

## Biology

/Biologi/

The governing rules common for all PhD Studies at Linköping University's Institute of Technology can be found in the faculty's *Study Handbook for PhD Studies*. Some overall rules can also be found in Linköping University's local rules and regulations as well as in the Higher Education Act and the Higher Education Ordinance.

The research area Biology includes four specialisations:

- **Biology with specialisation in Ecology/** Biologi med inriktning mot Ekologi/ SCB codes: 10611/
- **Biology with specialisation in Ethology/** Biologi med inriktning mot Etologi/ SCB codes: 10613/
- **Biology with specialisation in Genetics/** Biologi med inriktning mot Genetik/ SCB codes: 10609, 40402, 10615/
- **Biology with specialisation in Zoology/** Biologi med inriktning mot Zoologi/ SCB codes: 10608/

### General description of the research area

Biology includes science about cells and organisms in their environments. Ecology includes studies of wetland organisms, ecology and function, conservation biology, and biological environmental monitoring. Research within Ecology is focused on applied ecology. In Ethology, animal behaviour is studied and research focuses on application of ethology in various settings where animals are found (e.g. animal welfare in farms and zoos, ethology and conservation biology). In Genetics, the function of genes, regulation and evolution is studied, from molecular level to individual and population processes. Research in genetics includes domestication processes, genetic systems, life-history phenotypes, and evolutionary and population genetic questions. In Zoology, animals are studied with focus on the animal itself (e.g. anatomy, physiology), together with its interactions with the environment and members of other species. Research within Zoology focuses on basic research of e.g. cardio-respiratory physiology of birds, physiology of senses, applied studies of animal welfare and conservation biology in zoos.

### Eligibility requirements and selection

The basic eligibility requirements as well as the general principles for selection are specified in the faculty's *Study Handbook for PhD Studies*. Details regarding how the selection is made are specified in the respective post announcements.

### Specific eligibility requirements

Admission to PhD Studies in the research area of Biology requires completion of courses of at least 60 ECTS at the master level in a relevant research area. These 60 ECTS should include an independent project (degree project) of at least 30 ECTS in a field relevant to the subject of PhD studies.

### Degree

PhD studies in Biology leads to a Degree of Doctor or a Degree of Licentiate. The latter degree can also serve as a stage in the PhD studies. The Degree of Licentiate comprises 120 ECTS, of which

courses correspond to 30 ECTS and the licentiate thesis corresponds to 90 ECTS. The Degree of Doctor comprises 240 ECTS, of which courses correspond to 60 ECTS and the doctoral thesis corresponds to 180 ECTS.

### Goals and implementation of the PhD studies

The general goals and objectives of PhD studies are specified in the introduction to the faculty's *Study Handbook for PhD Studies*, as well as in the Higher Education Ordinance (reprinted in the *Study Handbook's* appendix A).

PhD studies in Biology aims to provide both broad and in-depth knowledge in the research area, especially with regard to environmental monitoring, conservation biology, animal welfare, evolutionary genetics, selection and domestication. The PhD studies are tied to ongoing research programmes within the research area and will give theoretical and practical knowledge of traditional methodology as well as modern molecular methods. Besides theoretical and practical knowledge, the PhD studies will endow the student with skills in the working methods of biology as well as insight into biology's unique position and relationship to other research areas.

The PhD studies consist of courses, literature studies and seminars on the one hand, and training in order to acquire adequate competencies in the planning and carrying out of research work on the other hand. Reporting on research results is also an important part of the education.

PhD studies in Biology will equip the PhD student with the knowledge and skills to fulfill all the degree outcomes. Exactly how the different degree outcomes are treated and tested is indicated more specifically in each PhD student's individual study plan. General examples are given below regarding how the degree outcomes could be treated and tested.

- The PhD studies will endow the PhD student with a broad knowledge and understanding of his/her area of research, for example through work with the various research projects, study of basic and wide-ranging courses (see examples below in the section on Courses), and participation in some of the multidisciplinary graduate schools' work, etc.
- The PhD student will acquire a deep knowledge and understanding of his/her research area, and in particular within his/her research specialisation, through, among other things, work with research projects, participation in the research group's seminars, and active participation in in-depth courses relevant to the research projects.
- The PhD student will develop familiarity with scientific methodology through his/her own research and by completing a mandatory course in research methodology.

PhD students will demonstrate their intellectual autonomy by, among other things, writing a thesis. PhD studies are structured in a way so that two years of full-time studies are required for a Degree of Licentiate, and four years of full-time studies are required for a Degree of Doctor. This assumes that the student not only meets the prerequisite knowledge but also studies full-time. If teaching or departmental duties are included in the PhD position, the period of study required to receive a Degree of Doctor can be extended up to one year, and the period of study required to receive a Degree of Licentiate can be extended up to half a year. PhD studies consist of courses, thesis work and literature studies in connection to the thesis.

Below are some examples of how PhD students in the research area of Biology acquire skills and competencies:

- By independently planning and carrying out experimental research.
- By participating in IFM (Department of Physics, Chemistry and Biology) Biology's seminars. This includes reporting the attained results, presenting plans for continued work and holding critical discussions of the research work at least once a year.
- By actively participating in the relevant research group's regular meetings.
- By participating in relevant national and international conferences and presenting at such fora research results, orally and/or as poster, as well as participating in discussions about the research.
- By collaborating with other national and international research groups.
- By participating in and passing so-called non-core subject courses such as presentation techniques, leadership, management, patent and intellectual property law, pedagogy (mandatory for PhD students who teach).

The PhD student in Biology will develop judgement and approach through, for example:

- Attending a mandatory course in research ethics.
- Participating in seminars and national and international conferences within his/her area of research.
- Holding an annual PhD student seminar to present his/her own research results
- Participating in some of the multidisciplinary graduate schools' work.
- Working together with his/her research group and with collaboration partners.

## Thesis

The overall rules regarding the format, submission and grading of a thesis can be found in the faculty's *Study Handbook for PhD Studies*.

### a) Doctoral thesis

The extent of the scientific research should correspond to approximately three years of full-time research work. The research results are submitted in a doctoral thesis, which can be presented either as a continuous piece of work or as a compilation of scientific essays. The thesis should be of such level of quality that it, in its entirety, can be judged to meet reasonable requirements to be accepted for publication in scientific journals of good quality. The thesis' submission and disputation will follow procedures according to general regulations. In a compilation thesis, the greater part of the included works should be accepted for publication or published.

### b) Licentiate thesis

The extent of the thesis work should correspond to 1,5 years of full-time work. The thesis can consist of one scientific essay or an investigative report conducted on scientific grounds.

Both types of theses can be done as part of teamwork, but the student's contribution should consist of independent work and be specifically accounted for in the thesis' introduction.

### Individual study plan

An individual study plan will be formulated for each PhD student. The detailed planning of courses and other components will be conducted in consultation with the supervisor and documented in the individual study plan (see *Study Handbook for PhD Studies*, section 5.3). The study plan should be established within one month after admission to PhD studies, and it should be revised at least once a year.

### Supervision

General rules governing supervision of PhD studies can be found in Chapter 4 of the *Study Handbook for PhD Studies* and in the *Policy for the Supervision of PhD Studies*.

At the beginning of PhD studies, a main supervisor will be appointed for each PhD student. Moreover, one or more co-supervisors will be appointed. The supervisors' roll is to guide the student during the period of study regarding, among other things, course selection and selection of research projects. The student and the supervisors should meet regularly to discuss and consult on the progress of the research work.

### Courses

For all the course requirements, please see the section on Degree. At least 38 ECTS in the research area's core subjects (including any accredited components) are required for a Degree of Doctor. At least 15 ECTS in the research area's core subjects (including any accredited components) are required for a Degree of Licentiate.

#### *Faculty course requirements*

##### *Scientific theory, methodology and ethics*

All PhD students admitted as of 1 January 2010 should complete mandatory courses as decided by the faculty in methodology/ethics, or be deemed to have equivalent competencies, in order to receive a degree.

##### *Pedagogic studies*

All PhD students who teach should complete a basic course in pedagogy. At least 3 ECTS from this course should be included in the PhD studies, and any remaining credits should be counted as departmental duties (see *Study Handbook for PhD Studies*, section 5.5).

##### *Courses within the core of the research area*

All PhD students should attend the seminar series in order to acquire an overview of the research field of biology and to actively participate in the seminar series for PhD students. Active participation consists of presenting one's own seminar each academic year as well as actively engaging in other seminars. Completion of the seminar series gives 10 ECTS (5 ECTS for Degree of Licentiate). Furthermore, PhD students specialising in Ethology and Zoology must complete a course in animal handling, preferably during the first year.

The choice of PhD courses is tailored to the student's background and specialisation in the research area.

- Examples of the research area's core courses within the specialisation Ecology: Biostatistics and specialized courses within ecology and conservation biology.
- Examples of the research area's core courses within the specialisation Ethology: neurobiology and specialized courses in ethology.
- Examples of the research area's core courses within the specialisation Genetics: quantitative genetics, molecular genetics, and population genetics.
- Examples of the research area's core courses within the specialisation Zoology: physiology, neurobiology, molecular genetics, and systems biology.

Specialised methodology courses are also relevant (e.g. real time-PCR, pyrosequencing, microarray analyses, bioinformatics, and methods for Next-Generation-Sequencing).

#### *Courses within non-core field*

In addition, courses that intend to complement undergraduate studies may be included. These can be courses with a broad orientation outside of the chosen field of specialisation. For example, courses in physics or chemistry can be of special interest for the chosen research specialisation. Even courses taken at other departments or universities, such as summer schools and self-study within special fields may be included. Likewise, special activities such as symposia, seminars, contract research, etc. may be reported and included as components of the PhD studies.

#### *Accreditation*

Master courses that are equivalent to at most 15 ECTS, that do not form part of the basic or specific eligibility requirements for the specialisation, and that are relevant to the PhD studies may be counted toward the degree. The PhD student should submit an application for accreditation using the appropriate form; the application is to be approved or rejected by the main supervisor, and a positive decision on accreditation can be made by the Director of PhD Studies at the relevant department. A decision to reject an application for accreditation may not be made by the Director of PhD Studies at the department, rather, such a decision can only be made by the faculty's Board of PhD Studies.

#### *Other*

During the first year the PhD student should write an introductory essay. The essay should provide a literature overview of the research area as well as ideas about the PhD student's own research. It should have approximately 10 pages of text (5 pages for a Degree of Licentiate). The essay will give 10 ECTS (5 ECTS for a Degree of Licentiate), which will be counted towards the research area's core courses.