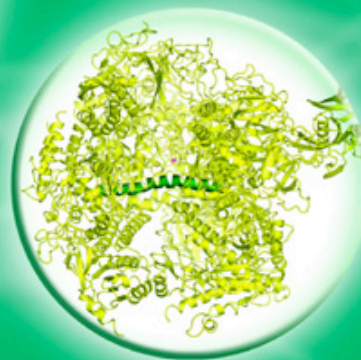
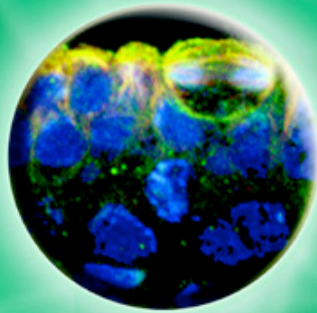


Gene Center

University of Munich-LMU

Master of Science Biochemistry

The University of Munich (LMU) offers a **new Master programme** in Biochemistry. This interfaculty course is open to **German and international students** with a Bachelor degree in Biochemistry or a related field. The programme is based at the **Gene Center**, on a leading European campus for the life sciences that offers diverse research opportunities.



Application deadlines:
January 15th and **July 15th**
each year. For further details see:
www.LMB.uni-muenchen.de.



Program description – April, 2015

Master of Science in Biochemistry

Structure of the program

The Master of Science in Biochemistry at the LMU Munich is an interfaculty program taught exclusively in English and open to German and international students. The highly competitive program provides students with an interdisciplinary education and a wide range of experimental and theoretical skills.

The program takes two years, divided into four semesters, and covers two major and one minor subject. The first, required, major is biochemistry, the second may be chosen from inorganic, organic, or physical chemistry, or cell biology. For each major subject, students take three lecture courses and one laboratory course. The minor can be chosen from any subject in biochemistry, chemistry, or biology and comprises two lecture courses and one lab course. Course work should be completed within the first three semesters; the fourth semester is devoted to the Master's thesis project, a six month research project in one of the participating labs

In each major, 21 credit points (CP) have to be earned (9 CP for lecture courses, 12 CP for the laboratory course). In the minor, 11 CP have to be earned (6 CP for lecture courses, 5 CP for the lab course). Once students have accumulated the necessary 53 CP, they may take the oral exams in the two major subjects (15 CP each) and the minor (7 CP). Subsequently, the students carry out their thesis project in any one of their three subjects (30 CP).

Organization of curriculum

During the first two semesters, the students should complete the lecture and laboratory courses for their majors and their minor. In their third semester, students attend the required research seminars and prepare for their oral exams, which they should take at the end of the semester. Detailed information regarding deadlines for the MSc exams can be found in the Regulations for the MSc Biochemistry Program ([link](#)). In their fourth semester, the students should complete their Master's thesis.

Course requirements

First, required Major – Biochemistry

Lectures:

For the major in Biochemistry, you can choose from the lecture courses listed below. In total, 9 credit points (CP) have to be earned through attendance of lecture courses and passing the respective final exams. 6 CP have to come from following courses.

Title	Time	SWS	CP	Instructor
Biochemistry 5 Life cycle of proteins	WS	2 SWS	3 CP	Prof. Beckmann
Biochemistry 6 Model organisms	SS	2 SWS	3 CP	Prof. Gaul, Tue 14-16, Lynen lecture hall
Biochemistry 7 Flow of genetic information	WS	2 SWS	3 CP	Prof. Hopfner

One lecture course from the minor subject “Molecular and Cellular Genetics” (“Posttranscriptional Gene Regulation” or “Genetics of Aging”) can replace one of the above lecture courses BC5, BC6 or BC7.

Laboratory Courses:

The research laboratory course in Biochemistry can be performed in any of the research groups at the Gene Center (see *Appendix*).

If you wish to perform the research lab course outside the Gene Center, you have to obtain permission from one of the designated representatives, Prof. Förstemann or Prof. Beckmann. Please put together a brief application containing a short description of the planned research (1-2 pages), an explanation why the research should be performed externally, and information about the host lab (research, contact). In addition, your external advisor needs to sign a consent form stating that s/he understands the requirements for the research lab course (see below).

A pdf of this form can be found on the Gene Center education websites.

For grading of internal and external research courses the supervisor should use a form that can be found on our website. Please point your supervisor to the respective website.

In addition, an electronic copy (pdf file) of the written report has to be send to Dr. Heidi Feldmann.

The research lab course is an all-day course, lasting 6 weeks during semester breaks and 8 weeks during the semester when lectures are being attended. During the course, you participate in the lab meetings of your research group. At the end of your research project, you will prepare a final written report and present a seminar in your group’s lab meeting. Your grades for the research lab course will be based on the evaluation of your research, your final report and seminar presentation.

Note: The research lab course can NOT be performed in the same lab where you carried out your Bachelor thesis project.

Seminars:

During the months preceding the oral exam, you have to attend the weekly Seminar Series of the Gene Center (Mondays, 5:00 p.m.) and the PhD/Postdoc Seminar Series (Thursday, 12:15 p.m.) on a regular basis. Seminar attendance has to be documented by the signature of the responsible organizer (host). When registering for the oral exam, you have to specify and document *at least* 10 seminars you have attended. The content of these seminars will be part of the oral exam in Biochemistry.

Second, elective Major – Chemistry or Cell Biology

For your elective major, you can choose **Chemistry** or **Cell Biology** as subjects.

Chemistry as second major subject:

If you select Chemistry as your second major, you have to choose between Inorganic Chemistry (IC), Organic Chemistry (OC), and Physical Chemistry (PC), and fulfil the same requirements in these subspecialties as Master Chemistry students. More detailed information is available under: http://www.cup.uni-muenchen.de/study/ch/master/po_ch.php

Lectures:

As in the first major, you have to earn a total of 9 CP through successful attendance of lecture courses. 6 CP have to be accumulated from the designated courses covering your subspecialty (IC, OC, PC). A current list of lectures can be found at the Chemistry Students Office (Building F).

Laboratory courses:

The research laboratory course can be completed in any research group of your chosen subspecialty (IC, OC, PC) at the Department of Chemistry, **but not in the research group in which you have carried out your Bachelor thesis project**. If you want to perform the research lab course outside the Department of Chemistry, you have to follow the same formalities as for the external lab course in Biochemistry (see above). Permission can be granted by any of the Professors in your chosen subspecialty in Chemistry. However, the requirements form has still to be signed by the external supervisor and the grading form should be used by the external supervisor. An electronic copy (pdf file) of the written report has to be send to Dr. Heidi Feldmann

For information about the research groups in Chemistry please go to:

<http://www.cup.uni-muenchen.de/dept/ch/profs.php>

Seminars:

During the months preceding the oral exam, you should attend research seminars in your chosen subspecialty and the GDCh seminar series. When registering for the oral exam, you have to specify 5 seminar lectures you have attended. The content of these seminars will be part of the oral exam in Chemistry.

Cell biology as second major subject:

Lectures:

For the winter semester 2014/15, Biochemistry Master's students can choose from the following cell biology lecture courses:

19008	Mechanisms of animal development (Conradt, Lambie...)	2 SWS 3 CP
19007	Biochemistry and Cell Biology of Plants (Vothknecht, Soll)	2 SWS 3 CP
19101	Methods in cell biology and human biology (Leanhardt)	2 SWS 3 CP
19083	Introduction to Scanning Electron Microscopy (WS, Wanner)	2 SWS 3 CP
19204	From cannabis and nicotine to anti-cancer drugs (Böttger)	2 SWS 3 CP

For the **summer semester 2015**, Biochemistry Master's students can choose from the following cell biology lecture courses:

19032	Membranes: Physical and Biological Aspects (Vothknecht)	2 SWS 3 CP
19051	Current Topics in Cell and Developmental Biology (Conradt)	2 SWS 3 CP
19094	Introduction to Electron Microscopy (KLingl) (NOT together with Introduction to Scanning Electron Microscopy from WS!!)	2 SWS 3 CP
19042	Signal transduction and Gene Regulation in Eukaryotes (Eick...)	2 SWS 3 CP

In total, 9 credit points (CP) have to be earned through attendance of lecture courses and passing their final exams. 6 CP have to come from the courses listed above, or from the corresponding list of courses for subsequent semesters.

Laboratory courses:

The research laboratory course in Cell Biology can be performed in any of the research groups in the Department of Cell Biology (listed in the Appendix).

If you wish to perform the research lab course outside the Department of Cell Biology, you have to obtain permission by the designated representative, Prof. Böttger or Prof. Conradt. Please put together a brief application containing a short description of the planned research (1-2 pages), an explanation why the research should be performed externally, and information about the host lab (research, contact). In addition, your external advisor needs to sign a consent form stating that s/he understands the requirements for the research lab course (see below).

A pdf of this form can be found on the Gene Center education websites.

For grading of internal and external research courses the supervisor should use a form that can be found on our website. Please point your supervisor to the respective website.

In addition, an electronic copy (pdf file) of the written report has to be send to Dr. Heidi Feldmann.

The research lab course is an all-day course, lasting 6 weeks during semester breaks and 8 weeks during the semester when lectures are being attended. During the course, you participate in the lab meetings of your research group. At the end of your research project, you will prepare a final written report and present a seminar in your group's lab meeting. Your grades for the research lab course will be based on the evaluation of your research, your final report and seminar presentation.

Seminars:

In the months preceding the oral exams, you have to attend research seminars in Cell Biology at the Faculty of Biology on a regular basis. Seminar attendance has to be documented by the signature of the responsible organizer (host). When registering for your oral exam, you have to specify and document *at least* 10 seminars you have attended. The content of these seminars will be part of the oral exam in Cell Biology.

Alternatively, you can attend the following block seminars:

Summer semester 2015:

- 19096 Seminar: Current methods in electron microscopy – Klingl
- 19117 Seminar: Molecular Architecture and Signaling – Vothknecht, Chigri
- 19173 Seminar: Mitochondrial quality control in health and disease – Conradt, Müller-Rischart
- 19175 Seminar: Development and evolution of eukaryotic cells – Soll, Bölter
- 19176 Seminar: Mechanisms of plant gene regulation – Frank
- 19420 Seminar: Signaling during embryonic development – Memar, Conradt
- 19421 Seminar: Single cell analysis – Conradt
- 19066 Seminar: Animal regeneration – Böttger
- 19059 Seminar: Optogenetic regulation of cellular functions – Lambie
- 19058 Seminar: Asymmetries in cell division – Conradt, Mikeladze-Dvali
- 19057 Seminar: Mitochondrial dynamics in health and disease – David, Rolland
- 19056 Seminar: non-coding RNAs – Lambie
- 19030 Seminar: Apoptose – Conradt, Memar

Minor subject

Your minor subject has to be different from your majors. The minor also has to be different from the minor you selected for your Bachelor studies. In total, you have to earn 6 CP from lecture courses and 5 CP from laboratory courses in your minor subject.

Choice of minor subjects:

Biochemistry:

Structural Biology:

Structural Biology 1 (lecture course) (Mo 12-14)	2 SWS,	3 CP	WS
Structural Biology 2 (seminar course) (Mo 12-14)	2 SWS,	3 CP	SS
Structural Biology laboratory course	10 SWS	5 CP	WS

Molecular and Cellular Genetics:

Posttranscriptional Gene Regulation (lecture course) (We 13-15)	2 SWS,	3 CP	WS
Genetics of Aging (lecture course) (Tue 10-12)	2 SWS,	3 CP	SS
Molecular and Cellular Genetics laboratory course	10 SWS	5 CP	WS

Molecular System Biology

Molecular System Biology 1 (lecture course)	2 SWS	3 CP	WS
Molecular System Biology 2 (seminar course)	2 SWS	3 CP	SS
Molecular System Biology laboratory course	10 SWS	5 CP	

Chemistry:

Inorganic Chemistry

Organic Chemistry

Physical Chemistry

With regard to Chemistry as a minor subject, Biochemistry Master's students are subject to the same regulations and as Master's students in Chemistry.

Biology:

Cell Biology

Lecture course list is the same as for the major in Cell Biology.

Genetics

19047 Methods in molecular genetics (Boshart)	2 SWS	3 CP	SS
19186 Molecular biology of the gene (Pansike)	2 SWS	3 CP	SS

Virology

19041 Molecular Virology 2	2 SWS	3 CP	
18601 Practical course	10 SWS	5 CP	

Microbiology

19199 Molecular Microbiology 2	2 SWS	3 CP	
18601 Practical course	10 SWS	5 CP	

Pharmaceutical Biology

Immunologische Arznei- und Impfstoffe (WS) and Rekombinante Arzneistoffe (SS)			
Exam: End of summer semester;		6 CP	
Practical course: Entwicklung biogener Arzneistoffe	10 SWS	5 CP	

Neurobiology

19040 Fundamentals in Neuroscience II	4 SWS	6 CP
19041 Audition and Communication	2 SWS	3 CP

Laboratory courses in Neurobiology (credit 3CP/6 SWS); attendance of two courses is required:

19108 Computersimulation of nerve cell electrophysiology		
19110 Molecular Neurogenetics)		
19106 Practical Course Extra- and Intracellular recordings of single and multi-units		

Immunology

Basic principles of Immunology 1	2 SWS	3 CP
Basic principles of Immunology 2	2 SWS	3 CP
Laboratory course Immunology	10 SWS	5 CP

Information about lectures and practical course you can find here:

<http://www.immunologie.med.uni-muenchen.de/studium/index.html>

Bioinformatics

16349 Einführung in die Bioinformatik II – Mewes	2 SWS	3 CP
16350 Übung zu Einführung in die Bioinformatik II - Mewes	2 SWS	3 CP

Human Biology

19016 Epigenetics - Leonhardt	2 SWS	3 CP
19065 Human Biology-Development and Disease - Leonhardt	2 SWS	3 CP
Laboratory course with Prof. Leonhardt	10 SWS	5 CP

Pharmaceutical Chemistry

Medizinische Chemie II	3 SWS	3 CP
Medizinische Chemie IV	3 SWS	3 CP
Pharmazeutische Chemiepraktikum	10 SWS	5 CP

Patent law

Minor subject patent law can only be chosen upon personal request

Send your personal request to fmann@lmb.uni-muenchen.de

Pharmacology and Toxicology

Pharmacology and Toxicology for life scientists	2 SWS	3 CP
Experimental Pharmacology and Toxicology	2 SWS	3 CP
Practical course in Pharmacology and Toxicology	10 SWS	5 CP

Botany

Physiology

Zoology

If the minor of your choice offers no designated laboratory course, you may choose any advanced lab course in your subspecialty that has 10 SWS/5CP, or carry out a 3-week research lab course in this subspecialty.

If you consider combinations of lectures and lab courses other than those listed above, your choice has to be approved by the examination committee.

APPENDIX

RESEARCH GROUPS IN BIOCHEMISTRY AT THE GENE CENTER

For the research laboratory course in the major subject Biochemistry, you can choose from the following research groups at the Gene Center:

Prof. Hopfner: Structural biology of DNA repair machines

DNA double strand breaks are a threat to genomic integrity. Unrepaired DNA double-strand breaks can lead to apoptosis or cancer development. We investigate the molecular mechanism of the DNA double-strand repair machinery using a combination of 3D structure determination by X-ray crystallography, molecular biology, and biochemistry.

Prof. Beckmann: Molecular machines in protein targeting and translocation

Our main interest is to better understand the fascinating process of protein sorting by looking at the complex molecular machines involved. To that end, we use a variety of molecular and cellular biochemistry methods and, most importantly, cryo-electron microscopy (cryo-EM) in combination with single particle analysis. Eventually, we aim at the 3D visualization of the complete sorting process at highest possible resolution.

Prof. Gaul: Systems biology of gene regulation and function of glia in the nervous system

Our lab's overarching goal is to understand complex biological systems at a systems level. To this end, we combine a range of molecular, genetic, genomic, and computational approaches, many developed in the lab or in collaboration with physicists and computational biologists. Our investigations are focused on deciphering the gene regulatory networks underlying animal development and on the molecular mechanisms of glia-neuron interactions in the nervous system.

Prof. Förstemann: Biology of microRNAs

MicroRNAs (miRNAs) are small RNA molecules (21-23 nt long) that repress the translation of cognate messenger RNAs. This post-transcriptional control is essential for many biological processes, for example embryonic development and growth control. With the help of our model organism *Drosophila melanogaster* (the fruitfly), we combine genetic and biochemical approaches to further elucidate the biogenesis and function of microRNAs.

Prof. Halic: Our lab is interested in small RNA mediated regulation of genome expression. It has become clear over the past decade that small RNA silencing pathways are involved in the cellular control of gene expression and in protection of the genome against mobile repetitive DNA sequences, retroelements and transposons. We combine genetic and systems biology with biochemistry and structural biology to elucidate mechanisms of small RNA mediated heterochromatin formation in fission yeast.

Dr. Herzog: Mass spectrometry of macromolecular complexes in cell cycle control

The ability of cells to make exact replicas of themselves by growth and division is central to the development of complex organisms. Dividing cells undergo a dramatic structural reorganization which is crucial to faithfully disseminate genetic information to daughter cells. Macromolecular protein assemblies serve as structural framework and central integration sites for regulatory mechanisms that ensure the correct order of these events. We will combine mass spectrometry with chemical cross-linking, biochemistry and cell biology to investigate the architecture and assembly of such cellular protein structures.

Dr. Neumüller: Cell growth regulation in stem cell fate specification and tumorigenesis

We aim to understand the cellular circuitry underlying differential cell growth regulation in stem cell lineages. In particular, we will investigate how (1) the activity of cell growth promoting transcription factors is asymmetrically regulated between stem cells and their daughter cells and (2) how DNA dependent RNA polymerases are co-regulated to sustain

the growth rate of a cell. We will use cell culture based and in vivo models as well as computational methods to address these questions.

Dr. Wendler: Protein remodeling and AAA+ assemblies

ATPases associated with various cellular activities (AAA+) constitute the engines in essential macromolecular complexes involved in re-organization and recycling of proteins, membranes and DNA in the cell. We investigate the structural changes triggered by the AAA+ motors in various protein interacting complexes. We employ cryo electron microscopy and single particle analysis to generate three dimensional snap shots of different active states and functionally characterize the assemblies using molecular, cellular and biochemical approaches.

Dr. Wilson: Antibiotics and the inhibition of protein synthesis

In every organism, translation of the genetic code into functional proteins is performed on ribosomes, which represent major targets in the cell for natural antibiotics. Our group investigates the inhibitory and resistance mechanisms of antibiotics using a combined structural (X-ray crystallography and cryo-EM) and biochemical (in vitro translation and binding assays) approach.

For the research laboratory course in Cell Biology, you can choose from the following research groups:

Prof. Barbara Conradt
Prof. Charles David
Prof. Jürgen Soll
Prof. Gerhard Wanner
Prof. Heinrich Leonhardt
Prof. Angelika Böttger
Prof. Ute Vothknecht