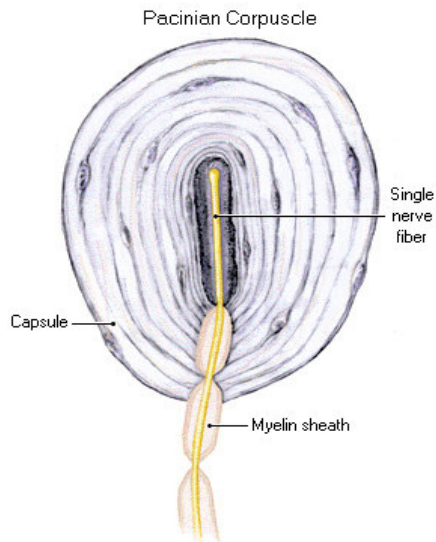


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THE PACINIAN CORPUSCLE as an example of a SENSORY CELL



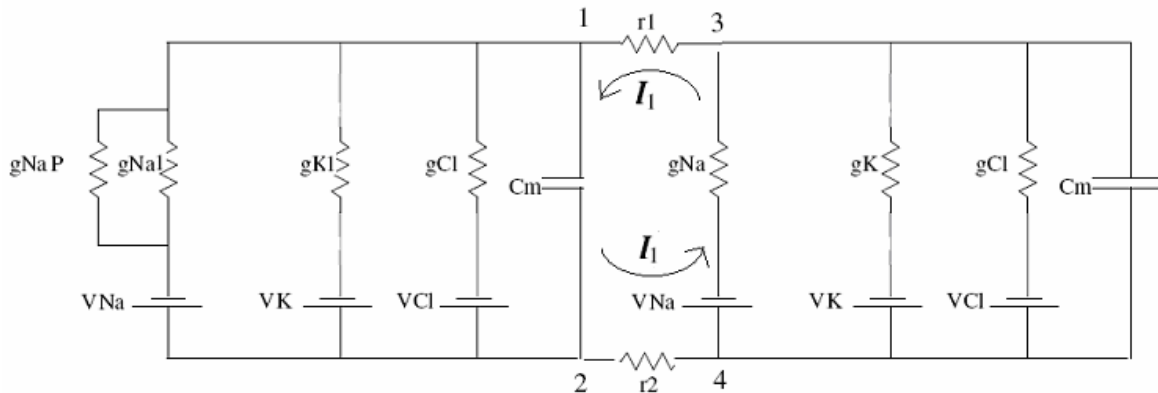
Pacinian Corpuscle is a sensory cell which exists under the skin all over the body. It measures pressure exerted locally on the skin. The picture below is a simple sketch of the sensory ending of the Pacinian Corpuscle

For qualitative descriptions of the Pacinian Corpuscle one can look in

http://en.wikipedia.org/wiki/Pacinian_corpuscle
<http://www.neuro.uu.se/fysiologi/gu/nbb/lectures/Pacini.html>

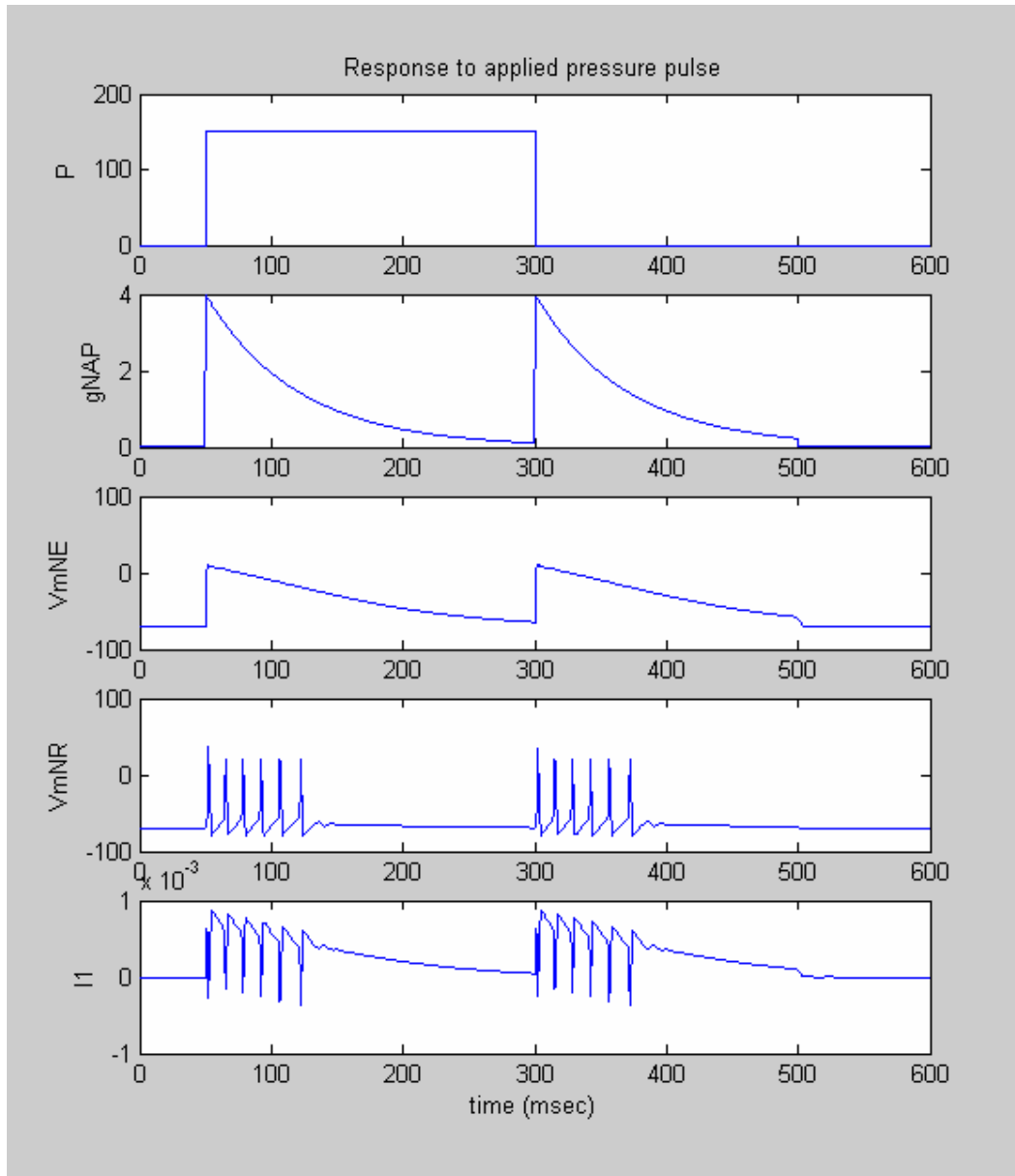
and many other sites. Here, a more quantitative and simple description is given.

The model for the Pacinian corpuscle may be simplified as follows:



$V_2 - V_1$ is the membrane voltage of the nerve ending and $V_4 - V_3$ is the membrane voltage of the first Node-of-Ranvier. Other nodes are not included in the model because once an AP is generated in the first Node-of-Ranvier it will propagate into the others. r_1 is the external resistance connecting the two sections and may be taken as 0. r_2 is the resistance of the internal solution from roughly the center of the nerve ending to the first node. g_{NaP} is the extra Na conductance caused by the deformation in the nerve ending due to the externally applied pressure. Since the internal material in the corpuscle is fluidic we assume that for a step applied pressure g_{NaP} increases sharply first but decreases thereon in an exponential manner. g_{NaI} and g_{KI} are the Na and K conductances of the nerve ending and they do not depend on the membrane potential. They have their initial resting values. The model for the first Node-of-Ranvier is an H-H model and has membrane potential dependent conductances g_{Na} and g_K .

By choosing appropriate values for the parameters one can obtain the following simulation results:



The first graph is applied pressure, P , the second is g_{NaP} , the third is membrane potential of the nerve ending, V_{mNE} , the fourth is the membrane potential of the first Node-of-Ranvier, V_{mNR} , and the last graph is the I_1 current between the sections. As observed in this figure g_{NaP} increases at $t = 50ms$ when a step pressure is applied, and decreases thereon. Membrane potential of the nerve ending reaches close to the Na Nernst potential but then decreases due to the decrease in g_{NaP} . During this time 6 APs are generated in the first Node-of-Ranvier and the initial frequency of firing is 75 Hz. When the pressure is released at $t = 300ms$ then we observe a similar train of APs because release of the pressure again causes a deformation in the membrane of the nerve ending.

When three times more pressure is applied we get the following graphs where initial frequency of firing is 87 Hz and the membrane potential of the nerve ending reaches almost the Na Nernst potential.

