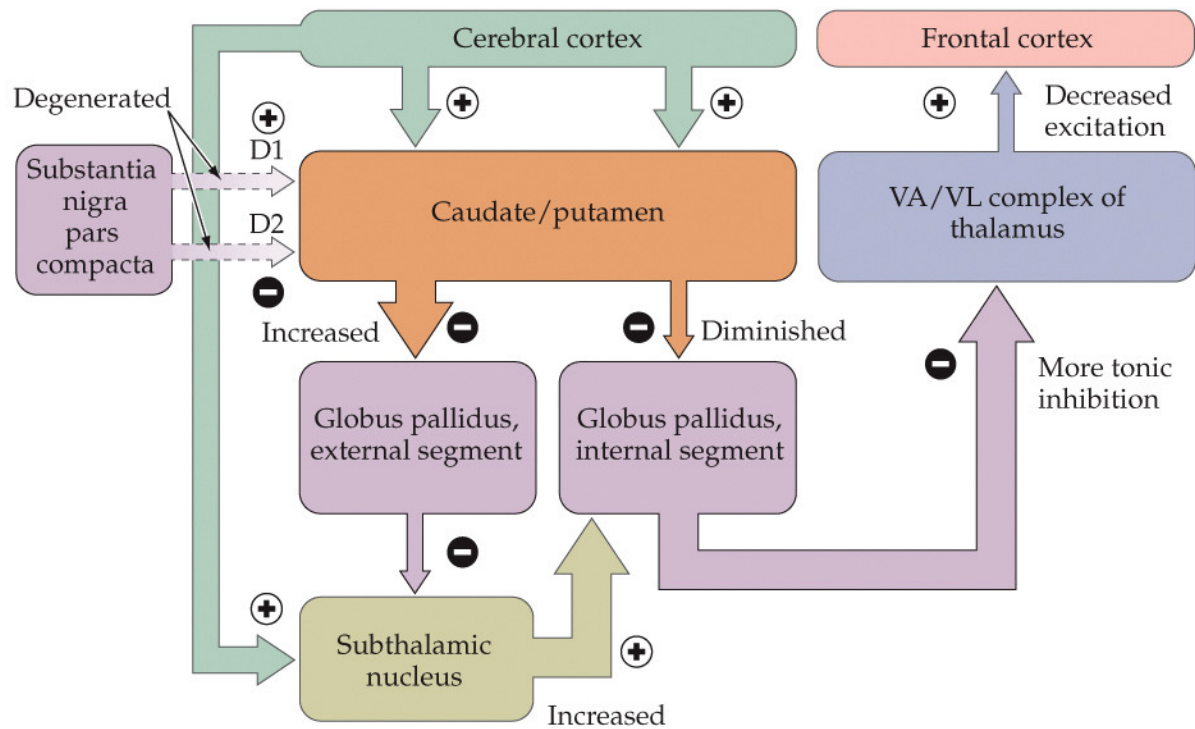
(B) Indirect and direct pathways



Parkinson's Disease



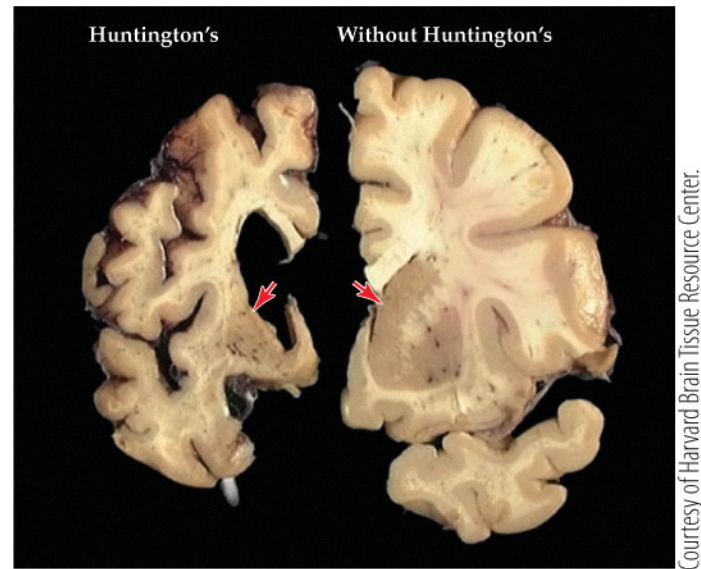
(B) Parkinson's disease (hypokinetic)



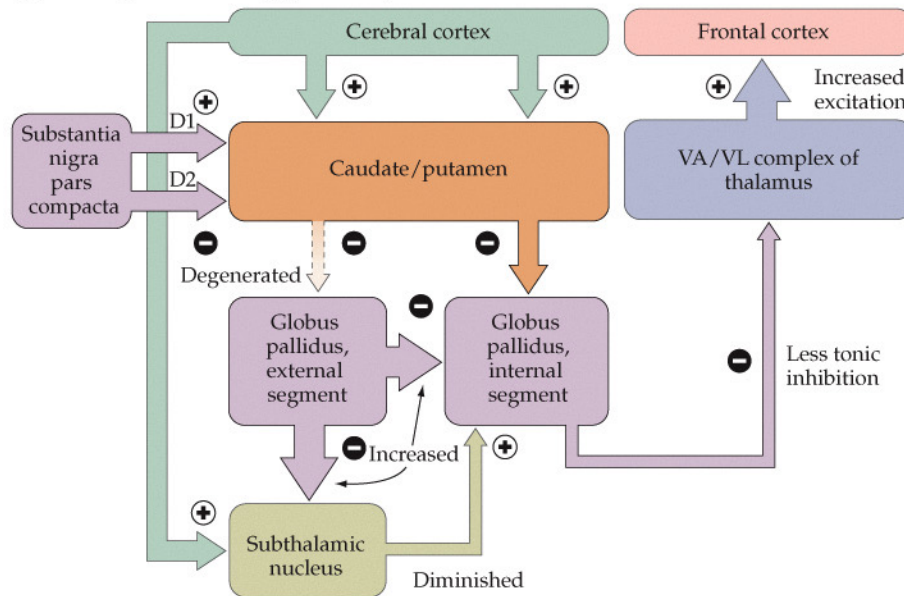
After DeLong (1990) *Trends Neurosci.* 13: 281–285.

Huntington's Disease

(A)



(B) Huntington's disease (hyperkinetic)

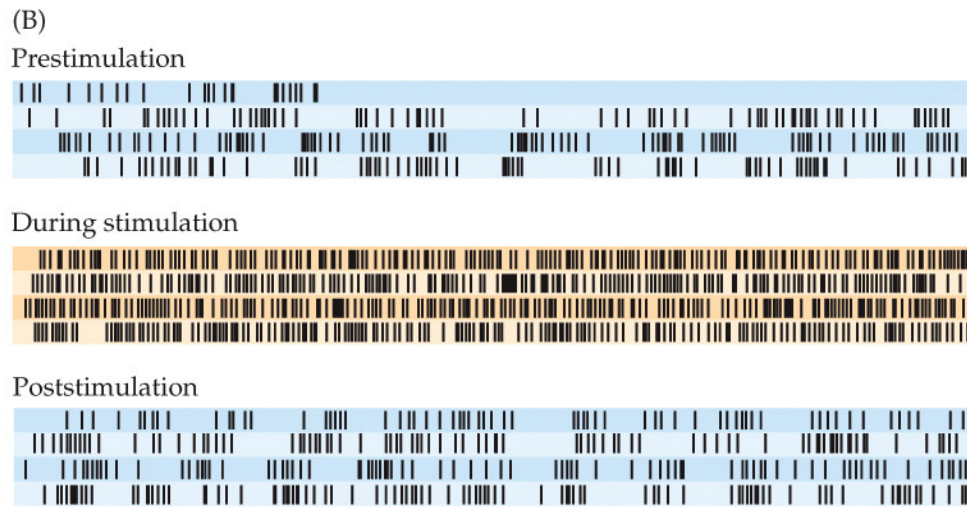
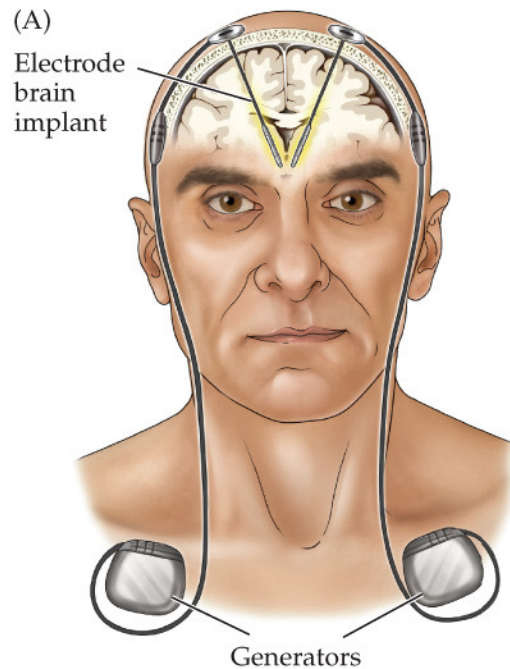


After DeLong (1990) *Trends Neurosci.* 13: 281–285.

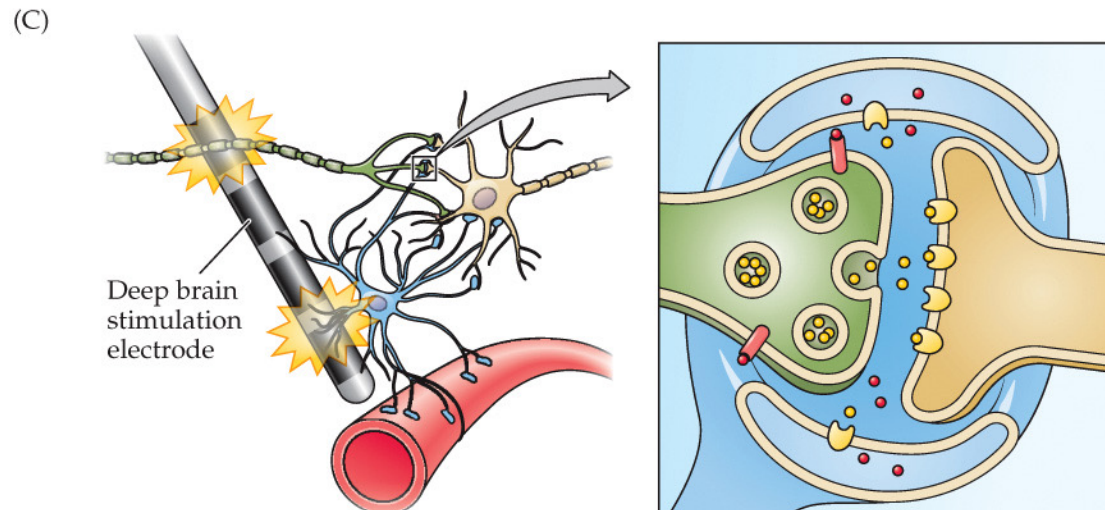
NEUROSCIENCE 6e, Figure 18.10

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Deep brain stimulation



From Hashimoto et al. (2003) *J. Neurosci.* 23: 1916–1923.



After McIntyre and Anderson (2016) *J. Neurochem.* 139 (Suppl. 1): 338–345.

Basal ganglia loops and non-motor brain functions

MOTOR LOOPS

NON-MOTOR LOOPS

