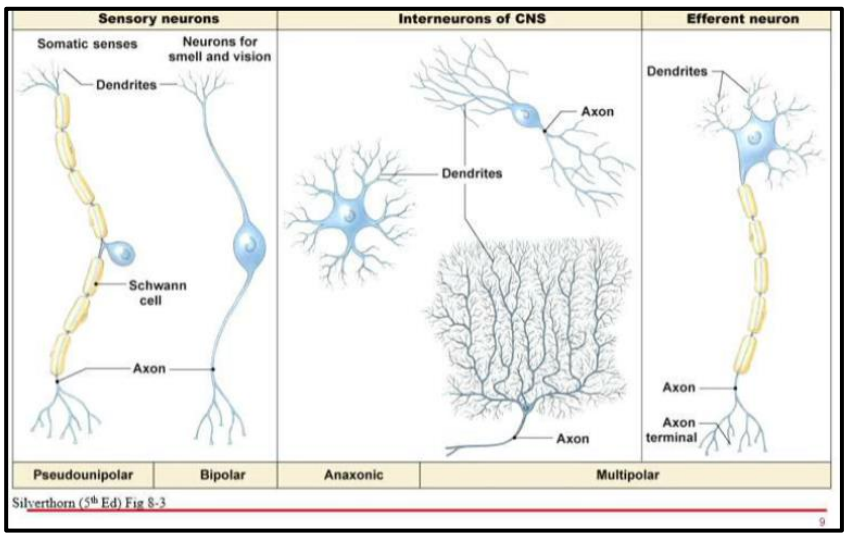
PHSI2601: Physiology for Pharmacy

Introduction to the nervous system

- two parts to the nervous system: central (integrating centre) and peripheral (afferent and efferent pathways)
- stimulus → sensory receptors → electrochemical signals → sensory neurones in afferent pathway feed into CNS → perception constructed → stimulus acted upon (motor commands)
- output can be voluntary by the somatic pathway, which is composed mostly of motor neurones, i.e. the nerve cells that allow us to move
- conversely, output can be via the autonomic pathway (involuntary); maintains homeostasis through body temperature, breathing, etc.
- two types of cells compose the nervous system:
  - neurones are nerve cells: active cells (functional unit of the NS) that transmit information as electrochemical signals through afferent pathway to integrating centre to efferent pathway
  - glia are glial cells: essentially support cells; physically support the neuronal structure, communicate with nerve cells, facilitate transmission of nervous impulses
- neurones are mononuclear cells: complex structure in that various parts to it
  - input: dendrites
  - body: axon
  - output: synapse
- neurones sometimes release neurotransmitters, which will bind at the dendrite on receptors
  - binding may open ion channels
  - neurones have a voltage – channels can allows ions to pass in and out of the cell and alter the membrane potential
- structural components of neurones fundamentally same but may differ relating to function
  - sensory neurones (afferent pathway) have cell bodies localised in ganglia in the middle of the neurone, with either side appearing almost symmetrical
  - efferent neurones have dendrites closer to the cell body
  - interneurons can differ vastly, mostly abundance of dendrites (to relay signal efficiently)



- neurones will form neural networks: connect to function by transmitting and processing information
- convergence vs. divergence of signals
- glial cells found in both CNS (4) and PNS (2)
  - Schwann cells are part of the PNS, oligodendrocytes are part of the CNS; both help form the myelin sheaths around the axon
- for an impulse to propagate along an axon, need an exchange of ions across the membrane; however, this is very slow
  - insulation on a wire accelerates the propagation BUT may cause signal to dissipate as it travels along the axon
  - myelin provides localised insulation, i.e. nodes of Ranvier are sections of unmyelinated axon that separate 2 Schwann cells
  - nodes of Ranvier have high concentration of ion channels
- neurone demyelination can result in the autoimmune disorder multiple sclerosis (MS), where signals are slower to propagate and dissipate with distance
  - immune cells attack and destroy myelin sheath in areas of CNS
  - remyelinating can occur; immunosuppressant drugs can slow down degeneration of existing myelin
- the other glial cells in PNS are satellite cells
- the other glial cells in CNS are
  - microglia: scavengers/modified immune cells (collect pathogens and waste products)
  - astrocytes: help to balance ionic concentration of peripheral environment, help form BBB
  - ependymal cells: help to form choroid plexus, neurogenerative cells (source of neural stem cells)
- bundles of neurones form nerves (PNS) and tracts (CNS)
  - composed of myelinated + unmyelinated axons which are surrounded by protective connective tissue to form a fascicle; several fascicles and blood vessels form a nerve
- in development, neural crest cells fuse together to form a neural tube (via neurulation) which becomes the CNS
- the neural crest itself becomes the PNS
- if anterior neural tube does not undergo neurulation completely/close properly → anencephaly (fatal)
- if posterior neural tube does not close properly → spinal bifida (treatable)
- neurulation (the fusion process) requires folic acid to properly occur
- much of the brain is developed by birth, although connections continue to develop during life