



UNIVERSITAS UDAYANA

REFERAT

# NEUROFISIOLOGI

## SEREBELUM

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A grayscale MRI scan of the human brain, specifically focusing on the cerebellum. The cerebellum is visible as a smaller, more textured structure compared to the larger cerebrum above it. The image shows the characteristic branching pattern of the cerebellar cortex.

# Serebelum

Organ motorik terbesar dalam tubuh manusia

**Keseimbangan**

**Tonus Otot**

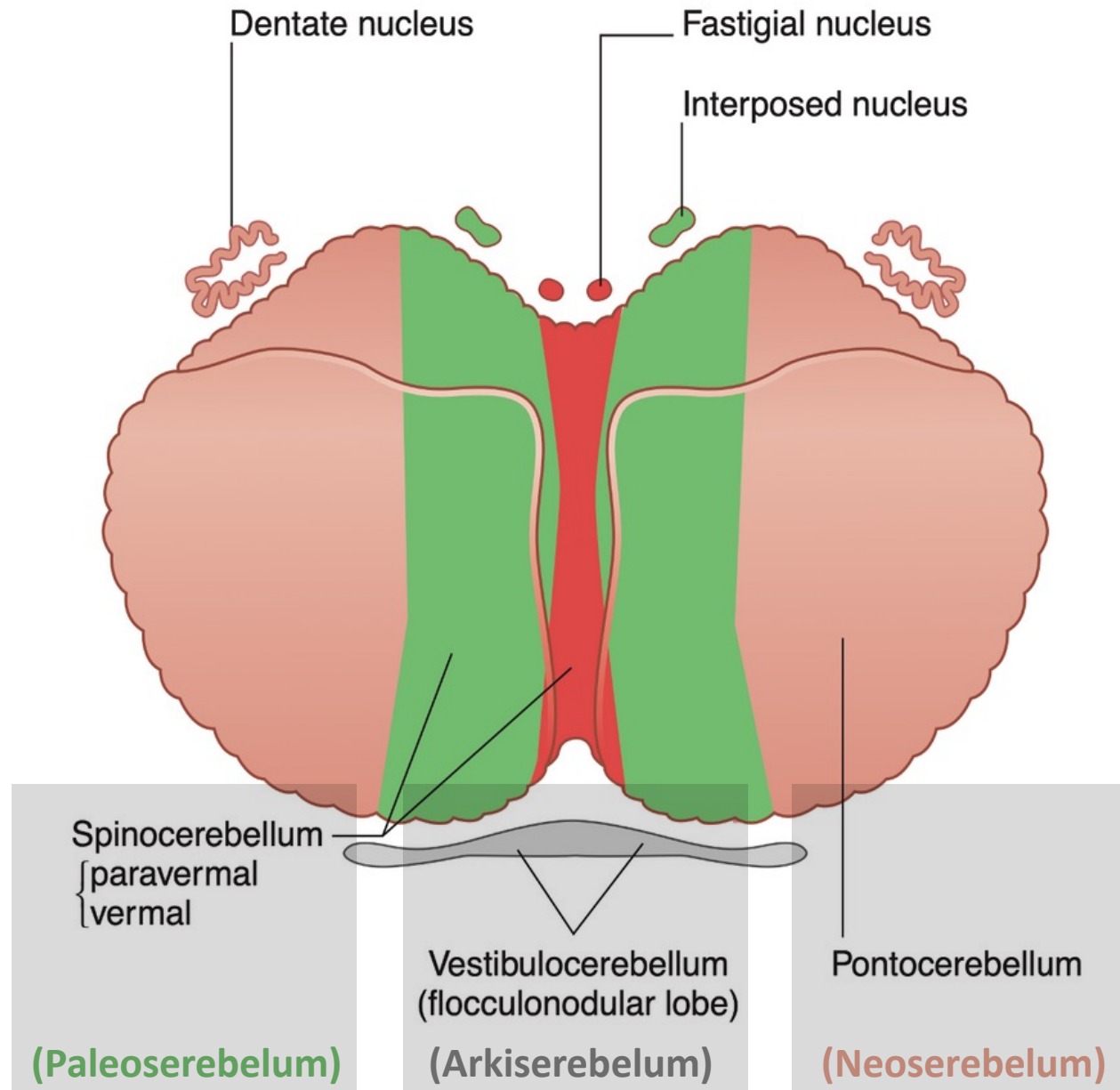
**Koordinasi**

**Pembelajaran Motorik**

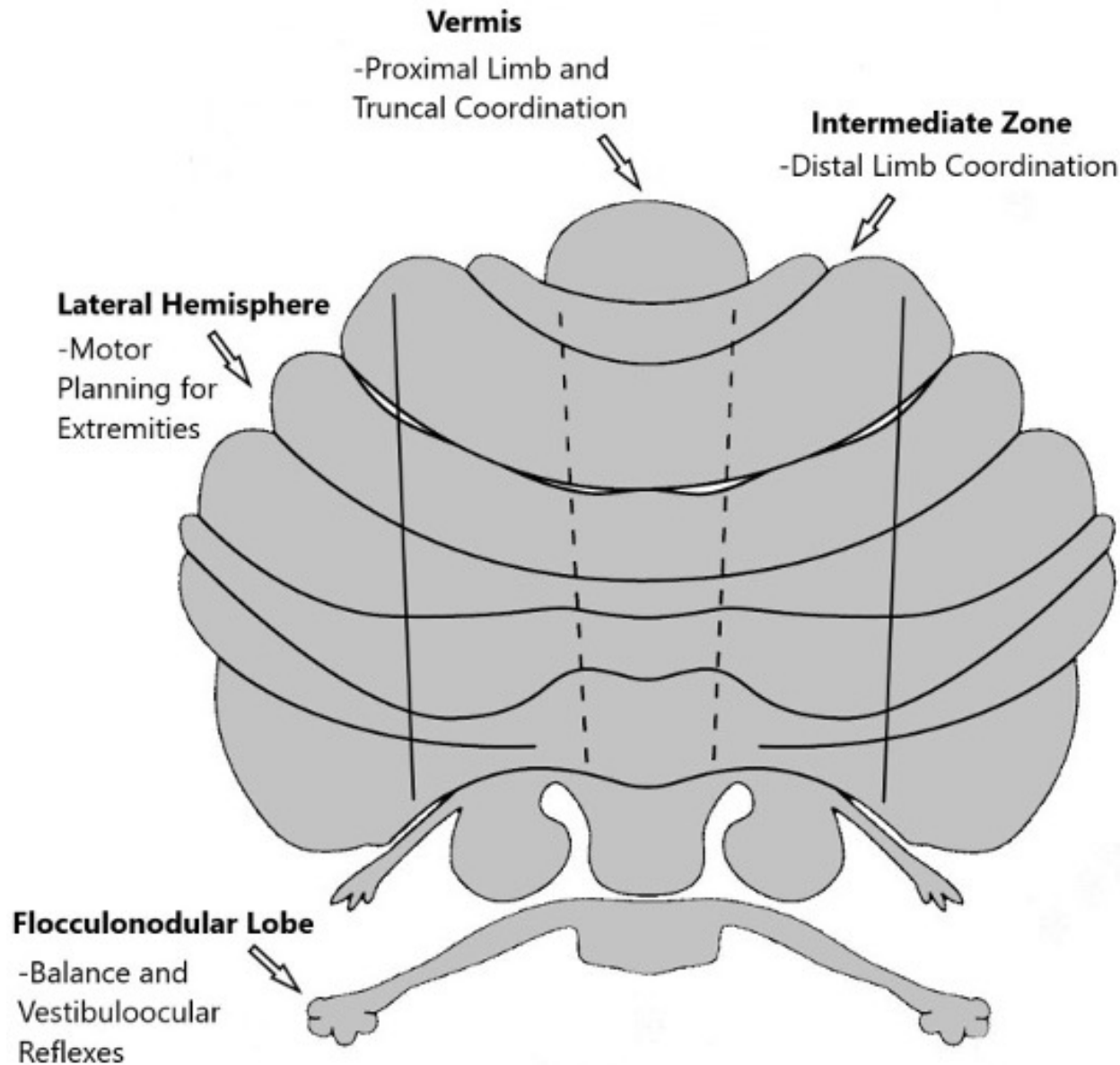
# Anatomi Fungsional Serebelum

<b>Filogenetik</b>	<b>Arkiserebelum</b>	<b>Paleoserebelum</b>	<b>Neoserebelum</b>
Anatomis	Flokulonodularis	Vermis dan Paravermis	Hemisfer lateral
Area	<b>Vestibuloserebelum</b>	<b>Spinocerebelum</b>	<b>Cerebroserebelum</b>
Nukleus	N. Vestibularis	Fastigeal, Interposed	Dentatus
Fungsi	Keseimbangan	Koordinasi	Motor Planning

# Area Fungsional Serebelum



# Area Fungsional Serebelum



# Anatomi Fungsional Serebelum

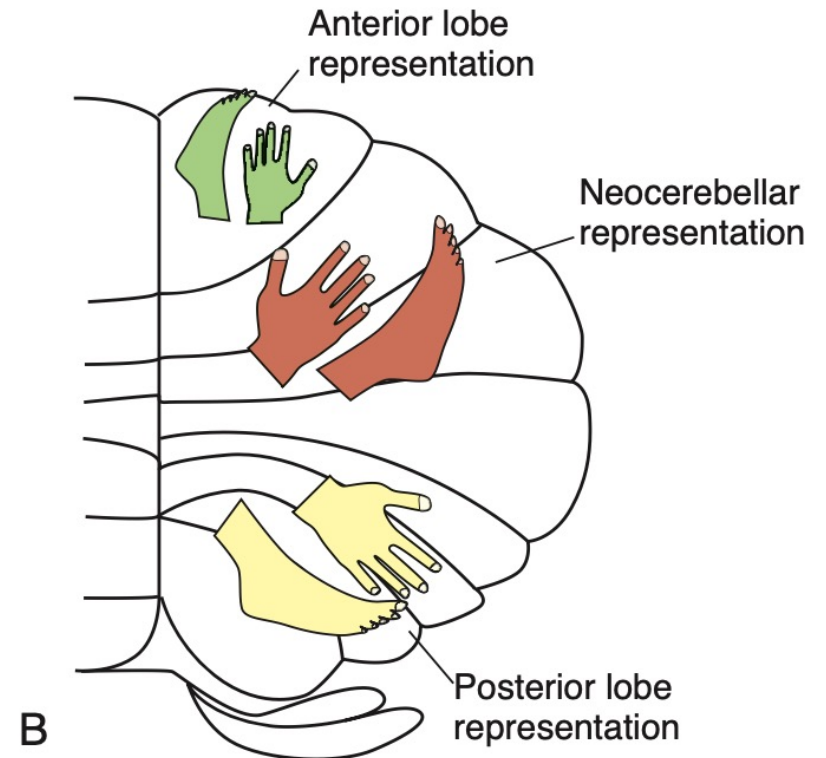
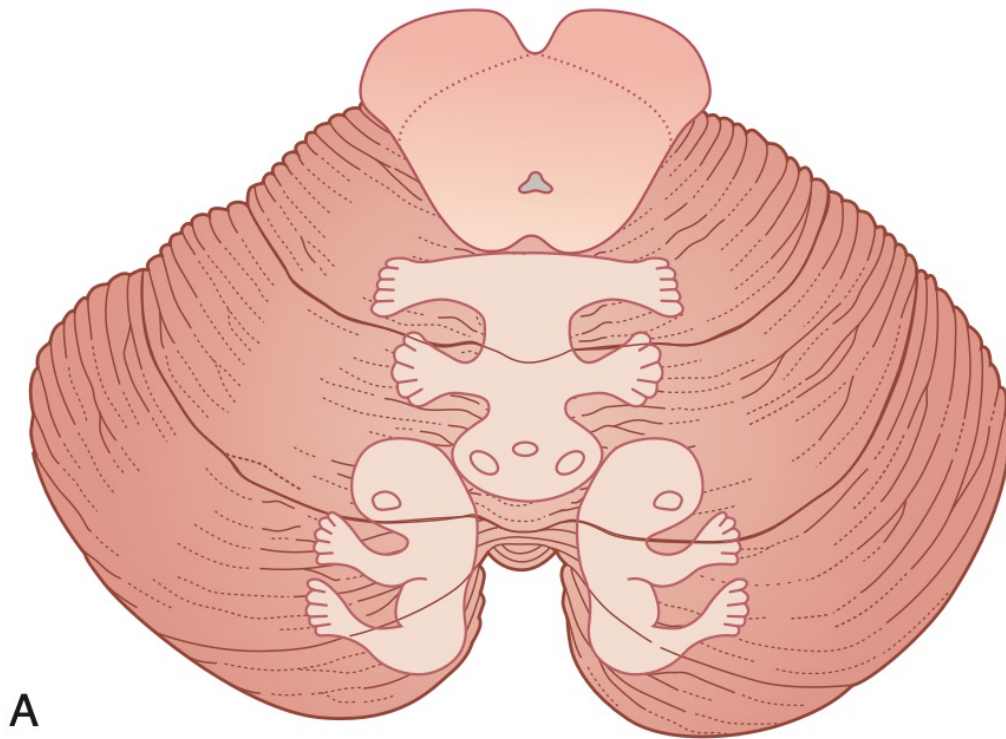
Function	Article	Experimental design	Cerebellar region involved
Detection of sensory prediction errors	Diedrichsen et al. (2005)	fMRI correlate of target error (unpredictable change in target location)	Lobules V, VI, VIII and dentate nucleus
	Schlerf et al. (2012)	fMRI correlate of target error (unpredictable change in target location)	Lobules V, VI, VIII and dentate nucleus
	Blakemore et al. (2001)	fMRI correlate of execution error (alteration of visual feedback)	Lobules V and VI
	van Kemenade et al. (2019)	Error detection	Border of lobule VI and crus II
On-line motor control	van Kemenade et al. (2019)	Correlation of cerebellar activity with the abnormal delay of sensory feedbacks	Lobule V
	Nahab et al. (2011)	Correlation with the loss of control	Left cerebellar tonsil, left cerebellar pyramid Lateral cerebellum
Sensory attenuation	Miall et al. (2007)	Cerebellar stimulation with TMS impairs on-line motor control	Right anterior cerebellar cortex
	Blakemore et al. (1998)	Decreased cerebellar activation in response to self-generated tactile stimulus	
	Brooks and Cullen (2013)	Electrophysiological recordings in the cerebellum of non-human primates suggest a role in the cancellation of self-produced afferences	
	Cao et al. (2017)	Cerebellar stimulation with TMS alters the cortical sensory attenuation of self-generated sounds	Lateral cerebellum

# Anatomi Fungsional Serebelum

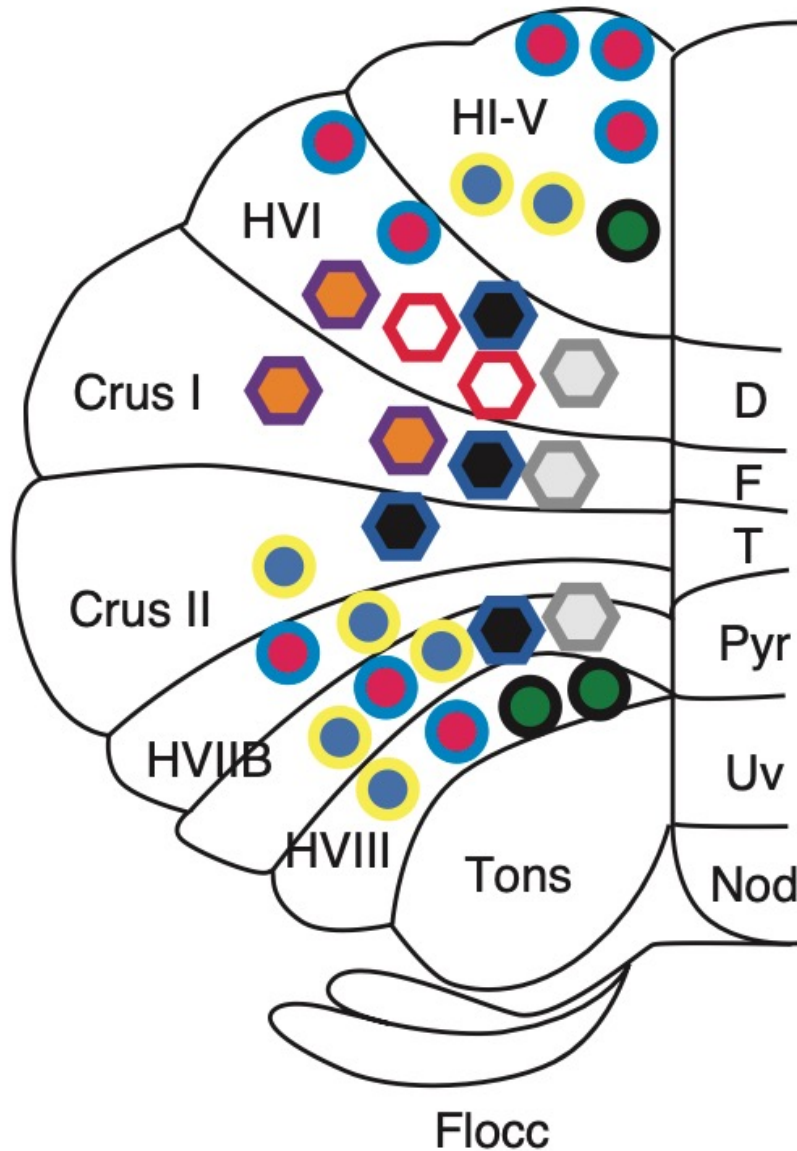
Visuomotor adaptation	Bernard and Seidler (2013)	A Meta-analysis of fMRI and PET study exploring visuomotor adaptation	Lobule IV
	Küper et al. (2014)	fMRI study of visuomotor adaptation	Lobule VIII and caudal dentate nucleus
	Tzvi et al. (2020)	fMRI study of visuomotor adaptation	Lobule VIII, crus II, lobule VI, crus I
	Galea et al. (2011)	tDCS over the cerebellum causes faster adaptation during visuomotor adaptation	Right cerebellar cortex
Conditional learning	Yavari et al. (2016)	tDCS over the cerebellum alters localization of the hand after a movement without visual feedback	Right cerebellar cortex
	Carta et al. (2019)	In mice, cerebellar nuclei send projections to the VTA and modulate the reward pathway	Deep cerebellar nuclei
	Rogers et al. (2011)	In mice, stimulation of the cerebellar nuclei triggers. Dopamine release in the medial prefrontal cortex	Dentate nucleus
	Heffley et al. (2018)	In mice, climbing fibers responses in the lateral cerebellum encode reward prediction	Lateral cerebellum
Anticipation	Kostadinov et al. (2019)	In mice, the cerebellum encodes reward prediction	Lobule simplex
	Tesche and Karhu (2000)	MEG study exploring the event-related potential during sensory omission	Lateral cerebellum + vermis
	Cui et al. (2000)	Event-related during a delayed sequential finger movement task	Cerebellum lobules VI
Sense of agency	Seghezzi et al. (2019)	A Meta-analysis of fMRI study exploring the sense of agency	Right cerebellum lobule VI
	Zapparoli et al. (2020b)	fMRI study of the cerebral regions which activity correlates with the intentional binding	Cerebellum lobules IV and V

*Anatomical specifications of the different cerebellar structures involved in the references listed in the manuscript.*




# Homonkulus pada Serebelum







# Homonculus pada Serebelum



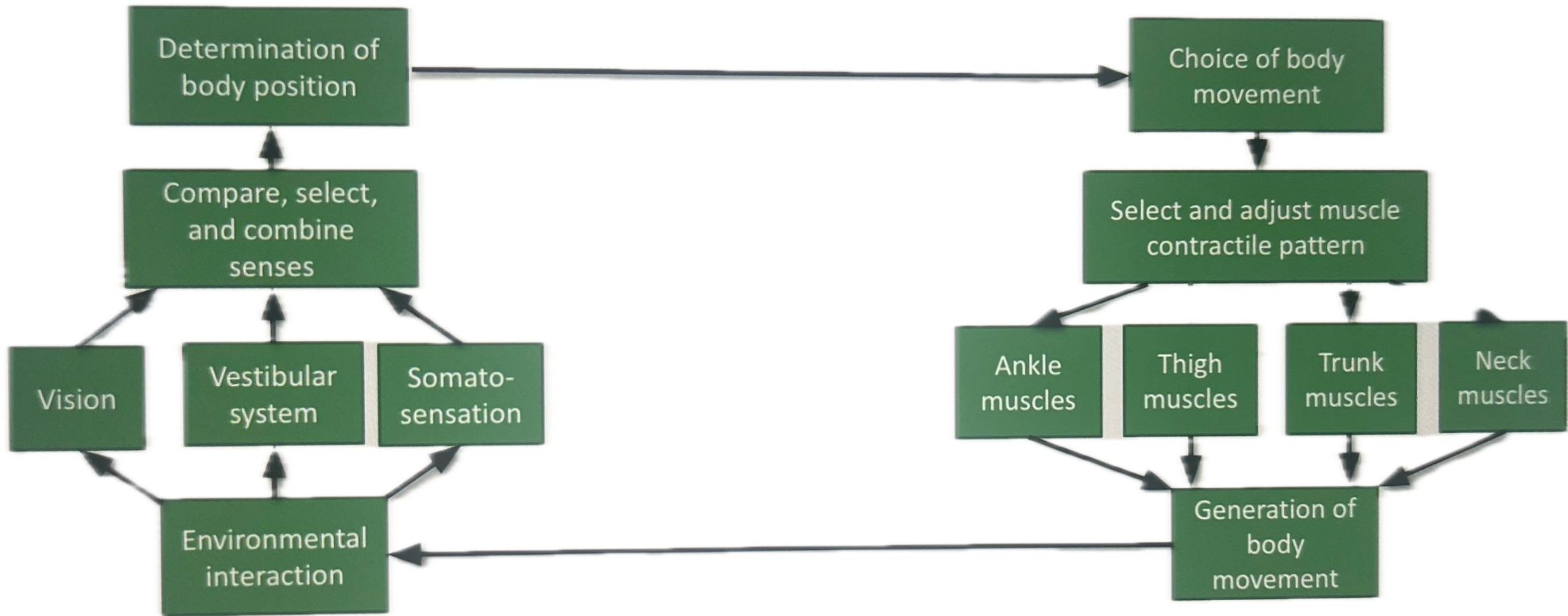
## MOTOR/SENSORY

-  Sensorimotor task
-  Motor activation
-  Somatosensory activation

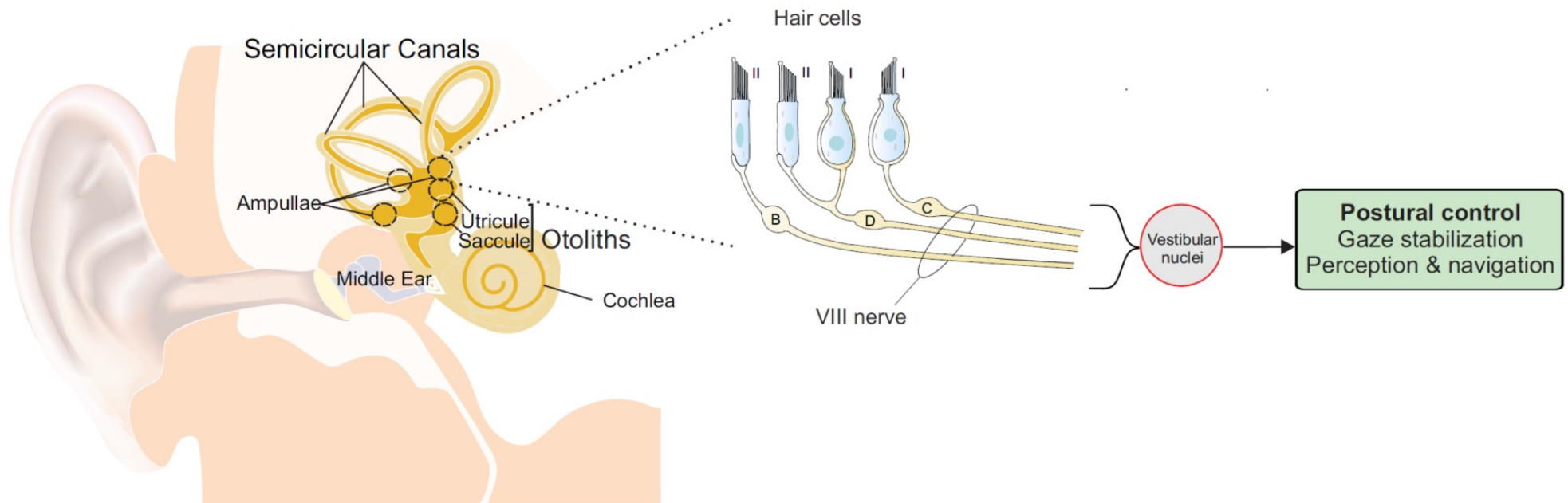
## COGNITIVE

-  Language/verbal working memory
-  Spatial
-  Executive functions
-  Emotions

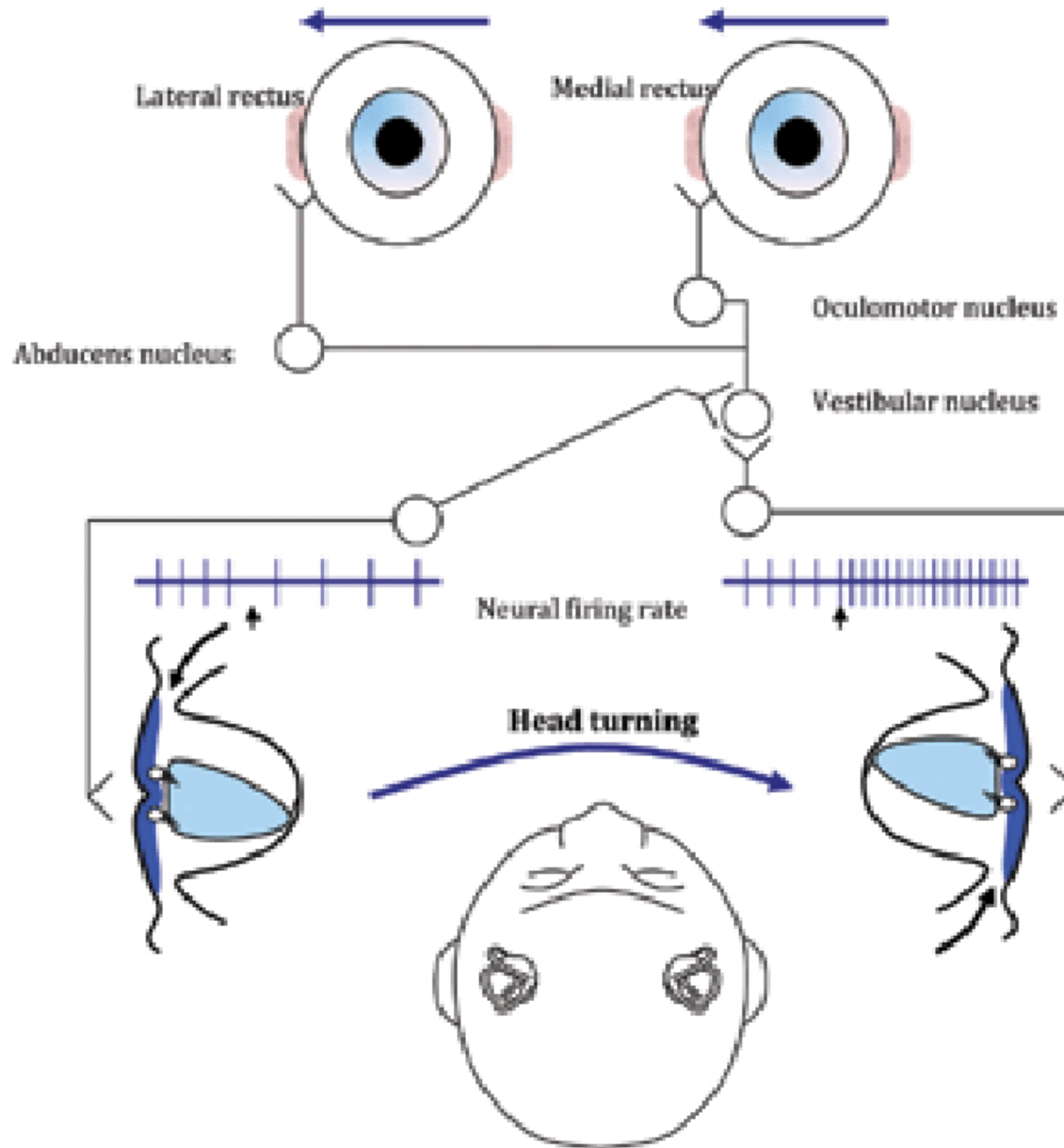
# Fisiologi Keseimbangan



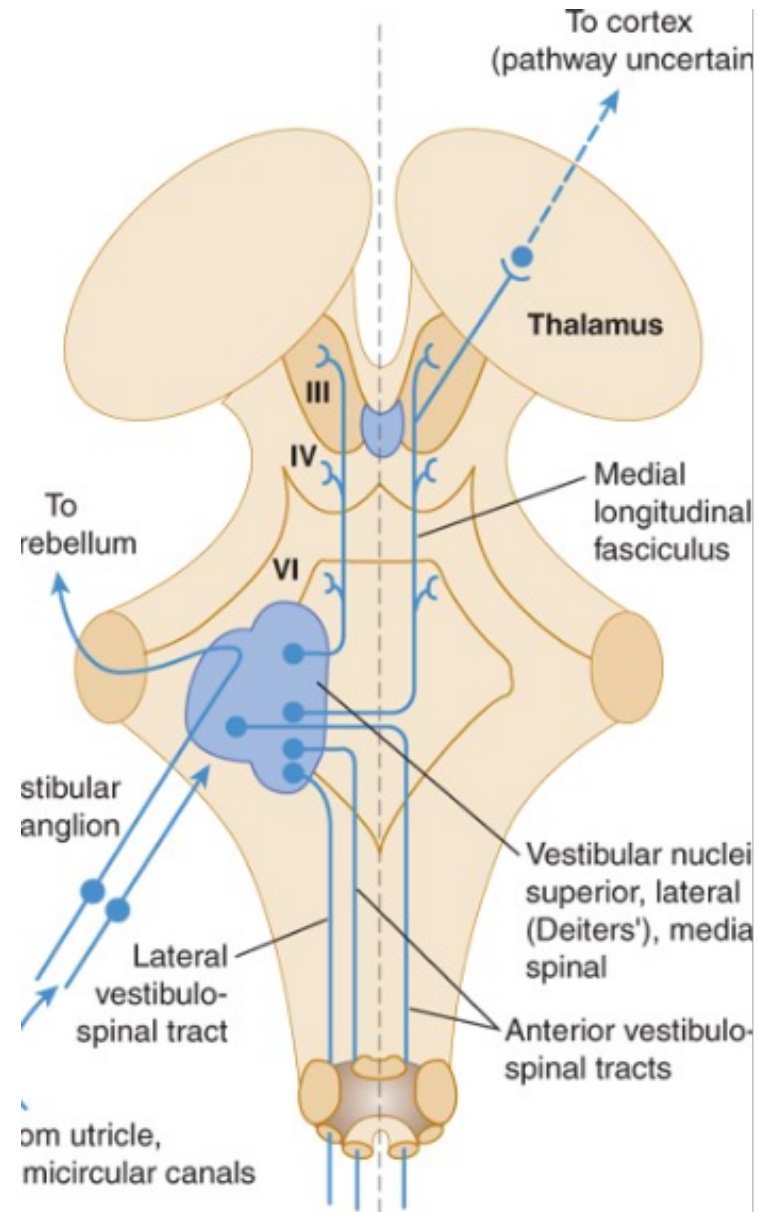
# Sistem Vestibular



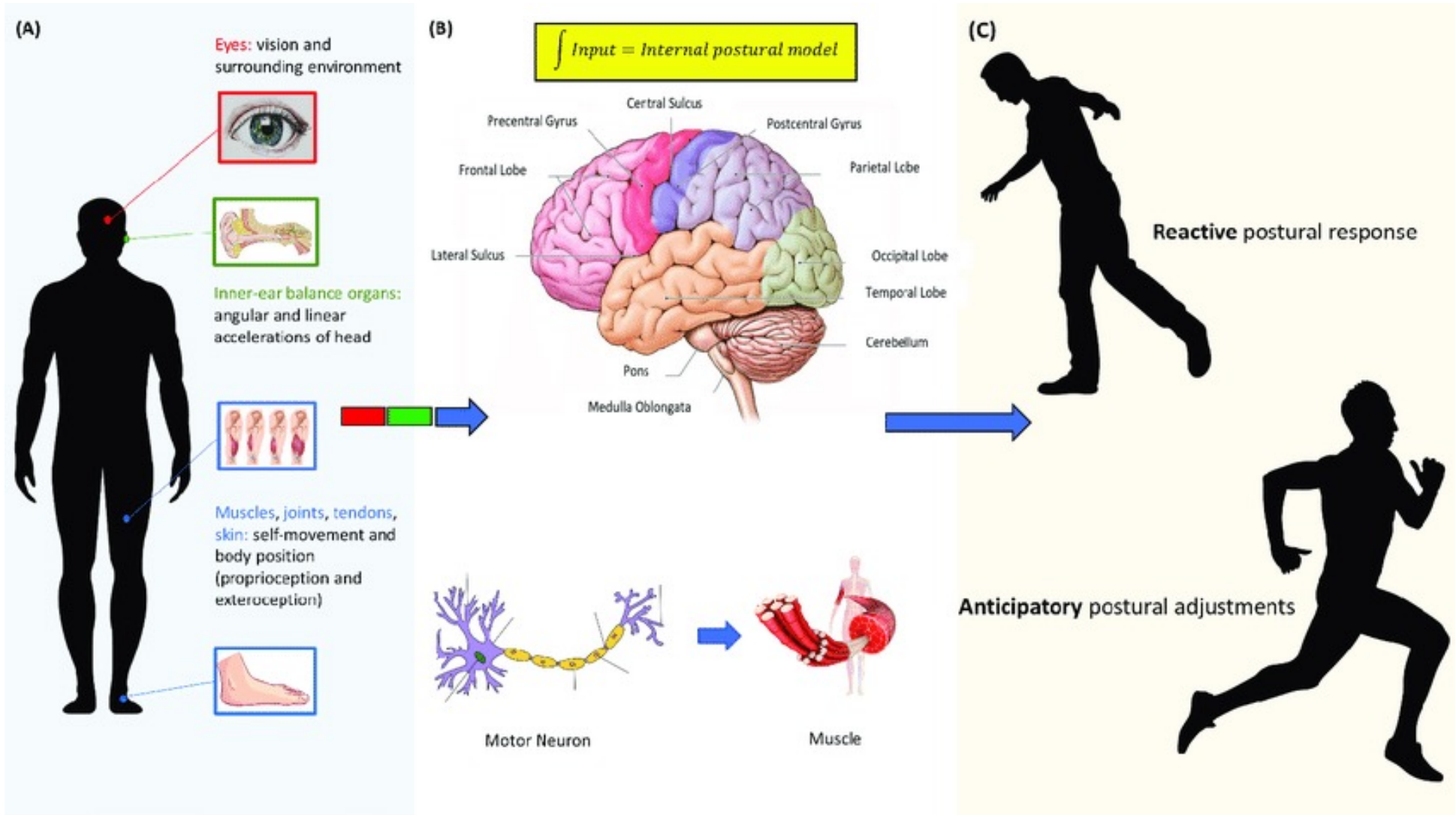
# Sistem Vestibular



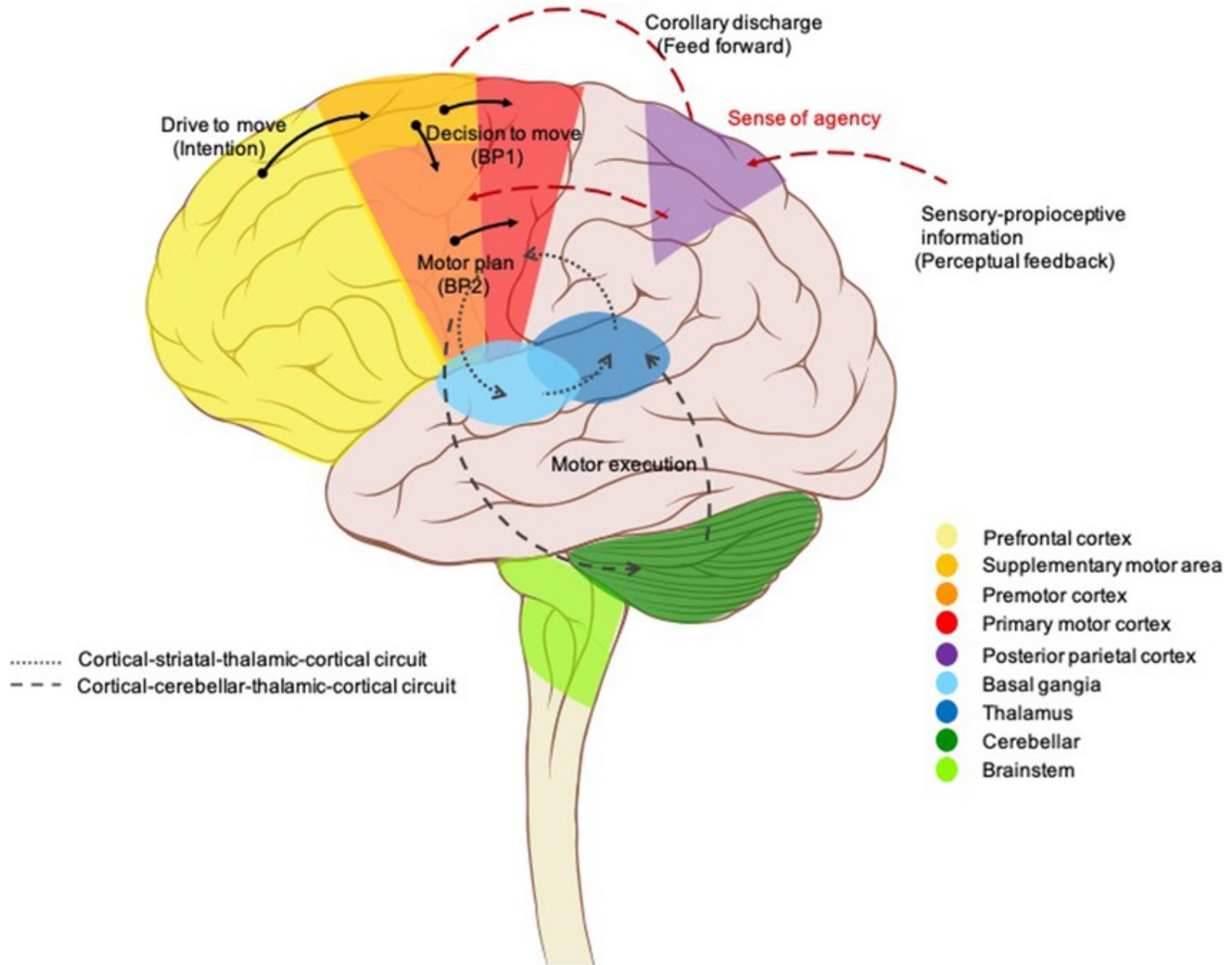
# Sistem Vestibular



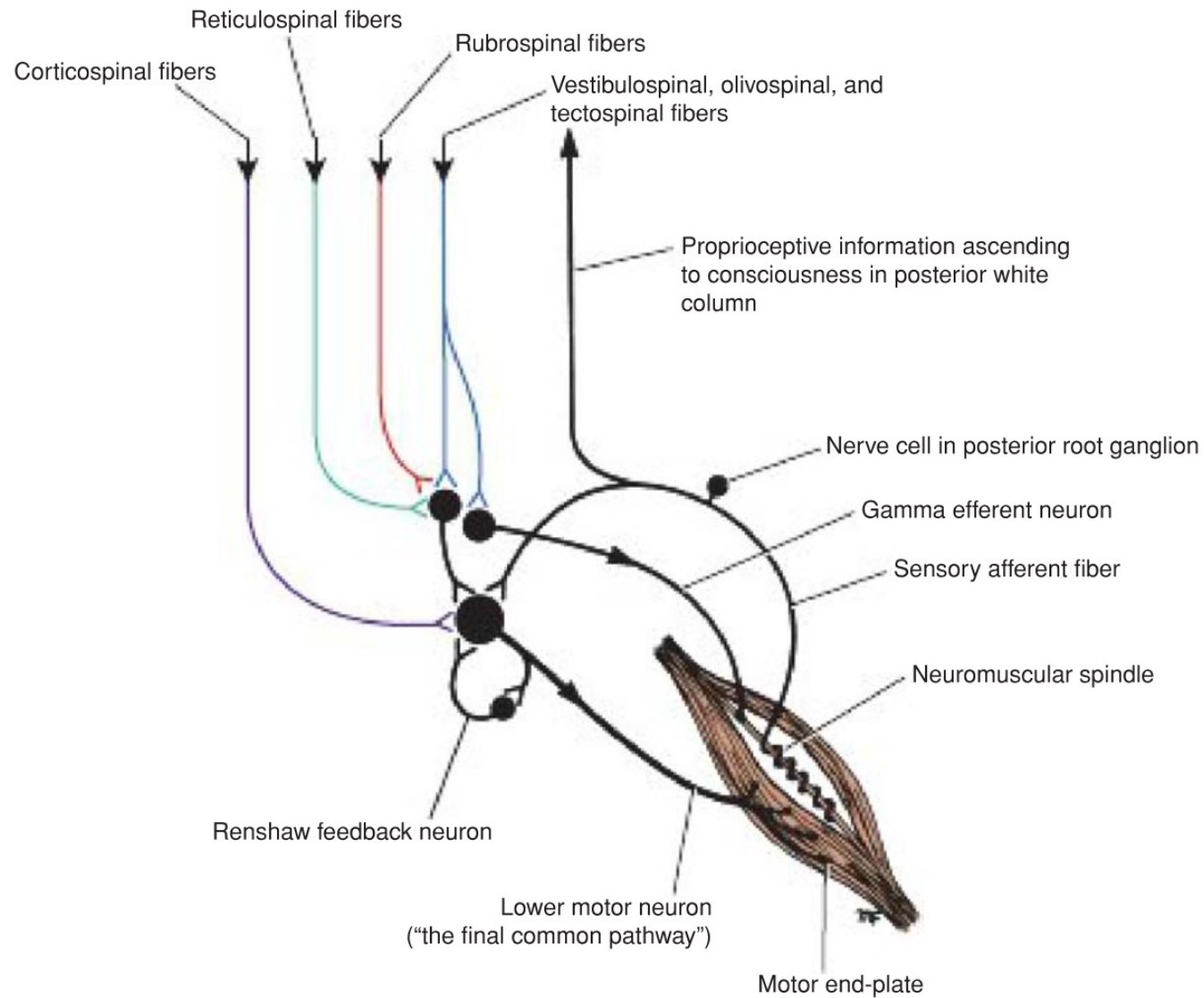
# Tonus dan Postur



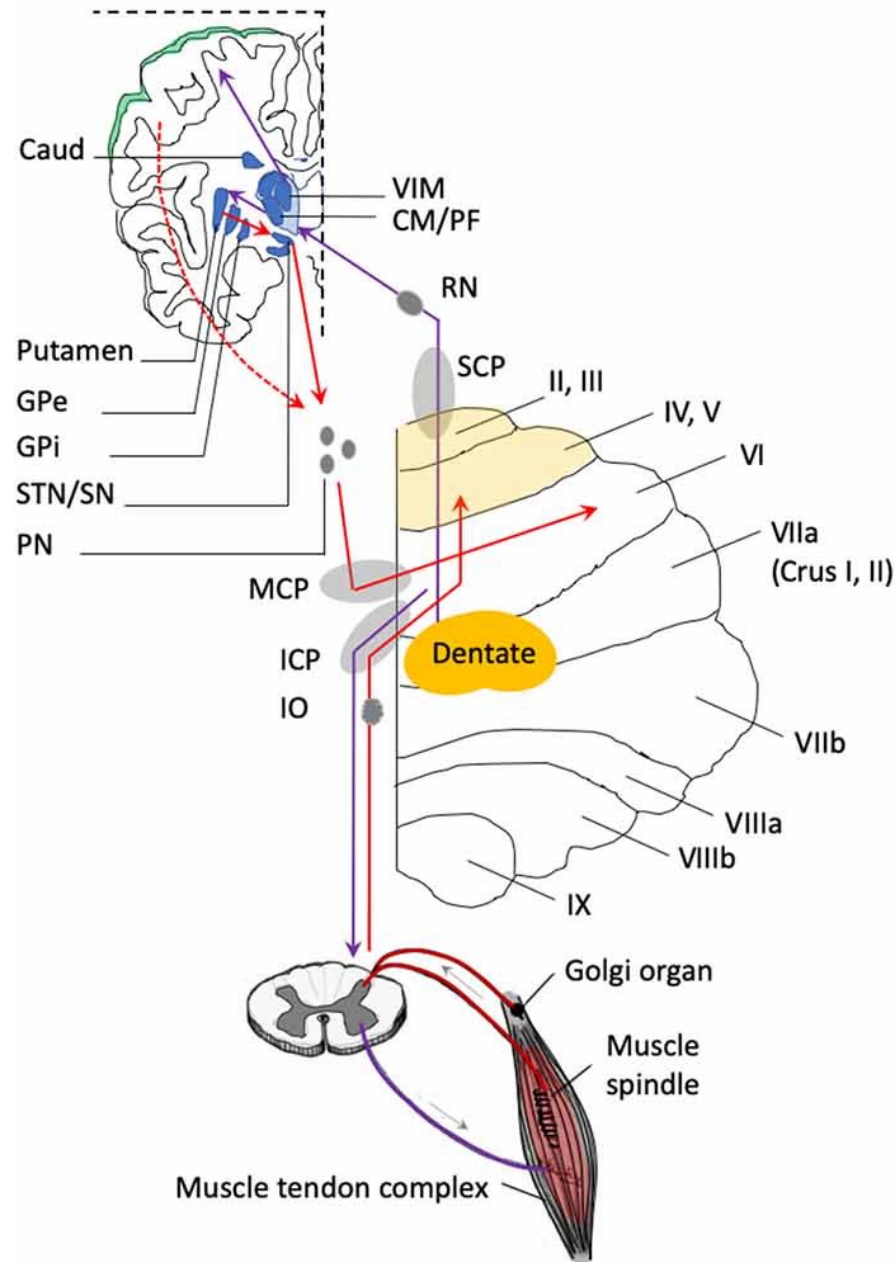
# Koordinasi motorik



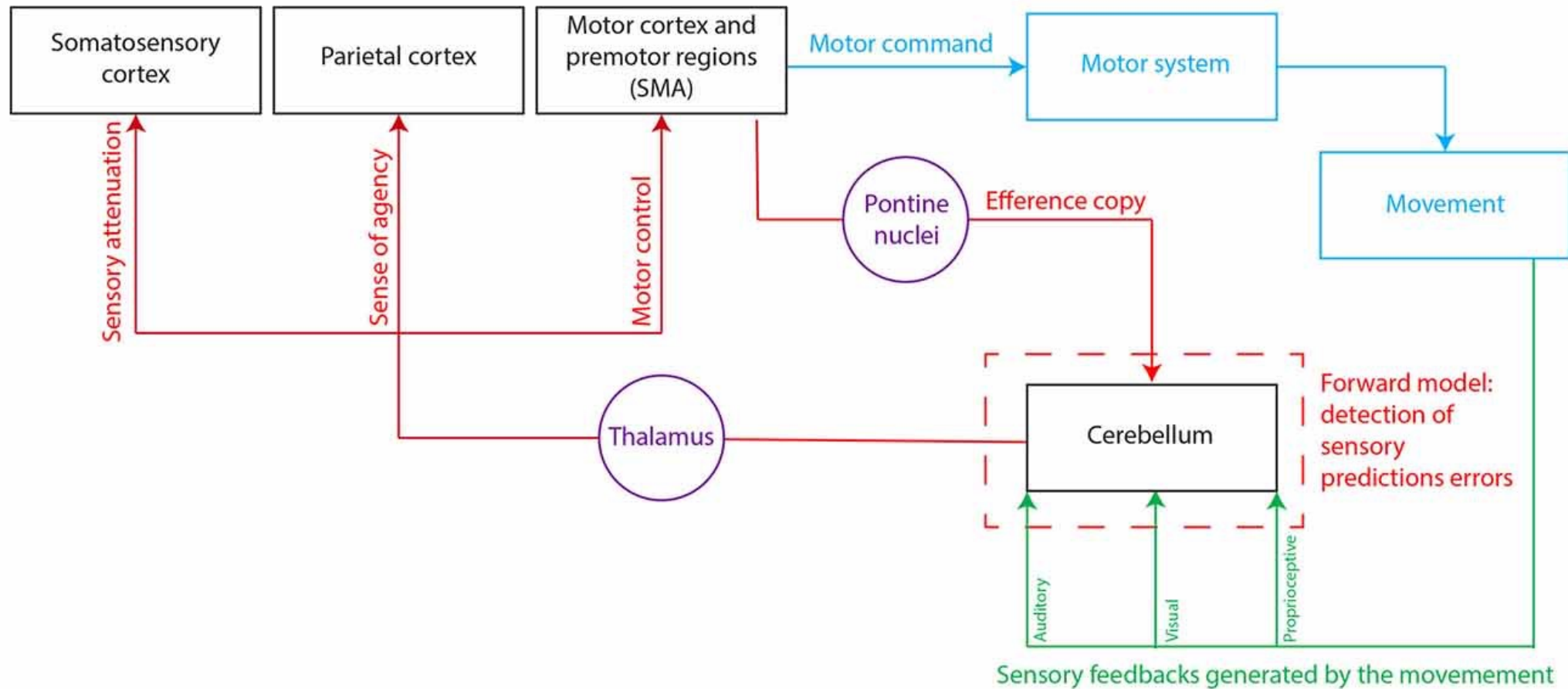
# Final Common Pathway



# Serebelum dan Sistem Motorik



# Motor Learning



# Kelainan Klinis Serebelum

- Dismetria dan Ataksia
- Gangguan Past-Pointing Test
- Disdiadokinesis
- Disartria
- Tremor Intensi
- Nistagmus Serebelum
- Hipotonia

# Kesimpulan



- Serebelum berperan dalam sistem motorik dan non-motorik

- Pembagian serebelum bisa berdasarkan lobus anatomi dan zona fungsional
- Serebelum berperan dalam motorik, keseimbangan Tonus otot, dan postur.
- Gangguan pada serebelum akan mengakibatkan gejala ipsilateral dismetria, ataksia, gangguan past pointing test, Diadokinesia, Disartria, tremor intensi, nystagmus serebelum dan hipotonia

Thank You