Ecology MSc

VU University Amsterdam - Fac. der Aard- en Levenswetenschappen - M Ecology - 2015-2016

The aim of the Master programme Ecology is to provide you with the knowledge, skills and insight required to operate as an independent professional and to be a suitable candidate for a subsequent course of study leading to a career in Ecological research. After having completed the programme, you will have developed a critical scientific approach and an awareness of the ethical and societal aspects of Ecology.

The programme has two specialisations: ‘Ecology and Evolution’ and ‘Environmental Chemistry and Toxicology’. These specialisations are organised in close cooperation with the University of Amsterdam (UvA). This implies that some (course) components will take place at the Science Park of UvA and others at the VU campus. In all courses teachers of both universities will be participating.

Each course is given at one or the other university, so teachers move between classes. In general elective courses are given every two years (except Adaptive Dynamics and Biodiversity and Landscapes that can be taken every year).

When registered in the MSc Ecology programme of the VU you will also automatically be registered as a ‘bijvakstudent’ at the UvA (similarly for UvA students). You will thus be assigned a VUnetID and a UvAnetID. You should enrol for VU (course) components at: vunet.vu.nl using your VUnetID and for UvA (course) components: http://datanose.nl/#masterenrol with your UvAnetID.

You can find the content, study load and other details of each of the course modules in the course descriptions in this guide.

You can find all regulations applying to the classes and examinations of the Master’s programme in Ecology in the Academic and Examination Regulations of the Master’s Programme Ecology at the FALW website.

The year schedule can be found at the FALW-website.
Further information about the MSc programme Ecology.

Note: Not every course is given each year, so please consult the year schedules for further information.

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Expired programme components Ecology

The course programme components presented in the list below will no longer be part of the examination programme in academic year 2015-2016.

The course Ethics in Life Sciences (AM_470707) will not be part of the E&E specialization anymore.

Evolutionary Dynamics (AMU_0007)

Courses:

Name	Period	Credits	Code
Environmental Chemistry and Toxicology I		6.0	AM_1032
Environmental Chemistry and Toxicology II		6.0	AMU_0004
Evolutionary Dynamics		6.0	AMU_0007

Ecology, specialisation Environmental Chemistry and Toxicology

This specialization is organized by the Institute for Environmental Studies of the VU University in cooperation with Institute of Biodiversity and Ecosystem Dynamics of the University of Amsterdam (UvA) and the Department of Analytical Chemistry and Applied Spectroscopy of the VU. Students registered at VU University who have successfully completed the Environmental Chemistry and Toxicology programme will obtain an MSc diploma in Ecology with a specialization in Environmental Chemistry and Toxicology.
The programme has four components:

1) Compulsory courses (30 ec), to be taken in the year of arrival
• Environmental and Human Toxicology (AM_1184, 6 ec)
• Environmental Chemistry (AM_0020, 6 ec)
• Ecotoxicology and Water Quality (AM_1054, 6 ec)
• Experimental Design and Analysis (AM_470505, 6 ec)
• Scientific Writing in English (AM_1157, 3 ec)
• Ethics (AM_470707, 3 ec)

2) Elective courses (18 ec), choose 12 ec from the list below
• Spatial Processes in Ecology and Evolution(AMU_0009, 6 ec)
• Environmental Genomics and Adaptation (AM_470506, 6 ec)
• Nature of life meetings (AM_1016, 3 ec)
• Biochemical Cycles (AMU_0002, 6 ec)
• Assessment of Natural and Chemical Hazards (AMU_0001, 6 ec)
• Environmental Measuring Techniques (AMU_0005, 6 ec)
• Separation Sciences (X_435609, 6 ec)
• Molecular Spectroscopy (X435062, 6 ec)
• Mass Spectrometry (X_435604, 6 ec)
• Ecosystem Services and Scientific Advocacy (AM_1053, 6 ec)
• Value of Ecosystem Services and Biodiversity (AM_468024, 6 ec)

3) Research projects (60-66 ec)
Students will have to carry out two research projects/internships. A

minor theses of 30 ec and a major thesis of 30- 36 ec. Students are encouraged to complete one project at their home university and the other elsewhere at another university or research institute. Both projects will focus on Environmental Chemistry or Toxicology. All research projects and internships have to be approved by the master coordinator in advance. Approval will take place on the basis of a project proposal written by the student. Please check the course description of the Research Project for more detailed information.

4) Literature thesis (12 ec)
Students are required to carry out a literature thesis of 12 ec. The literature thesis can focus on a fundamental question in Environmental Chemistry or Toxicology, but may also take a more applied or societal approach. The subject of the thesis has to be approved by the master coordinator on the basis of a proposal written by the student. Please check the course description of the Literature Thesis for more detailed information.

For the time schedule please check:
http://www.falw.vu.nl/en/students/schedules/Year-planning/index.asp

Coordinator MSc Ecology specialisation Environmental Chemistry and Toxicology:
Juliette Legler, juliette.legler@vu.nl, tel: 020-5989516

Courses:

Name	Period	Credits	Code
(Bio)Molecular Spectroscopy	Period 5	6.0	X_435062
Assessment of Natural and Chemical Hazards	Period 4	6.0	AMU_0001
Biogeochemical Cycles	Ac. Year (September)	6.0	AMU_0002
Ecosystem Services and Scientific Advocacy		6.0	AM_1053
Ecotoxicology and Water Quality	Period 2	6.0	AM_1054
Environmental and Human Toxicology	Period 1	6.0	AM_1184
Environmental Chemistry	Period 1	6.0	X_437004
Environmental Genomics and Adaptation	Period 2	6.0	AM_470506
Environmental Measuring Techniques	Ac. Year (September)	6.0	AMU_0005
Ethics in Life Sciences	Period 3	3.0	AM_470707
Experimental Design and Analysis	Period 2	6.0	AM_470505
Literature Survey Environmental Chemistry and Toxicology	Ac. Year (September)	12.0	AM_1132
Mass Spectrometry	Period 2	6.0	X_435604
Masterclasses in Ecology and Evolution	Ac. Year (September)	3.0	AM_1016

Research Project Environmental Chemistry and Toxicology I	Ac. Year (September)	30.0	AM_1108
Research Project Environmental Chemistry and Toxicology II	Ac. Year (September)	30.0	AM_1113
Scientific Writing in English (AM_ECOL)	Period 4	3.0	AM_1157
Separation Sciences	Period 1	6.0	X_435609
Spatial Processes in Ecology	Ac. Year (September)	6.0	AMU_0009

Specialization Ecology and Evolution

This specialization is organized by both the Department of Ecological Science (DES) of the VU University and the Institute of Biodiversity and Ecosystem Dynamics (IBED) of the University of Amsterdam (UvA). When you are registered at VU University and have successfully completed the Ecology and Evolution programme you will obtain an MSc diploma in Ecology with a specialization in Ecology and Evolution.

The programme has four components:

1) Compulsory courses (18 ec)
• Current Trends in Evolution (AMU_0003, 6 ec)
• Experimental Design and Analysis (AM_470505, 6 ec)
• Master classes in Ecology and Evolution (AM_1016, 3 ec)
• Scientific Writing in English (AM_1157, 6 ec)

2) Elective courses (12 - 18 ec)
• Environmental Genomics and Adaptation (AM_470506, 6 ec)
• Soil-Plant-Animal Interactions (AM_470507, 6 ec)
• Spatial Processes in Ecology and Evolution (AM_0009, 6 ec)
• Microbial Ecology (AMU_0008, 6 ec)
• Ecosystem Services and Scientific Advocacy (AM_1053, 6 ec)
• Evolution of Species Interactions (AMU_0006, 6 ec)

3) Two research projects (72 - 78 ec)
Students will have to carry out two research projects/internships. The shortest should be 30 ec at least. The first internship has to take place at the VU or UvA, the second may be carried out elsewhere at another university or research institute. Both projects will focus on Ecology and/or Evolution. All
research projects and internships have to be approved by the master coordinator in advance. Approval will take place on the basis of a project proposal written by the student. Please check the course description of the Research Project and the Internship Manual for more detailed information.

4) Literature thesis (12 ec)
Students are required to carry out a literature thesis of 12 ec. The literature thesis can focus on a fundamental question in Ecology and Evolution, but may also take a more applied or societal
approach. The subject of the thesis has to be approved by the master coordinator on the basis of a proposal written by the student. Please check the course description of the Literature Thesis and the Thesis

Manual for more detailed information.

For the time schedule please check:
http://www.falw.vu.nl/en/students/schedules/Year-planning/index.asp

Coordinator MSc Ecology specialization Ecology and Evolution:
Gerard Driessen, room H-142, 020-5987046, g.j.j.driessen@vu.nl

Courses:

Name	Period	Credits	Code
Current Trends in Evolution	Ac. Year (September)	6.0	AMU_0003
Ecosystem Services and Scientific Advocacy		6.0	AM_1053
Environmental Genomics and Adaptation	Period 2	6.0	AM_470506
Evolution of Species Interaction		6.0	AMU_0006
Experimental Design and Analysis	Period 2	6.0	AM_470505
Literature Survey Ecology and Evolution	Ac. Year (September)	12.0	AM_1131
Masterclasses in Ecology and Evolution	Ac. Year (September)	3.0	AM_1016
Microbial Ecology	Ac. Year (September)	6.0	AMU_0008
Research Project Ecology and Evolution 1	Ac. Year (September)	30.0	AM_1100
Research Project Ecology and Evolution II	Ac. Year (September)	30.0	AM_1114
Scientific Writing in English (AM_ECOL)	Period 4	3.0	AM_1157
Soil-Plant-Animal Interactions		6.0	AM_470507
Spatial Processes in Ecology	Ac. Year (September)	6.0	AMU_0009

(Bio)Molecular Spectroscopy

Course code	X_435062 (435062)
Period	Period 5
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	prof. dr. G.W. Somsen
Examinator	prof. dr. G.W. Somsen
Teaching staff	prof. dr. G.W. Somsen
Teaching method(s)	Lecture
Level	400

Course objective
This course deals with interactions between light and molecules as studied and employed by optical spectroscopy. Goal of the course is to acquire a deeper knowledge of several spectroscopic principles and techniques frequently applied in (bio)analytical chemistry.

Course content
The course will start with an introduction to photophysical principles and fundamentals of molecular spectroscopy. Basic aspects of molecular orbitals, electronic transitions and quantummechanics will be treated. Basic properties of light and principal optical instrumentation will be discussed. The fundamentals, practice and applications of electronic spectroscopy (UV/Vis absorption, fluorescence, phosphorescence) and vibrational spectroscopy (infrared, Raman) will be systematically treated.

Form of tuition
Lecture (h): 30 hrs
Seminar/werkcollege (w): 12 hrs

Type of assessment
Written examination (T)

Course reading
Lectures and problem solving sessions.

Entry requirements
Basic knowlegde on chemical structure, bonds and hybridization.

Recommended background knowledge
Basic principles of molecular orbitals, energy levels and molecular vibrations. Basic experience with absorption spectrometry.

Target group
mCh-AS

Assessment of Natural and Chemical Hazards

Course code	AMU_0001 ()
Period	Period 4
Credits	6.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/7775

Remarks
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Biogeochemical Cycles

Course code	AMU_0002 ()
Period	Ac. Year (September)
Credits	6.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/10611

Registration procedure
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Current Trends in Evolution

Course code	AMU_0003 ()
Period	Ac. Year (September)
Credits	6.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/74140

Registration procedure
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Ecosystem Services and Scientific Advocacy

Course code	AM_1053 ()
Credits	6.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	prof. dr. J.A. Harvey
Examinator	prof. dr. J.A. Harvey
Teaching method(s)	Lecture

Course objective
1. To stimulate the students in developing critical ways to evaluate and interpret scientific information, and particularly information on issues related to society, ecosystem services and the environment.
2. To teach students to filter through a large body of information that broaches both science and society.

The final attainment levels of this course include that students
1. understand the natural (ecological) economy and the many ways in

which it sustains the material (human) economy through the provisioning of conditions and processes that underpin civilization.
2. have the ability to evaluate the ways in which humans impact nature and how this is intimately linked with population and consumption patterns that differ between nation states.
3. know how to determine how sustainable (or not) different nations of the world are.
4. have the skills to critically evaluate the efficacy of information presented by various sources (the media, internet etc.) on scientific and environmental processes and problems.
5. can assess the role of scientists in studying and disseminating the results of their research to society, and whether their views should cross the threshold into the policy arena.

Course content
Four main topics with varying overlap and several themes.

1. Ecosystem services (ES) from an economic perspective; initial discussion of important ecosystem services (focusing on provisioning and supporting e.g. fisheries, crops, nutrient cycling, soil fertility, pest control etc. Five to six lectures envisaged by J. Harvey and several guest speakers. Assignment for students: provide an example of an ES that has been valuated (quantifiably) by economists. Try and find one that falls in to the category of ‘supporting’ because these are the most problematic in terms of valuation and prepare a short presentation. Following this, discussion groups are assembled to debate and argue over the over- or under-valuation of the services studied. Votes are taken amongst the student body before and after the debate to see whose arguments are most convincing.

2. Indices measuring human impact on the biosphere and on important ES. Focuses on ecological footprint analyses (EFA) and how they relate to nation states and the biosphere as a whole. Five to six lectures envisaged by J. Harvey and several guest speakers. Assignment: select a country and evaluate/calculate its ecological footprint in an essay. Is the country sustainable? How much must it reduce its footprint to achieve sustainability?

3.Critical evaluation of information on ecology and environmental issues. How accurate is the media in covering issues such as climate change and biodiversity loss? What other sources of information compete for public attention? How accurate are blogs and web sites on the internet? Are there hidden (or not-so-hidden) agendas that are at work? How does one deal with the huge amount of information at our disposal? Five to six lectures envisaged by J. Harvey and several guest speakers. Assignment: presentation of an analysis of a newspaper or internet article on a recent environmental issue. Evaluate its accuracy of information and possible alternate agenda.

4. The role of scientists: how far should we step outside of the university and research labs in disseminating information? The costs (professional risks) and benefits (pro-active) of becoming involved in societal debates. Lectures by prominent scientists. Assignment: write a critical review or evaluation of an important environmental issue, and design a plan for accurately conveying information on the subject to the public through the media or internet.

Form of tuition

Lectures and Workshops

Type of assessment
Based on essays (50%) and presentations and contributions to workshops (50%)

Course reading
Selected papers

Entry requirements
BSc in Biology, Earth and Economy, Future Planet Studies or Bèta-gamma with a minor in environmental science or ecology. Students with other previous education should contact the course coordinator.

Target group
MSc students with a focus on ecological economics. The maximum number of participants is 50. Priority is granted to students in the MSc Ecology and Evolution programme of the VU and UvA.

Ecotoxicology and Water Quality

Course code	AM_1054 ()
Period	Period 2
Credits	6.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	dr. ir. T.H.M. Hamers
Examinator	dr. ir. T.H.M. Hamers
Teaching method(s)	Lecture, Practical

Course objective
At the end of this course, students will have:
1. Gained theoretical knowledge of contaminants in the environment, their effects on organisms and ecosystems, and the assessment of water quality
2. Learned to determine the ecotoxicological effects of chemicals with laboratory toxicity testing
3. Developed a critical academic attitude in environmental management issues by combining scientific information and socio-economic arguments

Course content
This course focuses on the effects of contamination of aquatic ecosystems, from the molecular chemistry of major groups of toxicants to their impacts at the molecular, cellular, individual, population, and ecosystem level.

The first part of the course is a laboratory practical, in which students gain hands-on experience in ecotoxicity testing using methods from bacteria, aquatic invertebrates and fish. Both whole-organism and molecular biological techniques are taught. Students will evaluate scientific literature and the results of their experimental research to assess the risk of environmental contaminants for ecosystem health. At the end of the practical, students will present the results of their experimental work in a poster presentation.

The second part of the course is theoretical and will teach the student the state of the art in ecotoxicology. It is designed as a scientific symposium with invited lectures by internationally renowned guest lecturers as well as PhD candidates who present their PhD research in ecotoxicology. Students take the role of chairperson during the symposium and introduce the speakers, ask questions and discuss critical issues. Topics include emerging compounds, molecular mechanisms of toxicity, community effects, global environmental problems, and chemical regulation. Scientific literature will be given as background information on each topic. The symposium is finalized with oral presentations in which students present a critical evaluation of the topics presented.

Form of tuition

• Laboratory practical course: 56 hours
• Lectures (introduction to practicals + scientific symposium): 36 hours
• Independent study: 68 hours

Type of assessment

1. Participation in laboratory practical course, including lab journal (15%)
2. Poster presentation of the laboratory practical course (35%).
3. Oral presentation of scientific symposium (15%)
4. Written exam of 10 open questions (35% of mark)

The student has passed if each of the components has received a minimum of 5.0, and the final mark is equal to or higher than 5.5, in a range from 1-10.

Course reading

Protocols for the laboratory practical will be provided.
For the theoretical part of the course, scientific articles will be provided by guest lecturers including:
Thomas KV, et al. Comparing illicit drug use in 19 European cities through sewage analysis. Sci
Total Environ. 2012 Aug 15;432:432-9.
van Boxtel AL, et al. Microarray analysis reveals a mechanism of phenolic polybrominated diphenylether toxicity in zebrafish. Environ Sci Technol. 2008 Mar 1;42(5):1773-9.
Roessink I, et al. Impact of triphenyltin acetate in microcosms simulating floodplain lakes. II. Comparison of species sensitivity distributions between laboratory and semi-field. Ecotoxicology. 2006 Jul;15(5):411-24.
Boivin ME, et al. Algal-bacterial interactions in metal contaminated floodplain sediments. Environ Pollut. 2007 Feb;145(3):884-94.
Zweers, PGPC et al. Verification of a REACH Environmental Prioritization System against Regulatory Risk Indices. Human and Ecological Risk Assessment. 2012

Entry requirements

BSc in Biology, Ecology, Biomedical Sciences, Health Sciences, Earth Sciences, Chemistry or related fields

Recommended background knowledge

BSc course in Environmental Toxicology (e.g. AB_1020) is recommended but not mandatory.

Target group
Open to all MSc students in Biology, Ecology, Biomedical Sciences, Health Sciences, Earth Sciences, Chemistry or related fields. Compulsory course for MSc Ecology, ECT specialization. Optional course for UvA MSc Biology, L&O track.

Remarks
For more information, please contact: Prof. dr. ir J. Legler, Room A-645, 020-5989516, juliette.legler@vu.nl

Environmental and Human Toxicology

Course code	AM_1184 ()
Period	Period 1
Credits	6.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Teaching method(s)	Lecture, Computer lab
Level	400

Environmental Chemistry

Course code	X_437004 (437004)
Period	Period 1
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Level	400

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/21184

Remarks
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Environmental Chemistry and Toxicology I

Course code	AM_1032 ()
Credits	6.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	prof. dr. ir. J. Legler
Examinator	prof. dr. ir. J. Legler
Teaching staff	dr. ir. C.A.M. van Gestel, dr. ir. T.H.M. Hamers, dr. D.T. Jager
Teaching method(s)	Lecture

Level	400

Course objective
This course will teach you to evaluate the exposure to and effects of chemicals in the environment.
Environmental Chemistry and Toxicology (ECT) integrates two disciplines: environmental chemistry and environmental toxicology. This ECT I course focuses on environmental toxicology, which deals with effects of chemicals in the environment on wildlife and human health, covering the realm of effects ranging from molecular and cellular to whole organism and ecosystem effects. This course can be taken together with ECT II (AM_1033), which focusses on environmental chemistry deals with the sources and fate of chemicals, as well as their environmental partitioning and transport, degradation and deposition.
General aim:
The main aim of the course Environmental Chemistry and Toxicology I is to understand the biological effects of chemicals in the environment on organisms, including humans.
Learning objectives
At the end of the course you will have learned
1. The main questions and key concepts in the field of environmental toxicology
2. To think critically in environmental quality and risk assessment issues
3. To present scientific results (both written and oral) and place them in the appropriate scientific context

Course content
Students will obtain a sound theoretical background in the major concepts in toxicology. Topics include chemical uptake and metabolism, molecular mechanism of toxicity, biochemical and physiological effects, community and population effects. Major groups of toxicants that will be discussed include pesticides,
persistent organic pollutants and endocrine disrupting chemicals, as well as mixture toxicity. Toxicity testing and dose-response modeling are covered. Students will also research the main incidents and disasters involving chemicals in history. One important aspect of the course is the risk assessment of chemicals: when do we say that the exposure to a chemical is safe and when is it hazardous? Students will learn how to perform risk assessment as it is done in the real world, taking into account the exposure, effects on humans and wildlife, and other mitigating factors.

Form of tuition
This course contains a series of lectures, seminars and working classes. Students prepare a scientific report on an important historical disaster involving chemicals and the impact of this disaster on the risk assessment of chemicals, and present their results in a series of presentations.
Lectures: 44 hours
Working classes: 12 hours
Presentations: 12 hours

Type of assessment
The course is completed with a written exam worth 50% of the final mark. The environmental disaster report is worth 25% of the final mark. Oral presentations and the participation of the students in the course make up the final 25% of the course. The student has passed if the final mark

is equal to or higher than 5.5 in a range from 1-10. Each component of the course (exam, report and presentations) must achieve a 5.0 or higher to pass.

Course reading
Suggested reading: Walker et al, Principles of Ecotoxicology, 4th Edition, 2012, ISBN 978-1-4398-6266-7

Entry requirements
This course is open to all Master students with a BSc in Biology, Biomedical Sciences, Ecology or Chemistry. It is a compulsory course for MSc Ecology – ECT track students. For more information and to determin if you have sufficient background to take this course, please contact the coordinator (juliette.legler@vu.nl)

Recommended background knowledge
This course is open to all Master students with a BSc in Biology, Biomedical Sciences, or Chemistry. It is a compulsory course for MSc Ecology – ECT track students. For more information and to determine if you have sufficient background to take this course, please contact the coordinator (juliette.legler@vu.nl)

Target group
This course is open to all Master students with a Biology, Ecology or Chemistry BSc. It is a compulsory course for MSc Ecology – ECT track students and can be followed in combination with ECT II (see AM_1033).

Environmental Chemistry and Toxicology II

Course code	AMU_0004 ()
Credits	6.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen

Course content
This is an UvA course. For the course description, please visit http://studiegids.uva.nl/

Environmental Genomics and Adaptation

Course code	AM_470506 ()
Period	Period 2
Credits	6.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	dr. ir. T.F.M. Roelofs
Examinator	dr. ir. T.F.M. Roelofs
Teaching staff	dr. ir. T.F.M. Roelofs
Teaching method(s)	Lecture, Computer lab, Practical, Study Group, Seminar
Level	500

Course objective
Students will be able to:
1 Describe different molecular genetic techniques to study gene expression and genomic variation in response to environmental stimuli.
2 Explain how to use these techniques in ecological and physiological research.
3 Analyze experimental data generated by genomics research and knowing the possibilities for follow-up research
4 Find and analyze genomic data in databases on internet.
5 Describe the functional significance of genomic variation for organisms and populations in natural environments.
6 Characterize the evolutionary consequences of such variation for species abundance, community diversity, and the evolution of speciation

Course content
Researchers in ecology and physiology are making extensive use of molecular techniques. Environmental genomics can be applied to advance our
understanding of the way organisms functionally respond to changes within their local environment. Such responses may have consequences for species
abundance, community diversity, and the evolution of speciation. In this course we will focus on:
Regulation of gene expression. Which genes are turned on in response to environmental challenge, and what do they do?
Differences in the molecular basis of fitness among individuals.
Is there intraspecific variation in gene expression in response to environmental change, and is this variation adaptive?
Furthermore, we will assess evolutionary consequences of genomic variation. What are the
ecosystem-, community-, and population-level consequences of the molecular transformations in the genome? Does gene family expansion and contraction drive speciation, or does the emergence of new gene bodies and protein domains add to speciation?
We will follow topics covered by chapters in the book `An Introduction to Ecological Genomics' and include molecular adaptation to drought, genetic marker development and analytical methods, evolution of metal tolerance, speciation genetics.
Practical training include a Gene expression experiment, designed and executed by the students. Also, a computer exercise on transcriptomics (microarray data) will be performed. These data are extracted from peer-reviewed scientific papers. Finally, a journal club will be organized, in which students present a scientific paper on an Ecological Genomics topic.
The field of ecological genomics moves extermely quickly. Consequently, topics addressed in the accompanying book will be out of date to some extent. In order to address up-to-date and stat-of-art knowledge on ecological genomics topics, specialists in this field will be invited to give guest lectures.

Form of tuition
Lectures & Guest Lectures
Seminar (journal club) discussing recent literature on Environmental genomics. Presentation of a scientific paper during this seminar.
Written report summarizing the content of the presented scientific paper.
Practical training regarding gene expression analysis using Q-PCR

technology.
Written report of Practical: Introduction, Material & Methods, Results and Discussion.
Computer exercise on transcriptomic data retrieved from public databases. The Limma package in R will be used predominantly. TIGR Mev software will be applied to visualize data output.
Self study

Type of assessment
Pres: Assessment of oral presentation of a research paper by a panel consisting of course coordinator, junior lecturer and Post-doc. Standardized forms will be used to retrieve scores for different aspects of the presentation.
Verslag: Assessment of written reports on QPCR practical and scientific paper
Mean grade of presentation and written reports will make up 30% of the final grade; presentation can be compensated with written report and visa versa.
Tentamen: Written exam consisting of open questions will make up 70% of final grade. A score of at least 5.5 for the written exam is required to pass this course.

Course reading
N. M. van Straalen and D. Roelofs 2011. An Introduction to Ecological Genomics, 2nd edition. Oxford University Press.

Entry requirements
BSc level course on molecular biology, such as BSc course on Evolutionary Genetics (AB_1022) or Developmental Biology (AM_470613)

Target group
MSc students Biology and Ecology from VU and UvA

Registration procedure
Standard via VUnet

Environmental Measuring Techniques

Course code	AMU_0005 ()
Period	Ac. Year (September)
Credits	6.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/7903

Registration procedure
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Ethics in Life Sciences

Course code	AM_470707 ()

Period	Period 3
Credits	3.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	prof. dr. J.T. de Cock Buning
Examinator	prof. dr. J.T. de Cock Buning
Teaching staff	prof. dr. J.T. de Cock Buning, dr. J.F.H. Kupper
Teaching method(s)	Lecture, Study Group
Level	400

Course objective
To provide a toolbox of ethical instruments to analyze properly moral problems related (to one's own) research in the life sciences
• To acquire conceptual knowledge of the central concepts in applied philosophy and professional ethics
• To challenge an ethical reflection on one owns life science specialization and to open it for an impartial and constructive discussion
• To exercise a team based project to enter prepare and execute a moral dialogue
• To acquire the necessary skills to handle ethical issues in an accountable manner, as a professional academic beyond one's own inclinations and prejudgments

Course content
Researchers in life sciences generate the knowledge that builds the future of our society. Therefore, professional academics should be accountable for their decisions, experimental designs and presentation of results. In this short course, the principles of justification will be illustrated with cases of technology ethics and medical ethics. The way an ethical review committee on animal research works, is simulated by a role play exercise on an actual research protocol. Finally, as a small group training project, an ethical dialogue is prepared and executed together with another team.

Form of tuition
Ethics in the Life Sciences is a fulltime course of four weeks (3 ECTS). The total study time is 80 hours.
The different elements have the following study time:
• Lectures: 13 hours
• Work groups: 17 hours
• Group assignment: 24 hours
• Exam: 2 hour
• Presentation : 4 hours
• Self working (reading in the first week): 20 hours
Please note that attendance to the work group meetings is compulsory. Attendance to the lectures is highly recommended. In our experience, relying on self-study alone is insufficient to apply the theory of the lectures in the assignments of the workgroups, and to pass the exam.

Type of assessment
• Degree of intellectual participation in the workgroups (10%)
• exam (50%) has to be passed
• written and verbal execution of the ethical dialogue (40%)

Course reading
Available on Blackboard

Entry requirements
Bsc Biology, Biomedical Sciences, Psychology with profile Biological Psychology or Neuropsychology

Target group
Compulsory course in all FALW Master programmes, except Health Sciences and Neuro Sciences

Remarks
Lectures in English, part of the workgroups are in Dutch. All presentations and plenary discussions in English.
In order to maximize the experience of differences in values and preferences, and this increase meaningful ethical inquiry we will place you randomly in the workgroups. Placement will be communicated after the introduction lecture.

Evolution of Species Interaction

Course code	AMU_0006 ()
Credits	6.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	dr. ir. T.F.M. Roelofs
Examinator	dr. ir. T.F.M. Roelofs

Course content
This is an UvA course. For the course description, please visit http://studiegids.uva.nl/

Evolutionary Dynamics

Course code	AMU_0007 ()
Credits	6.0
Faculty	Fac. der Aard- en Levenswetenschappen

Course content
This is an UvA course. For the course description, please visit http://studiegids.uva.nl/

Experimental Design and Analysis

Course code	AM_470505 ()
Period	Period 2
Credits	6.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	dr. J.T. Weedon
Examinator	dr. J.T. Weedon

Teaching staff	dr. G.J.J. Driessen, dr. P.H. Vos, J. Duivenvoorden, dr. J.T. Weedon
Teaching method(s)	Lecture, Computer lab
Level	500

Course objective
The final attainment levels of this course, include that students:
- Are acquainted with possible experimental designs and can select the most suitable design depending on experimental objective and hypothesis
- Are acquainted with possible statistical analyses, understand the theory and the assumptions underlying the various analyses and can test the underlying assumptions
- Can select the most suitable statistical analysis depending on the design chosen and the statistical assumptions
- Can interpret the chain of hypotheses, design and analysis to validate hypotheses on-field-conditions and model behaviour

Course content
A proper experimental design combined to a suitable statistical analysis is essential to -biological- science, even though it is considered by many as a necessary evil. In this course, the whole chain of hypothesis and design to analysis and interpretation is covered to allow students to apply a range of statistical techniques independently. The application
and implementation of the techniques (in R) is the basis. Possible experimental designs are discussed in relation to specific biological questions and hypotheses. The application of statistical analysis is treated in relation to these designs. Theory and especially the assumptions underlying the test are treated to the extent that this information is necessary to apply the tests properly. Both -combinations of- regression and analysis of variance techniques and multivariate analysis techniques like unconstrained and constrained ordination and meta
analysis are dealt with. Other biological questions like classification issues, working with large datasets, data reduction and multiple response variables are discussed.

Form of tuition
As application is central to this course, case studies, assignments and working with real biological data is the core of this course. Starting of with the research question, hypothesis and the lab/field/model situation a proper design and statistical analysis will be discussed. A specific case study, explained by the researcher who performed that particular research, is used to illustrate this chain of arguments. Theory, assumptions and tests are all treated in the context of these case studies and are coupled directly to the case study and subsequent assignments. The course is finalised with an extensive case study, to which the theory is applied. This set-up translates into 30 contact hours for lectures, 4 contact hours for a practical on the first assignment and 20 contact hours for feedback on the assignments .

Type of assessment
Report on the final case study (100%)

Course reading
Quinn, G.P. and M.J. Keough (2002), Experimental design and data analysis for biologists Cambridge University Press

Dalgaard, P. (2008) Introductory Statistics with R

Logan, M. (2010) Biostatistical Design and Analysis Using R: A Practical Guide. Wiley

Borcard, D., F. Gillet and P. Legendre (2011) Numerical ecology in R. Springer

Bolker, B.M., M.E. Brooks, C.J. Clark, S.W. Geange, J.R. Poulsen, M.H.H. Stevens and J.S. White (2009). Generalized linear mixed models: a practical guide for ecology and evolution. Trends Ecol. Evol. 24: 127-135

Gurevitch, J. and L.V. Hedges (1999) Statistical issues in ecological meta-analyses. Ecology 80: 1142-1149

This literature is complimented by a syllabus, explanations on assignments, answers to the assignments, lecture handouts, background information, background notes on Blackboard.

Entry requirements
Methodology and statistics 1 and 2 or equivalent statistics courses. This implies that we require students to understand the interpretation of P-values, type I and type II errors and statistical hypotheses testing in general. In addition, students are required to have understanding on t-tests (paired and unpaired), linear regression and one-way ANOVAs.

Target group
The course is compulsory for MSc Ecology students at the VU doing the Ecology and Evolution or the Environmental Chemistry and Toxicology specialization and for UvA students doing the Ecology and Evolution specialization of the master Biological Science. The course is also open for master students in Biology, Ecology or Earth Sciences and PhD students at the VU and UvA universities with a deficiency in experimental design and statistics.

Remarks
The course is organized by the Department of Ecolgical Science at the VU and the Institute for Biodiversity and Ecosystem Dynamics of the UvA. All contact hours are at VU University.

Lecturers:
dr. J.T. Weedon,
dr. J. Duivenvoorden,
dr. M. Egas

Literature Survey Ecology and Evolution

Course code	AM_1131 ()
Period	Ac. Year (September)
Credits	12.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen

Coordinator	dr. G.J.J. Driessen
Examinator	dr. G.J.J. Driessen

Course objective
For master students in Ecology and Evolution it is required to carry out a thesis based on a literature survey (12 ec). The aim is to demonstrate the ability to efficiently process material in a given field and evaluating this critically.

IMPORTANT: A extensive manual containing the forms and a description of all procedures and requirements of the literature thesis Ecology and Evolution can be found on:
http://www.falw.vu.nl/nl/onderzoek/ecological-sciences/internships-at-the-institute/index.asp

Course content
The literature survey can focus on a fundamental ecological question but may also take a more
applied ecological approach. The topic and research question are free of choice.

Prior to participating in any thesis or literature survey, both student and faculty staff member and external supervisor (if applicable) involved should fill
out a written application and agreement form.
This form (and others) can also be downloaded from:
http://tinyurl.com/hvo9u4a

Form of tuition
Every literature survey has to be approved by the master coordinator in advance (on behalf of the examination board). Therefore you should hand in a proposal that you have discussed with the faculty staff member and/or external supervisor.

Consult the manual for the literature survey for further details concerning writing of the proposal and the thesis.

Type of assessment
At the end of the literature survey the student gives an oral presentation of the work in the Department of Ecology. The work and presentation will be assessed by the VU supervisor in consultation with the external supervisor, if applicable.

Literature theses will be will be assessed according to the following categories:
A. Execution (25%)
B. Thesis (50%)
C. Oral Presentation (25%)

Course reading
Selected papers

Target group
Students in MSc Ecology specialization Ecology and Evolution

Remarks
In order to successfully start up and complete the literature thesis it is of major importance to read carefully the manual on:

http://tinyurl.com/hvo9u4a

Literature Survey Environmental Chemistry and Toxicology

Course code	AM_1132 ()
Period	Ac. Year (September)
Credits	12.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	prof. dr. ir. J. Legler
Examinator	prof. dr. ir. J. Legler

Course objective
For master students in Environmental Chemistry and Toxicology, it is required to carry out a thesis based on a literature survey (12 ec). The aim is to demonstrate the ability to efficiently process material in a given field and evaluate this critically.

IMPORTANT: A extensive manual containing the forms and a description of all procedures and requirements of the literature thesis in the MSc Ecology programme can be found on:
http://www.falw.vu.nl/nl/onderzoek/ecological-sciences/internships-at-the-institute/index.asp

Course content
The literature survey can focus on a fundamental question in environmental chemistry and/or environmental toxicology but may also take a more applied approach. The topic and research question are free of choice, but should be discussed before starting with the programme coordinator (see below).

Prior to participating in any thesis or literature survey, both student and faculty staff member and external supervisor (if applicable) involved should fill out a written application and agreement form. This form (and others) can also be downloaded from:
http://www.falw.vu.nl/nl/onderzoek/ecological-sciences/internships-at-the-institute/index.asp

Form of tuition
Every literature survey has to be approved by the master coordinator in advance (on behalf of the examination board). Therefore you should hand in a proposal that you have discussed with the faculty staff member and/or
external supervisor.
Consult the manual for the literature survey for further details concerning writing of the proposal and the thesis.

Type of assessment
At the end of the literature survey the student gives an oral presentation of the work at the Institute for Environmental Studies. The work and presentation will be assessed by the VU supervisor in consultation with the external supervisor, if applicable.

Literature theses will be will be assessed according to the following categories:
A. Execution (25%)

B. Thesis (50%)
C. Oral Presentation (25%)

Course reading
Selected papers

Target group
Students in MSc Ecology specialization Environmental Chemistry and Toxicology

Registration procedure
In order to successfully start up and complete the literature thesis it is of major importance to read carefully the manual at: http://www.falw.vu.nl/nl/onderzoek/ecological-sciences/internships-at-the-institute/index.asp

Remarks
For more information, contact the MSc Ecology - ECT coordinator Prof.dr.ir Juliette Legler, room A645, tel 020 5989516, Juliette.legler@vu.nl

Mass Spectrometry

Course code	X_435604 (435604)
Period	Period 2
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Level	400

Course content
http://studiegids.uva.nl/web/uva/sgs/nl/c/229.html

Remarks
Registration via https://www.sis.uva.nl is mandatory 4 weeks before the start of the Semester.

Masterclasses in Ecology and Evolution

Course code	AM_1016 ()
Period	Ac. Year (September)
Credits	3.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	prof. dr. J. Ellers
Examinator	prof. dr. J. Ellers
Teaching method(s)	Lecture, Seminar
Level	400

Course objective
To obtain a broad overview of the latest research in ecology and evolution
- To learn to critically evaluate scientific research articles

- To practice skills of scientific argumentation and discussion
- Learning to discuss these topics with leading scientists in the field

Course content
Being able to participate in discussion is an important skill for scientists. It requires the ability to combine theoretical and empirical knowledge as well as a critical view on the arguments put forward by others. The best way to improve these skills is to practice them under supervision of senior scientists. In this course students are trained to discuss the important topics in Ecology and Evolution with top scientists in the world, in the form of a masterclass (described below). In doing so, students will attend seminars from these internationally renowned scientists in the Nature of Life meetings organized by the Institute of Ecological Sciences (VU) and in the series of IBED lectures organized by the Institute for Biodiversity and Ecosystem Dynamics (UvA). Both series are organized on a monthly basis throughout the year (except the summer period). The topics for the seminars cover the whole spectrum of ecology and evolution. An overview of upcoming and previous seminars can be found at www.falw.vu.nl/nl/onderzoek/ecological-sciences/nature-of-life-meetings/index.asp and www.science.uva.nl/ibed-agenda/see.cfm. Students must attend six masterclasses during the 2-year programme. Students may attend more theme lectures on a facultative basis, subject to availability.

Form of tuition
In preparation for each masterclass, several recent papers by the guest speaker will be studied and extensively discussed during a tutorial meeting with staff members of the Institute of Ecological Sciences or of the Institute for Biodiversity and Ecosystem Dynamics. Students then participate in a discussion meeting with the speaker (the actual masterclass), and finally they attend the seminar as part of the course. Students are required to participate actively in the discussion during the tutorials, masterclass and the seminar. The total number of contact hours (including lectures and discussions) is 30, the remaining time is spent on preparation.

Type of assessment
Factors which count for the final grade:
For each masterclass: active participation, theoretical insight, and argumentation of the students in the tutorial meeting, masterclass and seminar: 100%
Students pass after 6 satisfactorily participated masterclasses.

Course reading
Primary literature and recent articles by the guest speakers, to be announced at least one week before each masterclass.

Entry requirements
BSc Biology from a Dutch University. Students with a BSc in Earth Sciences, Social Geography, Beta/Gamma, and international BA's with Nuffic accreditation can be admitted, but extra elements can be obligatory.

Target group
Master students in Biology and Ecology (from both the Ecology and Evolution as well as the Environmental Chemistry and Toxicology specializations) at the VU and master students from the Biological Sciences specialization Ecology and Evolution at the UvA.

Remarks
Location: VU University Amsterdam, De Boelelaan 1085 Amsterdam
and University of Amsterdam, Science Park 904 Amsterdam

Microbial Ecology

Course code	AMU_0008 ()
Period	Ac. Year (September)
Credits	6.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/14424

Registration procedure
This course is offered at the UvA. For more information contact: FNWI
Education Service Centre, Science Park 904,
servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Research Project Ecology and Evolution 1

Course code	AM_1100 ()
Period	Ac. Year (September)
Credits	30.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	dr. G.J.J. Driessen
Examinator	dr. G.J.J. Driessen
Level	600

Course objective
The aims of the master's placement are:
• The student learns to independently conduct scientific research.
• The student is able to independently find scientific information and to evaluate this for the benefit of his or her own research question.
• The student is able to apply scientific methods and knowledge, to answer research questions and to generate evidencebased knowledge.
• The student is able to formulate a research question, to choose, to implement and to evaluate the (appropriate) research method, and to phrase the obtained results in a scientific report.
• The student is able to cooperate with researchers of various disciplines.
• The student is able to write a scientific report of the research on the level of peer-reviewed academic journals.
• The student is able to orally present the research results and to discuss the findings.
• The student obtains a good impression of a potential future field of career.

Course content
The two research projects in the Ecology and Evolution programme serve to get students acquainted and experienced with the practice of ecological research. Both research projects should thus reside in Ecology. If you have 12 ec in elective courses in your programme both research projects together will have to amount up to 78 ec. If you have 18 ec in elective courses the total study load is 72 ec. The shortest project should at least be 30 ec.

The first research project during your MSc Ecology and Evolution must take place at the Department of Ecological Science at the VU, or at the Institute for Bioversity and Ecosystem Dynamics at the UvA.
For research projects at the Ecology department of the VU check the website:

www.falw.vu.nl/nl/onderzoek/ecological-sciences/internships-at-the-insti

If you want to do a project outside the VU you may look for internships at the websites of other Dutch universities or research institutes, for example: NIOO (fundamental ecological research), NIOZ (marine ecology), ALTERRA (applied and environmental ecology), RIVM (applied and environmental ecology), SOVON (avian ecology), but also at the sites of nature conservation organisations such as Natuurmonumenten, Staatsbosbeheer, or regional authorities (Provincie and Waterschap).
However, organisations for the conservation of specific species (f.e. butterflies, dolphins, tigers, primates, etc.)will generally not be qualified enough. Research projects/internships in commercial companies are generally also not accepted, since commercial and educational interests often are quite different. Projects at universities or research institutes outside the Netherlands can also be accepted provided they are of sufficient academic quality.

In all cases: take care that you will be working on an ecological research question and that you will be able to collect enough reliable data to write a scientific report in the end. Purely monitoring or inventory projects are not of a masters' level and will not be allowed.

Form of tuition
A Placement Manual for Research Projects in the MSc Ecology can be obtained at:
http://tinyurl.com/hvo9u4a

This document contains the protocols, guidelines for proposals and reports and application and assessment forms, etc. needed to successfully complete a research project.

IT IS VERY IMPORTANT to read this document carefully in order to avoid unpleasant experiences during the progress of the placement. Every research project or literature study has to be approved by the master coordinator in advance.

Type of assessment
At the end of the project a scientific report of the work has to be written in English an oral presentation has to be given also in English. The final grade will be determined by the VU supervisor and VU second assessor in consultation with the external supervisor, if applicable. It is based on the following categories: attitude (pass/fail), execution (20%), presentation (20%) and report (60%).

Course reading
Selected papers

Entry requirements
You are not allowed to start a research project before having obtained already 18 ec in master courses.

Target group
MSc Ecology specialization Ecology and Evolution

Registration procedure
See placement manual at:
http://tinyurl.com/hvo9u4a

Remarks
The Placement Manual for Research Projects in the MSc Ecology can be obtained at:
http://tinyurl.com/hvo9u4a

Research Project Ecology and Evolution II

Course code	AM_1114 ()
Period	Ac. Year (September)
Credits	30.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	dr. G.J.J. Driessen
Examinator	dr. G.J.J. Driessen
Level	600

Course objective
The aims of the master's placement are:
• The student learns to independently conduct scientific research.
• The student is able to independently find scientific information and to evaluate this for the benefit of his or her own research question.
• The student is able to apply scientific methods and knowledge, to answer research questions and to generate evidencebased knowledge.
• The student is able to formulate a research question, to choose, to implement and to evaluate the (appropriate) research method, and to phrase the obtained results in a scientific report.
• The student is able to cooperate with researchers of various disciplines.
• The student is able to write a scientific report of the research on the level of peer-reviewed academic journals.
• The student is able to orally present the research results and to discuss the findings.
• The student obtains a good impression of a potential future field of career.

Course content
The two research projects in the Ecology and Evolution programme serve to get students acquainted and experienced with the practice of ecological research. Both research projects should thus reside in Ecology. If you have 12 ec in elective courses in your programme both

research projects together will have to amount up to 78 ec. If you have 18 ec in elective courses the total study load is 72 ec. The shortest project should at least be 30 ec.

The first research project during your MSc Ecology and Evolution must take place at the Department of Ecological Science at the VU, or at the Institute for Bioversity and Ecosystem Dynamics at the UvA.
For research projects at the Ecology department of the VU check the website:

www.falw.vu.nl/nl/onderzoek/ecological-sciences/internships-at-the-insti

If you want to do a project outside the VU you may look for internships at the websites of other Dutch universities or research institutes, for example: NIOO (fundamental ecological research), NIOZ (marine ecology), ALTERRA (applied and environmental ecology), RIVM (applied and environmental ecology), SOVON (avian ecology), but also at the sites of nature conservation organisations such as Natuurmonumenten, Staatsbosbeheer, or regional authorities (Provincie and Waterschap).
However, organisations for the conservation of specific species (f.e. butterflies, dolphins, tigers, primates, etc.)will generally not be qualified enough. Research projects/internships in commercial companies are generally also not accepted, since commercial and educational interests often are quite different. Projects at universities or research institutes outside the Netherlands can also be accepted provided they are of sufficient academic quality.

In all cases: take care that you will be working on an ecological research question and that you will be able to collect enough reliable data to write a scientific report in the end. Purely monitoring or inventory projects are not of a masters' level and will not be allowed.

Form of tuition
A Placement Manual for Research Projects in the MSc Ecology can be obtained at:
http://tinyurl.com/hvo9u4a

This document contains the protocols, guidelines for proposals and reports and application and assessment forms, etc. needed to successfully complete a research project.

IT IS VERY IMPORTANT to read this document carefully in order to avoid unpleasant experiences during the progress of the placement. Every research project or literature study has to be approved by the master coordinator in advance.

Type of assessment
At the end of the project a scientific report of the work has to be written in English an oral presentation has to be given also in English. The final grade will be determined by the VU supervisor and VU second assessor in consultation with the external supervisor, if applicable. It is based on the following categories: attitude (pass/fail), execution (20%), presentation (20%) and report (60%).

Course reading
Selected papers

Entry requirements
You are not allowed to start a research project before having obtained already 18 ec in master courses.

Target group
MSc Ecology specialization Ecology and Evolution

Registration procedure
See Placement Manual at:
http://tinyurl.com/hvo9u4a

Remarks
The Placement Manual for Research Projects in the MSc Ecology can be obtained at:
http://tinyurl.com/hvo9u4a

Research Project Environmental Chemistry and Toxicology I

Course code	AM_1108 ()
Period	Ac. Year (September)
Credits	30.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	prof. dr. ir. J. Legler
Examinator	prof. dr. ir. J. Legler
Level	600

Course objective
The aims of the master's placement are:
• The student learns to independently conduct scientific research.
• The student is able to independently find scientific information and to evaluate this for the benefit of his or her own research question.
• The student is able to apply scientific methods and knowledge, to answer research questions and to generate evidencebased knowledge.
• The student is able to formulate a research question, to choose, to implement and to evaluate the (appropriate) research method, and to phrase the obtained results in a scientific report.
• The student is able to cooperate with researchers of various disciplines.
• The student is able to write a scientific report of the research on the level of peer-reviewed academic journals.
• The student is able to orally present the research results and to discuss the findings.
• The student obtains a good impression of a potential future field of career.

Course content
The two research projects in the MSc Environmental Chemistry and Toxicology specialization serve to get students acquainted and experienced with the practice of research in environmental chemistry and environmental toxicology. Students are required to do one research project in environmental chemistry (AM_1108), and one in environmental toxicology (AM_1113). Each research projects is 30 Ec. One of the projects may be extended by 6 Ec by substituting an elective course.

The first research project during your MSc Ecology – ECT must take place at the Institute for Environmental Studies or Department of Ecological Sciences at the VU, or at the Institute for Biodiversity and Ecosystem Dynamics at the UvA.
For research projects at the VU, contact the coordinator or check the website:
www.falw.vu.nl/nl/onderzoek/ecological-sciences/internships-at-the-institute.

If you would like to do a project outside the VU you may look for internships at the websites of other Dutch universities or research institutes, for example: KWR or Waternet (applied water research), NIOO (fundamental ecological research), NIOZ (marine ecology), IMARES (fisheries and sea research), ALTERRA (applied and environmental ecology), RIVM (applied and environmental ecology), Deltares (applied environmental sciences), but also at the sites of nature conservation organisations such as Natuurmonumenten, Staatsbosbeheer, or regional authorities (Provincie and Waterschap). Projects at universities or research institutes outside the Netherlands can also be accepted provided they are of sufficient academic quality.
In all cases: take care that you will be working on either an environmental chemistry or environmental toxicology research question and that you will be able to collect enough reliable data to write a scientific report in the end. Purely monitoring or inventory projects will not be allowed.

Form of tuition
A Placement Manual for Research Projects in the MSc Ecology can be obtained from the master coordinator (g.j.j.driessen@vu.nl). This document contains the protocols, guidelines for proposals and reports and application and assessment forms, etc. needed to successfully complete a research project. It is very important to read this document carefully in order to avoid unpleasant experiences during the progress of the placement. Every research project or literature study has to be approved by the master coordinator in advance.

Type of assessment
At the end of the project a scientific report of the work has to be written in English an oral presentation has to be given also in English. The final grade will be based on the following categories: attitude (pass/fail), execution (20%), presentation (20%) and report (60%).

Entry requirements
You are not allowed to start a research project before having obtained already 18 ec in master courses.

Recommended background knowledge
The MSc course Experimental Design and Analysis (AM_470505) is strongly recommended.

Target group
MSc Ecology - ECT students

Remarks
For more information, please contact: Prof. dr. ir J. Legler, Room A-645, 020-5989516, juliette.legler@vu.nl

Research Project Environmental Chemistry and Toxicology II

Course code	AM_1113 ()
Period	Ac. Year (September)
Credits	30.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	prof. dr. ir. J. Legler
Examinator	prof. dr. ir. J. Legler
Level	600

Course objective
The aims of the master's placement are:
• The student learns to independently conduct scientific research.
• The student is able to independently find scientific information and to evaluate this for the benefit of his or her own research question.
• The student is able to apply scientific methods and knowledge, to answer research questions and to generate evidencebased knowledge.
• The student is able to formulate a research question, to choose, to implement and to evaluate the (appropriate) research method, and to phrase the obtained results in a scientific report.
• The student is able to cooperate with researchers of various disciplines.
• The student is able to write a scientific report of the research on the level of peer-reviewed academic journals.
• The student is able to orally present the research results and to discuss the findings.
• The student obtains a good impression of a potential future field of career.

Course content
The two research projects in the MSc Environmental Chemistry and Toxicology specialization serve to get students acquainted and experienced with the practice of research in environmental chemistry and environmental toxicology. Students are required to do one research project in environmental chemistry (AM_1108), and one in environmental toxicology (AM_1113). Each research projects is 30 Ec. One of the projects may be extended by 6 Ec by substituting an elective course.
The first research project during your MSc Ecology – ECT must take place at the Institute for Environmental Studies or Department of Ecological Sciences at the VU, or at the Institute for Biodiversity and Ecosystem Dynamics at the UvA.
For research projects at the VU, contact the coordinator or check the website:
www.falw.vu.nl/nl/onderzoek/ecological-sciences/internships-at-the-institute.

If you would like to do a project outside the VU you may look for internships at the websites of other Dutch universities or research institutes, for example: KWR or Waternet (applied water research), NIOO (fundamental ecological research), NIOZ (marine ecology), IMARES (fisheries and sea research), ALTERRA (applied and environmental ecology), RIVM (applied and environmental ecology), Deltares (applied environmental sciences), but also at the sites of nature conservation organisations such as Natuurmonumenten, Staatsbosbeheer, or regional authorities (Provincie and Waterschap). Projects at universities or research institutes outside the Netherlands can also be accepted

provided they are of sufficient academic quality.
In all cases: take care that you will be working on either an environmental chemistry or environmental toxicology research question and that you will be able to collect enough reliable data to write a scientific report in the end. Purely monitoring or inventory projects will not be allowed.

Form of tuition
A Placement Manual for Research Projects in the MSc Ecology can be obtained from the master coordinator (g.j.j.driessen@vu.nl). This document contains the protocols, guidelines for proposals and reports and application and assessment forms, etc. needed to successfully complete a research project. It is very important to read this document carefully in order to avoid unpleasant experiences during the progress of the placement. Every research project or literature study has to be approved by the master coordinator in advance.

Type of assessment
At the end of the project a scientific report of the work has to be written in English an oral presentation has to be given also in English. The final grade will be based on the following categories: attitude (pass/fail), execution (20%), presentation (20%) and report (60%).

Entry requirements
You are not allowed to start a research project before having obtained already 18 ec in master courses.

Recommended background knowledge
The MSc course Experimental Design and Analysis (AM_470505) is strongly recommended.

Target group
MSc Ecology - ECT students

Remarks
For more information, please conctact: Prof. dr. ir J. Legler, Room A-645, 020-5989516, juliette.legler@vu.nl

Scientific Writing in English (AM_ECOL)

Course code	AM_1157 ()
Period	Period 4
Credits	3.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	M. van den Hoorn
Examinator	M. van den Hoorn
Teaching method(s)	Study Group
Level	400

Course objective
The aim of this course is to provide Master's students with the essential linguistic know-how for writing a scientific article in English that is well organized idiomatically and stylistically appropriate and grammatically correct.

At the end of the course students
- know how to structure a scientific article;
- know what the information elements are in parts of their scientific article;
- know how to produce clear and well-structured texts on complex subjects;
- know how to cite sources effectively;
- know how to write well-structured and coherent paragraphs;
- know how to construct effective sentences;
- know what collocations are and how to use them appropriately;
- know how to adopt the right style (formal style, cohesive style, conciseness, hedging)
- know how to avoid the pitfalls of English grammar;
- know how to use punctuation marks correctly;
- know what their own strengths and weaknesses are in writing;
- know how to give effective peer feedback.

Final texts may contain occasional spelling, grammatical or word choice errors, but these will not distract from the general effectiveness of the text.

Course content
The course will start with a general introduction to scientific writing in English. Taking a top-down approach, we will then analyse the structure of a scientific article in more detail. As we examine each section of an article, we will peel back the layers and discover how paragraphs are structured, what tools are available to ensure coherence within and among paragraphs, how to write effective and grammatically correct sentences and how to choose words carefully and use them effectively.

Topics addressed during the course include the following:
- Structuring a scientific article
- Considering reading strategies: who is your readership? How do they read your text? What do they expect? How does that affect your writing?
- Writing well-structured and coherent paragraphs
- Composing effective sentences (sophisticated word order, information distribution).
- Arguing convincingly – avoiding logical fallacies
- Academic tone and style: hedging – why, how, where?
- Using the passive effectively
- Understanding grammar (tenses, word order, etc.)
- Understanding punctuation
- Referring to sources: summarising, paraphrasing, quoting (how and when?)
- Avoiding plagiarism
- Vocabulary development: using appropriate vocabulary and collocations

Form of tuition
Scientific Writing in English is an eight-week course and consists of 4 contact hours during the first week and 2 contact hours a week for the rest of the course. Students are required to spend at least 6 to 8 hours of homework per week. They will work through a phased series of exercises that conclude with the requirement to write several text parts (Introduction, Methods or Results section, Discussion and Abstract). Feedback on the writing assignments is given by the course teacher and by peers.

Type of assessment
Students will receive the three course credits when they meet the following requirements:
- Students hand in three writing assignments (Introduction, Methods or Results, Discussion) and get a pass mark for all writing assignments;
- Students provide elaborate peer feedback;
- Students attend all sessions;
- Students are well prepared for each session (i.e. do all homework assignments);
- Students actively participate in class;
- Students do not plagiarise or self-plagiarise.

Course reading
Effective Scientific Writing: An Advanced Learner's guide to Better English (A. Bolt & W. Bruins, ISBN 978 90 8659 6171). VU bookstore: €27.95.

Target group
Students Ecology

Registration procedure
Important: each group has a minimum of 18 and maximum of 24 participants, so students should register on time through VUnet to ensure a place in one of the (designated) groups. If you have registered for a group in VUnet, you are expected to attend all sessions (eight). If you decide to withdraw from the course, please do so in time. This all will avoid a 'fail' on your grade list for not taking part in this course and allows other students to fill in a possible very wanted group spot.

Each semester, one or more open/general groups also take place (with a minimum of 18 participants), for which students may register instead of the designated group for their master programme. Students are advised to consult their schedule carefully, since overlap may occur. For more information, please check course code AM_471023.

Remarks
- To do well, students are expected to attend all lessons. Group schedules are to be found at rooster.vu.nl and on Blackboard.
- If you (expect to) miss a session, please inform the group trainer as soon as possible. If you miss a session without notification, you may not be able to finish the course.
- For any questions concerning this course, please contact onderwijsbureau.beta@vu.nl.

Separation Sciences

Course code	X_435609 (435609)
Period	Period 1
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. H. Lingeman
Examinator	dr. H. Lingeman
Teaching staff	dr. H. Lingeman

Teaching method(s)	Lecture
Level	400

Course objective
Getting acquainted with the theory and practice of the main techniques in modern analytical separation science.

Course content
The topics discussed comprise the fundamentals, theory and practice of gas chromatography, the various modes of liquid chromatography, capillary-based electrophoretic approaches as well as the hyphenation of the various separation systems with mass spectrometry and other sensitive and selective detection devices.

Form of tuition
Lectures and tutorials. Students have to summarize and present an (assigned) recent article on separation science.

Type of assessment
Written examination and a mark for the article presentation.

Course reading
Hands-outs (electronically available).

Entry requirements
Basic knowledge of biochemistry, chromatography, electrophoresis and mass spectrometry.

Recommended background knowledge
Basic knowledge of biochemistry, chromatography, electrophoresis and mass spectrometry.

Target group
mCh-AS

Soil-Plant-Animal Interactions

Course code	AM_470507 ()
Credits	6.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	prof. dr. M.P. Berg
Examinator	prof. dr. M.P. Berg
Teaching staff	prof. dr. M.A.P.A. Aerts, ing. R.S.P. van Logtestijn, prof. dr. J.H.C. Cornelissen, prof. dr. M.P. Berg, prof. dr. H.A. Verhoef
Teaching method(s)	Lecture, Practical, Study Group, Excursion, Fieldwork
Level	500

Course objective
Students will be able to:
- Underpin the importance of ecological interactions (trophic and non-trophic) between soil organisms-plants-aboveground fauna (and vice versa)

- Critically evaluate and investigate the relevant interactions between soil-soil organisms, soil-vegetation, soil organisms-vegetation, vegetation-herbivores (and vice versa)
- Critically evaluate and investigate the relevant functional traits that underlie ecological interactions between the soil-subsystem (brown web) and plant-subsystem (green web)
- In the field: apply different techniques to survey the soil-subsystem and plant-subsystem, and to sample soil and soil organisms
- In the laboratory: carry out ecological and biochemical analyses relevant to brown-green web interactions, with emphasis on organismal traits.

Course content
A hot theoretical topic in Ecology concerns the interdependency of the brown web (belowground) and green web (aboveground) compartments. This comprises key conceptual issues relating to interactions between brown and green communities, the importance of functional traits to understand these interactions within and between these communities, and the processes carried out by each component. These concepts can be applied to current
critical questions, such as the regulation and function of biodiversity, vegetation development, and consequences of human-induced global change, e.g. biological invasions, extinctions, nitrogen deposition, land use change and climate change.
In this course we will focus theoretically on the following subjects:
- The brown and green food web: biotic interactions and regulators
- Plant species and plant trait control of brown web interactions and processes
- Belowground consequences of green food web interactions
- Completing the circle: how brown web effects are manifested aboveground
- The regulation and function of biological diversity, with a focus on functional traits of plants, animals and microbes
- Global change phenomena in an aboveground-belowground context
These subjects are discussed in various papers (see literature) that will be used as the basic literature for the seminars given by the (guest) lecturers. In the second week, students will perform experiments on location (in Zevenaar, The Netherlands) where brown-green web interactions in subarctic ecosystems are currently being studied, with emphasis on (a) design and statistical treatment of experiments on soil-plant-fauna interactions, (b) techniques to identify soil organisms and analyse soil processes, biochemistry and vegetation development.

Form of tuition
Individual performance in critical group discussions about important theory based on these papers/chapters, a preliminary presentation about the own research project, and a final presentation about background, design and (synthesis of) results of own research project.

Type of assessment
Individual performance in critical group discussions about important theory based on these papers/chapters, a preliminary presentation about the own research project, and a final presentation about background, design and (synthesis of) results of own research project.

Course reading
Selected literature will be made available via BB, which includes recent key papers in international journals and extracts from Richard D. Bardgett and David A.Wardle (2010): "Aboveground-Belowground Linkages;

Biotic interactions, ecosystem processes, and global change". Oxford Series in Ecology and Evolution.

Entry requirements
To attend this course their will be costs involved. A part of the expenses for accommodation at Zevenaar have to be covered by the MSc-students themselves.

Target group
MSc students with focus on ecology.

Spatial Processes in Ecology

Course code	AMU_0009 ()
Period	Ac. Year (September)
Credits	6.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen

Course content
This is an UvA course. For the course description, please visit http://studiegids.uva.nl/