

ENVIRONMENTAL SCIENCES

www.sci.waikato.ac.nz/study/subjects/environmental-sciences

If we are to achieve environmental sustainability, we need to understand how the environment works and ensure we leave the world in a healthy functioning state for future generations.

Environmental Sciences at the University of Waikato is the interdisciplinary and systematic study of our environment as well as our role in its management. Pressures and impacts on our environment are increasing as the human population grows and we seek to utilise natural resources in ever increasing amounts.

Environmental science can provide the scientific basis for understanding environmental problems, and finding solutions to them. By studying environmental science and becoming qualified to work as an environmental scientist or technician, you can become directly involved in solving our environmental problems. A comprehensive understanding of environmental science is also necessary for those entering industries, consulting companies, and government agencies to ensure that they wisely manage the resources.

CONTACTS FOR ENVIRONMENTAL SCIENCES

Environmental Sciences is jointly taught between the Departments of Biological Sciences, Chemistry and Earth & Ocean Sciences.

Convener Dr Karin Bryan	Room: E2.06 Phone: 07 838 4123 Email: k.bryan@waikato.ac.nz
Department of Biological Sciences Departmental Administrator Gloria Edwards	Room: E2.20 Phone: 07 838 4022 Email: biology@waikato.ac.nz
Department of Chemistry Departmental Administrator Jacqueline MacKenzie	Room: E3.20 Phone: 07 838 4027 Email: chemistry@waikato.ac.nz
Department of Earth & Ocean Sciences Departmental Administrator Sydney Wright	Room: E2.07 Phone: 07 838 4024 Email: earth@waikato.ac.nz

Degrees

Environmental Sciences is available as an interdisciplinary major for the Bachelor of Science or Bachelor of Science (Technology) degrees.

Environmental Sciences Interdisciplinary Major

General Structure of a Environmental Sciences Interdisciplinary Major for the BSc and BSc(Tech) degrees			
100 LEVEL	BIOL102 15 points	ERTH104 15 Points	
200 LEVEL	BIOL212 20 points	CHEM or EARTH* 20 points	ERTH* 20 points
300 LEVEL	BIOL** 20 points	ERTH*** 20 points	**** 20 points

100 Level – Recommended prerequisites: BIOL102 The Biology of Organisms and EARTH104 Earth and Ocean Environments.

200 Level – BIOL212 Ecology. *Choose from: CHEM261 Geochemistry and Environmental Chemistry, EARTH233 Soils in the Landscape, EARTH234 Soil Properties and their Management, EARTH242 Oceanography, EARTH245 Weather and Climate and EARTH246 Introduction to Hydrology.

300 Level – **Choose from: BIOL312 Applied Terrestrial Ecology, BIOL313 Applied Freshwater Ecology, and BIOL314 Marine Biology and Monitoring. ***Choose from: EARTH333 Pedology and Land Evaluation, EARTH334 Soil and Land Management, EARTH343 Coastal Geomorphology and Management, EARTH344 Coastal Oceanography and Engineering EARTH345 Catchment Hydrology, and EARTH346 Groundwater and Hydrological Analysis. ****Choose from the 300 Level papers listed above or CHEM304 Special Topics in Chemistry.

Specialisations

Students may undertake the following specialisations for the BSc or BSc(Tech) major in Environmental Sciences.

» Agribusiness	*
» Environmental Microbiology	page 115
» Environmental Modelling	page 117
» Land and Freshwater Environments	page 119
» Marine Sciences	page 121
» Science International	page 157
» Te Pūtaiao me ngā take Māori	page 162

**Enrolment in this specialisation should be completed in consultation with both the Faculty of Science & Engineering and the Waikato Management School.*

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Choosing Papers

Environmental Sciences Interdisciplinary Major

To complete a major in Environmental Sciences, students must complete 120 points above 100 Level, including 60 points about 200 Level, from compulsory papers.

100 Level – Papers are worth 15 points.

Prerequisites

- » BIOL102A – The Biology of Organisms
- » EARTH104B – Earth and Ocean Environments

Students are strongly advised to consider taking some of the following papers

- » CHEM101A – Chemical Concepts
- » EARTH103A – Discovering Planet Earth
- » ENVS101B – Environmental Science
- » GEOG103A – Resource and Environmental Sustainability
- » MATH165A – General Mathematics
- » STAT111B – Statistics for Science or
STAT121A/S – Introduction to Statistical Methods

200 Level – Papers are worth 20 points unless specified.

Students should seek advice when selecting 200 Level papers to ensure they select appropriate papers to cover prerequisites for the 300 Level papers they may wish to pursue.

Compulsory papers

- » BIOL212A – Ecology

*Choose a further 40 points from:

- » CHEM261B – Geochemistry and Environmental Chemistry
- » EARTH233A – Soils in the Landscape (10 points)
- » EARTH234A – Soil Properties and their Management (10 points)
- » EARTH242B – Oceanography
- » EARTH245A – Weather and Climate (10 points)
- » EARTH246B – Introduction to Hydrology (10 points)

Students are strongly advised to consider taking further papers from the list above.

Other papers to consider including are any other EARTH or BIOL papers, or:

- » CHEM204A – Analytical Chemistry and Instrumental Techniques
- » ENMP241B – Environmental Technology 1
- » ENVP206B – Principles of Environmental Planning
- » EARTH251B – Engineering Geomorphology
- » EARTH284B – Introduction to Environmental Monitoring
- » GEOG219A – Māori Lands and Communities
- » GEOG228A – Information Technology and Cartography

300 Level – Papers are worth 20 points unless specified.

**Choose 20 points from the following 300 Level Biological Sciences papers

- » BIOL312A – Applied Terrestrial Ecology
- » BIOL313B – Applied Freshwater Ecology
- » BIOL314A – Marine Biology and Monitoring

***Choose 20 points from the following 300 Level Earth Sciences papers:

- » EARTH333A – Pedology and Land Evaluation (10 points)
- » EARTH334B – Soil and Land Management (10 points)
- » EARTH343B – Coastal Geomorphology and Management
- » EARTH344A – Coastal Oceanography and Engineering
- » EARTH345A – Catchment Hydrology (10 points)
- » EARTH346B – Groundwater and Hydrological Analysis (10 points)

****Choose a further 20 points from the 300 Level papers listed above or CHEM304A/B/C/S/Y – Special Topics in Chemistry (in an approved environmental chemistry topic)

Students are strongly advised to consider taking further papers from the lists above.

Other papers to consider including are any other EARTH or BIOL papers, or:

- » CHEM306B – Advanced Analytical Chemistry
- » ENMP341A – Environmental Technology 2
- » GEOG306A – Disasters and Developments
- » GEOG328B – Geographical Information Systems

Note(s): For descriptions of individual papers refer to the following subjects: *BIOL* Biological Sciences; *CHEM* Chemistry; *ENMP* Materials and Processing; *ENVS* Environmental Sciences; *ERTH* Earth Sciences. For papers with other subject codes refer to the **University Calendar**.

Timetable Clashes

Your selection of papers may depend on your timetable. You will not usually be permitted to take papers which have lecture clashes. Laboratory clashes can usually be resolved. You should contact the relevant department if you have a laboratory clash.

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Environmental Sciences Papers

100 Level Papers

ENVS101-12B (HAM) – Environmental Science

15 Points

An interdisciplinary study of the fundamental concepts in environmental science. The paper includes ecosystems, nutrient cycles, population principles, water, soil and energy resources, wetlands, human food supplies, agrochemicals, heavy metals, the greenhouse effect, photochemical smog, and waste management.

Lecture material is complemented by a practical component that includes six three-hour laboratory sessions and two field trips.

Co-ordinator(s): Dr Megan Balks

Lecturer(s): Dr Ian Duggan, Dr Megan Balks, Dr Conrad Pilditch and Associate Professor Chris Hendy

Tutor(s): To be advised

Required reading: ENVS101 Study Guide

Assessment: Internal assessment/examination ratio: 1 : 1

BSc(Tech) Work Placement Papers

For details refer to Work Placements.

Environmental Sciences Specialisations

The Faculty of Science & Engineering has a strong environment-related focus with a range of specialisations for students interested in pursuing careers in environmental management, environmental planning and environmental engineering, and research related to the environment. These programmes draw on a range of subject areas including biology, chemistry, earth sciences, engineering, geography, mathematics and physics.

Environmental Microbiology

Environmental microbiology focuses on the understanding and manipulation of microbial pathways that influence the natural environment. Students will gain an understanding of the important role microorganisms play in underpinning the environmental process, their role in nutrient and carbon cycling and their importance in bioremediation, soil fertility, eutrophication and waste disposal.

Environmental microbiology may be taken as a specialisation of the Environmental Sciences major for the BSc or BSc(Tech) degrees.

Structure of the Environmental Microbiology Specialisation								
100 LEVEL	BIOL102 15 points	ERTH104 15 points	BIOL101 15 points	CHEM102 15 points	ERTH103 15 points	SCIENCE 15 points	SCIENCE 15 points	ELECTIVE 15 points
200 LEVEL	BIOL212 20 points	ERTH233 10 points ERTH234 10 points	CHEM261 20 points	BIOL241 20 points	BIOL210 20 points	ELECTIVE 20 points		
300 LEVEL	BIOL312 20 points	ERTH333 10 points ERTH334 10 points	* 20 points	BIOL341 20 points	SCIENCE ** 20 points	ELECTIVE ** 20 points		

100 Level – Papers are worth 15 points.

Major prerequisites

- » BIOL102A – The Biology of Organisms
- » ERTH104B – Earth and Ocean Environments

Environmental microbiology specialisation papers

- » BIOL101B – Cellular and Molecular Biology
- » CHEM102B – Chemical Change and Organic Compounds
- » ERTH103A – Discovering Planet Earth

Recommended science/elective papers

- » CHEM101A – Chemical Concepts
- » ENVS101B – Environmental Science

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200 Level – Papers are worth 20 points unless specified.

Major papers

- » BIOL212A – Ecology
- » EARTH233A – Soils in the Landscape (10 points)
- » EARTH234A – Soil Properties and their Management (10 points)
- » CHEM261B – Geochemistry and Environmental Chemistry

Environmental microbiology specialisation papers

- » BIOL210B – Introduction to Genetics
- » BIOL241A – Microbiology – Form, Function and Metabolism

Recommended elective papers

- » BIOL251A – Biochemistry
- » EARTH242B – Oceanography
- » EARTH245A – Weather and Climate
- » EARTH246B – Introduction to Hydrology

300 Level – Papers are worth 20 points unless specified.

Major papers

- » BIOL312A – Applied Terrestrial Ecology
- » EARTH333A – Pedology and Land Evaluation (10 points)
- » EARTH334B – Soil and Land Management (10 points)

*Choose 20 points from the following papers:

- » BIOL313B – Applied Freshwater Ecology
- » BIOL314A – Marine Biology and Monitoring
- » CHEM304A/B/C/S/Y – Special Topics in Chemistry
(in an approved environmental chemistry topic)
- » EARTH343B – Coastal Geomorphology and Management
- » EARTH344A – Coastal Oceanography and Engineering
- » EARTH345A – Catchment Hydrology (10 points)
- » EARTH346B – Groundwater and Hydrological Analysis (10 points)

Environmental microbiology specialisation papers

- » BIOL341B – Microbial Physiology and Ecology

Recommended science/elective papers

- » BIOL310A – Advanced Genetics
- » BIOL351A – Advanced Biochemistry
- » BIOL362C – Molecular Biology and Biotechniques

**May be chosen from 200 or 300 Level papers.

Note(s): For descriptions of individual papers refer to the following subjects: BIOL Biological Sciences; CHEM Chemistry; ENV5 Environmental Sciences; EARTH Earth Sciences. For papers with other subject codes refer to the *University Calendar*.

Environmental Modelling

Environmental modelling focuses on the quantitative skills necessary to write and operate computer models necessary to predict future environmental change, to investigate human impacts on natural ecosystems, and how to manage and mitigate those impacts. This specialisation is for students who want to be able to model dynamics of estuaries, lakes, rivers, and coastlines, waves and ocean currents, and predict sediment movement on the continental shelf and estuaries; as well as to understand principles of environmental modelling.

Environmental Modelling may be taken as a specialisation of the Environmental Sciences major for the BSc or BSc(Tech) degrees.

Structure of the Environmental Modelling Specialisation								
100 LEVEL	BIOL102 15 points	ERTH104 15 points	COMP103 15 points	MATH101 15 points	MATH102 15 points	STAT111 OR STAT121 15 points	SCIENCE 15 points	ELECTIVE 15 points
200 LEVEL	BIOL212 20 points	*	*	MATH259 10 points **	STAT221 20 points	ELECTIVE 20 points		
300 LEVEL	BIOL*** 20 points	ERTH**** 20 points	***** 20 points	SCIENCE † 20 points	ELECTIVE † 20 points	ELECTIVE 20 points		

[†]May be chosen from 200 or 300 Level papers.

100 Level – Papers are worth 15 points.

Major prerequisites

- » BIOL102A – The Biology of Organisms
- » ERTH104B – Earth and Ocean Environments

Environmental modelling specialisation papers

- » COMP103A – Introduction to Computer Science 1
- » MATH101A/B/C/D – Introduction to Calculus
- » MATH102A/B/C/D – Introduction to Algebra
- » STAT111B – Statistics for Science or
STAT121A/S – Introduction to Statistical Methods

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200 Level – Papers are worth 20 points unless specified.

Major papers

- » BIOL212A – Ecology

*Choose 40 points from the following papers:

- » CHEM261B – Geochemistry and Environmental Chemistry
- » EARTH242B – Oceanography
- » EARTH245A – Weather and Climate (10 points)
- » EARTH246B – Introduction to Hydrology (10 points)

Environmental modelling specialisation papers

- » MATH259B – Mathematical Modelling (10 points)
- » STAT221A – Statistical Data Analysis

**Choose 10 points from:

- » MATH255B – Differential Equations (10 points)
- » ENGG284B – Differential Equations for Engineers (10 points)

Recommended elective papers

- » ENGG283A – Linear Algebra for Engineers (10 points)
- » ENGG285A – Multivariable Calculus for Engineers (10 points)
- » GEOG228A – Information Technology and Cartography
- » MATH251A – Multivariable Calculus (10 points)
- » MATH253A – Linear Algebra (10 points)
- » MATH257A – Computational Mathematics (10 points)

300 Level – Papers are worth 20 points unless specified.

Major papers

***Choose 20 points from the following 300 Level Biological Sciences papers:

- » BIOL312A – Applied Terrestrial Ecology
- » BIOL313B – Applied Freshwater Ecology
- » BIOL314A – Marine Biology and Monitoring

****Choose 20 points from the following 300 Level Earth Sciences papers:

- » EARTH333A – Pedology and Land Evaluation (10 points)
- » EARTH334B – Soil and Land Management (10 points)
- » EARTH343B – Coastal Geomorphology and Management
- » EARTH344A – Coastal Oceanography and Engineering
- » EARTH345A – Catchment Hydrology (10 points)
- » EARTH346B – Groundwater and Hydrological Analysis (10 points)

*****Choose a further 20 points from the 300 Level Biological Sciences

or Earth Sciences papers listed above or

- » CHEM304A/B/C/S/Y – Special Topics in Chemistry
(in an approved environmental chemistry topic)

Recommended elective papers

- » GEOG328B – Geographic Information Systems
- » MATH331B – Applied Mathematics

Note(s): For descriptions of individual papers refer to the following subjects: BIOL Biological Sciences; CHEM Chemistry; ENGG Engineering; ENMP Materials and Processing; ENVS Environmental Sciences; EARTH Earth Sciences. For descriptions of papers with subject codes COMP, MATH or STATS, refer to the **Computing & Mathematical Sciences Handbook**. For papers with other subject codes refer to the **University Calendar**.

Land and Freshwater Environments

This specialisation is for students with interests in the management of land and water resources and approaches to mitigate adverse impacts. Specific areas include soil management, water quality and nutrient dynamics. Students will gain a combination of biological and earth science skills and theory to allow a broad understanding of terrestrial and aquatic environments, and the links between biophysical processes to ecosystem dynamics.

Land and Freshwater Environments may be taken as a specialisation of the Environmental Sciences major for the BSc or BSc(Tech) degrees.

Structure of the Land and Freshwater Environments Specialisation								
100 LEVEL	BIOL102 15 points	ERTH104 15 points	BIOL101 15 points	CHEM101 15 points	ERTH103 15 points	STAT111 or STAT121 15 points	SCIENCE 15 points	ELECTIVE 15 points
200 LEVEL	BIOL212 20 points	ERTH233 10 points	ERTH245 10 points	CHEM261 20 points	ELECTIVE 20 points	ELECTIVE 20 points		
		ERTH234 10 points	ERTH246 10 points					
300 LEVEL	BIOL313 20 points	ERTH333 10 points	ERTH345 10 points	BIOL312 20 points	SCIENCE *	ELECTIVE *		
		ERTH334 10 points	ERTH346 10 points					

*May be chosen from 200 or 300 Level papers.

100 Level – Papers are worth 15 points.

Major prerequisites

- » BIOL102A – The Biology of Organisms
- » ERTH104B – Earth and Ocean Environments

Land and freshwater environments specialisation papers

- » BIOL101B – Cellular and Molecular Biology
- » CHEM101A – Chemical Concepts
- » ERTH103A – Discovering Planet Earth
- » STAT111B – Statistics for Science or
STAT121A/S – Introduction to Statistical Methods

Recommended science/elective papers

- » CHEM102B – Chemical Change and Organic Compounds
- » ENV5101B – Environmental Science

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200 Level – Papers are worth 20 points unless specified.

Major papers

- » BIOL212A – Ecology
- » ERTH233A – Soils in the Landscape (10 points)
- » ERTH234A – Soil Properties and their Management (10 points)
- » ERTH245A – Weather and Climate (10 points)
- » ERTH246B – Introduction to Hydrology (10 points)

Land and freshwater environments specialisation papers

- » CHEM261B – Geochemistry and Environmental Chemistry

Recommended elective papers

- » BIOL241A – Microbiology – Form, Function and Metabolism
- » BIOL251A – Biochemistry
- » CHEM204A – Analytical Chemistry and Instrumental Techniques
- » ERTH222A – Stratigraphy and Tectonics
- » GEOG228A – Information Technology and Cartography

300 Level – Papers are worth 20 points unless specified.

Major papers

- » BIOL313B – Applied Freshwater Ecology
- » ERTH333A – Pedology and Land Evaluation (10 points)
- » ERTH334B – Soil and Land Management (10 points)
- » ERTH345A – Catchment Hydrology (10 points)
- » ERTH346B – Groundwater and Hydrological Analysis (10 points)

Land and freshwater environments specialisation papers

- » BIOL312A – Applied Terrestrial Ecology

Recommended science/elective papers

- » BIOL351A – Advanced Biochemistry
- » ERTH384B – Advanced Environmental Monitoring (10 points)
- » GEOG328B – Geographic Information Systems

Note(s): For descriptions of individual papers refer to the following subjects: BIOL Biological Sciences; CHEM Chemistry; ENVS Environmental Sciences; ERTH Earth Sciences. For papers with other subject codes refer to the *University Calendar*.

Marine Sciences

This specialisation provides an integrated approach to biological and physical processes in the marine environment, with particular reference to coastal waters and estuaries. The knowledge gained from biological studies that examine how marine organisms function, and the processes affecting their distribution and abundance, is critical for the sustainable exploitation of marine environments.

Marine Sciences may be taken as a specialisation of the Environmental Sciences major for the BSc or BSc(Tech) degrees.

Structure of the Marine Sciences Specialisation								
100 LEVEL	BIOL102 15 points	ERTH104 15 points	BIOL101 15 points	ERTH103 15 points	STAT111 OR STAT121 15 points	SCIENCE 15 points	SCIENCE 15 points	ELECTIVE 15 points
200 LEVEL	BIOL212 20 points	ERTH242 20 points	CHEM261 20 points	* 20 points	ELECTIVE 20 points	ELECTIVE 20 points		
300 LEVEL	BIOL314 20 points	ERTH343 20 points	ERTH344 20 points	SCIENCE ** 20 points	SCIENCE ** 20 points	ELECTIVE 20 points		

**May be chosen from 200 or 300 Level papers.

ENVIRONMENTAL SCIENCES

100 Level – Papers are worth 15 points.

Major prerequisites

- » BIOL102A – The Biology of Organisms
- » EARTH104B – Earth and Ocean Environments

Marine sciences specialisation papers

- » BIOL101B – Cellular and Molecular Biology
- » EARTH103A – Discovering Planet Earth
- » STAT121A/S – Introduction to Statistical Methods

Recommended science/elective papers

- » CHEM101A – Chemical Concepts

200 Level – Papers are worth 20 points unless specified.

Major papers

- » BIOL212A – Ecology
- » EARTH242B – Oceanography
- » CHEM261B – Geochemistry and Environmental Chemistry

Marine sciences specialisation papers

*Choose 20 points from:

- » BIOL201A – Evolution and Diversity of Life
- » EARTH245A – Weather and Climate (10 points)
- » EARTH246B – Introduction to Hydrology (10 points)

Recommended elective papers

- » CHEM204A – Analytical Chemistry and Instrumental Techniques
- » EARTH222A – Stratigraphy and Tectonics
- » EARTH284B – Introduction to Environmental Monitoring
- » GEOG228A – Information Technology and Cartography

300 Level – Papers are worth 20 points unless specified.

Major papers

- » BIOL314A – Marine Biology and Monitoring
- » EARTH343B – Coastal Geomorphology and Management
- » EARTH344A – Coastal Oceanography and Engineering

Recommended science/elective papers

- » BIOL312A – Applied Terrestrial Ecology
- » BIOL313B – Applied Freshwater Ecology
- » BIOL338B – Advanced Zoology
- » CHEM306B – Advanced Analytical Chemistry
- » EARTH322B – Sedimentary and Petroleum Geology
- » EARTH384B – Advanced Environmental Monitoring
- » GEOG328B – Geographic Information Systems