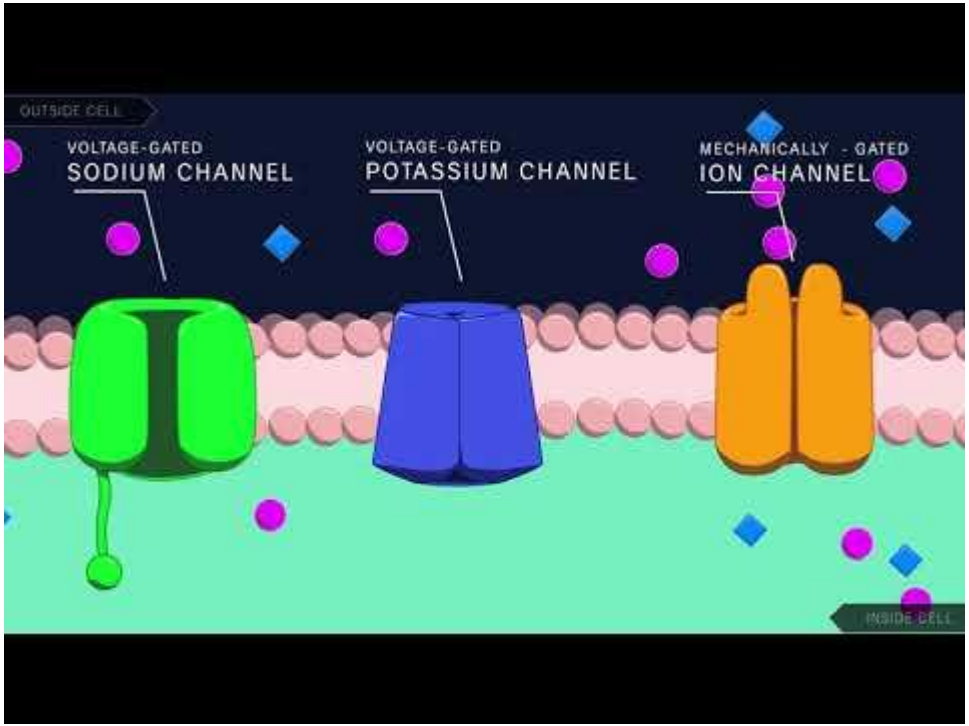
BIO-311 Neuroscience Overview

The neuron

Unit 1 Recap
Membrane potential and channels



https://www.youtube.com/watch?v=oa6rvUJlg7o

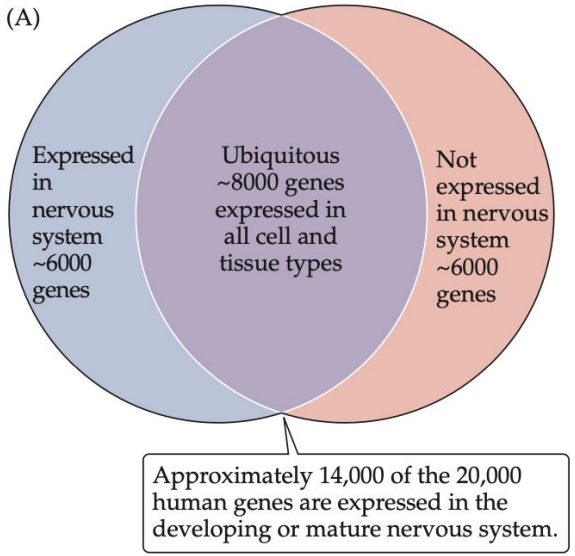
Unit 1: Key points

- Course overview
- Phospholipid bilayer permeability
- Ion concentrations — K^+, Na^+, Cl^- ATPase
- Equilibrium potential — Nernst Equation
- Resting membrane potential
- Passive membrane properties — RC circuit analogy

Reading: Purves *et al*, Chapter 1, page 1–9

Studying the Nervous System

- Genetics and genomics
  - Size of human genome: ~20,000 genes.
  - ~14,000 are expressed in the nervous system, ~6,000 of which are uniquely expressed in the nervous system.



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Studying the Nervous System

- Cellular components of the nervous system
  - Consists of neurons (signal processing) and glial cells (physical and metabolic support)

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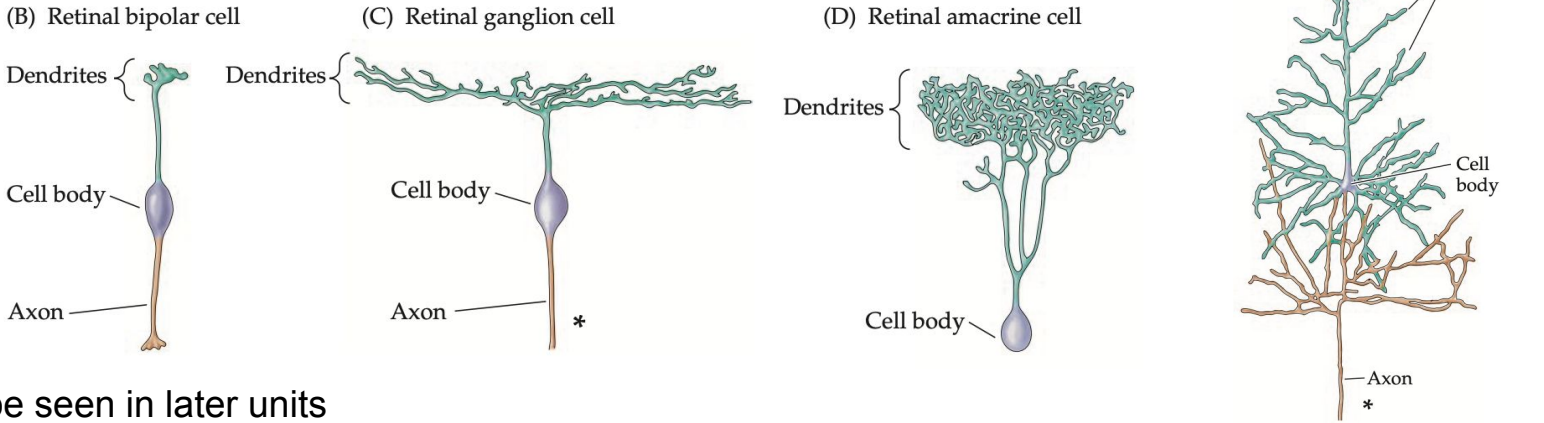
- Neurons
  - Neuronal processes: axons and dendrites.
  - Chemical synapses and electrical synapses (gap junctions).



This will be seen in later units

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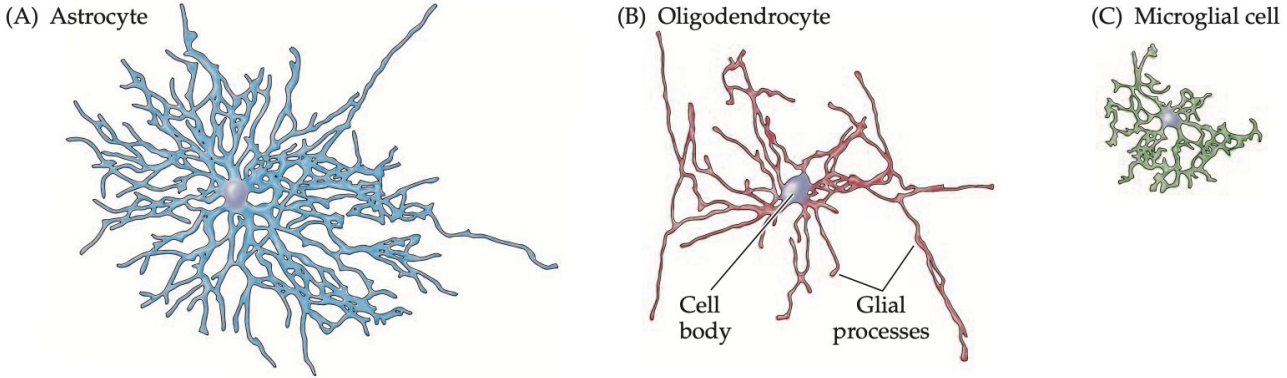
Studying the Nervous System

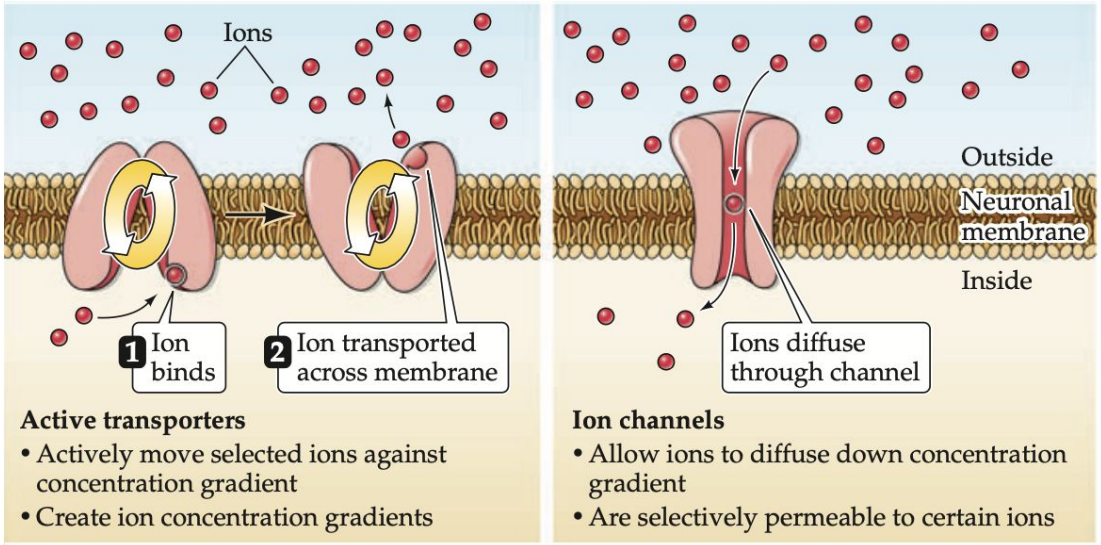
- Cellular components of the nervous system
  - Consists of neurons (signal processing) and glial cells (physical and metabolic support)
- Neurons
  - Neuronal processes: axons and dendrites.
  - Chemical synapses and electrical synapses (gap junctions).
- Glial cells
  - Three types:

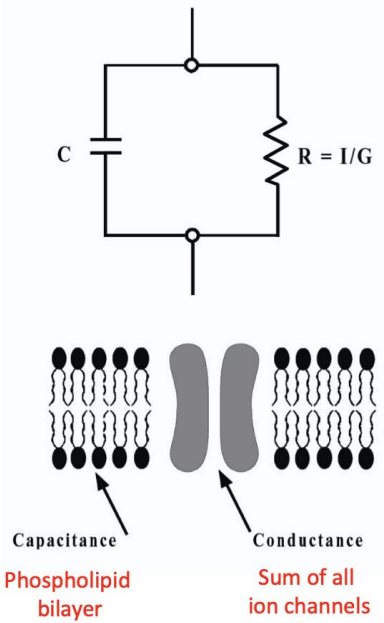


Reading: Purves *et al*, Chapter 2

Electrical Signals of Nerve Cells

- Movement of ions across the membrane
  - **Active transporters**: actively move ions into/out of the cell
  - **Ion channels**: selective permeability, allowing certain ions to diffuse through the membrane (in the direction of the concentration gradient)





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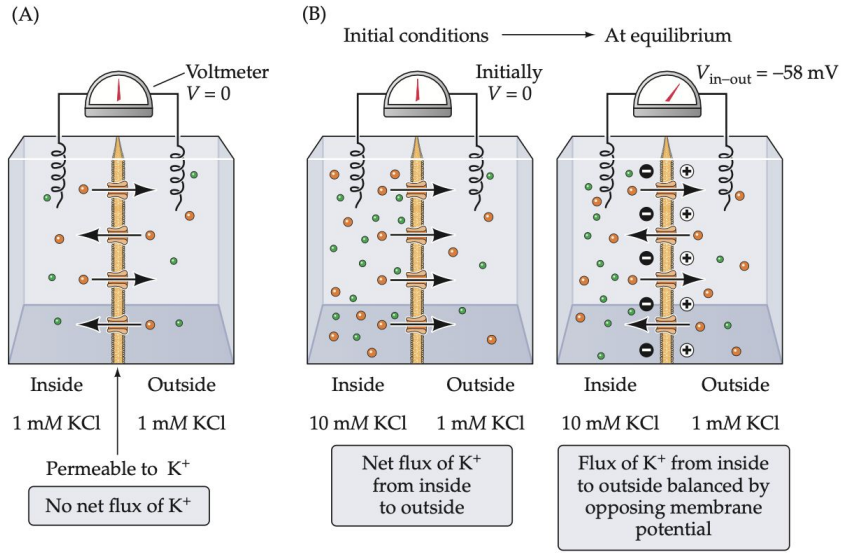
Electrical Signals of Nerve Cells

- Electrochemical equilibrium: resting membrane potentials
  - Balance between 2 opposing forces: (i) **concentration gradient** causing K^+ to move outside, (ii) **electrical gradient** that stops K^+ from leaving
  - One ion: **Nernst equation**; more than one ions: Goldman equation

[X]: concentration of X

$$E_X = \frac{RT}{zF} \ln \frac{[X]_{out}}{[X]_{in}}$$

$$V_m = 58 \log \frac{P_K[K]_{out} + P_{Na}[Na]_{out} + P_{Cl}[Cl]_{in}}{P_K[K]_{in} + P_{Na}[Na]_{in} + P_{Cl}[Cl]_{out}}$$



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Electrical Signals of Nerve Cells

- Action potentials
  - Boosting the spatial spread of electrical signals
  - Depolarization (rising phase) → repolarization (falling phase) → hyperpolarization (undershoot phase)
  - ***… More next week***