Neuronendynamik

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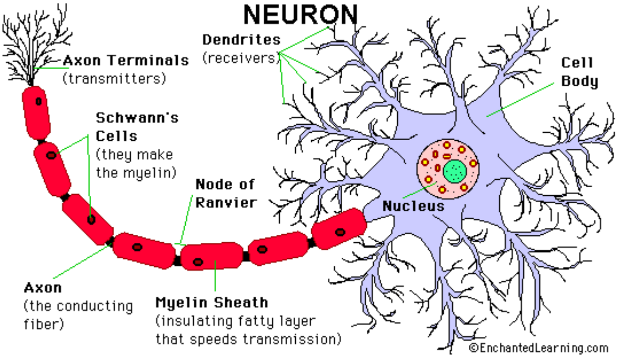
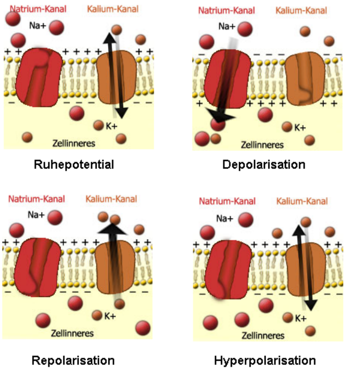
Das Neuron



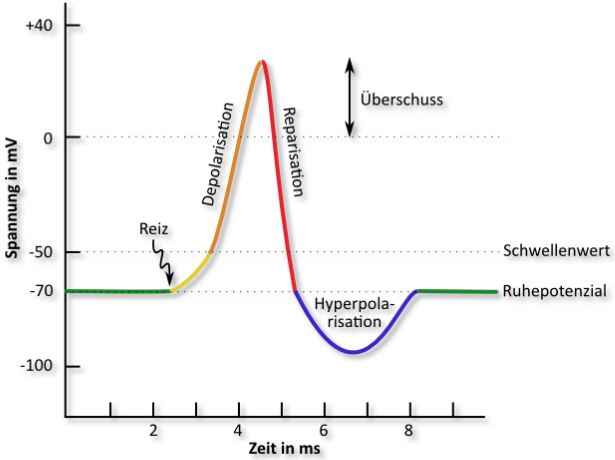
Quelle: http://www.enchantedlearning.com/subjects/anatomy/brain/gifs/Neuron.GIF

Elektrische Weiterleitung



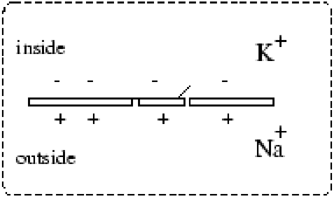
Quelle: http://pharmakologie.files.wordpress.com/2009/03/aktionspotential-2.png?w=530

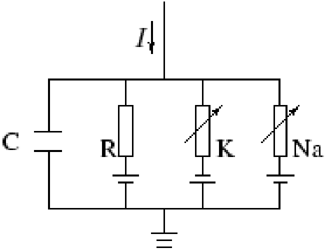
Elektrische Weiterleitung



http://51237776.de.strato-hosting.eu/biologie/bio13/neurobiologie/aktionspotenzial/files/aktionspotenzial.png

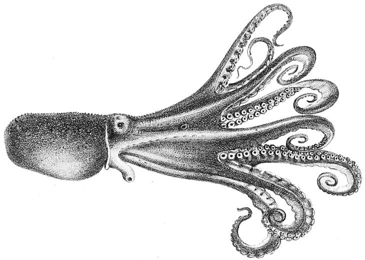
Schaltkreis





Quelle: http://icwww.epfl.ch/ gerstner/SPNM/img92.gif

Oktopus



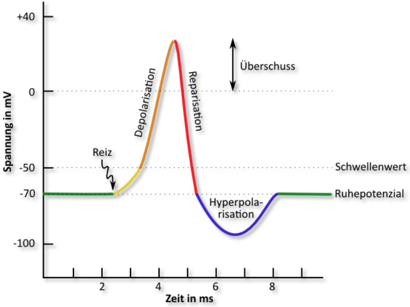
Quelle: http://commons.wikimedia.org/wiki/File:Octopusareolatus.jpg

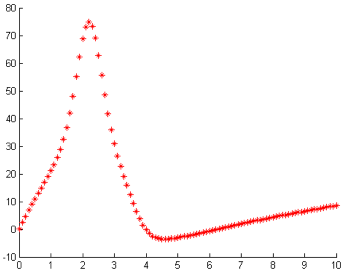
Differentialgleichungen für Hodgkin-Huxley

$$\frac{dV}{dt}C = g_{Na}m^3h(V - V_{Na}) - g_K n^4(V - V_K) - g_L(V - V_L) - I$$
$$\frac{dn}{dt} = a_n(V)(1 - n) - b_n(V)n$$
$$\frac{dm}{dt} = a_m(V)(1 - m) - b_m(V)m$$
$$\frac{dh}{dt} = a_h(V)(1 - h) - b_h(V)h$$

g_{Na}, g_K, g_L = Flusskonstanten
V_{Na}, V_K, V_L = Ausgleichspotential C = Kapazität der Membran

Der Spike

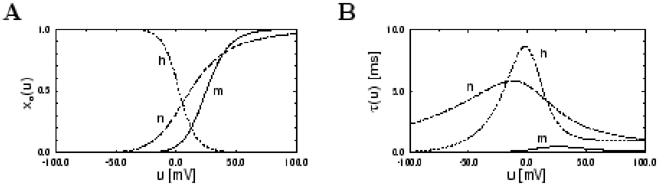




Spikemodell aus Hodgkin-Huxley Paper

Unser Spike

Variablen eliminieren



http://icwww.epfl.ch/ gerstner/SPNM/img96.gif

Setzen w:= $(b - h) = an$ für geeignetes b und a.
Und für $m := m_0(V)$

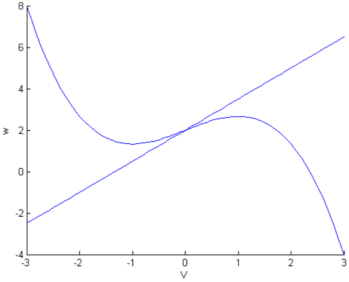
Variablen eliminieren

- $-\frac{dV}{dt}C = g_{Na}(m_0)^3(b-w)(V-V_{Na}) + g_K(\frac{w}{a})^4(V-V_K) + g_L(V-V_L)$ +I
- $\frac{dV}{dt} = \frac{1}{\tau}(F(V,w) + RI)$
- $R = \frac{1}{g_L}$ $\qquad \tau = RL$
- $\frac{dw}{dt} = \frac{1}{\tau_w}G(V,w)$

Fitzhugh-Nagumo

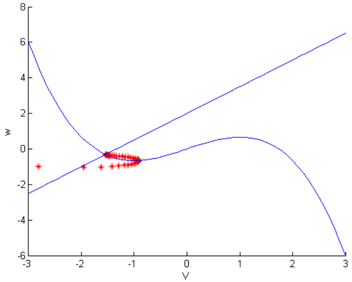
- $\frac{dV}{dt} = V - \frac{1}{3}V^3 - w + I$
- $\frac{dw}{dt} = \epsilon(b_0 + b_1 V - w)$

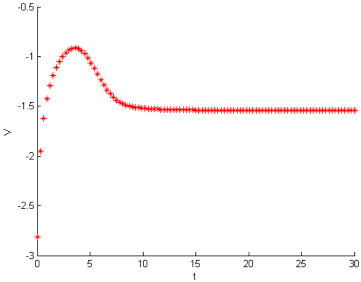
Nullklinen



Fitzhugh-Nagumo

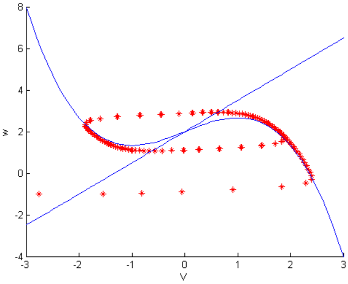
Wähle $\epsilon = 0.1$, $b_0 = 2$, $b_1 = 1.5$ und $I = 0$

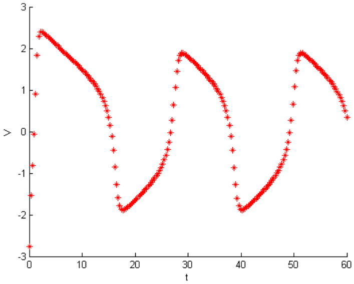




Fitzhugh-Nagumo

Wähle $\epsilon = 0.1$, $b_0 = 2$, $b_1 = 1.5$ und $I = 2$





Aussicht

- Analytische Untersuchung des Fitzhugh-Nagumo Modell
- Modell mit 2 gekoppelten Neuronen