Learning by Doing with the Virtual Physiology Series: Physiological and Pharmacological *in silico* Experiments.

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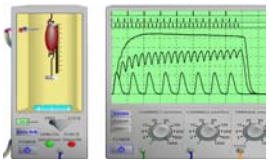
For more **information** and **downloads** of demo versions see **www.virtual-physiology.com**

The Virtual Physiology programs are different from conventional teaching tools, offering realistically appearing, fully equipped laboratories on the computer screen for experimentation almost like in the real world.

All stimulation and recording devices are freely adjustable. Mathematical algorithms guarantee for the appropriate reactions of the preparations, also considering their physiological diversity.

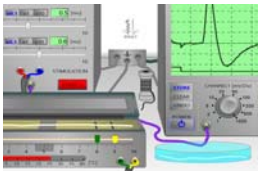
The Virtual Physiology series features classic physiological and pharmacological experiments with isolated preparations of the frog nerve and muscle (***SimNerv***, ***SimMuscle***) and of the rat heart and stripes of vessels and the gut (***SimHeart, SimVessel***), supplemented by technically more challenging experiments like voltage- and patch-clamp recordings (***SimNeuron, SimPatch***), that are unfeasible to be physically carried out in students' introductory courses but can be realized *in silico* with a user-friendly interface.



SimMuscle

Classical Experiments with isolated nerve-muscle preparations of the frog

isometric and isotonic contractions, stimulus dependencies (recruitment of motor units), superposition of single twitches, tetanic contractions, resting tension curves (prestretching), curves of isometric and isotonic maxima, muscle fatigue.



SimNerv

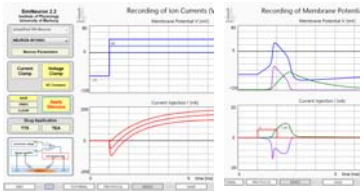
Compound Action Potentials from the isolated sciatic nerve of the frog

Stimulus-response curve. Strength-duration curve. Biphasic and monophasic responses. Refractory period. Anode opening potentials. Conduction velocity. Effects of ligatures and electrode positions.

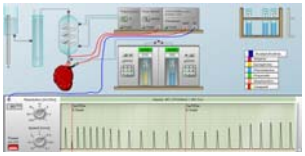
SimNeuron

Current- and Voltage-Clamp Experiments in a virtual lab with user-friendly interface

Recordings of membrane potentials and ion currents (e.g. I-V-curves, reversal potentials, conductances). Effects of altered of membrane properties (max. conductances, time-constants, etc.). Simulations of single channel activation and inactivation.



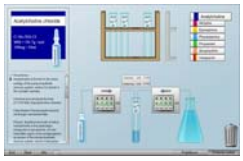
SimHeart (Physiology Lab)



Recordings of Heart Contractions in the classical Langendorff Set-up

Effects of Adrenaline and Acetylcholine on frequency and amplitude of heart contractions (Dose-Response curves). Competitive receptor blockers, Ca^{++}-channel blockers, heart glycosides.

SimVessel (Chemistry Lab)



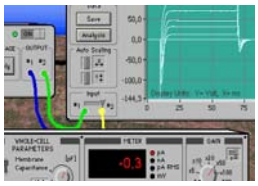
Experiments with smooth muscle strips (aorta and gastric antrum)

Myogenic automaticity, Stretch induced contraction - tonic and phasic. Functional antagonism of Adrenalin and Aceltylcholin. Drug Effects (receptor and ion channel blockers).

SimPatch

Whole-Cell Voltage Clamp Experiments with different types of retinal cells in a realistic lab environment

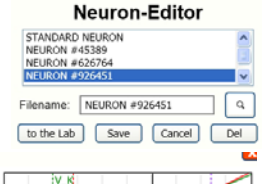
Determine the ionic currents and conductances of different types of neurons (Nernst potentials, maximum conductances, activation kinetics). Examine the effects of drug application and altered composition of intra- and extracellular solution

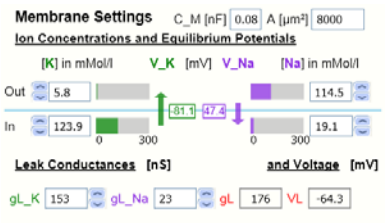


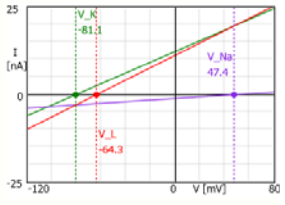
New Features for Practical Courses (Exp. from SimNeuron)

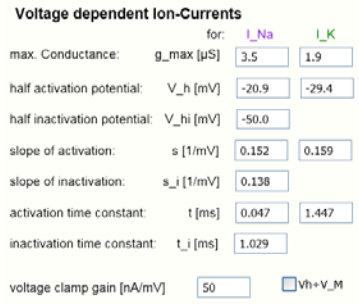
The neuron editor can be switched off and the students will receive realistic neurons of different size with random equilibrium potentials and (in-) activation parameters of voltage-dependent Na^+- and K^+- currents. Switching on the password protected neuron editor will allow the supervisor to directly countercheck the students' results.

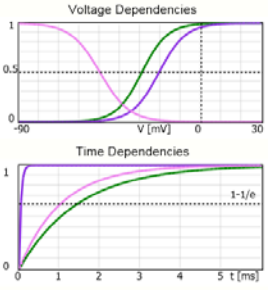
The neuron editor also allows changing the membrane parameters, for example. tuning a neuron with stable membrane potential into a pacemaker neuron.





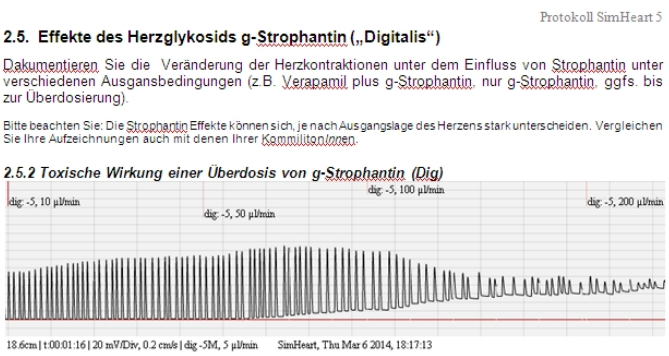






Documentation of the Results:

Tutorials, including computer-animated illustrations, and **protocol** forms are accessible from the virtual lab. The results of the experiments can directly be overtaken into the protocol forms with fully documented screenshots from the recording device, e.g. oscilloscope or chart recorders. An example from **SimHeart**:



Virtual Physiology - the Current State:

Win 7/8 versions of **SimHeart**, **SimMuscle, SimNerv,** and **SimNeuron**. can be downloaded from the Virtual Physiology website www.virtual-physiology.com ("Download Center") as fully functioning **demo versions.**

The previous **SimPatch** tools have been compiled for **Win 7/8**.
The **SimVessel** laboratories should be deliverable before WS 2014