

Comparative Account of Nervous System of Vertebrates

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- Main system of body, co-ordinate the other system of body.
- From lower chordates to higher chordates show the complexity.
- Structure built on same architectural plane, in accordance with the habit and behavior of animals.

Definition-

the system which to perceive stimuli detected by the receptors to transmit these to various body parts, and to effect response to through effectors is called the nervous system.

Function:-

1. Response to stimuli
2. Co-ordination
3. Learning.

Types of Nervous System

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graph TD; A[Types of Nervous System] --> B[Central]; A --> C[Peripheral]; A --> D[Autonomic]; B --- E[Consist of brain and spinal cord  
Coordinate that impulses receives from receptor and transmit to effectors]; C --- F[10 or 12 cranial and spinal nerves.  
Provides connection between the receptor, CNS and effectors.]; D --- G[Innervates smooth, cardiac muscles and glands.  
Concerted with involuntary and automatic body activity.];
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Central

Consist of brain and spinal cord

Coordinate that impulses receives from receptor and transmit to effectors

Peripheral

10 or 12 cranial and spinal nerves.

Provides connection between the receptor, CNS and effectors.

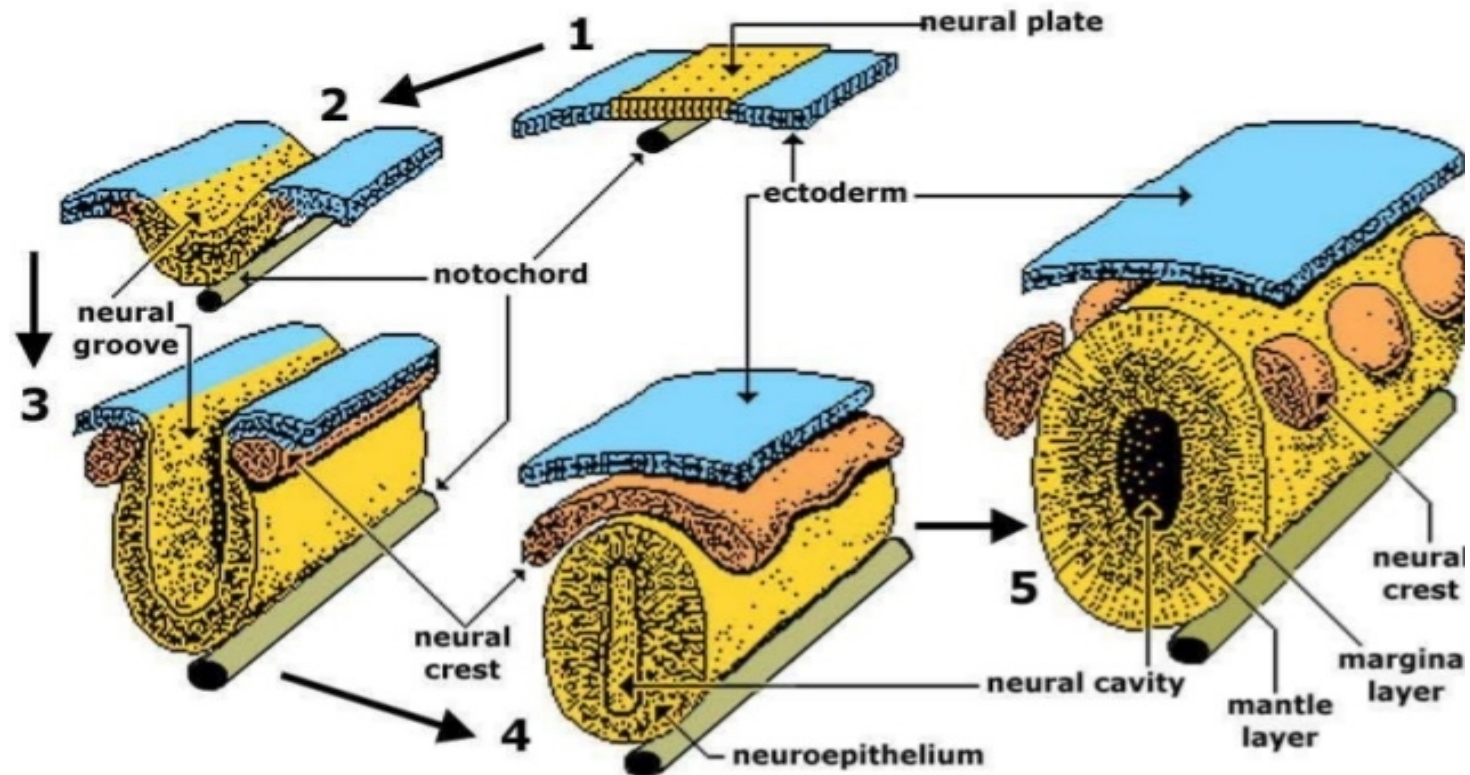
Autonomic

Innervates smooth, cardiac muscles and glands.

Concerted with involuntary and automatic body activity.

Development of Central Nervous System

Development of the Nervous System and Special Senses



Histological Layers of Embryonic Neural Tubes

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graph TD; A[Histological Layers of Embryonic Neural Tubes] --> B[Germinal]; A --> C[Mantal]; A --> D[Marginal];
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Germinal

- Consist actively deviding cells
- Forms from connective tissue layer of neural tube.
- Also called ependyma
- Also proliferate in to mantal

Mantal

Consist of embryonic neurons or neuroblasts forming gray matter.

Marginal

- Consist of nerves fibers surrounded by fatty myelin sheath
- Forms white matter.
- Neurons and fibrers supported by neuroglia.

General Structure of Brain

- Structure built as same plane of all vertebrates.
- Brain lies- within cranial cavity of skull, soft, white and somewhat flattened.

Ventricles-

Brain is hollow from within, cavities of its various parts is called as ventricles.

Cerebrospinal fluid-

Ventricles filled with a lymph like fluid is called as cerebrospinal fluid.

It is secreted by anterior and posterior choroid plexus.

Meninges- Brain Covering of Three Memberans

Piamater

Inner membrane

Thin, soft,
vascular

Closely applied
surface of brain

Arachnoid

Middle layer

Delicate and
highly vascular

Space

Subdural cavity

Duramater

Outer membrane

Very tough

Lies inner wall of
cranium

Space

Subarchnoid Cavity

Histology of brain

Cortex

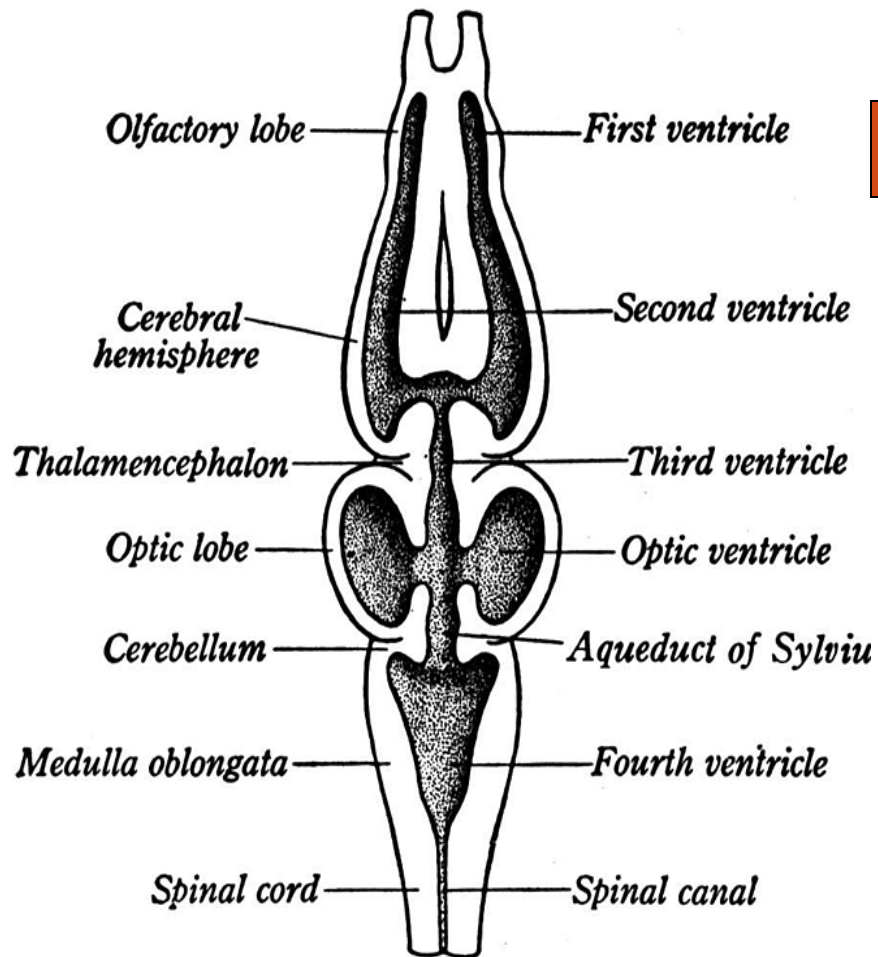
Outer part of brain and made by grey
mater

Consist nerve cells, nerve fibers,
neuroglia and blood vessels

Medulla

The inner part of brain and made by white
mater

Consist of only nerve fibers and glial cells.



rhinocoel

paracoel

iter

metacoel

FIG. 410. *Ventricles of Brain of Frog*

Parts of brains

- 1.forebrain
- 2.midbrain
- 3.hindbrain

Prosencephalon(forebrain)

Olfactory lobe

Anteriormost, paired, small cup shaped, separate each other.

Continuous beneath the frontal lobe of cerebrum as paired olfactory lobes connect hippocampal lobe.

Cavity- first ventricular-rhinocoel

Function- sense of smell.

Cerebral hemisphere

Paired separated by longitudinal median fissure.

Narrow in front and broad in behind and smooth.

Form 2/3 of brain and overlap to diencephalon.

Lateral Sylvian fissure divides frontal and temporal lobe

Ventrally longitudinal fissure divides from olfactory lobes shows hippocampal lobe.

Two hemispheres internally connect by band of nerve tissue called corpus callosum

Ventricular- second-paracoel and two paracoel connect form foramen of Monro.

Function- thought, memory, intelligence, reasoning

Diencephalon

along with the telencephalon (cerebrum)

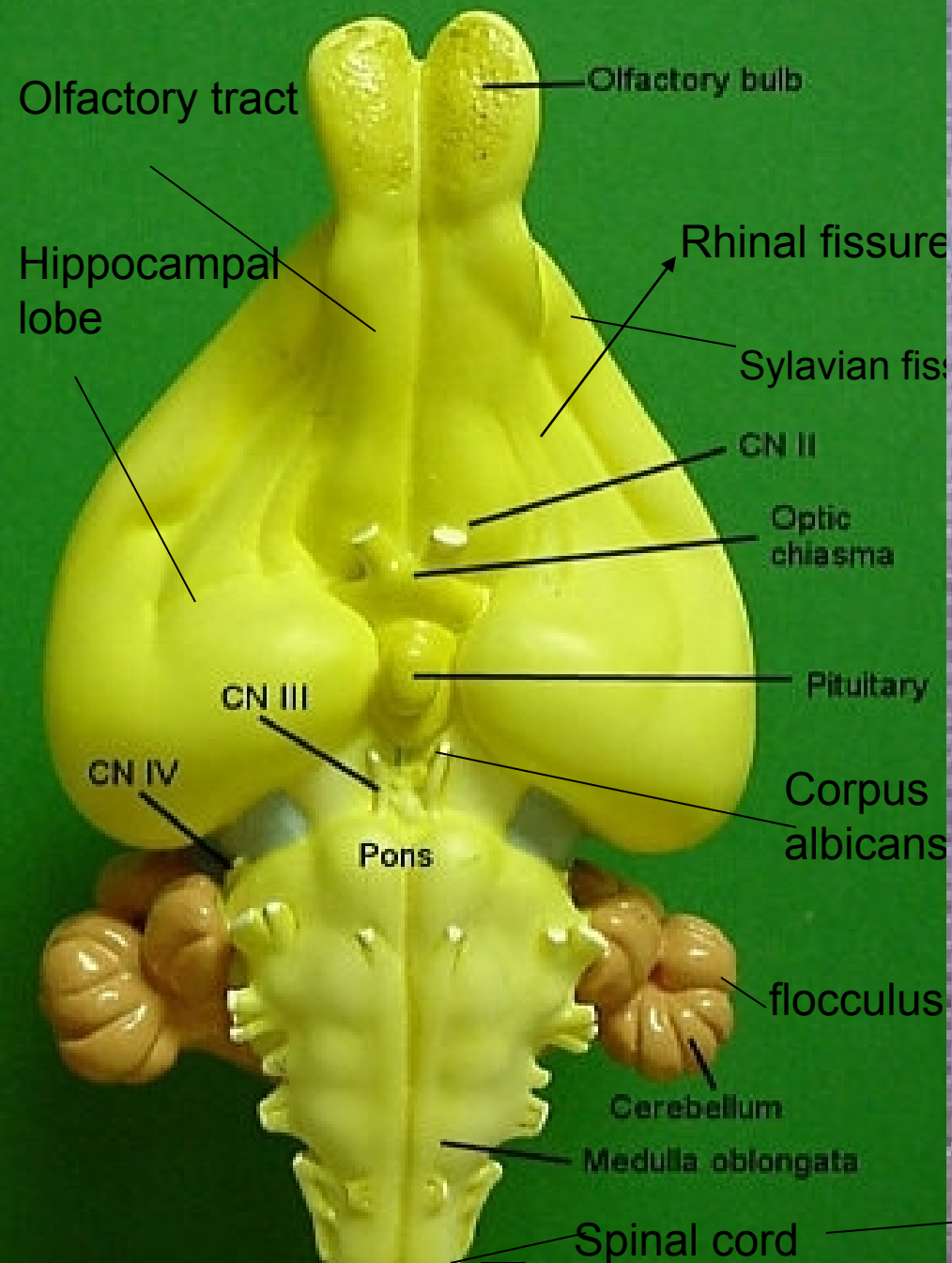
Main structures of the diencephalon include the hypothalamus, thalamus, epithalamus (including the pineal gland), and subthalamus.

The diencephalon relays sensory information between brain regions and controls many autonomic functions of the peripheral nervous system.

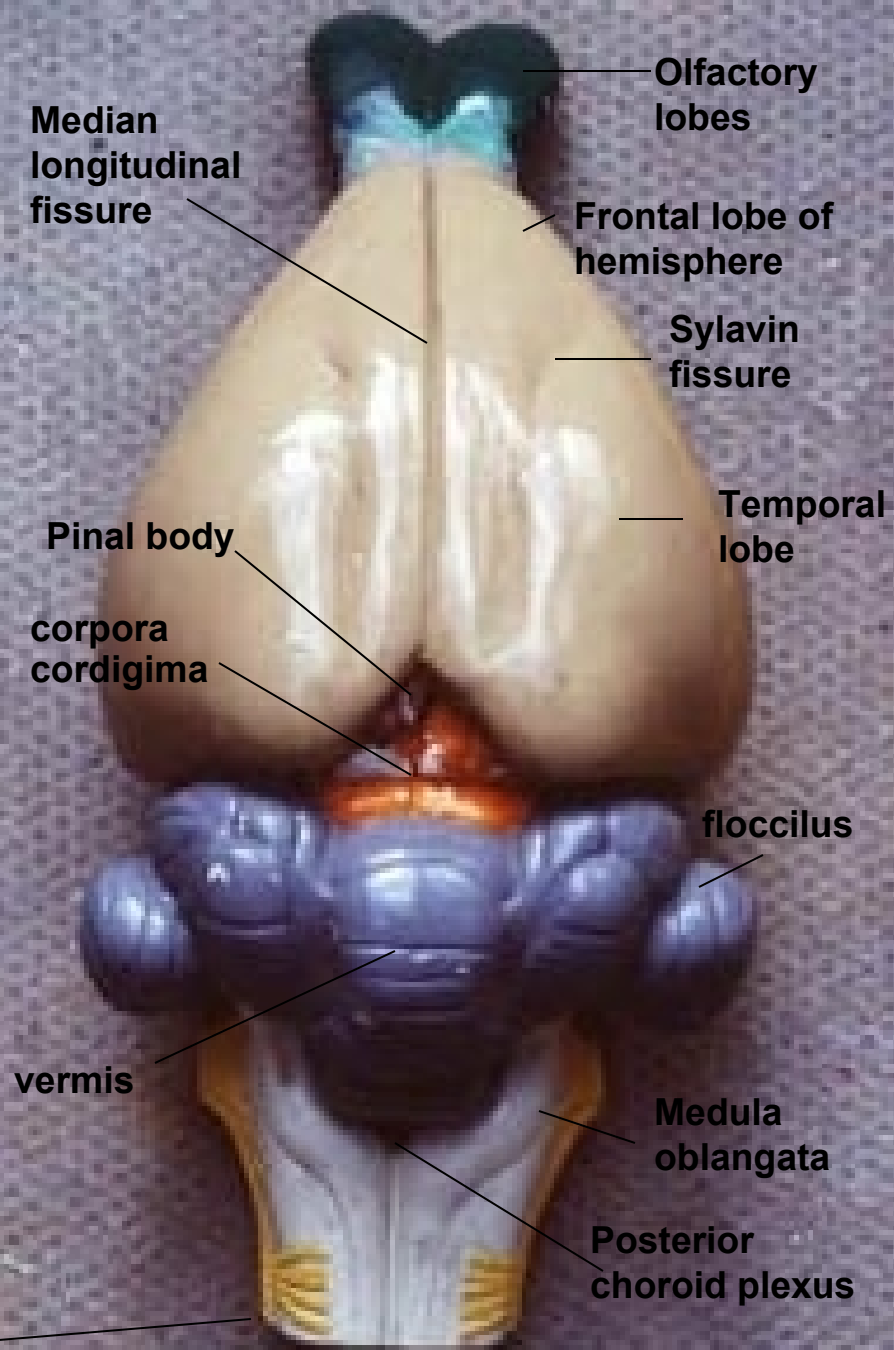
Function-

Directing Sense Impulses
Autonomic Function Control
Endocrine Function Control
Motor Function Control
Homeostasis
Touch Perception

Rabbit Brain Ventral View



Dorsal view



Mesencephalon or midbrain

- Small middle part of brain, lies below the cerebral hemisphere.
- Dorsal surface has 4 rounded optic lobes called corpora quadrigemina.
- The anterior two lobes called as superior colliculi and concerned with the sight.
- The posterior two lobes are smaller called inferior colliculi and associated with acute hearing.
- Cavity- narrow longitudinal passage-iter
- Its floor is thick fibres called crura cerebri, which link forebrain and hindbrain.
- **Function-** sight and acute hearing.

Hindbrain or Rhombencephalon

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graph TD; A[Hindbrain or Rhombencephalon] --> B[Cerebellum]; A --> C[Pons Varolii]; A --> D[Medula Oblongata]
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Cerebellum

Very well developed and transverse elongated.

Consist large median lobe called vermis and lateral lobe called as flocculus.

No cavity surface is much folded to increase the grey matter.

Surface folding forms elevation-gyri and grooves-sulci.

Function- equilibrium and co-ordination of voluntary muscles.

Pons Varolii

Ventral surface of hindbrain has stout transverse bands of fibers

Its connect right and left halves of the cerebellum named pons varolli.

Medula Oblongata

Last part of brain

Broad triangular anterior but taper in posterior

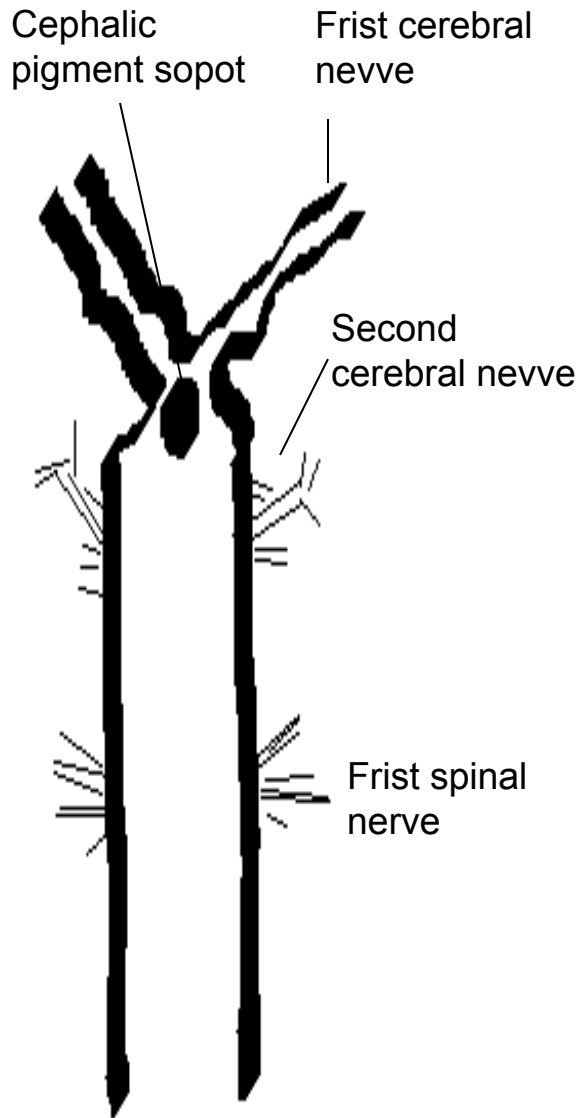
Continuous to spinal cord.

Cavity- fourth-metacoel

The roof of metacoel is non-nervous and vascular called the posterior choroid plexus.

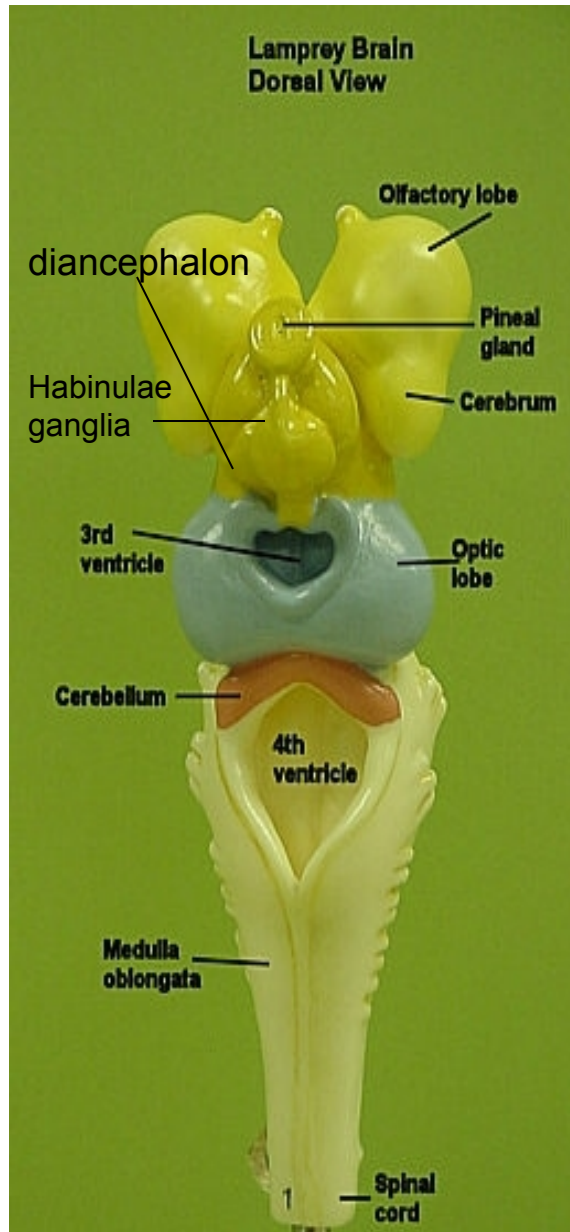
Function- control the involuntary actions.

1. Cephalochordata



- without divide, like forebrain, midbrain and hind brain
 - only consist of hollow dorsal nerve tube just above notochord.
 - no ganglia
- Anterior end slightly enlarge called brain and posterior end is spinal cord along the body.
- neural tube has hollow central tube neurocoel filled with the CSF.
 - Cerebral vesicles or brain consist of receptor organ pigment spot.

2. Cyclostoma Ex. Lampry



-brain is very primitive, subdivision is not well marked, two olfactory lobes are prominent, cerebral hemisphere quite small.

Pineal apparatus and parapineal body is well developed but absent in myxins.

-Connected to pineal apparatus is epithalamus made by two habenulae ganglia.

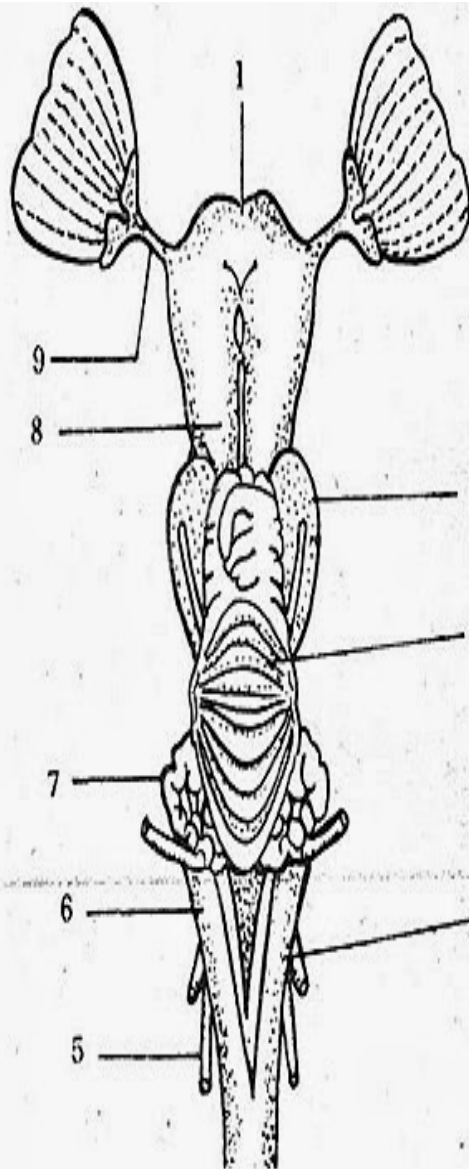
-Optic lobes are imperfectly developed

-Medulla oblongata well developed but cerebellum is small transverse band.

-Well defined infundibulum from hypothalamus of diencephalon bears a pituitary body.

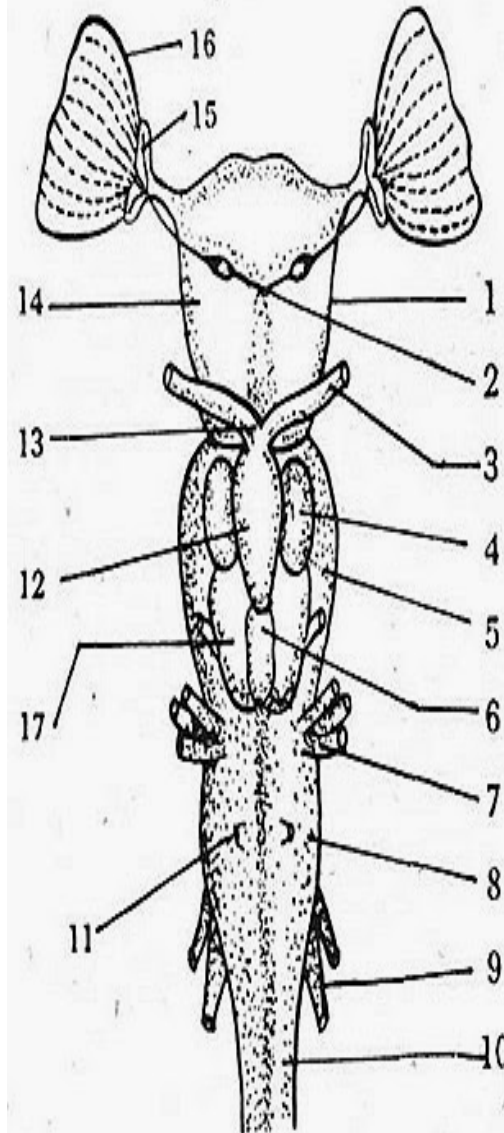
3.Pises

a. Elesmobranch Fish Ex. Scoliodon



- 1) CEREBRUM
- 2) OPTIC LOBE
- 3) CEREBELLUM
- 4) & 6) MEDULLA OBLONGATA
- 5) VAGUS NERVE
- 7) CORPORA RESTIFORMIA
- 8) CEREBRUM
- 9) OLFACTORY PEDUNCLE
- 10) OLFACTORY LOBE
- 11) OLFACTORY SAC

SCOLIODON BRAIN (DORSAL VIEW)



- 1) CEREBRUM
- 2) NEUROPORE
- 3) OPTIC NERVE
- 4) INFERIOR LOBE
- 5) CRURA CEREBRI
- 6) HYPOPHYSIS
- 7) AUDITORY NERVE
- 8) MEDULLA OBLONGATA
- 9) VAGUS NERVE
- 10) SPINAL CORD
- 11) ABDUSCENS NERVE
- 12) INFUNDIBULUM
- 13) OPTIC CHIASMS
- 14) TERMINAL NERVES GANGLION
- 15) OLFACTORY LOBE
- 16) OLFACTORY SAC
- 17) SACCUS VASCULOSUS

SCOLIODON (SHARK) BRAIN (VENTRAL VIEW)

- Brain of fishes are more advanced than that of cyclostomes, shows subdivision.
- In elasmobranches fishes the olfactory organs enlarged attached to cerebrum by short olfactory tract or peduncle.
- Optic lobes are relatively mordate in size.
- Midbrain cavity quite large and extend in to optic lobes. in pituitary attach small sensory organ called as saccus vasculosus.
- Pinal body well developed.
- Cerebellum is well developed because of the active swimming habitat.
- To assist cerebellum in the maintaince of equilibrium.
- Ruffle like restiform bodies are present at antero-lateral angle of medulla.

- Bony fishes brain is more specialized than elasmobranchs fishes.
- In perch, olfactory lobes, cerebral hemisphere and diencephalon is smaller while optic lobes and cerebellum are larger.
- Some bony fishes contain restiform bodies.
- In bottom feeders anterior-lateral side of medulla oblongata shows unusual bulging called vagal lobes.
- parapineal bodies are absent.

3. Amphibia Ex Frog

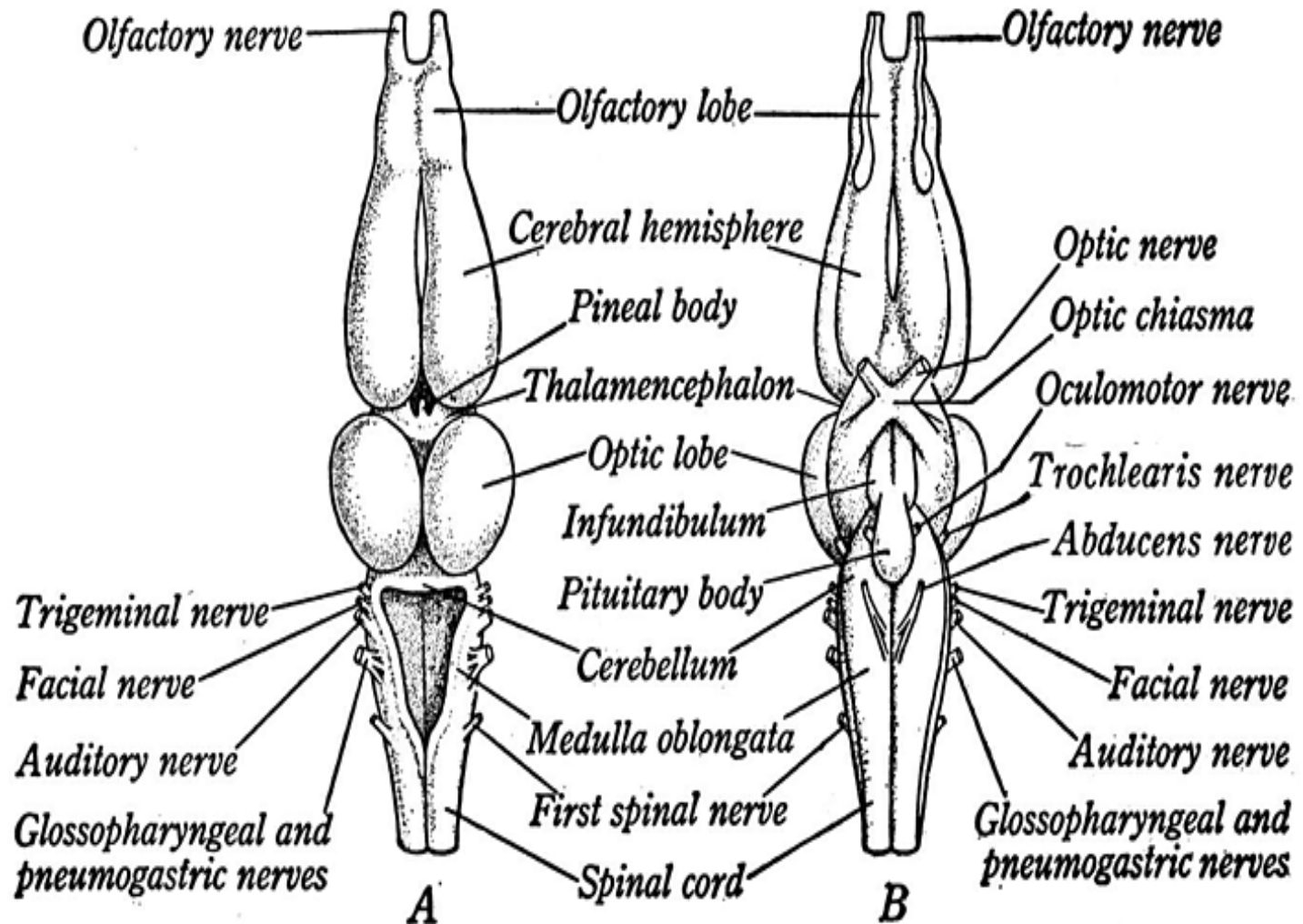


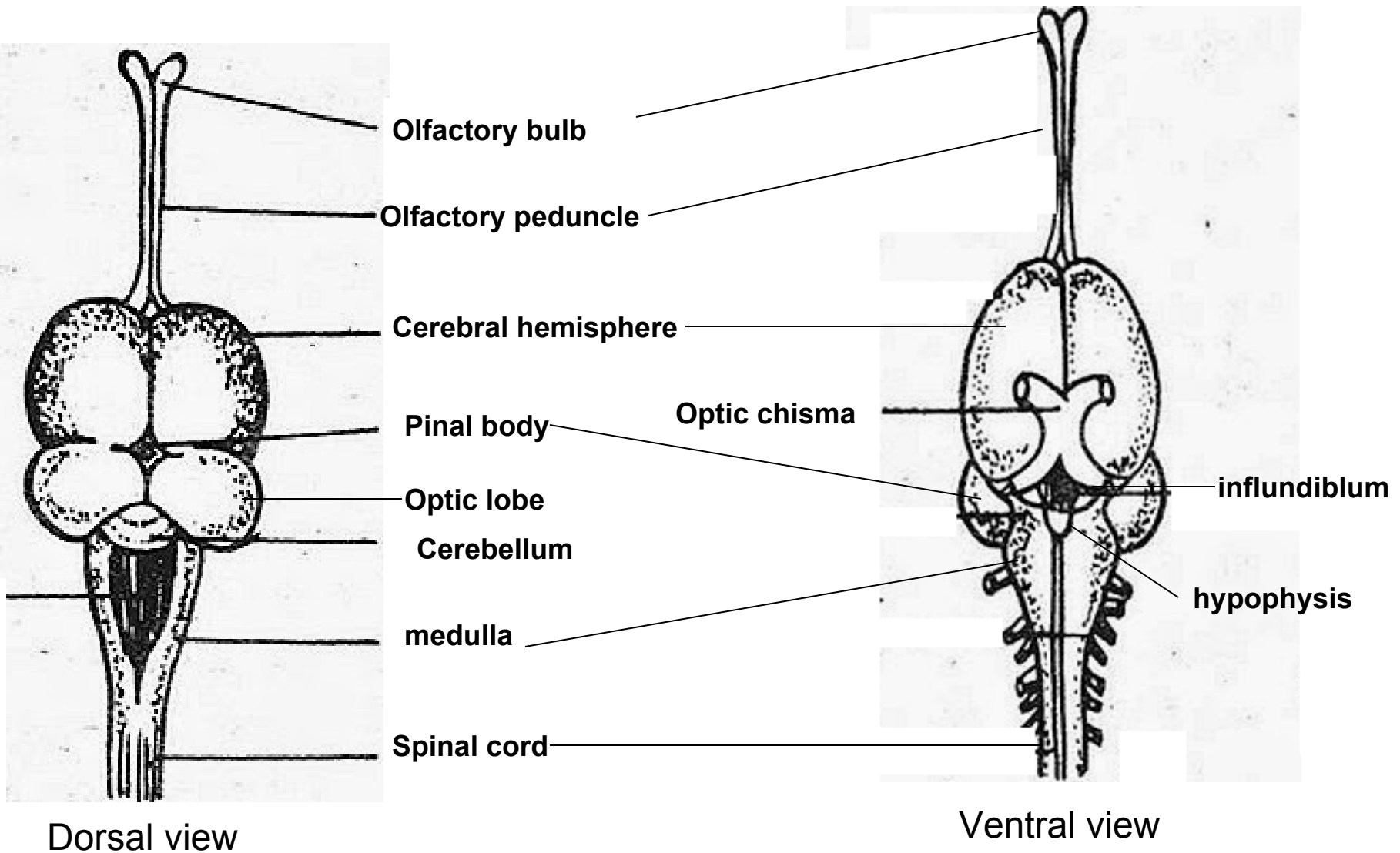
FIG. 409. Brain of Frog
A, dorsal view; B, ventral view

- Smaller olfactory lobes and greater optic lobes indicate that greater reliance is on sight rather than smell.
- Corpus striatum (floor of cerebrum) receives greater number of sensory fibers projected forward from thalamus than in fishes.
- Cerebral hemispheres are more developed for complex activity of locomotion, hibernation, breeding, etc.
- Optic lobes are dominant in center.
- Poorly developed cerebellum, and more transverse bands show relative decrease in muscular activity.
- Medulla is small
- Pineal body present.

Reptilians Ex-lizzard

- Shows advancement in size and porportion than that of amphibia because of the complete terrestrial mode of life.
- Telencephalon increase the size and become largest part of brain.
- Olfactory lobes connected to hemisphere and longer than amphibia.
- There is greater thickness and enlargement in corpora striata.
- Parapinal body more often callled the parietal eye is still found in some lizzard and sphenodon but is vestigeal or absent in other reptiles.
- A pair of auditory lobes present in posterior to optic lobes.
- Third ventrical is reduced.
- Cerebellum is somewhat pear shaped and larger than amphibia.

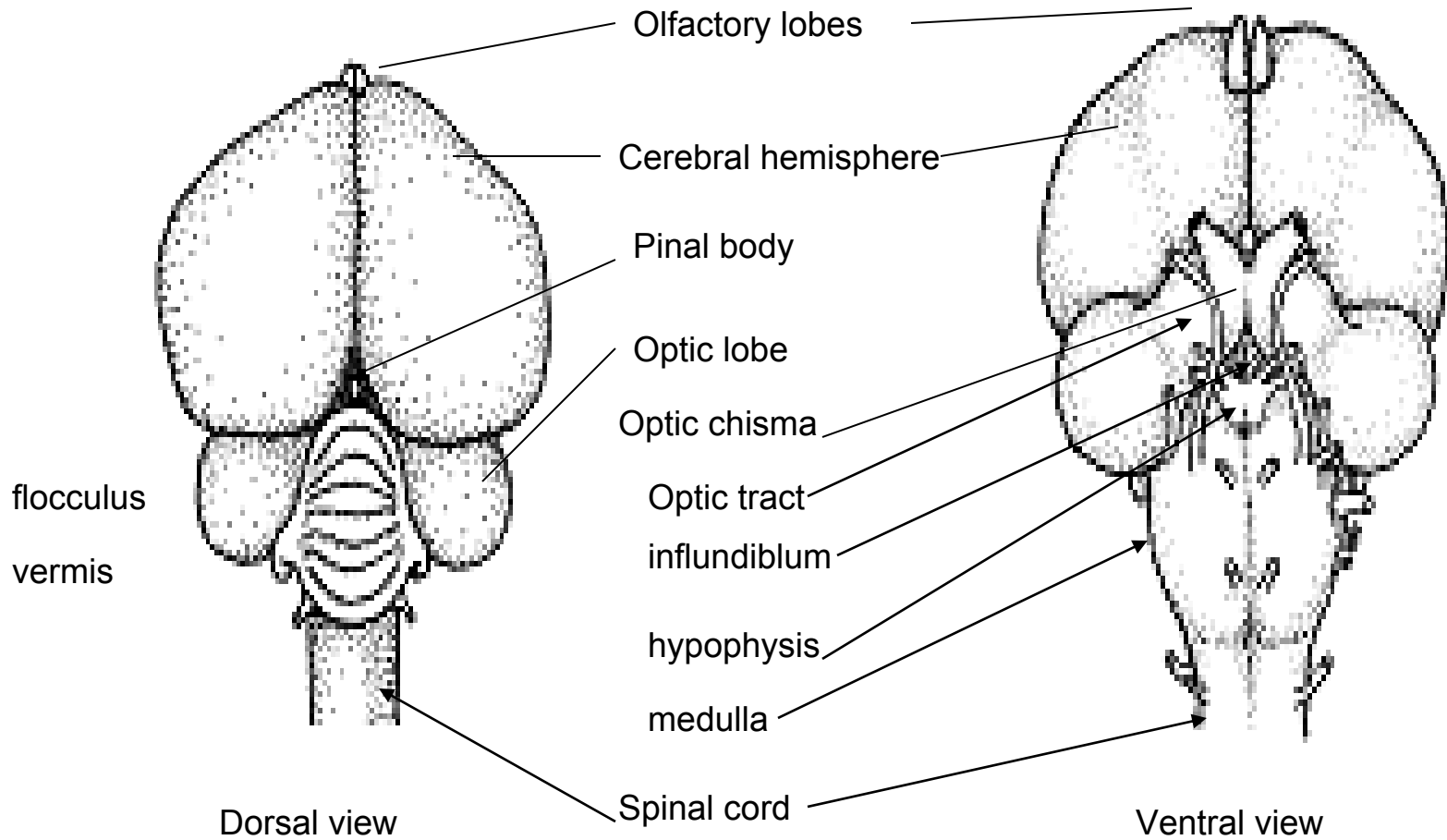
Lizard Brain



Birds Ex. Pigeon

- Avian brain is larger than that of reptilians.
- Olfactory lobes are smaller to poor sense of smell.
- Hemisphere are larger smooth and project posterior over the diencephalon to meet cerebellum.
- Third ventricle is narrow due to development of thalami.
- Optic lobes are well developed in co-relation with keen sight but they are somewhat laterally displaced.
- Cerebellum is greatly enlarged with several superficial folding, due to many activities involving muscular co-ordination and equilibrium such as flight and perching.

Pigeon Brain



- Questions-

1. Give an account of comparative structure of nervous system of vertebrates.
2. Write the functions of different parts of brain.
- 3.