

Patch Clamp Course (max. 8 participants)

- Supervisor:** Dr. Peter Bengtson, IZN, Department of Neurobiology
- Location:** Neurobiology Lab, INF 345, 69120 Heidelberg
- Date:** 01st -04th of September, 2026
- Contact:** bengtson@nbio.uni-heidelberg.de

Course description and prerequisites:

The course aims to give a basic introduction to electrophysiological methods with a focus on patch clamp electrophysiology for selected masters and PhD students. Both theoretical and practical components are included with the opportunity to patch a neuron yourself. Students should come with idea about the background concepts in patch clamp. Only students interested in doing electrophysiology should apply. Before the course begins, students are required to refresh their knowledge of basic electrical concepts like voltage, current, capacitance, resistance, Ohm's law, reversal potentials, etc.

3 x 1.5 hour interactive lectures

- Introduction to S1 lab & cell culture rules.
- Extracellular, intracellular and patch clamp electrophysiology.
- Channels underlying action potential waveforms.
- Channel nomenclature, structure, ion selectivity, voltage dependence.
- Channel reversal potentials, kinetics, multi-state models.
- Patch clamp configurations.
- Rapid application techniques.
- Heterologous expression systems vs. primary neuronal cultures vs. acute vs. organotypic brain slice preparations.
- Evoked, spontaneous and miniature postsynaptic currents.
- Paired pulse protocols & short-term plasticity.
- High frequency and theta burst stimulations and LTP/LTD.
- Dynamic clamp.
- High throughput patch clamp.
- Amplifiers, digitizers, stimulators, pipette pullers, vibratomes.
- Cameras, microscopes, light sources, filters.
- Brightfield contrast techniques.
- Intracellular and extracellular solutions.
- Pharmacological and voltage dependent isolation of channels.
- Ion substitution, osmolarity, relative permeability.
- NMDA receptor focus: Channel structure, function, measurement.
- Example scientific questions and the methods to answer them.

2x 3 hour lab demonstrations

- Pulling electrodes, perfusion, osmolarity & pH measurements.
- Patch clamp in primary neuronal cultures and HEK293 cells.
- Acute brain slice preparation

2x 3 hour hands-on lab practical (half the group in each session)