



Gaza Ophthalmic Centre

21.1.2 Midbrain (Part 2) Neurosciences I

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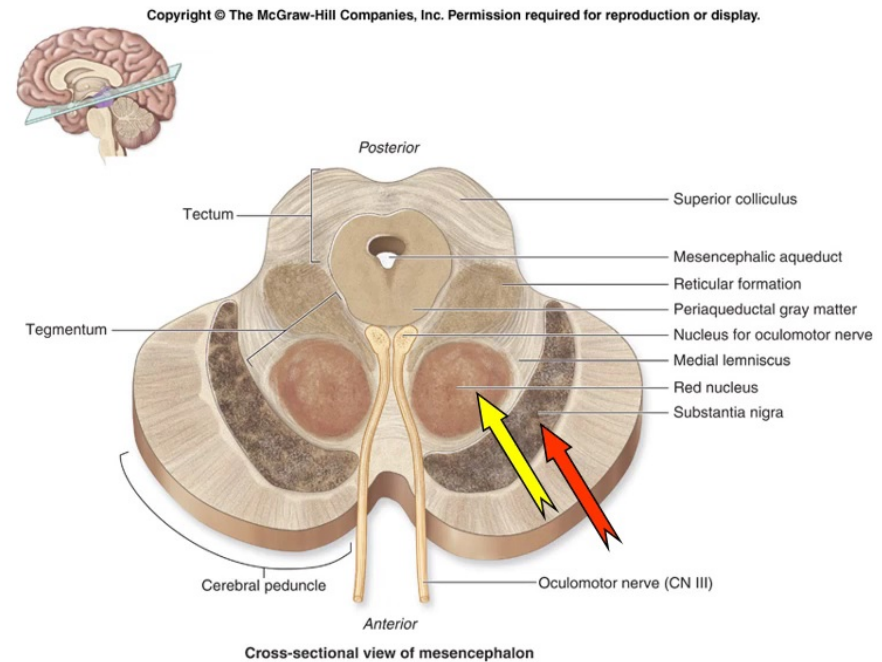
Gaza Ophthalmic Centre

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The Midbrain: Pigmented Nuclei

- Two pigmented nuclei
 1. Substantia nigra
 2. Red nucleus
- Imbedded in the
 - white matter of the
 - Midbrain



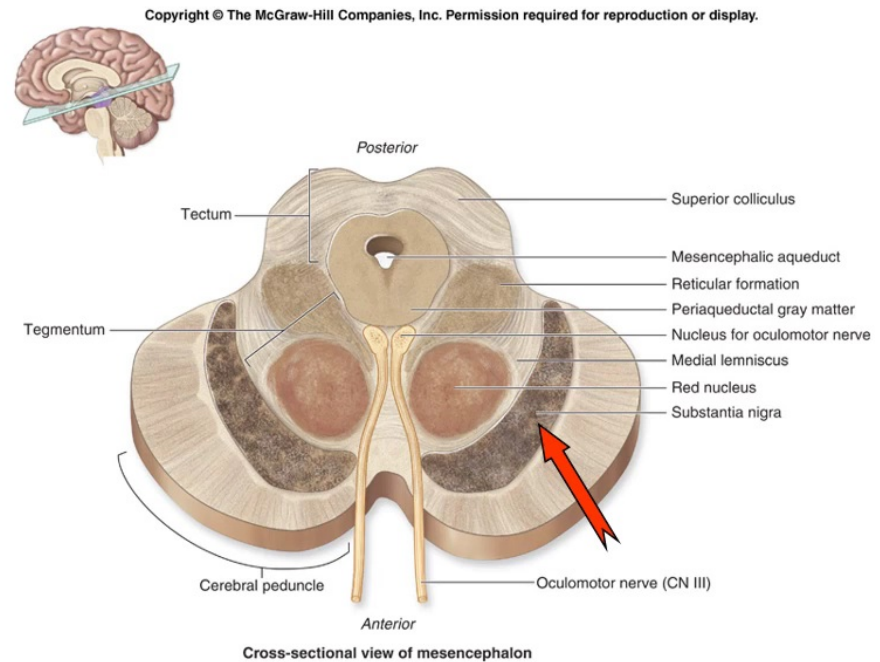
The Midbrain: Pigmented Nuclei

- Substantia Nigra

- neuronal cell bodies
- contain melanin

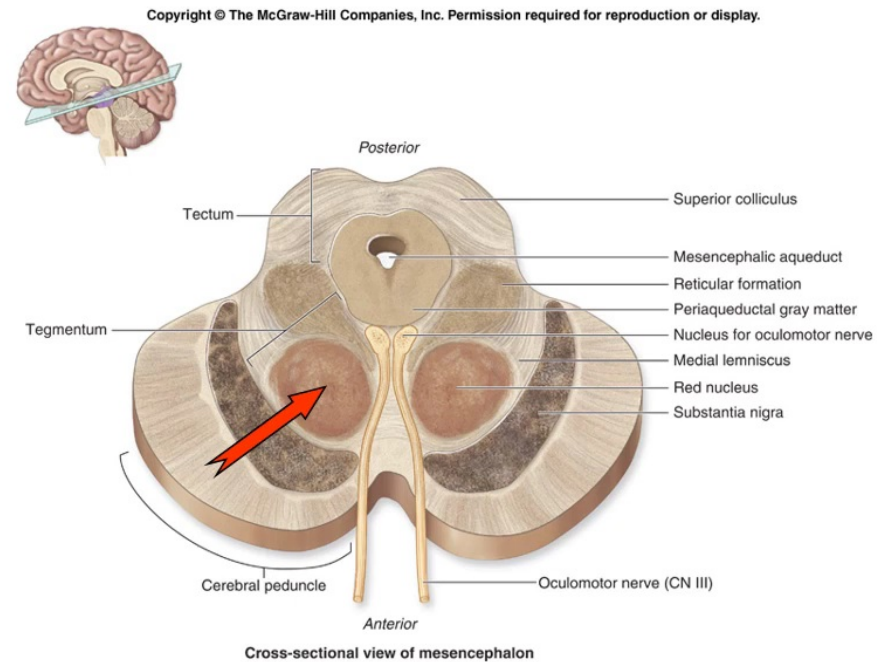
Functionally

- linked to the
- Basal nuclei



The Midbrain: Pigmented Nuclei

- Red nucleus
 - lies deep to the
 - Substantia nigra
- Largest nucleus of the
- Reticular formation

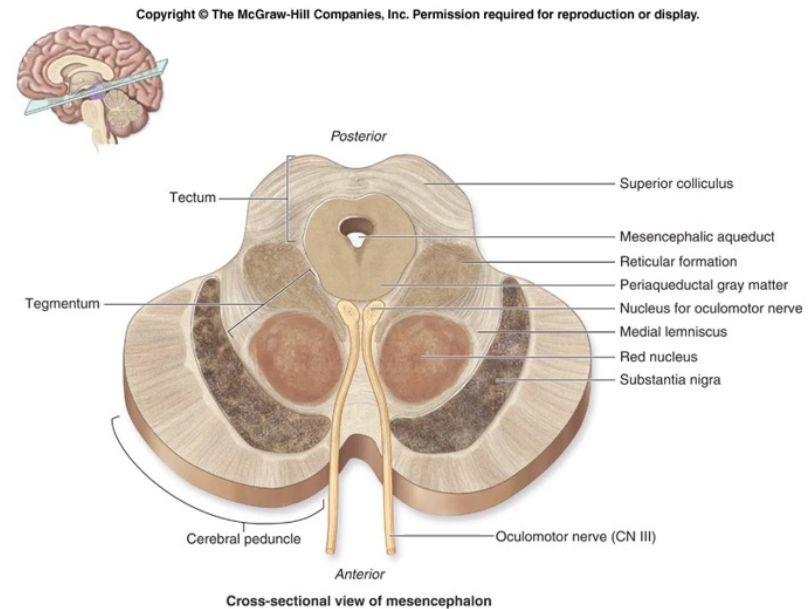


Midbrain: Substantia Nigra

- Curved lamina of
- grey matter

Between

- **Crus cerebri**
 - laterally
- **Tegmentum**
 - medially



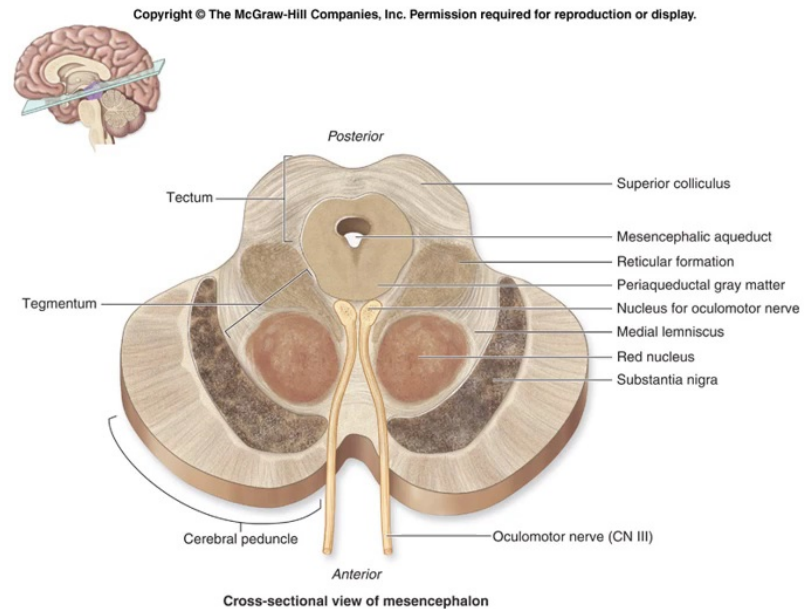
Midbrain: Substantia Nigra

All levels of MB

- up to the
- Subthalamus

1. Pars Compacta

2. Pars Reticulata



Midbrain: Substantia Nigra

- **Pars Compacta**
 - Dorsal in position

Linked with

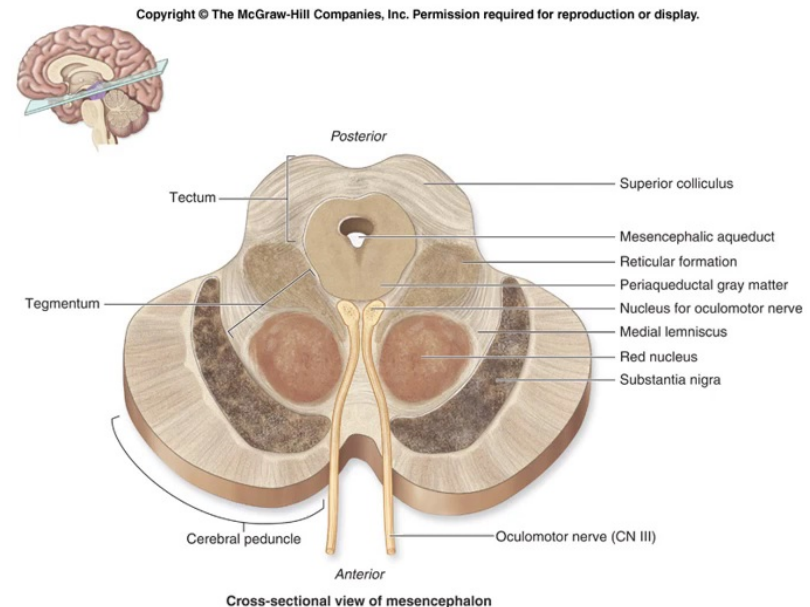
- IL neostriatum
- (Caudate & Putamen)



- **Ascending**
- **nigro striate projection**

- **Dopaminergic**

- **Degeneration →**
 - v Dopamine in
 - **Neostriatum →**
 - **Parkinson's disease**

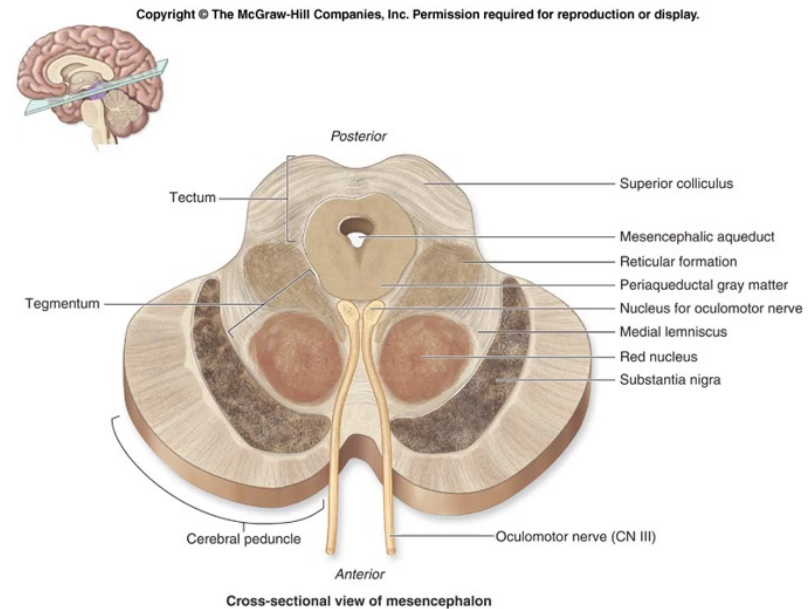


Midbrain: Substantia Nigra

- **Pars Reticulata**
 - Ventral in position
 - ? Caudally
 - displaced part of
 - Globus Pallidus
- **Input**
 - **Striato nigral**
 - **from neostriatum**
- **Output**
- **Tonic Inhibitory effect**
 - **Nigro thalamic f**
 - **Nigro tectal f** →
 - **Sup Colliculus**

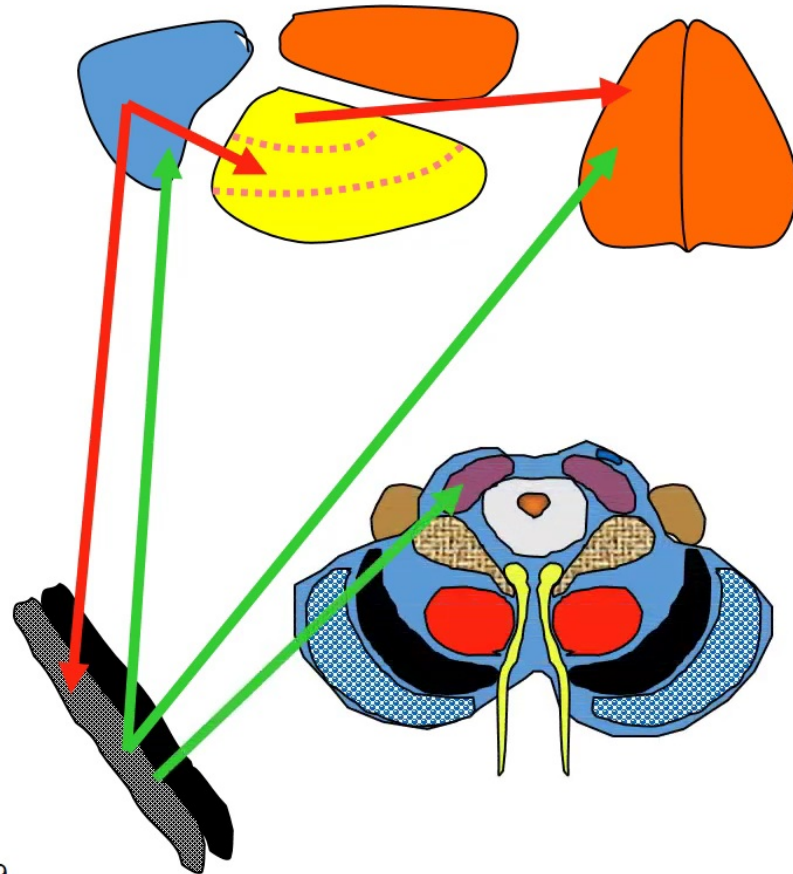
Puts Eye Movement under

- **BN effect**



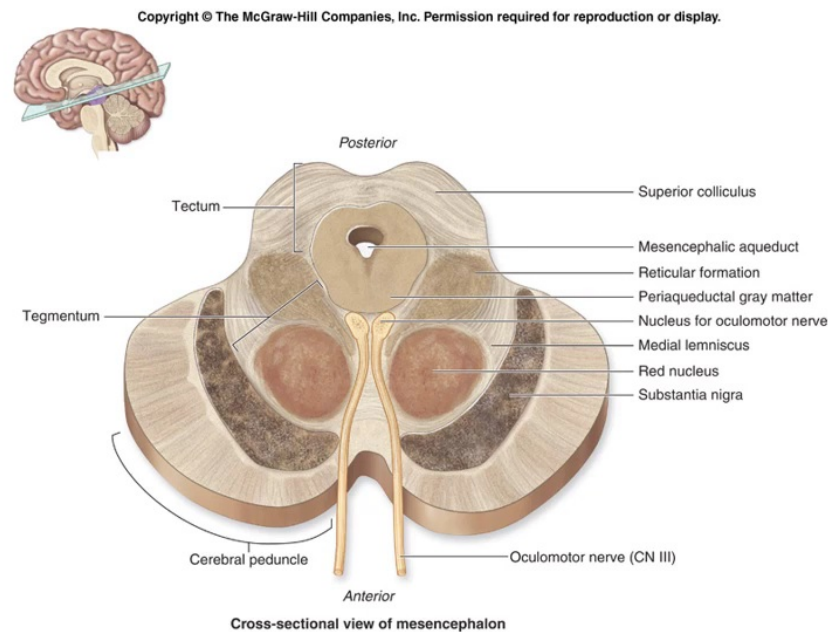
Substantia Nigra Main Connections

- Substantia Nigra
 - Pars Compacta (Dorsal)
 - Pars Reticulata (Ventral)
- Input
 - Caudate Nc (Neostriatum)
- Output
 - Caudate Nc
 - Thalamus
 - Superior Colliculus



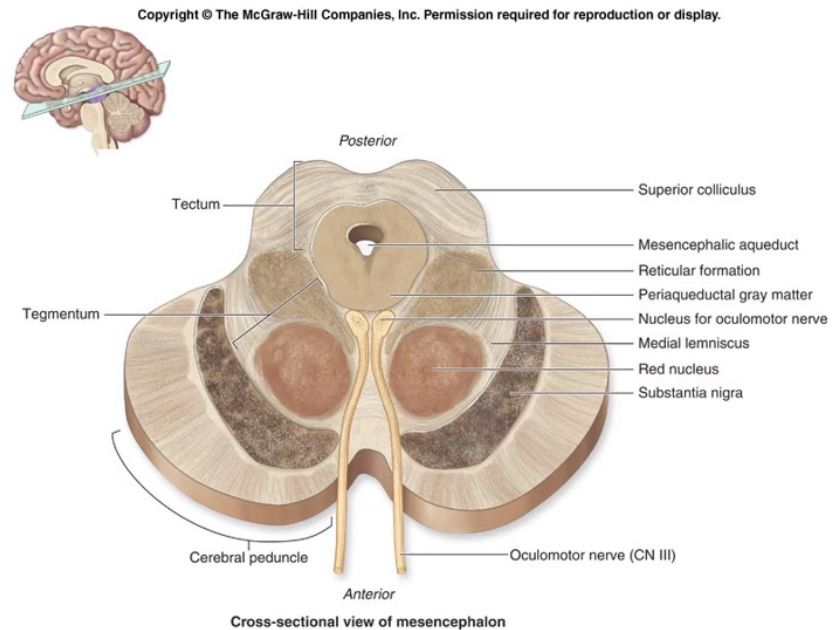
Midbrain: Red Nucleus

- Mass of nerve cells
 - Posterior part of
 - Tegmentum
 - Level of
 - Superior Colliculus
1. Caudal part
 2. Rostral part



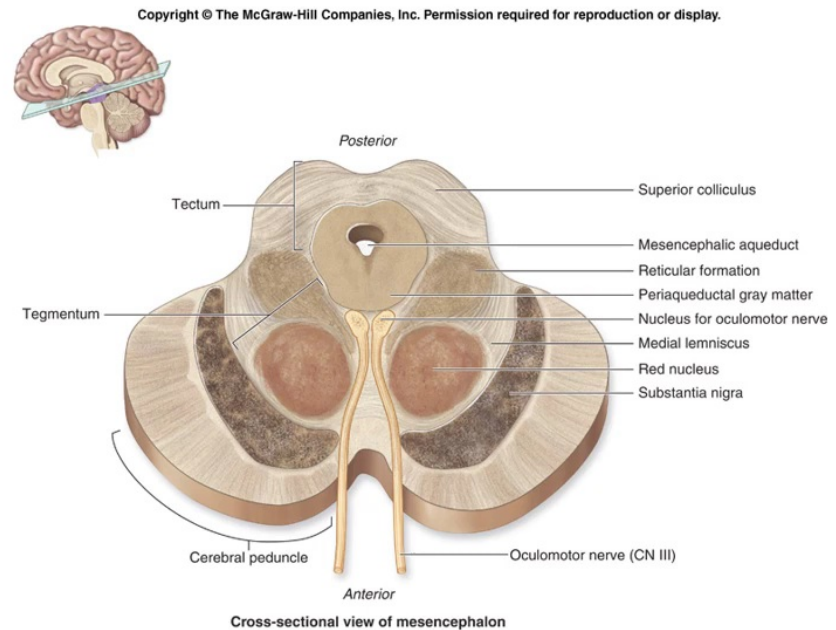
Midbrain: Red Nucleus

- Caudal part
 - Motor function
 - Magnocellular neurons
 - Large multipolar
- Input
 - Cortico rubral f from
 - IL Primary Motor Cortex
- Output
 - Rubro spinal tract
 - Crosses in the
 - Ventral Tegmental Decussation
 - Descends in the Brain Stem
 - → lateral white column of
 - Cervical
 - Spinal Cord



Midbrain: Red Nucleus

- Rostral part
 - Motor Learning function
- Parvocellular neurons
 - Small multipolar
- Input
 - Cortico rubral from
 - IL Motor &
 - Premotor Cortex
- Output
 - Rubro olivary f
 - → inferior Olive
 - Cross in the Medulla
 - → CL hemicerebellum
- Involved in Motor Learning



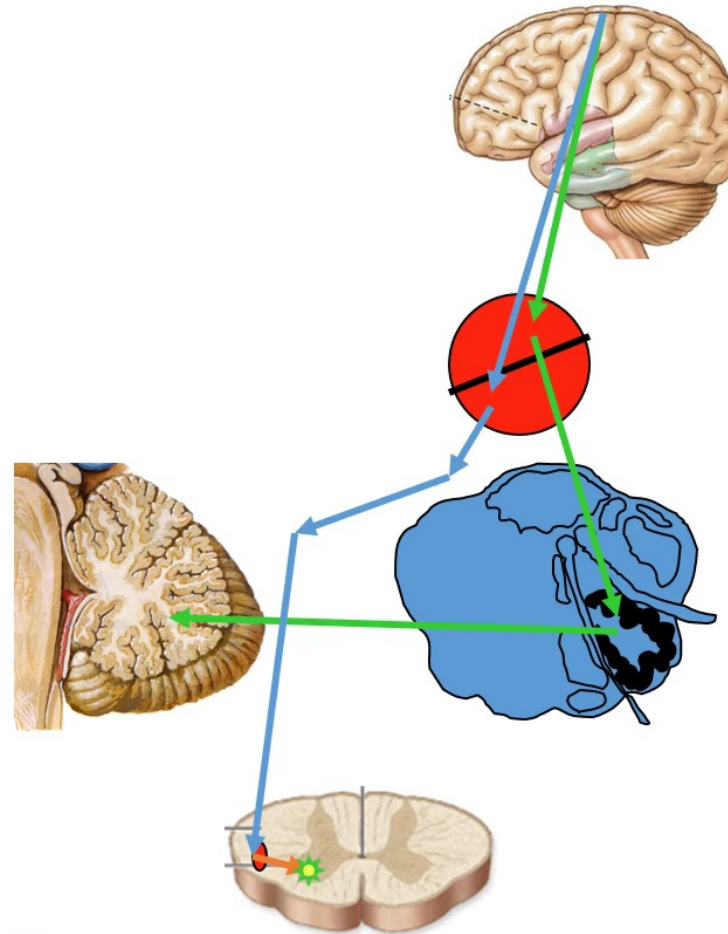
Red Nucleus Main Connections

1) Cerebral Cortex

- Corticorubral F 1
- Red Nc Rostral Part
- Rubroolivary F
- Inferior Olivary Nc
- Olivocerebellar F
- Cerebellum

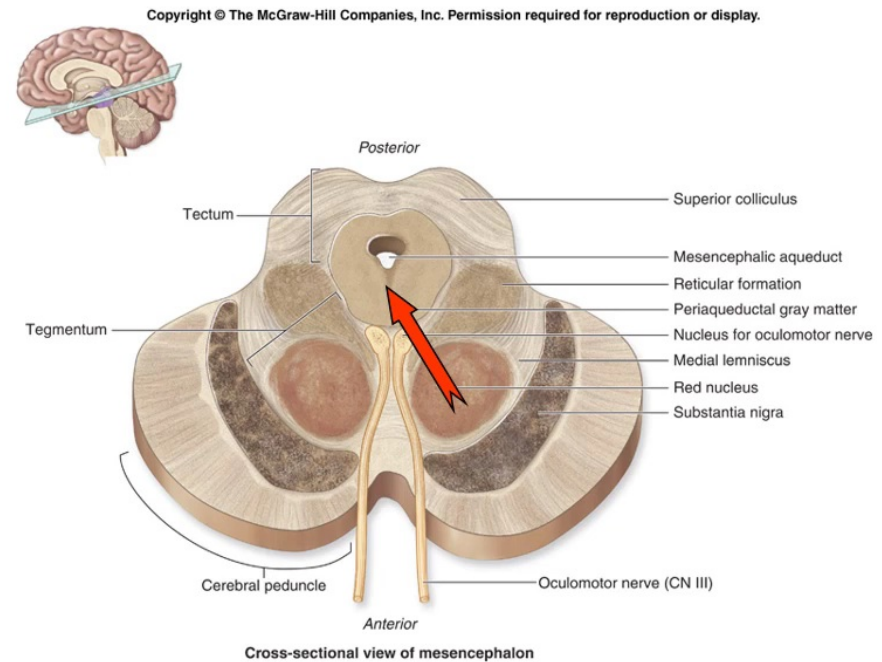
2) Cerebral Cortex

- Corticorubral F 2
- Red Nc Caudal Part
- Rubrospinal Tract
- AHC



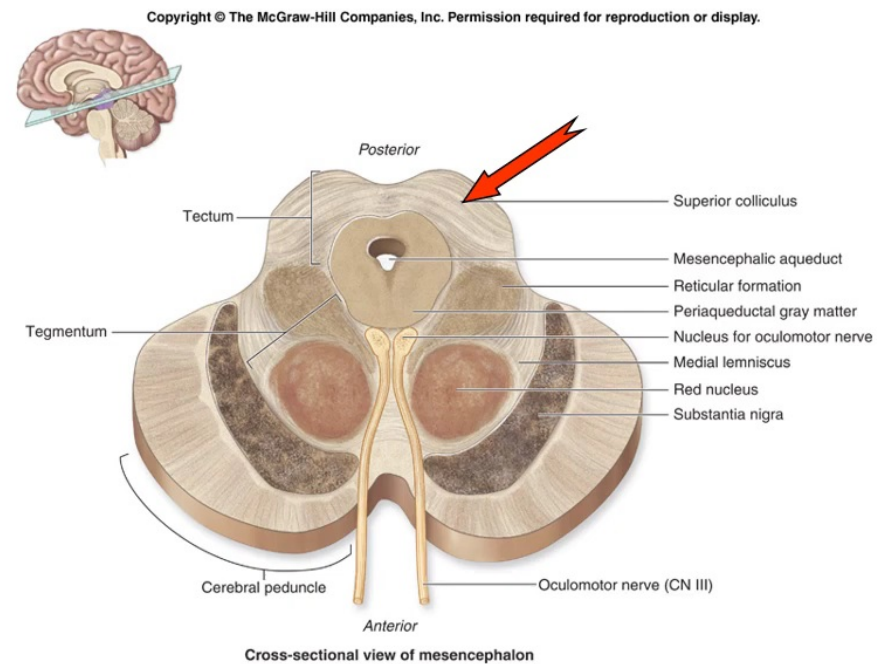
The Midbrain

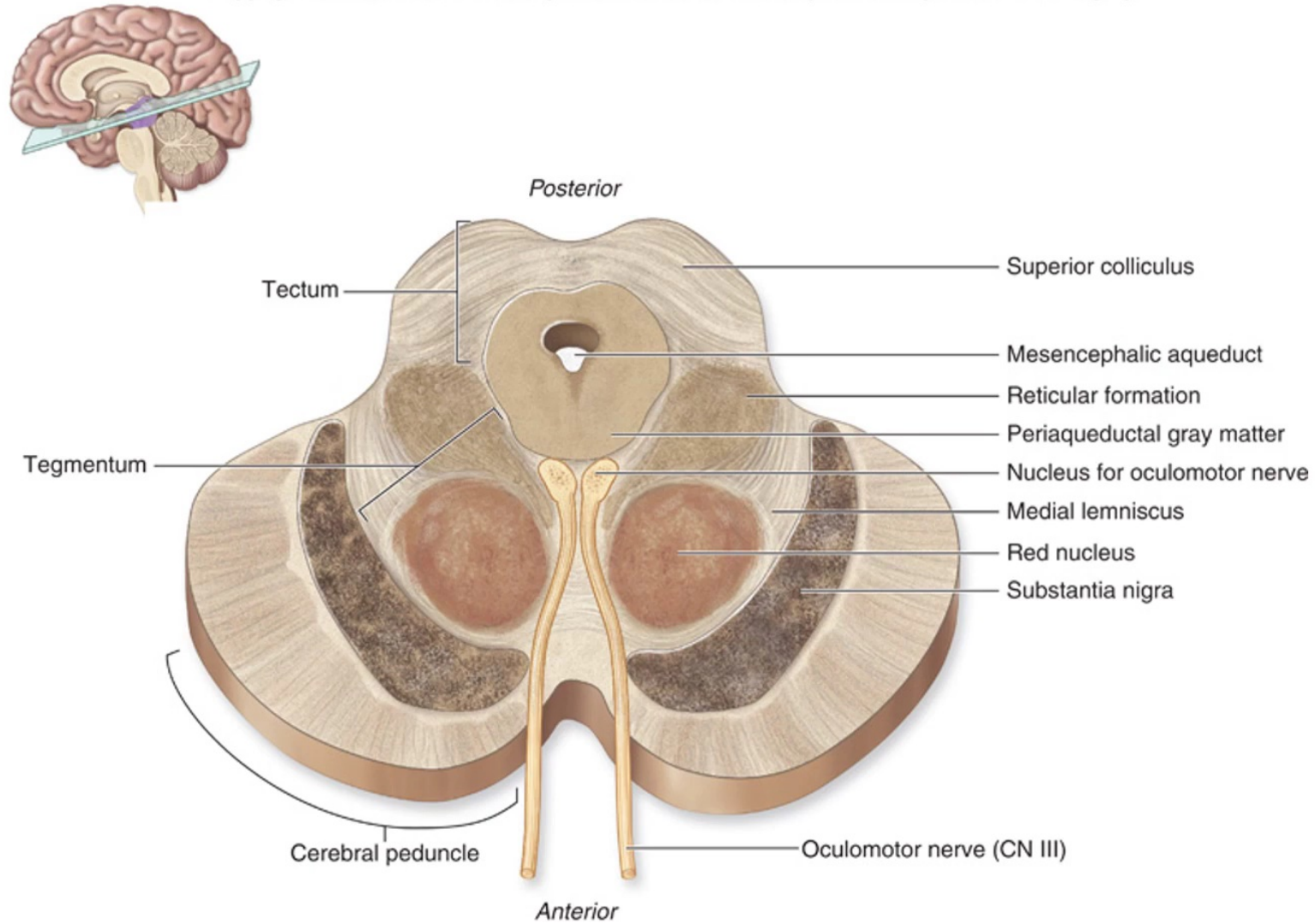
- Periaqueductal gray matter
 - surrounds the
 - cerebral aqueduct
- Involved in
- two related functions
 1. Fright-and-flight reaction
 2. Mediates response to visceral pain



The Midbrain

- Corpora quadrigemina
 - the largest nuclei
 - Divided into
 - Superior colliculi
 - nuclei that act in
 - visual reflexes
 - Inferior colliculi
 - nuclei that act in
 - reflexive response to
 - sound

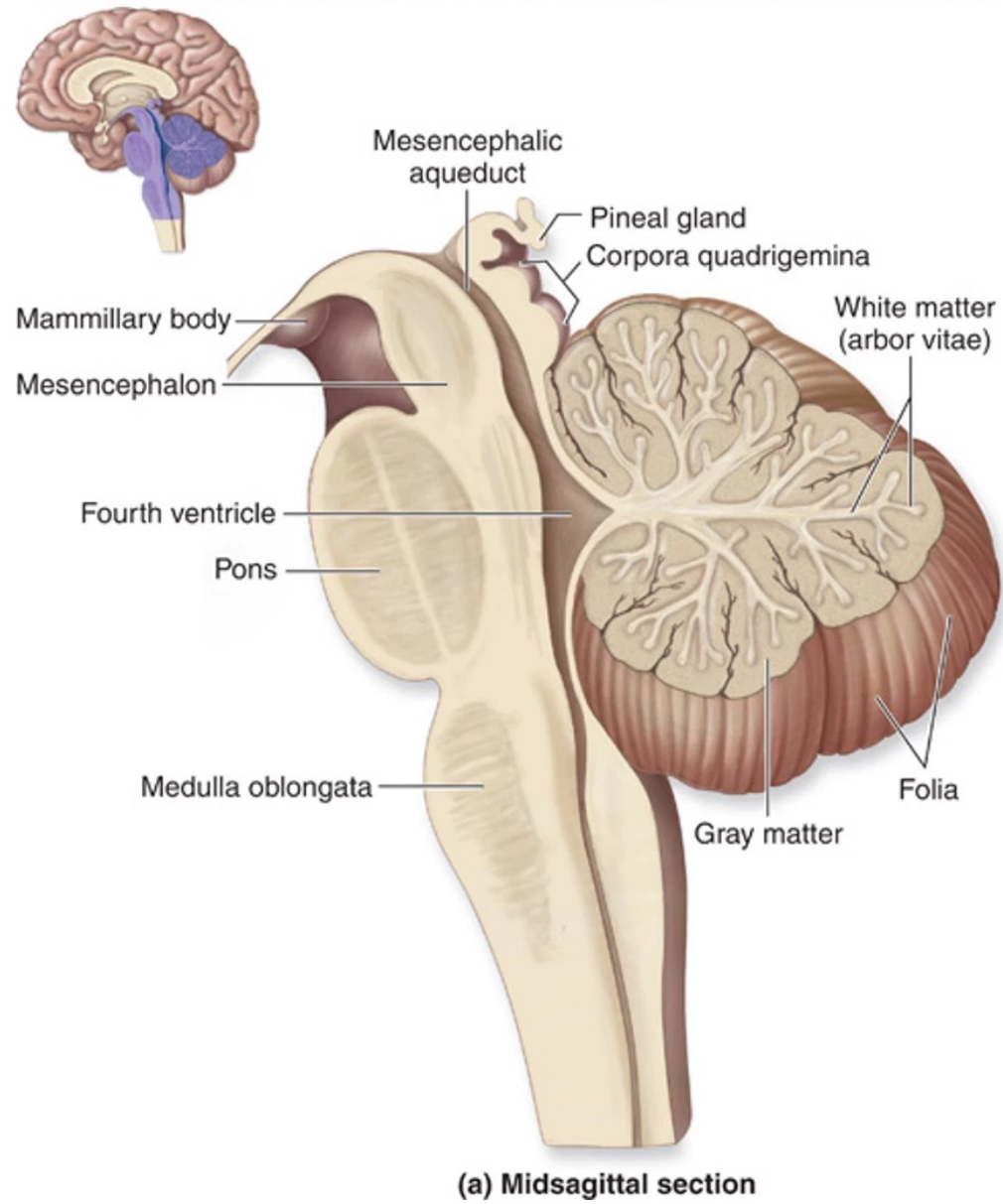




Cross-sectional view of mesencephalon

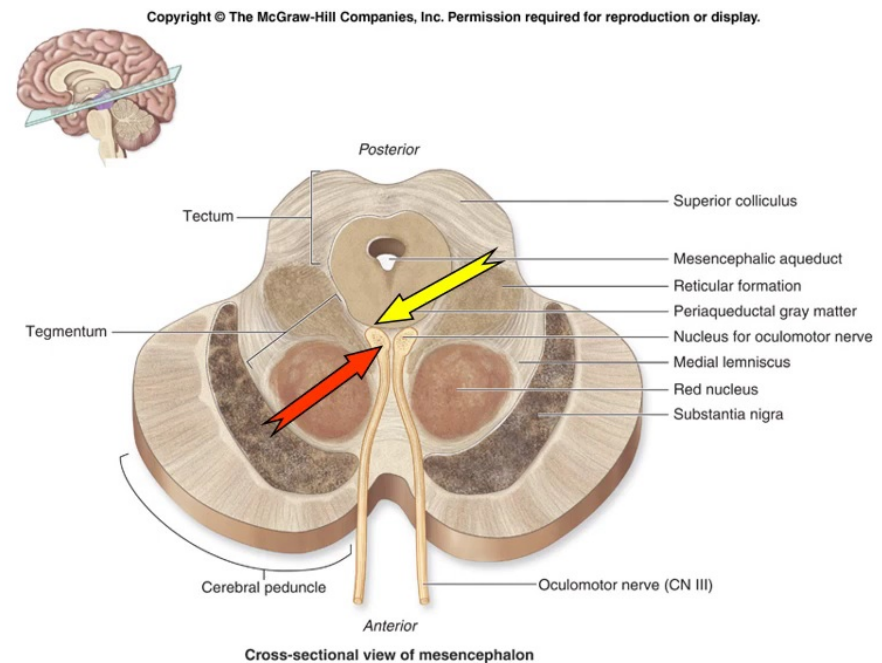
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Midbrain: Oculomotor Nerve

- 2 Nuclei
 - In the Tegmentum
 - Level with
 - Superior Colliculus
1. Motor Nucleus
 2. Parasympathetic Nucleus (EWN)

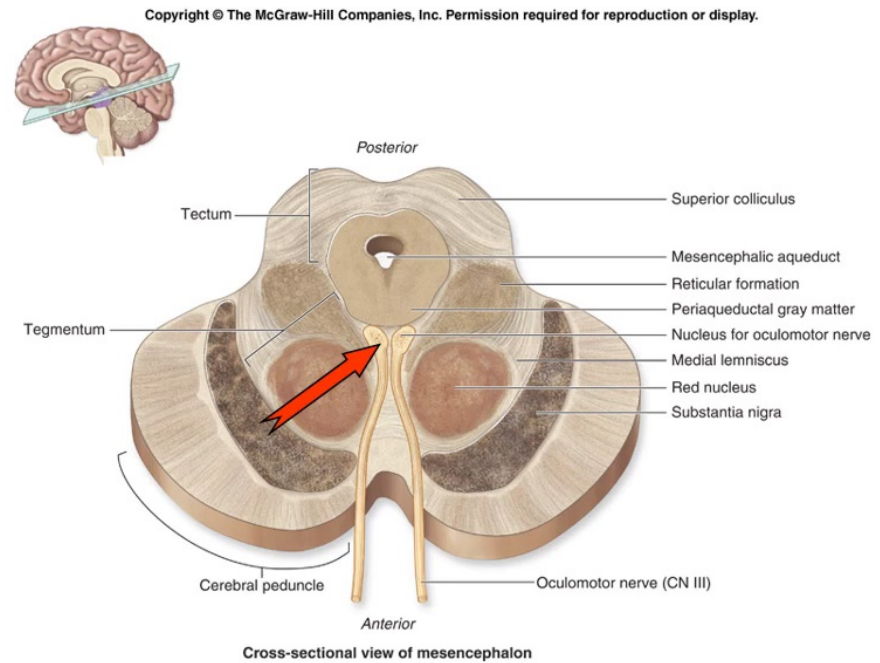


Midbrain: Oculomotor Nerve

- **Motor Nucleus**
 - **Somatic Nc**

Supply

- All EOM
- except
- SO & LR
- Central connections
- as VI & IV

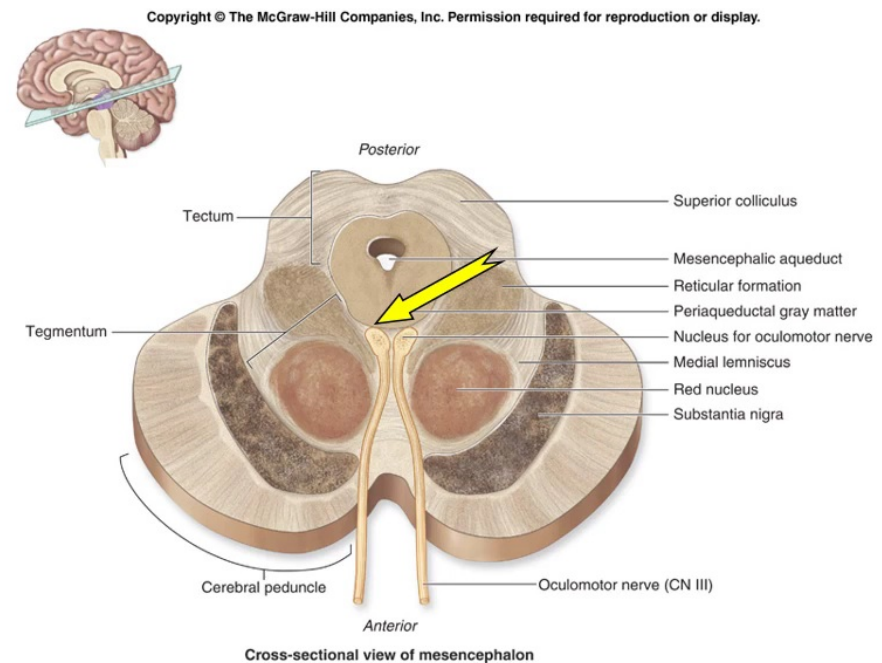


Midbrain: Oculomotor Nerve

- **Parasympathetic Nucleus**
 - **Edinger Westphal Nc**

Receives

- **Bilateral**
- **Afferent fibres**
- **from the**
- **Pretectal Nc**



Midbrain: Oculomotor Nerve

- **Parasympathetic Nucleus**

→ **Light Reflex**

1) **Preganglionic PS**

- → III

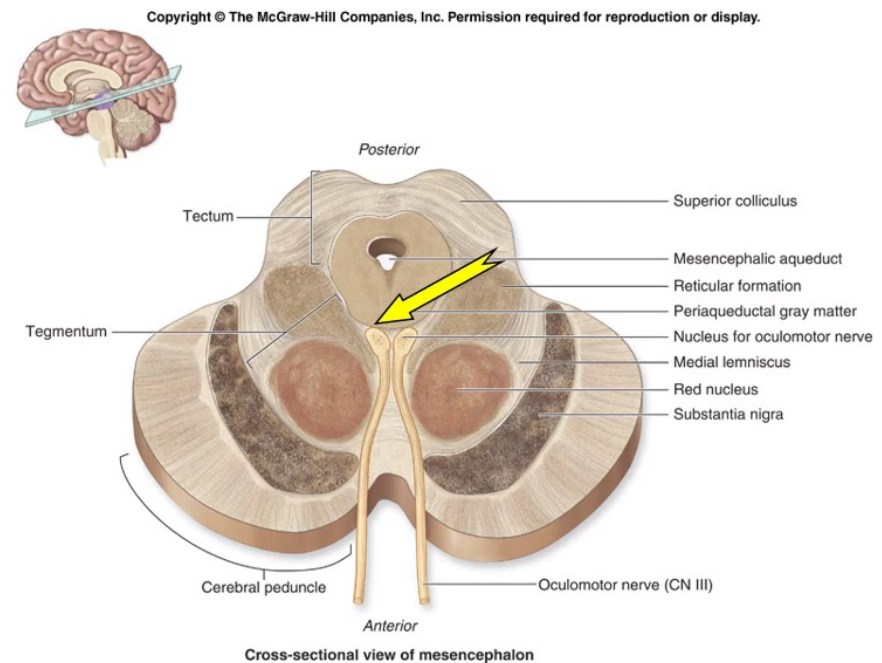
2) **Relay in the**

- **Ciliary Ganglion**

3) **Supply**

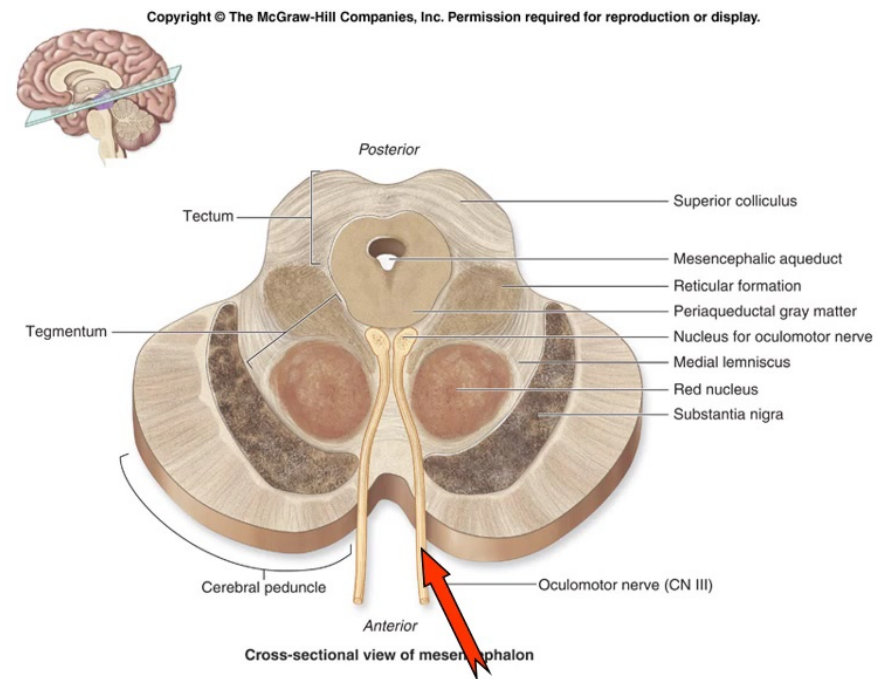
1. **Constrictor Pupillae**

2. **Ciliary muscle**



Midbrain: Oculomotor Nerve

- Exit
 - Passes ventrally
- Emerge from
- MB
- Just medial to
- Crus Cerebri



Midbrain: Oculomotor Nerve

NB

- Motor neurons of
- III, IV & VI
- does not receive input from
- Primary Motor Cortex

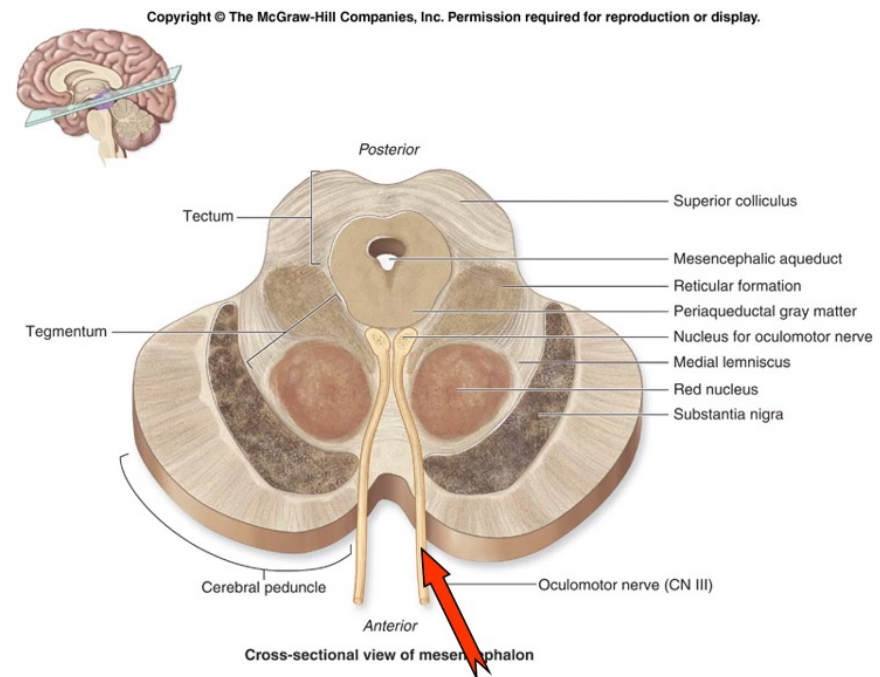
Controlled by

1) Frontal Eye Field

- area 8

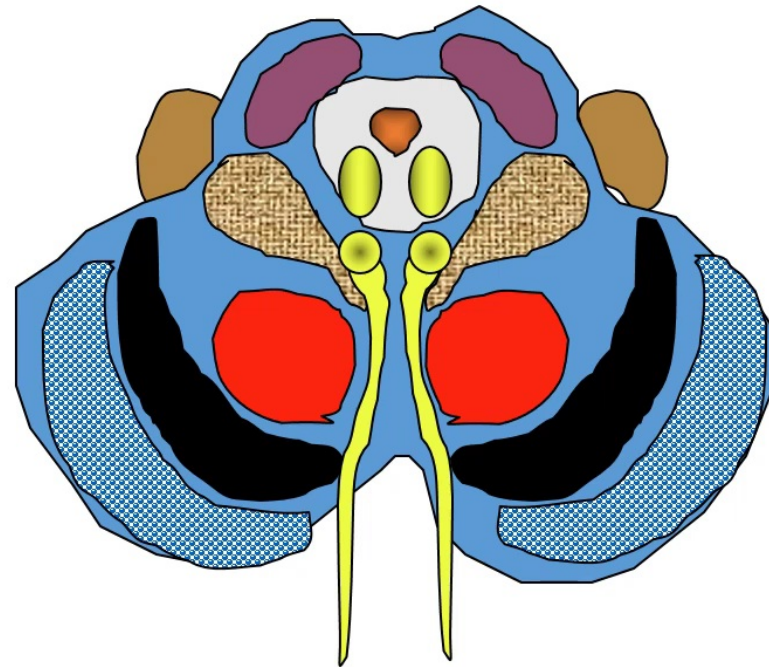
2) Visual Occipital Cortex

- area 19



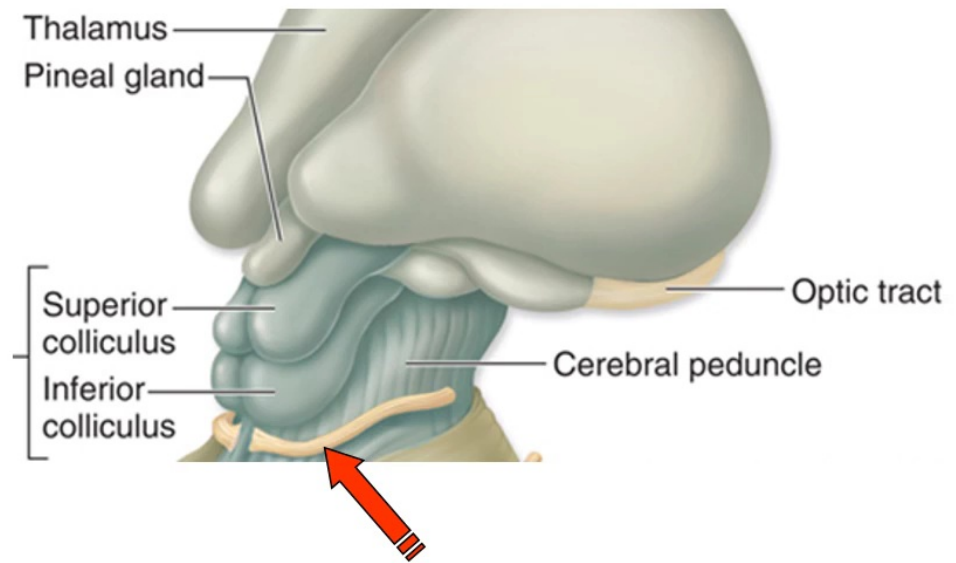
Midbrain: Oculomotor Nerve

- Major structure
- Midbrain SC level
- MGB
- Aquiduct
- Periaquiduct Grey Matter
- Superior Colliculus
- Pyramidal Tract
- Substantia Nigra
- Red Nucleus
- Reticular Formation
- Oculomotor Nerve
- Motor Nc
- Parasympathetic Nc



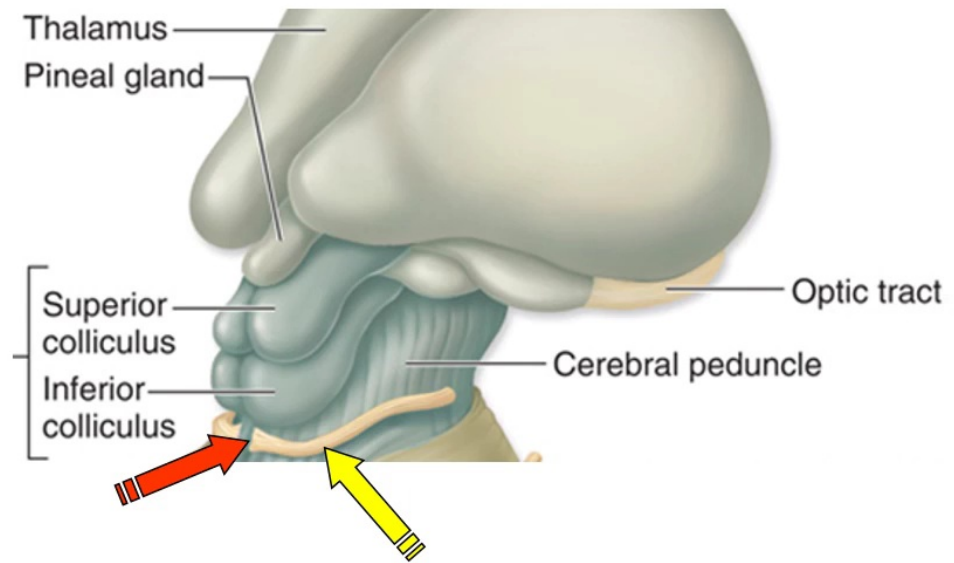
Midbrain: Trochlear Nerve

- Single Nc
 - Lies in the
 - Tegmentum
 - Level with
 - Inferior Colliculus
- Innervates
- SO muscle
- Input
 - The same as VI



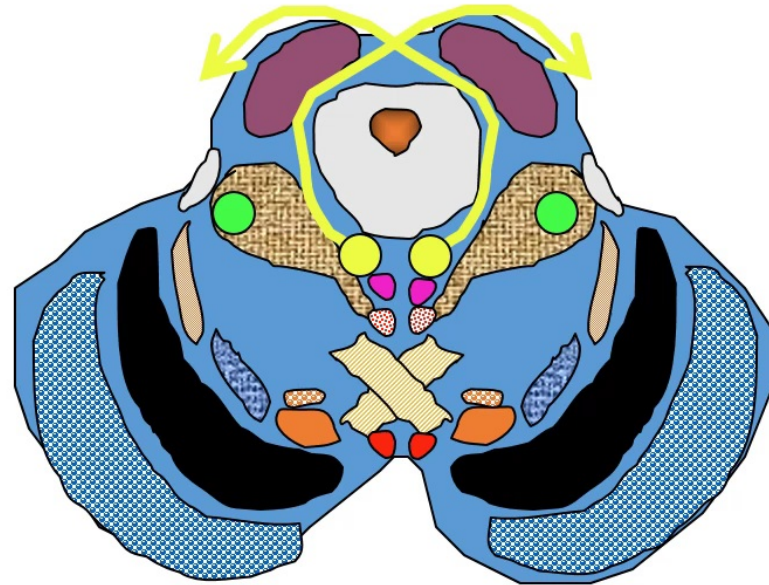
Midbrain: Trochlear Nerve

- Exit MB
 - 1) Fibres pass
 - dorsally
 - 2) Decussate to
 - opposite side
 - 3) Emerge from
 - MB dorsal surface
 - The only
 - cranial nerve to
 - exit dorsally
- Just below
- Inferior Colliculus



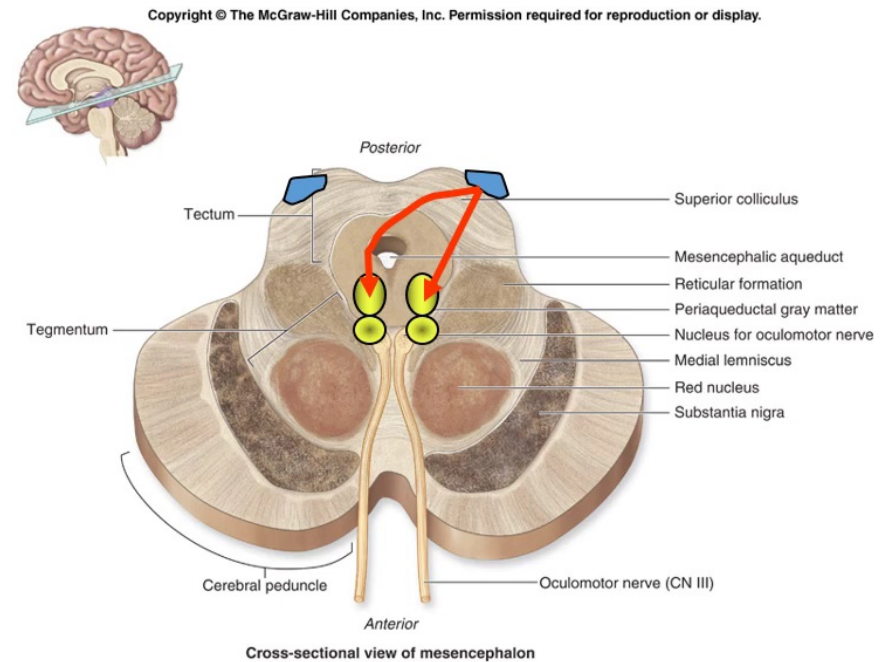
Midbrain: Level of Inferior Colliculus

- Special Details
- Inferior Colliculus
- Trochlear N Nc
- Trochlear N
- Central Tegmental Tract
- Decussation of SCP
- MLB
- Tectospinal Tract
- Rubrospinal Tract
- Inferior Brachium
- Lateral Lemniscus
- Spinal Lemniscus
- Medial lemniscus
- Trigeminal Lemniscus



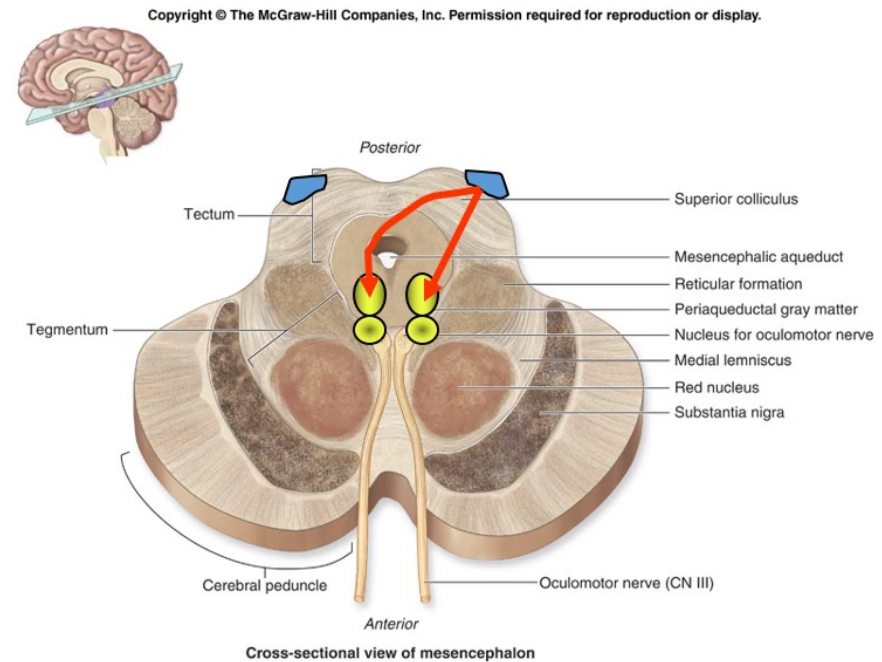
Midbrain: Pretectal Nucleus

- Group of nerve cells
 - Posterolateral to the
 - Sup Colliculus neurons
- Afferent
 - From Optic Nerve
 - (Light Reflex)
 - Retina
 - Optic N →
 - OX →
 - OT →
 - Pretectal Nc



Midbrain: Pretectal Nucleus

- Efferents
 - Projects to
 - IL EWN
 - → posterior Commissure →
 - CL EWN
 - Pregang F →
 - Oculomotor n →
 - Ciliary Ganglion
 - RELAY →
 - Postganglionic fibres →
 - Short ciliary Nn
- → constrictor Pupillae
- Both Eyes
- → Direct & Indirect LR

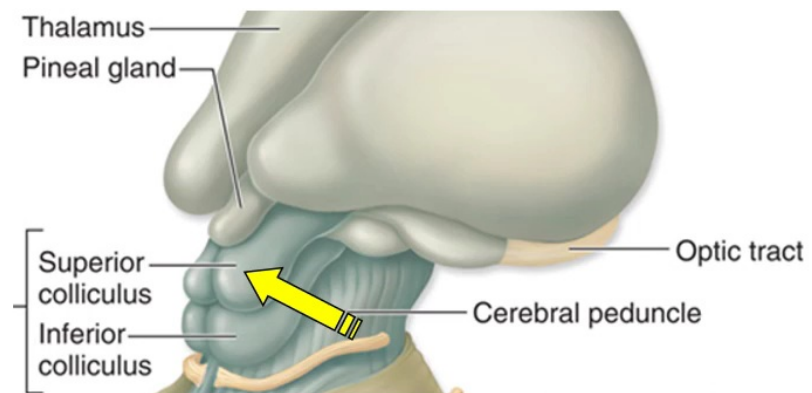


Midbrain: Superior Colliculus

- 2 rounded swellings
 - Form the
 - upper part of
 - Tectum

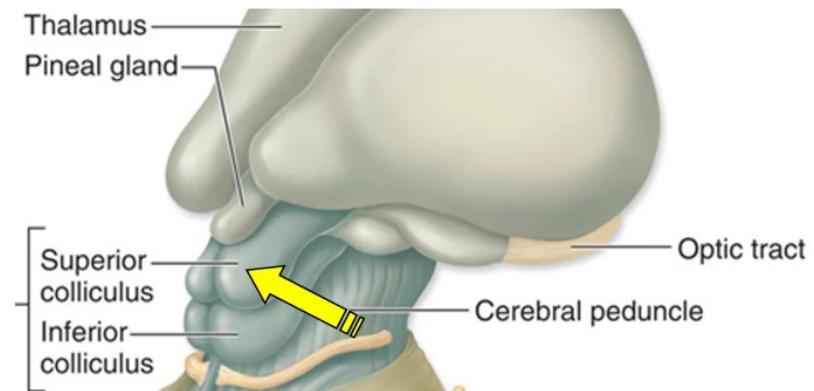
Responds to

- 3 sensory stimuli
 1. Visual
 2. Auditory
 3. Somatic cutaneous



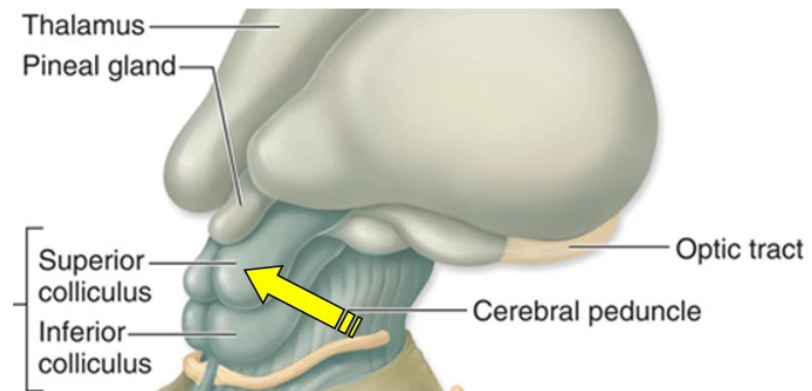
Midbrain: Superior Colliculus

- Afferent
 - Visual impulse from
 - Retina
 - Auditory impulse from
 - Inf Colliculus
 - Cutaneous impulse from
 - CL ½ Body via
 - Spino tectal tract



Midbrain: Superior Colliculus

- Efferent
 - Tecto nuclear →
 - moves eyes
 - Tecto spinal →
 - moves head & neck
- Towards
 - visual,
 - auditory &
 - cutaneous stimuli
- Most efferent fibres
 - decussate in the
 - dorsal tegmental decussation
 - the upper MB



Superior Colliculus Main Connections



1) Eye

- Retina → ON → OX → OT
- Retinotectal F
- Superior Colliculus

- Cerebral Cortex

2) Fronto Tectal F (8)

3) Occipito Tectal F (17)

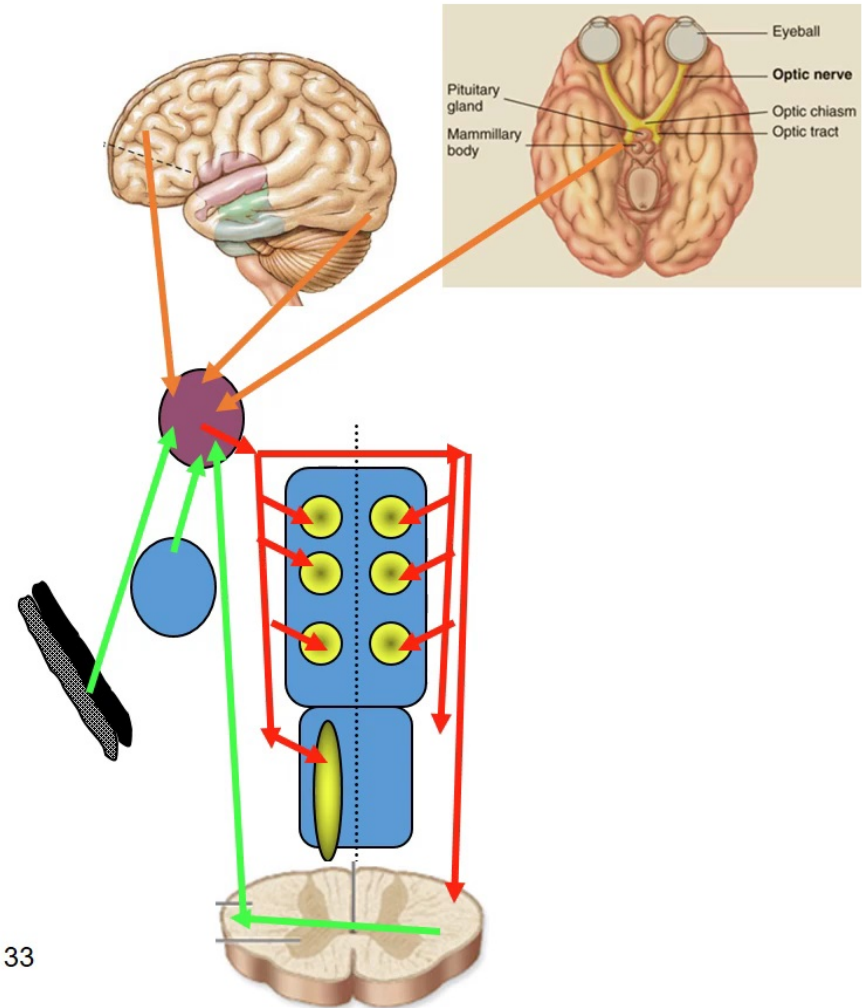
- Substantia Nigra
- Nigro Tectal F



- Tecto Nuclear F
- III IV VI & Spinal Nc of XI

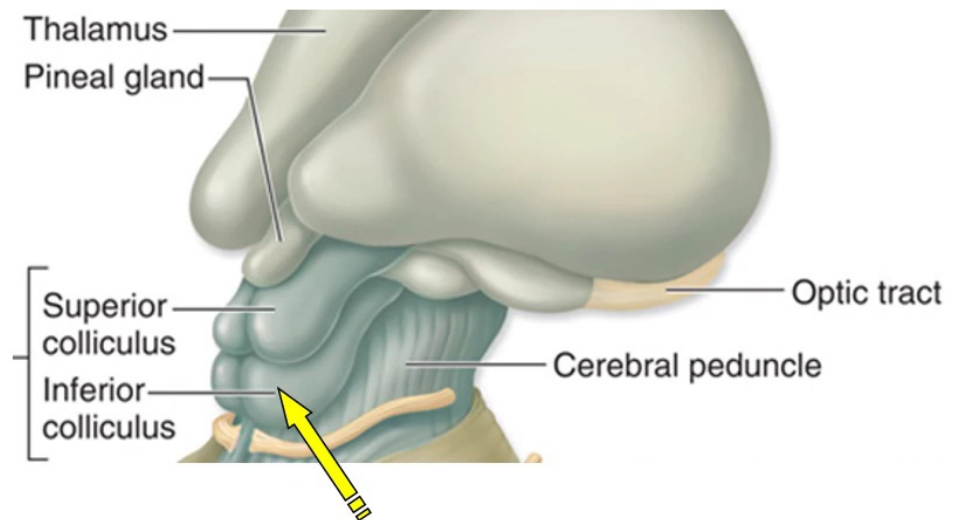
- Tecto Spinal T
- Spinal Cord

- Spino Tectal T
- Inferior Colliculus



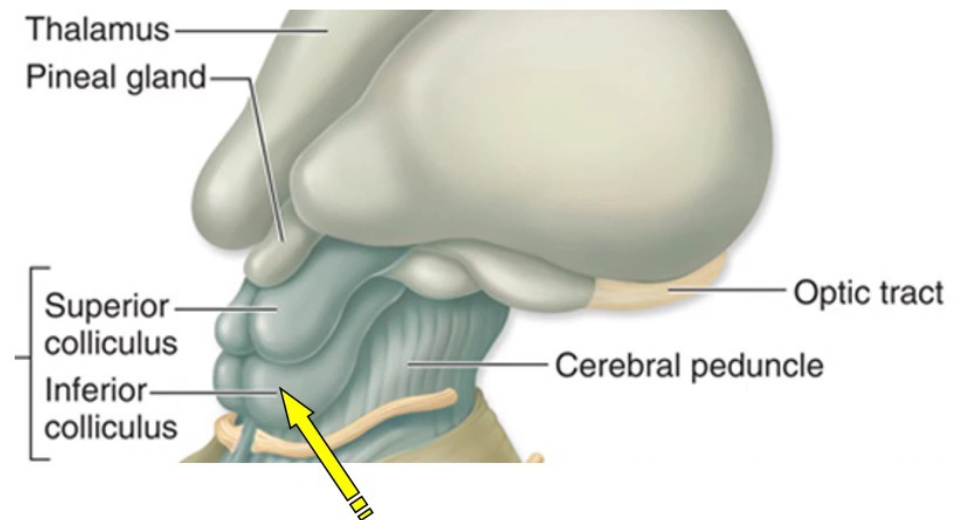
Midbrain: Inferior Colliculus

- 2 rounded swellings
 - Form the
 - inferior part of
 - Tectum
- Relay Nc in the
- Auditory Pathway



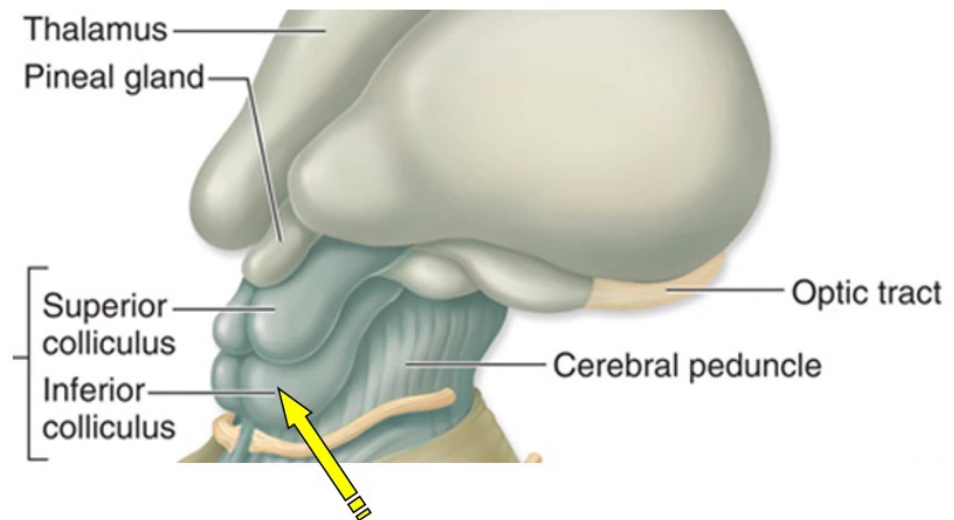
Midbrain: Inferior Colliculus

- Afferent
 - Hearing fibres
 - From
 - both ears
 - Via the
 - Lateral lemnisci



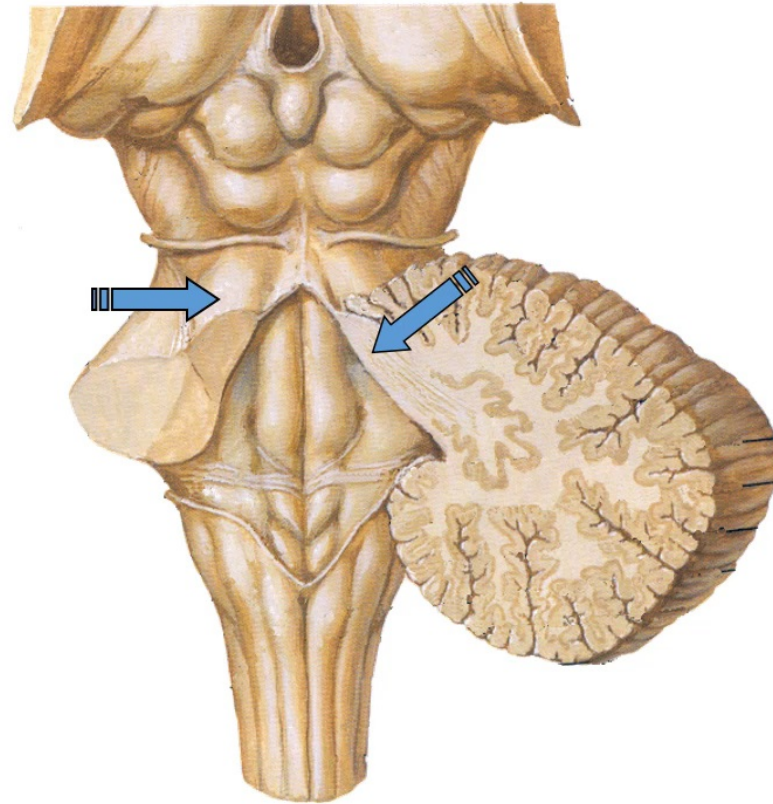
Midbrain: Inferior Colliculus

- Efferent
 - MGB
 - → auditory pathway
 - Sup Colliculus
 - Reflexes
 - Tecto nuclear →
 - moves eyes
 - Tecto spinal →
 - moves head & neck
- towards the
 - source of
 - Sound



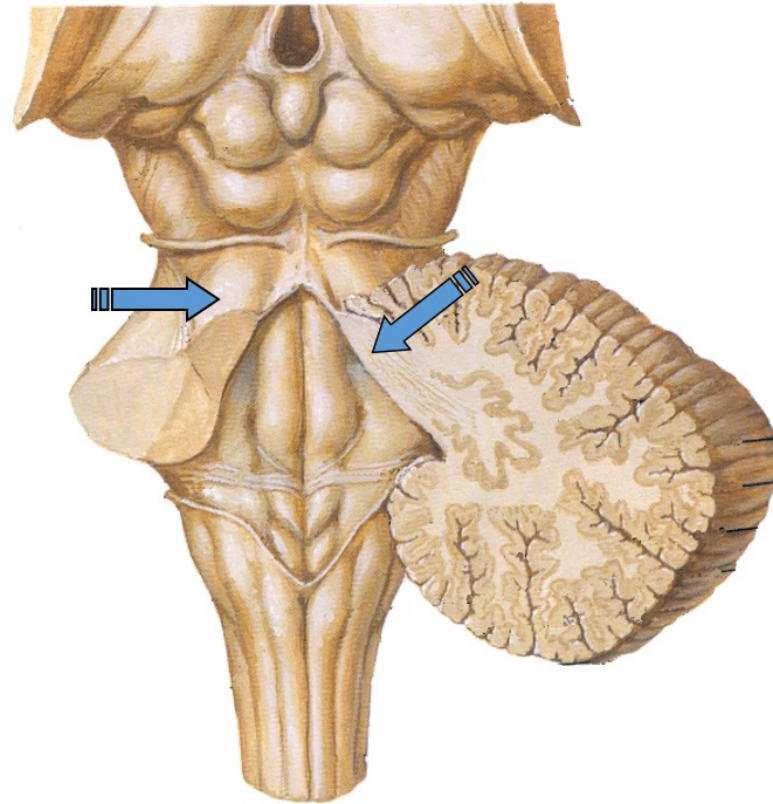
Midbrain: Superior Cerebellar Peduncle

- Bundle of Nerve Fibres
 - Connects
 - MB to
 - Cerebellum
- Decussate with
- CL side
- at the
- lower MB



Midbrain: Superior Cerebellar Peduncle

- Afferent pathway
 - 1) Ventral spinocerebellar tract
 - from LL
 - 2) Trigemino cerebellar f
 - from Mesencephalic Nc
 - 3) Tecto cerebellar fibres
 - Carries
 - **auditory and visual info**
 - From
 - **SC & IC**
 - to
 - **cerebellum**



Midbrain: Superior Cerebellar Peduncle

- Efferent Pathway

- Decussate in
- lower MB
- →

- 1) Fastigial Nc →

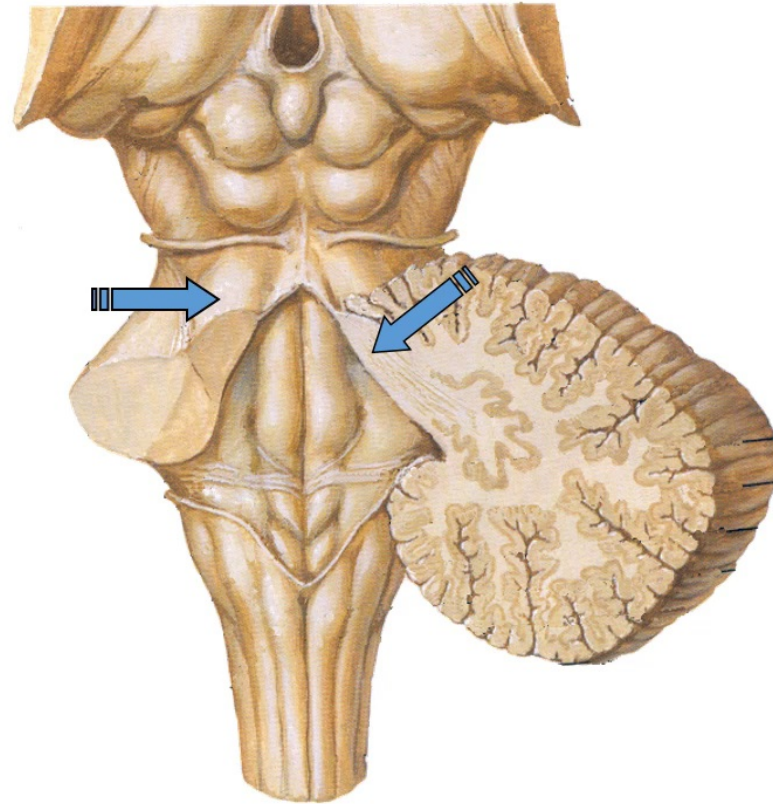
- BS Reticular Formation

- 2) Interpositus Nc →

- Red Nc

- 3) Dentate Nc →

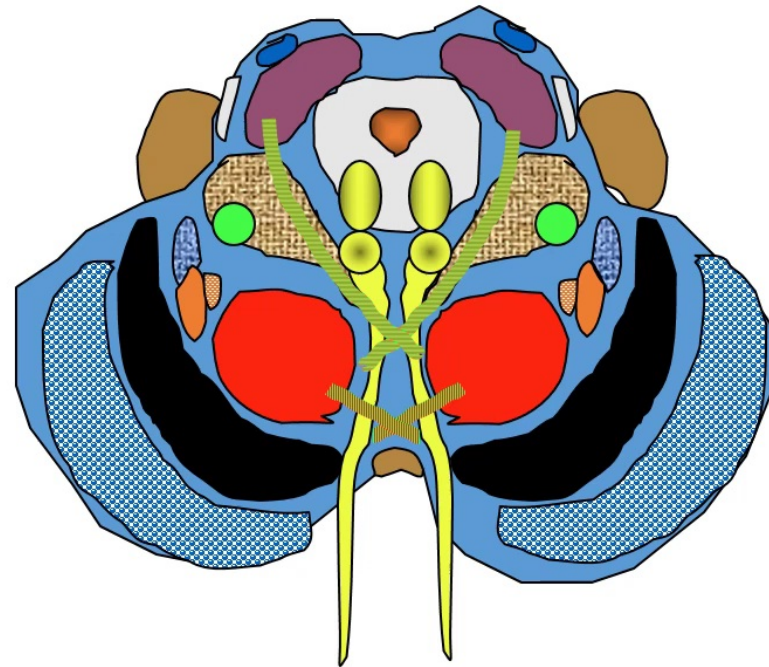
- Red Nc & TH →
- Cortex



Midbrain Decussations

2 @ level of
Superior Colliculus

- Ventral
 - Tegmental Decussation of the
 - Rubro Spinal Tract
- Dorsal
 - Tegmental Decussation of the
 - Tecto Spinal Tract



Midbrain Decussations

2 @ level of
Inferior Colliculus

- Decussation of
- Trochlear N
- Decussation of
- Sup Cerebellar Peduncle

