

## Study Schedule Master

### Molecular Cell Biology

|         |       | Compulsory modules               |   |  |                                   | Elective modules                                 |                             |                             | Internship;<br>Study Abroad | Σ credits<br>per semester |
|---------|-------|----------------------------------|---|--|-----------------------------------|--|-----------------------------|-----------------------------|-----------------------------|---------------------------|
| 1. Sem. | Oct   | Biochemistry<br>4 ECTS           | Molecular Genetics<br>4 ECTS                |  |                                   |  |                             |                             |                             | 30                        |
|         | Nov   |                                  |   | Developmental Biology<br>and Physiology 4 ECTS | Molecular Cell Biology<br>4 ECTS  |  |                             |                             |                             |                           |
|         | Dec   |                                  |   |  |                                   | Biophysics and Statistics<br>4 ECTS              |                             |                             |                             |                           |
|         | Jan   | Mandatory Basic Course<br>8 ECTS |   |  |                                   |  |                             |                             |                             |                           |
|         | Feb   |                                  | Examination Module<br>2 ECTS                |  |                                   |  |                             |                             |                             |                           |
|         | March |                                  |   |  |                                   |  |                             |                             |                             |                           |
| 2. Sem. | Apr   |                                  |   |  |                                   | Elective period 1                                | Elective period 2<br>5 ECTS |                             |                             | 30                        |
|         | May   | Teacher Seminar Series<br>2 ECTS |   |  |                                   |  |                             | Elective period 3<br>5 ECTS |                             |                           |
|         | June  |                                  | Soft Skills Course /<br>Bioethics<br>5 ECTS |  | Seminars / Journal Club<br>3 ECTS |  |                             | Elective period 6<br>5 ECTS |                             |                           |
|         | July  |                                  |   |  |                                   | Elective period 4<br>5 ECTS                      | Elective period 5<br>5 ECTS |                             |                             |                           |
|         | Aug   |                                  |   |  |                                   | Elective period 7<br>5 ECTS                      |                             |                             |                             |                           |
|         | Sep   |                                  |   |  |                                   | Four electives to be taken in 4 out of 7 periods |                             |                             |                             |                           |
| 3. Sem. | Oct   |                                  |   |  |                                   | Rotation 1<br>8 ECTS                             |                             |                             |                             | 30                        |
|         | Nov   | Student Presentation<br>2 ECTS   |   |  |                                   |  | Rotation 2<br>8 ECTS        |                             |                             |                           |
|         | Dec   |                                  |   |  |                                   |  |                             | Project/Exchange<br>12 ECTS |                             |                           |
|         | Jan   |                                  |   |  |                                   |  |                             |                             |                             |                           |
|         | Feb   |                                  |   |  |                                   |  |                             |                             |                             |                           |
|         | March |                                  |   |  |                                   |  |                             |                             |                             |                           |
| 4. Sem. | Apr   |                                  |   |  |                                   |  |                             |                             |                             | 30                        |
|         | May   |                                  |   |  |                                   |  |                             |                             |                             |                           |
|         | June  |                                  |   |  | Master thesis<br>30 ECTS          |  |                             |                             |                             |                           |
|         | July  |                                  |   |  |                                   |  |                             |                             |                             |                           |
|         | Aug   |                                  |   |  |                                   |  |                             |                             |                             |                           |
|         | Sep   |                                  |   |  |                                   |  |                             |                             |                             |                           |
|         |       |                                  |   |  |                                   |  |                             |                             |                             | 120                       |

**Compulsory modules**

|  |                     |
|--|---------------------|
| <b>Biochemistry</b><br>lecture & tutorial<br>30 hours weekly contact<br>time (4 SWS)             | <b>4</b><br>credits |
| <b>Molecular Genetics</b><br>lecture & tutorial<br>30 hours weekly contact<br>time               | <b>4</b><br>credits |
| <b>Developmental Biology<br/>and Physiology</b><br>lecture & tutorial<br>30 h wklly contact time | <b>4</b><br>credits |
| <b>Molecular Cell Biology</b><br>lecture & tutorial<br>30 h weekly contact time                  | <b>4</b><br>credits |
| <b>Biophysics and Statistics</b><br>lecture & tutorial<br>30 hours weekly contact<br>time        | <b>4</b><br>credits |
| <b>Mandatory Basic Course</b><br>practical exercise<br>40 hours weekly contact<br>time           | <b>8</b><br>credits |
| <b>Examination Module</b><br>examination<br>1 hour contact time                                  | <b>2</b><br>credits |

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|---|---------------------|
| <b>Teacher Seminar Series</b><br>seminar<br>2 hours weekly contact<br>time                | <b>2</b><br>credits |
| <b>Soft Skills / Bioethics</b><br>lecture / seminar<br>3 + 2 hours weekly<br>contact time | <b>5</b><br>credits |
| <b>Seminars / Journal Club</b><br>seminar<br>3 hours weekly contact<br>time               | <b>3</b><br>credits |

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| <b>Student Presentation</b><br>seminar<br>2 hours weekly contact<br>time | <b>2</b><br>credits |
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| <b>Master thesis</b> | <b>30</b><br>credits |
|----------------------|----------------------|

**Elective modules**

| 4 from 25 modules   |                     |   |                     |  |                     |
|---|---------------------|---|---------------------|--|---------------------|
| <b>Analysis of snRNP<br/>assembly</b><br>Practical exercise,<br>40 hours weekly contact<br>time                           | <b>5</b><br>credits | <b>Optogenetics</b><br>Practical exercise,<br>40 hours weekly contact<br>time                             | <b>5</b><br>credits | <b>Molecular Biology<br/>of the Cell</b><br>Practical exercise,<br>40 hours weekly contact<br>time                             | <b>5</b><br>credits |
| <b>Neuronal Cell Biology</b><br>Practical exercise,<br>40 hours weekly contact<br>time                                    | <b>5</b><br>credits | <b>Transportphysiology</b><br>Practical exercise,<br>40 hours weekly contact<br>time                      | <b>5</b><br>credits | <b>Pharmacology &amp;<br/>Metabolism</b><br>Practical exercise,<br>40 hours weekly contact<br>time                             | <b>5</b><br>credits |
| <b>Quantitative<br/>Fluorescence Microscopy</b><br>Practical exercise,<br>40 hours weekly contact<br>time                 | <b>5</b><br>credits | <b>Biochemistry and<br/>Bioanalytics</b><br>Practical exercise,<br>40 hours weekly contact<br>time        | <b>5</b><br>credits | <b>Molecular Membrane<br/>Biology</b><br>Practical exercise,<br>40 hours weekly contact<br>time                                | <b>5</b><br>credits |
| <b>Embryo Biotechnology</b><br>Practical exercise,<br>40 hours weekly contact<br>time                                     | <b>5</b><br>credits | <b>Drugs from Plants and<br/>Microorganisms</b><br>Practical exercise,<br>40 hours weekly contact<br>time | <b>5</b><br>credits | <b>Biosyntheses of Natural<br/>Products</b><br>Practical exercise,<br>40 hours weekly contact<br>time                          | <b>5</b><br>credits |
| <b>Preventive, Predictive<br/>and Personalised<br/>Medicine</b><br>Practical exercise,<br>40 hours weekly contact<br>time | <b>5</b><br>credits | <b>Cell Mechanics</b><br>Practical exercise,<br>40 hours weekly contact<br>time                           | <b>5</b><br>credits | <b>Biochemical Engineering</b><br>Practical exercise,<br>40 hours weekly contact<br>time                                       | <b>5</b><br>credits |
| <b>Genome Stability</b><br>Practical exercise,<br>40 hours weekly contact<br>time   | <b>5</b><br>credits | <b>Reconstructive<br/>Neurobiology</b><br>Practical exercise,<br>40 hours weekly contact<br>time          | <b>5</b><br>credits | <b>Applications of<br/>CrispR/Cas to study<br/>neuronal function</b><br>Practical exercise,<br>40 hours weekly contact<br>time | <b>5</b><br>credits |
| <b>Molecular Haematology</b><br>Practical exercise,<br>40 hours weekly contact<br>time                                    | <b>5</b><br>credits |   |                     | <b>Methods in<br/>Developmental- and<br/>Tumorpathology</b><br>Practical exercise,<br>40 hours weekly contact<br>time          | <b>5</b><br>credits |

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| <b>2 modules</b>  |                     |
| <b>Rotation 1</b><br>Individual laboratory<br>practical,<br>40 hours weekly contact<br>time | <b>8</b><br>credits |
| <b>Rotation 2</b><br>Individual laboratory<br>practical,<br>40 hours weekly contact<br>time | <b>8</b><br>credits |

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|---|----------------------|
| <b>Internship</b>   |                      |
| <b>Project/Exchange</b><br>Individual laboratory<br>practical,<br>40 hours weekly contact<br>time | <b>12</b><br>credits |

|  |                                     |  |                          |  |                                      |              |
|--|-------------------------------------|--|--------------------------|--|--------------------------------------|--------------|
| <b>Module Title:</b><br><b>Biochemistry</b>            |                                     |  |                          | <br>UNIVERSITÄT <b>BONN</b> |                                      |              |
| Module ID/Code:<br>MCB-P1                              |                                     |  |                          |  |                                      |              |
| <b>1. Content and intended learning outcomes</b>       |                                     |  |                          |  |                                      |              |
| Content  |                                     | Energy metabolism pathways, enzymes, enzyme reactions and coenzymes.<br>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.                        |                          |  |                                      |              |
| <b>2. Teaching and learning methods</b>                |                                     |  |                          |  |                                      |              |
|  | 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           |
| <b>3. Prerequisites for the module</b>                 |                                     |  |                          |  |                                      |              |
| compulsory   |                                     |  |                          |  |                                      |              |
| recommended  |                                     |  |                          |  |                                      |              |
| <b>4. Degree program allocation</b>                    |                                     |  |                          |  |                                      |              |
|  | Study program                       |  |                          | compulsory/<br>elective  | Semester                             |              |
|  | Molecular Cell Biology (M.Sc.)      |  |                          | compulsory   | 1                                    |              |
| <b>5. Requirements for the award of credits (ECTS)</b> |                                     |  |                          |  | <b>6. Credits</b>                    |              |
| Required achievements                                  |                                     |  |                          |  | 4 ECTS                               |              |
| Assessment (incl. weighting) and examination language  |                                     | written examination in English   |                          |  |                                      |              |
| <b>7. Frequency</b>                                    |                                     |  |                          | <b>8. Workload</b>   | <b>9. Duration</b>                   |              |
| Winter semester  | <input checked="" type="checkbox"/> | Winter and summer semester   | <input type="checkbox"/> | <b>120 h</b>   | <b>3 credit hours per week (SWS)</b> |              |
| Summer semester  | <input type="checkbox"/>            |  |                          |  |                                      |              |
| <b>Module coordination</b>                             |                                     |  |                          |  |                                      |              |
| Teacher  |                                     | Prof. Dr. Peter Dörmann, Prof. Dr. Andreas Meyer   |                          |  |                                      |              |
| Module coordinator                                     |                                     | Prof. Dr. Peter Dörmann  |                          |  |                                      |              |
| Institute/Department                                   |                                     | IMBIO (Biology)  |                          |  |                                      |              |
| <b>Further information</b>                             |                                     |  |                          |  |                                      |              |
| (Reading lists, information links etc.)                |                                     |  |                          |  |                                      |              |

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|--|---|---------------------------------|--------------------------|--|---------------------|--------------------------------------|
| <b>Module Title:</b><br><b>Molecular Genetics</b>      |   |                                 |                          | <br>UNIVERSITÄT <b>BONN</b> |                     |                                      |
| Module ID/Code:<br>MCB-P2                              |   |                                 |                          |  |                     |                                      |
| <b>1. Content and intended learning outcomes</b>       |   |                                 |                          |  |                     |                                      |
| 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.   |                                 |                          |  |                     |                                      |
| <b>2. Teaching and learning methods</b>                |   |                                 |                          |  |                     |                                      |
|  | 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                                   |
| <b>3. Prerequisites for the module</b>                 |   |                                 |                          |  |                     |                                      |
| compulsory   |   |                                 |                          |  |                     |                                      |
| recommended  |   |                                 |                          |  |                     |                                      |
| <b>4. Degree program allocation</b>                    |   |                                 |                          |  |                     |                                      |
|  | Study program   |                                 |                          | compulsory/<br>elective  | Semester            |                                      |
|  | Molecular Cell Biology (M.Sc.)  |                                 |                          | compulsory   | 1                   |                                      |
| <b>5. Requirements for the award of credits (ECTS)</b> |   |                                 |                          |  | <b>6. Credits</b>   |                                      |
| Required achievements                                  |   |                                 |                          |  |                     | 4 ECTS                               |
| Assessment (incl. weighting) and examination language  | Written examination in English  |                                 |                          |  |                     |                                      |
| <b>7. Frequency</b>                                    |   |                                 | <b>8. Workload</b>       |  | <b>9. Duration</b>  |                                      |
| Winter semester  | <input checked="" type="checkbox"/>   | Winter and summer semester      | <input type="checkbox"/> | <b>120 h</b>   |                     | <b>3 credit hours per week (SWS)</b> |
| Summer semester  | <input type="checkbox"/>  |                                 |                          |  |                     |                                      |
| <b>Module coordination</b>                             |   |                                 |                          |  |                     |                                      |
| Teacher  | Prof. Dr. Walter Witke  |                                 |                          |  |                     |                                      |
| Module coordinator                                     | Prof. Dr. Walter Witke  |                                 |                          |  |                     |                                      |
| Institute/Department                                   | Genetics (Biology)  |                                 |                          |  |                     |                                      |
| <b>Further information</b>                             |   |                                 |                          |  |                     |                                      |
| (Reading lists, information links etc.)                |   |                                 |                          |  |                     |                                      |

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| <b>Module Title:</b><br><b>Developmental Biology and Physiology</b> |  |   |                          | <br><b>UNIVERSITÄT BONN</b> |                     |                                      |
| Module ID/Code:<br>MCB-P3   |  |   |                          |  |                     |                                      |
| <b>1. Content and intended learning outcomes</b>                    |  |   |                          |  |                     |                                      |
| 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 organismic events during the development.   |   |                          |  |                     |                                      |
| <b>2. Teaching and learning methods</b>                             |  |   |                          |  |                     |                                      |
|   | 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                                   |
| <b>3. Prerequisites for the module</b>                              |  |   |                          |  |                     |                                      |
| compulsory  |  |   |                          |  |                     |                                      |
| recommended   |  |   |                          |  |                     |                                      |
| <b>4. Degree program allocation</b>                                 |  |   |                          |  |                     |                                      |
|   | Study program  |   |                          | compulsory/<br>elective  | Semester            |                                      |
|   | Molecular Cell Biology (M.Sc.)   |   |                          | compulsory   | 1                   |                                      |
| <b>5. Requirements for the award of credits (ECTS)</b>              |  |   |                          |  |                     | <b>6. Credits</b>                    |
| Required achievements   |  |   |                          |  |                     | 4 ECTS                               |
| Assessment (incl. weighting) and examination language               | written examination in English   |   |                          |  |                     |                                      |
| <b>7. Frequency</b>   |  |   | <b>8. Workload</b>       |  | <b>9. Duration</b>  |                                      |
| Winter semester   | <input checked="" type="checkbox"/>  | Winter and summer semester                        | <input type="checkbox"/> | <b>120 h</b>   |                     | <b>3 credit hours per week (SWS)</b> |
| Summer semester   | <input type="checkbox"/>   |   |                          |  |                     |                                      |
| <b>Module coordination</b>  |  |   |                          |  |                     |                                      |
| Teacher   | Prof. Dr. Oliver Gruß,<br>Prof. Dr. Bernd Fleischmann (Physiology / Life & Brain, Medicine)  |   |                          |  |                     |                                      |
| Module coordinator  | Prof. Dr. Oliver Gruß  |   |                          |  |                     |                                      |
| Institute/Department  | Genetics (Biology)   |   |                          |  |                     |                                      |
| <b>Further information</b>  |  |   |                          |  |                     |                                      |
| (Reading lists, information links etc.)                             |  |   |                          |  |                     |                                      |

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|--|-------------------------------------|---|--------------------------|--|--------------------------------------|--------------|
| <b>Module Title:</b><br><b>Molecular Cell Biology</b>  |                                     |   |                          | <br>UNIVERSITÄT <b>BONN</b> |                                      |              |
| Module ID/Code:<br>MCB-P4                              |                                     |   |                          |  |                                      |              |
| <b>1. Content and intended learning outcomes</b>       |                                     |   |                          |  |                                      |              |
| 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.   |                          |  |                                      |              |
| <b>2. Teaching and learning methods</b>                |                                     |   |                          |  |                                      |              |
|  | 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           |
| <b>3. Prerequisites for the module</b>                 |                                     |   |                          |  |                                      |              |
| compulsory   |                                     |   |                          |  |                                      |              |
| recommended  |                                     |   |                          |  |                                      |              |
| <b>4. Degree program allocation</b>                    |                                     |   |                          |  |                                      |              |
|  | Study program                       |   |                          | compulsory/<br>elective  | Semester                             |              |
|  | Molecular Cell Biology (M.Sc.)      |   |                          | compulsory   | 1                                    |              |
| <b>5. Requirements for the award of credits (ECTS)</b> |                                     |   |                          |  | <b>6. Credits</b>                    |              |
| Required achievements                                  |                                     |   |                          |  | 4 ECTS                               |              |
| Assessment (incl. weighting) and examination language  |                                     | written examination in English  |                          |  |                                      |              |
| <b>7. Frequency</b>                                    |                                     |   | <b>8. Workload</b>       |  | <b>9. Duration</b>                   |              |
| Winter semester  | <input checked="" type="checkbox"/> | Winter and summer semester  | <input type="checkbox"/> | <b>120 h</b>   | <b>3 credit hours per week (SWS)</b> |              |
| Summer semester  | <input type="checkbox"/>            |   |                          |  |                                      |              |
| <b>Module coordination</b>                             |                                     |   |                          |  |                                      |              |
| Teacher  |                                     | Prof. Dr. Dieter Fürst, Prof. Dr. Albert Haas, Prof. Dr. Jörg Höfeld  |                          |  |                                      |              |
| Module coordinator                                     |                                     | Prof. Dr. Dieter Fürst  |                          |  |                                      |              |
| Institute/Department                                   |                                     | Cell Biology (Biology)  |                          |  |                                      |              |
| <b>Further information</b>                             |                                     |   |                          |  |                                      |              |
| (Reading lists, information links etc.)                |                                     |   |                          |  |                                      |              |

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|--|--|--|--------------------------|--|---------------------|--------------------------------------|
| <b>Module Title:</b><br><b>Biophysics and Statistics</b> |  |  |                          | <br>UNIVERSITÄT <b>BONN</b> |                     |                                      |
| Module ID/Code:<br>MCB-P5                                |  |  |                          |  |                     |                                      |
| <b>1. Content and intended learning outcomes</b>         |  |  |                          |  |                     |                                      |
| 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.  |  |                          |  |                     |                                      |
| <b>2. Teaching and learning methods</b>                  |  |  |                          |  |                     |                                      |
|  | 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                                   |
| <b>3. Prerequisites for the module</b>                   |  |  |                          |  |                     |                                      |
| compulsory   |  |  |                          |  |                     |                                      |
| recommended  |  |  |                          |  |                     |                                      |
| <b>4. Degree program allocation</b>                      |  |  |                          |  |                     |                                      |
|  | Study program  |  |                          | compulsory/<br>elective  | Semester            |                                      |
|  | Molecular Cell Biology (M.Sc.)   |  |                          | compulsory   | 1                   |                                      |
| <b>5. Requirements for the award of credits (ECTS)</b>   |  |  |                          |  |                     | <b>6. Credits</b>                    |
| Required achievements                                    |  |  |                          |  |                     | 4 ECTS                               |
| Assessment (incl. weighting) and examination language    | written examination in English   |  |                          |  |                     |                                      |
| <b>7. Frequency</b>                                      |  |  | <b>8. Workload</b>       |  | <b>9. Duration</b>  |                                      |
| Winter semester  | <input checked="" type="checkbox"/>  | Winter and summer semester             | <input type="checkbox"/> | <b>120 h</b>   |                     | <b>3 credit hours per week (SWS)</b> |
| Summer semester  | <input type="checkbox"/>   |  |                          |  |                     |                                      |
| <b>Module coordination</b>                               |  |  |                          |  |                     |                                      |
| Teacher  | Dr. Pietro Pilo Boyl   |  |                          |  |                     |                                      |
| Module coordinator                                       | Dr. Pietro Pilo Boyl   |  |                          |  |                     |                                      |
| Institute/Department                                     | Genetics (Biology)   |  |                          |  |                     |                                      |
| <b>Further information</b>                               |  |  |                          |  |                     |                                      |
| (Reading lists, information links etc.)                  |  |  |                          |  |                     |                                      |

|  |                                     |   |                          |  |                     |                                      |
|--|-------------------------------------|---|--------------------------|--|---------------------|--------------------------------------|
| <b>Module Title:</b><br><b>Mandatory Basic Course</b>  |                                     |   |                          | <br>UNIVERSITÄT <b>BONN</b> |                     |                                      |
| Module ID/Code:<br>MCB-MBC                             |                                     |   |                          |  |                     |                                      |
| <b>1. Content and intended learning outcomes</b>       |                                     |   |                          |  |                     |                                      |
| 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'.<br>Contents are:   |                          |  |                     |                                      |
| <b>2. Teaching and learning methods</b>                |                                     |   |                          |  |                     |                                      |
|  | 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                                |
| <b>3. Prerequisites for the module</b>                 |                                     |   |                          |  |                     |                                      |
| compulsory   |                                     |   |                          |  |                     |                                      |
| recommended  |                                     |   |                          |  |                     |                                      |
| <b>4. Degree program allocation</b>                    |                                     |   |                          |  |                     |                                      |
|  | Study program                       |   |                          | compulsory/<br>elective  | Semester            |                                      |
|  | Molecular Cell Biology (M.Sc.)      |   |                          | compulsory   |                     |                                      |
| <b>5. Requirements for the award of credits (ECTS)</b> |                                     |   |                          |  |                     | <b>6. Credits</b>                    |
| Required achievements                                  |                                     | Regular participation in the practical exercise   |                          |  |                     | 8 ECTS                               |
| Assessment (incl. weighting) and examination language  |                                     | Practical report in English   |                          |  |                     |                                      |
| <b>7. Frequency</b>                                    |                                     |   | <b>8. Workload</b>       |  | <b>9. Duration</b>  |                                      |
| Winter semester  | <input checked="" type="checkbox"/> | Winter and summer semester  | <input type="checkbox"/> | <b>240 h</b>   |                     | <b>8 credit hours per week (SWS)</b> |
| Summer semester  | <input type="checkbox"/>            |   |                          |  |                     |                                      |
| <b>Module coordination</b>                             |                                     |   |                          |  |                     |                                      |
| Teacher  |                                     | Prof. Dr. Hubert Schorle, Prof. Dr. Jörg Höhfeld, Prof. Dr. Dieter Fürst, Prof. Dr. Oliver Gruß, Prof. Dr. Walter Witke, Prof. Dr. Diana Imhof  |                          |  |                     |                                      |
| Module coordinator                                     |                                     | Prof. Dr. Walter Witke  |                          |  |                     |                                      |
| Institute/Department                                   |                                     | Genetics (Biology)  |                          |  |                     |                                      |
| <b>Further information</b>                             |                                     |   |                          |  |                     |                                      |
| (Reading lists, information links etc.)                |                                     |   |                          |  |                     |                                      |

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| <b>Module Title:</b><br><b>Examination Module</b>      |                                     |  |                          | <br>UNIVERSITÄT <b>BONN</b> |                     |                   |
| Module ID/Code:<br>MCB-XM                              |                                     |  |                          |  |                     |                   |
| <b>1. Content and intended learning outcomes</b>       |                                     |  |                          |  |                     |                   |
| Content  |                                     | Proof of meeting qualification aims of the compulsory modules MCB-P1 to MCB-P5 |                          |  |                     |                   |
| Learning outcomes                                      |                                     |  |                          |  |                     |                   |
| <b>2. Teaching and learning methods</b>                |                                     |  |                          |  |                     |                   |
|  | 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               |
|  |                                     |  |                          |  |                     |                   |
| <b>3. Prerequisites for the module</b>                 |                                     |  |                          |  |                     |                   |
| compulsory   |                                     | MCB-P1, MCB-P2, MCB-P3, MCB-P4, MCB-P5   |                          |  |                     |                   |
| recommended  |                                     |  |                          |  |                     |                   |
| <b>4. Degree program allocation</b>                    |                                     |  |                          |  |                     |                   |
|  | Study program                       |  |                          | compulsory/<br>elective  | Semester            |                   |
|  | Molecular Cell Biology (M.Sc.)      |  |                          | compulsory   | 1                   |                   |
|  |                                     |  |                          |  |                     |                   |
| <b>5. Requirements for the award of credits (ECTS)</b> |                                     |  |                          |  |                     | <b>6. Credits</b> |
| Required achievements                                  |                                     |  |                          |  |                     | 2 ECTS            |
| Assessment (incl. weighting) and examination language  |                                     |  |                          |  |                     |                   |
| oral examination in English                            |                                     |  |                          |  |                     |                   |
| <b>7. Frequency</b>                                    |                                     |  |                          | <b>8. Workload</b>   | <b>9. Duration</b>  |                   |
| Winter semester  | <input checked="" type="checkbox"/> | Winter and summer semester   | <input type="checkbox"/> | <b>60 h</b>  |                     |                   |
| Summer semester  | <input type="checkbox"/>            |  |                          |  |                     |                   |
| <b>Module coordination</b>                             |                                     |  |                          |  |                     |                   |
| Teacher (examiners)                                    |                                     | Coordinators of Modules MCB-P1, -P2, -P3, -P4, -P5                             |                          |  |                     |                   |
| Module coordinator                                     |                                     | Prof. Dr. Walter Witke   |                          |  |                     |                   |
| Institute/Department                                   |                                     | Genetics (Biology)   |                          |  |                     |                   |
| <b>Further information</b>                             |                                     |  |                          |  |                     |                   |
| (Reading lists, information links etc.)                |                                     |  |                          |  |                     |                   |

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| <b>Module Title:</b><br><b>Teacher Seminar Series</b>  |                                     |  |                          | <br>UNIVERSITÄT <b>BONN</b> |                     |                                     |
| Module ID/Code:<br>MCB-TSS                             |                                     |  |                          |  |                     |                                     |
| <b>1. Content and intended learning outcomes</b>       |                                     |  |                          |  |                     |                                     |
| Content  |                                     | In this series, special topics in molecular biology and current research results are presented by the teachers |                          |  |                     |                                     |
| Learning outcomes                                      |                                     | Students learn about most recent topics and research in molecular cell biology                                 |                          |  |                     |                                     |
| <b>2. Teaching and learning methods</b>                |                                     |  |                          |  |                     |                                     |
|  | 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                                  |
| <b>3. Prerequisites for the module</b>                 |                                     |  |                          |  |                     |                                     |
| compulsory   |                                     |  |                          |  |                     |                                     |
| recommended  |                                     |  |                          |  |                     |                                     |
| <b>4. Degree program allocation</b>                    |                                     |  |                          |  |                     |                                     |
|  | Study program                       |  |                          | compulsory/<br>elective  | Semester            |                                     |
|  | Molecular Cell Biology (M.Sc.)      |  |                          | compulsory   | 1                   |                                     |
| <b>5. Requirements for the award of credits (ECTS)</b> |                                     |  |                          |  | <b>6. Credits</b>   |                                     |
| Required achievements                                  |                                     | Participation  |                          |  | 2 ECTS              |                                     |
| Assessment (incl. weighting) and examination language  |                                     | Proof of participation   |                          |  |                     |                                     |
| <b>7. Frequency</b>                                    |                                     |  |                          | <b>8. Workload</b>   |                     | <b>9. Duration</b>                  |
| Winter semester  | <input type="checkbox"/>            | Winter and summer semester   | <input type="checkbox"/> | <b>60 hours</b>  |                     | <b>1 credit hour per week (SWS)</b> |
| Summer semester  | <input checked="" type="checkbox"/> |  |                          |  |                     |                                     |
| <b>Module coordination</b>                             |                                     |  |                          |  |                     |                                     |
| Teacher  |                                     | Docents of the Master's Program [P and EM modules]   |                          |  |                     |                                     |
| Module coordinator                                     |                                     | Prof. Dr. Oliver Grub  |                          |  |                     |                                     |
| Institute/Department                                   |                                     | Genetics (Biology)   |                          |  |                     |                                     |
| <b>Further information</b>                             |                                     |  |                          |  |                     |                                     |
| (Reading lists, information links etc.)                |                                     |  |                          |  |                     |                                     |

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| <b>Module Title:</b><br><b>Soft Skills / Bioethics</b><br>Module ID/Code:<br>MCB-SSC |   | <br><b>UNIVERSITÄT BONN</b> |                          |                         |                     |                                      |
| <b>1. Content and intended learning outcomes</b>                                     |   |  |                          |                         |                     |                                      |
| Content  | Current Topics: The course consists of <ul style="list-style-type: none"> <li>▪ 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,</li> <li>▪ a seminar presentation by each student about a selected current topic in molecular biotechnology, and</li> <li>▪ writing a scientific paper about the topic.</li> </ul> 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.<br>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 perceive ethical reflection as an integral element of their education and future work.   |  |                          |                         |                     |                                      |
| <b>2. Teaching and learning methods</b>  |   |  |                          |                         |                     |                                      |
|  | 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                                   |
| <b>3. Prerequisites for the module</b>   |   |  |                          |                         |                     |                                      |
| compulsory   |   |  |                          |                         |                     |                                      |
| recommended  |   |  |                          |                         |                     |                                      |
| <b>4. Degree program allocation</b>  |   |  |                          |                         |                     |                                      |
|  | Study program   |  |                          | compulsory/<br>elective | Semester            |                                      |
|  | Molecular Cell Biology (M.Sc.)  |  |                          | compulsory              |                     |                                      |
| <b>5. Requirements for the award of credits (ECTS)</b>                               |   |  |                          |                         | <b>6. Credits</b>   |                                      |
| Required achievements  | Participation   |  |                          |                         | 5 ECTS              |                                      |
| Assessment (incl. weighting) and examination language                                | Proof of participation  |  |                          |                         |                     |                                      |
| <b>7. Frequency</b>  |   |  | <b>8. Workload</b>       |                         | <b>9. Duration</b>  |                                      |
| Winter semester  | <input type="checkbox"/>  | Winter and summer semester   | <input type="checkbox"/> | <b>150 h</b>            |                     | <b>5 credit hours per week (SWS)</b> |
| Summer semester  | <input checked="" type="checkbox"/>   |  |                          |                         |                     |                                      |
| <b>Module coordination</b>   |   |  |                          |                         |                     |                                      |
| Teacher  | Dr. Karl Peter Linscheid, Priv.-Doz. Dr. Sebastian Knell (IWE, Philosophy)  |  |                          |                         |                     |                                      |
| Module coordinator   | Dr. Karl Peter Linscheid  |  |                          |                         |                     |                                      |
| Institute/Department   | Institute of Molecular Physiology and Biotechnology of Plants (Biology)   |  |                          |                         |                     |                                      |
| <b>Further information</b>   |   |  |                          |                         |                     |                                      |
| (Reading lists, information links etc.)  |   |  |                          |                         |                     |                                      |

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| <b>Module Title:</b><br><b>Seminars / Journal Club</b> |                                     |  |                          | <br>UNIVERSITÄT <b>BONN</b> |                              |                   |
| Module ID/Code:<br>MCB-SJC                             |                                     |  |                          |  |                              |                   |
| <b>1. Content and intended learning outcomes</b>       |                                     |  |                          |  |                              |                   |
| Content  |                                     | Attendance of seminars and journal clubs                     |                          |  |                              |                   |
| Learning outcomes                                      |                                     | Awareness towards current research in molecular cell biology |                          |  |                              |                   |
| <b>2. Teaching and learning methods</b>                |                                     |  |                          |  |                              |                   |
|  | Type of instruction                 | Topic  | Language of instruction  | Group size   | Weekly contact time          | Workload [h]      |
|  | seminar                             | Molecular Cell Biology                                       | English                  | 25   | 3 h                          | 90 h              |
| <b>3. Prerequisites for the module</b>                 |                                     |  |                          |  |                              |                   |
| compulsory   |                                     |  |                          |  |                              |                   |
| recommended  |                                     |  |                          |  |                              |                   |
| <b>4. Degree program allocation</b>                    |                                     |  |                          |  |                              |                   |
|  | Study program                       |  |                          | compulsory/<br>elective  | Semester                     |                   |
|  | Molecular Cell Biology (M.Sc.)      |  |                          | compulsory   | 2                            |                   |
| <b>5. Requirements for the award of credits (ECTS)</b> |                                     |  |                          |  |                              | <b>6. Credits</b> |
| Required achievements                                  |                                     | Participation  |                          |  |                              | 3 ECTS            |
| Assessment (incl. weighting) and examination language  |                                     | Proof of participation                                       |                          |  |                              |                   |
| <b>7. Frequency</b>                                    |                                     |  |                          | <b>8. Workload</b>   | <b>9. Duration</b>           |                   |
| Winter semester  | <input type="checkbox"/>            | Winter and summer semester                                   | <input type="checkbox"/> | 90 h   | 1 credit hour per week (SWS) |                   |
| Summer semester  | <input checked="" type="checkbox"/> | semester   |                          |  |                              |                   |
| <b>Module coordination</b>                             |                                     |  |                          |  |                              |                   |
| Teacher  |                                     |  |                          |  |                              |                   |
| Module coordinator                                     |                                     | Dr. Karl Peter Linscheid                                     |                          |  |                              |                   |
| Institute/Department                                   |                                     | Molecular Physiology and Biotechnology of Plants (Biology)   |                          |  |                              |                   |
| <b>Further information</b>                             |                                     |  |                          |  |                              |                   |
| (Reading lists, information links etc.)                |                                     |  |                          |  |                              |                   |

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| <b>Module Title:</b><br><b>Student Presentation</b>    |                                     |  |                          | <br>UNIVERSITÄT <b>BONN</b> |                                     |                   |
| Module ID/Code:<br>MCB-SP                              |                                     |  |                          |  |                                     |                   |
| <b>1. Content and intended learning outcomes</b>       |                                     |  |                          |  |                                     |                   |
| 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 |                          |  |                                     |                   |
| <b>2. Teaching and learning methods</b>                |                                     |  |                          |  |                                     |                   |
|  | Type of instruction                 | Topic  | Language of instruction  | Group size   | Weekly contact time                 | Workload [h]      |
|  | seminar                             | Molecular Cell Biology   | English                  | 25   | 2 h                                 | 90                |
| <b>3. Prerequisites for the module</b>                 |                                     |  |                          |  |                                     |                   |
| compulsory   |                                     | Participation in rotations and Project/Exchange  |                          |  |                                     |                   |
| recommended  |                                     |  |                          |  |                                     |                   |
| <b>4. Degree program allocation</b>                    |                                     |  |                          |  |                                     |                   |
|  | Study program                       |  |                          | compulsory/<br>elective  | Semester                            |                   |
|  | Molecular Cell Biology (M.Sc.)      |  |                          | compulsory   | 3                                   |                   |
| <b>5. Requirements for the award of credits (ECTS)</b> |                                     |  |                          |  |                                     | <b>6. Credits</b> |
| Required achievements                                  |                                     | Participation  |                          |  |                                     | 2 ECTS            |
| Assessment (incl. weighting) and examination language  |                                     | Proof of participation   |                          |  |                                     |                   |
| <b>7. Frequency</b>                                    |                                     |  |                          | <b>8. Workload</b>   | <b>9. Duration</b>                  |                   |
| Winter semester  | <input type="checkbox"/>            | Winter and summer semester   | <input type="checkbox"/> | <b>90 h</b>  | <b>1 credit hour per week (SWS)</b> |                   |
| Summer semester  | <input checked="" type="checkbox"/> |  |                          |  |                                     |                   |
| <b>Module coordination</b>                             |                                     |  |                          |  |                                     |                   |
| Teacher  |                                     |  |                          |  |                                     |                   |
| Module coordinator                                     |                                     | Dr. Karl Peter Linscheid   |                          |  |                                     |                   |
| Institute/Department                                   |                                     | Molecular Physiology and Biotechnology of Plants (Biology)   |                          |  |                                     |                   |
| <b>Further information</b>                             |                                     |  |                          |  |                                     |                   |
| (Reading lists, information links etc.)                |                                     |  |                          |  |                                     |                   |

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| <b>Module Title:</b><br><b>Analysis of snRNP assembly</b> |   |                            |                          | <br>UNIVERSITÄT <b>BONN</b> |                                      |              |
| Module ID/Code:<br>MCB-EM1                                |   |                            |                          |  |                                      |              |
| <b>1. Content and intended learning outcomes</b>          |   |                            |                          |  |                                      |              |
| Content   | The following contents will be covered by the practical: <ul style="list-style-type: none"> <li>• Cell culture techniques for different cell lines</li> <li>• Live imaging of cells</li> <li>• Interfering with protein function inside cells: RNAi, Gene ko, small molecule inhibitors</li> <li>• Protein detection after knock-down or knock-out, quantification</li> <li>• Indirect immunofluorescence and light microscopy</li> <li>• Image quantification</li> </ul> |                            |                          |  |                                      |              |
| 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.  |                            |                          |  |                                      |              |
| <b>2. Teaching and learning methods</b>                   |   |                            |                          |  |                                      |              |
|   | 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          |
| <b>3. Prerequisites for the module</b>                    |   |                            |                          |  |                                      |              |
| 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   |   |                            |                          |  |                                      |              |
| <b>4. Degree program allocation</b>                       |   |                            |                          |  |                                      |              |
|   | Study program   |                            |                          | compulsory/<br>elective  | Semester                             |              |
|   | Molecular Cell Biology (M.Sc.)  |                            |                          | elective   | 2 (1 <sup>st</sup> time frame)       |              |
|   |   |                            |                          |  |                                      |              |
| <b>5. Requirements for the award of credits (ECTS)</b>    |   |                            |                          |  | <b>6. Credits</b>                    |              |
| Required achievements                                     | Regular participation in the practical exercise   |                            |                          |  |                                      | 5 ECTS       |
| Assessment (incl. weighting) and examination language     | Graded practical report in English  |                            |                          |  |                                      |              |
| <b>7. Frequency</b>                                       |   |                            |                          | <b>8. Workload</b>   | <b>9. Duration</b>                   |              |
| Winter semester   | <input type="checkbox"/>  | Winter and summer semester | <input type="checkbox"/> | <b>150 h</b>   | <b>3 credit hours per week (SWS)</b> |              |
| Summer semester   | <input checked="" type="checkbox"/>   |                            |                          |  |                                      |              |
| <b>Module coordination</b>                                |   |                            |                          |  |                                      |              |
| Teacher   | Prof. Dr. Oliver Größ   |                            |                          |  |                                      |              |
| Module coordinator  | Prof. Dr. Oliver Größ   |                            |                          |  |                                      |              |
| Institute/Department                                      | Genetics (Biology)  |                            |                          |  |                                      |              |
| <b>Further information</b>                                |   |                            |                          |  |                                      |              |
| (Reading lists, information links etc.)                   |   |                            |                          |  |                                      |              |

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| <b>Module Title:</b><br><b>Optogenetics</b>            |   | <br>UNIVERSITÄT <b>BONN</b> |                          |                                |                     |                                      |
| Module ID/Code:<br>MCB-EM2                             |   |  |                          |                                |                     |                                      |
| <b>1. Content and intended learning outcomes</b>       |   |  |                          |                                |                     |                                      |
| Content  | The following contents will be covered by the practical: <ul style="list-style-type: none"> <li>• Nucleic Acid Purification</li> <li>• Cell Culture Techniques</li> <li>• Cell Transfection</li> <li>• Gene Expression Studies</li> <li>• Microscopic Imaging Techniques</li> <li>• Fluorescence-based imaging</li> <li>• Optogenetics</li> </ul> |  |                          |                                |                     |                                      |
| 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.  |  |                          |                                |                     |                                      |
| <b>2. Teaching and learning methods</b>                |   |  |                          |                                |                     |                                      |
|  | Type of instruction   | Topic  | Language of instruction  | Group size                     | Weekly contact time | Workload [h]                         |
|  | Practical exercise  | Optogenetics   | English                  |                                | 40 h                | 150                                  |
| <b>3. Prerequisites for the module</b>                 |   |  |                          |                                |                     |                                      |
| 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  |   |  |                          |                                |                     |                                      |
| <b>4. Degree program allocation</b>                    |   |  |                          |                                |                     |                                      |
|  | Study program   |  | compulsory/<br>elective  | Semester                       |                     |                                      |
|  | Molecular Cell Biology (M.Sc.)  |  | elective                 | 2 (1 <sup>st</sup> time frame) |                     |                                      |
| <b>5. Requirements for the award of credits (ECTS)</b> |   |  |                          |                                |                     | <b>6. Credits</b>                    |
| Required achievements                                  | Regular participation in the practical exercise   |  |                          |                                |                     | 5 ECTS                               |
| Assessment (incl. weighting) and examination language  | Graded practical report in English  |  |                          |                                |                     |                                      |
| <b>7. Frequency</b>                                    |   |  | <b>8. Workload</b>       |                                | <b>9. Duration</b>  |                                      |
| Winter semester  | <input type="checkbox"/>  | Winter and summer semester   | <input type="checkbox"/> | <b>150 h</b>                   |                     | <b>3 credit hours per week (SWS)</b> |
| Summer semester  | <input checked="" type="checkbox"/>   |  |                          |                                |                     |                                      |
| <b>Module coordination</b>                             |   |  |                          |                                |                     |                                      |
| Teacher  | Prof. Dr. Dagmar Wachten  |  |                          |                                |                     |                                      |
| Module coordinator                                     | Prof. Dr. Dagmar Wachten  |  |                          |                                |                     |                                      |
| Institute/Department                                   | Innate Immunity (Medicine)  |  |                          |                                |                     |                                      |
| <b>Further information</b>                             |   |  |                          |                                |                     |                                      |
| (Reading lists, information links etc.)                |   |  |                          |                                |                     |                                      |

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| <b>Module Title:</b><br><b>Molecular Biology of the Cell</b><br>Module ID/Code:<br>MCB-EM3 |                                     |   |                          | <br>UNIVERSITÄT <b>BONN</b> |                                |                                      |
| <b>1. Content and intended learning outcomes</b>   |                                     |   |                          |  |                                |                                      |
| Content  |                                     | The following contents will be covered by the practical: <ul style="list-style-type: none"> <li>• Cell culture techniques</li> <li>• Differentiation and manipulation of cultured cells</li> <li>• Cell transfection and transduction</li> <li>• Knockdown of gene expression</li> <li>• High-resolution microscopic imaging of fluorescent proteins in cells</li> <li>• Analysis of protein localization, interactions and dynamics in living cells</li> </ul> |                          |  |                                |                                      |
| 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.   |                          |  |                                |                                      |
| <b>2. Teaching and learning methods</b>  |                                     |   |                          |  |                                |                                      |
|  | 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                                  |
| <b>3. Prerequisites for the module</b>   |                                     |   |                          |  |                                |                                      |
| 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  |                                     |   |                          |  |                                |                                      |
| <b>4. Degree program allocation</b>  |                                     |   |                          |  |                                |                                      |
|  | Study program                       |   |                          | compulsory/<br>elective  | Semester                       |                                      |
|  | Molecular Cell Biology (M.Sc.)      |   |                          | elective   | 2 (3 <sup>rd</sup> time frame) |                                      |
| <b>5. Requirements for the award of credits (ECTS)</b>                                     |                                     |   |                          |  | <b>6. Credits</b>              |                                      |
| Required achievements  |                                     | Regular participation in the practical exercise   |                          |  | 5 ECTS                         |                                      |
| Assessment (incl. weighting) and examination language                                      |                                     | Graded practical report in English  |                          |  |                                |                                      |
| <b>7. Frequency</b>  |                                     |   |                          | <b>8. Workload</b>   |                                | <b>9. Duration</b>                   |
| Winter semester  | <input type="checkbox"/>            | Winter and summer semester  | <input type="checkbox"/> | <b>150 h</b>   |                                | <b>3 credit hours per week (SWS)</b> |
| Summer semester  | <input checked="" type="checkbox"/> |   |                          |  |                                |                                      |
| <b>Module coordination</b>   |                                     |   |                          |  |                                |                                      |
| Teacher  |                                     | Prof. Dr. Dieter O. Fürst   |                          |  |                                |                                      |
| Module coordinator   |                                     | Prof. Dr. Dieter O. Fürst   |                          |  |                                |                                      |
| Institute/Department   |                                     | Cell Biology (Biology)  |                          |  |                                |                                      |
| <b>Further information</b>   |                                     |   |                          |  |                                |                                      |
| (Reading lists, information links etc.)  |                                     |   |                          |  |                                |                                      |

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| <b>Module Title:</b><br><b>Mechanical Stress Protection</b> |   |   |                          | <br>UNIVERSITÄT <b>BONN</b> |                                |                                      |
| Module ID/Code:<br>MCB-EM4                                  |   |   |                          |  |                                |                                      |
| <b>1. Content and intended learning outcomes</b>            |   |   |                          |  |                                |                                      |
| Content   | The following contents will be covered by the practical: <ul style="list-style-type: none"> <li>• Cell Culture Techniques</li> <li>• Expression of Recombinant Proteins</li> <li>• Protein Purification</li> <li>• Differentiation of Muscle Cells</li> <li>• Electrical Pulse Stimulation as an Exercise Model</li> <li>• Immunoprecipitation and Yeast-2-Hybrid System</li> <li>• Microscopic Imaging Techniques</li> <li>• Analysis of Protein Degradation Pathways</li> </ul> |   |                          |  |                                |                                      |
| 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.   |   |                          |  |                                |                                      |
| <b>2. Teaching and learning methods</b>                     |   |   |                          |  |                                |                                      |
|   | 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                                 |
| <b>3. Prerequisites for the module</b>                      |   |   |                          |  |                                |                                      |
| 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   |   |   |                          |  |                                |                                      |
| <b>4. Degree program allocation</b>                         |   |   |                          |  |                                |                                      |
|   | Study program   |   |                          | compulsory/<br>elective  | Semester                       |                                      |
|   | Molecular Cell Biology (M.Sc.)  |   |                          | elective   | 2 (3 <sup>rd</sup> time frame) |                                      |
|   |   |   |                          |  |                                |                                      |
| <b>5. Requirements for the award of credits (ECTS)</b>      |   |   |                          |  | <b>6. Credits</b>              |                                      |
| Required achievements                                       | Regular participation in the practical exercise   |   |                          |  | 5 ECTS                         |                                      |
| Assessment (incl. weighting) and examination language       | Graded practical report in English  |   |                          |  |                                |                                      |
| <b>7. Frequency</b>   |   |   | <b>8. Workload</b>       |  | <b>9. Duration</b>             |                                      |
| Winter semester   | <input type="checkbox"/>  | Winter and summer semester              | <input type="checkbox"/> | <b>150 h</b>   |                                | <b>3 credit hours per week (SWS)</b> |
| Summer semester   | <input checked="" type="checkbox"/>   |   |                          |  |                                |                                      |
| <b>Module coordination</b>                                  |   |   |                          |  |                                |                                      |
| Teacher   | Prof. Dr. Jörg Höfeld   |   |                          |  |                                |                                      |
| Module coordinator  | Prof. Dr. Jörg Höfeld   |   |                          |  |                                |                                      |
| Institute/Department  | Cell Biology (Biology)  |   |                          |  |                                |                                      |

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| <b>Module Title:</b><br><b>Mechanical Stress Protection</b><br>Module ID/Code:<br>MCB-EM4 | <br>UNIVERSITÄT <b>BONN</b> |
| <b>Further information</b>  |  |
| (Reading lists,<br>information links etc.)  |  |

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| <b>Module Title:</b><br><b>Neuronal Cell Biology</b><br>Module ID/Code:<br>MCB-EM5 |   | <br>UNIVERSITÄT <b>BONN</b> |                          |              |                     |                                      |
| <b>1. Content and intended learning outcomes</b>                                   |   |  |                          |              |                     |                                      |
| Content  | The following contents will be covered by the practical: <ul style="list-style-type: none"> <li>• Neuronal cell culture</li> <li>• Transfection of neurons</li> <li>• Immunocytochemistry</li> <li>• Fluorescent Microscopy</li> <li>• Live Cell Microscopy</li> <li>• Whole Tissue Imaging techniques</li> </ul> |  |                          |              |                     |                                      |
| 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.  |  |                          |              |                     |                                      |
| <b>2. Teaching and learning methods</b>  |   |  |                          |              |                     |                                      |
|  | Type of instruction   | Topic  | Language of instruction  | Group size   | Weekly contact time | Workload [h]                         |
|  | Practical exercise  | Neuronal Cell Biology  | English                  | 6            | 40 h                | 150                                  |
| <b>3. Prerequisites for the module</b>   |   |  |                          |              |                     |                                      |
| 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  |   |  |                          |              |                     |                                      |
| <b>4. Degree program allocation</b>  |   |  |                          |              |                     |                                      |
|  | Study program   |  | compulsory/<br>elective  |              | Semester            |                                      |
|  | Molecular Cell Biology (M.Sc.)  |  | elective                 |              | 2                   |                                      |
| <b>5. Requirements for the award of credits (ECTS)</b>                             |   |  |                          |              | <b>6. Credits</b>   |                                      |
| Required achievements  | Regular participation in the practical exercise   |  |                          |              |                     | 5 ECTS                               |
| Assessment (incl. <b>weighting</b> ) and examination language                      | Graded practical report (50 %) and oral examination (50 %) in English   |  |                          |              |                     |                                      |
| <b>7. Frequency</b>  |   |  | <b>8. Workload</b>       |              | <b>9. Duration</b>  |                                      |
| Winter semester  | <input type="checkbox"/>  | Winter and summer semester   | <input type="checkbox"/> | <b>150 h</b> |                     | <b>3 credit hours per week (SWS)</b> |
| Summer semester  | <input checked="" type="checkbox"/>   |  |                          |              |                     |                                      |
| <b>Module coordination</b>   |   |  |                          |              |                     |                                      |
| Teacher  | Prof. Dr. Walter Witke, Prof. Dr. Frank Bradke (DZNE)   |  |                          |              |                     |                                      |
| Module coordinator   | Prof. Dr. Walter Witke  |  |                          |              |                     |                                      |
| Institute/Department   | Genetics (Biology)  |  |                          |              |                     |                                      |
| <b>Further information</b>   |   |  |                          |              |                     |                                      |
| (Reading lists, information links etc.)  |   |  |                          |              |                     |                                      |

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| <b>Module Title:</b><br><b>Transportphysiology</b><br>Module ID/Code:<br>MCB-EM6 |                                     |  |                          | <br><b>UNIVERSITÄT BONN</b> |                                |              |
| <b>1. Content and intended learning outcomes</b>                                 |                                     |  |                          |  |                                |              |
| 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.  |                          |  |                                |              |
| <b>2. Teaching and learning methods</b>  |                                     |  |                          |  |                                |              |
|  | Type of instruction                 | Topic  | Language of instruction  | Group size   | Weekly contact time            | Workload [h] |
|  | Practical exercise                  | Transportphysiology  | English                  | 2  | 40 h                           | 150          |
| <b>3. Prerequisites for the module</b>   |                                     |  |                          |  |                                |              |
| 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  |                                     |  |                          |  |                                |              |
| <b>4. Degree program allocation</b>  |                                     |  |                          |  |                                |              |
|  | Study program                       |  |                          | compulsory/<br>elective  | Semester                       |              |
|  | Molecular Cell Biology (M.Sc.)      |  |                          | elective   | 2 (3 <sup>rd</sup> time frame) |              |
|  | Plant Sciences (M.Sc.)              |  |                          |  |                                |              |
|  | OEP Biology (M.Sc.)                 |  |                          |  |                                |              |
| <b>5. Requirements for the award of credits (ECTS)</b>                           |                                     |  |                          |  | <b>6. Credits</b>              |              |
| Required achievements  |                                     | Regular participation in the practical exercise  |                          |  | 5 ECTS                         |              |
| Assessment (incl. weighting) and examination language                            |                                     | Graded written examination in English  |                          |  |                                |              |
| <b>7. Frequency</b>  |                                     |  |                          | <b>8. Workload</b>   | <b>9. Duration</b>             |              |
| Winter semester  | <input type="checkbox"/>            | Winter and summer semester   | <input type="checkbox"/> | 150 h  | 3 credit hours per week (SWS)  |              |
| Summer semester  | <input checked="" type="checkbox"/> |  |                          |  |                                |              |
| <b>Module coordination</b>   |                                     |  |                          |  |                                |              |
| Teacher  |                                     | Prof. Dr. Lukas Schreiber  |                          |  |                                |              |
| Module coordinator   |                                     | Prof. Dr. Lukas Schreiber  |                          |  |                                |              |
| Institute/Department   |                                     | Cellular and Molecular Botany (Biology)  |                          |  |                                |              |
| <b>Further information</b>   |                                     |  |                          |  |                                |              |
| (Reading lists, information links etc.)  |                                     | 1. Taiz L, Zeiger E (2006) Plant Physiology. Sinauer Associates Inc., Sunderland, MA, 2.<br>Schulze ED, Beck E, and Müller-Hohenstein K. Plant Ecology, Heidelberg: Springer, 2005   |                          |  |                                |              |

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| <b>Module Title:</b><br><b>Pharmacology &amp; Metabolism</b> |   |                            |                          | <br>UNIVERSITÄT <b>BONN</b> |                     |                                      |
| Module ID/Code:<br>MCB-EM7                                   |   |                            |                          |  |                     |                                      |
| <b>1. Content and intended learning outcomes</b>             |   |                            |                          |  |                     |                                      |
| Content  | The following contents will be covered by the practical: <ul style="list-style-type: none"> <li>• Murine primary adipocyte isolation and culture</li> <li>• Human adipocyte cell culture</li> <li>• Pharmacological intervention of experimental model system</li> <li>• Ex vivo and in vitro metabolic measurements (including oxygen consumption, energy expenditure, lipolysis, mitochondrial function, etc.)</li> <li>• Data collection, analysis and interpretation</li> </ul>   |                            |                          |  |                     |                                      |
| 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 <i>in vivo</i> , <i>ex vivo</i> and <i>in vitro</i> pharmacological experimentation with the model system. The practical work will be supported by seminars covering, among other, signal transduction, metabolism and pharmacology. |                            |                          |  |                     |                                      |
| <b>2. Teaching and learning methods</b>                      |   |                            |                          |  |                     |                                      |
|  | Type of instruction   | Topic                      | Language of instruction  | Group size   | Weekly contact time | Workload [h]                         |
|  | Practical exercise  | Molecular Biology          | English                  | 6  | 40 h                | 150                                  |
| <b>3. Prerequisites for the module</b>                       |   |                            |                          |  |                     |                                      |
| 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  |   |                            |                          |  |                     |                                      |
| <b>4. Degree program allocation</b>                          |   |                            |                          |  |                     |                                      |
|  | Study program   |                            |                          | compulsory/<br>elective  | Semester            |                                      |
|  | Molecular Cell Biology (M.Sc.)  |                            |                          | elective   | 2                   |                                      |
| <b>5. Requirements for the award of credits (ECTS)</b>       |   |                            |                          |  | <b>6. Credits</b>   |                                      |
| Required achievements  | Regular participation in the practical exercise   |                            |                          |  | 5 ECTS              |                                      |
| Assessment (incl. weighting) and examination language        | Graded practical report in English  |                            |                          |  |                     |                                      |
| <b>7. Frequency</b>  |   |                            | <b>8. Workload</b>       |  | <b>9. Duration</b>  |                                      |
| Winter semester  | <input type="checkbox"/>  | Winter and summer semester | <input type="checkbox"/> | <b>150 h</b>   |                     | <b>3 credit hours per week (SWS)</b> |
| Summer semester  | <input checked="" type="checkbox"/>   |                            |                          |  |                     |                                      |
| <b>Module coordination</b>                                   |   |                            |                          |  |                     |                                      |
| Teacher  | Prof. Dr. Alexander Pfeifer   |                            |                          |  |                     |                                      |
| Module coordinator   | Prof. Dr. Alexander Pfeifer   |                            |                          |  |                     |                                      |
| Institute/Department   | Pharmacology and Toxicology (Medicine)  |                            |                          |  |                     |                                      |
| <b>Further information</b>                                   |   |                            |                          |  |                     |                                      |
| (Reading lists, information links etc.)                      |   |                            |                          |  |                     |                                      |

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| <b>Module Title:</b><br><b>Plant Transformation</b><br>Module ID/Code:<br>MCB-EM8 |  | <br><b>UNIVERSITÄT BONN</b> |                          |                         |                     |                                      |
| <b>1. Content and intended learning outcomes</b>                                  |  |  |                          |                         |                     |                                      |
| 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, <i>Agrobacterium</i> -mediated transformation, cloning in <i>Escherichia coli</i> and <i>Agrobacterium tumefaciens</i> , screening of transgenic lines, detection of transgenes by PCR, histochemical and biochemical methods.   |  |                          |                         |                     |                                      |
| <b>2. Teaching and learning methods</b>   |  |  |                          |                         |                     |                                      |
|   | Type of instruction  | Topic  | Language of instruction  | Group size              | Weekly contact time | Workload [h]                         |
|   | Practical exercise   | Plant transformation   | English                  |                         | 40 h                | 150                                  |
| <b>3. Prerequisites for the module</b>  |  |  |                          |                         |                     |                                      |
| 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   |  |  |                          |                         |                     |                                      |
| <b>4. Degree program allocation</b>   |  |  |                          |                         |                     |                                      |
|   | Study program  |  |                          | compulsory/<br>elective | Semester            |                                      |
|   | Molecular Cell Biology (M.Sc.)   |  |                          | elective                | 2                   |                                      |
| <b>5. Requirements for the award of credits (ECTS)</b>                            |  |  |                          |                         |                     | <b>6. Credits</b>                    |
| Required achievements   |  |  |                          |                         |                     | 5 ECTS                               |
| Assessment (incl. weighting) and examination language                             | Graded practical report in English   |  |                          |                         |                     |                                      |
| <b>7. Frequency</b>   |  |  | <b>8. Workload</b>       |                         | <b>9. Duration</b>  |                                      |
| Winter semester   | <input type="checkbox"/>   | Winter and summer semester   | <input type="checkbox"/> | <b>150 h</b>            |                     | <b>3 credit hours per week (SWS)</b> |
| Summer semester   | <input checked="" type="checkbox"/>  |  |                          |                         |                     |                                      |
| <b>Module coordination</b>  |  |  |                          |                         |                     |                                      |
| Teacher   | Prof. Dr. Peter Dörmann  |  |                          |                         |                     |                                      |
| Module coordinator  | Prof. Dr. Peter Dörmann  |  |                          |                         |                     |                                      |
| Institute/Department  | Molecular Physiology and Biotechnology of Plants (Biology)   |  |                          |                         |                     |                                      |
| <b>Further information</b>  |  |  |                          |                         |                     |                                      |
| (Reading lists, information links etc.)   |  |  |                          |                         |                     |                                      |

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| <b>Module Title:</b><br><b>Quantitative Fluorescence Microscopy</b> |  |                                      |                          | <br><b>UNIVERSITÄT BONN</b> |                                      |                   |
| Module ID/Code:<br>MCB-EM9  |  |                                      |                          |  |                                      |                   |
| <b>1. Content and intended learning outcomes</b>                    |  |                                      |                          |  |                                      |                   |
| Content   | The following contents will be covered by the practical: <ul style="list-style-type: none"> <li>• Transient and stable expression of fluorescent proteins</li> <li>• SNAP-, Halo, Clip-tag labelling</li> <li>• Super resolution confocal laser scanning microscopy</li> <li>• Fluorescence recovery after photobleaching (FRAP)</li> <li>• Analysis of intracellular protein mobility</li> <li>• Förster resonance energy transfer (FRET) measurements</li> <li>• Quantitative image analysis</li> <li>• 3D image reconstruction</li> </ul> |                                      |                          |  |                                      |                   |
| 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.   |                                      |                          |  |                                      |                   |
| <b>2. Teaching and learning methods</b>                             |  |                                      |                          |  |                                      |                   |
|   | 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               |
| <b>3. Prerequisites for the module</b>                              |  |                                      |                          |  |                                      |                   |
| 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   |  |                                      |                          |  |                                      |                   |
| <b>4. Degree program allocation</b>                                 |  |                                      |                          |  |                                      |                   |
|   | Study program  |                                      |                          | compulsory/<br>elective  | Semester                             |                   |
|   | Molecular Cell Biology (M.Sc.)   |                                      |                          | elective   |                                      |                   |
| <b>5. Requirements for the award of credits (ECTS)</b>              |  |                                      |                          |  |                                      | <b>6. Credits</b> |
| Required achievements   |  |                                      |                          |  |                                      | 5 ECTS            |
| Assessment (incl. weighting) and examination language               | Graded practical report in English   |                                      |                          |  |                                      |                   |
| <b>7. Frequency</b>   |  |                                      |                          | <b>8. Workload</b>   | <b>9. Duration</b>                   |                   |
| Winter semester   | <input type="checkbox"/>   | Winter and summer semester           | <input type="checkbox"/> | <b>150 h</b>   | <b>3 credit hours per week (SWS)</b> |                   |
| Summer semester   | <input checked="" type="checkbox"/>  |                                      |                          |  |                                      |                   |
| <b>Module coordination</b>  |  |                                      |                          |  |                                      |                   |
| Teacher   | Prof. Dr. Ulrich Kubitscheck   |                                      |                          |  |                                      |                   |
| Module coordinator  | Prof. Dr. Ulrich Kubitscheck   |                                      |                          |  |                                      |                   |
| Institute/Department  | Physical and Theoretical Chemistry (Chemistry)   |                                      |                          |  |                                      |                   |
| <b>Further information</b>  |  |                                      |                          |  |                                      |                   |
| (Reading lists, information links etc.)                             | Fluorescence Microscopy: From Principles to Application, 2 <sup>nd</sup> edition, Wiley-VCH, ed. U. Kubitscheck  |                                      |                          |  |                                      |                   |

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| <b>Module Title:</b><br><b>Biochemistry and Bioanalytics</b><br>Module ID/Code:<br>MCB-EM10 |  | <br><b>UNIVERSITÄT BONN</b> |                          |                         |                     |                                      |
| <b>1. Content and intended learning outcomes</b>  |  |  |                          |                         |                     |                                      |
| Content   | Strategies and methods of analytical biochemistry with focus on protein biochemistry, qualitative and quantitative analysis of protein-protein/ligand-interactions and bioactivity assays: <ul style="list-style-type: none"> <li>• Expression of recombinant proteins in <i>E. coli</i></li> <li>• Protein purification and analysis (MALDI-TOF, SDS-PAGE)</li> <li>• Binding studies (e.g. UV/Vis, MST, ITC, BLITZ)</li> <li>• Activity studies (chromogenic/fluorogenic assays)</li> <li>• Enzyme kinetics and enzyme/protein regulation</li> </ul> |  |                          |                         |                     |                                      |
| Learning outcomes   | The students will develop in-depth knowledge and practical exercise regarding modern techniques and methods in biochemistry and bioanalytics, gain experience in planning and performing experiments, and evaluate original literature independently.  |  |                          |                         |                     |                                      |
| <b>2. Teaching and learning methods</b>   |  |  |                          |                         |                     |                                      |
|   | Type of instruction  | Topic  | Language of instruction  | Group size              | Weekly contact time | Workload [h]                         |
|   | Practical exercise   | Biochemistry and Bioanalytics  | English                  |                         | 36 h                | 130                                  |
|   | Seminar  |  |                          |                         | 4 h                 | 20                                   |
| <b>3. Prerequisites for the module</b>  |  |  |                          |                         |                     |                                      |
| 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   |  |  |                          |                         |                     |                                      |
| <b>4. Degree program allocation</b>   |  |  |                          |                         |                     |                                      |
|   | Study program  |  |                          | compulsory/<br>elective | Semester            |                                      |
|   | Molecular Cell Biology (M.Sc.)   |  |                          | elective                |                     |                                      |
| <b>5. Requirements for the award of credits (ECTS)</b>                                      |  |  |                          |                         |                     |                                      |
| Required achievements   |  |  |                          |                         |                     | <b>6. Credits</b><br>5 ECTS          |
| Assessment (incl. weighting) and examination language                                       | Graded practical report (70 %) and seminar presentation (30 %) in English  |  |                          |                         |                     |                                      |
| <b>7. Frequency</b>   |  |  | <b>8. Workload</b>       |                         | <b>9. Duration</b>  |                                      |
| Winter semester   | <input type="checkbox"/>   | Winter and summer semester   | <input type="checkbox"/> | <b>150 h</b>            |                     | <b>3 credit hours per week (SWS)</b> |
| Summer semester   | <input checked="" type="checkbox"/>  |  |                          |                         |                     |                                      |
| <b>Module coordination</b>  |  |  |                          |                         |                     |                                      |
| Teacher   | Prof. Dr. Diana Imhof, Dr. Toni Kühl   |  |                          |                         |                     |                                      |
| Module coordinator  | Prof. Dr. Diana Imhof  |  |                          |                         |                     |                                      |
| Institute/Department  | Pharmacy   |  |                          |                         |                     |                                      |
| <b>Further information</b>  |  |  |                          |                         |                     |                                      |
| (Reading lists, information links etc.)   |  |  |                          |                         |                     |                                      |

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| <b>Module Title:</b><br><b>Molecular Membrane Biology</b> |   |                            |                          | <br>UNIVERSITÄT <b>BONN</b> |                                      |                   |
| Module ID/Code:<br>MCB-EM11                               |   |                            |                          |  |                                      |                   |
| <b>1. Content and intended learning outcomes</b>          |   |                            |                          |  |                                      |                   |
| Content   | The following contents are typically covered by the practical: <ul style="list-style-type: none"> <li>• Cell culture with macrophages and epithelial cells</li> <li>• Subcellular fractionation and biochemical analysis of fractions</li> <li>• Membrane purification</li> <li>• Membrane fusion with purified components</li> <li>• Gene expression knock-down with siRNA</li> <li>• Fluorescence microscopy</li> <li>• Computer-assisted image analysis</li> </ul> |                            |                          |  |                                      |                   |
| 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.   |                            |                          |  |                                      |                   |
| <b>2. Teaching and learning methods</b>                   |   |                            |                          |  |                                      |                   |
|   | 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                |
| <b>3. Prerequisites for the module</b>                    |   |                            |                          |  |                                      |                   |
| 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   |   |                            |                          |  |                                      |                   |
| <b>4. Degree program allocation</b>                       |   |                            |                          |  |                                      |                   |
|   | Study program   |                            |                          | compulsory/<br>elective  | Semester                             |                   |
|   | Molecular Cell Biology (M.Sc.)  |                            |                          | elective   | 2                                    |                   |
| <b>5. Requirements for the award of credits (ECTS)</b>    |   |                            |                          |  |                                      | <b>6. Credits</b> |
| 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   |                            |                          |  |                                      |                   |
| <b>7. Frequency</b>                                       |   |                            |                          | <b>8. Workload</b>   | <b>9. Duration</b>                   |                   |
| Winter semester   | <input type="checkbox"/>  | Winter and summer semester | <input type="checkbox"/> | <b>150 h</b>   | <b>3 credit hours per week (SWS)</b> |                   |
| Summer semester   | <input checked="" type="checkbox"/>   |                            |                          |  |                                      |                   |
| <b>Module coordination</b>                                |   |                            |                          |  |                                      |                   |
| Teacher   | Prof. Dr. Albert Haas   |                            |                          |  |                                      |                   |
| Module coordinator  | Prof. Dr. Albert Haas   |                            |                          |  |                                      |                   |
| Institute/Department                                      | Cell Biology Institute (Biology)  |                            |                          |  |                                      |                   |
| <b>Further information</b>                                |   |                            |                          |  |                                      |                   |
| (Reading lists, information links etc.)                   |   |                            |                          |  |                                      |                   |

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| <b>Module Title:</b><br><b>Bioinformatics Lab Course</b> |                                     |  |                          | <br>UNIVERSITÄT <b>BONN</b> |                                      |              |
| Module ID/Code:<br>MCB-EM12                              |                                     |  |                          |  |                                      |              |
| <b>1. Content and intended learning outcomes</b>         |                                     |  |                          |  |                                      |              |
| Content  |                                     | Practical introduction to algorithmics, bio-databases, modelling, programming  |                          |  |                                      |              |
| Learning outcomes  |                                     | Application oriented basic knowledge of bioinformatic methods  |                          |  |                                      |              |
| <b>2. Teaching and learning methods</b>                  |                                     |  |                          |  |                                      |              |
|  | Type of instruction                 | Topic  | Language of instruction  | Group size   | Weekly contact time                  | Workload [h] |
|  | Practical exercise                  | Bioinformatics   | English                  |  | 40 h                                 | 150          |
| <b>3. Prerequisites for the module</b>                   |                                     |  |                          |  |                                      |              |
| 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  |                                     |  |                          |  |                                      |              |
| <b>4. Degree program allocation</b>                      |                                     |  |                          |  |                                      |              |
|  | Study program                       |  |                          | compulsory/<br>elective  | Semester                             |              |
|  | Molecular Cell Biology (M.Sc.)      |  |                          | elective   | 2                                    |              |
| <b>5. Requirements for the award of credits (ECTS)</b>   |                                     |  |                          |  | <b>6. Credits</b>                    |              |
| Required achievements                                    |                                     |  |                          |  | 5 ECTS                               |              |
| Assessment (incl. weighting) and examination language    |                                     | Graded practical report in English   |                          |  |                                      |              |
| <b>7. Frequency</b>                                      |                                     |  |                          | <b>8. Workload</b>   | <b>9. Duration</b>                   |              |
| Winter semester  | <input type="checkbox"/>            | Winter and summer semester   | <input type="checkbox"/> | <b>150 h</b>   | <b>3 credit hours per week (SWS)</b> |              |
| Summer semester  | <input checked="" type="checkbox"/> |  |                          |  |                                      |              |
| <b>Module coordination</b>                               |                                     |  |                          |  |                                      |              |
| Teacher  |                                     | Prof. Dr. Martin Hofmann-Apitius   |                          |  |                                      |              |
| Module coordinator                                       |                                     | Prof. Dr. Martin Hofmann-Apitius   |                          |  |                                      |              |
| Institute/Department                                     |                                     | B-IT-Center (Informatics)  |                          |  |                                      |              |
| <b>Further information</b>                               |                                     |  |                          |  |                                      |              |
| (Reading lists, information links etc.)                  |                                     |  |                          |  |                                      |              |

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| <b>Module Title:</b><br><b>Embryo Biotechnology</b>    |   | <br>UNIVERSITÄT <b>BONN</b> |                          |                         |                     |                                      |
| Module ID/Code:<br>MCB-EM13                            |   |  |                          |                         |                     |                                      |
| <b>1. Content and intended learning outcomes</b>       |   |  |                          |                         |                     |                                      |
| Content  | <ul style="list-style-type: none"> <li>▪ gene transfer techniques - mammalian and bird embryos, fish, invertebrates, ES cell system, somatic gene transfer;</li> <li>▪ embryo technology - handling and culture of embryos, micromanipulation, freezing technique, transfer of nuclei, microinjection;</li> <li>▪ DNA integration - vector integration, expression and function;</li> <li>▪ use of transgenic animals - gene function, animal models, recombinant proteins, new genetic properties</li> </ul> |  |                          |                         |                     |                                      |
| Learning outcomes                                      | Overview of production of transgenic animals; insight into use of transgenic animals in biological research and biotechnological application.   |  |                          |                         |                     |                                      |
| <b>2. Teaching and learning methods</b>                |   |  |                          |                         |                     |                                      |
|  | Type of instruction   | Topic  | Language of instruction  | Group size              | Weekly contact time | Workload [h]                         |
|  | Practical exercise  | Embryo Biotechnology   | English                  |                         | 40 h                | 150                                  |
| <b>3. Prerequisites for the module</b>                 |   |  |                          |                         |                     |                                      |
| 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  |   |  |                          |                         |                     |                                      |
| <b>4. Degree program allocation</b>                    |   |  |                          |                         |                     |                                      |
|  | Study program   |  |                          | compulsory/<br>elective | Semester            |                                      |
|  | Molecular Cell Biology (M.Sc.)  |  |                          | elective                | 2                   |                                      |
|  |   |  |                          |                         |                     |                                      |
|  |   |  |                          |                         |                     |                                      |
| <b>5. Requirements for the award of credits (ECTS)</b> |   |  |                          |                         | <b>6. Credits</b>   |                                      |
| Required achievements                                  |   |  |                          |                         |                     | 5 ECTS                               |
| Assessment (incl. weighting) and examination language  | Graded practical report in English  |  |                          |                         |                     |                                      |
| <b>7. Frequency</b>                                    |   |  | <b>8. Workload</b>       |                         | <b>9. Duration</b>  |                                      |
| Winter semester  | <input type="checkbox"/>  | Winter and summer semester   | <input type="checkbox"/> | <b>150 h</b>            |                     | <b>3 credit hours per week (SWS)</b> |
| Summer semester  | <input checked="" type="checkbox"/>   |  |                          |                         |                     |                                      |
| <b>Module coordination</b>                             |   |  |                          |                         |                     |                                      |
| Teacher  | Priv.-Doz. Dr. Michael Hölker   |  |                          |                         |                     |                                      |
| Module coordinator                                     | Priv.-Doz. Dr. Michael Hölker   |  |                          |                         |                     |                                      |
| Institute/Department                                   | Animal Science (Agriculture)  |  |                          |                         |                     |                                      |
| <b>Further information</b>                             |   |  |                          |                         |                     |                                      |
| (Reading lists, information links etc.)                |   |  |                          |                         |                     |                                      |

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| <b>Module Title:</b><br><b>Drugs from Plants and Microorganisms</b> |                                     |   |                          | <br><b>UNIVERSITÄT BONN</b> |                                      |                   |
| Module ID/Code:<br>MCB-EM14   |                                     |   |                          |  |                                      |                   |
| <b>1. Content and intended learning outcomes</b>                    |                                     |   |                          |  |                                      |                   |
| Content   |                                     | Biosynthesis and analysis of physiologically active natural products: isolation and chemical analysis of natural products (HPLC, TLC, GC, NMR); biosynthesis of antibiotics, detection of genes for biosynthetic pathways, recombinant drugs, production and mode of action of chemotherapeutics. |                          |  |                                      |                   |
| 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.   |                          |  |                                      |                   |
| <b>2. Teaching and learning methods</b>                             |                                     |   |                          |  |                                      |                   |
|   | Type of instruction                 | Topic   | Language of instruction  | Group size   | Weekly contact time                  | Workload [h]      |
|   | Practical exercise                  | Drugs from Plants and Microorganisms  | English                  |  | 36 h                                 | 120               |
|   | Seminar                             |   |                          |  | 4 h                                  | 30                |
| <b>3. Prerequisites for the module</b>                              |                                     |   |                          |  |                                      |                   |
| 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   |                                     |   |                          |  |                                      |                   |
| <b>4. Degree program allocation</b>                                 |                                     |   |                          |  |                                      |                   |
|   | Study program                       |   |                          | compulsory/<br>elective  | Semester                             |                   |
|   | Molecular Cell Biology (M.Sc.)      |   |                          | elective   | 3                                    |                   |
| <b>5. Requirements for the award of credits (ECTS)</b>              |                                     |   |                          |  |                                      | <b>6. Credits</b> |
| Required achievements   |                                     |   |                          |  |                                      | 5 ECTS            |
| Assessment (incl. weighting) and examination language               |                                     | Graded practical report (34 %), written examination (33 %), seminar presentation (33 %) in English  |                          |  |                                      |                   |
| <b>7. Frequency</b>   |                                     |   |                          | <b>8. Workload</b>   | <b>9. Duration</b>                   |                   |
| Winter semester   | <input checked="" type="checkbox"/> | Winter and summer semester  | <input type="checkbox"/> | <b>150 h</b>   | <b>3 credit hours per week (SWS)</b> |                   |
| Summer semester   | <input type="checkbox"/>            |   |                          |  |                                      |                   |
| <b>Module coordination</b>  |                                     |   |                          |  |                                      |                   |
| Teacher   |                                     | Dr. Stefan Kehraus  |                          |  |                                      |                   |
| Module coordinator  |                                     | Dr. Stefan Kehraus  |                          |  |                                      |                   |
| Institute/Department  |                                     | Pharmaceutical Biology (Pharmacy)   |                          |  |                                      |                   |
| <b>Further information</b>  |                                     |   |                          |  |                                      |                   |
| (Reading lists, information links etc.)                             |                                     |   |                          |  |                                      |                   |

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| <b>Module Title:</b><br><b>Biosyntheses of Natural Products</b> |                                     |   |                          | <br>UNIVERSITÄT <b>BONN</b> |                                      |                   |
| Module ID/Code:<br>MCB-EM15                                     |                                     |   |                          |  |                                      |                   |
| <b>1. Content and intended learning outcomes</b>                |                                     |   |                          |  |                                      |                   |
| 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.           |                          |  |                                      |                   |
| <b>2. Teaching and learning methods</b>                         |                                     |   |                          |  |                                      |                   |
|   | 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                |
| <b>3. Prerequisites for the module</b>                          |                                     |   |                          |  |                                      |                   |
| 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   |                                     |   |                          |  |                                      |                   |
| <b>4. Degree program allocation</b>                             |                                     |   |                          |  |                                      |                   |
| Study program   |                                     |   | compulsory/<br>elective  | Semester   |                                      |                   |
| Molecular Cell Biology (M.Sc.)                                  |                                     |   | elective                 | 3  |                                      |                   |
| <b>5. Requirements for the award of credits (ECTS)</b>          |                                     |   |                          |  |                                      | <b>6. Credits</b> |
| Required achievements   |                                     |   |                          |  |                                      | 5 ECTS            |
| Assessment (incl. weighting) and examination language           |                                     | Graded practical report (34 %), written examination (33 %), seminar presentation (33 %) in English  |                          |  |                                      |                   |
| <b>7. Frequency</b>   |                                     |   |                          | <b>8. Workload</b>   | <b>9. Duration</b>                   |                   |
| Winter semester   | <input checked="" type="checkbox"/> | Winter and summer semester  | <input type="checkbox"/> | <b>150 h</b>   | <b>3 credit hours per week (SWS)</b> |                   |
| Summer semester   | <input type="checkbox"/>            |   |                          |  |                                      |                   |
| <b>Module coordination</b>                                      |                                     |   |                          |  |                                      |                   |
| Teacher   |                                     | Dr. Stefan Kehraus  |                          |  |                                      |                   |
| Module coordinator  |                                     | Dr. Stefan Kehraus  |                          |  |                                      |                   |
| Institute/Department  |                                     | Pharmaceutical Biology (Pharmacy)   |                          |  |                                      |                   |
| <b>Further information</b>                                      |                                     |   |                          |  |                                      |                   |
| (Reading lists, information links etc.)                         |                                     |   |                          |  |                                      |                   |

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| <b>Module Title:</b><br><b>Proteomics</b>              |  | <br>UNIVERSITÄT <b>BONN</b> |                          |                         |                     |                                      |
| Module ID/Code:<br>MCB-EM16                            |  |  |                          |                         |                     |                                      |
| <b>1. Content and intended learning outcomes</b>       |  |  |                          |                         |                     |                                      |
| Content  | Protein isolation and characterisation using mass spectrometry. Analysis of post-translational protein modifications.  |  |                          |                         |                     |                                      |
| Learning outcomes                                      | Students learn to identify, isolate and characterise proteins from tissues of moleculogenetically well defined model organisms.                              |  |                          |                         |                     |                                      |
| <b>2. Teaching and learning methods</b>                |  |  |                          |                         |                     |                                      |
|  | Type of instruction  | Topic  | Language of instruction  | Group size              | Weekly contact time | Workload [h]                         |
|  | Practical exercise   |  | English                  |                         | 40 h                | 150                                  |
|  |  |  |                          |                         |                     |                                      |
|  |  |  |                          |                         |                     |                                      |
| <b>3. Prerequisites for the module</b>                 |  |  |                          |                         |                     |                                      |
| 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  |  |  |                          |                         |                     |                                      |
| <b>4. Degree program allocation</b>                    |  |  |                          |                         |                     |                                      |
|  | Study program  |  |                          | compulsory/<br>elective | Semester            |                                      |
|  | Molecular Cell Biology (M.Sc.)   |  |                          | elective                | 3                   |                                      |
|  |  |  |                          |                         |                     |                                      |
|  |  |  |                          |                         |                     |                                      |
| <b>5. Requirements for the award of credits (ECTS)</b> |  |  |                          |                         | <b>6. Credits</b>   |                                      |
| Required achievements                                  |  |  |                          |                         |                     | 5 ECTS                               |
| Assessment (incl. weighting) and examination language  | Graded practical report in English   |  |                          |                         |                     |                                      |
| <b>7. Frequency</b>                                    |  |  | <b>8. Workload</b>       |                         | <b>9. Duration</b>  |                                      |
| Winter semester  | <input checked="" type="checkbox"/>  | Winter and summer semester   | <input type="checkbox"/> | <b>150 h</b>            |                     | <b>3 credit hours per week (SWS)</b> |
| Summer semester  | <input type="checkbox"/>   |  |                          |                         |                     |                                      |
| <b>Module coordination</b>                             |  |  |                          |                         |                     |                                      |
| 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)   |  |                          |                         |                     |                                      |
| <b>Further information</b>                             |  |  |                          |                         |                     |                                      |
| (Reading lists, information links etc.)                |  |  |                          |                         |                     |                                      |

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| <b>Module Title:</b><br><b>Preventive, Predictive and Personalised Medicine</b> |  |  |                          | <br><b>UNIVERSITÄT BONN</b> |                     |                                      |
| Module ID/Code:<br>MCB-EM17   |  |  |                          |  |                     |                                      |
| <b>1. Content and intended learning outcomes</b>                                |  |  |                          |  |                     |                                      |
| Content   | <ul style="list-style-type: none"> <li>▪ Significance of early or preventative diagnostics in cardiovascular and tumor diseases,</li> <li>▪ application of modern biotechnologies in medical diagnostics,</li> <li>▪ introduction into molecular and minimally invasive diagnostic technologies,</li> <li>▪ development of pathology-specific biomarkers.</li> </ul>   |  |                          |  |                     |                                      |
| Learning outcomes   | <ul style="list-style-type: none"> <li>▪ Metabolic pathways affected in pathomechanisms of cardiovascular complications secondary to Diabetes mellitus type II,</li> <li>▪ metabolic pathways affected in pathomechanisms of neurodegenerative diseases,</li> <li>▪ metabolic pathways affected in pathomechanisms of selected tumors, using the examples of glioblastoma and breast cancer,</li> <li>▪ stress and repair mechanisms (comet assay technology),</li> <li>▪ role and evaluation of tissue remodelling-protein complexes (technology of zymography),</li> <li>▪ pathology specific expression patterns (technologies of clinical proteomics and real-time PCR),</li> <li>▪ analysis of disease-specific expression arrays,</li> <li>▪ written summary of the experimental design and results, presentation of a research hypothesis.</li> </ul> |  |                          |  |                     |                                      |
| <b>2. Teaching and learning methods</b>   |  |  |                          |  |                     |                                      |
|   | 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                                   |
| <b>3. Prerequisites for the module</b>  |  |  |                          |  |                     |                                      |
| 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   |  |  |                          |  |                     |                                      |
| <b>4. Degree program allocation</b>   |  |  |                          |  |                     |                                      |
|   | Study program  |  |                          | compulsory/<br>elective  | Semester            |                                      |
|   | Molecular Cell Biology (M.Sc.)   |  |                          | elective   | 2                   |                                      |
| <b>5. Requirements for the award of credits (ECTS)</b>                          |  |  |                          |  | <b>6. Credits</b>   |                                      |
| Required achievements   |  |  |                          |  |                     | 5 ECTS                               |
| Assessment (incl. weighting) and examination language                           | Written practical report (60 %), written examination (20 %), seminar presentation (20 %) in English  |  |                          |  |                     |                                      |
| <b>7. Frequency</b>   |  |  | <b>8. Workload</b>       |  | <b>9. Duration</b>  |                                      |
| Winter semester   | <input type="checkbox"/>   | Winter and summer semester                       | <input type="checkbox"/> | <b>150 h</b>   |                     | <b>3 credit hours per week (SWS)</b> |
| Summer semester   | <input checked="" type="checkbox"/>  |  |                          |  |                     |                                      |
| <b>Module coordination</b>  |  |  |                          |  |                     |                                      |
| Teacher   | Prof. Dr. Olga Golubnitschaja  |  |                          |  |                     |                                      |
| Module coordinator  | Prof. Dr. Olga Golubnitschaja  |  |                          |  |                     |                                      |
| Institute/Department  | Radiology (Medicine)   |  |                          |  |                     |                                      |

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| <b>Module Title:</b><br><b>Preventive, Predictive and Personalised Medicine</b><br>Module ID/Code:<br>MCB-EM17 | <br>UNIVERSITÄT <b>BONN</b> |
| <b>Further information</b>   |  |
| (Reading lists,<br>information links etc.)   |  |

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| <b>Module Title:</b><br><b>Cell Mechanics</b><br>Module ID/Code:<br>MCB-EM18 |  | <br><b>UNIVERSITÄT BONN</b> |                         |                         |                     |              |
| <b>1. Content and intended learning outcomes</b>                             |  |  |                         |                         |                     |              |
| Content  | <ul style="list-style-type: none"> <li>▪ 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;</li> <li>▪ 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;</li> <li>▪ 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.</li> </ul>   |  |                         |                         |                     |              |
| Learning outcomes  | <p>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.</p> |  |                         |                         |                     |              |
| <b>2. Teaching and learning methods</b>                                      |  |  |                         |                         |                     |              |
|  | Type of instruction  | Topic  | Language of instruction | Group size              | Weekly contact time | Workload [h] |
|  | Practical exercise   |  | English                 |                         | 40 h                | 150          |
|  |  |  |                         |                         |                     |              |
|  |  |  |                         |                         |                     |              |
| <b>3. Prerequisites for the module</b>                                       |  |  |                         |                         |                     |              |
| 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  |  |  |                         |                         |                     |              |
| <b>4. Degree program allocation</b>  |  |  |                         |                         |                     |              |
|  | Study program  |  |                         | compulsory/<br>elective | Semester            |              |
|  | Molecular Cell Biology (M.Sc.)   |  |                         | elective                | 3                   |              |
|  |  |  |                         |                         |                     |              |
|  |  |  |                         |                         |                     |              |
| <b>5. Requirements for the award of credits (ECTS)</b>                       |  |  |                         |                         | <b>6. Credits</b>   |              |
| Required achievements  |  |  |                         |                         | 5 ECTS              |              |
| Assessment (incl.  | Graded practical report in English   |  |                         |                         |                     |              |

|   |                                     |                               |                          |  |                                      |
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| <b>Module Title:</b><br><b>Cell Mechanics</b> |                                     |                               |                          | <br>UNIVERSITÄT <b>BONN</b> |                                      |
| Module ID/Code:<br>MCB-EM18                   |                                     |                               |                          |  |                                      |
| weighting) and<br>examination language        |                                     |                               |                          |  |                                      |
| <b>7. Frequency</b>                           |                                     |                               | <b>8. Workload</b>       |  | <b>9. Duration</b>                   |
| Winter semester                               | <input type="checkbox"/>            | Winter and summer<br>semester | <input type="checkbox"/> | <b>150 h</b>   | <b>3 credit hours per week (SWS)</b> |
| Summer semester                               | <input checked="" type="checkbox"/> |                               |                          |  |                                      |
| <b>Module coordination</b>                    |                                     |                               |                          |  |                                      |
| Teacher                                       |                                     | Priv.-Doz. Dr. Bernd Hoffmann |                          |  |                                      |
| Module coordinator                            |                                     | Priv.-Doz. Dr. Bernd Hoffmann |                          |  |                                      |
| Institute/Department                          |                                     | Complex Systems (FZ Jülich)   |                          |  |                                      |
| <b>Further information</b>                    |                                     |                               |                          |  |                                      |
| (Reading lists,<br>information links etc.)    |                                     |                               |                          |  |                                      |

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| <b>Module Title:</b><br><b>Biochemical Engineering</b> |                                     |  |                          | <br>UNIVERSITÄT <b>BONN</b> |                                      |              |
| Module ID/Code:<br>MCB-EM19                            |                                     |  |                          |  |                                      |              |
| <b>1. Content and intended learning outcomes</b>       |                                     |  |                          |  |                                      |              |
| 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   |                          |  |                                      |              |
| <b>2. Teaching and learning methods</b>                |                                     |  |                          |  |                                      |              |
|  | Type of instruction                 | Topic  | Language of instruction  | Group size   | Weekly contact time                  | Workload [h] |
|  | Practical exercise                  |  | English                  |  | 40 h                                 | 150          |
|  |                                     |  |                          |  |                                      |              |
|  |                                     |  |                          |  |                                      |              |
| <b>3. Prerequisites for the module</b>                 |                                     |  |                          |  |                                      |              |
| 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  |                                     |  |                          |  |                                      |              |
| <b>4. Degree program allocation</b>                    |                                     |  |                          |  |                                      |              |
|  | Study program                       |  |                          | compulsory/<br>elective  | Semester                             |              |
|  | Molecular Cell Biology (M.Sc.)      |  |                          | elective   | 2                                    |              |
|  |                                     |  |                          |  |                                      |              |
|  |                                     |  |                          |  |                                      |              |
| <b>5. Requirements for the award of credits (ECTS)</b> |                                     |  |                          |  | <b>6. Credits</b>                    |              |
| Required achievements                                  |                                     |  |                          |  | 5 ECTS                               |              |
| Assessment (incl. weighting) and examination language  |                                     | Graded practical report in English   |                          |  |                                      |              |
| <b>7. Frequency</b>                                    |                                     |  | <b>8. Workload</b>       |  | <b>9. Duration</b>                   |              |
| Winter semester  | <input type="checkbox"/>            | Winter and summer semester   | <input type="checkbox"/> | <b>150 h</b>   | <b>3 credit hours per week (SWS)</b> |              |
| Summer semester  | <input checked="" type="checkbox"/> |  |                          |  |                                      |              |
| <b>Module coordination</b>                             |                                     |  |                          |  |                                      |              |
| Teacher  |                                     | Prof. Dr. Marco Oldiges  |                          |  |                                      |              |
| Module coordinator                                     |                                     | Prof. Dr. Marco Oldiges  |                          |  |                                      |              |
| Institute/Department                                   |                                     | Bio- and Geosciences (FZ Jülich)   |                          |  |                                      |              |
| <b>Further information</b>                             |                                     |  |                          |  |                                      |              |
| (Reading lists, information links etc.)                |                                     |  |                          |  |                                      |              |

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| <b>Module Title:</b><br><b>Fluorescent Protein-based Biosensors</b> |  |                                      |                          | <br>UNIVERSITÄT <b>BONN</b> |                     |                                      |
| Module ID/Code:<br>MCB-EM20   |  |                                      |                          |  |                     |                                      |
| <b>1. Content and intended learning outcomes</b>                    |  |                                      |                          |  |                     |                                      |
| Content   | Expression of recombinant proteins in <i>E. coli</i> ; 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 GFP-based probes for dynamic in vivo measurements of physiological parameters and for the analysis of membrane proteins  |                                      |                          |  |                     |                                      |
| <b>2. Teaching and learning methods</b>                             |  |                                      |                          |  |                     |                                      |
|   | Type of instruction  | Topic                                | Language of instruction  | Group size   | Weekly contact time | Workload [h]                         |
|   | Practical exercise   | Fluorescent Protein-based Biosensors | English                  | 4  | 40 h                | 150 h                                |
| <b>3. Prerequisites for the module</b>                              |  |                                      |                          |  |                     |                                      |
| 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   |  |                                      |                          |  |                     |                                      |
| <b>4. Degree program allocation</b>                                 |  |                                      |                          |  |                     |                                      |
|   | Study program  |                                      |                          | compulsory/<br>elective  | Semester            |                                      |
|   | Molecular Cell Biology (M.Sc.)   |                                      |                          | elective   | 3                   |                                      |
|   |  |                                      |                          |  |                     |                                      |
| <b>5. Requirements for the award of credits (ECTS)</b>              |  |                                      |                          |  | <b>6. Credits</b>   |                                      |
| Required achievements   | regular participation in the practical exercise  |                                      |                          |  | 5 ECTS              |                                      |
| Assessment (incl. weighting) and examination language               | graded practical report in English   |                                      |                          |  |                     |                                      |
| <b>7. Frequency</b>   |  |                                      | <b>8. Workload</b>       |  | <b>9. Duration</b>  |                                      |
| Winter semester   | <input type="checkbox"/>   | Winter and summer semester           | <input type="checkbox"/> | <b>150 h</b>   |                     | <b>3 credit hours per week (SWS)</b> |
| Summer semester   | <input checked="" type="checkbox"/>  |                                      |                          |  |                     |                                      |
| <b>Module coordination</b>  |  |                                      |                          |  |                     |                                      |
| Teacher   | Prof. Dr. Andreas Meyer  |                                      |                          |  |                     |                                      |
| Module coordinator  | Prof. Dr. Andreas Meyer  |                                      |                          |  |                     |                                      |
| Institute/Department  | Crop Science and Resource Conservation (Agriculture)   |                                      |                          |  |                     |                                      |
| <b>Further information</b>  |  |                                      |                          |  |                     |                                      |
| (Reading lists, information links etc.)                             |  |                                      |                          |  |                     |                                      |

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| <b>Module Title:</b><br><b>Genome Stability</b>        |  |                            |                          | <br>UNIVERSITÄT <b>BONN</b> |                                      |                   |
| Module ID/Code:<br>MCB-EM21                            |  |                            |                          |  |                                      |                   |
| <b>1. Content and intended learning outcomes</b>       |  |                            |                          |  |                                      |                   |
| Content  | The following contents will be covered by the practical: <ul style="list-style-type: none"> <li>▪ Nucleic Acid Purification</li> <li>▪ Protein Purification</li> <li>▪ Microscopic Imaging Techniques</li> <li>▪ Southern Blot analysis</li> <li>▪ Yeast genetics</li> <li>▪ Molecular cloning techniques</li> </ul> |                            |                          |  |                                      |                   |
| 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                                  |                            |                          |  |                                      |                   |
| <b>2. Teaching and learning methods</b>                |  |                            |                          |  |                                      |                   |
|  | Type of instruction  | Topic                      | Language of instruction  | Group size   | Weekly contact time                  | Workload [h]      |
|  | Practical exercise   | Telomere Biology           | English                  | 4 - 6  | 40 h                                 |                   |
| <b>3. Prerequisites for the module</b>                 |  |                            |                          |  |                                      |                   |
| 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  |  |                            |                          |  |                                      |                   |
| <b>4. Degree program allocation</b>                    |  |                            |                          |  |                                      |                   |
|  | Study program  |                            |                          | compulsory/<br>elective  | Semester                             |                   |
|  | Molecular Cell Biology (M.Sc.)   |                            |                          | elective   | 2                                    |                   |
| <b>5. Requirements for the award of credits (ECTS)</b> |  |                            |                          |  |                                      | <b>6. Credits</b> |
| Required achievements                                  | regular participation in the practical exercise  |                            |                          |  |                                      | 5 ECTS            |
| Assessment (incl. weighting) and examination language  | graded practical report in English   |                            |                          |  |                                      |                   |
| <b>7. Frequency</b>                                    |  |                            |                          | <b>8. Workload</b>   | <b>9. Duration</b>                   |                   |
| Winter semester  | <input type="checkbox"/>   | Winter and summer semester | <input type="checkbox"/> | <b>150 h</b>   | <b>3 credit hours per week (SWS)</b> |                   |
| Summer semester  | <input checked="" type="checkbox"/>  |                            |                          |  |                                      |                   |
| <b>Module coordination</b>                             |  |                            |                          |  |                                      |                   |
| Teacher  | Prof. Dr. Katrin Paeschke  |                            |                          |  |                                      |                   |
| Module coordinator                                     | Prof. Dr. Katrin Paeschke  |                            |                          |  |                                      |                   |
| Institute/Department                                   | Haematology/Oncology (Medicine)  |                            |                          |  |                                      |                   |
| <b>Further information</b>                             |  |                            |                          |  |                                      |                   |
| (Reading lists, information links etc.)                |  |                            |                          |  |                                      |                   |

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| <b>Module Title:</b><br><b>Reconstructive Neurobiology (Molecular tools for stem and developmental biology)</b><br>Module ID/Code:<br>MCB-EM22 |   | <br>UNIVERSITÄT <b>BONN</b> |                         |                         |                     |              |
| <b>1. Content and intended learning outcomes</b>   |   |  |                         |                         |                     |              |
| Content  | The following contents will be covered by the practical: <ul style="list-style-type: none"> <li>• Strategies to generate mouse models for the investigation of neurodevelopmental processes</li> <li>• Molecular mechanisms underlying neural fate determination</li> <li>• Extrinsic factor-driven differentiation and patterning</li> <li>• Forced expression of transcription factors and use of small molecules for forward programming approaches</li> <li>• Direct conversion of somatic cells into neural stem cells</li> <li>• Generation of 3D cortical organoids</li> <li>• Genetically engineered reporter gene systems for image-based phenotype analysis</li> <li>• Principles of primer design and construct engineering for setting up phenotype-specific reporter assays</li> <li>• Microscopy of 2D and 3D cultures (light sheet, bright field, high content and fluorescence)</li> <li>• Immunofluorescence imaging</li> </ul>  |  |                         |                         |                     |              |
| 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. |  |                         |                         |                     |              |
| <b>2. Teaching and learning methods</b>  |   |  |                         |                         |                     |              |
|  | 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        |
| <b>3. Prerequisites for the module</b>   |   |  |                         |                         |                     |              |
| 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  |   |  |                         |                         |                     |              |
| <b>4. Degree program allocation</b>  |   |  |                         |                         |                     |              |
|  | Study program   |  |                         | compulsory/<br>elective | Semester            |              |
|  | Molecular Cell Biology (M.Sc.)  |  |                         | elective                | 2                   |              |

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| <b>Module Title:</b><br><b>Reconstructive Neurobiology (Molecular tools for stem and developmental biology)</b><br>Module ID/Code:<br>MCB-EM22 |                                     |  |                          | <br>UNIVERSITÄT <b>BONN</b> |                                      |
|  |                                     |  |                          |  |                                      |
|  |                                     |  |                          |  |                                      |
| <b>5. Requirements for the award of credits (ECTS)</b>   |                                     |  |                          | <b>6. Credits</b>  |                                      |
| 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 |                          |  |                                      |
| <b>7. Frequency</b>  |                                     |  | <b>8. Workload</b>       |  | <b>9. Duration</b>                   |
| Winter semester  | <input type="checkbox"/>            | Winter and summer semester   | <input type="checkbox"/> | <b>150 h</b>   | <b>3 credit hours per week (SWS)</b> |
| Summer semester  | <input checked="" type="checkbox"/> |  |                          |  |                                      |
| <b>Module coordination</b>   |                                     |  |                          |  |                                      |
| Teacher  |                                     | Prof. Dr. Oliver Brüstle; Prof. Dr. Sandra Blaess                        |                          |  |                                      |
| Module coordinator   |                                     | Prof. Dr. Oliver Brüstle   |                          |  |                                      |
| Institute/Department   |                                     | Reconstructive Neurobiology (Medicine)                                   |                          |  |                                      |
| <b>Further information</b>   |                                     |  |                          |  |                                      |
| (Reading lists, information links etc.)  |                                     |  |                          |  |                                      |

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| <b>Module Title:</b><br><b>Applications of Crispr/Cas to study neuronal function</b> |                                     |  |                          | <br>UNIVERSITÄT <b>BONN</b> |                                      |                   |
| Module ID/Code:<br>MCB-EM23  |                                     |  |                          |  |                                      |                   |
| <b>1. Content and intended learning outcomes</b>                                     |                                     |  |                          |  |                                      |                   |
| Content  |                                     | The following contents will be covered by the course: <ul style="list-style-type: none"> <li>• Crispr/Cas background (lecture)</li> <li>• Crispr/Cas applications in neurobiological research (lecture)</li> <li>• Generation and application of viral vectors (lecture)</li> <li>• Design of Crispr/Cas vectors (practical)</li> <li>• Preparation of viral vectors (practical)</li> <li>• Cell culture (practical)</li> <li>• Analysis of cells edited with Crispr/Cas (fluorescence imaging, multi-electrode array recordings, time lapse imaging, luciferase) (practical)</li> </ul> |                          |  |                                      |                   |
| 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.  |                          |  |                                      |                   |
| <b>2. Teaching and learning methods</b>  |                                     |  |                          |  |                                      |                   |
|  | 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                |
| <b>3. Prerequisites for the module</b>   |                                     |  |                          |  |                                      |                   |
| 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  |                                     |  |                          |  |                                      |                   |
| <b>4. Degree program allocation</b>  |                                     |  |                          |  |                                      |                   |
|  | Study program                       |  |                          | compulsory/<br>elective  | Semester                             |                   |
|  | Molecular Cell Biology (M.Sc.)      |  |                          | elective   | 2                                    |                   |
| <b>5. Requirements for the award of credits (ECTS)</b>                               |                                     |  |                          |  |                                      | <b>6. Credits</b> |
| 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  |                          |  |                                      |                   |
| <b>7. Frequency</b>  |                                     |  |                          | <b>8. Workload</b>   | <b>9. Duration</b>                   |                   |
| Winter semester  | <input type="checkbox"/>            | Winter and summer semester   | <input type="checkbox"/> | <b>150 h</b>   | <b>3 credit hours per week (SWS)</b> |                   |
| Summer semester  | <input checked="" type="checkbox"/> |  |                          |  |                                      |                   |
| <b>Module coordination</b>   |                                     |  |                          |  |                                      |                   |
| Teacher  |                                     | Prof. Dr. Ina Vorberg (DZNE)<br>Prof. Dr. Susanne Schoch McGovern (Neuropathology)   |                          |  |                                      |                   |
| Module coordinator   |                                     | Prof. Dr. Ina Vorberg, Prof. Dr. Susanne Schoch McGovern   |                          |  |                                      |                   |
| Institute/Department   |                                     | Neuropathology (Medicine)  |                          |  |                                      |                   |
| <b>Further information</b>   |                                     |  |                          |  |                                      |                   |
| (Reading lists, information links etc.)  |                                     |  |                          |  |                                      |                   |

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| <b>Module Title:</b><br><b>Methods in Developmental- and Tumorpathology</b> |  |  |                          | <br>UNIVERSITÄT <b>BONN</b> |                     |                                      |
| Module ID/Code:<br>MCB-EM24   |  |  |                          |  |                     |                                      |
| <b>1. Content and intended learning outcomes</b>                            |  |  |                          |  |                     |                                      |
| 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 <i>in situ</i> 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  |  |                          |  |                     |                                      |
| <b>2. Teaching and learning methods</b>                                     |  |  |                          |  |                     |                                      |
|   | 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                                 |
| <b>3. Prerequisites for the module</b>                                      |  |  |                          |  |                     |                                      |
| 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   |  |  |                          |  |                     |                                      |
| <b>4. Degree program allocation</b>   |  |  |                          |  |                     |                                      |
|   | Study program  |  |                          | compulsory/<br>elective  | Semester            |                                      |
|   | Molecular Cell Biology (M.Sc.)   |  |                          | elective   | 2                   |                                      |
|   |  |  |                          |  |                     |                                      |
| <b>5. Requirements for the award of credits (ECTS)</b>                      |  |  |                          |  | <b>6. Credits</b>   |                                      |
| Required achievements   | regular participation in the practical exercise  |  |                          |  |                     | 5 ECTS                               |
| Assessment (incl. weighting) and examination language                       | graded practical report in English   |  |                          |  |                     |                                      |
| <b>7. Frequency</b>   |  |  | <b>8. Workload</b>       |  | <b>9. Duration</b>  |                                      |
| Winter semester   | <input type="checkbox"/>   | Winter and summer semester                   | <input type="checkbox"/> | <b>150 h</b>   |                     | <b>3 credit hours per week (SWS)</b> |
| Summer semester   | <input checked="" type="checkbox"/>  |  |                          |  |                     |                                      |
| <b>Module coordination</b>  |  |  |                          |  |                     |                                      |
| Teacher   | Prof. Dr. Hubert Schorle   |  |                          |  |                     |                                      |
| Module coordinator  | Prof. Dr. Hubert Schorle   |  |                          |  |                     |                                      |
| Institute/Department  | Pathology (Medicine)   |  |                          |  |                     |                                      |
| <b>Further information</b>  |  |  |                          |  |                     |                                      |
| (Reading lists, information links etc.)                                     |  |  |                          |  |                     |                                      |

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| <b>Module Title:</b><br><b>Molecular Haematology</b><br>Module ID/Code:<br>MCB-EM25 |  |  |                          | <br><b>UNIVERSITÄT BONN</b> |                                      |                   |
| <b>1. Content and intended learning outcomes</b>                                    |  |  |                          |  |                                      |                   |
| Content   | <ul style="list-style-type: none"> <li>- Identification of patients coagulation disorders:             <ul style="list-style-type: none"> <li>a. Coagulation assays (e.g. whole blood and plasma-based global coagulation assays, detection of coagulation factor inhibiting antibodies)</li> <li>b. DNA preparation from blood, PCR, Sanger sequencing and analysis</li> </ul> </li> <li>- Investigation of the identified mutation by several strategies in order to characterize the phenotype:             <ul style="list-style-type: none"> <li>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)</li> <li>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</li> <li>c. Protein modelling of wild-type and mutated protein</li> </ul> </li> </ul> |  |                          |  |                                      |                   |
| 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.  |  |                          |  |                                      |                   |
| <b>2. Teaching and learning methods</b>   |  |  |                          |  |                                      |                   |
|   | 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              |
| <b>3. Prerequisites for the module</b>  |  |  |                          |  |                                      |                   |
| 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   |  |  |                          |  |                                      |                   |
| <b>4. Degree program allocation</b>   |  |  |                          |  |                                      |                   |
|   | Study program  |  |                          | compulsory/<br>elective  | Semester                             |                   |
|   | Molecular Cell Biology (M.Sc.)   |  |                          | elective   |                                      |                   |
| <b>5. Requirements for the award of credits (ECTS)</b>                              |  |  |                          |  |                                      | <b>6. Credits</b> |
| Required achievements   | regular participation in the practical exercise  |  |                          |  |                                      | 5 ECTS            |
| Assessment (incl. weighting) and examination language                               | graded practical report in English   |  |                          |  |                                      |                   |
| <b>7. Frequency</b>   |  |  |                          | <b>8. Workload</b>   | <b>9. Duration</b>                   |                   |
| Winter semester   | <input type="checkbox"/>   | Winter and summer semester                 | <input type="checkbox"/> | <b>150 h</b>   | <b>3 credit hours per week (SWS)</b> |                   |
| Summer semester   | <input checked="" type="checkbox"/>  |  |                          |  |                                      |                   |

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| <b>Module Title:</b><br><b>Molecular Haematology</b> |  | <br>UNIVERSITÄT <b>BONN</b> |
| Module ID/Code:<br>MCB-EM25                          |  |  |
| <b>Module coordination</b>                           |  |  |
| Teacher  | Dr. Katrin Czogalla-Nitsche                                  |  |
| Module coordinator                                   | Prof. Dr. Johannes Oldenburg                                 |  |
| Institute/Department                                 | Experimental Haematology and Transfusion Medicine (Medicine) |  |
| <b>Further information</b>                           |  |  |
| (Reading lists,<br>information links etc.)           |  |  |

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| <b>Module Title:</b><br><b>Rotation 1</b>              |  | <br>UNIVERSITÄT <b>BONN</b> |                          |                         |                     |              |
| Module ID/Code:<br>MCB-EM91                            |  |  |                          |                         |                     |              |
| <b>1. Content and intended learning outcomes</b>       |  |  |                          |                         |                     |              |
| 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   |  |                          |                         |                     |              |
| <b>2. Teaching and learning methods</b>                |  |  |                          |                         |                     |              |
|  | Type of instruction  | Topic  | Language of instruction  | Group size              | Weekly contact time | Workload [h] |
|  | Practical exercise   | individual   | English                  | individual              | 40 h                | 240          |
| <b>3. Prerequisites for the module</b>                 |  |  |                          |                         |                     |              |
| 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  |  |  |                          |                         |                     |              |
| <b>4. Degree program allocation</b>                    |  |  |                          |                         |                     |              |
|  | Study program  |  |                          | compulsory/<br>elective | Semester            |              |
|  | Molecular Cell Biology (M.Sc.)   |  |                          | elective                |                     |              |
|  |  |  |                          |                         |                     |              |
|  |  |  |                          |                         |                     |              |
| <b>5. Requirements for the award of credits (ECTS)</b> |  |  |                          |                         | <b>6. Credits</b>   |              |
| Required achievements                                  |  |  |                          |                         |                     | 8 ECTS       |
| Assessment (incl. weighting) and examination language  |  |  |                          |                         |                     |              |
| <b>7. Frequency</b>                                    |  |  | <b>8. Workload</b>       |                         | <b>9. Duration</b>  |              |
| Winter semester  | <input checked="" type="checkbox"/>  | Winter and summer semester   | <input type="checkbox"/> | <b>240 h</b>            |                     |              |
| Summer semester  | <input type="checkbox"/>   |  |                          |                         |                     |              |
| <b>Module coordination</b>                             |  |  |                          |                         |                     |              |
| Teacher  | Teachers of the program  |  |                          |                         |                     |              |
| Module coordinator                                     | Dr. Karl Peter Linscheid   |  |                          |                         |                     |              |
| Institute/Department                                   | Molecular Physiology and Biotechnology of Plants (Biology)   |  |                          |                         |                     |              |
| <b>Further information</b>                             |  |  |                          |                         |                     |              |
| (Reading lists, information links etc.)                |  |  |                          |                         |                     |              |

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| <b>Module Title:</b><br><b>Rotation 2</b>              |  | <br>UNIVERSITÄT <b>BONN</b> |                          |                         |                     |                      |
| Module ID/Code:<br>MCB-EM92                            |  |  |                          |                         |                     |                      |
| <b>1. Content and intended learning outcomes</b>       |  |  |                          |                         |                     |                      |
| 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   |  |                          |                         |                     |                      |
| <b>2. Teaching and learning methods</b>                |  |  |                          |                         |                     |                      |
|  | Type of instruction  | Topic  | Language of instruction  | Group size              | Weekly contact time | Workload [h]         |
|  | Practical exercise   | individual   | English                  | individual              | 40 h                | 240                  |
| <b>3. Prerequisites for the module</b>                 |  |  |                          |                         |                     |                      |
| 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  |  |  |                          |                         |                     |                      |
| <b>4. Degree program allocation</b>                    |  |  |                          |                         |                     |                      |
|  | Study program  |  |                          | compulsory/<br>elective | Semester            |                      |
|  | Molecular Cell Biology (M.Sc.)   |  |                          | elective                |                     |                      |
| <b>5. Requirements for the award of credits (ECTS)</b> |  |  |                          |                         |                     |                      |
| Required achievements                                  |  |  |                          |                         |                     | 6. Credits<br>8 ECTS |
| Assessment (incl. weighting) and examination language  |  |  |                          |                         |                     |                      |
| <b>7. Frequency</b>                                    |  |  | <b>8. Workload</b>       |                         | <b>9. Duration</b>  |                      |
| Winter semester  | <input checked="" type="checkbox"/>  | Winter and summer semester   | <input type="checkbox"/> |                         |                     |                      |
| Summer semester  | <input type="checkbox"/>   |  |                          |                         |                     |                      |
| <b>Module coordination</b>                             |  |  |                          |                         |                     |                      |
| Teacher  | Teachers of the program as teachers and/or examiners   |  |                          |                         |                     |                      |
| Module coordinator                                     | Dr. Karl Peter Linscheid   |  |                          |                         |                     |                      |
| Institute/Department                                   | Molecular Physiology and Biotechnology of Plants (Biology)   |  |                          |                         |                     |                      |
| <b>Further information</b>                             |  |  |                          |                         |                     |                      |
| (Reading lists, information links etc.)                |  |  |                          |                         |                     |                      |

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| <b>Module Title:</b><br><b>Project/Exchange</b>        |                                     |  |                          | <br>UNIVERSITÄT <b>BONN</b> |                     |                              |
| Module ID/Code:<br>MCB-PE                              |                                     |  |                          |  |                     |                              |
| <b>1. Content and intended learning outcomes</b>       |                                     |  |                          |  |                     |                              |
| Content  |                                     |  |                          |  |                     |                              |
| Learning outcomes                                      |                                     |  |                          |  |                     |                              |
| <b>2. Teaching and learning methods</b>                |                                     |  |                          |  |                     |                              |
|  | Type of instruction                 | Topic  | Language of instruction  | Group size   | Weekly contact time | Workload [h]                 |
|  | Practical                           | Project/Exchange, individual   | English                  | Individual   | 40                  | 360                          |
| <b>3. Prerequisites for the module</b>                 |                                     |  |                          |  |                     |                              |
| compulsory   |                                     | Successful participation in basic modules MCB-P1 - MCB-P5, MCB-MBC, and MCB-XM; min. 60 credit points accumulated from previous examinations |                          |  |                     |                              |
| recommended  |                                     |  |                          |  |                     |                              |
| <b>4. Degree program allocation</b>                    |                                     |  |                          |  |                     |                              |
|  | Study program                       |  |                          | compulsory/<br>elective  | Semester            |                              |
|  | Molecular Cell Biology (M.Sc.)      |  |                          | elective   | 3                   |                              |
| <b>5. Requirements for the award of credits (ECTS)</b> |                                     |  |                          |  |                     |                              |
| Required achievements                                  |                                     |  |                          |  |                     | <b>6. Credits</b><br>12 ECTS |
| Assessment (incl. weighting) and examination language  |                                     |  |                          |  |                     |                              |
| <b>7. Frequency</b>                                    |                                     |  | <b>8. Workload</b>       |  | <b>9. Duration</b>  |                              |
| Winter semester  | <input checked="" type="checkbox"/> | Winter and summer semester   | <input type="checkbox"/> | <b>360 h</b>   |                     |                              |
| Summer semester  | <input type="checkbox"/>            |  |                          |  |                     |                              |
| <b>Module coordination</b>                             |                                     |  |                          |  |                     |                              |
| Teacher  |                                     | Teachers of the program  |                          |  |                     |                              |
| Module coordinator                                     |                                     | Dr. Karl Peter Linscheid   |                          |  |                     |                              |
| Institute/Department                                   |                                     | Molecular Physiology and Biotechnology of Plants (Biology)   |                          |  |                     |                              |
| <b>Further information</b>                             |                                     |  |                          |  |                     |                              |
| (Reading lists, information links etc.)                |                                     |  |                          |  |                     |                              |

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| <b>Module Title:</b><br><b>Master Thesis</b><br>Module ID/Code:<br>MCB-MT |   | <br><b>UNIVERSITÄT BONN</b> |                          |                         |                     |                   |
| <b>1. Content and intended learning outcomes</b>                          |   |  |                          |                         |                     |                   |
| 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.   |  |                          |                         |                     |                   |
| <b>2. Teaching and learning methods</b>                                   |   |  |                          |                         |                     |                   |
|   | 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                |
| <b>3. Prerequisites for the module</b>                                    |   |  |                          |                         |                     |                   |
| compulsory  | Successful participation in basic modules MCB-P1 - MCB-P5, MCB-MBC, and MCB-XM; min. 78 credit points accumulated from previous examinations  |  |                          |                         |                     |                   |
| recommended   |   |  |                          |                         |                     |                   |
| <b>4. Degree program allocation</b>                                       |   |  |                          |                         |                     |                   |
|   | Study program   |  |                          | compulsory/<br>elective | Semester            |                   |
|   | Molecular Cell Biology  |  |                          | compulsory              | 4                   |                   |
| <b>5. Requirements for the award of credits (ECTS)</b>                    |   |  |                          |                         |                     | <b>6. Credits</b> |
| 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   |  |                          |                         |                     |                   |
| <b>7. Frequency</b>   |   |  | <b>8. Workload</b>       |                         | <b>9. Duration</b>  |                   |
| Winter semester   | <input type="checkbox"/>  | Winter and summer semester   | <input type="checkbox"/> | <b>900 h</b>            |                     |                   |
| Summer semester   | <input type="checkbox"/>  |  |                          |                         |                     |                   |
| <b>Module coordination</b>  |   |  |                          |                         |                     |                   |
| Teacher   | Postdoctoral (habilitated) teachers of the program  |  |                          |                         |                     |                   |
| Module coordinator  | Prof. Dr. Walter Witke  |  |                          |                         |                     |                   |
| Institute/Department  | Genetics (Biology)  |  |                          |                         |                     |                   |
| <b>Further information</b>  |   |  |                          |                         |                     |                   |
| (Reading lists, information links etc.)                                   | Rogers (2007): Mastering Scientific and Medical Writing. Springer, Berlin, Heidelberg<br><a href="https://rd.springer.com/book/10.1007/978-3-540-34508-4">https://rd.springer.com/book/10.1007/978-3-540-34508-4</a>  |  |                          |                         |                     |                   |