

BIOL3833

Week 3b: Ion channel function

$$V = I \cdot R$$

$$I = G \cdot V$$

$$I_{\text{ion}} = (V_m - E_{\text{ion}}) * G_{\text{ion}}$$

$$V_m = \frac{g_K E_K + g_{Na} E_{Na}}{g_K + g_{Na}}$$

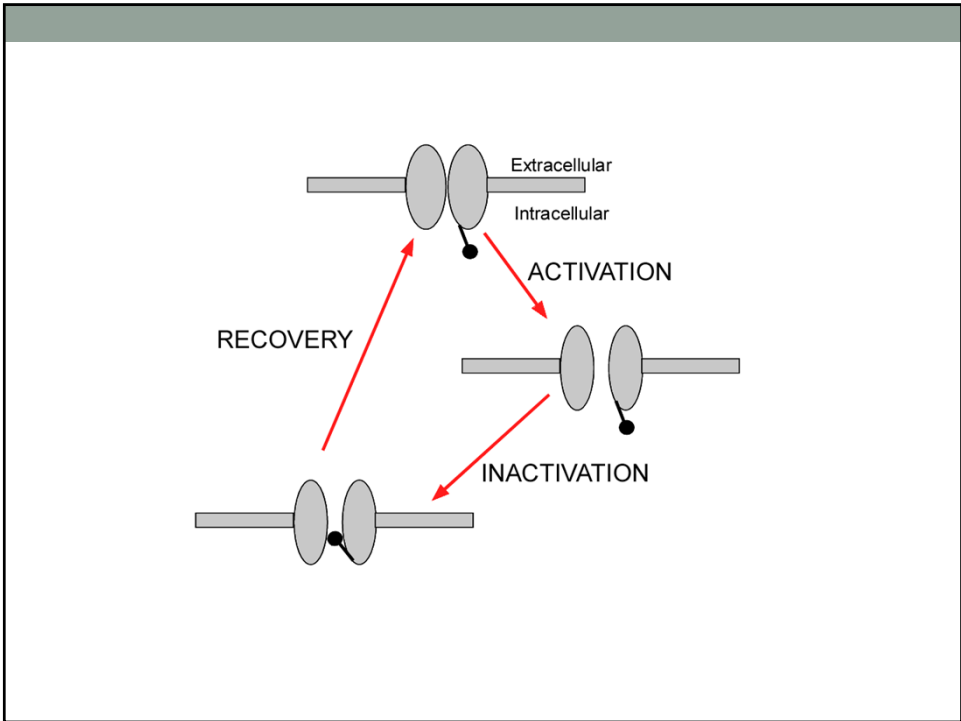
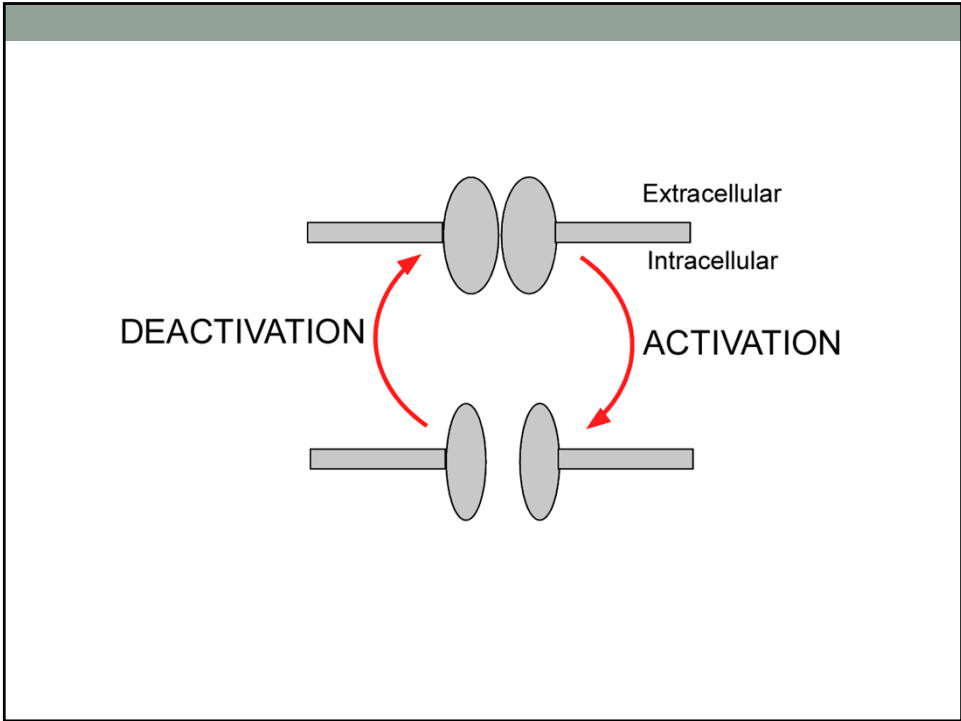
What is G?

Ion channels!

- Today – Analysis of ion channel function
- Tuesday – Simulations: voltage clamp experiments
- Thursday – Structure of ion channels

Ion channel function

What do we care about?



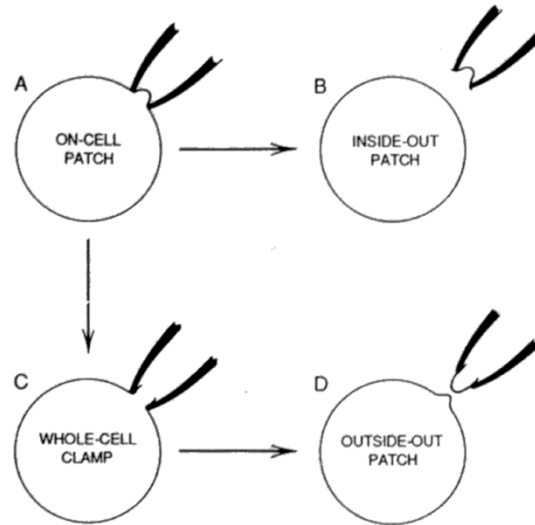
We care about:

- Activation, Deactivation, Inactivation, Recovery
- For each of these processes
 - Voltage dependence
 - Kinetics

How do we study ion channel function?

Voltage Clamp

Patch clamp:

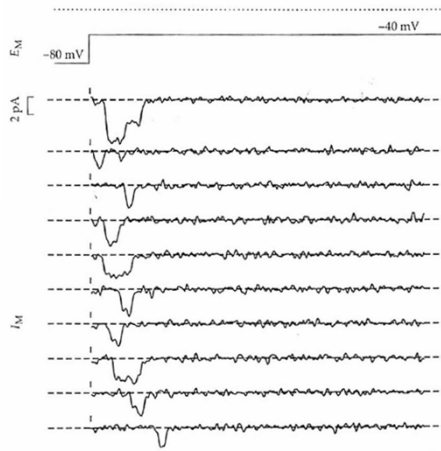


Patch movie

The opening and closing of single ion channels

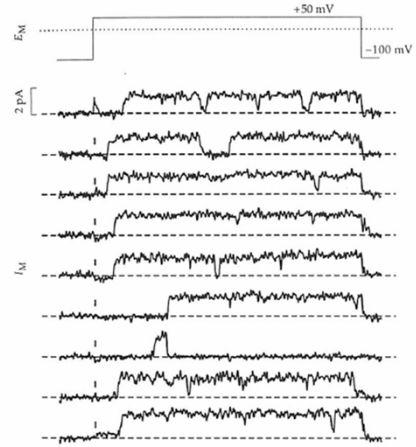
Sodium Channels

(A) UNITARY Na⁺ CURRENTS



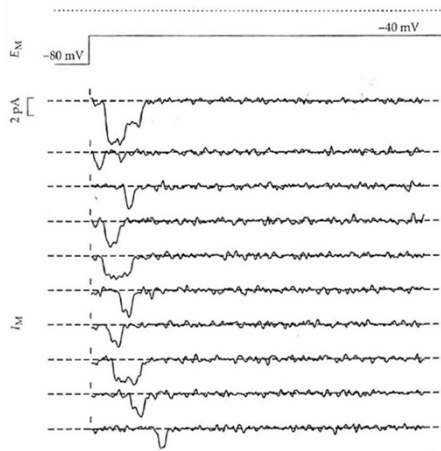
Potassium Channels

(A) UNITARY K⁺ CURRENTS

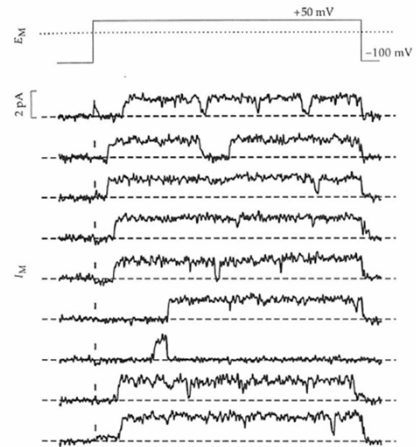


The opening and closing of single ion channels

(A) UNITARY Na⁺ CURRENTS

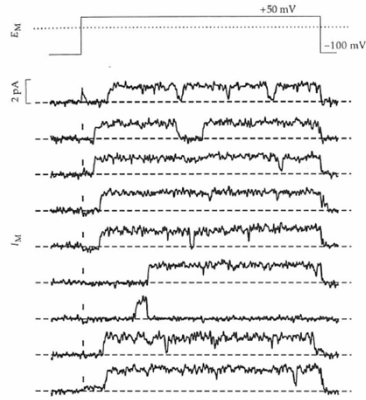


(A) UNITARY K⁺ CURRENTS

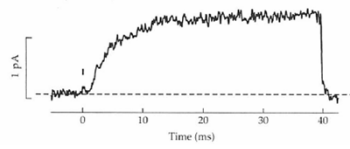


Single-channel currents

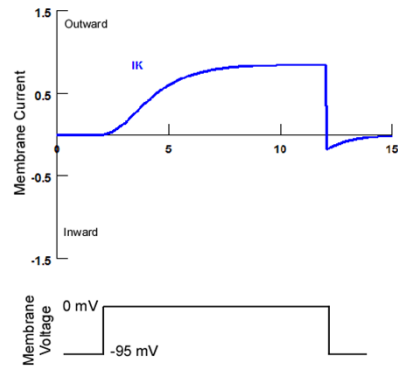
(A) UNITARY K^+ CURRENTS



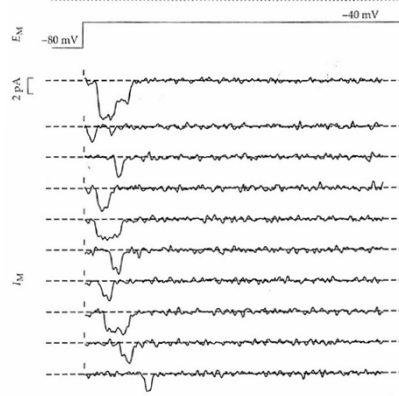
(B) ENSEMBLE AVERAGE



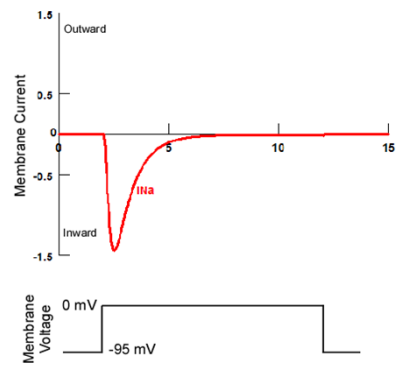
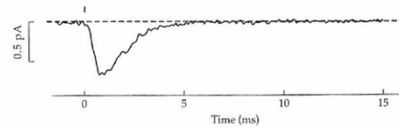
Whole-cell currents



(A) UNITARY Na^+ CURRENTS



(B) ENSEMBLE AVERAGE



Interpreting voltage clamp “families”