

[C1.2] <i>Cellular and Molecular Neurobiology</i>	Cellular and Molecular Neurobiology	Compulsory elective module in the core area C1	5 - 8 CP (total) = 150 - 240 h		4 - 6 SWS
			Contact study 4-6 SWS / 60-90 hrs	Self-study 90-150 h	
<b>Content</b>					
<p><b>Lecture:</b> History of neuroscience, structure of the human brain, cells of the nervous system, structure and function of nerve cells, compartments of neurons, neuronal cytoskeleton and transport in neurons, structural principles of simple nervous systems. Electrical properties of neurons, Nernst potential, cable theory, passive and active electrical properties of the neuronal membrane, spatial and temporal summation, action potential, electrophysiology. Voltage-gated ion channels, structures and function. Electrical and chemical synapses, synaptic plasticity, neurotransmitters, neuropeptides. Optogenetic methods. Presynaptic structures and mechanisms of neurotransmitter release. SNAREs, synaptic vesicles and their "cycle". Postsynaptic organization and mechanisms. Postsynaptic plasticity, mRNA transport in dendrites, local translation. Metabotropic and ionotropic (nAChR, P2XR, AMPAR, NMDAR) neurotransmitter receptors, chemoreceptors, structures and function. 2<sup>nd</sup> messengers and kinase cascades. Sensory receptor cells (mechano-, chemo-, photo-, noci-) and molecular receptors, processing of sensory signals in the brain. Olfactory system. Thermoreception. Neuronal developmental biology, morphogenesis, axogenesis and targeting, cell specificity of synapse formation. Higher brain functions, neuromodulatory systems, emotion, brain rhythms, epilepsy, sleep, learning, memory, reward system, hippocampus, LTP and LTD.</p> <p><b>Seminar (CEM):</b> In the literature seminar, current original literature from the cellular and molecular neurobiology field, published in the past year, and related to the topics of the lecture, is presented in a seminar talk (individual students or groups of two), and discussed and evaluated in the plenum. Also special methods in neurobiology are covered as part of these seminars.</p> <p><b>Practical course (CEM):</b> Basic cell- and neurobiology experiments using the model organism <i>Caenorhabditis elegans</i> (a soil nematode). Culture of <i>C. elegans</i>, visualization of specific cell types, organelles or cytoskeletal elements by fluorescent proteins, optogenetics, light-induced neurotransmitter release, secretion and endocytosis in <i>C. elegans</i>, pharmacological testing of synaptic transmission in wild-type and relevant mutants, sensory perception, thermotaxis, mechanoreception, chemotaxis, axon guidance.</p> <p><i>The lecture must be combined with either the seminar (CEM) or/and the practical course (CEM).</i></p>					
<b>Learning outcomes / competency goals</b>					
<p>After completing the module, students are able to:</p> <ul style="list-style-type: none"> <li>to reflect and distinguish the mechanisms of elementary nervous system functions, as well as (to some extent) higher brain functions in humans and mammals. Based on this knowledge, they can develop their own questions and work them out, aided by the research literature.</li> <li>to understand and critically evaluate current research literature on cellular and molecular neurobiology, to explain and critically discuss original work to a specialist audience in a lecture.</li> <li>Carry out, evaluate, and discuss, simple practical experiments on the cellular and molecular neurobiology as well as on the behavioral neurobiology of <i>C. elegans</i>.</li> </ul>					
<b>Participation requirements for the module or for individual courses of the module</b>					
None					
<b>Recommended requirements</b>					
None					
<b>Organizational details</b>					
The practical course is offered as a one-week block course during the lecture-free period.					
<b>Module allocation (degree programme/faculty)</b>			Master in Biochemistry / FB14		
<b>Module transferrable to other degree programmes</b>			Master in Biophysics / FB13		
<b>Module offered</b>			<ul style="list-style-type: none"> <li>Lecture: winter semester</li> <li>Seminar: summer semester</li> <li>Practical course: summer semester, if necessary also in the winter semester (during the lecture-free period)</li> </ul>		
<b>Duration</b>			2 semesters		
<b>Module coordinator</b>			Prof. Gottschalk		
<b>Course requirements for credits</b>					
<b>Participation record</b>			Seminar: Regular and active participation		
<b>Coursework</b>			<ul style="list-style-type: none"> <li>Seminar: Lecture presentation</li> <li>Practical course: Fulfillment and protocols of the practical course experiments</li> </ul>		
<b>Forms of teaching / learning</b>			Lecture, seminar, practical course		
<b>Language teaching and instruction</b>			English		
<b>Module assessment</b>			<b>Form / duration / content, if applicable</b>		
<b>Final module assessment</b>			Written exam for the lecture (90 min.) or oral examination (45 min.)		
<b>Cumulative module assessment consisting of</b>					
<b>Composition of the module grade for cumulative module assessment</b>					
			Semester CP		

	Type of teaching session	Semester hours per week	1	2	3	4
Cellular and molecular neurobiology	L	2	3			
<i>CEM</i> : Current topics in cellular and molecular neurobiology	S	2		3		
<i>CEM</i> : Basic cell- and neurobiological experiments	P	2		2		
TOTAL		4-6	5-8			