Study Schedule Master

Molecular Cell Biology

		Compulsory modules	Elective modules	Internship; Study Abroad	∑ credits per semester
1. Sem.	Oct Nov Dec Jan Feb March	Biochemistry 4 ECTS Molecular Genetics 4 ECTS Developmental Biology and Physiology 4 ECTS Molecular Cell Biology 4 ECTS Biophysics and Statistics 4 ECTS Mandatory Basic Course 8 ECTS Examination Module 2 ECTS			30
2. Sem.	Apr May June July Aug Sep	Teacher Seminar Series 2 ECTS Soft Skills Course / Bioethics 5 ECTS Seminars / Journal Club 3 ECTS	Elective period 1 Elective period 2 5 ECTS Elective period 3 5 ECTS Elective period 4 5 ECTS Elective period 5 5 ECTS Elective period 6 5 ECTS Elective period 7 5 ECTS Four electives to be taken in 4 out of 7 periods		30
3. Sem.	Oct Nov Dec Jan Feb March	Student Presentation 2 ECTS	Rotation 1 8 ECTS Rotation 2 8 ECTS Elective, Rotation, and Project/Exchange periods may be switched, if electives take place in Winter term and according to the needs of the students, Project/Exchange offering groups, etc.	Project/Exchange 12 ECTS	30
4. Sem.	Apr May June July Aug Sep	Master thesis 30 ECTS			30
					120

Compulsory modules

Biochemistry lecture & tutorial 30 hours weekly contact time (4 SWS)	**4 credits**
Molecular Genetics lecture & tutorial 30 hours weekly contact time	**4 credits**
Developmental Biology and Physiology lecture & tutorial 30 h wkly contact time	**4 credits**
Molecular Cell Biology lecture & tutorial 30 h weekly contact time	**4 credits**
Biophysics and Statistics lecture & tutorial 30 hours weekly contact time	**4 credits**
Mandatory Basic Course practical exercise 40 hours weekly contact time	**8 credits**
Examination Module examination 1 hour contact time	**2 credits**

Teacher Seminar Series seminar 2 hours weekly contact time	**2 credits**
Soft Skills / Bioethics lecture / seminar 3 + 2 hours weekly contact time	**5 credits**
Seminars / Journal Club seminar 3 hours weekly contact time	**3 credits**

Student Presentation seminar 2 hours weekly contact time	**2 credits**

Master thesis	**30 credits**

Elective modules

4 from 25 modules

Analysis of snRNP assembly Practical exercise, 40 hours weekly contact time	**5 credits**	**Optogenetics** Practical exercise, 40 hours weekly contact time	**5 credits**	**Molecular Biology of the Cell** Practical exercise, 40 hours weekly contact time	**5 credits**	**Mechanical Stress Protection** Practical exercise, 40 hours weekly contact time	**5 credits**
Neuronal Cell Biology Practical exercise, 40 hours weekly contact time	**5 credits**	**Transportphysiology** Practical exercise, 40 hours weekly contact time	**5 credits**	**Pharmacology & Metabolism** Practical exercise, 40 hours weekly contact time	**5 credits**	**Plant Transformation** Practical exercise, 40 hours weekly contact time	**5 credits**
Quantitative Fluorescence Microscopy Practical exercise, 40 hours weekly contact time	**5 credits**	**Biochemistry and Bioanalytics** Practical exercise, 40 hours weekly contact time	**5 credits**	**Molecular Membrane Biology** Practical exercise, 40 hours weekly contact time	**5 credits**	**Bioinformatics Lab Course** Practical exercise, 40 hours weekly contact time	**5 credits**
Embryo Biotechnology Practical exercise, 40 hours weekly contact time	**5 credits**	**Drugs from Plants and Microorganisms** Practical exercise, 40 hours weekly contact time	**5 credits**	**Biosyntheses of Natural Products** Practical exercise, 40 hours weekly contact time	**5 credits**	**Proteomics** Practical exercise, 40 hours weekly contact time	**5 credits**
Preventive, Predictive and Personalised Medicine Practical exercise, 40 hours weekly contact time	**5 credits**	**Cell Mechanics** Practical exercise, 40 hours weekly contact time	**5 credits**	**Biochemical Engineering** Practical exercise, 40 hours weekly contact time	**5 credits**	**Fluorescent Protein-based Biosensors** Practical exercise, 40 hours weekly contact time	**5 credits**
Genome Stability Practical exercise, 40 hours weekly contact time	**5 credits**	**Reconstructive Neurobiology** Practical exercise, 40 hours weekly contact time	**5 credits**	**Applications of CrispR/Cas to study neuronal function** Practical exercise, 40 hours weekly contact time	**5 credits**	**Methods in Developmental- and Tumorpathology** Practical exercise, 40 hours weekly contact time	**5 credits**
Molecular Haematology Practical exercise, 40 hours weekly contact time	**5 credits**						

2 modules

Rotation 1 Individual laboratory practical, 40 hours weekly contact time	**8 credits**
Rotation 2 Individual laboratory practical, 40 hours weekly contact time	**8 credits**

Internship

Project/Exchange Individual laboratory practical, 40 hours weekly contact time	**12 credits**

Module Title:
Biochemistry
Module ID/Code: MCB-P1

UNIVERSITÄT BONN

1. Content and intended learning outcomes	
Content	Energy metabolism pathways, enzymes, enzyme reactions and coenzymes. Posttranslational modifications as regulatory principle, analytical techniques
Learning outcomes	Deeper understanding of biochemical foundations of the cell, properties and biosyntheses of proteins, nucleic acids and lipids.

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	lecture	Biochemistry	English	25	10 h	80
	seminar	Tutorials in Biochemistry	English	25	20 h	40

3. Prerequisites for the module

compulsory	
recommended	

4. Degree program allocation

	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	compulsory	1

5. Requirements for the award of credits (ECTS)		**6. Credits**
Required achievements		4 ECTS
Assessment (incl. weighting) and examination language	written examination in English	

7. Frequency				**8. Workload**	**9. Duration**
Winter semester Summer semester	☑ ☐	Winter and summer semester	☐	**120 h**	**3 credit hours per week (SWS)**

Module coordination	
Teacher	Prof. Dr. Peter Dörmann, Prof. Dr. Andreas Meyer
Module coordinator	Prof. Dr. Peter Dörmann
Institute/Department	IMBIO (Biology)
Further information	
(Reading lists, information links etc.)	

Module Title:
Molecular Genetics
Module ID/Code: MCB-P2

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1. Content and intended learning outcomes

Content	Translation of the genetic information, regulation of the gene expression, translatory movement control, Posttranskriptionale mechanisms, Epigenetik. Methods of the molecular biology, manipulation of nucleid acids, genome Editing. Recombinant proteins, techniques and principles. Work with genome data and databases. Bases of the immune system into regard on antibody production. Antibody production and applications.
Learning outcomes	Understanding of the principles of the gene regulation and the methods of molecular genetics.

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	lecture	Molecular Genetics	English	25	10 h	80
	seminar	Tutorials in Molecular Genetics	English	25	20 h	40

3. Prerequisites for the module

compulsory	
recommended	

4. Degree program allocation

	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	compulsory	1

5. Requirements for the award of credits (ECTS)		6. Credits
Required achievements		4 ECTS
Assessment (incl. weighting) and examination language	Written examination in English	

7. Frequency				8. Workload	9. Duration
Winter semester Summer semester	☑ ☐	Winter and summer semester	☐	**120 h**	**3 credit hours per week (SWS)**

Module coordination	
Teacher	Prof. Dr. Walter Witke
Module coordinator	Prof. Dr. Walter Witke
Institute/Department	Genetics (Biology)
Further information	
(Reading lists, information links etc.)	

Module Title:
Developmental Biology and Physiology
Module ID/Code: MCB-P3

UNIVERSITÄT BONN

1. Content and intended learning outcomes

Content	Knowledge of the methodology for the analysis of multicellularity and development. General principles of development; Signalling pathways and decision mechanisms of the cell differentiation, cell division: mitosis, meiosis, nuclei; understanding of the principles of development in animals and plants; pattern formation, tissue differentiation, organ development; tissue homeostasis and stem cells; cell ageing; reproductive medicine.
Learning outcomes	Understanding of the cellular and molecular biological prerequisites of multicellularity and for the organismisc events during the development.

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	lecture	Developmental Biology and Physiology	English	25	10 h	80
	seminar	Tutorials in Developmental Biology and Physiology	English	25	20 h	40

3. Prerequisites for the module

compulsory	
recommended	

4. Degree program allocation

	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	compulsory	1

5. Requirements for the award of credits (ECTS)		6. Credits
Required achievements		4 ECTS
Assessment (incl. weighting) and examination language	written examination in English	

7. Frequency				8. Workload	9. Duration
Winter semester Summer semester	☑ ☐	Winter and summer semester	☐	**120 h**	**3 credit hours per week (SWS)**

Module Title: **Developmental Biology and Physiology** Module ID/Code: MCB-P3	UNIVERSITÄT BONN

Module coordination	
Teacher	Prof. Dr. Oliver Gruß Prof. Dr. Bernd Fleischmann, Physiology / Life & Brain, Medicine Prof. Dr. Hubert Schorle, Pathology, Medicine
Module coordinator	Prof. Dr. Oliver Gruß
Institute/Department	Genetics (Biology)
Further information	
(Reading lists, information links etc.)	

Module Title:
Molecular Cell Biology
Module ID/Code: MCB-P4

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1. Content and intended learning outcomes

Content	Organelles and compartments and their function. Cytoskeleton and cellular motors as an organizing element, membrane transport and general transport processes, ion canals. Protein sorting and proteostasis, apoptosis.
Learning outcomes	Deeper understanding of cell organisation and cellular processes.

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	lecture	Molecular Cell Biology	English	25	10 h	80
	seminar	Tutorials in Molecular Cell Biology	English	25	20 h	40

3. Prerequisites for the module

compulsory	
recommended	

4. Degree program allocation

	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	compulsory	1

5. Requirements for the award of credits (ECTS)		**6. Credits**
Required achievements		4 ECTS
Assessment (incl. weighting) and examination language	written examination in English	

7. Frequency				**8. Workload**	**9. Duration**
Winter semester Summer semester	☑ ☐	Winter and summer semester	☐	**120 h**	**3 credit hours per week (SWS)**

Module coordination	
Teacher	Prof. Dr. Dieter Fürst, Prof. Dr. Albert Haas, Prof. Dr. Jörg Höhfeld
Module coordinator	Prof. Dr. Dieter Fürst
Institute/Department	Cell Biology (Biology)
Further information	
(Reading lists, information links etc.)	

Module Title:
Biophysics and Statistics
Module ID/Code: MCB-P5

UNIVERSITÄT BONN

1. Content and intended learning outcomes	
Content	Introduction to biophysical and chemical calculations, biophysical bases of optics and microscopy, enzyme kinetics, spectroscopic methods in molecular biology, theory and methods of molecule interactions, methods for separation of macromolecules, application of statistical methods on experimental data sets.
Learning outcomes	Insight into biophysical methods and introduction to the statistical evaluation of experiments.

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	lecture	Biophysics and Statistics	English	25	10 h	80
	seminar	Tutorials in Biophysics and Statistics	English	25	20 h	40

3. Prerequisites for the module

compulsory	
recommended	

4. Degree program allocation

	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	compulsory	1

5. Requirements for the award of credits (ECTS)		**6. Credits**
Required achievements		4 ECTS
Assessment (incl. weighting) and examination language	written examination in English	

7. Frequency				**8. Workload**	**9. Duration**
Winter semester Summer semester	☑ ☐	Winter and summer semester	☐	**120 h**	**3 credit hours per week (SWS)**

Module coordination	
Teacher	Dr. Pietro Pilo Boyl Prof. Dr. Diana Imhof, Pharmacy
Module coordinator	Dr. Pietro Pilo Boyl
Institute/Department	Genetics (Biology)
Further information	
(Reading lists, information links etc.)	

Module Title:
Mandatory Basic Course
Module ID/Code: MCB-MBC

UNIVERSITÄT BONN

1. Content and intended learning outcomes	
Content	Cell culture techniques, methods of cell fractionation, isolation of nucleid acids and cloning, buffer calculations, techniques of protein biochemistry, application of antibodies, histology and microscopic methods. Proof and quantification of gene expression.
Learning outcomes	Basic methods of molecular biology shall be learned and carried out independently in the practice. The course shall put the bases for subsequent 'Elective modules'. Contents are:

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	Practical exercise	Mandatory Basic Laboratory Skills	English	25	40 h	240 h

3. Prerequisites for the module	
compulsory	
recommended	

4. Degree program allocation

	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	compulsory	

5. Requirements for the award of credits (ECTS)		**6. Credits**
Required achievements	Regular participation in the practical exercise	8 ECTS
Assessment (incl. weighting) and examination language	Practical report in English	

7. Frequency				**8. Workload**	**9. Duration**
Winter semester Summer semester	☑ ☐	Winter and summer semester	☐	**240 h**	**8 credit hours per week (SWS)**

Module coordination	
Teacher	Prof. Dr. Hubert Schorle, Prof. Dr. Jörg Höhfeld, Prof. Dr. Dieter Fürst, Prof. Dr. Oliver Gruß, Prof. Dr. Walter Witke, Dr. Pietro Pilo Boyl, Prof. Dr. Diana Imhof
Module coordinator	Prof. Dr. Walter Witke
Institute/Department	Genetics (Biology)
Further information	
(Reading lists, information links etc.)	

Module Title: Examination Module Module ID/Code: MCB-XM	UNIVERSITÄT BONN

1. Content and intended learning outcomes	
Content	Proof of meeting qualification aims of the compulsory modules MCB-P1 to MCB-P5
Learning outcomes	

2. Teaching and learning methods	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	self study	getting prepared for the examination	English	25		59 h
		examination	English	25		1 h

3. Prerequisites for the module	
compulsory	MCB-P1, MCB-P2, MCB-P3, MCB-P4, MCB-P5
recommended	

4. Degree program allocation	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	compulsory	1

5. Requirements for the award of credits (ECTS)		**6. Credits**
Required achievements		2 ECTS
Assessment (incl. weighting) and examination language	oral examination in English	

7. Frequency				**8. Workload**	**9. Duration**
Winter semester Summer semester	☑ ☐	Winter and summer semester	☐	**60 h**	

Module coordination	
Teacher (examiners)	Coordinators of Modules MCB-P1, -P2, -P3, -P4, -P5
Module coordinator	Prof. Dr. Walter Witke
Institute/Department	Genetics (Biology)
Further information	
(Reading lists, information links etc.)	

Module Title:
Teacher Seminar Series
Module ID/Code: MCB-TSS

UNIVERSITÄT BONN

1. Content and intended learning outcomes

Content	In this series, special topics in molecular biology and current reserch results are presented by the teachers
Learning outcomes	Students learn about most recent topics and research in molecular cell biology

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	Seminar	Current topics in molecular cell biology	English	25	2	60

3. Prerequisites for the module

compulsory	
recommended	

4. Degree program allocation

	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	compulsory	1

5. Requirements for the award of credits (ECTS)		**6. Credits**
Required achievements	Participation	2 ECTS
Assessment (incl. weighting) and examination language	Scientific exposé (abstract)	

7. Frequency		**8. Workload**	**9. Duration**
Winter semester ☐ Summer semester ☑	Winter and summer semester ☐	**60 hours**	**1 credit hour per week (SWS)**

Module coordination	
Teacher	Docents of the Master's Program [P and EM modules]
Module coordinator	Prof. Dr. Oliver Gruß
Institute/Department	Genetics (Biology)
Further information	
(Reading lists, information links etc.)	

Module Title:
Soft Skills / Bioethics
Module ID/Code: MCB-SSC

UNIVERSITÄT BONN

1. Content and intended learning outcomes

Content	Current Topics: The course consists of a lecture about text processing, formatting and layout, writing style in the life sciences, method of scientific citation, literature research and management, spreadsheet processing and diagrams, image processing and analysis, scientific posters and presentation. overview of free and open source software, a seminar presentation by each student about a selected current topic in molecular biotechnology, and writing a scientific paper about the topic. Bioethics: Bioethical problems of biotechnological processes in food production, agriculture, animal breeding, medicine
Learning outcomes	Soft Skills: current methods of data processing and visualization, literature research and management, scientific writing and presentation. Bioethics: selected literature on bio- and research ethics is used to make the students familiar with principles of ethical judgements with regard to bioscientific research and applications. The participants will be motivated to reflect on and analyze the ethical dimension of their own biotechnological fields of work and activities. The aim of the course is for the students to percieve ethical reflection as an integral element of their education and future work.

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	Lecture	Soft Skills	English	25	3 h	90
	Seminar	Bioethics	English	25	Block	60

3. Prerequisites for the module

compulsory	
recommended	

4. Degree program allocation

	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	compulsory	

5. Requirements for the award of credits (ECTS) / 6. Credits

Required achievements	Participation	5 ECTS
Assessment (incl. weighting) and examination language	Poster (50 %) Written examination (50 %)	

7. Frequency / 8. Workload / 9. Duration

Winter semester Summer semester	☐ ☑	Winter and summer semester	☐	**150 h**	**5 credit hours per week (SWS)**

Module Title: **Soft Skills / Bioethics** Module ID/Code: MCB-SSC	UNIVERSITÄT BONN

Module coordination	
Teacher	Dr. Roman Wagner, Dr. Jessica Sallach
Module coordinator	Dr. Jessica Sallach
Institute/Department	Genetics (Biology), Deutsches Referenzzentrum für Ethik in den Biowissenschaften (DRZE)
Further information	
(Reading lists, information links etc.)	

Module Title:
Seminars / Journal Club
Module ID/Code: MCB-SJC

UNIVERSITÄT BONN

1. Content and intended learning outcomes	
Content	Attendance of seminars and journal clubs
Learning outcomes	Awareness towards current research in molecular cell biology

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	seminar	Molecular Cell Biology	English	25	3 h	90 h

3. Prerequisites for the module	
compulsory	
recommended	

4. Degree program allocation

	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	compulsory	2

5. Requirements for the award of credits (ECTS)		**6. Credits**
Required achievements	Participation	3 ECTS
Assessment (incl. weighting) and examination language	Scientific exposé (abstract)	

7. Frequency				**8. Workload**	**9. Duration**
Winter semester Summer semester	☐ ☑	Winter and summer semester	☐	**90 h**	**1 credit hour per week (SWS)**

Module coordination	
Teacher	
Module coordinator	Prof. Dr. Oliver Gruß
Institute/Department	Genetics (Biology)
Further information	
(Reading lists, information links etc.)	

Module Title: **Student Presentation** Module ID/Code: MCB-SP	UNIVERSITÄT BONN

1. Content and intended learning outcomes	
Content	Students present their own work in rotations and Project/Exchange
Learning outcomes	Awareness towards current research in molecular cell biology for students attending, development of presentation skills of students presenting

2. Teaching and learning methods						
	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	seminar	Molecular Cell Biology	English	25	2 h	90

3. Prerequisites for the module	
compulsory	Participation in rotations and Project/Exchange
recommended	

4. Degree program allocation			
	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	compulsory	3

5. Requirements for the award of credits (ECTS)		**6. Credits**
Required achievements	Participation	2 ECTS
Assessment (incl. weighting) and examination language	Presentation	

7. Frequency		**8. Workload**	**9. Duration**
Winter semester ☐ Summer semester ☑	Winter and summer semester ☐	**90 h**	**1 credit hour per week (SWS)**

Module coordination	
Teacher	
Module coordinator	Dr. Jessica Sallach
Institute/Department	Genetics (Biology)
Further information	
(Reading lists, information links etc.)	

Module Title:
Analysis of snRNP assembly
Module ID/Code:
MCB-EM1 (A module)

UNIVERSITÄT BONN

1. Content and intended learning outcomes

Content	The following contents will be covered by the practical: • Cell culture techniques for different cell lines • Live imaging of cells • Interfering with protein function inside cells: RNAi, Gene ko, small molecule inhibitors • Protein detection after knock-down or knock-out, quantification • Indirect immunofluorescence and light microscopy • Image quantification
Learning outcomes	The practical course will provide insights into advanced techniques used in molecular biology. The students should learn methods and gain experience in planning and performing experiments independently.

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	Practical exercise	Analysis of snRNP assembly	English	6	40 h	150

3. Prerequisites for the module

compulsory	Participation in basic modules MCB-P1 - MCB-P5 (min. 3 out of 5 successfully/pass), successful praticipation (pass) in MCB-MBC, and successful (pass) MCB-XM
recommended	

4. Degree program allocation

	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	elective	2 (1st time frame)

5. Requirements for the award of credits (ECTS)		**6. Credits**
Required achievements	Regular participation in the practical exercise	5 ECTS
Assessment (incl. weighting) and examination language	Graded practical report in English	

7. Frequency				**8. Workload**	**9. Duration**
Winter semester Summer semester	☐ ☑	Winter and summer semester	☐	**150 h**	**3 credit hours per week (SWS)**

Module coordination	
Teacher	Prof. Dr. Oliver Gruß
Module coordinator	Prof. Dr. Oliver Gruß
Institute/Department	Genetics (Biology)
Further information	
(Reading lists, information links etc.)	

Module Title: Optogenetics

Module ID/Code:
MCB-EM2 (B module)

UNIVERSITÄT BONN

1. Content and intended learning outcomes

Content	The following contents will be covered by the practical: • Nucleic Acid Purification • Cell Culture Techniques • Cell Transfection • Gene Expression Studies • Microscopic Imaging Techniques • Fluorescence-based imaging • Optogenetics
Learning outcomes	The practical course will provide insights into how to apply optogenetics in tissue culture. The students should learn methods and gain experience in planning and performing experiments independently.

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	Practical exercise	Optogenetics	English		40 h	150

3. Prerequisites for the module

compulsory	Participation in basic modules MCB-P1 - MCB-P5 (min. 3 out of 5 successfully/pass), successful praticipation (pass) in MCB-MBC, and successful (pass) MCB-XM
recommended	

4. Degree program allocation

	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	elective	2 (1st time frame)

5. Requirements for the award of credits (ECTS)		6. Credits
Required achievements	Regular participation in the practical exercise	5 ECTS
Assessment (incl. weighting) and examination language	Graded practical report in English	

7. Frequency				8. Workload	9. Duration
Winter semester Summer semester	☐ ☑	Winter and summer semester	☐	**150 h**	**3 credit hours per week (SWS)**

Module coordination

Teacher	Prof. Dr. Dagmar Wachten
Module coordinator	Prof. Dr. Dagmar Wachten
Institute/Department	Innate Immunity (Medicine)

Further information

(Reading lists, information links etc.)	

Module Title:
Molecular Biology of the Cell
Module ID/Code:
MCB-EM3 (A module)

UNIVERSITÄT BONN

1. Content and intended learning outcomes

Content	The following contents will be covered by the practical: • Cell culture techniques • Differentiation and manipulation of cultured cells • Cell transfection and transduction • Knockdown of gene expression • High-resolution microscopic imaging of fluorescent proteins in cells • Analysis of protein localization, interactions and dynamics in living cells
Learning outcomes	The practical course will provide insights into advanced techniques used in molecular cell biology. The students should learn methods and gain experience in planning and performing experiments independently.

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	Practical exercise	Molecular Biology of the Cell	English	6	40 h	150

3. Prerequisites for the module

compulsory	Participation in basic modules MCB-P1 - MCB-P5 (min. 3 out of 5 successfully/pass), successful praticipation (pass) in MCB-MBC, and successful (pass) MCB-XM
recommended	

4. Degree program allocation

	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	elective	2 (3rd time frame)

5. Requirements for the award of credits (ECTS)		6. Credits
Required achievements	Regular participation in the practical exercise	5 ECTS
Assessment (incl. weighting) and examination language	Graded practical report in English	

7. Frequency				8. Workload	9. Duration
Winter semester Summer semester	☐ ☑	Winter and summer semester	☐	**150 h**	**3 credit hours per week (SWS)**

Module coordination

Teacher	Prof. Dr. Dieter O. Fürst
Module coordinator	Prof. Dr. Dieter O. Fürst
Institute/Department	Cell Biology (Biology)

Further information

(Reading lists, information links etc.)	

Module Title:
Mechanical Stress Protection
Module ID/Code:
MCB-EM4 (A module)

UNIVERSITÄT BONN

1. Content and intended learning outcomes

Content	The following contents will be covered by the practical: • Cell Culture Techniques • Expression of Recombinant Proteins • Protein Purification • Differentiation of Muscle Cells • Electrical Pulse Stimulation as an Exercise Model • Immunoprecipitation and Yeast-2-Hybrid System • Microscopic Imaging Techniques • Analysis of Protein Degradation Pathways
Learning outcomes	Cells in multicellular organisms are constantly subjected to stress resulting from mechanical forces. The course will teach advanced biochemical and cell biological approaches to study molecular mechanisms that provide protection against mechanical stress. These mechanisms are fundamental for cell adhesion and migration and for the maintenance of tissues such as skeletal muscle and heart.

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	Practical exercise	Methods in Mechanical Stress Protection	English	20	35 h	90 h
	Seminar	Mechanical Stress Protection	English	20	10 h	60 h

3. Prerequisites for the module

compulsory	Participation in basic modules MCB-P1 - MCB-P5 (min. 3 out of 5 successfully/pass), successful praticipation (pass) in MCB-MBC, and successful (pass) MCB-XM
recommended	

4. Degree program allocation

	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	elective	2 (3rd time frame)

5. Requirements for the award of credits (ECTS)		6. Credits
Required achievements	Regular participation in the practical exercise	5 ECTS
Assessment (incl. weighting) and examination language	Graded practical report (70 %) and seminar presentation (30 %) in English	

7. Frequency				8. Workload	9. Duration
Winter semester Summer semester	☐ ☑	Winter and summer semester	☐	**150 h**	**3 credit hours per week (SWS)**

Module Title: **Mechanical Stress Protection** Module ID/Code: MCB-EM4 (A module)	
Module coordination	
Teacher	Prof. Dr. Jörg Höhfeld
Module coordinator	Prof. Dr. Jörg Höhfeld
Institute/Department	Cell Biology (Biology)
Further information	
(Reading lists, information links etc.)	

Module Title:
Neuronal Cell Biology
Module ID/Code:
MCB-EM5 (A module)

UNIVERSITÄT BONN

1. Content and intended learning outcomes

Content	The following contents will be covered by the practical: • Neuronal cell culture • Transfection of neurons • Immunocytochemistry • Fluorescent Microscopy • Live Cell Microscopy • Whole Tissue Imaging techniques
Learning outcomes	The practical course will provide insights into advanced techniques used in neuronal cell biology. The students should learn methods and gain experience in planning and performing experiments independently.

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	Practical exercise	Neuronal Cell Biology	English	6	40 h	150

3. Prerequisites for the module

compulsory	Participation in basic modules MCB-P1 - MCB-P5 (min. 3 out of 5 successfully/pass), successful praticipation (pass) in MCB-MBC, and successful (pass) MCB-XM
recommended	

4. Degree program allocation

	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	elective	2

5. Requirements for the award of credits (ECTS)		**6. Credits**
Required achievements	Regular participation in the practical exercise	5 ECTS
Assessment (incl. weighting) and examination language	Graded practical report (50 %) and oral examination (50 %) in English	

7. Frequency				**8. Workload**	**9. Duration**
Winter semester Summer semester	☐ ☑	Winter and summer semester	☐	**150 h**	**3 credit hours per week (SWS)**

Module coordination	
Teacher	Prof. Dr. Walter Witke, Prof. Dr. Frank Bradke (DZNE)
Module coordinator	Prof. Dr. Walter Witke
Institute/Department	Genetics (Biology)
Further information	
(Reading lists, information links etc.)	

Module Title: Transportphysiology

Module ID/Code:
MCB-EM6 (A module)

UNIVERSITÄT BONN

1. Content and intended learning outcomes

Content	In the lab course relevant examples of plant environment interactions from the molecular to the organismic level will be studied. Experiments will deal with water and salt stress, effects of xenobiotics on plants, plant microorganism interaction and secondary plant metabolites. Experimental approaches include measurement of chlorophyll fluorescence, porometry, measurement of cuticular transpiration and uptake of xenobiotics in leaves and analysis of gene expression in response to environmental stimuli. Experiments will be conducted with model and crop species.
Learning outcomes	The practical course will provide insights into modern techniques used in molecular plant physiology and ecology. The students should learn different methods in transport physiology and gain experience in planning and performing experiments independently.

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	Practical exercise	Transportphysiology	English	2	40 h	150

3. Prerequisites for the module

compulsory	Participation in basic modules MCB-P1 - MCB-P5 (min. 3 out of 5 successfully/pass), successful praticipation (pass) in MCB-MBC, and successful (pass) MCB-XM
recommended	

4. Degree program allocation

	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	elective	2 (3rd time frame)
	Plant Sciences (M.Sc.)		
	OEP Biology (M.Sc.)		

5. Requirements for the award of credits (ECTS)		6. Credits
Required achievements	Regular participation in the practical exercise	5 ECTS
Assessment (incl. weighting) and examination language	Graded written examination in English	

7. Frequency				8. Workload	9. Duration
Winter semester Summer semester	☐ ☑	Winter and summer semester	☐	**150 h**	**3 credit hours per week (SWS)**

Module coordination	
Teacher	Prof. Dr. Lukas Schreiber
Module coordinator	Prof. Dr. Lukas Schreiber
Institute/Department	Cellular and Molecular Botany (Biology)

Module Title: Transportphysiology Module ID/Code: MCB-EM6 (A module)	
Further information	
(Reading lists, information links etc.)	1. Taiz L, Zeiger E (2006) Plant Physiology. Sinauer Associates Inc., Sunderland, MA, 2. Schulze ED, Beck E, and Müller-Hohenstein K. Plant Ecology, Heidelberg: Springer, 2005

Module Title:
Pharmacology & Metabolism
Module ID/Code:
MCB-EM7 (B module)

UNIVERSITÄT BONN

1. Content and intended learning outcomes

Content	The following contents will be covered by the practical: • Murine primary adipocyte isolation and culture • Human adipocyte cell culture • Pharmacological intervention of experimental model system • Ex vivo and in vitro metabolic measurements (including oxygen consumption, energy expenditure, lipolysis, mitochondrial function, etc.) • Data collection, analysis and interpretation
Learning outcomes	This module is dedicated to understanding and investigating how small molecular modulators can be used to specifically target prominent metabolic pathways using the mouse as an experimental animal model. Attendees will be introduced to murine animal handling, murine primary adipocyte isolation and *in vivo*, *ex vivo* and *in vitro* pharmacological experimentation with the model system. The practical work will be supported by seminars covering, among other, signal transduction, metabolism and pharmacology.

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	Practical exercise	Molecular Biology	English	6	40 h	150

3. Prerequisites for the module

compulsory	Participation in basic modules MCB-P1 - MCB-P5 (min. 3 out of 5 successfully/pass), successful praticipation (pass) in MCB-MBC, and successful (pass) MCB-XM
recommended	

4. Degree program allocation

	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	elective	2

5. Requirements for the award of credits (ECTS)		6. Credits
Required achievements	Regular participation in the practical exercise	5 ECTS
Assessment (incl. weighting) and examination language	Graded practical report in English	

7. Frequency				8. Workload	9. Duration
Winter semester Summer semester	☐ ☑	Winter and summer semester	☐	**150 h**	**3 credit hours per week (SWS)**

Module Title: **Pharmacology & Metabolism** Module ID/Code: MCB-EM7 (B module)	UNIVERSITÄT BONN

Module coordination	
Teacher	Prof. Dr. Alexander Pfeifer
Module coordinator	Prof. Dr. Alexander Pfeifer

Module Title:
Plant Transformation
Module ID/Code:
MCB-EM8 (A module)

UNIVERSITÄT BONN

1. Content and intended learning outcomes

Content	The practical lab exercise on plant expression systems will focus on techniques of generating transgenic plant lines employing different plant species including tobacco and Arabidopsis. Modern plant sciences involve different culture systems and transformation protocols. The most relevant techniques will be presented during this lab course. Laboratory techniques in modern cell biology, microscopy and visualization. Skills for documentation and presentation of scientific experiments and data.
Learning outcomes	Biolistic transformation of plants (leaf discs) with reporter constructs, *Agrobacterium*mediated transformation, cloning in Escherichia coli and *Agrobacterium tumefaciens*, screening of transgenic lines, detection of transgenes by PCR, histochemical and biochemical methods.

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	Practical exercise	Plant transformation	English		40 h	150

3. Prerequisites for the module

compulsory	Participation in basic modules MCB-P1 - MCB-P5 (min. 3 out of 5 successfully/pass), successful praticipation (pass) in MCB-MBC, and successful (pass) MCB-XM
recommended	

4. Degree program allocation

	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	elective	2

5. Requirements for the award of credits (ECTS)		**6. Credits**
Required achievements		5 ECTS
Assessment (incl. weighting) and examination language	Graded practical report in English	

7. Frequency				**8. Workload**	**9. Duration**
Winter semester Summer semester	☐ ☑	Winter and summer semester	☐	**150 h**	**3 credit hours per week (SWS)**

Module coordination	
Teacher	Prof. Dr. Peter Dörmann
Module coordinator	Prof. Dr. Peter Dörmann
Institute/Department	Molecular Physiology and Biotechnology of Plants (Biology)
Further information	
(Reading lists, information links etc.)	

Module Title:
Quantitative Fluorescence Microscopy
Module ID/Code:
MCB-EM9 (B module)

UNIVERSITÄT BONN

1. Content and intended learning outcomes

Content	The following contents will be covered by the practical: • Transient and stable expression of fluorescent proteins • SNAP-, Halo, Clip-tag labelling • Super resolution confocal laser scanning microscopy • Fluorescence recovery after photobleaching (FRAP) • Analysis of intracellular protein mobility • Förster resonance energy transfer (FRET) measurements • Quantitative image analysis • 3D image reconstruction
Learning outcomes	The practical course will provide insights into advanced light microscopy techniques used in molecular cell biology. The students should learn methods and gain experience in planning and performing experiments independently.

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	Lecture	Microscopy and Image Processing	English	6	6 h	30
	Practical exercise	Quantitative Fluorescence Microscopy	English	3x2	34 h	120

3. Prerequisites for the module

compulsory	Participation in basic modules MCB-P1 - MCB-P5 (min. 3 out of 5 successfully/pass), successful praticipation (pass) in MCB-MBC, and successful (pass) MCB-XM
recommended	

4. Degree program allocation

	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	elective	

5. Requirements for the award of credits (ECTS) / 6. Credits

Required achievements	5 ECTS
Assessment (incl. weighting) and examination language	Graded practical report in English

7. Frequency / 8. Workload / 9. Duration

Winter semester Summer semester	☐ ☑	Winter and summer semester	☐	**150 h**	**3 credit hours per week (SWS)**

Module Title:
Quantitative Fluorescence Microscopy
Module ID/Code:
MCB-EM9 (B module)

Module coordination	
Teacher	Prof. Dr. Ulrich Kubitscheck
Module coordinator	Prof. Dr. Ulrich Kubitscheck
Institute/Department	Physical and Theoretical Chemistry (Chemistry)
Further information	
(Reading lists, information links etc.)	Fluorescence Microscopy: From Principles to Application, 2nd edition, Wiley-VCH, ed. U. Kubitscheck

Module Title:
Molecular Membrane Biology
Module ID/Code:
MCB-EM11 (A module)

UNIVERSITÄT BONN

1. Content and intended learning outcomes

Content	The following contents are typically covered by the practical: • Cell culture with macrophages and epithelial cells • Subcellular fractionation and biochemical analysis of fractions • Membrane purification • Membrane fusion with purified components • Gene expression knock-down with siRNA • Fluorescence microscopy • Computer-assisted image analysis
Learning outcomes	The practical course will provide insights into advanced techniques used in molecular cell biology. The students should learn current methods and gain experience in planning and performing experiments.

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	Practical exercise	Molecular Membrane Biology	English	6	60 h	100
	Seminar and lectures				20 h	50

3. Prerequisites for the module

compulsory	Participation in basic modules MCB-P1 - MCB-P5 (min. 3 out of 5 successfully/pass), successful participation (pass) in MCB-MBC, and successful (pass) MCB-XM
recommended	

4. Degree program allocation

	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	elective	2

5. Requirements for the award of credits (ECTS) / 6. Credits

Required achievements		5 ECTS
Assessment (incl. weighting) and examination language	Graded practical report (70 % of final grade) and graded seminar presentation (30% of final grade) in English	

7. Frequency				8. Workload	9. Duration
Winter semester Summer semester	☐ ☑	Winter and summer semester	☐	**150 h**	**3 credit hours per week (SWS)**

Module Title: **Molecular Membrane Biology** Module ID/Code: MCB-EM11 (A module)	UNIVERSITÄT BONN
Module coordination	
Teacher	Prof. Dr. Albert Haas
Module coordinator	Prof. Dr. Albert Haas
Institute/Department	Cell Biology Institute (Biology)
Further information	
(Reading lists, information links etc.)	

Module Title:
Biosyntheses of Natural Products
Module ID/Code:
MCB-EM15 (B module)

UNIVERSITÄT BONN

1. Content and intended learning outcomes

Content	Overview of the structure and biosynthesis of natural products, analysis and identification of genes for biosynthetic pathways, enzymes and proteins using molecular methods (PCR, electrophoresis, blotting techniques).
Learning outcomes	The students get an overview of structures and biosynthesis of natural products, the course provides knowledge of molecular biological analysis and identification of biosynthesis genes, enzymes and proteins.

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	Practical exercise	Biosyntheses of Natural Products	English		36 h	120
	Seminar				4 h	30

3. Prerequisites for the module

compulsory	Participation in basic modules MCB-P1 - MCB-P5 (min. 3 out of 5 successfully/pass), successful praticipation (pass) in MCB-MBC, and successful (pass) MCB-XM
recommended	

4. Degree program allocation

	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	elective	3

5. Requirements for the award of credits (ECTS)		**6. Credits**
Required achievements		5 ECTS
Assessment (incl. weighting) and examination language	Graded practical report (34 %), written examination (33 %), seminar presentation (33 %) in English	

7. Frequency				**8. Workload**	**9. Duration**
Winter semester Summer semester	☑ ☐	Winter and summer semester	☐	**150 h**	**3 credit hours per week (SWS)**

Module coordination	
Teacher	Dr. Stefan Kehraus
Module coordinator	Dr. Stefan Kehraus
Institute/Department	Pharmaceutical Biology (Pharmacy)
Further information	
(Reading lists, information links etc.)	

Module Title:
Proteomics
Module ID/Code:
MCB-EM16 (B module)

UNIVERSITÄT BONN

1. Content and intended learning outcomes	
Content	Protein isolation and characterisation using mass spectrometry. Analysis of posttranslational protein modifications.
Learning outcomes	Students learn to identify, isolate and characterise proteins from tissues of moleculogenetically well defined model organisms.

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	Practical exercise		English		40 h	150

3. Prerequisites for the module	
compulsory	Participation in basic modules MCB-P1 - MCB-P5 (min. 3 out of 5 successfully/pass), successful praticipation (pass) in MCB-MBC, and successful (pass) MCB-XM
recommended	

4. Degree program allocation

	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	elective	3

5. Requirements for the award of credits (ECTS)	**6. Credits**
Required achievements	5 ECTS
Assessment (incl. weighting) and examination language	Seminar presentation (50 %), graded practical report (50 %), in English

7. Frequency				**8. Workload**	**9. Duration**
Winter semester Summer semester	☑ ☐	Winter and summer semester	☐	**150 h**	**3 credit hours per week (SWS)**

Module coordination	
Teacher	Priv.-Doz. Dr. Simone Diestel, Dr. Marc Sylvester (Molecular Biology, Medicine)
Module coordinator	Priv.-Doz. Dr. Simone Diestel
Institute/Department	Human Nutrition and Food Science (Agriculture)
Further information	
(Reading lists, information links etc.)	

Module Title:
Preventive, Predictive and Personalised Medicine
Module ID/Code:
MCB-EM17 (B module)

UNIVERSITÄT BONN

1. Content and intended learning outcomes

Content	Significance of early or preventative diagnostics in cardiovasculary and tumor diseases, application of modern biotechnologies in medical diagnostics, introduction into molecular and minimally invasive diagnostic technologies, development of pathology-specific biomarkers.
Learning outcomes	Metabolic pathways affected in pathomechanisms of cardiovasculary complications secondary to Diabetes mellitus type II, metabolic pathways affected in pathomechanisms of neurodegenerative diseases, metabolic pathways affected in pathomechanisms of selected tumors, using the examples of glioblastoma and breast cancer, stress and repair mechanisms (comet assay technology), role and evaluation of tissue remodelling-protein complexes (technology of zymography), pathology specific expression patterns (technologies of clinical proteomics and real-time PCR), analysis of disease-specific expression arrays, written summary of the experimental design and results, presentation of a research hypothesis.

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	Practical exercise	Preventive, Predictive and Personalised Medicine	English	8	36 h	120
	Seminar				4 h	30

3. Prerequisites for the module

compulsory	Participation in basic modules MCB-P1 - MCB-P5 (min. 3 out of 5 successfully/pass), successful praticipation (pass) in MCB-MBC, and successful (pass) MCB-XM
recommended	

4. Degree program allocation

	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	elective	2

5. Requirements for the award of credits (ECTS)		6. Credits
Required achievements		5 ECTS
Assessment (incl. weighting) and examination language	Written practical report (60 %), written examination (20 %), seminar presentation (20 %) in English	

Module Title: **Preventive, Predictive and Personalised Medicine** Module ID/Code: MCB-EM17 (B module)					UNIVERSITÄT BONN
7. Frequency				**8. Workload**	**9. Duration**
Winter semester Summer semester	☐ ☑	Winter and summer semester	☐	**150 h**	**3 credit hours per week (SWS)**
Module coordination					
Teacher		Prof. Dr. Olga Golubnitschaja			
Module coordinator		Prof. Dr. Olga Golubnitschaja			
Institute/Department		Radiology (Medicine)			
Further information					
(Reading lists, information links etc.)					

Module Title: Cell Mechanics Module ID/Code: MCB-EM18 (A module)	UNIVERSITÄT BONN

1. Content and intended learning outcomes

Content	Mechanical functions of the cell: live cell imaging and immunocytochemistry, substrate deformation and cellular force analysis of animal cells under various conditions and at different stages of cellular differentiation; Mechanical properties of the cell: atomic force microscopy (AFM) to measure the elasticity of cells under various conditions and at different stages of differentiation, high-resolution visualization of cytoskeletal structures, analysis of the influence of selective mechanical stimuli on the induction of cellular reactions, analysis of cellular viscoelasticity in the context of molecular mobility; Mechanical signals recognized by the cell: evaluation of parameters to control cellular behavior and differentiation – substrate stiffness, substrate stretch, topography – including morphological and functional tests.
Learning outcomes	Animal cells are continuously in contact with their environment and able to send as well as receive signals. In addition to chemical signals, mechanical signals play a pivotal role by regulating a plethora of essential cellular functions like embryogenesis, cell migration, adhesion, formation of multicellular structures, morphology, and differentiation. The aim of this module is to exactly analyze the diverse mechanical signals within animal organisms in order to elucidate the functioning of widespread mechanosensitive processes. This concept will help to understand that in experimental setups, which are designed close to the in vivo situation, a combination of chemical and mechanical signals must be used. To characterize cellular mechanics, cellular forces required for the function of each individual cell in processes of adhesion and migration, are analyzed. In addition to the mechanical forces induced by the cell itself, animal cells also react to mechanical signals from the surrounding tissue. These signals may induce minor adaptations as well as major processes of cellular differentiation or vectored migration and are more closely investigated through the parameters substrate elasticity, topography, and environmental stretch. Since virtually every mechanical event has an impact on cell viscosity and elasticity, the evaluation of these parameters completes the analysis of cellular mechanics.

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	Practical exercise		English		40 h	150

3. Prerequisites for the module

compulsory	Participation in basic modules MCB-P1 - MCB-P5 (min. 3 out of 5 successfully/pass), successful praticipation (pass) in MCB-MBC, and successful (pass) MCB-XM	
recommended		
Assessment (incl.	Graded practical report in English	

Module Title: Cell Mechanics Module ID/Code: MCB-EM18 (A module)					UNIVERSITÄT BONN
4. Degree program allocation					
	Study program			compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)			elective	3
5. Requirements for the award of credits (ECTS)					**6. Credits**
Required achievements					5 ECTS
Assessment (incl. weighting) and examination language	Graded practical report in English				
7. Frequency				**8. Workload**	**9. Duration**
Winter semester ☐ Summer semester ☑	Winter and summer semester	☐		**150 h**	**3 credit hours per week (SWS)**
Module coordination					
Teacher	Priv.-Doz. Dr. Bernd Hoffmann				
Module coordinator	Priv.-Doz. Dr. Bernd Hoffmann				
Institute/Department	Complex Sytems (FZ Jülich)				
Further information					
(Reading lists, information links etc.)					

Module Title:
Biochemical Engineering
Module ID/Code:
MCB-EM19 (B module)

UNIVERSITÄT BONN

1. Content and intended learning outcomes	
Content	The students work in a laboratory environment in the scientific groups of the departments involved in the study program.
Learning outcomes	Guided experimental work in the laboratory

2. Teaching and learning methods						
	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	Practical exercise		English		40 h	150

3. Prerequisites for the module	
compulsory	Participation in basic modules MCB-P1 - MCB-P5 (min. 3 out of 5 successfully/pass), successful praticipation (pass) in MCB-MBC, and successful (pass) MCB-XM
recommended	

4. Degree program allocation			
	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	elective	2

5. Requirements for the award of credits (ECTS)	**6. Credits**
Required achievements	5 ECTS
Assessment (incl. weighting) and examination language	Graded practical report in English

7. Frequency				**8. Workload**	**9. Duration**
Winter semester Summer semester	☐ ☑	Winter and summer semester	☐	**150 h**	**3 credit hours per week (SWS)**

Module coordination	
Teacher	Prof. Dr. Marco Oldiges
Module coordinator	Prof. Dr. Marco Oldiges
Institute/Department	Bio- and Geosciences (FZ Jülich)
Further information	
(Reading lists, information links etc.)	

Module Title:
Fluorescent Protein-based Biosensors
Module ID/Code:
MCB-EM20 (B module)

UNIVERSITÄT BONN

1. Content and intended learning outcomes	
Content	Expression of recombinant proteins in *E. coli*; spectral characterization of purified fluorescent proteins; selection of transgenic plants; ratiometric laser scanning microscopy; image analysis; Gateway cloning; transient expression of membrane proteins tagged with GFP-based biosensors in tobacco; membrane isolation and protein protection assays
Learning outcomes	Generation and validation of genetically encoded biosensors; application of GFPbased probes for dynamic in vivo measurements of physiological parameters and for the analysis of membrane proteins

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	Practical exercise	Fluorescent Proteinbased Biosensors	English	4	40 h	150 h

3. Prerequisites for the module	
compulsory	Participation in basic modules MCB-P1 - MCB-P5 (min. 3 out of 5 successfully/pass), successful praticipation (pass) in MCB-MBC, and successful (pass) MCB-XM
recommended	

4. Degree program allocation

	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	elective	3

5. Requirements for the award of credits (ECTS)		**6. Credits**
Required achievements	regular participation in the practical exercise	5 ECTS
Assessment (incl. weighting) and examination language	graded practical report in English	

7. Frequency				**8. Workload**	**9. Duration**
Winter semester Summer semester	☐ ☑	Winter and summer semester	☐	**150 h**	**3 credit hours per week (SWS)**

Module coordination	
Teacher	Prof. Dr. Andreas Meyer
Module coordinator	Prof. Dr. Andreas Meyer
Institute/Department	Crop Science and Resource Conservation (Agriculture)
Further information	
(Reading lists, information links etc.)	

Module Title:
Genome Stability
Module ID/Code:
MCB-EM21 (B module)

UNIVERSITÄT BONN

1. Content and intended learning outcomes

Content	The following contents will be covered by the practical: Nucleic Acid Purification Protein Purification Microscopic Imaging Techniques Southern Blot analysis Yeast genetics Molecular cloning techniques
Learning outcomes	The practical course will provide insights into advanced techniques used in molecular biology with the focus in telomere biology. The students should learn methods and gain experience in performing experiments independently and set them into context of the current literature

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	Practical exercise	Telomere Biology	English	4 – 6	40 h	

3. Prerequisites for the module

compulsory	Participation in basic modules MCB-P1 - MCB-P5 (min. 3 out of 5 successfully/pass), successful praticipation (pass) in MCB-MBC, and successful (pass) MCB-XM
recommended	

4. Degree program allocation

	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	elective	2

5. Requirements for the award of credits (ECTS)		6. Credits
Required achievements	regular participation in the practical exercise	5 ECTS
Assessment (incl. weighting) and examination language	graded practical report in English	

7. Frequency				8. Workload	9. Duration
Winter semester Summer semester	☐ ☑	Winter and summer semester	☐	**150 h**	**3 credit hours per week (SWS)**

Module coordination	
Teacher	Prof. Dr. Katrin Paeschke
Module coordinator	Prof. Dr. Katrin Paeschke
Institute/Department	Haematology/Oncology (Medicine)
Further information	
(Reading lists, information links etc.)	

Module Title:
Reconstructive Neurobiology (Molecular tools for stem and developmental biology)
Module ID/Code:
MCB-EM22 (B module)

UNIVERSITÄT BONN

1. Content and intended learning outcomes

Content	The following contents will be covered by the practical: • Strategies to generate mouse models for the investigation of neurodevelopmental processes • Molecular mechanisms underlying neural fate determination • Extrinsic factor-driven differentiation and patterning • Forced expression of transcription factors and use of small molecules for forward programming approaches • Direct conversion of somatic cells into neural stem cells • Generation of 3D cortical organoids • Genetically engineered reporter gene systems for image-based phenotype analysis • Principles of primer design and construct engineering for setting up phenotype-specific reporter assays • Microscopy of 2D and 3D cultures (light sheet, bright field, high content and fluorescence) • Immunofluorescence imaging
Learning outcomes	During this practical course students gain insight into the molecular mechanisms underlying the development of the central nervous system in mouse and human. They learn about tools used in mouse genetics and cell programming strategies applied in human stem cell biology. In particular, they acquire knowledge on the generation of iPS cells and their genetic modification via genome editing. After successful participation, attendees should be able to apply these tools for experimentally addressing questions relating to mouse developmental biology, human stem cell biology and genome editing. Attendees will design gRNAs for CRISPR/Cas9-based editing and use assays to evaluate genome editing efficiency. Furthermore, students prepare embryonic tissue for 3D imaging analysis, perform immunohistochemistry and RNA in situ hybridization on mouse brain sections and analyze the specimens using advanced microscopy techniques. In addition, students get insight into transcription factor based fate programming, learn to establish 3D cortical organoids and get to know the principles of image-based analyses of cellular (patho-) phenotypes using specific genetically engineered reporter assays. A particular focus is put on the discussion of the possibilities but also limitations of the presented techniques.

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	Practical exercise	Experimental neurobiology and stem cell biology	English	10	40 h	150 h

Module Title: **Reconstructive Neurobiology (Molecular tools for stem and developmental biology)** Module ID/Code: MCB-EM22 (B module)	UNIVERSITÄT BONN

3. Prerequisites for the module	
compulsory	Participation in basic modules MCB-P1 - MCB-P5 (min. 3 out of 5 successfully/pass), successful praticipation (pass) in MCB-MBC, and successful (pass) MCB-XM
recommended	

4. Degree program allocation			
	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	elective	2

5. Requirements for the award of credits (ECTS)		**6. Credits**
Required achievements	regular participation in the practical exercise	5 ECTS
Assessment (incl. weighting) and examination language	Graded, oral presentation of a recent high-impact publication in English	

7. Frequency				**8. Workload**	**9. Duration**
Winter semester Summer semester	☐ ☑	Winter and summer semester	☐	**150 h**	**3 credit hours per week (SWS)**

Module coordination	
Teacher	Prof. Dr. Oliver Brüstle; Prof. Dr. Sandra Blaess
Module coordinator	Prof. Dr. Oliver Brüstle
Institute/Department	Reconstructive Neurobiology (Medicine)
Further information	
(Reading lists, information links etc.)	

Module Title:
Communication between cells in the nervus systhem
MCB-EM23 (B module)

UNIVERSITÄT BONN

1. Content and intended learning outcomes

Content	The following contents will be covered by the course: • Crispr/Cas background (lecture) • Crispr/Cas applications in neurobiological research (lecture) • Generation and application of viral vectors (lecture) • Design of Crispr/Cas vectors (practical) • Preparation of viral vectors (practical) • Cell culture (pratical) • Analysis of cells edited with Crispr/Cas (fluorescence imaging, multielectrode array recordings, time lapse imaging, luciferase) (practical)
Learning outcomes	The course will provide an introduction into the usage of Crispr/Cas and the generation of viral vectors in neurobiological research on a theoretical level, on a practical level, and give an introduction into data analysis.

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	Practical exercise	Crispr/Cas	English	4	36 h	120
	Lectures				3 h	15
	Seminars				1 h	15

3. Prerequisites for the module

compulsory	Participation in basic modules MCB-P1 - MCB-P5 (min. 3 out of 5 successfully/pass), successful praticipation (pass) in MCB-MBC, and successful (pass) MCB-XM
recommended	

4. Degree program allocation

	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	elective	2

5. Requirements for the award of credits (ECTS)		6. Credits
Required achievements	regular participation in the practical exercise	5 ECTS
Assessment (incl. weighting) and examination language	Graded written examination (50 %) and graded seminar presentation (50 %) in English	

7. Frequency				8. Workload	9. Duration
Winter semester Summer semester	☐ ☑	Winter and summer semester	☐	**150 h**	**3 credit hours per week (SWS)**

Module Title: **Communication between cells in the nervus systhem** Module ID/Code: MCB-EM23 (B module)	UNIVERSITÄT BONN
Module coordination	
Teacher	Prof. Dr. Ina Vorberg (DZNE) Prof. Dr. Susanne Schoch McGovern (Neuropathology)
Module coordinator	Prof. Dr. Ina Vorberg, Prof. Dr. Susanne Schoch McGovern
Institute/Department	Neuropathology (Medicine)
Further information	
(Reading lists, information links etc.)	

Module Title:
Methods in Developmental- and Tumorpathology
Module ID/Code:
MCB-EM24 (B module)

UNIVERSITÄT BONN

1. Content and intended learning outcomes

Content	The practical comprises: isolation of molecules (RNA) from animal cells or tissues, reverse transcription PCR, gene specific PCR reactions, quantitative real-time PCR, gel electrophoresis, quantitative real time PCR and end point PCR data analysis, candidate gene analysis with *in situ* hybridization (ISH), fragment sequencing, sequence data analysis, use of public data bases.
Learning outcomes	The practical provides insights into basic and advanced techniques in molecular biology

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	Practical exercise	Methods in Developmental- and Tumorpathology	English	8	38 h	90 h
	Seminar	Developmental- and Tumorpathology	English	8	4 h	60 h

3. Prerequisites for the module

compulsory	Participation in basic modules MCB-P1 - MCB-P5 (min. 3 out of 5 successfully/pass), successful praticipation (pass) in MCB-MBC, and successful (pass) MCB-XM
recommended	

4. Degree program allocation

	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	elective	2

5. Requirements for the award of credits (ECTS)		**6. Credits**
Required achievements	regular participation in the practical exercise	5 ECTS
Assessment (incl. weighting) and examination language	graded practical report in English	

7. Frequency				**8. Workload**	**9. Duration**
Winter semester Summer semester	☐ ☑	Winter and summer semester	☐	**150 h**	**3 credit hours per week (SWS)**

Module coordination	
Teacher	Prof. Dr. Hubert Schorle
Module coordinator	Prof. Dr. Hubert Schorle
Institute/Department	Pathology (Medicine)
Further information	
(Reading lists, information links etc.)	

Module Title:
Molecular Haematology

Module ID/Code:
MCB-EM25 (B module)

UNIVERSITÄT BONN

1. Content and intended learning outcomes

Content	- Identification of patients coagulation disorders: a. Coagulation assays (e.g. whole blood and plasma-based global coagulation assays, detection of coagulation factor inhibiting antibodies) b. DNA preparation from blood, PCR, Sanger sequencing and analysis - Investigation of the identified mutation by several strategies in order to characterize the phenotype: a. Cloning of target cDNA into a vector by restriction-free cloning PCR, mutagenesis PCR, transfection and expression in mammalian cell line and genetically modified cell lines (CRISPR/Cas9), analysis of the mutant protein by coagulation based assays (e.g. ELISA) b. Reprogramming of patient and WT blood in induced pluripotent stem (IPS) cells, characterization of IPS cells (intracellular staining of pluripotency markers, embryoid body formation), cultivation of IPS cells (Clump splitting), differentiation into endothelial cells c. Protein modelling of wild-type and mutated protein
Learning outcomes	The aim of this module is to identify and further characterize patient´s phenotype by different methods. The students will learn how to plan a project and develop several strategies to investigate specific mutations on DNA and protein level. The course provides knowledge about current techniques used in molecular biology including DNA analysis, cell culture, cell-based assays and in silico modelling.

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	Practical exercise	From patient to phenotype characterization	English	6	40 h	80 h

3. Prerequisites for the module

compulsory	Participation in basic modules MCB-P1 - MCB-P5 (min. 3 out of 5 successfully/pass), successful praticipation (pass) in MCB-MBC, and successful (pass) MCB-XM
recommended	

4. Degree program allocation

	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	elective	

5. Requirements for the award of credits (ECTS)		6. Credits
Required achievements	regular participation in the practical exercise	5 ECTS
Assessment (incl. weighting) and examination language	graded practical report in English	

Module Title: **Molecular Haematology** Module ID/Code: MCB-EM25 (B module)					UNIVERSITÄT BONN
7. Frequency				**8. Workload**	**9. Duration**
Winter semester Summer semester	☐ ☑	Winter and summer semester	☐	**150 h**	**3 credit hours per week (SWS)**
Module coordination					
Teacher	Dr. Katrin Czogalla-Nitsche				
Module coordinator	Prof. Dr. Johannes Oldenburg				
Institute/Department	Experimental Haematology and Transfusion Medicine (Medicine)				
Further information					
(Reading lists, information links etc.)					

Module Title:
Mitochondrial Biology
Module ID/Code:
MCB-EM26 (B module)

UNIVERSITÄT BONN

1. Content and intended learning outcomes

Content	Blue native electrophoresis to study mitochondrial protein complexes. Organization of mitochondrial respiratory chain complexes Activity assays of respiratory chain complexes Membrane potential measurements Characterization of the growth phenotype of yeast mutant strains
Learning outcomes	The students will get an overview about state-of-the-art techniques to study mitochondrial respiratory chain in a well-defined organism

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	Practical exercise	Mitochondrial Biology	English		40 h	80 h

3. Prerequisites for the module

compulsory	Participation in basic modules MCB-P1 - MCB-P5 (min. 3 out of 5 successfully/pass), successful praticipation (pass) in MCB-MBC, and successful (pass) MCB-XM
recommended	

4. Degree program allocation

	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	elective	

5. Requirements for the award of credits (ECTS)		**6. Credits**
Required achievements	regular participation in the practical exercise	5 ECTS
Assessment (incl. weighting) and examination language	graded practical report in English	

7. Frequency				**8. Workload**	**9. Duration**
Winter semester Summer semester	☐ ☑	Winter and summer semester	☐	**150 h**	**3 credit hours per week (SWS)**

Module coordination	
Teacher	Prof. Dr. Thomas Becker
Module coordinator	Prof. Dr. Thomas Becker
Institute/Department	Institute for Biochemistry and Molecular Biology, Medicine
Further information	
(Reading lists, information links etc.)	

Module Title: Tumor Immunology
Module ID/Code:
MCB-EM27 (B module)

UNIVERSITÄT BONN

1. Content and intended learning outcomes

Content	• Introduction into tumor immunology (lecture) • Introduction to clinical cancer immunotherapy (lecture) • New developments in cellular therapies for cancer (seminar) • Assays for NK cell killing of tumor cells (practical) • Isolation of peripheral blood lymphocytes (practical) • T cell activation assays and cytokine release (practical) • Multiplex- spectral flow cytometry (FCM) T cells (practical) • FCM panel design, principles of analysis (seminar, practical)
Learning outcomes	The course will provide an introduction into techniques used in tumor immunology. The students will see and perform experiments.

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	Practical exercise	Tumor Immunology	English	6	40 h	80 h

3. Prerequisites for the module

compulsory	Participation in basic modules MCB-P1 - MCB-P5 (min. 3 out of 5 successfully/pass), successful praticipation (pass) in MCB-MBC, and successful (pass) MCB-XM
recommended	

4. Degree program allocation

	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	elective	

5. Requirements for the award of credits (ECTS) / 6. Credits

Required achievements	regular participation in the practical exercise	5 ECTS
Assessment (incl. weighting) and examination language	graded practical report in English	

7. Frequency				8. Workload	9. Duration
Winter semester Summer semester	☐ ☑	Winter and summer semester	☐	**150 h**	**3 credit hours per week (SWS)**

Module coordination

Teacher	Prof. Dr. Tobias Bald, Prof. Dr. Michael Hölzel
Module coordinator	Prof. Dr. Tobias Bald, Prof. Dr. Michael Hölzel
Institute/Department	Institut für Experimentelle Onkologie (IEO), Medicine

Module Title: Tumor Immunology Module ID/Code: MCB-EM27 (B module)	UNIVERSITÄT BONN
Further information	
(Reading lists, information links etc.)	

Module Title: **Rotation 1** Module ID/Code: MCB-EM91	UNIVERSITÄT BONN

1. Content and intended learning outcomes	
Content	The students work in an laboratory environment in the scientific groups of the departments involved in the study program.
Learning outcomes	Guided experimental work in the laboratory

2. Teaching and learning methods						
	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	Practical exercise	individual	English	individual	40 h	240

3. Prerequisites for the module	
compulsory	Participation in basic modules MCB-P1 - MCB-P5 (min. 3 out of 5 successfully/pass), successful praticipation (pass) in MCB-MBC, and successful (pass) MCB-XM
recommended	

4. Degree program allocation			
	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	elective	

5. Requirements for the award of credits (ECTS)	**6. Credits**
Required achievements	8 ECTS
Assessment (incl. weighting) and examination language	graded practical report in English

7. Frequency				**8. Workload**	**9. Duration**
Winter semester Summer semester	☑ ☐	Winter and summer semester	☐	**240 h**	

Module coordination	
Teacher	PIs to be appointed for individual rotations
Module coordinator	
Institute/Department	
Further information	
(Reading lists, information links etc.)	

Module Title:
Rotation 2
Module ID/Code: MCB-EM92

UNIVERSITÄT BONN

1. Content and intended learning outcomes	
Content	The students work in an laboratory environment in the scientific groups of the departments involved in the study program.
Learning outcomes	Guided experimental work in the laboratory

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	Practical exercise	individual	English	individual	40 h	240

3. Prerequisites for the module	
compulsory	Participation in basic modules MCB-P1 - MCB-P5 (min. 3 out of 5 successfully/pass), successful praticipation (pass) in MCB-MBC, and successful (pass) MCB-XM
recommended	

4. Degree program allocation

	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	elective	

5. Requirements for the award of credits (ECTS)	**6. Credits**
Required achievements	8 ECTS
Assessment (incl. weighting) and examination language	graded practical report in English

7. Frequency				**8. Workload**	**9. Duration**
Winter semester Summer semester	☑ ☐	Winter and summer semester	☐		

Module coordination	
Teacher	PIs to be appointed for individual rotations
Module coordinator	
Institute/Department	
Further information	
(Reading lists, information links etc.)	

Module Title: Project/Exchange

Module ID/Code: MCB-PE

UNIVERSITÄT BONN

1. Content and intended learning outcomes

Content	
Learning outcomes	

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	Practical	Project/Exchange, individual	English	Individual	40	360

3. Prerequisites for the module

compulsory	Successful participation in basic modules MCB-P1 - MCB-P5, MCB-MBC, and MCB-XM; min. 60 credit points accumulated from previous examinations
recommended	

4. Degree program allocation

	Study program	compulsory/ elective	Semester
	Molecular Cell Biology (M.Sc.)	elective	3

5. Requirements for the award of credits (ECTS)		6. Credits
Required achievements		12 ECTS
Assessment (incl. weighting) and examination language	graded practical report in English	

7. Frequency				8. Workload	9. Duration
Winter semester Summer semester	☑ ☐	Winter and summer semester	☐	**360 h**	

Module coordination	
Teacher	PIs to be appointed for individual rotations
Module coordinator	
Institute/Department	

Further information	
(Reading lists, information links etc.)	

Module Title: Master Thesis Module ID/Code: MCB-MT	UNIVERSITÄT BONN

1. Content and intended learning outcomes

Content	The Master Thesis is the final part of the studies. The students work in a laboratory environment in the scientific groups of the departments involved in the study program. Their work usually contributes to a project leading to a scientific publication. Towards the end of the semester, the students present their results in a seminar.
Learning outcomes	The previously acquired knowledge and skills are to be practically applied in the context of a well-defined scientific problem.

2. Teaching and learning methods

	Type of instruction	Topic	Language of instruction	Group size	Weekly contact time	Workload [h]
	Project	Master project	English	Individual project	40	720
	Thesis					150
	Seminar					30

3. Prerequisites for the module

compulsory	Successful participation in basic modules MCB-P1 - MCB-P5, MCB-MBC, and MCB-XM; min. 78 credit points accumulated from previous examinations
recommended	

4. Degree program allocation

	Study program	compulsory/ elective	Semester
	Molecular Cell Biology	compulsory	4

5. Requirements for the award of credits (ECTS)		**6. Credits**
Required achievements	having submitted the thesis in time and given the presentation	30 ECTS
Assessment (incl. weighting) and examination language	Graduation dissertation in English assessed by two referees	

7. Frequency				**8. Workload**	**9. Duration**
Winter semester Summer semester	☐ ☐	Winter and summer semester	☐	**900 h**	

Module coordination	
Teacher	Postdoctoral (habilitated) teachers of the program
Module coordinator	Prof. Dr. Walter Witke
Institute/Department	Genetics (Biology)
Further information	
(Reading lists, information links etc.)	Rogers (2007): Mastering Scientific and Medical Writing. Springer, Berlin, Heidelberg https://rd.springer.com/book/10.1007/978-3-540-34508-4