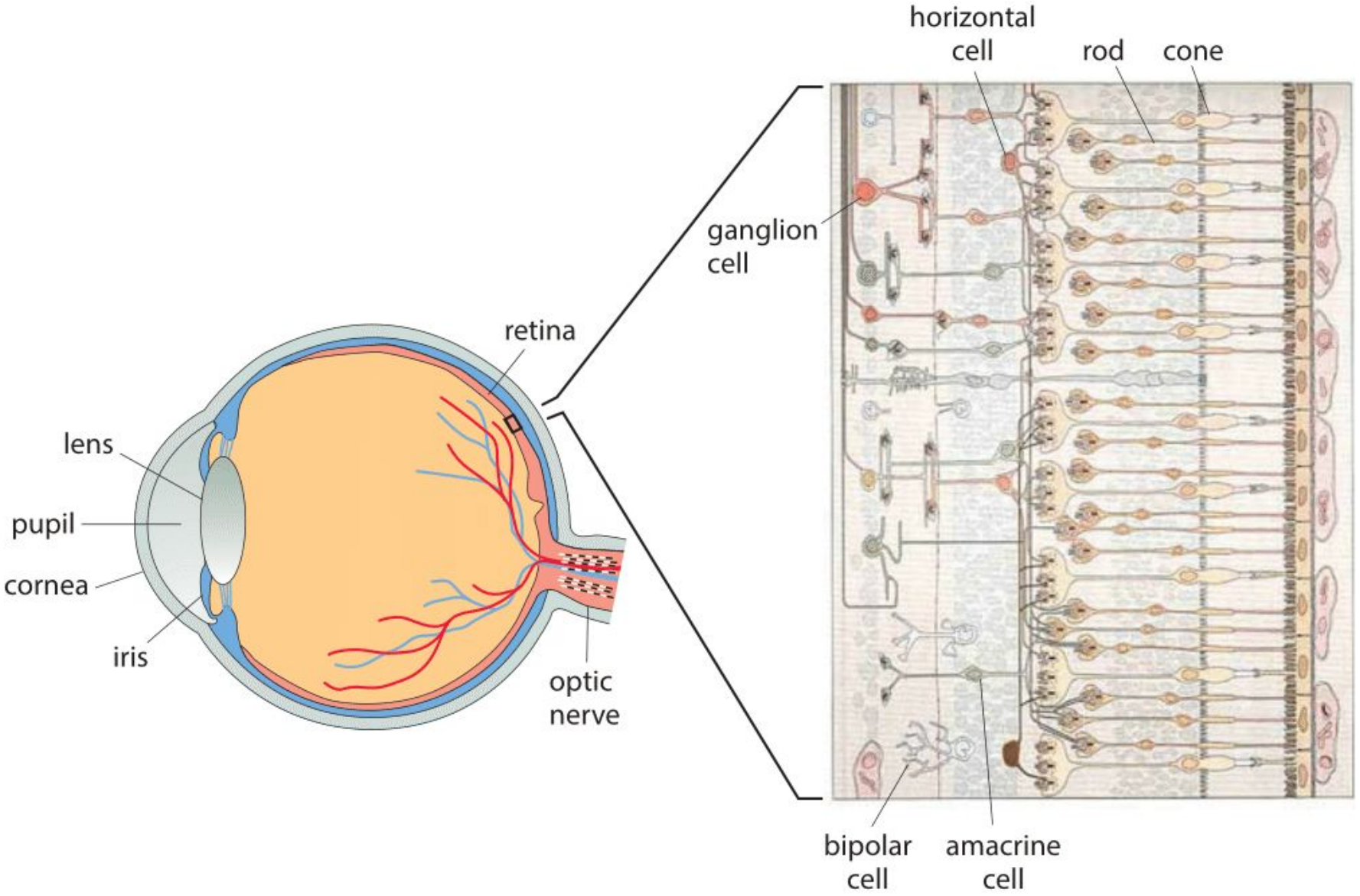
Vision & midterm review

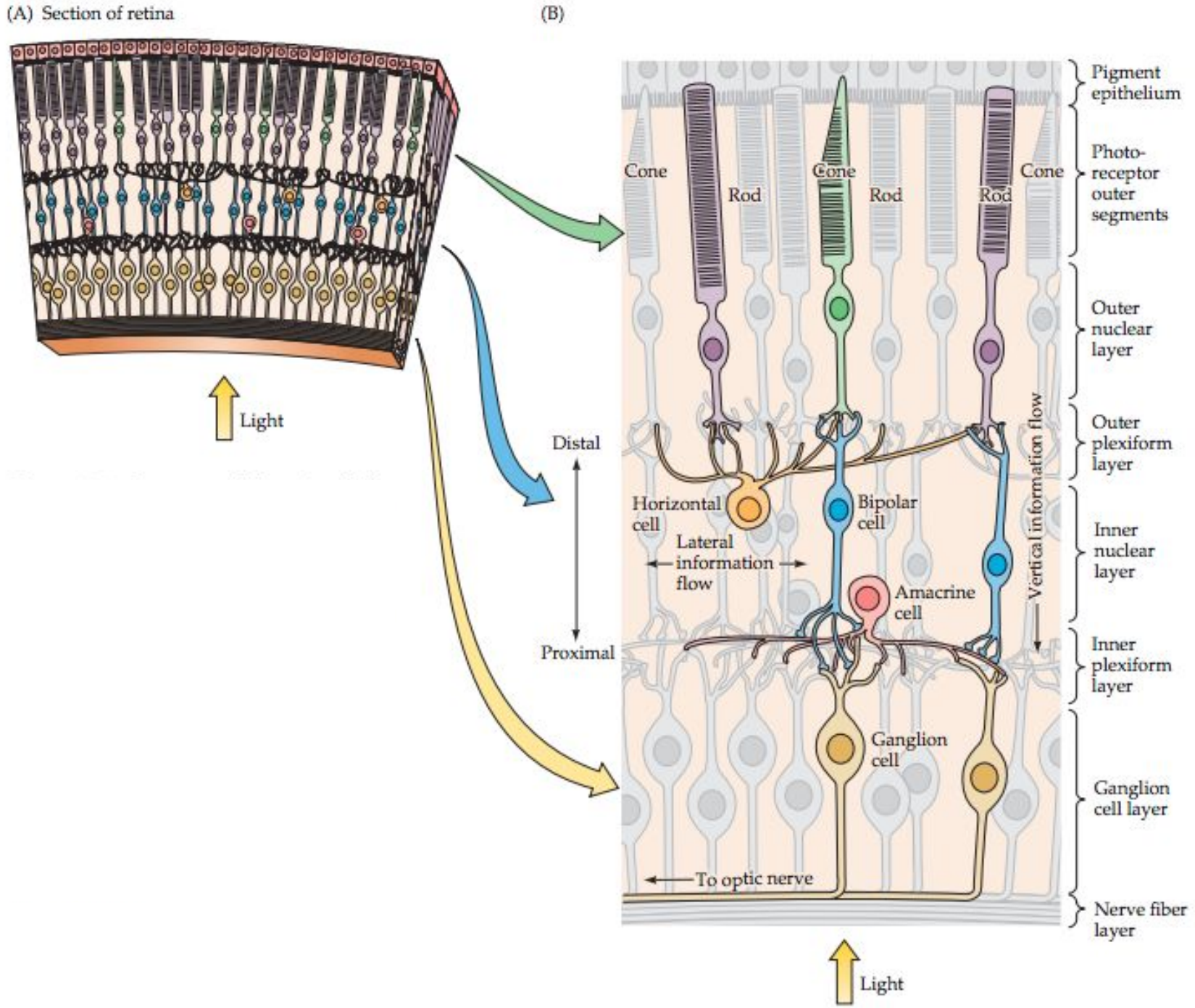
COGS17 - WEEK 3
7/15/19

Vision

the retina


horizontal cell
rod
cone
ganglion cell
retina
lens
pupil
cornea
iris
optic nerve
bipolar cell
amacrine cell

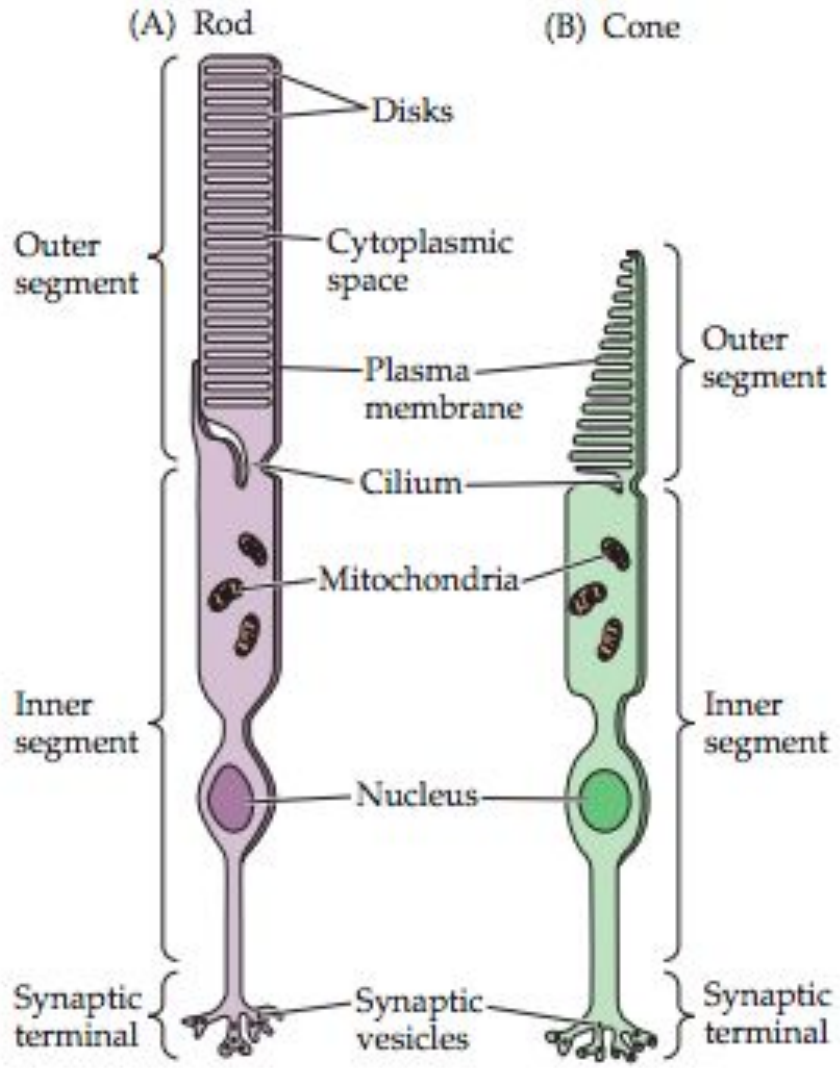
organization of the retina



rods & cones

Rods

- SCOTOPIC
- 1 kind of photopigment
- No colour
- Good for motion detection
- Poor acuity
- High sensitivity
  - (operate in **dim** light)
- Mainly Dorsal Path



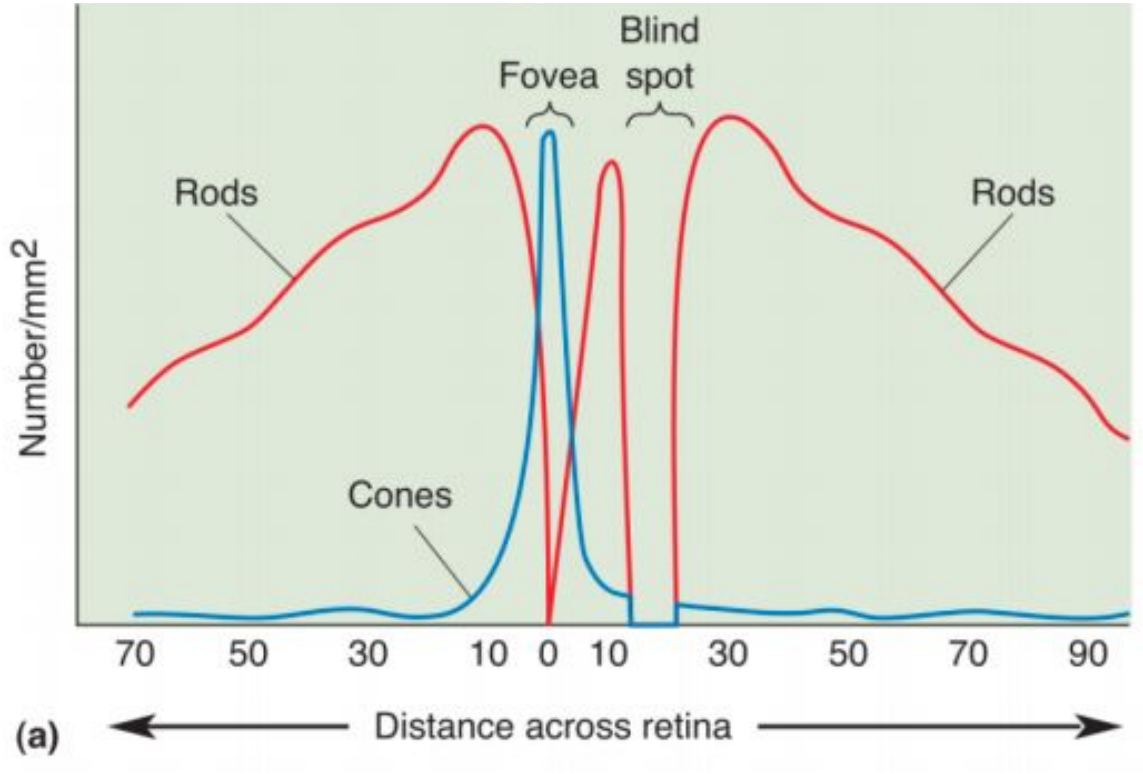
Cones

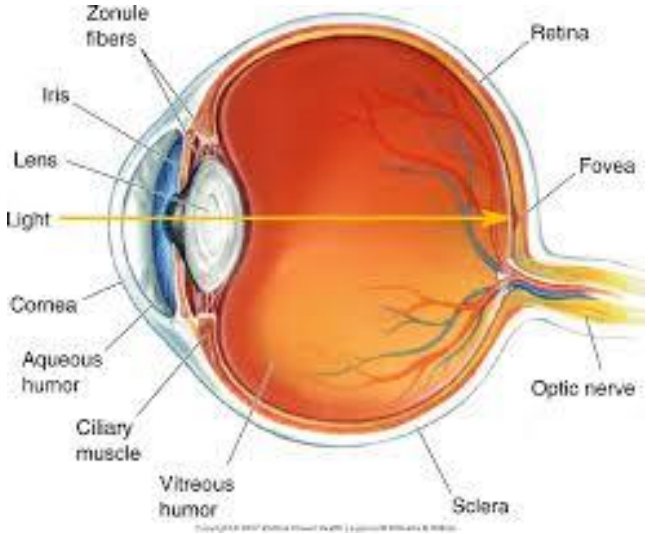
- PHOTOPIC
- COLOR
- 3 kinds of photopigment (1 type per cone, “blue, green, red” or “short, medium, long”)
- Poor for motion detection
- Excellent acuity
- Low sensitivity
- Mainly Ventral Path

density of rods vs cones in the retina

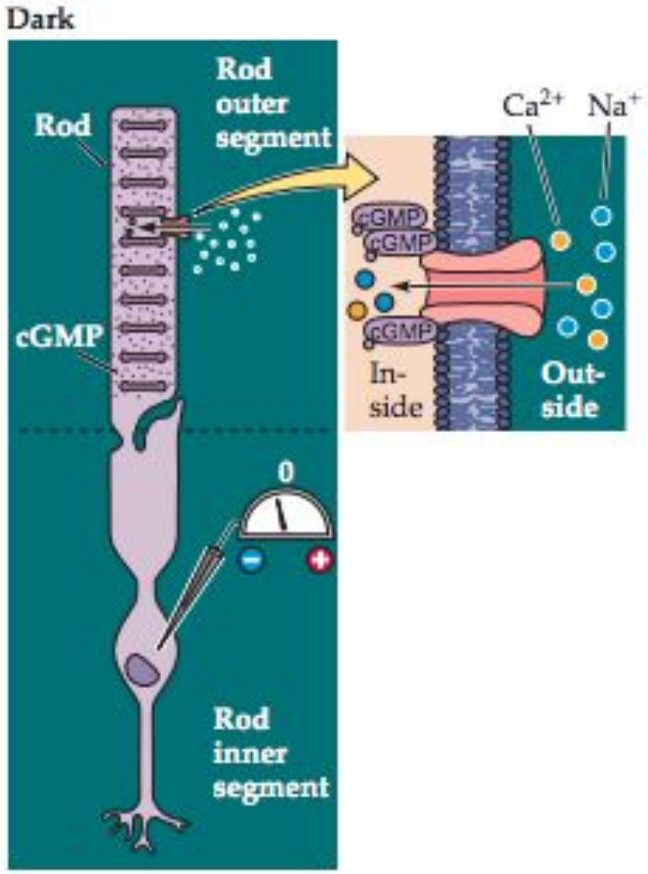
- Most cones are concentrated in the fovea
  - highest visual acuity

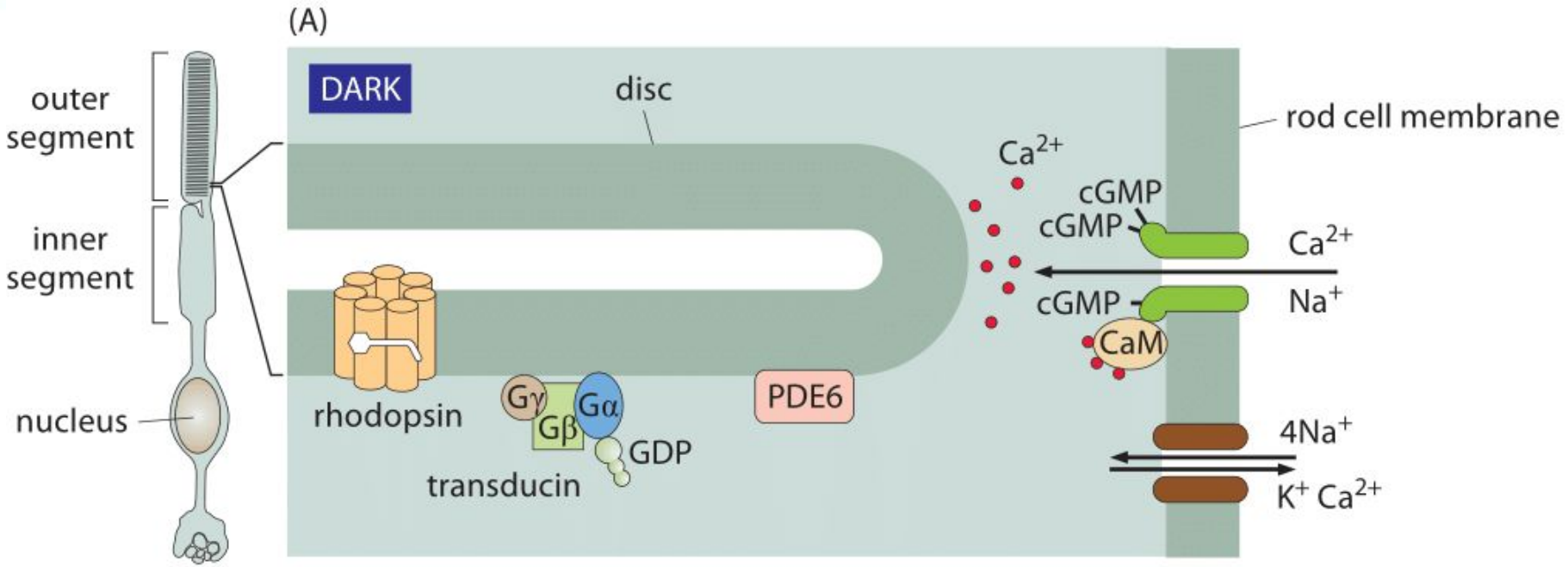
- What about the distribution of rods?
  - No rods in fovea or blind spot





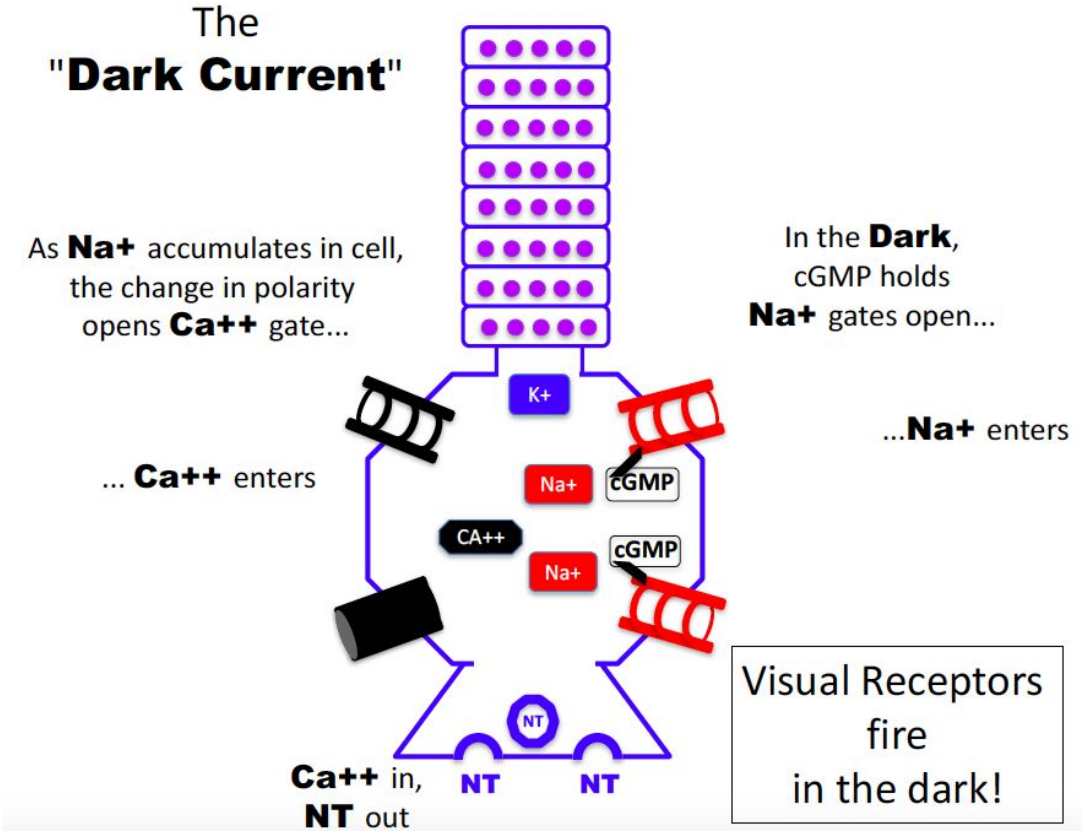
photoreceptors **in the dark**



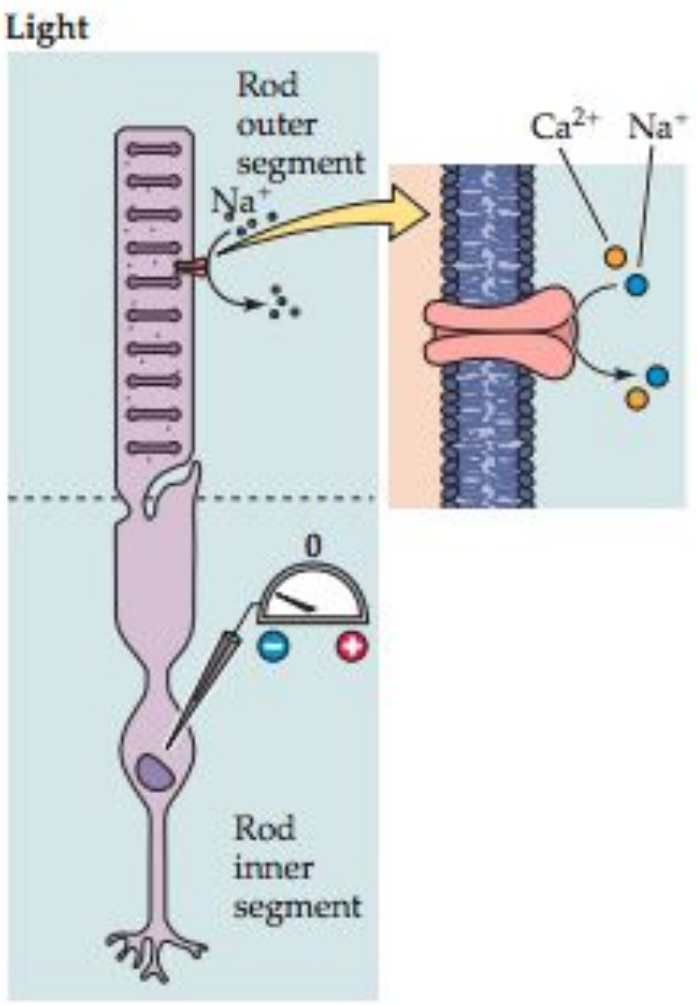


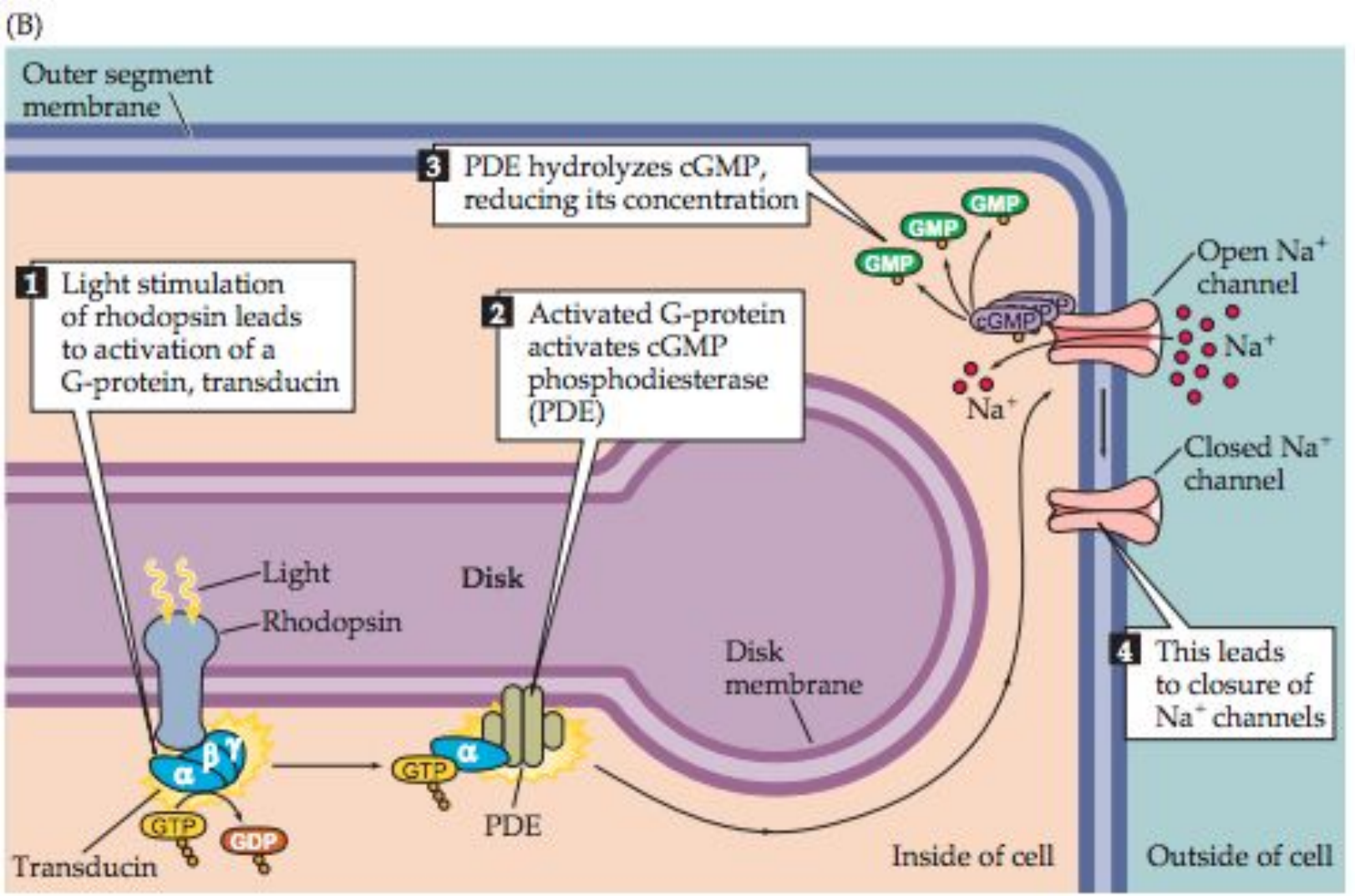
in the dark

- Flow of particles happens when there is no light
- cGMP holds the Na+ gates open → Na+ flows in → Change in polarity leads to Ca++ gates opening and influx of Ca++ → more NT released
- When positive charge accumulates in the cell, Na+ exits via electrostatic pressure
  - Builds up outside → flow in again
  - Ca++ enters again
  - Creates a continuous cycle
- Ca++ pump ejects calcium (requiring energy)
- Visual receptors fire in the dark. NT is continuously released as long as there is no light



photoreceptors **in light**

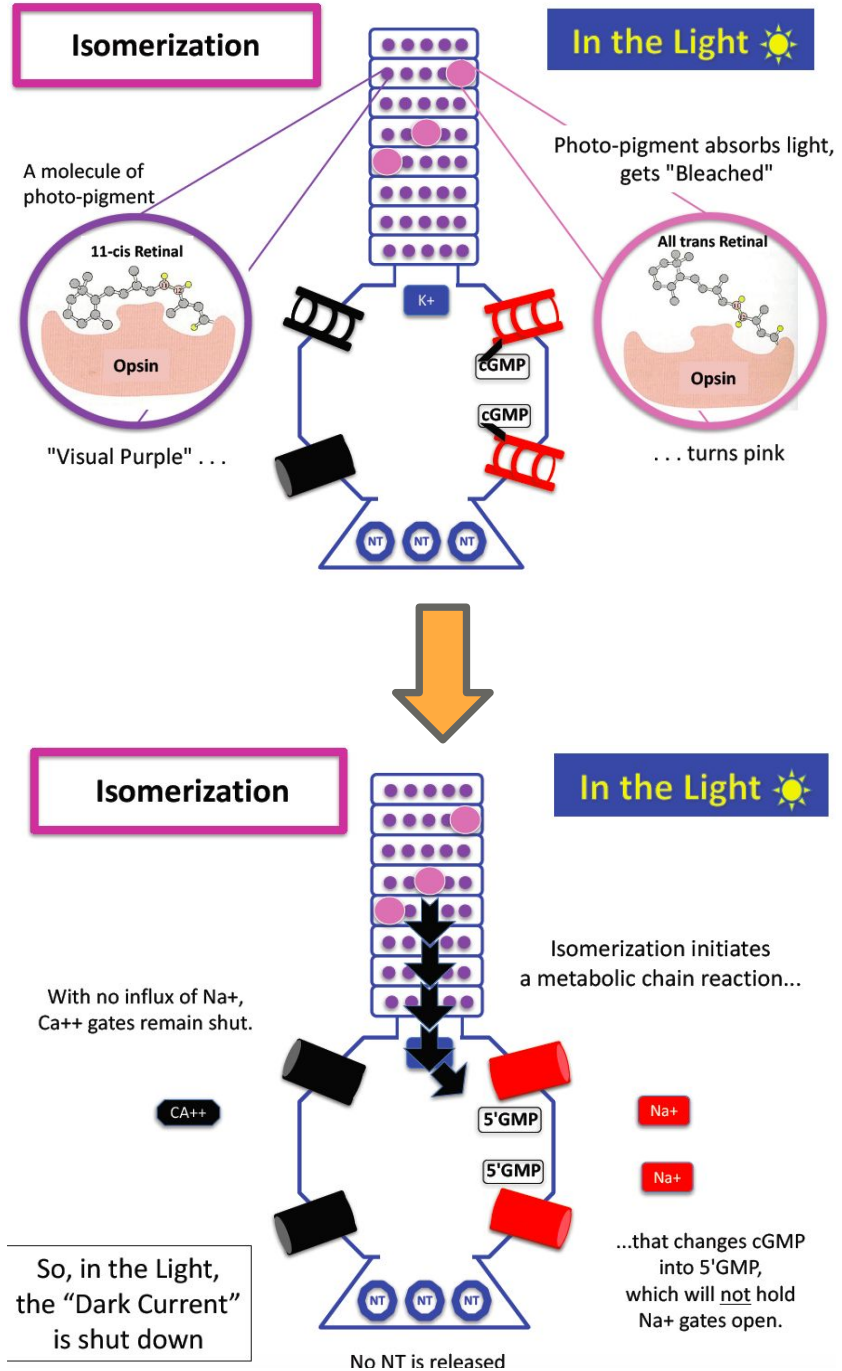




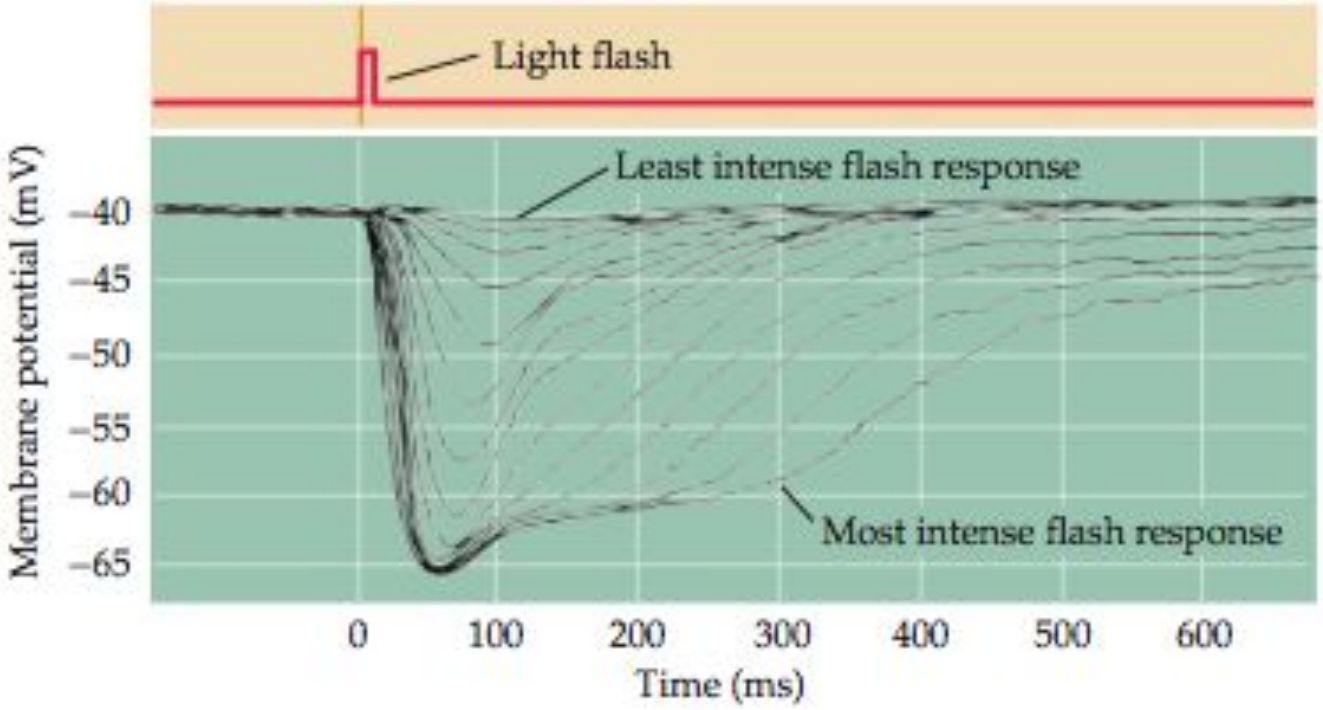
In light,
cis retinal → trans retinal
opsin → metarhodopsin II

in the light

- *Isomerization*
  - Before absorbing light, a molecule of photo-pigment is in its 11-cis Retinal form and attached to the opsin (known as “visual purple”)
  - In the light, photo-pigment absorbs the light and gets “bleached.” Causes the retinal protein to detach from the opsin when it becomes All-trans-Retinal and turns pink
- cGMP converts to 5’GMP when hydrolyzed by PDE. So Na+ gates are not held open b/c there’s less cGMP→ no Ca++ entering b/c Ca++ gates are closed → no NT release
- In the light, the “Dark Current” is shut down



graded potentials



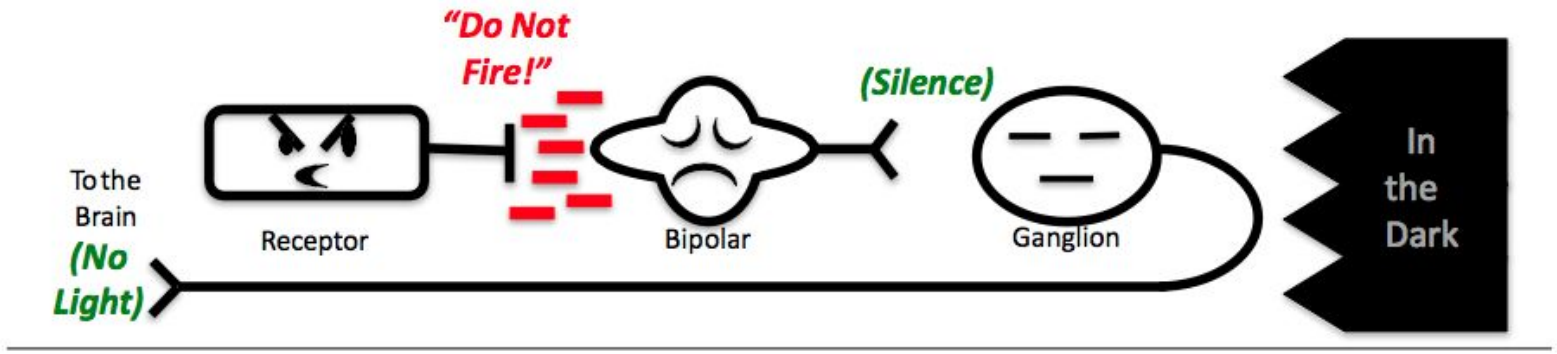
- Graded potentials are changes in membrane potential that vary in size, as opposed to being all-or-none

→ e.g. photoreceptors do not generate action potentials

- light activation causes a **graded change** in membrane potential

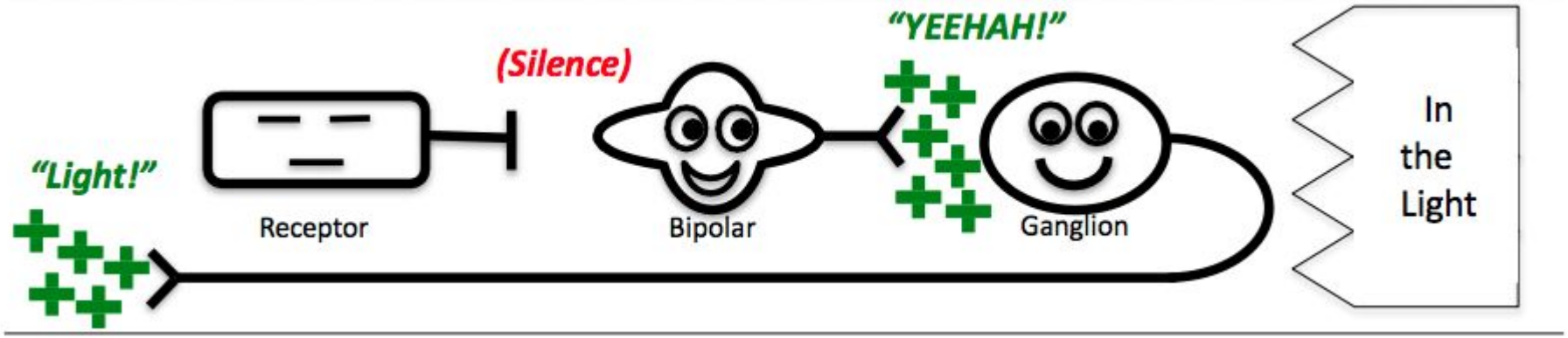
- subsequent transmitter release onto postsynaptic neurons depends on that change in membrane potential

photoreceptors are turned off by light



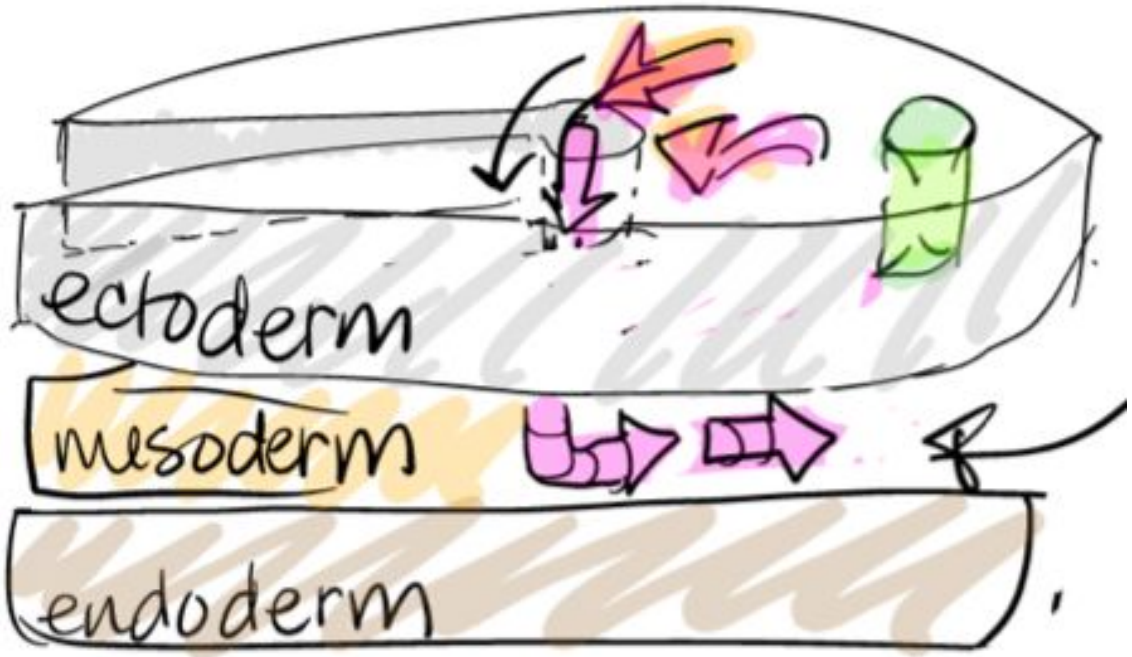
*Since the photoreceptor is depolarized in the dark, glutamate is being released to bipolar cells in the dark

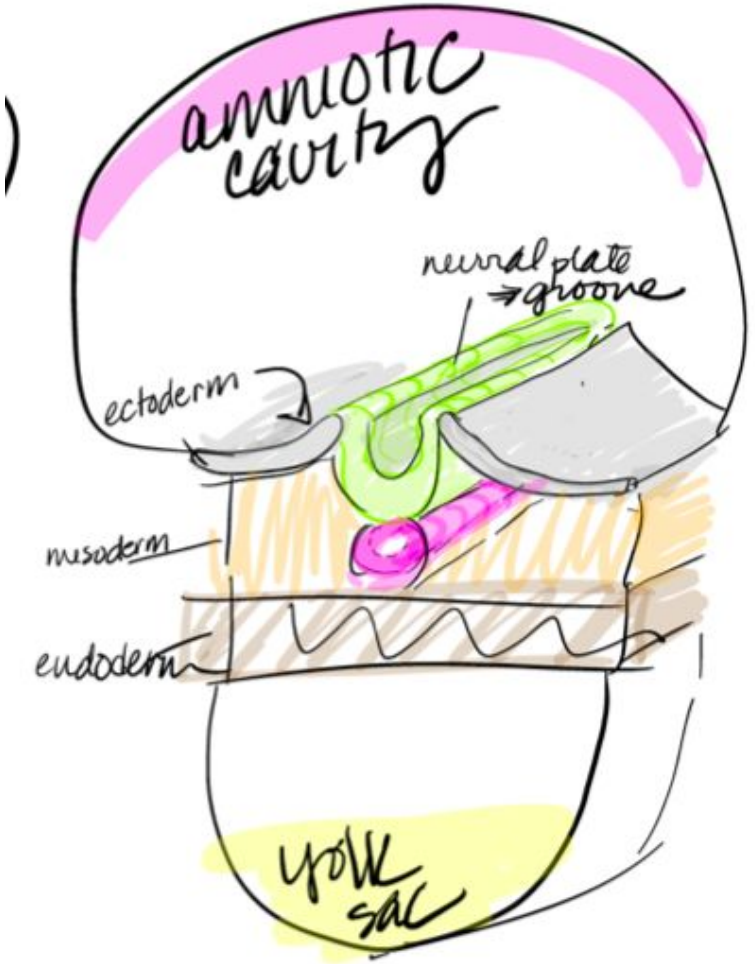
glutamate



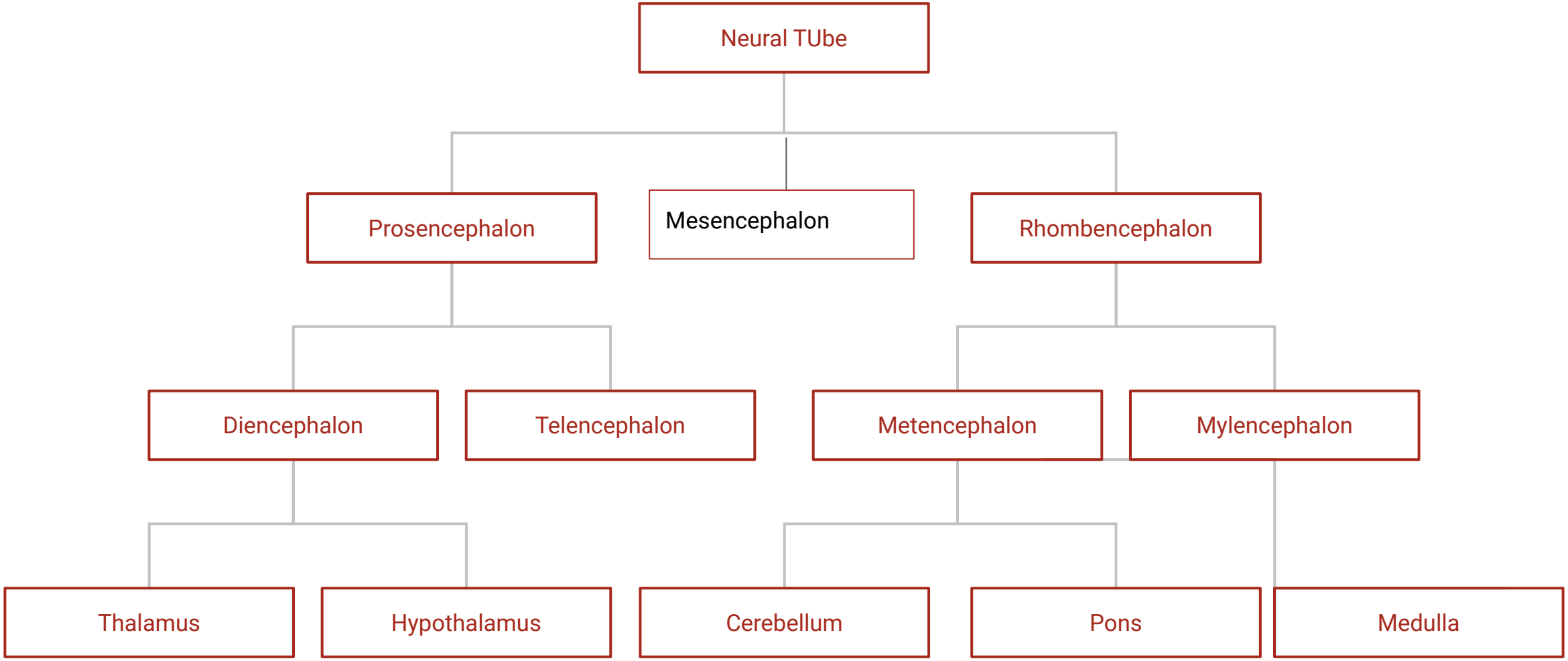
Neuronal Development

Trilaminar Disc and the Neural Plate/Notochord

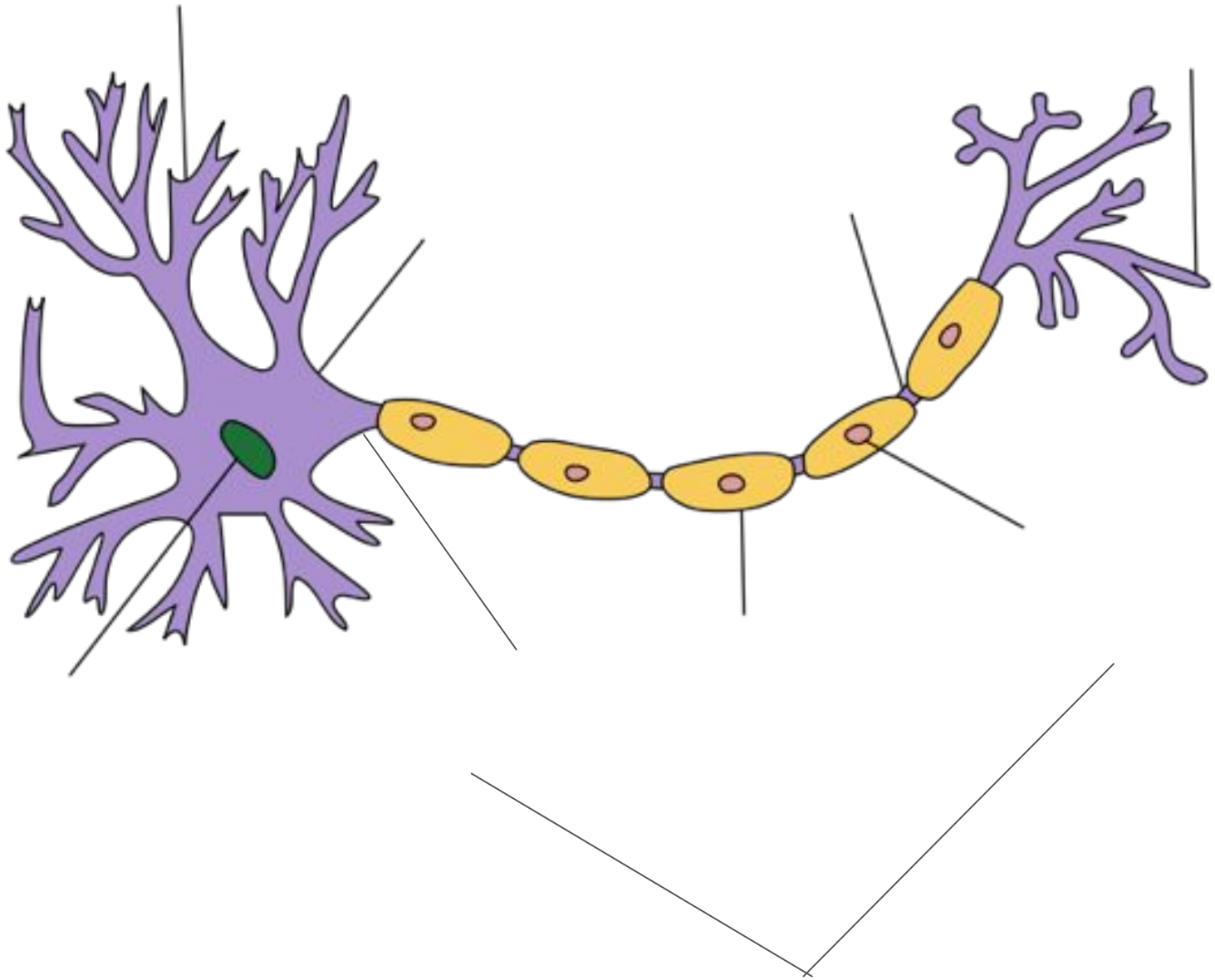




Derivatives of the Neural Tube



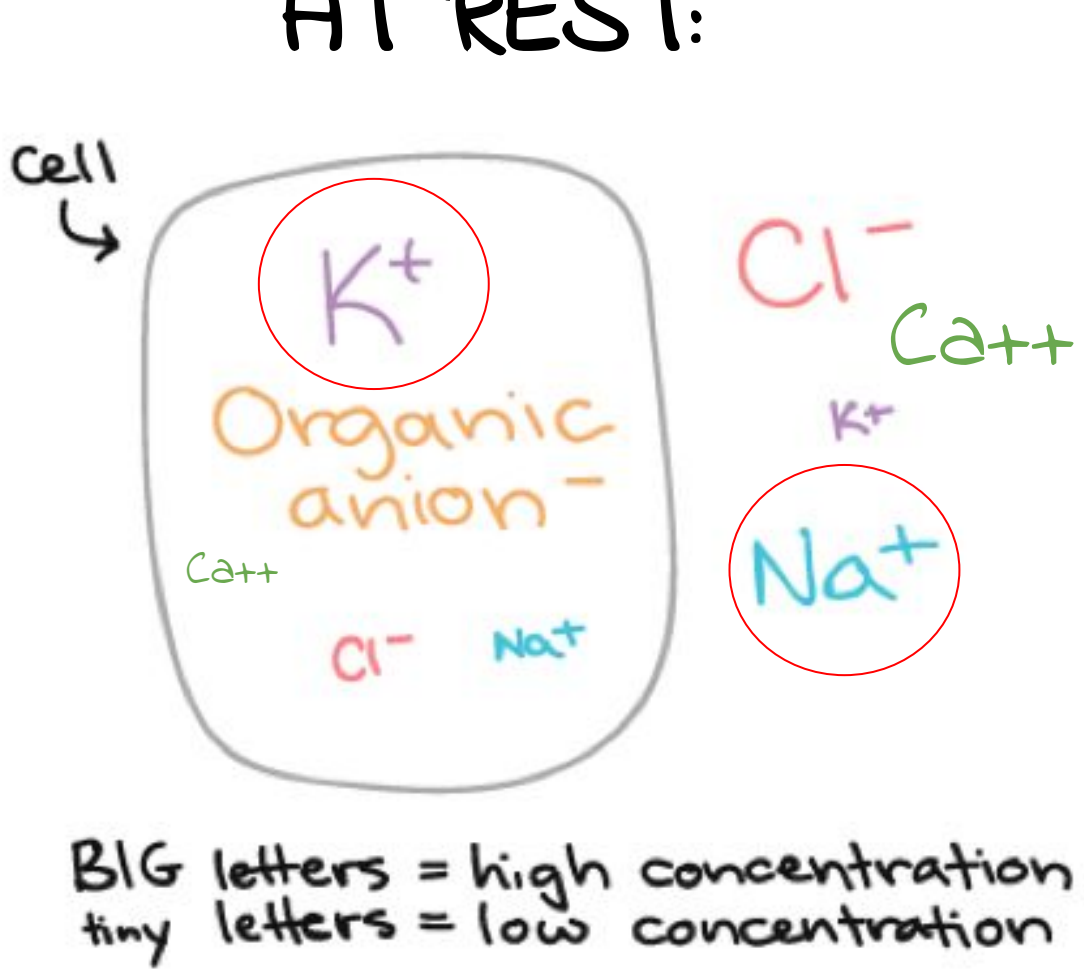
Neural Functioning

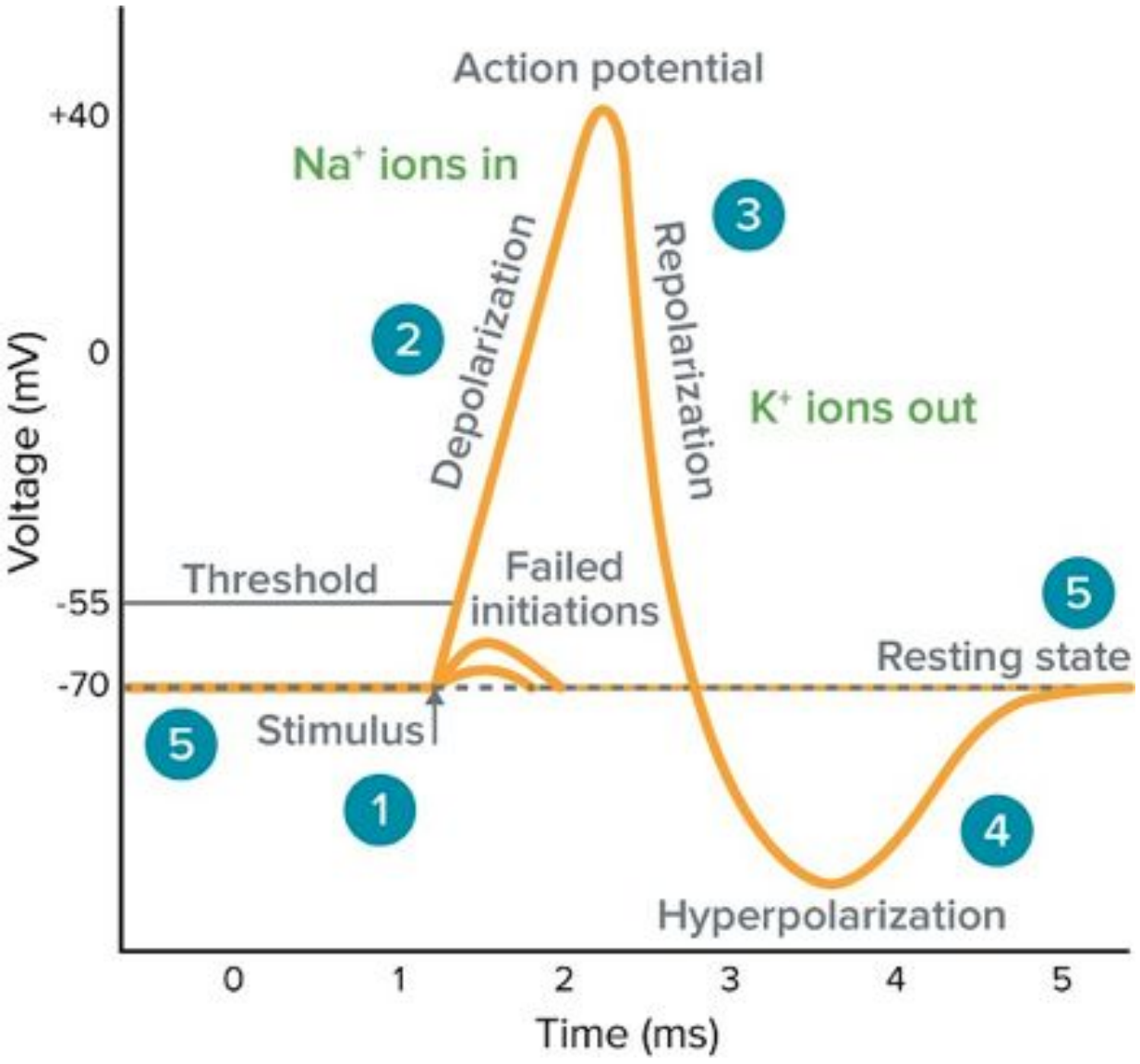


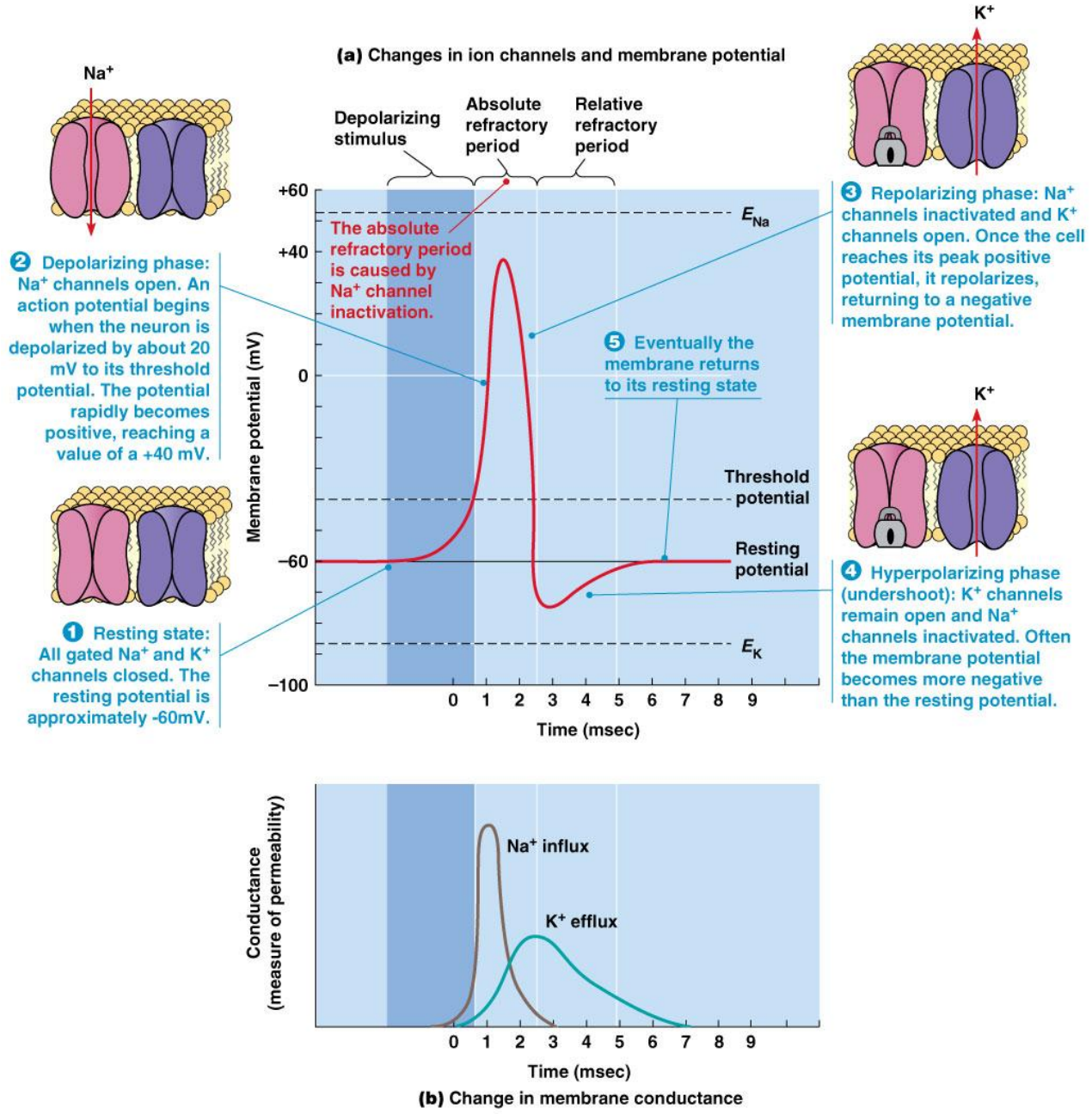
Membrane Potential

- **Membrane potential** is the difference in charge between the inside and outside of the cell (measured in mV)

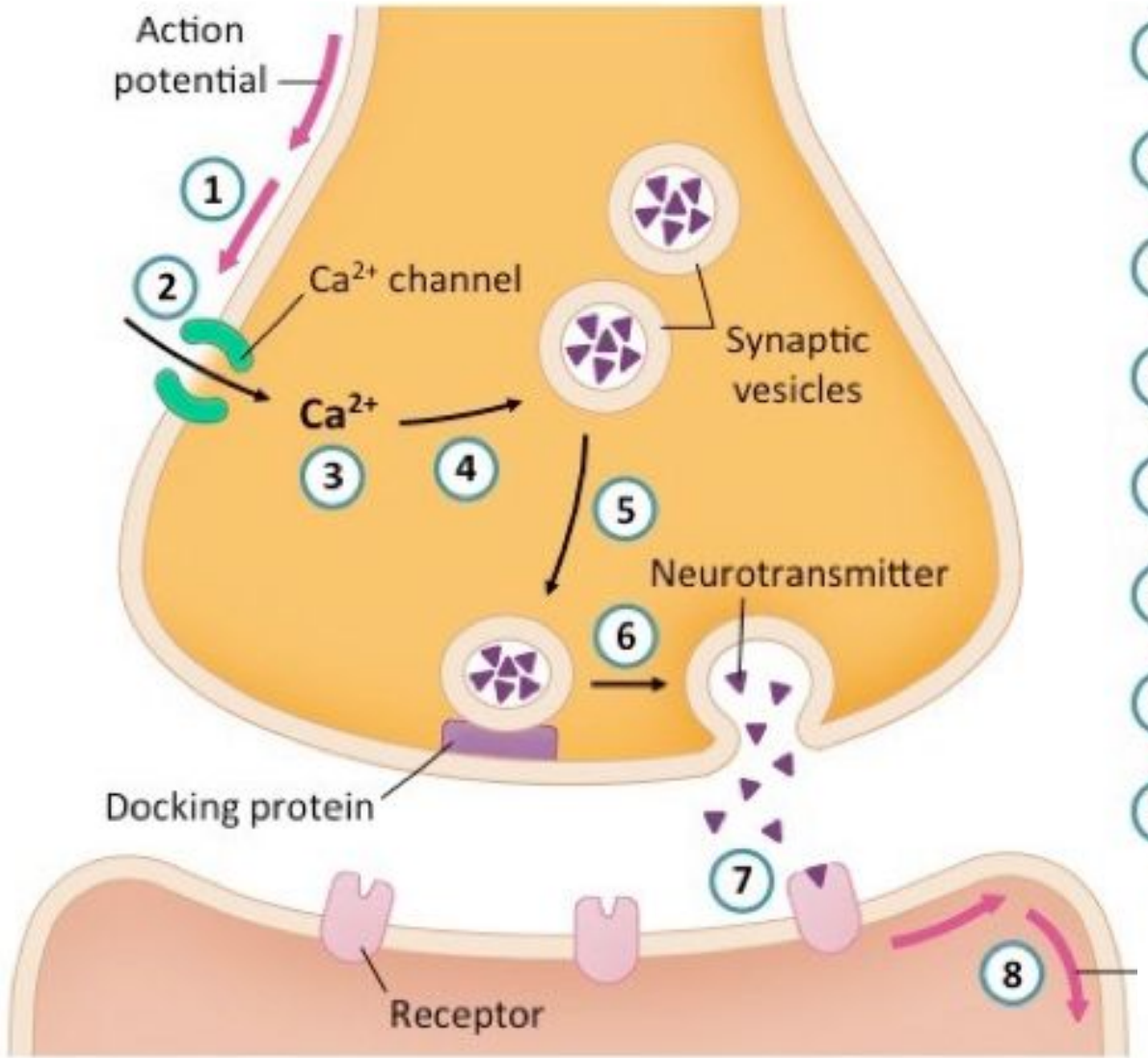
- Distribution of ions inside and outside the cell is controlled
- **Important ions**: Na^+, K^+, Ca^{++}, Cl^-







exocytosis

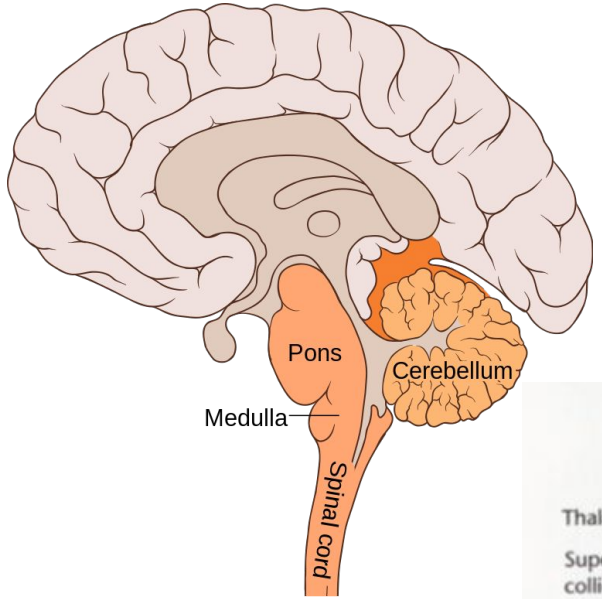


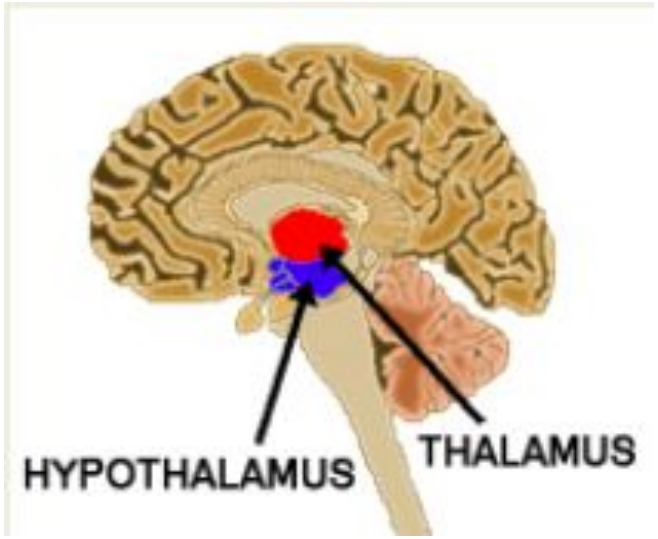
1. Action potential arrives at axon terminal
2. Voltage-gated Ca^{2+} channels open
3. Ca^{2+} enters the presynaptic neuron
4. Ca^{2+} signals to neurotransmitter vesicles
5. Vesicles move to the membrane and dock
6. Neurotransmitters released via exocytosis
7. Neurotransmitters bind to receptors
8. Signal initiated in postsynaptic cell

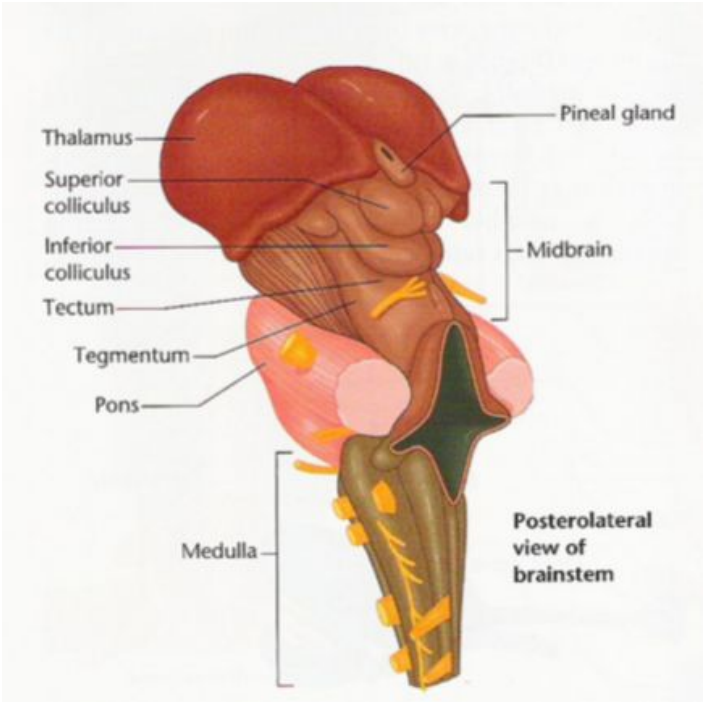
Anatomy of the Nervous System

Divisions of the Brain

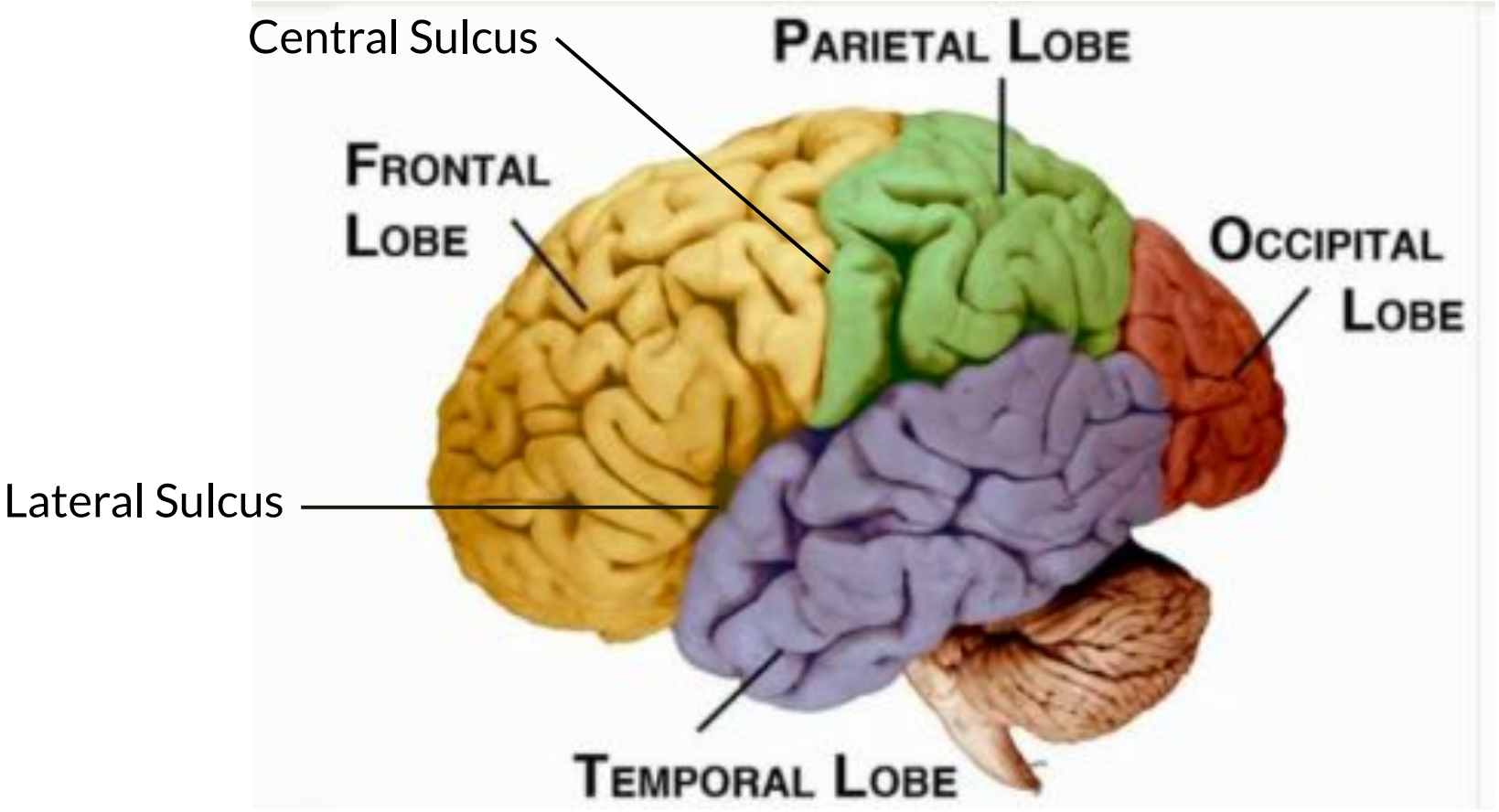
- Hindbrain
  - Medulla, Pons, Cerebellum
- Midbrain
  - Tectum, Tegmentum
- Forebrain
  - Diencephalon (brain stem)
    - Thalamus
    - Hypothalamus
  - Telencephalon (cortex/lobes)

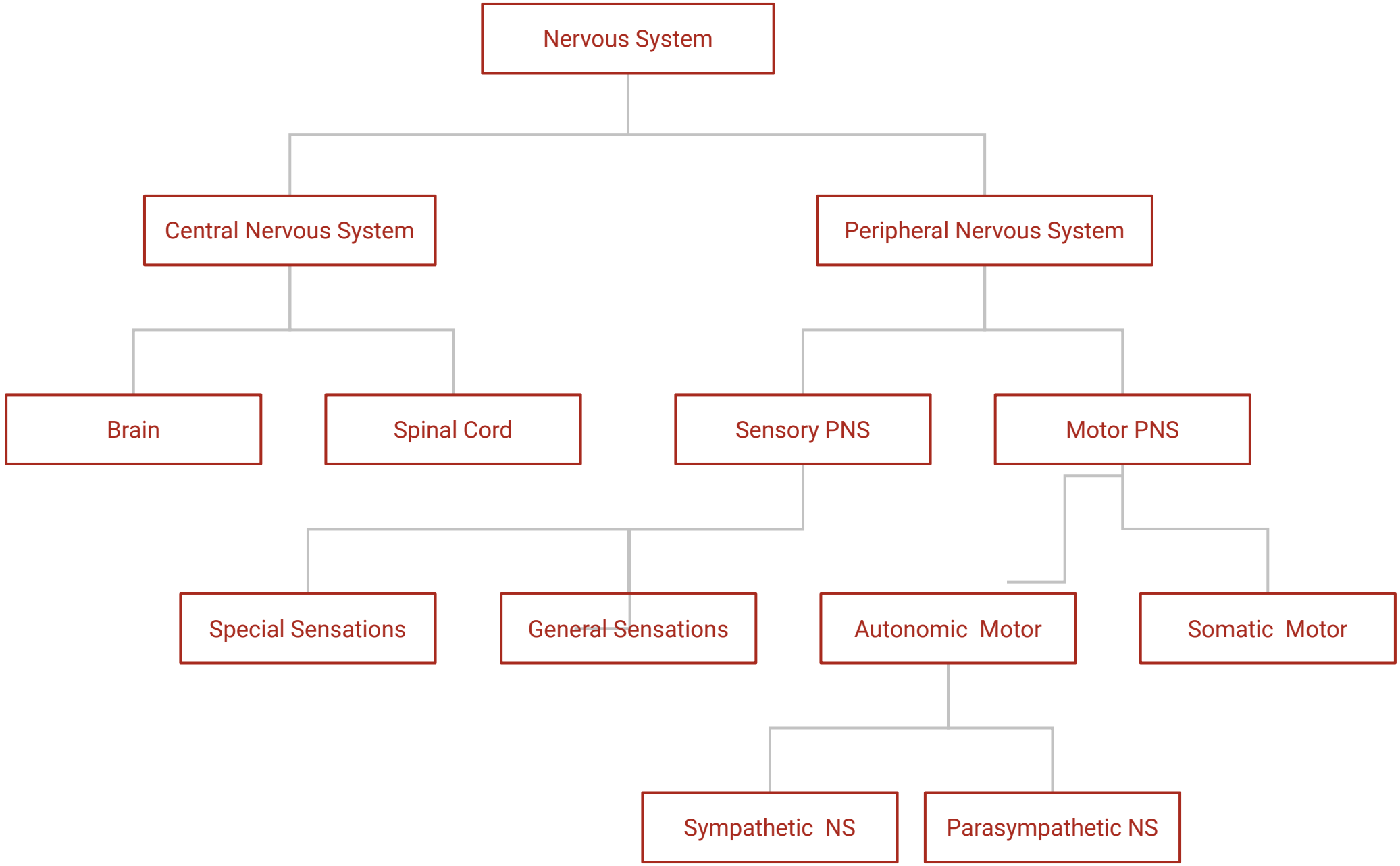






Cerebral Cortex - 4 Lobes of the Brain




Nervous System
Central Nervous System
Peripheral Nervous System
Brain
Spinal Cord
Sensory PNS
Motor PNS
Special Sensations
General Sensations
Autonomic Motor
Somatic Motor
Sympathetic NS
Parasympathetic NS

Support Structures

- Meninges
  - Pia Mater: flexible inner layer that conforms to the brain and spinal surfaces
  - Arachnoid Space: spongy layer filled with CSF
  - Dura Mater: thick outer layer
- Ventricles
  - Hollow inter-connected cavities
  - Produces CSF
  - 2 lateral ventricles, third ventricle, cerebral aqueduct, and fourth ventricle
  - Cushions and supports the brain
  - Hydrocephalus
- Blood Vessels
  - Web of incoming arteries and outgoing veins
  - Cleanses brain
  - Uses A LOT of blood relative to its weight
- Blood-Brain Barrier
  - Strict control over chemicals in the brain
  - Protects the brain from infection
  - What it protects: brain, spinal cord, and peripheral nerves
  - What is allowed in: water, O2, CO2, lipids, glucose, amino acids
  - What is not allowed in: large and highly polarized molecules