

ENCEPHALON - BRAIN

□ **Encephalon: (Gr.– en+kephalos):** Within the head
(in + head)

- The brain is a part of CNS that enclosed within the skull and continuous with the spinal cord.
- It is the highest control center and the most complex organ of the body in all vertebrates.
- It consists of neurons and glia cells
- It collects the information from sense organs, processes this raw data, combines the processed sensory information with memory of past circumstances and generates motor response patterns that are suited to maximize the welfare of the animal.

Shape and Size of Brain

- ❑ The shape and size of the brain varies greatly between species.
- ❑ Brain size is sometimes measured by weight and sometimes by volume.
- ❑ Average adult brain volume of 1300 cm³ for men and 1150 cm³ for women
- ❑ Average adult brain weight of 1400 g for men and 1200 g for women

Brain Size - Intelligence ?

- ❑ **Second Hypothesis !!! Relative brain size (brain to body weight ratio)?**
- ❑ **It can used to be a rough estimate of the intelligence of an animal. Is it true?**
- ❑ **Women's BBWR are higher than Men's (1/42 – 1/50)**
- ❑ **Shrews have the highest BBWR of all known vertebrates**

Species	Brain-Body mass ratio
shrew	1:10
small birds	1:14
Mouse	1:40
Human	1:50
cat	1:110
dog	1:125
lion	1:550
elephant	1:560
horse	1:600
shark	1:2496

Brain Size - Intelligence ?

- ❑ **Third (proximate) Hypothesis !!! Number of cortical neurons and Neuron concentration?**
- ❑ Among the mammals number of the cortical neurons can give a data for intelligence quotient (IQ)
- ❑ If we compare the numbers individually in same species ?
- ❑ Having more neurons should mean more cognitive capabilities ?

Brain Size - Intelligence ?

- **Result :** it is now recognized that the cognitive differences between species are a matter of degree. That is, they are quantitative, not qualitative, differences. Relations and connections between the neurons are the most important criteria to define intelligency.
- **So, the size is not important for brain. Important is what you do with it?**

Brain Anatomy - Division

Anatomical

Developmental

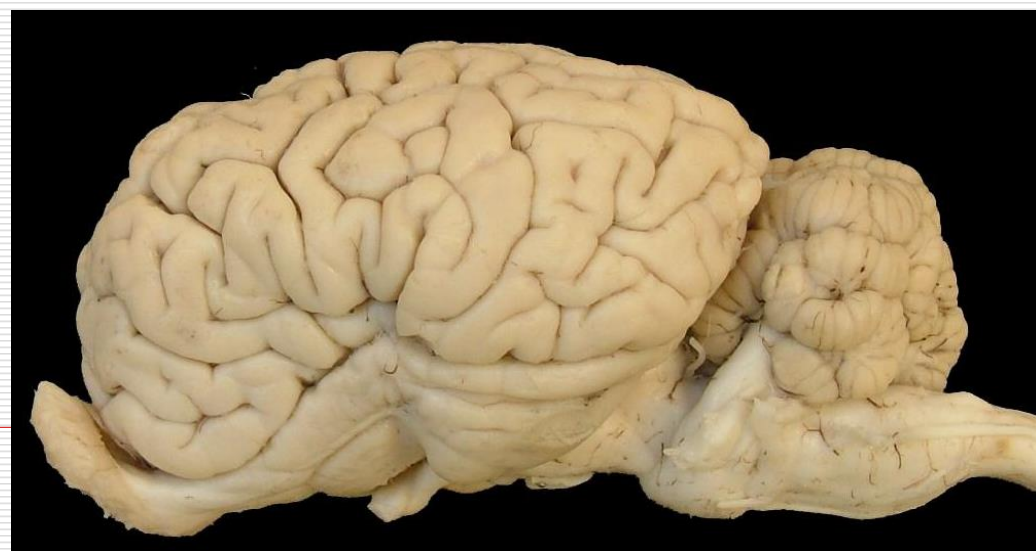
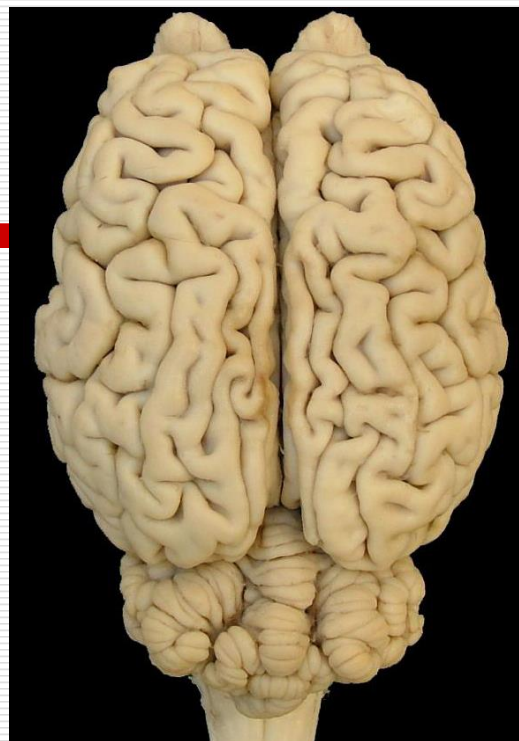


Anatomical Division

Cerebrum

Cerebellum

Brain stem





Developmental Division

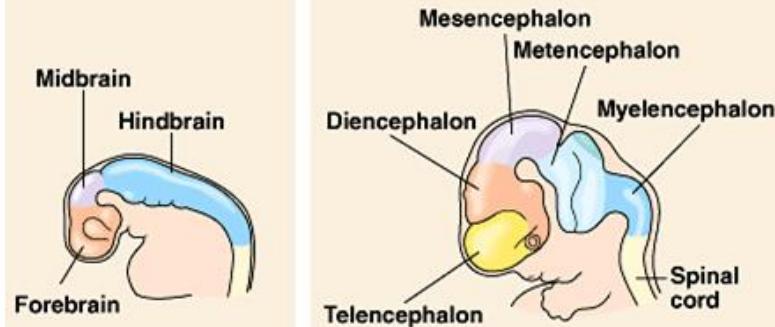
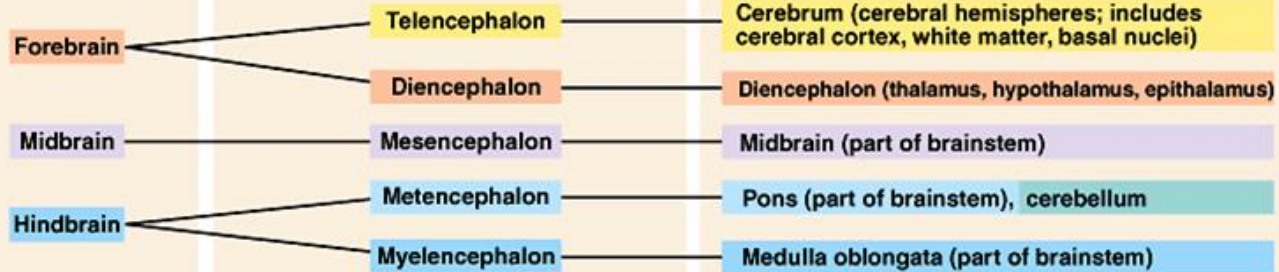
Prosencephalon

Mesencephalon

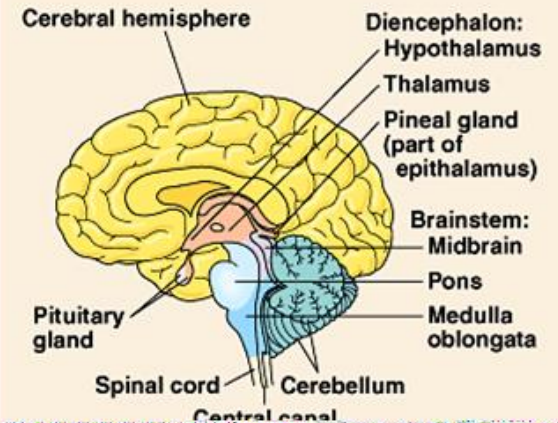
Rhombencephalon

Embryonic Brain Regions

Brain Structures Present in Adults



(a) Embryo one



□ **Prosencephalon (forebrain)**

Telencephalon

Diencephalon

□ **Mesencephalon (Midbrain)**

□ **Rhombencephalon (Hindbrain)**

Metencephalon

Myelencephalon

A-) PROSENCEPHALON (forebrain)

1- Telencephalon

Hemispherium cerebri, Corpus callosum, Corpus striatum, Rhinencephalon,
(1st cranial nerve)

Ventriculi laterales

2- Diencephalon

Hypothalamus, Thalamus, Metathalamus, Epithalamus
(2nd cranial nerve)

Ventriculus tertius

B-) MESENCEPHALON (Midbrain)

Crus cerebri, Tegmentum mesencephali, Tectum mesencephali
(3rd and 4th cranial nerves)

Aqueductus mesencephali

C-) RHOMBENCEPHALON (Hindbrain)

1- Metencephalon

Pons, Cerebellum, (5th cranial nerves)

2- Myelencephalon

Medulla oblongata (6th, 7th, 8th, 9th, 10th, 11th, 12th cranial nerves)

Ventriculus quartus

PROSENCEPHALON

❑ Forebrain is the most rostral portion of the brain.

❑ Telencephalon

Hemispherium

Rhinencephalon

Corpus callosum

Corpus striatum

Vent. lateralis

❑ Diencephalon

Hypothalamus

Thalamus

Metathalamus

Epithalamus

Vent. tertius



Telencephalon

□ HEMISPHERIUM CEREBRI

Fiss. longitudinalis cerebri

Fiss. transversa cerebri

Facies convexa

Facies medialis

Facies basalis

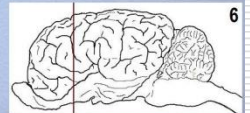
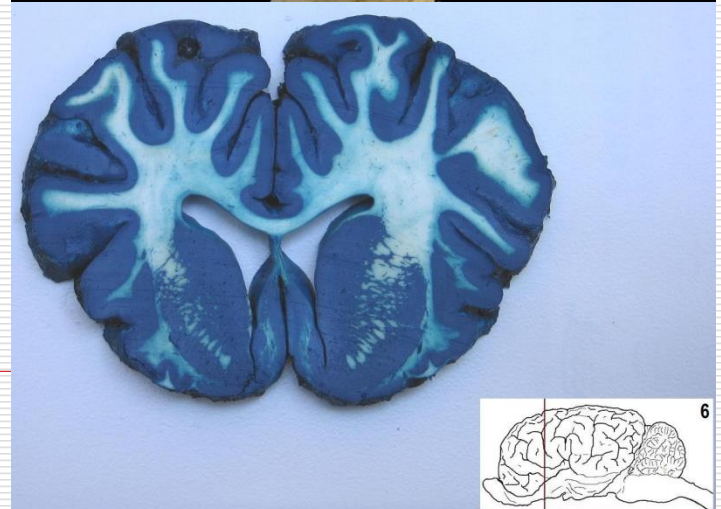
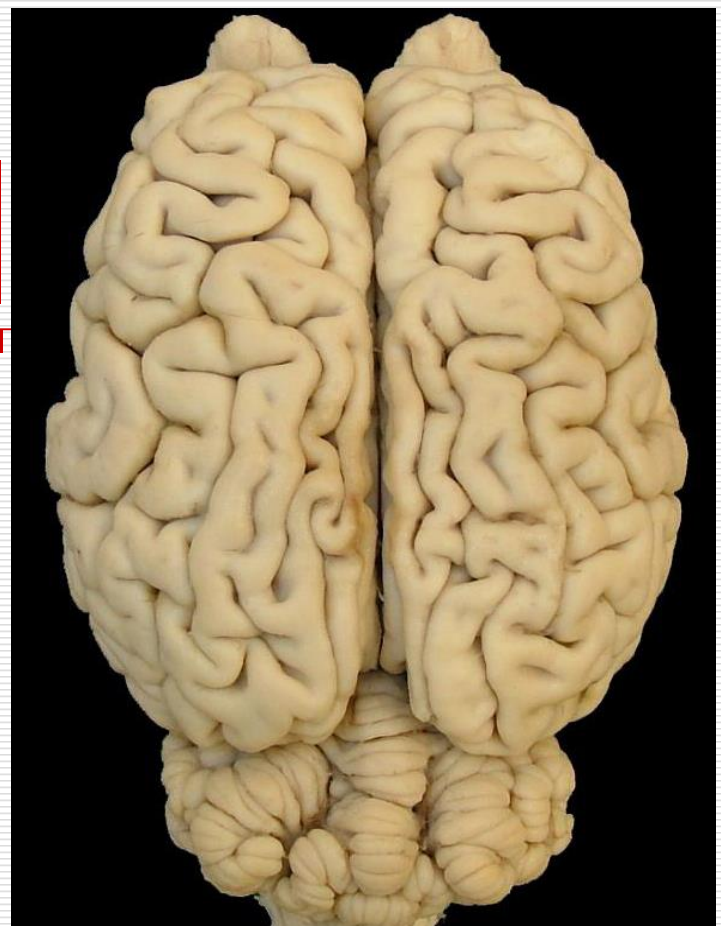
Sulci et Gyri cerebri

Polus rostralis et caudalis

Cortex cerebri

Medulla cerebri

Brain Lobes



Telencephalon

Brain lobes:

Lobus frontalis (**projection**)

Lobus occipitalis (**Vision**)

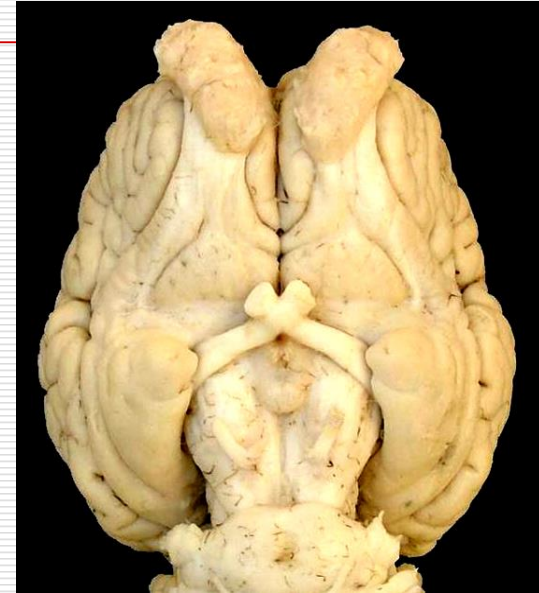
Lobus parietalis (**perception**)

Lobus temporalis (**Hearing**)

Telencephalon

□ RHINENCEPHALON

- Bulbus olfactorius
 - Pedunculus olfactorius
 - Gyrus olfactorius lateralis
 - Gyrus olfactorius medialis
 - Sulcus rhinalis
 - Sulcus endorhinalis
- Trigonum olfactorium
- Lobus piriformis
- Hippocampus (cornu ammonis)
- Fornix
- Septum pellucidum



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Pedunculus olfactorius

Gyrus olfactorius lateralis

Gyrus olfactorius medialis

Sulcus rhinalis

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- Trigonum olfactorium

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- Hippocampus (cornu ammonis)

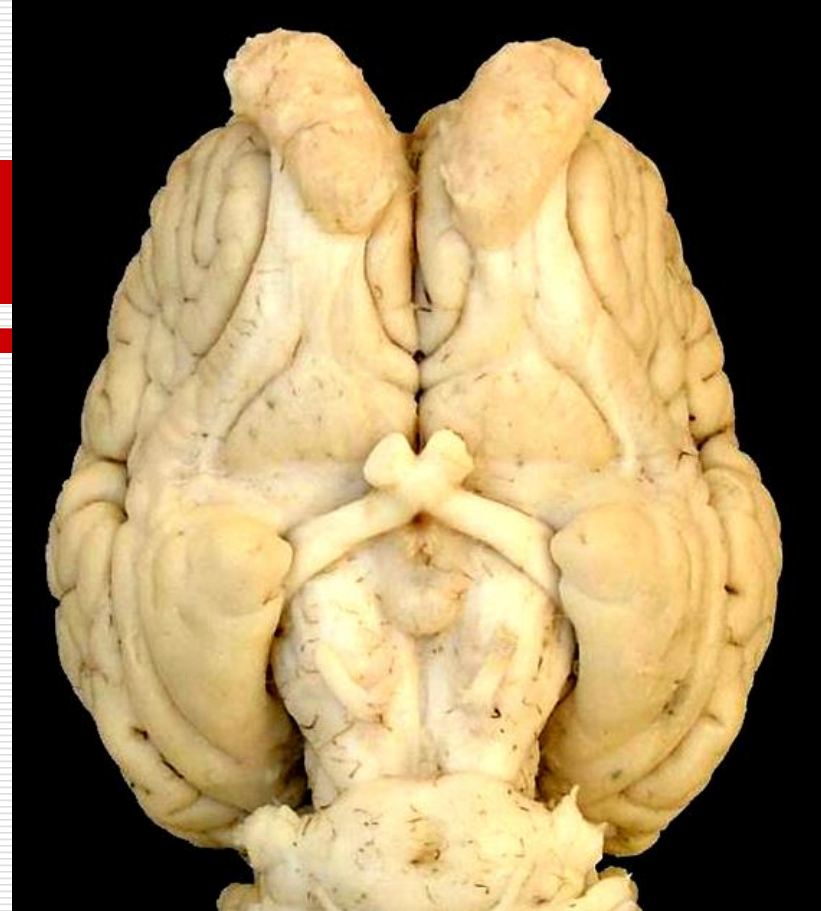
- Fornix

- Septum pellucidum

Telencephalon

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 - Pedunculus olfactorius
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 - Gyrus olfactorius medialis
 - Sulcus rhinalis
 - Sulcus endorhinalis
- Trigonum olfactorium
 - Lamina perforata rostralis
- Lobus piriformis
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Telencephalon

□ CORPUS CALLOSUM

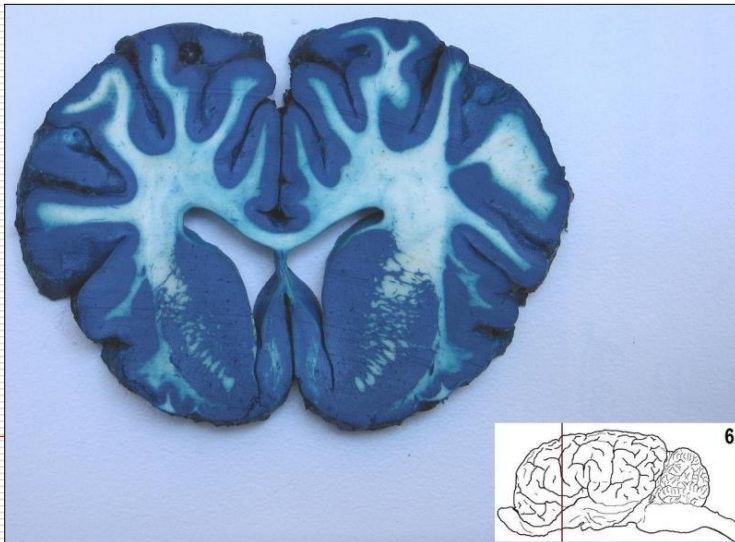
Genu corporis callosi

Truncus corporis callosi

Splenium corporis callosi

□ VENTRICULUS LATERALIS

For. interventriculare



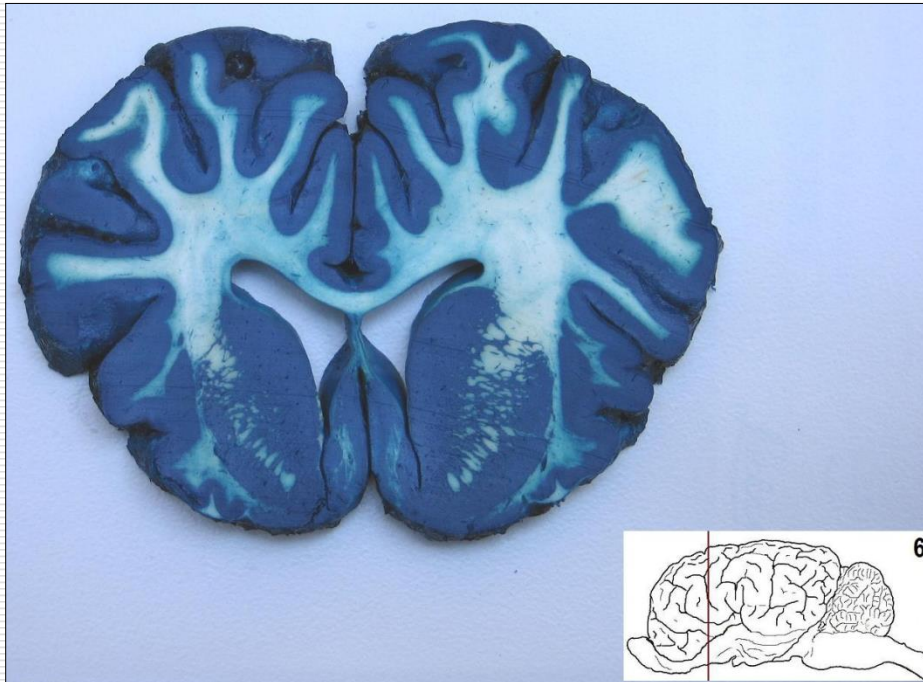
Telencephalon

□ Corpus striatum

Nucleus caudatus

Nucleus lentiformis (putamen + pallidum)

Capsula interna et externa





Diencephalon



□ Hypothalamus

Corpus mamillare (double in dog and man)

Tuber cinereum

Infundibulum

Tractus opticus

Chiasma opticum

Hypophysis cerebri

□ Thalamus

Adhesio interthalamica

□ Metathalamus

Corpus geniculatum laterale-mediale

□ Epithalamus

Epiphysis cerebri

□ Ventriculus tertius



Diencephalon

□ Hypothalamus

Corpus mamillare

Tuber cinereum

Infundibulum

Tractus opticus

Chiasma opticum

Hypophysis cerebri

□ Thalamus

Adhesio interthalamica

□ Metathalamus

Corpus geniculatum laterale-mediale

□ Epithalamus

Epiphysis cerebri

□ Ventriculus tertius

Diencephalon

□ Hypothalamus

Corpus mamillare

Tuber cinereum

Infundibulum

Tractus opticus

Chiasma opticum

Hypophysis cerebri

□ Thalamus

Adhesiointerthalamica

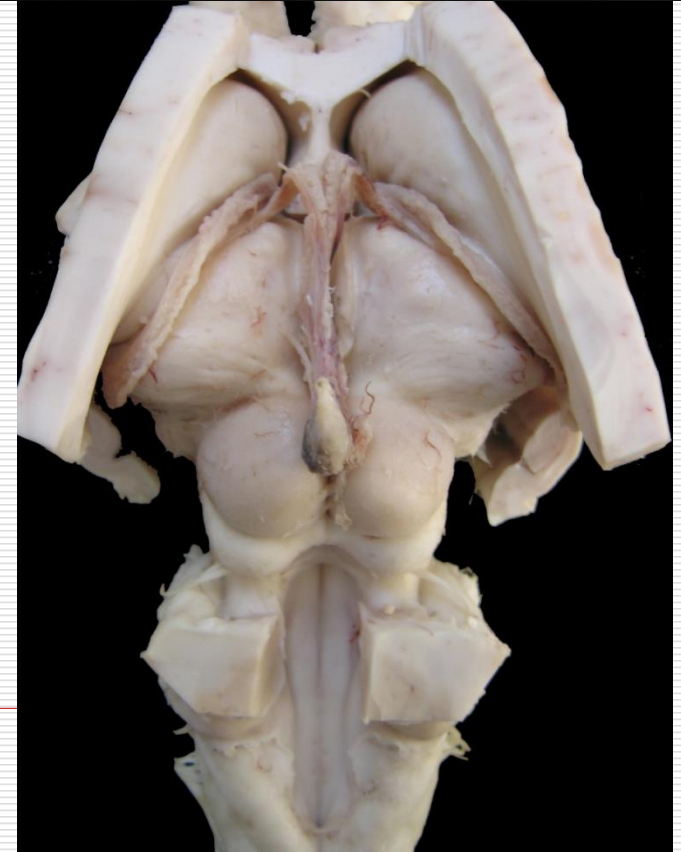
□ Metathalamus

Corpus geniculatum laterale-mediale

□ Epithalamus

Epiphysis cerebri

□ Ventriculus tertius



MESENCEPHALON

- ❑ Crura cerebri
- ❑ Tegmentum mesencephali
- ❑ Tectum mesencephali
- ❑ Aqueductus mesencephali



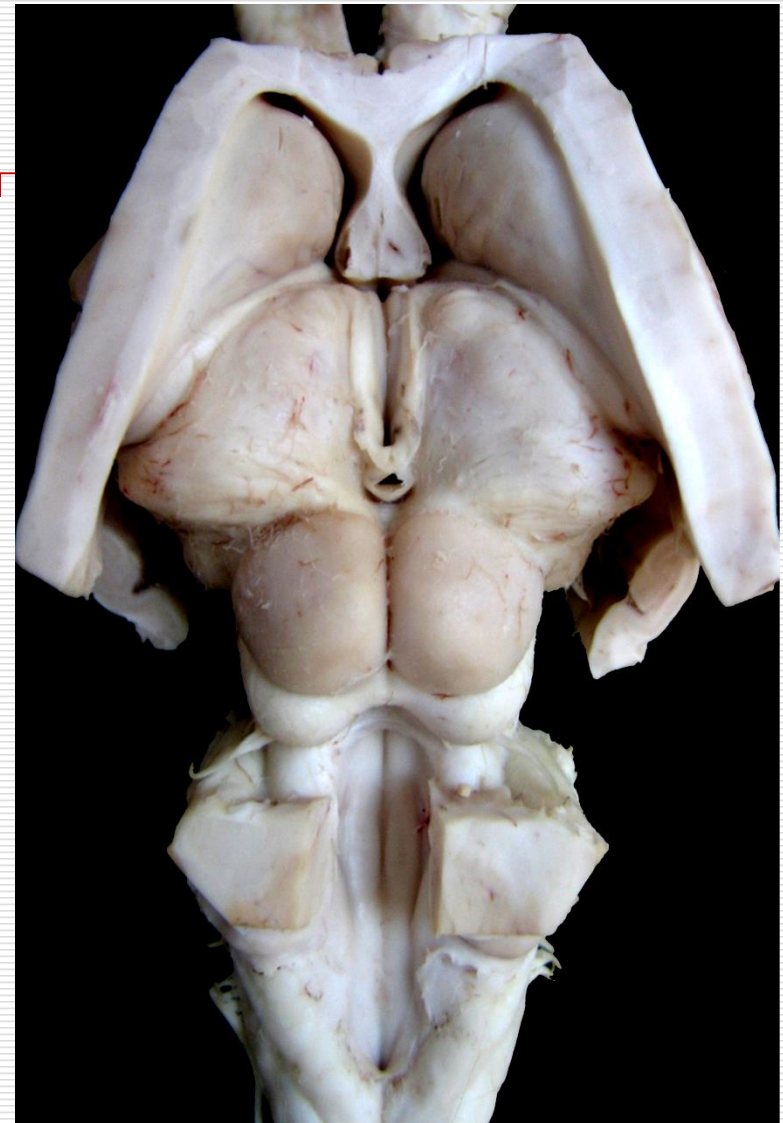
Crura cerebri

- ❑ fossa intercruialis
- ❑ 3rd cranial nerve



Tectum mesencephali

- ❑ Colliculi rostrales et caudales
- ❑ Sulcus medianus laminae tecti
- ❑ Sulcus transversus laminae tecti
- ❑ 4th cranial nerve



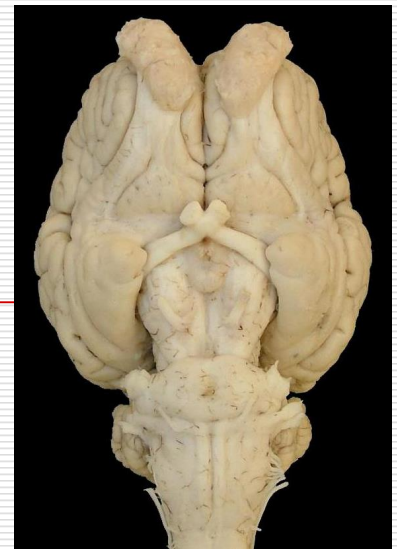
RHOMBENCEPHALON

- ❑ Pons
- ❑ Cerebellum
- ❑ Medulla oblongata
- ❑ Ventriculus quartus



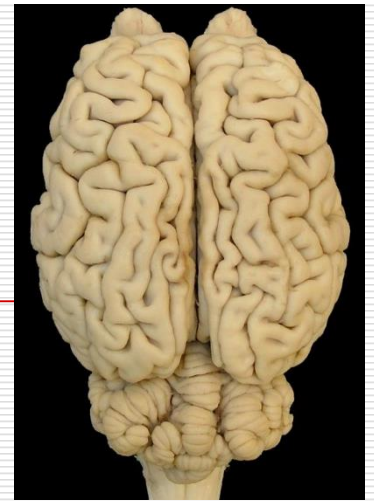
Pons

- ❑ Sulcus pontobulbaris
- ❑ Sulcus pontocruralis
- ❑ Sulcus basilaris
- ❑ 5th cranial nerve



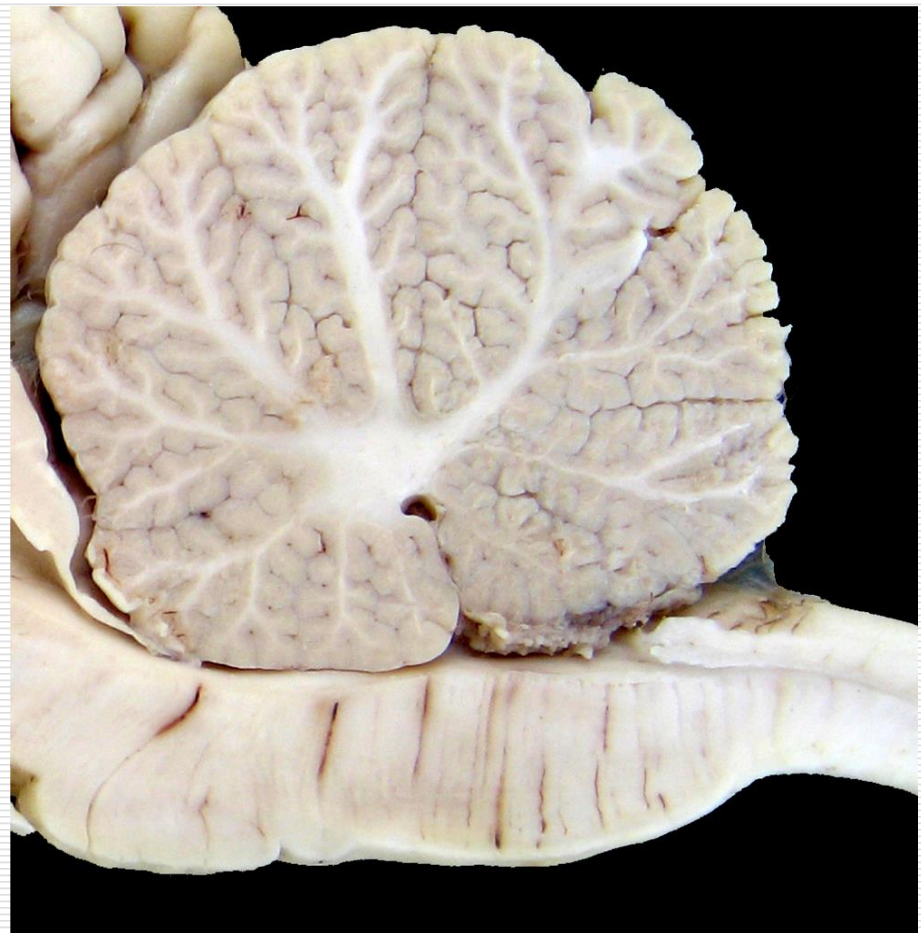
Cerebellum

- ❑ Vermis
- ❑ Lobi laterales cerebelli
- ❑ Sulci cerebelli
- ❑ Folia cerebelli



Cerebellum

- ❑ Vallecula cerebelli
- ❑ Fissura prima
- ❑ Lobus rostralis et caudalis
- ❑ Corpus medullare
- ❑ Laminae albae
- ❑ ***Arbor vitae cerebelli
- ❑ Velum medullare rostrale
- ❑ Velum medullare caudale
- ❑ Crus laterale cerebelli
- ❑ Crus rostrale cerebelli
- ❑ Crus caudale cerebelli



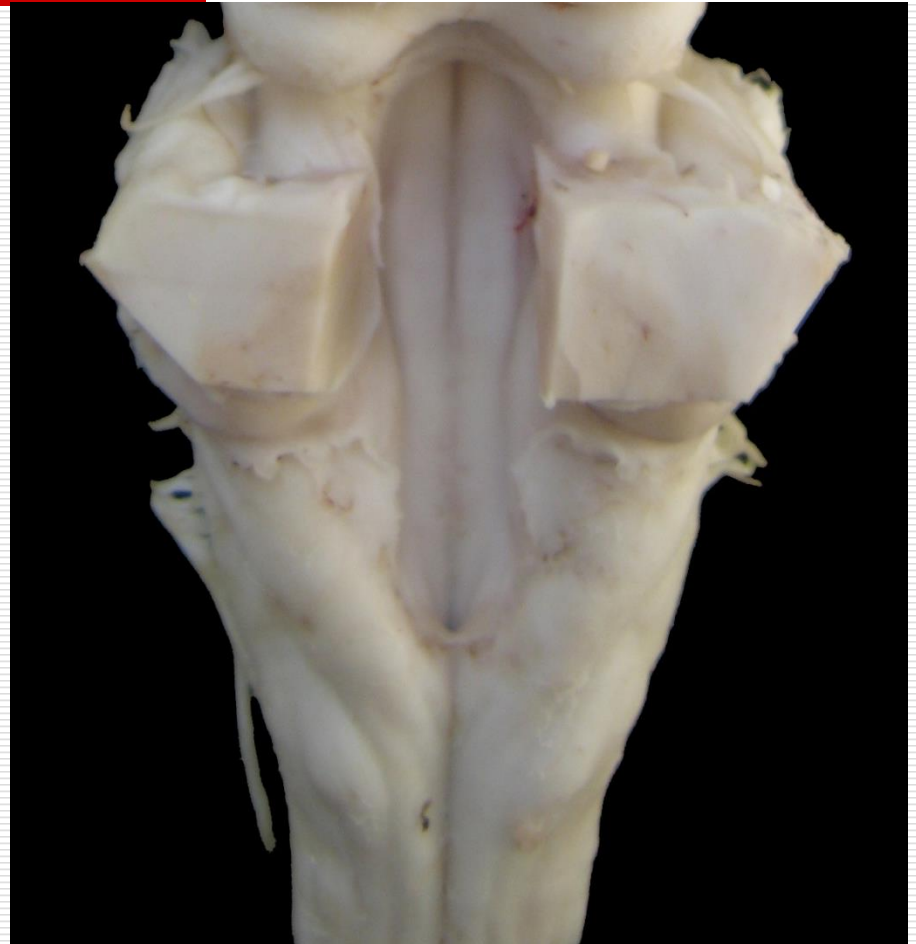
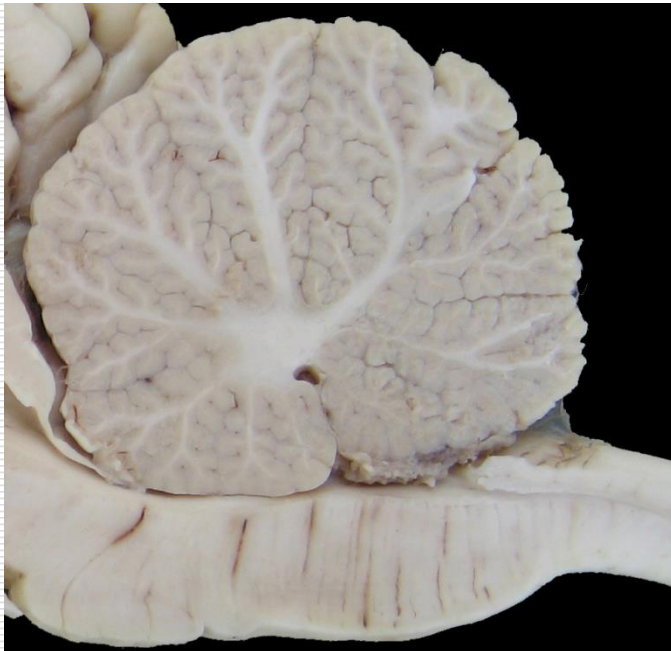
Medulla oblongata

- ❑ Sulcus pontobulbaris
- ❑ Corpus trapezoideum
7th and 8th cranial nerves
- ❑ Pyramis medullae oblongatae
- ❑ Fissura mediana ventralis
- ❑ Sulcus lateralis ventralis
- ❑ Decussatio pyramidium



Medulla oblongata

- ❑ Fossa rhomboidea
- ❑ Sulcus medianus dorsalis
- ❑ Ventriculus quartus



Ventriculus quartus

- ❑ **Aqueductus mesencephali**
- ❑ **Canalis centralis**
- ❑ **Apertura lateralis ventriculi quarti**
(Foramina Luscka)
- ❑ **Apertura mediana ventriculi quarti**
(Foramen Magendii) (in dog)



MEDULLA SPINALIS (Spinal cord)

- **Spinal cord is a part of CNS. This tubular bundle tissue is located in vertebral canal, enveloped by vertebral column and covered by 3 meningeal layers.**

SPINAL CORD

- The cord begins from the for.magnum of occipital bone, extends backward almost to the level of the hips and terminates with a **conus medullaris** on the lumbal region.
- The length of the cord is shorter than the length of the veretebral column. The width and ovality is also vary in sections.
- *****Intumescentia cervicalis**
Cervical enlargement
- *****Intumescentia lumbalis**
Lumbal enlargement

Segmentation of Spinal Cord

- The cord can be divided into 5 regions and numbers of segments which are equal to the vertebral bony structure.

Species	Cervical	Thoracic	Lumbar	Sacral	Caudal	Total
Dog	8	13	7	3	5	36
Cat	8	13	7	3	5	36
Cow	8	13	6	5	5	37
Horse	8	18	6	5	5	42
Pig	8	15/14	6/7	4	5	38
Human	8	12	5	5	1	31

Segmentation of Spinal Cord

- At each spinal segment, right and left pairs of spinal nerves that one on each side of the spinal cord pass through related intervertebral foramen.

Ascensus medulla spinalis

- In the fetus, vertebral segments correspond with spinal cord segments. However, because the vertebral column grows longer than the spinal cord, spinal cord segments do not correspond to vertebral segments in the adult, particularly in the lower spinal cord. For example, lumbar and sacral spinal cord segments are found between vertebral levels T9 and L2, and the spinal cord ends around the L5/L6 vertebral level, forming a structure known as the conus medullaris.
- Cauda equina – Tail of Horse

Ascensus medulla spinalis

- **Cauda equina**
 - **conus medullaris**
 - **filum terminale**
 - **roots of sacral spinal nerves**

Section of the Spinal Cord

- Substantia grisea – grey matter**
Inner «H» zone
- Substantia alba – white matter**
Location of tracts
- Canalis centralis**

Fissura mediana ventralis

Sulcus medianus dorsalis

Sulcus lateralis ventralis

Sulcus lateralis dorsalis

Cornu dorsale

Cornu ventrale

Cornu laterale

Funiculus dorsalis

Funiculus lateralis

Funiculus ventralis

- Fissura mediana ventralis
- Sulcus medianus dorsalis
- Sulcus lateralis ventralis
- Sulcus lateralis dorsalis

- Cornu dorsale
- Cornu laterale
- Cornu ventrale
- Funiculus dorsalis
- Funiculus lateralis
- Funiculus ventralis

Function of the Spinal Cord

- **Transmission of neural signals between the brain and the rest of the body**
 - **Afferent Pathways (Ascending tracts) : Touch, pressure, temperature, pain**
 - **Efferent Pathways (Descending tracts) : Pyramidal, extrapyramidal, autonomic pathways**
- **It also makes a neural circuits that can control numerous reflexes independently from brain as a central pattern generators.**
 - **Reflex arch**

Afferent pathways;

Efferent pathways;