The 1963 Nobel Prize-winning Hodgkin-Huxley equations model the voltage potential of a single neuron.

\[ \frac{1}{R} \frac{\partial^2 V}{\partial x^2} = C_m \frac{\partial V}{\partial t} + \left[ g_{\infty} m^0 h (V-V_{Na}) + g_{K} n^0 (V-V_{K}) + g_L (V-V_T) \right] \]

\[ \frac{\partial m}{\partial t} = \alpha_m (1-m) - \beta_m m \]

\[ \frac{\partial h}{\partial t} = \alpha_h (1-h) - \beta_h h \]

\[ \frac{\partial n}{\partial t} = \alpha_n (1-n) - \beta_n n \]

The traveling pulse solution to the Hodgkin-Huxley equations

\[ \frac{dP}{dt} = -P + a_{11} S_1(P) - a_{21} S_2(I) \]

\[ \frac{dI}{dt} = -\kappa I + a_{12} S_1(P) \]

The Wilson-Cowan equations describe the dynamics of networks of neurons.

Mathematical scientists are helping to unlock the mysteries of the brain!

They have:
- modeled electrical activity of neurons
- designed methods for transforming MRI and other signals into clear images
- modeled dynamics of neurological networks, such as those related to epilepsy and Parkinson's disease, learning and memory, schizophrenia
- developed algorithms for imaging the brain for diagnosis of tumors, disease and psychological states
- ...and much more.

Mathematics Awareness Month April 2007

www.mathaware.org

SPONSORED BY
THE JOINT POLICY BOARD FOR MATHEMATICS
American Mathematical Society
American Statistical Association
Mathematical Association of America
Society for Industrial and Applied Mathematics