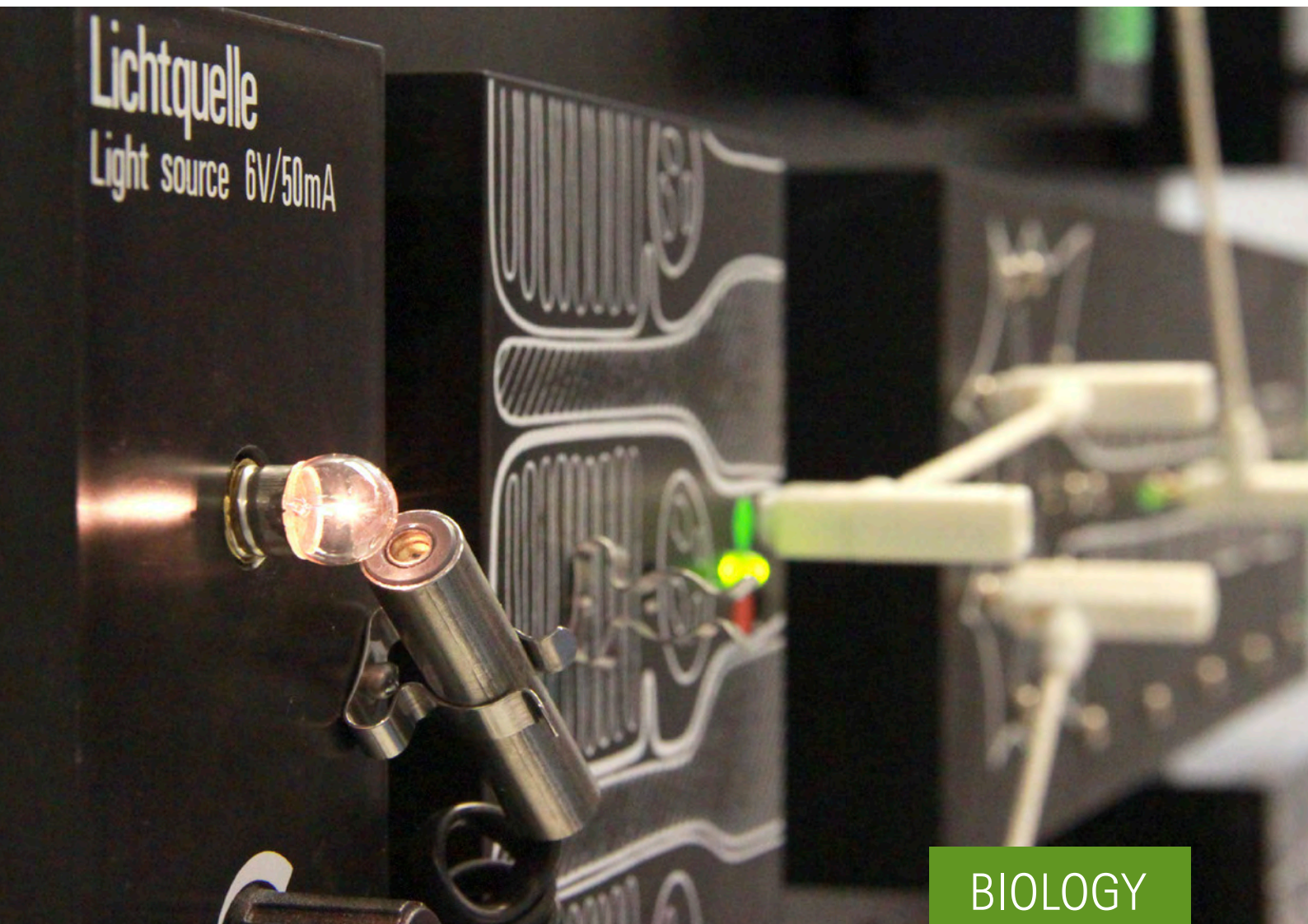


# LEYBOLD®

## NEUROBIOLOGY WITH BIOMODULE



BIOLOGY

### THE SYSTEM

FOR DEMONSTRATION OF THE NERVOUS SYSTEM  
IN BIOLOGY CLASSES

# BIOMODULE

System Components for Simulation Experiments

# LEYBOLD®

## BIOMODULE – THE SYSTEM

Use the **BIOMODULE** for representing processes on nerve cells and the nervous system with simulation experiments.

The **BIOMODULE** is modular designed i.e. every »module« of the nervous system relates to a module in the **BIOMODULE** system. Therefore teachers can select their experiment according to didactic perspectives and develop the experiments from the required system components.

The **BIOMODULE** has been developed on the basis of the day-to-day requirements for teaching practices in close collaboration with teachers. All the sensory components, the synapse component and the stimulus component have a separate output for supporting and inhibiting stimuli with which the other components can be controlled. The information will be transmitted via stimuli to the downstream components. The nerve cell components integrate the

incoming signals and form an output signal which is transmitted depending on the result to a supporting or inhibiting output on the downstream component.

The design for the separate experiment(s) is executed by simply connecting the required **BIOMODULE** components on the plug-in board; the functions of the nerve conductors (axons) is assumed via cables.

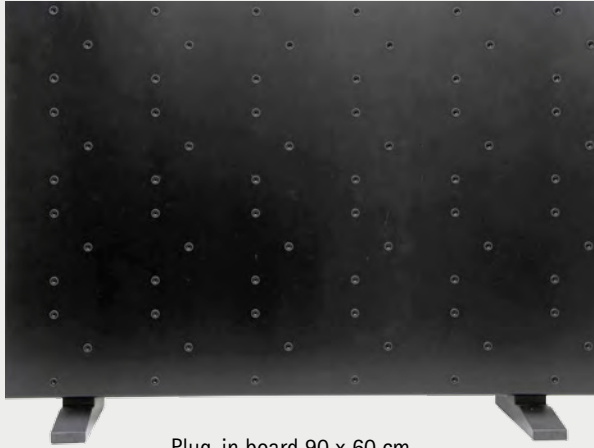
The power supply for the component is executed directly via a touch-safe, extra-low voltage of  $\pm 8$  V from the plug-in board which is supplied from a power pack. All parts of the **BIOMODULE** system are protected against short-circuits and resistant to faulty switching. The simplified operating and the electrical safety from the **BIOMODULE** in combination with the multiple variable application possibilities enable the teacher to concentrate fully on the content-related aspects of their experiment.

## BENEFITS

- MODULAR SYSTEM
- UNCOMPLICATED AND FLEXIBLE EXPERIMENTAL DESIGN
- FROM SIMPLE EXPERIMENTS UP TO COMPLEX SYSTEMS
- TRANSPARENT AND CLEARLY STRUCTURED
- GRAPHICAL REPRESENTATION OF THE SYSTEM MODULES
- OPTICAL AND ACOUSTIC REPRESENTATION OF THE SIGNALS
- TOUCH-SAFE, SIMPLIFIED OPERATING POWER SUPPLY

# PRODUCT OVERVIEW

## BASIC EQUIPMENT

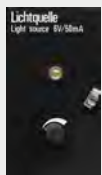


Plug-in board 90 x 60 cm

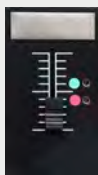


Power supply

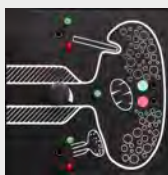
## STIMULUS MODULES



Light source module

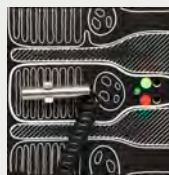


Stimulus source module

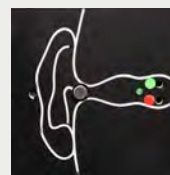


Synapse module

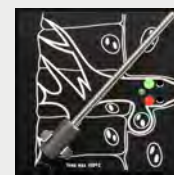
## SENSORY CELL MODULES



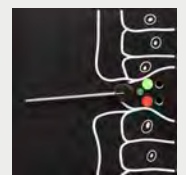
Light sensory cell module



Auditory cell module



Adaptive temperature sensory cell module

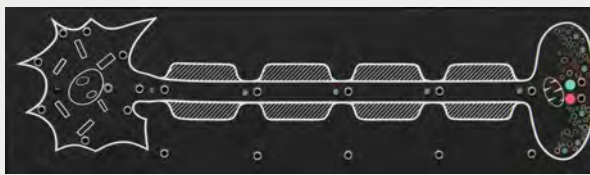


Tactile sensory cell module

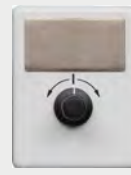
## NERVE CELL MODULES



Unineuron module

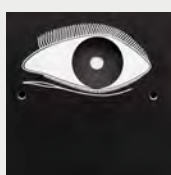


Demonstration neuron module

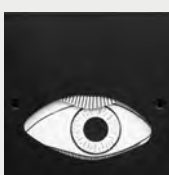


Drug function module

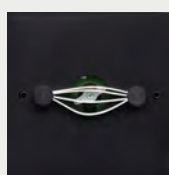
## EFFECTOR ORGAN MODULES



Pupil module



Eyelid module



Muscle module

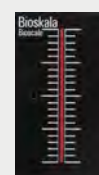


Gland module

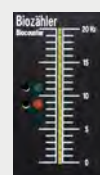
## MEASURING MODULES



Bioscale, green



Bioscale, red



Bio-counter



Loudspeaker

# EXPERIMENTS

# LEYBOLD®

## BIOMODULE BASIC KIT 662 2201

Processes on nerve cells and in the nervous system will be represented with simulation experiments. The basic model enables 6 experiments to be executed on the basis of the literature 668 78EN.

Scope of delivery:

662 200	Plug-in board for BIOMODULE
662 201	Power supply for BIOMODULE
662 203	2 x Connection cable (5 cm)
662 210	Light source module
662 212	Light sensory cell module
662 216	Demonstration neuron module
662 230	Loudspeaker

Cat. No.	Description
662 2201	BIOMODULE Basic Kit

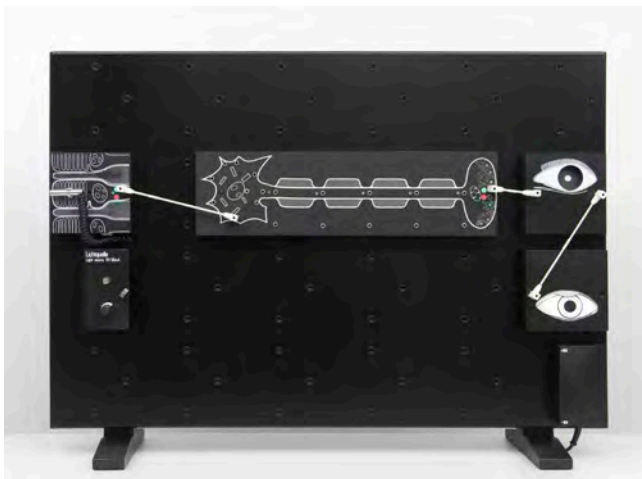
Additionally recommended

668 78EN	LIT: Experiments with BIOMODULE
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### EXPERIMENTS WITH BIOMODULE BASIC KIT:

- Light sensitive cells of the eye
- Electrical signals of a sense cell
- Information transfer
- Detection of nerve activity



THE PUPIL AND EYE LID OPENINGS ARE DEPENDENT ON THE AMBIENT BRIGHTNESS

## STIMULUS REACTION DIAGRAM BD4.1.1.07

The correlation between the signal strength, stimulus transmission and reaction will be graphically clarified by utilising the effector organ module. The dependency of the pupil opening on the light signal will be comprehensively displayed here.

Required devices and equipment:

Cat. No.	Description
662 200*	Plug-in board for BIOMODULE
662 201*	Power supply for BIOMODULE
662 210*	Light source module
662 204	3 x Connection cable (12 cm)
662 212*	Light sensory cell module
662 216*	Demonstration neuron module
662 226	Pupil module
662 228	Eyelid module
668 78EN	LIT: Experiments with BIOMODULE

# EXPERIMENTS

## PROCESSING STIMULI

### BD4.1.1.09

An explanation for the sensory and nerve cells as well as for transmitting the signals received will be explained on the BIOMODULE system. In addition to the light sensitive cell as a basic element of every eye the mechanical deflection of tactile hairs as triggering signals can be represented.

Required devices and equipment:

Cat. No.	Description
662 200*	Plug-in board for BIOMODULE
662 201*	Power supply for BIOMODULE
662 230*	Loudspeaker
662 233	Biocounter
662 204	1 x Connection cable (12 cm)
662 205	1 x Connection cable (25 cm)
662 223	Tactile sensory cell module
668 78EN	LIT: Experiments with BIOMODULE



THE TACTILE HAIRS ARE STIMULATED VIA MECHANICAL DEFLECTION



DEPENDENCY OF THE ACTION POTENTIAL FREQUENCY ON THE STIMULUS STRENGTH

## CODING STIMULI

### BD4.1.1.13

The strength of the received stimulus must be coded for the signal transmission. This occurs via the frequency modulation from the action potential. The dependency of the frequency of the action potential on the stimulus strength can be displayed very legibly by utilising the stimulus input module and the downstream loudspeaker.

Required devices and equipment:

Cat. No.	Description
662 200*	Plug-in board for BIOMODULE
662 201*	Power supply for BIOMODULE
662 211	Stimulus source module
662 231	Bioscale, green
662 230*	Loudspeaker
662 233	Biocounter
662 204	2 x Connection cable (12 cm)
662 205	3 x Connection cable (25 cm)
662 216*	Demonstration neuron module
662 212*	Light sensory cell module
668 78EN	LIT: Experiments with BIOMODULE

\* This product is included at „BIOMODULE BASIC KIT“.

# EXPERIMENTS

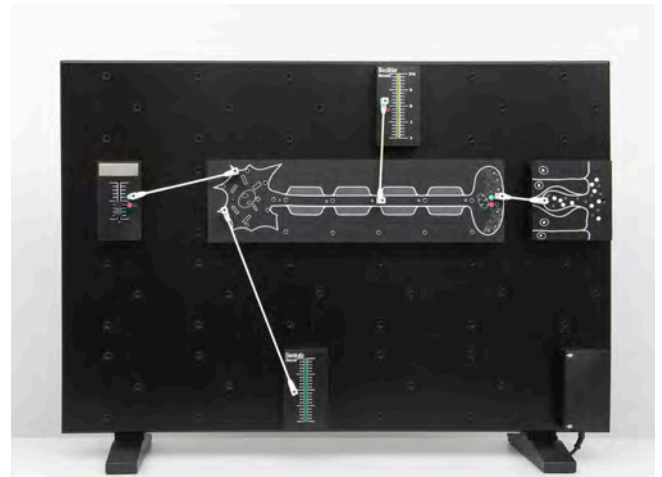
# LEYBOLD®

## REPRESENTING ACTION POTENTIALS BD4.1.2.06

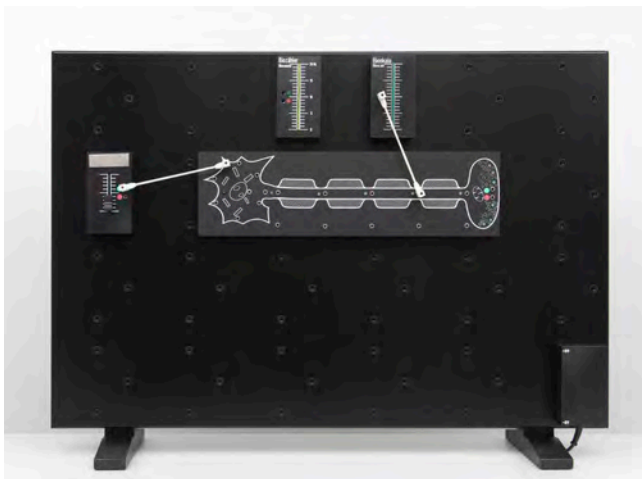
If the stimulus threshold is exceeded, then action potentials will occur which are essential for the nerve conduction. The experiments with BIOMODULE will clarify the correlation between the stimulus strength, stimulus threshold and action potential.

Required devices and equipment:

Cat. No.	Description	
662 200*	Plug-in board for BIOMODULE	
662 201*	Power supply for BIOMODULE	
662 211	Stimulus source module	
662 216*	Demonstration neuron module	
662 233	Biocounter	
662 231	Bioscale, green	
662 214	Gland module	
662 205	1 x Connection cable (25 cm)	
662 204	2 x Connection cable (12 cm)	
662 203*	1 x Connection cable (5 cm)	
668 78EN	LIT: Experiments with BIOMODULE	



DEMONSTRATION FOR THE ELECTRONIC PROPAGATION FROM VOLTAGE VARIATIONS ON THE MEMBRANE



PROPAGATION OF THE IMPULSE WITH NEURON MODULE

## TRANSMITTING STIMULI BD4.1.2.08

The basic principles for the stimulus transmission will be made comprehensible in additional experimental designs for nerve and sensory cells. Along with the saltatory stimulus conduction, the continuous stimulus conduction will also be identified and intuitively imparted via local verification of the nerve activity.

Required devices and equipment:

Cat. No.	Description	
662 200*	Plug-in board for BIOMODULE	
662 201*	Power supply for BIOMODULE	
662 211	Stimulus source module	
662 231	Bioscale, green	
662 233	Biocounter	
662 204	2 x Connection cable (12 cm)	
662 216*	Demonstration neuron module	
668 78EN	LIT: Experiments with BIOMODULE	

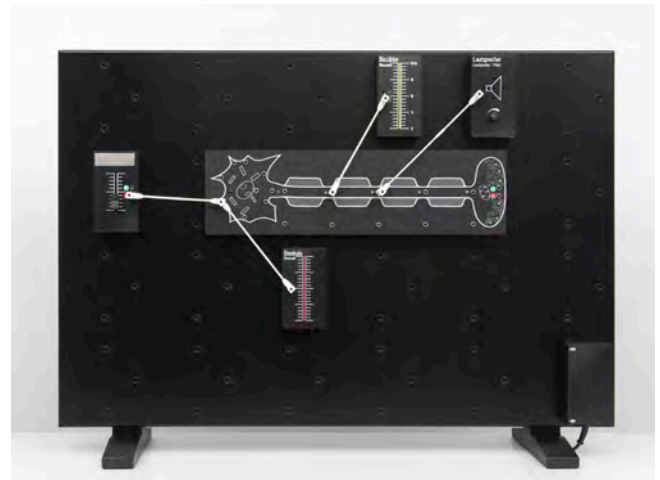
# EXPERIMENTS

## SUPPORTING AND INHIBITING STIMULI BD4.1.3.02

Not every impulse has a resulting effect on the signal transmission. The **BIOMODULE** enables various experimental designs for comprehensible representations for the different effects of supporting and inhibiting impulses.

Required devices and equipment:

Cat. No.	Description
662 200*	Plug-in board for BIOMODULE
662 201*	Power supply for BIOMODULE
662 211	Stimulus source module
662 232	Bioscale, red
662 233	Biocounter
662 204	2 x Connection cable (12 cm)
662 205	2 x Connection cable (25 cm)
662 230*	Loudspeaker
662 216*	Demonstration neuron module
668 78EN	LIT: Experiments with BIOMODULE



### THE INHIBITING POSTSYNAPTIC POTENTIAL (IPSP)



### STIMULUS SUMMATION IN SYNAPSE AND EXCEEDING THE THRESHOLD

## SUMMATING STIMULI BD4.1.3.03

Stimuli on various nerve sensory cells can convene on a synapse and influence them in various ways. To decide whether the threshold value for the action potential has been exceeded, there will be a summation of the excitatory and inhibitory stimuli in the synapse. The principle can be competently clarified by utilising the sensory cell, synapse and neuron modules.

Required devices and equipment:

Cat. No.	Description
662 200*	Plug-in board for BIOMODULE
662 201*	Power supply for BIOMODULE
662 211	2 x Stimulus source module
662 230*	Loudspeaker
662 233	Biocounter
662 204	3 x Connection cable (12 cm)
662 205	2 x Connection cable (25 cm)
662 231	Bioscale, green
662 216*	Demonstration neuron module
668 78EN	LIT: Experiments with BIOMODULE

# EXPERIMENTS

# LEYBOLD®

## STIMULUS THRESHOLD BD4.1.3.06C

On the basis of the universal neuron, the principle for the stimulus threshold will be demonstrated on the BIOMODULE. Stimuli below threshold do not result in stimulus transmission and/or conductivity. The lowest degree of stimulation, which is necessary for stimulus transmission, will be discernible. Thereby the principles for the stimulus summation and the changes in sensitivity for the neurons will also be comprehensible.

Required devices and equipment:

Cat. No.	Description
662 200*	Plug-in board for BIOMODULE
662 201*	Power supply for BIOMODULE
662 211	3 x Stimulus source module
662 233	Biocounter
662 203*	2 x Connection cable (5 cm)
662 204	2 x Connection cable (12 cm)
662 213	Unineuron module
662 217	Synapse module
668 78EN	LIT: Experiments with BIOMODULE



## STIMULUS SUMMATION AND SENSITIVITY OF THE SYNAPSE



## EFFECTS OF TOXICANTS ON THE SYNAPTIC SIGNAL TRANSMISSION

## EFFECTS FROM NARCOTICS BD4.1.3.12

Toxicants and narcotics such as e.g. opium and clonidine have long-term effects on the stimulus transmission in the nervous system. Utilising the narcotics module enables an effective conveyance for the effects of these substances on the signal transmission.

Required devices and equipment:

Cat. No.	Description
662 200*	Plug-in board for BIOMODULE
662 201*	Power supply for BIOMODULE
662 211	Stimulus source module
662 230*	Loudspeaker
662 203*	1 x Connection cable (5 cm)
662 204	2 x Connection cable (12 cm)
662 205	1 x Connection cable (25 cm)
662 213	2 x Unineuron module
662 215	Drug function module
662 229	Muscle module
668 78EN	LIT: Experiments with BIOMODULE



# EXPERIMENTS

## POSITIVE AND NEGATIVE FEEDBACK BD4.1.3.15

Positive feedback loops can enable a weak signal to be strengthened or to be extended. Negative feedbacks however create a weakening of a strong signal or will shorten it. Utilising the universal neuron module, incoming signals and the effector organ modules, this principle is shown in a very descriptive and comprehensible representation.

Required devices and equipment:

Cat. No.	Description
662 200*	Plug-in board for BIOMODULE
662 201*	Power supply for BIOMODULE
662 233	Biocounter
662 204	5 x Connection cable (12 cm)
662 217	Synapse module
662 213	2 x Unineuron module
662 229	Muscle module
668 78EN	LIT: Experiments with BIOMODULE



FEEDBACK SWITCHING WITH THE  
UNIVERSAL NEURON MODULE



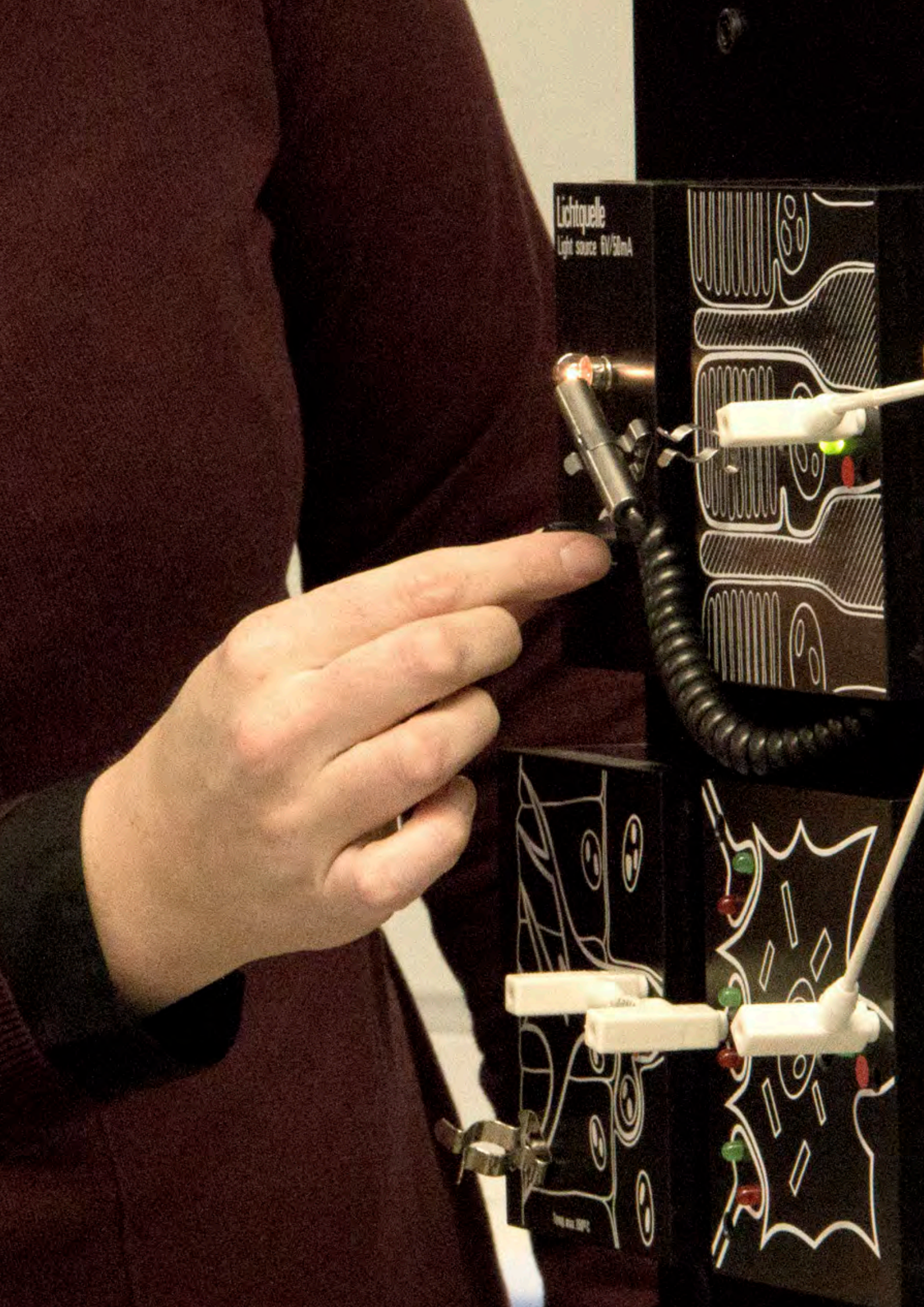
SIMULATION OF THE LATERAL INHIBITION

## LATERAL INHIBITION BD4.1.3.18

Utilising multiple universal neuron modules, which will be contacted by various stimuli or synapse, the BIOMODULE creates a clearly discernible simulation for the lateral inhibition.

Required devices and equipment:

Cat. No.	Description
662 200*	Plug-in board for BIOMODULE
662 201*	Power supply for BIOMODULE
662 233	Biocounter
662 204	7 x Connection cable (12 cm)
662 205	1 x Connection cable (25 cm)
662 217	3 x Synapse module
662 213	3 x Unineuron module
668 78EN	LIT: Experiments with BIOMODULE



Lichtquelle  
Light source 6V/50mA



## TEACHING CONTENT

- PROCESSING STIMULI
- STIMULUS REACTION DIAGRAM
- STIMULUS THRESHOLD
- TRANSMITTING STIMULI
- CODING STIMULI
- REPRESENTING ACTION POTENTIALS
- SUPPORTING AND INHIBITING STIMULI
- SUMMATING STIMULI
- LATERAL INHIBITION
- EFFECTS FROM NARCOTICS
- POSITIVE AND NEGATIVE FEEDBACK
- BIOLOGICAL REGULATING CIRCUIT

PHYSICS

CHEMISTRY  
BIOLOGY

ENGINEERING

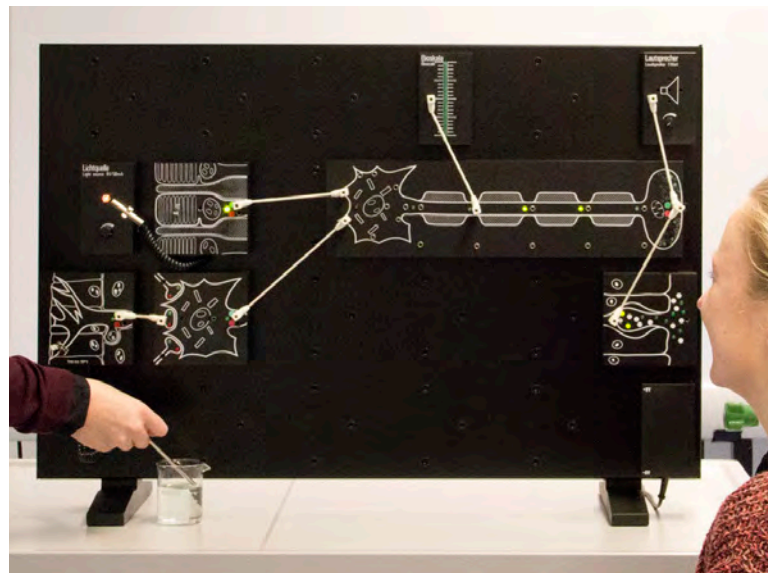
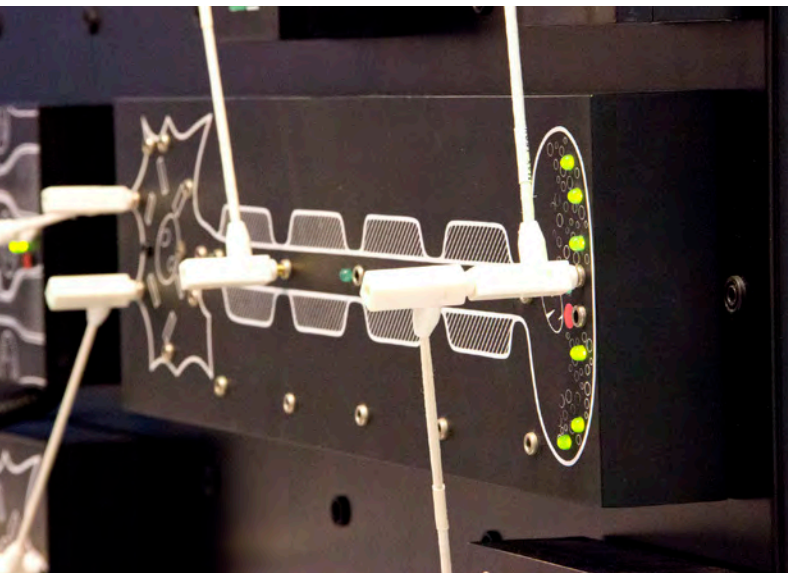


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[www.ld-didactic.com](http://www.ld-didactic.com)

110 0604EN 03.2016 LD  
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