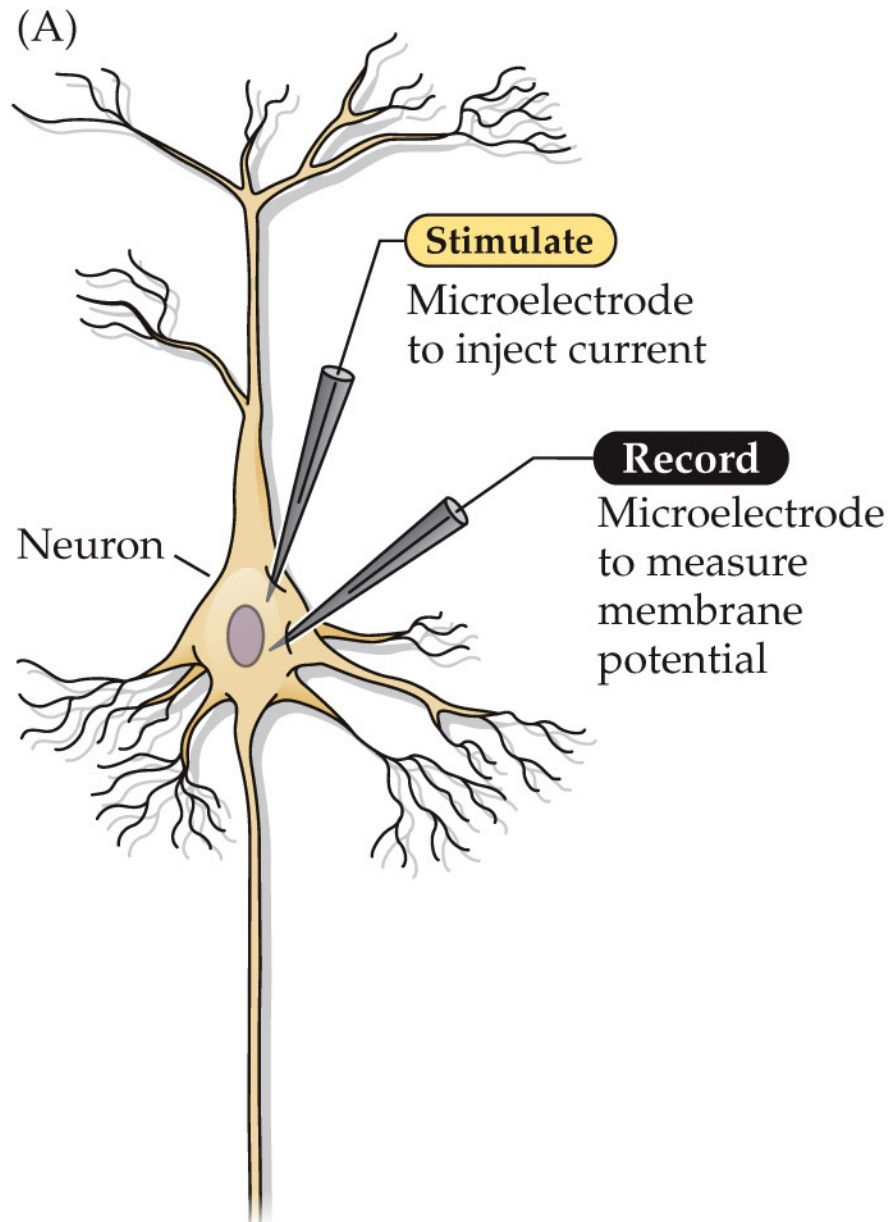


BMD ENG 301

Quantitative Systems Physiology (Nervous System)

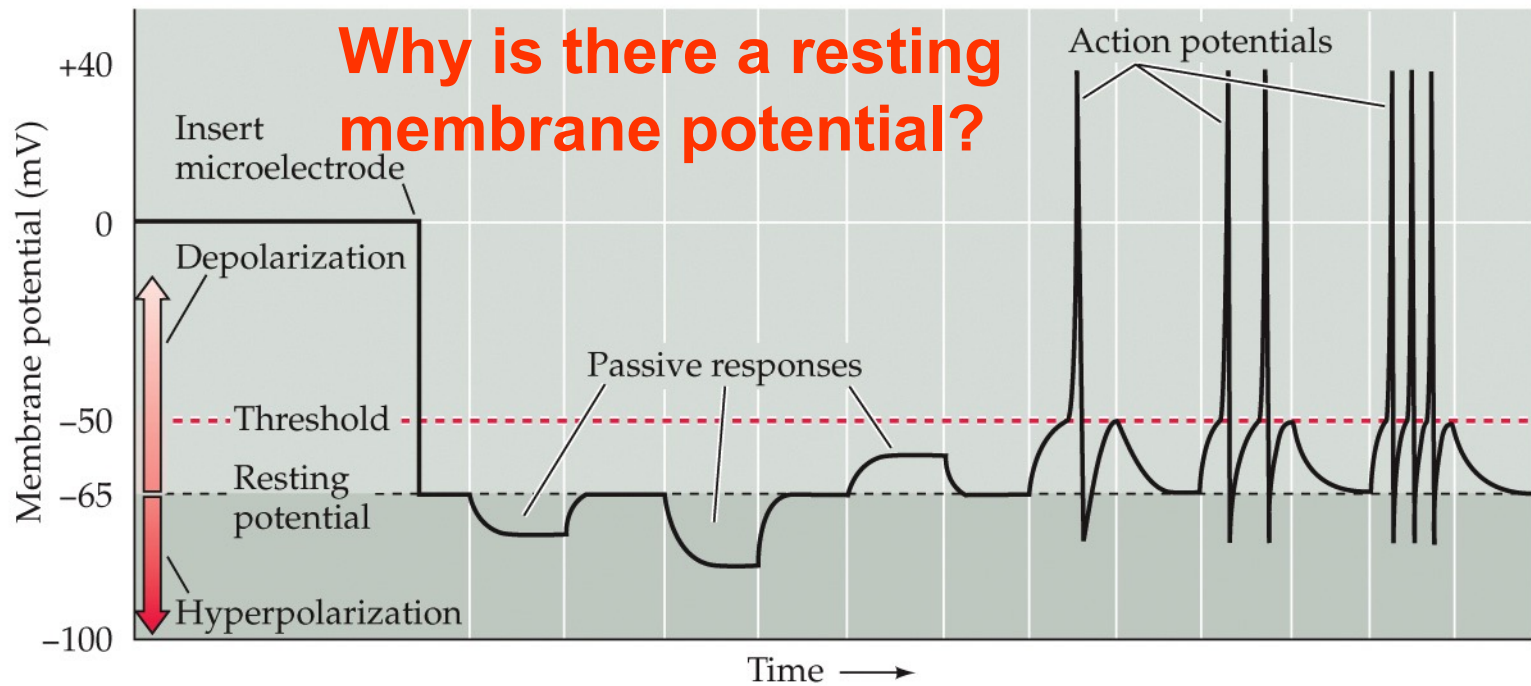
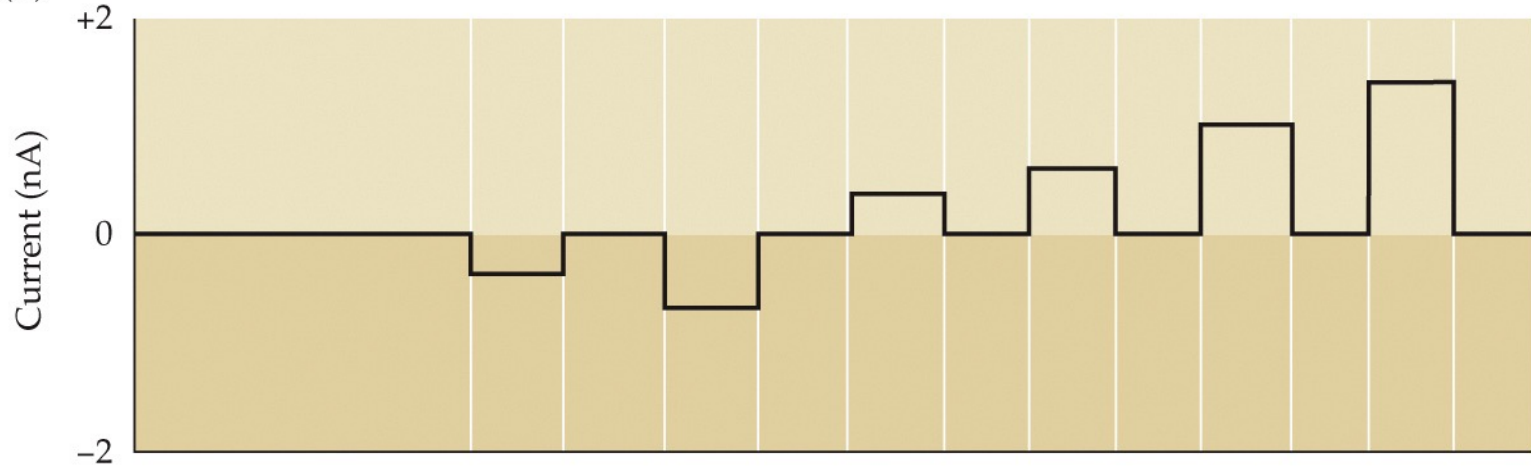
Lecture 5: Resting Membrane Potential
2022_v1

Professor Malcolm A. MacIver

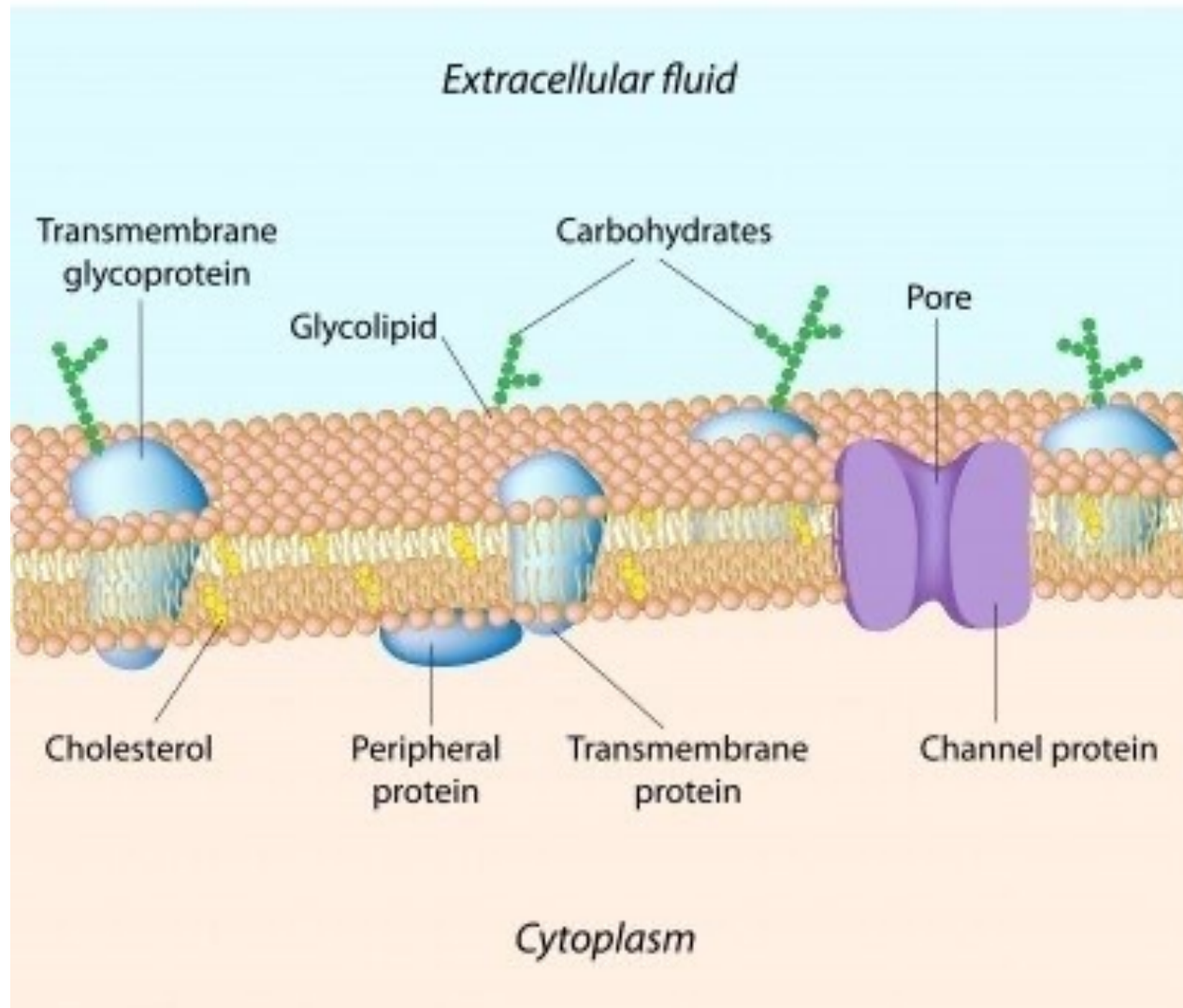


Recording passive and active electrical signals in a nerve cell

(B)



Plasma Membrane Structure



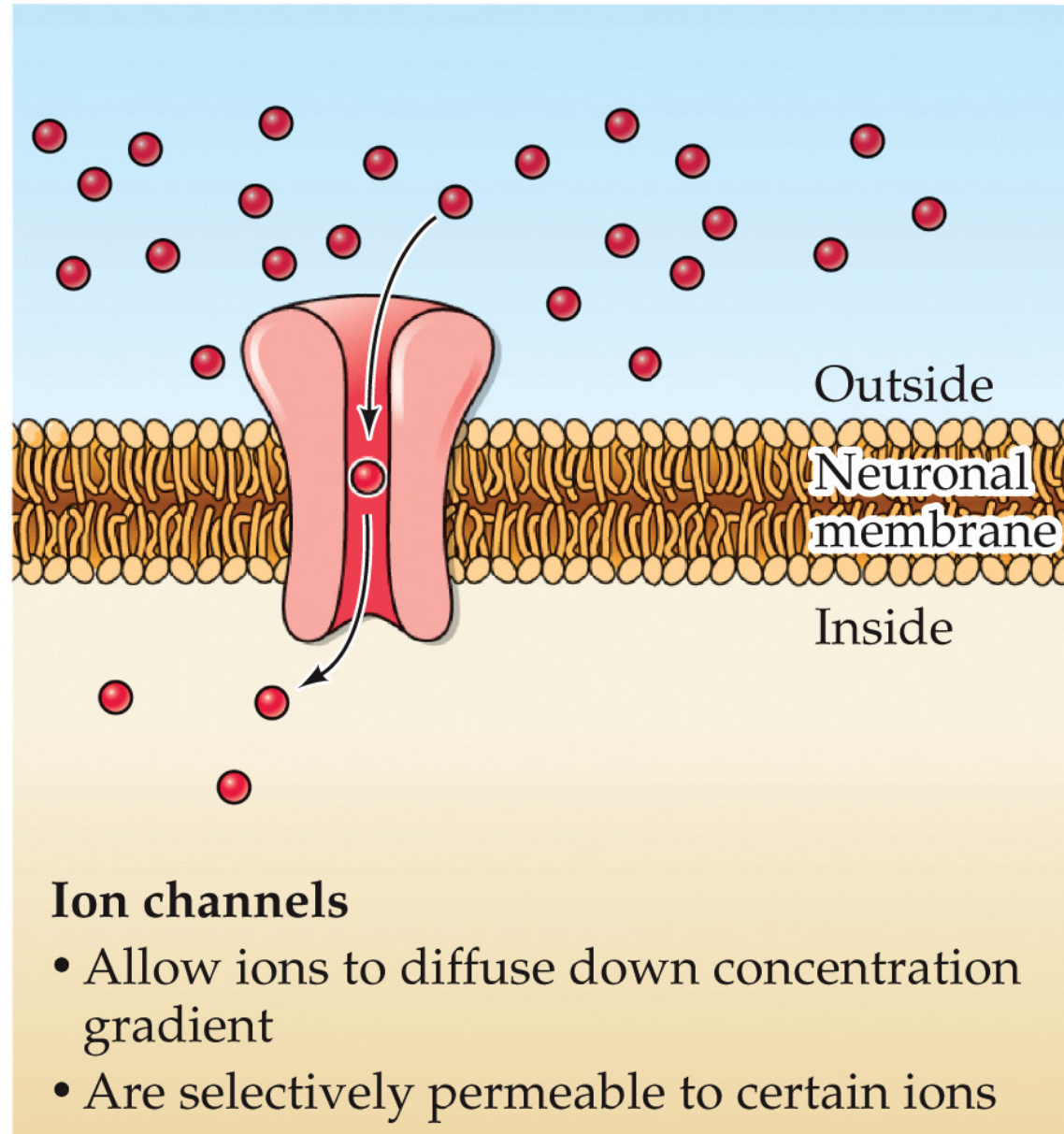


TABLE 2.1 ■ **Extracellular and Intracellular Ion Concentrations**

Ion	Concentration (mM)	
	Intracellular	Extracellular
Squid neuron		
Potassium (K^+)	400	20
Sodium (Na^+)	50	440
Chloride (Cl^-)	40–150	560
Calcium (Ca^{2+})	0.0001	10
Mammalian neuron		
Potassium (K^+)	140	5
Sodium (Na^+)	5–15	145
Chloride (Cl^-)	4–30	110
Calcium (Ca^{2+})	0.0001	1–2

Squid Axon

Intracellular: $400 + 50 - 95$

Extracellular: $20 + 440 + 20 - 560$

Mammalian Neuron

Intracellular: $140 + 10 - 17$

Extracellular: $5 + 145 + 3 - 110$

TABLE 2.1 ■ Extracellular and Intracellular Ion Concentrations

Ion	Concentration (mM)	
	Intracellular	Extracellular
Squid neuron		
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Squid neuron

- Intracellular excess of cations
- Extracellular excess of anions

Mammalian neuron

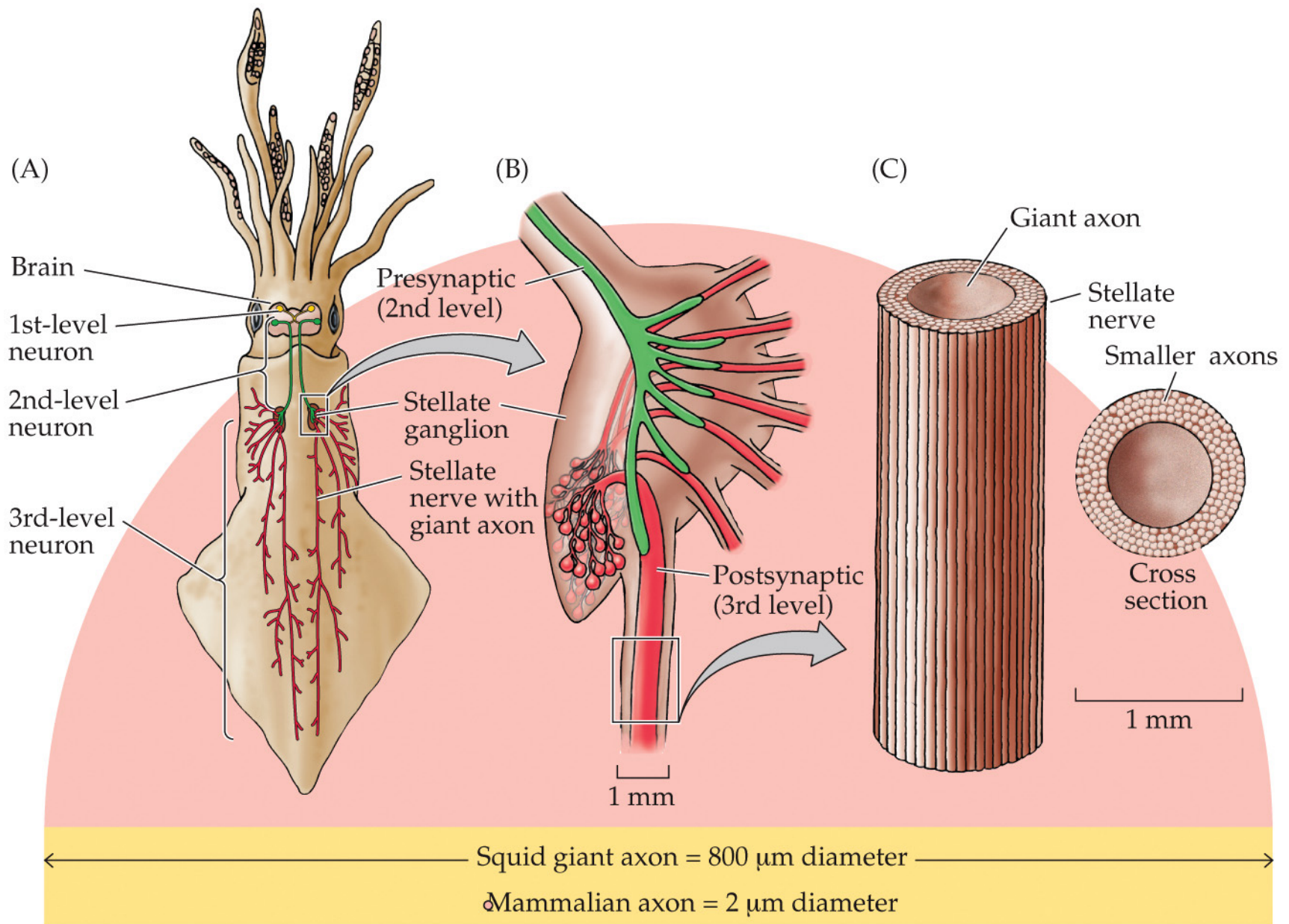
- Intracellular excess of cations
- Extracellular excess of cations

One might expect there to be an excess of intracellular anions and extracellular cations to account for the negative resting membrane potential, but a -65 mV membrane potential is obtained without affecting mM ion concentrations.

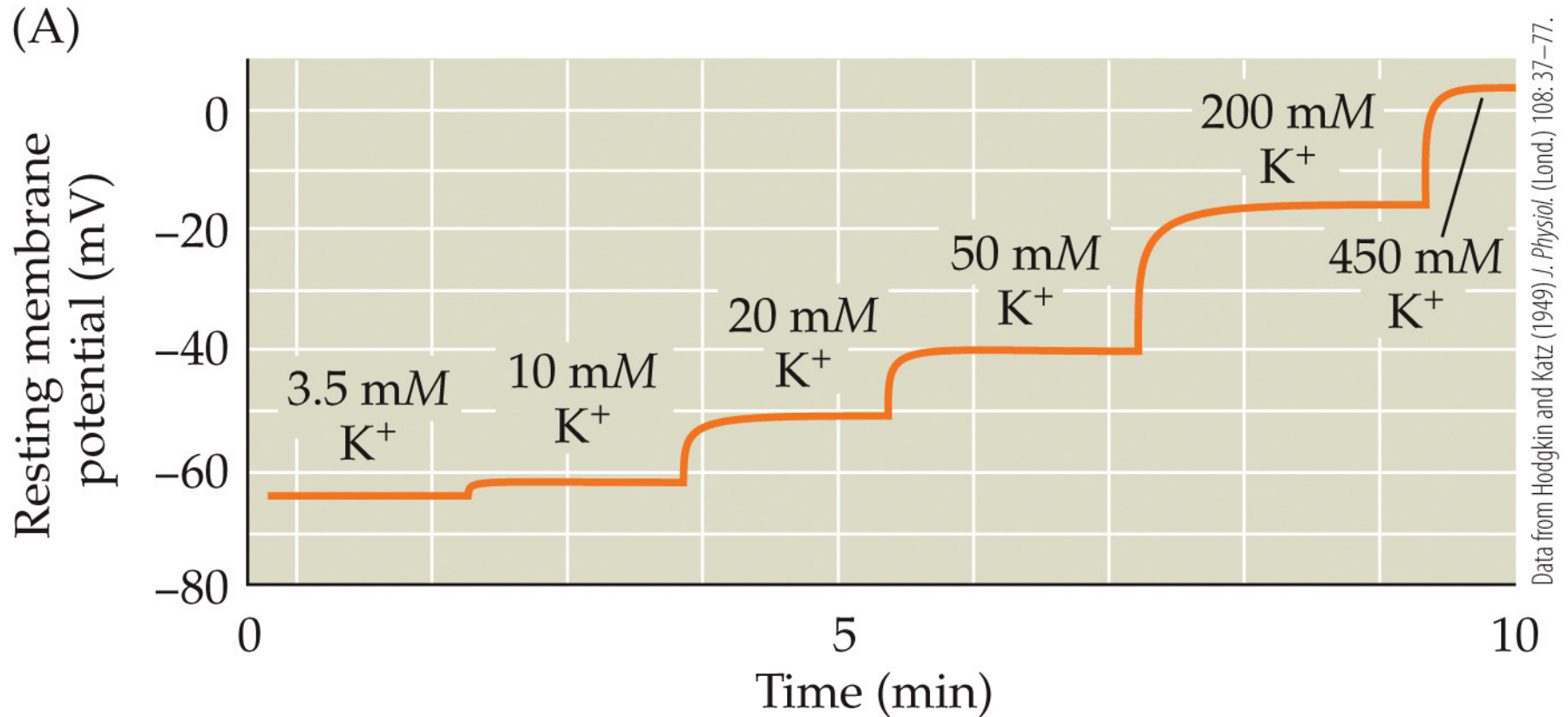
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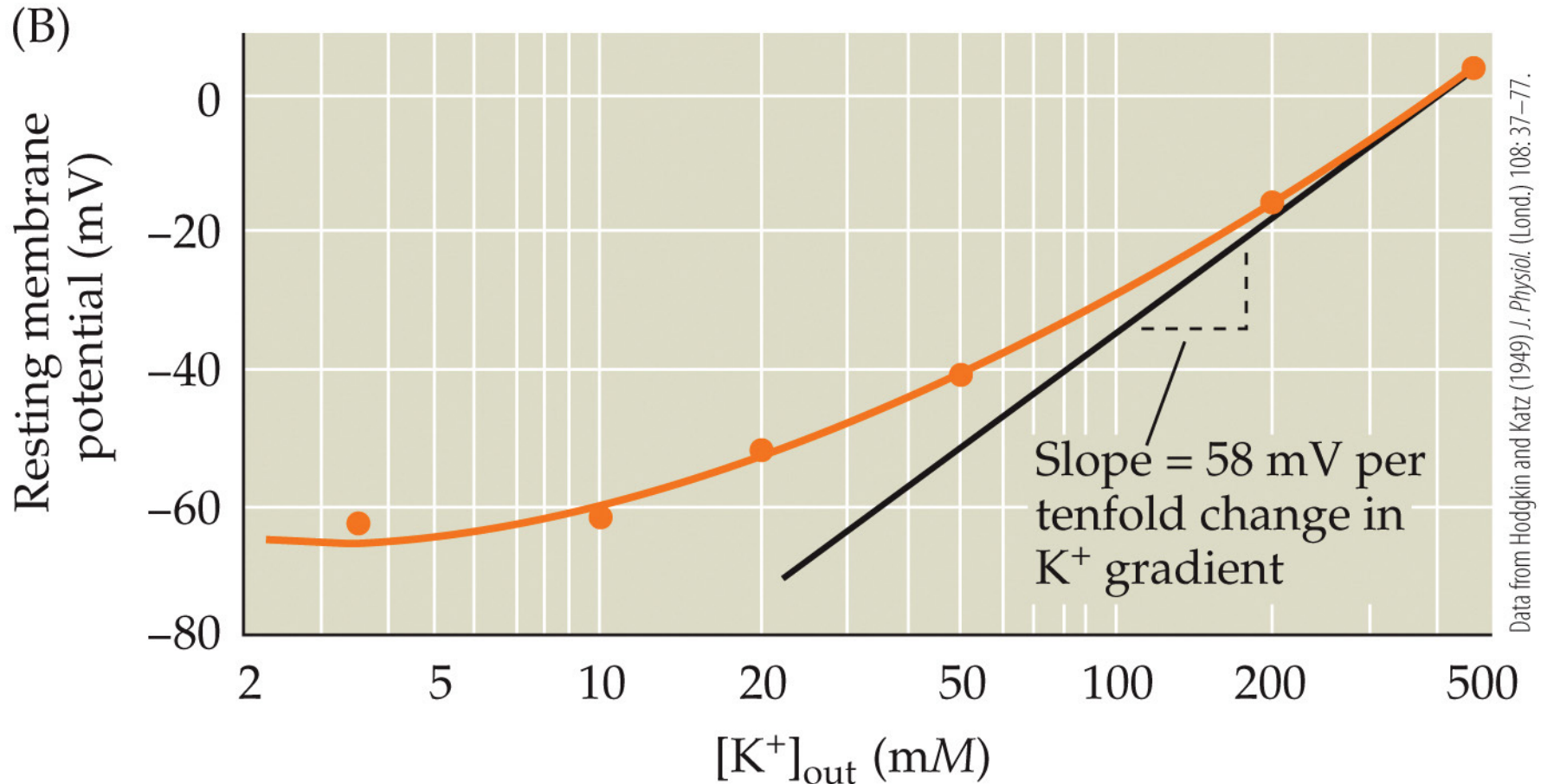
The Remarkable Giant Nerve Cells of Squid



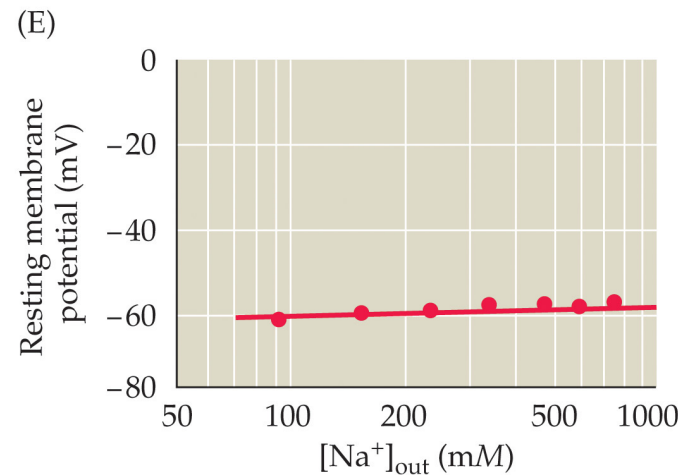
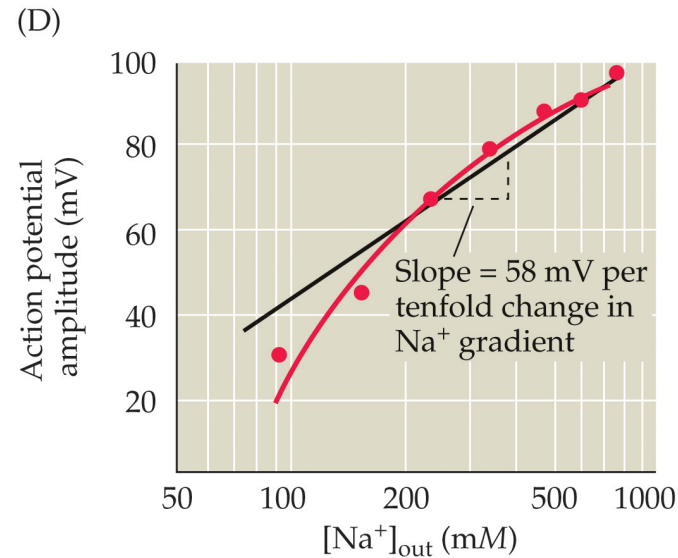
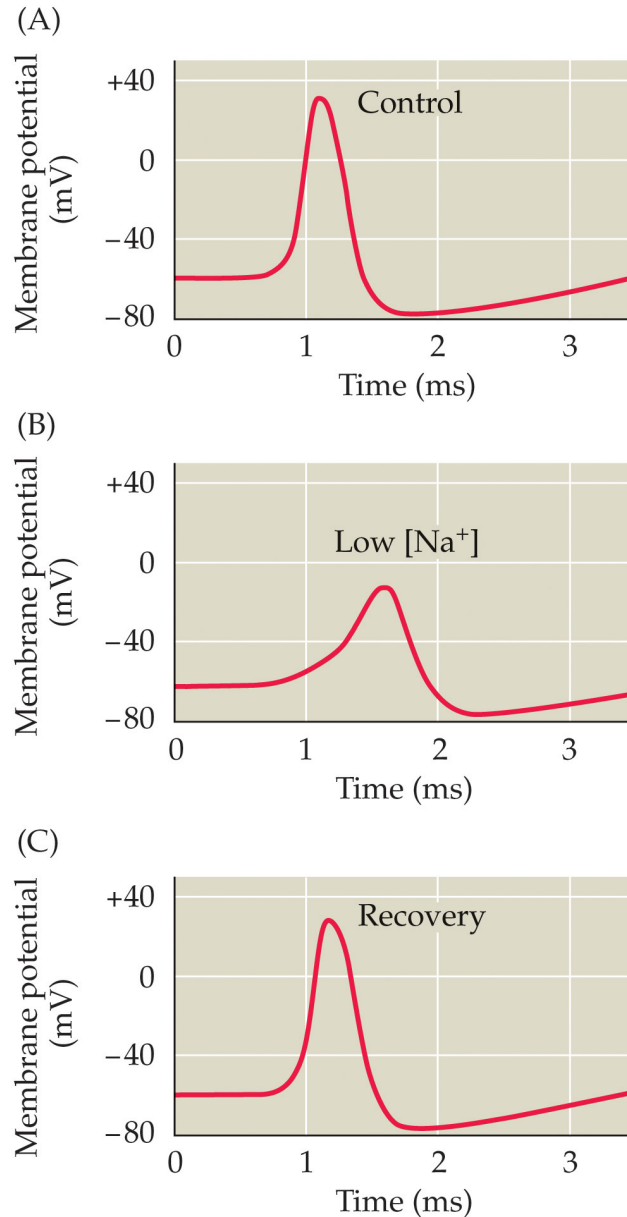
The resting membrane potential of a squid giant axon is determined by the K^+ concentration gradient across the membrane



The resting membrane potential of a squid giant axon is determined by the K^+ concentration gradient across the membrane



The role of Na^+ in generating an action potential in a squid giant axon



After Hodgkin and Katz (1949) *J. Physiol. (Lond.)* 108: 37–77.

Resting membrane potential
does depend on $[\text{Na}^+]_{\text{OUT}}$

Resting membrane potential depends on both K^+ and Na^+ , but the dependence on K^+ ions is clearly more important