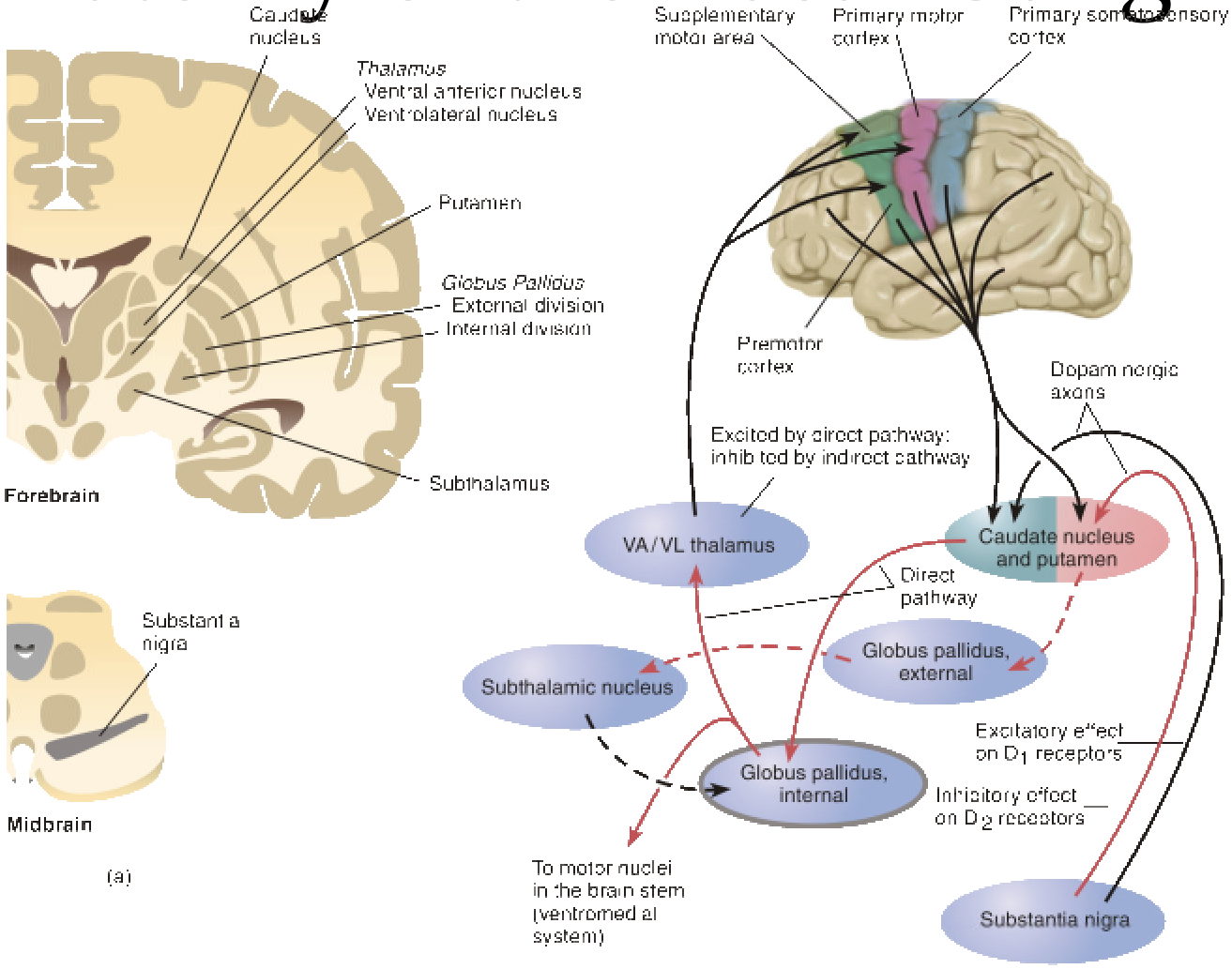
The Basal Ganglia

- Basal ganglia consist of the caudate nucleus, the putamen and the globus pallidus
  - Input to the basal ganglia is from the primary motor cortex and the substantia nigra
  - Output of the basal ganglia is to
    - Primary motor cortex, supplemental motor area, premotor cortex
    - Brainstem motor nuclei (ventromedial pathways)
  - Cortical-basal ganglia loop
    - Frontal, parietal, temporal cortex send axons to caudate/putamen
    - Caudate/putamen projects to the globus pallidus
    - Globus pallidus projects back to motor cortex via thalamic nuclei

Anatomy of the Basal Ganglia

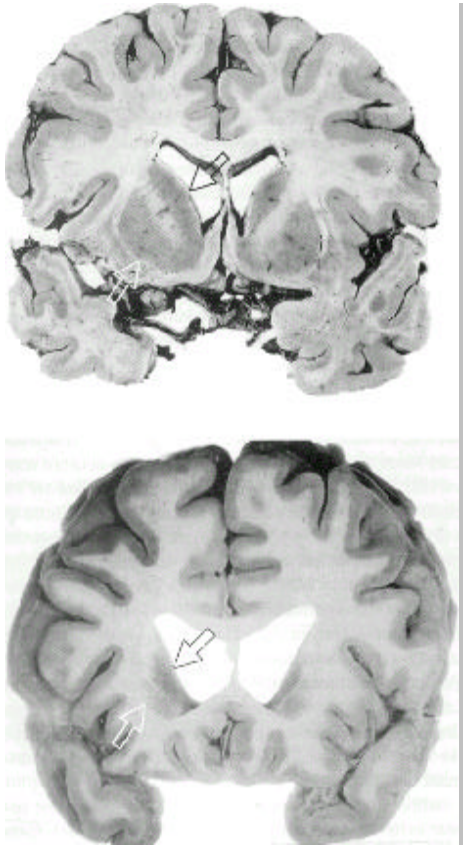


Parkinson's Disease

- Parkinson's disease (PD) involves muscle rigidity, resting tremor, slow movements
  - Parkinson's results from damage to dopamine neurons within the nigrostriatal bundle (projects to caudate and putamen)
  - Slow movements and postural problems result from
    - Loss of excitatory input to the direct circuit (caudate-Gpi-VA/VL thalamus-motor cortex)
    - Loss of output from the indirect circuit (which is overall an excitatory circuit for motor behavior)
  - Neurological treatments for PD:
    - Transplants of dopamine-secreting neurons (fetal subtantia nigra cells or cells from the carotid body)
    - Stereotaxic lesions of the globus pallidus (internal division) alleviates some symptoms of Parkinson's disease

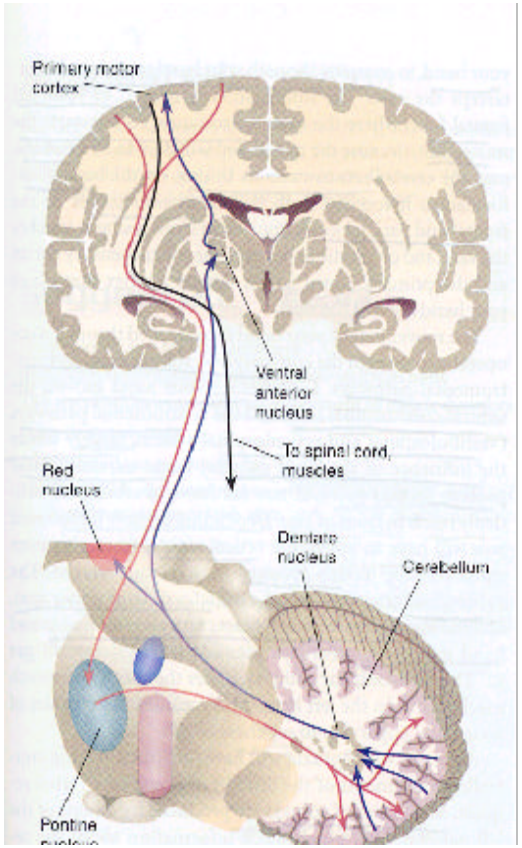
Huntington's Disease

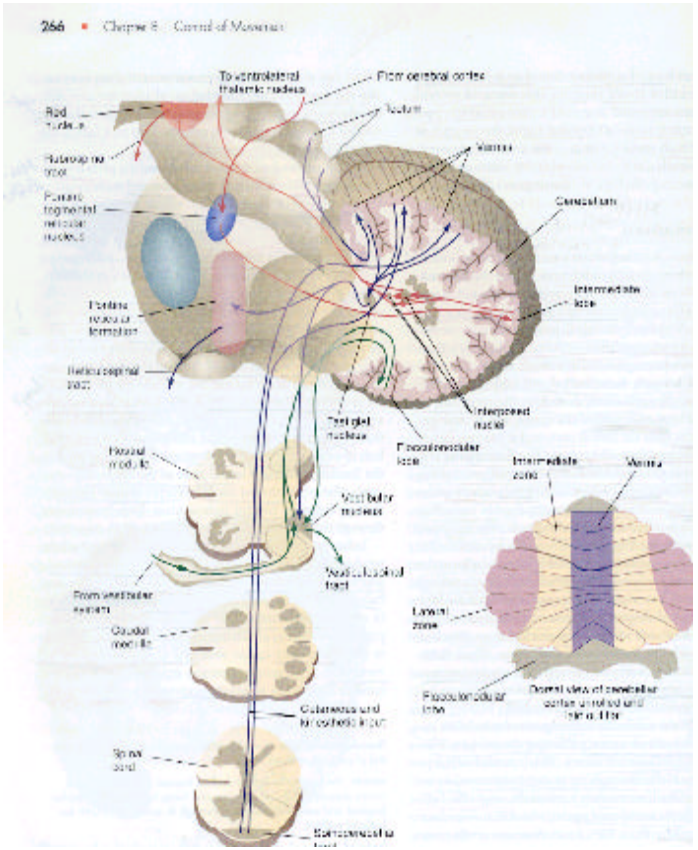
- Huntington's disease (HD) involves uncontrollable, jerky movements of the limbs
  - HD is caused by degeneration of the caudate nucleus and putamen
  - Cell loss involves GABA-secreting axons that innervate the external division of the globus pallidus (GPe)
  - The GPe cells increase their activity, which inhibits the activity of the subthalamic nucleus, which reduces the activity level of the GPi, resulting in excessive movements
- HD is a hereditary disorder caused by a dominant gene on chromosome 4
  - This gene produces a faulty version of the protein huntingtin



The Cerebellum

- Cerebellum consists of two hemispheres with associated deep nuclei
  - Flocculonodular lobe is located at the caudal aspect of the cerebellum
    - This lobe has inputs and outputs to the vestibular system
    - Involved in control of posture
  - Vermis is located on the midline of the cerebellum
    - Receives auditory and visual information from the tectum and cutaneous information from the spinal cord
    - Vermis projects to the fastigial nucleus which in turn projects to the vestibular nucleus and to brainstem motor nuclei
- Damage to the cerebellum generally results in jerky, erratic and uncoordinated movements


Primary motor cortex
Ventral anterior nucleus
To spinal cord, muscles
Red nucleus
Dentate nucleus
Cerebellum
Pontine


To contralateral thalamic nucleus
From cerebral cortex
Red nucleus
Nucleus
Rubrospinal tract
Vermis
Pontine tegmental reticular nucleus
Cerebellum
Intermediate lobe
Pontine reticular formation
Reticulospinal tract
Interposed nuclei
Fastigial nucleus
Flocculonodular lobe
Flocculus
Vestibular nucleus
Vestibulospinal tract
From vestibular system
Caudal reticular
Corticospinal and tectospinal tract
Spinal cord
Spinocerebellar tract
Intermediate zone
Vermis
Lateral zone
Flocculonodular lobe
Dorsal view of cerebellar cortex unfolded and flattened