**Filters used for the printout**

**Curriculum period:** 2023-24. **Studies included in the printout:** Study modules and courses. **Filters for the studies:** Master's Programme in Neuroscience. **Languages of the descriptions:** All. **Language of the printout template:** English.

# **MH57_004** Master's Programme in Neuroscience

**MH57_004** Neurotieteen maisteriohjelma

**MH57_004** Magisterprogrammet i neurovetenskap

2023-24

| | |
|---|---|
| Curriculum period | 2023-24 |
| Validity period | since 1 Aug 2023 |
| Credits | 120 cr |
| Languages | English, Swedish, Finnish |
| Grading scale | Pass-Fail |
| Content approval required | no |
| Locations | Helsinki |
| University | University of Helsinki |
| Responsible organisation | Faculty of Biological and Environmental Sciences 100% |
| Responsible persons | Jukka Lehtonen, Administrative person<br>Taru Nordman, Administrative person<br>Katri Wegelius, Administrative person<br>Juha Voipio, Responsible teacher |
| Degree programme type | Master's Degree |
| Degree titles | Master of Science |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |
| Education classification | 742701 MSc, Biology |

**Content description**

**EN:**

Profile and study tracks

Are you interested in understanding how the nervous system, brain, and the complex regulatory networks of organisms work? The Master’s Programme in Neuroscience is an interdisciplinary programme providing two complementary study tracks: Neuroscience, and Cell and Systems Physiology.

Neuroscience is an interdisciplinary field that studies the brain and the entire nervous system at different levels of organisation, from genes and molecules to nerve cells and networks; and beyond. The focus of a neuroscientist’s research may lie in understanding the neurobiological bases of behaviour, analysing the functional roles of a single molecule, or developing new treatments for neurological disorders or sensory deficits. In the Neuroscience study track you will gain knowledge and understanding in the field, and you will learn to know modern research methods.

Cell and Systems Physiology focuses on the body functions and integrated systems that are required to maintain the life and health of individuals. Many of the general principles trace back to organisms that appeared early during evolution. You will get to know factors favouring large diversity in the design of animal life, and limits for adaptation in the rapidly changing Earth. You will learn how systems biology approaches and new analytical techniques are used to collect information on the state of the system when our cells, and we as systems, develop and age. Skills in modern omics technologies combined with deep philosophy of the emergence of life from complexity help you find new research questions.

Students studying for qualification as biology teachers can specialise in either Neuroscience or Cell and Systems Physiology. They have 60 cr of pedagogical studies in their degree. Please note that this applies

only to Finnish or Swedish speaking students who have been accepted to the biology teacher study track during their bachelor studies.

Find out more about the study tracks.

### International skills

The study tracks of Master's Programme in Neuroscience provide you with the opportunity to gain multi-disciplinary knowledge and skills in a scientifically vibrant international environment. The research groups participate in international collaborative networks, which is also reflected in teaching and research training. You will be taught by scientists who will provide you with a wide spectrum of opportunities for practical training and for becoming integrated into the stimulating neuroscience and cell and systems physiology community.

A large number of international exchange students and degree students pursue their studies in our Master´s programme, and many international scholars participate in teaching.

The Master's Programme in Neuroscience is part of the Network of European Schools in Neuroscience, NENS, which provides further opportunities for exchange programmes and networking within European universities.

### Skills relevant to employment and continuous learning

Studies include courses supporting career orientation and planning and generic academic skills important in work life.

### Sustainability expertise

The students can include the multidisciplinary SUST-001 Sustainability course, 3 cr in their degree.

### Assessment practices

Assessment is based on exams, written reports or essays, oral presentations, learning diaries and practical work. The assessment practises and criteria are described in the course pages or in Moodle.

### Practices for collecting and processing student feedback

Anonymous student feedback is collected from all courses which involves teaching by the Norppa feedback system, and other general feedback is collected annually by separate surveys. In addition, all University of Helsinki Master's degree students participate in annual HowULearn survey. The feedback and survey results are discussed in the programme board and in annual feedback sessions together with students and teachers.

### Structure and schedule of completion for studies

You undertake modules amounting to the value of 120 credits (ECTS) according to your personal study plan. The Master's Degree consists of

- 60–65 credits of advanced studies, including a research project (Master's thesis, 30 credits)
- 55–60 credits of other studies chosen from the Programme (courses from both topical study tracks are available) or from other Programmes.

Degree structure

The curriculum of the Programme enables you to complete 90 credits in 12 months of full-time studying and utilising study opportunities during the summer months, but not including your Master's thesis research project. However, we recommend that you complete the Programme in 2 years as this will give you more flexibility for your optional studies.

Most of the courses are organized on-site, but some courses can be completed by distance learning either partly or completely as described for each course.

## Learning outcomes

**EN:**

### Key learning outcomes and objectives of education

After completing your M.Sc. studies in the Master's Programme in Neuroscience, you will:

- understand the interdisciplinary nature of neuroscience and physiology.
- understand the basic functions of the nervous system and the complex regulatory networks of organism, from genes and molecules to nerve cells, networks and systems level.
- understand what are the main experimental methods used in the research field.
- understand how to produce new scientific results by means of experimental studies.
- be able to implement good scientific practice in your own work.
- understand how to utilise existing research data and various biological databases and tools to solve scientific problems.
- understand how to analyse scientific knowledge critically and how to communicate it to diverse audiences.
- be capable of project management and problem solving, as well as for maintaining and developing your own expertise.
- be able to work in multi-disciplinary and multicultural communities.

### Professional qualifications and competencies provided by the degree

When you graduate from the Master's Programme in Neuroscience, you will have mastered the essentials of neuroscience and physiology , complementing each other, and have deeper knowledge and skills in the subfields of your choice. The Programme prepares you for PhD studies and a research career, or for a career in the private or public sector, in e.g. duties as a specialist, or other posts in administration and/or teaching.

### Additional information

**EN:** Career opportunities
Basic research and biomedical research are career paths that offer many opportunities. After completing a Master’s degree, you can continue for PhD studies. In addition to Academia, neuroscientists and physiologists work as specialists in many fields, such as the pharmaceutical industry, education, biotechnology, public policy, science writing and publishing.

The study tracks of Master’s degree in Neuroscience are popular choices among Finnish and Swedish speaking students studying towards biology teacher qualification.

### Postgraduate study options

After completing a Master’s degree in Neuroscience, following any of its study tracks, you can apply for a Doctoral Programme at the University of Helsinki or any other relevant PhD programme within or outside Europe.

At the University of Helsinki, doctoral studies consist of a 40 credit study module and a doctoral dissertation. Doctoral candidates often do their dissertation work in the same research group in which they completed their Master’s thesis. Courses suitable for doctoral students are organised by Doctoral Programmes, such as the Doctoral Programme Brain & Mind,Doctoral Programme in Biomedicine and Doctoral Programme in Integrative Life Science. More information about doctoral training at the University of Helsinki can be found here: https://www.helsinki.fi/en/research/doctoral-education.

### Student admissions to degree programme

For more information for graduates from outside of University of Helsinki
and for graduates from the University of Helsinki Bachelor´s programmes

### Procedures for the recognition and validation of prior learning

We follow th general practices of the Faculty of Biological and Environmental Sciences.

### Graduation practices and criteria

We follow the general practices of the Faculty of Biological and Environmental Sciences.

### Student supervision

All students are appointed a guiding teacher who will support and advise them in study planning.

# DEGREE STRUCTURE

| Part of the degree | Credits |
|---|---|
| MASTER'S PROGRAMME IN NEUROSCIENCE * | 120 cr |
| STUDY TRACK (grouping module) | |
| **NEU-N** NEUROSCIENCE * | 120-135 cr |
| **NEU-100** NEUROSCIENCE, ADVANCED STUDIES | 60 cr |
| **NEU-101** Cellular physiology | 5 cr |
| **NEU-102** Cellular neurobiology | 5 cr |
| **NEU-103** Systems Neuroscience | 5 cr |
| **NEU-104** Integrative neurobiology | 5 cr |
| **NEU-105** Methods and Trends in Neuroscience | 5 cr |
| **NEU-106** Master’s Seminar in Neuroscience | 5 cr |
| **NEU-110** Master's thesis in neuroscience | 30 cr |
| **VIIKB-001** Master's Maturity Test * | 0 cr |
| **NEU-MUUT** OTHER STUDIES | min 0 cr |
| CAREER ORIENTATION AND PROFESSIONAL SKILLS TRAINING (grouping module) | |
| **TMED-901** Career Development * THERE IS NO VERSION OF THE STUDY IN THE SELECTED CURRICULUM PERIOD | 3 cr |
| **NEU-404** Practical training 1 | 5-10 cr |
| **NEU-405** Practical training 2 | 5 cr |
| **NEU-414** Research project | 5 cr |
| **NEU-415** Creative scientific thinking | 5 cr |
| **NEU-416** Creative scientific project | 2-5 cr |
| **NEU-603** Laboratory animal science | 1-5 cr |
| **MPHARM-004** Research ethics * | 1 cr |
| **SUST-001** Sustainability course * | 3 cr |
| **MAT12001** Basics of statistics and R I * | 5 cr |
| **NEUBM-702** Public outreach in neuroscience * | 1-4 cr |
| **PED590** Towards better well-being and studying * | 3 cr |
| OPTIONAL COURSES (grouping module) | |
| **NEU-102** Cellular neurobiology | 5 cr |
| **NEU-104** Integrative neurobiology | 5 cr |
| **NEU-207** Regulatory Networks in Metabolism | 5 cr |
| **NEU-231** Mechanisms of regeneration and aging | 5 cr |
| **NEU-251** Molecular Nutrition | 5 cr |
| **NEU-502** Synaptic Signaling and Plasticity | 5 cr |
| **NEU-503** Neuronal cell culture workshop | 3 cr |
| **NEU-511** Systems and Cognitive Neuroscience | 5 cr |
| **NEU-512** Animal models in behavioural neuroscience | 5 cr |
| **NEU-521** Basic mechanisms of nervous system diseases | 1-5 cr |
| **NEU-531** Developmental neuroscience | 5 cr |
| **NEU-541** Introduction to neurobiophysics | 5 cr |
| **NEU-542** Electrophysiological techniques | 5 cr |
| **NEU-543** Brain slice electrophysiology | 5 cr |
| **NEU-551** Sensory Biology | 3-5 cr |
| **NEU-552** Studies of sensory performance in animals and humans | 5 cr |

- NEU-561 Principles of bioscience omics 10 cr
- NEU-601 Book examination in neuroscience 2-10 cr
- NEU-602 Book examination in cell and systems physiology 2-10 cr
- NEU-604 Functional lipidomics seminar 5-10 cr
- NEU-606 Neuroscience seminar series 2 cr
- NEU-771 Other elective studies 1-10 cr
- NEU-991 Other elective studies 1-10 cr
- TMED-406 Translational Psychiatry * 5 cr
  THERE IS NO VERSION OF THE STUDY IN THE SELECTED CURRICULUM PERIOD
- MPHARM-009 Introduction to research methods in drug discovery and development – theory * 5 cr
- PROV-004 Introduction to Cell and Molecular Biology Methods * 5 cr
- PROV-502 Neuropharmacology * 5 cr
- BIO-404 Adapted animal * 5 cr
- BIO-405 Exposed animal * 5 cr
- GMB-401 Integrative health biosciences * 5-10 cr
- GMB-305 Stem cells and organogenesis * 5 cr
- NEUBM-102 B&M Symposium 2 * 1-2 cr
- NEUBM-205 Advances in neuroimmunology and neuroinflammation * 3 cr
- NEUBM-211 Microglia and recent technologies * 3 cr
- NEUBM-301 Biological psychiatry 1 * 1-2 cr
- NEUBM-303 NeuPhar 1 * 2-5 cr
- NEUBM-309 Computational neuroscience * 1-3 cr
- NEUBM-507 B&M "What's up" Journal Club * 1-2 cr
- NEUBM-533 Functional neuroanatomy * 3 cr
- NEUBM-610 Big questions in neuroscience and current limits of knowledge * 1-2 cr
- TMED-202 Regenerative Medicine from Bench to Bedside * 5 cr
  THERE IS NO VERSION OF THE STUDY IN THE SELECTED CURRICULUM PERIOD
- MED-TOU11 An Introduction to Sleep and Circadian Neurobiology * 2.5 cr
- MED-TOU25 Interdisciplinary insights into sleep and circadian rhythms * 2.5 cr
  DRAFT
- HNFB-221 Nutrition and society * 5 cr

NEU-VAL ELECTIVE STUDY MODULES min 0 cr

NEU-500 MOLECULAR AND CELLULAR NEUROSCIENCE, STUDY MODULE 15-30 cr

- NEU-502 Synaptic Signaling and Plasticity 5 cr
- NEU-531 Developmental neuroscience 5 cr
- NEU-543 Brain slice electrophysiology 5 cr
- PROV-004 Introduction to Cell and Molecular Biology Methods * 5 cr

NEU-510 SYSTEMS AND COGNITIVE NEUROSCIENCE, STUDY MODULE 15-30 cr

- NEU-511 Systems and Cognitive Neuroscience 5 cr

ELECTIVE (grouping module)

- NEU-512 Animal models in behavioural neuroscience 5 cr

NEU-520 NEUROSCIENCE IN HEALTH AND DISEASE, STUDY MODULE 15-30 cr

- NEU-521 Basic mechanisms of nervous system diseases 1-5 cr

ELECTIVE (grouping module)

- TMED-406 Translational Psychiatry * 5 cr
  THERE IS NO VERSION OF THE STUDY IN THE SELECTED CURRICULUM PERIOD

- **MED-TOU11** An Introduction to Sleep and Circadian Neurobiology * — 2.5 cr
- **MED-TOU25** Interdisciplinary insights into sleep and circadian rhythms * — 2.5 cr
  DRAFT
- **NEU-512** Animal models in behavioural neuroscience — 5 cr

**NEU-530** DEVELOPMENT, REGENERATION AND AGEING, STUDY MODULE — 15-30 cr

- **NEU-531** Developmental neuroscience — 5 cr
- **NEU-231** Mechanisms of regeneration and aging — 5 cr
- ELECTIVE (grouping module)
  - **TMED-202** Regenerative Medicine from Bench to Bedside * — 5 cr
    THERE IS NO VERSION OF THE STUDY IN THE SELECTED CURRICULUM PERIOD
  - **GMB-305** Stem cells and organogenesis * — 5 cr

**NEU-540** ELECTROPHYSIOLOGY AND NEUROBIOPHYSICS, STUDY MODULE — 15-30 cr

- **NEU-541** Introduction to neurobiophysics — 5 cr
- **NEU-542** Electrophysiological techniques — 5 cr
- ELECTIVE (grouping module)
  - **NEU-543** Brain slice electrophysiology — 5 cr

**NEU-550** SENSORY BIOLOGY, STUDY MODULE — 15-30 cr

- **NEU-551** Sensory Biology — 3-5 cr
- **NEU-552** Studies of sensory performance in animals and humans — 5 cr
- ELECTIVE (grouping module)
  - **NEU-512** Animal models in behavioural neuroscience — 5 cr
  - **NEU-542** Electrophysiological techniques — 5 cr

**NEU-560** OMICS, STUDY MODULE — 15-30 cr

- **NEU-561** Principles of bioscience omics — 10 cr
- OPTIONAL (grouping module)
  - **TMED-915** Introduction to Bioinformatics * — 5 cr

**NEU-570** ENVIRONMENTAL PHYSIOLOGY, STUDY MODULE — 15-30 cr

- **BIO-404** Adapted animal * — 5 cr
- **BIO-405** Exposed animal * — 5 cr
- OPTIONAL (grouping module)

**NEU-240** NEUROSCIENCE FROM CELLS TO SYSTEMS, STUDY MODULE — 15-30 cr

- **NEU-102** Cellular neurobiology — 5 cr
- OPTIONAL (grouping module)
  - **NEU-502** Synaptic Signaling and Plasticity — 5 cr
  - **NEU-512** Animal models in behavioural neuroscience — 5 cr
  - **NEU-521** Basic mechanisms of nervous system diseases — 1-5 cr

**NEU-250** NUTRITION AND HEALTH, STUDY MODULE — 15-30 cr

- **NEU-251** Molecular Nutrition — 5 cr
- **GMB-401** Integrative health biosciences * — 5-10 cr
- **HNFB-221** Nutrition and society * — 5 cr
- OPTIONAL (grouping module)

**NEU-F** CELL AND SYSTEMS PHYSIOLOGY * — 120-135 cr

**NEU-201** CELL AND SYSTEMS PHYSIOLOGY, ADVANCED STUDIES — 65 cr

- **NEU-101** Cellular physiology — 5 cr
- **NEU-203** Systems Physiology — 5 cr
- **NEU-205** Methods and Trends in Physiology and Neuroscience — 5 cr

NEU-207 Regulatory Networks in Metabolism 5 cr
NEU-561 Principles of bioscience omics 10 cr
NEU-306 Master's seminar in cell and systems physiology 5 cr
NEU-220 Master's thesis in cell and systems physiology 30 cr
VIIKB-001 Master's Maturity Test * 0 cr

NEU-MUUT OTHER STUDIES min 0 cr

CAREER ORIENTATION AND PROFESSIONAL SKILLS TRAINING (grouping module)

TMED-901 Career Development * 3 cr
THERE IS NO VERSION OF THE STUDY IN THE SELECTED CURRICULUM PERIOD
NEU-404 Practical training 1 5-10 cr
NEU-405 Practical training 2 5 cr
NEU-414 Research project 5 cr
NEU-415 Creative scientific thinking 5 cr
NEU-416 Creative scientific project 2-5 cr
NEU-603 Laboratory animal science 1-5 cr
MPHARM-004 Research ethics * 1 cr
SUST-001 Sustainability course * 3 cr
MAT12001 Basics of statistics and R I * 5 cr
NEUBM-702 Public outreach in neuroscience * 1-4 cr
PED590 Towards better well-being and studying * 3 cr

OPTIONAL COURSES (grouping module)

NEU-102 Cellular neurobiology 5 cr
NEU-104 Integrative neurobiology 5 cr
NEU-207 Regulatory Networks in Metabolism 5 cr
NEU-231 Mechanisms of regeneration and aging 5 cr
NEU-251 Molecular Nutrition 5 cr
NEU-502 Synaptic Signaling and Plasticity 5 cr
NEU-503 Neuronal cell culture workshop 3 cr
NEU-511 Systems and Cognitive Neuroscience 5 cr
NEU-512 Animal models in behavioural neuroscience 5 cr
NEU-521 Basic mechanisms of nervous system diseases 1-5 cr
NEU-531 Developmental neuroscience 5 cr
NEU-541 Introduction to neurobiophysics 5 cr
NEU-542 Electrophysiological techniques 5 cr
NEU-543 Brain slice electrophysiology 5 cr
NEU-551 Sensory Biology 3-5 cr
NEU-552 Studies of sensory performance in animals and humans 5 cr
NEU-561 Principles of bioscience omics 10 cr
NEU-601 Book examination in neuroscience 2-10 cr
NEU-602 Book examination in cell and systems physiology 2-10 cr
NEU-604 Functional lipidomics seminar 5-10 cr
NEU-606 Neuroscience seminar series 2 cr
NEU-771 Other elective studies 1-10 cr
NEU-991 Other elective studies 1-10 cr
TMED-406 Translational Psychiatry * 5 cr
THERE IS NO VERSION OF THE STUDY IN THE SELECTED CURRICULUM PERIOD

- **MPHARM-009** Introduction to research methods in drug discovery and development – theory * — 5 cr
- **PROV-004** Introduction to Cell and Molecular Biology Methods * — 5 cr
- **PROV-502** Neuropharmacology * — 5 cr
- **BIO-404** Adapted animal * — 5 cr
- **BIO-405** Exposed animal * — 5 cr
- **GMB-401** Integrative health biosciences * — 5-10 cr
- **GMB-305** Stem cells and organogenesis * — 5 cr
- **NEUBM-102** B&M Symposium 2 * — 1-2 cr
- **NEUBM-205** Advances in neuroimmunology and neuroinflammation * — 3 cr
- **NEUBM-211** Microglia and recent technologies * — 3 cr
- **NEUBM-301** Biological psychiatry 1 * — 1-2 cr
- **NEUBM-303** NeuPhar 1 * — 2-5 cr
- **NEUBM-309** Computational neuroscience * — 1-3 cr
- **NEUBM-507** B&M "What's up" Journal Club * — 1-2 cr
- **NEUBM-533** Functional neuroanatomy * — 3 cr
- **NEUBM-610** Big questions in neuroscience and current limits of knowledge * — 1-2 cr
- **TMED-202** Regenerative Medicine from Bench to Bedside * — 5 cr
  THERE IS NO VERSION OF THE STUDY IN THE SELECTED CURRICULUM PERIOD
- **MED-TOU11** An Introduction to Sleep and Circadian Neurobiology * — 2.5 cr
- **MED-TOU25** Interdisciplinary insights into sleep and circadian rhythms * — 2.5 cr
  DRAFT
- **HNFB-221** Nutrition and society * — 5 cr

**NEU-VAL** ELECTIVE STUDY MODULES — min 0 cr

**NEU-500** MOLECULAR AND CELLULAR NEUROSCIENCE, STUDY MODULE — 15-30 cr

- **NEU-502** Synaptic Signaling and Plasticity — 5 cr
- **NEU-531** Developmental neuroscience — 5 cr
- **NEU-543** Brain slice electrophysiology — 5 cr
- **PROV-004** Introduction to Cell and Molecular Biology Methods * — 5 cr

**NEU-510** SYSTEMS AND COGNITIVE NEUROSCIENCE, STUDY MODULE — 15-30 cr

- **NEU-511** Systems and Cognitive Neuroscience — 5 cr

  ELECTIVE (grouping module)

  - **NEU-512** Animal models in behavioural neuroscience — 5 cr

**NEU-520** NEUROSCIENCE IN HEALTH AND DISEASE, STUDY MODULE — 15-30 cr

- **NEU-521** Basic mechanisms of nervous system diseases — 1-5 cr

  ELECTIVE (grouping module)

  - **TMED-406** Translational Psychiatry * — 5 cr
    THERE IS NO VERSION OF THE STUDY IN THE SELECTED CURRICULUM PERIOD
  - **MED-TOU11** An Introduction to Sleep and Circadian Neurobiology * — 2.5 cr
  - **MED-TOU25** Interdisciplinary insights into sleep and circadian rhythms * — 2.5 cr
    DRAFT
  - **NEU-512** Animal models in behavioural neuroscience — 5 cr

**NEU-530** DEVELOPMENT, REGENERATION AND AGEING, STUDY MODULE — 15-30 cr

- **NEU-531** Developmental neuroscience — 5 cr
- **NEU-231** Mechanisms of regeneration and aging — 5 cr

  ELECTIVE (grouping module)

- **TMED-202** Regenerative Medicine from Bench to Bedside * — 5 cr
  THERE IS NO VERSION OF THE STUDY IN THE SELECTED CURRICULUM PERIOD
- **GMB-305** Stem cells and organogenesis * — 5 cr

**NEU-540** ELECTROPHYSIOLOGY AND NEUROBIOPHYSICS, STUDY MODULE — 15-30 cr

- **NEU-541** Introduction to neurobiophysics — 5 cr
- **NEU-542** Electrophysiological techniques — 5 cr
- ELECTIVE (grouping module)
  - **NEU-543** Brain slice electrophysiology — 5 cr

**NEU-550** SENSORY BIOLOGY, STUDY MODULE — 15-30 cr

- **NEU-551** Sensory Biology — 3-5 cr
- **NEU-552** Studies of sensory performance in animals and humans — 5 cr
- ELECTIVE (grouping module)
  - **NEU-512** Animal models in behavioural neuroscience — 5 cr
  - **NEU-542** Electrophysiological techniques — 5 cr

**NEU-560** OMICS, STUDY MODULE — 15-30 cr

- **NEU-561** Principles of bioscience omics — 10 cr
- OPTIONAL (grouping module)
  - **TMED-915** Introduction to Bioinformatics * — 5 cr

**NEU-570** ENVIRONMENTAL PHYSIOLOGY, STUDY MODULE — 15-30 cr

- **BIO-404** Adapted animal * — 5 cr
- **BIO-405** Exposed animal * — 5 cr
- OPTIONAL (grouping module)

**NEU-240** NEUROSCIENCE FROM CELLS TO SYSTEMS, STUDY MODULE — 15-30 cr

- **NEU-102** Cellular neurobiology — 5 cr
- OPTIONAL (grouping module)
  - **NEU-502** Synaptic Signaling and Plasticity — 5 cr
  - **NEU-512** Animal models in behavioural neuroscience — 5 cr
  - **NEU-521** Basic mechanisms of nervous system diseases — 1-5 cr

**NEU-250** NUTRITION AND HEALTH, STUDY MODULE — 15-30 cr

- **NEU-251** Molecular Nutrition — 5 cr
- **GMB-401** Integrative health biosciences * — 5-10 cr
- **HNFB-221** Nutrition and society * — 5 cr
- OPTIONAL (grouping module)

**NEU-A** BIOLOGY SUBJECT TEACHER * — 120-135 cr

**NEU-300** BIOLOGY TEACHER STUDY TRACK, ADVANCED STUDIES — 60 cr

- **NEU-310** Master's thesis in the study track of biology teacher — 30 cr
- **VIIKB-001** Master's Maturity Test * — 0 cr
- OPTIONAL (grouping module)
  - NEUROTIEDE (grouping module)
    - **NEU-101** Cellular physiology — 5 cr
    - **NEU-102** Cellular neurobiology — 5 cr
    - **NEU-103** Systems Neuroscience — 5 cr
    - **NEU-104** Integrative neurobiology — 5 cr
    - **NEU-105** Methods and Trends in Neuroscience — 5 cr
    - **NEU-106** Master's Seminar in Neuroscience — 5 cr
  - CELL AND SYSTEMS PHYSIOLOGY (grouping module)
    - **NEU-101** Cellular physiology — 5 cr

- **NEU-203** Systems Physiology 5 cr
- **NEU-205** Methods and Trends in Physiology and Neuroscience 5 cr
- **NEU-561** Principles of bioscience omics 10 cr
- **NEU-306** Master's seminar in cell and systems physiology 5 cr

SUBJECT TEACHER PEDAGOGICAL STUDIES (grouping module)

- **PED100** PEDAGOGICAL STUDIES FOR TEACHERS 60 CR (FOR TEACHING IN BASIC EDUCATION AND UPPER SECONDARY SCHOOL LEVEL), BASIC AND INTERMEDIATE STUDIES IN EDUCATION * 60 cr
  - **PED110** PEDAGOGICAL STUDIES FOR TEACHERS (FOR TEACHING IN BASIC EDUCATION AND UPPER SECONDARY SCHOOL LEVEL), BASIC STUDIES IN EDUCATION * 25 cr
    - **PED002** Introduction to Educational Psychology * 5 cr
    - **PED111** Basic practice * 10 cr
    - **PED00322** SUBJECT DIDACTICS I: CURRICULUM AND TEACHING * 10 cr
      - **PED0032BI** Subject Didactics I: Curriculum and Teaching - Biology * 5 cr
      - **PED0032ET** Subject Didactics I: Curriculum and Teaching - Ethics * 5 cr
      - **PED0032FIL** Subject Didactics I: Curriculum and Teaching - Philosophy * 5 cr
      - **PED0032FYS** Subject Didactics I: Curriculum and Teaching - Physics * 5 cr
      - **PED0032HIS** Subject Didactics I: Curriculum and Teaching - History * 5 cr
      - **PED0032KASV** Subject Didactics I: Curriculum and Teaching - Educational Sciences * 5 cr
      - **PED0032KEM** Subject Didactics I: Curriculum and Teaching - Chemistry * 5 cr
      - **PED0032MAA** Subject Didactics I: Curriculum and Teaching - Geography * 5 cr
      - **PED0032MAT** Subject Didactics I: Curriculum and Teaching - Mathematics * 5 cr
      - **PED0032PSY** Subject Didactics I: Curriculum and Teaching - Psychology * 5 cr
      - **PED0032SUOKI** Subject Didactics I: Curriculum and Teaching - Finnish language and Litterature * 10 cr
      - **PED0032SUOKI5** Subject Didactics I: Curriculum and Teaching - Finnish language and Litterature - 5 cr * 5 cr
      - **PED0032TKT** Subject Didactics I: Curriculum and Teaching - Computer Science * 5 cr
      - **PED0032USK** Subject Didactics I: Curriculum and Teaching - Religion * 5 cr
      - **PED0032VIEKI** Subject Didactics I: Curriculum and Teaching - Foreign Languages * 10 cr
      - **PED0032VIEKI5** Subject Didactics I: Curriculum and Teaching - Foreign Languages - 5 cr * 5 cr
      - **PED0032YHT** Subject Didactics I: Curriculum and Teaching - Social Studies * 5 cr
      - **PED0032AIK** Subject Didactics I: Curriculum and Teaching - Adult Education Didactics * 5 cr
      - **PED0032TÄYD** Subject Didactics I: Curriculum and Teaching - * 5 cr

- **PED120** PEDAGOGICAL STUDIES FOR TEACHERS (FOR TEACHING IN BASIC EDUCATION AND UPPER SECONDARY SCHOOL LEVEL), INTERMEDIATE STUDIES IN EDUCATION * — 35 cr
  - **PED0071** SUBJECT DIDACTICS II: ASSESSMENT AND DEVELOPMENT * — 5 cr
    - **PED0071BI** Subject Didactics II: Assessment and Development - Biology * — 2.5 cr
    - **PED0071ET** Subject Didactics II: Assessment and Development - Ethics * — 2.5 cr
    - **PED0071FIL** Subject Didactics II: Assessment and Development - Philosophy * — 2.5 cr
    - **PED0071FYS** Subject Didactics II: Assessment and Development - Physics * — 2.5 cr
    - **PED0071HIS** Subject Didactics II: Assessment and Development - History * — 2.5 cr
    - **PED0071KEM** Subject Didactics II: Assessment and Development - Chemistry * — 2.5 cr
    - **PED0071MAA** Subject Didactics II: Assessment and Development - Geography * — 2.5 cr
    - **PED0071MAT** Subject Didactics II: Assessment and Development - Mathematics * — 2.5 cr
    - **PED0071PSY** Subject Didactics II: Assessment and Development - Psychology * — 2.5 cr
    - **PED0071SUOKI** Subject Didactics II: Assessment and Development - Finnish language and Litterature * — 5 cr
    - **PED0071SUOKI2.5** Subject Didactics II: Assessment and Development - Finnish language and Litterature - 2.5 cr * — 2.5 cr
    - **PED0071TKT** Subject Didactics II: Assessment and Development - Computer Science * — 2.5 cr
    - **PED0071USK** Subject Didactics II: Assessment and Development - Religion * — 2.5 cr
    - **PED0071VIEKI** Subject Didactics II: Assessment and Development - Foreign Languages * — 5 cr
    - **PED0071VIEKI2.5** Subject Didactics II: Assessment and Development - Foreign Languages - 2.5 cr * — 2.5 cr
    - **PED0071YHT** Subject Didactics II: Assessment and Development - Social Studies * — 2.5 cr
    - **PED0071TÄYD** Subject Didactics II: Assessment and Development - * — 2.5 cr
  - **PED001** Social, Cultural and Philosophical Foundations of Education * — 5 cr
  - **PED004** Support for Learning and Well-being * — 5 cr
  - **PED0061** Teacher as a Researcher - Didactics 2 op * — 2 cr
  - **PED121** Advanced Practice * — 10 cr
  - **PED0066** Teacher as a Researcher (subject teacher education) * — 8 cr
- **PED200** PEDAGOGICAL STUDIES FOR TEACHERS 60 CR (ADULT EDUCATION), BASIC AND INTERMEDIATE STUDIES IN EDUCATION * — 60 cr
  - **PED210** PEDAGOGICAL STUDIES FOR TEACHERS (ADULT EDUCATION), BASIC STUDIES IN EDUCATION * — 25 cr
    - **PED002** Introduction to Educational Psychology * — 5 cr
    - **PED211** Basic practice * — 8 cr
    - **PED2111** Basic Practice: Distance and Online Learning * — 2 cr
    - **PED00322** SUBJECT DIDACTICS I: CURRICULUM AND TEACHING * — 10 cr

PED0032BI Subject Didactics I: Curriculum and Teaching - Biology * 5 cr

PED0032ET Subject Didactics I: Curriculum and Teaching - Ethics * 5 cr

PED0032FIL Subject Didactics I: Curriculum and Teaching - Philosophy * 5 cr

PED0032FYS Subject Didactics I: Curriculum and Teaching - Physics * 5 cr

PED0032HIS Subject Didactics I: Curriculum and Teaching - History * 5 cr

PED0032KASV Subject Didactics I: Curriculum and Teaching - Educational Sciences * 5 cr

PED0032KEM Subject Didactics I: Curriculum and Teaching - Chemistry * 5 cr

PED0032MAA Subject Didactics I: Curriculum and Teaching - Geography * 5 cr

PED0032MAT Subject Didactics I: Curriculum and Teaching - Mathematics * 5 cr

PED0032PSY Subject Didactics I: Curriculum and Teaching - Psychology * 5 cr

PED0032SUOKI Subject Didactics I: Curriculum and Teaching - Finnish language and Litterature * 10 cr

PED0032SUOKI5 Subject Didactics I: Curriculum and Teaching - Finnish language and Litterature - 5 cr * 5 cr

PED0032TKT Subject Didactics I: Curriculum and Teaching - Computer Science * 5 cr

PED0032USK Subject Didactics I: Curriculum and Teaching - Religion * 5 cr

PED0032VIEKI Subject Didactics I: Curriculum and Teaching - Foreign Languages * 10 cr

PED0032VIEKI5 Subject Didactics I: Curriculum and Teaching - Foreign Languages - 5 cr * 5 cr

PED0032YHT Subject Didactics I: Curriculum and Teaching - Social Studies * 5 cr

PED0032AIK Subject Didactics I: Curriculum and Teaching - Adult Education Didactics * 5 cr

PED0032TÄYD Subject Didactics I: Curriculum and Teaching - * 5 cr

PED220 PEDAGOGICAL STUDIES FOR TEACHERS (ADULT EDUCATION), INTERMEDIATE STUDIES IN EDUCATION * 35 cr

PED001 Social, Cultural and Philosophical Foundations of Education * 5 cr

PED004 Support for Learning and Well-being * 5 cr

PED0071 SUBJECT DIDACTICS II: ASSESSMENT AND DEVELOPMENT * 5 cr

PED0071BI Subject Didactics II: Assessment and Development - Biology * 2.5 cr

PED0071ET Subject Didactics II: Assessment and Development - Ethics * 2.5 cr

PED0071FIL Subject Didactics II: Assessment and Development - Philosophy * 2.5 cr

PED0071FYS Subject Didactics II: Assessment and Development - Physics * 2.5 cr

PED0071HIS Subject Didactics II: Assessment and Development - History * 2.5 cr

- **PED0071KEM** Subject Didactics II: Assessment and Development - Chemistry * 2.5 cr
- **PED0071MAA** Subject Didactics II: Assessment and Development - Geography * 2.5 cr
- **PED0071MAT** Subject Didactics II: Assessment and Development - Mathematics * 2.5 cr
- **PED0071PSY** Subject Didactics II: Assessment and Development - Psychology * 2.5 cr
- **PED0071SUOKI** Subject Didactics II: Assessment and Development - Finnish language and Litterature * 5 cr
- **PED0071SUOKI2.5** Subject Didactics II: Assessment and Development - Finnish language and Litterature - 2.5 cr * 2.5 cr
- **PED0071TKT** Subject Didactics II: Assessment and Development - Computer Science * 2.5 cr
- **PED0071USK** Subject Didactics II: Assessment and Development - Religion * 2.5 cr
- **PED0071VIEKI** Subject Didactics II: Assessment and Development - Foreign Languages * 5 cr
- **PED0071VIEKI2.5** Subject Didactics II: Assessment and Development - Foreign Languages - 2.5 cr * 2.5 cr
- **PED0071YHT** Subject Didactics II: Assessment and Development - Social Studies * 2.5 cr
- **PED0071TÄYD** Subject Didactics II: Assessment and Development - * 2.5 cr

- **PED221** Advanced Practice * 10 cr
- **PED0061** Teacher as a Researcher - Didactics 2 op * 2 cr
- **PED0066** Teacher as a Researcher (subject teacher education) * 8 cr

**PED600** EDUCATION, PEDAGOGICAL STUDIES FOR TEACHERS 60 CR * 60 cr

- **PED610** EDUCATION, PEDAGOGICAL STUDIES FOR TEACHERS, BASIC STUDIES * 25 cr
  - **PED002** Introduction to Educational Psychology * 5 cr
  - **PED003SVE** Planning, Implementation and Assessment of Teaching I * 5 cr
  - **PED611** Ämnesdidaktik * 5 cr
  - **PED612** Basic practice * 10 cr
- **PED620** EDUCATION, PEDAGOGICAL STUDIES FOR TEACHERS, INTERMEDIATE STUDIES * 35 cr
  - **PED001** Social, Cultural and Philosophical Foundations of Education * 5 cr
  - **PED004** Support for Learning and Well-being * 5 cr
  - **PED006SVE** Teacher as a researcher * 10 cr
  - **PED007SVE** Curriculum Studies and Developing Educational Institutions * 5 cr
  - **PED621** Advanced practice * 10 cr

**PED800** EDUCATION, PEDAGOGICAL STUDIES FOR TEACHERS 60 CR (ADULT EDUCATION) * 60 cr

- **PED810** PEDAGOGICAL STUDIES FOR TEACHERS (ADULT EDUCATION), BASIC STUDIES * 25 cr
  - **PED002** Introduction to Educational Psychology * 5 cr
  - **PED003SVE** Planning, Implementation and Assessment of Teaching I * 5 cr
  - **PED611** Ämnesdidaktik * 5 cr
  - **PED613** Basic practice * 10 cr

PED820 EDUCATION, PEDAGOGICAL STUDIES FOR TEACHERS, INTERMEDIATE STUDIES (ADULT EDUCATION) * — 35 cr

- PED001 Social, Cultural and Philosophical Foundations of Education * — 5 cr
- PED004 Support for Learning and Well-being * — 5 cr
- PED006SVE Teacher as a researcher * — 10 cr
- PED007SVE Curriculum Studies and Developing Educational Institutions * — 5 cr
- PED622 Advanced practice * — 10 cr

NEU-MUUT OTHER STUDIES — min 0 cr

CAREER ORIENTATION AND PROFESSIONAL SKILLS TRAINING (grouping module)

- TMED-901 Career Development * — 3 cr
  THERE IS NO VERSION OF THE STUDY IN THE SELECTED CURRICULUM PERIOD
- NEU-404 Practical training 1 — 5-10 cr
- NEU-405 Practical training 2 — 5 cr
- NEU-414 Research project — 5 cr
- NEU-415 Creative scientific thinking — 5 cr
- NEU-416 Creative scientific project — 2-5 cr
- NEU-603 Laboratory animal science — 1-5 cr
- MPHARM-004 Research ethics * — 1 cr
- SUST-001 Sustainability course * — 3 cr
- MAT12001 Basics of statistics and R I * — 5 cr
- NEUBM-702 Public outreach in neuroscience * — 1-4 cr
- PED590 Towards better well-being and studying * — 3 cr

OPTIONAL COURSES (grouping module)

- NEU-102 Cellular neurobiology — 5 cr
- NEU-104 Integrative neurobiology — 5 cr
- NEU-207 Regulatory Networks in Metabolism — 5 cr
- NEU-231 Mechanisms of regeneration and aging — 5 cr
- NEU-251 Molecular Nutrition — 5 cr
- NEU-502 Synaptic Signaling and Plasticity — 5 cr
- NEU-503 Neuronal cell culture workshop — 3 cr
- NEU-511 Systems and Cognitive Neuroscience — 5 cr
- NEU-512 Animal models in behavioural neuroscience — 5 cr
- NEU-521 Basic mechanisms of nervous system diseases — 1-5 cr
- NEU-531 Developmental neuroscience — 5 cr
- NEU-541 Introduction to neurobiophysics — 5 cr
- NEU-542 Electrophysiological techniques — 5 cr
- NEU-543 Brain slice electrophysiology — 5 cr
- NEU-551 Sensory Biology — 3-5 cr
- NEU-552 Studies of sensory performance in animals and humans — 5 cr
- NEU-561 Principles of bioscience omics — 10 cr
- NEU-601 Book examination in neuroscience — 2-10 cr
- NEU-602 Book examination in cell and systems physiology — 2-10 cr
- NEU-604 Functional lipidomics seminar — 5-10 cr
- NEU-606 Neuroscience seminar series — 2 cr
- NEU-771 Other elective studies — 1-10 cr
- NEU-991 Other elective studies — 1-10 cr

| | |
|---|---|
| **TMED-406** Translational Psychiatry * THERE IS NO VERSION OF THE STUDY IN THE SELECTED CURRICULUM PERIOD | 5 cr |
| **MPHARM-009** Introduction to research methods in drug discovery and development – theory * | 5 cr |
| **PROV-004** Introduction to Cell and Molecular Biology Methods * | 5 cr |
| **PROV-502** Neuropharmacology * | 5 cr |
| **BIO-404** Adapted animal * | 5 cr |
| **BIO-405** Exposed animal * | 5 cr |
| **GMB-401** Integrative health biosciences * | 5-10 cr |
| **GMB-305** Stem cells and organogenesis * | 5 cr |
| **NEUBM-102** B&M Symposium 2 * | 1-2 cr |
| **NEUBM-205** Advances in neuroimmunology and neuroinflammation * | 3 cr |
| **NEUBM-211** Microglia and recent technologies * | 3 cr |
| **NEUBM-301** Biological psychiatry 1 * | 1-2 cr |
| **NEUBM-303** NeuPhar 1 * | 2-5 cr |
| **NEUBM-309** Computational neuroscience * | 1-3 cr |
| **NEUBM-507** B&M "What's up" Journal Club * | 1-2 cr |
| **NEUBM-533** Functional neuroanatomy * | 3 cr |
| **NEUBM-610** Big questions in neuroscience and current limits of knowledge * | 1-2 cr |
| **TMED-202** Regenerative Medicine from Bench to Bedside * THERE IS NO VERSION OF THE STUDY IN THE SELECTED CURRICULUM PERIOD | 5 cr |
| **MED-TOU11** An Introduction to Sleep and Circadian Neurobiology * | 2.5 cr |
| **MED-TOU25** Interdisciplinary insights into sleep and circadian rhythms * DRAFT | 2.5 cr |
| **HNFB-221** Nutrition and society * | 5 cr |

* Not included because it does not correspond to the selected responsible organisations or curriculum period

## FILTERED STUDY MODULES

## **NEU-100** Neuroscience, Advanced Studies

**NEU-100** Neurotiede, syventävät opinnot

**NEU-100** Neurovetenskap, fördjupade studier

Abbreviation: Neurotiede, syv

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 60 cr |
| Languages | English |
| Graded module | yes |
| Grading scale | General scale, 0-5 |
| Content approval required | no |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible person | Juha Voipio, Responsible teacher |
| Study module level | Advanced studies |

| | |
|---|---|
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Content description**

**EN:** Choose all:
. NEU-101: Cellular physiology, 5 cp
. NEU-102: Cellular neurobiology, 5 cp
. NEU-103: Systems neuroscience, 5 cp
. NEU-104: Integrative neurobiology, 5 cp
. NEU-105: Methods and trends in neuroscience, 5 cp
. NEU-106: Master’s seminar in neuroscience, 5 cp
. NEU-110: Master's thesis in neuroscience, 30 cp
. VIIKB-001: Maturity test, 0 cp

**Learning outcomes**

**EN:** This module covers the core content in neuroscience that every neuroscience student graduating from the Programme should know. In addition, the module introduces students to various fields within neuroscience, and students get to know the local scientific community. The module includes the Master's thesis.

**Additional information**

**EN:** Target group
Degree students in the Master's Programme in Neuroscience must choose between the following study tracks: 1) neuroscience, 2) cell and systems physiology or 3) biology teacher.

The module is intended for degree students of the Master’s Programme in Neuroscience. Lecture courses are available for students of other programmes. Degree students of the Master’s Programme in Neuroscience are provided priority access to courses where group work may require limiting the maximum number of students.

Timing

1st year of Master’s studies, periods I-II (except Master's Thesis and Master's Seminar that is recommended to be completed during the 2nd year or in parallel with the Master's Thesis project)

Responsible person
Professor Juha Voipio

EQF level: 7

| Study module structure | Credits |
|---|---|
| **NEU-100** NEUROSCIENCE, ADVANCED STUDIES | 60 cr |
| **NEU-101** Cellular physiology | 5 cr |
| **NEU-102** Cellular neurobiology | 5 cr |
| **NEU-103** Systems Neuroscience | 5 cr |
| **NEU-104** Integrative neurobiology | 5 cr |
| **NEU-105** Methods and Trends in Neuroscience | 5 cr |
| **NEU-106** Master’s Seminar in Neuroscience | 5 cr |
| **NEU-110** Master's thesis in neuroscience | 30 cr |
| **VIIKB-001** Master's Maturity Test * | 0 cr |

* Not included because it does not correspond to the selected responsible organisations or curriculum period

# **NEU-MUUT** Other studies

**NEU-MUUT** Muut opinnot

**NEU-MUUT** Övriga studier

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | min 0 cr |
| Languages | Finnish, Swedish, English |
| Graded module | yes |
| Grading scale | Pass-Fail |
| Content approval required | no |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible persons | Katri Wegelius, Administrative person<br>Juha Voipio, Responsible teacher |
| Study module level | Other studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

### Content description

**EN:** Elective studies chosen from the Programme (courses from both topical study tracks are available) or from other Programmes. The courses can include career orientation and professional skills training in addition to subject-specific studies.

| Study module structure | Credits |
|---|---|
| **NEU-MUUT** OTHER STUDIES | min 0 cr |
| CAREER ORIENTATION AND PROFESSIONAL SKILLS TRAINING (grouping module) | |
| **TMED-901** Career Development * | 3 cr |
| THERE IS NO VERSION OF THE STUDY IN THE SELECTED CURRICULUM PERIOD | |
| **NEU-404** Practical training 1 | 5-10 cr |
| **NEU-405** Practical training 2 | 5 cr |
| **NEU-414** Research project | 5 cr |
| **NEU-415** Creative scientific thinking | 5 cr |
| **NEU-416** Creative scientific project | 2-5 cr |
| **NEU-603** Laboratory animal science | 1-5 cr |
| **MPHARM-004** Research ethics * | 1 cr |
| **SUST-001** Sustainability course * | 3 cr |
| **MAT12001** Basics of statistics and R I * | 5 cr |
| **NEUBM-702** Public outreach in neuroscience * | 1-4 cr |
| **PED590** Towards better well-being and studying * | 3 cr |
| OPTIONAL COURSES (grouping module) | |
| **NEU-102** Cellular neurobiology | 5 cr |
| **NEU-104** Integrative neurobiology | 5 cr |
| **NEU-207** Regulatory Networks in Metabolism | 5 cr |
| **NEU-231** Mechanisms of regeneration and aging | 5 cr |
| **NEU-251** Molecular Nutrition | 5 cr |
| **NEU-502** Synaptic Signaling and Plasticity | 5 cr |
| **NEU-503** Neuronal cell culture workshop | 3 cr |

| | |
|---|---|
| **NEU-511** Systems and Cognitive Neuroscience | 5 cr |
| **NEU-512** Animal models in behavioural neuroscience | 5 cr |
| **NEU-521** Basic mechanisms of nervous system diseases | 1-5 cr |
| **NEU-531** Developmental neuroscience | 5 cr |
| **NEU-541** Introduction to neurobiophysics | 5 cr |
| **NEU-542** Electrophysiological techniques | 5 cr |
| **NEU-543** Brain slice electrophysiology | 5 cr |
| **NEU-551** Sensory Biology | 3-5 cr |
| **NEU-552** Studies of sensory performance in animals and humans | 5 cr |
| **NEU-561** Principles of bioscience omics | 10 cr |
| **NEU-601** Book examination in neuroscience | 2-10 cr |
| **NEU-602** Book examination in cell and systems physiology | 2-10 cr |
| **NEU-604** Functional lipidomics seminar | 5-10 cr |
| **NEU-606** Neuroscience seminar series | 2 cr |
| **NEU-771** Other elective studies | 1-10 cr |
| **NEU-991** Other elective studies | 1-10 cr |
| **TMED-406** Translational Psychiatry * THERE IS NO VERSION OF THE STUDY IN THE SELECTED CURRICULUM PERIOD | 5 cr |
| **MPHARM-009** Introduction to research methods in drug discovery and development – theory * | 5 cr |
| **PROV-004** Introduction to Cell and Molecular Biology Methods * | 5 cr |
| **PROV-502** Neuropharmacology * | 5 cr |
| **BIO-404** Adapted animal * | 5 cr |
| **BIO-405** Exposed animal * | 5 cr |
| **GMB-401** Integrative health biosciences * | 5-10 cr |
| **GMB-305** Stem cells and organogenesis * | 5 cr |
| **NEUBM-102** B&M Symposium 2 * | 1-2 cr |
| **NEUBM-205** Advances in neuroimmunology and neuroinflammation * | 3 cr |
| **NEUBM-211** Microglia and recent technologies * | 3 cr |
| **NEUBM-301** Biological psychiatry 1 * | 1-2 cr |
| **NEUBM-303** NeuPhar 1 * | 2-5 cr |
| **NEUBM-309** Computational neuroscience * | 1-3 cr |
| **NEUBM-507** B&M "What's up" Journal Club * | 1-2 cr |
| **NEUBM-533** Functional neuroanatomy * | 3 cr |
| **NEUBM-610** Big questions in neuroscience and current limits of knowledge * | 1-2 cr |
| **TMED-202** Regenerative Medicine from Bench to Bedside * THERE IS NO VERSION OF THE STUDY IN THE SELECTED CURRICULUM PERIOD | 5 cr |
| **MED-TOU11** An Introduction to Sleep and Circadian Neurobiology * | 2.5 cr |
| **MED-TOU25** Interdisciplinary insights into sleep and circadian rhythms * DRAFT | 2.5 cr |
| **HNFB-221** Nutrition and society * | 5 cr |

* Not included because it does not correspond to the selected responsible organisations or curriculum period

# **NEU-VAL** Elective study modules

**NEU-VAL** Valinnaiset opintokokonaisuudet

**NEU-VAL** Valfria studiemoduler

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | min 0 cr |
| Languages | Finnish, Swedish, English |
| Graded module | no |
| Grading scale | ⚠ [information missing] |
| Content approval required | no |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible person | Juha Voipio, Responsible teacher |
| Study module level | Other studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Content description**

**EN:** With optional study modules you can refine your specialisation within the field of neuroscience and broaden your knowledge in other disciplines.

| Study module structure | Credits |
|---|---|
| **NEU-VAL** ELECTIVE STUDY MODULES | min 0 cr |
| **NEU-500** MOLECULAR AND CELLULAR NEUROSCIENCE, STUDY MODULE | 15-30 cr |
| **NEU-502** Synaptic Signaling and Plasticity | 5 cr |
| **NEU-531** Developmental neuroscience | 5 cr |
| **NEU-543** Brain slice electrophysiology | 5 cr |
| **PROV-004** Introduction to Cell and Molecular Biology Methods * | 5 cr |
| **NEU-510** SYSTEMS AND COGNITIVE NEUROSCIENCE, STUDY MODULE | 15-30 cr |
| **NEU-511** Systems and Cognitive Neuroscience | 5 cr |
| ELECTIVE (grouping module) | |
| **NEU-512** Animal models in behavioural neuroscience | 5 cr |
| **NEU-520** NEUROSCIENCE IN HEALTH AND DISEASE, STUDY MODULE | 15-30 cr |
| **NEU-521** Basic mechanisms of nervous system diseases | 1-5 cr |
| ELECTIVE (grouping module) | |
| **TMED-406** Translational Psychiatry * THERE IS NO VERSION OF THE STUDY IN THE SELECTED CURRICULUM PERIOD | 5 cr |
| **MED-TOU11** An Introduction to Sleep and Circadian Neurobiology * | 2.5 cr |
| **MED-TOU25** Interdisciplinary insights into sleep and circadian rhythms * DRAFT | 2.5 cr |
| **NEU-512** Animal models in behavioural neuroscience | 5 cr |
| **NEU-530** DEVELOPMENT, REGENERATION AND AGEING, STUDY MODULE | 15-30 cr |
| **NEU-531** Developmental neuroscience | 5 cr |
| **NEU-231** Mechanisms of regeneration and aging | 5 cr |
| ELECTIVE (grouping module) | |
| **TMED-202** Regenerative Medicine from Bench to Bedside * THERE IS NO VERSION OF THE STUDY IN THE SELECTED CURRICULUM PERIOD | 5 cr |

- **GMB-305** Stem cells and organogenesis * 5 cr

**NEU-540** ELECTROPHYSIOLOGY AND NEUROBIOPHYSICS, STUDY MODULE 15-30 cr
- **NEU-541** Introduction to neurobiophysics 5 cr
- **NEU-542** Electrophysiological techniques 5 cr
- ELECTIVE (grouping module)
  - **NEU-543** Brain slice electrophysiology 5 cr

**NEU-550** SENSORY BIOLOGY, STUDY MODULE 15-30 cr
- **NEU-551** Sensory Biology 3-5 cr
- **NEU-552** Studies of sensory performance in animals and humans 5 cr
- ELECTIVE (grouping module)
  - **NEU-512** Animal models in behavioural neuroscience 5 cr
  - **NEU-542** Electrophysiological techniques 5 cr

**NEU-560** OMICS, STUDY MODULE 15-30 cr
- **NEU-561** Principles of bioscience omics 10 cr
- OPTIONAL (grouping module)
  - **TMED-915** Introduction to Bioinformatics * 5 cr

**NEU-570** ENVIRONMENTAL PHYSIOLOGY, STUDY MODULE 15-30 cr
- **BIO-404** Adapted animal * 5 cr
- **BIO-405** Exposed animal * 5 cr
- OPTIONAL (grouping module)

**NEU-240** NEUROSCIENCE FROM CELLS TO SYSTEMS, STUDY MODULE 15-30 cr
- **NEU-102** Cellular neurobiology 5 cr
- OPTIONAL (grouping module)
  - **NEU-502** Synaptic Signaling and Plasticity 5 cr
  - **NEU-512** Animal models in behavioural neuroscience 5 cr
  - **NEU-521** Basic mechanisms of nervous system diseases 1-5 cr

**NEU-250** NUTRITION AND HEALTH, STUDY MODULE 15-30 cr
- **NEU-251** Molecular Nutrition 5 cr
- **GMB-401** Integrative health biosciences * 5-10 cr
- **HNFB-221** Nutrition and society * 5 cr
- OPTIONAL (grouping module)

* Not included because it does not correspond to the selected responsible organisations or curriculum period

## NEU-201 Cell and Systems Physiology, Advanced Studies

**NEU-201** Solu- ja systeemifysiologia, syventävät opinnot

**NEU-201** Cell- och systemfysiologi, fördjupade studier

Abbreviation: Solu- ja systee

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 65 cr |
| Languages | English |
| Graded module | yes |
| Grading scale | General scale, 0-5 |
| Content approval required | no |

| | |
|---|---|
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible person | Reijo Käkelä, Responsible teacher |
| Study module level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Content description**

**EN:** Choose all:
. NEU-101: Cellular physiology, 5 cp
. NEU-203: Systems physiology, 5 cp
. NEU-207: Regulatory networks in metabolism 5 cp
. NEU-205: Methods and trends in physiology and neuroscience 5 cp
. NEU-561 Principles of bioscience omics 10 cp
. NEU-306: Master’s seminar in cell and systems physiology, 5 cp
. NEU-220: Master's thesis in cell and systems physiology, 30 cp
. VIIKB-001: Maturity test, 0 cp

**Learning outcomes**

**EN:** This module covers the core content in cell and systems physiology that every physiology student graduating from the Programme should know. In addition, the module introduces students to various fields within physiology and neuroscience, and students get to know the local scientific community. The module includes the Master's thesis.

**Additional information**

**EN:** Target group
Degree students in the Master's Programme in Neuroscience must choose between the following study tracks: 1) neuroscience, 2) cell and systems physiology or 3) biology teacher.

The module is intended for degree students of the Master’s Programme in Neuroscience. Lecture courses are available for students of other programmes. Degree students of the Master’s Programme in Neuroscience are provided priority access to courses where group work may require limiting the maximum number of students.

Timing

1st year of Master’s studies, periods I-IV (except Master's Thesis and Master's Seminar that is recommended to be completed during the 2nd year or in parallel with the Master's Thesis project)

Responsible person:

Reijo Käkelä

EQF level: 7

| Study module structure | Credits |
|---|---|
| **NEU-201** CELL AND SYSTEMS PHYSIOLOGY, ADVANCED STUDIES | 65 cr |
| **NEU-101** Cellular physiology | 5 cr |
| **NEU-203** Systems Physiology | 5 cr |
| **NEU-205** Methods and Trends in Physiology and Neuroscience | 5 cr |
| **NEU-207** Regulatory Networks in Metabolism | 5 cr |
| **NEU-561** Principles of bioscience omics | 10 cr |
| **NEU-306** Master’s seminar in cell and systems physiology | 5 cr |
| **NEU-220** Master's thesis in cell and systems physiology | 30 cr |

VIIKB-001 Master's Maturity Test * 0 cr

* Not included because it does not correspond to the selected responsible organisations or curriculum period

## NEU-300 Biology Teacher Study Track, Advanced Studies

**NEU-300 Biologian aineenopettajan opintosuunta, syventävät opinnot**

**NEU-300 Biologi ämneslärarens studieinriktning, fördjupade studier**

Abbreviation: Biologian ainee

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 60 cr |
| Languages | English, Finnish, Swedish |
| Graded module | yes |
| Grading scale | General scale, 0-5 |
| Content approval required | no |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible person | Juha Voipio, Responsible teacher |
| Study module level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

### Content description

**FI:** 30 opintopisteen opinnot neurotieteen tai solu- ja systeemifysiologian opintosuunnan mukaan sekä maisterintutkielma ja siihen liittyvä kypsyysnäyte.

**SV:** 30 högskolepoäng i neurovetenskap eller cell- och systemfysiologi, beroende på studieområde, plus en magisteruppsats och mognadsprov.

### Learning outcomes

**FI:** Opintokokonaisuus kattaa ydinaineksen, joka koulutusohjelmasta aineenopettajaksi valmistuvan tulisi hallita. Lisäksi opiskelija omaksuu yleistietoja neurotieteen ja solu- ja systeemifysiologian monilta osa-alueilta ja tutustuu paikalliseen tiedeyhteisöön. Opintokokonaisuus sisältää maisterintutkielman.

**SV:** Modulen omfattar det centrala innehåll som en lärarstuderande bör behärska. Studenterna kommer också att få en allmän kunskap om de många aspekterna av neurovetenskap och cell- och systemfysiologi och bli bekanta med det lokala forskarsamhället. I modulen ingår en magisteruppsats.

### Additional information

**FI:** Kohderyhmä
Opintokokonaisuus on pakollinen aineenopettajiksi neurotieteen maisteriohjelmassa opiskeleville. Kokonaisuuden sisällä opinnot voi suunnata neurotieteeseen tai solu- ja systeemifysiologiaan vastaavalla tavalla kuin valitsemalla neurotieteen tai solu- ja systeemifysiologian suuntautumisvaihtoehtojen välillä.

Ajoitus

Ensimmäinen tai toinen opiskeluvuosi riippuen pedagogisten opintojen suoritusvuodesta. Opinnot on suositeltavaa suorittaa saman syyslukukauden aikana (periodit I-II) lukuun ottamatta maisteriseminaaria, joka on suositeltavaa suorittaa maisterintutkielmatyön kanssa samanaikaisesti.

### Arviointimenetelmät ja -kriteerit

Arvosanojen painotettu keskiarvo.

## Lisätiedot

Opetuskieli englanti. Suomen- tai ruotsinkielistä tutkintoa tekevät voivat käyttää tutkintokieltään vastauksissaan ja tutkielmassaan.

## Vastuuhenkilö

Professori Juha Voipio

**SV:** Målgrupp
Studiemodulen är obligatorisk för studenter som studerar för att bli ämneslärare. Inom modulen kan studierna inriktas på neurovetenskap eller cell- och systemfysiologi.

Tidsplanering

Första eller andra studieåret, beroende på vilket år de pedagogiska studierna avslutas. Det rekommenderas att studierna avslutas under samma höstterm (perioderna I-II), med undantag för magisterseminariet, som rekommenderas att avslutas samtidigt med magisteruppsatsen.

Utvärderingsmetoder och -kriterier.

Det vägda genomsnittet av poängen

Undervisningsspråket är engelska. Studerande med finsk- eller svenskspråkig examen får använda det språk som används i deras examen i svaren och avhandlingen.

Ansvarig person

Professor Juha Voipio

| Study module structure | Credits |
|---|---|
| **NEU-300** BIOLOGY TEACHER STUDY TRACK, ADVANCED STUDIES | 60 cr |
| **NEU-310** Master’s thesis in the study track of biology teacher | 30 cr |
| **VIIKB-001** Master's Maturity Test * | 0 cr |
| OPTIONAL (grouping module) | |
| NEUROTIEDE (grouping module) | |
| **NEU-101** Cellular physiology | 5 cr |
| **NEU-102** Cellular neurobiology | 5 cr |
| **NEU-103** Systems Neuroscience | 5 cr |
| **NEU-104** Integrative neurobiology | 5 cr |
| **NEU-105** Methods and Trends in Neuroscience | 5 cr |
| **NEU-106** Master’s Seminar in Neuroscience | 5 cr |
| CELL AND SYSTEMS PHYSIOLOGY (grouping module) | |
| **NEU-101** Cellular physiology | 5 cr |
| **NEU-203** Systems Physiology | 5 cr |
| **NEU-205** Methods and Trends in Physiology and Neuroscience | 5 cr |
| **NEU-561** Principles of bioscience omics | 10 cr |
| **NEU-306** Master’s seminar in cell and systems physiology | 5 cr |

* Not included because it does not correspond to the selected responsible organisations or curriculum period

# NEU-500 Molecular and Cellular Neuroscience, Study Module

**NEU-500** Molekyyli- ja solutason neurotiede, opintokokonaisuus

**NEU-500** Molekylär och cellulär neurovetenskap, studiehelhet

Abbreviation: Molekyyli- ja s

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 15-30 cr |
| Languages | English |
| Graded module | yes |
| Grading scale | General scale, 0-5 |
| Content approval required | no |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible person | Sari Lauri, Responsible teacher |
| Study module level | Other studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Content description**

**EN:** 15-30 cr including at least two of the courses listed below. Other courses or book exam relevant to the field can be included in the module.

- NEU-502: Synaptic Signaling and Plasticity, 5 cr
- NEU-531: Developmental Neuroscience, 5 cr
- NEU-543: Brain slice electrophysiology, 5 cr
- PROV-004: Introduction to cell and molecular biology methods, 5 cr

**Learning outcomes**

**FI:**

**EN:** On completion of the module, the student has gained knowledge on the molecular and biochemical basis of brain function with a focus on developmental neurobiology and/or synaptic signaling and plasticity. The student understands the key research methods used to study neurons at molecular and cellular level and is able to critically read research articles in the field.

**Prerequisites**

**EN:** Basic knowledge on neurobiology as well as cell and molecular biology is necessary to obtain good learning outcomes.

**Additional information**

**EN:**

## Target group

Optional module of the Master’s Programme in Neuroscience. The module is available for students of other programmes, but students of the Master’s Programmes in Neuroscience and in Translational Medicine are provided priority access to laboratory courses. The courses can also be included in doctoral studies.

## Timing

First or Second year of Master’s studies

## Assessment criteria

Weighted average of the grades

### Responsible person

Sari Lauri

| Study module structure | Credits |
|---|---|
| **NEU-500** MOLECULAR AND CELLULAR NEUROSCIENCE, STUDY MODULE | 15-30 cr |
| **NEU-502** Synaptic Signaling and Plasticity | 5 cr |
| **NEU-531** Developmental neuroscience | 5 cr |
| **NEU-543** Brain slice electrophysiology | 5 cr |
| **PROV-004** Introduction to Cell and Molecular Biology Methods * | 5 cr |

* Not included because it does not correspond to the selected responsible organisations or curriculum period

## NEU-510 Systems and Cognitive Neuroscience, Study Module

**NEU-510** Systeeminen ja kognitiivinen neurotiede, opintokokonaisuus

**NEU-510** Systemisk och kognitiv neurovetenskap, studiehelhet

Abbreviation: Systeeminen ja

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 15-30 cr |
| Languages | English |
| Graded module | yes |
| Grading scale | General scale, 0-5 |
| Content approval required | no |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible persons | Henna-Kaisa Wigren, Responsible teacher<br>Juha Voipio, Responsible teacher |
| Study module level | Other studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Tweet text**

**EN:** Acquire comprehensive knowledge of the interdisciplinary field of systems and cognitive neuroscience

**Content description**

**EN:** 15-30 cr. Select NEU-511 and optional courses applicable to the module.

- NEU-511: Systems and cognitive neuroscience, 5 cr (compulsory)
- NEU-512: Animal models in behavioural neuroscience, 5 cr (recommended optional)
- Other courses or book exams related to the field of systems and cognitive neuroscience (optional).
- Courses related to the field of the module, organized by other study programs and/or Aalto University, can be included in the module.

**Learning outcomes**

**EN:** Upon completion of the module, the student has gained a broad general knowledge in systems and cognitive neuroscience. He/she understands how the nervous system and the brain can be described and examined as a dynamic system that is acting and reacting in cognitive and behavioral processes, emotions and social interactions. He /she also understands how brain dynamics, and cognitive and behavioral

processes are altered in brain diseases and neuropsychiatric disorders. He/she knows the research methods that are commonly used in the field, and is aware of their applicability and limitations. He/she has gained a sufficient level of knowledge to be able to carry out experimental research work under professional supervision.

**Prerequisites**

**EN:** Prior knowledge needed for studying this module depends on the choice of optional courses. Basic knowledge of neurobiology/neuroscience is needed for good learning outcome. Some level of prior knowledge of psychology, cognitive science or neuroscience related biomedical engineering may be helpful but is not necessary.

**Additional information**

**EN:** Target group
Master's Programme in Neuroscience is responsible for the module. The module is optional and it is also available for students of Master's Programme in Translational Medicine and to other MSc students and doctoral candidates unless restricted by space limitations.

Assessment criteria and practices

Weighted mean of grades.

Recommended time or stage of studies for completion

First year, spring term, in the Master's Programme, or later.

EQF level: 7

| Study module structure | Credits |
|---|---|
| **NEU-510** SYSTEMS AND COGNITIVE NEUROSCIENCE, STUDY MODULE | 15-30 cr |
| **NEU-511** Systems and Cognitive Neuroscience | 5 cr |
| ELECTIVE (grouping module) | |
| **NEU-512** Animal models in behavioural neuroscience | 5 cr |

## NEU-520 Neuroscience in Health and Disease, Study Module

**NEU-520** Hermoston sairaudet, opintokokonaisuus

**NEU-520** Nervsystemet i hälsa och sjukdom, studiehelhet

Abbreviation: Hermoston saira

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 15-30 cr |
| Languages | English |
| Graded module | yes |
| Grading scale | General scale, 0-5 |
| Content approval required | no |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible person | Henna-Kaisa Wigren, Responsible teacher |

| | |
|---|---|
| Study module level | Other studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Content description**

**EN:** 15-30 cr. Select NEU-521 and optional courses applicable to the module.

- NEU-521: Basic mechanisms of nervous system diseases, 5 cr (compulsory)

Optional courses:

- TMED-406 Translational psychiatry, 5 cr
- MED-TOU11 Sleep and Circadian Neurobiology, 2.5 cr (Moodle course)
- MED-TOU25 Interdisciplinary insights into sleep and circadian rhythm, 2.5 cr (Intensive sleep course)
- NEU-512 Animal models in behavioural neuroscience (5 cr)
- Other optional courses applicable to the module

**Learning outcomes**

**EN:** After completion of the module the student:

- is familiar with clinical manifestations of selected nervous system diseases
- is familiar on the current understanding on the molecular basis and the underlying pathophysiological mechanisms of selected nervous system disorders
- knows the most common pre-clinical models of neurological diseases and can evaluate them by their strengths and weaknesses
- can describe the components and function of the brain regulatory systems underlying emotional and motivational states and how they are perturbed in various pathological states
- knows the basic experimental models used for studying brain disorders resulting from dysfunctional regulatory systems
- knows the basic mechanisms of the current treatments and is familiar with some of the emerging therapies and understands the basics on how they proceed from research to clinic.

**Prerequisites**

**EN:** A prerequisite for successful completion of the module is that the student comprehends the basic concepts in genetics, molecular biology and neurobiology.

**Additional information**

**SV:** Target group
Master's Programme in Neuroscience is responsible for the module. The module is optional and it is also available for students of Master's Programme in Translational Medicine and other interested MSc/PhD students.

Content

≥ 15 cp. Select NEU-521 and optional courses applicable to the module.
. NEU-521: Basic mechanisms of nervous system diseases, 5 cp (obligatory)
. NEU-522: Pre-clinical models of neurological diseases and emerging therapies, 5 cp (not organized in 2022-2023)
. TMED-406 Translational psychiatry, 5 cp
. Optional courses applicable to the module 0-10 cp

Assessment methods and criteria
Weighted mean of grades.

**EN:** Target group
Master's Programme in Neuroscience is responsible for the module. The module is optional and it is also available for students of Master's Programme in Translational Medicine and other interested MSc/PhD students.

Assessment methods and criteria

Weighted mean of grades.

**Responsible person:**

Henna-Kaisa Wigren

EQF level: 7

| Study module structure | Credits |
|---|---|
| **NEU-520** NEUROSCIENCE IN HEALTH AND DISEASE, STUDY MODULE | 15-30 cr |
| **NEU-521** Basic mechanisms of nervous system diseases | 1-5 cr |
| ELECTIVE (grouping module) | |
| **TMED-406** Translational Psychiatry * THERE IS NO VERSION OF THE STUDY IN THE SELECTED CURRICULUM PERIOD | 5 cr |
| **MED-TOU11** An Introduction to Sleep and Circadian Neurobiology * | 2.5 cr |
| **MED-TOU25** Interdisciplinary insights into sleep and circadian rhythms * DRAFT | 2.5 cr |
| **NEU-512** Animal models in behavioural neuroscience | 5 cr |

* Not included because it does not correspond to the selected responsible organisations or curriculum period

## NEU-530 Development, Regeneration and Ageing, Study Module

**NEU-530 Kehitys, regeneraatio ja vanheneminen, opintokokonaisuus**

**NEU-530 Utveckling, regeneration och åldring, studiehelhet**

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 15-30 cr |
| Languages | English |
| Graded module | yes |
| Grading scale | General scale, 0-5 |
| Content approval required | no |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible person | Ulla Pirvola, Responsible teacher |
| Study module level | Other studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

### Content description

**EN:** 15-30 cr. Select the compulsory courses and optional course(s) applicable to the module:

- NEU-531: Developmental neuroscience, 5 cr (compulsory)
- NEU-231 Mechanisms of regeneration and aging, 5 cr (compulsory)
- Optional courses applicable to the module (≥ 5 cr): GMB-305: Stem cells and organogenesis (5 cr), applicable courses in Master's Programmes in Translational Medicine and Pharmaceutical Research

### Learning outcomes

**EN:** After completion of the module, student can explain the basic concepts of the development of the nervous system and neuronal communication. Student can explain the key molecular, cellular and tissue-level mechanisms known to be involved in regeneration and aging and can critically evaluate the current and fu-

ture possibilities to manipulate these processes. Student can explain the key principles of organ development, including stem cell biology.

**Prerequisites**

**EN:** Recommended prerequisites: basic knowledge of neuroscience, cell biology and developmental biology

**Additional information**

**EN:** Target group
Responsible programme: Master's Programme in Neuroscience, optional module.

The module is also available for master students of other degree programmes. The courses can also be included in doctoral studies.

### Assessment methods and criteria

The weighted mean of the grades of the courses

### Responsible person

Ulla Pirvola

EQF level: 7

| Study module structure | Credits |
|---|---|
| **NEU-530** DEVELOPMENT, REGENERATION AND AGEING, STUDY MODULE | 15-30 cr |
| **NEU-531** Developmental neuroscience | 5 cr |
| **NEU-231** Mechanisms of regeneration and aging | 5 cr |
| ELECTIVE (grouping module) | |
| **TMED-202** Regenerative Medicine from Bench to Bedside * THERE IS NO VERSION OF THE STUDY IN THE SELECTED CURRICULUM PERIOD | 5 cr |
| **GMB-305** Stem cells and organogenesis * | 5 cr |

* Not included because it does not correspond to the selected responsible organisations or curriculum period

## NEU-540 Electrophysiology and Neurobiophysics, Study Module

**NEU-540** Elektrofysiologia ja neurobiofysiikka, opintokokonaisuus

**NEU-540** Elektrofysiologi och neurobiofysik, studiehelhet

Abbreviation: Elektrofysiolog

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 15-30 cr |
| Languages | English |
| Graded module | yes |
| Grading scale | General scale, 0-5 |
| Content approval required | no |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible person | Juha Voipio, Responsible teacher |
| Study module level | Other studies |

| | |
|---|---|
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Tweet text**

**EN:** Gain deep understanding of the molecular basis of electrical signaling in excitable cells, and in electrophysiological microelectrode techniques

**Content description**

**EN:** 15-30 cr. Courses NEU-541 and NEU-542 are compulsory in this module. Recommended elective courses: NEU-543. Other courses or book exams related to the field of electrophysiology and neurobiophysics can be included in the module.

- NEU-541: Introduction to neurobiophysics, 5 cr (compulsory)
- NEU-542: Electrophysiological techniques, 5 cr (compulsory)
- NEU-543: Brain slice electrophysiology, 5 cr (recommended)
- Optional courses applicable to the module

**Learning outcomes**

**EN:** Upon completion of the module, the student will be able to start using microelectrode techniques in an electrophysiology lab, he/she knows and can explain the biophysical and molecular mechanisms underlying electrical signalling at the cellular and subcellular level, and he/she has the theoretical knowledge that is needed when reading scientific papers published in the field.

**Prerequisites**

**FI:**

**EN:** Previous knowledge of molecular and cellular neurobiology is necessary for good learning outcomes.

**Additional information**

**EN:** Target group
Compulsory courses of the module are available for students of other programmes, but students of the Master's Programme in Neuroscience are provided priority access to laboratory courses.

Courses of the module can be included in doctoral studies.

Assessment criteria and practices:

Weighted mean of grades.

Recommended time or stage of studies for completion

First year, spring term, in the Master's Programme, or later.

## Responsible person

Professor Juha Voipio

Optional module. Responsible programme: Master's Programme in Neuroscience.

| Study module structure | Credits |
|---|---|
| **NEU-540** ELECTROPHYSIOLOGY AND NEUROBIOPHYSICS, STUDY MODULE | 15-30 cr |
| **NEU-541** Introduction to neurobiophysics | 5 cr |
| **NEU-542** Electrophysiological techniques | 5 cr |
| ELECTIVE (grouping module) | |

**NEU-543** Brain slice electrophysiology 5 cr

# **NEU-550** Sensory Biology, Study Module

**NEU-550** Aistinbiologia, opintokokonaisuus

**NEU-550** Sinnesbiologi, studiehelhet

Abbreviation: Aistinbiologia

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 15-30 cr |
| Languages | English |
| Graded module | yes |
| Grading scale | General scale, 0-5 |
| Content approval required | no |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible persons | Ulla Pirvola, Responsible teacher<br>Petri Ala-Laurila, Responsible teacher |
| Study module level | Other studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

### Content description

**EN:** 15-30 cr. Select the two compulsory courses and optional course(s) applicable to the module. Book exams related to the field of sensory biology may be included in the module.

- NEU-551: Sensory biology, 5 cr (compulsory)
- NEU-552: Studies of sensory performance in animals and humans, 5 cr (compulsory)
- Optional courses (≥ 5 cr): NEU-542: Electrophysiological techniques (5 cr); NEU-512: Animal models in behavioural neuroscience (5 cr); courses at Aalto University applicable to the module.

### Learning outcomes

**EN:** After completion of the module, student can explain the basic concepts of sensory information and the constraining physical and biological factors. Student can explain how different evolutionary adaptations determine species-specific sensory environments and sensory trade-offs as well as animal communication. Student can explain the basics of neural information processing in the major sensory modalities of vertebrates and arthropods. Student can start to apply basic electrophysiological and psychophysical approaches to analyse sensory information flow from cells to behaviour, and to apply the knowledge gained for quantitative data analysis.

### Prerequisites

**EN:** Prerequisites: basic knowledge of neuroscience

### Additional information

**EN:** Target group
Responsible programme: Master’s Programme in Neuroscience, optional module. The module is also available for master students of other degree programmes. The courses can also be included in doctoral studies.

## Assessment methods and criteria

The weighted mean of the grades of the courses

## Responsible person

Ulla Pirvola

EQF level: 7

| Study module structure | Credits |
|---|---|
| **NEU-550** SENSORY BIOLOGY, STUDY MODULE | 15-30 cr |
| **NEU-551** Sensory Biology | 3-5 cr |
| **NEU-552** Studies of sensory performance in animals and humans | 5 cr |
| ELECTIVE (grouping module) | |
| **NEU-512** Animal models in behavioural neuroscience | 5 cr |
| **NEU-542** Electrophysiological techniques | 5 cr |

## **NEU-560** Omics, Study Module

**NEU-560** Omiikat, opintokokonaisuus

**NEU-560** Omiker, studiehelhet

Abbreviation: Omiikat, opinto

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 15-30 cr |
| Languages | English |
| Graded module | yes |
| Grading scale | General scale, 0-5 |
| Content approval required | no |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible persons | Pia R-M Siljander, Responsible teacher<br>Reijo Käkelä, Responsible teacher |
| Study module level | Other studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

### Content description

**EN:** 15-30 cr. Select Principles of Bioscience Omics 10 Cr, and related additional studies in the fields of biochemistry, genetics, physiology, medicine, omics, bioinformatics or statistics, chosen by the student and approved by a coordinating teacher.

- NEU-561: Principles of bioscience omics, 10 cr (compulsory)
- Optional courses applicable to the module ≥ 5 cr

### Learning outcomes

**EN:** The students acquire a general view of the work flow of different systems scale methods of biochemical analyses, known collectively as omics, and the related bioinformatics required for data analysis. After the module, students can design omics-based experimentation and are aware of methodological pitfalls. Students will be able to read and interpret multivariate omics data, which allows them to efficiently utilize data produced by different omics core facilities. They will also be able to integrate results from different omics approaches and platforms, e.g. between genome, proteome and metabolome.

### Prerequisites

**EN:** BSc in any life science field.

**Additional information**

**EN:** Target group
Master's Programme in Neuroscience is responsible for the module, which is organized in collaboration with Master's Programme in Genetics and Molecular Biology and Master's Programme in Translational Medicine. The module can be included as optional studies in any Life science field master's programme. The module is obligatory in the study track of Molecular and Analytical Health Biosciences of the Master's Programme in Genetics and Molecular Biosciences. If in need to limit class size, the students from the organizing master's programmes and faculties are prioritized.

The courses can also be included in doctoral studies.

### Timing

No recommendations concerning the stage of studies.

### Assessment methods and criteria

The module is graded according to the weighted mean of the grades of the courses included.

EQF level: 7

| Study module structure | Credits |
|---|---|
| **NEU-560** OMICS, STUDY MODULE | 15-30 cr |
| **NEU-561** Principles of bioscience omics | 10 cr |
| OPTIONAL (grouping module) | |
| **TMED-915** Introduction to Bioinformatics * | 5 cr |

* Not included because it does not correspond to the selected responsible organisations or curriculum period

## NEU-570 Environmental physiology, Study Module

**NEU-570** Ympäristöfysiologia, opintokokonaisuus
**NEU-570** Miljöfysiologi, studiehelhet

Abbreviation: Ympäristöfysiol

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 15-30 cr |
| Languages | English, Swedish, Finnish |
| Graded module | yes |
| Grading scale | General scale, 0-5 |
| Content approval required | no |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible person | Reijo Käkelä, Responsible teacher |
| Study module level | Other studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

### Content description

**EN:** 15-30 cr. Select compulsory courses BIO-404 and BIO-405 and related additional studies in the fields of physiology, ecology or environmental science, chosen by the student and approved by a coordinating teacher.

- BIO-404: Adapted animal, 5 cp (compulsory)
- BIO-405: Exposed animal, 5 cp (compulsory)
- Optional courses applicable to the module ≥ 5 cp

### Learning outcomes

**EN:** The student is able to tell how different physical or chemical factors, which vary in the environment in different time scales, affect the body morphology, physiology and biochemistry of animals. The students are able to predict the animal responses to variations in natural conditions as well as the responses to different stressors caused by human activities.

### Additional information

**EN:** Target group
Master's Programme in Neuroscience is responsible for the module. The module or its courses can be included as optional studies in any bachelor's or master's programmes.

The courses can be included even in doctoral studies (personal tailoring of contents and assignments).

Assessment criteria and practices
The module is graded according to the weighted mean of the grades of the courses included.

Responsible person

University lecturer Reijo Käkelä

| Study module structure | Credits |
|---|---|
| **NEU-570** ENVIRONMENTAL PHYSIOLOGY, STUDY MODULE | 15-30 cr |
| **BIO-404** Adapted animal * | 5 cr |
| **BIO-405** Exposed animal * | 5 cr |
| OPTIONAL (grouping module) | |

* Not included because it does not correspond to the selected responsible organisations or curriculum period

## NEU-240 Neuroscience from Cells to Systems, Study Module

**NEU-240** Neurotiedettä soluista systeemitasolle, opintokokonaisuus

**NEU-240** Neurovetenskap från celler till systems, studiehelhet

Abbreviation: Neurotiedettä s

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 15-30 cr |
| Languages | English |
| Graded module | yes |
| Grading scale | General scale, 0-5 |
| Content approval required | no |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |

| | |
|---|---|
| Responsible persons | Sari Lauri, Responsible teacher<br>Reijo Käkelä, Responsible teacher |
| Study module level | Other studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Content description**

**EN:** 15 -30 cp. Select compulsory course NEU-102 and recommended optional courses NEU-502, NEU-512 or NEU-521. Related additional studies in the field of neuroscience can be included, chosen by the student and approved by a coordinating teacher.
. NEU-102 Cellular neurobiology 5 cp, (compulsory)
. NEU-502 Synaptic signaling and plasticity 5 cp
. NEU-512: Animal models in behavioural neuroscience, 5 cp
. NEU-521: Basic mechanisms of nervous system diseases, 5 cp
. Optional courses applicable to the module 0-10 cp

**Learning outcomes**

**EN:** Students acquire understanding of the mechanisms underlying fast electrochemical signaling in neurons and are able to integrate this information into a broader physiological context. They learn how cellular and synaptic mechanisms control the function of neuronal networks and recognize the links to behavior. Students get familiar either with common animal models and study designs of behavioral neuroscience or the mechanisms of developing neural diseases.

**Additional information**

**EN:** Target group
Primarily designed to be an optional module for the Cell and Systems Physiology study track of the Master's Programme in Neuroscience.

Assessment criteria and practices

The module is graded (0-5) according to the weighted mean of the grades of the courses included.

### Responsible teachers

Sari Lauri and Reijo Käkelä

EQF level: 7

| Study module structure | Credits |
|---|---|
| **NEU-240** NEUROSCIENCE FROM CELLS TO SYSTEMS, STUDY MODULE | 15-30 cr |
| **NEU-102** Cellular neurobiology | 5 cr |
| OPTIONAL (grouping module) | |
| **NEU-502** Synaptic Signaling and Plasticity | 5 cr |
| **NEU-512** Animal models in behavioural neuroscience | 5 cr |
| **NEU-521** Basic mechanisms of nervous system diseases | 1-5 cr |

## NEU-250 Nutrition and health, Study Module

**NEU-250** Ravitsemus ja terveys, opintokokonaisuus
**NEU-250** Näring och hälsa, studiehelhet

Abbreviation: Ravitsemus ja t

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 15-30 cr |

| | |
|---|---|
| Languages | English |
| Graded module | yes |
| Grading scale | General scale, 0-5 |
| Content approval required | no |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible persons | Pia R-M Siljander, Responsible teacher<br>Reijo Käkelä, Responsible teacher |
| Study module level | Other studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Content description**

**EN:** 15-30 cr. Select compulsory courses NEU-251, GMB-401 and HBFB-221. Related additional studies in the field of nutrition and health can be included, chosen by the student and approved by a coordinating teacher.

- NEU-251 Molecular nutrition 5 cr, (compulsory)
- GMB-401 Integrative health biosciences 5 cr, (compulsory)
- HNFB-221 Nutrition and society 5 cr, (compulsory)
- Optional courses applicable to the module

**Learning outcomes**

**EN:** Students realize that structurally slightly different molecules affect systemic physiology differently due to their different mechanistic interactions at the levels of digestion, absorption and metabolism, including signaling functions. They get familiar with contemporary technologies and commercial and industrial activities in the field of health biosciences. Students also gain insight on how population-based health promotion campaigns and programs are planned and evaluated according to the socio-ecological model of health promotion.

**Additional information**

**EN:** Target group
Master’s Programme in Neuroscience organizes the module in collaboration with the Master's Programmes in Genetics and Molecular Biosciences (Faculty of Biological and Environmental Sciences) and Human Nutrition and Food-Related Behaviour (Faculty of Agriculture and Forestry). The module is optional.

Arviointimenetelmät ja -kriteerit

The module is graded (0–5) according to the weighted mean of the grades of the courses included.

## Responsible teachers

Reijo Käkelä, Pia Siljander

EQF level: 7

| Study module structure | Credits |
|---|---|
| **NEU-250** NUTRITION AND HEALTH, STUDY MODULE | 15-30 cr |
| **NEU-251** Molecular Nutrition | 5 cr |
| **GMB-401** Integrative health biosciences * | 5-10 cr |
| **HNFB-221** Nutrition and society * | 5 cr |
| OPTIONAL (grouping module) | |

* Not included because it does not correspond to the selected responsible organisations or curriculum period

# FILTERED COURSES

## **NEU-101** Cellular physiology

**NEU-101** Solufysiologia
**NEU-101** Cell fysiologi

Abbreviation: Solufysiologia

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 5 cr |
| Languages | English |
| Grading scale | General scale, 0-5 |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible person | Ulla Pirvola, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Prerequisites**

**EN:** Recommended prerequisites: Basic knowledge of cell biology and cell physiology

**Learning outcomes**

**EN:** After completion of the study unit, student can explain the key principles of cell biological mechanisms and is able to integrate this information into a functional context. Student can explain the key principles of cell signaling, membrane permeability and transport, and is able to apply this knowledge to explain the molecular mechanisms that underlie common cell physiological processes.

**Content**

**EN:** Lectures and group work of the course deal with: Internal structure of the cell; Cellular proteostasis; Cytoskeleton, cell-cell junctions, and mechanobiology; Cell cycle and cell death; Stem cells and cellular reprogramming; Cell signaling and bioenergetics; Cell biology of inflammation; Membrane permeability and transport: molecular mechanisms and their involvement in cell physiological processes.

**Additional information**

**SV:** Target group
Timing

Content

Assessment methods and criteria

Completion methods

Connections to other studies

**EN:** Target group
The course is compulsory for students of the Master’s Programme in Neuroscience. The course is also open for master students of other degree programmes, including biology, psychology, physics and biomedical engineering, and for exchange students..

Timing

Period 1, organized annually. Degree students of the Master's Programme in Neuroscience are recommended to take this course during the first year of studies.

### Assessment methods and criteria

The exam is based on lectures and reading material indicated by lecturers. Final grading (scale 0-5) based on the exam (80 %) and other activity during the course (20 %).

### Completion methods

Participation in teaching (lectures, group work, final exam). The course includes compulsory face-to-face meetings and cannot be completed entirely by distance learning. Minimum of 70 % participation in lectures and group work.

EQF level 7

### Study materials

**EN:** Lecture material and other material assigned to the course in Moodle, including applicable parts of Alberts et al., Molecular Biology of the Cell and of Sperelakis N., Cell Physiology Sourcebook: Essentials of Membrane Biophysics.

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 5 cr |
| Participation in teaching | | 5 cr |

## NEU-102 Cellular neurobiology

**NEU-102** Solutason neurobiologia

**NEU-102** Cellulär neurobiologi

Abbreviation: Solutason neuro

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 5 cr |
| Languages | English |
| Grading scale | General scale, 0-5 |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible person | Juha Voipio, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

### Prerequisites

**EN:** Basic knowledge of cell biology and cellular physiology is necessary to obtain good learning outcomes

### Learning outcomes

**EN:** On completion of the course, the student has gained understanding of the mechanisms underlying fast electrochemical signaling in neurons and is able to integrate this information into a broader physiological context. He/she is able to explain how electrical signals are created, how they propagate in neuronal membranes and how they are transmitted from one neuron to another via chemical synapses. In addition, the student recognizes how cellular and synaptic mechanisms control the function of neuronal networks and link to behavior.

**Content**

**EN:** The course addresses the mechanisms of cellular excitability, electrical signaling and synaptic transmission in neurons. In addition, the students familiarize with the mechanisms by which synaptic transmission can be regulated during physiological activity and how it is affected in various brain diseases.

**Additional information**

**EN:** Completion methods
Lectures, homework, and group work that may include also student presentations, and an exam. The course consists of approximately 35 h of contact teaching and 100 h of independent and group work.

### Assessment practices and criteria

Grade (scale 0-5) is based on the exam, and passing the course requires minimum attendance that is 70% of the scheduled contact hours. If assignments are given any weight in grading, it will be announced before teaching begins.

### Activities and methods in support of learning

Group work questions and assignments support learning during the course.

### Target groups

The course is compulsory for students choosing the neuroscience study track, and optional for other students of the programme. The course is available, space permitting, also to other graduate and advanced undergraduate students of neuroscience, molecular biosciences and related life sciences.

### Teaching period when the course will be offered

Period 1.

### Recommended time or stage of studies for completion

Degree students of the Master's Programme in Neuroscience are recommended to take this course during the first year of studies.

### Language of instruction

English

EQF level: 7

**Study materials**

**EN:** Relevant parts from neuroscience textbooks complemented with material given by the teachers. The exact study materials will be specified in the beginning of the course.

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 5 cr |
| Participation in teaching | | 5 cr |

## NEU-103 Systems Neuroscience

**NEU-103** Systeemineurotiede

**NEU-103** Systemisk neurovetenskap

Abbreviation: Systeemineuroti

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 5 cr |
| Languages | Finnish, English, Swedish |
| Grading scale | General scale, 0-5 |

| | |
|---|---|
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible persons | Mikael Segerstråle, Responsible teacher<br>Katri Wegelius, Administrative person<br>Reijo Käkelä, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Prerequisites**

**EN:** Successful completion of the course requires basic knowledge in neurobiology (as provided by e.g. the course Cellular neurobiology)

**Learning outcomes**

**EN:** After completion of the course, the student knows and is able to explain the roles and the organizational principles of the major functional systems of the brain and the nervous system.

**Content**

**EN:** Organization of the central nervous system and the neural basis of cognition. Perception: somatosensory and sensory systems. Motor system and the control of movement.

**Additional information**

**EN:** Target group
The course is intended primarily for students of the Master's Programme in Neuroscience. It is compulsory for degree students of the Programme in the Neuroscience study track, but is also suitable for students in the biological, (neuro)psychological and biomedical sciences more generally.

Timing

Period 2, 1st year of Master's studies. The course is organized annually.

Assessment methods and criteria

The exam is based on the spoken pptx-lectures, and on book chapters and other material indicated by lecturers. Final grading (scale 0-5) based on the exam (60 %) and the assignments (40 %).

Completion methods

Lectures in Moodle (22 h), and obligatory group work in Zoom including presentations by students (22 h). In addition, the student needs to submit assignments and pass the final exam (appr. 90 h own work). Lectures as pptx-files with soundtracks and other study materials (e.g., scientific articles, videos etc.) are found in the Moodle area of the course.

Connections to other studies

Part of the lectures of NEU-103 Systems Neuroscience are shared with the course NEU-203 Systems Physiology, and thus both courses cannot be included in the Master's studies of the student.

EQF level: 7

**Study materials**

**EN:** Lectures as pptx-files with sound tracks, and other study materials (e.g. scientific articles, videos etc.) can be found in the Moodle area of the course.

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 5 cr |
| Participation in teaching | | 5 cr |

# NEU-104 Integrative neurobiology

**NEU-104** Integrativiinen neurobiologia

**NEU-104** Integrativ neurobiologi

Abbreviation: Integrativiinen

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 5 cr |
| Languages | English |
| Grading scale | General scale, 0-5 |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible persons | Kai Kaila, Responsible teacher<br>Katri Wegelius, Administrative person |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

### Prerequisites

**EN:** Courses on Cellular neuroscience and Cellular physiology are recommended before this course.

### Equivalences to other studies

52265 Introduction to neurobiology

### Learning outcomes

**EN:** After completion of the course, the student has comprehensive insight into brain functions ranging from signaling mechanisms at the cellular level to behavioral, cognitive, neuroendocrine and metabolic processes and their interrelations within an organism. Lots of emphasis is put on critical evaluation of diverse techniques and interpretation of data and concepts, as well as on their historical aspects. Brain functions and disorders as well as standard clinical concepts will be discussed and re-examined in an evolutionary context.

### Content

**EN:** The aim of the course is to give a thorough overview of neurobiology and its relationships to other fields of science, research methods, and to history of key ideas and ideologies. Specific topics include biophysics of neuronal membranes, neuronal signaling, synaptic function and plasticity, brain disorders, immune responses, neuroinflammation, genes and brains, learning and memory, motor system, neuroendocrinology, neuroethology, sensations and perception, and neurobiology of consciousness.

### Additional information

**EN:** Target group
Students from different disciplines, including biology, molecular biosciences, neuroscience, psychology, medicine, physics and biomedical engineering.

Timing

Period II. Recommended to be completed during the first year of studies in the Master's Programme in Neuroscience. Compulsory for students choosing the Neuroscience study track.

Completion methods

The course consists of lectures (appr. 35 h) and independent studying (appr. 100h). To complete the course, the students need to attend the lectures (minimum of 70%) and to pass the final exam.

Assessment practices and criteria

Examination based on lectures and the additional material (see above). The exam tests the students' comprehension of major concepts as well as important data-based knowledge in neuroscience. Grading scale 0-5.

### Responsible teacher

Professor Kai Kaila (kai.kaila@helsinki.fi)

Primary contact for practical matters related to the course: planning officer Katri Wegelius (Katri.wegelius@helsinki.fi)

EQF level: 7

### Study materials

**EN:** Lecture handouts and notes. Selected chapters of relevant neuroscience text books and review articles may be used as background reading material.

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 5 cr |
| Participation in teaching | | 5 cr |

## NEU-105 Methods and Trends in Neuroscience

**NEU-105** Neurotieteen menetelmiä ja kehityssuuntia

**NEU-105** Metoder och trender inom neurovetenskap

Abbreviation: Neurotieteen me

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 5 cr |
| Languages | Finnish, English, Swedish |
| Grading scale | Pass-Fail |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible person | Juha Voipio, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

### Tweet text

**EN:** Course thematic days, laboratory visits and excursions acquaint students with the local neuroscience community, timely research topics and modern methods.

### Prerequisites

**EN:** It is recommended that the courses NEU-101 Cellular Physiology and NEU-102 Cellular Neurobiology be taken in parallel with (or before) this course.

### Equivalences to other studies

52276 Neurobiology Seminar

### Learning outcomes

**FI:**

**EN:** The aim of this course is to provide students with exposure to current trends and methods in neuroscience, and thereby broaden students' knowledge beyond what is taught on the lecture courses. In addition, students will learn to know better the local neuroscience community.

**Content**

**EN:** The course consists of thematic days on specific topics. Students will learn to know the local neuroscience community and modern research methods during laboratory visits and excursions, they will be introduced to cutting edge research trends, and they will work on group assignments and presentations.

**Additional information**

**FI:**

**EN:**

## Completion methods

A minimum of 70% attendance and active participation in in-class discussions and assignments including group work and quizzes, as well as completing independent homework assignments on time are required for passing the course.

## Assessment practices and criteria

Grading scale pass/fail

## Activities and methods in support of learning

## Target groups

This course is primarily intended for students of the Master's Programme in Neuroscience, and compulsory for students choosing the Neuroscience study track. It is designed to be studied during the first autumn term in parallel with the courses "Cellular Physiology" and "Cellular Neurobiology".

## Teaching period when the course will be offered

Periods 1 and 2, annually.

## Recommended time or stage of studies for completion

First year in the Master's Programme.

## Study module

## Expiry of studies

## Language of instruction

English

## EQF level

7

**Study materials**

**FI:**

**EN:** Material will be defined during the course and provided by the teachers or via Moodle.

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 5 cr |
| Participation in teaching | | 5 cr |

## NEU-106 Master's Seminar in Neuroscience

**NEU-106** Neurotieteen maisteriseminaari

**NEU-106** Magister seminar i neurovetenskap

Abbreviation: MNeuro seminar

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 5 cr |
| Languages | English |
| Grading scale | General scale, 0-5 |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible persons | Eva Ruusuvuori, Responsible teacher<br>Henna-Kaisa Wigren, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

### Tweet text

**EN:** Interactive exercises and student presentations provide academic project and communication skills and readiness to complete a master's thesis project.

### Equivalences to other studies

NEU-206 Master's seminar in physiology

or

NEU-306 Master's seminar in cell and systems physiology

### Learning outcomes

**FI:**

**EN:** The objective of the seminar is to support the Master's thesis project of the student. The students acquire the knowledge needed to carry out either an experimental or theoretical research project in accordance with the best procedures and standards of science. Students will practice scientific presentation skills and are trained in scientific argumentation and reasoning. Students gain experience in reporting their work in the context of relevant literature and with the quality and clarity required for a Master's thesis.

### Content

**EN:** At the seminar, students practice academic writing and citing techniques, give oral presentations and have interactive scientific dialogue on topics related to neuroscience and physiology. They learn how to

carry out experimental or theoretical scientific projects and rehearse problem-solving skills and critical thinking.

**Additional information**

**EN:** Completion methods
Contact teaching appr. 35 h, assignments prepared at own time appr. 100 h (personal and group work). Participation to 100 % of seminar sessions (possible absences must be agreed upon with teachers in advance) and approved completion of all individual and group assignments and presentations are required in order to pass the course.

Assessment methods and criteria

Grade (scale 1-5) is based on assignments and activity in the class.

Target group

Degree students of Master's Programme in Neuroscience. Master's Seminar in Neuroscience and Master's Seminar in Cell and Systems Physiology have combined teaching and classes.

Teaching period when the course will be offered

Periods 1- 4, recommended to start during the autumn term of 2nd year of master's degree studies. If timely, it is possible to start the seminar already during the spring term of 1st year. The course is organized annually.

Language of instruction

English

EQF level: 7

**Study materials**

**FI:**

**EN:** Study material is defined during the seminar or provided by the teachers.

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 5 cr |
| Participation in teaching | | 5 cr |

## NEU-110 Master's thesis in neuroscience

**NEU-110** Maisterintutkielma neurotieteessä

**NEU-110** Magisteravhandling i neurovetenskap

Abbreviation: Maisterintutkie

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 30 cr |
| Languages | Finnish, Swedish, English |
| Grading scale | General scale, 0-5 |

| | |
|---|---|
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible person | Juha Voipio, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Prerequisites**

**FI:** Opiskelijalla tulisi olla hyvät esitiedot tutkielmaprojektin teoreettisen perustan, tavoitteiden ja sisällön ymmärtämiseksi, riittävät tiedot ja taidot aineiston keräämiseen, käsittelyyn, sekä kykyä tieteelliseen kirjoittamiseen.

**EN:** The student should have a good theoretical understanding of the project, its aims and context, the necessary knowledge and skills for collecting and processing data, and sufficient skills in scientific writing.

**Learning outcomes**

**FI:** Maisterintutkielman suoritettuaan opiskelija tuntee tutkimusprojektin vaiheet työn suunnittelusta ja sopivien tutkimusmenetelmien valinnasta kokeiden suorittamiseen (tai lähdeaineistopohjaisiin tai teoreettisiin tarkasteluihin), tulosten analysoimiseen ja tieteellisen raportin kirjoittamiseen saakka. Opiskelijalla on valmius tieteelliseen ajatteluun ja tutkimusmenetelmien hallitsemiseen, hän omaa projektinhallintataitoja, ja hän kykenee kirjalliseen tieteelliseen ilmaisuun.

**EN:** After completing the Master's Thesis the student knows how a research project proceeds, from planning the work and choosing appropriate methods to performing the experiments (or carrying out a theoretical or data-based study), analysing results, and writing a scientific report. The student is capable of scientific thinking and mastering some research methods, and he/she has acquired relevant skills in project management and written scientific communication.

**Content**

**FI:** Maisterintutkielma perustuu useimmiten kokeelliseen tutkimusprojektiin ja tulosten kriittiseen tarkasteluun tutkimusaiheeseen liittyvän kirjallisuuden avulla. Tutkielma voi olla myös pelkästään kirjallisuuteen tai muuhun tieteelliseen lähdeaineistoon perustuva tutkimustyö. Biologian aineenopettajaksi opiskelevan maisterintutkielma voi käsitellä biologian opetukseen liittyviä kysymyksiä. Maisterintutkielma tehdään kokeneen tutkijan ohjauksessa, ja työssä on tyypillisesti neljä vaihetta: 1. Työn suunnittelu (sisältää keskeiseen kirjallisuuteen perehtymisen) 2. Aineiston kerääminen (esim. laboratoriotyöt) 3. Aineiston käsittely (esim. laadun tarkistaminen, tulosten käsittely, tilastolliset analyysit, graafinen esitys) 4. Tulosten tulkitseminen ja tarkastelu aiemman kirjallisuuden pohjalta ja tutkielman kirjoittaminen. Tutkielma kirjoitetaan tieteellisen julkaisun tapaan ja siinä kuvataan tulokset ja tarkastellaan niitä kriittisesti aiheesta aiemmin ilmestyneiden tieteellisten julkaisujen pohjalta.

**EN:** The Master's thesis is usually based on an experimental research project and critical contemplation of the results in the light of scientific literature on the topic. The thesis may also consist of a theoretical literature study. The Master's thesis project is carried out under the supervision of an experienced researcher, and it usually consists of four distinct phases: 1. Design and planning of the study (includes reading of relevant literature) 2. Gathering the data (e.g. laboratory work) 3. Analysing the data (e.g. validation/quality control, processing data, statistical analysis, plotting) 4. Interpreting and discussing the results in the light of existing literature, and writing the thesis. The thesis is written as if it were a scientific publication, critically describing, contemplating and discussing the results in the light of previous scientific literature on the topic.

**Additional information**

**FI:**

## Suoritustavat

Ennen tutkielmatyön aloittamista opiskelija laatii yhdessä työn ohjaajan tai ohjaajien kanssa maisterintutkielman suunnitelman ja hakee sille hyväksymisen maisterintutkielma-opintojakson vastuuopettajalta. Suunnitelmassa kuvataan riittävällä tarkkuudella mm. työn tavoitteet ja käytettävät menetelmät.

Maisterintutkielman hyväksyminen ja arvosana perustuvat opiskelijan kirjoittamaan maisterintutkielmaan. Tutkielmaa ei ole mahdollista hyväksyä ennen kuin opiskelija on suorittanut hyväksytysti kypsyysnäytteen. Maisterintutkielma on kirjallinen työ, jossa esitetään tutkimuksen tausta ja kysymyksenasettelu, työn aineisto ja menetelmät sekä työssä saadut tulokset, ja jossa lopuksi tarkastellaan tuloksia alalla julkaistun kirjallisuuden valossa. Tutkielman teko on pääosin itsenäistä työskentelyä, mutta työllä on aina ohjaaja. Työ tehdään useimmiten tutkimushankkeessa, jossa opiskelijalla on itsenäinen ja selkeä rooli. Tutkielma on kirjoitettava itse, mutta ohjaajan tulee antaa palautetta ja opastaa tieteellisessä kirjoittamisessa. Työhön (30 op) menevä aika on noin 4,5 kk eli 800 työtuntia eli 40 tuntia 20 viikon aikana. Tarkempi kuvaus ja ohjeet maisterintutkielmaa varten löytyvät tiedekunnan maisterintutkielman yleisohjeista sekä maisteriohjelman omista tarkentavista ohjeista.

## Arviointimenetelmät ja -kriteerit

Tutkielman arvioinnissa käytetään yliopiston ja tiedekunnan hyväksymiä arvostelukriteereitä. Arvosana-asteikkona 0 - 5.

## Oppimista tukevat aktiviteetit ja menetelmät

Maisterintutkielmalla on oltava nimetty ohjaaja, joka on kokenut tutkija (yleensä vastuullinen tutkija (Principal Investigator, PI), professori, yliopistonlehtori tai muu alan asiantuntija). Tutkielmalla voi olla myös muita nimettyjä ohjaajia. Työn vastaavan ohjaajan tulee olla vähintään tohtorin tutkinnon suorittanut tai vastaavan tasoinen henkilö.

## Kohderyhmät

Neurotieteen maisteriohjelman neurotieteen opintosuunnan opiskelijat.

## Järjestämisajankohta opetusperiodin tarkkuudella

Maisterintutkielmaa voi tehdä läpi vuoden, myös opetusperidoen ulkopuolella.

## Suositeltava suoritusajankohta tai -vaihe

Toinen opiskeluvuosi maisteriohjelmassa.

**SV:**

## Prestationssätt

## Bedömningsmetoder och kriterier

## Aktiviteter och metoder som stöder lärandet

## Målgrupper

## När studieavsnittet ordnas – undervisningsperiod

## Rekommenderad tidpunkt för prestationen

**EN:**

## Completion methods

Before commencing the research work, the student prepares a Master's Thesis Plan together with the supervisor(s), submits it for approval by sending it to the teacher who is in charge of Master's Theses in the Programme. The aims of the study and the methods that will be used must be described in sufficient detail in the plan. Approval and grading is based on the written Master’s thesis. The thesis cannot be approved until the student has passed the maturity test.

Master's thesis is a written report that presents the background and motivation of the study, materials and methods used as well as the results obtained in the study, and finally discusses the results in light of scientific literature published in the field. The thesis work is carried out under supervision, typically in a research project in which you have a clearly defined and an independent role. The student writes the thesis himself/herself, but the supervisor is supposed to provide feedback and advice on scientific writing. The total workload (30 credits) from designing the project to its completion is approximately 4.5 months (800

hrs, or 20 weeks at 40 hrs/week). For detailed information about the Master's thesis, see the Faculty's General Instructions for Master's Theses as well as the Programme's own guidelines.

### Assessment practices and criteria

The MSc thesis will be graded according the guidelines and criteria set by the University and the Faculty (information available on the Instructions for Students website). Grading scale 0 - 5.

### Activities and methods in support of learning

The Master's thesis project must have an assigned supervisor who is an experienced researcher (usually a Principal Investigator (PI), professor, university lecturer, or some other specialist in the field). A thesis may have additional officially appointed co-supervisors. The primary supervisor must hold at least a doctoral degree or equivalent qualifications.

### Target groups

Students on the Neuroscience study track of the Master's Programme in Neuroscience.

### Teaching period when the course will be offered

Throughout the year.

### Recommended time or stage of studies for completion

Second year of studies.

EQF level: 7

**Study materials**

**FI:** Maisterintutkielman aihealueeseen liittyvä kirjallisuus, pääosin kansainvälisiä tieteellisiä julkaisuja.

**EN:** Mainly international, scientific papers depending on the topic of the Master's thesis.

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 30 cr |
| Participation in teaching | | 30 cr |

## NEU-203 Systems Physiology

**NEU-203** Systeemifysiologia
**NEU-203** Systemfysiologi

Abbreviation: Systeemifysiolo

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 5 cr |
| Languages | English |
| Grading scale | General scale, 0-5 |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |

| | |
|---|---|
| Responsible person | Reijo Käkelä, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Tweet text**

**EN:** Prerecorded lectures followed by obligatory group work in Zoom on systems physiology, integrating life functions from molecules to functioning organisms.

**Prerequisites**

**EN:** BSc in any life science field.

**Learning outcomes**

**EN:** Systems physiology integrates life functions at several levels of organization from molecules to functioning organism. After completing the course, the student understands at very fundamental level the concepts of life emerging from complexity, and the features of the regulatory systems of life. Students acquire the skills to systematically dissect the processes at different organizational levels, through integrated molecular and cellular mechanisms, which determine the organism's development, life functions and interactions with the environment.

**Content**

**EN:** The course starts by characterizing the essential properties of biological systems, the emergence of new traits by complexity, and the regulation of the functions by homeostatic or allostatic mechanisms. Next demonstrative examples are presented where molecular and cellular interactions are integrated to form regulated physiological systems of animals. These cases reveal principles of neural and hormonal functions, sensing the environment, energy metabolism, and maintaining water balance, solute concentrations and body temperature. In addition, tissue renewal and repair, and setting the pace for reproduction are addressed. In each of the lectures and exercises the focus is on the principles of the design from molecules to organisms.

**Additional information**

**EN:**

## Completion methods

Lectures in Moodle (22 h), and obligatory group work in Zoom including presentations by students (22 h). In addition, the student needs to submit assignments and pass the final exam (appr. 90 h own work). Lectures as pptx-files with soundtracks and other study materials (e.g., scientific articles, videos etc.) are found in the Moodle area of the course.

## Assessment methods and criteria

The exam is based on the spoken pptx-lectures, and on book chapters and other material indicated by lecturers. Final grading (scale 0-5) based on the exam (60 %) and the assignments (40 %).

## Target groups

The course is obligatory for students of the Cell and Systems Physiology study track of the Master's Programme in Neuroscience. The course is also offered for master and graduate students in any life science field. If in need to limit class size, the students from the organizing master's programmes and faculty are prioritized. NOTE: Part of the lectures of NEU-203 Systems Physiology are shared with the course NEU-103 Systems Neuroscience, and thus both courses cannot be included in the Master's studies of the student.

## Teaching period when the course will be offered

Period 2, annually.

## Recommended time or stage of studies for completion

First year of Master's studies.

## Language of instruction

English

### EQF level

7

**Study materials**

**EN:** Lectures as pptx-files with soundtracks, and other study materials (e.g., scientific articles, videos etc.) can be found in the Moodle area of the course.

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 5 cr |
| Participation in teaching | | 5 cr |

## NEU-205 Methods and Trends in Physiology and Neuroscience

**NEU-205** Fysiologian ja neurotieteen menetelmiä ja kehityssuuntia

**NEU-205** Metoder och trender i fysiologi och neurovetenskap

Abbreviation: Fysiologian ja

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 5 cr |
| Languages | Finnish, English, Swedish |
| Grading scale | Pass-Fail |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible persons | Juha Voipio, Responsible teacher<br>Reijo Käkelä, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Tweet text**

**EN:** Course thematic days, laboratory visits and excursions present local cell and systems physiology and neuroscience community and modern research methods.

**Prerequisites**

**EN:** It is recommended that the course ”Cellular Physiology” (and “Cellular Neurobiology” or other optional course) is taken in parallel (or before) this course.

**Equivalences to other studies**

NEU-105 Methods and Trends in Neuroscience

**Learning outcomes**

**EN:** The aim of this course is to provide students with exposure to current trends and methods in cellular and systems physiology and neuroscience, and thereby broaden the students’ knowledge beyond what is taught on the lecture courses. In addition, students will learn to know better the local physiology and neuroscience community.

**Content**

**EN:** The course consists of thematic days on specific topics. Students will learn to know the local cell and systems physiology and neuroscience community and modern research methods during laboratory visits

and excursions, they will be introduced to cutting edge research trends, and they will work on group assignments and presentations.

**Additional information**

**EN:**

### Completion methods

A minimum of 70% attendance and active participation in in-class discussions and assignments including group work and quizzes, as well as completing independent homework assignments on time are required for passing the course.

### Assessment practices and criteria

Grading scale pass/fail.

### Target groups

This course is primarily intended for students of the Master's Programme in Neuroscience, and compulsory for students choosing the Cell and Systems Physiology study track. It is designed to be studied during the first autumn term in parallel with the courses "Cellular Physiology" and "Cellular Neurobiology" (obligatory and optional, respectively, for the Cell and Systems Physiology study track).

### Teaching period when the course will be offered

Periods 1 and 2, annually.

### Recommended time or stage of studies for completion

First year in the Master's Programme.

### Language of instruction

English

### EQF level

7

**Study materials**

**EN:** Material will be defined during the course and provided by the teachers or via Moodle.

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 5 cr |
| Participation in teaching | | 5 cr |

## NEU-207 Regulatory Networks in Metabolism

**NEU-207** Aineenvaihdunnan säätelyverkot

**NEU-207** Metaboliska regleringsnätverk

Abbreviation: Aineenvaihdunna

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 5 cr |
| Languages | Finnish, English |
| Grading scale | General scale, 0-5 |

| | |
|---|---|
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible persons | Ville Hietakangas, Responsible teacher<br>Reijo Käkelä, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Tweet text**

**EN:** Lecture course on regulatory mechanisms of animal metabolism with metabolic flux data analysis rehearsal.

**Prerequisites**

**EN:** BSc in any life science field.

**Learning outcomes**

**EN:** Students get familiar with the principles of regulatory mechanisms controlling metabolic pathway activities, including gene regulation, signaling and systemic control of metabolism by hormones. After the course they recognize that metabolic regulation occurs though integrated control at different organization levels. The students are able to describe central features of the metabolic design of biological systems, name key regulators of metabolism and understand their physiological roles. The students are introduced to the methods of metabolic flux analyses, which ease the way to take advanced modeling courses later during their career.

**Content**

**EN:** The mechanisms of regulating animal metabolism in response to the dietary intake in terms of nutrient quantity and quality are addressed. Lectures deal with the fundamental nutrient-responsive signaling pathways and gene regulatory networks involved. In addition, the role of mitochondrial signaling in adjusting metabolism is studied. The focus is on the principles of the integration of metabolic events, not on the detailed description of the pathways per se. For example, the signaling systems used to integrate metabolism of carbohydrates, lipids, and proteins on cellular and organismal levels are among central themes of the course. The principles are introduced by using examples from vertebrate and invertebrate animal models. The regulation of metabolic fluxes in different conditions are studied by using the systems biology approach, and the methods of performing metabolic flux analysis are demonstrated as one central topic of the exercises.

**Additional information**

**EN:**

## Completion methods

The students need to participate (min 70%) in the obligatory lectures and exercises and submit all assignments and an exercise report. The work required on own time is about 90 h.

## Assessment practices and criteria

Grading 0-5 is based on obligatory assignments and exercises. Detailed instructions for assignments appear on the Moodle page of the course.

## Target groups

Primarily for Master students in any life science field. Provided also for graduate students in these fields. If in need to limit class size, the students from the organizing master’s programmes and faculties are prioritized. Master's Programme in Neuroscience organizes the course in collaboration with the Master's Programme in Genetics and Molecular Biosciences (Faculty of Biological and Environmental Sciences).

## Teaching period when the course will be offered

Period 2, annually.

## Language of instruction

English

### EQF level

7

**Study materials**

**EN:** Selected review articles illuminating the mechanisms of metabolic regulatory networks are studied while preparing the graded assignments and exercise report.

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 5 cr |
| Participation in teaching | | 5 cr |

## NEU-561 Principles of bioscience omics

**NEU-561** Biotieteellisten omiikkojen perusteet

**NEU-561** Grunderna i biovetenskapliga omiker

Abbreviation: Biotieteelliste

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 10 cr |
| Languages | English |
| Grading scale | General scale, 0-5 |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible persons | Reijo Käkelä, Responsible teacher<br>Pia R-M Siljander, Responsible teacher<br>Marc Baumann, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Tweet text**

**EN:** Lectures and laboratory demonstrations clarify workflow of different systems scale methods of biochemical analyses, known as omics, and related bioinformatics.

**Prerequisites**

**EN:** BSc in any life science field.

**Learning outcomes**

**EN:** The students acquire a general view of the workflow of different systems scale methods of biochemical analyses, known collectively as omics, and the related bioinformatics required for data analysis. After the course, students can design omics-based experimentation and are aware of methodological pitfalls. Students will be able to read and interpret multivariate omics data, which allows them to efficiently utilize data produced by different omics core facilities. They will also be able to integrate results from different omics approaches and platforms, e.g., between genome, proteome and metabolome.

**Content**

**EN:** During the course the principles of genomics, epigenomics, transcriptomics, proteomics, glycoproteomics, metabolomics and lipidomics are studied to the extent which is needed to read and interpret these omics data. Contemporary methodologies in genomics and transcriptomics are demonstrated. The

mass spectrometry approaches presented are targeted mass spectrometric analysis of preselected molecules, compositional analysis of metabolites by non-targeted mass spectrometric profiling and mass spectrometric imaging of tissue compound localization. In addition, data integration across different omics approaches and platforms are demonstrated. Students are familiarized with the most frequently used bioinformatics methods, which are used in the context of the demonstrated omics.

**Additional information**

**EN:**

### Completion methods

The students need to participate (min 80%) in the obligatory lectures and exercises (70 h), submit all assignments, and pass all the Moodle quizzes. The work required on own time is about 200 h.

### Assessment practices and criteria

Grading 0-5 is based on the obligatory assignments. In addition, for each course section (6-7) a Moodle quiz needs to be passed. The points given for each assignment are detailed on the Moodle page of the course.

### Target groups

Primarily for master's and doctoral students in any life science field. If in need to limit class size, the students from the organizing programmes and faculties are prioritized. Master's Programme in Neuroscience (responsible; Faculty of Biological and Environmental Sciences) organizes the course in collaboration with the Master's Programme in Translational Medicine (Faculty of Medicine), Master's Programme in Genetics and Molecular Biosciences (the course is obligatory in the study track of Molecular and Analytical Health Biosciences of the programme; Faculty of Biological and Environmental Sciences), and Doctoral Programme in Integrative Life Science

### Teaching period when the course will be offered

Periods 3 and 4, annually.

### Language of instruction

English

### EQF level

7

**Study materials**

**EN:** Selected review articles illuminating the principles of omics and related bioinformatics are studied while preparing the graded assignments.

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 10 cr |
| Participation in teaching | | 10 cr |

## NEU-306 Master’s seminar in cell and systems physiology

**NEU-306** Solu- ja systeemifysiologian maisteriseminaari

**NEU-306** Magisterseminar i cell- och systemfysiologi

Abbreviation: Solu- ja systee

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 5 cr |
| Languages | Finnish, English |
| Grading scale | General scale, 0-5 |

| | |
|---|---|
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible persons | Reijo Käkelä, Responsible teacher<br>Eva Ruusuvuori, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Tweet text**

**EN:** Interactive exercises and student presentations provide academic project and communication skills and readiness to complete a master's thesis project.

**Equivalences to other studies**

NEU-206 Master's seminar in physiology

or

NEU-106 Master's Seminar in Neuroscience

**Learning outcomes**

**EN:** The objective of the seminar is to support the master's thesis project of the student. The students acquire the knowledge needed to carry out either an experimental or theoretical research project in accordance with the best procedures and standards of science. Students will practice scientific presentation skills and are trained in scientific argumentation and reasoning. Students gain experience in reporting their work in the context of relevant literature and with the quality and clarity required for a master's thesis.

**Content**

**EN:** At the seminar, students practice academic writing and citing techniques, give oral presentations and have interactive scientific dialogue on topics related to physiology and neuroscience. They learn how to carry out experimental or theoretical scientific projects and rehearse problem-solving skills and critical thinking.

**Additional information**

**SV:** .

**EN:**

## Completion methods

Contact teaching appr. 35 h, assignments prepared at own time appr. 100 h (personal and group work). Participation in 100 % of seminar sessions (possible absences must be agreed upon with teachers in advance) and approved completion of all individual and group assignments and presentations are required to pass the course.

## Assessment practices and criteria

Grade (scale 1-5) is based on assignments and activity in the class.

## Target groups

Degree students of the Cell and Systems Physiology study track of the Master's Programme in Neuroscience. Master's Seminar in Neuroscience and Master's Seminar in Cell and Systems Physiology have combined teaching and classes.

## Teaching period when the course will be offered

Periods 1- 4, recommended to start during the autumn term of 2nd year of master's degree studies. If timely, it is possible to start the seminar already during the spring term of 1st year. The course is organized annually.

## Language of instruction

English

### EQF level

7

**Study materials**

**EN:** Study material is defined during the seminar or provided by the teachers.

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 5 cr |
| Participation in teaching | | 5 cr |

## NEU-220 Master's thesis in cell and systems physiology

**NEU-220** Maisterintutkielma solu- ja systeemifysiologiassa
**NEU-220** Magisteravhandling i cell- och systemfysiologi

Abbreviation: Maisterintutkie

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 30 cr |
| Languages | Finnish, Swedish, English |
| Grading scale | General scale, 0-5 |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible person | Juha Voipio, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Prerequisites**

**FI:** Opiskelijalla tulisi olla hyvät esitiedot tutkielmaprojektin teoreettisen perustan, tavoitteiden ja sisällön ymmärtämiseksi, riittävät tiedot ja taidot aineiston keräämiseen, käsittelyyn, sekä kykyä tieteelliseen kirjoittamiseen.

**SV:** .

**EN:** The student should have a good theoretical understanding of the project, its aims and context, the necessary knowledge and skills for collecting and processing data, and sufficient skills in scientific writing.

**Learning outcomes**

**FI:** Maisterintutkielman suoritettuaan opiskelija tuntee tutkimusprojektin vaiheet työn suunnittelusta ja sopivien tutkimusmenetelmien valinnasta kokeiden suorittamiseen (tai lähdeaineistopohjaisiin tai teoreettisiin tarkasteluihin), tulosten analysoimiseen ja tieteellisen raportin kirjoittamiseen saakka. Opiskelijalla on valmius tieteelliseen ajatteluun ja tutkimusmenetelmien hallitsemiseen, hän omaa projektinhallintataitoja, ja hän kykenee kirjalliseen tieteelliseen ilmaisuun.

**EN:** After completing the Master’s Thesis the student knows how a research project proceeds, from planning the work and choosing appropriate methods to performing the experiments (or carrying out a theoretical or data-based study), analysing results, and writing a scientific report. The student is capable of scientific thinking and mastering some research methods, and he/she has acquired relevant skills in project management and written scientific communication.

**Content**

**FI:** Maisterintutkielma perustuu useimmiten kokeelliseen tutkimusprojektiin ja tulosten kriittiseen tarkasteluun tutkimusaiheeseen liittyvän kirjallisuuden avulla. Tutkielma voi olla myös pelkästään kirjallisuuteen tai muuhun tieteelliseen lähdeaineistoon perustuva tutkimustyö. Biologian aineenopettajaksi opiskelevan maisterintutkielma voi käsitellä biologian opetukseen liittyviä kysymyksiä. Maisterintutkielma tehdään kokeneen tutkijan ohjauksessa, ja työssä on tyypillisesti neljä vaihetta: 1. Työn suunnittelu (sisältää keskeiseen kirjallisuuteen perehtymisen) 2. Aineiston kerääminen (esim. laboratoriotyöt) 3. Aineiston käsittely (esim. laadun tarkistaminen, tulosten käsittely, tilastolliset analyysit, graafinen esitys) 4. Tulosten tulkitseminen ja tarkastelu aiemman kirjallisuuden pohjalta ja tutkielman kirjoittaminen. Tutkielma kirjoitetaan tieteellisen julkaisun tapaan ja siinä kuvataan tulokset ja tarkastellaan niitä kriittisesti aiheesta aiemmin ilmestyneiden tieteellisten julkaisujen pohjalta.

**EN:** The Master's thesis is usually based on an experimental research project and critical contemplation of the results in the light of scientific literature on the topic. The thesis may also consist of a theoretical literature study. The Master's thesis project is carried out under the supervision of an experienced researcher, and it usually consists of four distinct phases: 1. Design and planning of the study (includes reading of relevant literature) 2. Gathering the data (e.g. laboratory work) 3. Analysing the data (e.g. validation/quality control, processing data, statistical analysis, plotting) 4. Interpreting and discussing the results in the light of existing literature, and writing the thesis. The thesis is written as if it were a scientific publication, critically describing, contemplating and discussing the results in the light of previous scientific literature on the topic.

**Additional information**

**FI:**

## Suoritustavat

Ennen tutkielmatyön aloittamista opiskelija laatii yhdessä työn ohjaajan tai ohjaajien kanssa maisterintutkielman suunnitelman ja hakee sille hyväksymisen maisterintutkielma-opintojakson vastuuopettajalta. Suunnitelmassa kuvataan riittävällä tarkkuudella mm. työn tavoitteet ja käytettävät menetelmät.

Maisterintutkielman hyväksyminen ja arvosana perustuvat opiskelijan kirjoittamaan maisterintutkielmaan. Tutkielmaa ei ole mahdollista hyväksyä ennen kuin opiskelija on suorittanut hyväksytysti kypsyysnäytteen. Maisterintutkielma on kirjallinen työ, jossa esitetään tutkimuksen tausta ja kysymyksenasettelu, työn aineisto ja menetelmät sekä työssä saadut tulokset, ja jossa lopuksi tarkastellaan tuloksia alalla julkaistun kirjallisuuden valossa. Tutkielman teko on pääosin itsenäistä työskentelyä, mutta työllä on aina ohjaaja. Työ tehdään useimmiten tutkimushankkeessa, jossa opiskelijalla on itsenäinen ja selkeä rooli. Tutkielma on kirjoitettava itse, mutta ohjaajan tulee antaa palautetta ja opastaa tieteellisessä kirjoittamisessa. Työhön (30 op) menevä aika on noin 4,5 kk eli 800 työtuntia eli 40 tuntia 20 viikon aikana. Tarkempi kuvaus ja ohjeet maisterintutkielmaa varten löytyvät tiedekunnan maisterintutkielman yleisohjeista sekä maisteriohjelman omista tarkentavista ohjeista.

## Arviointimenetelmät ja -kriteerit

Tutkielman arvioinnissa käytetään yliopiston ja tiedekunnan hyväksymiä arvostelukriteereitä. Arvosana-asteikkona 0 - 5.

## Oppimista tukevat aktiviteetit ja menetelmät

Maisterintutkielmalla on oltava nimetty ohjaaja, joka on kokenut tutkija (yleensä vastuullinen tutkija (Principal Investigator, PI), professori, yliopistonlehtori tai muu alan asiantuntija). Tutkielmalla voi olla myös muita nimettyjä ohjaajia. Työn vastaavan ohjaajan tulee olla vähintään tohtorin tutkinnon suorittanut tai vastaavan tasoinen henkilö.

## Kohderyhmät

Neurotieteen maisteriohjelman solu- ja systeemifysiologian opintosuunnan opiskelijat.

## Järjestämisajankohta opetusperiodin tarkkuudella

Maisterintutkielmaa voi tehdä läpi vuoden, myös opetusperidoen ulkopuolella.

## Suositeltava suoritusajankohta tai -vaihe

Toinen opiskeluvuosi maisteriohjelmassa.

**EN:**

### Completion methods

Before commencing the research work, the student prepares a Master's Thesis Plan together with the supervisor(s), submits it for approval by sending it to the teacher who is in charge of Master's Theses in the Programme. The aims of the study and the methods that will be used must be described in sufficient detail in the plan. Approval and grading is based on the written Master's thesis. The thesis cannot be approved until the student has passed the maturity test.

Master's thesis is a written report that presents the background and motivation of the study, materials and methods used as well as the results obtained in the study, and finally discusses the results in light of scientific literature published in the field. The thesis work is carried out under supervision, typically in a research project in which you have a clearly defined and an independent role. The student writes the thesis himself/herself, but the supervisor is supposed to provide feedback and advice on scientific writing. The total workload (30 credits) from designing the project to its completion is approximately 4.5 months (800 hrs, or 20 weeks at 40 hrs/week). For detailed information about the Master's thesis, see the Faculty's General Instructions for Master's Theses as well as the Programme's own guidelines.

### Assessment practices and criteria

The MSc thesis will be graded according the guidelines and criteria set by the University and the Faculty (information available on the Instructions for Students website). Grading scale 0 - 5.

### Activities and methods in support of learning

The Master's thesis project must have an assigned supervisor who is an experienced researcher (usually a Principal Investigator (PI), professor, university lecturer, or some other specialist in the field). A thesis may have additional officially appointed co-supervisors. The primary supervisor must hold at least a doctoral degree or equivalent qualifications.

### Target groups

Students on the Cell and Systems Physiology study track of the Master's Programme in Neuroscience.

### Teaching period when the course will be offered

Throughout the year.

### Recommended time or stage of studies for completion

Second year of studies.

EQF level: 7

**Study materials**

**FI:** Maisterintutkielman aihealueeseen liittyvä kirjallisuus, pääosin kansainvälisiä tieteellisiä julkaisuja.

**EN:** Mainly international, scientific papers depending on the topic of the Master's thesis.

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 30 cr |
| Participation in teaching | | 30 cr |

## NEU-310 Master's thesis in the study track of biology teacher

**NEU-310** Maisterintutkielma biologian opettajan opintosuunnassa

**NEU-310** Magisteravhandling i biologi ämneslärarens studieinriktning

Abbreviation: Maisterintutkie

Curriculum periods 2023-24, 2024-25, 2025-26

| | |
|---|---|
| Validity period | since 1 Aug 2023 |
| Credits | 30 cr |
| Languages | Finnish, Swedish |
| Grading scale | General scale, 0-5 |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible person | Juha Voipio, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Prerequisites**

**FI:** Opiskelijalla tulisi olla hyvät esitiedot tutkielmaprojektin teoreettisen perustan, tavoitteiden ja sisällön ymmärtämiseksi, riittävät tiedot ja taidot aineiston keräämiseen, käsittelyyn, sekä kykyä tieteelliseen kirjoittamiseen.

**SV:** Den studerande bör ha en god teoretisk förståelse för projektet, dess mål och sammanhang, nödvändiga kunskaper och färdigheter för att samla in och bearbeta data samt tillräckliga färdigheter i vetenskapligt skrivande.

**EN:** The student should have a good theoretical understanding of the project, its aims and context, the necessary knowledge and skills for collecting and processing data, and sufficient skills in scientific writing.

**Learning outcomes**

**FI:** Maisterintutkielman suoritettuaan opiskelija tuntee tutkimusprojektin vaiheet työn suunnittelusta ja sopivien tutkimusmenetelmien valinnasta kokeiden suorittamiseen (tai lähdeaineistopohjaisiin tai teoreettisiin tarkasteluihin), tulosten analysoimiseen ja tieteellisen raportin kirjoittamiseen saakka. Opiskelijalla on valmius tieteelliseen ajatteluun ja tutkimusmenetelmien hallitsemiseen, hän omaa projektinhallintataitoja, ja hän kykenee kirjalliseen tieteelliseen ilmaisuun.

**SV:** Efter att ha slutfört magisteruppsatsen vet studenten hur ett forskningsprojekt går till, från planering av arbetet och val av lämpliga metoder till genomförande av experiment (eller en teoretisk eller databaserad studie), analys av resultaten och skrivande av en vetenskaplig rapport. Den studerande är kapabel till vetenskapligt tänkande och behärskar vissa forskningsmetoder, och han/hon har förvärvat relevanta färdigheter i projektledning och skriftlig vetenskaplig kommunikation.

**EN:** After completing the Master's Thesis the student knows how a research project proceeds, from planning the work and choosing appropriate methods to performing the experiments (or carrying out a theoretical or data-based study), analysing results, and writing a scientific report. The student is capable of scientific thinking and mastering some research methods, and he/she has acquired relevant skills in project management and written scientific communication.

**Content**

**FI:** Maisterintutkielma perustuu useimmiten kokeelliseen tutkimusprojektiin ja tulosten kriittiseen tarkasteluun tutkimusaiheeseen liittyvän kirjallisuuden avulla. Tutkielma voi olla myös pelkästään kirjallisuuteen tai muuhun tieteelliseen lähdeaineistoon perustuva tutkimustyö. Biologian aineenopettajaksi opiskelevan maisterintutkielma voi käsitellä biologian opetukseen liittyviä kysymyksiä. Maisterintutkielma tehdään kokeneen tutkijan ohjauksessa, ja työssä on tyypillisesti neljä vaihetta: 1. Työn suunnittelu (sisältää keskeiseen kirjallisuuteen perehtymisen) 2. Aineiston kerääminen (esim. laboratoriotyöt) 3. Aineiston käsittely (esim. laadun tarkistaminen, tulosten käsittely, tilastolliset analyysit, graafinen esitys) 4. Tulosten tulkitseminen ja tarkastelu aiemman kirjallisuuden pohjalta ja tutkielman kirjoittaminen. Tutkielma kirjoitetaan tieteellisen julkaisun tapaan ja siinä kuvataan tulokset ja tarkastellaan niitä kriittisesti aiheesta aiemmin ilmestyneiden tieteellisten julkaisujen pohjalta.

**SV:** Magisteruppsatsen bygger vanligtvis på ett experimentellt forskningsprojekt och en kritisk granskning av resultaten mot bakgrund av den vetenskapliga litteraturen om ämnet. Avhandlingen kan också bestå av en teoretisk litteraturstudie. Masteruppsatsen genomförs under handledning av en erfaren forskare och består vanligtvis av fyra olika faser: 1. Utformning och planering av studien (innefattar läsning av relevant

litteratur) 2. Insamling av data (t.ex. laboratoriearbete) 3. Analys av data (t.ex. validering/kvalitetskontroll, bearbetning av data, statistisk analys, plottning) 4. Tolkning och diskussion av resultaten mot bakgrund av befintlig litteratur samt skrivande av avhandlingen. Avhandlingen skrivs som om den vore en vetenskaplig publikation, där man kritiskt beskriver, betraktar och diskuterar resultaten mot bakgrund av tidigare vetenskaplig litteratur i ämnet.

**EN:** The Master's thesis is usually based on an experimental research project and critical contemplation of the results in the light of scientific literature on the topic. The thesis may also consist of a theoretical literature study. The Master's thesis project is carried out under the supervision of an experienced researcher, and it usually consists of four distinct phases: 1. Design and planning of the study (includes reading of relevant literature) 2. Gathering the data (e.g. laboratory work) 3. Analysing the data (e.g. validation/quality control, processing data, statistical analysis, plotting) 4. Interpreting and discussing the results in the light of existing literature, and writing the thesis. The thesis is written as if it were a scientific publication, critically describing, contemplating and discussing the results in the light of previous scientific literature on the topic.

**Additional information**

**FI:** Suoritustavat
Ennen tutkielmatyön aloittamista opiskelija laatii yhdessä työn ohjaajan tai ohjaajien kanssa maisterintutkielman suunnitelman ja hakee sille hyväksymisen maisterintutkielma-opintojakson vastuuopettajalta. Suunnitelmassa kuvataan riittävällä tarkkuudella mm. työn tavoitteet ja käytettävät menetelmät.

Maisterintutkielman hyväksyminen ja arvosana perustuvat opiskelijan kirjoittamaan maisterintutkielmaan. Tutkielmaa ei ole mahdollista hyväksyä ennen kuin opiskelija on suorittanut hyväksytysti kypsyysnäytteen. Maisterintutkielma on kirjallinen työ, jossa esitetään tutkimuksen tausta ja kysymyksenasettelu, työn aineisto ja menetelmät sekä työssä saadut tulokset, ja jossa lopuksi tarkastellaan tuloksia alalla julkaistun kirjallisuuden valossa. Tutkielman teko on pääosin itsenäistä työskentelyä, mutta työllä on aina ohjaaja. Työ tehdään useimmiten tutkimushankkeessa, jossa opiskelijalla on itsenäinen ja selkeä rooli. Tutkielma on kirjoitettava itse, mutta ohjaajan tulee antaa palautetta ja opastaa tieteellisessä kirjoittamisessa. Työhön (30 op) menevä aika on noin 4,5 kk eli 800 työtuntia eli 40 tuntia 20 viikon aikana. Tarkempi kuvaus ja ohjeet maisterintutkielmaa varten löytyvät tiedekunnan maisterintutkielman yleisohjeista sekä maisteriohjelman omista tarkentavista ohjeista.

## Arviointimenetelmät ja -kriteerit

Tutkielman arvioinnissa käytetään yliopiston ja tiedekunnan hyväksymiä arvostelukriteereitä. Arvosana-asteikkona 0 - 5.

## Oppimista tukevat aktiviteetit ja menetelmät

Maisterintutkielmalla on oltava nimetty ohjaaja, joka on kokenut tutkija (yleensä vastuullinen tutkija (Principal Investigator, PI), professori, yliopistonlehtori tai muu alan asiantuntija). Tutkielmalla voi olla myös muita nimettyjä ohjaajia. Työn vastaavan ohjaajan tulee olla vähintään tohtorin tutkinnon suorittanut tai vastaavan tasoinen henkilö.

## Kohderyhmät

Neurotieteen maisteriohjelman biologian opettajan opintosuunnan opiskelijat.

## Järjestämisajankohta opetusperiodin tarkkuudella

Maisterintutkielmaa voi tehdä läpi vuoden, myös opetusperidoen ulkopuolella.

## Suositeltava suoritusajankohta tai -vaihe

Toinen opiskeluvuosi maisteriohjelmassa.

**SV:** PrestationssättInnan avhandlingen påbörjas utarbetar studenten tillsammans med handledaren/handledarna en plan för magisteruppsatsen och ansöker om godkännande av handledaren för magisteruppsatsen. I planen beskrivs tillräckligt detaljerat bl.a. avhandlingens mål och de metoder som ska användas. Godkännande och betygsättning av magisteruppsatsen baseras på den magisteruppsats som studenten skrivit. Avhandlingen kan inte godkännas förrän den studerande har avlagt mognadsprovet. Magisteruppsatsen är ett skriftligt arbete som presenterar bakgrunden och forskningsfrågorna, arbetets material och metodik, arbetets resultat och slutligen diskuterar resultaten i ljuset av den publicerade litteraturen på området. Avhandlingen är huvudsakligen ett självständigt arbete, men det finns alltid en handledare. I de flesta fall utförs arbetet i ett forskningsprojekt där den studerande har en självständig och tydlig roll. Av-

handlingen ska skrivas av studenten, men handledaren ska ge feedback och vägledning om vetenskapligt skrivande. Avhandlingen (30 poäng) tar cirka 4,5 månader, dvs. 800 arbetstimmar eller 40 timmar under 20 veckor. En mer detaljerad beskrivning och anvisningar för magisteruppsatsen finns i fakultetens allmänna riktlinjer för magisteruppsatsen och i magisterprogrammets egna specifika riktlinjer.

### Bedömningsmetoder och kriterier

Utvärderingen av avhandlingen baseras på de utvärderingskriterier som godkänts av universitetet och fakulteten.

### Aktiviteter och metoder som stöder lärandet

Masteruppsatsen måste ha en handledare som är en erfaren forskare (vanligtvis en huvudforskare, professor, universitetslektor eller någon annan specialist inom området). En avhandling kan ha ytterligare officiellt utsedda medhandledare. Den primära handledaren måste ha minst en doktorsexamen eller motsvarande kvalifikationer.

### Målgrupper

Studenter som studerar biologi för lärare i masterprogrammet i neurovetenskap.

### Rekommenderad tidpunkt för prestationen

Andra året av studierna.

EQF level: 7

**EN:** Completion methods
Before commencing the research work, the student prepares a Master's Thesis Plan together with the supervisor(s), submits it for approval by sending it to the teacher who is in charge of Master's Theses in the Programme. The aims of the study and the methods that will be used must be described in sufficient detail in the plan. Approval and grading is based on the written Master’s thesis. The thesis cannot be approved until the student has passed the maturity test.

Master's thesis is a written report that presents the background and motivation of the study, materials and methods used as well as the results obtained in the study, and finally discusses the results in light of scientific literature published in the field. The thesis work is carried out under supervision, typically in a research project in which you have a clearly defined and an independent role. The student writes the thesis himself/herself, but the supervisor is supposed to provide feedback and advice on scientific writing. The total workload (30 credits) from designing the project to its completion is approximately 4.5 months (800 hrs, or 20 weeks at 40 hrs/week). For detailed information about the Master’s thesis, see the Faculty’s General Instructions for Master’s Theses as well as the Programme’s own guidelines.

### Assessment practices and criteria

The MSc thesis will be graded according the guidelines and criteria set by the University and the Faculty (information available on the Instructions for Students website). Grading scale 0 - 5.

### Activities and methods in support of learning

The Master’s thesis project must have an assigned supervisor who is an experienced researcher (usually a Principal Investigator (PI), professor, university lecturer, or some other specialist in the field). A thesis may have additional officially appointed co-supervisors. The primary supervisor must hold at least a doctoral degree or equivalent qualifications.

### Target groups

Students on the Biology Teacher study track of the Master’s Programme in Neuroscience.

### Teaching period when the course will be offered

Throughout the year.

### Recommended time or stage of studies for completion

Second year of studies.

EQF level: 7

**Study materials**

**FI:** Maisterintutkielman aihealueeseen liittyvä kirjallisuus, pääosin kansainvälisiä tieteellisiä julkaisuja.

**SV:** Huvudsakligen internationella, vetenskapliga artiklar beroende på ämnet för magisteruppsatsen.

**EN:** Mainly international, scientific papers depending on the topic of the Master's thesis.

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 30 cr |
| Participation in teaching | | 30 cr |

## NEU-404 Practical training 1

**NEU-404** Harjoittelujakso 1
**NEU-404** Praktikperiod 1

Abbreviation: Harjoittelujaks

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 5-10 cr |
| Languages | English, Finnish, Swedish |
| Grading scale | Pass-Fail |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible persons | Katri Wegelius, Responsible teacher<br>Mikael Segerstråle, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Medical science |

**Equivalences to other studies**

920027 Practical Training

**Learning outcomes**

**EN:** After the practical training period, the student

- has acquired practical experience in a research group or company
- has improved her/his ability to apply and assess her/his own knowledge and skills
- has improved her/his ability for independent work and reporting of results
- has enhanced her/his potential as a future jobseeker in a wider network within the field of study

**Content**

**EN:** Before starting the practical training period, the student agrees with the internship supervisor about the timing and project content and the methods to be learned. After the internship period, the student writes a report that summarises the experience gained. Internship period can be with or without salary (although the latter is not recommended), in a university or outside university. Before the internship starts, the student must register to NEU-404 in Sisu indicating the supervisor(s) and the planned time period of the practical training. The responsible teacher of the NEU-404 checks the suitability of the planned internship and verifies the registration.

**Additional information**

**EN: Target group:** Students of the Master's Programme in Neuroscience
**Timing**: Recommended to be completed during the first or second year, but before the Master's thesis.

Assessment criteria and practices:

Grading pass / fail.

Completion methods:

Writing a practical training plan and report according to given instructions at the Student Guide. A minimum of 1 month of full-time work corresponding 5 cr. In order to be worth 10 credits, the training period must include more diverse tasks and offer a more comprehensive learning experience (e.g. participating in more than one project and learning several different methods) instead of just lasting twice longer than a 5 cr training period. This will be estimated according to the report written by the student and the email statement given by the supervisor.

EQF level: 7

**Study materials**

**EN:** Instructions are available at the students' instructions website.

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 5 cr |
| Participation in teaching (min) | | 5 cr |
| Method 2 | | 10 cr |
| Participation in teaching (max) | | 10 cr |
| Method 3 | | 5-10 cr |
| Participation in teaching | | 5-10 cr |

## **NEU-405** Practical training 2

**NEU-405** Harjoittelujakso 2
**NEU-405** Harjoittelujakso 2

Abbreviation: Harjoittelujaks

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 5 cr |
| Languages | Finnish, English, Swedish |
| Grading scale | Pass-Fail |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible persons | Mikael Segerstråle, Responsible teacher<br>Katri Wegelius, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Learning outcomes**

**EN:** After the practical training period, the student

- has acquired practical experience in a research group or company
- has improved her/his ability to apply and assess her/his own knowledge and skills

- has improved her/his ability for independent work and reporting of results
- has enhanced her/his potential as a future jobseeker in a wider network within the field of study

**Content**

**EN:** NEU-404 and NEU-405 can be done in the same research group or company only if the project or the methods applied are different, and if the two training periods do not form a continuum in the same group or company
Before starting the practical training period, the student agrees with the internship supervisor about the timing and project content and the methods to be learned. After the internship period, the student writes a report that summarises the experience gained. Internship period can be with or without salary (although the latter is not recommended), in a university or outside university. Before the internship starts, the student must register to NEU-405 in Sisu indicating the supervisor(s) and the planned time period of the practical training. The responsible teacher of the NEU-405 checks the suitability of the planned internship and verifies the registration.

**Additional information**

**EN: Target group:** Students of the Master's Programme in Neuroscience
**Timing**: Recommended to be completed during the first or second year, but before the Master's thesis.

Assessment criteria and practices:

Grading pass / fail.

Completion methods:

Writing a practical training plan and report according to given instructions at the Student Guide. A minimum of 1 month of full-time work corresponding 5 cr.

EQF level: 7

**Study materials**

**EN:** Instructions are available at the students' instructions website.

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 5 cr |
| Participation in teaching | | 5 cr |

## NEU-414 Research project

**NEU-414** Tutkimusprojekti
**NEU-414** Forsningsprojekt

Abbreviation: Tutkimusprojekt

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 5 cr |
| Languages | English |
| Grading scale | General scale, 0-5 |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible person | Juha Voipio, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Tweet text**

**EN:** Learn the steps of a research project from planning to writing a paper - all this in four weeks

**Prerequisites**

**EN:** Studying most of the obligatory courses of your study track is recommended before taking the research project.

**Learning outcomes**

**EN:** The student will gain skills in planning, performing and reporting scientific research, as well as in research project management, by carrying out a mini project.

**Content**

**EN:** The mini project includes all steps of a typical scientific research project, from project planning to writing up a manuscript, but in a very concise form. Within about four weeks of full time work you are supposed to accomplish steps including defining a research question, reviewing a few papers that are most relevant to the project, formulating a hypothesis and choosing an appropriate method, designing and performing one or a few experiments to answer the research question, analysing the obtained data, and finally writing a mini paper. The experimental part of the project is done either by participating in a few experiments done by the supervisor, or by doing one or a few experiments yourself under your supervisor's guidance. All steps will be supervised by a researcher, and it is essential to plan the project so that each step will take no more than a few days. Thus, the manuscript to be written may be based on a single result. The manuscript should have the structure that is typical for papers published in the field of research (e.g., abstract, introduction, materials and methods, results, discussion, references, figure(s) and figure legend(s)), yet it should be very concise (max 2500 words in the whole document).

**Additional information**

**EN:** Completion methods
The student finds a supervisor, they agree about the project and prepare a brief written proposal that must be accepted by the responsible teacher before the project is commenced. The project may then be carried out as described above. Although supported by the supervisor's guidance, a significant part of the four weeks full time work is supposed to be the student's independent work. Completion requires submitting the written manuscript to the responsible teacher, and the supervisors' assessment of the student's performance.

## Assessment practices and criteria

Grading scale: pass – fail, based on the written manuscript and the supervisor's assessment.

## Target groups

Students of Master's Programme in Neuroscience

## Teaching period when the course will be offered

Throughout the year.

## Recommended time or stage of studies for completion

Recommended to be completed during the first or second year, but before the Master's thesis.

## Language of instruction

As agreed between the student and the supervisor.

EQF level: 7

**Study materials**

**EN:** Less that ten published papers recommended by the supervisor of the project.

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 5 cr |
| Participation in teaching (min) | | 5 cr |

# NEU-415 Creative scientific thinking

**NEU-415** Luova tieteellinen ajattelu

**NEU-415** Kreativt vetenskapligt tänkande

Abbreviation: Luova tieteelli

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 5 cr |
| Languages | English |
| Grading scale | Pass-Fail |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible persons | Reijo Käkelä, Responsible teacher<br>Eva Ruusuvuori, Responsible teacher<br>Leonardo de Almeida Souza, Responsible teacher<br>Elina Roine, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

### Tweet text

**EN:** Online activity taking two semesters and enhancing empathy, team work skills, and abilities to handle complex phenomena and find creative new solutions.

### Prerequisites

**EN:** No prerequisites.

### Learning outcomes

**EN:** The creative activity will encourage the participants to integrate material and information across subject areas, question their assumptions, and imagine new viewpoints and possibilities. The goal is to promote collaborative and innovative scientific thinking. The open-minded search of new ideas is followed by analytical thinking and building logical graphical models. Participants are encouraged to take advantage of their personal interests and experiences to aid their reasoning in a scientific context.

### Content

**EN:** The activity takes place online, and after students have submitted their first thoughts on the trigger material and questions, they have a group work session where a graphical mind map organizing the ideas of all participants is prepared. The questions require creative thinking and do not have one predicted solution. The mind maps produced by groups are discussed in a following session with invited experts. Each case is completed by submitting a rethinking assignment.

### Additional information

**EN:**

## Completion

Students take part in 6 cases of the creative activity programme and a spring event, and prepare the different assignments related to them. Few missed cases can be compensated by a small scale creative scientific

project, according to instructions of NEU-416 Creative scientific project but included as supplementary work to accomplish NEU-415 Creative scientific thinking.

### Assessment practices and criteria

After getting familiar with the trigger material of a case, participants submit their preliminary ideas of the case topic to Moodle. They then participate in two sessions of the case: the first one includes group work and producing and submitting of a mind map in graphical form, and the second one includes discussions on the created mind maps with invited experts, and a rethinking assignment.

### Target groups

Student's from any bachelor's, master's and doctoral programmes can attend and will be working in heterogeneous groups. Teaching and research staff are also welcomed to join the working groups. This course can be arranged in a different format and with different assessment method for open university students. Master's Programme in Neuroscience is responsible for the activity, which is organized in collaboration with Master's Programme in Genetics and Molecular Biosciences.

### Teaching period when the course will be offered

Periods 1–4, annually. The course takes two semesters and can be started either at the beginning of autumn or spring semester.

### Language of instruction

English

### EQF level

7

**Study materials**

**EN:** The trigger materials for the creative group work are provided by the facilitators of each case. The case themes are interdisciplinary, which allows persons with different backgrounds from basic biosciences to applied, technical or humanistic fields to participate.

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 5 cr |
| Participation in teaching | | 5 cr |

## NEU-416 Creative scientific project

**NEU-416** Luova tieteellinen projekti

**NEU-416** Kreativt vetenskapligt projekt

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 2-5 cr |
| Languages | English |
| Grading scale | Pass-Fail |
| University | University of Helsinki |
| Responsible organisations | Master's Programme in Neuroscience 50%<br>Master's Programme in Genetics and Molecular Biosciences 50% |
| Responsible persons | Reijo Käkelä, Responsible teacher<br>Eva Ruusuvuori, Responsible teacher<br>Leonardo de Almeida Souza, Responsible teacher<br>Elina Roine, Responsible teacher<br>Katri Wegelius, Administrative person |
| Study level | Advanced studies |

| | |
|---|---|
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Tweet text**

**EN:** Students plan, perform and report a creative scientific project based on their own innovative idea, utilizing their interests and often artistic content.

**Prerequisites**

**EN:** NEU-415 Creative scientific thinking (recommended ongoing)

**Learning outcomes**

**EN:** The students are given the possibility to carry out a creative scientific project based on their own innovative idea and utilizing their particular interests. The project promotes interdisciplinary thinking and can have artistic implementation. The project encourages to take initiatives, innovate and may lead to entrepreneurship.

**Content**

**EN:** Students plan, perform and report the results of a creative project based on their own innovative idea, utilizing their particular interests. The projects or ideas may pursue immaterial or material outcomes and can include artistic content. The media that is used to present the work is not restricted, provided that the scientific content remains sufficient. Project can be accomplished individually or as a member of a group.

**Additional information**

**EN:**

## Completion methods

Project plan describing an overview of the project, its participants and their roles, supervision and consultations, scientific content, creativity aspects, schedule and practical implementation, and publication of the project. The plan needs to be accepted by responsible teachers before initiating the project. The course is passed when the project is accomplished essentially as planned or with alterations approved by responsible teachers. To confirm this, the project results are presented, and the possible changes in the plan are reported and their influence on the outcome is reflected.

## Assessment practices and criteria

Written project plan, and supervised completion of the project with the result approved by responsible teachers.

## Activities and methods in support of learning

Regular consultations with supervisor and when applicable with Helsinki Think Company or other experts are provided.

## Target groups

Bachelor's, master's and doctoral students who also study NEU-415 Creative scientific thinking.

## Teaching period when the course will be offered

Periods 1-4.

## EQF level

7

**Study materials**

**EN:** All supporting materials are provided in Moodle.

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 2-5 cr |

Participation in teaching 2-5 cr

# NEU-603 Laboratory animal science

**NEU-603** Koe-eläintiede

**NEU-603** Försöksdjursvetenskap

Abbreviation: LAS NEU-603

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 1-5 cr |
| Languages | English |
| Grading scale | General scale, 0-5 |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible persons | Mikael Segerstråle, Responsible teacher<br>Eva Ruusuvuori, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Tweet text**

**EN:** The course covers the main aspects you need to know when using animals for scientific purposes: from basic theory and handling to advanced design of projects.

**Equivalences to other studies**

522049 Lectures in Laboratory Animal Science

or

522055 Practical Work in Laboratory Animal Science

or

522085 Laboratory Animal Science: Design of Animal Experiments

**Learning outcomes**

**EN:** The aim of the course is to provide theoretical and practical training in laboratory animal science in accordance with the Directive 2010/63/EU and national legislation.
Basic theoretical studies (2 credits)#provide the obligatory theoretical knowledge for persons euthanizing or carrying out procedures on animals and designing procedures and projects involving animals.

Hands-on exercises (1 credit) Students will learn to apply their theoretical knowledge on *e.g.*, handling, marking and sample collection in an actual hands-on situation under supervision.

Advanced#Design Exercises(2 credits) Students obtain in depth knowledge on how to design procedures and projects with an emphasis on animal welfare and on understanding and implementing good scientific practices.

**Content**

**EN:** Content
The course content follows the structure outlined in the EU Expert Working Group document (February 2014) on common education and training framework in the EU.

The basic theoretical studies (2 cr)# cover e.g. legislation; ethical aspects; biology and husbandry of laboratory mice and rats; design and conduct of animal experiments; minimally invasive experimental procedures; humane endpoints; and assessment of pain, distress and suffering, anesthesia and surgical proce-

dures. Note that the basic material focuses on rats and mice. If you want to gain competence to work with other animal species, e.g., zebrafish, please contact the responsible teacher Mikael Segerstråle.

The practical hands-on exercises (0,5 - 1 cr)# include training appropriate handling of the common laboratory rodents (mice and rats), and in basic procedures, such as marking animals, blood sampling, injections, induction and maintenance of anesthesia, and humane methods of killing. Responsible teacher Mikael Segerstråle.

The advanced design exercises (2 cr)# cover level II education in implementation of 3Rs when designing procedures and projects; and in the principles of good scientific strategies necessary to achieve robust results; enhance understanding of legal and regulatory framework within which projects are constructed and managed, and of the legal responsibilities of those working with animals; and give training in identifying, understanding and responding appropriately to the ethical and welfare issues raised by the use of animals for scientific purposes. Responsible teacher Eva Ruusuvuori.

**Additional information**

EN: Completion methods
#To pass Basic theoretical studies (2 cr) students need to 1) acceptably complete the relevant study-material, and 2) pass the final exam. The study-material of Basic theoretical studies must be successfully completed before participating practical hands-on or advanced design exercises.

To pass Hands-on exercises students need to 1) attend practical work sessions (100 % attendance) and 2) demonstrate acquisition of the required skills.

To pass Advanced Design Exercises students need to 1) acceptably complete the relevant study-material , 2) attend contact teaching and group work sessions (100 % attendance), 3) accomplish assignments given during the course; and 4) finalize group work.

Assessment practices and criteria:

Basic theoretical studies (2 credits): Assessment is based on a final exam covering the study material (grading 0-5).

Hands-on exercises (0,5 - 1 credit): Assessment (pass/fail) is based on a separate evaluation matrix.

Advanced Design Exercises (2 credits): Assessment is based on course assignments (grading 0 – 5).

5 credits: Grading scale 0-5, based on the exam on study material and the grade from design exercises; hands-on (pass-fail).

Target group

For those who aim to gain competence to do procedures on animals or to design procedures and projects on animals, the courses are mandatory as explained below. Theoretical studies and design exercises are suitable to all students and university personnel interested in research involving animals and for those who want to continue their professional development.

- The Basic theoretical studies are obligatory for persons carrying out procedures on animals (function A competence), for persons designing procedures and projects involving animals (function B) and killing animals (function D).
- The hands-on exercises are obligatory for persons carrying out procedures on animals and euthanizing them (functions A and D competence) and recommended for those aiming for function B competence (designing procedures and projects involving animals).
- The Advanced design exercises are obligatory for persons who want to become competent to design procedures and projects involving animals (function B competence).

The hand-on exercises are primarily aimed for degree students of the Master's Programme in Neuroscience and of the Doctoral Programme Brain & Mind who aim to carry out procedures on rodents .

Teaching period when the course will be offered

Web-material can be completed year-round and must be successfully finalized before attending hands-on teaching (period 2) or design exercises (period 2).

Teaching language

English

This course can be arranged in a different format and with different assessment method for open university students.

Motivational letter for hands-on exercises

Participants to the hands-on exercises are selected based on their motivational letter explaining why the candidate needs to complete the practical training part.

EQF level: 7

**Study materials**

**EN:** After enrolling to the course, students gain access to “LASDigi” study-material. Lecturers may provide additional study material.

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 5 cr |
| Participation in teaching (LAS Online Theory) | | 2 cr |
| Participation in teaching (Design) | | 2 cr |
| Participation in teaching (Hands-on) | | 1 cr |

## NEU-231 Mechanisms of regeneration and aging

**NEU-231** Uusiutumisen ja vanhenemisen mekanismit

**NEU-231** Regenererandets och åldrandets mekanismer

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 5 cr |
| Languages | English |
| Grading scale | General scale, 0-5 |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible persons | Ulla Pirvola, Responsible teacher<br>Pekka Katajisto, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Prerequisites**

**EN:** BSc in any life science field.

**Learning outcomes**

**EN:** After completion of the study unit, student can explain the key molecular, cellular and tissue-level mechanisms known to be involved in regeneration and aging. Student can explain evolutionary perspectives of regeneration and aging. Student can critically evaluate the current and future possibilities to manipulate the regeneration and aging processes. This provides deep understanding of the functional systems level differences that occur between different organisms and during the life span of an organism.

**Content**

**EN:** During the first half of the course (1) regeneration mechanisms based on stem cells and functional cell types are explained. The differences in regeneration capacity between animals of different phyla and different ages are addressed as well as the nature of the regeneration barriers of many mammalian cell types. Differences between regeneration and repair are explained. Invertebrate model organisms as well as vertebrate muscle, heart, central nervous system and sensory organs are dealt with. It is discussed whether this knowledge could be brought into therapeutic interventions. The latter half of the course addresses (2) the mechanistic reasons of aging that eventually reduce tissue function and result in frailty, aging associated diseases, and death. Mechanistic insight is provided to understand how the rate of aging can be influenced and why different organisms age very differently. The multiple types of age-associated alterations and their counteracting repair mechanisms will be detailed to address how levels of tissue renewal by tissue specific stem cells and damage accumulation influence aging. Current methods in regeneration and aging research are illuminated.

**Additional information**

**EN:**

### Target group

Open to students in the Neuroscience Master's Programme and in other master degree programmes (molecular biosciences, biology, medicine). If in need to limit class size, students from the organizing master's programmes and faculty are prioritized.

### Timing

Period 4 / The course is taught annually

### Assessment practices and criteria

Grading (0-5) is based on written assignments that are individually graded, on the oral presentation of each student in the final symposium of the course, and on general activity during sessions.

### Completion methods

Participation in teaching (lectures, group work, assignments, presentation). The course includes compulsory face-to-face meetings and cannot be completed entirely by distance learning. Minimum of 80 % participation in sessions.

### Responsible person

Ulla Pirvola, Pekka Katajisto

EQF level 7

**Study materials**

**EN:** Lecture material and other material assigned to the course in Moodle. Selected articles illuminating the mechanisms of regeneration and aging are studied while preparing the assignments and presentation.

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 5 cr |
| Participation in teaching | | 5 cr |

## **NEU-251** Molecular Nutrition

**NEU-251** Molekulaarinen ravitsemus

**NEU-251** Molekylär näring

Abbreviation: Molekulaarinen

Curriculum periods 2023-24, 2024-25, 2025-26

| | |
|---|---|
| Validity period | since 1 Aug 2023 |
| Credits | 5 cr |
| Languages | Finnish, English |
| Grading scale | General scale, 0-5 |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible persons | Reijo Käkelä, Responsible teacher<br>Katri Wegelius, Administrative person<br>Eva Ruusuvuori, Responsible teacher<br>Mikael Segerstråle, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Tweet text**

**EN:** Gamified digicourse on molecular nutrition that students can study at their own pace.

**Prerequisites**

**EN:** BSc in any life science field. Advanced exchange students (from BSc programmes) with good knowledge on physiology, biochemistry or molecular biology are welcome.

**Learning outcomes**

**EN:** Students learn the mechanisms of neuronal and hormonal control of digestive system, and how satiety, hunger and thirst are regulated. They get to know the specific features of brain energy supply and understand the consequences of biological rhythms on body metabolism. They learn how dietary fibers and the short chain fatty acids produced of them affect health employing the central signaling pathways of the microbiota-gut-brain axis. They understand the mechanisms how fructose and lipid-rich diets affect macrophages and lead to altered cholesterol and lipoprotein transport, and eventually cause atherosclerosis and fatty liver disease. They learn that the development of cardiovascular diseases can be influenced by choices of dietary fats. In addition to addressing humans and mammalian models, it is demonstrated that also aquatic organisms may suffer from insufficient quality of food. Students get the newest mechanistic insight how fatty acid-derived lipid mediators regulate physiology and modulate immune functions, and how nutrition affects non-coding RNA and thereby regulates metabolism, allowing to use non-coding RNA as therapeutics. The generic skills trained during this web course include fact-finding and processing, problem solving and analytical mechanistic thinking. In addition, students develop skills of writing short answers that encapsulate all the essential information from the scientific references.

**Content**

**EN:** The course is a gamified digicourse that students can study at their own pace. The course includes four topical themes: 1) Nervous system and nutrition, 2) Carbohydrates and gut microbes, 3) Lipids in health and disease, and 4) Non-coding RNA in regulating metabolism. These themes are divided to obligatory and optional levels.

**Additional information**

**EN:**

## Completion methods

Students accomplish in sequence several assignments in the Moodle area, and when passing one, the student is allowed to enter the following assignment. The course is passed when all the obligatory assignments are passed. The very final obligatory assignment is an oral exam in zoom.

## Assessment practices and criteria

Grading 3–5 is based on passing the web assignments of obligatory and optional levels. Passing all the obligatory quizzes and assignments provides the grade 3/5. Passing all the quizzes and assignments, obligatory and voluntary, provides the grade 5/5. The course is completed with an oral examination where stu-

dent assignment answers are discussed (pass/needs updating before receiving the previously determined grade).

### Target groups

Primarily for master's students in any life science field. Provided also for doctoral students in these fields. This course can be arranged in a different format and with different assessment method for open university students.

### Teaching period when the course will be offered

Course can be taken annually, and anytime during periods 1–4. Once students register in the Moodle area of the course, they can start to study.

### Language of instruction

English

### EQF level

7

**Study materials**

**EN:** All the study material (e.g., scientific articles, videos etc.) can be found in the Moodle area and its ThingLink environments.

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 5 cr |
| Independent study | | 5 cr |

## NEU-502 Synaptic Signaling and Plasticity

**NEU-502** Synaptinen signalointi ja plastisuus

**NEU-502** Synaptisk signalering och plasticitet

Abbreviation: Synaptinen sign

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 5 cr |
| Languages | English |
| Grading scale | General scale, 0-5 |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible persons | Sari Lauri, Responsible teacher<br>Kari Keinänen, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Prerequisites**

**EN:** Basic knowledge of neurobiology as well as cell and molecular biology is assumed.

**Learning outcomes**

**EN:** The students will familiarize with the concept, mechanisms and consequences of synaptic signaling and activity–dependent synaptic plasticity in the central nervous system. On completion of the course, the student has gained an understanding of the molecular mechanisms of chemical neurotransmission, can explain how neurotransmitters act on their receptors and induce downstream signals and is able to integrate

this information into a physiological context. The student has also obtained practice in critical reading and discussing literature and communicating scientific knowledge.

**Content**

**EN:** The course addresses the mechanisms underlying fast synaptic transmission and activity-dependent synaptic plasticity in the brain. The topics include structure and function of ligand-gated ion channel and G-protein coupled receptors for major neurotransmitters, mechanisms underlying neurotransmitter release as well as induction and expression of Hebbian and homeostatic plasticity. The focus is on the molecular mechanisms mediating glutamatergic transmission, but modulation of these mechanisms in response to physiological signals as well as its relevance for circuit function and behavior will be covered as well.

**Additional information**

**EN:** Target group
Advanced BSc, MSc and PhD students of Neuroscience, Molecular Biosciences and related Life Sciences.

## Timing

Period 3 or 4

## Assessment practices and criteria

Grade (scale 0-5) is based on attendance and activity in class, presentation and the exam.

## Completion

Lectures, seminars (incl. own oral presentation and written summary) and an exam. Contact teaching approximately 35 h, independent and group work 100 h.

## Relations to other study units

The course provides useful background for studies of neurobiology, pharmacology and cell and molecular biology.

## Responsible person

Sari Lauri and Kari Keinänen

**Study materials**

**EN:** Reading list covering relevant material from neuroscience textbooks and review and research articles will be given in the beginning of and during the course.

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 5 cr |
| Participation in teaching | | 5 cr |

# NEU-503 Neuronal cell culture workshop

**NEU-503** Neuronal cell culture workshop

**NEU-503** Neuronal cell culture workshop

Abbreviation: Neuronal cell c

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |

| | |
|---|---|
| Credits | 3 cr |
| Languages | English |
| Grading scale | Pass-Fail |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible person | Pirta Hotulainen, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Prerequisites**

**EN:** NEU-101 and NEU-102 or similar courses are recommended before the course.

**Learning outcomes**

**EN:** After completion of the course the student will understand

- how neurons can be dissociated and cultured
- how to transfect and image cultured primary neurons and how the images can be analyzed.
- the importance of an in vitro system

**Content**

**EN:** Aseptic working methods, establishment and maintenance of primary neural cell cultures, transfection, immunofluorescence staining, and live cell imaging.

**Additional information**

**EN:** Target group
Maximum number of students: 9, selected based on the student's degree program and application/motivation letter.

1. Students of Master's Programmes in Neuroscience and Doctoral Programme Brain & Mind

2. Other MSc students and doctoral candidates interested in neuronal cell cultures

Completion methods

Attendance to the hands on demonstration and to the lectures is necessary (exact times can be negotiated).

Presentation and assignment completion based on lectures and study material.

**Study materials**

**EN:** Study material will be provided during the course

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 3 cr |
| Participation in teaching | | 3 cr |

## NEU-511 Systems and Cognitive Neuroscience

**NEU-511** Systeeminen ja kognitiivinen neurotiede
**NEU-511** Systemisk och kognitiv neurovetenskap

Abbreviation: Systeeminen ja

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |

| | |
|---|---|
| Validity period | since 1 Aug 2023 |
| Credits | 5 cr |
| Languages | English |
| Grading scale | Pass-Fail |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible person | Juha Voipio, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Tweet text**

**EN:** This self-study e-course gives you a comprehensive introduction to the interdisciplinary field of systems and cognitive neuroscience

**Prerequisites**

**EN:** Successful studying of the course requires good basic knowledge in at least one of the following fields: neurobiology/neuroscience, psychology, cognitive science, neuroscience related biomedical engineering.

**Learning outcomes**

**EN:** The course provides a comprehensive introduction to the interdisciplinary field of systems and cognitive neuroscience and a good basis for further studies in the field. Students learn the rationale of research as well as experimental methods and approaches, concepts and theoretical frameworks that are common in the field. After successful completion of the course, students have gained knowledge and understanding in what follows:

- conceptual and theoretical frameworks of cognitive neuroscience
- cellular functions and neuroanatomy (basics needed to study the course)
- brain imaging and behavioral methods used for studying cognitive functions
- sensory systems processing of sensory information
- how emotions are enabled by the brain and imaged in cognitive research
- executive actions and control of behavior, and the underlying brain mechanisms
- basics of the neurophysiology of sleep
- processing of social information and neural systems involved in social interaction
- neural basis of language functions
- storing and processing information in memory

**Content**

**EN:** Course modules cover the following topics:

- What is systems and cognitive neuroscience?
- Principles of neuronal function and neuroanatomy: Neurons and glial cells, chemical and electrical signaling in the brain. Brain anatomy: major brain tracts, functional cortical areas, brain topology.
- Brain imaging methods: MEG, EEG, TMS, fMRI, DTI, NIRS, PET. Behavioral methods: experimental methods, questionnaire methods. Analysis and interpretation of data.
- Sensory systems: vision, hearing, tactile and proprioceptive senses, chemical senses.
- Selective processing of incoming information: attention; disorders of attention.
- Emotions in the brain; and how emotions are studied using neuroimaging methods.
- Storing and processing information in memory: types of memory, neural basis of memory, emotions and memory.
- Executive actions and control of behavior: Deficits in executive functions. Neural systems of reward, decision making, motor control, visual cues and the control of movement.
- Sleep: circadian rhythm, vigilance states, brain processes during sleep.

- Neuronal processes underlying social interaction and cooperation: face perception, social cues, social brain networks. Developmental disorder of social interaction.
- Brain and language. Music.

**Additional information**

**EN:**

### Target groups

Students of the Master's Programme in Neuroscience, as well as MSc and doctoral students and exchange students who meet the prior knowledge requirements.

### Completion methods

After enrolling to this self-study e-course, students gain access to the "Systems and cognitive neuroscience" Moodle site that is divided into modules. You will study materials of each module following the instructions given, and monitor your own learning using quizzes and module-specific tests. Each module forms a unit that is completed before you can continue to the next module. Completion of the whole course is based on the module-specific tests and a final exam.

### Assessment practices and criteria

Passing the course and assessment are based on exams incorporated in the Moodle platform of the course. Grading scale 0 - 5.

### Activities and methods in support of learning

The available web-material consists of self-study-materials, including text, illustrations, videos, rehearsals, quizzes, etc.

### Teaching period when the course will be offered

This is a self-study e-course, available throughout the year.

### Recommended time or stage of studies for completion

Any time after completing the majority of compulsory courses in the Master's Programme in Neuroscience.

### Language of instruction

English

### EQF level:

7

**Study materials**

**EN:** All materials are in Moodle, and consist of various forms of self-study-materials, including text, illustrations, videos, rehearsals, quizzes, etc.

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 5 cr |
| Independent study | | 5 cr |

## NEU-512 Animal models in behavioural neuroscience

**NEU-512** Eläinmallit käyttäytymisneurotieteessä

**NEU-512** Djurmodeller inom beteende-neurovetenskap

Abbreviation: Eläinmallit käy

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |

| | |
|---|---|
| Credits | 5 cr |
| Languages | English |
| Grading scale | General scale, 0-5 |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible person | Vootele Voikar, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Prerequisites**

**EN:** Basic knowledge in neuroscience and laboratory animal science

**Learning outcomes**

**EN:** After the course the students should be able to

- describe the general principles and basic concepts of animal models and study design in behavioural neuroscience, adhering to good scientific practice
- understand importance of species-specific characteristics in animal models
- critically evaluate the role of genetic background, sex and environmental influences on experimental outcome
- indicate appropriate tests for behavioural assessment of animal models for neuropsychiatric and neurodegenerative disorders
- describe the animal behaviour in ethological perspective

**Content**

**EN:** General principles of animal models and study design in behavioural neuroscience; Behavioural phenotyping of animal models for neuropsychiatric and neurodegenerative disorders, learning and memory; Challenges of comprehensive phenotyping – role of environment, standardization of the procedures, genetic background; Ethological perspective

**Additional information**

**EN:** Target group

1. Students of Master's Programme in Neuroscience and Doctoral Programme Brain & Mind.
2. Other MSc students and doctoral candidates

## Timing

Period III or IV

## Assessment practices and criteria

Full attendance at lectures and group works (minimum requirements will be defined in more detail at the beginning of the course), written exam and learning diary.

## Completion methods

The course consists of lectures (~32 h), individual work (~90 h) and group work (~12 h) followed by examination

## Responsible person

Vootele Voikar, vootele.voikar@helsinki.fi

## EQF level: 7

**Study materials**

**EN:** List of recommended literature will be provided for course participants.

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 5 cr |
| Participation in teaching | | 5 cr |

## NEU-521 Basic mechanisms of nervous system diseases

**NEU-521** Hermoston sairauksien perusmekanismit

**NEU-521** Grundläggande mekanismer bakom sjukdomar i nervsystemet

Abbreviation: Hermoston saira

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 1-5 cr |
| Languages | English |
| Grading scale | General scale, 0-5 |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible persons | Emil Ylikallio, Responsible teacher<br>Henna Tyynismaa, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Prerequisites**

**EN:** A prerequisite for successful completion of the course is that the student comprehends the basic concepts in genetics, molecular biology and neurobiology.

**Learning outcomes**

**FI:**

**EN:** After completion of the course the student:

- is familiar with clinical manifestations of selected nervous system diseases
- is familiar with the current understanding on the molecular basis and the underlying pathophysiological mechanisms of selected nervous system disorders
- has gained understanding into the research paradigms of nervous system disorders
- has gained understanding into the treatment paradigms of selected nervous system disorders

**Content**

**EN:** The lectures of the course include neurodegenerative, ischemic, neuroimmunological, neuropsychiatric and neuromuscular diseases. The lectures are given by both basic researchers and clinicians, who are experts on their topic.

**Additional information**

**EN:** Target group

1. Students of Master’s Programmes in Neuroscience and Translational Medicine, and Doctoral Programme Brain & Mind.

2. Other MSc students and doctoral candidates interested in mechanisms underlying nervous system diseases

### Timing

Period III

### Assessment practices and criteria

For 5 credits: Final examination based on lectures and review articles indicated by the lecturers. Grading scale of the exam 0-5.

For 1 credit: 80% attendance in the lectures. Pass-fail

### Completion methods

Lectures, 80% attendance required (1 credit);

Lectures, 50% attendance required, independent reading of literature, passing of the final exam (5 credits).

### Equivalences with other studies

Replaces the former course 920007 Basic mechanisms of nervous system disorders 1.5-5 cr.

### Responsible person

Henna Tyynismaa, Emil Ylikallio

EQF level: 7

**Study materials**

**EN:** Lecture material and specific scientific review articles indicated by the lecturers (1-2 articles / lecture).

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 5 cr |
| Participation in teaching + exam | | 5 cr |
| Method 2 | | 1 cr |
| Participation in teaching | | 1 cr |

## NEU-531 Developmental neuroscience

**NEU-531** Hermoston kehitysbiologia

**NEU-531** Nervsystemets utvecklingsbiologi

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 5 cr |
| Languages | English |
| Grading scale | General scale, 0-5 |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible person | Ulla Pirvola, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Prerequisites**

**EN:** Recommended prerequisites: basic knowledge of neuroscience and developmental biology

**Equivalences to other studies**

920002 Developmental neuroscience

**Learning outcomes**

**EN:** After completing the study unit, student can explain the main concepts and events of development of the central and peripheral nervous system and sensory organs. Student can explain and apply current methods of developmental neuroscience research.

**Content**

**EN:** Lectures and group work of the course deal with: Neuronal induction and neurogenesis; Regulation of neuronal fate; Ionic regulation of neuronal development; Axonal outgrowth and regeneration; Synaptogenesis and synaptic plasticity; Development and refinement of neuronal circuits; Gliogenesis and myelinization; Neuronal migration; Neuronal cell death; Development of the peripheral nervous system; Development of sensory systems; Developmental brain disorders.

**Additional information**

**EN:**

## Target group

Open to students of the Master's Programme in Neuroscience and to master students of other degree programmes (biology, molecular biosciences, psychology, physics, biomedical engineering, medicine).

## Timing

Period 3 / The course is taught annually

## Completion methods

Participation in teaching (lectures, group work, final exam). The course includes compulsory face-to-face meetings and cannot be completed entirely by distance learning. Minimum of 80 % participation in lectures and group work.

## Assessment practices and criteria

The exam is based on lectures and reading material indicated by lecturers. Final grading (scale 0-5) is based on the exam (80 %) and other activity during the course (20 %).

## Responsible person

Ulla Pirvola

EQF level 7

**Study materials**

**EN:** Lecture material and other material assigned to the course in Moodle, including applicable parts of Kandel E. et al. Principles of Neuroscience and of Sanes D. et al., Development of the Nervous System.

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 5 cr |
| Participation in teaching | | 5 cr |

# **NEU-541** Introduction to neurobiophysics

**NEU-541** Johdatus neurobiofysiikkaan

**NEU-541** Introduktion till neurobiofysik

Abbreviation: Johdatus neurob

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 5 cr |
| Languages | English |
| Grading scale | General scale, 0-5 |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible person | Juha Voipio, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Prerequisites**

**EN:** Students need to have some previous knowledge of molecular and cellular neurobiology in order to be able to achieve good learning outcomes.

**Learning outcomes**

**EN:** After completing the course, students will be able to explain how electrical signals arise at the cellular level using biophysical theories and models. They know and are able to explain, in biophysical terms, structure-function relationships in ion channels, and they have acquainted themselves in detail with some ion channel structures.

**Content**

**EN:** Basic concepts and principles of ion flux-mediated signalling; the Hodgkin-Huxley model, voltage gated channels, and permeation models; physicochemical principles and molecular mechanisms of ion channel function; structure-function relationships of ion channels including mechanisms of selective permeability, gating and block; types of ion channels and their interplay at the cellular level; electrical signalling in dendrites; synaptic transmission and the origin and analysis of extracellular field potential signals.

**Additional information**

**FI:**

**EN:** Completion methods
Weekly written examinations (recommended method of completion) or alternatively a final exam.

## Assessment practices and criteria

Grading scale 0 – 5. With weekly exams, passing the course requires passing ≥80 % of the weekly exams, and grading is based on the mean of the separately graded weekly exams.

## Activities and methods in support of learning

The course consists of approximately 20 h of contact teaching and 100 h of independent studying.

## Target groups

This course is well suited for students of the Master’s Programme in Neuroscience or of related Programmes, as well as for doctoral students.

## Teaching period when the course will be offered

This course runs annually in spring term (periods 3 and 4).

### Recommended time or stage of studies for completion

First or second year in Master's Programme, or later.

EQF level: 7

**Study materials**

**EN:** The study materials include a major part of the book by Bertil Hille, Ion Channels of Excitable Membranes, 3rd edition, 2001, Sinauer, plus some more recently published review articles and lecture handouts.

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 5 cr |
| Participation in teaching | | 5 cr |

## NEU-542 Electrophysiological techniques

**NEU-542** Sähköfysiologisen mittaustekniikan kurssi
**NEU-542** Kurs i elektrofysiologisk mätteknik

Abbreviation: Sähköfysiologis

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 5 cr |
| Languages | English |
| Grading scale | General scale, 0-5 |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible person | Juha Voipio, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Tweet text**

**EN:** Learn to understand electrophysiology, and how to properly use different microelectrode techniques

**Prerequisites**

**EN:** Previous knowledge of basic neurobiology is necessary, and some knowledge of elementary physics and electricity is helpful (but not required), for achieving good learning outcomes.

**Learning outcomes**

**EN:** Upon successful completion of the course, students gain an in-depth understanding of the implementation of microelectrode recordings in current clamp and voltage clamp modes using either sharp or patch-clamp micropipettes. They are able to explain the sources of error and critical steps in the proper use of electrophysiological equipment. Students will be able to critically read scientific papers where data have been obtained using electrophysiological methods, and they will have the theoretical knowledge that is needed when using electrophysiological methods in a wetlab.

**Content**

**EN:** 1) The theory part of the course covers the theoretical basis of electrophysiology: Basic principles and concepts of electricity; electrical properties of cells, microelectrodes and amplifiers; equivalent circuit representation; accuracy and sources of error in microelectrode measurements; single and two microelectrode

current and voltage clamp techniques; other microelectrode techniques; mechanisms of noise coupling and means for noise reduction; safety in an electrophysiology laboratory.
2) The theoretical knowledge will then be repeated and deepened in hands-on exercises, first using simple circuits and basic recording devices, and then with passive and active model cells and research instruments. Students will learn how to properly use equipment in current and voltage clamp experiments when using one or two microelectrodes, and to evaluate the quality of acquired data.

**Additional information**

**EN:** Completion methods
Passing the course is based on active participation in laboratory exercises and a written exam. Grading is based on the written exam only. Attending the approximately 50 hours of contact teaching (lectures and laboratory practicals), plus up to 80 hours of independent studying (depending on prior knowledge) may be needed for achieving an excellent grade.

### Assessment practices and criteria

Grading scale 0 – 5. Grading is based on a written exam where the student is supposed to show comprehension of key concepts and principles, as well as ability to explain proper use and sources of error of the different recording techniques.

### Activities and methods in support of learning

This is a hands-on laboratory course where students work in small groups under guidance of the teacher.

### Target groups

This course is intended primarily for students of the Master's Programme in Neuroscience or other students studying the Electrophysiology and Neurobiophysics -module. The course is also suitable for doctoral students. Maximum number of students: 18.

### Teaching period when the course will be offered

This two week course runs annually in spring term (period 3 or 4).

If the number of students attending the course is 10 to 18, the second week will run in two shifts (morning and afternoon shifts) and the detailed schedule of the second week will be planned together with the students.

### Recommended time or stage of studies for completion

First year, spring term, in the Master's Programme, or later.

EQF level: 7

**Study materials**

**EN:** Lecture handouts and written instructions for laboratory exercises. Additional supporting literature will be made available during the course.

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 5 cr |
| Participation in teaching | | 5 cr |

## NEU-543 Brain slice electrophysiology

**NEU-543** Aivoleikkeiden sähköfysiologia

**NEU-543** Hjärnsnitt elektrofysiologi

Abbreviation: Aivoleikkeiden

Curriculum periods 2023-24, 2024-25, 2025-26

| | |
|---|---|
| Validity period | since 1 Aug 2023 |
| Credits | 5 cr |
| Languages | English |
| Grading scale | General scale, 0-5 |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible person | Svetlana Molchanova, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Prerequisites**

**EN:** A strong background in neuroscience is needed, including lectures in neurobiology, molecular neurobiology, book examination in neuroscience etc. For example, course “Cellular Neurobiology” gives theoretical knowledge, needed for the successful accomplishment of the current course. A letter of motivation is required when applying for the course. Motivation letter should include a brief description of theoretical knowledge in neuroscience and explanation why this course is needed for the study track of the student.

**Learning outcomes**

**EN:** The main goal is to learn widely used in vitro methods in electrophysiology (field recordings and patch clamp). During the course, students strengthen their theoretical knowledge on the basic electrical behavior of neurons and synaptic transmission and relate their theoretical knowledge to observations of the real experiments. After the course, students will be able to describe mostly used electrophysiological techniques. They will be able to make preparations of the living brain slices in vitro, perform extracellular and intracellular recordings of neuronal electrical activity, analyze the collected data and understand how it relates to scientific principles and evidences published in scientific papers. In addition, practical work in small groups will let students to practice the problem-solving and team work skills.

**Content**

**EN:** During the course, several techniques are discussed and applied in practice (field potentials, whole-cell patch-clamp, electrical stimulation of the synaptic inputs). Techniques are applied to demonstrate the main principles of neuronal electrical activity, synaptic transmission and plasticity in real laboratory experiments, using living slices of the rodent brain in vitro. Theoretical course material includes the manual and hand-outs of lectures. In addition, students are encouraged to use the scientific publications during preparation of the report.

**Additional information**

**EN:** Target group
1. Students of Master’s Programme in Neuroscience and Doctoral Programme Brain & Mind. 2. Other MSc students and doctoral candidates

Maximum number of participants for the hands-on part of the course: 9. Selection of participants will be based on the study program, previous studies and motivation letter.

Timing

Spring term (period 3-4). The contact teaching consists of 7 full days of laboratory practice (5 days according to the course schedule plus 2 days, with different dates for the groups), and one 2h-session for discussion of prepared course reports.

## Assessment practices and criteria

Assessment includes course laboratory work and written report. The report is done according to the template provided at the course. Grading scale: 0-5, based on the evaluation matrix. Participation in at least six of seven hands-on course days and a written report are needed for completion of the course.

### Completion

The total amount of work (135h) is divided into contact sessions (80h) and preparation of written reports (55h).

### Responsible person

Svetlana Molchanova

EQF level: 7

**Study materials**

**EN:** Lecture handouts and written instructions for laboratory exercises.

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 5 cr |
| Participation in teaching | | 5 cr |

## NEU-551 Sensory Biology

**NEU-551** Aistinbiologia

**NEU-551** Sinnesbiologi

Abbreviation: Aistinbiologia

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 3-5 cr |
| Languages | Finnish, English, Swedish |
| Grading scale | General scale, 0-5 |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible persons | Kristian Donner, Responsible teacher<br>Petri Ala-Laurila, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Prerequisites**

**EN:** Students need to have some previous knowledge of molecular and cellular neurobiology in order to be able to achieve good learning outcomes.

**Equivalences to other studies**

52090 Sensory Biology

**Learning outcomes**

**EN:** After completing the course, the student will have the ability to analyze, qualitatively as well as quantitatively, physical and biological boundary conditions limiting sensory information, understand the principles and mechanisms of information processing in different sensory organs and nervous systems, and analyze structural and functional adaptations of these for performance in different tasks in different environments. This includes understanding the basics of animal communication.

**Content**

**EN:** All known sensory modalities and their qualities, the major senses familiar from humans as well as "minority senses" of species other than humans, with limiting factors and evolutionary solutions as a pervading theme.

**Additional information**

**EN:** Target group
Target group

Primarily for students orienting towards Sensory Biology, but open to all students of the Master's Program of Neuroscience as well as other programs

### Timing

Taught in period III or IV

### Assessment criteria

Grading scale 0-5, based on the mean of the grades of the four "best" exams. For students that pass, the grade may be raised or lowered by 1 depending on the activity at the exercises.

Passing the course (grades 1-5) requires passing the final exam and four of the miniexams, and attendance at 12 lectures. This gives 3 credits.

To get 2 additional credits, write an essay on a selected topic.

### Completion methods

Five examinations covering the main topics of the lectures, a final exam, active participation in exercises and article presentations. The course comprises approximately 32 hours of contact teaching and 100 hours of independent studying. Passing the course requires passing at least four of the exams, the final exam, and ≥ 80 % participation in the exercises.

EQF level: 7

**Study materials**

**EN:** Lecture handouts, plus review articles and original research articles that will be presented during the course and used for exercises (including article presentations by the students).

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 3-5 cr |
| Participation in teaching | | 3-5 cr |

## NEU-552 Studies of sensory performance in animals and humans

**NEU-552** Aistien suorituskyvyn tutkiminen eläimillä ja ihmisillä

**NEU-552** Undersökning av sinnenas prestanda hos djur och människor

Abbreviation: Aistien suoritu

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 5 cr |
| Languages | Finnish, English |
| Grading scale | General scale, 0-5 |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |

| | |
|---|---|
| Responsible persons | Ulla Pirvola, Responsible teacher<br>Petri Ala-Laurila, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Prerequisites**

**EN:** Connected with the lecture course in Sensory Biology

**Learning outcomes**

**EN:** After completing the study unit, student can apply and take into action the basic electrophysiological and psychophysical approaches to analyze sensory information flow from sensory cells to animal behaviour. Student has the theoretical knowledge for analysing data quantitatively and for critically reading scientific papers published in the field.

**Content**

**EN:** Hands-on laboratory work and demonstrations including electrophysiology, microspectrophotometry, microscopical quantitative image analysis, human psychophysics and behavioural animal tests. Planning and analysis of experiments and seminar work based on research articles. The main emphasis is on vision, hearing and olfaction.

**Additional information**

**EN:**

## Target group

For students choosing Sensory Biology as their main orientation. The number of participants is limited.

## Timing

Periods 3 and 4

## Assessment practices and criteria

Grading (scale 0-5) is based on the activity during practical work and on written reports and assignments for each course unit, and on the oral presentation in the closing symposium.

## Completion methods

The course consists of several (5 to 6) units, each with lectures, planning of experiments, hands-on experiments, data analysis and writing reports. Student is given a grade for each course unit. The course has a closing symposium for which student prepares an oral presentation. The course includes compulsory face-to-face meetings and cannot be completed entirely by distance learning.

## Responsible person

Ulla Pirvola

EQF level 7

**Study materials**

**EN:** Lecture material and other material assigned to the course in Moodle

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 5 cr |
| Participation in teaching | | 5 cr |

# NEU-601 Book examination in neuroscience

**NEU-601** Neurotieteen kirjatentti

**NEU-601** Boktentamen i neurovetenskap

Abbreviation: Neurotieteen ki

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 2-10 cr |
| Languages | English, Finnish, Swedish |
| Grading scale | General scale, 0-5 |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible person | Juha Voipio, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Equivalences to other studies**

520003 Book Exam in Neurobiology

**Learning outcomes**

**EN:** The aim of book exams is to deepen the student's theoretical knowledge within his/her field of studies.

**Content**

**EN:** Specified by the literature studied.

**Additional information**

**EN:**

## Completion methods

Exam on literature as agreed with the responsible teacher. The course code can be used multiple times.

## Assessment practices and criteria

Grading scale 0 - 5.

## Activities and methods in support of learning

Independent studying.

## Target groups

Primarily degree students of the Master's Programme in Neuroscience.

## Teaching period when the course will be offered

Throughout the year on the general examination days of the faculty or in Examinarium, or as agreed with the responsible teacher.

## Recommended time or stage of studies for completion

After your first year in the programme.

EQF level: 7

### Study materials

**EN:** The examination is based on literature that is chosen together with the responsible teacher and specified in your personal study plan. Books may be supplemented with review articles. Please consult the responsible and/or exam assessing teacher about examination arrangements at least two weeks before the exam.

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 2-10 cr |
| Exam (2-10 cr) | | 2-10 cr |
| Method 2 | | 2 cr |
| Exam (min) | | 2 cr |
| Method 3 | | 10 cr |
| Exam (max) | | 10 cr |

## NEU-602 Book examination in cell and systems physiology

**NEU-602** Solu- ja systeemifysiologian kirjatentti

**NEU-602** Boktentamen i cell- och systemfysiologi

Abbreviation: Solu- ja systee

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 2-10 cr |
| Languages | English, Finnish, Swedish |
| Grading scale | General scale, 0-5 |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible person | Reijo Käkelä, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

### Tweet text

**EN:** Examination on cell and systems physiology literature to deepen student's theoretical knowledge in her/his specific field.

### Prerequisites

**EN:** BSc in life sciences, and the examination included in the personal study plan of the student.

### Equivalences to other studies

520002 Book Exam in Physiology and Neuroscience

### Learning outcomes

**EN:** The aim of book exams is to deepen the student's theoretical knowledge within his/her field of studies.

### Content

**EN:** Advanced literature on any field of cell and systems physiology that is in line with student's personal study plan.

**Additional information**

**EN:**

### Completion methods

Exam in Examinarium. Other arrangements when required.

### Assessment practices and criteria

Grading 0-5.

### Target groups

Primarily for the students of the Master's Programme in Neuroscience.

### Teaching period when the course will be offered

Periods 1–4, according to agreement. This course can be taken multiple times for the specified credits.

### EQF level

7

**Study materials**

**EN:** The examination is based on exam books as agreed in the personal study plan. Books may be supplemented with review articles. Please consult the responsible and exam assessing teachers about the books at least two weeks before the exam.

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 2-10 cr |
| Exam (2-10 cr) | | 2-10 cr |
| Method 2 | | 2 cr |
| Exam (min) | | 2 cr |
| Method 3 | | 10 cr |
| Exam (max) | | 10 cr |

## **NEU-604** Functional lipidomics seminar

**NEU-604** Lipidit elintoiminnoissa-seminaari

**NEU-604** Seminarium i funktionell lipidomik

Abbreviation: Lipidit elintoi

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 5-10 cr |
| Languages | Finnish, English |
| Grading scale | General scale, 0-5 |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible persons | Hanna Ruhanen, Responsible teacher<br>Minna Holopainen, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Prerequisites**

**EN:** BSc degree in any life science field.

**Learning outcomes**

**EN:**Students become aware of the importance of lipids in animal and human physiology and get familiar with the use of lipids and their structural parts as biomarkers in ecology, physiology and biomedicine. Students are able to connect lipid metabolism with the metabolic pathways of other organic molecules.Students recognize the applicable methods among the modern techniques of lipid analyses which they could utilize in their projects and get to know experts able to support their work and career development.

**Content**

**EN:** Seminars cover lipids and fatty acids as energy storage, structural components and signaling molecules of living organisms. Lipid metabolism is integrated with general cell and systems level metabolism**.** The role of lipids in the pathogenesis of human and animal diseases and in the mechanisms of biochemical adaptation to environmental or physiological stimuli is addressed. Seminars introduce students to the use of cellular and tissue profiles of different fat-soluble substances as markers, which indicate the health of individuals, populations an ecosystems, or give dietary information. Methodological knowledge is gained in various chromatographic and mass spectrometric methods and bioinformatics. The seminar promotes networking of students, post docs and senior experts from different disciplines.

**Additional information**

**EN:** Target group: Postgraduate and master's level students of any life science field.
Timing: Periods 1–4, according to a schedule fixed separately for each term / The course is organized annually.

Assessment: Grading 0–5 is based on learning diaries, and optional seminar presentation of the student.

Completion: Participation in the Functional lipidomics seminars supplemented with suitable Metabolism seminars or other related seminars. To pass, students need to attend 12 seminars (achievable in 1-2 years) and submit learning diaries for each seminar session attended. Student presentation in the Functional Lipidomics seminar equals participation of three seminar events.

EQF level: 7

**Study materials**

**EN:** Seminars delivered by the speakers.

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 5-10 cr |
| Participation in teaching | | 5-10 cr |

## NEU-606 Neuroscience seminar series

**NEU-606** Neurotieteen seminaarisarja

**NEU-606** Seminarium i neurovetenskap

Abbreviation: Neurotieteen se

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 2 cr |
| Languages | English |
| Grading scale | General scale, 0-5 |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible person | Katri Wegelius, Responsible teacher |
| Study level | Advanced studies |

| | |
|---|---|
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Learning outcomes**

**EN:** The objective is to familiarize students with the state-of-the-art international research related to neuroscience and/or physiology. The students will develop their abilities for scientific reasoning and for understanding the concepts of neuroscience research.

**Content**

**EN:** Seminar presentations by key lecturers in neuroscience or physiology.

**Additional information**

**EN:** Target group
Students of Master's Programme in Neuroscience and Doctoral Programme Brain & Mind. Available also to other master's and doctoral students.

Assessment practices and criteria

The seminar participation form is returned together with short summaries of seminar presentations to the responsible teacher. Grading scale approved/failed.

Completion methods

Participation in seminar series (e.g. Neuroscience seminar, HiLIFE seminar, Aalto Brain Center seminar):

20 seminar presentations by international experts (~ 20 h) and independent studying (~ 30h). The form is available at the course page. For each seminar presentation, a short summary (about 1000 characters) is written by the student.

2 seminar presentations can be replaced by participation in 2 doctoral dissertation defenses (with a short written summary).

Responsible person

Katri Wegelius, katri.wegelius@helsinki.fi

EQF level: 7

**Study materials**

**EN:** Optional/recommended reading: selected publications of the seminar speakers.

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 2 cr |
| Participation in teaching | | 2 cr |

## NEU-771 Other elective studies

**NEU-771** Muut tieteenalan opinnot
**NEU-771** Valfria studier i neurobiologi

Abbreviation: Muut tieteenala

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |
| Credits | 1-10 cr |
| Languages | English, Finnish, Swedish |
| Grading scale | Pass-Fail |
| University | University of Helsinki |

| | |
|---|---|
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible person | Juha Voipio, Responsible teacher |
| Study level | Other studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Learning outcomes**

**EN:** To be defined separately for each course arranged with this course code.

**Content**

**EN:** This course code is used for optional course(s) that support the Master's studies in neuroscience and are organized by the University of Helsinki or Aalto University sporadically/once. The course content varies and is announced in each case separately. For more information, contact the education planning officer of the programme: katri.wegelius(at)helsinki.fi

**Additional information**

**EN:** Completion methods
Participation and tasks accomplished according to the course description (completion methods will be defined separately for each course arranged with this course code).

### Assessment practices and criteria

Pass-fail, according to the assessment practices and criteria of the course.

### Activities and methods in support of learning

To be defined separately for each course arranged with this course code.

### Target groups

Students of the Master's Programme in Neuroscience.

### Teaching period when the course will be offered

Not defined; will be announced separately in each case.

### Recommended time or stage of studies for completion

Not defined.

EQF level: 7

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 1-10 cr |
| Participation in teaching | | 1-10 cr |
| Method 2 | | 1-10 cr |
| Independent study | | 1-10 cr |

## NEU-991 Other elective studies

**NEU-991** Muut tieteenalan opinnot

**NEU-991** Andra valfria studier

Abbreviation: Muut tieteenala

| | |
|---|---|
| Curriculum periods | 2023-24, 2024-25, 2025-26 |
| Validity period | since 1 Aug 2023 |

| | |
|---|---|
| Credits | 1-10 cr |
| Languages | Finnish, English, Swedish |
| Grading scale | General scale, 0-5 |
| University | University of Helsinki |
| Responsible organisation | Master's Programme in Neuroscience 100% |
| Responsible person | Juha Voipio, Responsible teacher |
| Study level | Advanced studies |
| Study field | Fields of education (Ministry of Education and Culture), Natural sciences |

**Learning outcomes**

**EN:** To be defined separately for each course arranged with this course code.

**Content**

**EN:** This course code is used for optional course(s) that support the Master's studies in neuroscience and are organized by the University of Helsinki or Aalto University sporadically/once. The course content varies and is announced in each case separately. For more information, contact the education planning officer of the programme: katri.wegelius(at)helsinki.fi

**Additional information**

**EN:**

## Completion methods

Participation and tasks accomplished according to the course description (completion methods will be defined separately for each course arranged with this course code).

## Assessment practices and criteria

General scale 0 - 5, according to the assessment practices and criteria of the course.

## Activities and methods in support of learning

To be defined separately for each course arranged with this course code.

## Target groups

Students of the Master's Programme in Neuroscience.

## Teaching period when the course will be offered

Not defined; will be announced separately in each case.

## Recommended time or stage of studies for completion

Not defined.

EQF level: 7

| Completion method and assessment items | Recurrence | Credits |
|---|---|---|
| Method 1 | | 1-10 cr |
| Participation in teaching | | 1-10 cr |
| Method 2 | | 1-10 cr |
| Independent study | | 1-10 cr |