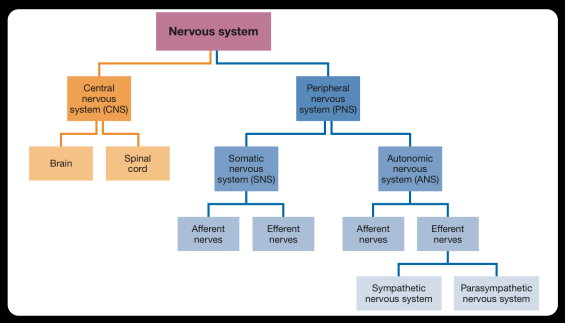
# human nervous system

## General layout of NERVOUS SYSTEM

- major divisions of nervous system:
  CNS = brain, spinal cord
  PNS = everything else.
- Has efferent and afferent nerves.
  ↳ paral sympathetic nerves.

parasymb. = at the sacral + brain
sympathetic = lumbar + thoracic

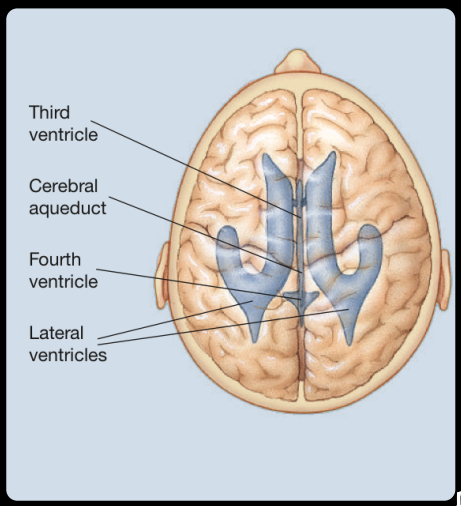
- afferent nerves: sensory, unipolar
  - dorsal horn: synapses at the DRG.
- efferent nerves: motor, multipolar.
  - ventral horn, synapse @ the gray matter ventral horn.




parasympathetic nerves: synapse near the target organ.
sympathetic nerve: synapse near the CNS.

**Meninges:** layers which surround the brain for cushioning and protection (also in spinal cord).

Outside → in: Dura, Arachnoid, subarachnoid, pia.




## CSF flow in the brain:

- CSF = cushions the brain during movement.
- flow: in the 3, 4, lateral ventricles, central canal of the brain.
- the pia mater has choroid plexus (blood vessels) protruding from it (into ventricles) ⟶ production of CSF.

Drainage: subarachnoid membrane into the dural sinuses, then into jugular vein.

## Blood Brain Barrier

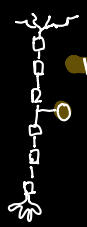
- found in the brain only; the cells of the blood brain barrier are very tightly so that there can't be harmful chemicals passing through
  ↳ large molecules that need to pass through need active transport in.
- blood brain barrier penetration level = how well the drugs can act on the brain.

## cells of the NERVOUS SYSTEM


- cell body:
  - nucleus
  - ribosome
  - microtubules
  - golgi
  - ER
  - mitochondria.
- buttons:
  - vesicle
  - MT
  - NT inside.

myelin = fatty substance, covering the axons.

interneuron



unipolar neuron
- one dendrite
- one button.

bipolar neuron
- cell body connected on both ends.

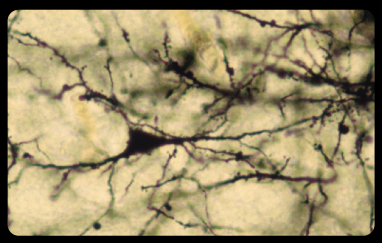
cell cluster in CNS | PNS:
nuclei
ganglia
cell axon in CNS/PNS
axon
nerves

## Glial Cells

- oligodendrocyte: wraps around neurons (multiple) w/ myelin sheath
- astrocytes: starshaped cell which is used to make up blood brain barrier, maintains it.
- microglia: smallest cell; regulates the inflammation in the brain, clears cellular debris
- schwann cells: in the PNS, myelinates the neurons and is involved in the regeneration of axons.

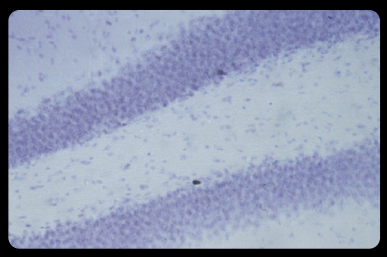
# neuroanatomical
## TECHNIQUES + DIRECTION

Golgi stain

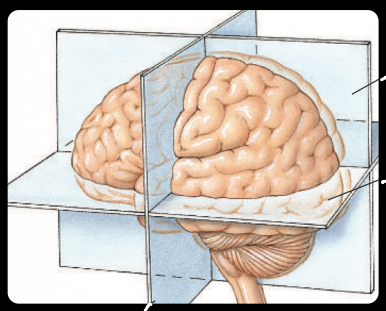


① Golgi stain: stains the neurons, but can only see silhouttes. (dark)
② Nissl stain: stains individual parts in the neuron and allows for the distribution of neurons to be seen. (purple)
③ SEM, TEM.

Nissl stain



- anterograde tracing: chemical in soma → axon.
- retrograde tracing: chemical in dendrites → soma.



sagittal plane

horizontal plane.

coronal plane

cut @ R angle to a slender structure (ie. spinal cord) = cross section.

# anatomy of the
## CENTRAL NERVOUS SYSTEM


5 main divisions of the brain:

Telecephalon → cortex, hippocampus.


Diencephalon → thalamus, hypothalamus
Mesencephalon → tectum / tegmentum
Metencephalon → pons, cerebellum
Myelencephalon → medulla, reticular formation.

## Telencephalon

- largest division: has the cortex + the hippocampus.
- cortex: has main lobes (4)
  - frontal → planning + executive fcn.
  - occipital
  - temporal → visual
  - parietal → language, attention.

landmarks: post/pre central gyri, superior temporal gyri.

- connecting tracts in the brain between hemispheres = commissures, largest = corpus callosum.
- most of the brain = neocortex, except hippocampus.
  - 6 functional layers.
  - pyramidal (apical dendrite), reaches through the layers.
  - stellate cells (small star shaped).
  - differ in terms of size depending on location (layer 4 = sensory, thickest in sensory cortices)
  - columnar organization: all of the cells within a column all do the same things.
- Hippocampus: spatial learning, memory.

## Mesencephalon

- midbrain: tectum and tegmentum.

interior and superior colliculi; inf = auditory, sup = visual — input

Periaqueductal gray, Red nucleus, Substantia nigra. — parts of sensorimotor system.

# Limbic System + BASAL GANGLIA

- limbic system = surrounds the hypothalamus:
  - cingulate cortex (in cingulate gyrus).
  - septum
  - fornix
  - amygdala

- Basal ganglia: voluntary responses.
  - putamen
  - caudate nucleus
  - striatum
  - globus pallidus

## Diencephalon

- thalamus and hypothalamus.
  - thalamus = 2 lobes joined by the mass intermedia.
  - thalamus contains the sensory relay nuclei, responsible for relaying information from the sense organ → 1° sensory cortex:
  - lateral, medial geniculate nuclei, ventral posterior nuclei.

visual — sensorimotor — hearing.

- Hypothalamus: regulatory region, regulates the pituitary gland.
  - optic chiasm inferior surface.
  - mamillary bodies, amygdala are all located around the hypothalamus.

## Metencephalon

- cerebellum and pons: centers for balance.
  - cerebellum = sensorimotor learning.
  - pons = bulge.

## Myelencephalon

- Meanlla, reticular formation.

tracts carrying info to the rest of the body. — complex network required for proper brain function.