1. BRAIN & NEURONAL COMPONENTS

- Neurons require blood vessels for constant E supply → cannot store E
- Glia have complex structure - cover surface of neurons & contact blood vessels
- Astrocytes:
  - Fibrous: among bundles of myelinated axons ∴ in white matter
  - Protoplasmic: in grey matter
- Radial Glia = dvlpment → first to develop from neural progenitors
- Microglia are immune cells ∴ injury response → macrophage derivatives
- Satellite cells acts as support cells in PNS
- Schwann cells & oligodendrocytes produce myelin
- Ependymal cells line ventricles in brain → barriers b/w compartments; source of new neurons

ASTROCYTES

- Hold structure together – number of astrocytes per neuron ↑ w brain complexity
- Synapse is only region of CNS free of glial processes
- Each Astrocyte has own discrete territory → little overlap b/w astrocytes
- Siphon processes attach to blood vessels
  - Produce blood-brain barrier to control selective permeability of molecules to brain
  - Brain only wants/needs certain substances
- Circumventricular organs have leaky blood-brain barrier → communicate w periphery & control body env
- **N.B:** Astrocyte as source of E will likely change blood flow in response to E dependent activity

ECF homeostasis:

- Astrocytes = key components of info processing
  - Rapidly remove neurotransmitter from synaptic cleft to prevent ↑ activation of post-synaptic cell
- Synaptic activity results in extravasation of K+
  - memb potential of glia determined by K ∴ small change in ECF K+ = changes in voltage
  - Depolarization occurs when [K+] changes
- Remove excess K^+ from ECF after AP is fired → possess Na/K ATPase to assist spatial buffering
  - K^+ released from cell is enough to change ECF comp.
  - ↑ K = change in excitability ∴ change in info processing
  - 3mM [K^+] needed for normal neuron fctn
- Astrocytes connected ∴ transmit ions by gap jctn to dissipate through syncytium
  - Gap jctn = 6 connexin subunit proteins forming regulated pore
  - Gap jctn only discriminate molecules based on size
- Inward current of K+ induces local depol of glial cells → spread throughout cell and to neighbouring glia via gap jctn
  - K released into ECF at other regions
- Astrocytes can transmit electrical currents

Responsive Astrocytes

- Astrocytes have transmitter receptors ∴ capable of responding to signals
  - Send info b/w themselves via changes in intracellular [Ca^{2+}]
- - Ca^{2+} = key signalling mediator ∴ activation of intracellular Ca^{2+} via IP_3 & release of intracellular Ca stores

- Activation of neighbouring occurs via gap jctn

Reactive astrocytes:

- Possess receptors for transmitters
- In response to stimulation, glia release gliotransmitters
  - Signal via ATP binding to receptor of distant cell
- Gliotransmitters released by exocytosis ∴ have machinery for vesicular release
  - Transmitter pumped into synaptic-like vesicles
  - Cluster at release sites associated w exocytotic proteins (SNAP, SNARE, VAMP)
- Dense core secretory granules also present - nucleotides and peptides
- Exocytosis slower than in neurons → triggered by IP_3 induced changes in intracellular Ca
- Signalling confined b/c confined territories of glia
- Gliotransmitters allow integration of info in response to stimuli
- Info from synapse moves b/w glia via intracellular Ca2+ & transmitter release
  ∴ ability to modulate neighbouring synapse

RESTING MEMBRANE POTENTIAL

- Neurons = excitable cells
- Imbalance of charge a/c membrane ∴ potential diff allows signalling & AP
- Current = mvmnt of charged ion → can be injected into cell to change RMP
- Mvmnt of current determines direction of potential change
  +ve ion = +ve current
- Graded potentials: local fluctuations in memb potential due to incoming signals
  - Depol or hyperpol → amnt of current α size of potential change
- Reaching threshold generates AP → independent of potential size
  - AP = info processing unit of nervous system
- Imbalance of ions in system
  - [K] higher intracellularly
  - [Na] [Ca] [Cl] higher extracellularly
- **N.B:** Ca has v large [] gradient → small intracellularly b/c taken into organelles
- Ions move a/c [] gradient ∴ E stored along memb
- Ability to communicate derived from gradient of ions

ION TRANSPORTERS

- Ion transporters determine [] gradient
- Pumps use ATP to move ions against [] gradient
  - Na/K ATPase = electrogenic pump using 70% of brain E
  - Binds ions & changes cong. in response to E binding
- Ca2+ pump exchanges H ions
- Na/K pump activity occurs at α Subunit
  - Multiple transmemb spanning domain protein → single aa chain
  - Various binding sites → Na/K site, phosphorylation site for regulatn, ATP binding,
  - Oubain binding can block activity
  - β subunit used for modulation & trafficking to various sites
- Pump establishes Na/K [] gradient
- Ion exchangers use drive of ions from ion gradient to move/ exchange molecules
  - Na/K/Cl exchanger critical for setting intracellular Cl gradient)
- **N.B:** Ion exchangers have binding sites for ion → change conformation to transport ions like pumps whereas ion channels are just holes in memb
- At rest, memb selectively permeable to K