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Biology Courses offered in 2018-2019 International Bachelor Student Project "3+1"

Uppsala University Sweden

A selection of courses for the Exchange programme at Biology Education center is described below. A full list of courses given at the department as well as detailed information on the courses can be found here: www.ibg.uu.se/education/course-programmes/biology-courses/

Study plan
All students within the exchange programme will obtain an individual study plan for their exchange studies at Uppsala University. The study counsellor Eva Damm at the Biology Education Center will be support for development of individual study plans for exchange students.
The study plan can be developed before or after arrival in Uppsala.
Note: The first course for the fall (period 1) has to be determined for *all* students before May 1st 2018.

Research Practice/Internship
The aim of the course is to give an insight into research and development, its organisation and implementation. Optional places for Research training are research departments and institutions, companies or authorities within relevant subject area. The students individually perform practice in a research setting under co-supervision of supervisors and coordinators of education. The students will get training in research methodology and in oral and written presentation.

Bachelor thesis
All degree projects at the Biology Education Centre are carried out as courses. The degree project gives training in how to plan, realize and report a scientific project. The project work is carried out under the guidance of a supervisor, in close connection to current research.
A supervisor as well as a coordinator will guide the students before, during and in the final stage of the degree project.

Application Exchange Bachelor Programme: Margareta Krabbe, International Coordinator Asia
margareta.krabbe@ibg.uu.se; Skype ID: margareta.krabbe
Courses and Individual Study plan Eva Damm, Study Counsellor: Eva.Damm@ibg.uu.se
Information in Chinese: Yin Zheng-Yuan: yin.zheng_yuan@uadm.uu.se

Information on courses
First/second cycle
First cycle corresponds to undergraduate level (bachelor) and ***Second cycle*** to graduate level (master). The second level courses may be applicable for exchange students depending on their study background.

Study periods
Period 1: September 3 October 28 2018 (weeks 36-43)
Period 2: October 29-January 20, 2019 (weeks 44-03)
Period 3: January 21-March 24, 2019 (weeks 4-12)
Period 4: March 25-June 9, 2019 (weeks 13-23)

Christmas break: *usually* there is a break over Christmas and New Year's and no scheduled teaching between December 23 2018 to January 20, 2019. Additional days with no academic schedule 2019 are April 30th and May 31st.

Courses in English Biology Education Center Uppsala University

1. **Course track in *Ecology***

Course	Level/Cycle	Time period	Comment
1BG200 Ecology 15hp	1 *(First cycle*)	Period 1 Fall 2018	
1BG227 Limnology (Inland water) 15hp	1	Period 2 Fall 2018	Can be followed by 1BG305 Applied Ecosystems Ecology
1BG305 Applied Ecosystems Ecology	2 (*Second cycle*)	Period 2 Fall 2018	Can follow on 1BG227 Limnology (Inland water)
1BG203 Animal Structure and function 15hp	1	Period 2 Fall 2018	
1BG319 Behavioural Ecology 15hp	2	Period 3 Spring 2018	Background in ecology and standard statistics (e.g. ANOVA, regression using R or similar)
1BG206 Plant structure and function 15hp	1	Period 3 Spring 2019	
1BG506 Aquatic Ecosystems 15hp[1]	*2*	*Period 3 Spring 2019*	*1BG227 Limnology required prerequisite*
1BG318 Conservation Biology 15hp[1]	*2*	*Period 3 Spring 2019*	
1BG225 Research Practice 15hp	1	Period 3 Spring 2019	
1BG214 Degree Project Bachelor	1	Period 4 Spring 2019	*Mandatory*

[1]These courses are seen as second hand choices/recommendation/alternatives to 1BG319 Behavioural Ecology 15hp or 1BG225, 1BG206 Plant structure and function 15hp or Research Practice 15hp

See Appendix 1 for Course Syllabuses for Ecology track, page 4

2. Course track in *Toxicology*

Course	Level/Cycle	Time period	Comment
1BG209 Toxicology 15hp	1	Period 1 Fall 2018	Background knowledge in human/animal physiology necessary. Can be followed by 1BG308 Ecotoxicology
1BG203 Animal Structure and function 15hp	1	Period 2 Fall 2018	
1BG308 Ecotoxicology 15hp	2	Period 2 Fall 2018	Can follow on 1BG209 Toxicology
1BG206 Plant structure and function 15hp	1	Period 3Spring 2019	
1BG225 Research Practice 15hp	1	Period 3 Spring 2019	
1BG214 Degree Project Bachelor	1	Period 4 Spring 2019	*Mandatory*

See Appendix 2 for Course Syllabuses for Toxicology track, page 20

3. Course track in *Biotechnology/Molecular biology*

Course	Level/Cycle	Time period	Comment
1BG201 Microbial Genetics 15hp	1	Period 1 Fall 2018	
1BG307 Microbiology 15hp	2	Period 2 Fall 2018	
1BG205 Evolutionary Genetics 15hp[2]	*2*	*Period 2 Fall 2018*	
1BG349 Structure and Function of Macromolecules 15hp[2]	*2*	*Period 2 Fall 2018*	
1BG230 Molecular Biology and Genetics II[3]	1[a]	Period 3 Spring 2019	
1BG313 Immunology 15hp[3]	2	Period 3 Spring 2019	
1BG207 Neurobiology[3]	1	Period 3 Spring 2019	
1BG225 Research Practice 15hp	1	Period 3 Spring 2019	
1BG320 Molecular Cell Biology 15hp[3]	*2*	*Period 3 Spring 2019*	*More advanced course than 1BG230*
1BG214 Degree Project Bachelor	1	Period 4 Spring 2019	*Mandatory*

[2] The courses 1BG205 Evolutionary Genetics 15hp and 1BG349 Structure and Function of Macromolecules 15hp should be seen as second hand choices/recommendation/alternatives to 1BG307 Microbiology 15hp

[3] In period 3 *one* of the courses 1BG230Molecular Biology 15hp and Genetics II, 1BG313 Immunology 15hp, 1BG207 Neurobiology 15hp or 1BG225 Research practice 15hp is chosen

[4] The course1BG320 Molecular Cell Biology 15hp offered in period 3 is only recommended for students with advanced knowledge in Cell Biology

See Appendix 3 for Course Syllabuses for Biotechnology/Molecular biology track, page 31

UPPSALA UNIVERSITET

APPENDIX 1 Course syllabuses for track Ecology

Syllabus for Ecology

Ekologi

15 credits
Course code: 1BG200
Education cycle: First cycle
Main field(s) of study and in-depth level: Biology G2F
Grading system: Fail (U), 3, 4, 5.
Established: 2007-03-15
Established by: The Faculty Board of Science and Technology
Revised: 2016-04-25
Revised by: The Faculty Board of Science and Technology
Applies from: week 27, 2016
Entry requirements: 80 credits in biology equivalent to the basic course in biology within the Bachelor Programme in Biology/Molecular Biology, and Floristics and Faunistics, 7.5 credits
Responsible department: Biology Education Centre

LEARNING OUTCOMES

The course gives an overview of ongoing ecological research and constitutes a basis for second-cycle studies and work within fields requiring knowledge in ecology, ranging from research in evolutionary ecology to practical work in nature conservation. After completing the course, the student should be able to

- account for behavioural-ecological theories of sexual selection, foraging, altruism, cooperation, signalling and communication
- demonstrate understanding of plant and anmal life histories
- quantify and interpret diversity patterns
- account for theories of population dynamics, interspecific competition and trophic interactions in food webs
- carry out simple computer simulations of population dynamics
- plan, carry out and statistically evaluate an ecological study and presentthe results orally and in writing
- critically review and discuss primary scientific texts in Ecology.

CONTENT

Behavioural ecology including the connection between ecology, evolutionary theory, sexual selection and foraging, mating systems, kinship, altruism, cooperation and group living, adaptations to biological enemies, the evolution of signals and communication, and basic life history. Ecology and evolution of plant life histories, covering seed germination and dispersal as well as pollination ecology and an introduction to plant demography. Quantification and interpretation of diversity patterns. Models for population growth and population regulation as well as for interspecific competition and trophic interactions (e g Lotka-Volterra models, harvesting models), and food web theory.

INSTRUCTION

The course comprises a field course and a theory part that consists of lectures, computer simulations, calculation exercisesand seminars . The course includes integrated communication training with feedback and self-assessment.

ASSESSMENT

Modules: Theory 12 credits; Field course 3 credits;
The theory part is examined through a written examination. Active participation in seminarsand exercises is required. The field course is presented both in writing (project report) and orally.

OTHER DIRECTIVES

1BG200 Ecology C and 1BG382 Ecology D can not be included in the same degree.

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Syllabus for Limnology

Limnologi

15 credits
Course code: 1BG227
Education cycle: First cycle
Main field(s) of study and in-depth level: Biology G2F
Grading system: Fail (U), 3, 4, 5.
Established: 2014-03-13
Established by: The Faculty Board of Science and Technology
Revised: 2017-04-27
Revised by: The Faculty Board of Science and Technology
Applies from: week 27, 2017
Entry requirements: One of the following is required: (1) 80 credits in biology equivalent to the basic course in biology within the Bachelor Programme in Biology/Molecular Biology, or (2) 60 credits in chemistry and at least 15 credits in biology, or (3) 30 credits in earth science and at least 15 credits in biology, and in all three cases Floristics and Faunistics, 7.5 credits.
Responsible department: Biology Education Centre

LEARNING OUTCOMES

The general aim of the course is to give students knowledge of relevance for their future career in limnology, in research or with an applied focus. After completing the course, the student should be able to

- analyse and evaluate abiotic and biotic conditions in aquatic systems
- account for structure and dynamics in biogeochemical cycles and organism communities
- carry out basic sampling and analyses in freshwater field/laboratory systems
- plan and carry out experiment/field studies
- present and evaluate experiment/field studies both orally and in writing.

CONTENT

The course communicates an ecosystem perspective on inland water, which comprises both physical, chemical and biological parts. Various types of inland water will be studied such as nutritious flatland lakes and nutrient-poor forest lakes.
Lake morphometry. The optical and thermal properties of water, dissolved gases, trace elements, nutrients, dissolved salts and organic substances. Sampling theory is also included, as well palaeolimnology and an orientation in aquatic environmental problems such as eutrophication and acidification.
Limnetic ecosystems and communities including phytoplankton, macrophytes, zooplankton, benthic fauna and fish and bacteria will be included. Common species and characteristic species for different lake types are discussed. Seasonal variation and its steering factors, as well as growth and nutrient demands in different organism groups are also included in this part of the limnology course. Furthermore, microbial limnology and the biogeochemical cycle of carbon, nitrogen and phosphorus, as well as aerobic and anaerobic microbial processes in water and sediment are included.

Field course. Practical training in sampling and analyses, collaborative projects in groups, and in oral and written presentation.

INSTRUCTION

The teaching is conducted as lectures, seminars, computer exercises, field course and laboratory sessions. Participation in seminars, field course and laboratory sessions are compulsory.

ASSESSMENT

Modules: Species taxonomy 5 credits; Field course 4 credits; Theory 6 credits. The module species taxonomy is examined through written and oral tests. The field course requires active participation and oral and written presentations. The theory part requires active participation in seminars and laboratory sessions.

OTHER DIRECTIVES

Can not at the same time be included with 1BG380 Limnology I D, 1BG505 Limnology D, 1BG202 Limnology I or 1BG041 Limnology L.

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Syllabus for Applied Ecosystem Ecology

Tillämpad ekosystemekologi

15 credits
Course code: 1BG305
Education cycle: Second cycle
Main field(s) of study and in-depth level: Biology A1N
Grading system: Fail (U), 3, 4, 5.
Established: 2007-03-15
Established by: The Faculty Board of Science and Technology
Revised: 2015-04-15
Revised by: The Faculty Board of Science and Technology
Applies from: week 30, 2015
Entry requirements: 120 credits including (1) 60 credits in biology and 30 credits in chemistry or 30 credits in earth science, or (2) 90 credits in biology, in both cases, including a second course of 15 credits in ecology or limnology.
Responsible department: Biology Education Centre

LEARNING OUTCOMES

The course builds further on the students' knowledge and experiences from earlier courses in ecology or limnology and aims at communicating an independent and source-critical working method for a future career in research or as professionals within the society, with sustainable development as the general aim. After passing the course the student should be able to

- explain overall structure and function of aquatic and terrestrial ecosystems and interactions between them from a catchment perspective, and motivate the use of catchments as a the basis for nature conservation, environmental protection and other planning purposes in society
- describe and apply the EU Water Framework Directive and generally know how water issues are handled also outside Europe
- handle GPS equipment and geographic information systems using the software ArcGIS
- independently plan, motivate and carry out sampling and analysis for monitoring of water quality in a catchment, and evaluate the result
- explain and distinguish between different forms of anthropogenic influence on aquatic systems and use this in evaluations of nature values and damages on lakes and watercourses
- critically review and communicate theories, complex problems and research results
- identify and discuss aspects related to environmental ethics.

CONTENT

Applied ecosystem ecology
The course handles catchment areas from an integrated ecosystem perspective, and the following parts are included:

- The hydrological cycling and water as carrier of different substances
- Definition and identification of catchment areas from map material and in field
- Flow analyses of different substances in catchment areas
- The structure and function of different catchment ecosystems, interactions between terrestrial and aquatic ecosystems
- Global carbon cycling and climate change
- Anthropogenically influenced versus natural systems. Effects of different land use on hydrological, chemical and biological processes in soil and water
- Anthropogenic threats to aquatic ecosystems, in the form of hydromorphological changes (construction of dams and dikes,drainage of land), pollution (eutrophication, acidification, dangerous substances), introduction of non-native species and exploitation of species populations.
- Case studies for assessing Natura 2000 object
- Oral and written presentations and group assignment are included in the course

GIS training
Practical training in handling the software ArcGIS, to a large extent integrated in other parts of the course. An individual GIS project is also included.

Literature seminar; Water management
from Swedish, European and international perspective.

INSTRUCTION

The teaching is given as lectures, seminars, computer exercises, laboratory sessions, field exercises and group assignments. Participation in seminars, computer exercises, laboratory sessions, field exercises and group assignments are compulsory. Integrated communication training with feedback and self evaluation is included in the course.

ASSESSMENT

Modules: Applied ecosystem ecology 8 credits; GIS training 5 credits; Literature seminar 2 credits
Examination of the applied ecosystem ecology is continuously performed during the course through written reports, oral presentations and/or seminars.

Examination of the GIS training is made by written assignments and by individual tasks where the students produce and present an assignment where a GIS map is included. The literature seminar requires active participation in the discussions.

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Syllabus for Animal Structure and Function

Djurens struktur och funktion

15 credits
Course code: 1BG203
Education cycle: First cycle
Main field(s) of study and in-depth level: Biology G2F
Grading system: Fail (U), 3, 4, 5.
Established: 2007-03-15
Established by: The Faculty Board of Science and Technology
Revised: 2015-04-10
Revised by: The Faculty Board of Science and Technology
Applies from: week 30, 2015
Entry requirements: 80 credits in biology equivalent to the basic course in biology within the Bachelor Programme in Biology/Molecular Biology.
Responsible department: Biology Education Centre

LEARNING OUTCOMES

The aim of the course is to provide advanced knowledge of animals as integrated biomechanical and physiological organisms.

After the course, the student should be able to:

- describe and be familiar with how some selected organisms have been morphologically and anatomically adapted to a certain mode of life
- describe the most important organ systems and explain their functions
- draw conclusions about interrelationships and evolution through comparative anatomy and morphology
- describe and be familiar with different life cycles of selected groups of organisms
- describe important tissue types, such as muscle, connective tissue, bone, cartilage, kidney tissue, etc., on the basis of histological sections
- practically carry out detailed dissections of selected groups of organisms
- identify and discuss ethical aspects related to animal testing and other uses of animals in teaching and research.

CONTENT

The course explores the connections between comparative morphology, histology, biomechanics and physiology. The information is presented within a phylogenetic framework. The focus lies on how structure and function are integrated, and how they differ between animals with different life styles. Invertebrates and vertebrates will be studied, with an emphasis on the latter.
In-depth knowledge of the animals' structure, for example through a systematic overview of different animal groups, their organ systems and tissue types. Overview of reproductive strategies, life cycles and evolution,.

The course consists of two modules: Invertebrates and Vertebrates. Invertebrates (theory 4 credits, practicals 2 credits) and Vertebrates (theory 6 credits, practical 3 credits).

INSTRUCTION

The theoretical teaching is given as lectures and seminars. The practical teaching includes a field course and a series of laboratory practicals based on dissections and physiological experiments. Participation in laboratory practical, field course and seminars is compulsory.

ASSESSMENT

Each module will have a written examination. To pass the course the student is required to pass both examinations (4 and 6 credits) and participate in the compulsory parts (2 and 3 credits).

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Syllabus for Behavioural Ecology

Beteendeekologi

15 credits
Course code: 1BG319
Education cycle: Second cycle
Main field(s) of study and in-depth level: Biology A1N
Grading system: Fail (U), 3, 4, 5.
Established: 2007-03-15
Established by: The Faculty Board of Science and Technology
Revised: 2015-10-23
Revised by: The Faculty Board of Science and Technology
Applies from: week 30, 2016
Entry requirements: 120 credits including (1) 60 credits in biology and 30 credits in chemistry or 30 credits in earth science, or (2) 90 credits in biology, in both cases including the intermediate course Ecology, 15 credits.
Responsible department: Biology Education Centre

LEARNING OUTCOMES

All animals are selected to pay close attention to the behaviour of others, be it conspecifics, prey or predators. The course treats these behaviours as evolved characters with a survival and a reproductive value. After completing the course, the student should be able to

- account for and critically evaluate theories and models for sexual selection, foraging, mating and life history strategies, sociality, predation, speciation, personality and communication
- handle and present current problems in behavioural ecology, in writing as well as orally
- carry out and present practical studies in behavioural ecology
- independently and critically review scientific texts and theories
- identify and in a structured way discuss ethical issues related to animal testing.

CONTENT

Sexual reproduction, ways of reproducing, and sexual selection. Models for sexual selection, foraging, alternative mating and life history strategies, cooperation and personality. The relationship between sexual selection and speciation, life history, sexual conflict and partner manipulation. The relationship between life history theory, energy use, predation and survival. The evolution of communication and design of signals. Orientation in current behavioural ecology research, with an aim to prepare for research.

INSTRUCTION

Teaching consists of lectures, group exercises (labs and computer exercises), group seminars and group as well as independent literature assignments. Independent work as well as discussions and group exercises make up an important part of the course. The course includes handling and presenting behavioural ecology problems in writing as well as orally, and independently and critically reviewing scientific texts and theories . Participation in group exercises, seminars and literature assignments are compulsory. The course employs integrated communication training with feedback and self-assessment.

ASSESSMENT

Modules: Theory 10 credits; Exercise 5 credits.
The module exercises require an active participation in group as well as independent assignments. The course ends with a written examination.

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Syllabus for Plant Structure and Function

Växternas struktur och funktion

15 credits
Course code: 1BG206
Education cycle: First cycle
Main field(s) of study and in-depth level: Biology G2F
Grading system: Fail (U), 3, 4, 5.
Established: 2007-03-15
Established by: The Faculty Board of Science and Technology
Revised: 2012-11-28
Revised by: The Faculty Board of Science and Technology
Applies from: week 02, 2013
Entry requirements: 80 credits in biology equivalent to the basic course in biology within the Bachelor Programme in Biology/Molecular Biology.
Responsible department: Biology Education Centre

LEARNING OUTCOMES

After the course, the student should be able to:
• Give examples of several evolutionary innovations essential for the terrestrial plants possibilities to establish and diversify in different environments
• Account for fundamental physiological/functional, genetic/developmental and phylogenetic/biodiversity aspects of these innovations
• Describe how we, from different perspectives, can illustrate and contribute to a more general understanding of the origin of evolutionary innovations and their underlying genotypic and phenotypic mechanisms
• Describe
– fundamental aspects regarding phylogenetic relationships, morphology, anatomy and physiology of plants
– the principles behind historical analysis of relationships and character evolution
– molecular mechanisms behind important morphological and physiological innovations
– the principles of inference for evolutionary mechanisms based on genomic variation
– the principles for analysis of DNA sequences and gene expression
• Independently make use of phylogenetic trees to describe evolutionary patterns and analyse evolutionary causalities
• Perform and show practical skills in microscopy and genetic analysis
• Discuss and communicate principles, problems and research results for questions within the framework of the contents of the course

CONTENT

During evolution, different morphological, structural and physiological innovations have had central importance for the possibility of plants to establish and diversify in different environments. The course focuses on some of these innovations, for example the origin of vascular tissue and flowers and how different plants adapt to their environment. The course provides a deep understanding of these evolutionary innovations from different perspectives. The subparts include:

- Physiological/functional aspects of the evolutionary innovations covered by the course
- Genetic-developmental biological aspects of evolutionary innovations covered by the course
- Phylogenetic-biodiversity aspects of evolutionary innovations covered by the course
- Project work: in connection to one of the involved research disciplines, and related to one or more of the learning outcomes, a practical or literature-based independent project is carried out.

INSTRUCTION

The teaching consists of lectures, seminars, project work, study visits, and laboratory sessions. Participation in seminars, laboratory sessions, and project work are compulsory.

ASSESSMENT

Parts of the course: Theory 8 credits, projects 3 credits, laboratory sessions 4 credits.

The theory part is examined by written exams, written and oral presentations of parts with PBL character. The project work is examined through a written and an oral presentation including peer-review on another project. Laboratory sessions and seminars require active participation.

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Syllabus for Aquatic Ecosystems

Akvatiska ekosystem

15 credits
Course code: 1BG506
Education cycle: Second cycle
Main field(s) of study and in-depth level: Biology A1N, Earth Science A1N
Grading system: Fail (U), 3, 4, 5.
Established: 2014-03-13
Established by: The Faculty Board of Science and Technology
Revised: 2017-04-27
Revised by: The Faculty Board of Science and Technology
Applies from: week 27, 2017
Entry requirements: 120 credits including (1) 60 credits in biology and 30 credits in chemistry or 30 credits in earth science, or (2) 90 credits in biology, in both cases including Limnology I, 15 credits.
Responsible department: Biology Education Centre

LEARNING OUTCOMES

The course intends to convey advanced knowledge on ecosystems, with focus on aquatic environments. Students are prepared for professional work and research within areas which require a solid understanding of the interactions between organisms, their abiotic environment, and human perturbations. After the course, the students will be able to

- apply knowledge on aquatic ecosystems and environmental issues based on current research in a future profession inside or outside academia
- independently and in groups, plan and carry out field studies and laboratory experiments as well as compile, critically analyse and evaluate results
- critically evaluate and present various types of results and compilations of knowledge, both orally and in written form
- communicate theories, complex problems and research results
- identify and in a structured way discuss aspects related to research ethics.

CONTENT

The course is given in close collaboration to the ongoing research activities and includes

- ecosystem processes and their linkages to biogeochemical cycles and global environmental change
- biodiversity and its regulation and connection to ecosystem function and ecosystem services
- the structure, function, dynamics and role of food webs in aquatic ecosystems
- scientific methodology, including experimental design and research ethics

The course is focused on ecosystems in inland waters and coastal regions. Emphasis is on the scientific method including theoretical models and reasoning, as well as methods for the study of ecosystem processes.

INSTRUCTION

The teaching is given in the form of lectures, seminars, computer exercises and field work as well as laboratory sessions. A large part of the course consists of an experimental project performed in groups. The data obtained from field studies and experiments are processed and presented in written as well as oral form.

ASSESSMENT

Modules: Theory 9 credits, Project 6 credits.

The module theory is examined through a written exam (6 credits) and participation in seminars and exercises (3 credits). The project requires participation in seminars, laboratory work, field studies, exercises and written reports and oral presentations.

OTHER DIRECTIVES

Cannot be included in the degree together with Limnology II, 15 credits.

UPPSALA UNIVERSITET

Syllabus for Conservation Biology

Bevarandebiologi

15 credits
Course code: 1BG318
Education cycle: Second cycle
Main field(s) of study and in-depth level: Biology A1N
Grading system: Fail (U), 3, 4, 5.
Established: 2007-03-15
Established by: The Faculty Board of Science and Technology
Revised: 2015-10-23
Revised by: The Faculty Board of Science and Technology
Applies from: week 30, 2016
Entry requirements: 150 credits including (1) 60 credits in biology and 30 credits in chemistry or 30 credits in earth science, or (2) 90 credits biology, in both cases including the intermediate course Ecology, 15 credits, or Limnology, 15 credits.
Responsible department: Biology Education Centre

LEARNING OUTCOMES

The general aim is that the student after the course should have advanced knowledge within ecology and conservation genetics to a large extent be able to use them in nature conservation applications.

On completion of the course, the student should be able to

- analyse the causes behind the vulnerability and extinction risks of small and large populations
- apply models of demography/population dynamics and of genetic variation within and between populations
- identify and in a structured way discuss ethical issues related to conservation biology.

CONTENT

The course comprises theories and concept of great importance to be able to tax the threat assessment for plants and animals, for example how genetic drift, inbreeding and inbreeding depression can influence the survival opportunities of threatened species, and how stochastic and density dependent demographic processes can affect extinction risk. The course also focuses on population models of relevance for conservation problems. Under a project work, the students will analyse for example action programmes for threatened species or environments.
The course is based on the students ' previous knowledge in ecology and genetics and the advanced study and the labour market links are ensured through increased depth and independence and in exercises where the students apply their knowledge when working with nature conservation and sustainable development.

INSTRUCTION

The teaching is given in the form of lectures, seminars, computer exercises, calculation exercises, field trips, contacts with public authorities and a longer project work. Participation in seminars, computer exercises, calculation exercises, field trips, and project work are compulsory.

ASSESSMENT

Modules: Theory 11 credits; Project 4 credits.
The theory part is comprised by a written examination. The module project includes active participation in project work, field trips, seminars, computer-based laboratory sessions, and calculation exercises and is examined through oral and written presentations.

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Syllabus for Research Training in Biology

Forskningspraktik i biologi

15 credits
Course code: 1BG225
Education cycle: First cycle
Main field(s) of study and in-depth level: Biology G2F
Grading system: Fail (U), Pass (G).
Established: 2012-03-08
Established by: The Faculty Board of Science and Technology
Applies from: week 27, 2012
Entry requirements: Biology, 80 credits equivalent basic course in biology within the Bachelor programme in biology.
Responsible department: Biology Education Centre

LEARNING OUTCOMES

After the course, the student should have relevant working experience After completing the course, the student should be able to

- in extent and time delimit and plan for implementation of the training period
- carry out a compilation of the literature in the field
- give a correct oral and written presentation of the work training period

CONTENT

The student participates in regular activities within industry, public administration or academic research. The student should under supervision or independently participate in work relevant to the subject.

INSTRUCTION

The student is given private tuition at the working place

ASSESSMENT

Written and oral presentation of the work training period

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Syllabus for Degree Project C in Biology

Examensarbete C i biologi

15 credits
Course code: 1BG214
Education cycle: First cycle
Main field(s) of study and in-depth level: Biology G2E
Grading system: Fail (U), Pass (G).
Established: 2008-03-13
Established by: The Faculty Board of Science and Technology
Revised: 2014-04-16
Revised by: The Faculty Board of Science and Technology
Applies from: week 27, 2014
Entry requirements: The basic course in biology 80 credits within the Bachelor programme in biology. For admission, a project plan approved by the department is required
Responsible department: Biology Education Centre

LEARNING OUTCOMES

After the course, the student shall:

- be able to search for relevant scientific literature and critically summarise and interpret it
- be able to generate hypotheses to explain the observations made in the chosen area of specialisation
- be able to present his/her knowledge in Swedish, and to some extent in English, to different target groups, both in scientific and popular scientific styles
- have a good ability to handle text and present data (figures, tables), references, etc. according to the format specified for the particular genre
- be able to give constructive criticism of other students' manuscript drafts
- be able to present his/her knowledge in a poster in a pedagogic manner
- identify and in a structured way discuss ethical issues related to the topic the student has chosen.

CONTENT

An individual assignment is carried out, where the knowledge from previously completed courses is applied. The work is carried out guided by a supervisor in close connection with ongoing research or development projects.

To achieve the aims, the student should

- under supervision delimit a scientific problem, examine this, interpret and evaluate the results and present the work oral and written
- search, evaluate and compile information relevant to the chosen problem
- participate actively in seminars and other activities on the workplace where the work is carried out

INSTRUCTION

The teaching is designed individually depending on the specialisation of the project.

ASSESSMENT

To pass, a passed oral and written presentation of the degree project at a seminar is required. The written presentation should consist of a scientific report, a popular summary and a summary in English.

To pass it is required, apart from passed presentations, that the student has participated actively in seminars drafts to the three presentations are discussed.

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APPENDIX 2 Course syllabuses for track Toxicology

Syllabus for Toxicology

Toxikologi

15 credits
Course code: 1BG209
Education cycle: First cycle
Main field(s) of study and in-depth level: Biology G2F
Grading system: Fail (U), 3, 4, 5.
Established: 2007-03-15
Established by: The Faculty Board of Science and Technology
Revised: 2011-12-01
Revised by: The Faculty Board of Science and Technology
Applies from: week 27, 2012
Entry requirements: 80 credits in biology equivalent to the basic course in biology within the Bachelor Programme in Biology/Molecular Biology.
Responsible department: Biology Education Centre

LEARNING OUTCOMES

After the course, the student should be able to:

- describe basic toxicological principles and describe how different chemicals are taken up by, processed in and eliminated from the body
- describe different the importance of different organs for detoxification/ toxification of chemicals, and describe mechanisms for chemically induced neurotoxicity and endocrine toxicity
- describe different behaviour tests and their importance to discover of different neurological and endocrinological disturbances
- describe when different chemicals are most toxic, and mechanisms behind the effects. Be able to discuss when and how different chemicals can interact under the development to induce effects
- describe different genetic testing methods and injuries after various types of ionising radiation
- apply different toxicological frameworks within the professional disciplines and have awareness about different risk assessment criteria

CONTENT

General toxicological principles and overview of toxic substances: The part includes basic description how substances are absorbed by, distributed and eliminated from the body. The part contains awareness about toxicokinetic models and the processes of biotransformation.

Toxicity in specific target organs ? effects and mechanisms: The part includes basic toxicological knowledge of the effect of chemicals on central organs that are of significance for the uptakes/elimination and detoxification/toxification. Basic knowledge about how the communication systems of the body, the nervous system and the endocrine system is influenced of chemicals.

Behaviour toxicology: The part includes basic behaviour toxicological knowledge, how behavioural techniques can reveal chemicals that give functional disturbances

Development toxicology: The part includes basic knowledge of different developmental phases; embryonic and embryonic development, development during the neonatal period. Critical developmental phases then teratogenic injuries and functional disturbances are induced.

Genetic toxicology and ionising radiation: The part includes basic knowledge about genetic injuries and general genetic testing methods and

mechanisms behind chemically induced injuries and injuries after ionising radiation.

Toxicology in the society: Environmental toxicology, food toxicology, clinical toxicology, epidemiology, risk assessment.

INSTRUCTION

Lectures, group tuition, seminars and laboratory sessions. Attendance at the laboratory work and connected lessons is compulsory. The course may be given in English.

ASSESSMENT

Modules: Theory 10 credits: Written examination
Laboratory sessions 4 credits: Written laboratory reports
Literature assignment 1 credit: Written and oral presentation of literature assignment
A passing grade for the entire course requires passing grades for the laboratory work and seminars.

UPPSALA UNIVERSITET

Syllabus for Animal Structure and Function

Djurens struktur och funktion

15 credits
Course code: 1BG203
Education cycle: First cycle
Main field(s) of study and in-depth level: Biology G2F
Grading system: Fail (U), 3, 4, 5.
Established: 2007-03-15
Established by: The Faculty Board of Science and Technology
Revised: 2015-04-10
Revised by: The Faculty Board of Science and Technology
Applies from: week 30, 2015
Entry requirements: 80 credits in biology equivalent to the basic course in biology within the Bachelor Programme in Biology/Molecular Biology.
Responsible department: Biology Education Centre

LEARNING OUTCOMES

The aim of the course is to provide advanced knowledge of animals as integrated biomechanical and physiological organisms.

After the course, the student should be able to:

- describe and be familiar with how some selected organisms have been morphologically and anatomically adapted to a certain mode of life
- describe the most important organ systems and explain their functions
- draw conclusions about interrelationships and evolution through comparative anatomy and morphology
- describe and be familiar with different life cycles of selected groups of organisms
- describe important tissue types, such as muscle, connective tissue, bone, cartilage, kidney tissue, etc., on the basis of histological sections
- practically carry out detailed dissections of selected groups of organisms
- identify and discuss ethical aspects related to animal testing and other uses of animals in teaching and research.

CONTENT

The course explores the connections between comparative morphology, histology, biomechanics and physiology. The information is presented within a phylogenetic framework. The focus lies on how structure and function are integrated, and how they differ between animals with different life styles. Invertebrates and vertebrates will be studied, with an emphasis on the latter.
In-depth knowledge of the animals' structure, for example through a systematic overview of different animal groups, their organ systems and tissue types. Overview of reproductive strategies, life cycles and evolution,.

The course consists of two modules: Invertebrates and Vertebrates. Invertebrates (theory 4 credits, practicals 2 credits) and Vertebrates (theory 6 credits, practical 3 credits).

INSTRUCTION

The theoretical teaching is given as lectures and seminars. The practical teaching includes a field course and a series of laboratory practicals based on dissections and physiological experiments. Participation in laboratory practical, field course and seminars is compulsory.

ASSESSMENT

Each module will have a written examination. To pass the course the student is required to pass both examinations (4 and 6 credits) and participate in the compulsory parts (2 and 3 credits).

UPPSALA UNIVERSITET

Syllabus for Ecotoxicology

Ekotoxikologi

15 credits
Course code: 1BG308
Education cycle: Second cycle
Main field(s) of study and in-depth level: Biology A1N
Grading system: Fail (U), 3, 4, 5.
Established: 2007-03-15
Established by: The Faculty Board of Science and Technology
Revised: 2017-04-27
Revised by: The Faculty Board of Science and Technology
Applies from: week 27, 2017
Entry requirements: 120 credits including (1) 60 credits in biology and 30 credits in chemistry or 30 credits in earth science, or (2) 90 credits in biology, in both cases including Toxicology, 12 credits.
Responsible department: Biology Education Centre

LEARNING OUTCOMES

The main objective of the course is to give the students knowledge and skills that allow an overall assessment of the fate of foreign chemicals in the environment and of their effects on different biological organisation levels. To that end, the conceptual framework introduced during the course in toxicology will be further developed and used.
On completion of the course, the student should be able to

- describe sources and fates of chemicals in the environment
- present and explain mechanisms for adverse effects of chemicals
- estimate the risk for adverse effects of a chemical on different biological organisation levels based on knowledge about the toxicity, degradability, and bioavailability of the chemical
- retrieve and critically evaluate toxicological information from different sources (internet-based databases, hand books, scientific articles)
- independently carry out, and present orally and in writing , classification and labelling of chemicals dangerous for the environment
- independently carry out, and present orally and in writing, environmental risk assessment of chemicals

CONTENT

Environmental chemistry: This part comprises an overview of different chemical groups of anthropogenic origin present in the environment. Focus is on their sources and fates in the environment.

Effects of anthropogenic chemicals: This part comprises negative effects of chemicals on different biological organisation levels (cell, organ, organism, population, ecosystem) with focus on mechanisms. An experimental study is carried out.

Hazard assessment: This part comprises retrieval and critical evaluation of toxicological information from different sources (internet-based databases, hand books, scientific articles etc.) for classification and labelling of chemicals. The students perform an individual project on classification and labelling of chemicals dangerous for the environment according to EU guidelines.

Environmental risk assessment: This part comprises environmental risk assessments of chemicals and is done as projects.

INSTRUCTION

The teaching is given as lectures, seminars, a laboratory practical, exercises and theoretical project work. Active participation in all parts of the laboratory practical and the theoretical project work is compulsory. The course includes integrated communication training.

ASSESSMENT

Modules: Theory 8 credits; Project work 7 credits
The theory is examined through written examination. The module project work is examined through written and oral presentations and critical evaluation of other course participants' project reports.

UPPSALA UNIVERSITET

Syllabus for Plant Structure and Function

Växternas struktur och funktion

15 credits
Course code: 1BG206
Education cycle: First cycle
Main field(s) of study and in-depth level: Biology G2F
Grading system: Fail (U), 3, 4, 5.
Established: 2007-03-15
Established by: The Faculty Board of Science and Technology
Revised: 2012-11-28
Revised by: The Faculty Board of Science and Technology
Applies from: week 02, 2013
Entry requirements: 80 credits in biology equivalent to the basic course in biology within the Bachelor Programme in Biology/Molecular Biology.
Responsible department: Biology Education Centre

LEARNING OUTCOMES

After the course, the student should be able to:
• Give examples of several evolutionary innovations essential for the terrestrial plants possibilities to establish and diversify in different environments
• Account for fundamental physiological/functional, genetic/developmental and phylogenetic/biodiversity aspects of these innovations
• Describe how we, from different perspectives, can illustrate and contribute to a more general understanding of the origin of evolutionary innovations and their underlying genotypic and phenotypic mechanisms
• Describe
– fundamental aspects regarding phylogenetic relationships, morphology, anatomy and physiology of plants
– the principles behind historical analysis of relationships and character evolution
– molecular mechanisms behind important morphological and physiological innovations
– the principles of inference for evolutionary mechanisms based on genomic variation
– the principles for analysis of DNA sequences and gene expression
• Independently make use of phylogenetic trees to describe evolutionary patterns and analyse evolutionary causalities
• Perform and show practical skills in microscopy and genetic analysis
• Discuss and communicate principles, problems and research results for questions within the framework of the contents of the course

CONTENT

During evolution, different morphological, structural and physiological innovations have had central importance for the possibility of plants to establish and diversify in different environments. The course focuses on some of these innovations, for example the origin of vascular tissue and flowers and how different plants adapt to their environment. The course provides a deep understanding of these evolutionary innovations from different perspectives. The subparts include:

- Physiological/functional aspects of the evolutionary innovations covered by the course
- Genetic-developmental biological aspects of evolutionary innovations covered by the course
- Phylogenetic-biodiversity aspects of evolutionary innovations covered by the course
- Project work: in connection to one of the involved research disciplines, and related to one or more of the learning outcomes, a practical or literature-based independent project is carried out.

INSTRUCTION

The teaching consists of lectures, seminars, project work, study visits, and laboratory sessions. Participation in seminars, laboratory sessions, and project work are compulsory.

ASSESSMENT

Parts of the course: Theory 8 credits, projects 3 credits, laboratory sessions 4 credits.

The theory part is examined by written exams, written and oral presentations of parts with PBL character. The project work is examined through a written and an oral presentation including peer-review on another project. Laboratory sessions and seminars require active participation.

UPPSALA UNIVERSITET

Syllabus for Research Training in Biology

Forskningspraktik i biologi

15 credits
Course code: 1BG225
Education cycle: First cycle
Main field(s) of study and in-depth level: Biology G2F
Grading system: Fail (U), Pass (G).
Established: 2012-03-08
Established by: The Faculty Board of Science and Technology
Applies from: week 27, 2012
Entry requirements: Biology, 80 credits equivalent basic course in biology within the Bachelor programme in biology.
Responsible department: Biology Education Centre

LEARNING OUTCOMES

After the course, the student should have relevant working experience After completing the course, the student should be able to

- in extent and time delimit and plan for implementation of the training period
- carry out a compilation of the literature in the field
- give a correct oral and written presentation of the work training period

CONTENT

The student participates in regular activities within industry, public administration or academic research. The student should under supervision or independently participate in work relevant to the subject.

INSTRUCTION

The student is given private tuition at the working place

ASSESSMENT

Written and oral presentation of the work training period

UPPSALA UNIVERSITET

Syllabus for Degree Project C in Biology

Examensarbete C i biologi

15 credits
Course code: 1BG214
Education cycle: First cycle
Main field(s) of study and in-depth level: Biology G2E
Grading system: Fail (U), Pass (G).
Established: 2008-03-13
Established by: The Faculty Board of Science and Technology
Revised: 2014-04-16
Revised by: The Faculty Board of Science and Technology
Applies from: week 27, 2014
Entry requirements: The basic course in biology 80 credits within the Bachelor programme in biology. For admission, a project plan approved by the department is required
Responsible department: Biology Education Centre

LEARNING OUTCOMES

After the course, the student shall:

- be able to search for relevant scientific literature and critically summarise and interpret it
- be able to generate hypotheses to explain the observations made in the chosen area of specialisation
- be able to present his/her knowledge in Swedish, and to some extent in English, to different target groups, both in scientific and popular scientific styles
- have a good ability to handle text and present data (figures, tables), references, etc. according to the format specified for the particular genre
- be able to give constructive criticism of other students' manuscript drafts
- be able to present his/her knowledge in a poster in a pedagogic manner
- identify and in a structured way discuss ethical issues related to the topic the student has chosen.

CONTENT

An individual assignment is carried out, where the knowledge from previously completed courses is applied. The work is carried out guided by a supervisor in close connection with ongoing research or development projects.

To achieve the aims, the student should

- under supervision delimit a scientific problem, examine this, interpret and evaluate the results and present the work oral and written
- search, evaluate and compile information relevant to the chosen problem
- participate actively in seminars and other activities on the workplace where the work is carried out

INSTRUCTION

The teaching is designed individually depending on the specialisation of the project.

ASSESSMENT

To pass, a passed oral and written presentation of the degree project at a seminar is required. The written presentation should consist of a scientific report, a popular summary and a summary in English.

To pass it is required, apart from passed presentations, that the student has participated actively in seminars drafts to the three presentations are discussed.

UPPSALA UNIVERSITET

APPENDIX 3 Course syllabuses for track Biotechnology/Molecular Biology

Syllabus for Microbial Genetics

Mikrobiell genetik

15 credits
Course code: 1BG201
Education cycle: First cycle
Main field(s) of study and in-depth level: Biology G2F
Grading system: Fail (U), 3, 4, 5.
Established: 2007-03-15
Established by: The Faculty Board of Science and Technology
Revised: 2010-04-21
Revised by: The Faculty Board of Science and Technology
Applies from: week 27, 2010
Entry requirements: 80 credits in biology equivalent to the basic course in biology within the Bachelor Programme in Biology/Molecular Biology.
Responsible department: Biology Education Centre

LEARNING OUTCOMES

After completing the course, the student should be able to

- explain the processes behind mutations and other genetic changes
- identify and distinguish genetic regulatory mechanisms at different levels
- solve theoretical and practical problems in genetic analysis particularly concerning genetic mapping and strain construction
- identify genes and mutations in non-annotated sequence data from databases by means of relevant bioinformatics programs
- plan basic experiments in microbial genetics concerned with clarifying phenotypes and their relationship with the genotype
- use common methods in microbial genetics
- describe and summarise experimental work in a correct way in a laboratory notebook.

CONTENT

Mechanisms behind stability and change in microbial genomes. Mechanisms behind the information flow from DNA to proteins and the multiple levels at which gene expression can be regulated. Genetic aspects of extrachromosomal elements such as bacteriophages and plasmids. Genetic methods to construct, map and move mutations, and to measure gene expression, and through exercises in problem-solving at seminars where scientific data are analysed. Laboratory sessions where the students through strain construction, genetic selection and screening familiarise themselves with important and common methods in microbial genetics. Careful and proper use of a laboratory notebook to record laboratory work.

INSTRUCTION

The teaching is given in the form of lectures, seminars and laboratory sessions. Participation in seminars and laboratory sessions is compulsory.

ASSESSMENT

Modules: Laboratory and seminar exercises 3 credits; Keeping a laboratory notebook 2 credits; Theory examination I 5 credits; Theory examination II 5 credits. The module laboratory and seminar exercises require active participation in laboratory sessions and seminars. The

module laboratory notebook requires proper laboratory reports. The theory is examined through two written tests. The one exam concerns theoretical knowledge, the other exam concerns analysis of data and problems in genetics of which some will be connected with the laboratory course.

OTHER DIRECTIVES

The course can not be included, for the purposes of credits, with 1BG389 Microbial genetics D.

UPPSALA UNIVERSITET

Syllabus for Microbiology

Mikrobiologi

15 credits
Course code: 1BG307
Education cycle: Second cycle
Main field(s) of study and in-depth level: Biology A1N, Technology A1N
Grading system: Fail (U), 3, 4, 5.
Established: 2007-03-15
Established by: The Faculty Board of Science and Technology
Revised: 2015-04-15
Revised by: The Faculty Board of Science and Technology
Applies from: week 30, 2015
Entry requirements: 120 credits including (1) 60 credits in biology and 30 credits in chemistry, or (2) 60 credits in chemistry, including Biochemistry, 15 credits, and 30 credits in biology, including 15 credits in molecular genetics.
Responsible department: Biology Education Centre

LEARNING OUTCOMES

The course in microbiology gives the student knowledge on microorganismal morphology, metabolism, physiology, ecology and evolution. The student also gets training in problem-solving and critical analysis of scientific work within the subject area. This course prepares the student for in depth studies in the subject or for professional activities related to for instance biotechnological production, food handling and combating of infectious diseases.

After completing the course, the student should be able to

- account for the structure, organisation, metabolism and evolution of viruses, bacteria, archaea and eukaryotic microorganisms
- explain the life processes of chosen microorganisms at the molecular level and how these processes influence the environments as well as how environmental influences affect microorganismal differentiation, development of multi-cellularity, formation of biofilms, etc.
- account for the most common pathogenic microorganisms and their main virulence factors
- account for the use of genetically modified microorganisms (GMOs) within the biotechnology industry as well as review and discuss their use critically
- work safety with microorganisms in the laboratory and cultivate microorganisms from natural environments
- plan, carry out and analyse microbiological experiments, draw conclusions from these and design new testable hypotheses from generated and analysed data
- review scientific work critically within the subject area. and communicate knowledge within the field both orally and in written form
- identify and discuss ethical aspects related to genetic engineering and synthetic biology.

CONTENT

The course focuses on microorganisms in their natural context, including their relationship with the environment and other organisms. Central themes are the cells' structure and function, and molecular mechanisms underlying cellular function as well as interactions between organisms and their environment. Lectures and individual literature studies are complemented with practical exercises (laboratory work, seminars, etc.).

Microbial diversity and evolution: History, molecular phylogenetics, evolutionary mechanisms: plasmids, phages and horizontal exchange. Groups of bacteria, archeons and unicellular eukaryotes. Methods for analysis of microbial diversity, metagenomics, and non-culturable organisms.

Microbial cell biology and developmental biology: Cell morphology, cytoskeleton, cell growth and division, compartmentalisation in bacterial cells. Bacterial cell cycle, DNA replication and chromosome segregation from a biological perspective. Motility. Signalling, biofilm, multicllularity, sporulation, differentiation.

Metabolism and physiology: Aerobic and anaerobic energy production, uptake and secretion mechanisms, cell wall synthesis. Environmental effects and adaptations to environmental changes, molecular mechanisms behind these adaptations. Growth, culturing, and culture

methodology (batch, chemostats). Growth phases, "non-culturable" resting phases.

Interaction, attack and defence: Symbiosis, virulence factors, secondary metabolism and their regulation. Antibiotic production and resistance to antibiotics.

Applications of the above for handling and controlling microorganisms in the society, e.g., in the food and biotechnology industries, and in connection with sustainable development. Ecological and evolutionary aspects of pathogens: how they have become what they are and how we can treat them. Genetic modification of microorganisms, implementation and ethical aspects.

Laboratory exercises: Microbiological work techniques, enrichment of bacteria and identification of them by physiological methods and bioinformatics, bacteriological water tests.

Seminars: Critical analysis of published articles and scientific data, calculation exercises concerning microbial growth, mini-symposium with critical analysis of recently reported research on a microorganism chosen by the student.

INSTRUCTION

Instruction is provided in the form of lectures, seminars, laboratory sessions and on-site visit. Participation in seminars and laboratory sessions are compulsory.

ASSESSMENT

Modules: Exercises (laboratory sessions and seminars) 5 credits; Examination I 5 credits; Examination II 5 credits.
The module exercises require active participation and laboratory reports and presentations according to instructions. The theory is examined through two written tests.

UPPSALA UNIVERSITET

Syllabus for Evolutionary Genetics

Evolutionär genetik

15 credits
Course code: 1BG205
Education cycle: First cycle
Main field(s) of study and in-depth level: Biology G2F
Grading system: Fail (U), 3, 4, 5.
Established: 2007-03-15
Established by: The Faculty Board of Science and Technology
Revised: 2011-04-18
Revised by: The Faculty Board of Science and Technology
Applies from: week 27, 2011
Entry requirements: 80 credits in biology equivalent to the basic course in biology within the Bachelor Programme in Biology/Molecular Biology.
Responsible department: Biology Education Centre

LEARNING OUTCOMES

On completion of the course, the student should be able to:

- describe the basic mechanisms behind evolution of DNA sequences and gene structure
- describe the principles for population genetics
- describe the latest progress within molecular genetics
- use molecular genetic laboratory methods
- describe the main fields of research and studies of modern evolutionary genetics.
- use available sources of information as well as basic laboratory methods to generate molecular genetic information

CONTENT

The course focuses on the following concept and processes: Historical introduction to evolutionary genetics. Mutations: the source of genetic variation. DNA sequence evolution and mechanisms for molecular evolution. Population genetics: factors determining the composition and change in allale and genotype frequencies. Genetic markers and sequencing technologies. Mapping of genes: establishing the link between phenotype and genotype. Conservation genetics. Evolution of genetic systems, sex chromosomes and sex determination mechanisms. Speciation processes. Selfish genes: conflicts between genetic elements within an individual. Phylogeny: methods to analyse evolutionary relatedness between populations. Domestication: changes in the genetic composition of wild animals through selective breeding.

INSTRUCTION

Lectures, laboratory sessions, seminars, discussion sessions, computer exercises, literature assignments and projects. Participation in lab practicals, computer assignments and project work is compulsory.

ASSESSMENT

To pass the course, the students should:
o complete practical exercises and lab reports, 4 credits
o participate in seminars, 3 credits
o pass an examination, 8 credits

The grading is based on the results of the examination. Satisfactorily performed laboratory sessions and discussions can give extra points. After the examination, the students are offered to mark his/her own examination and well performed marking will give extra points.

UPPSALA UNIVERSITET

Syllabus for Structure and Function of Macromolecules

Makromolekylers struktur och funktion

15 credits
Course code: 1BG349
Education cycle: Second cycle
Main field(s) of study and in-depth level: Biology A1N
Grading system: Fail (U), 3, 4, 5.
Established: 2008-03-13
Established by: The Faculty Board of Science and Technology
Revised: 2015-10-23
Revised by: The Faculty Board of Science and Technology
Applies from: week 01, 2016
Entry requirements: 150 credits including (1) 60 credits in biology and 30 credits in chemistry, or (2) 90 credits in chemistry and biology, including at least 60 credits in chemistry.
Responsible department: Biology Education Centre

LEARNING OUTCOMES

The overall goal of this course is to give students advanced knowledge of the relationship between the structure and function of biomolecules. After completing the course, the student should be able to

- account for the basis of biological macromolecules constitution and traits
- explain structural mechanisms for how important biological processes take place and are controlled, for example catalysis, cell signalling, transcription and translation
- explain the structure of molecular complexes like ribosomes and proteasomes and aggregates like filaments and tubules
- account for the principles of the most important methods for structural analysis: X-ray crystallography, NMR spectroscopy and electron microscopy and analyse the quality of models produced by these methods
- analyse structural details in macromolecules using a molecular graphics program
- use databases with information of structure and function of macromolecules
- use analyse, and critically evaluate results from methods to predict secondary - and tertiary structure of macromolecules
- explain basic concepts and critically assess the relative strengths and weaknesses of fundamental approaches in computational biology

CONTENT

Basic structural biology and structural bioinformatics:
Methods for experimental structure determination of macromolecules and complexes. Basic macromolecular structure: proteins, DNA, and RNA Biological sequence and structure databases. Relation between sequence, structure and function. Prediction of secondary- and tertiary structure of proteins and nucleic acids based on sequence data. Structure analysis and classification of proteins in structural families.

Structural biology of the cell:
Macromolecular structure and function in transcription, translation, folding and other fields of cell biology. The folding process and structural background to the dynamics of macromolecules.

Enzyme structure and function:
Binding specificity, catalysis and cooperativity in enzymes and receptors.
Enzyme/receptor-based drugs-rational drug design. Introduction to computational modelling of ligand binding, protein folding and enzyme catalysis.

INSTRUCTION

Instruction is provided in the form of lectures, computer exercises, laboratory sessions, seminars and projects. Participation in computer exercises, laboratory sessions, seminars and project are compulsory.

ASSESSMENT

Modules: Theory 7 credits; Seminars, computer exercises, and laboratory sessions 3 credits; Project 3.5 credits; Written report in Computational biology 1.5 credits
The theory is examined through written examinations. Computer exercises and laboratory sessions require active participation. The project is examined through written and oral presentation.

OTHER DIRECTIVES

Can not be included in the degree together with 1BG351 Structure and Function of Biomolecules 10 credits.

UPPSALA UNIVERSITET

Syllabus for Molecular Biology and Genetics II

Molekylärbiologi och genetik II

15 credits
Course code: 1BG230
Education cycle: First cycle
Main field(s) of study and in-depth level: Biology G2F
Grading system: Fail (U), 3, 4, 5.
Established: 2015-03-12
Established by: The Faculty Board of Science and Technology
Revised: 2016-04-25
Revised by: The Faculty Board of Science and Technology
Applies from: week 27, 2016
Entry requirements: 80 credits in biology equivalent to the basic course in biology within the Bachelor Programme in Biology/Molecular Biology.
Responsible department: Biology Education Centre

LEARNING OUTCOMES

After passing the course the student should be able to

- describe thoroughly how gene expression is regulated in bacteria, archaea and eukaryotes
- independently use and optimise basic molecular tools such as PCR and cloning
- use some and describe several methods and strategies for deeper analysis of biological questions, e.g. gene inactivation, fluorescent reporter genes and model organisms
- describe how advanced molecular tools such as large-scale sequencing and proteomics can be used to study gene expression
- describe genetic applications such as evolutionary genetics, disease genetics and forensic genetics
- read and evaluate scientific articles and suggest follow-up experiments
- describe ethical issues related to the subjects that are covered during the course

CONTENT

The course focuses on regulation of gene expression in bacteria, archaea and eukaryotes, and basic molecular biological and genetic methods as well as the latest large-scale methods that are used to study gene function and gene expression. The following subjects are covered during the course: Repetition of basic molecular biology and genetics; Epigenetics; Post-transcriptional regulation mediated by small and large RNA molecules; Translational control. The latest methods within analysis of gene expression, e.g. large-scale sequencing and proteomics. Applied genetics: Evolutionary genetics, disease genetics and forensic genetics. Methods for further studies of gene function: inactivation of genes, reporter genes, model organisms. Experimental strategies: selection of methods to study a specific scientific problem. Practical training in PCR, cloning, epigenetics in fission yeast and inactivation of gene expressions by means of RNA-interference in the roundworm C. elegans. Ethical questions within molecular biology and genetics. Study visits at e.g. SciLifeLab.

INSTRUCTION

Lectures, laboratory sessions, seminars and study visits.

ASSESSMENT

Theory 9 credits (written examination), laboratory sessions 5 credits (attendance and written and oral presentation), seminar 1 credit (attendance in seminars and oras as well as written presentation for literature seminar).

UPPSALA UNIVERSITET

Syllabus for Immunology

Immunologi

15 credits
Course code: 1BG313
Education cycle: Second cycle
Main field(s) of study and in-depth level: Biology A1N
Grading system: Fail (U), 3, 4, 5.
Established: 2007-03-15
Established by: The Faculty Board of Science and Technology
Revised: 2011-11-23
Revised by: The Faculty Board of Science and Technology
Applies from: week 29, 2012
Entry requirements: 120 credits including (1) 60 credits in biology and 30 credits in chemistry, or (2) 60 credits in chemistry, including Biochemistry, 15 credits, and 30 credits in biology, including 15 credits in molecular genetics.
Responsible department: Biology Education Centre

LEARNING OUTCOMES

To give a broad and detailed overview of the field of immunology and detailed knowledge about many of the most important immunological technologies.

After the course, students will be able to

- use immunological terminology
- account for the different haematopoietic cell groups regarding phenotype, function and distribution
- account for how these cells are formed and in which organs this take place and how the cells are governed by growth and differentiation factors as well as cell adhesion molecules
- explain differences between the adaptive and non-adaptive (innate) immune defence regarding specificity, memory and kinetics
- account for the different genetic - and selection mechanisms at the molecular and cellular level, that governs the formation of the enormous numbers of antigen-specific receptors, immunoglobulins and T-cell receptors, that are the basis for the adaptive immune defence in vertebrates
- account for the immune response against different pathogens and how these pathogens through different virulence factors influence the immune system possibilities to combat the infection
- account for the mechanisms and components that participate in an inflammatory response
- compare different immunological diseases and the genetic basis for these at the molecular and cellular level
- account for the immune response against tumours and transplanted tissue
- account for various types of immunotherapies and vaccinations
- account for different immunological methods and be able to apply a number of these
- analyse data from immunological trials, draw conclusions and generate hypotheses

- plan and carry out an immunological project with literature search and present the results written, in the form of a summary, and orally, in the form of a scientific presentation
- critically review both data - and review papers.

CONTENT

The student achieves the aims by acquiring knowledge of the immune system, its subcomponents and molecular and cellular processes for development of the immune system, how the immune system functions in healthy people and in immunological disease, cancer and transplantation and how immunotherapies and vaccinations can be used to hamper or prevent disease. This knowledge is acquired through lectures that cover the whole field of immunology through self-studies and through laboratory sessions, where students learn important and common immunological methods. The student obtain a scientific work procedure and approach through careful documentation of his/her laboratory work in a laboratory journal and problem-solving at seminars, where scientific data are analysed (theoretical practical assignments).

Immunological projects with literature search, in addition to oral and written reports of scientific data, give skills in how to find information and how to structure and present this information.

Several parts of the course have labour market links:

- Bases in scientific work and approach.
- Skills in documentation and critical evaluation of scientific data
- Oral and written presentation in both English and Swedish.
- Through their broad and solid knowledge in immunology, the students will be attractive on the labour market for both small, medium, and large biotechnology companies, pharmaceutical industry and humanitarian aid projects.

INSTRUCTION

The teaching is given in the form of lectures, project work, theoretical practical assignments and laboratory sessions. Participation in project work, theoretical practical assignments and laboratory sessions are compulsory.

ASSESSMENT

Modules: Theory 9 credits; Laboratory session 3 credits; Exercise 3 credits
The theory module will be examined through two written tests, 1) theoretical knowledge, and 2) theoretical knowledge and theoretical laboratory skills and analysis of data and immunological problems. For the module laboratory sessions, accomplished laboratory sessions including laboratory reports, are required. The module Exercise requires implemented theoretical practical assignments that are presented orally, and active participation in project work that is presented in written form and orally.

UPPSALA UNIVERSITET

Syllabus for Neurobiology

Neurobiologi

15 credits
Course code: 1BG207
Education cycle: First cycle
Main field(s) of study and in-depth level: Biology G2F
Grading system: Fail (U), 3, 4, 5.
Established: 2007-03-15
Established by: The Faculty Board of Science and Technology
Revised: 2017-04-27
Revised by: The Faculty Board of Science and Technology
Applies from: week 27, 2017
Entry requirements: 80 credits in biology equivalent to the basic course in biology within the Bachelor Programme in Biology/Molecular Biology.
Responsible department: Biology Education Centre

LEARNING OUTCOMES

After completing the course, the student should be able to

- describe the structure and function of neurons and glia cells
- describe how neurons are connected in neuronal circuits that control our behaviour
- describe the central nervous system, the autonomous nervous system and the peripheral nervous system including the structure and function of the sensory organs and describe and analyse how the interactions between these and the most important transmitters influence the functions of the body
- describe some of the functions of the nervous system such as the regulation of , movement, motivation, pain, emotions and memory
- describe neurological disorders such as Parkinson's disease, addiction, schizophrenia, depression
- analyse a given theoretical problem/case, identify gaps in knowledge and retrieve knowledge independently to be able to present a scientifically sound solution
- give an account for the current neurobiological techniques, such as brain histology, optogenetics, electrophysiology and electrochemistry, behavioural analyses, transgenics
- identify and apply a suitable method theoretically or practically to address the research question at hand
- compile and present a literature study and develop an ability to critically analyse and discuss science by reviewing texts in public and scientific papers
- identify and discuss ethical issues related to scientific activities.

CONTENT

The course structure is aimed at in-depth knowledge of the molecular and cellular neurobiology and basic knowledge of general neurobiology. The emphasis is on mammalian neurobiology, particularly humans. Course introduction focuses on neuroanatomy and basic cellular mechanisms such as neurotransmitter release and electrophysiology. It then describes more integrated functions of the nervous system from the molecular to the cognitive level, such as the different senses (sight, smell, etc.), musculoskeletal neurobiology, reward system, biological rhythms, emotions and pain. The course also describes the current methods in neuroscience research.

INSTRUCTION

The teaching consists of lectures, laboratory sessions, problem-based learning sessions and literature seminars.

ASSESSMENT

To pass the course, passed participation in compulsory part (laboratory sessions, problem-based learning sessions, seminars and literature seminars), passed laboratory report, passed oral half-time examinations and passed results of examination are required. Credit points of the

modules are: written exam 9 credits, laboratory sessions 2 credits, seminars, 2 credits, the literature assignment seminars 1 credit, and oral exams 1 credit.

UPPSALA UNIVERSITET

Syllabus for Molecular Cell Biology

Molekylär cellbiologi

15 credits
Course code: 1BG320
Education cycle: Second cycle
Main field(s) of study and in-depth level: Biology A1N
Grading system: Fail (U), 3, 4, 5.
Established: 2007-03-15
Established by: The Faculty Board of Science and Technology
Revised: 2011-10-06
Revised by: The Faculty Board of Science and Technology
Applies from: week 32, 2011
Entry requirements: 150 credits including (1) 60 credits in biology and 30 credits in chemistry, or (2) 60 credits in chemistry, including Biochemistry, 15 credits, and 30 credits in biology, including 15 credits in molecular genetics and 15 credits in cell biology, or (3) admission to the Master Programme in Chemistry with specialisation in Biochemistry.
Responsible department: Biology Education Centre

LEARNING OUTCOMES

The aim of the course is to provide the students with advanced knowledge and understanding of molecular processes in cells and organisms.

After the course, students will be able to

- Explain the principles and the structural and mechanistic details of important processes in cells and organisms (cell growth, gene expressions, signal transduction, cell structure, cell differentiation and cell adhesion) and be able to discuss the complexity of the different interacting systems
- Account for certain key experiments within the subject area
- Analyse experimental data, and from the data, draw conclusions and formulate scientific hypotheses
- Critically review chosen subjects within current research in the subject area and present analyses in the form of an oral presentation and a poster
- Use certain important laboratory techniques within the subject area (mammalian cell culture, light optical microscopy and gel electrophoresis)
- Analyse structural details in proteins and protein complexes by using molecular graphics program.

CONTENT

The course consists of the following parts

Signal transduction: The principles of cell-to-cell communication via chemical signalling; signal molecules and receptors, components in intracellular signal pathways and their functions

The cytoskeleton: The architecture and dynamics of the three types of cytoskeleton systems and their motor proteins

Adhesion: Macromolecules in the extracellular matrix and the cellular adhesions proteins as well as their interactions; different types of adhesion complexes

The cell cycle: Regulation and mechanisms for cell replication in eukaryotes; the molecular mechanisms important for the development of cancer

Transcription: Roles of general and specific transcription factors in the initiation of transcription, protein-DNA interaction, and mRNA processing

Translation and protein targeting: Mechanisms of regulation of the translation initiation, mechanisms of peptide synthesis and control of the accuracy of protein synthesis, protein processing and quality control in the endoplasmic reticulum, vesicle-mediated protein transport

Computer exercises: The mechanistic details of different processes are studied in a number of computer exercises where the relevant macromolecules and their interactions are analysed

Laboratory sessions: Cultivation of mammalian cells, fluorescence microscopy, SDS-PAGE and silver staining.

Literature projects: The students work in groups with a chosen current research topic within the subject. The results are presented as a poster and a short oral presentation.

INSTRUCTION

The teaching is given in the form of lectures, seminars, computer exercises, laboratory sessions and literature projects. Participation in seminars, computer exercises, laboratory sessions and literature projects is compulsory. Integrated communication training with feedback and self evaluation occurs during the course.

ASSESSMENT

Modules: Signal transduction, transcription and translation 5 credits; The cell cycle, cytoskeleton and cell adhesion 5 credits; Laboratory sessions, seminars and literature project 5 credits
The module signal transduction, transcription and translation is examined with a written examination. The module the cell cycle, cytoskeleton and cell adhesion is examined with a written examination. The laboratory sessions are presented in the form of laboratory reports. The seminars require active participation and oral presentations. The literature project is presented as a poster and an oral presentation.

UPPSALA UNIVERSITET

Syllabus for Research Training in Biology

Forskningspraktik i biologi

15 credits
Course code: 1BG225
Education cycle: First cycle
Main field(s) of study and in-depth level: Biology G2F
Grading system: Fail (U), Pass (G).
Established: 2012-03-08
Established by: The Faculty Board of Science and Technology
Applies from: week 27, 2012
Entry requirements: Biology, 80 credits equivalent basic course in biology within the Bachelor programme in biology.
Responsible department: Biology Education Centre

LEARNING OUTCOMES

After the course, the student should have relevant working experience After completing the course, the student should be able to

- in extent and time delimit and plan for implementation of the training period
- carry out a compilation of the literature in the field
- give a correct oral and written presentation of the work training period

CONTENT

The student participates in regular activities within industry, public administration or academic research. The student should under supervision or independently participate in work relevant to the subject.

INSTRUCTION

The student is given private tuition at the working place

ASSESSMENT

Written and oral presentation of the work training period

UPPSALA UNIVERSITET

Syllabus for Degree Project C in Biology

Examensarbete C i biologi

15 credits
Course code: 1BG214
Education cycle: First cycle
Main field(s) of study and in-depth level: Biology G2E
Grading system: Fail (U), Pass (G).
Established: 2008-03-13
Established by: The Faculty Board of Science and Technology
Revised: 2014-04-16
Revised by: The Faculty Board of Science and Technology
Applies from: week 27, 2014
Entry requirements: The basic course in biology 80 credits within the Bachelor programme in biology. For admission, a project plan approved by the department is required
Responsible department: Biology Education Centre

LEARNING OUTCOMES

After the course, the student shall:

- be able to search for relevant scientific literature and critically summarise and interpret it
- be able to generate hypotheses to explain the observations made in the chosen area of specialisation
- be able to present his/her knowledge in Swedish, and to some extent in English, to different target groups, both in scientific and popular scientific styles
- have a good ability to handle text and present data (figures, tables), references, etc. according to the format specified for the particular genre
- be able to give constructive criticism of other students' manuscript drafts
- be able to present his/her knowledge in a poster in a pedagogic manner
- identify and in a structured way discuss ethical issues related to the topic the student has chosen.

CONTENT

An individual assignment is carried out, where the knowledge from previously completed courses is applied. The work is carried out guided by a supervisor in close connection with ongoing research or development projects.

To achieve the aims, the student should

- under supervision delimit a scientific problem, examine this, interpret and evaluate the results and present the work oral and written
- search, evaluate and compile information relevant to the chosen problem
- participate actively in seminars and other activities on the workplace where the work is carried out

INSTRUCTION

The teaching is designed individually depending on the specialisation of the project.

ASSESSMENT

To pass, a passed oral and written presentation of the degree project at a seminar is required. The written presentation should consist of a scientific report, a popular summary and a summary in English.

To pass it is required, apart from passed presentations, that the student has participated actively in seminars drafts to the three presentations are discussed.