MANCHESTER 1824
The University of Manchester

THE HUMAN BRAIN

How nerve impulses are propagated

Dr. Bip Choudhury

MANCHESTER 1824
The University of Manchester

Amazing brain

Controls important body functions

Processes information

Dreams, emotions, reasoning

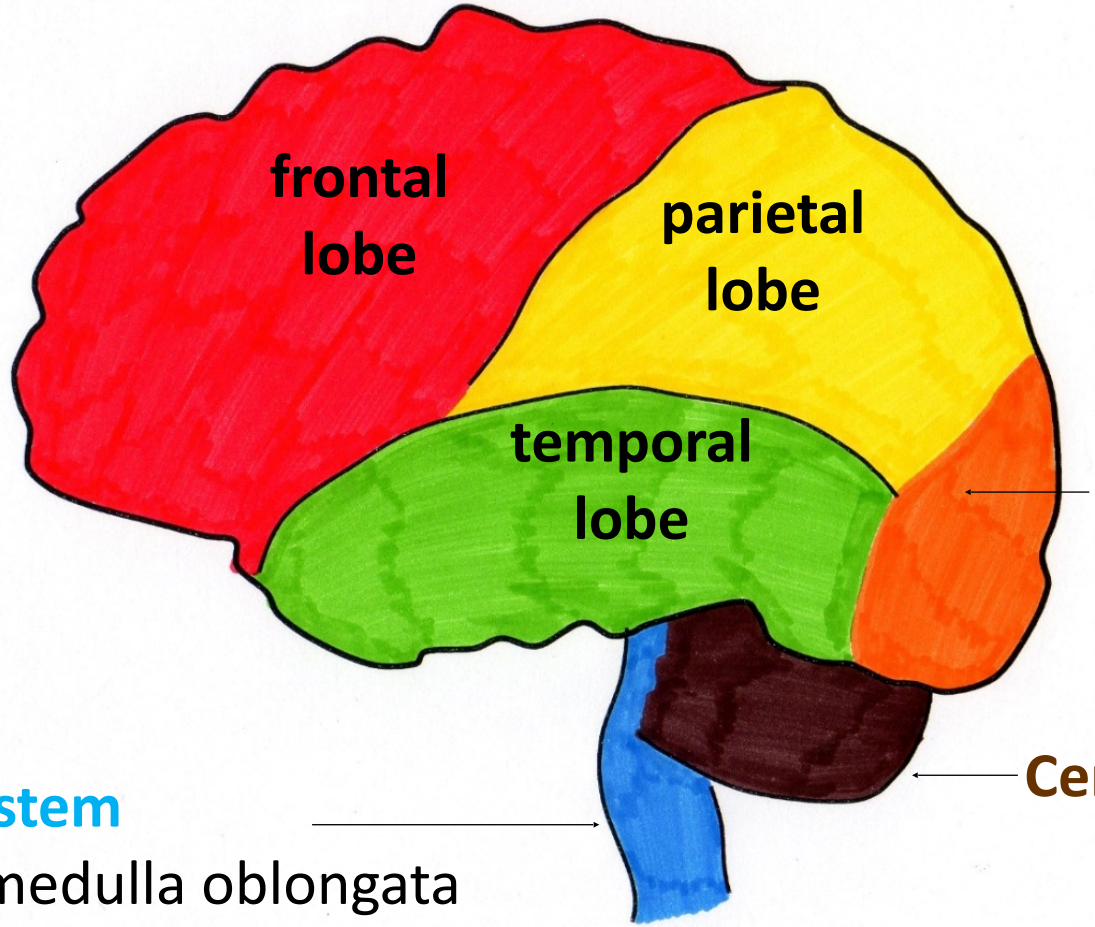
Walk, sit & stand

MANCHESTER 1824
The University of Manchester

Brain: basic anatomy

front

back

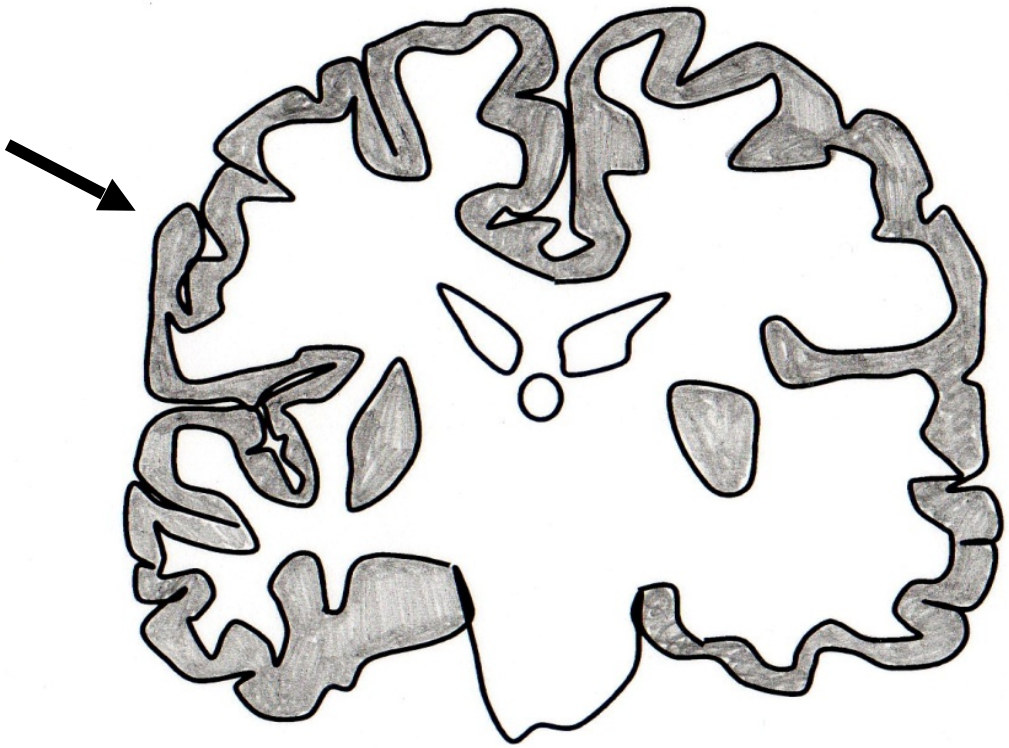


midbrain, pons & medulla oblongata

MANCHESTER 1824
The University of Manchester

Convoluted surface

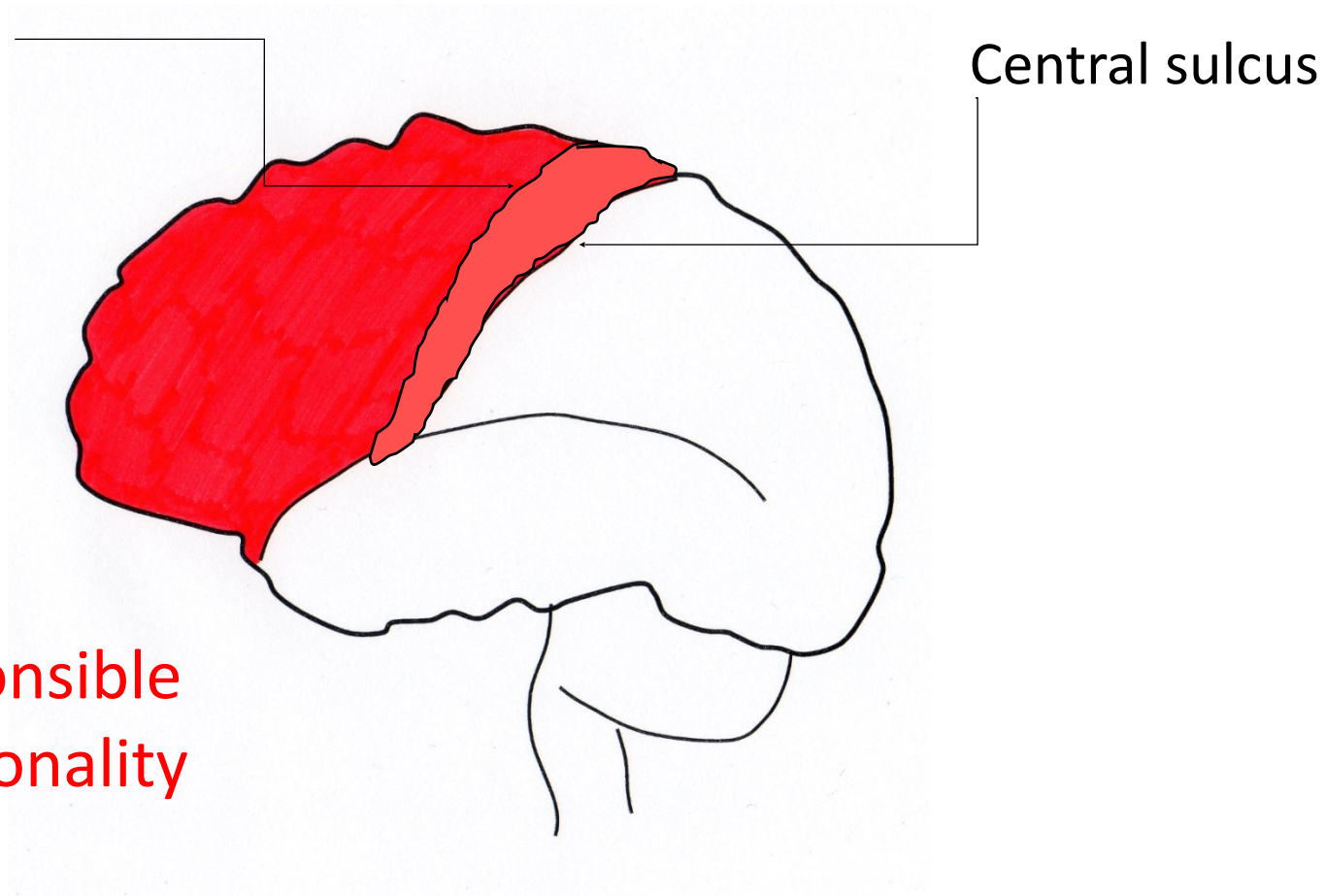
An obvious feature of the hemispheres is their highly convoluted surface.



Ridges = **gyri** Valleys = **sulci**/fissure

Allows more cortical surface area

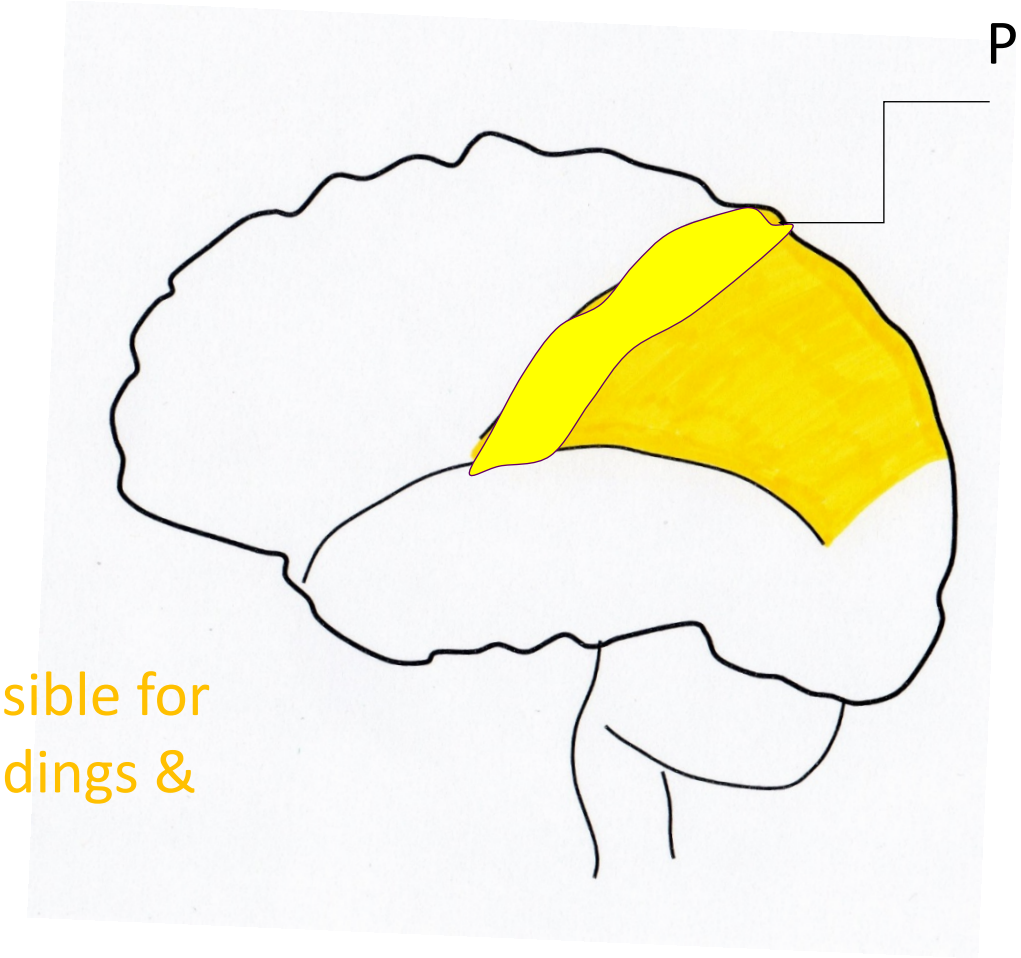
Frontal Lobe



Frontal lobe is responsible for movement, personality and planning

MANCHESTER 1824
The University of Manchester

Parietal Lobe



Parietal lobe is responsible for awareness of surroundings & stereognosis.

Temporal Lobe

Temporal lobe is responsible for hearing and language.

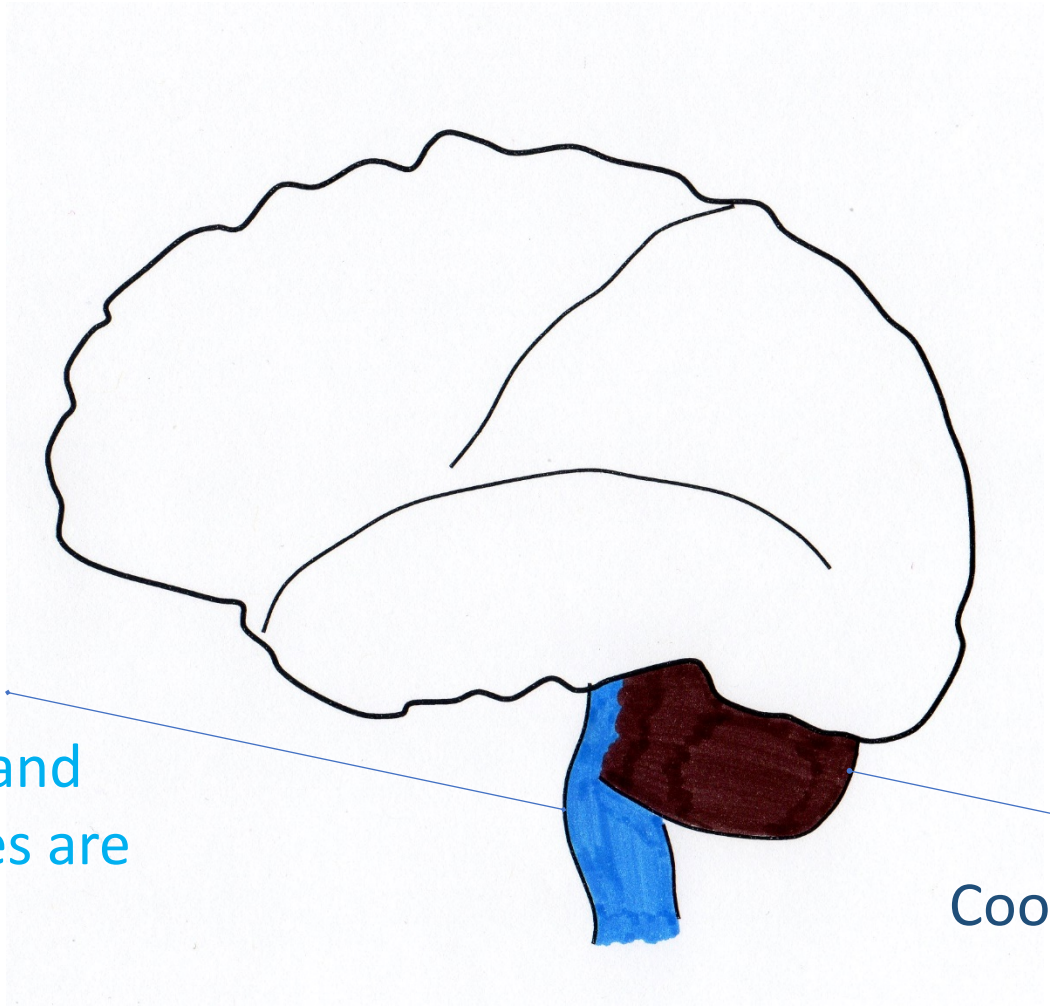
MANCHESTER 1824
The University of Manchester

Occipital Lobe

Occipital lobe is responsible for processing visual signals.

MANCHESTER 1824
The University of Manchester

Cerebellum & Brain Stem

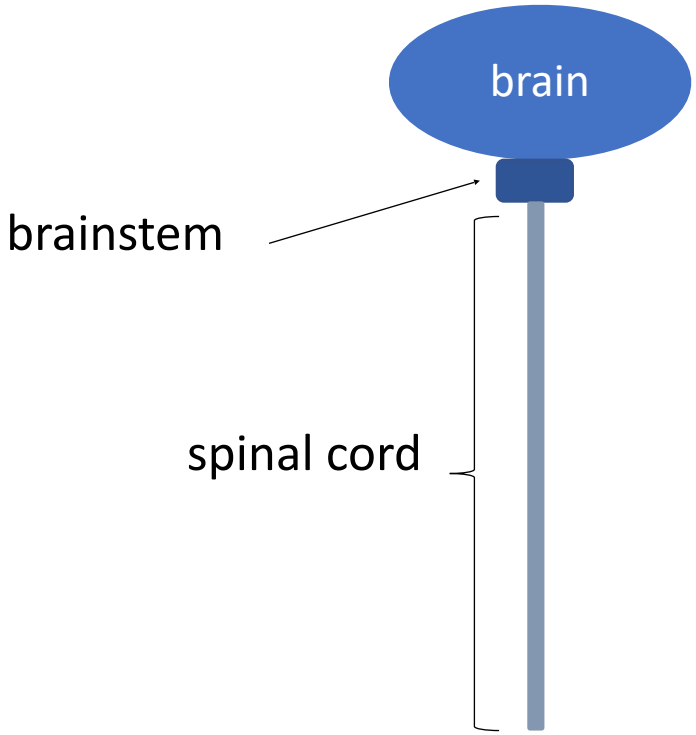


Brainstem
Cardiovascular and respiratory centres are located here

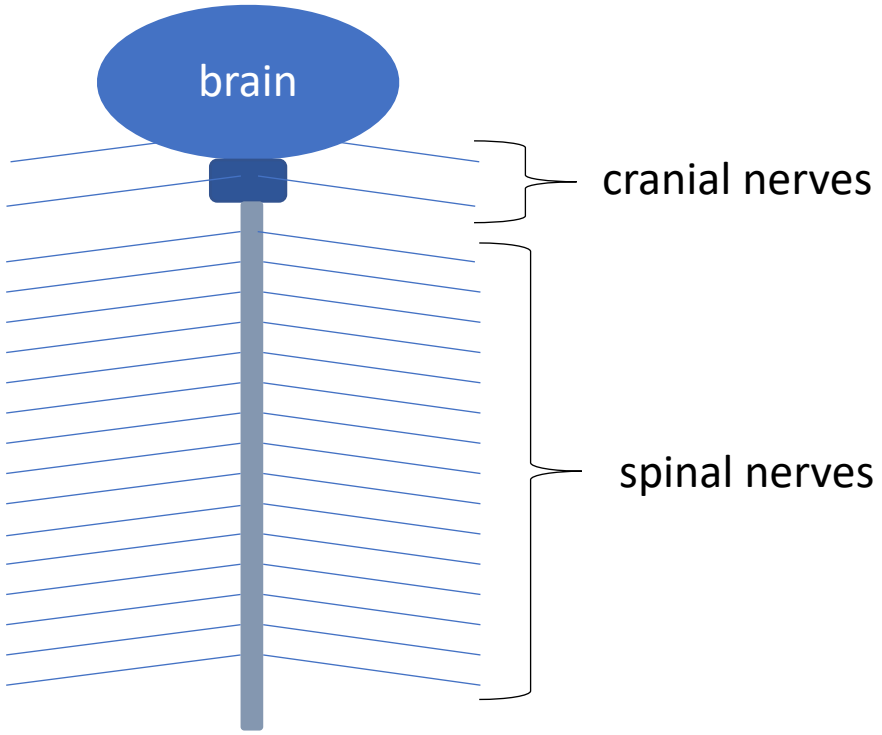
Cerebellum
Coordinates movement & posture

Somatic Nervous System

Central Nervous System (CNS)

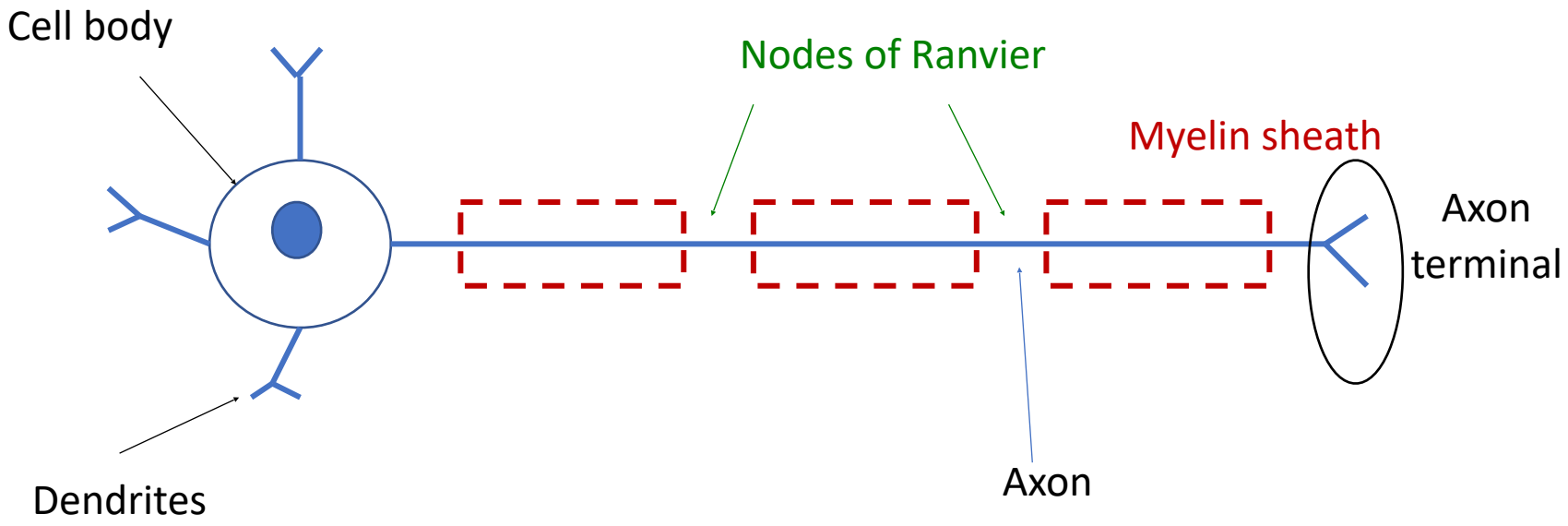


Peripheral Nervous System (PNS)



MANCHESTER 1824
The University of Manchester

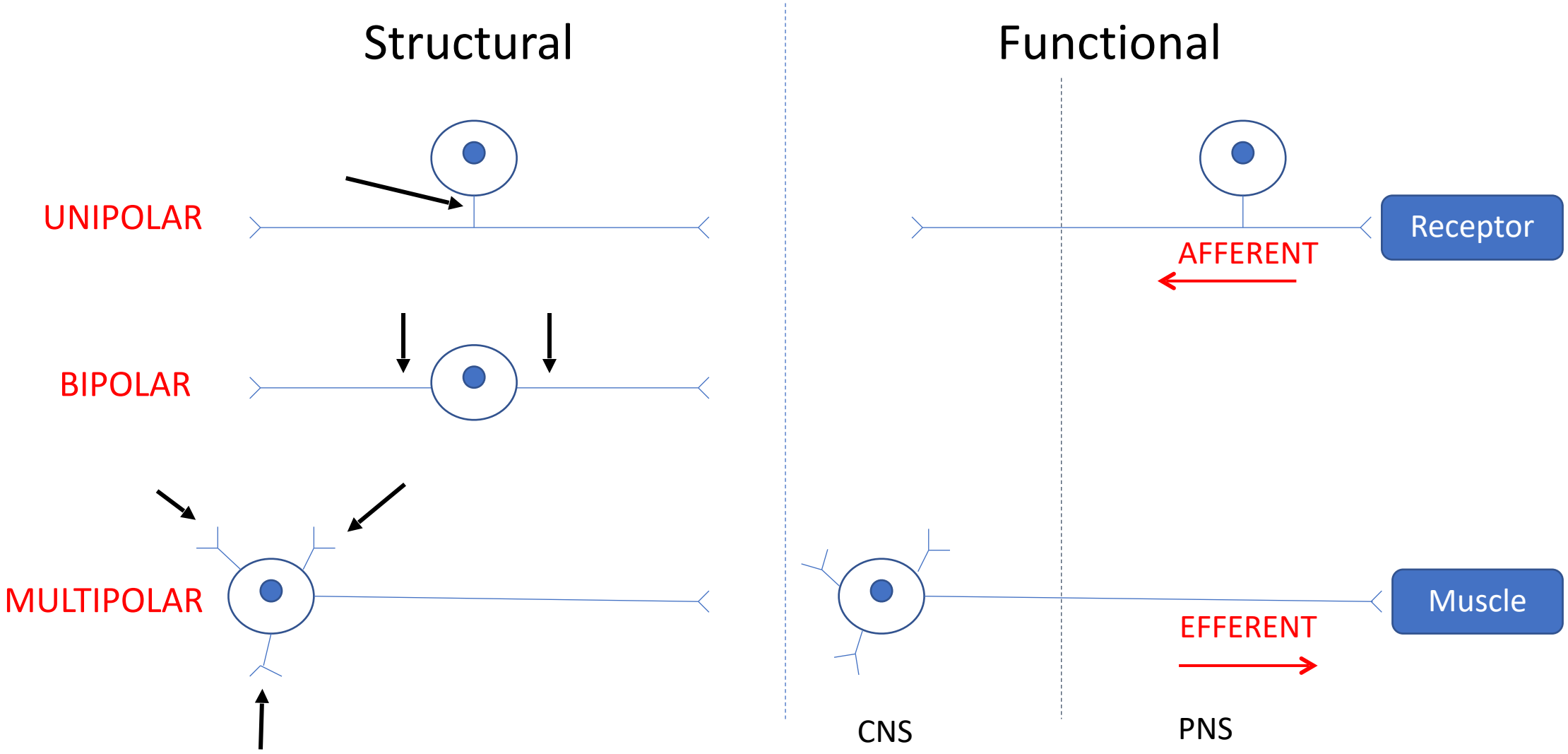
The neurone : basic unit of the nervous system



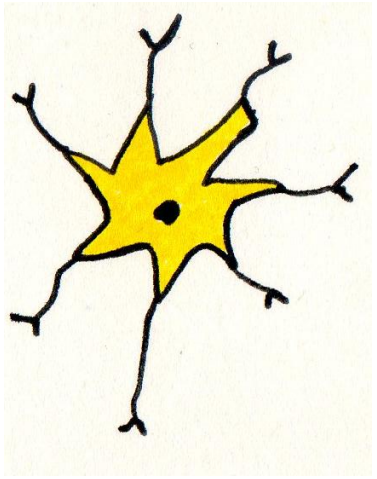
saltatory conduction

MANCHESTER 1824
The University of Manchester

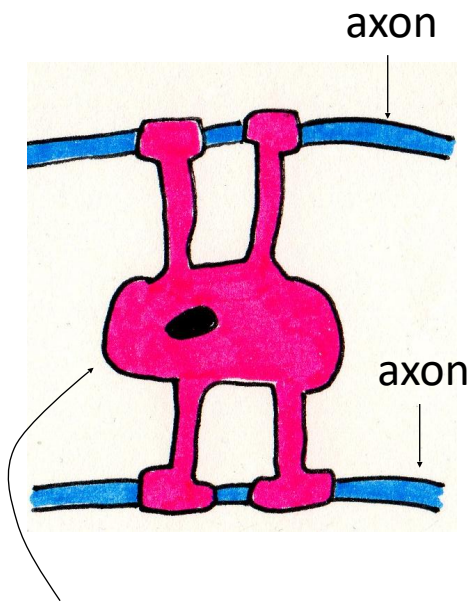
Different Classifications



Neuroglia



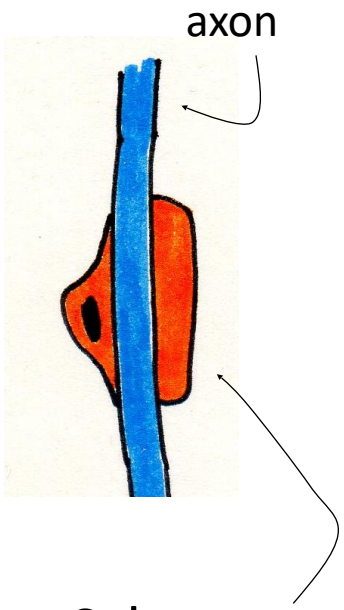
Astrocyte



Oligodendrocyte

Produce the myelin sheath in the CNS

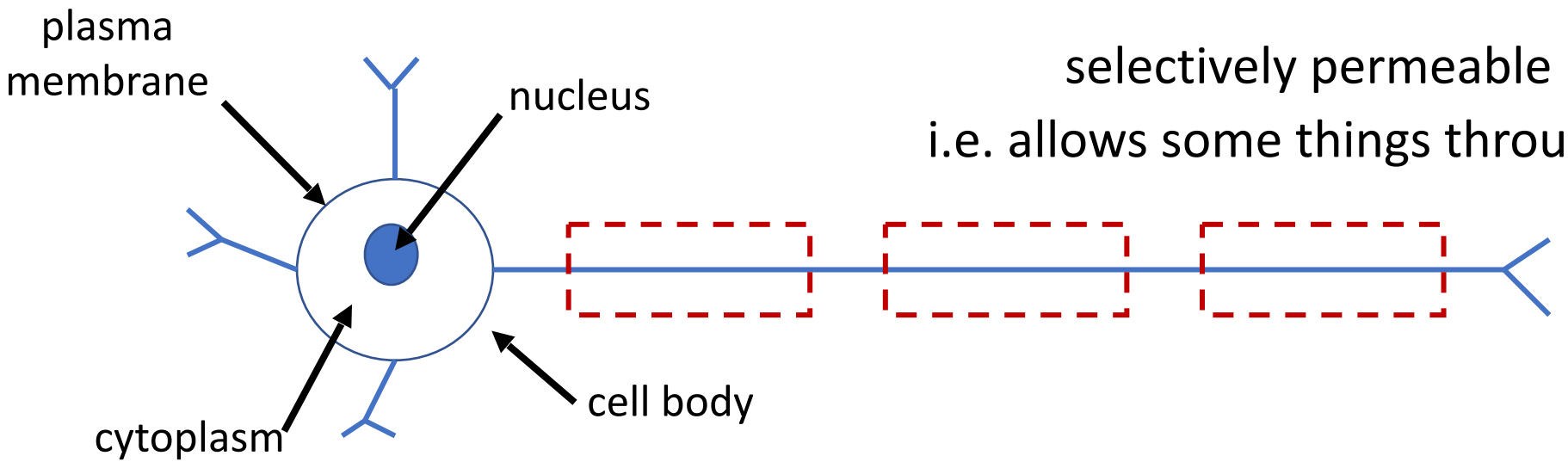
Muller



Schwann

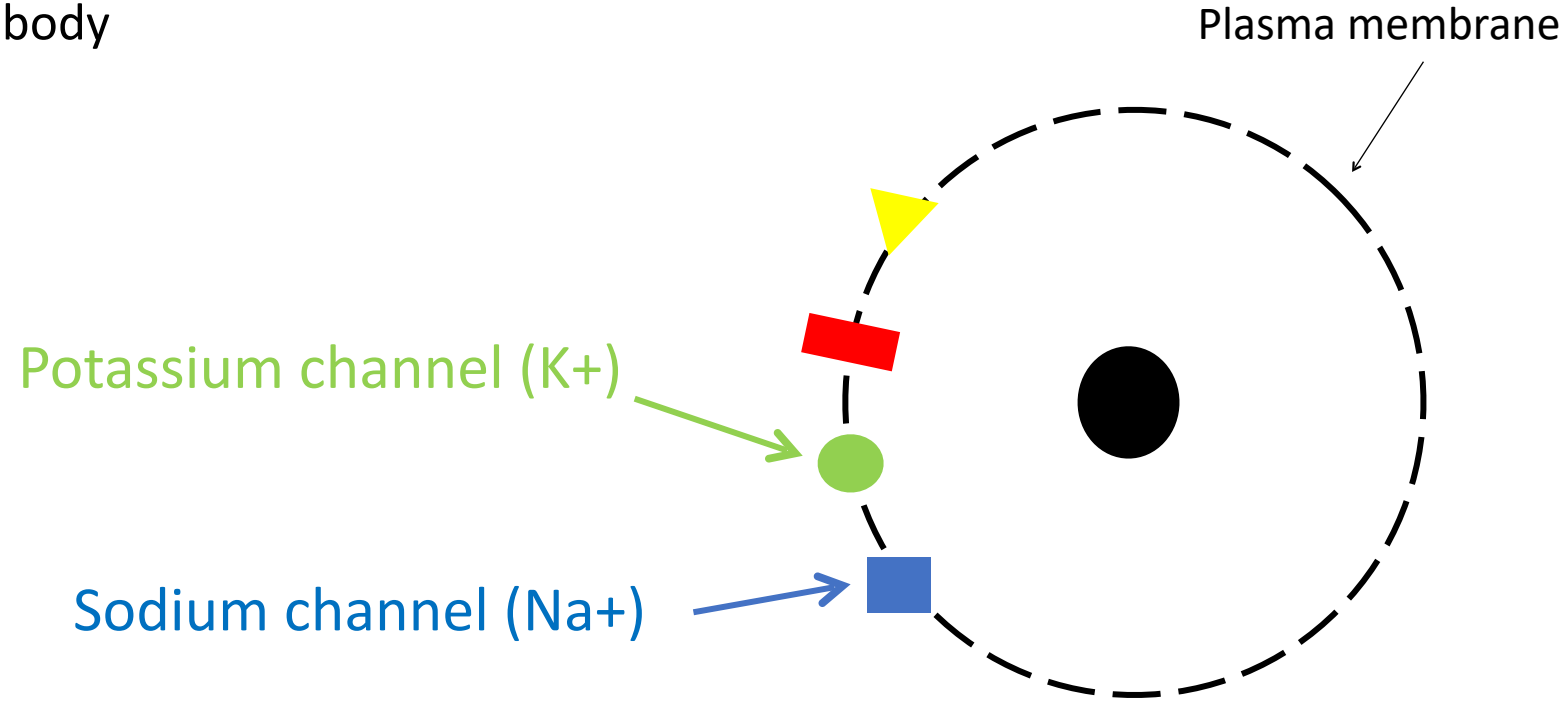
Produce the myelin sheath in the PNS

The Plasma Membrane

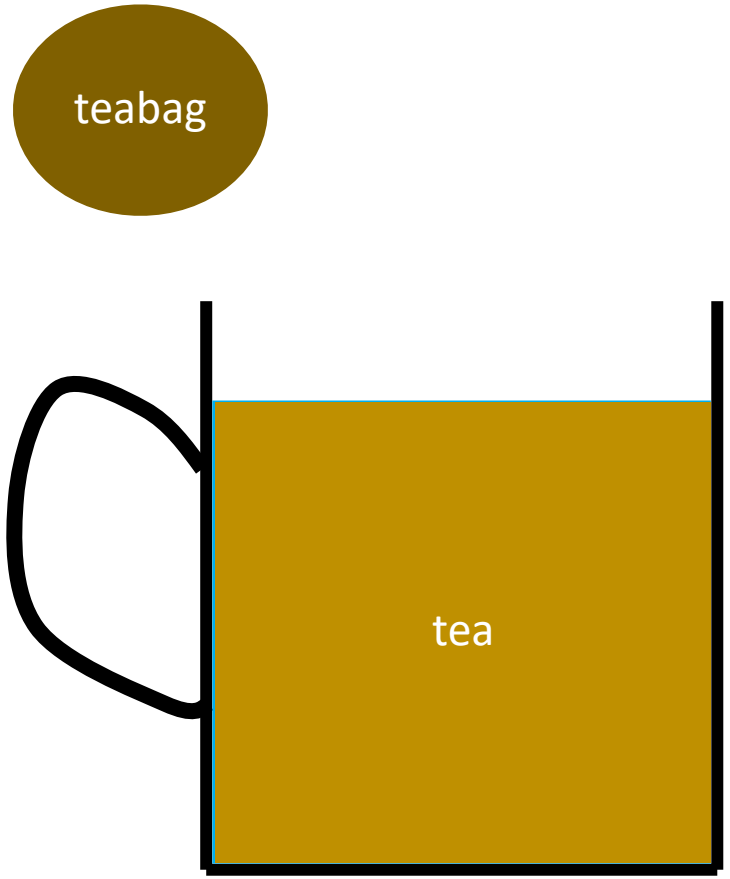


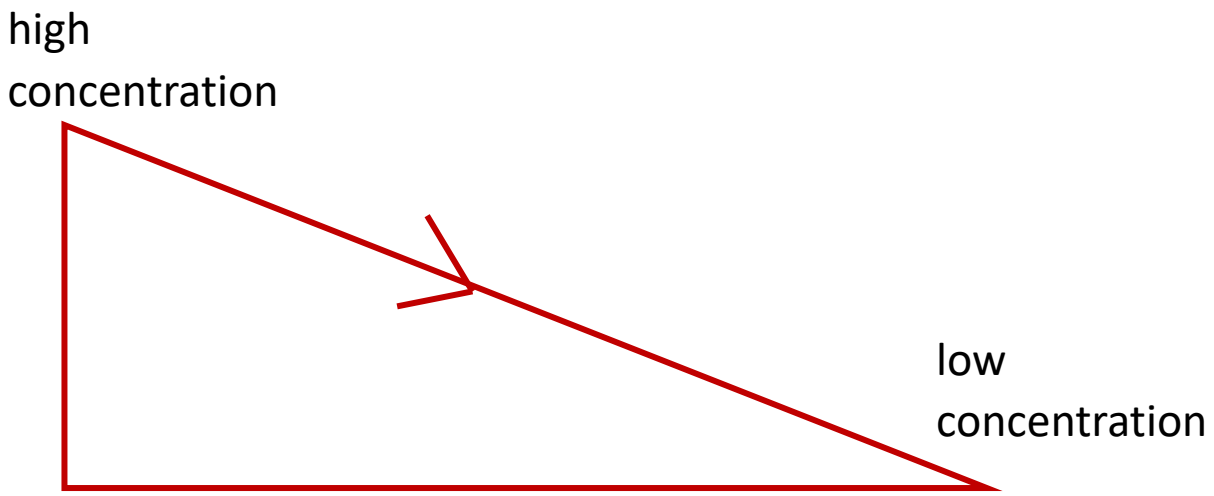
selectively permeable membrane

i.e. allows some things through & stops others



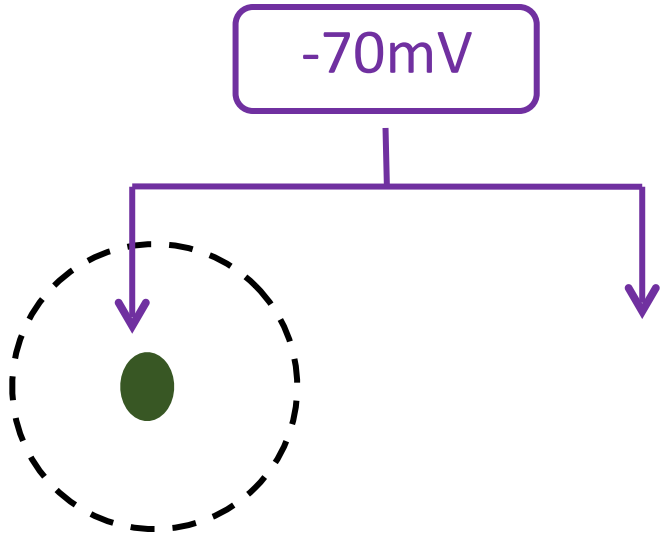
Diffusion





Diffuses down the concentration gradient

Resting Membrane Potential

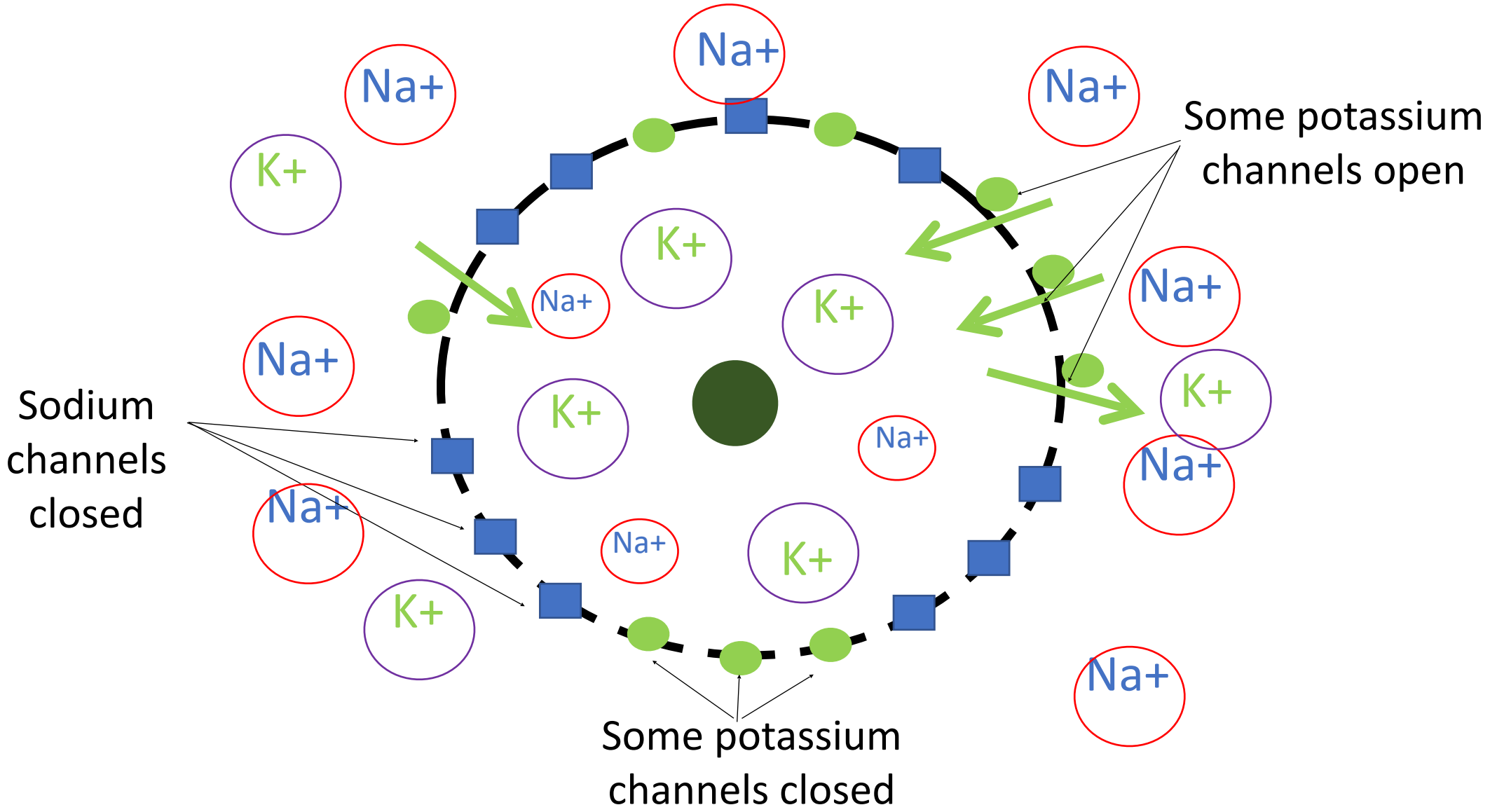


The inside of the cell has a negative charge.

This is called the RESTING MEMBRANE POTENTIAL
(i.e. the cell is not stimulated, it is at ‘rest’).

MANCHESTER 1824
The University of Manchester

The cell at rest

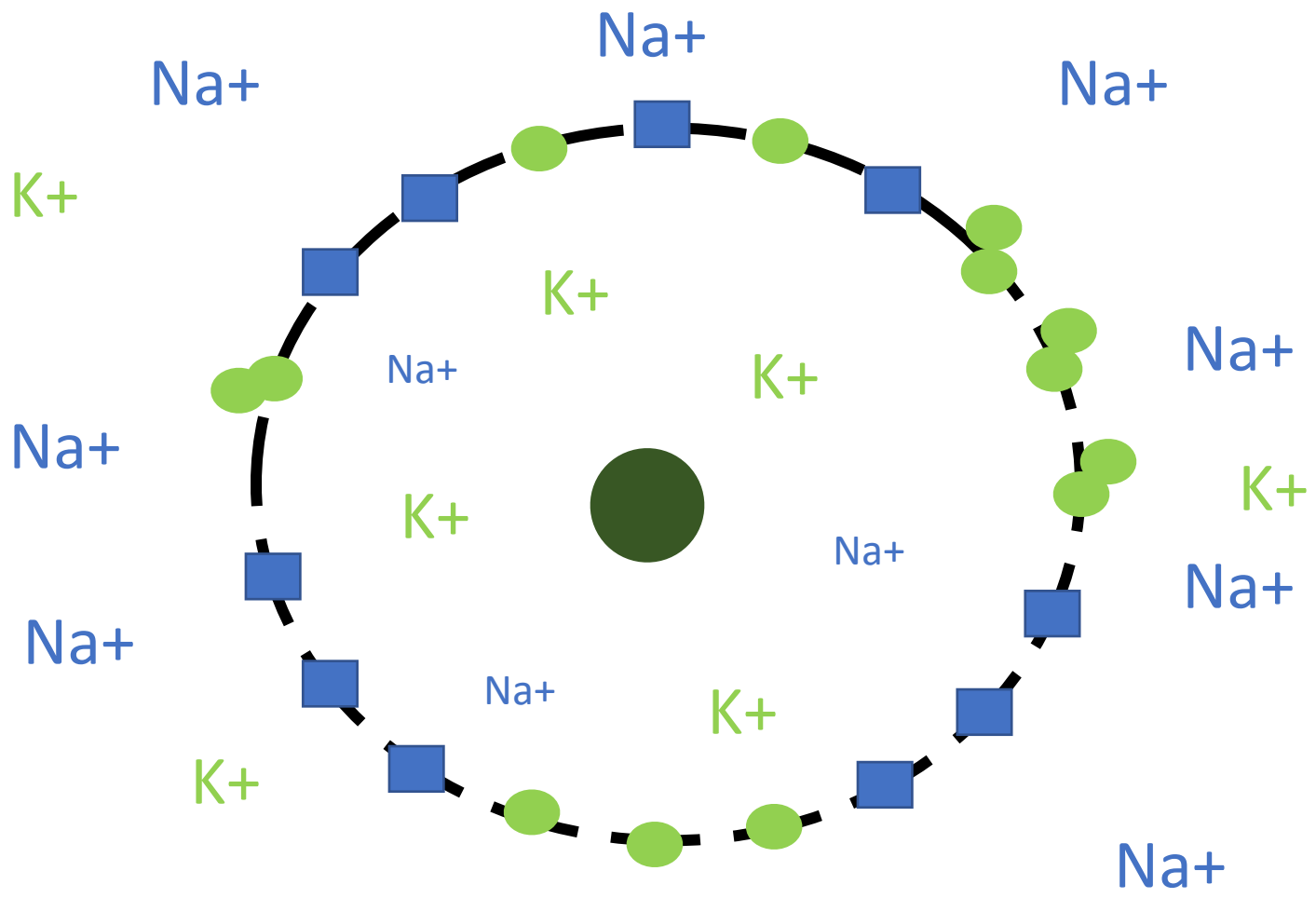


MANCHESTER 1824
The University of Manchester

The cell when stimulated

ALL sodium channels open

Sodium travels down it's concentration gradient into the cell



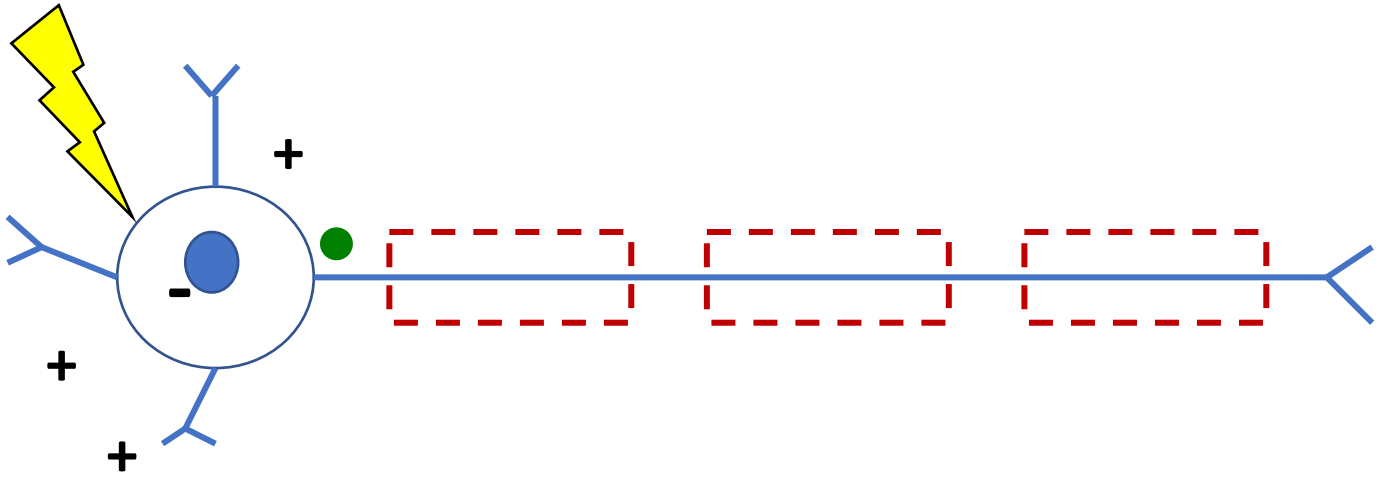
Potassium channels close

depolarisation

Summary

- At rest, the inside of the cell is negative (-70mV) because the sodium channels are closed and only some potassium channels are open.
- This is called the RESTING MEMBRANE POTENTIAL.
- Once the cell is stimulated, all sodium channels open allowing sodium to flood into the cell. The potassium channels close.
- The interior of the cell becomes positive.
- This is called DEPOLARISATION (cell interior going from –ve to +ve).

Action Potentials

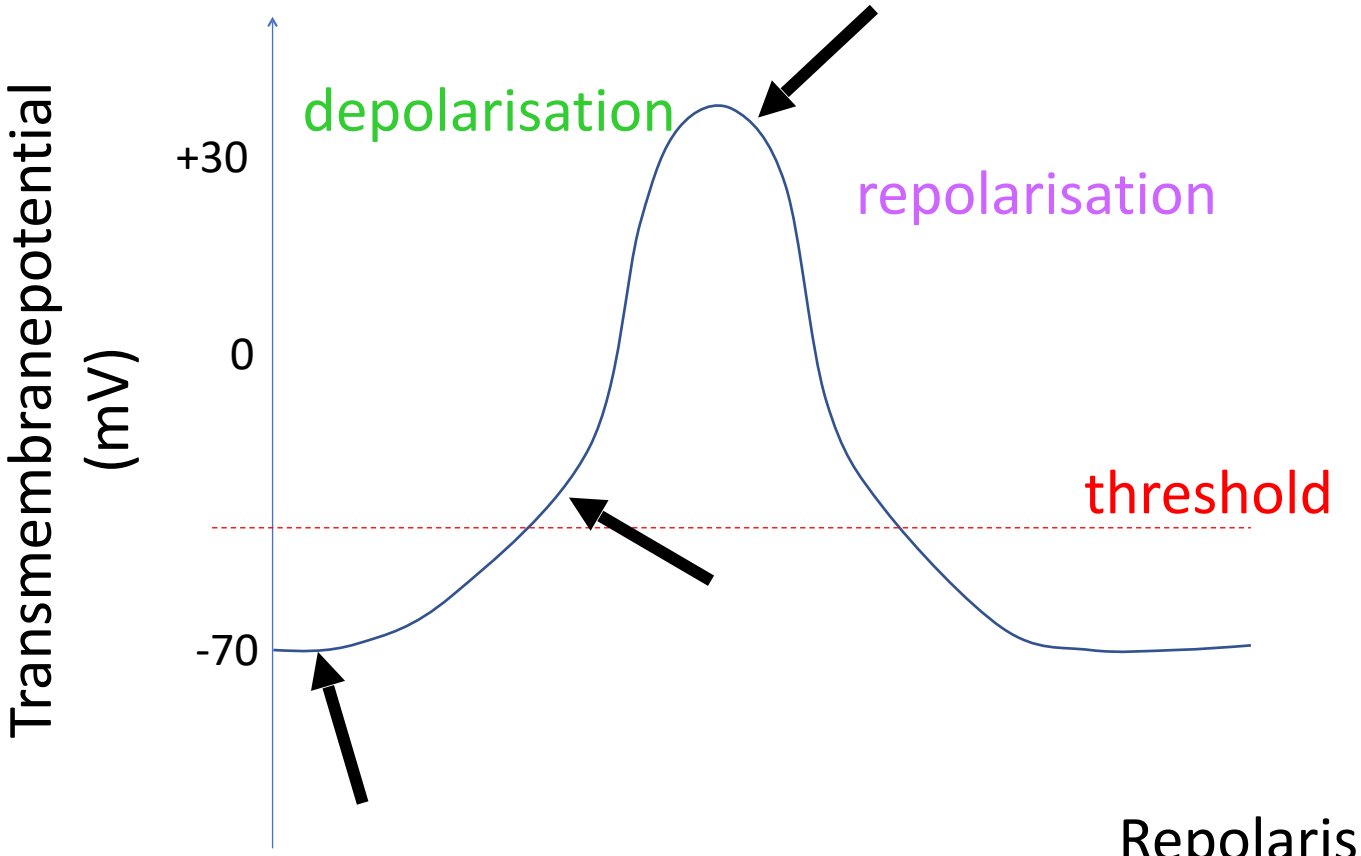


● = action potential

Action Potential: summary

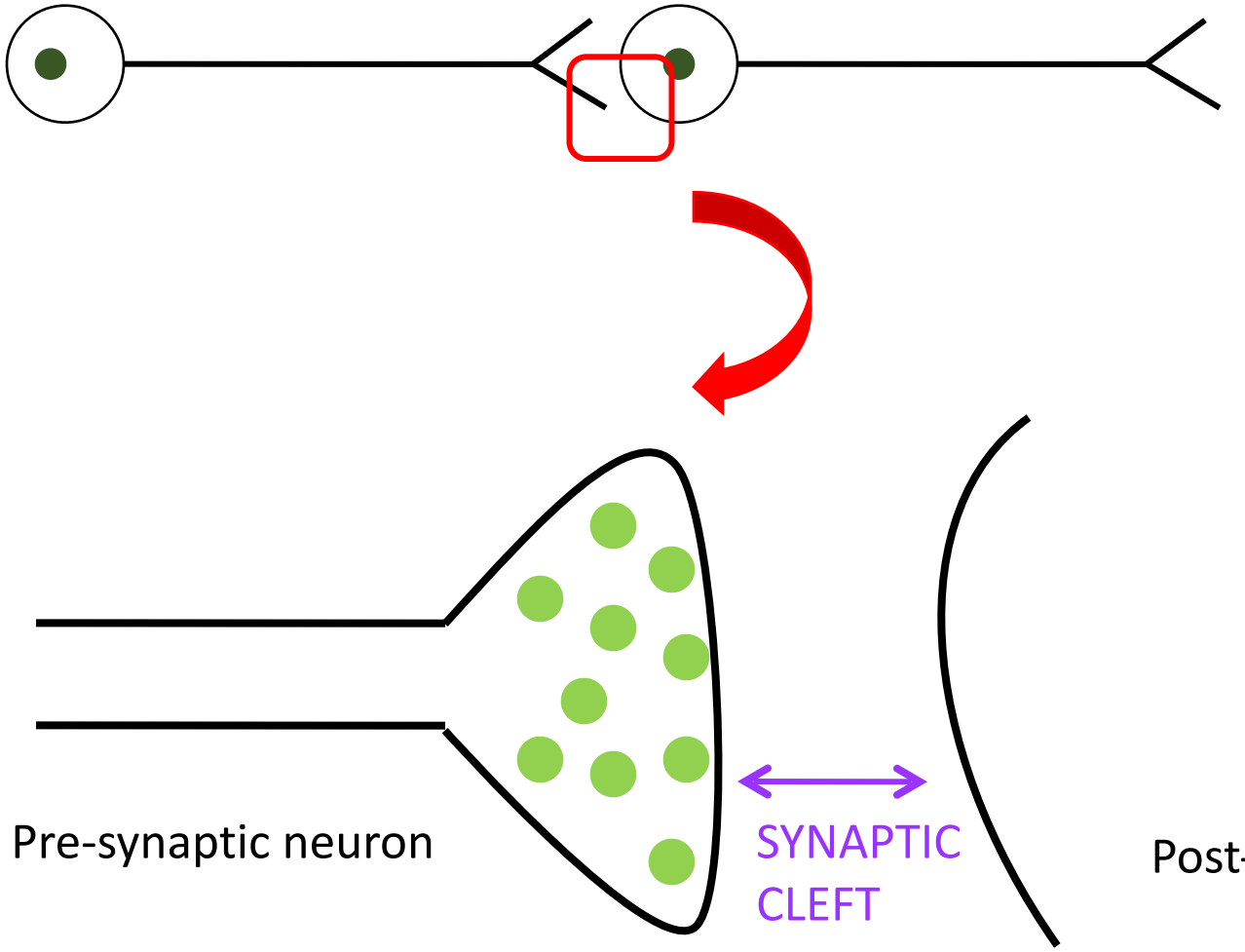
- It is an ‘explosion’ of electrical activity created by a depolarising current.
- It occurs when a neuron sends information down the axon, away from the cell body.
- It is an ALL or NOTHING event.

Action Potentials



Repolarisation occurs due to the sodium/potassium pump

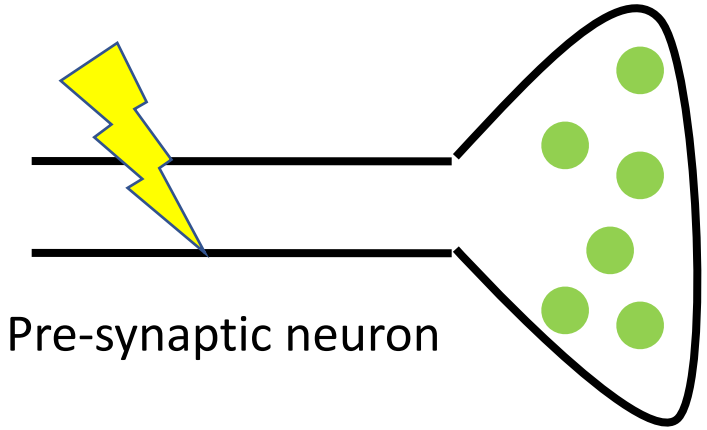
The synaptic cleft



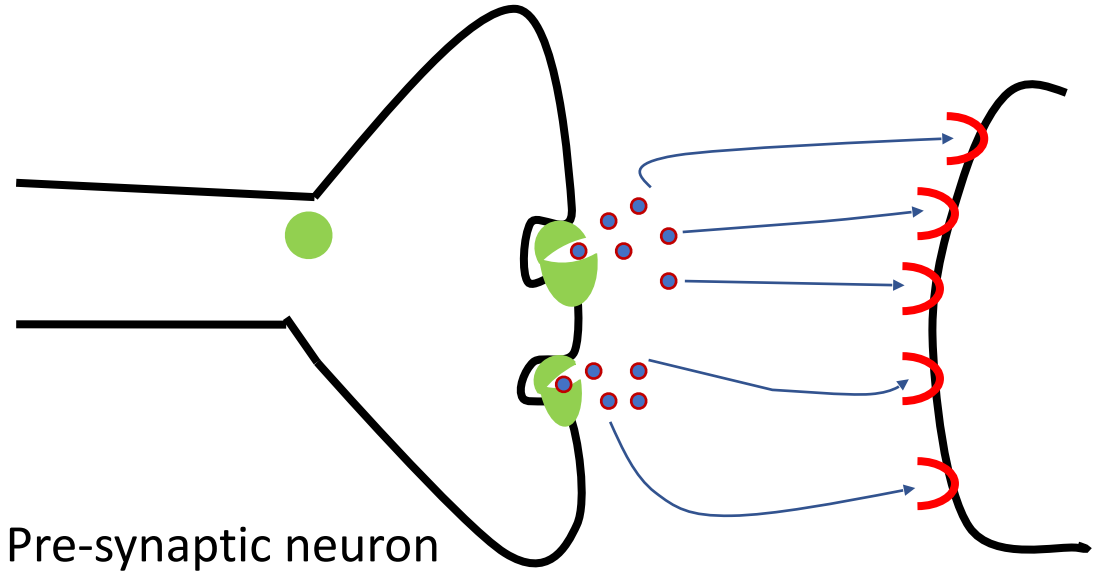
= Vesicles

These contain neurotransmitters (chemical messengers)

Events at the synapse



Action potential reaches axon terminal. Vesicles fuse with the pre-synaptic membrane.



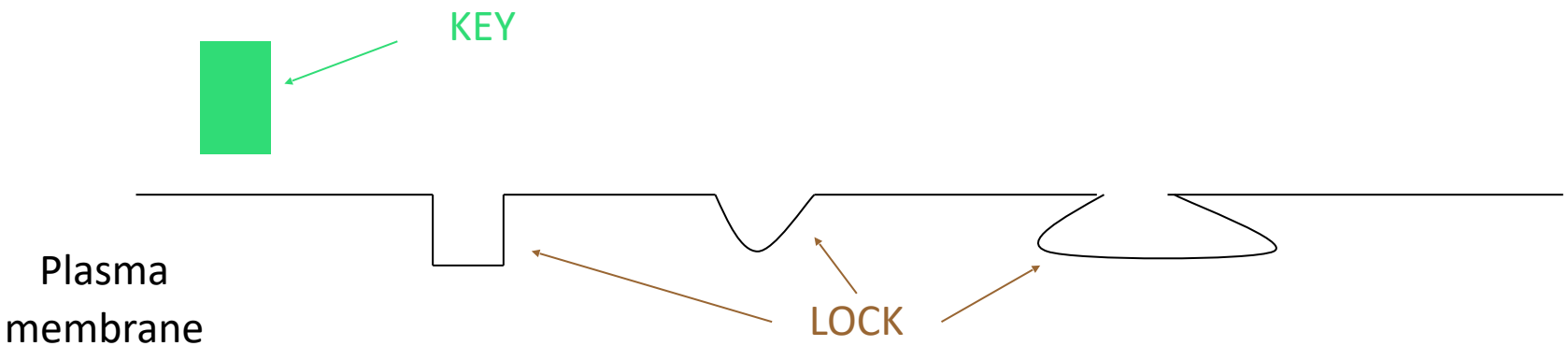
Neurotransmitters are released from vesicles – they travel in the synaptic cleft to bind with receptors on post-synaptic neuron.

Lock and Key

If the key is not the correct shape, it will not unlock the lock

LOCK = receptor

KEY = neurotransmitter/ions/drugs



Summary

- When the action potential reaches the axon terminal, vesicles containing neurotransmitters (chemical messengers) fuse with the pre-synaptic membrane.
- This causes the release of the neurotransmitter into the synaptic cleft (process is called **exocytosis**).
- The neurotransmitter 'locks onto' a shape-specific receptor on the post-synaptic membrane.
- This may cause an excitatory effect (which would give rise to an action potential) or an inhibitory effect (which would dampen down the post-synaptic neuron and cause no action potential to be generated).
- The preceding slides describe a CHEMICAL synapse (typical of most in the nervous system).