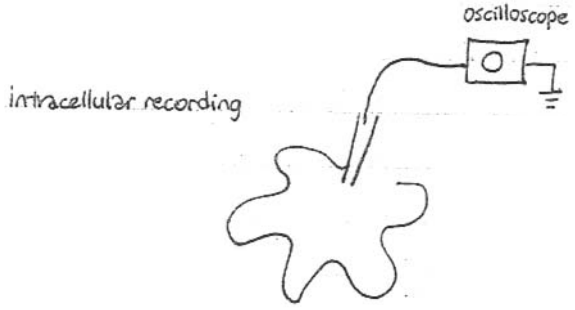
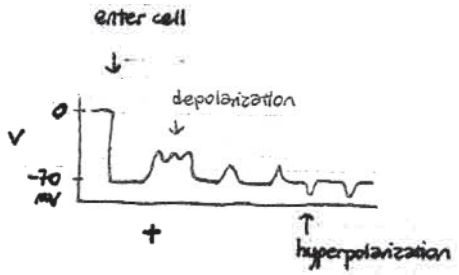
2/9/04

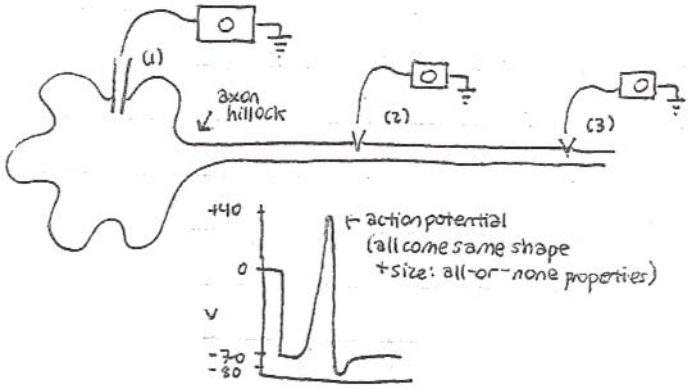
axon hillock - between cell body + axon





- same synapses depolarize, some hyperpolarize

- summation of depolarizations may depolarize membrane sufficiently to cause action potential



reading from (2) or (3): will be same, undiminished in size

- from 3m/s to 100m/s (not speed of light)
- unlike readings from (1), which do diminish in size as propagated

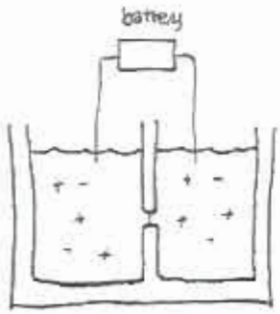
synaptic potentials

- Summation of ΔV at axon hillock to -55mV (threshold) will give action potential

refractory period - time after action potential during which you can't get another action potential

relative refractory period - push harder, get "puny" action potential (smaller amplitude)

- axons usually ~10μm in diameter; up to 1mm in giant squid axons
  - Hodgkin + Cain (sp?) squished all cytoplasm to end of axon w/ rubber roller, squeezed out like toothpaste
    - did + flame photometry on squished out cytoplasm to see $[Na^+]$, $[K^+]$
      - found more K^+ inside, Na^+ outside
    - reinflated axon with appropriate salt solution (no other cytoplasmic elements): got action potential (all in membrane)



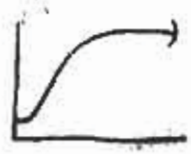
2 salt water chambers, hole (~ ½ mm in diameter)
can paint phospholipid across hole, form bilayer membrane

- salts in solution (Na^+ and Cl^- ?), apply voltage across membrane, measure conductance etc

R = ohms, resistance
g = conductance ($= \frac{1}{R}$), measured in siemens

- artificial membranes much less conductive than real ones with proteins

- put step voltage across membrane, will get to max w/ exponential decay

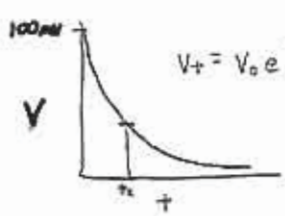


$\tau = RC$ (if you know resistance and τ, can get C)

- C depends on area of plates and plate distance between them (putting in proteins will change resistance but not capacitance)

lipid bilayer 

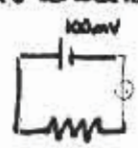
↑ protein (make hole lined w/ polar groups so ions can go through)



$V_+ = V_0 e^{-t/RC}$ $\quad \frac{t_c}{RC} = V_0 e^{-1}$

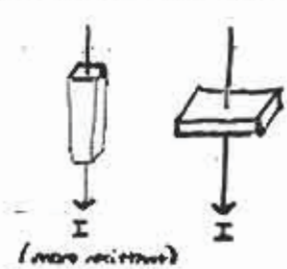
look at exponential decay after short circuit

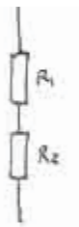
for homework: know how to measure conductance, resistance, make circuit w/ Ohm's law



$V = IR$
$I = gV$

how does property of resistor depend on shape?





$R = R_1 + R_2$

resistance proportional to length

if same length, skinny more resistant than fat

(because fat like resistors in parallel)

$R = \rho + \frac{l}{A}$ ← cross section

resistivity

- how do you measure capacitance in an RC system? charge or discharge

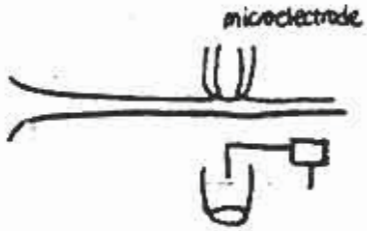
time it takes to get to max is measure of capacitance (know R & t)

$V = V_f (1 - e^{-t/RC})$

- neurotransmitter can bind ligand-gated channels, let Na^+ in (depolarize) or K^+ out (hyperpolarize)

action potential - Na^+ channels opened by voltage, depolarize axon, positive feedback depolarization until saturated, then channels close

patch clamp:



apply suction w/ microelectrode, form tight seal w/ membrane

tear patch away from axon

put voltage across membrane (-75 mV outside)

measure current

ion channels

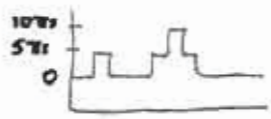
conductance

ion selectivity - Na^+

K^+

Cl^-

Ca^{++}



current is quantized

patch contains 1-3 of same channel, see current caused by opening & closing of channels

quantization of channel conductances; all- or-none

gating

- ligand (small molecules)
- voltage
- second messenger (phosphorylation eg by PKA or dephosphorylation)

7.29J / 9.09J Cellular Neurobiology

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