THE CEREBELLUM & ITS RELEVANT CONNECTIONS

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OBJECTIVES

At the end of the lecture, students should:

❑ Describe the external features of the cerebellum (lobes, fissures).

❑ Describe briefly the internal structure of the cerebellum.

❑ List the name of cerebellar nuclei.

❑ Relate the anatomical to the functional subdivisions of the cerebellum.

❑ Describe the important connections of each subdivision.

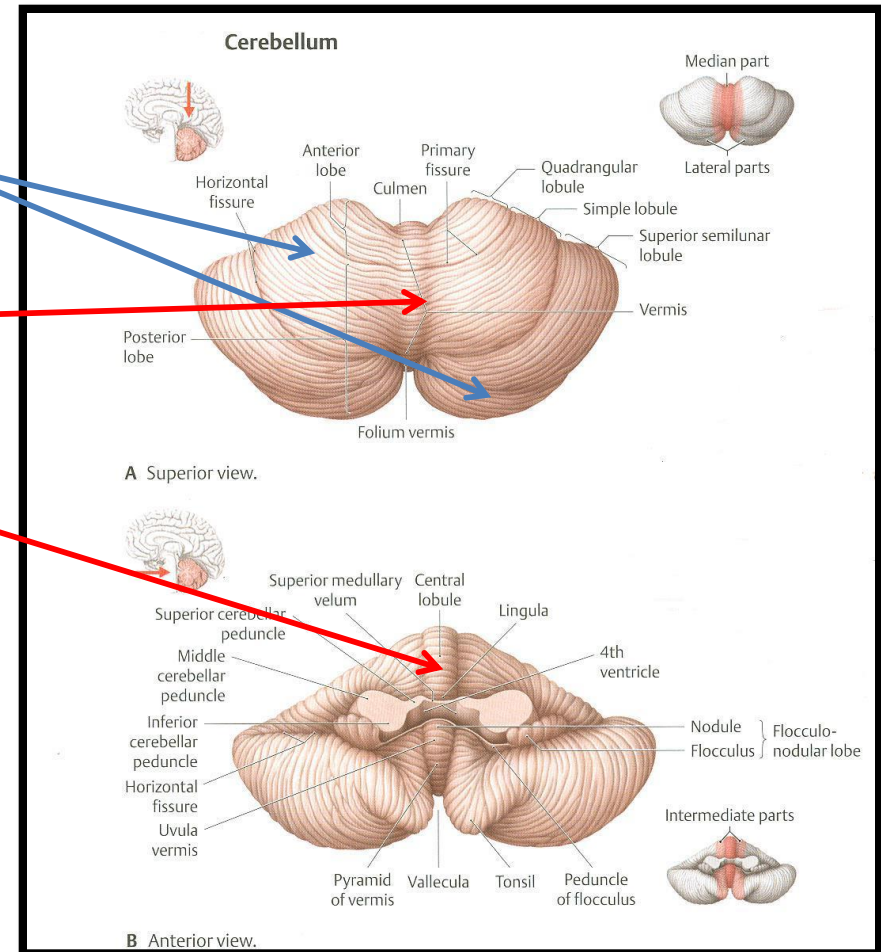❑ Describe briefly the main effects in case of lesion of the cerebellum.

THE CEREBELLUM
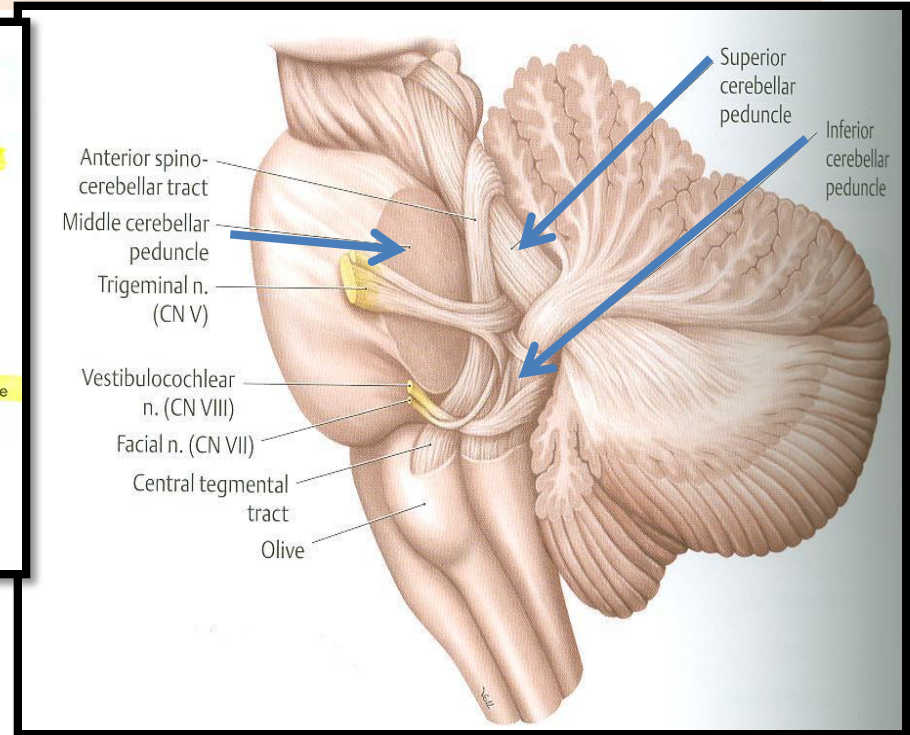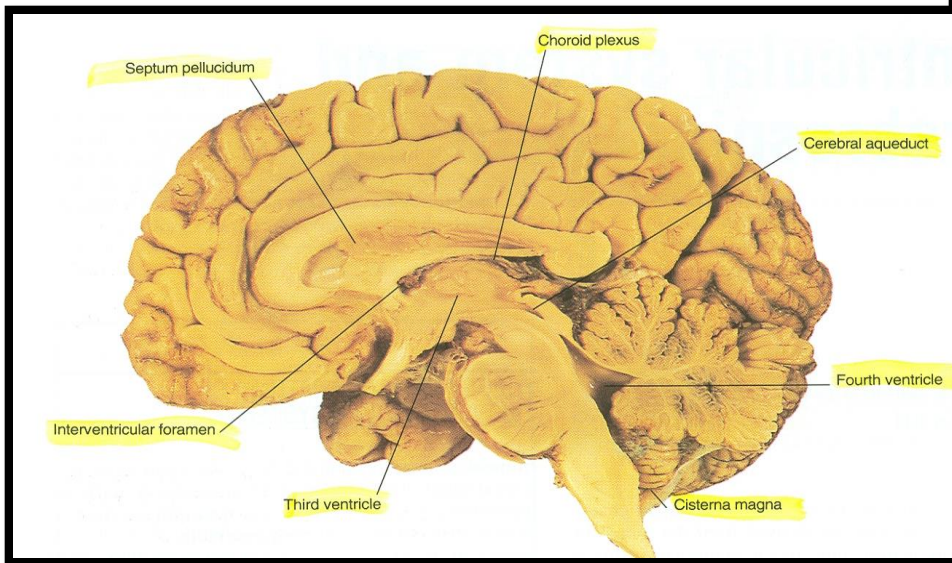
□ **ORIGIN:** from hindbrain, separated from pons & medulla by fourth ventricle.

□ **CONNECTION TO BRAIN STEM:** by inferior, middle & superior cerebellar peduncles.
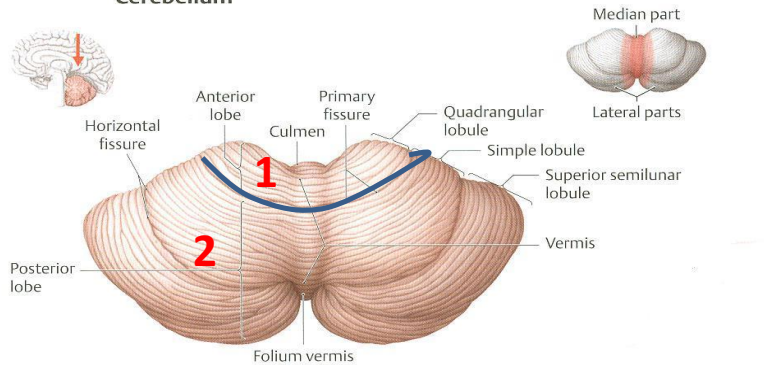
EXTERNAL FEATURES

❑ **It consists of two cerebellar hemispheres joined in midline by the vermis.**

❑ **Its surface is highly convoluted forming folia separated by fissures.**
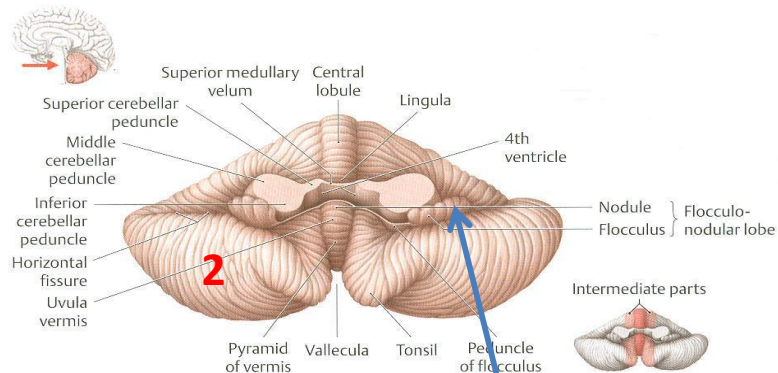

Cerebellum

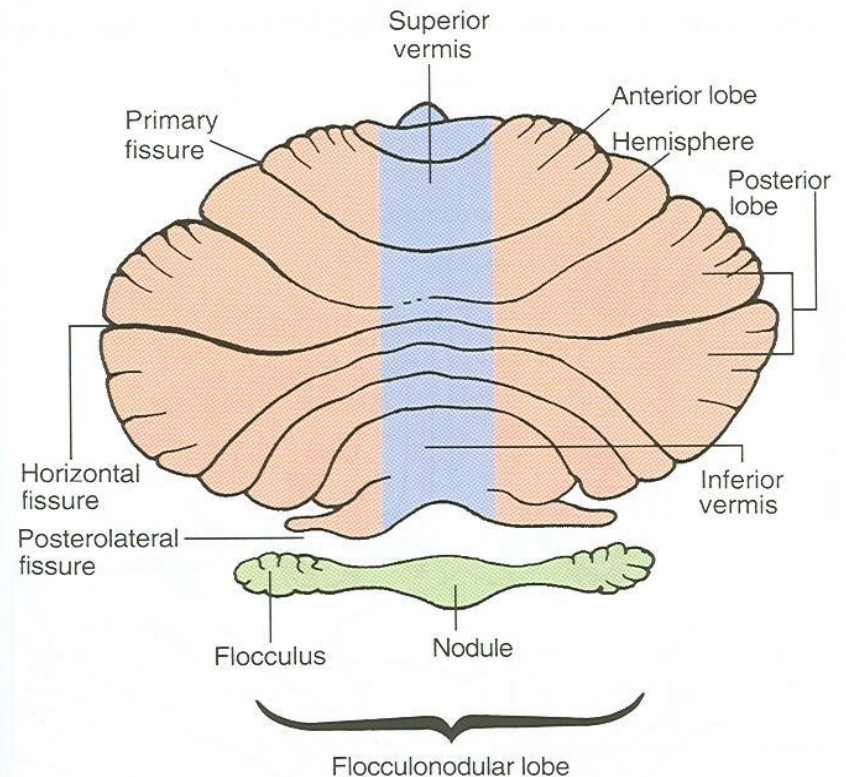A Superior view.

B Anterior view.

ANATOMICAL SUBDIVISION

1. **Anterior lobe:** in front of primary fissure
2. **Posterior (middle) lobe:** behind primary fissure
3. **Flocculonodular lobe.**

CONSTITUENTS
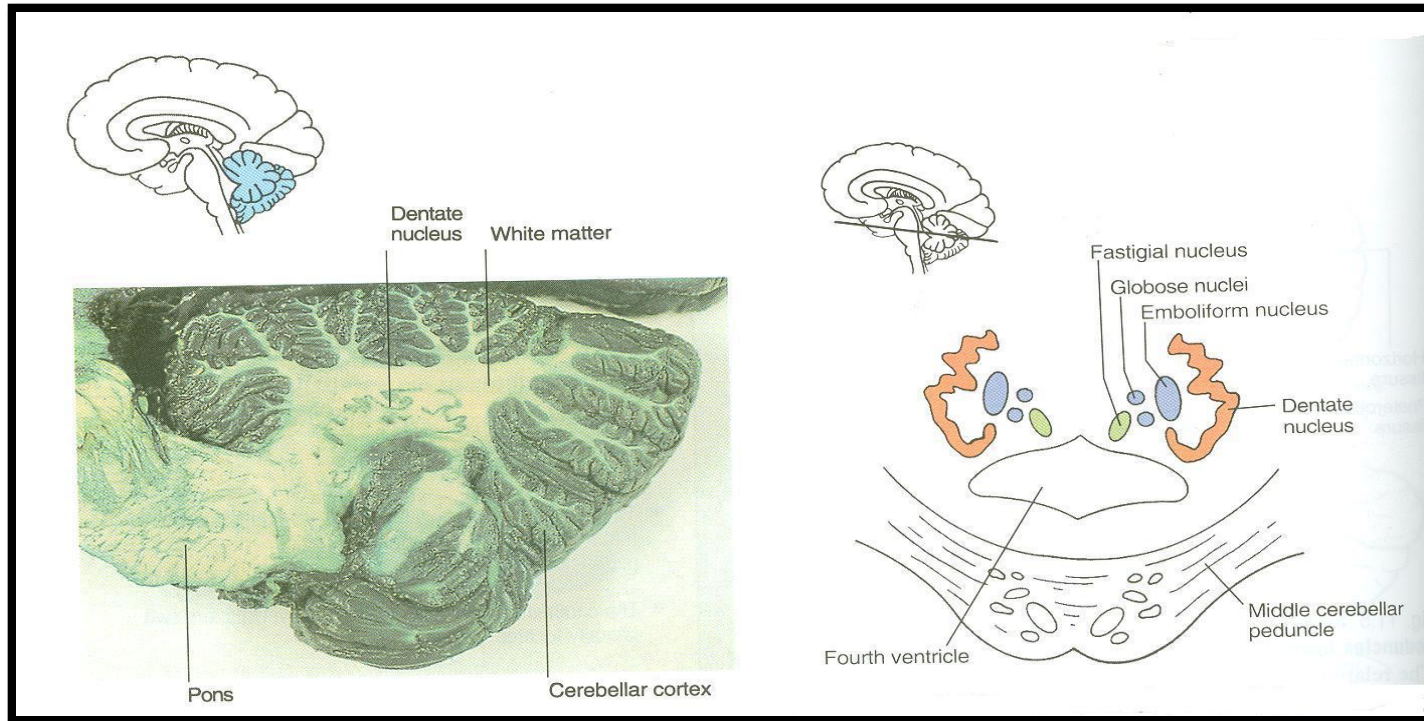
1. **Outer grey matter:** cerebellar cortex.
2. **Inner white matter:** cerebellar medulla.
3. **Deeply seated nuclei in white matter:** *from medial to lateral:*
- **Fastigeal nucleus:** smallest one.
- **Globose nucleus.**
- **Emboliform nucleus.**
- **Dentate nucleus:** largest one.

CEREBELLAR CORTEX
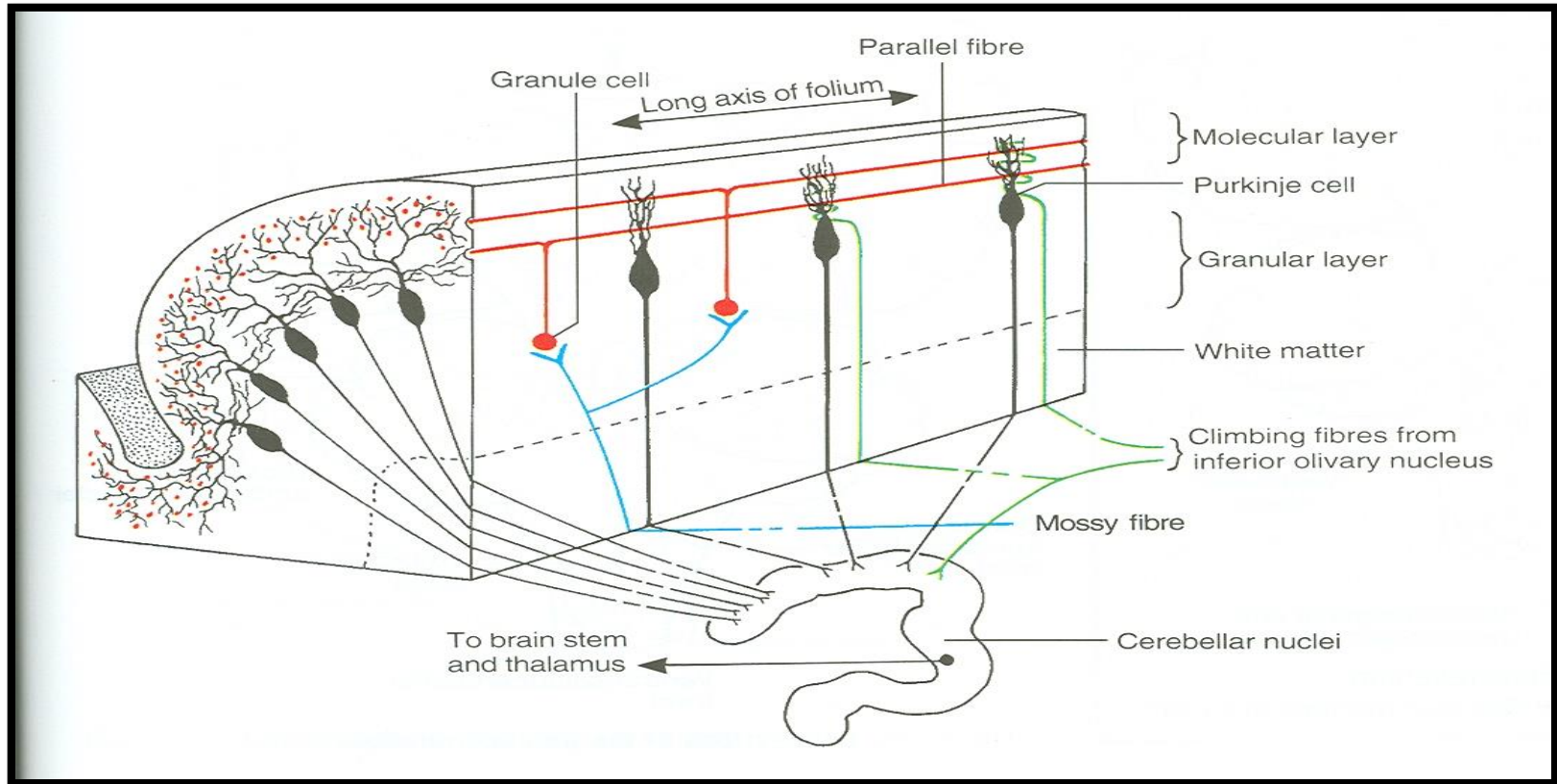
❑ **Divided into 3 layers:**
1. **Outer molecular layer**
2. **Intermediate Purkinje cell layer**
3. **Inner granular layer**

CEREBELLAR MEDULLA

AFFERENT FIBRES:

❑ **Climbing fibres:** from *inferior olivary nucleus*, relay to purkinge cells

❑ **Mossy fibres:** rest of fibres:

1. *From vestibular nuclei*

2. *From spinal cord*

3. *From pons*

• They relay to granule cells which in turn relay to purkinge cells

CEREBELLAR MEDULLA

❑ **Axons of purkinge cells are the only axons to leave the cortex to medulla:**

1. **The great majority of axons do not leave cerebellum & end in deep cerebellar nuclei.**

2. **Some of axons leave cerebellum as efferent fibres.**

CEREBELLAR MEDULLA

EFFERENT FIBRES:

❑ **Most of efferent fibres are axons of deep cerebellar nuclei.**

❑ **Main efferents go to:**

1. *Vestibular nuclei*

2. *Red nucleus*

3. *Ventral lateral nucleus of thalamus*

FUNCTIONAL SUBDIVISIONS OF THE CEREBELLUM

ARCHICEREBELLUM

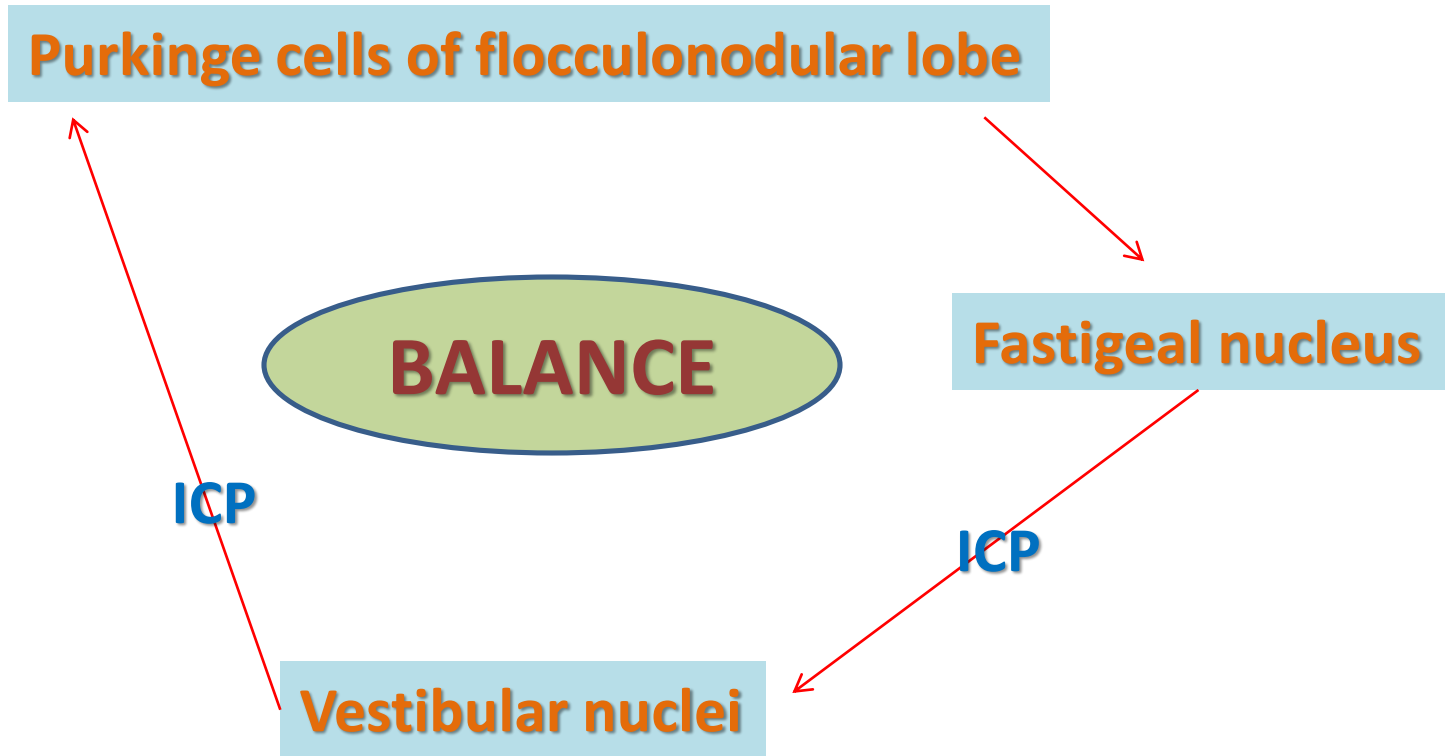**Purkinge cells of flocculonodular lobe**

BALANCE

Fastigeal nucleus

ICP

ICP

Vestibular nuclei

ARCHICEREBELLUM

- ❑ **Part of cerebellum:** flocculonodular lobe
- ❑ **Nuclei:** fastigeal
- ❑ **Afferents: from <u>vestibular nuclei</u> (through ICP)**
- ❑ **Efferents: to <u>vestibular nuclei</u> (through ICP)**
- ❑ **Function: controls balance**

PALEOCEREBELLUM

Purkinge cells of vermis & paravermis

ICP

SCP

POSTURE & MUSCLE TONE

Spinal cord

Globose & emboliform nuclei

SCP
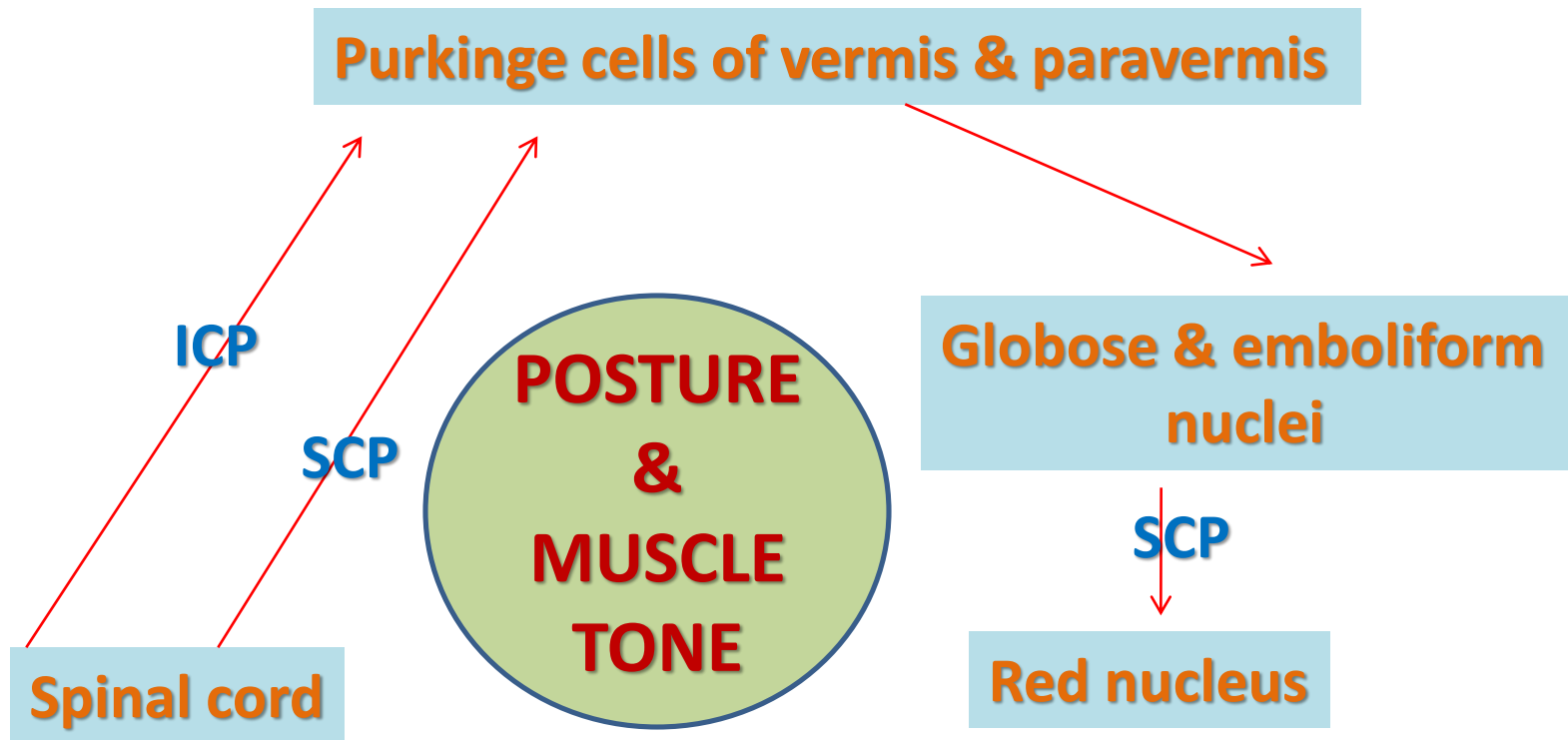
Red nucleus

PALEOCEREBELLUM

- **Part of cerebellum**: vermis & paravermis
- **Nuclei**: globose & emboliform
- **Afferents**: from spinal cord (dorsal & ventral spinocerebellar tracts through ICP & SCP, respectively)
- **Efferents**: to red nucleus (through SCP)
- **Function**: influences posture & muscle tone

NEOCEREBELLUM

Purkinge cells of rest of cerebellum

Dentate nucleus

MCP

Pons

COORDINATION OF VOLUNTARY MOVEMENTS

Red nucleus & Ventral lateral nucleus of thalamus

Motor cortex

NEOCEREBELLUM

- **Part of cerebellum**: rest of cerebellum
- **Nuclei:** dentate
- **Afferents:** from pons (through MCP)
- **Efferents:** to red nucleus but mostly to ventral lateral nucleus of thalamus (through SCP) then to motor cortex
- **Function:** coordination of voluntary movements

CEREBELLAR LESIONS

- **MIDLINE LESION: Loss of postural control**

- **UNILATERAL LESION: "Cerebellar ataxia" causes *ipsilateral*:**

1. **Incoordination of arm: intention tremor (on performing voluntary movements)**
2. **Incoordination of leg: unsteady gait**
3. **Incoordination of eye movements: nystagmus**
4. **Slowness of speech: dysarthria**

SUMMARY

☐ **Anatomically, the cerebellum is divided into: anterior, posterior & flocculonodular lobes.**

☐ **Developmentally & functionally, it is divided into: archi- paleo- & neocerebellum.**

☐ **Archicerebellum (flocculonodular lobe) is the oldest part of cerebellum, related to *fastigeal* nucleus, connected to vestibular nuclei & concerning for control of body balance.**

SUMMARY

❑ **Paleocerebellum (vermis & paravermis) is related to *globose & emboliform* nucleus, connected to spinal cord & red nucleus & concerning for regulation of posture & muscle tone.**

❑ **Neocerebellum (most of human cerebellum) is related to *dentate* nucleus, connected to pons, thalamus. Its final destination is to motor cortex. It is concerned with coordination of voluntary movements.**

❑ **Cerebellar lesions lead to ipsilateral incoordination (ataxia).**

QUESTION 1

☐ **Which __one__ of the following nucleus is related to archicerebellum?**

1. **Fastigeal nucleus** ⬅
2. **Dentate nucleus**
3. **Globose nucleus**
4. **Emboliform nucleus**

QUESTION 2

❑ **To which part of the CNS the flocculonodular lobe send its efferent fibers?**

1. **Red nucleus**
2. **Pons**
3. **Vestibular nuclei** ⬅
4. **Motor cortex**

THANK YOU