the nervous system: introduction and cell types

neuron

- different parts
  - cell body <- contains nucleus
  - dendrites coming of the cell body
  - axon <- taking information away : when meets cell body is initial segment
- type of glial cells
  - schwann cells: peripheral nervous system
    * support axons of neurons
    * wrap around axon segments
    * electrical insulation
  - oligodendrocytes
    * send several processes
    * myelinates several axons
    * in a way similar job that schwann cell
    * electrical insulation
  - peripheral nervous system
    * schwann
  - central nervous system
    * oligodendrocytes
  - astrocytes
    * support neurons
  - microglial cells -immune cells of central nervous system

membrane potentials

- changes of charges in either side of the membrane
- electrochemical gradient
  - gradient of electrical charged particles
  - set by atp pump
  - outside: Na+ (+) ; inside: K+ (+), more sodium in the outside
  - negative membrane potential
    * more negative charge inside
- equilibrium potential
  - potassium leaves the cell -> more negative inside: negative membrane potential
  - potassium diffuses down chemical concentration
  - inside becomes more negative
  - now electrical gradient is strong and pushes potassium inside
  - when potassium input/output is equal: equilibrium potential for potassium
  - sodium: 60mV
  - potassium: -90mV . resting membrane potential

- ATP
    - 3 na+ out; 2 k+ in; negative membrane potential
- leak channels
    - determine the resting membrane potential
    - more potassium leak channels, less sodium leak channels

- changes in membrane potential
  - polarized: difference in charge (negative)
  - depolarization: less polarized, less negative
  - overshoot: more positive inside, reversal of polarity
  - hyperpolarization: more negative than resting potential
  - repolarizing: becoming more negative but still above resting potential
- graded potential
  - change in membrane dependent in stimulus strength
  - membrane potential decay over distance and time

how to calculate the equilibrium potential

- membrane potential: voltage difference between the inside and the outside of a cell
  - major mobile ions are K+, Na+ and Cl-
  - affected by the different concentration
  - permeability of the plasma membrane to each ion
  - permeability to K+'is super high in the membrane
    - concentration of K+ will determine the resting memebrane potential
- nernst equation
  - formula that describes how the equilibrium potential for an ion is influenced by its concentration gradient across the plasma membrane

action potentials

- voltage gated na+ and k+ channels
  - membrane depolarization gates them
  - Na+ fast
    - inactive and closed states
  - K+ slow
    - inactive state
- unidirectional propagation of AP
  - move one way because of the absolute refractory period of the voltage gates na+ channel

integration of signals

- dendrites: ligand gates ion channels, graded potentials
- cell body (soma): ligand gated ion channels; graded potentials

- axon: voltage gated channels, lowest threshold for initiating an action potential, “integrative zone”

saltatory conduction

- large diameter, myelinated axons transmit action potential very rapidly
- voltage gated channels are concentrated at the nodes
- inactivation of voltage gated na+ channels insures uni-directional propagation along the axon