

MSc-Programme in Biology

(Including educational cooperation with Nordic Academy of Biodiversity and Systematic Studies (Nabis))

Grade name: 'Master of Science in Biology'

Programme code: MSBIO

Course descriptions:

MSc in biology has four **specializations**:

- Cell and Molecular Biology
- Physiology
- Ecology, Behaviour, Evolution and Biosystematics
- Biodiversity and Systematics (Nabis)

The specializations are different in terms of compulsory subjects for admission.

The master-degree study has two main components

- Master- thesis (60 credits)
- Theoretical and methodological courses, required and elective courses (60 credits)

A general condition of a 'MSc in Biology' is two years of full-time study where the normal workload for a full-time student for one academic year is 60 credits. Teaching is given in English for all four study areas.

Learning outcomes 'MSc in Biology':

General outcome for all students:

The master-program in Biology provides candidates with research-based, specialized knowledge. Practical projects provides skills and general competence at an advanced level, with the aim of working in research, manufacturing, consulting, education and public administration or for further education in a doctoral program. The Msc-thesis provides expertise in one of the research areas: Cell and molecular biology, physiology, ecology, behavior, evolution and biosystematics

Master candidate shall have acquired upon complete education:

Knowledge

- Have expertise and research experience in selected topics in biology, some of these supporting the master project.
- Have a thorough knowledge to the various labor and analytical methods used in the field.
- Have a thorough knowledge to the extent of research being conducted in biology today.
- Have a thorough knowledge and experience of current work- and analyze-methods.

Skills

- An experience of written and oral presentations of own research results to specialists and to a broader audience.
- Be able to combine knowledge from multiple disciplines.
- Be able to work with deadlines in relation to a larger project.
- Be able to update themselves on the scientific knowledge of their specialization.

General competence

- Be able to critically evaluate scientific work including methods and results.
- Be able to independently carry out a scientific project from initial hypotheses, collecting and analyzing data to an oral and written report in scientific format.

- Be able to obtain and evaluate research information.
- Be able to work in projects, both independently and in collaboration with others, including interdisciplinary teams.
- Be able to analyze key issues within their specialization.
- Be able to communicate extensive scientific work.
- Be able to contribute to innovation within their specialization.
- Have knowledge and experience in risk analysis and management of chemical and biological materials and understand the environmental consequences of these, with a focus on health, safety and environment (HSE).
- Be able to communicate written and orally and in English about academic matters.

Learning outcome for individual study specializations:

Specialization: Cell and Molecular Biology

The specialization will provide deep molecular understanding of cell biological mechanisms and their regulation. After completing the program, the candidate should have good knowledge of the main methods in cell and molecular biology and the use of modern experimental techniques and apparatus. A scientific investigation is conducted with subsequent written presentation within a particular topic. The candidate shall here display technical expertise and ability to critically evaluate scientific work.

Master candidate shall upon complete education:

Knowledge

- Have advanced research based knowledge of important biological cell-communication principles and processes and how they are regulated.
- Have advanced knowledge of the cell and molecular biology area.
- Have applied knowledge in cell and molecular biology.

Skills

- Be able to use and master important techniques to perform independent laboratory work and conduct an independent scientific investigation.
- Can use cell and molecular biological methods in a research paper and give a written presentation of research results.
- Ability to apply existing theories in cell and molecular biology.

Specialization: Physiology

The specialization provides insight into how animals and plants function in their natural environment. Candidates will acquire thorough understanding of the relationship between specific factors in the external environment and physiological characteristics. A scientific survey is conducted with subsequent written presentation within a particular topic. Here, the candidates should show professional expertise and ability to critically evaluate scientific work.

Master candidate shall upon complete education:

Knowledge

- Have up-to-date scientific knowledge of how animals and plants function in their natural environment and have acquired a thorough understanding of the relationship between specific factors in the external environment and physiological characteristics.
- Have a thorough knowledge of the field of physiology.
- Be able to analyze and solve physiological problems.

Skills

- Be able to master important methods (in field and/or laboratory) and to conduct an independent scientific investigation and subsequent written presentation within a particular topic.

- Be able to analyze theories of physiology.

Specialization: Ecology, Behaviour, Evolution and Biosystematics

The specialization provides a thorough introduction to one of the fields: ecology, behaviour, evolution and biosystematics. Considering the special field, courses will provide a thorough introduction to living organisms' relation to the environment and other living organisms, both within and between species. Specialization gives understanding of micro-and macro-evolutionary processes, and methods used to study them, including methods based on morphological and molecular characters.

Master candidate shall upon complete education

Knowledge

- Have new knowledge on theoretical and / or experimental aspects of the specialty and broad knowledge in nearby fields.
- Have a thorough knowledge of how biology can yield understanding and solutions to environmental problems.
- Have deep knowledge about biodiversity.
- Be able to understand the evolutionary history and ecological processes.

Specialization: Biodiversity and Systematics

The specialization provides a thorough introduction to biodiversity and systematics including identification skills in one or more groups of organisms. The program will provide an overview of living organisms and kinship / classification between them, species formation and evolutionary history and processes underlying diversity patterns, as well as knowledge about the rules for naming of species. A scientific investigation is conducted in a particular subject with subsequent written presentation. Here, the candidates should show professional expertise and ability to critically evaluate scientific work.

Master candidate shall upon complete education:

Knowledge

- Have advanced knowledge and understanding of theories related to the fields of biodiversity and systematics and specialized knowledge in a defined area.
- Extensive knowledge of current research and practice in methodology of biodiversity and systematics.

Skills

- Be able to describe the evolutionary mechanisms that lead to speciation.
- Be able to explain species concept and be able to produce and critically analyze molecular data.
- Be able to assess their own work critically and thereby contribute to knowledge in the field.

General competence

- Understand the importance of biodiversity in a global perspective and understanding of ethical and economic aspects related to the conservation of biological diversity.
- Show awareness of ethical issues in relation to research and management practices within the specialization.

Curriculum for the specializations (see table below):

- **Cell and Molecular Biology**
- **Physiology**
- **Ecology, Behaviour, Evolution and Biosystematics**

Semester	7,5 ECTS	7,5 ECTS	7,5 ECTS	7,5 ECTS
4. Spring	BI3091 Special Syllabus			
3. Autumn	Optional course	Optional course		
2. Spring	Experts in Teamwork	Optional course		
1. Autumn	Optional course	Optional course	Optional course	

• **Cell and Molecular Biology:**

The compulsory courses for the specializations are:

Experts in teamwork, spring

BI3016 Molecular and Cell Biology, autumn

BI 3091 Special Syllabus BI3091 Special syllabus exam (and similar special curriculum courses) can be held together with the final master exam or at an earlier stage in the master programme.

In addition we recommend the following courses

Autumn:

BI 3013 Experimental Cell- and Molecular Biology	7,5 ECTS
BI3019 System biology; Resources, Standards, Tools	7,5 ECTS
TBT4135 Biopolymers	7,5 ECTS
BI3071 Advanced Ecotoxicology	7,5 ECTS
BI3072 Environmental toxicology	7,5 ECTS
BI3075 Experimental toxicology	7,5 ECTS
BI2021 Plant Ecophysiology	7,5 ECTS

Spring:

BI3018 Patentation and Commercialization of Biotech and Medtech Invention,	7,5 ECTS
TBT4125 Food Chemistry	7,5 ECTS
TBT4130 Environmental Biotechnology	7,5 ECTS
TBT4165 Systems Biology and Biological Networks	7,5 ECTS
BI3073 Genetic toxicology	7,5 ECTS

Courses from The Medical Faculty can also be chosen, but are not planned according to fit in the programme (timetable and examination date).

• **Physiology:**

The compulsory courses for the specializations are:

Experts in teamwork,

BI3021 Ecophysiology or BI3020 Advanced physiology

BI 3091 Special Syllabus BI3091 Special syllabus exam (and similar special curriculum courses) can be held together with the final master exam or at an earlier stage in the master programme.

In addition we recommend the following courses

BI2022 Plant growth and Development	7,5 ECTS
BI2021 Plant Eco Physiology	7,5 ECTS
BI2014 Molecular Biology	7,5 ECTS
BI2012 Cell Biology	7,5 ECTS
BI2015 Molecular Biology, lab.course	7,5 ECTS
BI3016 Molecular Cell Biology	7,5 ECTS
BI3019 Systems Biology: Resources, standards and tools,	7,5 ECTS

BI3020 Advanced Physiology	7,5 ECTS
BI3071 Advanced Ecotoxicology	7,5 ECTS
BI3072 Environmental Toxicology	7,5 ECTS
BI3073 Genetic Toxicology	7,5 ECTS

Courses from The Medical Faculty can also be chosen, but are not planned according to fit in the programme (timetable and examination date).

• **Ecology, Behaviour, Evolution and Biosystematics;**

The compulsory courses for the specializations are:

Experts in teamwork,

BI3081 Scientific Seminars,

BI 3091 Special Syllabus; BI3091 Special syllabus exam (and similar special curriculum courses) can be held together with the final master exam or at an earlier stage in the master programme.

At least two of the courses (*In addition we recommend the courses*):

BI3010 Population Genetics,

BI3036 Plant Ecology,

BI3037 Freshwater Ecology,

BI3040 Behavioural Ecology,

BI3051 Evolutionary Analysis,

BI3082 Biodiversity and Conservation Biology II,

BI3083 Evolutionary and Ecological Genetics,

BI3084 Conservation Biology,

Curriculum for the specialization (see table below):

• **Biodiversity and Systematics (Nabis)**

	5 ECTS	5 ECTS	5 ECTS	5 ECTS	5 ECTS	5 ECTS
4. Spring	Master thesis					
3. Autumn	Master thesis					
2. Spring	Optional courses					
1. Autumn	Alpha taxonomical principles (UiO, compulsory)	Fundamental and molecular systematics (Uppsala U, compulsory)		Optional courses		

Nabis is a Nordic education cooperation where students take all their courses in master Nabis program and students are therefore exempted from the 'Experts in team'. Participation in Nabis will involve exchange and obligations at the various institutions. Participation in Nabis will give students at this program access to a course portfolio in biosystematics with advanced courses in floristics and faunistics, topics in taxonomic classification for different groups of organisms, theoretical systematics, evolutionary biology and phylogeography, bioinformatics and molecular biology. Nabis program currently offers 24 courses that are categorized as follows:

- biodiversity identification (9 courses each 5 ECTS)
- biodiversity classification (6 courses each 10 ECTS)
- systematic theory (3 courses each 10 ECTS)
- tools and skills (6 courses each 5 ECTS)

Students are required to take at least one course in each of the categories above. For course overview, see <http://www.nabismaster.org/courses.php>. The courses are given at NTNU, University of Oslo, University of Tromsø, Gothenburg University, Stockholm University, Lund University, Uppsala University, Aarhus University and University of Copenhagen. Theory courses are mainly e-learning organized, but may include meetings with practical elements or intensive laboratory part which require attendance at the course location. An example is the compulsory course 'Fundamental and Molecular Systematics' which starts with two weeks of intensive laboratory component at a biological station in the beginning of the first semester. Attendance at the course location also applies to field-courses.

Admission requirements:

The same entry requirements apply as for other graduate degrees: the Bachelor of Science in Biology (180 ECTS) or equivalent. The various specializations will have slightly different requirements for subjects completed in biology bachelor's degree.

Career prospects

Graduates in Biology are employed in research, private industry, government and education in Norway and internationally. NTNU is together with University of Oslo and Bergen educating most of the master students in biology in Norway. A survey recently conducted by the Department of Biology, NTNU shows that 40% of master's graduates from this biology Department get jobs before the end of the study. Three months after finished the master's exam, over 65% have gained relevant work. The market for graduates is likely to increase because of environmental challenges.

A) Information about the Master's Study

Workload and Structure

The programme requires two years of full-time study, beginning with the autumn term (medio August). The normal work load for a full-time student for one academic year is 60 ECTS credits.

The Master's study consists of two parts:

3. A written thesis of the project (Master's thesis). The extent of the assignment should correspond to a work load of 60 credits. The work on the thesis is time limited. The thesis has to be handed in within May 15th of the 2nd year.
4. An approved selection of courses, of a minimum of total of 60 credits, from what (at least) 30 credits must be courses at 3000-level (master level) (UTF§14.1).

Master's agreement

Every master student has to make a Master's agreement. This agreement comprises your syllabus and master project together with regulations for the counseling given during the master's study. The subjects, compulsory or elective, stated as syllabus in your Masters Agreement cannot be changed. If there for serious reason develops a need for change, the Masters Agreement must be revised. The supervisor, the responsible institute and the student must agree upon the revision and the new Agreement filed.

The Master's thesis

The Master thesis should be developed as your own original work (with some support from your adviser). Any quotation, use of data, information etc. from other sources (including the scientifically literature and your fellow students) should therefore be carefully listed and

included in the reference list of your thesis, according to best practice within your field of study.

Submission and Examination

The student has to:

- Register for the final master's degree exam (through STUDWEB) within February the 15th of the 2nd academic year
- Apply for approval of your [individual special syllabus](#) if your Masters Agreement demands a special syllabus. It is important that this is done well in advance of the examination. A study committee will evaluate the syllabus, and if it is not accepted, you must change it. Your supervisor must approve and sign the form. The syllabus should be a minimum of 50 pages per credit.
- Hand in the thesis (within the deadline given, see below) for print through [DAIM](#). The Department will give you 5 copies of the thesis.

In addition to the judgment of thesis, the candidate will have an oral exam consisting of:

- A conversation on/presentation ("defense") of the research assignment (the master's thesis)

Examination on the theoretic syllabus of the advanced subjects which has previously not been evaluated during the study (at least 7,5 credits, preferentially individual special syllabus). All exams, except the Individual Special Syllabus (if any) have to be passed before the date of the final Master's Degree exam, unless otherwise stated in your Masters Agreement.

A grade is given for every course / special syllabus that constitutes a part of the exam.

Important deadlines

- **15th of October (1st year):** Decide on a Master's project in cooperation with A supervisor.
- **1st of November (1st year)** Register your Master's Agreement in DAIM and hand in the project description.
- **15th of February (2nd year):** Deadline for the signing up of the final Master's Degree exam (through STUDWEB)
- **15th of May (2nd year).** Deadline for the submission of the master thesis. If the thesis is not submitted within this date the grade "not passed" will be awarded, unless there is an application for extension of the deadline in reasonable time before the deadline. The reasons given in the application must be in accordance with Supplementary Regulations for the Natural Sciences (UTF) § 20.3 and the Examination Regulations at NTNU, § 20. The Supplementary Regulations for the Natural Sciences (UTF) § 7 and the Examination Regulations at NTNU, § 7. See below for further information regarding §7 and §23.3.
- **15th of June (approximately, 2nd year):** The date for the final Master's Degree exam. (Individual agreement with the respective Department, approximately four weeks after the thesis is submitted).

Leave of absence from the Master Study (UTF § 7) (extract):

- c) Leave of absence from the master studies of two years of duration and from the two last year of master studies of five years of duration is normally not granted.
- d) Leaves of absence may nevertheless be granted when applied for and compelling circumstances are present. Such circumstances might be illness (yourself or among close family member) etc.

Prolongation of the study (UTF § 20.3) (extract):

The master's thesis is time limited. In case of illness, the deadline for handing in the thesis

can be postponed equivalent to the time of absence due to illness. The illness must be documented by medical certificate.

If there is a valid reason for not handing in the thesis in time, one can apply for up to three months prolongation of the deadline. If the thesis is not handed in within the extended deadline, a new extension must be applied for, or else the candidate is regarded failed. Delay of deadline can only be applied for twice.

Valid reasons for postponement (in addition to illness) is teaching, organized student activity, social work and unmerited problems concerning the thesis. Written documentation or statement is required, in addition to a new plan of completion. The Faculty, or Department when given the assignment by the Faculty, determines the application. When the reason for delay is teaching, organized student activity or social work, the extended time given is according to the time spent on these activities.

The agreed delay has no influence on the evaluation of the thesis.

B) Programme Specific Regulations

Department of Biology:

“BI3091 Special syllabus exam (and similar special curriculum courses) can be held together with the final master exam or at an earlier stage in the master programme.”