

Telencephalon (“endbrain”)

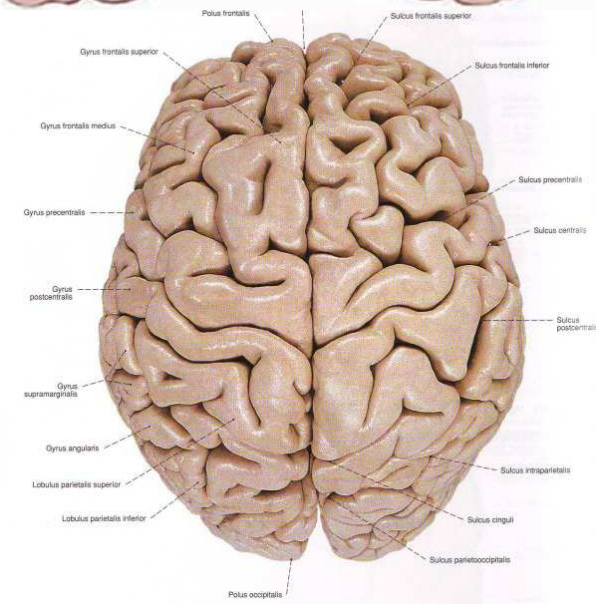
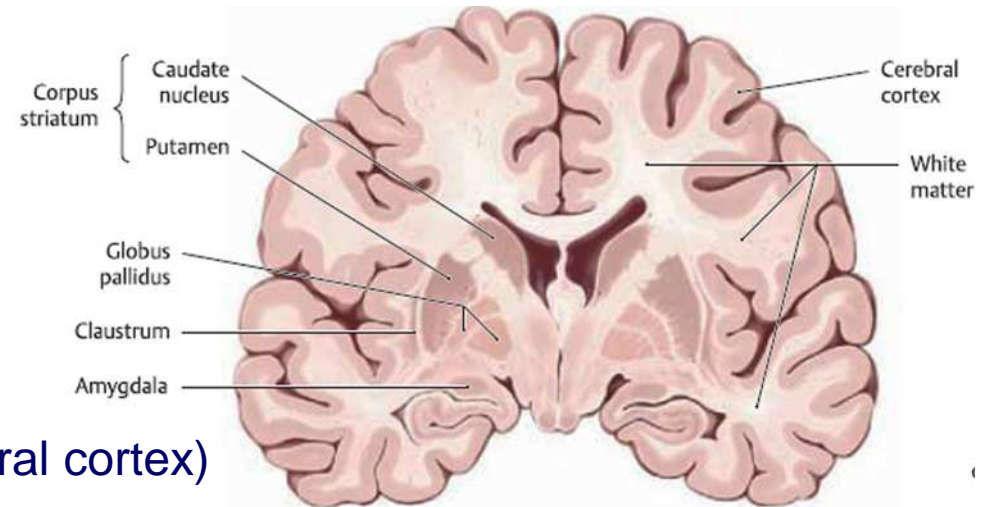
1. Telencephalon (cerebrum) – general overview
2. Cerebral hemispheres:
 - ✓ surface anatomy – major sulci, gyri and lobes
 - ✓ cerebral cortex – microscopic structure, cyto- and myeloarchitecture
 - ✓ cerebral white matter – association, commissural and projection fibers
3. Basal ganglia – structural and functional considerations
4. Lateral ventricle
5. Olfactory system, rhinencephalon
6. Limbic system
7. Functional differentiation of the cerebral cortex





Cerebrum – general overview

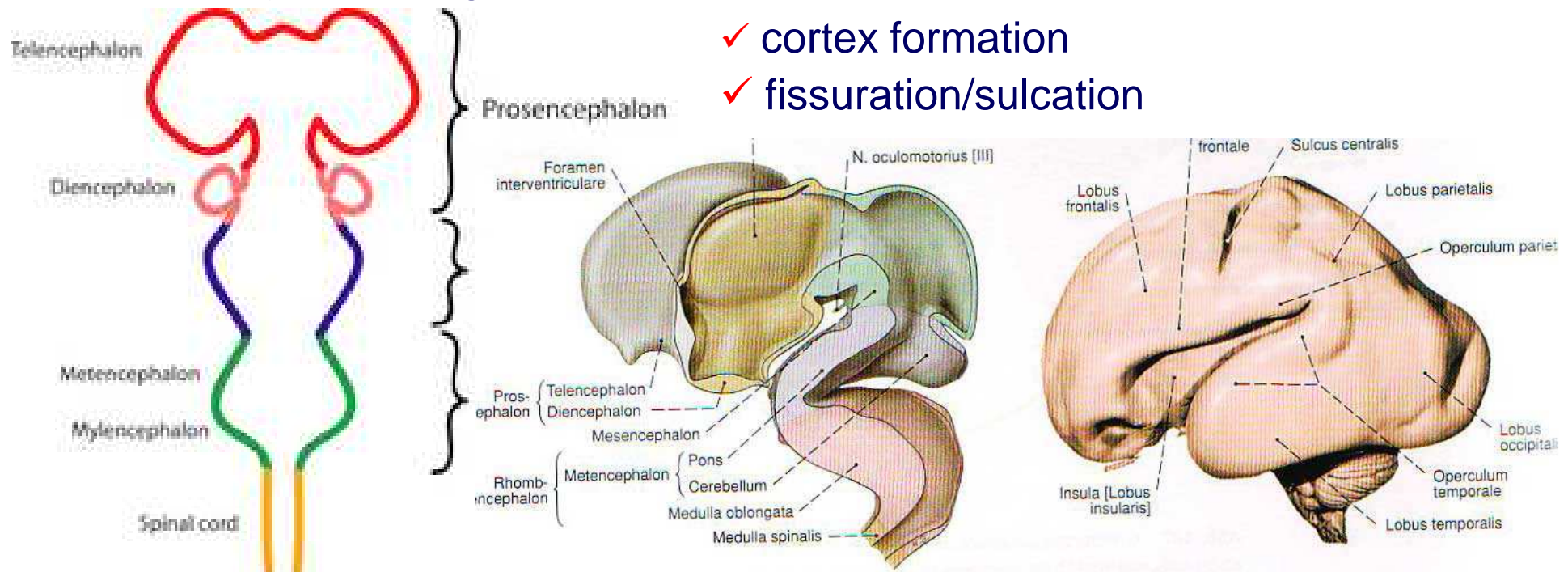
- weight ~ 1100 g
- 80% of the total brain mass
- cerebral hemispheres:
 - ✓ pallium
 - superficial grey matter (cerebral cortex)
 - deep grey matter (basal ganglia)
 - white matter
 - ventricular cavity (lateral ventricle)
 - ✓ longitudinal fissure of the cerebrum:
 - *falx cerebri*
 - *corpus callosum*





Telencephalon – development

- Embryonic origin – rostral part of the *prosencephalon*



- at birth ~ 340 g = 1/10 of the total body weight
- up to 9th postnatal month – weight duplication
- mid-3 year ~ 1000 g
- about 20 years of age – definitive size and weight



Cerebral hemispheres

■ three surfaces:

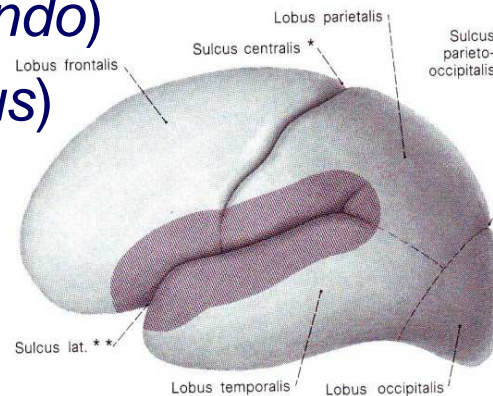
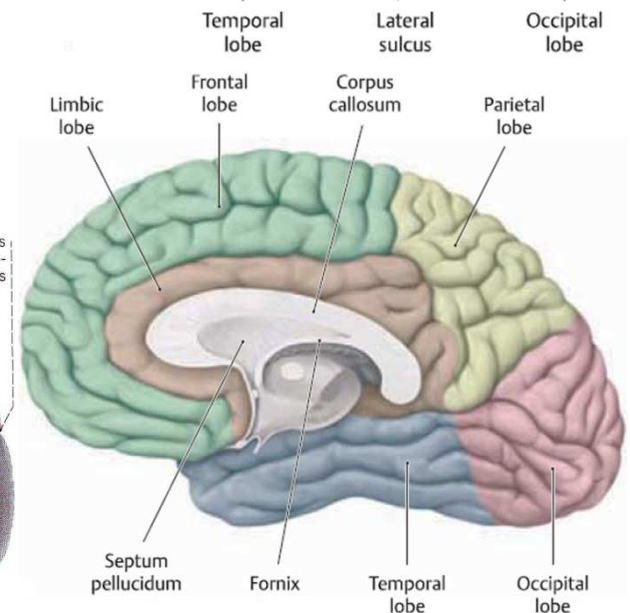
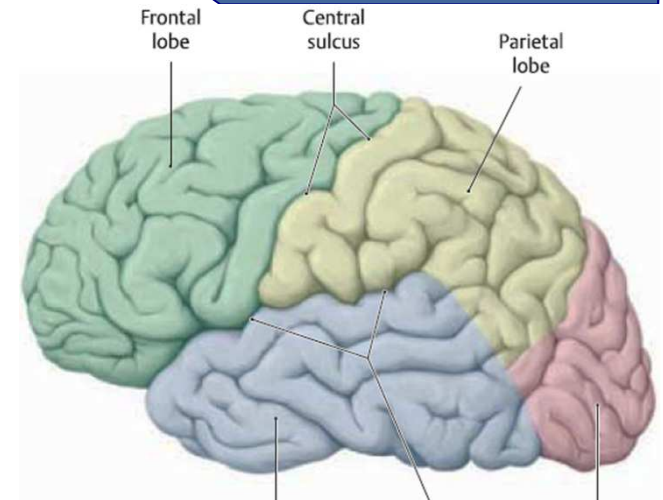
- ✓ superolateral (convex)
- ✓ medial (flat and vertical)
- ✓ inferior (irregular):
 - orbital part
 - tentorial part

■ main sulci:

- ✓ central sulcus (of *Rolando*)
- ✓ lateral sulcus (of *Sylvius*)
- ✓ parietooccipital sulcus
- ✓ cingulate sulcus ⇒ collateral sulcus

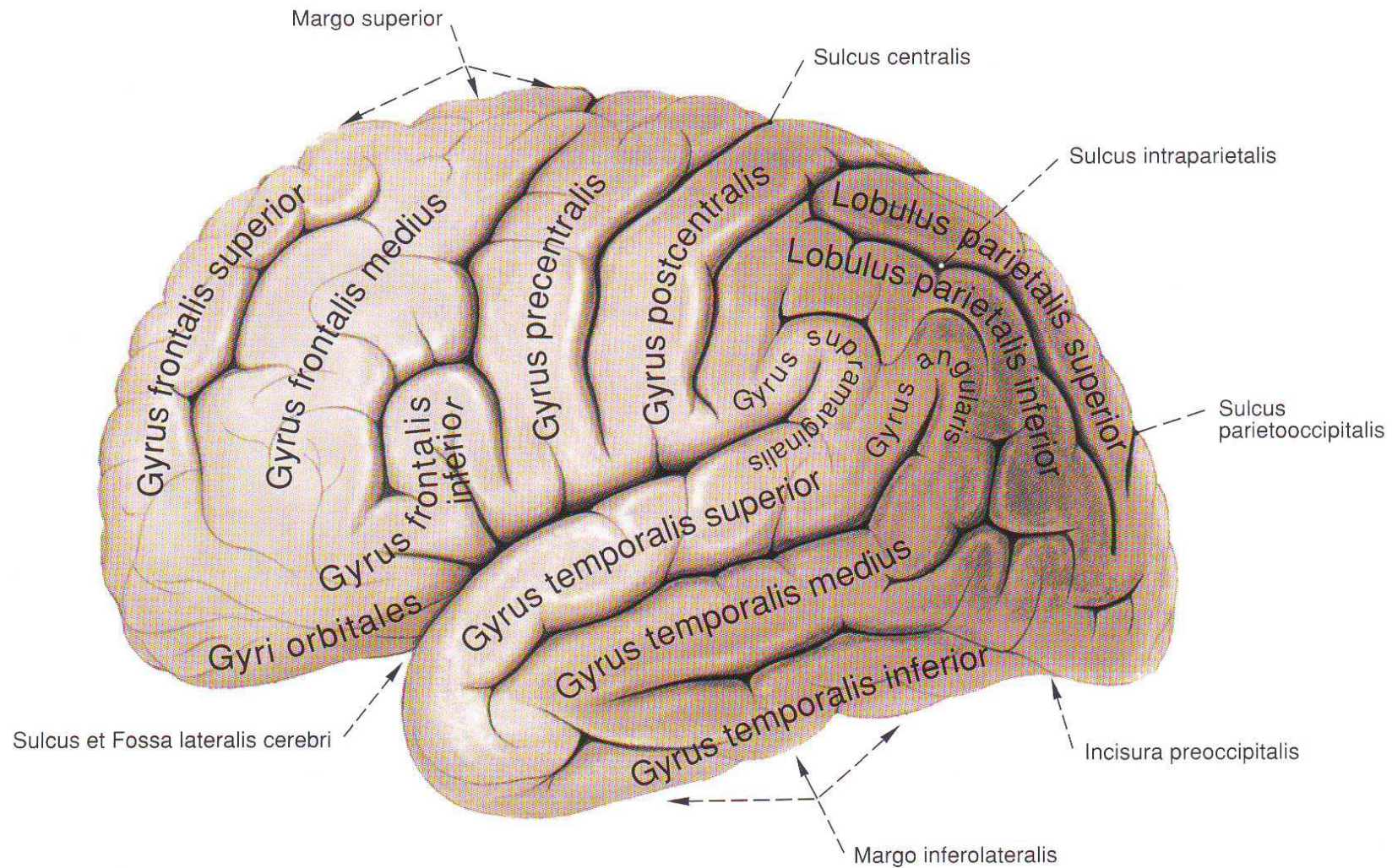
■ six lobes:

- ✓ frontal lobe
- ✓ parietal lobe
- ✓ occipital lobe
- ✓ temporal lobe
- ✓ insular lobe
- ✓ limbic lobe





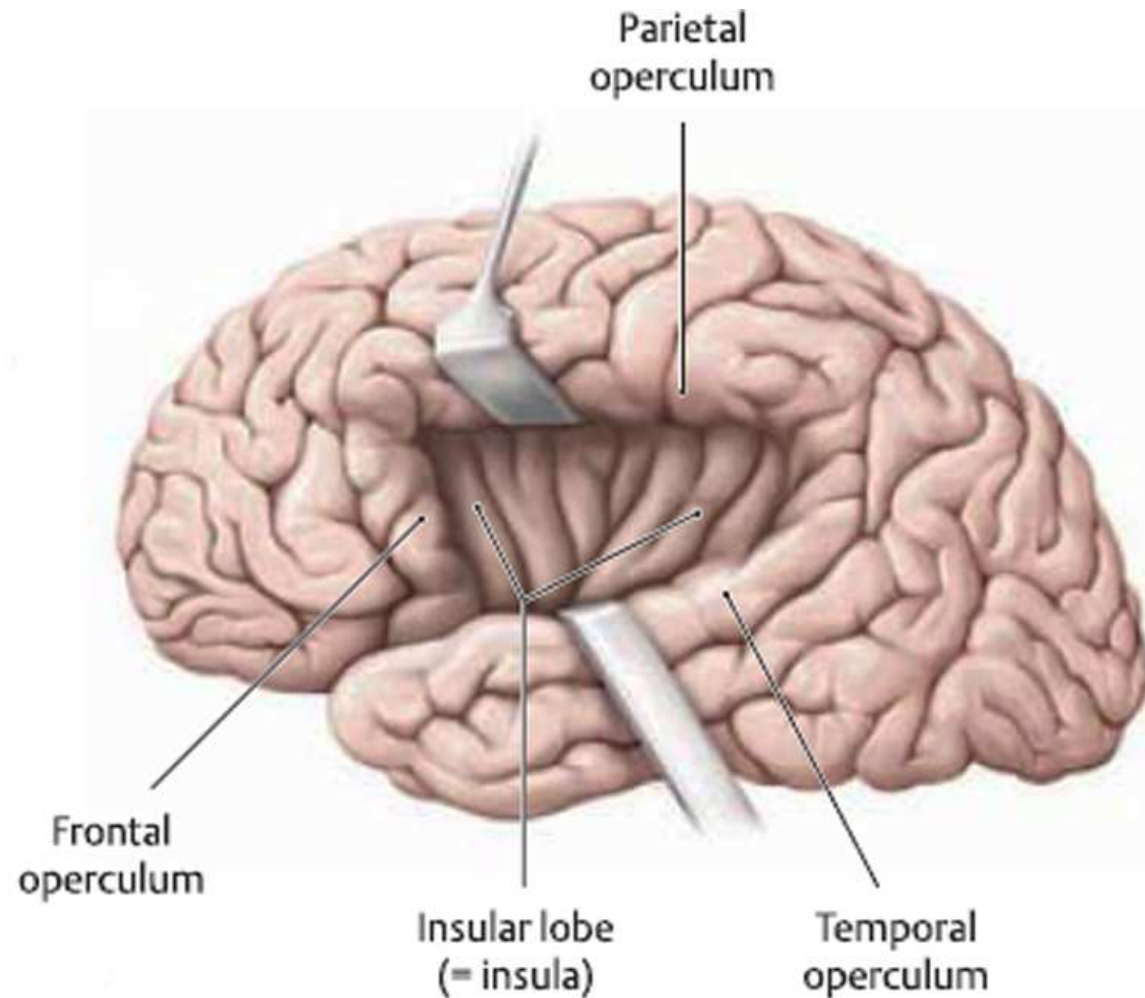
Superolateral surface





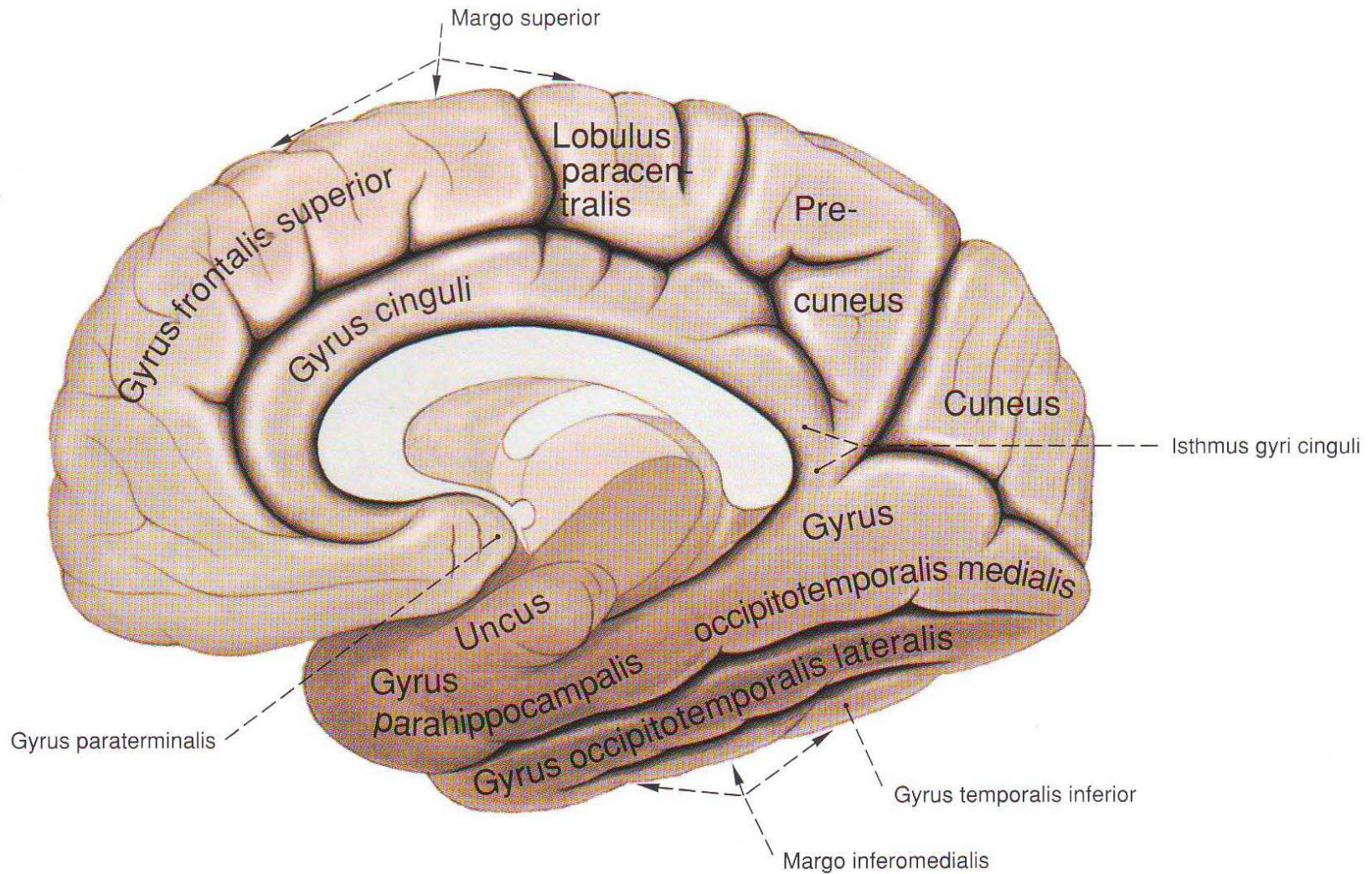
Superolateral surface

✓ *insular lobe (insula, island of Reil)*



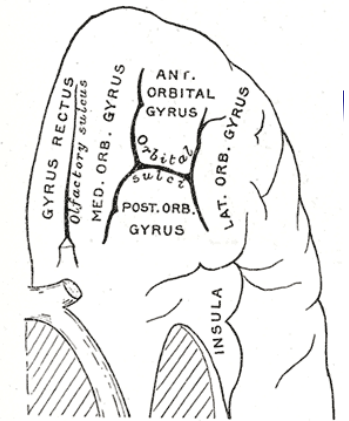
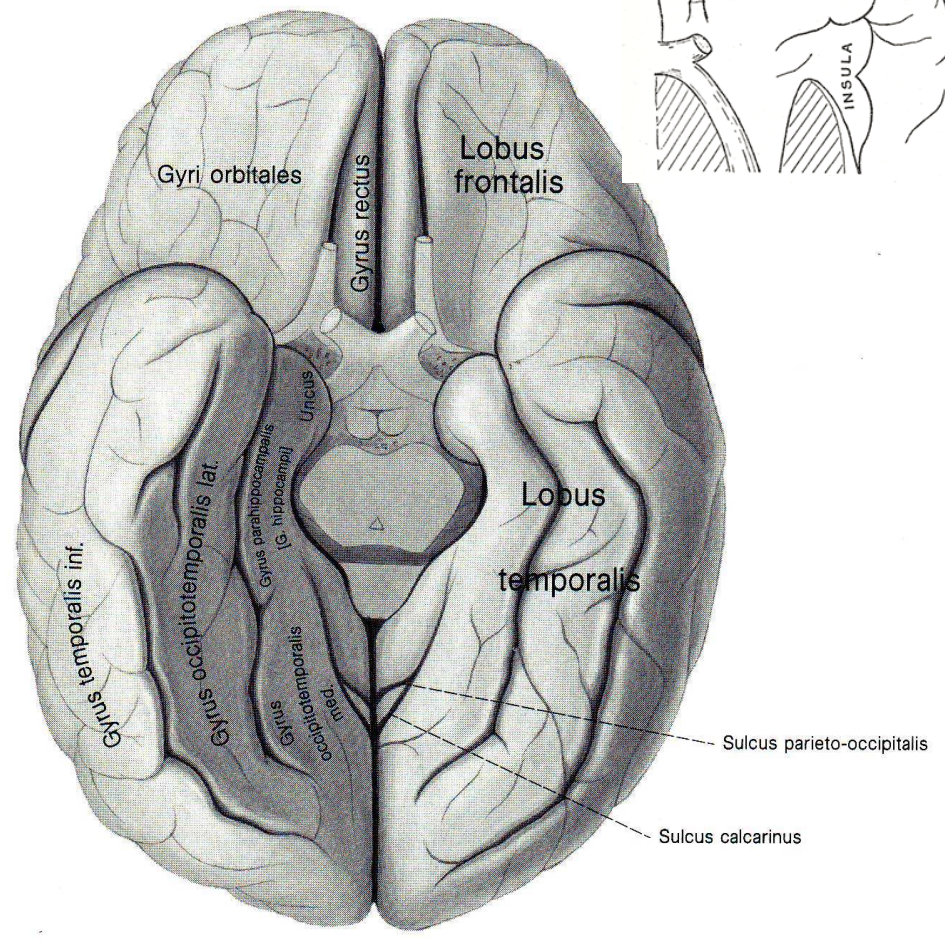
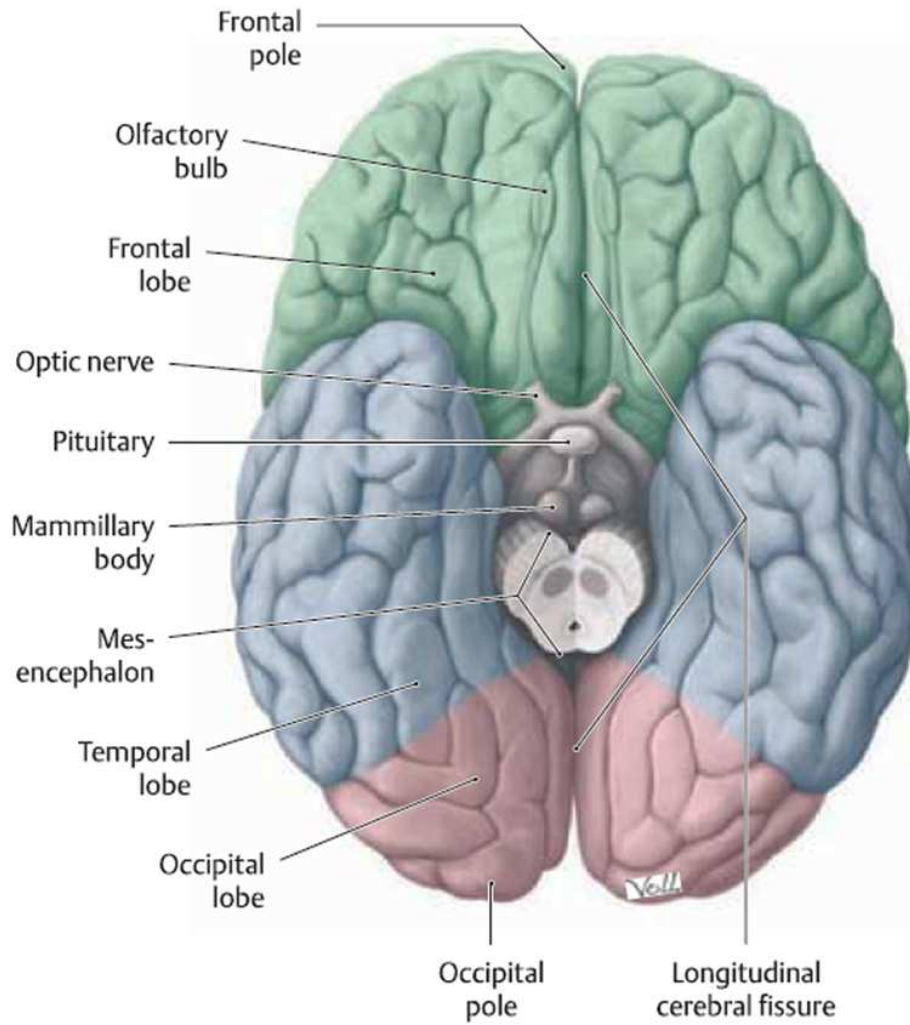


Medial surface





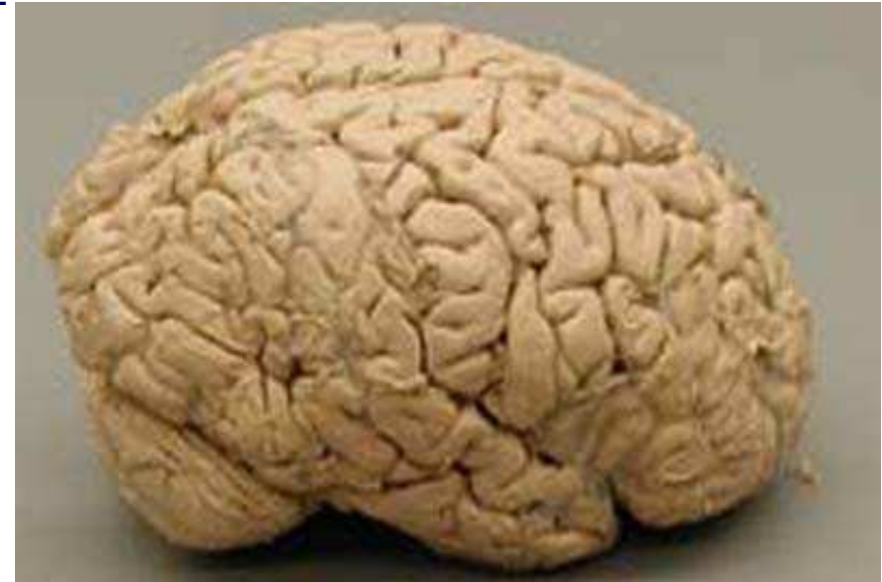
Inferior surface





Cerebral cortex

- ✓ surface area: approx. 2200-2850 cm²
- ✓ thickness:
 - 1.5 mm – frontal and temporal poles
 - 5 mm – in the precentral gyrus
- ✓ total number of cortical neurons:
 - ✓ 2.6-20 billion



- ✓ 0.6×10^9 synapses per mm³
- ✓ 60000 synapses over one pyramidal neuron
- ✓ one pyramidal nerve cell – 600 neurons



Cerebral cortex



Prof. Dr. Nikolai Lazarov

***NB:** The human brain contains roughly 90 billion neurons, which transmit information across roughly 150 trillion synapses!*



Cortical cell types

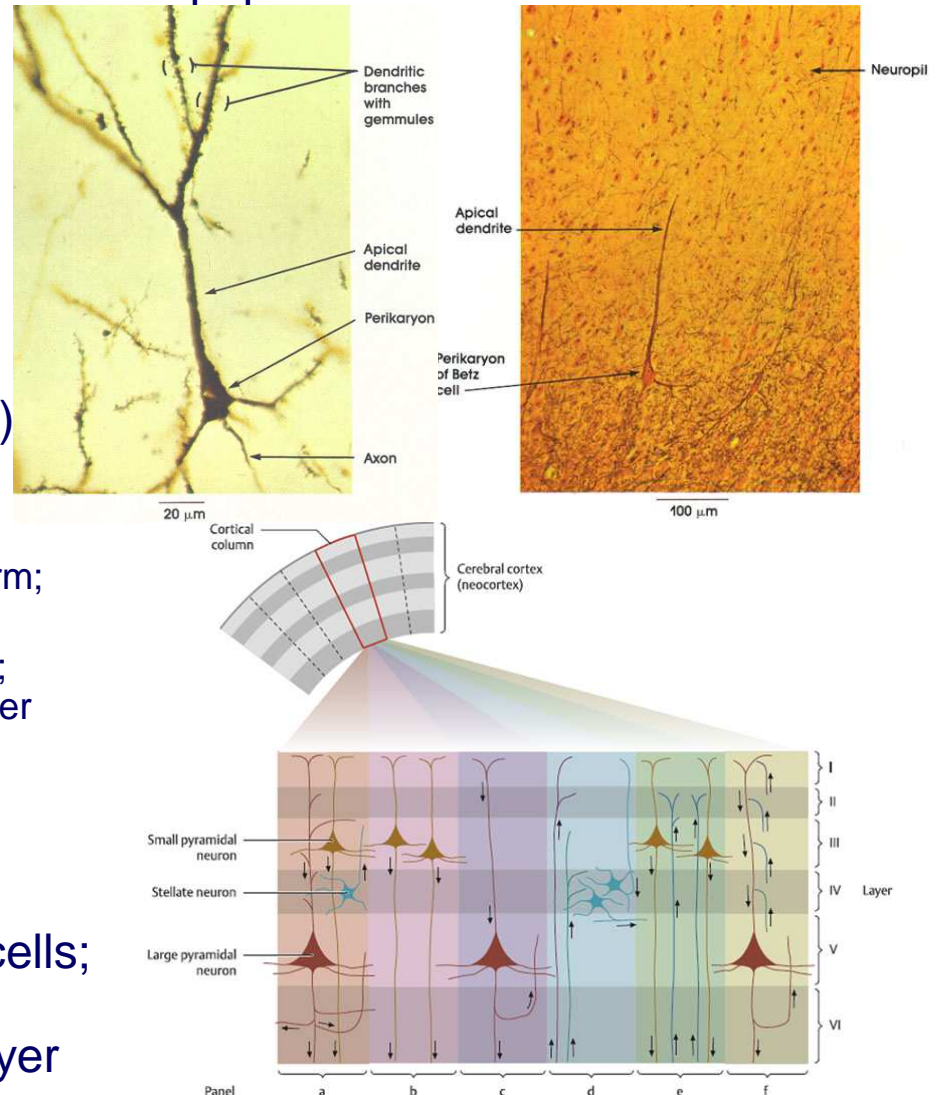
- pyramidal cells – 66% of the total neocortical cell population (glutamate- and aspartatergic)

- ✓ small-sized (10-15 μm)
- ✓ medium-sized (20-40 μm)
- ✓ large-sized (50-80 μm)
- ✓ giant pyramidal cells of *Betz* (80-120 μm) – in the precentral gyrus (motor cortex)

- stellate (granule) cells – 33% of the total neocortical population (*Golgi* type II cells)

- ✓ small in size (8-14 μm) – interneurons (GABA, VIP, SP, CCK, ENK)
 - horizontal cells of *Cajal* – small and fusiform; in the most superficial cortical layer
 - fusiform cells – “modified pyramidal cells”; spindle-shaped, in the deepest cortical layer
 - cells of *Martinotti* – small and multipolar; in practically all cortical layers
 - basket cells – horizontally extended
 - neurogliaform stellate cells – small in size

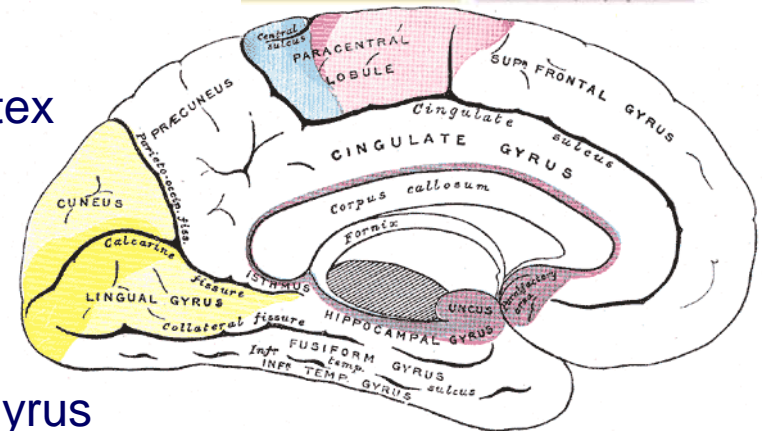
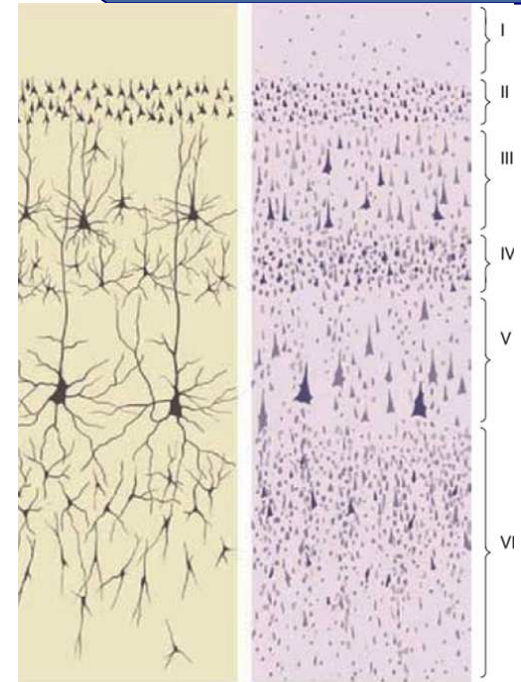
- pleomorphic cells – modified pyramidal cells; – large-sized and varying in shape, in the deepest layer





Cytoarchitectonic mapping

- **neocortex** (Latin for "new bark" or "new rind") – 6-layered;
neopallium ("new mantel") – 90% of hemispheric surface
isocortex (Greek *isos* = "equal rind");
phylogenetically newer part of the cortex
- **allocortex, archipallium** – the older, original part
of the cerebral cortex;
(Gr. *allos* = "different, other, another");
fewer than six layers – 3- or 4-layered:
 - ✓ **paleocortex, paleopallium** – 1% of the cerebral cortex
(Gr. *palaios* = "ancient, old"); 4-layered,
⇒ olfactory cortex (*rhinencephalon*)
 - ✓ **archaeocortex, archipallium** – 3-4% of the cortex
(Gr. *arche* = "beginning"); 3-layered,
⇒ hippocampal cortex
- **mesocortex** – intermediate in form
between the allocortex and the isocortex;
5-6-layered, ⇒ cingulate gyrus



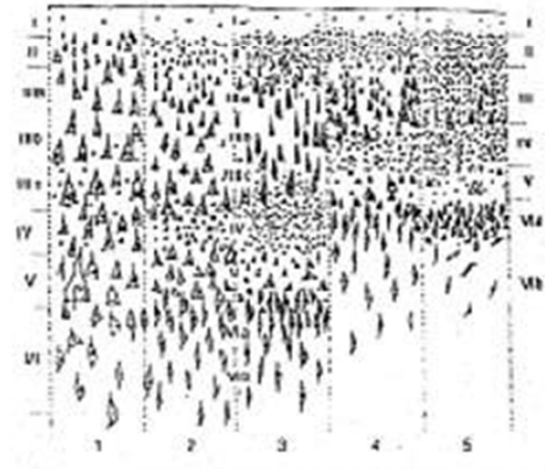
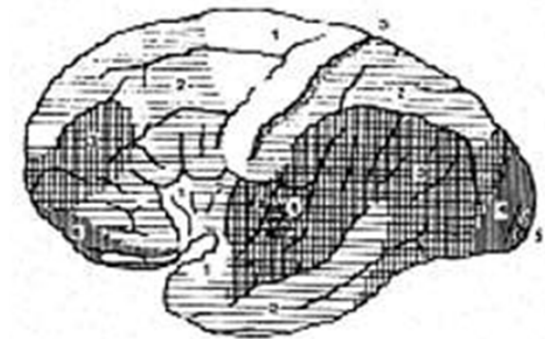
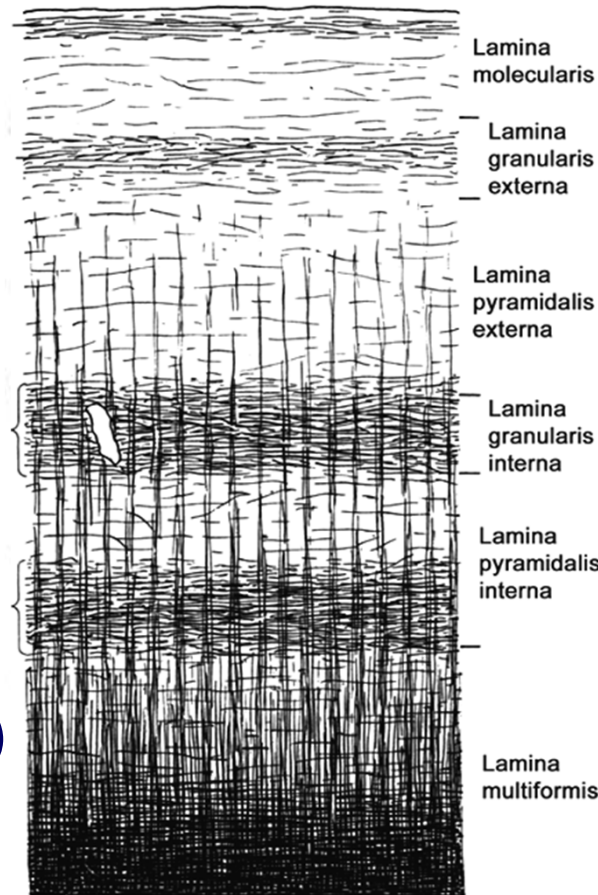


Laminar pattern in the cerebral cortex

Cortical layers (*Brodmann*):

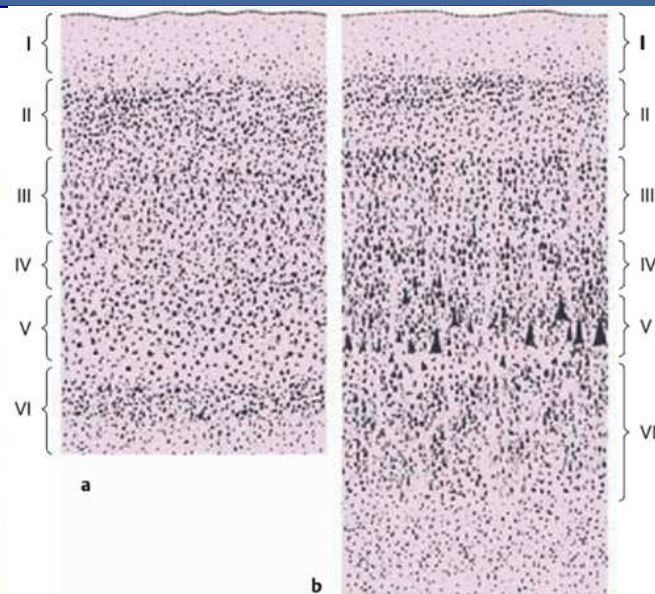
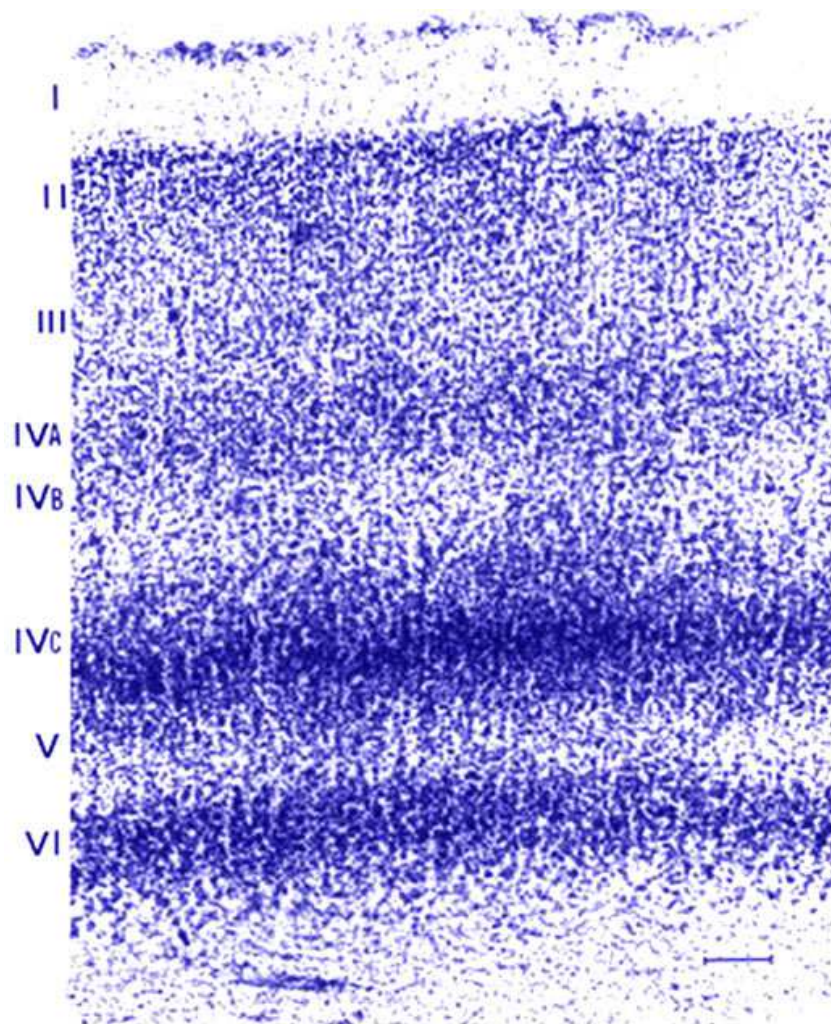
- I. Molecular layer (plexiform lamina)
- II. External granular lamina
- III. External pyramidal lamina
- IV. Internal granular lamina
- V. Internal pyramidal (ganglionic) lamina
- VI. Multiform (fusiform) lamina

- *Meynert* – 5 layers (laminae)
- *B. Lewis* – 6 layers





Variants of neocortical structure

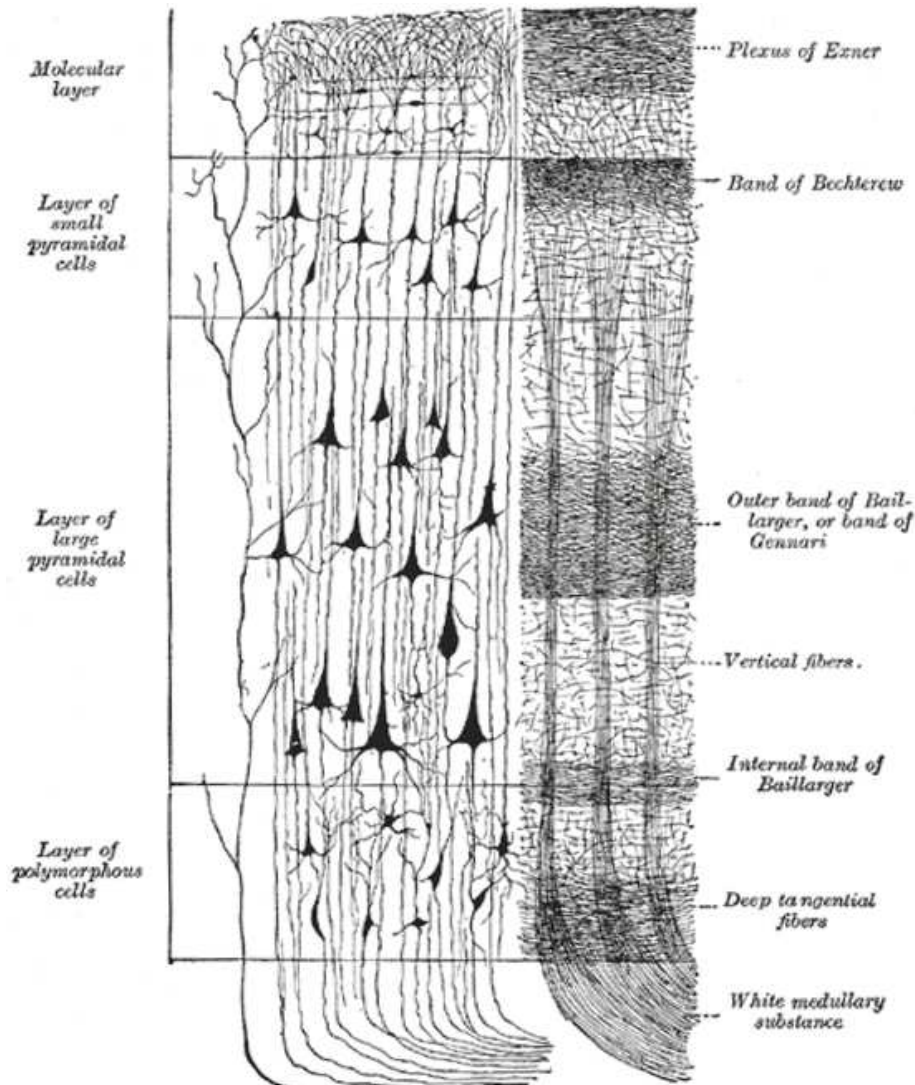


5 major types of cerebral cortex:

- heterotypical cortex (*Brodmann*):
 - ✓ agranular type – III, V, VI (motor cortex)
 - ✓ granular type (koniocortex) – II, IV layers (sensory cortex)
- homotypical cortex:
 - ✓ frontal type cortex – premotor cortex
 - ✓ parietal type – postcentral cortex
 - ✓ polar type – visuopsychic cortex



Myeloarchitecture: cortical fiber structure



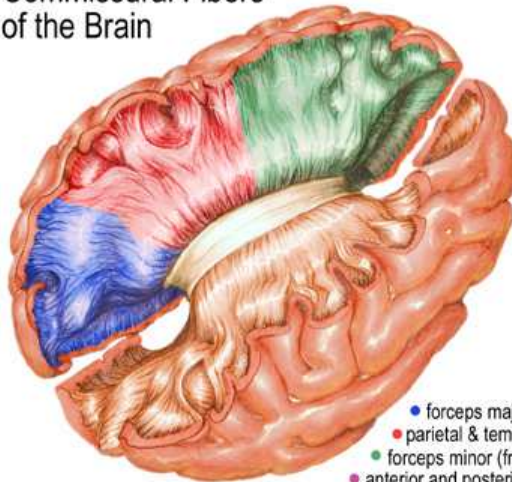
- *Flechsig* – 35 myelogenic areas
- C. and O. *Vogt* – 400 areas
- *stria laminae molecularis* (*plexiformis*), (*plexus of Exner*)
- *stria laminae granularis externae* (*band of Bechterew*)
- *stria laminae granularis interna*e (*external band of Baillarger, or band of Gennari*)
 - *in sulcus calcarinus* (*area striata* – *band of Vicq d’Azyr*)
- *stria laminae pyramidalis interna*e (*ganglionaris*), (*internal band of Baillarger*)



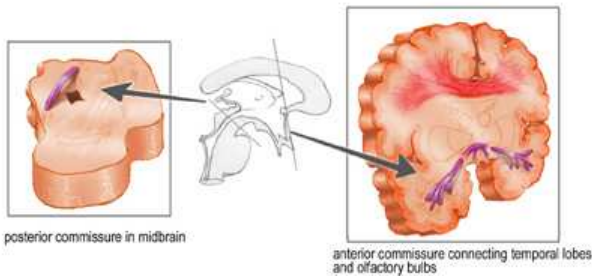
Cerebrum – white matter



Commissural Fibers of the Brain ©2005 Debra T. Tyler

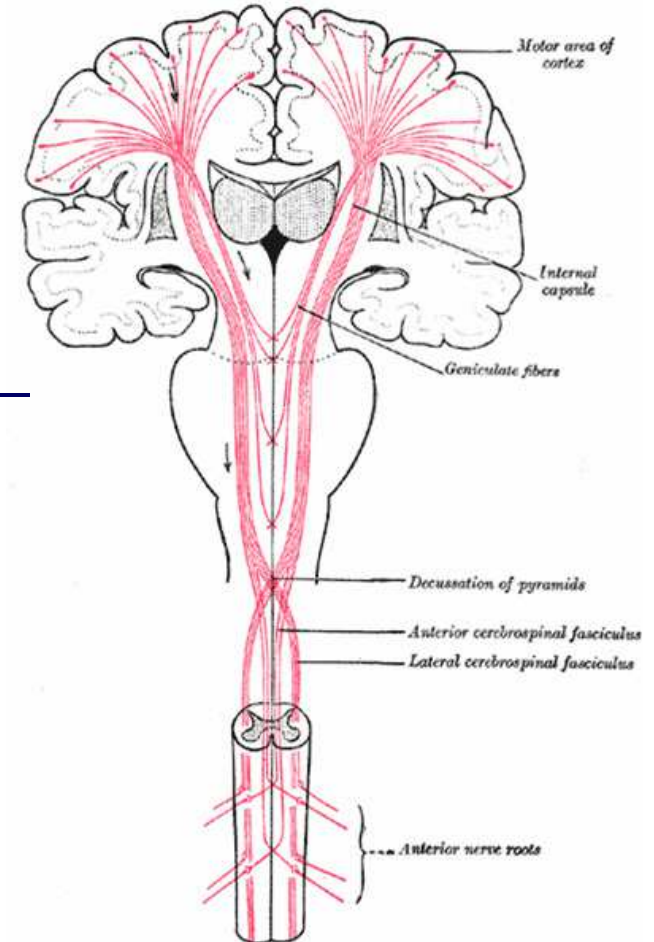


- forceps major (occipital)
- parietal & temporal fibers
- forceps minor (frontal)
- anterior and posterior fibers



■ Three vast fiber systems:

- ✓ association fibers – *fibrae associationes telencephali*
- ✓ commissural fibers – *fibrae commissurales telencephali*
- ✓ projection fibers – *fibrae projectiones telencephali*





Association fibers

- short association fibers:

- ✓ *fibrae arcuatae cerebri* (U fibers)

- long association fibers:

- ✓ *cingulum*

- ✓ *superior longitudinal fasciculus*

- ✓ *inferior longitudinal fasciculus*

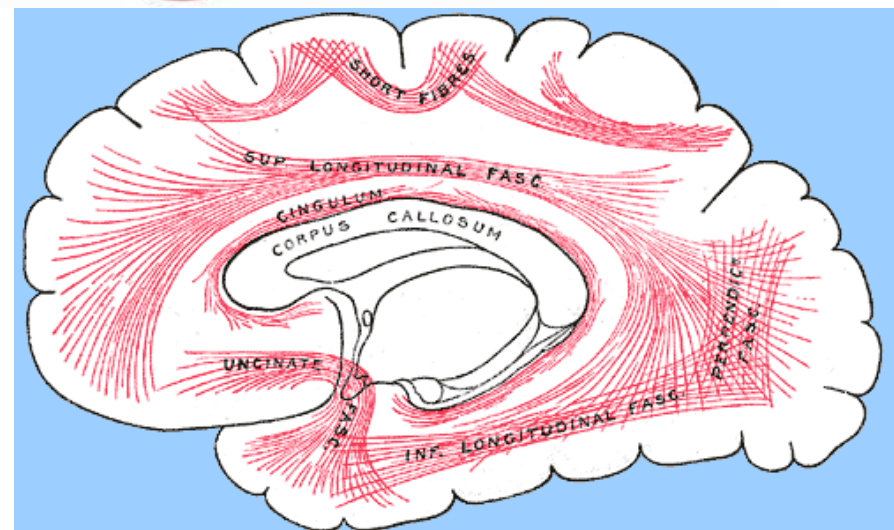
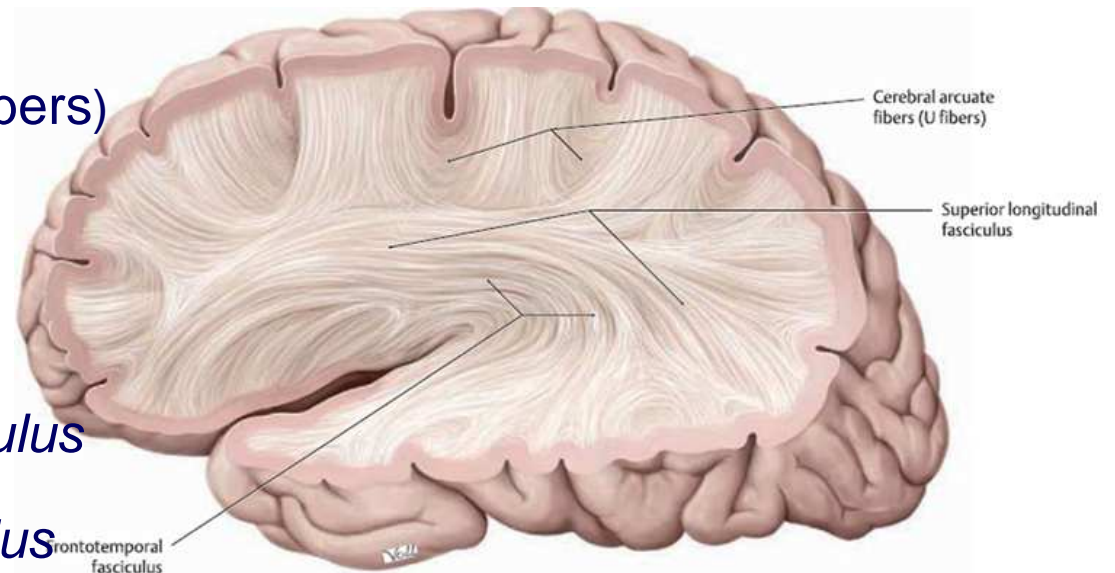
- ✓ *uncinate fasciculus* ⇨

inferior frontooccipital fasciculus

- ✓ *arcuate fasciculus*

- ✓ *vertical occipital*

fasciculus





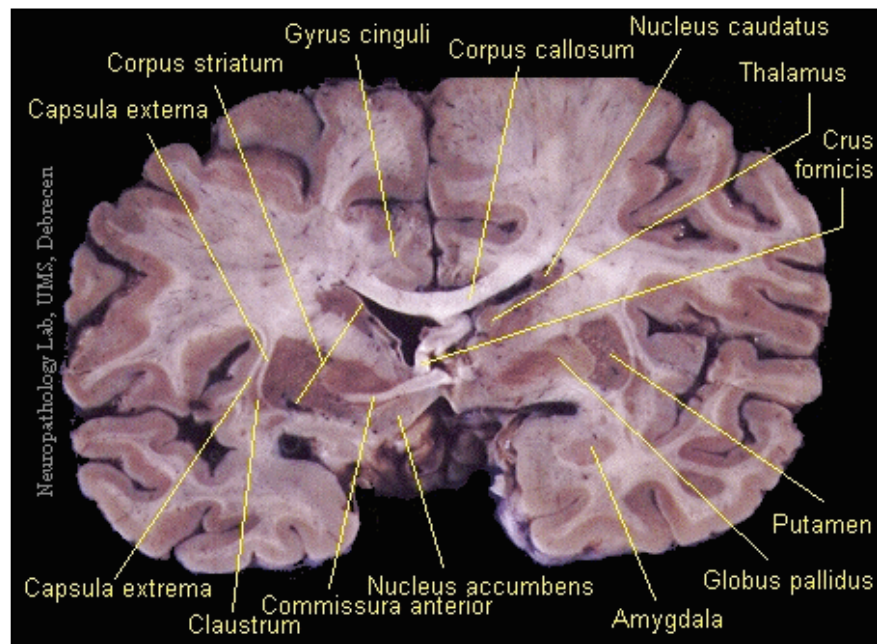
Association fibers



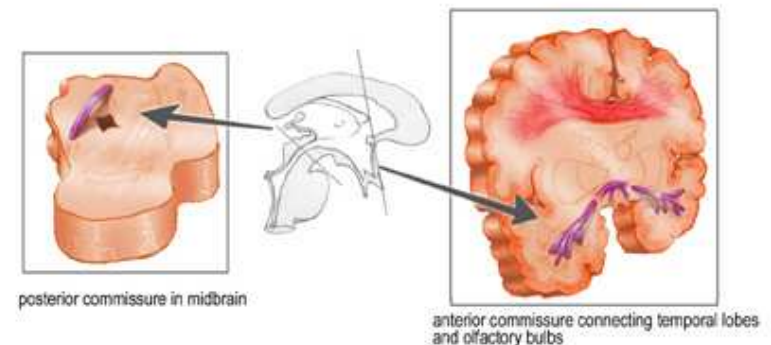
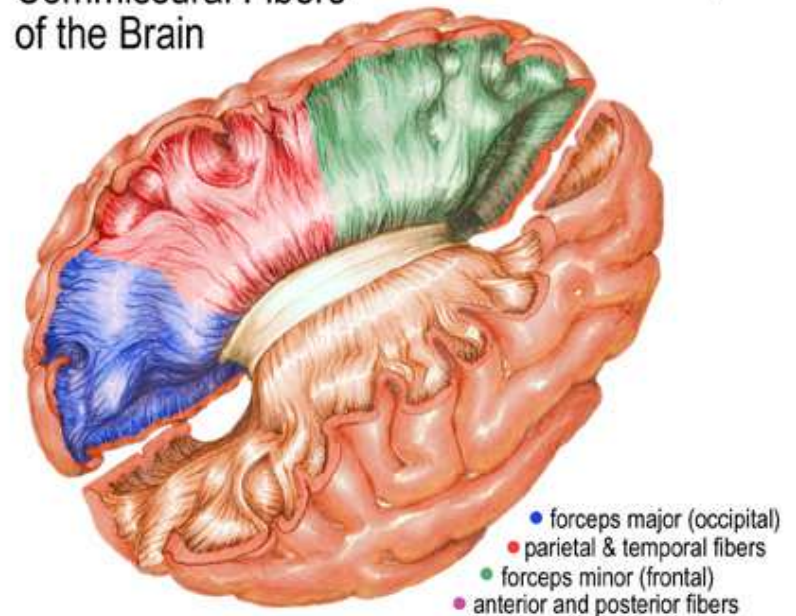


Commissural fibers

- anterior (rostral) commissure
- commissure of the fornix (hippocampal commissure)
- commissura magna (corpus callosum)



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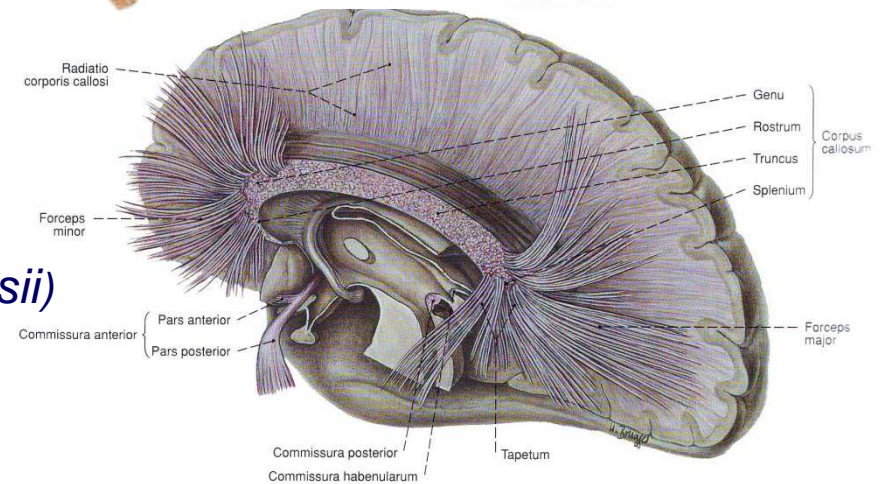
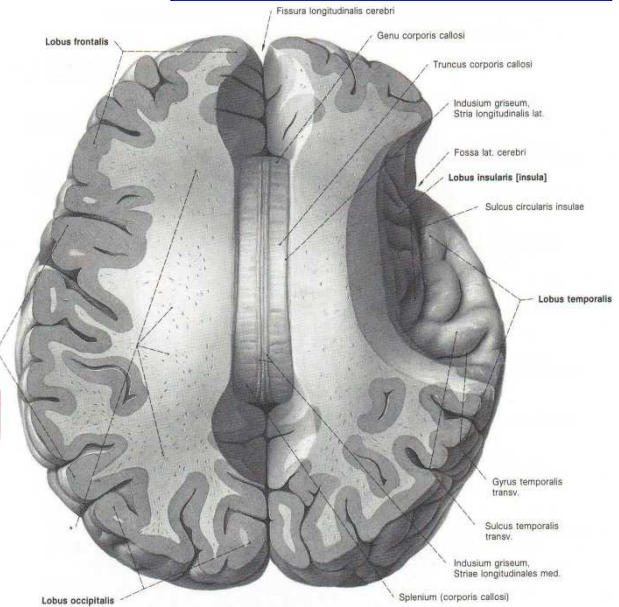
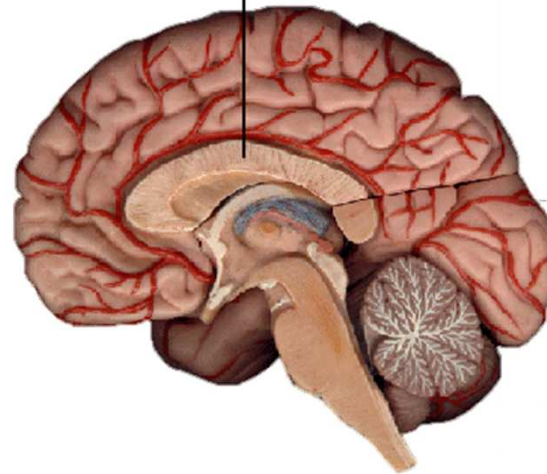


Corpus callosum

- broad, thick plate of myelinated fibers ~ 10 cm in length

- ✓ *rostrum corporis callosi*
- ✓ *genu corporis callosi*
- ✓ *truncus corporis callosi*
- ✓ *splenium corporis callosi*
- ✓ *forceps minor* (frontal)
- ✓ *forceps major* (occipital)
- ✓ *indusium griseum* – limbic system
 - *stria longitudinalis medialis (Lancisii)*
 - *stria longitudinalis lateralis*

Corpus Callosum

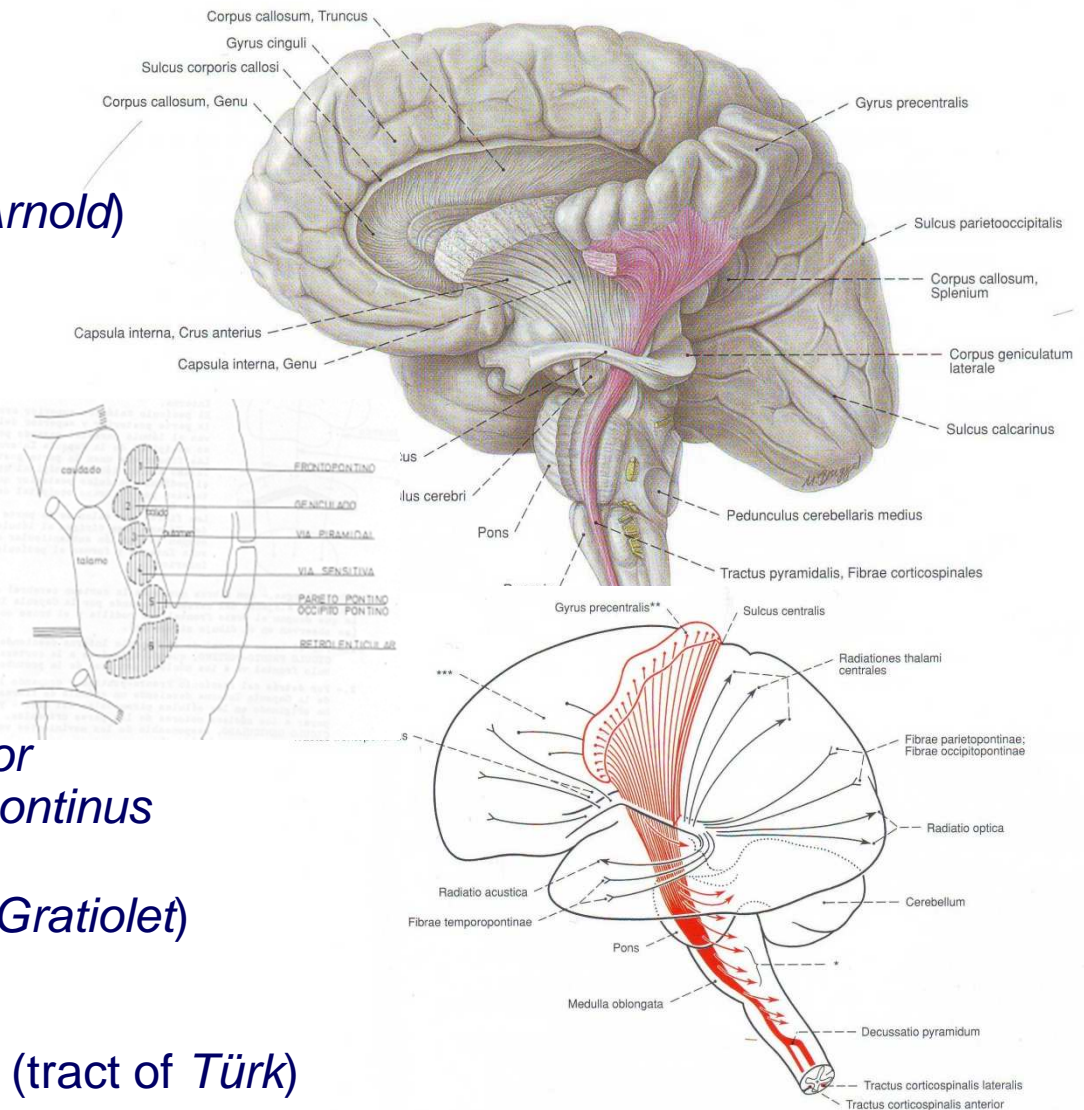




Projection fibers

■ internal capsule:

- ✓ anterior limb – 1.5 cm
 - *radiatio thalami anterior*
 - *tractus frontopontinus* (of Arnold)
 - *fibrae corticostriatae*
- ✓ *genu capsulae internae*
 - *fibrae corticonucleares*
- ✓ posterior limb:
 - thalamolentiform part:
 - *fibrae corticospinales*
 - *fibrae corticorubrales*
 - *fibrae corticoreticulares*
 - retrolentiform part:
 - *radiatio thalami posterior*
 - *tractus parietooccipitopontinus*
 - sublentiform part:
 - *radiatio optica* (tract of *Gratiolet*)
 - *radiatio acustica*
 - *fibrae corticotectales*
 - *fibrae temporopontinae* (tract of *Türk*)





Basal nuclei (“Basal ganglia”)

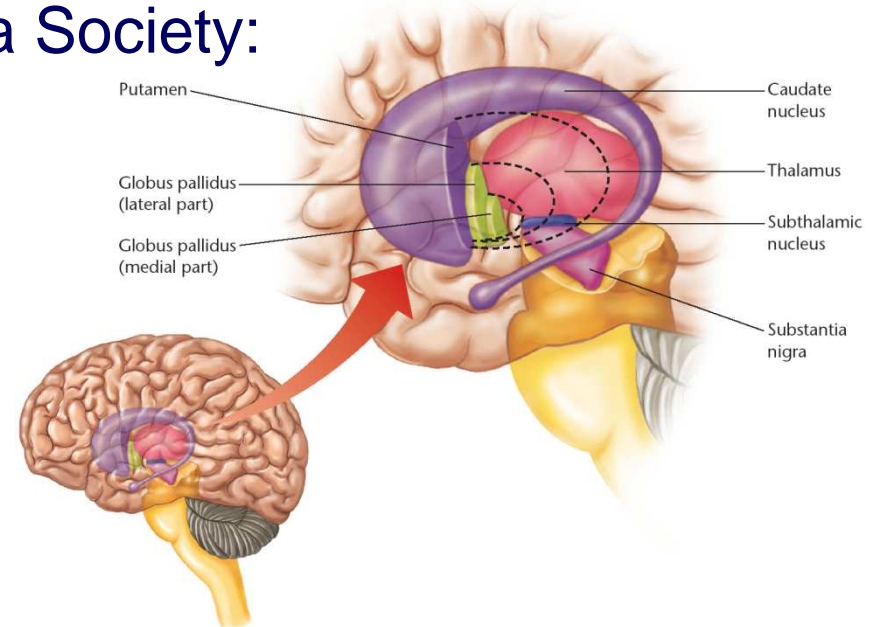
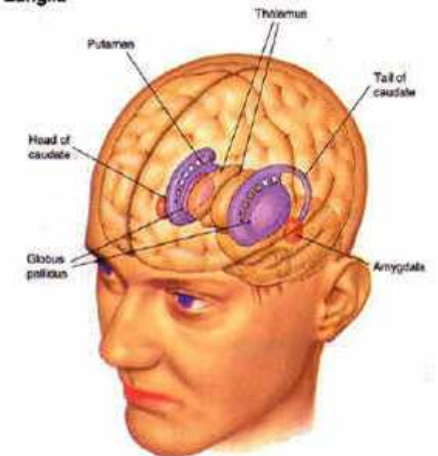
■ Classically:

- ✓ *nucleus caudatus*
- ✓ *nucleus lentiformis*
- ✓ *claustrum*
- ✓ *corpus amygdaloideum* – limbic system

■ The International Basal Ganglia Society:

- ✓ *nucleus caudatus*
- ✓ *nucleus lentiformis*
- ✓ *nucleus subthalamicus*
- ✓ *substantia nigra*

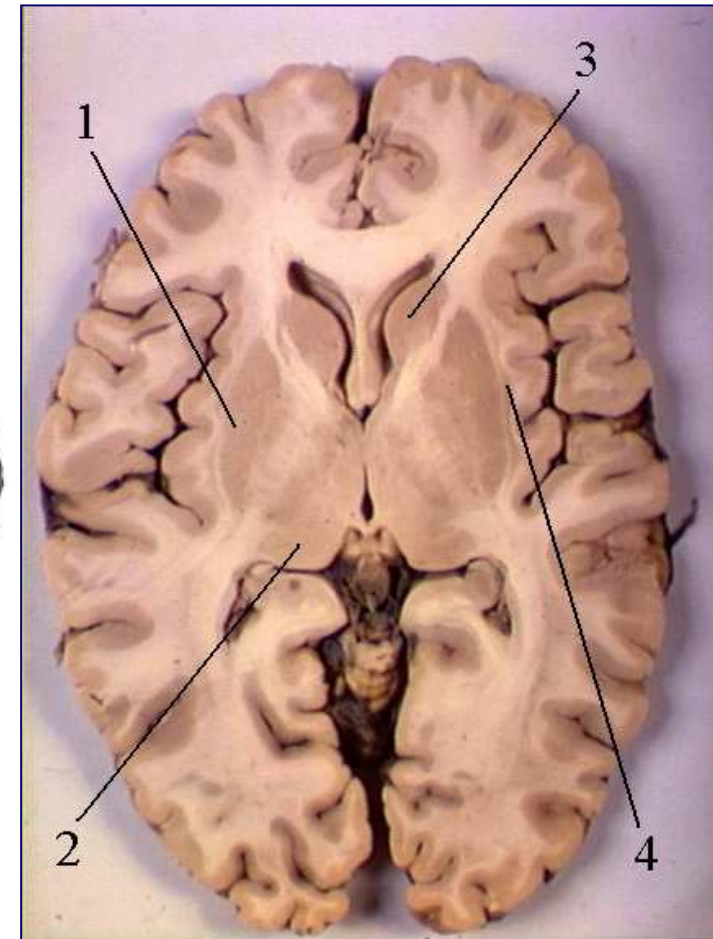
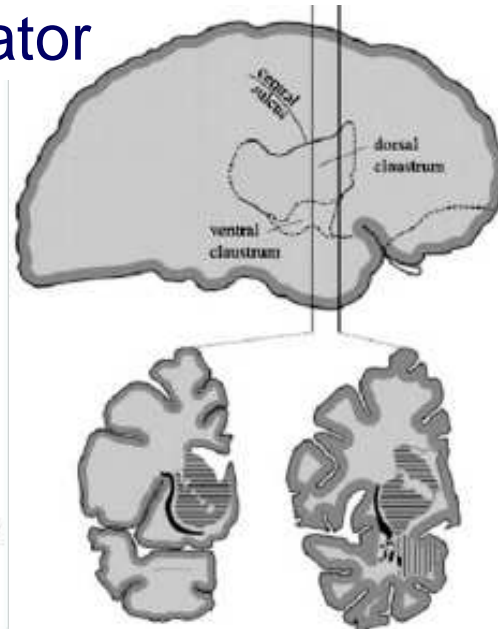
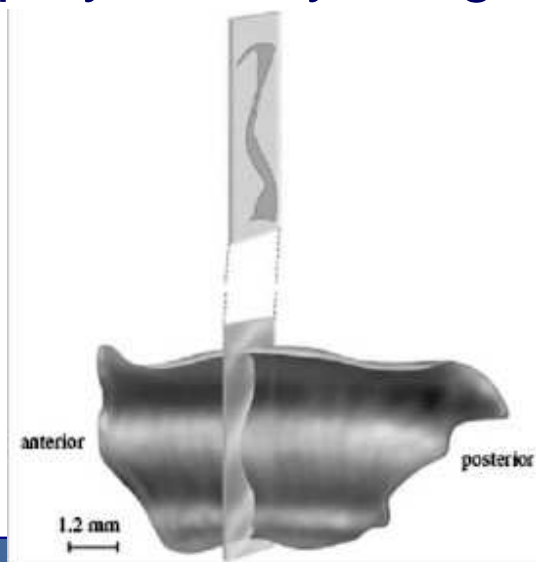
► The Basal Ganglia





Clastrum

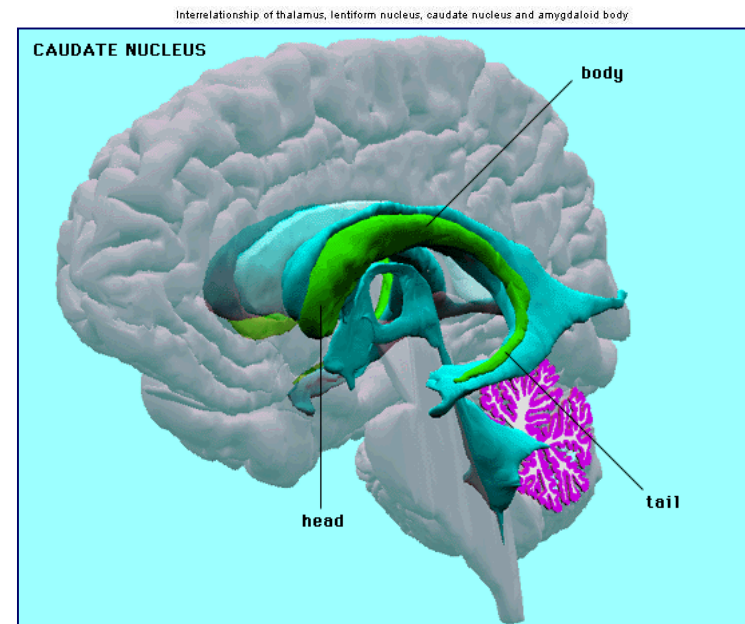
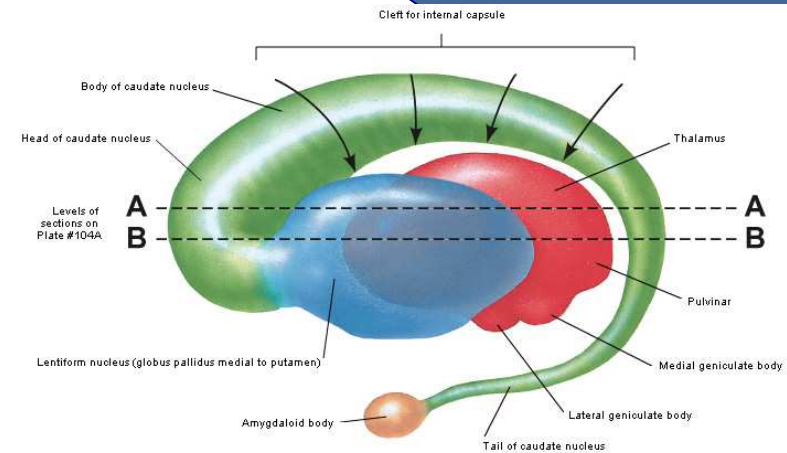
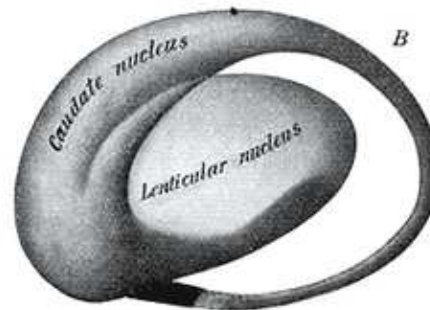
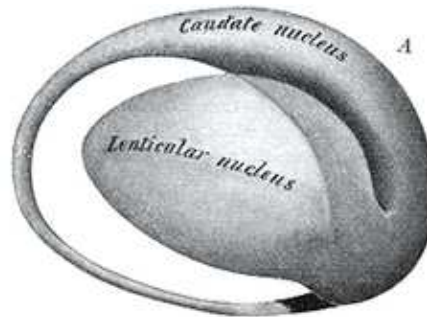
- Lat. *claudere* – barrier
- ✓ a thin (1-2 mm) lamina of grey matter
- ✓ *capsula externa*
- ✓ *capsula extrema*
- ✓ part of the lentiform nucleus?
- ✓ part of the insular cortex?
- ✓ polysensory integrator





Caudate nucleus

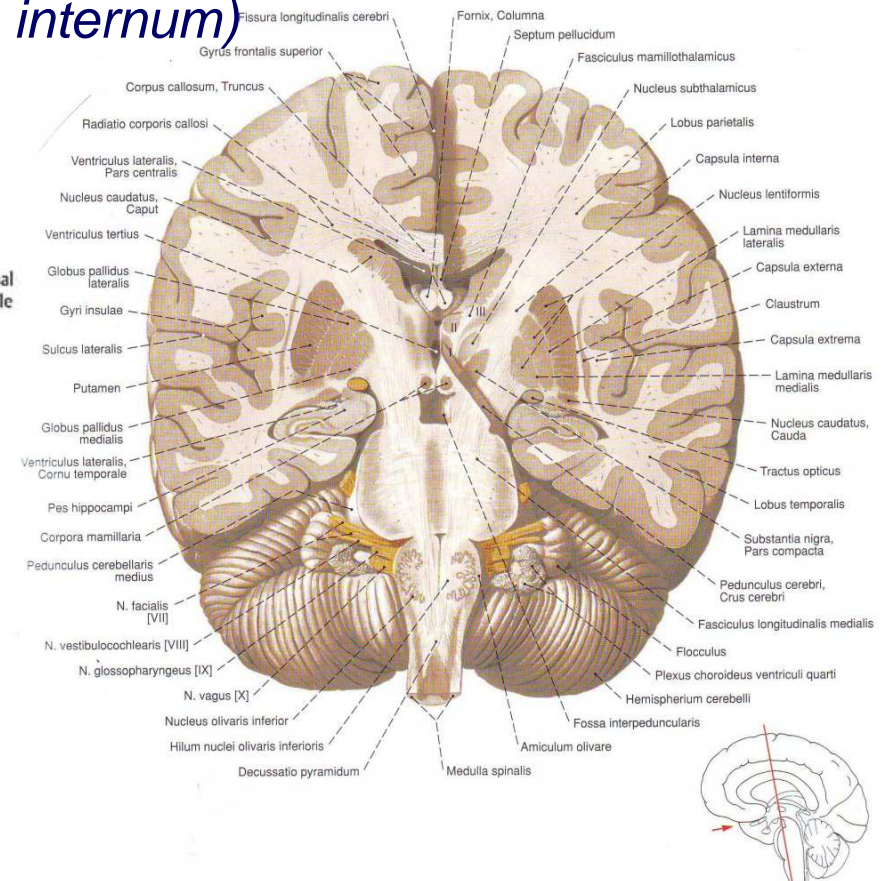
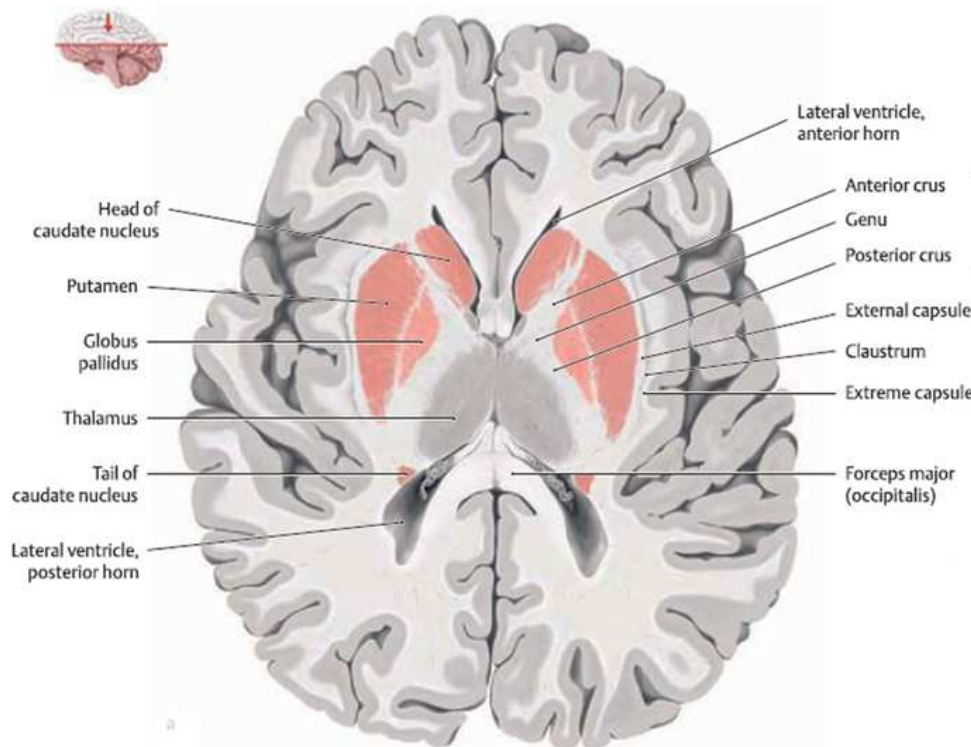
- arcuate mass of grey matter
- length ~ 7 cm
- parts:
 - ✓ head (*caput nuclei caudati*)
 - ✓ body
(*corpus nuclei caudati*)
 - ✓ tail
(*cauda nuclei caudati*)





Lentiform nucleus

- *putamen + nucleus caudatus = striatum (neostriatum)*
- *globus pallidus = pallidum (palleostriatum):*
 - ✓ *globus pallidus lateralis (pallidum externum)*
 - ✓ *globus pallidus medialis (pallidum internum)*



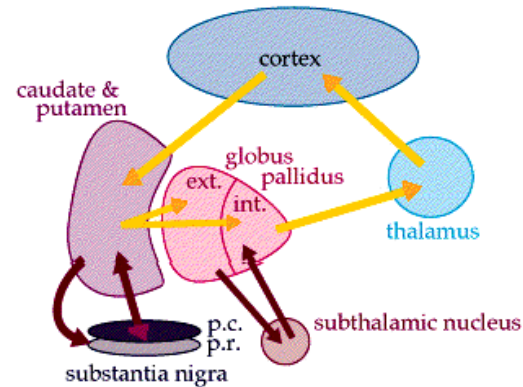


Striopallidal system

✓ *striatum + pallidum*

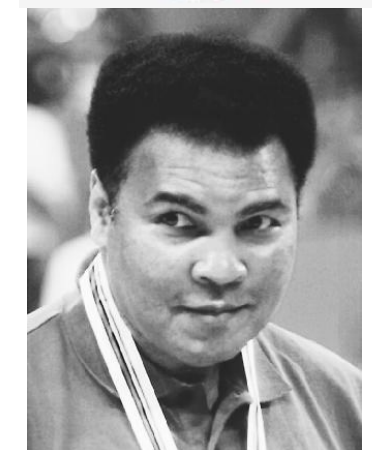
■ functions:

- ✓ role in the planning and modulation of movements
- ✓ involved in a variety of cognitive processes involving executive function



■ pathology:

- ✓ dyskinesia (tremor, athetosis, chorea, ballismus)
- ✓ muscle rigidity
- ✓ *paralysis agitans* (Parkinson's disease)
- ✓ Huntington's chorea



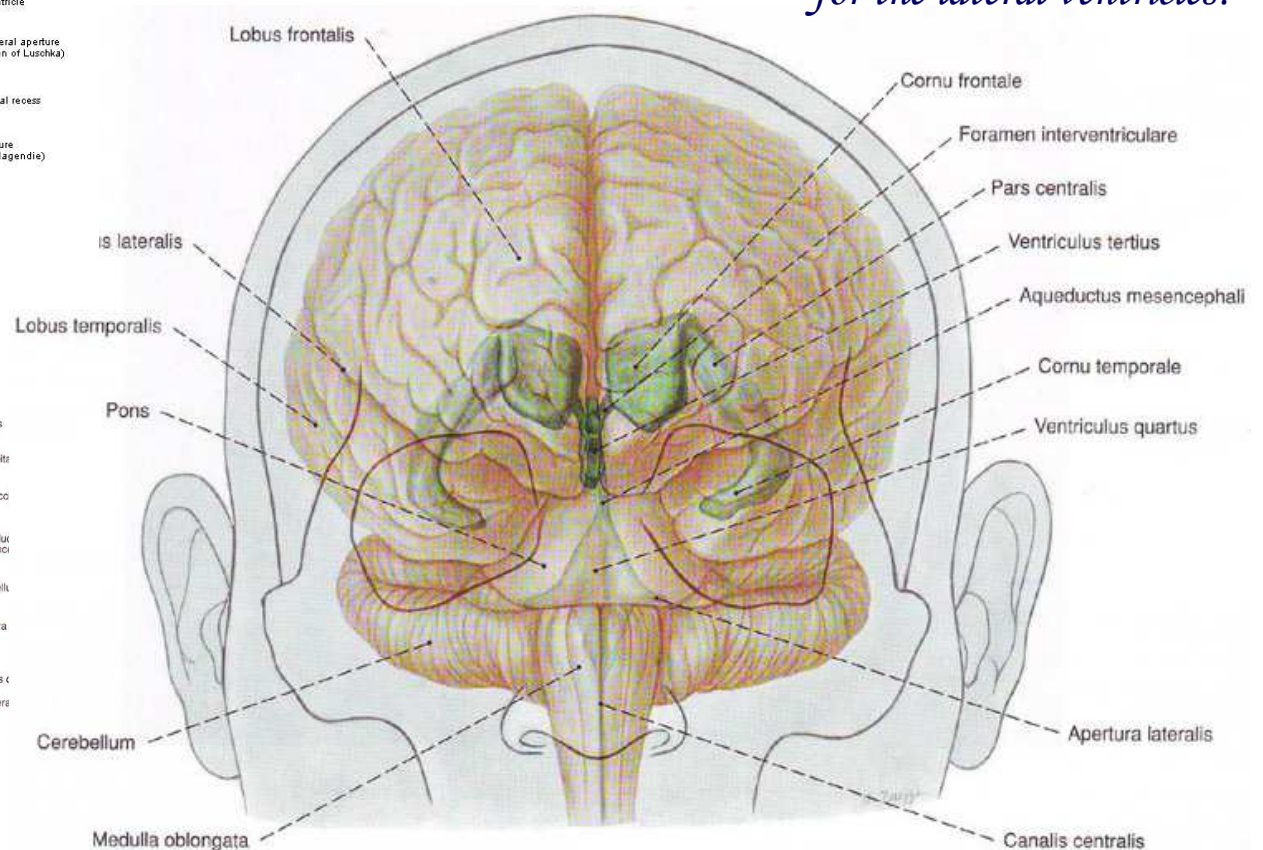
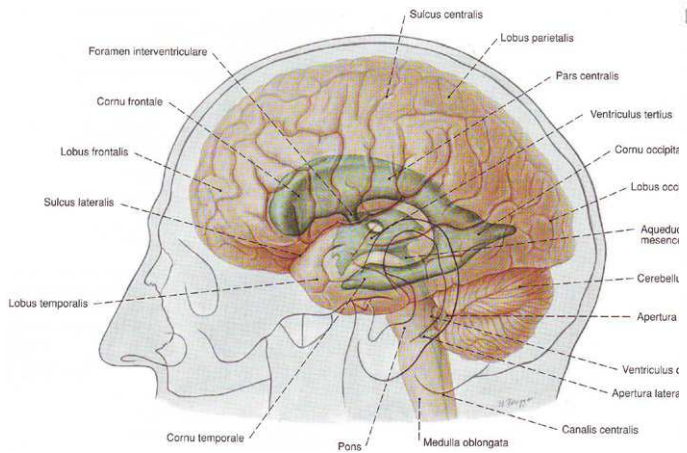
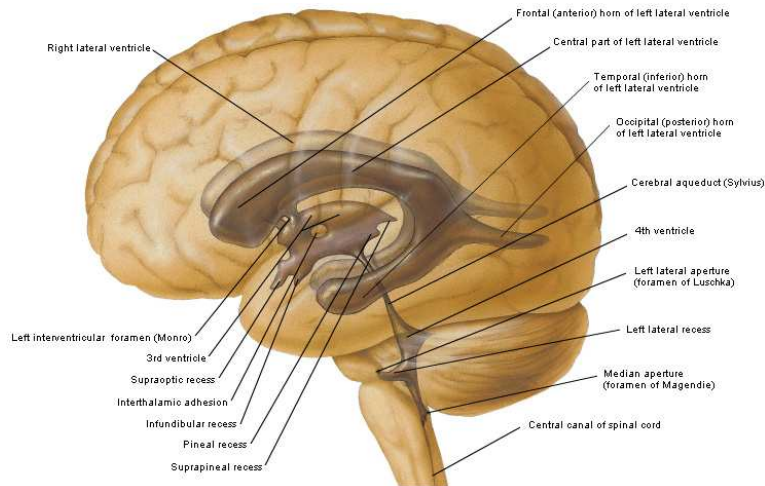


Lateral ventricle

✓ Left lateral ventricle – first ventricle?

✓ Right lateral ventricle – second ventricle?

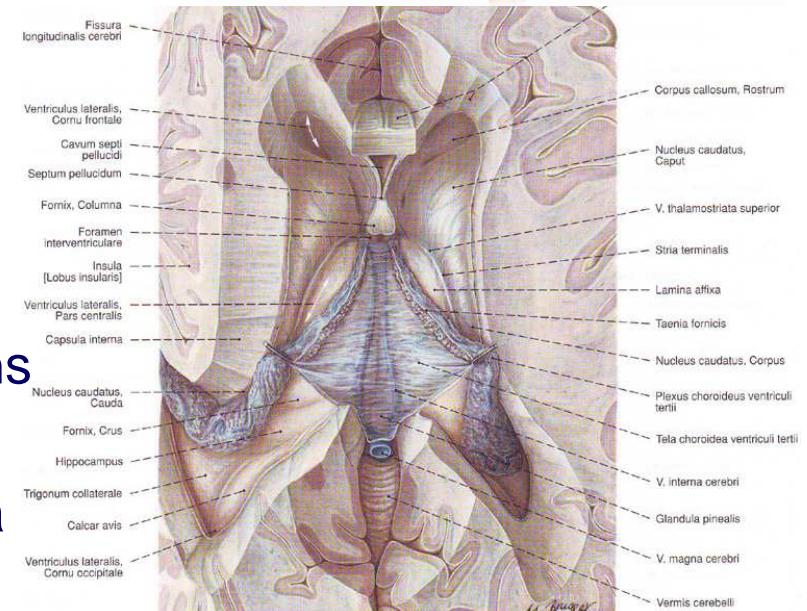
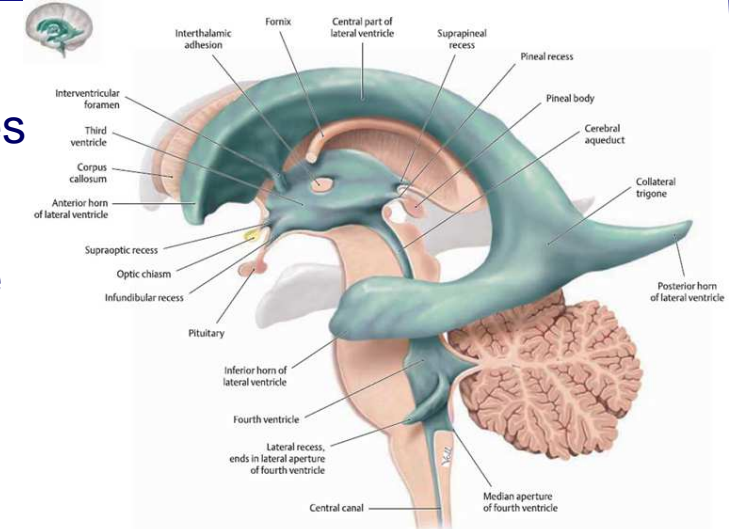
***NB:** Since they are symmetric, a numbering system was not used for the lateral ventricles!*





Lateral ventricle

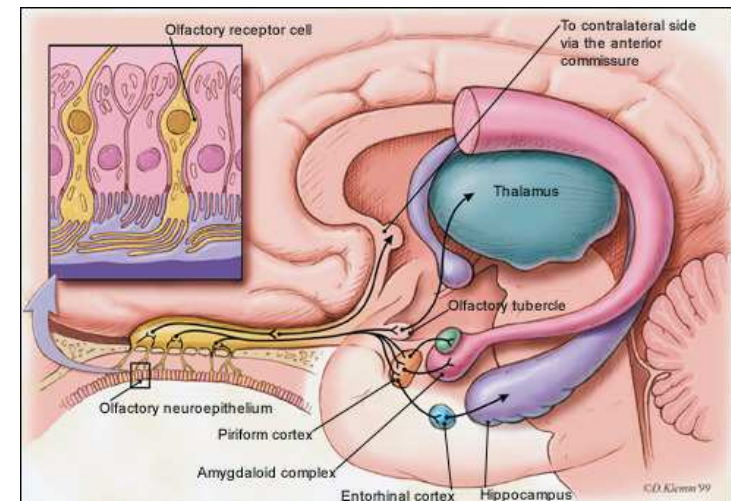
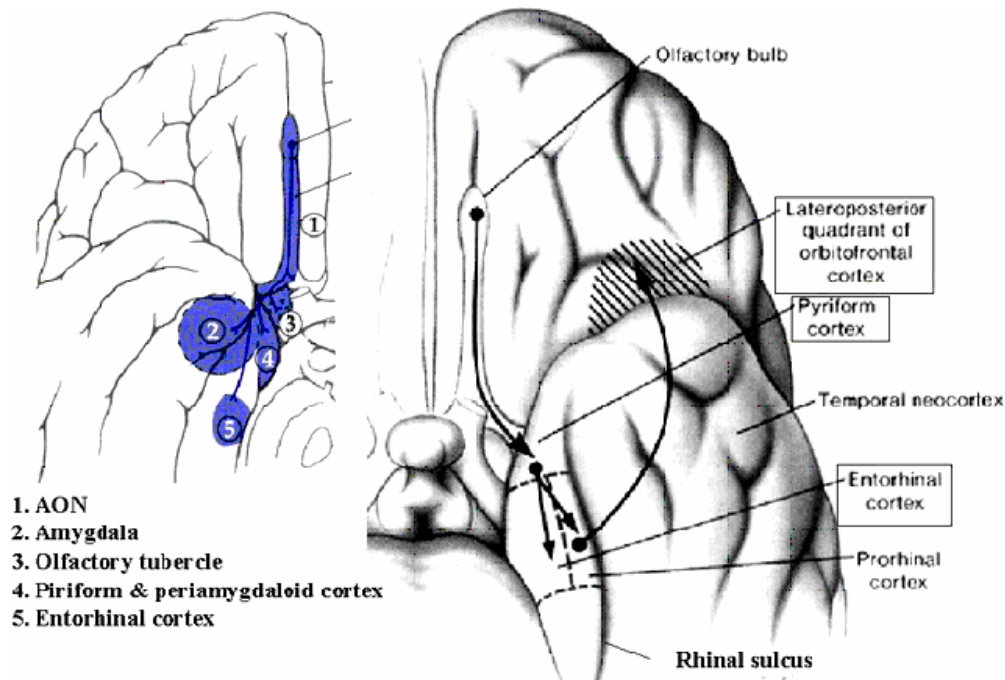
- embryonic origin – *prosencephalon*
- arched-shaped – general shape of hemispheres
- parts:
 - ✓ anterior horn (*cornu*) ~3 cm; triangular shape into the frontal lobe ⇒ *septum pellucidum*
 - ✓ central part ~4 cm; into the parietal lobe; collateral trigone
 - ✓ posterior horn (*cornu*) – 1.2-2 cm; into the occipital lobe ⇒ *calcar avis*
 - ✓ inferior horn (*cornu*) – 3-4 cm; into the temporal lobe ⇒ *hippocampus*; collateral eminence
- composition – cerebrospinal fluid:
 - ✓ *plexus choroideus ventriculi lateralis* – missed in the anterior and posterior horns
- communication with:
 - ✓ third ventricle – interventricular foramina (of *Monro*)





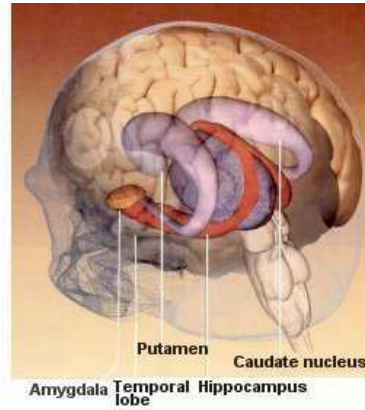
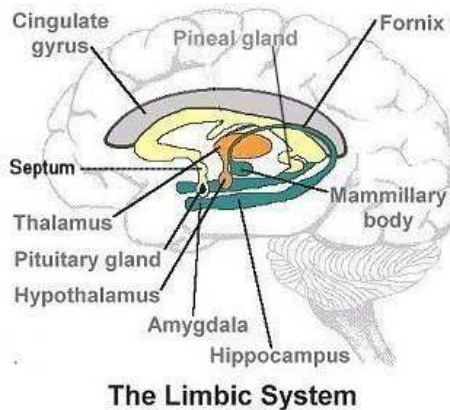
Olfactory system, rhinencephalon

- Gr. *rhinencephalon* = nose-brain
 - *rhin* = nose, *encephalon* = brain
 - part of the basal forebrain
 - mediates olfaction (the sense of smell), olfactory brain
- rhinencephalon includes:
 - ✓ olfactory bulb and tract
 - ✓ olfactory striae and trigone
 - ✓ olfactory tubercle
 - ✓ primary olfactory cortex:
 - piriform area (*gyrus ambiens*)
 - periamygdaloid area (*gyrus semilunaris*)
 - ✓ secondary olfactory cortex:
 - entorhinal area, cranial part of parahippocampal gyrus





Limbic system



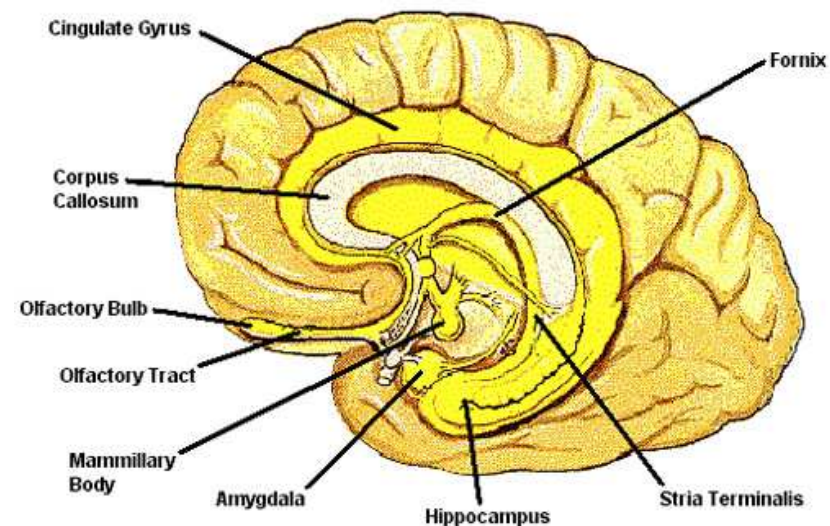
- Papez circuit, 1937:
 - ✓ a route the limbic system communicates between the hippocampus, thalamus, hypothalamus, and cortex
- Functions – cortical control of:



James Papez
(1883-1958)

- Limbic system:
 - Lat. *limbus* = "border", "belt"
- paleopallium (old mammalian) brain
- cortical structures – limbic lobe
- subcortical nuclei:
 - ✓ hippocampal formation and fornix
 - ✓ amygdaloid nuclear complex
 - ✓ septal nuclei
 - ✓ hypothalamus, epithalamus
 - ✓ various thalamic nuclei
 - ✓ part of the basal ganglia

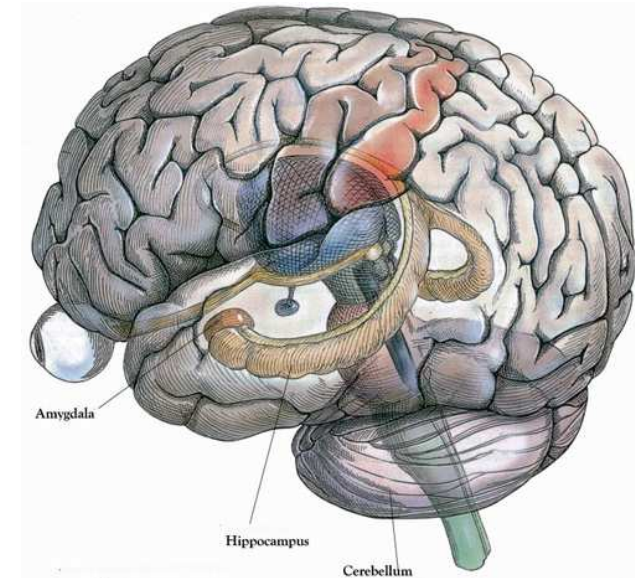
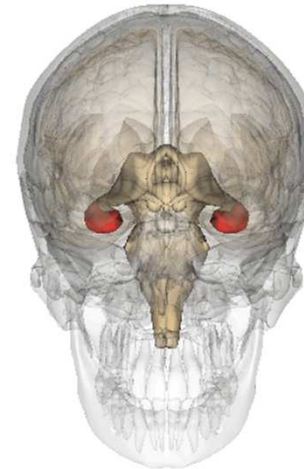
- ✓ long-term memory
- ✓ learning
- ✓ emotions



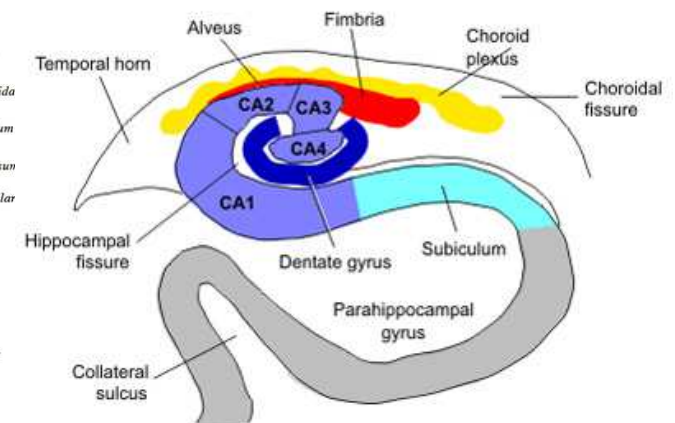
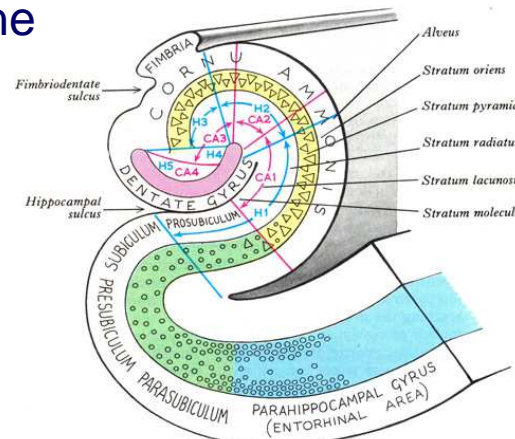


Hippocampal formation

- Hippocampus, seahorse: Gr. ιππος, *hippos* = horse, κάμπος, *kampos* = sea monster
- location – inside the medial temporal lobe
- three major regions:
 - ✓ hippocampus proper (Ammon's horn) – CA1-CA4 fields of *Lorente de Nó*
 - ✓ dentate gyrus
 - three-layered cortices
 - ✓ subiculum – transition zone
- hippocampal functions:
 - ✓ behavioral inhibition (anxiety)
 - ✓ learning and recent memory
 - ✓ spatial coding



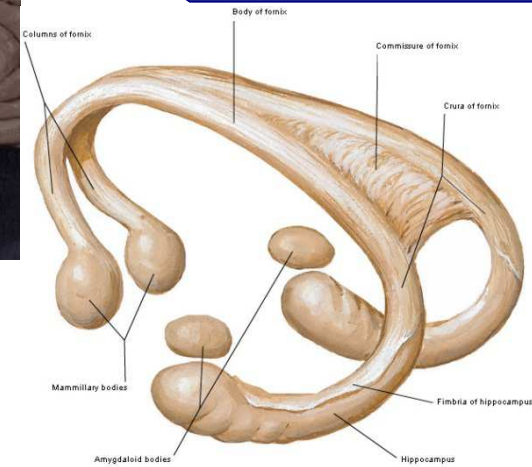
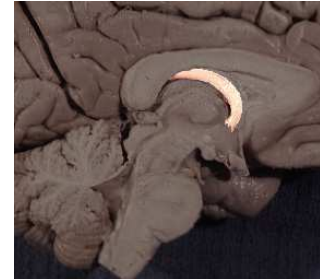
Hippocampal Anatomy





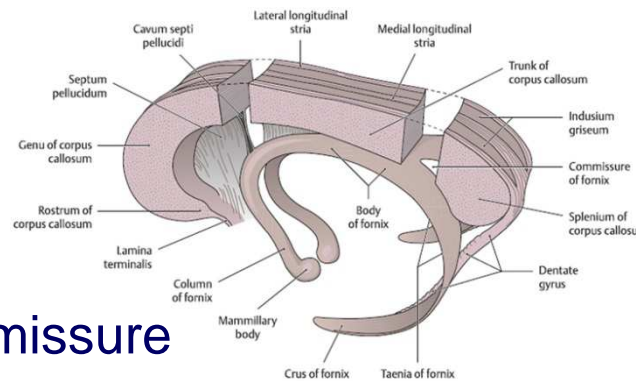
Fornix

- Fornix, Lat. = “vault”, “arch”
 - ✓ C-shaped bundle of fibres (axons)
 - ✓ the sole efferent system
 - ✓ carries signals from the hippocampus to the mammillary bodies and septal nuclei

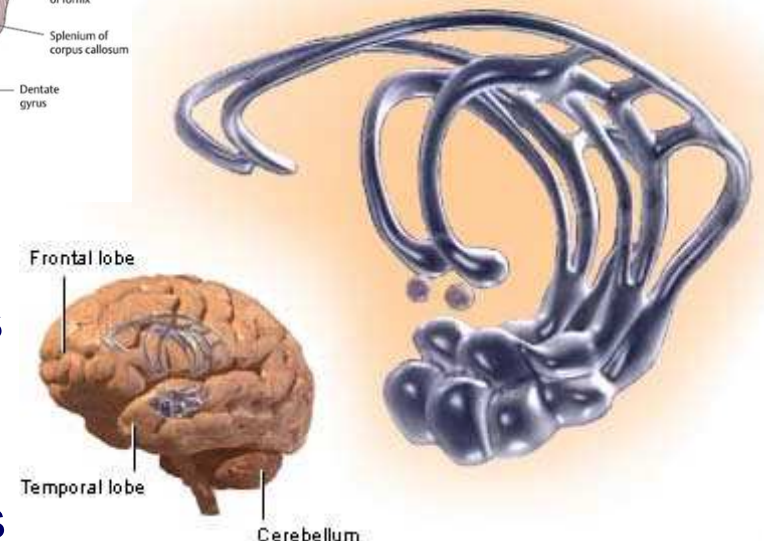


- Structure:

- ✓ crus of the fornix
- ✓ body of the fornix
- ✓ (hippocampal) commissure
- ✓ anterior fibers, "precommissural fornix" ⇒ the septal nuclei and nucleus accumbens
- ✓ posterior fibres, "postcommissural fornix" (column of the fornix)



Hippocampus and fornix (limbic system)

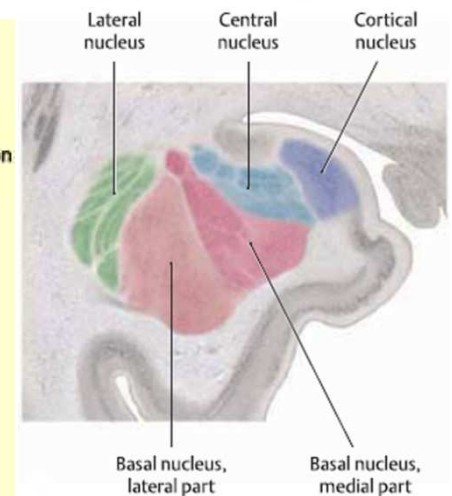
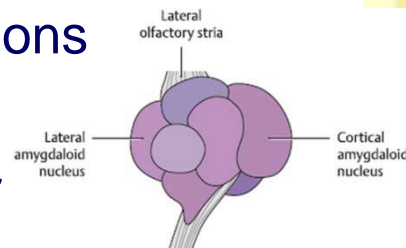
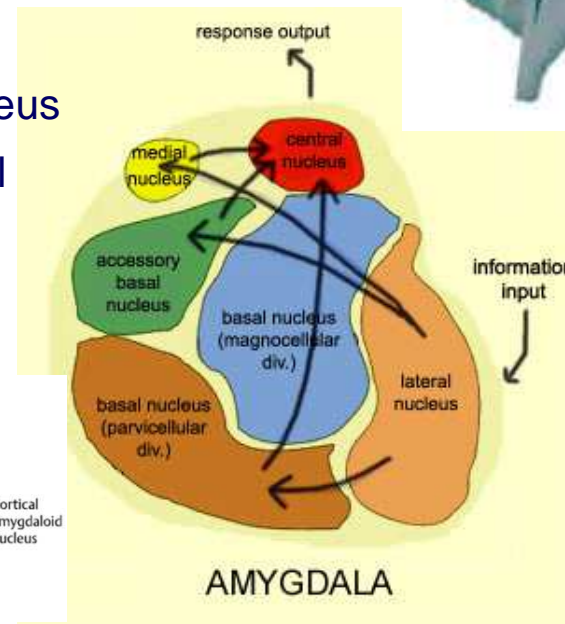
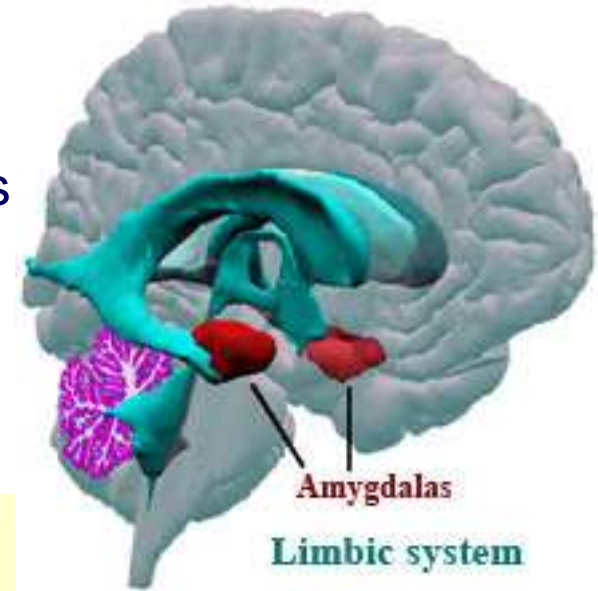


⇒ the mammillary bodies



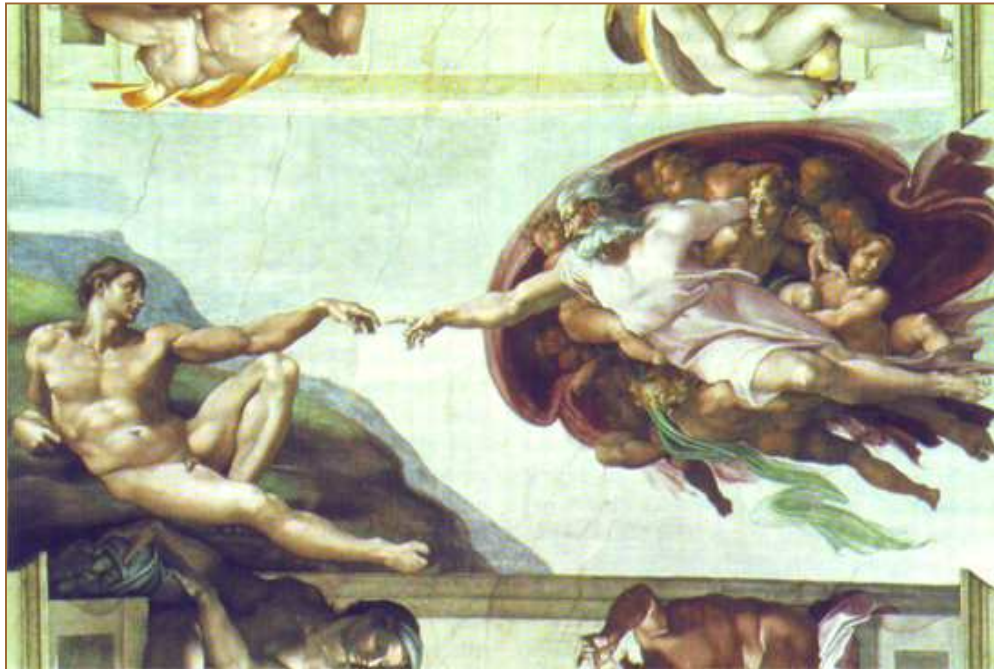
Amygdala (amygdaloid nuclear complex)

- Lat. *corpus amygdaloideum*
Gr. αμυγδαλή, *amygdalē*, “almond”, “tonsil”
- Location – deep within the medial temporal lobes
- Amygdala nuclei:
 - ✓ corticomedial nuclear group – basal ganglia
 - ✓ basolateral nuclear group:
 - lateral amygdaloid nucleus
 - basal amygdaloid nucleus
 - accessory basal amygdaloid nucleus
 - ✓ central nucleus, medial and lateral
- Functions:
 - ✓ fear reactivity and other emotional functions
 - ✓ feeding
 - ✓ sexual behavior

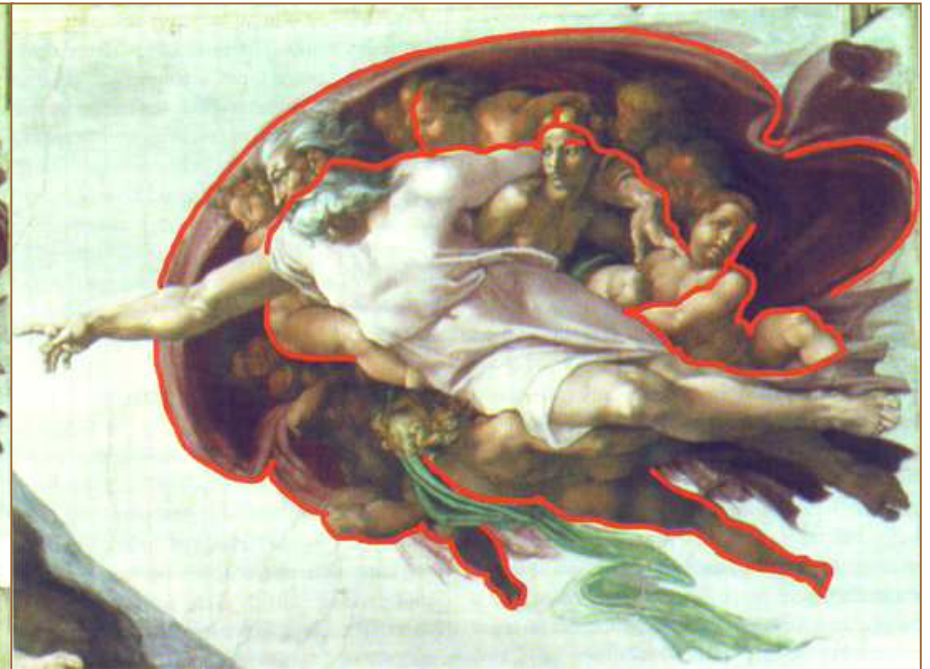




Localization of cerebral functions



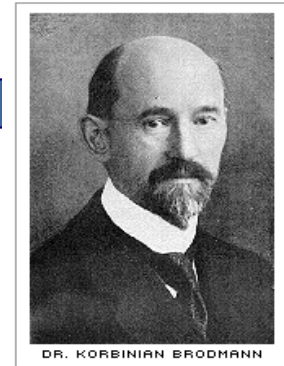
Michelangelo's *Creation of Adam*
(1508-1512)



Meshberger's interpretation
JAMA 264:1837-1841, 1990



Cytoarchitectural maps

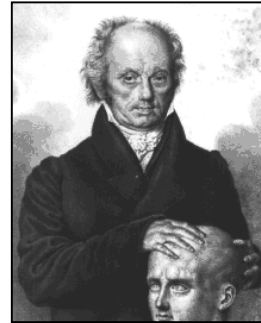
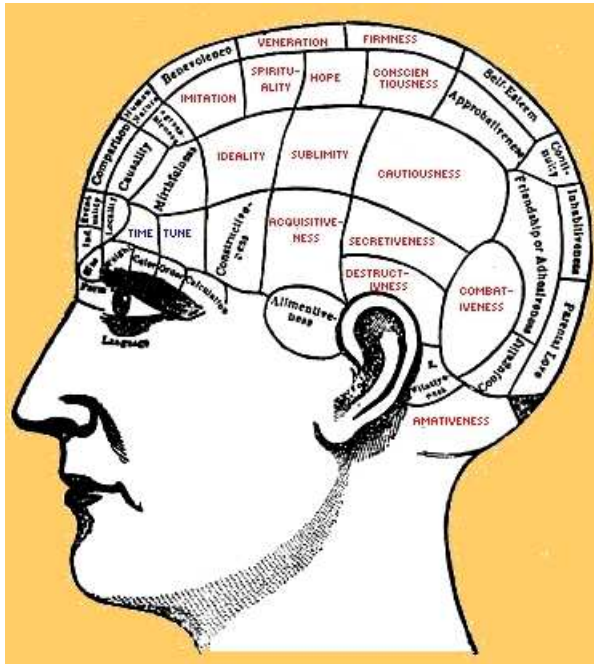


DR. KORBINIAN BRODMANN

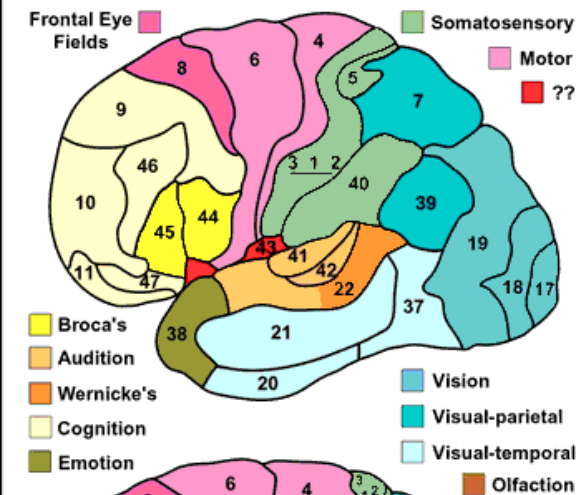
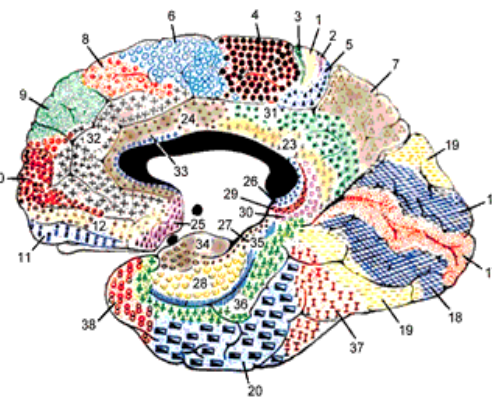
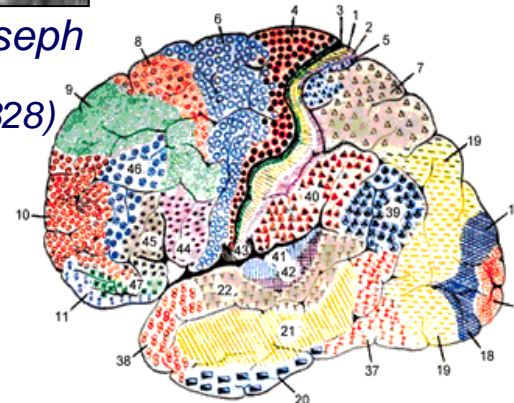
Schädellehre, Phrenology, 1796
Gr. φρήν, *phrēn*, "mind";
λόγος, *logos*, "knowledge"

Campbell (1905) – 20 areas

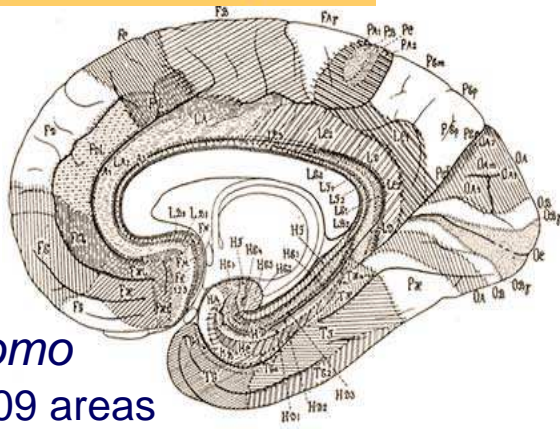
Brodmann (1909) – 52 cytoarchitectural areas



Franz Joseph Gall
(1758-1828)



von Economo
(1925) – 109 areas

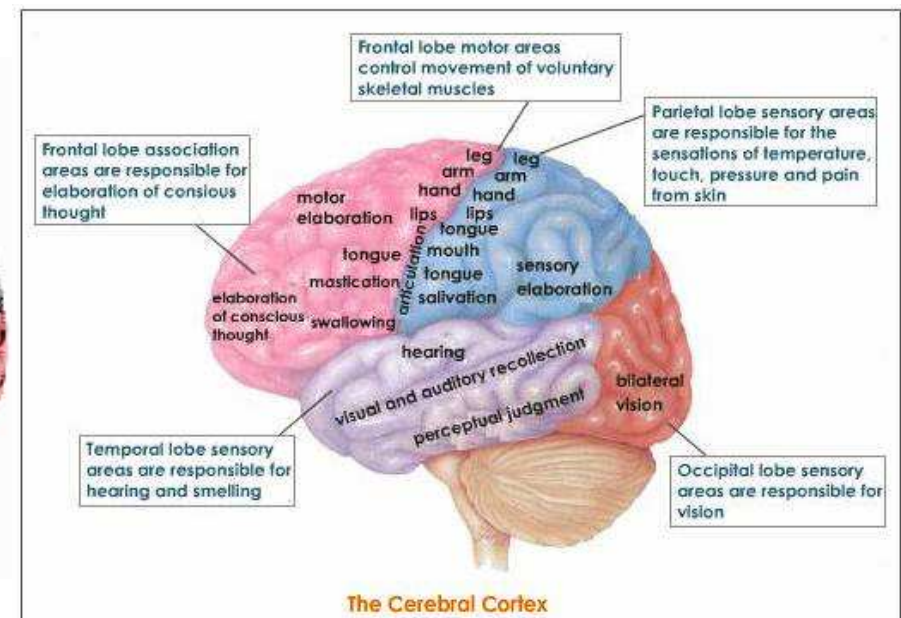
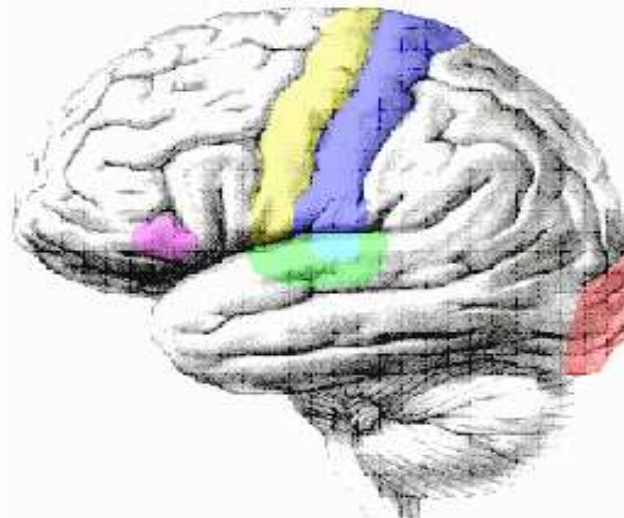




Functional differentiation of the cerebral cortex

- Main cortical areas:
 - ✓ Sensory areas ⇔ afferent projections
 - ✓ Motor areas ⇒ efferent projections
 - ✓ Associational ('silent') areas
 - ✓ 'Visuopsychic' cortex

- Somatosensory
- Visual
- Auditory
- Gustatory
- Olfactory
- Motor





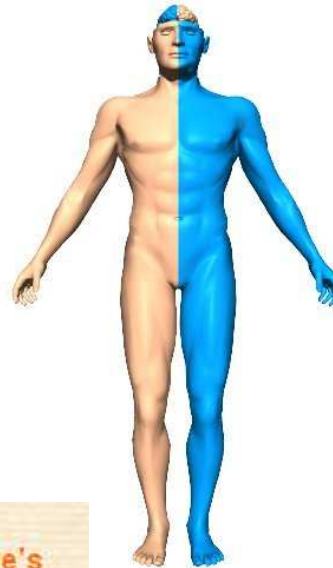
Cerebral asymmetry (hemispheric dominance)



DR. WILDER PENFIELD

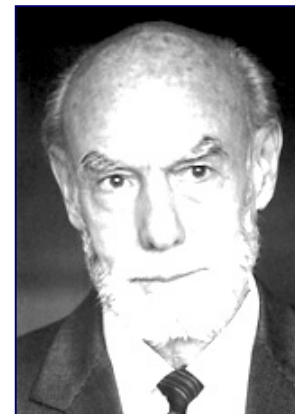
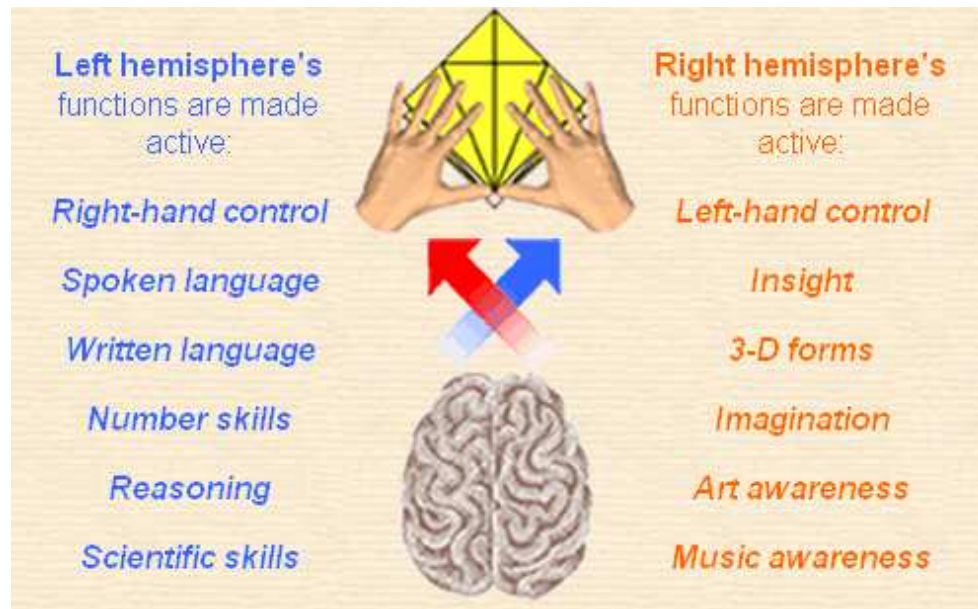
Left hemisphere:

- ✓ verbal
- ✓ linguistic description
- ✓ mathematical
- ✓ sequential
- ✓ analytical
- ✓ direct link to 'consciousness'



Right hemisphere:

- ✓ almost non-verbal
- ✓ musical
- ✓ geometrical
- ✓ spatial comprehension
- ✓ temporal synthesis
- ✓ link to 'consciousness'?

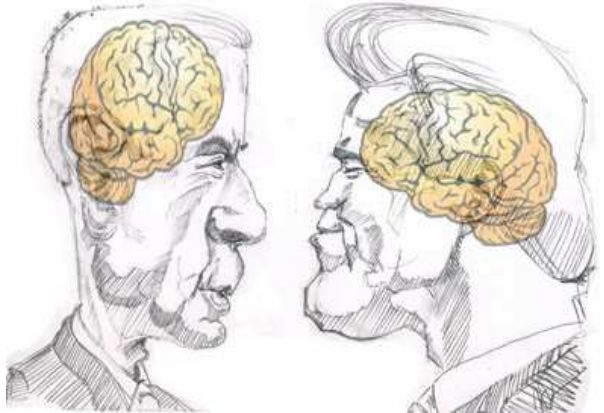


Roger W. Sperry – "split-brain"



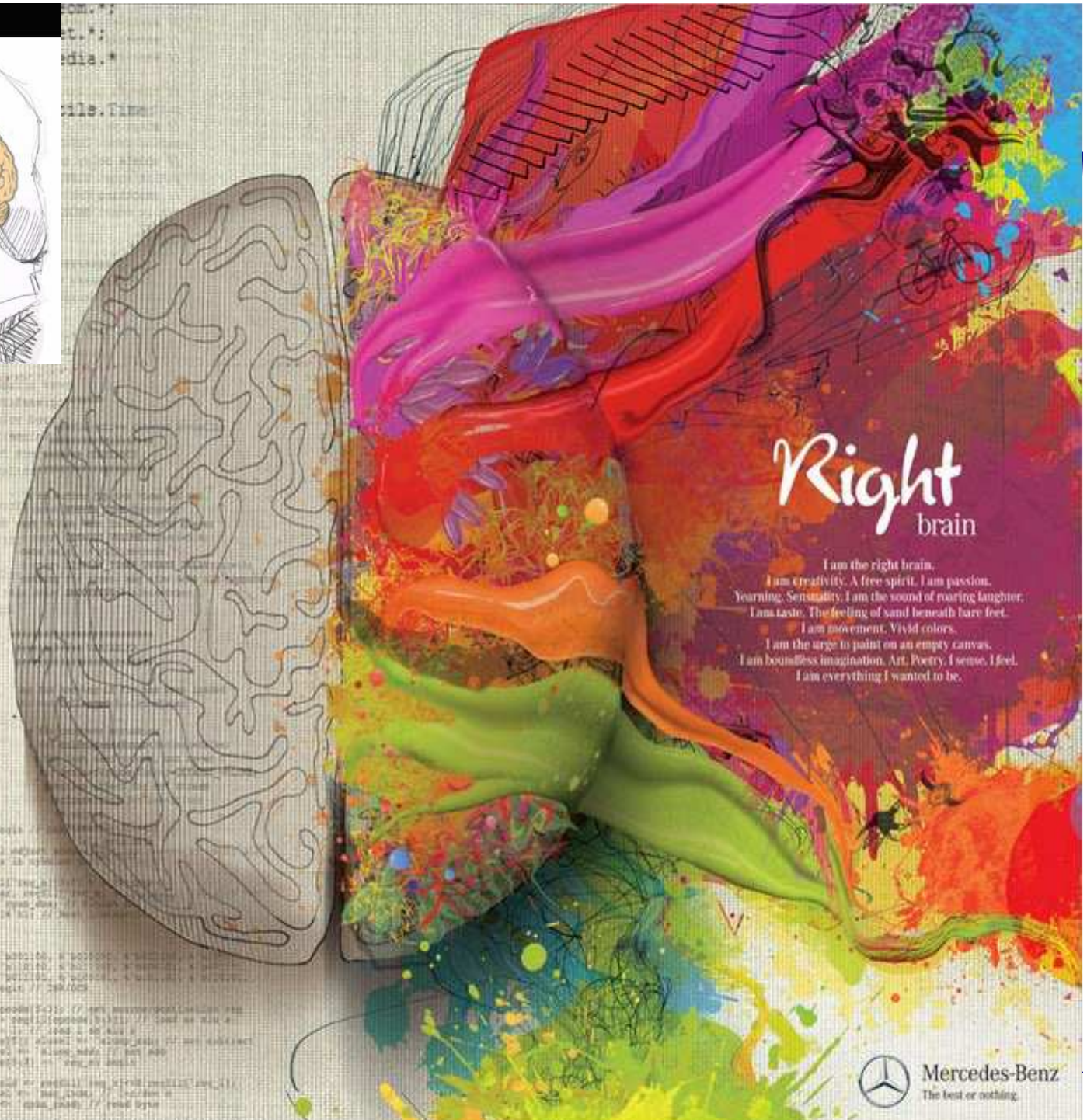
The Nobel Prize in Physiology or Medicine 1981
Roger W. Sperry, David H. Hubel, Torsten N. Wiesel

Left Brain versus Right Brain



Left brain

I am the left brain.
I am a scientist. A mathematician.
I love the familiar. I categorize. I am accurate. Linear.
Analytical. Strategic. I am practical.
Always in control. A master of words and language.
Realistic. I calculate equations and play with numbers.
I am order. I am logic.
I know exactly who I am.

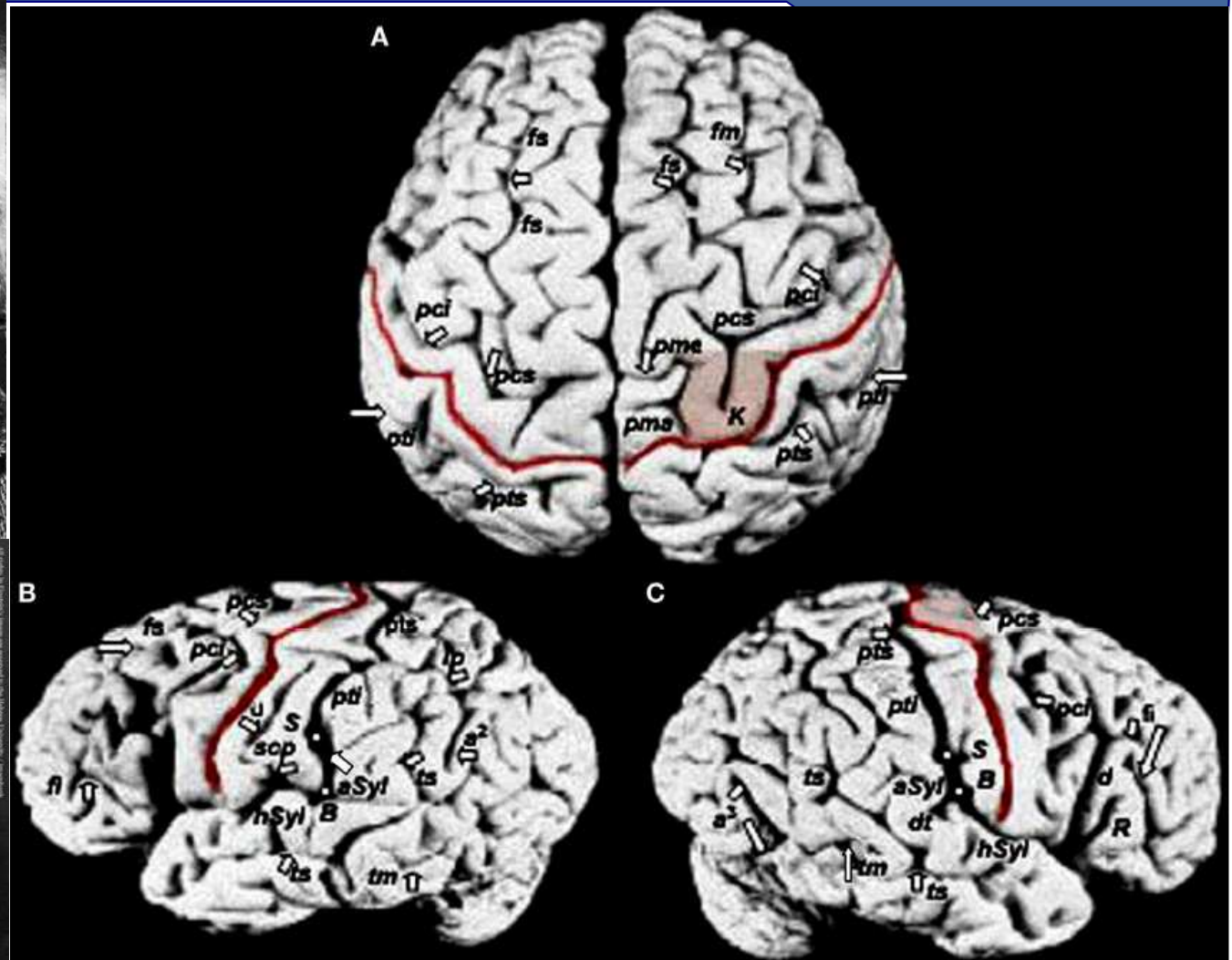
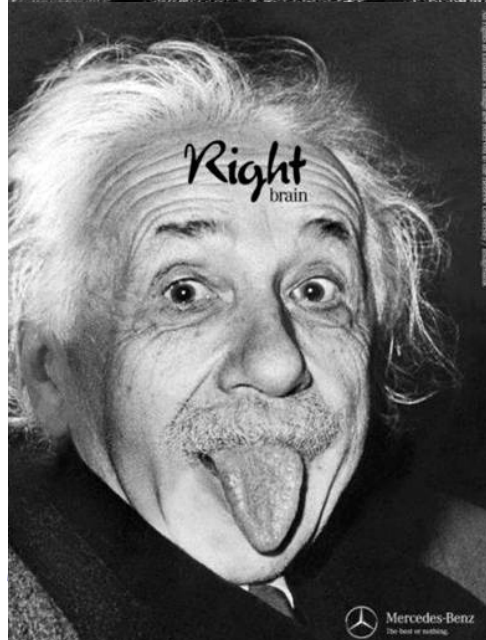
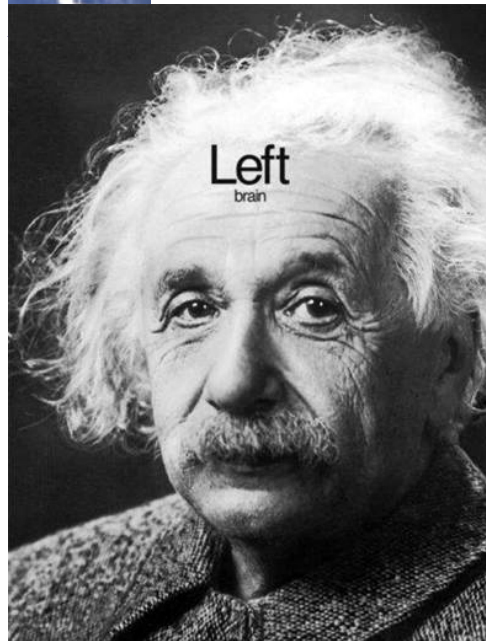


Right brain

I am the right brain.
I am creativity. A free spirit. I am passion.
Yearning. Sensuality. I am the sound of roaring laughter.
I am taste. The feeling of sand beneath bare feet.
I am movement. Vivid colors.
I am the urge to paint on an empty canvas.
I am boundless imagination. Art. Poetry. I sense. I feel.
I am everything I wanted to be.



An old brain with new tricks



*Dean Frank; New Information about Albert Einstein's brain
Front. Evol. Neurosci. 1:3, 2009*



Somatomotor areas



- primary somatomotor area (M-I) = primary (precentral) motor cortex (area 4 of *Brodmann*):

- ✓ *gyrus precentralis*
- ✓ *lobulus paracentralis* ⇒ *paresis and palsy*

- second somatomotor area = premotor cortex (area 6 and parts of areas 8, 44, 45):

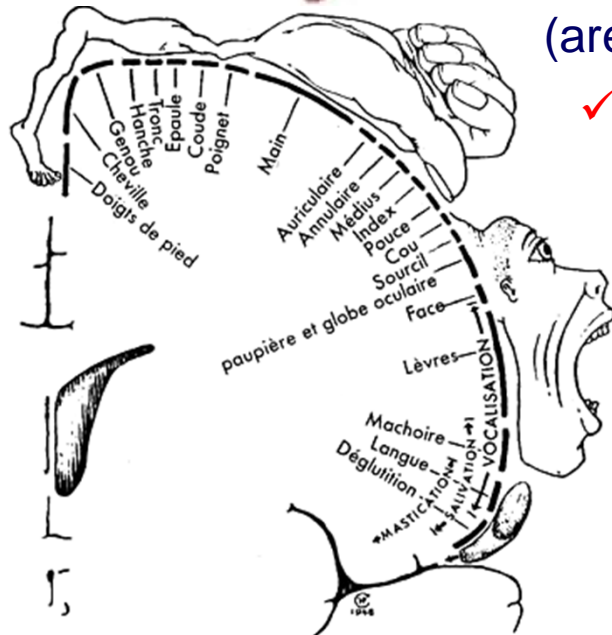
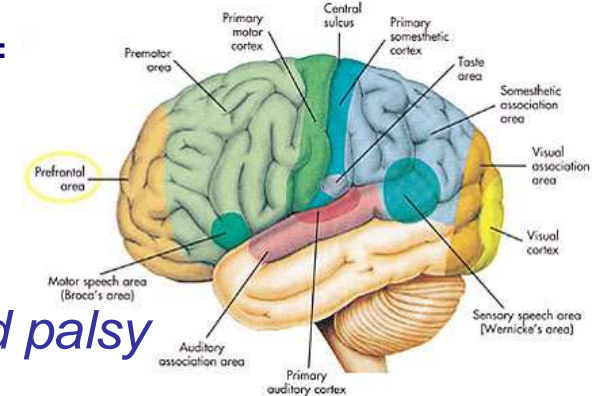
⇒ *apraxia*

- ✓ most caudal parts of *gyri frontales sup., med. et inf.*

- supplementary motor area (M-II):

- ✓ medial surface – medial part of area 6
 - between area 4 and cingulate gyrus
 - ahead of *lobulus paracentralis*

⇒ “*motor homunculus*” (Latin: “*little man*”) of *Penfield and Rasmussen*



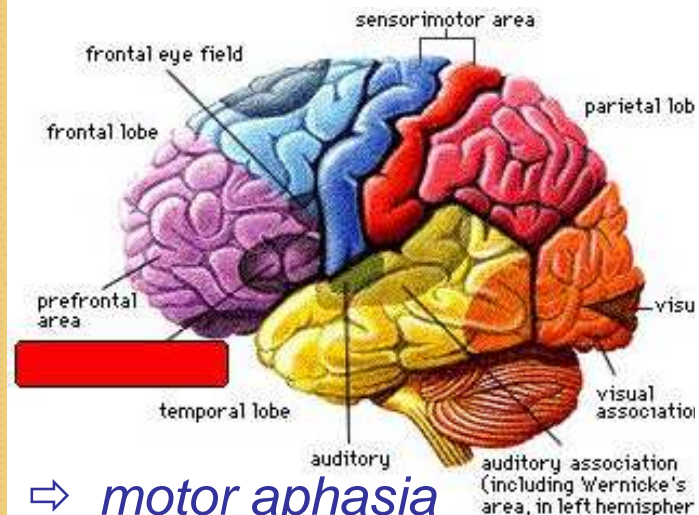
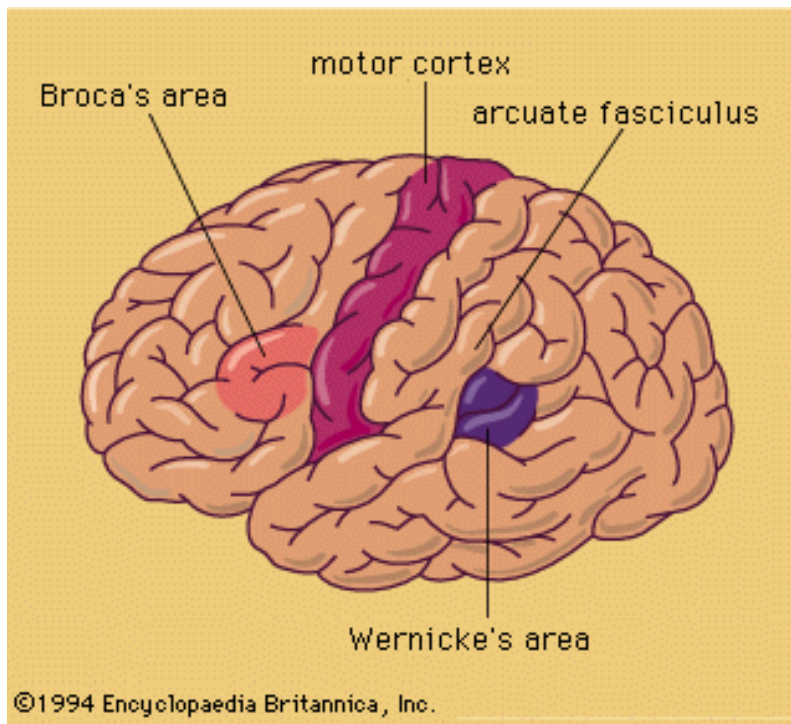


Somatomotor areas



Paul Broca, 1861
speech center

- frontal eye field – middle frontal gyrus
“center for voluntary eye movements”:
 - ✓ considerable (inferior) part of area 8
 - ✓ area 6 behind and probably area 9 in front
- second frontal eye field – anterior to the above
- motor speech area:
 - ✓ posterior part of the inferior frontal gyrus – area 44 and part of area 45 (*gyrus Brocae*)

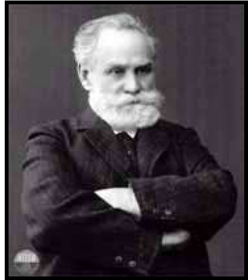


⇒ *motor aphasia*
(paralysis of speech in man)
⇒ *agrammatismus*





Somatosensory areas



И.П. Павлов

- I.P. Pavlov – Pavlov's cortical irradiation hypothesis, "cortical representations" of sensory modalities

- ✓ primary (first-order) areas
- ✓ associative (second- and third-order) areas – involved in integration of incoming sensory information

- primary somatosensory area (S-I) – areas 3, 1 and 2:

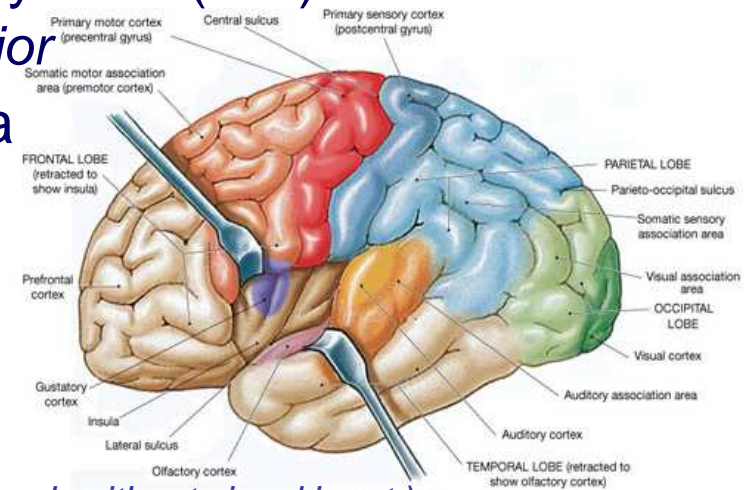
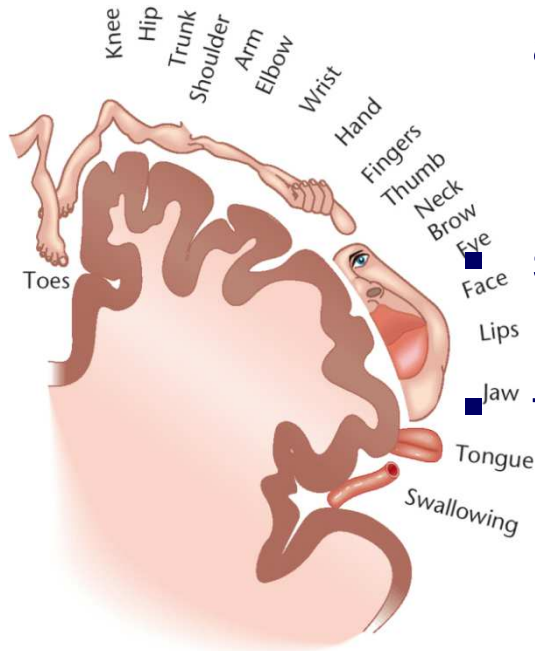
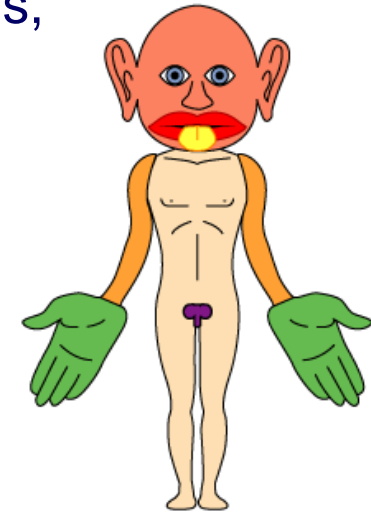
- ✓ *gyrus postcentralis*
- ✓ part of *lobulus paracentralis*

- secondary somatosensory area (S-II) – area 5

- ✓ *lobulus parietalis superior*

- third somatosensory area (S-III) – area 7

- ✓ between the primary and parainsular cortex



⇒ "sensory homunculus" ⇒ *tactile agnosia*
 of Penfield and Rasmussen ⇒ *astereognosis*
 (inability to identify an object by touch without visual input)



Visual receptive areas

- primary visual cortex (V-I) – area 17
calcarine sulcus ↔ *optic radiation*

- ✓ granular type cortex (koniocortex)

- ✓ *area striata* (striate cortex)

- 3% of cerebral surface area

- 10% of cortical neurons – numerous GABAergic interneurons

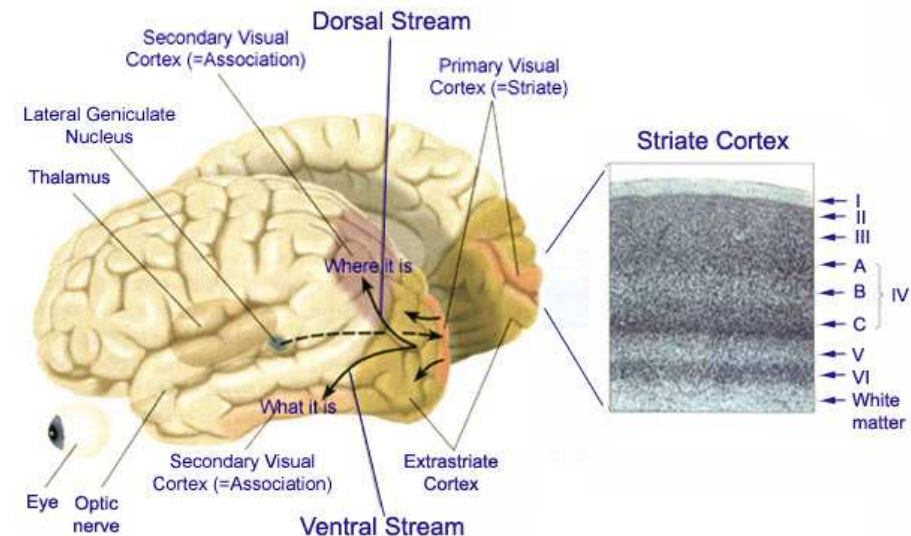
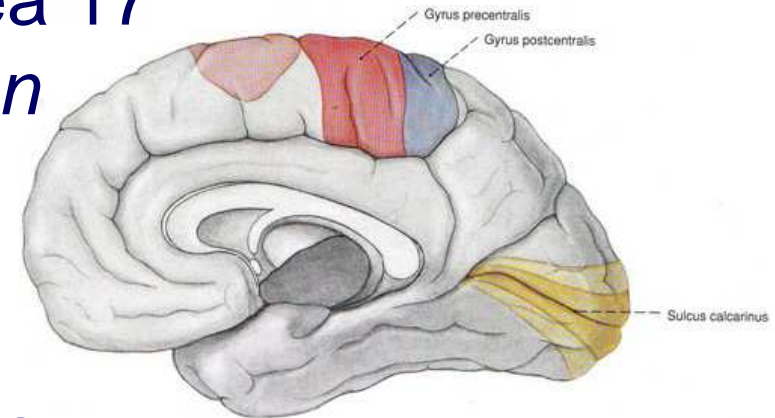
- ✓ visual agnosia – inability of the brain to make sense (“mentally blindness”)

- secondary visual cortex (association areas):

- ✓ in the occipital lobe

- V-II – area 18

- V-III – area 19

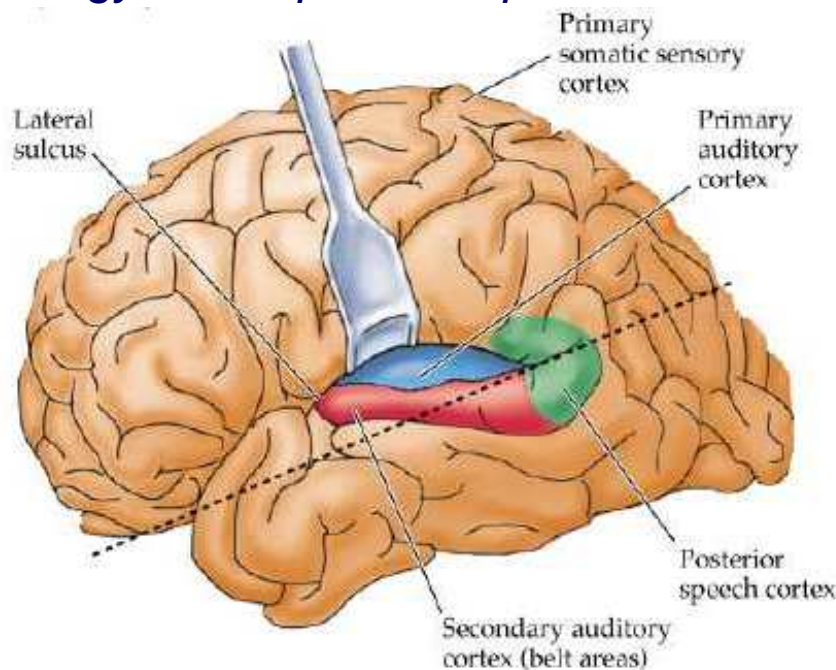




Auditory receptive areas

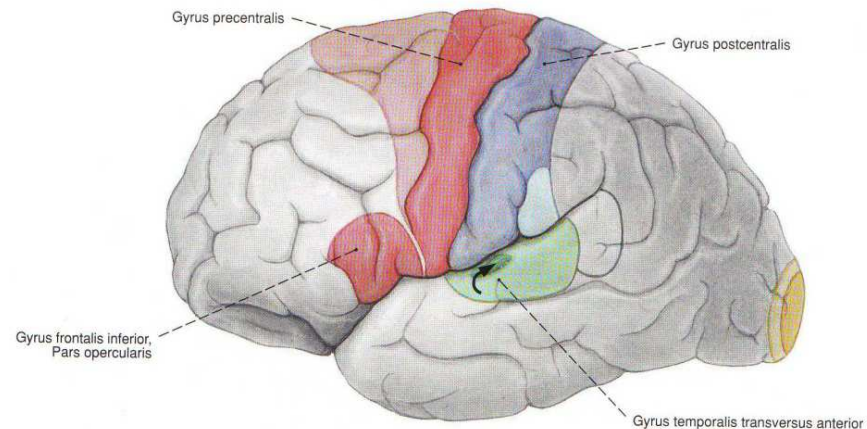
- primary auditory cortex (A-I) = area 41 ⇔ *acoustic radiation*
 - ✓ granular type cortex
 - ✓ upper part of *gyrus temporalis superior* ⇒ *acoustic agnosia*
(*word but not sound deafness*)
 - ✓ *gyri temporales transversi* (Heschl's gyrus)
- secondary auditory cortex (A-II) = area 42; belt areas
 - association (second-order) auditory area:

- ✓ *gyrus temporalis superior*



- tertiary auditory cortex (A-III) = area 21; association (third-order) auditory area:

- ✓ between the first, second acoustic area and parainsular cortex

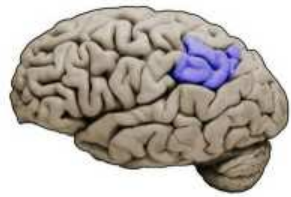




Gnostic areas

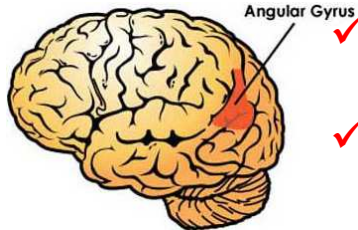
- supramarginal gyrus (area 40) – inferior parietal lobe:

- ✓ involved in phonological and articulatory processing of words
- ✓ *agraphia* (writing apraxia = inability to write)
- ✓ *astereognosia*
- ✓ *apraxia* (inability to execute a normal volitional act)



- angular gyrus (area 39):

- ✓ written word is translated to internal monologue
- ✓ *alexia* (“word blindness”) – inability to recognize written words or the meaning of words



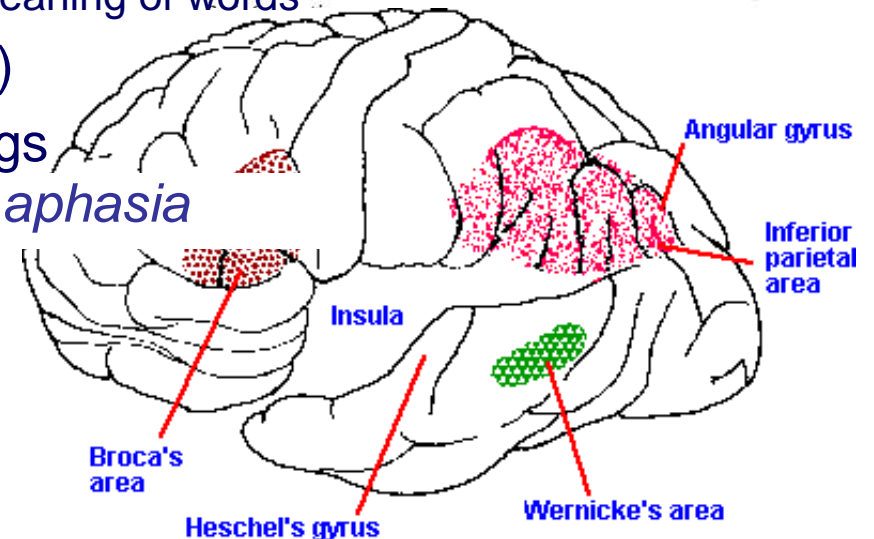
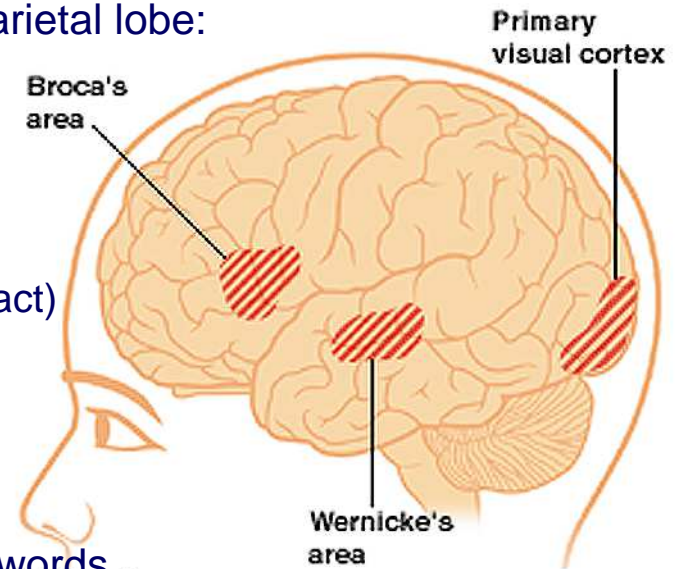
- speech area of *Wernicke* (area 22)

processes dominant word meanings (semantic processing): ⇒ *sensory aphasia*

- ✓ posterior section of the superior temporal gyrus
- ✓ *gyrus supramarginalis*
- ✓ *gyrus angularis*



C. Wernicke
1874

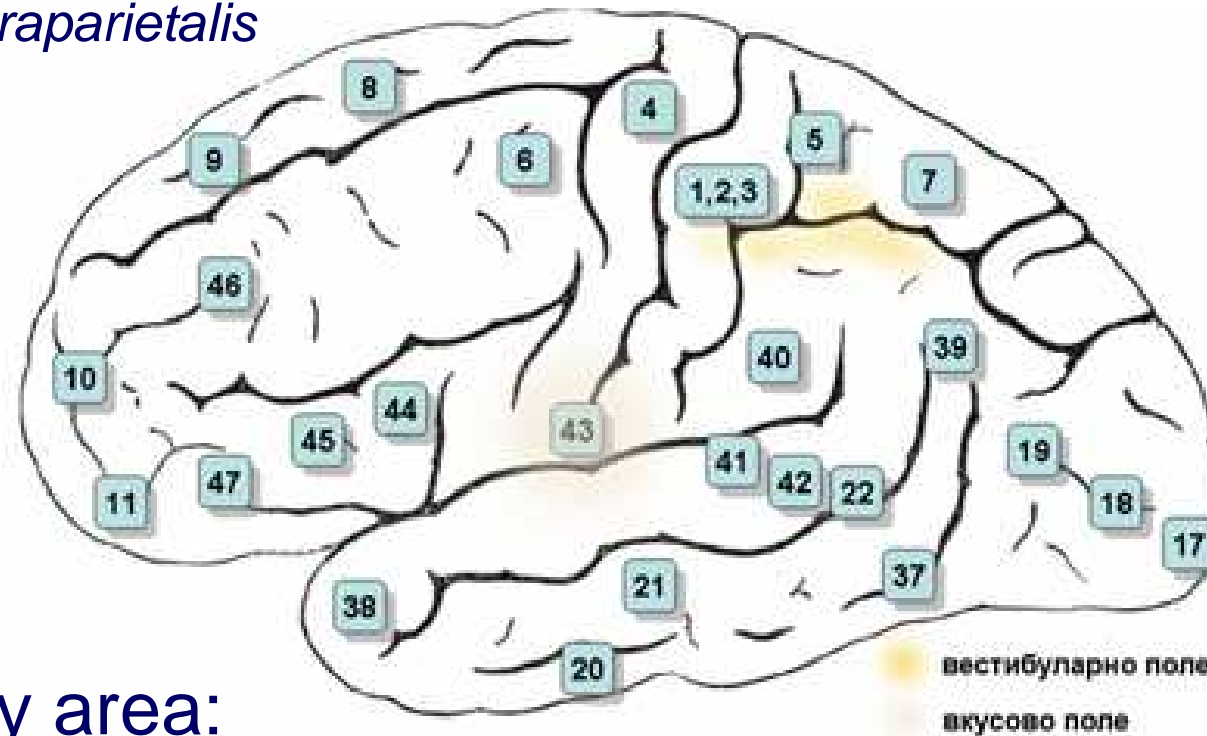




Other cortical areas

■ Vestibular area:

- ✓ *gyrus postcentralis* ⇒ *sensations of turning movements and dizziness*
- ✓ *sucus intraparietalis*



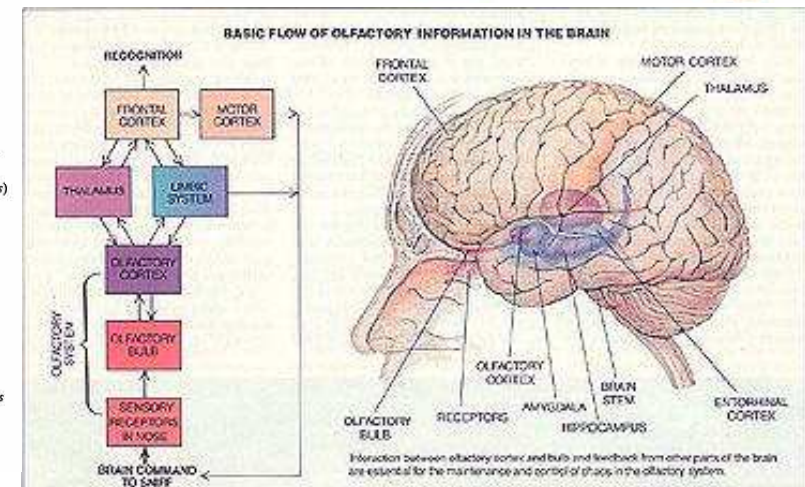
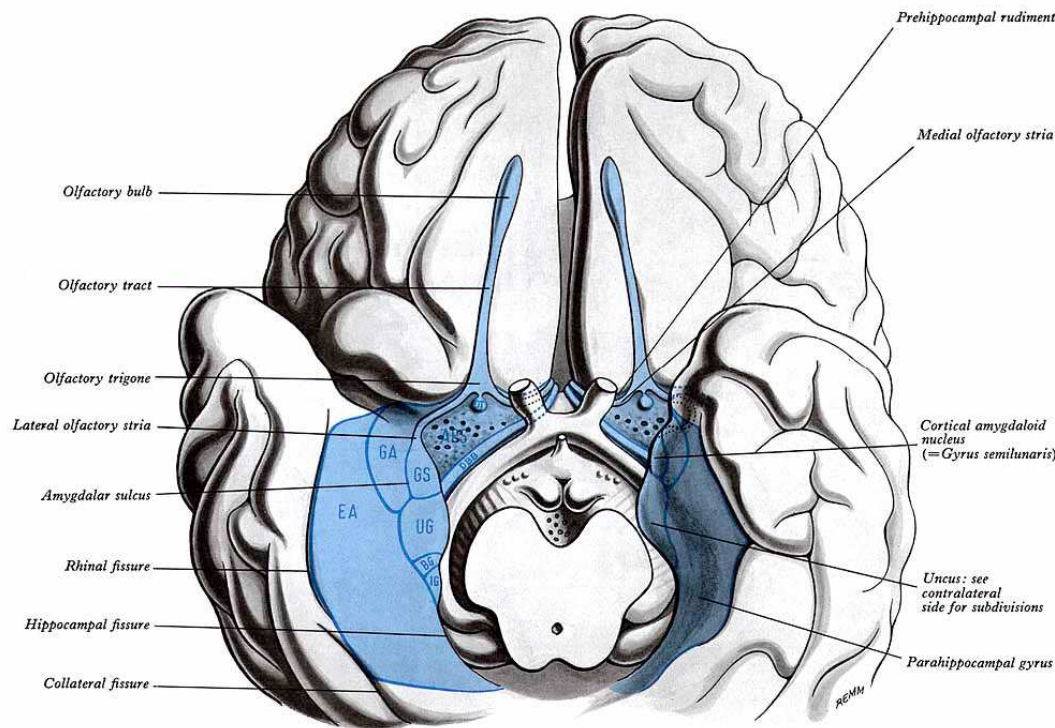
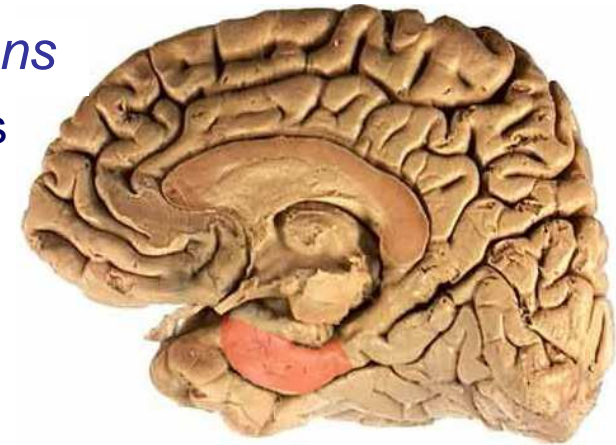
■ Gustatory area:

- ✓ the lowest part of *gyrus postcentralis*, parietal operculum (area 43)
- ✓ parainsular cortex? ⇒ *loss of gustatory sensations*
⇒ *gustatory hallucinations*



Olfactory cortex (piriform lobe)

- primary olfactory cortex:
 - ✓ prepiriform cortex – lateral olfactory gyrus \Rightarrow gyrus ambiens
 - ✓ periamygdaloid area – lateral olfactory stria \Rightarrow gyrus semilunaris
- secondary olfactory cortex: \Rightarrow *olfactory hallucinations*
 - ✓ entorhinal area, cranial part of parahippocampal gyrus

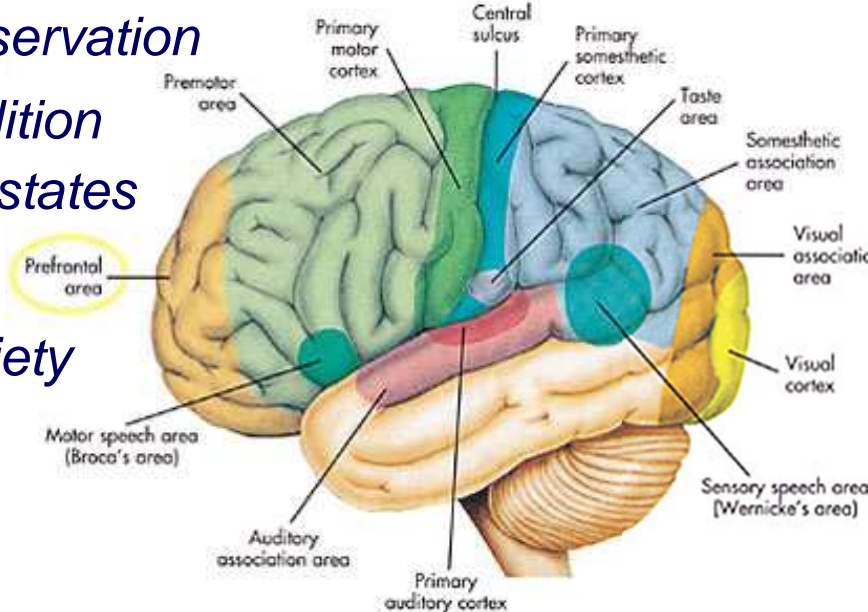
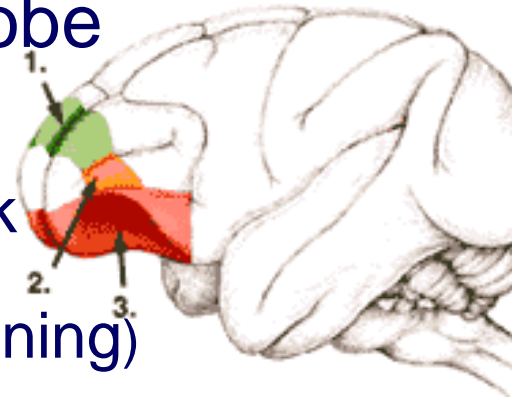




Prefrontal cortex

- rostral part of frontal lobe (areas 9-12):
 - ✓ ability to perform a task
- in bilateral ablation (sectioning) and frontal lobotomy (leucotomy):

- ✓ *intellectual preservation*
- ✓ *successful abolition of obsessional states*
- ✓ *pain relief*
- ✓ *removal of anxiety and fear*



The researchers found that the relationship between cortex thickness and IQ varied with age, particularly in the prefrontal cortex (yellow), seat of abstract reasoning, planning, and other "executive" functions.

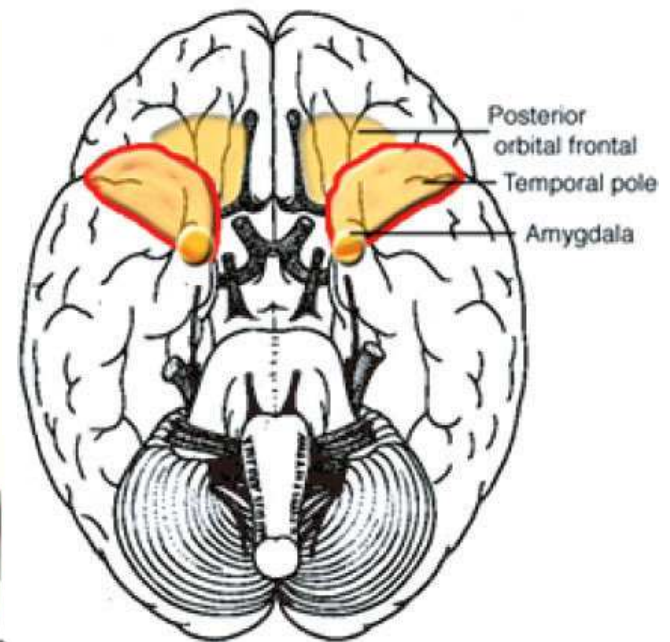
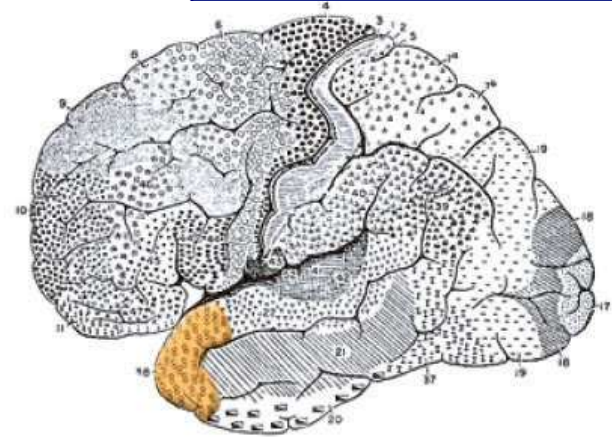


what makes us humans



Temporo-polar (“psychic”) cortex

- Temporal pole – a paralimbic region:
 - ✓ part of an extended limbic system
 - ✓ role in both social and emotional processes, including face recognition
 - ✓ integration of emotion with perception
 - ✓ recognition from auditory or visual cues ⇒ visual and acoustic hallucinations

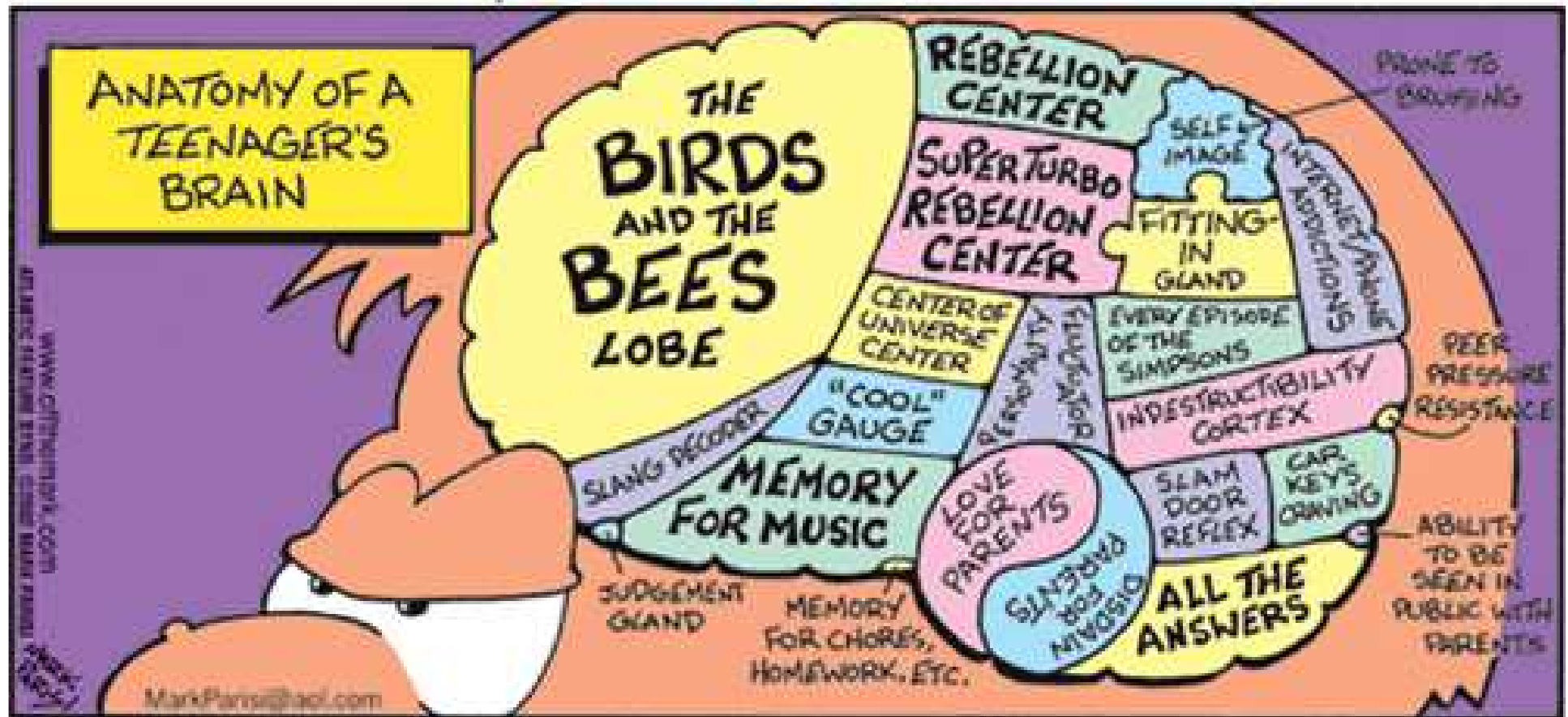


Homer J. Simpson

Prof. Dr. Nikolai Lazarov



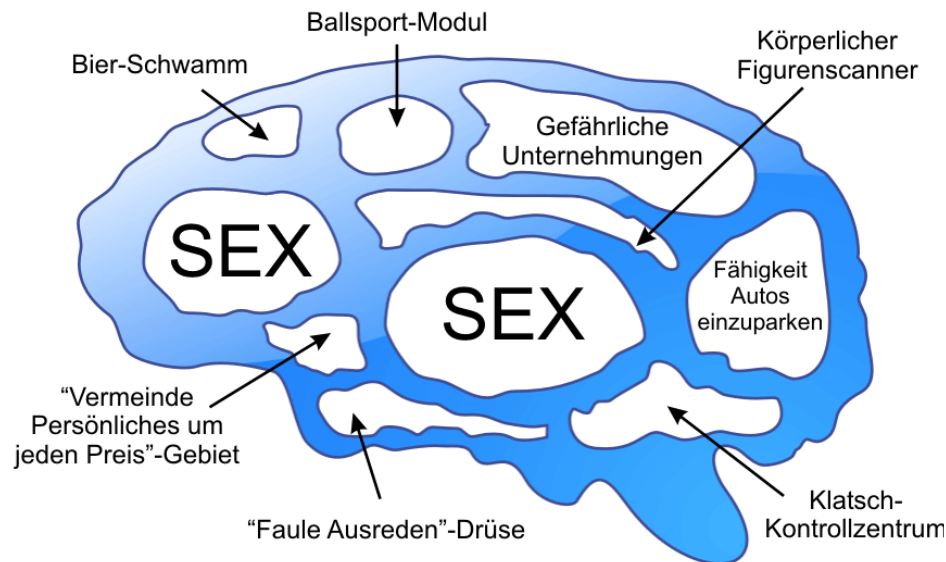
Age-related functional specialization





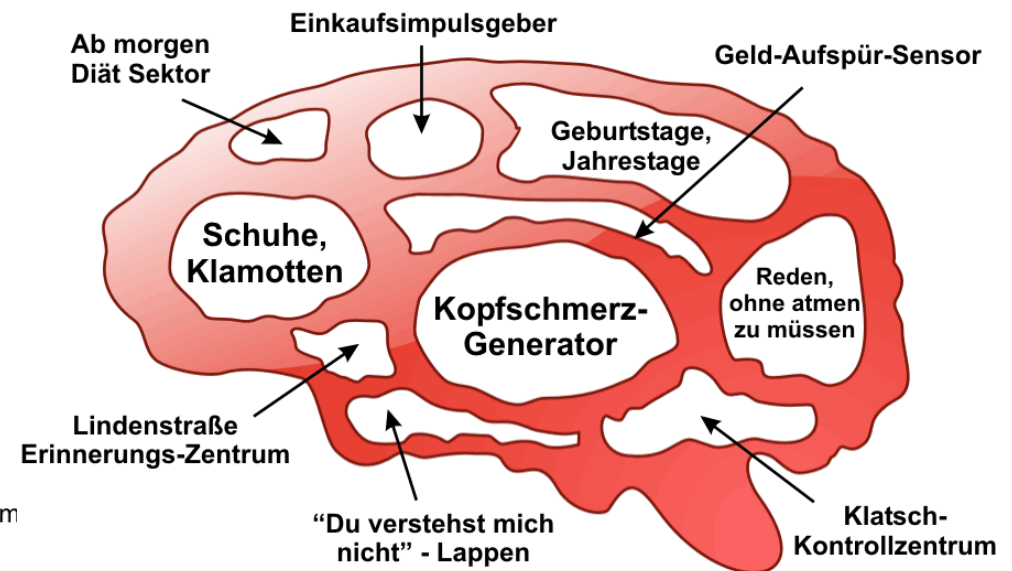
Sex differences in the cerebrum

Das männliche Gehirn

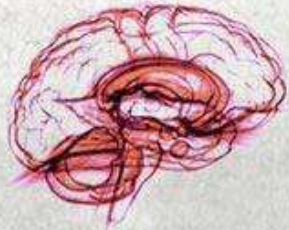


Männliche Hirnregionen, die eng miteinander verbunden sind: "Bier-Schwamm", "Sex" und "Faule Ausreden"

Das weibliche Gehirn



Hat ER ihren Einkaufsimpuls befriedigt, unterdrückt SIE eventuell auch mal den "Du verstehst mich nicht" - Reflex



**THE HUMAN BRAIN
IS AWESOME
IT FUNCTIONS 24 HOURS A DAY
FROM THE DAY WE ARE BORN
AND ONLY STOPS WHEN
WE ARE TAKING AN EXAM
OR
FALL IN LOVE**

Thank you...

