Proposal: Application of a long duration constant current to the Hodgkin Huxley model produces a train of action potentials.

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Hypothesis: The frequency of the action potentials increases with increasing current amplitude.

Background: According to the Gerstner and Kistler book *Spiking Neuron Models: Single neurons, populations, plasticity*, Cambridge University Press 2002, Example 2.2.2.3 *Step Current Input*, the responce to a step current of amplitude ΔI can either be a graded potential in the inactive regime *I*, an action potential in the single spike regime *S* or a train of action potentials in the repetitive firing region *R*. The periodic action potential frequency in the *R* region should be proportional to the Step Current Input amplitude.

Procedure: We will simulate the HH model for varying pairs of initial current density and step magnitude (ΔI). The initial current will vary from -10 $\mu A/cm^2$ to 10 $\mu A/cm^2$ by 0.1 $\mu A/cm^2$. The step magnitude will also vary from 0 $\mu A/cm^2$ to 20 $\mu A/cm^2$ by 0.1 $\mu A/cm^2$. Each simulation will take place over 100 milliseconds. The frequency will be determined through a simple automated Fourier transform of the voltage response over the time period. We will graph these frequencies against the initial current density and step magnitude using a two-dimensional heat map. We will perform a linear regression analysis of frequencies in the repetitive region with initial current 0 $\mu A/cm^2$ to confirm that the frequency under these conditions is directly proportional to the step current. Finally, we will perform this same analysis for other initial currents ranging from -10 $\mu A/cm^2$ to 10 $\mu A/cm^2$ by 2 $\mu A/cm^2$ to determine whether this proportionality holds for different initial conditions.