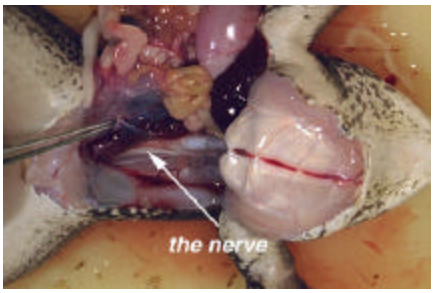
Frog Sciatic Nerve Preparation

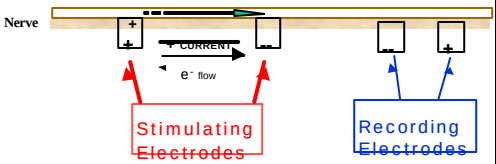
Compound Action Potentials
- Properties of CAPs
- Threshold
- Conduction Velocity
- Refractory Period
- Strength Duration Relationship

Frog Sciatic Nerve Preparation



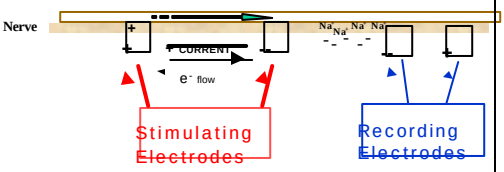
Electrophysiology Recording Methods

Extracellular
Recording

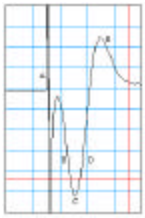


Electrophysiology Recording Methods

Extracellular
Recording

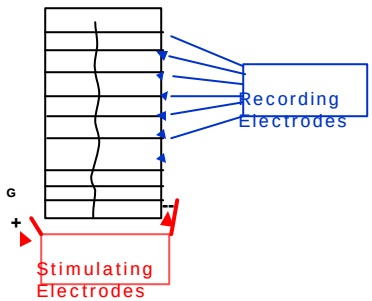


Diphasic CAP

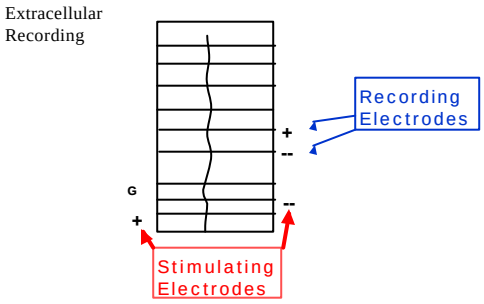


Extracellular Recording

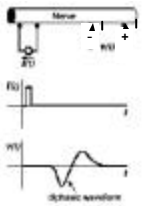
Extracellular
Recording



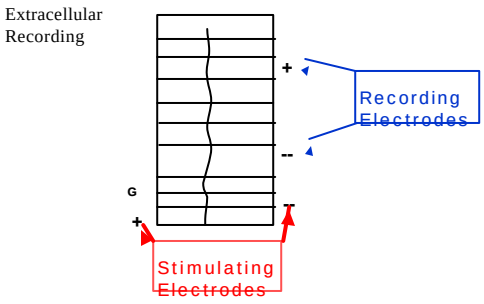
Extracellular Recording



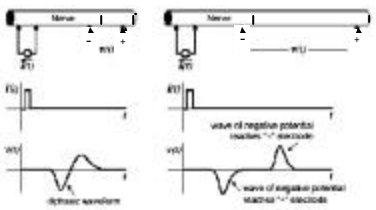
Di or Biphasic CAP



Extracellular Recording

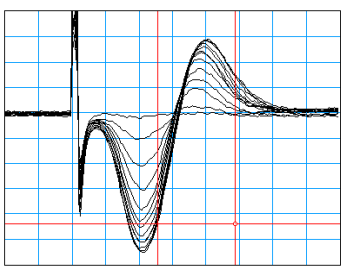


Diphasic v. Monophasic CAPs

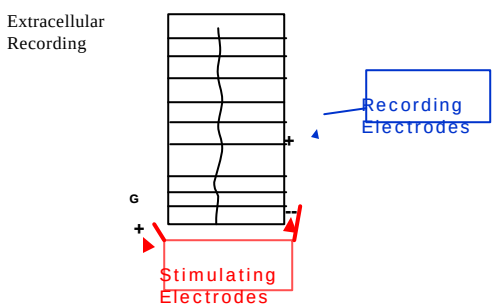


Can the Amplitude Change?

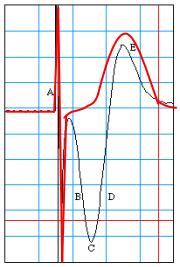
Threshold & Maximal Stimulation



Extracellular Recording

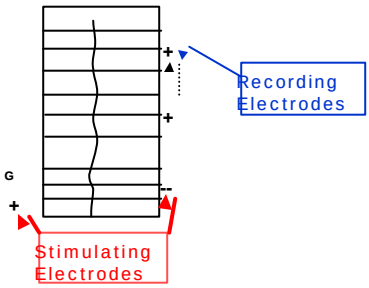


Diphasic v. Monophasic CAP

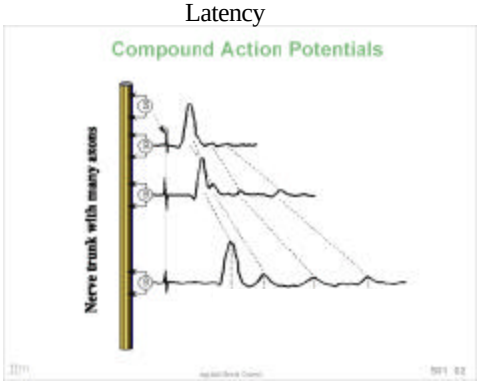


Electrophysiology Recording Methods

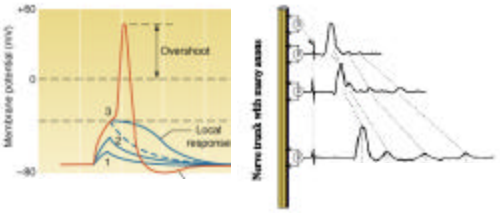
Extracellular Recording



Latency



Action Potential vs. Compound Action Potential (CAP)

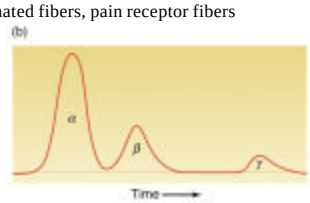


Neuron Fiber Types

- Aα - largest diameter fibers myelinated peripheral neurons
- Aβ - second largest diameter
- Aγ - smaller than α & β fibers
- A δ - smallest & slowest fibers
- B - myelinated sympathetic neurons (not in frog sciatic nerve)
- C - unmyelinated fibers, pain receptor fibers

Largest Fibers are affected first by pressure

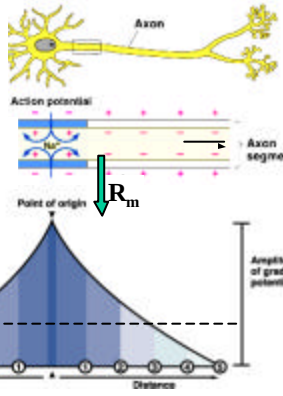
➔ At end of Experiment try crushing the nerve bundle to see if you can eliminate α responses



Vertebrate Neuron Fiber Types

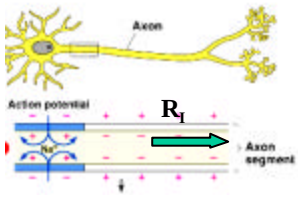
Fiber class	Fiber diameter (mm)	Velocity (m/s)
A a Myelinated skeletal, muscle sensory	18.5	42
A b Myelinated skeletal, muscle sensory	14	25
C Unmyelinated / pain fibers	2.5	0.5

Neuronal Conduction



- An Increase in R_m means current spreads farther along the axon

Neuronal Conduction Speeds



Passive spread of neuronal signal is inversely proportional to Longitudinal Resistance (R_l)

- An increase in R_l means current spreads less

Neuronal Conduction Speeds

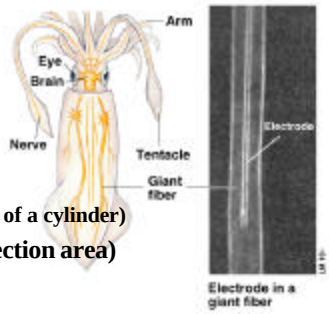
Resistance Decreases as hose radius gets bigger

$R_m \propto 1/2\pi rl$ (S.A. of a cylinder)

$R_l \propto 1/\pi r^2$ (X section area)

$\lambda = \sqrt{R_m / R_l}$

Neuronal Conduction Speeds



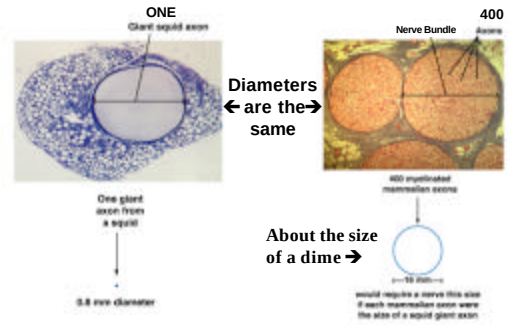
$\lambda = \sqrt{R_m / R_l}$

$R_m \propto 1/2\pi rl$ (S.A. of a cylinder)

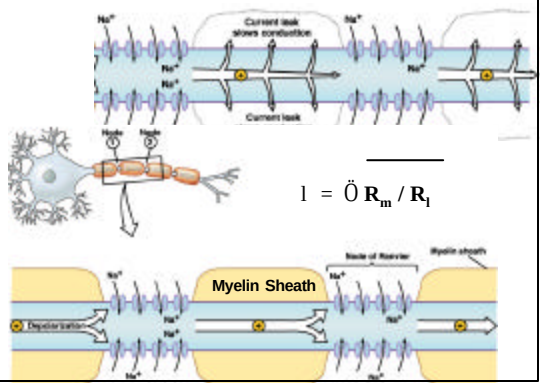
$R_l \propto 1/\pi r^2$ (X section area)

Squid Giant axon is 1 mm in diameter with conduction velocities 10x that of smaller axons.

Neuronal Insulation



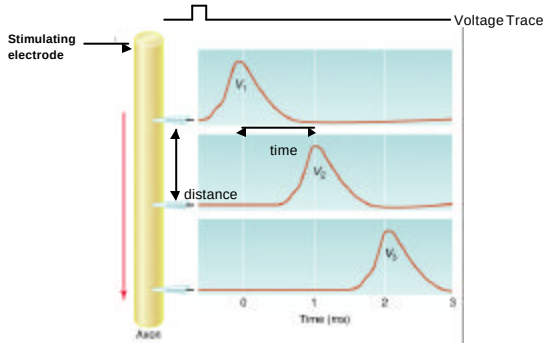
Neuronal Insulation



$\lambda = \sqrt{R_m / R_l}$

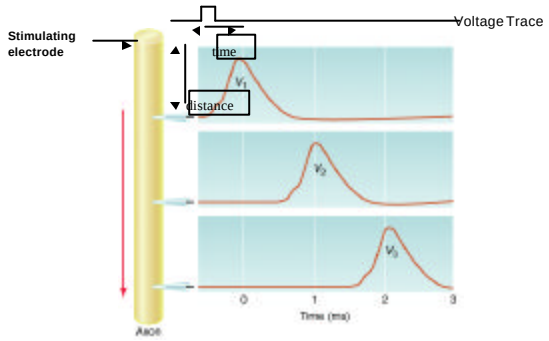
Conduction Velocity- Method 1

Velocity (m/sec) = Distance traveled (mm) / travel time (msec)

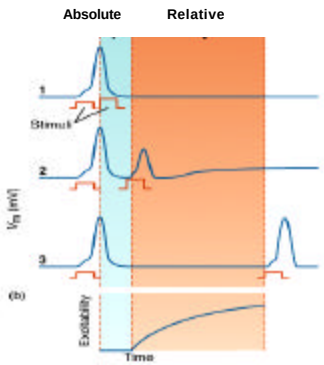


Conduction Velocity – Method 2

Velocity (m/sec) = Distance traveled (mm) / travel time (msec)



Refractory Period



Strength Duration Relationship

Rheobase

-The minimal strength of an electrical stimulus of indefinite duration that is able to cause excitation of a tissue, e.g., muscle or nerve

➔The voltage to which the Strength-Duration curve asymptotes.

Chronaxie

- A Measure of Excitability of neurons. This varies with axon size.

➔ Calculate 2×rheobase

➔Determine the Stimulus Duration at 2×rheobase.

Optional Manipulations

COLD

Early studies on neuronal transmission and AP propagtion used Temperature as a tool. What effect does temperature have on Conduction Velocities?

Nerve Block by Crushing

Large diameter axons are affected more than small diameter axons by pressure.

Partial crushing of the axon AT THE END of the lab may allow you to identify other classes of neurons in addition to the Aα fibers.