

Schwerpunktmodule II

Modul- und Veranstaltungshandbuch

für den Studiengang M.Sc. Biologie

Fakultät für Biologie an der

Albert-Ludwigs-Universität Freiburg



UNI
FREIBURG



Inhaltsverzeichnis

| | |
|--|----------|
| Prolog | 3 |
| Schwerpunktmodule II (SP2) - PO 2013..... | 4 |
| SP2-01 Advanced Immunobiology II..... | 5 |
| SP2-02 Microbiology..... | 11 |
| SP2-03 Aktuelle Methoden der Bionik / Biomechanik..... | 17 |
| SP2-04 Computational Neuroscience and Neurotechnology..... | 23 |
| SP2-05 Developmental Neurobiology..... | 31 |
| SP2-06 Functional Proteomics and Biochemistry..... | 40 |
| SP2-07 Developmental Biology..... | 48 |
| SP2-08 Advanced molecular genetics of eukaryotic organisms..... | 56 |
| SP2-09 Experiments in Evolutionary Biology & Functional Ecology..... | 61 |
| SP2-10 Plant Biotechnology..... | 68 |
| SP2-11 Spezielle Themen der Pflanzenwissenschaften..... | 73 |
| SP2-12 Synthetic Biology and Biochemistry..... | 82 |
| SP2-13 Molecular Genetics and Signalling in Prokaryotic Organisms..... | 89 |
| SP2-14 Neurophysiology..... | 95 |
| SP2-16 Neurogenetics..... | 110 |
| SP2-17 Genetics and Experimental Bioinformatics | 119 |
| SP2-18 Chemical and Molecular Cell Biology..... | 125 |

Prolog

Der M.Sc. Studiengang bietet ein vertiefte Ausbildung in Biologie mit einem weiten Themenspektrum, das die gesamte Breite der Forschungsrichtungen der Freiburger Fakultät für Biologie wider spiegelt. Dieses Spektrum beinhaltet sowohl die organismische Vielfalt der Untersuchungsobjekte als auch die verschiedenen Betrachtungs- und Komplexitätsebenen der Biowissenschaft (von molekularen Strukturen über Zellen, Gewebe und Organe zu Organismen, Ökosystemen und komplexen Evolutionsprozessen).

Der Master ist forschungsorientiert und leitet insbesondere zum experimentellen wissenschaftlichen Arbeiten an. Wahlmodule erlauben einerseits, dem Studium ein eigenes Profil zu geben. Andererseits besteht die attraktive Möglichkeit zur Spezialisierung in einem der folgenden Schwerpunkte:

- Angewandte Biowissenschaften
- Genetik und Entwicklungsbiologie
- Immunbiologie
- Biochemie und Mikrobiologie
- Neurowissenschaften
- Pflanzenwissenschaften
- Ökologie und Evolutionsbiologie

Das erste Semester dient der Orientierung. Aus sieben Orientierungsmodulen, die in jeweils einen der Schwerpunkte einführen, sind drei Module zu wählen. Einer der Schwerpunkte wird im weiteren Studium zum Hauptfach.

Im zweiten Semester setzt sich die Spezialisierung durch die Wahl des Hauptfaches fort. Es sind ein Pflichtmodul (Schwerpunktmodul I) und ein Wahlmodul aus dem Angebot des jeweiligen Schwerpunktes zu belegen, ein weiteres Wahlmodul ist frei wählbar. Das Schwerpunktmodul I gibt einen vertieften Einblick in das gewählte Hauptfach. Es hat vor allem methodischen Charakter und baut auf den Inhalten des Orientierungsmoduls auf. Die Wahlmodule A spiegeln die vielfältigen Teildisziplinen innerhalb der Schwerpunkte wider. Wahlmodul B kann aus einem beliebigen Schwerpunkt der Biologie, aus dem Lehrangebot anderer Fakultäten oder Hochschulen gewählt werden oder ist als berufsbezogenes Praktikum zu absolvieren.

Im dritten Semester wird der jeweilige Schwerpunkt durch Schwerpunktmodul II weiter vertieft. Auch hier gibt es Wahlmöglichkeiten zur individuellen Studiengestaltung. Die Schwerpunktmodule II sind im praktischen Teil forschungsnah konzipiert. Das Projektmodul am Ende des dritten Semesters bereitet auf die Masterarbeit vor, die im vierten Semester im gewählten Schwerpunkt anzufertigen ist.

Der zweijährige Studiengang beginnt jeweils zum Wintersemester.

| Name des Kontos | Nummer des Kontos |
|--------------------------------------|-------------------|
| Schwerpunktmodule II (SP2) - PO 2013 | |
| Fachbereich / Fakultät | |
| | |

| | |
|----------------------------|-----------------------|
| Pflicht/Wahlpflicht (P/WP) | Wahlpflicht |
| ECTS-Punkte | 21,0 |
| Benotung | A- Berechnung 1 NachK |
| Empfohlenes Fachsemester | 3 |

| Kommentar |
|--|
| Dieses Modulhandbuch enthält die Modulbeschreibungen für die Schwerpunktmodule II im 3. Fachsemester des M.Sc. Biologie. Die Studierenden müssen ein Schwerpunktmodul II aus dem von ihnen gewählten Schwerpunkt wählen. Das Schwerpunktmodul II umfasst das komplette 3. Fachsemester und geht direkt über in das auf die Master-Arbeit vorbereitende 3-wöchige Projektmodul. In den Modulbeschreibungen können Sie unter "Verwendbarkeit" nachlesen, welche Schwerpunktmodule II für Ihren Schwerpunkt angeboten werden. |

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| Modulname | Nummer |
|----------------------------------|----------------|
| SP2-01 Advanced Immunobiology II | 09LE03M-SP2-01 |
| Modulverantwortliche/r | |
| Prof. Dr. Michael Reth | |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 21.0 |
| Semesterwochenstunden (SWS) | 17.0 |
| Empfohlenes Fachsemester | 3 |
| Moduldauer | 1 |
| Pflicht/Wahlpflicht (P/WP) | Wahlpflicht |
| Präsenzstudium | 255 Stunden |
| Selbststudium | 375 Stunden |
| Workload | 630 Stunden |
| Angebotsfrequenz | nur im Wintersemester |

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|---|
| Teilnahmevoraussetzung |
| <ul style="list-style-type: none"> ■ OM-03 ■ SP1-03 |
| Empfohlene Voraussetzung |
| WM-04, WM-06, WM-23 or WM-27 |

| | | | | | |
|--------------------------------|---------|---------|------|-------|-------------|
| Zugehörige Veranstaltungen | | | | | |
| Name | Art | P/WP | ECTS | SWS | Workload |
| Advanced Methods in Immunology | Übung | Pflicht | 18.0 | 15.00 | 540 Stunden |
| Immunological Seminars | Seminar | Pflicht | 3.0 | 2.00 | 90 Stunden |

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|---|
| Qualifikationsziel |
| <p>The students are able to:</p> <ul style="list-style-type: none"> ■ use their knowledge and immunological theory to design experiments and develop scientific hypotheses ■ perform and document experiments on a current research topic in the field of molecular, cellular, clinic, synthetic immunology or virology ■ present, evaluate and discuss results from own experimental studies. ■ instruct less advanced students in performing experiments using immunological techniques ■ instruct less advanced students in reading, interpreting and presenting original immunological research papers |
| Zu erbringende Prüfungsleistung |
| final written report |

Zu erbringende Studienleistung

- self-motivated work on the chosen research project
- active discussion and thorough documentation of experimental work
- presentation of results to other members of the lab
- supervision of experimental work

Benotung

final written report

Literatur

Will be provided individually.

Verwendbarkeit der Veranstaltung

M.Sc. Biology, Major Immunobiology

↑

| Modulname | Nummer |
|--|---------------------|
| SP2-01 Advanced Immunobiology II | 09LE03M-SP2-01 |
| Veranstaltung | |
| Advanced Methods in Immunology | |
| Veranstaltungsart | Nummer |
| Übung | 09LE03Ü-SP2-01_0001 |
| Veranstalter | |
| Institut für Biologie 3, Professur für Immunologie | |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 18.0 |
| Semesterwochenstunden (SWS) | 15.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | englisch |
| Präsenzstudium | 225 Stunden |
| Selbststudium | 315 Stunden |
| Workload | 540 Stunden |

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| Inhalte |
| The students will experimentally work in the laboratory on a state-of-the-art scientific objective in one of the following topics: |
| <ul style="list-style-type: none"> ■ molecular or synthetic immunology ■ cellular or clinic immunology ■ virology ■ Further, the students will supervise a practical course in the Bachelor or Master curriculum in the field of immunobiology. |
| Qualifikationsziel |
| The students are able to: |
| <ul style="list-style-type: none"> ■ use their knowledge and immunological theory to design experiments and develop scientific hypotheses ■ perform and document experiments on a current research topic in the field of molecular, cellular, clinic, synthetic immunology or virology ■ present, evaluate and discuss results from own experimental studies. ■ instruct less advanced students in performing experiments using immunological techniques |
| Zu erbringende Prüfungsleistung |
| final written report |

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|--|
| Zu erbringende Studienleistung |
| <ul style="list-style-type: none">■ self-motivated work on the chosen research project■ active discussion and thorough■ documentation of experimental work■ presentation of results to other members of the lab■ supervision of experimental work |
| Literatur |
| Will be provided individually. |
| Zwingende Voraussetzung |
| s. Modulebene |
| Lehrmethoden |
| <ul style="list-style-type: none">■ close supervision of research work conducted individually or in groups of 2-3 depending on the number of participants by the assigned group leader■ weekly group meeting for presentation and discussion of methods, experimental problems and results■ media: board, PowerPoint presentations |

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| Modulname | Nummer |
|--|---------------------|
| SP2-01 Advanced Immunobiology II | 09LE03M-SP2-01 |
| Veranstaltung | |
| Immunological Seminars | |
| Veranstaltungsart | Nummer |
| Seminar | 09LE03S-SP2-01_0002 |
| Veranstalter | |
| Institut für Biologie 3, Professur für Immunologie | |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 3.0 |
| Semesterwochenstunden (SWS) | 2.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | englisch |
| Präsenzstudium | 30 Stunden |
| Selbststudium | 60 Stunden |
| Workload | 90 Stunden |

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| Inhalte |
| The students will read and discuss current scientific literature on the following topics: |
| <ul style="list-style-type: none"> ■ molecular or synthetic immunology ■ cellular or clinic immunology ■ virology ■ Further, the students will supervise seminar presentations in the Bachelor or Master curriculum in the field of immunobiology. |
| Qualifikationsziel |
| The students are able to: |
| <ul style="list-style-type: none"> ■ search literature databases ■ plan and design a scientific talk in form of a power point presentation ■ obtain experience in giving didactically good seminars ■ instruct less advanced students in reading, interpreting and presenting original immunological research papers |
| Zu erbringende Prüfungsleistung |
| none |

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| Zu erbringende Studienleistung |
| <ul style="list-style-type: none">■ self-motivated work on the chosen research project■ active discussion and thorough■ presentation of relevant literature to other members of the lab■ supervision of experimental work |
| Literatur |
| Will be provided individually. |
| Zwingende Voraussetzung |
| s. Modulebene |
| Lehrmethoden |
| Discussion in plenum and individually media: board, PowerPoint presentations |

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| Modulname | Nummer |
|-------------------------|----------------|
| SP2-02 Microbiology | 09LE03M-SP2-02 |
| Modulverantwortliche/r | |
| Prof. Dr. Matthias Boll | |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 21.0 |
| Semesterwochenstunden (SWS) | 17.0 |
| Empfohlenes Fachsemester | 3 |
| Moduldauer | 1 |
| Pflicht/Wahlpflicht (P/WP) | Wahlpflicht |
| Präsenzstudium | 255 Stunden |
| Selbststudium | 375 Stunden |
| Workload | 630 Stunden |
| Angebotsfrequenz | nur im Wintersemester |

| Teilnahmevoraussetzung |
|------------------------|
| ■ OM-04 |
| ■ SP1-04 |

| Zugehörige Veranstaltungen | | | | | |
|--------------------------------------|---------|---------|------|-------|-------------|
| Name | Art | P/WP | ECTS | SWS | Workload |
| Current Topics in Microbial Sciences | Seminar | Pflicht | 3.0 | 2.00 | 90 Stunden |
| Methods in Microbial Sciences | Übung | Pflicht | 18.0 | 15.00 | 540 Stunden |

| Qualifikationsziel |
|---|
| The students are able to |
| <ul style="list-style-type: none"> ■ design, perform and document experiments on a current research topic in the field of microbial biochemistry, microbial molecular biology, microbial cellular biology or microbial ecology ■ present, evaluate and discuss results from own experimental studies. ■ present and discuss results from research topics related to that of the own experimental study |
| Zu erbringende Prüfungsleistung |
| <ul style="list-style-type: none"> ■ Comprehensive protocol (~20 pages): 50% ■ Seminar talk (30 min) about own experimental work plus extended discussion (15-30 min) about the research field: 50% |

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| Zu erbringende Studienleistung |
| <ul style="list-style-type: none">■ Comprehensive protocol (~20 pages) of own experimental work■ Seminar talk (30 min) about own experimental work■ Seminar talk (30 min) about related work on the topic |
| Benotung |
| Comprehensive protocol (~20 pages): 50% Seminar talk (30 min) about own experimental work plus extended discussion (15-30 min) about the research field: 50% |
| Literatur |
| Selected literature of the individual research topic (original articles, reviews, PhD/Master thesis etc.) |
| Verwendbarkeit der Veranstaltung |
| M.Sc. Biology, Major Biochemistry & Microbiology |

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| Modulname | Nummer |
|--------------------------------------|---------------------|
| SP2-02 Microbiology | 09LE03M-SP2-02 |
| Veranstaltung | |
| Current Topics in Microbial Sciences | |
| Veranstaltungsart | Nummer |
| Seminar | 09LE03S-SP2-02_0002 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 3.0 |
| Semesterwochenstunden (SWS) | 2.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | deutsch oder englisch |
| Präsenzstudium | 30 Stunden |
| Selbststudium | 60 Stunden |
| Workload | 90 Stunden |

| Inhalte |
|---|
| The students will present a seminar talk on a current scientific topic related to: <ul style="list-style-type: none"> ■ Catabolic and anabolic pathways in <i>archaea</i> and bacteria ■ Bioenergy, microbial energy metabolism ■ Degradation of pollutants/bioremediation strategies ■ Characteristic microbial enzymes involved in metabolism, cellular function, host-symbiont interactions (microbial) ■ Microbial symbiosis and intracellular bacteria ■ Taxonomy and phylogeny of ‘uncultivable’ microorganisms ■ Function and assembly of molecular machines involved in microbial movement ■ Signaling in microorganisms |
| Qualifikationsziel |
| The students are able to: <ul style="list-style-type: none"> ■ present and discuss results from research topics related to that of the own experimental study and others. ■ search literature in databases ■ plan and design a scientific talk in form of a power point presentation |
| Zu erbringende Prüfungsleistung |
| none |
| Zu erbringende Studienleistung |
| <ul style="list-style-type: none"> ■ Attendance of seminar talks (at least 90%) ■ Own seminar talk (30 min+discussion) |

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|---|
| Literatur |
| Selected literature of the individual research topic (original articles, reviews, PhD/Master thesis etc.) |
| Zwingende Voraussetzung |
| s. Modulebene |
| Lehrmethoden |
| Powerpoint-presentation, handout, discussion in plenum |

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| Modulname | Nummer |
|-------------------------------|---------------------|
| SP2-02 Microbiology | 09LE03M-SP2-02 |
| Veranstaltung | |
| Methods in Microbial Sciences | |
| Veranstaltungsart | Nummer |
| Übung | 09LE03Ü-SP2-02_0001 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 18.0 |
| Semesterwochenstunden (SWS) | 15.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | deutsch oder englisch |
| Präsenzstudium | 225 Stunden |
| Selbststudium | 315 Stunden |
| Workload | 540 Stunden |

| Inhalte |
|--|
| The students will experimentally work in the laboratory on a current scientific objective in various topics of microbiology: <ul style="list-style-type: none"> ■ Genes and enzymes involved in the degradation pathways of pollutants (aromatics, organohalides, steroids and other endocrine disruptors, crude oil components, etc.) ■ Molecular tools for monitoring degradation pathways in the environment ■ Novel enzymes for biotechnological applications ■ Novel aspects of energy metabolism in anaerobes ■ Genetics in Archaea ■ Motility in halophilic and thermophilic archaea ■ Signaling in Archaea ■ Biofilm formation of Archaea ■ DNA transport in Archaea and Bacteria ■ Detection and characterization of intracellular bacteria and their host ■ Genomics and transcriptomics of intracellular bacteria and their host ■ Functional analyses of symbioses ■ Signaling in microorganisms |
| Qualifikationsziel |
| The students are able to: <ul style="list-style-type: none"> ■ identify and describe state of the art research objectives in microbial research ■ plan, design, perform and document experiments on a current research topic in the field of microbial biochemistry, microbial molecular biology, microbial cellular biology or microbial ecology ■ present, evaluate and discuss results from own experimental studies and integrate them in state of the art of the research field |

Zu erbringende Prüfungsleistung

- Written scientific protocol of experimental work (~20 pages): 50%
- Seminar talk (30 min) about own experimental work plus extended discussion about the research field: 50%

Zu erbringende Studienleistung

- Experimental work in laboratories
- Comprehensive protocol (~20 pages) of own experimental work
- Seminar talk (30 min) about own experimental work

Literatur

Selected literature of the individual research topic (original articles, reviews, PhD/Master thesis etc.)

Zwingende Voraussetzung

s. Modulebene

Lehrmethoden

Experimental work in research laboratories, teamwork, protocols, power-point-presentation, handout



| Modulname | Nummer |
|---|----------------|
| SP2-03 Aktuelle Methoden der Bionik / Biomechanik | 09LE03M-SP2-03 |
| Modulverantwortliche/r | |
| Prof. Dr. Thomas Speck | |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 21.0 |
| Semesterwochenstunden (SWS) | 17.7 |
| Empfohlenes Fachsemester | 3 |
| Moduldauer | 1 |
| Pflicht/Wahlpflicht (P/WP) | Wahlpflicht |
| Präsenzstudium | 265 Stunden |
| Selbststudium | 365 Stunden |
| Workload | 630 Stunden |
| Angebotsfrequenz | nur im Wintersemester |

| Teilnahmevoraussetzung |
|------------------------|
| ■ OM-01 and/or OM-06 |
| ■ SP1-01 or SP1-06 |

| Zugehörige Veranstaltungen | | | | | |
|---|-----------|---------|------|-------|-------------|
| Name | Art | P/WP | ECTS | SWS | Workload |
| Bionik | Vorlesung | | 1.4 | 1.40 | 42 Stunden |
| Laborprojekt "Funktionelle Morphologie und Biomechanik" | Übung | Pflicht | 19.6 | 16.30 | 588 Stunden |

| Qualifikationsziel |
|--|
| Die Studierenden können: |
| ■ die grundlegenden Ansätze und Methoden der Bionik erklären |
| ■ die verschiedenen Fachbereiche der Bionik definieren |
| ■ Wissen aus verschiedenen Disziplinen (Morphologie, Anatomie, Biomechanik) integrieren um Beispiele der Bionik vom biologischen Vorbild bis zur technischen Anwendung zu erklären |
| ■ mindestens eine experimentelle Methode biomechanischer Forschung selbständig anwenden |
| Zu erbringende Prüfungsleistung |
| ■ Protokoll zum Laborprojekt (60%) |
| ■ mündliche Präsentation (40%) |

| |
|---|
| Zu erbringende Studienleistung |
| <ul style="list-style-type: none">■ mindestens 90 % Anwesenheit■ aktive Teilnahme■ Führung eines Laborbuches■ Verfassen eines Protokolls zum Laborprojekt nach wissenschaftlichem Standard |
| Benotung |
| <ul style="list-style-type: none">■ Protokoll zum Laborprojekt (60%)■ mündliche Präsentation (40%) |
| Literatur |
| Publikationen, je nach Thema des Laborprojektes. |
| Verwendbarkeit der Veranstaltung |
| M.Sc. Biologie, Angewandte Biowissenschaften und Pflanzenwissenschaften |

↑

| Modulname | Nummer |
|---|---------------------|
| SP2-03 Aktuelle Methoden der Bionik / Biomechanik | 09LE03M-SP2-03 |
| Veranstaltung | |
| Bionik | |
| Veranstaltungsart | Nummer |
| Vorlesung | 09LE03V-SP2-03_0001 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 1.4 |
| Semesterwochenstunden (SWS) | 1.4 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | |
| Lehrsprache | deutsch |
| Präsenzstudium | 21 Stunden |
| Selbststudium | 21 Stunden |
| Workload | 42 Stunden |

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| Inhalte |
| In der Vorlesung werden die grundlegenden Prinzipien und Methoden bionischer Forschung definiert und Beispiele vom biologischen Vorbild bis zur technischen Anwendung präsentiert. |
| <ul style="list-style-type: none"> ■ Einführung in die Methoden und Fachbereiche der Bionik ■ bionische Verpackungsmaterialien ■ verzweigte und unverzweigte Faserverbundmaterialien ■ Formoptimierung und Spannungsoptik ■ bionische Selbstreparaturmechanismen ■ Bionik und Architektur ■ bionische Oberflächen |
| Qualifikationsziel |
| Die Studierenden können die grundlegenden Prinzipien und Methoden der Bionik erklären und die vorgestellten Beispiele bionischer Forschung vom biologischen Vorbild bis zur technischen Anwendung darlegen. |
| Zu erbringende Prüfungsleistung |
| keine |
| Zu erbringende Studienleistung |
| Selbstständiges Nacharbeiten der Vorlesungsinhalte |
| Literatur |
| Publikationen, je nach Thema des Laborprojektes |
| Zwingende Voraussetzung |
| s. Modulebene |

Lehrmethoden

Powerpoint Präsentationen, Tafel/Kreide, Diskussion



| Modulname | Nummer |
|---|---------------------|
| SP2-03 Aktuelle Methoden der Bionik / Biomechanik | 09LE03M-SP2-03 |
| Veranstaltung | |
| Laborprojekt "Funktionelle Morphologie und Biomechanik" | |
| Veranstaltungsart | Nummer |
| Übung | 09LE03Ü-SP2-03_0002 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 19.6 |
| Semesterwochenstunden (SWS) | 16.3 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | deutsch |
| Präsenzstudium | 244 Stunden |
| Selbststudium | 344 Stunden |
| Workload | 588 Stunden |

| |
|---|
| Inhalte |
| Laborprojekt: Durchführung von Experimenten, Datenanalyse und -interpretation im Rahmen eines laufenden Forschungsprojektes im Fachbereich Funktionelle Morphologie, Biomechanik und Bionik |
| Qualifikationsziel |
| Die Studierenden können: |
| <ul style="list-style-type: none"> ■ mindestens eine Methode der Funktionellen Morphologie, Biomechanik und Bionik selbstständig durchführen (zum Laborprojekt) ■ experimentelle Daten analysieren (zum Laborprojekt) ■ die experimentellen Daten diskutieren (zum Laborprojekt) |
| Zu erbringende Prüfungsleistung |
| <ul style="list-style-type: none"> ■ mündliche Präsentation (40%) ■ Protokoll nach wissenschaftlichem Standard je nach Laborprojekt (60%) |
| Zu erbringende Studienleistung |
| <ul style="list-style-type: none"> ■ aktive Teilnahme ■ Führen eines Laborbuches ■ Verfassen eines Protokolls nach wissenschaftlichem Standard zum Laborprojekt |
| Literatur |
| Publikationen, je nach Thema des Laborprojektes |
| Zwingende Voraussetzung |
| s. Modulebene |

Lehrmethoden

Anleitung zur Durchführung der Experimente, je nach Laborprojekt



| Modulname | Nummer |
|---|----------------|
| SP2-04 Computational Neuroscience and Neurotechnology | 09LE03M-SP2-04 |
| Modulverantwortliche/r | |
| Prof. Dr. Stefan Rotter | |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 21.0 |
| Semesterwochenstunden (SWS) | 17.0 |
| Empfohlenes Fachsemester | 3 |
| Moduldauer | 1 |
| Pflicht/Wahlpflicht (P/WP) | Wahlpflicht |
| Präsenzstudium | 255 Stunden |
| Selbststudium | 375 Stunden |
| Workload | 630 Stunden |
| Angebotsfrequenz | nur im Wintersemester |

| |
|------------------------|
| Teilnahmevoraussetzung |
| OM-05 and SP1-05 |

| Zugehörige Veranstaltungen | | | | | | |
|--|-------|---------|------|-------|-----------|--|
| Name | Art | P/WP | ECTS | SWS | Workload | |
| Scientific Programming in Python (S1) | Übung | Pflicht | 3.0 | 2.00 | 90 hours | |
| Quantitative Methods and Statistics in Neuroscience (P1) | Übung | Pflicht | 9.0 | 5.00 | 270 hours | |
| Research Project (P2) | Übung | Pflicht | 9.0 | 10.00 | 270 hours | |

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| Qualifikationsziel |
| The students |
| <ul style="list-style-type: none"> ■ can design and carry out a research project on a state-of-the art research question in computational neuroscience/neurotechnology ■ can present and critically discuss findings of their research project. ■ are able to efficiently implement simple programs for research in the neurosciences. ■ can provide written and oral presentations about their own research work and published scientific literature. |
| Zu erbringende Prüfungsleistung |
| <ul style="list-style-type: none"> ■ Written examination (2,5 hours) in P1 (50%) ■ Written report (10 pages) of P2 coursework (40%) ■ Presentation and discussion of P2 coursework (10%) |

Zu erbringende Studienleistung

- regular attendance, active participation and self-guided study in S1, P1 and P2
- passing a written examination ACQ v. 1•Din S1

Literatur

- S1: See <http://www.python.org/> for some general information and an online tutorial on the programming language Python.
- P1 and P2: Will be provided at the start of the module.

Verwendbarkeit der Veranstaltung

M.Sc. Biology, Major Neuroscience

↑

| Modulname | Nummer |
|---|---------------------|
| SP2-04 Computational Neuroscience and Neurotechnology | 09LE03M-SP2-04 |
| Veranstaltung | |
| Scientific Programming in Python (S1) | |
| Veranstaltungsart | Nummer |
| Übung | 09LE03Ü-SP2-04_0001 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 3.0 |
| Semesterwochenstunden (SWS) | 2.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | englisch |
| Präsenzstudium | 30 hours |
| Selbststudium | 60 hours |
| Workload | 90 hours |

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| Inhalte |
| This course equips students with the techniques to design their own scientific programs in Python, for example to analyze data or simulate a problem. The lectures cover basics of Python programming. |
| <ul style="list-style-type: none"> ■ Variables, types and expressions ■ Loops, conditions and exceptions ■ Built-in functions and user designed functions ■ Numpy (numerical library for Python) ■ Plotting in Python, guidelines for good plotting practice |
| Qualifikationsziel |
| The students have the competence to |
| <ul style="list-style-type: none"> ■ Convert a simple problem into a Python program ■ Implement simple programs for data analysis ■ Implement simple programs for data visualization |
| Zu erbringende Prüfungsleistung |
| none |
| Zu erbringende Studienleistung |
| <ul style="list-style-type: none"> ■ Regular participation in discussion of exercises ■ Passing a written exam (2 hours) |
| Literatur |
| See http://www.python.org/ for some general information and an online tutorial on the programming language Python. Further documentation on the scientific libraries used in the course is also found online (see http://scipy.org/). |

Zwingende Voraussetzung

see module level

Lehrmethoden

Lectures, exercises, students programming on the computer

↑

| Modulname | Nummer |
|--|---------------------|
| SP2-04 Computational Neuroscience and Neurotechnology | 09LE03M-SP2-04 |
| Veranstaltung | |
| Quantitative Methods and Statistics in Neuroscience (P1) | |
| Veranstaltungsart | Nummer |
| Übung | 09LE93Ü-SP2-04_0002 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

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|-----------------------------|-----------------------|
| ECTS-Punkte | 9.0 |
| Semesterwochenstunden (SWS) | 5.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | englisch |
| Präsenzstudium | 75 hours |
| Selbststudium | 195 hours |
| Workload | 270 hours |

| Inhalte |
|--|
| <p>Lectures will introduce important theoretical concepts and mathematical tools essential for model building and data analysis in biology and, in particular in neuroscience. Emphasis will be on deterministic and stochastic models, statistical analysis approaches in biology and network dynamics, and signal processing.</p> <ul style="list-style-type: none"> ■ Basic mathematics (numbers, vectors, calculus, linear algebra) ■ Simple dynamical systems ■ Signal processing and spectral analysis ■ Linear time invariant systems ■ Basic concepts in statistics |
| Qualifikationsziel |

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| The student |
| <ul style="list-style-type: none"> ■ can explain the theory behind commonly used methods to analyze the various types of data obtained from biological systems (e.g. neuron spike trains, local field potentials) ■ is able to apply theoretical concepts from linear systems theory, dynamical systems and stochastic processes to analyze and model biological data (e.g. neuronal spike trains) and infer mechanisms underlying the functioning of biological systems (e.g. the brain) ■ can discuss the limitations of experimental data and mathematical models and can derive countermeasures ■ can perform and interpret basic statistical analyses |

| Zu erbringende Prüfungsleistung |
|---------------------------------|
| Written examination (2,5 hours) |
| Zu erbringende Studienleistung |
| none |

Literatur

See <http://www.python.org/> for some general information and an online tutorial on the programming language Python. Further documentation on the scientific libraries used in the course is also found online (see <http://scipy.org/>).

Zwingende Voraussetzung

see module level

Lehrmethoden

Lectures, exercises

↑

| Modulname | Nummer |
|---|---------------------|
| SP2-04 Computational Neuroscience and Neurotechnology | 09LE03M-SP2-04 |
| Veranstaltung | |
| Research Project (P2) | |
| Veranstaltungsart | Nummer |
| Übung | 09LE03Ü-SP2-04_0003 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 9.0 |
| Semesterwochenstunden (SWS) | 10.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | englisch |
| Präsenzstudium | 150 hours |
| Selbststudium | 120 hours |
| Workload | 270 hours |

| |
|---|
| Inhalte |
| Depending on the chosen project and supervisor the student will learn different neuroscience research methods. Among them experimental techniques, data analysis techniques, mathematical modelling techniques and numerical simulation techniques. The student will further acquire knowledge about the neuroscientific topic of his research project and will learn how to write a scientific project report and give an oral presentation about their research project. |
| Qualifikationsziel |
| Students <ul style="list-style-type: none">■ can carry out a neuroscientific research project under the supervision of an experienced researcher■ can write a scientific report (10 pages) about their research project■ can give a scientific oral presentation about their research project■ can explain the neuroscientific context of their research project |
| Zu erbringende Prüfungsleistung |
| <ul style="list-style-type: none">■ Written report (80%): The written report should have the form of a short scientific paper, typically including the sections Introduction, Methods, Results and Discussion followed by a list of references. The cover page should contain your name, the title of the research project, the name and affiliation of the supervisor, the starting- and end-date of your project and the date of submission of the report. A typical report is about 5 to 10 pages incl. figures, excl. references and appendix (when using font size 11, single line spacing, a margin of min 1.5 cm all sides).■ Oral presentation (20%): You will give an oral presentation of the results of your research project to the corresponding supervisor (typically including the research group of the supervisor). |
| Zu erbringende Studienleistung |
| none |

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|---|
| Literatur |
| Will be provided at the beginning of the module |
| Zwingende Voraussetzung |
| see module level |
| Lehrmethoden |
| regular discussion of findings, methods and problems with the supervisors |

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| Modulname | Nummer |
|-----------------------------------|----------------|
| SP2-05 Developmental Neurobiology | 09LE03M-SP2-05 |
| Modulverantwortliche/r | |
| Prof. Dr. Wolfgang Driever | |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 21.0 |
| Semesterwochenstunden (SWS) | 25.5 |
| Empfohlenes Fachsemester | 3 |
| Moduldauer | 1 |
| Pflicht/Wahlpflicht (P/WP) | Wahlpflicht |
| Präsenzstudium | 382,5 Stunden |
| Selbststudium | 247,5 Stunden |
| Workload | 630 Stunden |
| Angebotsfrequenz | nur im Wintersemester |

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| Teilnahmevoraussetzung |
| <ul style="list-style-type: none"> ■ OM-02 and/or OM-05 ■ SP1-02 or SP1-05 |
| Empfohlene Voraussetzung |
| WM-07 |

| Zugehörige Veranstaltungen | | | | | | |
|--|---------|---------|------|-------|-------------|--|
| Name | Art | P/WP | ECTS | SWS | Workload | |
| Selected advanced topics in developmental neurobiology | Seminar | Pflicht | 3.0 | 1.50 | 90 Stunden | |
| From Genes to Circuits and Behavior | Seminar | Pflicht | 1.5 | 1.00 | 45 Stunden | |
| Research Seminar Developmental Biology | Seminar | Pflicht | 0.5 | 1.00 | 45 Stunden | |
| Developmental Neurobiology Lab Projects | Übung | Pflicht | 16.0 | 22.00 | 480 Stunden | |

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|---|
| Qualifikationsziel |
| The students can: |
| <ul style="list-style-type: none"> ■ explain detailed molecular mechanisms of neural development (transcriptional control, signaling pathways) and present them with examples ■ explain molecular mechanisms of nervous system development and relevance to human disease ■ integrate knowledge of several disciplines (developmental biology, genetics, physiology, neurology) to aid comprehension of complex neural systems ■ apply state-of-the-art technologies for research on nervous system development |
| |

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|--|
| <ul style="list-style-type: none">■ analyze experiments using statistical tools and evaluate their results critically.■ write a laboratory project report in the format of a scientific primary research publication■ define the essential findings from a primary research publication in developmental neurosciences, and explain, interpret and discuss them together with the experimental logic in a scientific presentation |
| <p>Zu erbringende Prüfungsleistung</p> <ul style="list-style-type: none">■ Protocol of the laboratory project written in the format of a primary scientific publication. The protocol and the performance in the laboratory will be graded and together contribute 25% to the module grade■ Oral presentation (30 minutes) and discussion of the project and its background (15 minutes) account for 25% of the total grade of the module.■ Oral exam (30 minutes) on the topics of the seminars and quality of the two oral presentations given will contribute 50% to the module grade |
| <p>Zu erbringende Studienleistung</p> <ul style="list-style-type: none">■ at least 80% physical presence during practical classes and seminars.■ two oral presentations in the seminar "Selected advanced topics in developmental neurobiology "■ active participation in seminar discussions, seminars and lab projects■ independent follow-up learning of the topics of seminars and lab projects.■ preparation of scientific standard protocol of laboratory project by January 15 |
| <p>Literatur</p> <ul style="list-style-type: none">■ Sanes et al., Development of the Nervous System (2012, 3rd. Ed. chapt. 1-7)■ Price et. al. Building Brains (2011, chapt. 1-12)■ S.F.Gilbert: Developmental Biology 11th ed■ Scientific articles addressing selected topics (will be deposited on Illias) |
| <p>Verwendbarkeit der Veranstaltung</p> <p>M.Sc. Biology, Majors Neurosciences or Genetics & Developmental Biology</p> |

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| Modulname | Nummer |
|--|---------------------|
| SP2-05 Developmental Neurobiology | 09LE03M-SP2-05 |
| Veranstaltung | |
| Selected advanced topics in developmental neurobiology | |
| Veranstaltungsart | Nummer |
| Seminar | 09LE03S-SP2-05_0001 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 3.0 |
| Semesterwochenstunden (SWS) | 1.5 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | englisch |
| Präsenzstudium | 22,5 Stunden |
| Selbststudium | 67,5 Stunden |
| Workload | 90 Stunden |

| Inhalte |
|---|
| This part will be organized in "inverted classroom" format: each student will present an introduction into an area of developmental neurobiology based on presentations provided online, the text books and 1-2 reviews provided by lecturers. In the classroom, following the presentation, the topic is discussed between students and lecturer with respect to open questions, future directions and disease relevance. |
| Topics: |
| <ul style="list-style-type: none"> ■ Neural stem cells and their niches ■ Neural regeneration ■ Neural patterning and differentiation ■ Axonal pathfinding ■ Epigenetics and neural development ■ Laterality and the brain (habenula) ■ Neuromodulatory systems: Dopamine ■ Sensory systems development: from circuit to function ■ Motors systems development: from circuit to function ■ Development of topographic neural maps ■ Activity-dependent mechanisms and critical periods |

| Qualifikationsziel |
|---|
| The students are able to |
| <ul style="list-style-type: none"> ■ explain cellular and molecular mechanisms of neural development of model organism in detail using examples (including transcriptional control, signaling mechanisms) ■ integrate knowledge of several disciplines (developmental biology, genetics, neurobiology) towards comprehension of complex developmental processes resulting in formation of functional circuits ■ draw parallels between developmental processes and human diseases using examples |

- explain mechanisms of stem cell fate maintenance and stem cell differentiation with examples
- propose experimental approaches and appropriate model organisms to address neurodevelopmental questions
- propose experimental approaches and appropriate model organisms to address mechanisms of neural circuit formation and function

Zu erbringende Prüfungsleistung

- The topics of the seminar are at the focus of a 30 minute oral exam at the end of the module
- The oral exam (30 minutes) on the topics of the lectures and the quality of the two oral presentations given by each student will contribute 50% to the module grade

Zu erbringende Studienleistung

- Preparation and presentation of introductory seminar presentations for two of the topics
- independent reading on all topics using the seminar materials, text books and current scientific reviews provided

Literatur

- Sanes et al., Development of the Nervous System (2012, 3rd. Ed. chapt. 1-7)
- Price et. al. Building Brains (2011, chapt. 1-12)
- S.F.Gilbert: Developmental Biology 11th ed
- Primary literature and academic reviews as provided by lecturers

Zwingende Voraussetzung

s. Modulebene

Lehrmethoden

- Handouts of slides as PDFs on Illias server.
- Up-to-date scientific reviews provided on Illias server
- Seminar presentations by the students as PowerPoint or Keynote presentations
- Development of schemes using chalk / board
- Distribution of a question/problem sheets for each topic
- Discussion of concepts and open questions, and the distributed questions/problems after the students introductory seminar presentations

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| Modulname | Nummer |
|-------------------------------------|---------------------|
| SP2-05 Developmental Neurobiology | 09LE03M-SP2-05 |
| Veranstaltung | |
| From Genes to Circuits and Behavior | |
| Veranstaltungsart | Nummer |
| Seminar | 09LE03S-SP2-05_0002 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 1.5 |
| Semesterwochenstunden (SWS) | 1.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | englisch |
| Präsenzstudium | 15 Stunden |
| Selbststudium | 30 Stunden |
| Workload | 45 Stunden |

| |
|---|
| Inhalte |
| Each student presents a primary research scientific publication from the fields of neural circuit function, behavior or neurodevelopment. The research paper will be discussed in the plenum by all participants of the seminar. |
| Qualifikationsziel |
| The students are able to |
| <ul style="list-style-type: none"> ■ recognize the important findings in a research publication and present them in a meaningful way using PowerPoint slides ■ critically evaluate the techniques, analysis methods and conclusions of a research publication ■ relate the findings of a primary research publication to the scientific context in this closer field of research ■ prepare and present a well structured scientific presentation. |
| Zu erbringende Prüfungsleistung |
| none |
| Zu erbringende Studienleistung |
| Preparation and presentation of a scientific seminar reporting a primary research publication from the field of developmental neurosciences. |
| Literatur |
| <ul style="list-style-type: none"> ■ Textbooks in neurobiology as background reading (e.g. Kandel et al. Principles of Neural Sciences (2012, 5th Ed.) ■ Primary literature and academic reviews as provided by the instructors and placed on Illias |

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| Zwingende Voraussetzung |
| s. Modulebene |
| Lehrmethoden |
| <ul style="list-style-type: none">■ Discussion of the independently prepared seminar presentation before and after the seminar with the supervising faculty member■ Students will be guided to contribute actively to the critical discussion of the publication in the plenum. |

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| Modulname | Nummer |
|--|---------------------|
| SP2-05 Developmental Neurobiology | 09LE03M-SP2-05 |
| Veranstaltung | |
| Research Seminar Developmental Biology | |
| Veranstaltungsart | Nummer |
| Seminar | 09LE03S-SP2-05_0003 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 0.5 |
| Semesterwochenstunden (SWS) | 1.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | englisch |
| Präsenzstudium | 15 Stunden |
| Selbststudium | 30 Stunden |
| Workload | 45 Stunden |

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|---|
| Inhalte |
| Students attend the weekly scientific progress reports of the members of the developmental biology department and participate in the scientific discussion of the projects. |
| Qualifikationsziel |
| The students are able to |
| <ul style="list-style-type: none"> ■ critically evaluate the data, techniques, analysis methods and conclusions presented in a scientific talk ■ actively participate in a scientific discussion in English |
| Zu erbringende Prüfungsleistung |
| none |
| Zu erbringende Studienleistung |
| Physical presence in at least 80% of the seminars. |
| Zwingende Voraussetzung |
| s. Modulebene |
| Lehrmethoden |
| <ul style="list-style-type: none"> ■ Seminar presentations of the scientific members of the Developmental Biology laboratories, ■ Students will be guided to contribute actively to the critical discussion of the presentations in the plenum. |

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| Modulname | Nummer |
|---|---------------------|
| SP2-05 Developmental Neurobiology | 09LE03M-SP2-05 |
| Veranstaltung | |
| Developmental Neurobiology Lab Projects | |
| Veranstaltungsart | Nummer |
| Übung | 09LE03Ü-SP2-05_0004 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 16.0 |
| Semesterwochenstunden (SWS) | 22.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | englisch |
| Präsenzstudium | 330 Stunden |
| Selbststudium | 150 Stunden |
| Workload | 480 Stunden |

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|--|
| Inhalte |
| Students work on a research project full time for 6 weeks or part time (75%) for 8 weeks in one of the participating research laboratories in the field of developmental biology ("lab rotation of 6 weeks"). The lab project should contain molecular, cellular and/or circuit level analysis. Students learn how to develop and plan a project, apply current experimental approaches towards solution of a scientific question, and write a report in the format of a primary scientific publication. |
| Qualifikationsziel |
| Students can <ul style="list-style-type: none"> ■ develop and plan a small research project addressing a current question in neurodevelopment or a closely related research area ■ apply state-of-the-art technologies for research on neurodevelopmental questions ■ analyze their experiments using statistical tools and to evaluate their results critically. ■ write a laboratory project report in the format of a scientific primary research publication |
| Zu erbringende Prüfungsleistung |
| <ul style="list-style-type: none"> ■ Protocol of the laboratory project written in the format of a primary scientific publication. The protocol and the performance in the laboratory will be graded and together contribute 25% to the module grade ■ Oral presentation (30 minutes) and discussion of the project and its background (15 minutes) account for 25% of the total grade of the module. |
| Zu erbringende Studienleistung |
| <ul style="list-style-type: none"> ■ at least 80% physical presence during time of lab projects. ■ active planning and experimental execution of lab projects. ■ preparation of a scientific standard protocol of laboratory project |

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|--|
| Literatur |
| ■ Sanes et al., Development of the Nervous System (2012, 3rd. Ed. chapt. 1-7) |
| ■ Price et. al. Building Brains (2011, chapt. 1-12) |
| ■ S.F.Gilbert: Developmental Biology 11th ed |
| ■ Primary literature and academic reviews as provided by lecturers |
| Zwingende Voraussetzung |
| s. Modulebene |
| Lehrmethoden |
| ■ Instructions for practical work by faculty. |
| ■ Students perform experiments independently individually or in teams of two with support by teaching staff. |

↑

| Modulname | Nummer |
|---|----------------|
| SP2-06 Functional Proteomics and Biochemistry | 09LE03M-SP2-06 |
| Modulverantwortliche/r | |
| Prof. Dr. Bettina Warscheid | |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 21.0 |
| Semesterwochenstunden (SWS) | 17.0 |
| Empfohlenes Fachsemester | 3 |
| Moduldauer | 1 |
| Pflicht/Wahlpflicht (P/WP) | Wahlpflicht |
| Präsenzstudium | 255 Stunden |
| Selbststudium | 375 Stunden |
| Workload | 630 Stunden |
| Angebotsfrequenz | nur im Wintersemester |

| Teilnahmevoraussetzung |
|------------------------|
| ■ OM-01 and/or OM-04 |
| ■ SP-01 or SP-04 |
| ■ WM-17 |

| Zugehörige Veranstaltungen | | | | | | |
|--|-----------|---------|------|-------|-------------|--|
| Name | Art | P/WP | ECTS | SWS | Workload | |
| Trends in Functional Proteomics | Vorlesung | | 1.0 | 1.00 | 30 Stunden | |
| Applied Biochemistry and Functional Proteomics | Übung | Pflicht | 15.5 | 13.00 | 465 Stunden | |
| Scientific Writing and Project Management | Seminar | Pflicht | 4.5 | 3.00 | 135 Stunden | |

| Qualifikationsziel |
|---|
| The students are able |
| ■ to explain and apply modern methods of biochemistry and quantitative mass spectrometry-based proteomics |
| ■ to analyze and visualize complex functional proteomics data |
| ■ to present a project management plan |
| ■ to write a short scientific proposal |
| Zu erbringende Prüfungsleistung |
| ■ Written research proposal (40%) |
| ■ project management presentation (60%) |

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| Zu erbringende Studienleistung |
| <ul style="list-style-type: none">■ At least 90 % attendance.■ Active participation■ Writing of experimental lab journal |
| Benotung |
| <ul style="list-style-type: none">■ Written research proposal (40%)■ project management presentation (60%) |
| Literatur |
| Course script will be distributed |
| Verwendbarkeit der Veranstaltung |
| M.Sc. Biology, Major Translational Biology M.Sc. Biology, Major Biochemistry/Microbiology |

↑

| Modulname | Nummer |
|---|---------------------|
| SP2-06 Functional Proteomics and Biochemistry | 09LE03M-SP2-06 |
| Veranstaltung | |
| Trends in Functional Proteomics | |
| Veranstaltungsart | Nummer |
| Vorlesung | 09LE03V-SP2-06_0001 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 1.0 |
| Semesterwochenstunden (SWS) | 1.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | |
| Lehrsprache | englisch |
| Präsenzstudium | 15 Stunden |
| Selbststudium | 15 Stunden |
| Workload | 30 Stunden |

| |
|---|
| Inhalte |
| The lecture provides insight into advanced functional proteomics techniques and strategies applied to biological and disease-related questions. The lecture covers the following topics: |
| <ul style="list-style-type: none"> ■ Structure-function analysis of muscle proteins ■ Signaling networks at the Z-disc and their role in muscle diseases ■ Oncogenic signaling and interactome of oncoproteins ■ Phosphatase PTP1B interactome in B cells ■ Cellular oxidative stress response in yeast ■ The peroxisomal import pore and its regulation ■ Mitochondrial protein import and dynamics ■ Structural analysis of protein complexes |
| Qualifikationsziel |
| The students are able to explain and discuss functional proteomics approaches to address biological questions. |
| Zu erbringende Prüfungsleistung |
| none |
| Zu erbringende Studienleistung |
| Independent rehearsal of the lecture contents |
| Literatur |
| None |

Zwingende Voraussetzung

s. Modulebene

Lehrmethoden

Power Point Presentation, Discussion

↑

| Modulname | Nummer |
|--|---------------------|
| SP2-06 Functional Proteomics and Biochemistry | 09LE03M-SP2-06 |
| Veranstaltung | |
| Applied Biochemistry and Functional Proteomics | |
| Veranstaltungsart | Nummer |
| Übung | 09LE03Ü-SP2-06_0002 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 15.5 |
| Semesterwochenstunden (SWS) | 13.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | deutsch oder englisch |
| Präsenzstudium | 195 Stunden |
| Selbststudium | 270 Stunden |
| Workload | 465 Stunden |

| |
|---|
| Inhalte |
| Lab work on a topic in the field of functional proteomic. |
| Qualifikationsziel |
| The students are able to: |
| <ul style="list-style-type: none"> ■ define and explain a project in the field of functional proteomic ■ conduct a complex functional proteomics workflow including biological sample generation, sample processing, and LC/MS analysis ■ analyze and visualize complex MS datasets ■ discuss the results of their experimental work ■ document their experimental data in a lab journal ■ search for relevant literature |
| Zu erbringende Prüfungsleistung |
| none |
| Zu erbringende Studienleistung |
| <ul style="list-style-type: none"> ■ active participation ■ record experimental conditions and results in a lab journal |
| Literatur |
| Literature search by the students (supported by the supervisor). |
| Zwingende Voraussetzung |
| s. Modulebene |

Lehrmethoden

Lab work under supervision of an experienced group member.



| Modulname | Nummer |
|---|------------------------|
| SP2-06 Functional Proteomics and Biochemistry | 09LE03M-SP2-06 |
| Veranstaltung | |
| Scientific Writing and Project Management | |
| Veranstaltungsart | Nummer |
| Seminar | 09LE03S-SP2-06/12_0003 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 4.5 |
| Semesterwochenstunden (SWS) | 3.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | deutsch oder englisch |
| Präsenzstudium | 45 Stunden |
| Selbststudium | 90 Stunden |
| Workload | 135 Stunden |

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|--|
| Inhalte |
| <ul style="list-style-type: none"> ■ Scientific writing ■ Project management ■ Presentation style ■ Time and stress management ■ Patenting and exploitation of inventions |
| Qualifikationsziel |
| <p>The students are able to:</p> <ul style="list-style-type: none"> ■ write a short scientific proposal ■ present a project management plan ■ describe the steps for patenting and exploitation of inventions |
| Zu erbringende Prüfungsleistung |
| <ul style="list-style-type: none"> ■ Written research proposal (40%) ■ oral presentation of a project management plan respective to the planned master thesis (60%) |
| Zu erbringende Studienleistung |
| <ul style="list-style-type: none"> ■ At least 90% attendance (1 day max. absence) ■ Active participation |
| Literatur |
| Course script will be distributed |
| Zwingende Voraussetzung |
| s. Modulebene |

Lehrmethoden

- Power point presentation
- Group work
- Discussion

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| Modulname | Nummer |
|------------------------------|----------------|
| SP2-07 Developmental Biology | 09LE03M-SP2-07 |
| Modulverantwortliche/r | |
| Prof. Dr. Annette Neubüser | |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 21.0 |
| Semesterwochenstunden (SWS) | 19.0 |
| Empfohlenes Fachsemester | 3 |
| Moduldauer | 1 |
| Pflicht/Wahlpflicht (P/WP) | Wahlpflicht |
| Präsenzstudium | 277 Stunden |
| Selbststudium | 353 Stunden |
| Workload | 630 Stunden |
| Angebotsfrequenz | nur im Wintersemester |

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|--------------------------|
| Teilnahmevoraussetzung |
| ■ OM-02 |
| ■ SP1-02 |
| Empfohlene Voraussetzung |
| ■ WM-12 |

| Zugehörige Veranstaltungen | | | | | | |
|--|---------|---------|------|-------|-------------|--|
| Name | Art | P/WP | ECTS | SWS | Workload | |
| Animal Developmental Biology | Seminar | Pflicht | 8.5 | 3.00 | 255 Stunden | |
| Developmental Biology Lab Projects | Übung | Pflicht | 11.0 | 15.00 | 330 Stunden | |
| From Genes to Tissues and Organs: Presenting and discussing recent original publications | Seminar | Pflicht | 1.5 | 1.00 | 45 Stunden | |

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| Qualifikationsziel |
| The students can: |
| ■ explain molecular mechanisms of embryonic development of model organism and their relevance to human disease |
| ■ integrate knowledge of several disciplines (developmental biology, genetics, cell biology) towards comprehension of complex developmental processes |
| ■ apply state-of-the-art technologies for research on embryonic development |
| ■ analyze their experiments using statistical tools and to evaluate their results critically. |
| ■ write a laboratory project report in the format of a scientific primary research publication |

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|--|
| ■ define the essential findings from a primary research publication in developmental biology, and explain, interpret and discuss them together with the experimental logic in a scientific presentation |
| Zu erbringende Prüfungsleistung |
| ■ Protocol of the laboratory project written in the format of a primary scientific publication. ■ Oral presentation (30 minutes) and discussion of the project and its background (15 minutes) ■ Oral exam (30 minutes) on the topics of the lectures |
| Zu erbringende Studienleistung |
| ■ at least 80% physical presence during practical classes and seminars. ■ active participation in discussions, seminars and lab projects ■ independent follow-up learning of the topics of seminars and lab projects ■ preparation of scientific standard protocol of laboratory project |
| Benotung |
| ■ Protocol of the laboratory project written in the format of a primary scientific publication. The protocol and the performance in the laboratory will be graded and together contribute 25% to the module grade ■ Oral presentation (30 minutes) and discussion of the project and its background (15 minutes) account for 25% of the total grade of the module. ■ Oral exam (30 minutes) on the topics of the lectures will contribute 50% to your module grade |
| Literatur |
| ■ S.F.Gilbert: Developmental Biology 9th or 10th ed ■ Scientific articles addressing selected topics (will be deposited on Illias) |
| Verwendbarkeit der Veranstaltung |
| M.Sc. Biology, Major Genetics & Developmental Biology |

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| Modulname | Nummer |
|-------------------------------|---------------------|
| SP2-07 Developmental Biology | 09LE03M-SP2-07 |
| Veranstaltung | |
| Animal Developmental Biology | |
| Veranstaltungsart | Nummer |
| Seminar | 09LE03S-SP2-07_0001 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 8.5 |
| Semesterwochenstunden (SWS) | 3.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | englisch |
| Präsenzstudium | 42 Stunden |
| Selbststudium | 213 Stunden |
| Workload | 255 Stunden |

| Inhalte |
|---|
| <p>This seminar will give the participants an overview over the development of <i>Drosophila</i> and vertebrates, with a strong focus on developmental mechanisms and molecular regulation. The seminar will be based on the Gilbert text book but will also include research results not yet included in the Gilbert.</p> <p>Topics include:</p> <ul style="list-style-type: none"> ■ Overview over <i>Drosophila</i> development and its molecular regulation ■ Early vertebrate development, cleavage, gastrulation axis formation and patterning in amphibians, birds and mammals ■ Pluripotent stem cells, their developmental origin and their regulatory networks, cloning and ES cell technology ■ Mesoderm development and differentiation ■ The left right axis in vertebrates ■ Organogenesis ■ Sex determination, gonad development and germ cells ■ Development of the central nervous system: Neurulation, patterning and neurogenesis ■ Neural crest and craniofacial development ■ Limb development ■ Tissue specific stem cells and tissue regeneration |
| Qualifikationsziel |

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|---|
| The students are able to: |
| <ul style="list-style-type: none"> ■ explain cellular and molecular mechanisms of embryonic development of model organism in detail using examples (including transcriptional control, signaling mechanisms) |
| <ul style="list-style-type: none"> ■ integrate knowledge of several disciplines (developmental biology, genetics, cell biology) towards comprehension of complex developmental processes |
| <ul style="list-style-type: none"> ■ draw parallels between developmental processes and human diseases using example |

- explain mechanisms of stem cell fate maintenance and stem cell differentiation with examples
- propose experimental approaches and appropriate model organisms to address developmental questions

Zu erbringende Prüfungsleistung

The topics of the seminars are at the focus of a 30 minute oral exam at the end of the module

Zu erbringende Studienleistung

Reading of the Gilbert text book and current scientific reviews provided; solving the problems and questions provided, presentation of textbook chapters to fellow students, independent follow-up learning of the topics of the seminars using the materials provided and text books

Literatur

- Gilbert, Developmental Biology (2013, 10th Ed)
- Primary literature and academic reviews as provided by lecturers

Zwingende Voraussetzung

s. Modulebene

Lehrmethoden

- Introductory lectures using PowerPoint or Keynote presentations by the instructors, and presentations of chapters from the Gilbert textbook or selected review articles by the students. Distribution of a question/problem sheet for each topic. Discussion of the distributed questions/problems and concepts and open questions.
- Handouts of lecture and presentations slides as PDFs on Illias server.
- Up-to-date scientific reviews provided on Illias server
- Development of schemes using chalk / board



| Modulname | Nummer |
|------------------------------------|---------------------|
| SP2-07 Developmental Biology | 09LE03M-SP2-07 |
| Veranstaltung | |
| Developmental Biology Lab Projects | |
| Veranstaltungsart | Nummer |
| Übung | 09LE03Ü-SP2-07_0002 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 11.0 |
| Semesterwochenstunden (SWS) | 15.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | englisch |
| Präsenzstudium | 220 Stunden |
| Selbststudium | 110 Stunden |
| Workload | 330 Stunden |

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| Inhalte |
| Students work on a research project full time for 6 weeks in one of the participating research laboratories in the field of developmental biology ("lab rotation of 6 weeks"). The lab project should contain molecular and cellular level analysis. Students learn how to develop and plan a project, apply current experimental approaches towards solution of a scientific question, and write a report in the format of a primary scientific publication. |
| Qualifikationsziel |
| The students can: |
| <ul style="list-style-type: none"> ■ develop and plan a small research project addressing a current question in the developmental biology or a closely related research area ■ apply state-of-the-art technologies for research on developmental questions ■ analyze their experiments using statistical tools and to evaluate their results critically ■ write a laboratory project report in the format of a scientific primary research publication |
| Zu erbringende Prüfungsleistung |
| <ul style="list-style-type: none"> ■ Protocol of the laboratory project written in the format of a primary scientific publication. The protocol and the performance in the laboratory will be graded and together contribute 25% to the module grade ■ Oral presentation (30 minutes) and discussion of the project and its background (15 minutes) account for 25% of the total grade of the module. |
| Zu erbringende Studienleistung |
| <ul style="list-style-type: none"> ■ at least 80% physical presence during time of lab projects. ■ active planning and experimental execution of lab projects. ■ preparation of scientific standard protocols of laboratory projects |

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| Literatur |
| ■ Gilbert, Developmental Biology (2013, 10th Ed) |
| ■ Protocols and primary literature and academic reviews as provided by the instructors |
| Zwingende Voraussetzung |
| s. Modulebene |
| Lehrmethoden |
| Instructions for practical work by faculty. Students perform experiments independently individually or in teams of two with support by teaching staff. |

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| Modulname | Nummer |
|--|---------------------|
| SP2-07 Developmental Biology | 09LE03M-SP2-07 |
| Veranstaltung | |
| From Genes to Tissues and Organs: Presenting and discussing recent original publications | |
| Veranstaltungsart | Nummer |
| Seminar | 09LE03S-SP2-07_0003 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 1.5 |
| Semesterwochenstunden (SWS) | 1.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | englisch |
| Präsenzstudium | 15 Stunden |
| Selbststudium | 30 Stunden |
| Workload | 45 Stunden |

| |
|---|
| Inhalte |
| Each student presents a primary research scientific publication from the field of developmental biology. The research paper will be discussed in the plenum by all participants of the seminar. |
| Qualifikationsziel |
| The students are able to <ul style="list-style-type: none"> ■ recognize the important findings in a research publication and present them in a meaningful way using PowerPoint slides ■ critically evaluate the techniques, analysis methods and conclusions of a research publication ■ relate the findings of a primary research publication to the scientific context in this closer field of research ■ prepare and present a well structured scientific presentation in English. |
| Zu erbringende Prüfungsleistung |
| none |
| Zu erbringende Studienleistung |
| Preparation and presentation of a scientific seminar reporting on a primary research publication from the field of developmental biology. |
| Literatur |
| <ul style="list-style-type: none"> ■ Gilbert, Developmental Biology (2013, 10th Ed) ■ Primary literature and academic reviews as provided by the instructors and placed on Illias |
| Zwingende Voraussetzung |
| s. Modulebene |

Lehrmethoden

- Discussion of the independently prepared seminar presentation before and after the seminar with the supervising faculty member
- Students will be guided to contribute actively to the critical discussion of the publication in the plenum.

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| Modulname | Nummer |
|--|----------------|
| SP2-08 Advanced molecular genetics of eukaryotic organisms | 09LE03M-SP2-08 |
| Modulverantwortliche/r | |
| Prof. Dr. Ralf Baumeister | |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 21.0 |
| Semesterwochenstunden (SWS) | 25.0 |
| Empfohlenes Fachsemester | 3 |
| Moduldauer | 1 |
| Pflicht/Wahlpflicht (P/WP) | Wahlpflicht |
| Präsenzstudium | 375 Stunden |
| Selbststudium | 255 Stunden |
| Workload | 630 Stunden |
| Angebotsfrequenz | nur im Wintersemester |

| |
|---|
| Teilnahmevoraussetzung |
| <ul style="list-style-type: none"> ■ OM-02 ■ SP1-02 |
| Empfohlene Voraussetzung |
| <ul style="list-style-type: none"> ■ WM-01 ■ WM-03 |

| | | | | | |
|---|-------|---------|------|-------|-------------|
| Zugehörige Veranstaltungen | | | | | |
| Name | Art | P/WP | ECTS | SWS | Workload |
| Advanced genetics of eukaryotic organisms | Übung | Pflicht | 21.0 | 25.00 | 630 Stunden |

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| Qualifikationsziel |
| Students choosing a wet-lab project will be able to: |
| <ul style="list-style-type: none"> ■ use the framework of genetic theory to design experiments and develop scientific hypotheses ■ translate biomedical questions into genetically tractable models using the powerful model organism <i>C. elegans</i> ■ conduct experiments carefully (including experimental controls) |
| Students working on a project with a focus on bioinformatics will be able to: |
| <ul style="list-style-type: none"> ■ translate biological questions into software and analyses that provide biologically relevant answers for geneticists ■ explain bioinformatics to geneticists and genetics to bioinformaticians |
| Independent of the specific project, students will learn to: |
| <ul style="list-style-type: none"> ■ document their work sufficiently for others to judge and repeat it |

- | |
|--|
| <ul style="list-style-type: none">■ discuss scientific problems, data and results with other scientists■ present results to a scientific audience |
|--|

Zu erbringende Prüfungsleistung

- | |
|--|
| <ul style="list-style-type: none">■ self-motivated work on the research project and weekly presentation of results■ oral exam |
|--|

Zu erbringende Studienleistung

- | |
|--|
| <ul style="list-style-type: none">■ self-motivated work on the chosen research project■ active discussion and thorough documentation of experimental work■ presentation of results to other members of the lab |
|--|

Literatur

Will be provided individually.

Verwendbarkeit der Veranstaltung

M.Sc. Biology, Major Genetics & Developmental Biology



| Modulname | Nummer |
|--|---------------------|
| SP2-08 Advanced molecular genetics of eukaryotic organisms | 09LE03M-SP2-08 |
| Veranstaltung | |
| Advanced genetics of eukaryotic organisms | |
| Veranstaltungsart | Nummer |
| Übung | 09LE03Ü-SP2-08_0001 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 21.0 |
| Semesterwochenstunden (SWS) | 25.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | deutsch oder englisch |
| Präsenzstudium | 375 Stunden |
| Selbststudium | 255 Stunden |
| Workload | 630 Stunden |

| Inhalte |
|--|
| We are offering lab training in various aspects of advanced genetics. Students have the possibility to choose a research project from the following list of topics adressed by the indicated group leaders in the lab of Prof. Baumeister: |
| <ul style="list-style-type: none"> ■ Baumeister: Signalling studies in aging and age-related disorders ■ Maier: Molecular function of Parkinson's Disease genes ■ Schulze: Mechanisms of mitochondrial stress signalling ■ Seifert/Maier/Schulze: Applying Bioinformatics in Genetics |
| Depending on the exact project, students can get to know state-of-the-art methods of modern genetic/molecular biological analysis from the following areas: |
| <p>DNA and RNA:</p> <ul style="list-style-type: none"> ■ cloning ■ mutagenesis ■ molecular analyses ■ generation of transgenic animals ■ gene knock-out ■ transformation ■ RNA interference ■ expression analysis <p>Proteins:</p> <ul style="list-style-type: none"> ■ labelling ■ antibodies |

- immunoprecipitation
- mass spectrometry
- phosphorylation assays
- protein expression
- quantitative protein analyses
- Protein aggregation

Cellular and organismal analyses:

- behavioral analyses
- cell migration
- neuronal outgrowth
- synapse function
- microsurgery
- lifespan analyses
- live imaging

or in case of Bioinformatics can gain practical experience in:

- analysis of whole-genome sequencing data
- integration of bioinformatic tools into a local Galaxy installation
- manual and automated database queries for homology searches, function prediction and general data mining
- use of the programming languages Python or Perl in bioinformatics

Qualifikationsziel

Students choosing a wet-lab project will be able to:

- use the framework of genetic theory to design experiments and develop scientific hypotheses
- translate biomedical questions into genetically tractable models using the powerful model organism *C. elegans*
- conduct experiments carefully (including experimental controls)

Students working on a project with a focus on bioinformatics will be able to:

- translate biological questions into software and analyses that provide biologically relevant answers for geneticists
- explain bioinformatics to geneticists and genetics to bioinformaticians

Independent of their specific project, students will be able to:

- document their work sufficiently for others to judge and repeat it
- discuss scientific problems, data and results with other scientists
- present results to a scientific audience

Zu erbringende Prüfungsleistung

- self-motivated work on the research project and weekly presentation of results (80%)
- final oral exam (20%)

Zu erbringende Studienleistung

- self-motivated work on the chosen research project
- active discussion and thorough documentation of experimental work
- presentation of results to other members of the lab

Literatur

Will be provided individually

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|--|
| Zwingende Voraussetzung |
| s. Modulebene |
| Lehrmethoden |
| <ul style="list-style-type: none">■ close supervision of research work conducted individually or in groups of 2-3 depending on the number of participants by the assigned group leader■ weekly group meeting for presentation and discussion of methods, experimental problems and results■ media: board, PowerPoint presentations |
| Bemerkung / Empfehlung |
| see www.celegans.de for further information about the participating groups |

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| Modulname | Nummer |
|---|----------------|
| SP2-09 Experiments in Evolutionary Biology & Functional Ecology | 09LE03M-SP2-09 |
| Modulverantwortliche/r | |
| Prof. Dr. Judith Korb | |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 21.0 |
| Semesterwochenstunden (SWS) | 15.6 |
| Empfohlenes Fachsemester | 3 |
| Moduldauer | 1 |
| Pflicht/Wahlpflicht (P/WP) | Wahlpflicht |
| Präsenzstudium | 234 Stunden |
| Selbststudium | 396 Stunden |
| Workload | 630 Stunden |
| Angebotsfrequenz | nur im Wintersemester |

| |
|--------------------------|
| Teilnahmevoraussetzung |
| ■ OM-07 |
| ■ SP1-07 |
| Empfohlene Voraussetzung |
| ■ EDS |

| | | | | | | |
|---|-----------|---------|------|------|-------------|--|
| Zugehörige Veranstaltungen | | | | | | |
| Name | Art | P/WP | ECTS | SWS | Workload | |
| Trends in Ecology & Evolution | Vorlesung | | 9.0 | 6.00 | 270 Stunden | |
| Experiments in Evolutionary Biology & Functional Ecology | Übung | Pflicht | 11.0 | 9.00 | 330 Stunden | |
| Current topics in Evolutionary Biology & Functional Ecology | Seminar | Pflicht | 1.0 | 0.60 | 30 Stunden | |

| |
|--|
| Qualifikationsziel |
| The students can: |
| <ul style="list-style-type: none"> ■ develop and execute own experimental research projects in the area of ecology and evolutionary biology, including preparation of a research proposal, formulation of scientific hypotheses, selection of adequate methodologies, execution of experiments, as well as analysis and interpretation of empirical results. ■ explain and apply fundamental concepts and theories in ecology and evolutionary biology in great detail, and can critically reflect and evaluate own research against this knowledge. |

Zu erbringende Prüfungsleistung

- Practical: Scientific project reports (protocols) counts 25% of the module grade.
- Seminar: presentation of scientific project results with discussion of project results within the conceptual framework of the lecture ('defense') counts 25% of module grade.
- oral examination: 50% of module grade.

Zu erbringende Studienleistung

- All parts: 100% presence time, active participation in discussions, post-processing of presented information
- Practical: planning, execution and analysis of a scientific experimental project
- Seminar: Preparation of talk and presentation of results from experimental project, 'defense' of project results

Benotung

- Practical: Scientific project reports (protocols) counts 25% of the module grade.
- Seminar: presentation of scientific project results with discussion of project results within the conceptual framework of the lecture ('defense') counts 25% of module grade.
- oral examination: 50% of module grade

Literatur

Scientific textbooks and papers presented in lecture, lecture slides.

Verwendbarkeit der Veranstaltung

M.Sc. Biology, Major Ecology and Evolutionary Biology



| Modulname | Nummer |
|---|---------------------|
| SP2-09 Experiments in Evolutionary Biology & Functional Ecology | 09LE03M-SP2-09 |
| Veranstaltung | |
| Trends in Ecology & Evolution | |
| Veranstaltungsart | Nummer |
| Vorlesung | 09LE03V-SP2-09_0001 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 9.0 |
| Semesterwochenstunden (SWS) | 6.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | |
| Lehrsprache | deutsch oder englisch |
| Präsenzstudium | 90 Stunden |
| Selbststudium | 180 Stunden |
| Workload | 270 Stunden |

| Inhalte |
|--|
| Selected topics of Evolutionary Biology & Functional Ecology, such as: |
| Zoology: |
| ■ Genes and Behaviour |
| ■ Life History Evolution |
| ■ Ageing |
| ■ Biodiversity & Ecosystem Functioning |
| ■ Parasitism & Mutualism |
| Geobotany: |
| ■ Comparative Plant Ecology |
| ■ Plant Functional Traits |
| ■ Plant Ecophysiology |
| ■ Biogeochemistry |
| ■ Biodiversity and Ecosystem Functioning |
| Global Change Ecology |
| Limnology: |
| ■ Physical limnology – light and heat |
| ■ water movements and stratification. |
| Biotic limnology: |
| ■ life in the aquatic environment |
| ■ biogeochemistry of elements (C,N,P,S) |

- microbial processes
- trophic types of lakes
- community ecology of the plankton
- fish ecology

Qualifikationsziel

The students are able to:

- explain and apply fundamental theories and concepts in evolutionary biology and ecology in great detail.
- critically reflect and discuss scientific studies
- implement theories in evolutionary biology and ecology into scientific research projects

Zu erbringende Prüfungsleistung

- Conceptual discussion ('defense' of project results) within the framework of the seminar (25%).
- oral examination (50%).

Zu erbringende Studienleistung

- active participation in discussions
- post-processing of lecture

Literatur

Zoology:

- Scientific papers presented in lecture, lecture slides

Geobotany:

- Schulze et al. 2005, Plant Ecology, Chapters 2 and 3, Springer, Heidelberg.
- Chapin III F.S., et al. 2011, Principles of terrestrial ecosystem ecology. Springer, New York.
- Larcher W. (1995). Physiological plant ecology. Springer-Verlag, Berlin.
- Lambers H., Chapin III F.S. & Pons T.L. (1998). Plant Physiological Ecology. Springer-Verlag, Berlin, Heidelberg.

Limnology:

- Lampert W., Sommer U. (2007). Limnoecology: The Ecology of Lakes and Streams. Oxford University Press.
- Schwoerbel J., Brendelberger H. (2013) Einführung in die Limnologie (10. Aufl.). Spektrum Akademischer Verlag.

Zwingende Voraussetzung

s. Modulebene

Lehrmethoden

Lectures supported by power point presentations; discussions on selected topics.



| Modulname | Nummer |
|---|---------------------|
| SP2-09 Experiments in Evolutionary Biology & Functional Ecology | 09LE03M-SP2-09 |
| Veranstaltung | |
| Experiments in Evolutionary Biology & Functional Ecology | |
| Veranstaltungsart | Nummer |
| Übung | 09LE03Ü-SP2-09_0002 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 11.0 |
| Semesterwochenstunden (SWS) | 9.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | deutsch oder englisch |
| Präsenzstudium | 135 Stunden |
| Selbststudium | 195 Stunden |
| Workload | 330 Stunden |

| Inhalte |
|---|
| 1) Advanced Statistics (5 ECTS): e.g. multiple testing, multiple regression, GLM, mixed effect models, PCA and 2) Experiments in Evolutionary Biology & Functional Ecology (6 ECTS): |
| Zoology: The practical part involves the design, realization, and analyses of tailored experiments in evolutionary biology, tropical ecology and biodiversity research. Topics include e.g., Genes and Behaviour; Life history Evolution & Ageing; Sexual Selection; Communication; Community Assembly & Phylogenetics; Populations Genetics & Conservation...Each students will perform an own research project under the guidance of a supervisor or |
| Geobotany: The practical part involves the design and execution of experiments in plant functional ecology, which demonstrate central ecological processes and functions in terrestrial ecosystems. Topics include, among others: Plant competition; Interactions between trophic levels; Phenotypic plasticity of plant functional traits; Effects of changing environmental conditions on trait expression and plant performance |
| Qualifikationsziel |
| Advanced Statistics: <ul style="list-style-type: none"> ■ The students can apply advanced statistics and can select and implement tests in the statistical program R. For Zoology & Geobotany, the students can: |

- perform a scientific experiment independently (under supervision) from experimental design to statistical analyses and critical discussion.
- implement theories in ecology and evolutionary biology into own scientific projects.
- master the experimental methods and techniques (see above) necessary to perform their Master thesis project in Evolutionary Biology & Ecology.
- formulate a short research proposal and can write a report in the form of a scientific paper.

For geobotany, the students will specifically be able to

- quantify and interpret the complex interactions between changing environmental conditions and the expression and plasticity of plant functional traits.
- perform advanced analytical methods involved in plant ecophysiology and nutrient cycling.

Zu erbringende Prüfungsleistung

Scientific project report (25% of course mark)

Zu erbringende Studienleistung

- Scientific project, 100 % presence time
- Formulation of a short research proposal

Literatur

Selected papers on current topics in Evolutionary Biology and Functional Ecology.

Zwingende Voraussetzung

s. Modulebene

Lehrmethoden

Advanced Statistics: Lecture & Tutorials with worksheets

Experiments in Evolutionary Biology & Functional Ecology:

The students will do independent student-tailored scientific projects on topics currently investigated in the departments:

Zoology, e.g., host-parasite interactions, ageing, social evolution, communication.

Geobotany, e.g. plant functional ecology, ecophysiology, functional biodiversity research.

Each student will work on his/her own project (maximum 2 students per project) for the duration of 6 weeks (half-day) or 3 weeks (full-time) supervised by one scientist. Depending on the project they will learn and apply different techniques (Zoology: behavioral observations, chemical analyses, genetic microsatellite and sequencing studies, genomic analyses, gene expression studies via qPCR and gene silencing via RNA interference, phylogenetic reconstruction. Geobotany: chemical analyses of soil and plants, field spectroscopy, thermal imaging, gas exchange measurements, ecophysiological measurements, morphological trait analyses).

Each student will also formulate a short research proposal.



| Modulname | Nummer |
|---|---------------------|
| SP2-09 Experiments in Evolutionary Biology & Functional Ecology | 09LE03M-SP2-09 |
| Veranstaltung | |
| Current topics in Evolutionary Biology & Functional Ecology | |
| Veranstaltungsart | Nummer |
| Seminar | 09LE03S-SP2-09_0003 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 1.0 |
| Semesterwochenstunden (SWS) | 0.6 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | deutsch oder englisch |
| Präsenzstudium | 9 Stunden |
| Selbststudium | 21 Stunden |
| Workload | 30 Stunden |

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| Inhalte |
| Current topics in Evolutionary Biology and Functional Ecology: see Lecture and Practical exercise. |
| Qualifikationsziel |
| The students can: |
| <ul style="list-style-type: none"> ■ present and explain published scientific results to peers in English. ■ critical reflect and discuss those results within current concepts of Evolutionary Biology and Ecology |
| Zu erbringende Prüfungsleistung |
| <ul style="list-style-type: none"> ■ Presentation of scientific project results with discussion of project results within the conceptual framework of the lecture ('defense') make 25% of module grade. ■ oral examination (50% of module grade). |
| Zu erbringende Studienleistung |
| Preparation of talks, presence time 100% |
| Literatur |
| Selected papers on current topics in Evolutionary Biology and Ecology. |
| Zwingende Voraussetzung |
| s. Modulebene |
| Lehrmethoden |
| Oral presentations (in english) supported by power point. Active discussions between students and teachers. |

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| Modulname | Nummer |
|----------------------------|----------------|
| SP2-10 Plant Biotechnology | 09LE03M-SP2-10 |
| Modulverantwortliche/r | |
| Prof. Dr. Ralf Reski | |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

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|-----------------------------|-----------------------|
| ECTS-Punkte | 21.0 |
| Semesterwochenstunden (SWS) | 21.0 |
| Empfohlenes Fachsemester | 3 |
| Moduldauer | 1 |
| Pflicht/Wahlpflicht (P/WP) | Wahlpflicht |
| Präsenzstudium | 316 Stunden |
| Selbststudium | 314 Stunden |
| Workload | 630 Stunden |
| Angebotsfrequenz | nur im Wintersemester |

| Teilnahmevoraussetzung |
|------------------------|
| ■ OM-01 and/or OM-06 |
| ■ SP1-01 or SP1-06 |

| Zugehörige Veranstaltungen | | | | | |
|--|---------|---------|------|-------|-------------|
| Name | Art | P/WP | ECTS | SWS | Workload |
| Plant Biotechnology and functional Genome Analysis | Übung | Pflicht | 20.0 | 20.00 | 600 Stunden |
| Current topics in Plant Biotechnology | Seminar | Pflicht | 1.0 | 1.00 | 30 Stunden |

| Qualifikationsziel |
|--|
| The students can: |
| ■ work on an experimental project, e.g. with <i>Physcomitrella patens</i> , with a focus on molecular biology, cell biology or protein biochemistry or work on a theoretical project with a focus on bioinformatics. |
| ■ apply the acquired methods independently, document and interpret their results scientifically correctly and discuss them in the scientific context. |
| ■ reflect the basic principles of advanced microscopy (confocal laser scanning microscopy) and to perform microscopic analyses under supervision. |
| ■ collect information about scientific inventions in publications and patent applications, to interpret and judge patents and estimate the degree of inventive ingenuity. |
| ■ reflect on and discuss current topics of plant biotechnology. |
| Zu erbringende Prüfungsleistung |
| ■ written protocol |
| ■ oral exam |

Zu erbringende Studienleistung

- about 300 h of lab work during the exercises
- write a lab journal
- literature research
- written protocol
- taking part in discussions during the seminar

Benotung

- comprehensive, scientifically and linguistically correctly written protocol (20 – 30 pages; 50%)
- oral exam (50%)

Literatur

Scientific publications will be provided during the module

Verwendbarkeit der Veranstaltung

- M.Sc. Biology, Major Translational Biology
- M.Sc. Biology, Major Plant Sciences

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| Modulname | Nummer |
|--|---------------------|
| SP2-10 Plant Biotechnology | 09LE03M-SP2-10 |
| Veranstaltung | |
| Plant Biotechnology and functional Genome Analysis | |
| Veranstaltungsart | Nummer |
| Übung | 09LE03Ü-SP2-10_0001 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 20.0 |
| Semesterwochenstunden (SWS) | 20.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | deutsch oder englisch |
| Präsenzstudium | 300 Stunden |
| Selbststudium | 300 Stunden |
| Workload | 600 Stunden |

| Inhalte |
|--|
| The tutorial will prepare students for a master thesis in plant biotechnology or related applied research. The students will work independently, supervised by experienced group members, on an individual research objective. Possible topics: <ul style="list-style-type: none"> ■ Functional genome or proteome analysis with <i>Physcomitrella patens</i> ■ Analysis of differential gene regulation ■ Organelle proteomics ■ Protein targeting ■ Principles of homologous recombination and gene targeting in <i>Physcomitrella patens</i> ■ Phytohormone action and developmental processes ■ miRNA and cell cycle regulation in <i>Physcomitrella patens</i> ■ Production of recombinant glycoproteins in <i>Physcomitrella patens</i>: glyco-engineering, gene expression, optimization of cultivation conditions, downstream processing ■ Research, structure and analysis of biotechnological patents |
| Qualifikationsziel |
| The students can: <ul style="list-style-type: none"> ■ work on an experimental project, e.g. with <i>Physcomitrella patens</i>, with a focus on molecular biology, cell biology or protein biochemistry or work on a theoretical project with a focus on bioinformatics. ■ apply the acquired methods independently, document and interpret their results scientifically correctly and discuss them in the scientific context. ■ reflect on the basic principles of advanced microscopy (confocal laser scanning microscopy) and to perform microscopic analyses under supervision. ■ collect information about scientific inventions in publications and patent applications, to interpret and judge patents and estimate the degree of inventive ingenuity. |

Zu erbringende Prüfungsleistung

- Comprehensive, scientifically and linguistically correctly written protocol (20-30 pages; 50%)
- oral exam (50%)

Zu erbringende Studienleistung

- regular attendance
- about 300 h of lab work during the tutorials
- write a lab journal
- literature research
- written protocol

Literatur

Scientific publications will be provided during the module

Zwingende Voraussetzung

s. Modulebene

Lehrmethoden

Experimental work in a research laboratory (individually or in a group of two students), discussion of contents and results in the research group, scientific publications, manuals and written protocols of methods, Internet searches, databases.

Bemerkung / Empfehlung

Attendance of the lecture „Moderne Konzepte der Pflanzenwissenschaften II“ (SP2-11) is recommended.

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| Modulname | Nummer |
|---------------------------------------|---------------------|
| SP2-10 Plant Biotechnology | 09LE03M-SP2-10 |
| Veranstaltung | |
| Current topics in Plant Biotechnology | |
| Veranstaltungsart | Nummer |
| Seminar | 09LE03S-SP2-10_0002 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 1.0 |
| Semesterwochenstunden (SWS) | 1.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | englisch |
| Präsenzstudium | 16 Stunden |
| Selbststudium | 14 Stunden |
| Workload | 30 Stunden |

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| Inhalte |
| Current topics of the plant biotechnology group and scientific literature |
| Qualifikationsziel |
| The students can |
| <ul style="list-style-type: none"> ■ reflect on the presented questions and discuss the results ■ describe own approaches and report, explain and discuss their results |
| Zu erbringende Prüfungsleistung |
| none |
| Zu erbringende Studienleistung |
| <ul style="list-style-type: none"> ■ regular attendance (at least 80%) ■ active participation in the discussions |
| Literatur |
| Scientific publications and concepts will be provided during the module |
| Zwingende Voraussetzung |
| s. Modulebene |
| Lehrmethoden |
| Powerpoint presentation, handout, discussion in plenum or analysis of problems and results in teamwork as well as text analysis. Media: PowerPoint presentation, lab journal, scientific publications, whiteboard. |

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| Modulname | Nummer |
|--|----------------|
| SP2-11 Spezielle Themen der Pflanzenwissenschaften | 09LE03M-SP2-11 |
| Modulverantwortliche/r | |
| PD Dr. Thomas Kretsch | |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 21.0 |
| Semesterwochenstunden (SWS) | 22.0 |
| Empfohlenes Fachsemester | 3 |
| Moduldauer | 1 |
| Pflicht/Wahlpflicht (P/WP) | Wahlpflicht |
| Präsenzstudium | 330 Stunden |
| Selbststudium | 300 Stunden |
| Workload | 630 Stunden |
| Angebotsfrequenz | nur im Wintersemester |

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| Teilnahmevoraussetzung |
| <ul style="list-style-type: none"> ■ OM-06 ■ SP1-06 |
| Empfohlene Voraussetzung |
| <ul style="list-style-type: none"> ■ WM-18 ■ WM-19 ■ WM-24 ■ WM-25 |

| Zugehörige Veranstaltungen | | | | | |
|--|-----------|---------|------|-------|-------------|
| Name | Art | P/WP | ECTS | SWS | Workload |
| Moderne Konzepte der Pflanzenwissenschaften II | Vorlesung | | 2.0 | 2.00 | 60 Stunden |
| Übungen für Fortgeschrittene im Schwerpunkt Pflanzenwissenschaften | Übung | Pflicht | 19.0 | 20.00 | 570 Stunden |

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|--|
| Qualifikationsziel |
| <p>Die Studierenden können:</p> <ul style="list-style-type: none"> ■ grundlegende Konzepte und Vorgehensweisen des Pathway Engineering, der Produktion pharmazeutischer Proteine in Pflanzen und der Bionik erläutern ■ molekularbiologische Mechanismen darlegen, welche es der Pflanze ermöglichen adäquat auf biotische und abiotische Stressoren zu reagieren. ■ die grundlegenden Mechanismen und die verschiedenen Ebenen der Regulation der Genexpression bei Pflanzen beschreiben |

- die Prozesse und Dynamik der Biogenese von Plastiden und Mitochondrien darlegen und können die Funktion wichtige Proteinkomplexe bei diesen Vorgängen erläutern.
- wichtige Prozesse in der Entwicklung und Morphogenese der Pflanzen skizzieren und erläutern. Sie wissen wie exogene und endogene Faktoren in die Regulation der pflanzlichen Entwicklung eingreifen können und können darlegen, welche molekularen Mechanismen daran beteiligt sind.
- grundlegende Arbeitsabläufe in einem Labor der pflanzlichen Molekularbiologie anwenden
- an Hand von Versuchsprotokollen oder eigener Literaturrecherche selbstständig zellbiologische und molekularbiologische Experimente zu planen und durchzuführen.
- die Grundlagen, die Durchführung und die Grenzen wichtiger Methoden im Bereich der Molekularbiologie, Proteinbiochemie, Zellbiologie und Bioinformatik erläutern und darlegen.
- Versuchsergebnisse kritisch zu beurteilen und zur diskutieren.

Zu erbringende Prüfungsleistung

- Mindestens ein benotetes, ausführliches Protokoll in Form einer wissenschaftlichen Arbeit (ca. 20-30 Seiten) über ein Thema der Laborpraktika (50%)
- Mündliche Prüfung (45-60 min) durch zwei Dozenten aus dem SP2-11, einer der Prüfer muss ein offizieller Betreuer der Übungen sein, ein weiterer kann aus den Dozenten der Vorlesung ausgewählt werden (50% der Endnote)

Zu erbringende Studienleistung

- Mindestens 80% Anwesenheit bei den Vorlesungen
- selbständiges Nacharbeiten der Vorlesungsinhalte
- 300 h Arbeit im Labor während der Übungen (mindesten 2 x 4 Wochen in 2 Laboren oder 1 x 8 Wochen in einem Labor)
- schriftliche Ausarbeitung von Protokollen

Benotung

- Mindestens ein benotetes, ausführliches Protokoll in Form einer wissenschaftlichen Arbeit (ca. 20-30 Seiten) über ein Thema der Laborpraktika (50%)
- Mündliche Prüfung (45-60 min) durch zwei Dozenten aus dem SP2-11, einer der Prüfer muss ein offizieller Betreuer der Übungen sein, ein weiterer kann aus den Dozenten der Vorlesung ausgewählt werden (50% der Endnote)

Verwendbarkeit der Veranstaltung

M.Sc. Biologie, Schwerpunkt Pflanzenwissenschaften

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| Modulname | Nummer |
|--|---------------------|
| SP2-11 Spezielle Themen der Pflanzenwissenschaften | 09LE03M-SP2-11 |
| Veranstaltung | |
| Moderne Konzepte der Pflanzenwissenschaften II | |
| Veranstaltungsart | Nummer |
| Vorlesung | 09LE03V-SP2-11_0001 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 2.0 |
| Semesterwochenstunden (SWS) | 2.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | |
| Lehrsprache | deutsch oder englisch |
| Präsenzstudium | 30 Stunden |
| Selbststudium | 30 Stunden |
| Workload | 60 Stunden |

| Inhalte |
|--|
| <p>Die Vorlesung soll den Studierenden des Schwerpunkts nochmals einen Überblick über wichtige Themen und Konzepte in den Pflanzenwissenschaften bieten, welche im Schwerpunktmodul I bisher nicht behandelt wurden. Die Themenschwerpunkte sind:</p> <p>Biotechnologische Anwendungen:</p> <ul style="list-style-type: none"> ■ Pathway Engineering bei Pflanzen ■ Glykoprotein-Produktion im Moos-Bioreaktor ■ Produktionssysteme für rekombinante Biopharmazeutika: Kultivierungstechniken und Up-Scaling; N- und O-Glykosylierung von Proteinen; pharmazeutische Zielproteine; Vergleich von mikrobiellen Systemen, Säugetierzellkulturen und pflanzlichen Systemen ■ Grundlegende Begriffsdefinition der Bionik und der bionischen Arbeitsweise. ■ Zusammenhang und Wirkungsgefüge von technischer Biologie & Bionik ■ Selbstorganisationsprozesse in der Biologie ■ Entstehung und Eigenschaften biologischer Materialien und Strukturen ■ Teilbereiche der Bionik mit Beispielen ■ Beispiele für bionische Self-X Materialien: selbstadaptives Haften, Kleben und Antihafsten, selbstreparierende Materialien und selbstadaptive Formgebung ■ Strukturoptimierter bionischer Leichtbau: verzweigte und unverzweigte bionische Faserverbünde sowie bionische Dämpfungsmaterialien <p>Reaktionen auf biotische und abiotische Stressoren:</p> <ul style="list-style-type: none"> ■ Grundlegende Begrifflichkeiten zu biotischen Stressoren: Pathogenität, Virulenz und Aggressivität pflanzenpathogener Viren, Bakterien und Pilze, präformierte Barrieren ■ Reaktion von Pflanzen auf Infektionen (Symptomatik) ■ Pathogene Schadmechanismen: Nekrotrophie und Biotrophie |

- Infektionsmechanismen von Pathogenen: mechanische und enzymatische Penetration, Infektionsstrukturen, Parasitierungsmechanismen über Haustorien und aktive Aufnahme von Nährstoffen
- Gegenüberstellung pflanzliche Immunität und Immunsystem bei Vertebraten.
- PAMP/MAMP induzierte Immunität (PTI): Eigenschaften von Pathogen-assoziierten molekularen Mustern; Erkennung durch membranständige Rezeptoren; Aktivierung von Signalkaskaden und Transkriptionsfaktoren; Expression von Abwehrgenen und Abwehrmechanismen
- Anfälligkeit der Wirtspflanze: Mechanismen der Hemmung der PTI durch Effektoren der Pathogene (ETS)
- Effektoren der induzierte Immunität (ETI): Mechanismen der Erkennung von Effektoren, deren nachgeschalteten Signalweitergabe und die Auslösung der „Hypersensitive Response“
- Erläuterung des Phänomens der Nichtwirtsresistenz
- Coevolution zwischen Pathogen und Wirt: Wettkampf zwischen Pathogen und Wirt (Arms Race & Red-Queen-Hypothesis)
- Definitionen: abiotischer Stress und wichtiger Parameter bei abiotischem Stress.
- Reaktionen der Pflanze auf verschiedene Stressoren: Trockenstress, Kältestress, Salzstress, UV-Stress, oxidativer Stress und Überflutungsstress
- Akklimatisierungsmechanismen der Pflanze auf verschiedene Stressarten
- Signalwege zur Akklimatisierung bei den verschiedenen abiotischen Stressoren von der Perzeption über die Signaltransduktion bis hin zur Genexpression und zu Veränderungen im Metabolismus
- Reactive Oxygen Species (ROS) und ROS abfangende Mechanismen der Pflanze

Mechanismen der Genregulation:

- Eukaryotische Genstruktur: Promoter, Intron/Exon-Struktur, nicht-translatierte Bereiche, kodierende Abschnitte sowie Transkriptionsstart
- Expression eukaryontischer Gene: Transkription, Translation, Spleißen, Polyadenylierung, Capping sowie Nonsense-Mediated-Decay
- Regulation der Genaktivität über kleine RNAs: sRNA/siRNA/miRNA, Biogenese der miRNA, miRNA::Target-Interaktionen und Silencing
- Chromatinmodifikationen und deren Einfluss auf die Genaktivität von Pflanzen

Entwicklungsbiologie:

- Grundlagen der Entwicklungsbiologie bei Pflanzen
- MADS-box Proteine in der Entwicklung: Aufbau, Funktionsweise und Phylogenetik
- Die Rolle von MADS-Box Proteinen in der Spezifizierung der Identität der Blütenorgane und in der Embryonalentwicklung
- Mechanismen der Blühinduktion bei Pflanzen
- Grundlagen der Wirkungsmechanismen des Pflanzenhormons Auxin: Biosynthese, Transport und Signaltransduktion.

Biogenese und Dynamik von Plastiden und Mitochondrien:

- Organellen und Endosymbiontentheorie.
- Kompartimentierung des Metabolismus in den Organellen
- Proteintargeting und Import in Plastiden und Mitochondrien
- Subcellular Proteomics.
- Organelldynamik: Biogenese, Autophagie, Bewegung sowie Kontaktstellen zwischen Organellen.

Qualifikationsziel

Themenschwerpunkt „Biotechnologische Anwendungen“:

Die Studierenden können:

- die Notwendigkeit des Pathway Engineering für Mineralien und Metabolite schildern.
- die bei der Veränderung von Biosynthesewegen wesentlichen Strategien und Parameter bezüglich zellulärer Kompartimentierung, Kinetik und struktureller Organisation erläutern.

- Die Konzepte des kanalisierten Metabolismus und des Metabolons darlegen
- die Vor- und Nachteile verschiedener Produktionssysteme für rekombinante Biopharmazeutika beurteilen und Optimierungsebenen für pflanzliche Produktionssysteme beschreiben.
- grundlegende Begriffsdefinitionen der Bionik verwenden und die bionische Arbeitsweise erläutern.
- den Zusammenhang und das Wirkungsgefüge von technischer Biologie, Bionik & Reverser Bionik darstellen.
- Selbstorganisationsprozesse in der Biologie an Hand von Beispielen beschreiben.
- die Entstehung und Eigenschaften biologischer Materialien und Strukturen beschreiben.
- die Teilbereiche der Bionik benennen und können diese mit Beispielen darstellen.
- die biologischen Vorbilder, die Funktionsprinzipien und die technische Übertragung von bionischen Self-X Materialien anhand von Beispielen darstellen.
- die biologische Vorbilder, die Funktionsprinzipien und die technische Übertragung von strukturoptimierten bionischen Leichtbaustrukturen anhand von Beispielen darstellen.

Themenschwerpunkt „Biotische und abiotische Stressoren“:

Die Studierenden können:

- die Infektionsmechanismen phytopathogener Organismen und die Reaktionen der zweistufigen pflanzlichen Immunität (PTI und ETI) beschreiben.
- der Rolle von pflanzlichen Rezeptoren und Signalkaskaden für die pflanzliche Immunität beschreiben.
- die Funktion von Effektoren für die Anfälligkeit bzw. Pathogenität von Mikroorganismen benennen.
- pflanzlichen Abwehrmechanismen wie Reactive-Oxgene-Species und Hypersensitive Response benennen.
- die komplexen Interaktionen zwischen Pflanzen und Mikroorganismen bei der Entstehung von Pflanzenkrankheiten beschreiben.
- die evolutionären Aspekte von der Wechselwirkung zwischen pflanzlicher Immunität und der Pathogenität von Mikroorganismen beschreiben und deren Hintergründe darlegen.
- die Unterschiede zwischen pflanzlicher und tierischer Immunität benennen.
- Strukturen der präformierten Resistenz (Cuticula, Epidermis, Verkorkung) in Beziehung zu weiteren Funktionen des Abschlussgewebes der Pflanze setzen.
- abiotischen Stress und wichtige Parameter von abiotischem Stress definieren.
- die Reaktionen und Akklimatisierungsmechanismen der Pflanze auf Stressoren wie Kälte, Trockenheit/Hitze, Überflutung, Salz, Oxidativem Stress und UV beschreiben.
- Signaltransduktionswege bei verschiedenen Arten von abiotischem Stress sowie die daraus resultierende veränderte Genexpression und Änderungen des pflanzlichen Metabolismus zu beschreiben.
- die Bedeutung von ROS und ROS-abfangenden Mechanismen für die Pflanze erklären.

Themenschwerpunkt „Mechanismen der Genregulation“

Die Studierenden können:

- die Struktur eines eukaryotischen Gens skizzieren und beschreiben.
- an Hand der Darstellung von Expressions-evidenzen innerhalb eines Genome Browsers auf mögliche Regulations-mechanismen rückschließen und die Qualität der Aussage beurteilen.
- die Biogenese von miRNAs und Proteinen beschreiben.
- die verschiedenen Chromatinmodifikationen und den Einfluss der Chromatinmodifikationen sowie der Nukleosomen-verteilung auf die Genaktivität benennen.
- die verschiedenen Gruppen der Chromatin-faktoren (Chromatin Remodeler, Enzyme zur Modifizierung der DNA/Histone, Nucleosome Assembly Factors) benennen und jeweils Beispiele in Arabidopsis darlegen und deren Funktion erklären.

Themenschwerpunkt „Entwicklung“:

Die Studierenden:

- verstehen grundsätzliche Merkmale der Pflanzenentwicklung.

- erhalten eine Übersicht über Mechanismen der Zell-Zellkommunikation.
- verstehen Prinzipien der Meristemfunktion und von Stammzellen.

Die Studierenden können:

- die Rolle der MADS-Box Proteine in der Pflanzenentwicklung, insbesondere in der Blütenentwicklung erklären.
- den molekularen Wirkungsmechanismus dieser Proteine beschreiben.
- einen Einblick über den Einfluss der MADS-Box Proteine auf die morphologische Evolution der Blütenpflanzen gewinnen.
- den molekularen Mechanismus der Blühinduktion bei Lang- und Kurztagpflanzen beschreiben.
- unterschiedliche Funktionen von FT-Homologen in verschiedenen Pflanzen benennen.
- verstehen wie der Wechsel zwischen Vegetations- und Ruheperiode in ausdauernden Pflanzen auf molekularer Ebene reguliert wird.
- den Begriff "Vernalisierung" erklären und den entsprechenden Regulationsmechanismus beschreiben.
- den molekularen Mechanismus der Auxin-Signalwege erklären.
- verstehen, wie der Auxin-Transport funktioniert und kennen die molekularen Bausteine, die im Auxin-Transport eine wichtige Rolle spielen.
- die Grundlage und die molekulare Mechanismen von Auxin-Homöostase in der Zelle erklären.

Themenschwerpunkt „Biogenese und Dynamik von Plastiden und Mitochondrien“:

Die Studierenden können die Grundzüge des Proteintargeting und des Imports in Organellen beschreiben. Die Studierenden können die Dynamik von Plastiden und Mitochondrien beschreiben und mindestens ein Beispiel für Interaktionen zwischen Organellen an Kontaktstellen benennen.

Zu erbringende Prüfungsleistung

Die Inhalte der Vorlesung sind Bestandteil der mündlichen Abschlussprüfung des Moduls

Zu erbringende Studienleistung

Selbständiges Nacharbeiten der Vorlesungsinhalte

Literatur

Für den Bionik-Teil:

T. Speck, O. Speck, C. Neinhuis & H. Bargel (2012): Bionik - Faszinierende Lösungen der Natur für die Technik der Zukunft, 148 pp. – Lavori-Verlag, Freiburg.

Zwingende Voraussetzung

s. Modulebene

Lehrmethoden

Lehrmethoden: Frontalvortrag im Plenum; Frontalvortrag mit Fallbeispielen und anschließender Diskussion im Plenum

Medien: PowerPoint-Präsentationen, Folienhandouts



| Modulname | Nummer |
|--|---------------------|
| SP2-11 Spezielle Themen der Pflanzenwissenschaften | 09LE03M-SP2-11 |
| Veranstaltung | |
| Übungen für Fortgeschrittene im Schwerpunkt Pflanzenwissenschaften | |
| Veranstaltungsart | Nummer |
| Übung | 09LE03Ü-SP2-11_0002 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 19.0 |
| Semesterwochenstunden (SWS) | 20.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | deutsch oder englisch |
| Präsenzstudium | 300 Stunden |
| Selbststudium | 270 Stunden |
| Workload | 570 Stunden |

| Inhalte |
|--|
| <p>Die Übung dient der gezielten inhaltlichen und methodischen Vorbereitung auf eine Masterarbeit in den Pflanzenwissenschaften. Die Studierenden bearbeiten dabei, betreut durch erfahrene Mitglieder der verschiedenen Arbeitsgruppen, individuell eigene Projekte. Die Arbeitsgruppen und deren jeweilige Themen:</p> <p>AG Beyer (Beyer/Schaub/Welsch/Wüst):</p> <ul style="list-style-type: none"> ■ Molekulare Mechanismen des Carotinoid-Turnovers in <i>Arabidopsis</i> Mutanten ■ Charakterisierung von Carotinoid-Biosynthese-Enzymen <i>in vitro</i> ■ Analysen zur Wirkung von Strigolactonen und Karrikinen <p>AG Hiltbrunner (Hiltbrunner/Sheerin):</p> <ul style="list-style-type: none"> ■ Untersuchung der subzellulären Lokalisierung, Proteindynamik und Signalleitung von Phytochrom A unter natürlichen Lichtverhältnissen. <p>AG Kassemeyer:</p> <ul style="list-style-type: none"> ■ Mikroskopische und molekulare Untersuchungen zu Infektionsmechanismen phytopathogener Pilze und zur Abwehrantwort verschiedener Genotypen der Wirtspflanze (anfällige und resistente Kultivare bzw. Arten von <i>Vitis</i>/Weinrebe). <p>AG Kretsch:</p> <ul style="list-style-type: none"> ■ Untersuchungen zur Funktion der Familie der EID1-ähnlichen F-Box Proteine in der ABA- und Lichtsignalkaskade von <i>Arabidopsis</i> <p>AG Laux (Laux/Groot):</p> <ul style="list-style-type: none"> ■ Signaling pathways in plant stem cell maintenance ■ Live imaging of cellular development <p>AG Neuhaus (Fischer-Iglesias/Rodriguez/Weise):</p> |

- Untersuchung der MADS-Box Protein Signalnetzwerke
- Untersuchungen zur Analyse von Mutanten im STO/BBX24 Light Signaling Pathway
- Untersuchungen zur Expressionskontrolle von Saccharose Transporter Genen

AG Palme (Kircher/Li):

- Auxin signaling pathway in plant root growth and development
- Investigation of polarity regulation in plant cells using auxin efflux carriers (PINs and other markers)
- Untersuchungen zur Phytochrom Signalleitung bei *Arabidopsis*

AG Reski (Decker/Lang/Müller/Reski/Wiedemann):

- Definition und molekulare Analyse von Genfamilien und deren Diversifizierung
- Funktionelle Genom- und Proteomanalyse bei *Physcomitrella patens*: Analyse differentieller Genregulation, Organellen-Proteomics, Protein-Targeting, Grundlagen von homologer Rekombination und Gen-Targeting, Entwicklungssteuerung, Hormonwirkung, miRNA- und Zellzyklusregulation in *Physcomitrella patens*
- Produktion rekombinanter Glykoproteine in *Physcomitrella patens*: Glyco-Engineering, Optimierung der Genexpression, Kultivierungsparameter, Downstream-Processing
- Recherche, Aufbau und Analyse biotechnologischer Patente
- *In silico* Identifikation und Analyse von Genregulationsmechanismen mit Hilfe von Web-Tools oder bioinformatischen Methoden

AG Seiler:

- Signaltransduktionsmechanismen in filamentösen Pilzen
- Analyse von Zellkommunikation und Differenzierung bei *Neurospora*

Qualifikationsziel

Die Studierenden können:

- sich selbstständig in einem molekularbiologisch arbeitenden Labor zurechtfinden und beherrschen grundlegende Arbeitsabläufe in einem entsprechenden Labor.
- nach ausgewählten Arbeitsprotokollen selbstständig zellbiologische und molekularbiologische Experimente durchzuführen.
- alle wichtigen Informationen zu den Abläufen und Ergebnissen der Versuche zu dokumentieren und zu deuten und weiterführender Experimente zu planen.
- Versuchsergebnisse kritisch zu beurteilen und mit anderen zur Diskutieren.
- die Grundlagen, die Durchführung und Grenzen wichtiger Methoden im Bereich der Molekularbiologie, Proteinbiochemie, Zellbiologie und Bioinformatik erläutern und darlegen.
- sich selbstständig in ein Themengebiet der pflanzlichen Molekularbiologie einzuarbeiten.
- Die Studierenden können putative Genregulationsmechanismen für einzelne Gene mithilfe von Webtools wie gbrowse/Galaxy oder genomweit im Hochdurchsatz mit Hilfe von bioinformatischen Methoden erkennen und analysieren.
- wissenschaftliche Erfindungen in Publikationen und Patentschriften recherchieren, Patente interpretieren und bewerten und die Erfindungshöhe einschätzen.

Zu erbringende Prüfungsleistung

Der Inhalt der Vorlesung ist Bestandteil der mündlichen Abschlussprüfung des Moduls; Benotung des Protokolls.

Zu erbringende Studienleistung

- 300 h Arbeit im Labor während der Übungen (2 x 4 oder 1 x 8 Wochen); Auswertung der Daten aus den Experimenten
- Verfassen eines ausführlichen Protokolls in Form einer wissenschaftlichen Arbeit (ca. 20 – 30 Seiten) über ein Thema der Laborpraktika aus den Übungen

| |
|---|
| Literatur |
| Für den Bionik-Teil: T. Speck, O. Speck, C. Neinhuis & H. Bargel (2012): Bionik - Faszinierende Lösungen der Natur für die Technik der Zukunft, 148 pp. – Lavori-Verlag, Freiburg. |
| Zwingende Voraussetzung |
| s. Modulebene |
| Lehrmethoden |
| Lehrmethoden: Durchführung von Experimenten nach Anleitung durch einen Betreuer; Fallanalysen & Debattieren der erzielten Resultate mit dem Betreuer innerhalb der beteiligten Arbeitsgruppen; individuelles Verfassen eines ausführlichen Protokolls Medien: schriftliche Anleitungen zur Durchführung der Experimente; Tafel/Papier; Datenbanken, Internet-Recherche |
| Bemerkung / Empfehlung |
| Die Studierenden können frei zwischen den angebotenen Übungen in den verschiedenen Arbeitsgruppen wählen. Beginn und Ende der jeweiligen Übungen erfolgt in Absprache mit den anbietenden Dozenten. Es besteht die Möglichkeit die Übungen in 2 verschiedenen oder in einem einzigen Labor zu absolvieren. |

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| Modulname | Nummer |
|---|----------------|
| SP2-12 Synthetic Biology and Biochemistry | 09LE03M-SP2-12 |
| Modulverantwortliche/r | |
| Prof. Dr. Wilfried Weber | |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 21.0 |
| Semesterwochenstunden (SWS) | 17.0 |
| Empfohlenes Fachsemester | 3 |
| Moduldauer | 1 |
| Pflicht/Wahlpflicht (P/WP) | Wahlpflicht |
| Präsenzstudium | 255 Stunden |
| Selbststudium | 375 Stunden |
| Workload | 630 Stunden |
| Angebotsfrequenz | nur im Wintersemester |

| Teilnahmevoraussetzung |
|------------------------|
| ■ OM-01 |
| ■ SP1-01 |
| ■ WM-09 |

| Zugehörige Veranstaltungen | | | | | | |
|---|-----------|---------|------|-------|-------------|--|
| Name | Art | P/WP | ECTS | SWS | Workload | |
| Trends in Synthetic Biology | Vorlesung | | 1.0 | 1.00 | 30 Stunden | |
| Design and implementation of synthetic biological systems | Übung | Pflicht | 15.5 | 13.00 | 465 Stunden | |
| Scientific Writing and Project Management | Seminar | Pflicht | 4.5 | 3.00 | 135 Stunden | |

| Qualifikationsziel |
|--|
| The students are able: |
| ■ to explain the principles of synthetic biology |
| ■ to apply methods of synthetic biology |
| ■ to present a project management plan |
| ■ to write a short scientific proposal |
| Zu erbringende Prüfungsleistung |
| ■ Written research proposal |
| ■ project management presentation |

| |
|---|
| Zu erbringende Studienleistung |
| <ul style="list-style-type: none">■ At least 90 % attendance.■ Active participation■ Writing of experimental lab journal |
| Benotung |
| <ul style="list-style-type: none">■ Written research proposal (40%)■ project management presentation (60%) |
| Literatur |
| <ul style="list-style-type: none">■ Course script will be distributed■ Literature search by the students (supported by the supervisor) |
| Verwendbarkeit der Veranstaltung |
| M.Sc. Biologie, Major Translational Biology |

↑

| Modulname | Nummer |
|---|---------------------|
| SP2-12 Synthetic Biology and Biochemistry | 09LE03M-SP2-12 |
| Veranstaltung | |
| Trends in Synthetic Biology | |
| Veranstaltungsart | Nummer |
| Vorlesung | 09LE03V-SP2-12_0001 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 1.0 |
| Semesterwochenstunden (SWS) | 1.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | |
| Lehrsprache | englisch |
| Präsenzstudium | 15 Stunden |
| Selbststudium | 15 Stunden |
| Workload | 30 Stunden |

| Inhalte |
|--|
| Latest insights in Synthetic Biology: <ul style="list-style-type: none"> ■ Synthetic Biology in mammalian cells ■ Molecular switches ■ Synthetic gene networks ■ Optogenetic approaches ■ Plant synthetic biotechnology ■ Interactive hybrid biomaterials ■ Synthetic membrane systems |
| Qualifikationsziel |
| The students are able to explain the principles of synthetic biology in detail |
| Zu erbringende Prüfungsleistung |
| none |
| Zu erbringende Studienleistung |
| Independent rehearsal of the lecture contents |
| Zwingende Voraussetzung |
| s. Modulebene |
| Lehrmethoden |
| Power Point Presentation, Discussion |

↑

| Modulname | Nummer |
|---|---------------------|
| SP2-12 Synthetic Biology and Biochemistry | 09LE03M-SP2-12 |
| Veranstaltung | |
| Design and implementation of synthetic biological systems | |
| Veranstaltungsart | Nummer |
| Übung | 09LE03Ü-SP2-12_0002 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 15.5 |
| Semesterwochenstunden (SWS) | 13.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | deutsch oder englisch |
| Präsenzstudium | 195 Stunden |
| Selbststudium | 270 Stunden |
| Workload | 465 Stunden |

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|---|
| Inhalte |
| Lab work on a topic in the field of synthetic biology. |
| Qualifikationsziel |
| The students are able: |
| <ul style="list-style-type: none"> ■ to define and explain a project in the field of synthetic biology ■ to design, construct and implement synthetic networks in mammalian and/or plant cells ■ to design synthetic membrane systems and to reconstitute cellular processes ■ to analyze and discuss the results of their experimental work ■ to prepare and use hybrid biomaterials ■ to document their experimental data in a lab journal ■ to search for relevant literature |
| Zu erbringende Prüfungsleistung |
| none |
| Zu erbringende Studienleistung |
| <ul style="list-style-type: none"> ■ active participation ■ record experimental conditions and results in a lab journal |
| Literatur |
| Literature search by the students (supported by the supervisor). |
| Zwingende Voraussetzung |
| s. Modulebene |

Lehrmethoden

Lab work under supervision of an experienced group member.



| Modulname | Nummer |
|---|------------------------|
| SP2-12 Synthetic Biology and Biochemistry | 09LE03M-SP2-12 |
| Veranstaltung | |
| Scientific Writing and Project Management | |
| Veranstaltungsart | Nummer |
| Seminar | 09LE03S-SP2-06/12_0003 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 4.5 |
| Semesterwochenstunden (SWS) | 3.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | deutsch oder englisch |
| Präsenzstudium | 45 Stunden |
| Selbststudium | 90 Stunden |
| Workload | 135 Stunden |

| |
|--|
| Inhalte |
| <ul style="list-style-type: none"> ■ Scientific writing ■ Project management ■ Presentation style ■ Time and stress management ■ Patenting and exploitation of inventions |
| Qualifikationsziel |
| <p>The students are able to:</p> <ul style="list-style-type: none"> ■ write a short scientific proposal ■ present a project management plan ■ describe the steps for patenting and exploitation of inventions |
| Zu erbringende Prüfungsleistung |
| <ul style="list-style-type: none"> ■ Written research proposal (40%) ■ oral presentation of a project management plan respective to the planned master thesis (60%) |
| Zu erbringende Studienleistung |
| <ul style="list-style-type: none"> ■ At least 90% attendance (1 day max. absence) ■ Active participation |
| Literatur |
| Course script will be distributed |
| Zwingende Voraussetzung |
| s. Modulebene |

Lehrmethoden

- Power point presentation
- Group work
- Discussion

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| Modulname | Nummer |
|---|----------------|
| SP2-13 Molecular Genetics and Signalling in Prokaryotic Organisms | 09LE03M-SP2-13 |
| Modulverantwortliche/r | |
| Prof. Dr. Annegret Wilde | |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 21.0 |
| Semesterwochenstunden (SWS) | 17.0 |
| Empfohlenes Fachsemester | 3 |
| Moduldauer | 1 |
| Pflicht/Wahlpflicht (P/WP) | Wahlpflicht |
| Präsenzstudium | 255 Stunden |
| Selbststudium | 375 Stunden |
| Workload | 630 Stunden |
| Angebotsfrequenz | nur im Wintersemester |

| Teilnahmevoraussetzung |
|------------------------|
| ■ none |

| Zugehörige Veranstaltungen | | | | | |
|--------------------------------------|---------|---------|------|-------|-------------|
| Name | Art | P/WP | ECTS | SWS | Workload |
| Methods in Molecular Biology | Übung | Pflicht | 18.0 | 15.00 | 540 Stunden |
| Current Topics in Microbial Genetics | Seminar | Pflicht | 3.0 | 2.00 | 90 Stunden |

| Qualifikationsziel |
|---|
| The students are able to: |
| <ul style="list-style-type: none"> ■ design, perform, document and evaluate experiments on a current research topic in the field of prokaryotic genetics and molecular biology ■ present and discuss results from their own experimental work. ■ understand and discuss experimental studies from their colleagues as well as from other laboratories in the field of Molecular Biology and Genetics of Prokaryotes. ■ assess the use of methods from other studies for their own work. |
| Zu erbringende Prüfungsleistung |
| <ul style="list-style-type: none"> ■ Comprehensive protocol ■ Seminar talk |

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| Zu erbringende Studienleistung |
| <ul style="list-style-type: none">■ 225 h experimental work in the lab or bioinformatics analyses■ Comprehensive protocol of own research work■ Seminar talk (30 min) and discussion about own experimental work |
| Benotung |
| <ul style="list-style-type: none">■ Comprehensive protocol: 66%■ Seminar talk (30 min) about own experimental work plus extended discussion (15-30 min) about the research field: 33% |
| Literatur |
| Selected literature of the individual research topic (original articles, reviews). |
| Verwendbarkeit der Veranstaltung |
| M.Sc. Biology, Major Genetics & Developmental Biology M.Sc. Biology, Major Biochemistry & Microbiology |

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| Modulname | Nummer |
|---|---------------------|
| SP2-13 Molecular Genetics and Signalling in Prokaryotic Organisms | 09LE03M-SP2-13 |
| Veranstaltung | |
| Methods in Molecular Biology | |
| Veranstaltungsart | Nummer |
| Übung | 09LE03Ü-SP2-13_0001 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 18.0 |
| Semesterwochenstunden (SWS) | 15.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | deutsch oder englisch |
| Präsenzstudium | 225 Stunden |
| Selbststudium | 315 Stunden |
| Workload | 540 Stunden |

| Inhalte |
|--|
| <p>Students work in the laboratory in a current research project of the lecturers including:</p> <ul style="list-style-type: none"> ■ Gene regulation in prokaryotic and eukaryotic microorganisms ■ Analysis of differential gene expression ■ Methods for genetic manipulation (targeted gene knockout, homologous recombination, antisense technology, conjugation and transformation) ■ Design and implementation of synthetic metabolic and regulatory pathways and elements ■ RNA-based regulation ■ RNA degradation ■ Regulation based on light perception via photoreceptors ■ Biotechnological application of microalgae (green biotechnology) ■ Signalling in prokaryotes with second messengers and other small molecules ■ Design of new optogenetic tools |
| Qualifikationsziel |
| <p>The students are able to:</p> <ul style="list-style-type: none"> ■ design experiments in relation to a scientific hypothesis ■ understand the role of their small scientific project in the whole project ■ conduct experiments carefully (including experimental controls and statistical analysis) ■ establish new methods in the lab or establish existing methods to a new problem or organism ■ document their work sufficiently for others to judge and repeat it ■ explain and comment on the basics, realization and limitations of important methods in Molecular Biology, Genetics, Biochemistry, Microbiology and Bioinformatics |

Zu erbringende Prüfungsleistung

Written protocol of the experimental work, consisting of Introduction, Materials and Methods, Results and Discussion sections. (66% of module grade)

Zu erbringende Studienleistung

- 225 h experimental work in the lab or bioinformatics analyses
- Comprehensive protocol of own experimental work

Literatur

Selected literature on the individual research topic (original publications, review articles).

Zwingende Voraussetzung

s. Modulebene

Lehrmethoden

- Experimental work in research laboratories, teamwork, documentation
- Supervision by experienced researchers with stimulation of independence.



| Modulname | Nummer |
|---|---------------------|
| SP2-13 Molecular Genetics and Signalling in Prokaryotic Organisms | 09LE03M-SP2-13 |
| Veranstaltung | |
| Current Topics in Microbial Genetics | |
| Veranstaltungsart | Nummer |
| Seminar | 09LE03S-SP2-13_0002 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 3.0 |
| Semesterwochenstunden (SWS) | 2.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | englisch |
| Präsenzstudium | 30 Stunden |
| Selbststudium | 60 Stunden |
| Workload | 90 Stunden |

| |
|---|
| Inhalte |
| Tje students will present a seminar on their scientific laboratory project related to: |
| <ul style="list-style-type: none"> ■ Gene regulation in prokaryotic and eukaryotic microorganisms ■ Analysis of differential gene expression ■ Methods for genetic manipulation (targeted gene knockout, homologous recombination, antisense technology, conjugation and transformation) ■ Design and implementation of synthetic metabolic and regulatory pathways and elements ■ RNA-based regulation ■ Regulation based on light perception via photoreceptors ■ Interpretation and application of genomic data ■ Biotechnological application of microalgae ■ Signalling in prokaryotes with second messengers and other small molecules |
| Qualifikationsziel |
| <p>The students are able to:</p> <ul style="list-style-type: none"> ■ present their results and discuss them in relation to scientific literature ■ search literature and gene informations in databases ■ plan and design a scientific talk in form of a power point presentation ■ discuss their work in terms of trouble-shooting and statistical analysis ■ evaluate their specific contribution to a broader topic |
| Zu erbringende Prüfungsleistung |
| Own seminar talk (30 min and intensive discussion) (33% of module grade). |

| |
|--|
| Zu erbringende Studienleistung |
| Own seminar talk (30 min and intensive discussion). |
| Literatur |
| Selected literature on the individual research topic (original publications, review articles). |
| Zwingende Voraussetzung |
| s. Modulebene |
| Lehrmethoden |
| Power Point presentation, discussion with the members of the laboratories and supervisor. |

↑

| Modulname | Nummer |
|------------------------|----------------|
| SP2-14 Neurophysiology | 09LE03M-SP2-14 |
| Modulverantwortliche/r | |
| Prof. Dr. Ulrich Egert | |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 21.0 |
| Semesterwochenstunden (SWS) | 20.0 |
| Empfohlenes Fachsemester | 3 |
| Moduldauer | 1 |
| Pflicht/Wahlpflicht (P/WP) | Wahlpflicht |
| Präsenzstudium | 260 Stunden |
| Selbststudium | 370 Stunden |
| Workload | 630 Stunden |
| Angebotsfrequenz | nur im Wintersemester |

| Teilnahmevoraussetzung |
|------------------------|
| ■ OM-05 |
| ■ SP1-05 |

| Zugehörige Veranstaltungen | | | | | | |
|---|---------|-------------|------|-------|-------------|--|
| Name | Art | P/WP | ECTS | SWS | Workload | |
| Scientific Programming in Python (S1) | Übung | Pflicht | 3.0 | 2.00 | 90 hours | |
| Neurophysiology I: Measurement and Analysis of Neuronal Activity | Übung | Wahlpflicht | 2.0 | 2.00 | 60 Stunden | |
| Neurophysiology II – Neurophysiology of Acute Brain Slices | Übung | Wahlpflicht | 6.0 | 6.00 | 180 Stunden | |
| Lab Projects Neurophysiology | Übung | Pflicht | 6.0 | 6.00 | 180 Stunden | |
| Current Research Topics in Systems Neuroscience (S1) | Seminar | Pflicht | 2.0 | 1.30 | 60 Stunden | |
| Neural Circuits and Behavior: Developmental Neurosciences and behavioral physiology | Seminar | Wahlpflicht | 2.0 | 2.00 | 60 Stunden | |
| Research Project (P2) | Übung | Pflicht | 9.0 | 10.00 | 270 hours | |

| Qualifikationsziel |
|---|
| The students are able to: |
| ■ explain the theoretical foundations of neurophysiological measurement techniques and data analyses and can record and analyze electrical activity in individual neurons and networks with tools used in current research. |

- assess the electrophysiological properties of individual neurons, synaptic properties and network dynamics with the corresponding experimental paradigms and techniques.
- present and critically assess the concepts, implementations and interpretation of electrophysiological experiments in scientific style using own data.
- connect neurobiological concepts / signal with methods for quantitative analysis.

Zu erbringende Prüfungsleistung

- Protocols of the exercises Neurophysiology I and II
- Two oral presentations in Neurophysiology II

Benotung

- Printed protocol of the results of Neurophysiology I (10% of the module grade)
- Printed protocol of the exercises in the style of a journal publication on Neurophysiology II (50% of the module grade)
- Two oral presentations on Neurophysiology II (each counting 10% of the module grade)
- Seminar presentation and discussion (30% of the module grade)

Literatur

- Bear, Connors, Paradiso: Neurowissenschaften, Spektrum Vlg., Chapt. 2-7, 8-14, 24, 25
- Johnston, Wu: Foundations of Cellular Neurophysiology, MIT Press, Chapt. 1-6, 14, 15
- Primary literature and academic reviews as provided for Neurophysiology II.

Verwendbarkeit der Veranstaltung

M.Sc. Biology, Major Neuroscience

↑

| Modulname | Nummer |
|---------------------------------------|---------------------|
| SP2-14 Neurophysiology | 09LE03M-SP2-14 |
| Veranstaltung | |
| Scientific Programming in Python (S1) | |
| Veranstaltungsart | Nummer |
| Übung | 09LE03Ü-SP2-04_0001 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 3.0 |
| Semesterwochenstunden (SWS) | 2.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | englisch |
| Präsenzstudium | 30 hours |
| Selbststudium | 60 hours |
| Workload | 90 hours |

| |
|---|
| Inhalte |
| This course equips students with the techniques to design their own scientific programs in Python, for example to analyze data or simulate a problem. The lectures cover basics of Python programming. |
| <ul style="list-style-type: none"> ■ Variables, types and expressions ■ Loops, conditions and exceptions ■ Built-in functions and user designed functions ■ Numpy (numerical library for Python) ■ Plotting in Python, guidelines for good plotting practice |
| Qualifikationsziel |
| The students have the competence to |
| <ul style="list-style-type: none"> ■ Convert a simple problem into a Python program ■ Implement simple programs for data analysis ■ Implement simple programs for data visualization |
| Zu erbringende Prüfungsleistung |
| none |
| Zu erbringende Studienleistung |
| <ul style="list-style-type: none"> ■ Regular participation in discussion of exercises ■ Passing a written exam |
| Literatur |
| See http://www.python.org/ for some general information and an online tutorial on the programming language Python. Further documentation on the scientific libraries used in the course is also found online (see http://scipy.org/). |

Zwingende Voraussetzung

see module level

Lehrmethoden

Lectures, exercises, students programming on the computer

↑

| Modulname | Nummer |
|--|---------------------|
| SP2-14 Neurophysiology | 09LE03M-SP2-14 |
| Veranstaltung | |
| Neurophysiology I: Measurement and Analysis of Neuronal Activity | |
| Veranstaltungsart | Nummer |
| Übung | 09LE03Ü-SP2-14_0002 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 2.0 |
| Semesterwochenstunden (SWS) | 2.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Wahlpflicht |
| Lehrsprache | deutsch oder englisch |
| Präsenzstudium | 30 Stunden |
| Selbststudium | 30 Stunden |
| Workload | 60 Stunden |

| Inhalte |
|--|
| Technical introduction to data analysis techniques for beginners. The exercises cover <ul style="list-style-type: none"> ■ analysis of spikes ■ synaptic events and neuronal properties ■ local field potentials. |
| Qualifikationsziel |
| The students <ul style="list-style-type: none"> ■ can explain and apply the theoretical foundations of neurophysiological measurement techniques and data analyses. ■ can adequately use recording devices and analyze electrical activity in individual neurons and networks. ■ are able to program basic analyses of spike activity, synaptic potentials and local field potentials using Matlab. |
| Zu erbringende Prüfungsleistung |
| Printed protocol of the results (10% of the module grade) |
| Zu erbringende Studienleistung |
| <ul style="list-style-type: none"> ■ Active participation in the practical parts and programming exercises. ■ Active participation in the interactive presentations. ■ Submission of a written protocol on the exercises. ■ Submission of a printed results protocol of the Matlab exercises according to guidelines of the script. ■ Attendance of the course days (100%). |
| Literatur |
| None |

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| Zwingende Voraussetzung |
| s. Modulebene |
| Lehrmethoden |
| <p>The course will be taught in the form of</p> <ul style="list-style-type: none">■ classroom lectures,■ Interactive presentations■ tutoring during practical sessions and programming. <p>The following media will be used:</p> <ul style="list-style-type: none">■ scripts for practical sessions,■ Powerpoint presentations,■ self-paced Matlab tutorials,■ data from neurophysiological recordings. |

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| Modulname | Nummer |
|--|---------------------|
| SP2-14 Neurophysiology | 09LE03M-SP2-14 |
| Veranstaltung | |
| Neurophysiology II – Neurophysiology of Acute Brain Slices | |
| Veranstaltungsart | Nummer |
| Übung | 09LE03Ü-SP2-14_0003 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 6.0 |
| Semesterwochenstunden (SWS) | 6.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Wahlpflicht |
| Lehrsprache | deutsch oder englisch |
| Präsenzstudium | 90 Stunden |
| Selbststudium | 90 Stunden |
| Workload | 180 Stunden |

| Inhalte |
|--|
| The course covers electrophysiological recordings in acute brain slices of the neocortex and the hippocampus to teach widely used methods by recording and analyzing the activity and properties of individual neurons and networks. The course is an intense exercise using advanced techniques of neurophysiological research, emphasizing independent use of high-tech equipment and critical analysis and interpretation of own research data. Specifically, participants will perform <ul style="list-style-type: none"> ■ Intracellular recordings using the patch clamp technique, ■ Extracellular recordings using microelectrode arrays, ■ Measure fundamental properties of pyramidal cells of the neocortex, ■ Analyze the properties of synaptic potentials, ■ Measure local field potentials in different tissue configurations, ■ Visualize activity dynamics in brain slices, ■ Assess synaptic plasticity in long-term potentiation paradigms. The results obtained will be presented in the style of a conference workshop among the participants. |
| Qualifikationsziel |
| The students <ul style="list-style-type: none"> ■ are able to prepare and document immunocytochemical stains of brain slices ■ can name neuronal subtypes in the hippocampus, fiber tracts and their connectivity and explain their functions, respectively ■ can record and analyze electrical activity in individual neurons and networks with tools used in current research. ■ are able to assess the electrophysiological properties of individual neurons, synaptic properties and network dynamics with the corresponding experimental paradigms and techniques. ■ can stimulate neurons and neural tissue for different paradigms |

- are able to present in speech and writing the concepts, implementations and interpretation of electrophysiological experiments in scientific style using own data.
- are able to critically assess electrophysiological experiments.
- are able to connect neurobiological concepts and signal with methods for their quantitative analysis.

Zu erbringende Prüfungsleistung

- Printed protocol of the exercises in the style of a journal publication (50% of the module grade)
- Two oral presentations (each counting 10% of the module grade)

Zu erbringende Studienleistung

- Active participation in the practical parts,
- Active participation in the interactive colloquia,
- Preparation and oral presentation of introductory topics as assigned during the course,
- Preparation in a group and oral presentation of the results of the experiments in the style of a scientific conference contribution,
- Preparation of a protocol on the exercises,
- Attendance of the course days (100%).

Literatur

- Johnston, Wu: Foundations of Cellular Neurophysiology, MIT Press, Chapt. 1-6, 14, 15
- Primary literature and academic reviews as provided

Zwingende Voraussetzung

s. Modulebene

Lehrmethoden

The course will be taught in the form of

- classroom lectures,
- Interactive presentations,
- Individual work on electrophysiological setups and during data analysis,
- group work
- lab visits to research laboratories,
- tutoring during practical sessions and programming.

The following media will be used:

- scripts for practical sessions,
- electrophysiological research equipment,
- lab equipment for histology
- Powerpoint presentations,
- several software toolboxes for data analysis and visualization,
- data from neurophysiological recordings.



| Modulname | Nummer |
|-------------------------------|---------------------|
| SP2-14 Neurophysiology | 09LE03M-SP2-14 |
| Veranstaltung | |
| Lab Projects Neurophysiology | |
| Veranstaltungsart | Nummer |
| Übung | 09LE03Ü-SP2-14_0004 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 6.0 |
| Semesterwochenstunden (SWS) | 6.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | deutsch oder englisch |
| Präsenzstudium | 90 Stunden |
| Selbststudium | 90 Stunden |
| Workload | 180 Stunden |

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|--|
| Inhalte |
| The lab-projects introduce the students to specific research topics in one laboratory in the context of a small project. Students learn to prepare their project, plan, carry out, analyze and interpret the respective experiments. At the end of the project, they will summarize the findings in the form of a scientific report and present them to the respective laboratory. During the course, the students will attend advanced laboratory seminars. |
| Qualifikationsziel |
| Students can: <ul style="list-style-type: none">■ design small projects for specific research questions,■ perform background literature research using journal articles,■ plan the necessary experiment and analysis steps,■ present in speech and writing the concepts, implementations and interpretation of electrophysiological experiments in scientific style using own data,■ critically assess electrophysiological experiments. |
| The skills acquired depend on the specific project and will vary as needed to perform the necessary experiments. |
| Zu erbringende Prüfungsleistung |
| none |

Zu erbringende Studienleistung

- At least 80% physical presence during time of lab projects.
- Active participation in all steps of the project.
- Presentation of the results in a written and an oral report.
- Participation in the laboratory seminar.

Literatur

Primary literature and academic reviews as provided.

Zwingende Voraussetzung

s. Modulebene

Lehrmethoden

The course will be taught in the form of
Individual instructions by faculty and staff:

- Tutoring
- Self-guided studying.

The following media will be used:

- Research equipment for neurophysiology



| Modulname | Nummer |
|--|---------------------------|
| SP2-14 Neurophysiology | 09LE03M-SP2-14 |
| Veranstaltung | |
| Current Research Topics in Systems Neuroscience (S1) | |
| Veranstaltungsart | Nummer |
| Seminar | 09LE03S-SP2-04/14/16_0005 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 2.0 |
| Semesterwochenstunden (SWS) | 1.3 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | englisch |
| Präsenzstudium | 18,2 Stunden |
| Selbststudium | 41,8 Stunden |
| Workload | 60 Stunden |

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|---|
| Inhalte |
| Each student presents an advanced research topic from the neurosciences. All students from "Neurophysiology", "Neurogenetics" and "Computational Neuroscience" will take part in this seminar. The topic of each student will be related to the Schwerpunktmodul II that the student chose. |
| Qualifikationsziel |
| The students have the competence to |
| <ul style="list-style-type: none"> ■ extract the important findings in a research publication and summarize and present them in a meaningful way ■ prepare and present a well structured scientific presentation in English. ■ explain an advanced research topic from the neurosciences |
| Zu erbringende Prüfungsleistung |
| <ul style="list-style-type: none"> ■ presentation ■ answers to questions and discussion after the presentation |
| Zu erbringende Studienleistung |
| <ul style="list-style-type: none"> ■ regular attendance (100%) ■ active participation in the discussions ■ preparation and presentation of a seminar topic |
| Literatur |
| Literature for the seminar topics will be provided in advance |
| Zwingende Voraussetzung |
| s. Modulebene |

Lehrmethoden

- discussion of the seminar presentation with the supervisor before and after the talk
- advice concerning the structure, format and appearance of the presentation as well as the use of scientific language, rhetorical skills and body language
- guided discussion after each presentation
- explanation of unclear aspects of the presentations by the supervisors

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| Modulname | Nummer |
|---|-----------------|
| SP2-14 Neurophysiology | 09LE03M-SP2-14 |
| Veranstaltung | |
| Neural Circuits and Behavior: Developmental Neurosciences and behavioral physiology | |
| Veranstaltungsart | Nummer |
| Seminar | 09LE03S-OS_0033 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-------------------|
| ECTS-Punkte | 2.0 |
| Semesterwochenstunden (SWS) | 2.0 |
| Empfohlenes Fachsemester | |
| Angebotsfrequenz | in jedem Semester |
| Pflicht/Wahlpflicht (P/WP) | Wahlpflicht |
| Lehrsprache | englisch |
| Präsenzstudium | 15 Stunden |
| Selbststudium | 15 Stunden |
| Workload | 60 Stunden |

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|---|
| Inhalte |
| |
| Zu erbringende Prüfungsleistung |
| Seminarvortrag |
| Zu erbringende Studienleistung |
| Aktive Teilnahme an den Seminarvorträgen. |
| Zwingende Voraussetzung |
| |

↑

| Modulname | Nummer |
|-------------------------------|---------------------|
| SP2-14 Neurophysiology | 09LE03M-SP2-14 |
| Veranstaltung | |
| Research Project (P2) | |
| Veranstaltungsart | Nummer |
| Übung | 09LE03Ü-SP2-04_0003 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 9.0 |
| Semesterwochenstunden (SWS) | 10.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | englisch |
| Präsenzstudium | 150 hours |
| Selbststudium | 120 hours |
| Workload | 270 hours |

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| Inhalte |
| Depending on the chosen project and supervisor the student will learn different neuroscience research methods. Among them experimental techniques, data analysis techniques, mathematical modelling techniques and numerical simulation techniques. The student will further acquire knowledge about the neuroscientific topic of his research project and will learn how to write a scientific project report and give an oral presentation about their research project. |
| Qualifikationsziel |
| Students <ul style="list-style-type: none">■ can carry out a neuroscientific research project under the supervision of an experienced researcher■ can write a scientific report (10 pages) about their research project■ can give a scientific oral presentation about their research project■ can explain the neuroscientific context of their research project |
| Zu erbringende Prüfungsleistung |
| <ul style="list-style-type: none">■ Written report (80%): The written report should have the form of a short scientific paper, typically including the sections Introduction, Methods, Results and Discussion followed by a list of references. The cover page should contain your name, the title of the research project, the name and affiliation of the supervisor, the starting- and end-date of your project and the date of submission of the report. A typical report is about 5 to 10 pages incl. figures, excl. references and appendix (when using font size 11, single line spacing, a margin of min 1.5 cm all sides).■ Oral presentation (20%): You will give an oral presentation of the results of your research project to the corresponding supervisor (typically including the research group of the supervisor). |
| Zu erbringende Studienleistung |
| none |

| |
|---|
| Literatur |
| Will be provided at the beginning of the module |
| Zwingende Voraussetzung |
| see module level |
| Lehrmethoden |
| regular discussion of findings, methods and problems with the supervisors |

↑

| Modulname | Nummer |
|------------------------|----------------|
| SP2-16 Neurogenetics | 09LE03M-SP2-16 |
| Modulverantwortliche/r | |
| Prof. Dr. Dierk Reiff | |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|----------------------------|
| ECTS-Punkte | 21.0 |
| Semesterwochenstunden (SWS) | 20.0 |
| Empfohlenes Fachsemester | 3 |
| Moduldauer | 1 |
| Pflicht/Wahlpflicht (P/WP) | Wahlpflicht |
| Präsenzstudium | rechne ich selber zusammen |
| Selbststudium | rechne ich selber zusammen |
| Workload | 630 Stunden |
| Angebotsfrequenz | nur im Wintersemester |

| Teilnahmevoraussetzung |
|------------------------|
| ■ OM-05 |
| ■ SP1-05 |

| Zugehörige Veranstaltungen | | | | | |
|---|---------|-------------|------|-------|------------|
| Name | Art | P/WP | ECTS | SWS | Workload |
| Scientific Programming in Python (S1) | Übung | Pflicht | 3.0 | 2.00 | 90 hours |
| Current Research Topics in Systems Neuroscience (S1) | Seminar | Pflicht | 2.0 | 1.30 | 60 Stunden |
| Neural Circuits and Behavior: Developmental Neurosciences and behavioral physiology | Seminar | Wahlpflicht | 2.0 | 2.00 | 60 Stunden |
| Research Project (P2) | Übung | Pflicht | 9.0 | 10.00 | 270 hours |

| Qualifikationsziel |
|--|
| bitte gib mir hier noch die Lernziele des Gesamtmoduls |
| Zu erbringende Prüfungsleistung |
| bitte Prüfungsleistungen spezifizieren |
| Zu erbringende Studienleistung |
| bitte Studienleistungen spezifizieren |
| Benotung |
| ■ bitte gib mir hier noch die Prüfungsleistungen an |

Literatur

- Bitte Literatur fürs Gesamtmodul angeben

Verwendbarkeit der Veranstaltung

M.Sc. Biology, Major Neuroscience

↑

| Modulname | Nummer |
|---------------------------------------|---------------------|
| SP2-16 Neurogenetics | 09LE03M-SP2-16 |
| Veranstaltung | |
| Scientific Programming in Python (S1) | |
| Veranstaltungsart | Nummer |
| Übung | 09LE03Ü-SP2-04_0001 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 3.0 |
| Semesterwochenstunden (SWS) | 2.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | englisch |
| Präsenzstudium | 30 hours |
| Selbststudium | 60 hours |
| Workload | 90 hours |

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| Inhalte |
| This course equips students with the techniques to design their own scientific programs in Python, for example to analyze data or simulate a problem. The lectures cover basics of Python programming. |
| <ul style="list-style-type: none"> ■ Variables, types and expressions ■ Loops, conditions and exceptions ■ Built-in functions and user designed functions ■ Numpy (numerical library for Python) ■ Plotting in Python, guidelines for good plotting practice |
| Qualifikationsziel |
| The students have the competence to |
| <ul style="list-style-type: none"> ■ Convert a simple problem into a Python program ■ Implement simple programs for data analysis ■ Implement simple programs for data visualization |
| Zu erbringende Prüfungsleistung |
| none |
| Zu erbringende Studienleistung |
| <ul style="list-style-type: none"> ■ Regular participation in discussion of exercises ■ Passing a written exam |
| Literatur |
| See http://www.python.org/ for some general information and an online tutorial on the programming language Python. Further documentation on the scientific libraries used in the course is also found online (see http://scipy.org/). |

Zwingende Voraussetzung

see module level

Lehrmethoden

Lectures, exercises, students programming on the computer

↑

| Modulname | Nummer |
|--|---------------------------|
| SP2-16 Neurogenetics | 09LE03M-SP2-16 |
| Veranstaltung | |
| Current Research Topics in Systems Neuroscience (S1) | |
| Veranstaltungsart | Nummer |
| Seminar | 09LE03S-SP2-04/14/16_0005 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 2.0 |
| Semesterwochenstunden (SWS) | 1.3 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | englisch |
| Präsenzstudium | 18,2 Stunden |
| Selbststudium | 41,8 Stunden |
| Workload | 60 Stunden |

| |
|---|
| Inhalte |
| Each student presents an advanced research topic from the neurosciences. All students from "Neurophysiology", "Neurogenetics" and "Computational Neuroscience" will take part in this seminar. The topic of each student will be related to the Schwerpunktmodul II that the student chose. |
| Qualifikationsziel |
| The students have the competence to |
| <ul style="list-style-type: none"> ■ extract the important findings in a research publication and summarize and present them in a meaningful way ■ prepare and present a well structured scientific presentation in English. ■ explain an advanced research topic from the neurosciences |
| Zu erbringende Prüfungsleistung |
| <ul style="list-style-type: none"> ■ presentation ■ answers to questions and discussion after the presentation |
| Zu erbringende Studienleistung |
| <ul style="list-style-type: none"> ■ regular attendance (100%) ■ active participation in the discussions ■ preparation and presentation of a seminar topic |
| Literatur |
| Literature for the seminar topics will be provided in advance |
| Zwingende Voraussetzung |
| s. Modulebene |

Lehrmethoden

- discussion of the seminar presentation with the supervisor before and after the talk
- advice concerning the structure, format and appearance of the presentation as well as the use of scientific language, rhetorical skills and body language
- guided discussion after each presentation
- explanation of unclear aspects of the presentations by the supervisors

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| Modulname | Nummer |
|---|-----------------|
| SP2-16 Neurogenetics | 09LE03M-SP2-16 |
| Veranstaltung | |
| Neural Circuits and Behavior: Developmental Neurosciences and behavioral physiology | |
| Veranstaltungsart | Nummer |
| Seminar | 09LE03S-OS_0033 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-------------------|
| ECTS-Punkte | 2.0 |
| Semesterwochenstunden (SWS) | 2.0 |
| Empfohlenes Fachsemester | |
| Angebotsfrequenz | in jedem Semester |
| Pflicht/Wahlpflicht (P/WP) | Wahlpflicht |
| Lehrsprache | englisch |
| Präsenzstudium | 15 Stunden |
| Selbststudium | 15 Stunden |
| Workload | 60 Stunden |

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|---|
| Inhalte |
| |
| Zu erbringende Prüfungsleistung |
| Seminarvortrag |
| Zu erbringende Studienleistung |
| Aktive Teilnahme an den Seminarvorträgen. |
| Zwingende Voraussetzung |
| |

↑

| Modulname | Nummer |
|-------------------------------|---------------------|
| SP2-16 Neurogenetics | 09LE03M-SP2-16 |
| Veranstaltung | |
| Research Project (P2) | |
| Veranstaltungsart | Nummer |
| Übung | 09LE03Ü-SP2-04_0003 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 9.0 |
| Semesterwochenstunden (SWS) | 10.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | englisch |
| Präsenzstudium | 150 hours |
| Selbststudium | 120 hours |
| Workload | 270 hours |

| |
|---|
| Inhalte |
| Depending on the chosen project and supervisor the student will learn different neuroscience research methods. Among them experimental techniques, data analysis techniques, mathematical modelling techniques and numerical simulation techniques. The student will further acquire knowledge about the neuroscientific topic of his research project and will learn how to write a scientific project report and give an oral presentation about their research project. |
| Qualifikationsziel |
| Students <ul style="list-style-type: none">■ can carry out a neuroscientific research project under the supervision of an experienced researcher■ can write a scientific report (10 pages) about their research project■ can give a scientific oral presentation about their research project■ can explain the neuroscientific context of their research project |
| Zu erbringende Prüfungsleistung |
| <ul style="list-style-type: none">■ Written report (80%): The written report should have the form of a short scientific paper, typically including the sections Introduction, Methods, Results and Discussion followed by a list of references. The cover page should contain your name, the title of the research project, the name and affiliation of the supervisor, the starting- and end-date of your project and the date of submission of the report. A typical report is about 5 to 10 pages incl. figures, excl. references and appendix (when using font size 11, single line spacing, a margin of min 1.5 cm all sides).■ Oral presentation (20%): You will give an oral presentation of the results of your research project to the corresponding supervisor (typically including the research group of the supervisor). |
| Zu erbringende Studienleistung |
| none |

| |
|---|
| Literatur |
| Will be provided at the beginning of the module |
| Zwingende Voraussetzung |
| see module level |
| Lehrmethoden |
| regular discussion of findings, methods and problems with the supervisors |

↑

| Modulname | Nummer |
|---|----------------|
| SP2-17 Genetics and Experimental Bioinformatics | 09LE03M-SP2-17 |
| Modulverantwortliche/r | |
| Prof. Dr. Wolfgang Heß | |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 21.0 |
| Semesterwochenstunden (SWS) | 17.0 |
| Empfohlenes Fachsemester | 3 |
| Moduldauer | 1 |
| Pflicht/Wahlpflicht (P/WP) | Wahlpflicht |
| Präsenzstudium | 255 Stunden |
| Selbststudium | 375 Stunden |
| Workload | |
| Angebotsfrequenz | nur im Wintersemester |

| |
|------------------------|
| Teilnahmevoraussetzung |
| SP1-02 or SP1-04 |

| Zugehörige Veranstaltungen | | | | | |
|--|---------|---------|------|-------|-------------|
| Name | Art | P/WP | ECTS | SWS | Workload |
| Methods in Molecular Genetics and Experimental Bioinformatics | Übung | Pflicht | 18.0 | 15.00 | 540 Stunden |
| Current Topics in Molecular Genetics and Experimental Bioinformatics | Seminar | Pflicht | 3.0 | 2.00 | 90 Stunden |

| |
|--|
| Qualifikationsziel |
| The students are able to <ul style="list-style-type: none"> ■ design, perform, document and evaluate experiments on a current research topic in the field of molecular genetics and applied bioinformatics ■ present and discuss results from their own experimental work ■ understand and discuss experimental studies from their colleagues as well as from other laboratories in the field of molecular genetics and applied bioinformatics ■ assess the use of methods from other studies for their own work |
| Zu erbringende Prüfungsleistung |
| <ul style="list-style-type: none"> ■ Comprehensive protocol ■ Seminar presentation (30 min) about own experimental work plus extended discussion (15-30 min) about the research field |

Zu erbringende Studienleistung

- 225 h experimental work in the lab or bioinformatics analyses
- Comprehensive protocol of own research work
- Seminar presentation (30 min) and discussion about own experimental work

Benotung

- Comprehensive protocol: 66%
- Seminar presentation (30 min) about own experimental work plus extended discussion (15-30 min) about the research field: 33%

Literatur

Selected literature of the individual research topic (original articles, reviews)

Verwendbarkeit der Veranstaltung

- M.Sc. Biology, Major Genetics & Developmental Biology
- M.Sc. Biology, Major Biochemistry & Microbiology



| Modulname | Nummer |
|---|---------------------|
| SP2-17 Genetics and Experimental Bioinformatics | 09LE03M-SP2-17 |
| Veranstaltung | |
| Methods in Molecular Genetics and Experimental Bioinformatics | |
| Veranstaltungsart | Nummer |
| Übung | 09LE03Ü-SP2-17_0001 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 18.0 |
| Semesterwochenstunden (SWS) | 15.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | deutsch oder englisch |
| Präsenzstudium | 225 Stunden |
| Selbststudium | 315 Stunden |
| Workload | 540 Stunden |

| Inhalte |
|---|
| <p>Students work in the laboratory in a current research project of the lecturers including</p> <ul style="list-style-type: none"> ■ Gene regulation in prokaryotic and eukaryotic microorganisms ■ Analysis of differential gene expression ■ Methods for genetic manipulation (targeted gene knockout, homologous recombination, antisense technology, conjugation and transformation) ■ Design and implementation of synthetic metabolic and regulatory pathways and elements ■ RNA-based regulation ■ RNA degradation ■ Genome editing using advanced technologies ■ CRISPR technology beyond defense ■ Interpretation and application of genomic data ■ Biotechnological application of microalgae (green biotechnology) ■ Interpretation and application of transcriptomic data ■ Computational prediction and analysis of sRNA targets |
| Qualifikationsziel |
| <p>Students are able to:</p> <ul style="list-style-type: none"> ■ design experiments in relation to a scientific hypothesis ■ understand the role of their small scientific project in the whole project ■ conduct experiments carefully (including experimental controls and statistical analysis) ■ establish new methods in the lab or establish existing methods to a new problem or organism ■ document their work sufficiently for others to judge and repeat it |

| |
|--|
| ■ explain and comment on the basics, realization and limitations of important methods in Molecular Biology, Genetics, Biochemistry, Microbiology and Bioinformatics |
| Zu erbringende Prüfungsleistung |
| Written protocol of the experimental work, consisting of Introduction, Materials and Methods, Results and Discussion sections. (66% of module grade) |
| Zu erbringende Studienleistung |
| ■ 225 h experimental work in the lab or bioinformatics analyses ■ Comprehensive protocol of own experimental work |
| Literatur |
| Selected literature on the individual research topic (original publications, review articles) |
| Zwingende Voraussetzung |
| s. Modulebene |
| Lehrmethoden |
| ■ Experimental work in research laboratories, teamwork, documentation ■ Supervision by experienced researchers with stimulation of independence |
| Bemerkung / Empfehlung |
| The student can choose for their lab work one of the laboratories of the lecturers. Joint projects including supervision by two different lecturers are also possible (e.g. bioinformatic analyses including experimental lab work). |

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| Modulname | Nummer |
|--|---------------------|
| SP2-17 Genetics and Experimental Bioinformatics | 09LE03M-SP2-17 |
| Veranstaltung | |
| Current Topics in Molecular Genetics and Experimental Bioinformatics | |
| Veranstaltungsart | Nummer |
| Seminar | 09LE03S-SP2-17_0002 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 3.0 |
| Semesterwochenstunden (SWS) | 2.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | englisch |
| Präsenzstudium | 30 Stunden |
| Selbststudium | 60 Stunden |
| Workload | 90 Stunden |

| Inhalte |
|--|
| <p>Students will present a seminar on their scientific laboratory project related to</p> <ul style="list-style-type: none"> ■ Gene regulation in prokaryotic and eukaryotic microorganisms ■ Analysis of differential gene expression ■ Methods for genetic manipulation (targeted gene knockout, homologous recombination, antisense technology, conjugation and transformation) ■ Genome editing using advanced technologies ■ Design and implementation of synthetic metabolic and regulatory pathways and elements ■ RNA-based regulation ■ Regulation based on light perception via photoreceptors ■ Interpretation and application of genomic data ■ Biotechnological application of microalgae ■ Natural functions of CRISPR systems ■ Approaches for the biocomputational analysis and prediction of gene functions |
| Qualifikationsziel |
| <p>The students are able to</p> <ul style="list-style-type: none"> ■ present their results and discuss them in relation to scientific literature ■ search literature and gene informations in databases ■ plan and design a scientific talk in form of a power point presentation ■ discuss their work in terms of trouble-shooting and statistical analysis ■ evaluate their specific contribution to a broader topic |
| Zu erbringende Prüfungsleistung |
| <ul style="list-style-type: none"> ■ Own seminar presentation (30 min and intensive discussion) (33% of module grade) |

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| Zu erbringende Studienleistung |
| ■ preparing and presenting the seminar talk |
| Literatur |
| Selected literature on the research topic (Original publications and review articles) |
| Zwingende Voraussetzung |
| s. Modulebene |
| Lehrmethoden |
| Power Point presentation, discussion with the members of the laboratories and supervisor |

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| Modulname | Nummer |
|--|----------------|
| SP2-18 Chemical and Molecular Cell Biology | 09LE03M-SP2-18 |
| Modulverantwortliche/r | |
| Prof. Dr. Maja Banks-Köhn | |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 21.0 |
| Semesterwochenstunden (SWS) | 17.0 |
| Empfohlenes Fachsemester | 3 |
| Moduldauer | 1 |
| Pflicht/Wahlpflicht (P/WP) | Wahlpflicht |
| Präsenzstudium | 255 hours |
| Selbststudium | 375 jours |
| Workload | 630 hours |
| Angebotsfrequenz | nur im Wintersemester |

| Teilnahmevoraussetzung |
|------------------------|
| ■ OM-01 or OM-04 |
| ■ SP1-01 or SP1-04 |
| ■ WM-29 or WM-21 |

| Zugehörige Veranstaltungen | | | | | | |
|--|-----------|---------|------|-------|-----------|--|
| Name | Art | P/WP | ECTS | SWS | Workload | |
| Trends in Chemical Cell Biology | Vorlesung | Pflicht | 1.0 | 1.00 | 30 hours | |
| Chemical biology tools in molecular cell biology | Übung | Pflicht | 15.5 | 13.00 | 465 hours | |
| Scientific Writing and Project Management | Seminar | Pflicht | 4.5 | 3.00 | 135 hours | |

| Qualifikationsziel |
|--|
| The students are able |
| ■ to explain the principles of chemical biology |
| ■ to design/apply methods of chemical biology and molecular cell biology |
| ■ to present a project management plan |
| ■ to write a short scientific proposal |
| Zu erbringende Prüfungsleistung |
| ■ research proposal (40%) |
| ■ project management presentation (60%) |

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|---|
| Zu erbringende Studienleistung |
| <ul style="list-style-type: none">■ At least 90 % attendance■ Active participation■ Writing of experimental lab journal |
| Bemerkung / Empfehlung |
| <ul style="list-style-type: none">■ Course script will be distributed■ Literature search by the students (supported by the supervisor) |
| Verwendbarkeit der Veranstaltung |
| <ul style="list-style-type: none">■ M.Sc. Biology, Major Translational Biology■ M.Sc. Biology, Major Biochemistry & Microbiology |

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| Modulname | Nummer |
|--|---------------------|
| SP2-18 Chemical and Molecular Cell Biology | 09LE03M-SP2-18 |
| Veranstaltung | |
| Trends in Chemical Cell Biology | |
| Veranstaltungsart | Nummer |
| Vorlesung | 09LE03V-SP2-18_0001 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 1.0 |
| Semesterwochenstunden (SWS) | 1.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | englisch |
| Präsenzstudium | 15 hours |
| Selbststudium | 15 hours |
| Workload | 30 hours |

| |
|---|
| Inhalte |
| Latest insights in Chemical Cell Biology: <ul style="list-style-type: none"> ■ Chemical Biology in mammalian cells ■ Chemical modulators ■ Photocaging ■ Molecular cell biology methods ■ Phosphatase biology ■ Cellular imaging |
| Lernziele / Lernergebnisse |
| The students are able to explain the principles of synthetic biology in detail. |
| Zu erbringende Prüfungsleistung |
| none |
| Zu erbringende Studienleistung |
| Active participation |
| Zwingende Voraussetzung |
| s. Module level |
| Empfohlene Voraussetzung |
| s. Module level |

Lehrmethoden

- Power Point Presentation
- Discussion

↑

| Modulname | Nummer |
|--|---------------------|
| SP2-18 Chemical and Molecular Cell Biology | 09LE03M-SP2-18 |
| Veranstaltung | |
| Chemical biology tools in molecular cell biology | |
| Veranstaltungsart | Nummer |
| Übung | 09LE03Ü-SP2-18_0002 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 15.5 |
| Semesterwochenstunden (SWS) | 13.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | englisch |
| Präsenzstudium | 195 hours |
| Selbststudium | 270 hours |
| Workload | 465 hours |

| |
|---|
| Inhalte |
| Lab work on a topic in the field of chemical and/or molecular cell biology |
| Lernziele / Lernergebnisse |
| The students are able <ul style="list-style-type: none"> ■ to define and explain a project in the field of chemical biology ■ to design and implement chemical tools in mammalian cells ■ to apply molecular biology methods ■ to analyze and discuss the results of their experimental work ■ to document their experimental data in a lab journal ■ to search for relevant literature |
| Zu erbringende Prüfungsleistung |
| none |
| Zu erbringende Studienleistung |
| <ul style="list-style-type: none"> ■ active participation ■ record experimental conditions and results in a lab journal |
| Literatur |
| Literature search by the students (supported by the supervisor) |
| Zwingende Voraussetzung |
| s. Module level |

Empfohlene Voraussetzung

s. Module level

Lehrmethoden

Lab work under supervision of an experienced group member

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| Modulname | Nummer |
|--|---------------------|
| SP2-18 Chemical and Molecular Cell Biology | 09LE03M-SP2-18 |
| Veranstaltung | |
| Scientific Writing and Project Management | |
| Veranstaltungsart | Nummer |
| Seminar | 09LE03S-SP2-18_0003 |
| Fachbereich / Fakultät | |
| Fakultät für Biologie | |

| | |
|-----------------------------|-----------------------|
| ECTS-Punkte | 4.5 |
| Semesterwochenstunden (SWS) | 3.0 |
| Empfohlenes Fachsemester | 3 |
| Angebotsfrequenz | nur im Wintersemester |
| Pflicht/Wahlpflicht (P/WP) | Pflicht |
| Lehrsprache | englisch |
| Workload | 135 hours |

| |
|---|
| Inhalte |
| <ul style="list-style-type: none"> ■ Scientific writing ■ Project management ■ Presentation style ■ Time and stress management ■ Strengths and weaknesses ■ Potential for success ■ Patenting and exploitation of inventions |
| Lernziele / Lernergebnisse |
| <p>The students are able</p> <ul style="list-style-type: none"> ■ to write a short scientific proposal ■ to present a project management plan ■ to describe the steps for patenting and exploitation of inventions |
| Zu erbringende Prüfungsleistung |
| <ul style="list-style-type: none"> ■ Written research proposal (40%) ■ oral presentation of a project management plan respective to the planned master thesis (60%) |
| Zu erbringende Studienleistung |
| <ul style="list-style-type: none"> ■ At least 90% attendance (1 day max. absence) ■ Active participation |
| Literatur |
| Course script will be distributed |
| Zwingende Voraussetzung |
| s. Module level |

Empfohlene Voraussetzung

s. Module level

Lehrmethoden

- Power point presentation
- Group work
- Discussion

↑

Albert-Ludwigs-Universität Freiburg