Neuroanatomy - overview

Lennart Brodin
The components of the CNS

- Telencephalon
- Diencephalon
- Brainstem
- Cerebellum
- Spinal cord
Sectioning the brain - nomenclature
Coronal section

Grey matter: cell bodies of neurons

White matter: nerve tracts, Myelin gives the white color
Corpus callosum: Connects the hemispheres

Thalamus

Hypothalamus

Brainstem

Cerebellum

Spinal cord

Telencephalon

Diencephalon

Sagittal section
Telencephalon

Diencephalon

Thalamus

Hypothalamus

Hjärnstammen

Ryggmärgen

Cerebellum

From CNS Visual Perspectives: www.3d-brain.ki.se

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The Cerebral Cortex

- Sulcus
- Gyrus
- Grey matter
- White matter
Gyrus precentralis: Motor functions

Gyrus postcentralis: Sensory functions

Sulcus centralis
The Cerebral Cortex – Division into Functional Areas

Association areas

Primary areas

motor
sensory
hearing
vision
The Cerebral Cortex – Division into Lobes

- Frontal lobe
- Sulcus centralis
- Parietal lobe
- Occipital lobe
- Temporal lobe
The Cerebral Cortex – Division into Lobes

- Frontal lobe
- Parietal lobe
- Occipital lobe
- Temporal lobe
Localization of functions to lobes
1848: The famous case of the railway worker Phineas Gage gave the first insights into the functions of the frontal lobe.
The Frontal lobe
The Frontal lobe

Personality
Motivation
Planning
Decision-making
Social skills
The temporal lobe recognition
Activation of the temporal lobe during recognition of a known face.
The parietal lobe attention
Damage of the right parietal lobe

Normal

Right hemisphere lesion
(severe left neglect)
Damage of the right parietal lobe

(A) "Draw a house"

Model          Patient’s copy

(B) "Bisect the line"
Recent data: The temporal lobe is also involved

The parietal lobe
attention

The posterior temporal lobe
The occipital lobe receives and processes visual information.
Language: specific regions in the frontal and temporal lobes

- Primary motor cortex
- Primary somatic sensory cortex
- Broca’s area
- Wernicke’s area
- Primary auditory cortex
- Primary visual cortex
Language: specific regions in the frontal and temporal lobes

Wernicke's area: language perception
Damage results in sensory aphasia

Broca's area: language expression
Damage results in motor aphasia
Subcortical nuclei

Telencephalon:

The basal ganglia

Nucleus caudatus

Putamen

Globus pallidus

Striatum

Motor control

Cognition

Emotions
The Basal Ganglia

Level of section shown in (A)

Level of section shown in (B)

Nucleus caudatus

Putamen
The Basal Ganglia
coronal section

Nucleus caudatus

Putamen
The Basal Ganglia

coronal section
The Basal Ganglia
coronal section
The Basal Ganglia
horizontal section

- Putamen
- Globus pallidus
- Nucleus caudatus
Nucleus caudatus

Putamen

Diencephalon

Thalamus

Nucleus caudatus
Diencephalon

Thalamus:

the brains “switch board”:
relays sensory input to the cerebral cortex
Thalamus relays sensory input to the cerebral cortex

cortex

thalamus

nerve fiber from the skin
The anatomy of emotions

The “old” view of the limbic system
The “modern” view of the limbic system:
Anterior part: emotions; Posterior part: memory
The anatomy of emotions

The “modern” view of the limbic system:
Anterior part: emotions; Posterior part: memory
Different Forms of Memory

<table>
<thead>
<tr>
<th>Declarative memory</th>
<th>Non-declarative memory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memories that can be described in words</td>
<td>Can not be described (e.g how to ride a bicycle)</td>
</tr>
</tbody>
</table>
Brain structures participating in declarative memory: The posterior part of the limbic system
Brain structures participating in declarative memory:
The posterior part of the limbic system
Hippocampus seen from below (parts of the temporal lobes removed)
Cranial nerves emerging from the brainstem mediate sensory and motor functions in the head.

(I. N. Olfactorii)
(II. N. Opticus)
III. N. Oculomotorius
IV. N. Trochlearis
V. N. Trigeminus
VI. N. Abducens
VII. N. Facialis
VIII. N. Vestibulo-cochlearis
IX. N. Glosso-pharyngeus
X. N. Vagus
XI. N. Accesorius
XII. N. Hypoglossus
The Reticular Formation

Descending part: Motor functions

Ascending part: Consciousness
The Brainstem - Summary

**Cranial nerves:** sensory and motor functions in the head incl eye movements, hearing, balance, inner organs

**Reticular Formation:** consciousness, motor functions

**Dopamine systems:** motivation, reward, motor functions

**Serotonin systems:** mood, emotions, hunger-satiety, motor functions

**Other functions:** breathing, swallowing
Cerebellum
Cerebellum: connected to pons via the peduncles
Pons
Medulla oblongata
Peduncle
Peduncle
Fine-tuning of motor functions
Motor learning
Cognition
Cerebellum
The Spinal Cord

Grey matter

White matter

Dorsal horn - sensory

Ventral horn - motor

cervical

thoracic

lumbar

sacral
sensory nerves

motor nerves

The Spinal Cord