Title: Models for the Action Potential

Abstract: A threshold potential must be reached before an actual action potential is triggered in neurons. Thus, the end plate potential of a neuron is quantized to "on" and "off" states. This switch-like behavior of the action potential suggests that it may be modeled through mathematical means. Assuming that the action potential depends solely on the ion concentration in the neuron, three possible models come to mind: an ode that relates the membrane potential to the concentration of various ions (similar to mathematical model of genetic switches done in class), a thermodynamic approach to derive potential from ion concentration (i.e. the Nernst equation), or a statistical relation (what would happen if ion channels opened randomly).

The action potential can also be modeled physically as an RC circuit by considering the membrane ion channel as a resistor, lipid bilayer as a capacitor, and the ion gradients as a battery. Physical estimations of bilayer width (and hence estimation of capacitance by approximating the bilayer as a parallel plate capacitor) will yield numbers which can be used for the "Feel for the Numbers" part of the project.

Other math-like stuff that can be done would be estimating the energy consumption of firing the action potential, estimate the frequency of firing, and multiplying by the number of neurons in the body to estimate the energy consumption neurons.

Michael