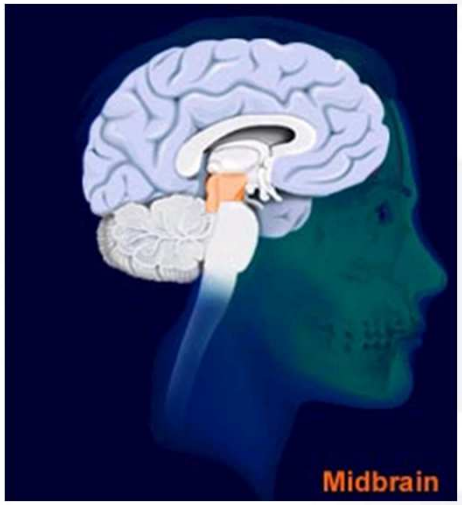
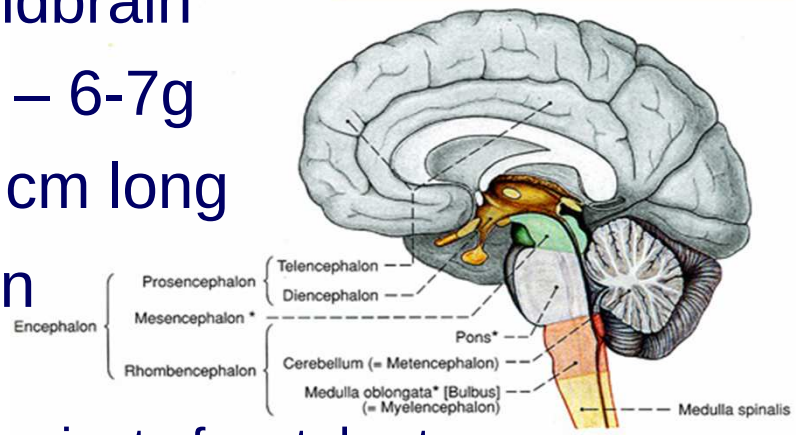


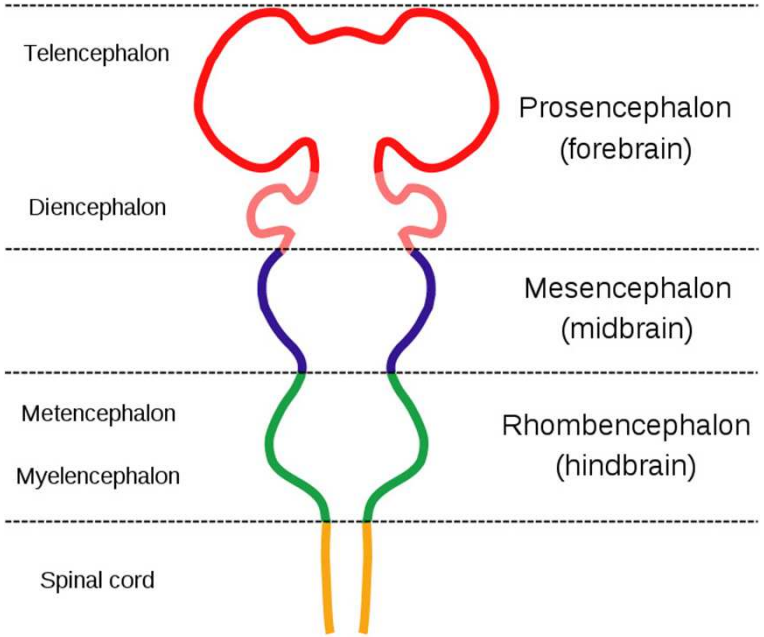
Brainstem: Midbrain

1. Midbrain – gross external anatomy
2. Internal structure of the midbrain:
   - cerebral peduncles
   - tegmentum
   - tectum (guadrigeminal plate)

Midbrain – general features

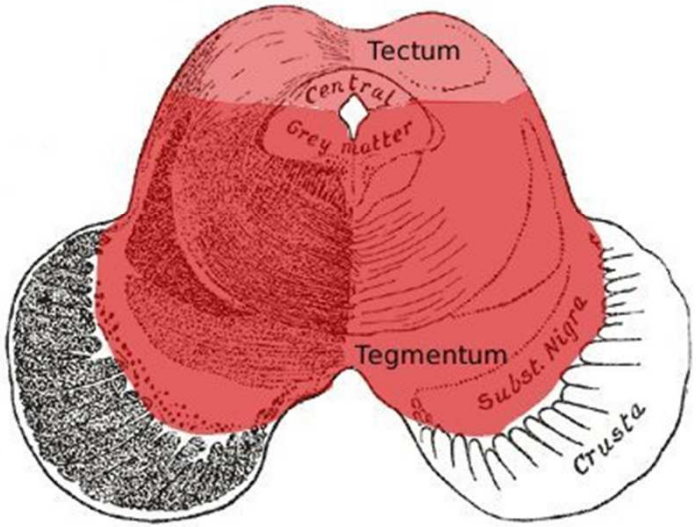
- location – between forebrain and hindbrain
- the smallest region of the brainstem – 6-7g
- the shortest brainstem segment ~ 2 cm long
- least differentiated brainstem division
- human midbrain is archipallian –
  shared general architecture with the most ancient of vertebrates
- embryonic origin – mesencephalon
- main functions:
  - ✓ a sort of relay station
    for sound and visual information
  - ✓ serves as a nerve pathway
    of the cerebral hemispheres
  - ✓ controls the eye movement
  - ✓ involved in control of body movement

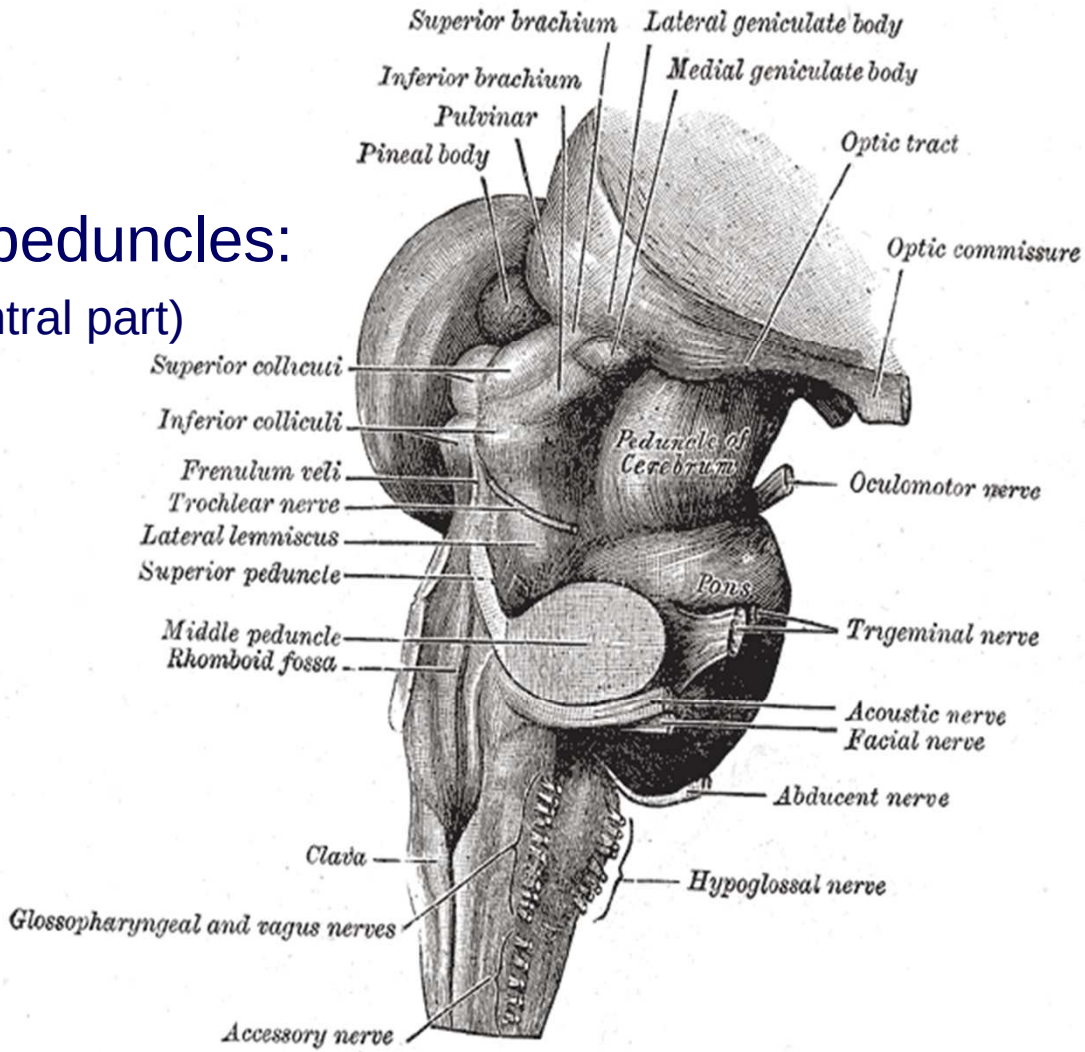




Midbrain – gross anatomy

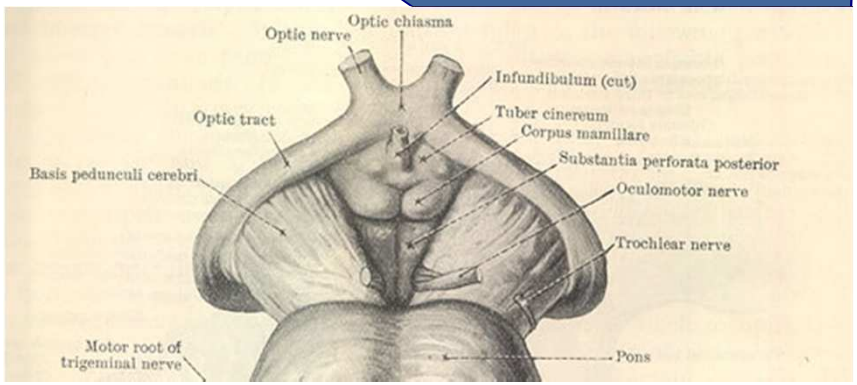
- dorsal part – *tectum* (quadrigeminal plate):
  - ✓ superior colliculi
  - ✓ inferior colliculi
  - ⇨ cerebral aqueduct
- ventral part – cerebral peduncles:
  - ✓ dorsal – tegmentum (central part)
  - ✓ ventral – cerebral crus
  - ⇨ substantia nigra



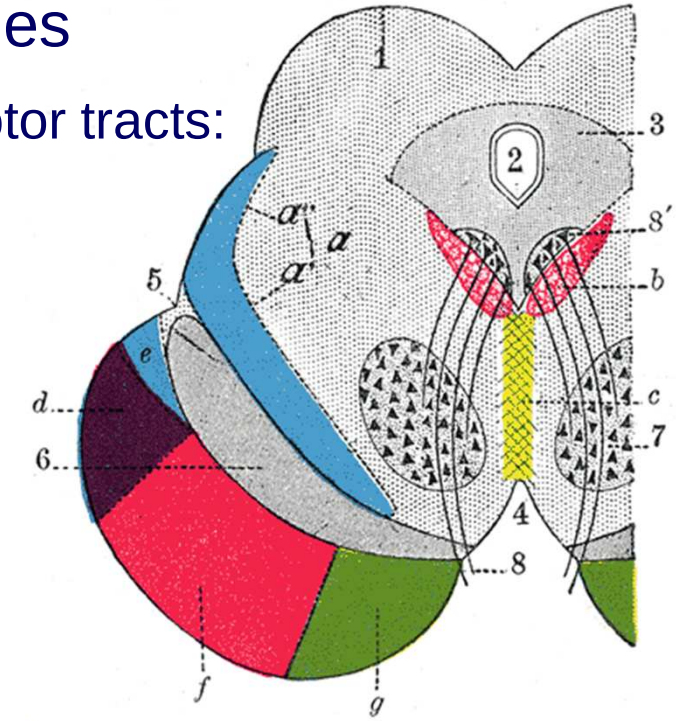


Cerebral crus – internal structure

- Cerebral peduncle:
  - ✓ *crus cerebri*
  - ✓ *tegmentum mesencephali*
  - ✓ *substantia nigra*



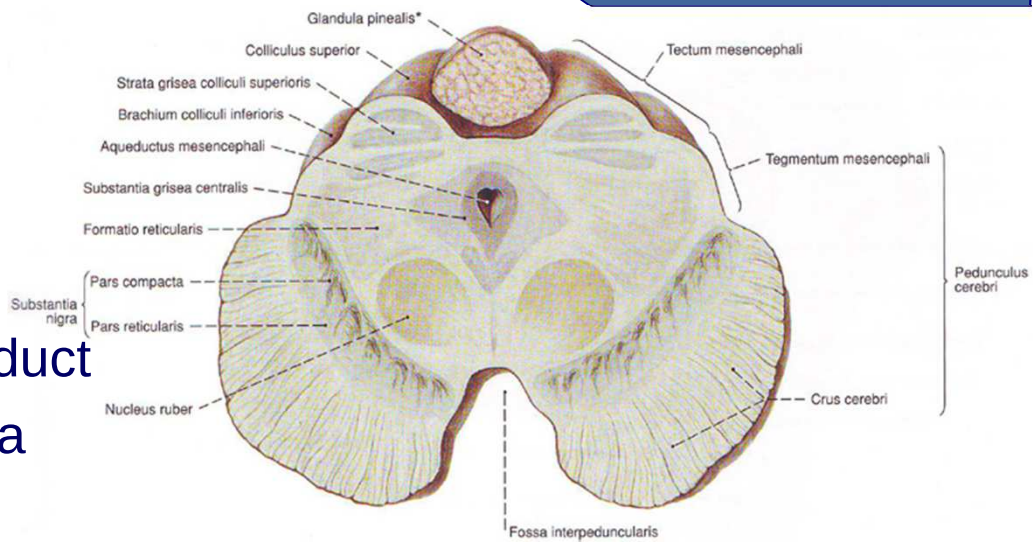
- two thick semilunar white matter bundles
- composition – somatotopically arranged motor tracts:
  - ✓ corticospinal
  - ✓ corticobulbar
  } pyramidal tracts – medial ⅔
  - ✓ corticopontine fibers:
    - ➢ frontopontine tracts – medially
    - ➢ temporopontine tracts – laterally
- interpeduncular fossa (of *Tarin*)
  - ✓ posterior perforated substance



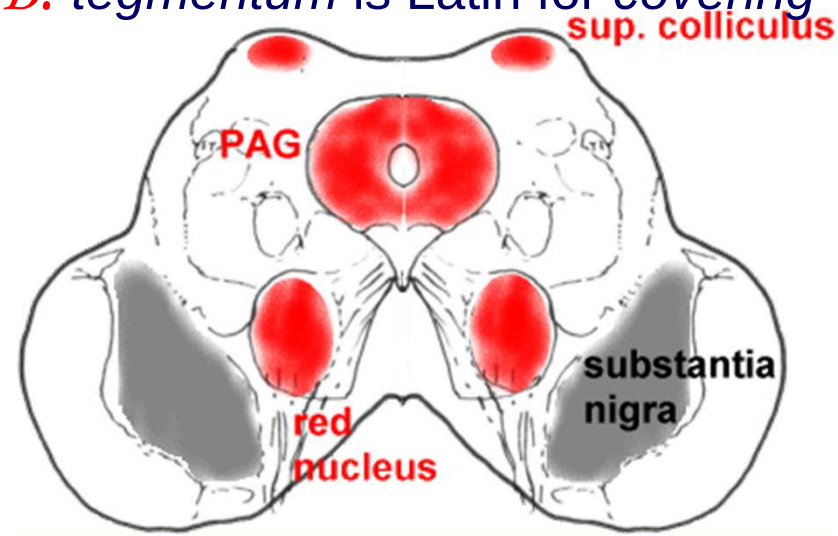
Midbrain tegmentum – internal structure

- ✓ *crus cerebri*
- ✓ *tegmentum mesencephali*
- ✓ *substantia nigra*

- location:
  - ✓ ventral to the cerebral aqueduct
  - ✓ dorsal to the substantia nigra
- grey matter content:
  - ✓ periaqueductal grey matter
  - ✓ nuclei of cranial nerves III & IV
  - ✓ midbrain reticular formation
  - ✓ red nucleus, *nucleus ruber:*
    - ➢ parvocellular part – rostral third
    - ➢ magnocellular part – caudal portion
  - ✓ ventral tegmental area

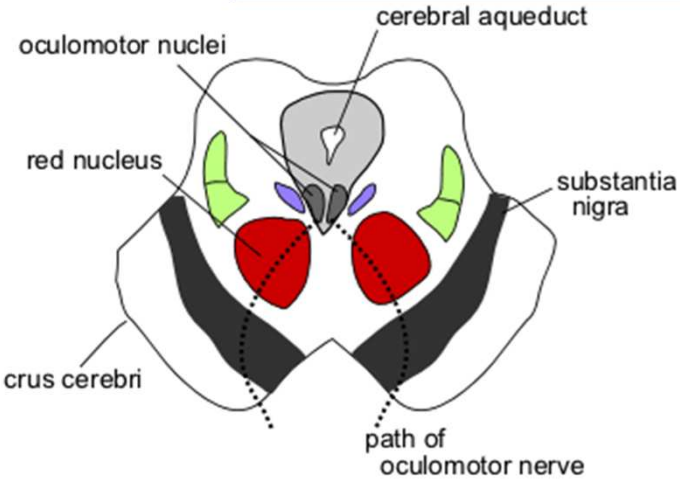


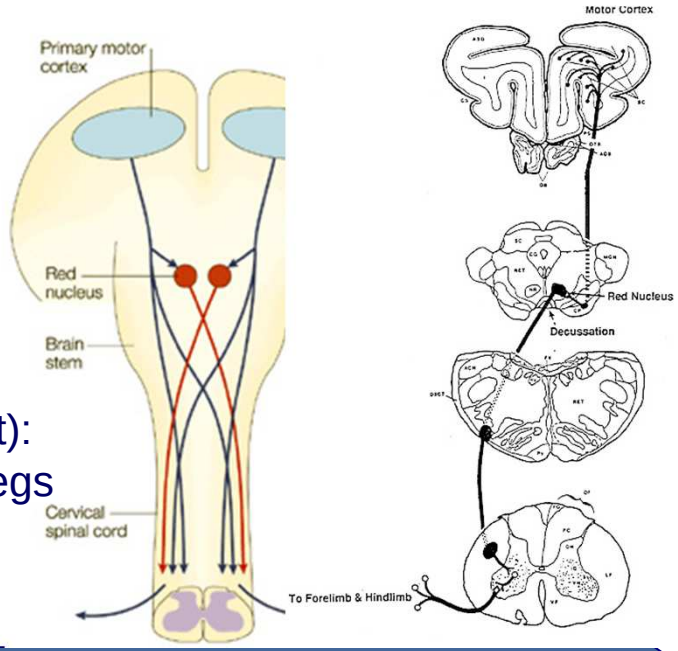
NB: *tegmentum* is Latin for *covering*



Red nucleus, *nucleus ruber*

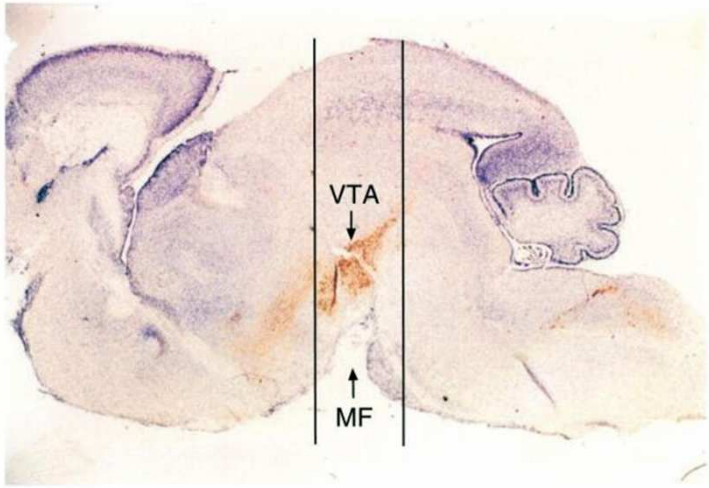
- Red nucleus:
  - ✓ ovoid mass ~ 5 mm in diameter
  - ✓ pinkish-yellow in color – iron-containing pigment
- Rubral inputs:
  - ✓ contralateral cerebellum – cerebellorubral tract
  - ✓ ipsilateral motor cortex – corticorubral tract
- Rubral outputs – rubrospinal projections (tract of *Monakow*) to:
  - ✓ contralateral side (crossed in ventral tegmental decussation of *Forel*) of:
    - ➢ rhombencephalic reticular formation
    - ➢ spinal cord
- Functions – extrapyramidal system:
  - ✓ controls the muscles of the shoulder&upper arm
  - ✓ in humans – vestigial (dominated by corticospinal tract):
    - ➢ large muscle movement such as that for arms and legs
    - ➢ arm-swinging in normal walking
    - ➢ crawling of babies



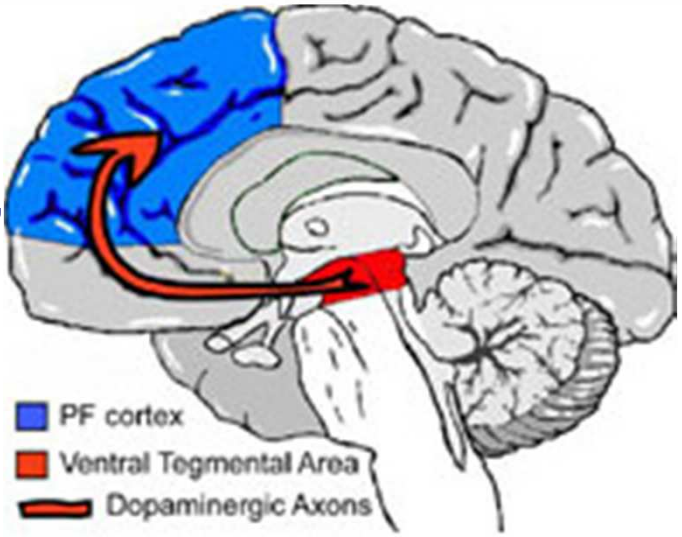


Ventral tegmental area

- a group of neurons located close to the midline on the floor of the midbrain
  - ✓ dorsomedial to the substantia nigra
  - ✓ ventral to the red nucleus
- rich in dopaminergic (50-60% of all neurons) and serotoninergic neurons
- comprises the mesocorticolimbic dopamine system (A10)
- important projection to nucleus accumbens

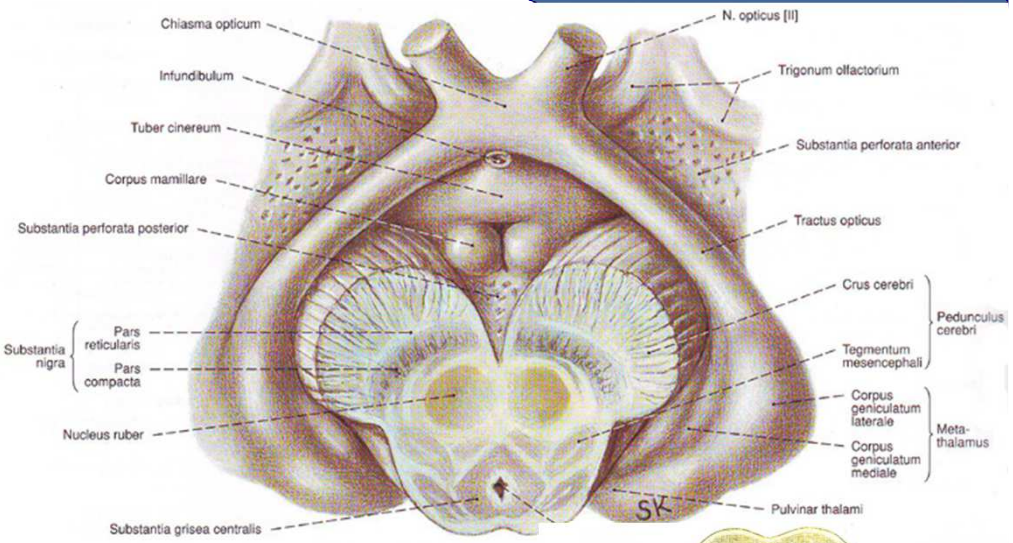


- Functions:
  - ✓ implicated in the reward system, motivation, cognition, drug addiction
  - ✓ process various types of emotion output from the amygdala
  - ✓ role in avoidance and fear-conditioning

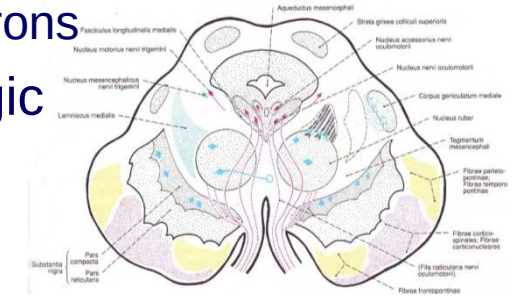


Substantia nigra

- ✓ *crus cerebri*
- ✓ *tegmentum mesencephali*
- ✓ *substantia nigra*

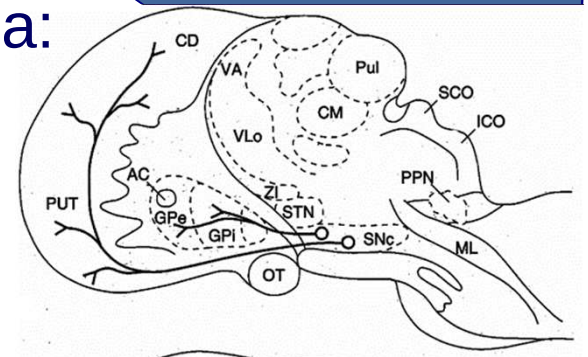


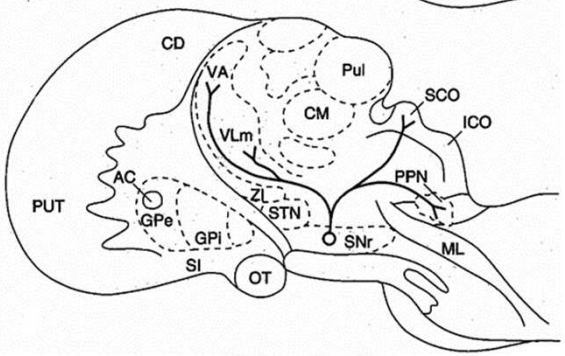
- pigmented grey matter
  (also called ***"Black Matter"***
  though it is **not entirely black**!)
  ⇨ neuromelanin and dopamine:
  nigrostriatal pathway
- part of the basal ganglia
- subdivisions – two entirely different parts:
  - ✓ *pars compacta:* dorsal cell-rich zone of numerous medium-sized neuromelanin-containing dopaminergic neurons
  - ✓ *pars reticularis:* ventral cell-poor zone of dopaminergic and nonpigmented GABAergic neurons intermingled with nerve fibers

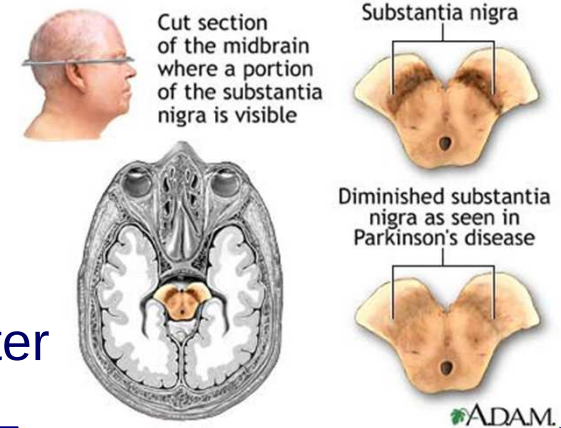


Substantia nigra: efferent connections

- *pars compacta* – input to the basal ganglia:
  - ✓ nigrostriatal projection – dopamine
- *pars reticulata* – output conveying signals from the basal ganglia to numerous other brain structures:
  - ✓ thalamus – nigrothalamic pathway (GABA)
  - ✓ superior colliculus
  - ✓ reticular formation
- Functions:
  - ✓ *pars compacta*: motor control
    - ➢ Parkinson's disease
    - ➢ learned responses to stimuli
    - ➢ "spatial learning"
  - ✓ *pars reticulata*: important processing center



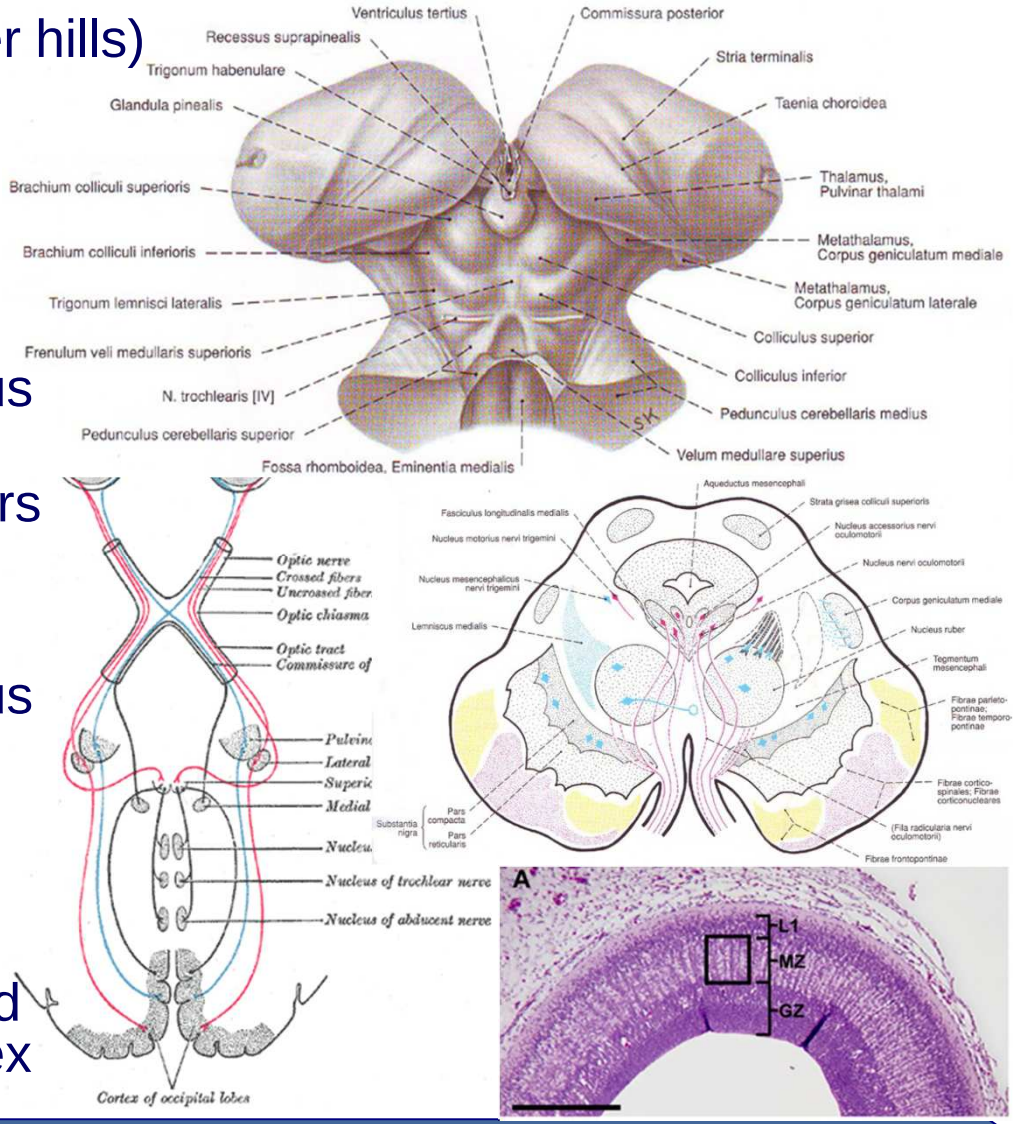




Tectum, quadrigeminal plate

- ✓ *superior colliculi* (Latin, higher hills)
- ✓ *inferior colliculi* (lower hills)

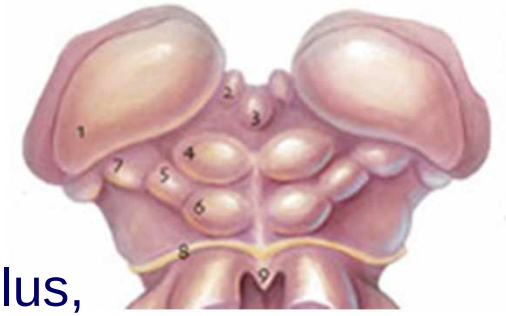
- Location:
  - ✓ rostral half of the tectum, beneath the thalamus
  - ✓ brachium of superior colliculus ⇨ lateral geniculate body
  - ✓ alternate grey and white layers
  - ✓ superior colliculus nucleus
  - ✓ oculomotor nucleus
  - ✓ accessory oculomotor nucleus (of *Edinger-Westphal*)
- Functions:
  - ✓ primary integrating center for visual responses
  - ✓ visual coordination of eye and head movements – start reflex

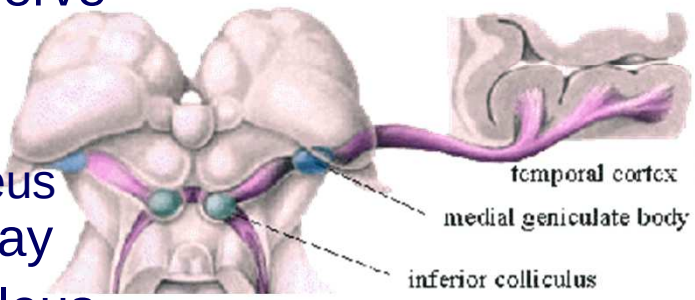


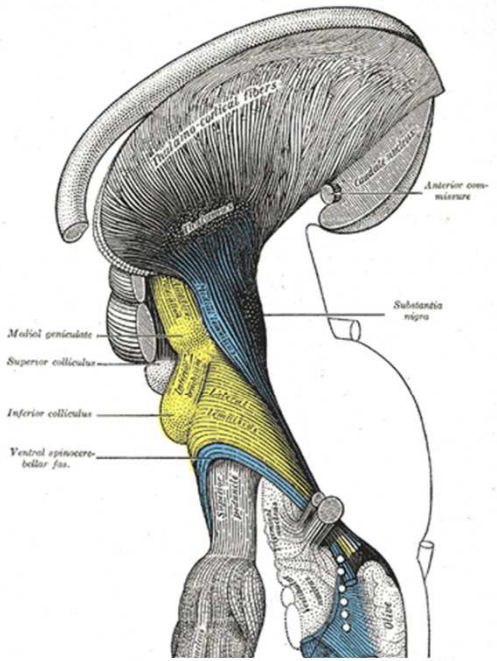
Tectum, quadrigeminal plate

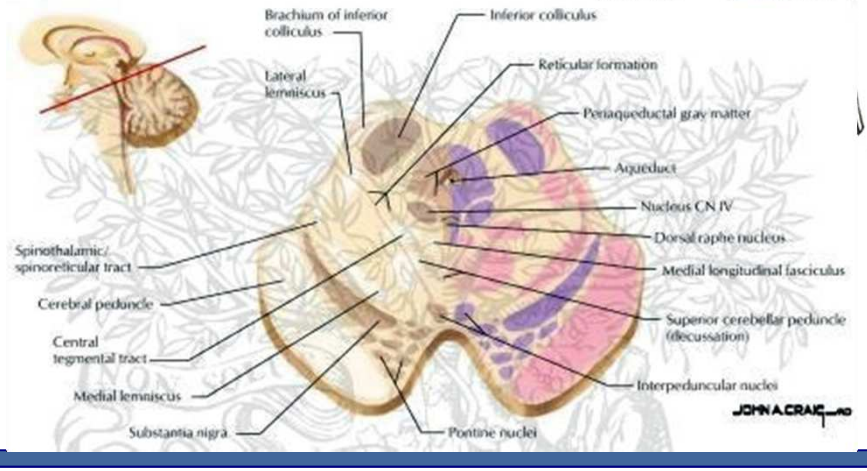
- ✓ *superior colliculi*
- ✓ *inferior colliculi*

- Location:
  - ✓ caudal to the superior colliculus, above the trochlear nerve
  - ✓ inferior brachium ⇨ medial geniculate body
  - ✓ principal midbrain nucleus of the auditory pathway
  - ✓ inferior colliculus nucleus ⇦ lateral lemniscus
  - ✓ trochlear nucleus – trochlear decussation
- Function:
  - ✓ principal way station for ascending sound information









Thank you…