



Module handbook

Neurobiology Master of Science

Valid from Winter Term 2024/25

**Faculty of Sciences
Department of Biology
Institute for Neurobiology**

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1 Programme overview

The *Master of Science in Neurobiology* programme is offered by the [Institute for Neurobiology](#) in the Department of Biology. The programme addresses a wide range of neurobiological questions from a comparative, i.e. evolutionary, point of view. The spectrum of topics ranges from sensory stimulus encoding in lower vertebrates to cognitive abilities of higher vertebrates including humans. The methods range from single cell electrophysiology, cellular imaging and optogenetics to computational neuroscience and behavioural analyses.

The Institute for Neurobiology at the University of Tübingen is part of the large [Tübingen Neuroscience Campus](#) with about 100 research groups. The *Master of Science in Neurobiology* complements This vivid neuroscience research environment offers many opportunities for successful participants. As such, students can also attend a selection of related courses offered by the faculty of science and the medical faculty.

Admission requirements

To be eligible for admission, applicants must have a Bachelor's degree with a final grade better or equal to 2.5 and at least 30 ECTS from courses associated to neurobiology. The course language is English, all applicants must have English language proficiency at least on the B2 level. International applicants must further prove their German language proficiency at least on A2 level. More information on the admission process and the deadlines can be found on the websites of the [Department of Biology](#).

Study aims

The *Master of Science in Neurobiology* programme is designed for a duration of four semesters (120 ECTS credits). Its main aim is to provide solid neurobiological background on all levels (cellular, systems, cognitive and computational neuroscience). The theoretical knowledge is complemented by training in experimental techniques and data analysis skills matching the needs of modern neurosciences and also qualifies for job opportunities outside academia. The institute's broad spectrum of model systems and methods is reflected in our teaching. One of the programme's foci is on comparative approaches across species, sensory modalities, and methods. The comparative approach trains the participant's ability to interpret data in a broader context, draw more general conclusions, and understand the common concepts.

Balance of compulsory and elective modules

The programme's curriculum balances compulsory and elective parts. Only 21 out of the 120 credits do not allow for selections. These modules are scheduled for the first semester and ensure a common basis for the remaining studies. The larger part of the curriculum allows selecting courses according to the own interests which offers the opportunity to create a personalized profile matching the own interests.

Successful graduates will:

- have received a sound education on the neurobiological foundations.
- have received solid training in automated data processing and computational neuroscience.

- know state-of-the-art experimental and computational methods enabling them for working in modern neuroscience.
- be proficient in the theoretical principles of the life sciences especially in the fields of systemic, cognitive and theoretical neurosciences.
- have received sound education in all aspects related to laboratory animal science.
- be able to critically assess the state-of-the-art in the field and to use their knowledge to devise and address scientific questions.
- excel in their ability to defend and discuss their scientific results in written or oral form.
- be able to pursue careers in a multitude of occupational fields, especially those with neurobiological and medical orientations.

2 Curriculum

The programme is split into different *Modules* that convey the competences required to successfully complete the programme and enable working in modern neuroscience research. Some of these modules are *compulsory* while others are *elective*. The compulsory modules scheduled for the 2nd and 3rd semester are in themselves flexible and allow course selections according to personal preferences and interests. The topic of the Master thesis is, of course, a free choice¹.

Each *Module* has a certain weight given in ECTS that depends on the contact hours and the time spent into individual self-reliant course work. One ECTS credit point equals a workload of about 30 hours (contact hours + self-reliant work + preparations for the exam). Each year of studies usually yields 60 credits. Module details can be found in the electronic course catalogue [ALMA](#).

¹The topic must be neurobiology related

2.1 Overview by Modules

Within the programme, some modules are compulsory for all students. In the first semester the three compulsory modules [Integrative Neurobiology](#), [Scientific Computing for Neuroscientists](#), and [Laboratory Animal Science](#) teach the fundamentals of Neurobiology ranging from cellular and network mechanisms to behaviour and cognition, the basics of data processing and analysis and the legal, and ethical framework of animal research. These competences are key for the remaining studies and the taught concepts and methods will reappear and be applied in different contexts. All later modules build on these. **It is highly recommended to not delay these courses to later semesters!**

In the second semester you are free to choose from courses that provide advanced training in neurobiological methods (compulsory module: [Neurobiology Laboratory](#)) or discuss advanced topics (compulsory module: [Key Classes in Neurobiology](#)). As neurobiology is an interdisciplinary subject that requires a broader view, you are encouraged to also attend advanced courses offered by the biology department (module: [Study Area — Biology/Neurobiology](#)) or even from the full University course catalogue (module [Study Area — Interdisciplinary](#)).

The 3rd semester is entirely devoted to the [Research Lab Course Neurobiology \(Großpraktikum\)](#) in which you will apply your skills, and learn new methods in four different experimental settings in small teams. The courses are offered by labs in the Institute for Neurobiology, the Werner Reichardt Center for Integrative Neuroscience, and the medical faculty. In the courses a wide variety of sensory modalities, methods, and animal models will be used. Based on this experience, you are prepared to select the topic for the [Master Thesis Neurobiology](#) in the fourth semester.

Module number	Compulsory/ elective	Module name	Recommended semester	CP
NEU-001	c	Integrative Neurobiology	1	9
NEU-002	c	Scientific Computing for Neuroscientists	1	9
NEU-003	c	Laboratory Animal Science	1	3
NEU-004	c	Neurobiology Laboratory	2	12
NEU-005	c	Key Classes in Neurobiology	1, 2	12
NEU-006	c	Research Lab Course Neurobiology (Großpraktikum)	3	30
	e	Study Area — Biology/Neurobiology	1, 2	6
	e	Study Area — Interdisciplinary	1, 2	9
NEU-100	c	Master Thesis Neurobiology ¹	4	30
			total ²	120

¹at least 60 CP must be achieved before candidates can be admitted to the master thesis

²up to 30 additional credits can be listed in the transcript but will not affect the final grade

2.2 Overview by Study Progress

The first semester is meant to lay the foundations on which the following modules will build. **Again, it is highly recommended to not delay these courses to later semesters!**

Semester	Total CP	Module number	compulsory elective	Module name	CP
1	30	NEU-001	c	Integrative Neurobiology	9
		NEU-002	c	Scientific Computing for Neuroscientists	9
		NEU-003	c	Laboratory Animal Science	3
		NEU-004	c	Key Classes in Neurobiology	
			e	and/or Study Area — Biology/Neurobiology	9
			e	and/or Study Area — Interdisciplinary	
				Σ	30
2	30	NEU-005	c	Neurobiology Laboratory	12
		NEU-004	c	and/or Key Classes in Neurobiology	
			e	and/or Study Area — Biology/Neurobiology	18
			e	and/or Study Area — Interdisciplinary	
				Σ	60
3	30	NEU-006	c	Research Lab Course Neurobiology (Großpraktikum)	30
				Σ	90
4	30	NEU-100	c	Master Thesis Neurobiology ¹	30
				total ²	120

¹at least 60 CP must be achieved before candidates can be admitted to the master thesis

²up to 30 additional credits can be listed in the transcript but will not affect the final grade

2.3 Compulsory modules

2.3.1 Integrative Neurobiology

The *Integrative Neurobiology* module lays the theoretical groundwork for further courses in the Master's programme in Neurobiology. This module prepares for a deeper understanding of neurobiological processes at different levels. The neurobiological fundamentals are discussed at three distinct levels, ranging from cellular and molecular processes of neuronal activity to the functioning of nervous systems, and behavioural and cognitive performance. Accordingly, the module consists of three parallel lectures.

Whenever possible, connections between these levels are highlighted and discussed from various perspectives. The accompanying optional tutorial serves to rehearse and discuss the topics of the lectures with a broader, overarching scope.

Study aims

This module provides

- the basic knowledge of the cellular and molecular mechanisms of neuronal functioning.
- the development, design, and functions of nervous systems that are the neurobiological basis of behavioural and cognitive abilities across species.
- the theoretical basis for comparative analyses of the nervous systems.

NEU-001	Integrative Neurobiology		
Category	compulsory		
ECTS Credits	9		
Workload	270 h	attendance: 90 h (6 class hours)	private study: 180 h
Duration	1 term		
Cycle of offer	Each winter term		
Language	English		
Format	Lecture		
Requirements	Sound biological background		
Assessment and grading	Non-assessed coursework: regular attendance of the lectures Assessment: Written exam		
Usability	Master of Science in Neurobiology		
Module coordination	Prof. Dr. J. Benda		

Currently assigned courses (may change)

Course name	Term	Format	CP
Integrative Neurobiology: Cellular and Molecular	W	lecture	3
Integrative Neurobiology: Systems	W	lecture	3
Integrative Neurobiology: Behaviour and Cognition	W	lecture	3
		Σ	9

2.3.2 Scientific Computing for Neuroscientists

Automated data processing and analysis are integral components of modern scientific work. They are essential for data analyses, experiment control, managing vast amounts of data, and conducting simulations of neuronal processing. Automation plays a critical role in ensuring the reproducibility of scientific findings and objectivity of analyses. Solid knowledge of statistical methods is critical to justify conclusions and evaluate results. Therefore, proficiency in higher programming languages such as Python, Matlab, or R is indispensable for aspiring scientists. Moreover, a strong grasp of programming, data analysis and statistics also qualifies for various job opportunities outside sciences.

Study aims

You will

- learn a programming language and learn to handle modern programming tools to run up-to-date analyses on neuroscientific data.
- train your skills to transform scientific questions into analysis algorithms.
- gain a solid understanding of statistical methods used in neurobiological research.
- be able to create publication-ready figures that accurately represent the data directly from within the analysis pipeline.
- work on a small data-analysis project and train your presentation skills.

NEU-002	Scientific Computing for Neuroscientists		
Category	compulsory		
ECTS Credits	9		
Workload	270 h	attendance: 90 h (6 class hours)	private study: 180 h
Duration	1 term		
Cycle of offer	Each winter term		
Language	English		
Format	Lecture, exercises		
Requirements	none		
Assessment and grading	Non-assessed coursework: regular attendance & exercises Assessment: Solution of a data-analysis problem		
Usability	Master of Science in Neurobiology		
Module coordination	Dr. J. Grewe		

Currently assigned courses (may change)

Course name	Term	Format	CP
Introduction to Scientific Computing in Python	W	lecture/exercises	9
		Σ	9

2.3.3 Laboratory Animal Science

This module introduces the fundamentals of laboratory animal science and provides the compulsory skills to handle experimental animals and to conduct animal experiments responsibly.

Study aims

You will learn:

- the essential legal regulations concerning animal welfare and to apply them to specific experimental situations.
- the basic biology and specific needs of different laboratory animals
- important standard procedures for housing and breeding of laboratory animals
- the basics on animal health management and hygiene management
- species specific methods of handling and procedures
- to recognize pain distress and suffering in laboratory animals
- the basics on anaesthesia, pain relieving methods and killing
- the requirement of replacement, reduction and refinement (3R)
- to judge various ethical aspects of animal use in the laboratory

NEU-003	Laboratory Animal Science		
Category	compulsory		
ECTS Credits	3		
Workload	90 h	attendance: 30 h (2 class hours)	private study: 60 h
Duration	1 term		
Cycle of offer	Each winter term		
Language	English		
Format	Lecture, seminar, excursion		
Requirements	Advanced knowledge of biology		
Assessment and grading	Non-assessed coursework: regular attendance, presentation in the seminar, participation in the excursion Assessment: written exam, ungraded		
Usability	Master of Science in Neurobiology		
Module coordination	Dr. A. Denzinger		

Currently assigned courses (may change)

Course name	Term	Format	CP
Laboratory Animal Science	W	lecture/seminar/excursion	3
		Σ	3

2.3.4 Key Classes in Neurobiology

This module offers advanced seminars and lectures that offer training in topics beyond the introductory lectures. At least 12 ECTS credits must be taken from these courses.

Additional courses can be credited as part of the [Study Area — Biology/Neurobiology](#) or [Study Area — Interdisciplinary](#) modules.

Study aims

You will

- dive into advanced neurobiological topics.
- apply your knowledge to discuss and evaluate current research topics.
- train your reading, understanding, and presentation skills.

NEU-004	Key Classes in Neurobiology		
Category	compulsory		
ECTS Credits	12		
Workload	360 h	attendance: 120 h (8 class hours)	private study: 240 h
Duration	—		
Cycle of offer	Various		
Language	English		
Format	Seminar, lecture		
Requirements	Advanced knowledge of biology		
Assessment and grading	Non-assessed coursework: will be announced at the beginning of the chosen course Assessment: Written or oral exam		
Usability	Master of Science in Neurobiology		
Module coordination	Prof. Dr. A. Nieder		

Currently assigned courses (may change)

Course name	Term	Format	CP
Birdsong as a Model in Cognitive and Systems Neuroscience	W	S	3
Cognitive Neuroscience	S	L/S	6
Fundamentals of Sensorimotor Integration	S	L	3
Introduction to Computational Neuroscience	W	L	3
Models of Neural Systems	W	L/E	6
Visual and Spatial Cognition	S	L/S	6
		Σ	27

2.3.5 Neurobiology Laboratory

"How does the brain work?" Neurobiological research approaches this big question from different angles and applies different methods. In this module you will receive advanced training in key methods. Covering anatomy to understand neuroanatomy, morphology, and connectivity, behavioural methods, to investigate cognitive abilities of the system under study, electrophysiological as well as optogenetics and imaging techniques to observe neuronal functioning on the cellular level. These methods will be taught and discussed in the context of current research.

Experiments take time and thus, the *laboratory* courses are so called *block* courses which span four weeks and block the full morning (8 am to 2 pm). The afternoon is free to take other courses.

Notes

In case of collisions talk to the lecturers to find a solution. At least 12 ECTS credits must be taken from these courses. Additional courses of this module can be credited as part of the [Study Area — Biology/Neurobiology](#) or [Study Area — Interdisciplinary](#).

Study aims

You will

- learn at least two different advanced neurobiological techniques that are applied in different contexts (animal models, scientific questions).
- apply previously acquired knowledge to interpret the experimental observations.
- apply and improve your data-analysis skills in various settings.
- present scientific results in oral and written form.

NEU-005	Neurobiology Laboratory		
Category	compulsory		
ECTS Credits	12		
Workload	360 h	attendance: 120 h (8 class hours)	private study: 240 h
Duration	—		
Cycle of offer	Each summer term		
Language	English		
Format	Practical course, seminar		
Requirements	Advanced knowledge of biology		
Assessment and grading	Non-assessed coursework: regular attendance, presentation in the seminar Assessment: Protocols		
Usability	Master of Science in Neurobiology		
Module coordination	Prof. Dr. A. Bungalossi		

Currently assigned courses (may change)

Course name	Term	Format	CP
Advanced neuroanatomy	S	block	6
Electrophysiology	S	block	6
Optogenetics & microscopy in neurobiology	S	block	6
Sensory systems in natural environments	S	block	6
		Σ	24

2.3.6 Research Lab Course Neurobiology (Großpraktikum)

Within the framework of the Research Lab Course Neurobiology, you will be exposed to a wide range of neurobiological questions, model systems, and techniques. Guided by the project supervisors you will apply these to independently address scientific problems.

Each cycle of the Lab Course takes three weeks. You will work in small teams of three or four participants each. You can select specific experiments from a broad array of options and, as a result, you can tailor the Lab Course to your own preferences by focusing on specific areas of interest.

The accompanying seminar focuses on essential soft skills required in the scientific world. Each participant is required to present the results of their own experiments during the seminar in form of a talk or a poster presentation. The intensive discussion of the presented results in a protected environment aims to prepare for real-life discussions in the future.

Study aims

You will

- learn to familiarize yourself with a current research topic within the given time frame.
- tackle a challenging scientific topics autonomously while applying your biological methodological knowledge and skills to the different problems.
- enhance your skills in experimental design.
- improve your problem-solving skills.
- will train and improve your data-analysis and presentation skills.
- will experience working in international team in the scientific environments of the participating laboratories.

NEU-006	Research Lab Course Neurobiology		
Category	compulsory		
ECTS Credits	30		
Workload	900 h	attendance: 300 h (20 class hours)	private study: 600 h
Duration	1 term		
Cycle of offer	Each winter term		
Language	English		
Format	Lecture, seminar, practical course		
Requirements	Integrative Neurobiology , Laboratory Animal Science		
Assessment and grading	Non-assessed coursework: regular attendance, presentation in the seminar Assessment: Protocol		
Usability	Master of Science in Neurobiology		
Module coordination	Dr. S. Westendorff		

2.3.7 Master Thesis Neurobiology

The Master's thesis is supposed to show a candidate's ability to work on a scientific, neurobiological question and present the results adequately. The thesis is worth of 30 ECTS credits, that is, about 6 months of working at 40 h per week. The thesis may be written in German or English. The thesis is reviewed by two reviewers which must be admitted reviewers of the Department of Biology. A list of possible reviewers is available at the examination office. **To start a thesis at least 60 ECTS credits must have been collected. It is required to register the thesis' topic and combination of thesis advisors with the examination office in advance!**

Study aims

Within the Master's thesis you:

- will show that you are capable of familiarizing yourself with a current research problem within the given time frame.
- you will learn and apply appropriate scientific methods independently and present the results in a scientifically appropriate manner.
- will independently, yet guided, work on a demanding scientific topic while applying your biological methodological knowledge effectively.
- will enhance your problem-solving skills and transfer knowledge and insights.
- will experience working in a team within an international scientific environment.

NEU-100	Master Thesis Neurobiology		
Category	compulsory		
ECTS Credits	30		
Workload	900 h		private study: 900 h
Duration	1 term		
Cycle of offer	Flexible		
Language	English		
Format	Laboratory work.		
Requirements	At least 60 ECTS of the MSc programme		
Assessment	Graded thesis		
Usability	Master of Science in Neurobiology		
Module coordination	Thesis supervisor		

2.4 Required elective modules

With the *required elective modules* the following general rules apply:

1. At maximum 12 ECTS credits may be ungraded.
2. Only courses from the course catalogue of the University of Tübingen, or foreign universities in the context of an official semester abroad (e.g. via Erasmus) can be credited.
3. External courses such as internships in external laboratories, companies etc. **can not** be credited.
4. Modules already listed in the BSc transcript **can not** be credited.
5. Up to 30 additional ECTS credits can be listed in the transcript of records. They will **not** affect the final grade, though.

2.4.1 Study Area — Biology/Neurobiology

Neurobiology is an integral part of the biology. In this programme we value comparative and integrative approaches. An animal's nervous system or behavioural strategies are shaped by evolution to optimize its fitness. Thinking along these lines and asking overarching questions requires at least some advanced knowledge outside neurobiology.

Within the [Study Area — Biology/Neurobiology](#) you can choose courses described in the module handbooks of the Master programmes on *Evolution and Ecology*, *Microbiology*, *Cellular and Molecular biology*, *Ethics*, *Human genetics*, *Parasitology*, and, of course, the *Master of Science in Neurobiology*. **6 ECTS CP can be credited within this module. Note: Additional [Neurobiology Laboratory](#), or [Key Classes in Neurobiology](#) can be also be used to fill this category.**

Study aims

You will

- increase your knowledge of advanced biological (including neurobiological) topics to broaden the scope of your education.

The following neurobiological courses are also available in this module

Course name	Term	Format	CP
Current topics in cognitive neuroscience	S	S	3
Fundamentals of Sensorimotor Integration	S	L	3
Vision and cognition in bees	S	P	6
		Σ	12

2.4.2 Study Area — Interdisciplinary

Neurobiology is an interdisciplinary research area. Interdisciplinarity refers to the applied methods and also to the (not necessarily biological) characteristics of the niche that is occupied by a model organism. Candidates of the *Master of Science in Neurobiology* are encouraged to broaden their education with courses from other related disciplines. In the interdisciplinary study area up to 9 ECTS credits, achieved in any advanced course offered by the University, can be credited.

9 CP can be credited within this module. Note: Additional [Neurobiology Laboratory](#), or [Key Classes in Neurobiology](#) can be also be used to fill this category.

Study aims

You

- can broaden the scope of your education beyond (neuro-)biology.
- gain competences that qualify for a broad spectrum of occupations according to your own fields of interest.

The following neurobiological courses are also available in this study area

Course name	Term	Format	CP
Current topics in cognitive neuroscience	S	S	3
Fundamentals of Sensorimotor Integration	S	L	3
Vision and cognition in bees	S	P	6
		Σ	12

3 Contact & Information

General Information about the programme

Website of *Master of Science in Neurobiology* programme.

Application

Online via the [Alma](#) portal of the Universität. Application deadline: 15th July.

Study coordinator

[Dr. Jan Grewe](#)

Academic advisory service

[Dr. Matthias Stoll](#), Studiendekanat

Transcript, Certification

[Examinations office](#), Biology

Enrolling/Changing of the subject, granting of a leave

[Student administration](#)

Informal information about studying biology, help and hints

Study body of the department of Biology: www.fsbiotuebingen.de