Cerebellum by Pierre Johnson

I used the curriculum, lecture notes and slides, Nadeau textbook, Nolte textbook, and Haines atlas. All objectives are addressed.

Functions:

I. Muscle (motor) Coordination
- -Muscle Tone
- -Balance and Equilibrium
- -Posture

II. Motor Learning

How?

Cerebellum compares the intended movement with the movement occurring and it smoothes the contractions and relaxations of striated muscle (which is needed for all automatic and postural movements).

- -the cerebellum receives unconscious proprioceptive info. from deep tissues of the body through the spinocerebellar tracts (limbs send info to spine which send it to the cerebellum)
- -receives input from the Vestibular system
- - receives input from reticular formation of the brain stem.

***Most* Important concepts to grasp about Cerebellum!!!!!!!!!!!!!!!!!!!!!!!!!!!!**

Although the cerebellum has primary motor function, it has **NO** direct connections to Lower Motor Neurons.

- -Cerebellum **Must** communicate to an Upper Motor Neuron for actions to happen, which it does by sending neural info to the brainstem UMN nuclei
- -Cerebellum must communicate to the Cortex which it does so through VA & VL of Thalamus

Unilateral lesion of Cerebellar hemisphere or peduncles result in Ipsilateral Movement disorder!!!!!!!!!!!!!!!!!!!!!!!!!!!!

Cerebellar hemispheres communicate to the contralateral Thalamus and contralateral Cortex

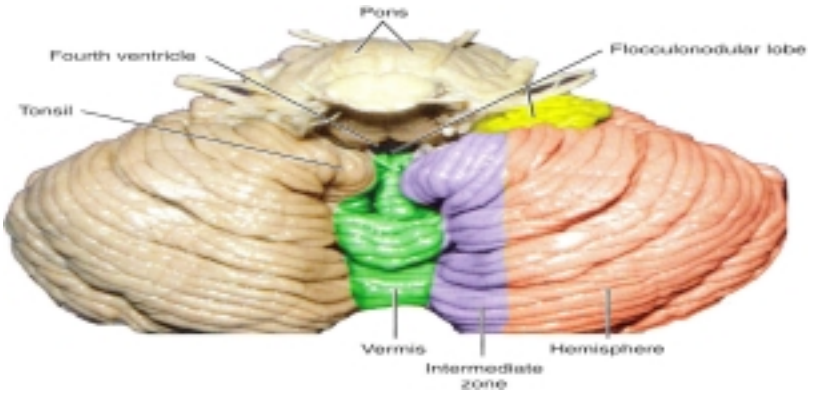
Sectional break-up of the cerebellum:

It must always be kept in mind that although the cerebellum is divided into three separate lobes, the zones for the lobes are the same. (ie. The Flocculonodular, Posterior, and Anterior *Lobes* all have a vermis (zone), intermediate zone, and a lateral hemisphere).

- -The lobes themselves serve different purposes, but the zones of each lobe all share the same responsibilities.
- -The cerebellum is attached to the spinal cord by three peduncles that carry neural info.

Lobes of Cerebellum

	Anterior Lobe	Posterior Lobe	Floccolondular Lobe
Nucleus Within lobe (only)			Vestibular Nucleus
Function			Equilibrium & Balance and control of eye mvmts.
Alternate name			Vestibulocerebellum
Input			Proprioceptive input from vestibular nuclei
Problems that arise with lesion			Gait disturbances, head rotation, nystagmus, saccadic breakdown of ocular smooth pursuit



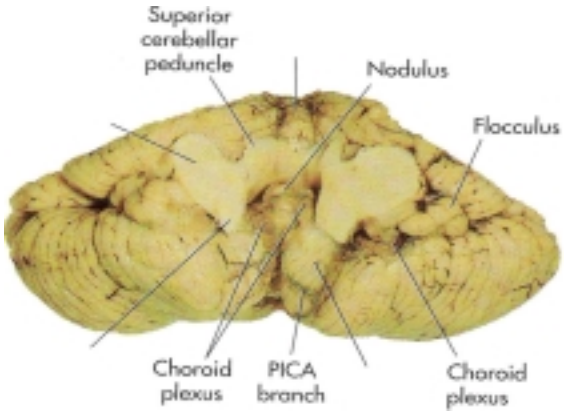
Zones of the Cerebellum

	Vermis	Intermediate	Lateral

		Zone	Hemisphere
Deep Nucleus within Zone	Fastigal Nucleus	Emboliform & Globose Nuclei	Dentate Nucleus
Function	Locomotion, Gaze Control, Postural Control of head neck, trunk, leg, gait, stereotyped mvmts.	Distal muscle control coordination in ipsilateral arm and hand, online comparison of ongoing motor activities with the desired activities	Coordination of skilled mvmt. (distal limbs), Planning mvmts., Learning Motor Skills
Alternate Name	Spinocerebellum (Vermis +Int.zone)	Spinocerebellum (Vermis +Int.zone)	Cerebrocerebellum Neocerebellum(lat. Hem. + midline vermis)
Extra Facts	Dorsal (and Ant) Spinocerebellar Tract plays role in posture of limb muscles; carries both space and modality specific info from lower trunk and legs.	Dorsal (and Ant.) Spinocerebellar Tract plays role in posture of limb muscles; carries both space and modality specific info from lower trunk and legs.	Influences motor pthwys. (corticospinal, corticobulbar, and corticopontine.
What problems arise with lesion	Poor balance during sitting and standing, broad-based, unsteady gait, tendency to fling legs while walking	Have many of the same complications as lateral hemisphere.	Hypotonia, pendular knee jerk, irregular trajectory and fluctuating velocity during reaching mvmts. (dyssynergia), inaccuracy of reaching dysmetria, *intention tremor*, gait disturb., Holmes sign (exaggerated mvmt. when resistance to mvmt. is eliminated

Peduncles of the Cerebellum

	Superior Peduncle	Middle Peduncle	Inferior Peduncle
What type of info goes through	Mostly output	Input from Cortex (through pontine nuclei)	Mostly input (from body and brainstem)



Blood Supply:
Posterior (mostly) and Anterior Inferior Cerebral Arteries {PICA & AICA}

Cell Types of the Cerebellum:
I. Purkinje Cells
- *-Only outflow projection neurons in the cerebellum*
- -Axons terminate on neurons in the Cerebellar nuclei (white matter), or on neurons in the Lateral Vestibular Nucleus at the pontine-medullary junction)
- *-Release GABA (inhibitory neurotrans.)*
- *-since Purkinje cell outflow is inhibitory, the output of cerebellar gray matter is inhibitory*

II. Basket Cells (Molecular Layer)
- -powerful *inhibitors* of Purkinje cells

III. Stellate Cells (Molecular Layer)
- -powerful *inhibitors* of Purkinje cells

IV. Granule Cells (Granular Layer)
- *-Only excitatory (Glutamate) interneurons in the cerebellum*
- -Excite Purkinje dendrites, which are the only ones that can leave
- -Axons form *parallel fibers* that contacts other cells

V. Golgi Cells (Granular Layer)
- -*Inhibit* Granule Cells

Fiber Types:

I. Mossy Fibers

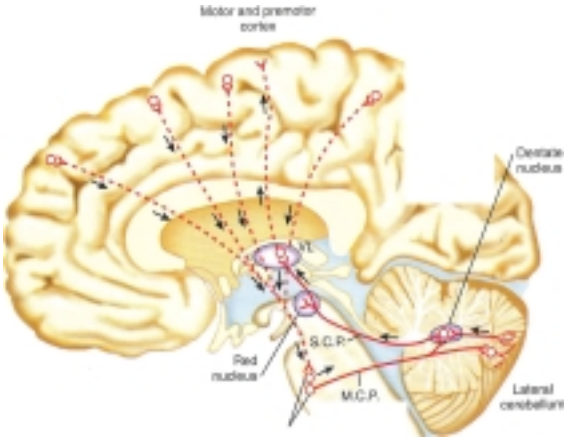
-from everywhere besides inferior olivary nucleus

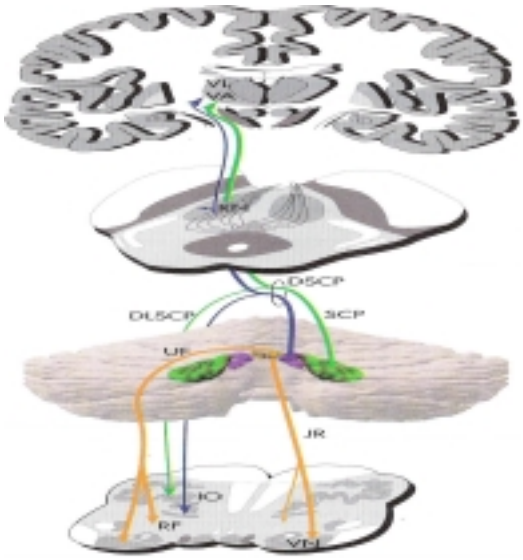
II. Climbing Fibers

-Exclusively rise from neurons in the inferior olivary nucleus

Pathway of Inputs to the Cerebellum:

Input from Body (extremities)>>>>>Spinal Cord (Clark's Nucleus T1-L2)>>>>>Cerebellum





Input from Cerebral (motor-related) Cortex (feed-forward input to cerebellum: goal or target info.)>>>>>Pontine Nuclei (via. *Corticobolbar tracts)*>>>>>Contralateral cerebellum (through middle cerebellar peduncle)

Tell-Tell signs of Cerebellar Lesion (Ipsilateral of Course):

I. Ataxia

-uncoordinated voluntary mvmt.

II. Hypotonia

III. Cerebellar Gait

-wide base

-may veer towards side of lesion
-will sway standing with feet together eyes open or closed(not a sign of Rhomberg b/c because none of those three senses are causing the patient to loose balance)

IV. Intention Tremor
-present when moving, not at rest

V. Dysdiadochokinesia
-inability to move rapidly

VI. Dysmetria
-can't measure distance, so there is a loss of control of range mvmts. (past-pointing), cant reach out to perform tasks

VII. Dysarthria
-slurred (scanning) speech

Common Causes of Cerebellar Lesions:

I. Multiple Sclerosis
II. Cerebellar Strokes
III.Tumors
IV. Degeneration
V. Wernicke-Korsakoff Syndrome
-caused by Thyamine Deficiency, mostly from alcohol abuse
-Wernicke's encephalopathy *symptoms* are gait ataxia, nystagmus, diplopia, strabismus
-Korsakoff syndrome- sever anterograde and retrograde amnesia
-treatment with glucose and no thiamine can result in death

VI. Alcoholic Cerebellar Degeneration (case 6-18 Nadeau)
-gait ataxia without limb ataxia
-different pathology than Wernicke's

VII. Cerebellar Hemorrhage
-vomiting
-ataxia

VIII. Fredrick's Ataxia
-Genetic (triple repeat GAA on Chrm.9)
-gradual onset in first 3 decades of life
-gait disturbances,dysarthria, sensory loss to extremities (case 6-20 Nadeau)

In the notes Dr. Galman says that we should read cycle 6-10 for the clinical correlates. It would be a good idea to check those out. I have completely covered everything else.