

Structural Biology: Cryo Electron Microscopy					
Identification number	Workload	Credit points	Term of studying	Frequency of occurrence	Duration
MN-B-SM (Z 2)	360 h	12 CP	1 st or 2 nd term of studying	Summer term, 1 th half	7 weeks
1	Type of lesson		Contact times	Self-study times	Intended group size*
	a) Lecture		24 h	48 h	max. 16
	b) Practical/lab		150 h	106 h	max. 16
	c) Seminar		8 h	24 h	max. 16
2	Aims of the module and acquired skills Students who successfully completed this module... <ul style="list-style-type: none"> • have acquired fundamental knowledge about the principles of electron microscopy (EM) as a tool in structural biology, including the physical background of electron optics, and about the computational methods required to reconstruct 3D objects from 2D images. • are able to prepare sample grids for negative-stain EM, operate a low-kV transmission electron microscope, assess protein quality by EM, and use computational tools to process EM datasets to determine the 3D structures of proteins. • are familiar with the use of high-performance computing resources for advanced computational tasks, and are able to write simple computer scripts to automate repetitive tasks. • have learned how to present research results in oral and written form, and to critically discuss scientific publications related to the topic of the module on a professional level. • are able to transfer skills acquired in this module to other fields of biochemistry. 				
3	Contents of the module <ul style="list-style-type: none"> • Imaging with electrons: theory and practical aspects • Sample preparation for EM: negative-staining and vitrification of biological macromolecules • Data collection using electron microscopes, routine operations on electron microscopes, and strategies for automated data collection and quality assessment • Basic introduction into using high-performance computing resources in structural biology • Reconstruction of 3D structures from 2D EM images using single-particle refinement strategies 				
4	Teaching/Learning methods <ul style="list-style-type: none"> • Lectures; Practical/Lab; Seminar; Computer exercises; Guidance to independent research; Training on presentation techniques in oral and written form 				
5	Requirements for participation Enrollment in the Master's degree course "Biological Sciences", in the Master's degree course "Biochemistry" or in the Master's degree course "Chemistry". Prior participation in an advanced Biochemistry module, including its practical lab part, during the Bachelor's degree course (e.g. MN-B-WP I [BC 2] for Cologne students) or similar skills (after consultation) are required.				

6	<p>Type of module examination</p> <p>The final examination consists of three parts: 30 min oral examination about topics of the lectures and seminar presentations (50 % of the total module mark), oral presentation in the framework of a seminar (25 % of the total module mark) and seminar paper (= poster presentation; 25 % of the total module mark)</p>
7	<p>Requirements for the allocation of credits</p> <p>Regular and active participation (= accepted laboratory notebook); Each examination part at least "sufficient" (see appendix of the examination regulations for details)</p>
8	<p>Compatibility with other Curricula</p> <p>Biochemical subject module in the master's degree course "Biochemistry" and in the master's degree course "Chemistry"</p>
9	<p>Significance of the module mark for the overall grade</p> <p>In the Master's degree course "Biological Sciences": 15 % of the overall grade (see also appendix of the examination regulations)</p>
10	<p>Module coordinator</p> <p>Prof. Dr. Elmar Behrmann, phone 470 76300, e-mail: elmar.behrmann@uni-koeln.de</p>
11	<p>Additional information</p> <p>Subject module of the Master's degree course "Biological Sciences"</p> <p>Participating faculty: Prof. Dr. E. Behrmann, Dr. M. Gunkel, Dr. S. Pöpsel</p> <p>Literature</p> <ul style="list-style-type: none"> • Frank, J. (2006) Three-Dimensional Electron Microscopy of Macromolecular Assemblies: Visualization of Biological Molecules in Their Native State. Oxford University Press • Jensen, G. Getting Started in Cryo-EM. Online course @Caltech [http://em-learning.com/] • Additional material and subject specific literature will be provided <i>ad hoc</i> <p>Note: the module contains hand-on laboratory work conducted by small groups of students and is taught in course rooms and research laboratories. The module contains also computer-based research/practicals as a main component.</p> <p>Location: The course will take place at the Institute of Biochemistry, Zùlpicher Str. 47, 50674 Cologne.</p> <p>General time schedule: Week 1-5 (Mon.-Fri.): Lectures from 9:00 to 10:30 three times a week, Experimental/computational work 10:30 to 16:00 including a short lunch break five times a week. Exact times can vary according to the laboratory needs; Week 6 (Mon.-Fri.): Preparation and presentation of the seminar talk and the poster; Week 7 (Mon.-Fri.): Preparation for the oral examination</p> <p>Introduction to the module: April 12, 2021 at 9:00 a.m., online (further information/link will be sent to your Smail-Account)</p> <p>Oral examination: May 31 – June 02, 2021, second/supplementary examination August 06, 2021; the latter date may vary if students and module coordinator agree. More details will be given at the beginning of the module.</p>

* 4 students from the Master's degree course "Biological Sciences", 10 students from the Master's degree course "Biochemistry" and 2 student from the Master's degree course "Chemistry".

Corona note! Depending on the Corona situation during the summer term, practical work may be skipped either totally or in part. In this case, some or all practical parts will be replaced by adequate alternatives so that (i) the workload and (ii) the principle content of the modules remained unchanged.