

Biological Sciences

*Undergraduate
Handbook*

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Disclaimer

While every effort has been taken to ensure the information contained in this Biological Sciences Handbook is accurate and up-to-date, the contents are periodically subject to change and review. The University of Canterbury makes no guarantees as to the accuracy of the information contained in this publication.

For formal course regulations and prescriptions, please see the University of Canterbury Calendar.

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Welcome



Welcome to Biology at UC.

Biology literally means the study of living things. Biologists study animals, plants and microbes in many different ways and at various scales from biological molecules and cells to individual organisms, populations, and even ecosystems.

Our courses will help prepare you for a career, where the opportunities for a biologist are far-reaching: be it in research, teaching, policy, or as a front-line biosecurity officer. You will find our courses exciting, challenging, and up-to-the minute as our lecturers are all actively engaged in research in some aspect of the Biological Sciences. With three National Tertiary Teaching Excellence Awards and six UC Teaching Awards in recent years, we have a proven track record in excellence in teaching. We are also host to three Rutherford Discovery Fellows. The Fellowships support New Zealand's most talented early- to mid-career researchers.

It has been suggested that the 21st Century will belong to the biologist. We now have incredibly powerful tools available to us - from the laboratory tools of the molecular biologist to the computer tools employed by those engaged in modelling the processes occurring in ecosystems.

This handbook is provided to help you plan a course of study in Biology. If you have any questions please contact us.

Professor Paula Jameson
Head of School

Biology at UC



The Biology major offered at the undergraduate level provides a broad-based introduction to Biology.

Staff and research students in the School are engaged in research in three areas of biology that are vital to humankind:

- **Biodiversity** – defining, sustaining and rehabilitating the diversity of life contained in New Zealand's natural and managed ecosystems.
- **Biosecurity/Biosafety** – protecting our native biota from threats imposed by invasive organisms; understanding the potential impacts of genetic technologies on our environment
- **Biotechnology** – the application of biological understanding to provide products that benefit society and support sustainable economic development.

Biology is taught by the School of Biological Sciences. We offer over 40 undergraduate courses in biology and biochemistry. They are taught by academic staff who have expertise in diverse areas of biology ranging from genetics, biochemistry and molecular biology to ecology, conservation biology and biotechnology. Biology courses also support multidisciplinary studies such as Health Studies, Environmental Science, Biosecurity, Conservation Biology and Management and Antarctic Studies –Biology at UC offers something for everyone!

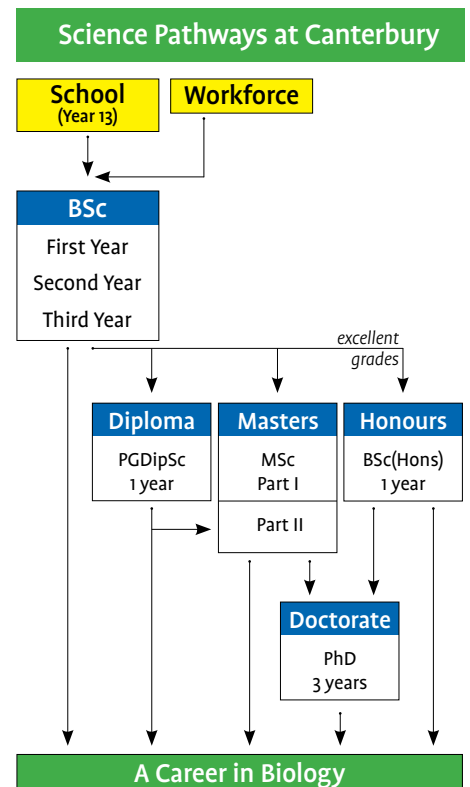
We expect all our Biology majors to study the

three core papers: BIOL 111 Cellular Biology and Biochemistry, BIOL 112 Ecology Evolution and Conservation and BIOL 113 Diversity of Life. BIOL 116 Human Biology is available as an extra course.

Having gained an introduction to the breadth of Biology, many students start to favour particular facets of biology. Such interests are catered for in the major thematic areas described in pages 10 to 21. You will see that there is overlap between the streams. The overlap is important – the new area of molecular genetics, for example, is just as important to the study of biodiversity as it is to the study of animal or plant development!

Entry to Biology

Entry into Biological Sciences is straight forward. However, students who have not completed Year 13 Biology may find the Science Headstart summer course in biology very useful. The diagram at right shows the different paths that may be followed to complete undergraduate and postgraduate studies in biology.



Graduate Profiles



James McCarthy

MSc Student, Ecology

With a keen interest in ecology, UC seemed an excellent choice to complete my studies as the courses offered suited my interests extremely well. While working toward my undergraduate qualification, I completed a summer studentship assessing the effects of the invasion of wilding pine on invertebrate species in native grassland systems. This moved on to a project assessing the interplay of biotic and abiotic factors determining colonisation of sapstain (a fungus that discolours wood) on windthrown plantation pine. After completing a BSc in Biological Sciences, I moved on to complete a masters degree researching the effect of tree-feeding bark beetles as vectors of pathogenic fungi that also affect trees. The broad range of academic expertise at Canterbury allowed me to undertake such a multi-disciplinary project ranging from field- and laboratory-based ecology, to the realms of molecular biology.



Rachel van Heugten

MSc student, Population Genetics

Out of high school, Rachel was offered entrance into the Chemistry Honours Program at UC but didn't want to give up biology. So in 2009, with interests in genetics, evolutionary ecology and biochemistry, she graduated with a BSc in Biological Sciences. Rachel was awarded a Masters Scholarship from UC, and is currently working on the population genetics of the rare Banks Peninsula tree weta (*Hemideina ricta*). Her study aims to determine whether this species is at risk of going extinct from hybridisation with the more common Canterbury tree weta (*Hemideina femorata*). This research will also ascertain how the remaining *H. ricta* populations are connected across fragmented habitat. Rachel hopes that her work will aid the future conservation of *H. ricta* and perhaps provide valuable insights relevant to broader conservation efforts.



Laura Young

PhD Student, Alpine Ecology

After completing a BSc at Auckland University, I began considering options for postgraduate study. The moment I heard that UC had a range of field stations situated in stunning locations, along with top ecology academics, I signed up. I completed a Masters in Ecology in 2006 and worked the following year as a research assistant on a Marsden grant in fire ecology. I was then awarded a Top Achiever Doctoral Scholarship to do my PhD, investigating seed dispersal in New Zealand's alpine ecosystems. The issue facing these systems is that there is a paucity of alpine fauna, but an abundance of fleshy-fruited alpine plants that depend on animals to their move seeds away. One of the highlights of my research has been the discovery of how important kea - the world's only alpine parrot - are, for moving these seeds around compared with all other birds combined. This makes kea globally unique amongst parrots, which generally forage on and destroy seeds, consequently having a detrimental effect on plant regeneration.



Sol Heber

PhD student, Conservation Biology

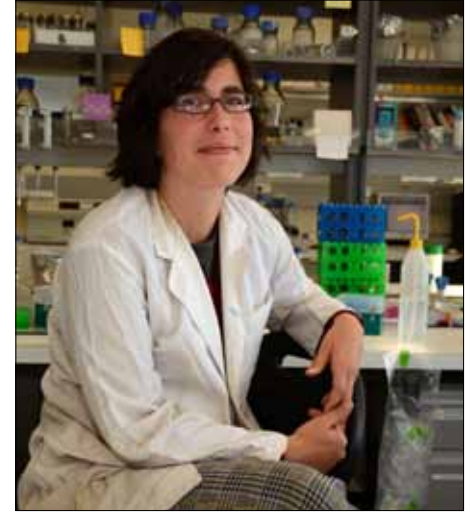
After completing an MSc in International and Tropical Forestry at Georg-August University in Göttingen, Germany, Sol began a PhD at UC, in 2008. Her PhD project focuses on testing the effectiveness of reciprocal translocations between inbred and fragmented populations as a conservation management tool. To test whether translocations can be used as a method of “genetic rescue” even in the absence of outbred donor populations, she exchanged female individuals between two isolated, inbred populations of the New Zealand robin in the Marlborough Sounds. Her results suggest that translocations between inbred populations may be valuable in the genetic rescue of species showing severe inbreeding depression. For endangered species that survive only in small, inbred populations, this may be the only method to rescue a population from the brink of extinction.



Kieran Tibble

MSc student, Animal Behaviour

After completing his BSc, Kieran decided to pursue his passion for nature and New Zealand wildlife and begin his postgraduate studies at UC. Kieran is doing his Masters thesis on the South Island robin (*Petroica australis australis*) and studying their unusual caching behaviour of storing food in trees and relocating it later in the day to consume. Robins are one of the friendliest birds you will come across in the New Zealand forest. Their willingness to come within metres of humans makes the robins ideal subjects for behavioural studies in the wild. Kieran studies the robins in the lowland bush in Kaikoura and works regularly out of the Kaikoura Field Station. There are many other UC students studying the forest birds and marine life in and around Kaikoura, making for a stimulating environment among great friends.



Dorien Coray

PhD student, Microbial Genetics

I came to New Zealand on a Fulbright Scholarship to work with Prof. Jack Heinemann. I was fascinated by his work on the transfer of genetic material between species, and his involvement in international discussions on GMO risk-assessment. I work on genetic constructs used for transgenic plant sterility, a particularly controversial form of genetic engineering. I am interested in the ability of these constructs to act as addiction modules, which are difficult for a cell to get rid of once acquired. This may affect the risks of genetic material from transgenic plants transferring to and persisting in bacterial populations in the field. My project allows me to do research into theories of gene transfer and evolution, with real-world relevance. The work is sometimes challenging, but advances my knowledge and critical thinking skills, helping me develop into an independent scientist.

BSc Degree Structure

The Bachelor of Science degree requires a minimum total of 360 credit points, of which at least 255 points must be from science courses. The remaining 105 points can be from science or non-science courses. The maximum number of points at 100-level is 135, at least 225 points must be above 100-level, of which at least 90 must be at 300-level, 60 of them in a single subject (BIOL) – this is your major. Students can take more than 225 points above 100-level and some choose to do a double major by taking two science subjects through to 300-level with 60 points in each.

Biological Sciences BSc basic degree structure

	Biology or Biochemistry major courses			Other science courses		Courses from science or other degrees		
3	300 Level	300 Level	300 Level	200 Level	200 Level	200 Level	200 Level	200 Level
2	200 Level	200 Level	200 Level	200 Level	200 Level	200 Level	200 Level	100 Level
1	Biol 111	Biol 112	Biol 113	100* Level	100** Level	100 Level	100 Level	100 Level

Biological Sciences Postgraduate Fourth Year structure

4	400 Level	400 Level	400 Level	400 Level	Honours Research Project
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The diagrams above show the minimum requirements for a BSc degree in Biology or Biochemistry. Many students take more than 225 points above the 100 level, and most take more than 60 points in their major. Students must take BIOL 209 in their degree, and BIOL 309 is strongly recommended, especially for potential postgraduate students. The Design Your Degree section has a table for planning your degree.

* Biochemistry majors must take CHEM 112 (General Chemistry B) and are strongly recommended to take CHEM 111 (General Chemistry A) during their first year. Biology majors are strongly recommended to take some chemistry, such as CHEM 114.

** All students are encouraged to include 15 points of statistics or mathematics, which count as a science course.

Biology Endorsements

An endorsement can be added to your BIOL major in recognition of the fact that your studies have had a particular focus. The biology endorsements reflect the three strengths of the School: Biodiversity (ecology), biosecurity and biotechnology.

Biotechnology Endorsement

Biotechnology covers many aspects. We focus on two key areas of biotechnology – environmental biotechnology and plant biotechnology.

Environmental Biotechnology

Environmental biotechnology includes fundamental research contributing knowledge about ecological and evolutionary processes; research underpinning biodiversity and biosecurity management in New Zealand; and research directed towards technology development with dual economic and environmental outcomes

Biotechnology research has key roles to play in helping us characterise New Zealand's indigenous genetic heritage through biosystematics, to protect New Zealand's indigenous genetic heritage through the provision of tools to identify biosecurity threats, and, through research, to help counter the environmental impacts of farming.

Plant Biotechnology

It is important to recognise, in addition to the overlap with environmental biotechnology, that plant biotechnology goes beyond genetic modification and includes a range of laboratory based plant tissue culture and plant breeding techniques. Universities have access to unique germplasm collections and genomics databases for research and much research focused on plant breeding is now regarded as 'biotechnology-assisted' and has developed beyond the need to genetically modify crop plants.

Biosecurity Endorsement

Biosecurity is an emerging issue of both national and international importance. New Zealand is particularly well suited for studies related to Biosecurity as it is a small island nation vulnerable to exotic invasions. Furthermore, on-going global climate change and its effects on ecosystems make understanding Biosecurity issues crucial.

The School of Biological Sciences has identified Biosecurity as a major theme in many of its courses and believes that an endorsement to its undergraduate major will help students choose a course of study that will allow flexibility, but will provide these students with a core understanding of Biosecurity issues.

Ecology Endorsement

Ecology is a broad topic encompassing studies on individuals, species, populations, communities and ecosystems, and including behaviour, evolution, physiology and increasingly, molecular biology.

In New Zealand, the study of ecology is especially important. As a small group of islands separated from larger land masses, the New Zealand flora and fauna evolved unique characteristics in the absence of mammals. The invasion of New Zealand by humans, and the organisms that they introduced has drastically altered its ecology, leading to drastic reductions in numbers, or even extinctions of the original animals and plants. In addition, global climate change is affecting the ecology of New Zealand, altering the distribution of both native and introduced organisms. In this rapidly changing environment it is vital that we continue to train competent and capable ecologists.

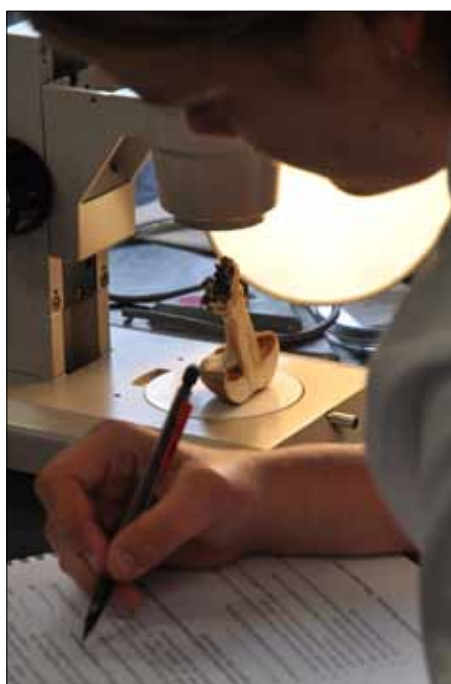
Ecology is a major part of the School of Biological Sciences reflecting its importance in New Zealand, and indeed in the world. An endorsement in ecology gives guidance to our students as they progress through their undergraduate courses and it sends a clear signal to potential employers that they have a thorough grounding in this subject.

Starting Your BSc in Biology

Biological Sciences Major

The Bachelor of Science, or BSc degree, is a three-year undergraduate degree requiring 360 points. The School offers a single undergraduate major in Biological Sciences (BIOL). Our three core 100 level courses provide a comprehensive overview of biology, from which our 200- and 300-level courses provide advanced training in specialised areas. We believe that this broad approach in curriculum delivery is of great benefit to student learning.

To major in BIOL, students must have BIOL 111, 112, 113 and 209 (or equivalent background, e.g. STAT201 or PSYC206). To gain a pass a student must do satisfactory practical work in laboratory classes and in field courses as well as performing satisfactorily in written tests and examinations. Students who have not taken Chemistry to Year 13 or Scholarship level should take 15 points of CHEM (e.g. CHEM 114) before enrolling in 200 level courses. Students who have not taken Maths (with Calculus) to Year 13 or Scholarship level should strongly consider taking 15 points of MATH (e.g. MATH 101) before enrolling in 200 level courses. BIOL 309 cannot be used as part of the minimum 60 points needed at 300 level to major in Biological Sciences. Students intending to enrol for fourth year courses should have gained the equivalent of at least 90 points in 300 level BIOL courses. Students admitted to an Honours or Masters Degree in Ecology must include BIOL 309, or an equivalent course, in their undergraduate degree. BIOL 309 is strongly recommended for ALL intending postgraduate students.



Choosing your courses in first year

Starting your BSc in Biology is straightforward. Biological Sciences offers a range of streams to make planning your degree easy and still allows you to create a personalised degree that suits your interests. See pages 10–21 for stream details.

Most students begin by taking the core biology courses during their first year at Canterbury, but students who discover an interest in biology later can also take the core courses during their second year. The three core courses are:

- BIOL 111** Cellular Biology and Biochemistry
- BIOL 112** Ecology, Evolution and Conservation
- BIOL 113** Diversity of Life

[BIOL 111 is required for Biochemistry majors, BIOL 112 and 113 are recommended.]

Two additional first year courses are also offered for students. These courses cannot be substituted for the core biology courses and should be taken as additional courses.

- BIOL 116** Human Biology
- SCIM 101** Science, Maori and Indigenous Knowledge

What other courses should I take?

Modern biological research is undergoing some exciting changes. The barriers between traditionally separate areas of biology are breaking down, and at the same time researchers trained in mathematics, statistics, chemistry, physics, geology, geography and computer science are collaborating with biologists in new and exciting ways. This doesn't mean you need to be an expert in everything, but the more you are comfortable talking with and working with scientists from other fields, the better prepared you will be for the job market, whether you wish to work in industry, a research university or institute, or even science journalism. Have a close look at the recommended additional courses you might take in the detailed "streams in biology" pages that follow.

Do I need Chemistry, Maths, Physics or Stats?

More and more areas of biology require a basic knowledge of statistics, mathematics, chemistry and physics. To give you some examples, molecular biology and biochemistry both require a working knowledge of chemistry, the study of populations requires some understanding of basic algebra and statistics, the mathematics of networks applies to areas as diverse as biochemistry and ecological food webs, and to analyse biological data, statistics is a must. It is also worth keeping in mind that areas of biology

which as recently as 10 years ago did not require maths, stats, physics or chemistry have now embraced these disciplines. There are many niches in biological and ecological sciences for those that are not chemically or mathematically inclined, but background in these areas may expand your options.

Because statistical analysis and experimental design is such a fundamental aspect of all biological research, all Biology majors are required to take BIOL 209 Introduction to Biological Data Analysis (or equivalent preparation e.g. STAT 201, PSYC 206). Entry to this course does not require STAT 101, but if you haven't done maths or stats at level 12 or 13, then think about doing STAT 101.

Find maths or chemistry intimidating?

Mathematics and chemistry can seem intimidating to many - if you lack confidence in these (or haven't done them to year 13) but want to expand your background, don't worry! UC provides plenty of support. This includes introductory courses at 1st year that are specifically tailored to biologists needs - Methods of Mathematics (MATH 101) and Introductory Chemistry (CHEM 114). There is also the Science Headstart summer programme to help you up-skill if you have no background in a range of science subjects, see www.uco.canterbury.ac.nz/bridging/headstart/courses.shtml. If in doubt, talk to one of our academic advisors.

Love maths or computers?

If you enjoy mathematics or computing, and are interested in biology, UC is well suited to cater for your needs. There are mathematicians on campus who work closely with biologists, and UC is home to the BlueFern Supercomputer. Combining biology with computing and/or mathematics will give you plenty of options in the future. Some papers you could do at first year to complement your interest in biology include MATH 120/170 and COSC 121/122.

Streams in Biology

Animal Behaviour

Animal Behaviour is the scientific study of the “how” and “why” of what animals do. This can range from answering questions about how animals communicate and how neural mechanisms control behaviour, to questions about why animals are altruistic to family members, why some animals look after their offspring while others do not, or why species differ in their mating systems.

Humans probably always have been fascinated by the behaviour of animals. By studying animal behaviour through a scientific framework, we can understand the reasons for the rich behavioural repertoire seen across the animal kingdom and in the process perhaps learn something about our own sometimes perplexing behaviour. Understanding the behaviour of animals in nature also is becoming increasingly important in conservation biology programmes to ensure that they survive and reproduce.

Career paths

Graduates who specialise in Behaviour generally also take courses in Ecology and Evolution. Some of our recent graduates have taken up careers such as:

- Monitoring endangered species like the Chatham Island taiko for the Department of Conservation
- Working on nature documentaries for the BBC
- Conducting research projects for Wool Research
- Biosecurity officer for the Department of Conservation in Wellington
- Researching behavioural means to control agricultural pest insects in Australia
- Conducting research on spider monkeys in Panama

- Teaching animal behaviour courses in Fiji
- Curator at the Canterbury Museum

Postgraduate

BSc (Hons) - Students complete a fourth year of study comprising four 400-level papers and a research project.

PGDipSc - Students complete a fourth year of study comprising four 400-level papers.

MSc - Students complete a fourth year of study comprising four 400-level papers (part I), then proceed to a research project (part II), written up as a thesis.

PhD - Students complete a 3–4 year research project written up as a thesis. Entry is after successful completion of either BSc(Hons) or an MSc.

Year 1

Essential

BIOL 111	Cellular Biology & Biochemistry
BIOL 112	Ecology, Evolution & Conservation
BIOL 113	Diversity of Life

Recommended

CHEM 112	General Chemistry B *
MATH 101	Methods of Mathematics
PSYC 105	Introductory Psychology

Optional

STAT 101	Statistics 1 †
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* Note: Unless you have good NCEA level 3 credits in maths, it is essential that you take a minimum of 15 points in MATH (MATH 101). Students with fewer than 9 credits of NCEA level 3 chemistry (or equivalent) will need to take CHEM 114 before doing CHEM 112.

† Note: Biology majors are required to take BIOL 209 Introduction to Biological Data Analysis (or equivalent preparation e.g. STAT 201, PSYC 206). Entry to this course does not require STAT 101, but if you haven't done maths or stats at level 12 or 13, then think about doing STAT 101 in your first year.

Year 2

Essential

BIOL 272	Principles of Animal Behaviour
BIOL 209	Introduction to Biological Data Analysis

At least 30 points from:

BIOL 210	Vertebrate Biology
BIOL 211	Insect Biology
BIOL 212	Marine Biology and Ecology
BIOL 231	Foundations in Molecular Biology
BIOL 250	Principles of Animal Physiology
BIOL 270	Ecology
BIOL 271	Evolution
BIOL 273	NZ Biodiversity and Biosecurity

Year 3

Essential

BIOL 309	Experimental Design and Data Analysis for Biologists §
BIOL 373	Behavioural Ecology

At least 30 points from:

BIOL 355	Neurons, Hormones and Behaviour
BIOL 354	Animal Ecophysiology
BIOL 371	Evolutionary Ecology
BIOL 374	Marine Ecosystems
BIOL 375	Freshwater Ecosystems
BIOL 377	Global Change and Biosecurity
BIOL 378	Population Ecology and Conservation
BIOL 379	Sustaining Native Biodiversity in Primary Production Systems

§ Note students wishing to progress to 4th year in any Biology major are expected to have taken BIOL 309.

Animal Physiology

Animal physiology is the study of the physical and chemical processes that occur within animals—in other words, how animals work! Animal physiology is concerned with such topics as gas exchange, blood and circulation, osmoregulation, digestion, nervous and muscle systems and endocrinology.

Career paths

Graduates specialising in Animal Physiology can find teaching and research careers in hospitals, schools of medicine, universities, pharmaceutical laboratories and crown research institutes.

They may also work in fields as diverse as conservation, the food industry, fisheries and aquaculture concerns and in the sports industry.

Postgraduate

BSc (Hons) - Students complete a fourth year of study comprising four 400-level papers and a research project.

PGDipSc - Students complete a fourth year of study comprising four 400-level papers.

MSc - Students complete a fourth year of study comprising four 400-level papers (part I), then proceed to a research project (part II), written up as a thesis.

PhD - Students complete a 3–4 year research project written up as a thesis. Entry is after successful completion of either BSc(Hons) or an MSc.

Year 1

Essential

BIOL 111	Cellular Biology & Biochemistry
BIOL 112	Ecology, Evolution & Conservation
BIOL 113	Diversity of Life
CHEM 112	General Chemistry B *
MATH 101	Methods of Mathematics

Recommended

BIOL 116	Human Biology
CHEM 111	General Chemistry A

Optional

STAT 101	Statistics 1 †
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* Note: Unless you have good NCEA level 3 credits in maths, it is essential that you take a minimum of 15 points in MATH (MATH101). Unless you have 9 NCEA level 3 credits in chemistry it is essential that you take a CHEM 114 before CHEM 111 and CHEM 112.

† Note: Biology majors are required to take BIOL 209 Introduction to Biological Data Analysis (or equivalent preparation e.g. STAT 201, PSYC206). Entry to this course does not require STAT 101, but if you haven't done maths or stats at level 12 or 13, then think about doing STAT 101 in your first year.

Year 2

Essential

BIOL 209	Introduction to Biological Data Analysis
BIOL 250	Principles of Animal Physiology
BIOL 251	Exercise and Health

Recommended

BCHM 221	Biochemistry A - Biomolecules and their interactions
BIOL 210	Vertebrate Biology
BIOL 212	Marine Biology and Ecology
BIOL 231	Foundations in Molecular Biology
BIOL 253	Cell Biology 1
BIOL 271	Evolution
BIOL 272	Principles of Animal Behaviour

Year 3

Essential

BIOL 309	Experimental Design and Data Analysis for Biologists §
BIOL 351	Cell Biology 2
BIOL 355	Neurons, Hormones and Behaviour
BIOL 354	Animal Ecophysiology

Optional

BIOL 330	Advanced Concepts in Genetics
BIOL 373	Behavioural Ecology

§ Note students wishing to progress to 4th year in any Biology major are expected to have taken BIOL 309.

Biochemistry (major)

Biochemistry uses the techniques of chemistry, physics and molecular biology to probe the mysteries of biology. At UC, biochemistry courses are taught as a collaboration between the Department of Chemistry and the School of Biological Sciences. For Biochemistry students it is important to consider both biology and chemistry courses in addition to the biochemistry core when designing your degree.

Within the broad field of biochemistry, research interests at UC focus on the following key areas:

- Intermediary metabolism: studies of the integration of reactions in living cells; how cells make and use energy; biosynthesis of proteins; DNA & RNA; and cellular control mechanisms
- The molecular basis for biological phenomena: studies of molecular biology; gene expression and control; hormones and physiological phenomena

- The nature of enzyme-catalysed reactions.
- Ultrastructure: studies of the coordination of the structure and function of cells, their organelles and their proteins.
- The structure of biopolymers: studies of the structure of proteins, DNA & RNA, cell walls, etc.
- Applied biochemistry: studies of immobilised enzymes; biochemical engineering, food biochemistry, etc.
- Free radical biochemistry.
- Enzyme inhibition and drug design
- Natural products chemistry and drug discovery

Career paths

Biochemistry is a “central science” allowing employment across a wide range of disciplines - from chemistry to molecular biology; from medicine to food technology.

A Biochemistry major can prepare you for diverse careers including teaching and research in hospitals and medical fields, in the food and drink industries, in agriculture and in industry.

Postgraduate

BSc (Hons) - Students complete a fourth year of study comprising four 400-level papers and a research project.

PGDipSc - Students complete a fourth year of study comprising four 400-level papers.

MSc - Students complete a fourth year of study comprising four 400-level papers (part I), then proceed to a research project (part II), written up as a thesis.

PhD - Students complete a 3–4 year research project written up as a thesis. Entry is after successful completion of either BSc(Hons) or an MSc.

Year 1

Essential

BIOL 111 Cellular Biology & Biochemistry
CHEM 112 General Chemistry B *

Recommended

BIOL 112 Ecology, Evolution & Conservation
BIOL 113 Diversity of Life
CHEM 111 General Chemistry A
STAT 101 Statistics 1 (or MATH 101)

* Note: Students with fewer than 9 credits of NCEA level 3 chemistry (or equivalent) will need to take CHEM 114 before doing CHEM 112.

Year 2

Essential

BCHM 221 Biochemistry A - Biomolecules and their interactions
BCHM 222 Biochemistry B - Metabolism; the reactions of molecules in cells
BCHM202 Molecular Genetics
BCHM 212 Chemical Reactivity
BCHM 281 Practical Biochemistry

Optional

BCHM 206 Organic Chemistry
BIOL 209 Introduction to Biological Data Analysis
BIOL 213 Microbiology and Genetics
BIOL 251 Exercise and Health
BCHM 253 Cell Biology 1
BIOL 254 Plant Developmental Biology
CHEM 211 Molecules

Year 3

Essential

BCHM 301 Biochemistry 3 (aka BIOL 331)
BCHM 302 Biological Chemistry (aka CHEM 325)
BCHM 381 Biochemical Techniques (for those intending to study to 4th year or beyond)

Optional

BIOL 330 Advanced Concepts in Genetics
BIOL 351 Cell Biology 2
BIOL 352 Plant Development and Biotechnology
CHEM 321 Inorganic and Structural Chemistry
CHEM 322 Organic Chemistry
CHEM 381 Advanced Synthetic Methods

Biosecurity (endorsement)

Biosecurity is more than just a subject stream; we have determined that it is important enough to warrant it being an endorsement to the degree. What this means is that rather than just gaining a BSc in Biological Sciences you gain a BSc in Biological Sciences (Biosecurity). This tells prospective employers that you have a degree that is focused on issues relevant to the security of New Zealand's flora and fauna.

Biosecurity focuses on native organisms, how they have shaped New Zealand, and the impact of human occupation and consequent invasions. However, biosecurity is global and our courses reflect this. Biosecurity also focuses on epidemics, such as bird flu, how it could affect New Zealand, and how we keep ourselves free of it.

Career paths

Biosecurity is a major growth industry in New Zealand, spearheaded by the regulatory authority Ministry of Agriculture and Forestry Biosecurity New Zealand (MAFBNZ), and this is generating many positions, from border control, to pest surveillance and eradication, to strategic planning. District and regional councils employ biologists to manage invading organisms, while DoC and other environmental agencies need biologists to manage our native heritage.

Postgraduate

BSc (Hons) - Students complete a fourth year of study comprising four 400-level papers and a research project.

PGDipSc - Students complete a fourth year of study comprising four 400-level papers.

MSc - Students complete a fourth year of study comprising four 400-level papers (part I), then proceed to a research project (part II), written up as a thesis.

PhD - Students complete a 3–4 year research project written up as a thesis. Entry is after successful completion of either BSc(Hons) or an MSc.

Year 1

Essential

BIOL 111	Cellular Biology & Biochemistry
BIOL 112	Ecology, Evolution & Conservation
BIOL 113	Diversity of Life
CHEM 112	General Chemistry B * (or CHEM 114)

Recommended

LAWS 101	The Legal System
LAWS 110	Legal System: Research, Writing and Legal Foundations
SCIM 101	Science, Maori and Indigenous Knowledge
MATH 101	Methods of Mathematics

Optional

STAT 101	Statistics 1 †
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* Note: Unless you have good NCEA level 3 credits in maths, it is important that you consider taking a minimum of 15 points in MATH (MATH 101). Unless you have 9 NCEA level 3 credits in chemistry it is essential that you take CHEM 114 before taking CHEM 112.

† Note: Biology majors are required to take BIOL 209 Introduction to Biological Data Analysis (or equivalent preparation e.g. STAT 201, PSYC 206). Entry to this course does not require STAT 101, but if you haven't done maths or stats at level 12 or 13, then think about doing STAT 101 in your first year.

Year 2

Essential

BIOL 209	Introduction to Biological Data Analysis
BIOL 231	Foundations in Molecular Biology
BIOL 270	Ecology
BIOL 271	Evolution
BIOL 273	New Zealand Biodiversity and Biosecurity
BIOS 201	Issues in New Zealand Biosecurity

Recommended

BIOL 215	Plant Diversity and Systematics
BIOL 203	Introduction to Forensic Biology
Any 2nd year BIOL courses	
FORE 218	Forest Ecosystem Health
ANTA 201	Antarctica and Global Change

Year 3

Essential

BIOL 332	Genetics and Evolution of Invasive Species
BIOL 377	Global Change and Biosecurity

Recommended

BIOL 305	Practical Field Botany
BIOL 309	Experimental Design & Data Analysis
BIOL 313	Advanced Microbiology
BIOL 330	Advanced Concepts in Genetics
BIOL 352	Plant Development & Biotechnology
BIOL 371	Evolutionary Ecology
BIOL 374	Marine Ecosystems
BIOL 375	Freshwater Ecosystems
BIOL 378	Population Ecology & Conservation
BIOL 379	Sustaining Biodiversity in Primary Production Systems

Biotechnology (endorsement)

Biotechnology is of national and international importance. It can be defined as fundamental research contributing knowledge about biochemical, molecular, ecological and evolutionary processes; research underpinning biodiversity and biosecurity management in New Zealand; and research directed towards technology development with dual economic and environmental outcomes.

Consequently, biotechnology research has key roles to play in helping us characterise New Zealand's indigenous genetic heritage through biosystematics, to protect New Zealand's indigenous genetic heritage through the provision of tools to identify biosecurity threats, and, through research, to help counter the environmental impacts of farming in areas such as

agricultural methane emissions and nitrogen fixers in pastures.

Biotechnology goes beyond genetic modification and includes a range of laboratory based tissue culture and breeding techniques such as the use of somatic hybridisation.

Career paths

Employment opportunities for graduates with good biotechnology training are exceptionally attractive overseas, since biotechnology is widely considered to be the industrial growth area of this century.

Postgraduate

BSc (Hons) - Students complete a fourth year of study comprising four 400-level papers and a research project.

PGDipSc - Students complete a fourth year of study comprising four 400-level papers.

MSc - Students complete a fourth year of study comprising four 400-level papers (part I), then proceed to a research project (part II), written up as a thesis.

PhD - Students complete a 3–4 year research project written up as a thesis. Entry is after successful completion of either BSc(Hons) or an MSc.

Year 1

Essential

BIOL 111	Cellular Biology and Biochemistry
BIOL 112	Ecology, Evolution & Conservation
BIOL 113	Diversity of Life
CHEM 112	General Chemistry B *

Recommended

MATH 101	Methods of Mathematics
LAWS 101	Legal System: Legal Method and Institutions
LAWS 110	Legal System: Research, Writing and Legal Foundations
SCIM 101	Science, Maori and Indigenous Knowledge
ENGR 101	Foundations of Engineering
CHEM 111	General Chemistry A *

* Note: Students with fewer than 9 credits of NCEA level 3 chemistry (or equivalent) will need to take CHEM 114 before doing CHEM 112/111

Year 2

Essential

BIOL 209	Introduction to Biological Data Analysis
BIOL 213	Microbiology and Genetics
BIOL 231	Foundations in Molecular Biology
BIOL 271	Evolution
BIOL 253	Cell Biology 1
or	
BIOL 254	Plant Developmental Biology

Recommended

BIOL 215	Plant Diversity & Systematics
BIOL 255	Plant Ecophysiology
BIOL 210	Vertebrate Biology
BIOL 211	Insect Biology
BIOL 212	Marine Biology and Ecology
BIOL 250	Principles of Animal Physiology
BIOL 273	New Zealand Biodiversity and Biosecurity
POLS 206	Public Policy: An Introduction
BCHM 221	Biochemistry A - Biomolecules and their interactions
BCHM 222	Biochemistry B - Metabolism; the reactions of molecules in cells
BCHM 281	Practical Biochemistry
PHIL 249	Environmental Ethics

Year 3

Essential

BIOL 352	Plant Development and Biotechnology
or	
BIOL 313	Advanced Microbiology

and a minimum of 30 points from the following:

BIOL 330	Advanced Concepts in Genetics
BIOL 332	Genetics and Evolution of Invasive Species
BIOL 351	Cell Biology 2
BIOL 371	Evolutionary Ecology

Recommended

BCHM 303	Special Topic: Toxicology
BIOL 331	Biochemistry 3
SCIE 301	Science and Entrepreneurship Part 1
SCIE 302	Science and Entrepreneurship Part 2

Cell Biology

Cell biology is the science of the living cell. Cell theory, developed in the 1800s, states that all organisms are composed of one or more cells, that cells are the smallest living units of all living organisms, and that cells arise only by division of a previously existing cell. Recent decades have seen stunning advances in the study of cell biology as a range of different imaging, biochemical and molecular techniques have been used to investigate how cells work, and how cells interact with other cells.

Career paths

Cell biologists have many career options. They are employed by in Universities, biotechnology companies and Crown research institutes (e.g. AgResearch, Plant & Food Research). Many cell biologists also work in the medical sciences, either as researchers or in the pharmaceutical industry.

Postgraduate

BSc (Hons) - Students complete a fourth year of study comprising four 400-level papers and a research project.

PGDipSc - Students complete a fourth year of study comprising four 400-level papers.

MSc - Students complete a fourth year of study comprising four 400-level papers (part I), then proceed to a research project (part II), written up as a thesis.

PhD - Students complete a 3–4 year research project written up as a thesis. Entry is after successful completion of either BSc(Hons) or an MSc.

Year 1

Essential

BIOL 111	Cellular Biology & Biochemistry
BIOL 112	Ecology, Evolution & Conservation
BIOL 113	Diversity of Life
CHEM 112	General Chemistry B *
MATH 101	Methods of Mathematics

Recommended

STAT 101	Statistics 1† [#]
CHEM 111	General Chemistry A *

Optional

SCIM 101	Science, Maori and Indigenous Knowledge
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* Note: Students with fewer than 9 credits of NCEA level 3 chemistry (or equivalent) will need to take CHEM 114 before doing CHEM 112/111.

† Note: Unless you have good NCEA level 3 credits in maths, it is essential that you take a minimum of 15 points in mathematics (MATH 101).

[#] Note: Biology majors are required to take BIOL 209 Introduction to Biological Data Analysis (or equivalent preparation e.g. STAT 201, PSYC 206). Entry to this course does not require STAT 101, but if you haven't done maths or stats at level 12 or 13, then think about doing STAT 101 in your first year.

Year 2

Essential

BIOL 209	Introduction to Biological Data Analysis
BIOL 231	Foundations in Molecular Biology
BIOL 253	Cell Biology 1
BCHM 221	Biochemistry A - Biomolecules and their interactions
BCHM 222	Biochemistry B - Metabolism; the reactions of molecules in cells

Recommended

at least 30 points from the following courses

BIOL 213	Microbiology and Genetics
BIOL 250	Principles of Animal Physiology
BIOL 251	Exercise and Health
BIOL 254	Plant Developmental Biology
BIOL 255	Plant Ecophysiology
BCHM 281	Practical Biochemistry

Year 3

Essential

BIOL 351	Cell Biology 2
BCHM 301	Biochemistry 3

Recommended

at least 30 points from the following courses

BIOL 309	Experimental Design and Data Analysis for Biologists §
BIOL 313	Advanced Microbiology
BIOL 330	Advanced Concepts in Genetics
BIOL 352	Plant Development and Biotechnology
BIOL 354	Animal Ecophysiology
BIOL 355	Neurons, Hormones and Behaviour
BCHM 381	Biochemical Techniques

§ Note: Students wishing to progress to 4th year in any Biology major are expected to have taken BIOL 309.

Ecology (endorsement)

Ecology is the study of organisms and how they relate to their environment. Evolution is a closely related area of study that focuses on how organisms change to adapt to their local surroundings. Related courses are also offered on plant systematics (the study of plant classification and evolutionary relationships) and animal behaviour.

Ecology is an increasingly important field, as we struggle to protect plants and animals from growing human impacts. Ecologists and evolutionists try to understand our endangered native organisms such as kiwi, kakapo and rare plants, and they also try to predict or mitigate the effects of exotic pests such as possums and old man's beard. This work can take them to a wide range of beautiful and unique areas in New Zealand and beyond.

The School has teaching and research strengths in terrestrial, freshwater and marine ecology.

Career paths

Graduates who specialise in Ecology, Evolution and Behaviour may take up careers like:

District conservation officer for the Department of Conservation in Tekapo, Haast.

Monitoring of ecological values along streams, rivers and estuary for the Christchurch City Council

Field technician in Landcare Research's programme to help meet Kyoto agreements on global warming

Member of project team with a private environmental consulting company

Operating an aquaculture facility for a Marlborough Sounds seafood company

Postgraduate

BSc (Hons) - Students complete a fourth year of study comprising four 400-level papers and a research project.

PGDipSc - Students complete a fourth year of study comprising four 400-level papers.

MSc - Students complete a fourth year of study comprising four 400-level papers (part I), then proceed to a research project (part II), written up as a thesis.

PhD - Students complete a 3–4 year research project written up as a thesis. Entry is after successful completion of either BSc(Hons) or an MSc.

Year 1

Essential

BIOL 111	Cellular Biology & Biochemistry
BIOL 112	Ecology, Evolution & Conservation
BIOL 113	Diversity of Life

Recommended

CHEM 112	General Chemistry B *
MATH 101	Methods of Mathematics
GEOG 106	Global Environmental Change
GEOG 108	Resources and Sustainability
GEOL 111	Planet Earth: An Introduction to Geology
GEOL 112	Understanding Earth History

Optional

CHEM 111	General Chemistry A *
FORE 111	Trees, Forest and Environment
SCIM 101	Science, Maori and Indigenous Knowledge
STAT 101	Statistics 1 †

Year 2

Essential

BIOL 209	Introduction to Biological Data Analysis
BIOL 270	Ecology
BIOL 271	Evolution

Recommended

At least 45 points from:

BIOL 210	Vertebrate Biology
BIOL 211	Insect Biology
BIOL 212	Marine Biology and Ecology
BIOL 215	Plant Diversity & Systematics
BIOL 255	Plant Ecophysiology
BIOL 272	Principles of Animal Behaviour
BIOL 273	New Zealand Biodiversity and Biosecurity

Year 3

Essential

BIOL 309	Experimental Design and Data Analysis for Biologists §
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At least 60 points from:

BIOL 354	Animal Ecophysiology
BIOL 371	Evolutionary Ecology
BIOL 373	Behavioural Ecology
BIOL 374	Marine Ecosystems
BIOL 375	Freshwater Ecosystems
BIOL 377	Global Change and Biosecurity
BIOL 378	Population Ecology and Conservation
BIOL 379	Sustaining Native Biodiversity in Primary Production Systems

§ Note: Students wishing to progress to 4th year in any Biology major are expected to have taken BIOL 309.

* Note: Unless you have good NCEA level 3 credits in maths, it is recommended that you take a minimum of 15 points in MATH (MATH 101). Unless you have 9 NCEA level 3 credits in chemistry it is essential that you take a CHEM 114 before taking CHEM 112/111.

† Note: Biology majors are required to take BIOL 209 Introduction to Biological Data Analysis (or equivalent preparation e.g. STAT 201, PSYC 206). Entry to this course does not require STAT 101, but if you haven't done maths or stats at level 12 or 13, then think about doing STAT 101 in your first year.

Environmental Science (endorsement)

Environmental Science is more than just a subject stream, we have determined that it is important enough to warrant it being an endorsement to the degree. What this means is that rather than just gaining a BSc in Biological Sciences you gain a BSc in Biological Sciences (Environmental Sciences). This tells prospective employers that you have a degree that is much wider than just biology and that it has a focus on environmental issues.

Environmental Science is bigger than just biology, it includes subjects such as law, chemistry, geography, geology and forestry. It is all about identifying aspects of the environment and having the right tools to manage it. So to

graduate with Environmental Science you need to be much broader than a single subject area. Obviously you will not be able to study all of the listed areas in depth, but you should aim to take a wide range of topics in your first year and at least two subject areas in your second year.

Career paths

Graduates with an endorsement in Environmental Science are likely to find employment with organisations involved with managing the environment, such as city and regional councils, Department of Conservation, Cawthron Institute, Landcare.

Postgraduate

BSc (Hons) - Students complete a fourth year of study comprising four 400-level papers and a research project.

PGDipSc - Students complete a fourth year of study comprising four 400-level papers.

MSc - Students complete a fourth year of study comprising four 400-level papers (part I), then proceed to a research project (part II), written up as a thesis.

PhD - Students complete a 3–4 year research project written up as a thesis. Entry is after successful completion of either BSc(Hons) or an MSc.

Year 1

Essential

BIOL 112 Ecology, Evolution & Conservation

BIOL 113 Diversity of Life

GEOG 106 Global Environmental Change

15 points of CHEM

15 points of GEOG

Recommended

GEOL 113 Environmental Geohazards

SCIM 101 Science, Maori and Indigenous Knowledge

† Note: Biology majors are required to take BIOL 209 Introduction to Biological Data Analysis (or equivalent preparation e.g. STAT 201, PSYC 206). Entry to this course does not require STAT 101, but if you haven't done maths or stats at level 12 or 13, then think about doing STAT 101 in your first year.

Year 2

Essential

BIOL 209 Introduction to Biological Data Analysis †

BIOL 270 Ecology

GEOG 205 Introduction to GIS

We recommend you follow the guidelines from the streams listed below to choose courses of interest for your 200-level.

- Biosecurity
- Biotechnology
- Ecology
- Microbiology
- Plant Biology

Year 3

Essential

At least 60 points in your major (BIOL).

We recommend you follow the guidelines from the streams listed below to choose courses of interest for your 300-level.

- Biosecurity
- Biotechnology
- Ecology
- Microbiology
- Plant Biology

Evolutionary Biology

Tools and technologies of evolutionary biology underpin all the biological sciences, including molecular biology, cell biology, ecology, biodiversity and behaviour. A course in evolution may cover topics as diverse as understanding HIV; measuring natural selection; investigating how new species arise, and making predictions about the survival of rare species and the spread of invasive ones. The common theme is the study of how organisms change and adapt to their local environment.

Evolution complements Ecology in areas such as conservation biology, the study of plant and animal invasions, and predicting the potential spread of GMOs. Evolution complements Behaviour in explaining topics such as sexual selection and social behaviour. Evolution is also fundamental to the designing of effective drugs and predicting the spread of new diseases such as swine flu.

Career paths

Graduates who specialise in Evolutionary Biology generally also take courses in Ecology and Behaviour. Some of our recent graduates have taken up careers like:

- Private environmental consultancy work
- Botanist / Zoologist at Landcare Research involved in biodiversity studies and the management of New Zealand biodiversity
- Botanist/Zoologist for the Department of Conservation monitoring and managing rare species
- Biosecurity officer for MAF involved in predicting and managing the spread of introduced organisms
- Scientist for AgResearch working in biocontrol

- Scientist/Technician with Crop & Food Research involving plant breeding
- Technician at the National Herbarium

Postgraduate

BSc (Hons) - Students complete a fourth year of study comprising four 400-level papers and a research project.

PGDipSc - Students complete a fourth year of study comprising four 400-level papers.

MSc - Students complete a fourth year of study comprising four 400-level papers (part I), then proceed to a research project (part II), written up as a thesis.

PhD - Students complete a 3–4 year research project written up as a thesis. Entry is after successful completion of either BSc(Hons) or an MSc.

Year 1

Essential

BIOL 111	Cellular Biology & Biochemistry
BIOL 112	Ecology, Evolution & Conservation
BIOL 113	Diversity of Life
CHEM 112	General Chemistry B *
MATH 101	Methods of Mathematics

Optional

STAT 101	Statistics 1 †
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* Note: Unless you have good NCEA level 3 credits in maths, it is essential that you take a minimum of 15 points in MATH (MATH 101). Unless you have 9 NCEA level 3 credits in chemistry it is essential that you take CHEM 114 before taking CHEM 112/111.

† Note: Biology majors are required to take BIOL 209 Introduction to Biological Data Analysis (or equivalent preparation e.g. STAT 201, PSYC 206). Entry to this course does not require STAT 101, but if you haven't done maths or stats at level 12 or 13, then think about doing STAT 101 in your first year.

Year 2

Essential

BIOL 209	Introduction to Biological Data Analysis
BIOL 231	Foundations in Molecular Biology
BIOL 213	Microbiology and Genetics
BIOL 271	Evolution

At least 45 points from:

BIOL 210	Vertebrate Biology
BIOL 211	Insect Biology
BIOL 212	Marine Biology and Ecology
BIOL 215	Plant Diversity & Systematics
BIOL 270	Ecology
BIOL 272	Principles of Animal Behaviour
BIOL 273	New Zealand Biodiversity and Biosecurity

Year 3

Essential

BIOL 309	Experimental Design and Data Analysis for Biologists §
BIOL 371	Evolutionary Ecology

At least 30 points from:

BIOL 330	Advanced Concepts in Genetics
BIOL 332	Genetics and Evolution of Invasive Species
BIOL 373	Behavioural Ecology
BIOL 377	Global Change and Biosecurity
BIOL 378	Population Ecology and Conservation

§ Note: Students wishing to progress to 4th year in any Biology major are expected to have taken BIOL 309.

Genetics

Genetics is the science of heredity. It has a history of less than 150 years, yet the most significant discovery, the double helix, celebrated its 50th birthday in 2003. The completion of the human genome project, followed by a proliferation of genome projects on endemic and endangered species has promised to challenge the creativity of future scientists. Genetics will provide a platform for the development of new drugs to combat diseases, methodology for the conservation of endangered species and understanding evolutionary history. Furthermore, it will help us to understand who we are and what we are, enhance our biosecurity and even catch criminals.

Career paths

Geneticists have a wide range of possible career options. They are employed by biotechnology companies and research institutes (e.g. AgResearch, Plant and Food Research, Landcare Research) to undertake genetic typing and to develop new strains of organisms.

They may also work for pharmaceutical companies developing approaches to disease control, and for health research organisations and hospitals using genetics to identify disease-causing organisms as well as the genetic basis for human diseases.

Postgraduate

BSc (Hons) - Students complete a fourth year of study comprising four 400-level papers and a research project.

PGDipSc - Students complete a fourth year of study comprising four 400-level papers.

MSc - Students complete a fourth year of study comprising four 400-level papers (part I), then proceed to a research project (part II), written up as a thesis.

PhD - Students complete a 3–4 year research project written up as a thesis. Entry is after successful completion of either BSc(Hons) or an MSc.

Year 1

Essential

BIOL 111	Cellular Biology & Biochemistry
BIOL 112	Ecology, Evolution & Conservation
BIOL 113	Diversity of Life
CHEM 112	General Chemistry B *
MATH 101	Methods of Mathematics

Optional

SCIM 101	Science, Maori and Indigenous Knowledge
STAT 101	Statistics 1 †

* Note: Unless you have good NCEA level 3 credits in maths, it is essential that you take a minimum of 15 points in MATH (MATH 101). Students with fewer than 9 credits of NCEA level 3 chemistry (or equivalent) will need to take CHEM 114 before doing CHEM 112/111.

† Note: Biology majors are required to take BIOL 209 Introduction to Biological Data Analysis (or equivalent preparation e.g. STAT 201, PSYC 206). Entry to this course does not require STAT 101, but if you haven't done maths or stats at level 12 or 13, then think about doing STAT 101 in your first year.

Year 2

Essential

BIOL 209	Introduction to Biological Data Analysis
BIOL 213	Microbiology and Genetics
BIOL 231	Foundations in Molecular Biology
BIOL 271	Evolution

Recommended

BCHM 221	Biochemistry A - Biomolecules and their interactions
BCHM 222	Biochemistry B - Metabolism; the reactions of molecules in cells
BCHM 281	Practical Biochemistry
BIOL 253	Cell Biology 1
BIOL 215	Plant Diversity & Systematics

Year 3

Essential

BIOL 330	Advanced Concepts in Genetics
BIOL 332	Genetics and Evolution of Invasive Species

Recommended

BIOL 309	Experimental Design and Data Analysis for Biologists §
BIOL 331	Biochemistry 3 (aka BCHM 301)
BIOL 313	Advanced Microbiology
BIOL 351	Cell Biology 2
BIOL 352	Plant Development and Biotechnology
BIOL 371	Evolutionary Ecology
BCHM 381	Biochemical Techniques

§ Note students wishing to progress to 4th year in any Biology major are expected to have taken BIOL 309.

Microbiology

Microbiology is the study of organisms such as algae, fungi, bacteria and viruses that cannot be seen with the naked eye. These micro-organisms are abundant and diverse, and they affect humans in both negative and positive ways. Some micro-organisms cause diseases in humans, other animals, or agricultural crops. Others can be used to benefit humans, such as microbes that can be used to kill insect pests (biocontrol) and those that destroy harmful chemicals such as pesticides (bio-remediation). Other microbes are simply essential to the maintenance of all life, such as those that generate oxygen and other critical elements.

Career paths

Microbiologists are employed by various industries to test product safety, by waste-water treatment plants to ensure water quality, by hospitals to identify disease-causing microbes, and by research institutes to explore basic aspects of microbial biology, diversity and ecology.

The food industry employs many microbiologists for food testing and production of items such as wine, beer, dairy products and mushrooms.

Careers can also be in horticulture, plant disease research, terrestrial and freshwater ecology, water pollution investigations and biology teaching.

Postgraduate

BSc (Hons) - Students complete a fourth year of study comprising four 400-level papers and a research project.

PGDipSc - Students complete a fourth year of study comprising four 400-level papers.

MSc - Students complete a fourth year of study comprising four 400-level papers (part I), then proceed to a research project (part II), written up as a thesis.

PhD - Students complete a 3–4 year research project written up as a thesis. Entry is after successful completion of either BSc(Hons) or an MSc.

Year 1

Essential

BIOL 111	Cellular Biology & Biochemistry
BIOL 112	Ecology, Evolution & Conservation
BIOL 113	Diversity of Life
CHEM 112	General Chemistry B *
MATH 101	Methods of Mathematics

Recommended

CHEM 111	General Chemistry A
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Optional

STAT 101	Statistics 1 †
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* Note: Unless you have good NCEA level 3 credits in maths, it is essential that you take a minimum of 15 points in MATH (MATH 101). Unless you have 9 NCEA level 3 credits in chemistry it is essential that you take CHEM 114 before taking CHEM 112/111.

† Note: Biology majors are required to take BIOL 209 Introduction to Biological Data Analysis (or equivalent preparation e.g. STAT 201, PSYC 206). Entry to this course does not require STAT 101, but if you haven't done maths or stats at level 12 or 13, then think about doing STAT 101 in your first year.

Year 2

Essential

BIOL 209	Introduction to Biological Data Analysis
BIOL 213	Microbiology and Genetics
BIOL 231	Foundations in Molecular Biology

Optional

BCHM 221	Biochemistry A - Biomolecules and their interactions
BCHM 222	Biochemistry B - Metabolism; the reactions of molecules in cells

Year 3

Essential

BIOL 309	Experimental Design and Data Analysis for Biologists §
BIOL 313	Advanced Microbiology

At least 30 points from:

BIOL 331	Biochemistry 3 (aka BCHM 301)
BIOL 330	Advanced Concepts in Genetics
BIOL 332	Genetics and Evolution of Invasive Species
BIOL 352	Plant Development and Biotechnology

§ Note: Students wishing to progress to 4th year in any Biology major are expected to have taken BIOL 309.

Plant Biology

Plants are central to the maintenance of life on Earth and for the basis of agricultural production. Plant biology is a very broad discipline that covers the study of the structure, function and evolution and diversity of plants. Plant biologists study processes at the cellular and whole organism level, and address questions on how plants respond to the environment and other organisms. Others study the evolutionary history of the huge diversity of plant species. The study of plant biology can be undertaken in the lab or in the field, and is central to agricultural production and ecosystem function.

Career paths

Plant Biology graduates may find employment in diverse fields, including teaching and research for Universities, Crown Research Institutes and biological industries. Employment opportunities for graduates with good biotechnology training are exceptionally attractive overseas, since biotechnology is widely considered to be the industrial growth area of this century.

Postgraduate

BSc (Hons) - Students complete a fourth year of study comprising four 400-level papers and a research project.

PGDipSc - Students complete a fourth year of study comprising four 400-level papers.

MSc - Students complete a fourth year of study comprising four 400-level papers (part I), then proceed to a research project (part II), written up as a thesis.

PhD - Students complete a 3–4 year research project written up as a thesis. Entry is after successful completion of either BSc(Hons) or an MSc.

Year 1

Essential

BIOL 111	Cellular Biology & Biochemistry
BIOL 112	Ecology, Evolution & Conservation
BIOL 113	Diversity of Life
CHEM 112	General Chemistry B*
MATH 101	Methods of Mathematics

Recommended

STAT 101	Statistics 1 * †
CHEM 111	General Chemistry A *

Optional

SCIM 101	Science, Maori and Indigenous Knowledge
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* Note: Students with fewer than 9 credits of NCEA level 3 chemistry (or equivalent) will need to take CHEM 114 before doing CHEM 112./111

† Note: Unless you have good NCEA level 3 credits in maths, it is essential that you take a minimum of 15 points in mathematics (MATH 101).

Note: Biology majors are required to take BIOL 209 Introduction to Biological Data Analysis (or equivalent preparation e.g. STAT 201, PSYC 206). Entry to this course does not require STAT 101, but if you haven't done maths or stats at level 12 or 13, then think about doing STAT 101 in your first year.

Year 2

Essential

BIOL 209	Introduction to Biological Data Analysis
BIOL 215	Plant Diversity & Systematics
BIOL 254	Plant Developmental Biology
BIOL 255	Plant Ecophysiology

Recommended

At least 30 points from the following courses:

BCHM 221	Biochemistry A - Biomolecules and their interactions
BCHM 222	Biochemistry B - Metabolism; the reactions of molecules in cells
BCHM 281	Practical Biochemistry
BIOL 213	Microbiology and Genetics
BIOL 231	Foundations in Molecular Biology
BIOL 253	Cell Biology 1
BIOL 271	Evolution

Year 3

Essential

BIOL 352	Plant Development and Biotechnology
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Recommended

At least 30 points from the following courses:

BIOL 305	Practical Field Botany
BIOL 309	Experimental Design and Data Analysis for Biologists §
BIOL 313	Advanced Microbiology
BIOL 330	Advanced Concepts in Genetics
BIOL 331	Biochemistry 3 (aka BCHM 301)
BIOL 351	Cell Biology 2
BCHM 381	Biochemical Techniques

§ Note: Students wishing to progress to 4th year in any Biology major are expected to have taken BIOL 309.

Biology Courses

Note: In all Biology courses satisfactory performance is required in both the year's work and the examination. Some courses have tutorials and/or field trips. Attendance at laboratory classes and field trips is compulsory.

Key

P: Pre-requisites

RP: Recommended Preparation

R: Restrictions

EQ: Equivalent Course

BIOL 111 Cellular Biology and Biochemistry

Semester 1 15 points

BIOL 111 is a foundation course that will introduce you to the basic processes of cellular biology. The cell is considered the basic unit of life because every organism whether animal, plant, or micro-organism consists of cells or is itself a single cell. As such the structure and function of the cell impacts on all other levels of life including organisms, ecosystems and the biosphere. For this reason it is essential for all biologists to understand the fundamentals of cell biology. In this course you will learn the basic concepts of cell function and how these are related to cell structure, which is in turn dependent on molecular structure and biochemical interactions between molecules.

Lect: 3 x 50 minutes per week

Lab: 3 hrs per week

BIOL 112 Ecology, Evolution and Conservation

Semester 2 15 points

This is an integrated course, with a conservation perspective, embracing the principles of genetics, evolution, behaviour and ecology.

Lect: 3 x 50 minutes per week

Lab: 3 hrs per week

BIOL 113 Diversity of Life

Semester 1 15 points

This course provides an overview of the vast diversity of life on Earth. You will hear about the evolution, structure, function and importance of animals, plants and microbes. The first half of the course focuses on the diversity, reproduction and structure of bacteria, protists, fungi and plants. The second half examines animals and includes discussion of locomotion, respiration, and circulation, nervous and endocrine systems.

Lect: 3 x 50 minutes per week

Lab: 3 hrs per week

BIOL 116 Human Biology

Semester 2 15 points

An introduction to the biology of humans. It will focus on anatomy and physiology, as well as how the human body is affected by the environment. The course is particularly recommended for students wishing to advance in topics in health and sport, as well as those students advancing in science subjects.

Lect: 3 x 50 minutes per week

Lab: 3 hrs per week

SCIM 101 Science, Maori and Indigenous Knowledge

Semester 2 15 points

This is an integrated multi-disciplinary course between the School of Maori and Indigenous Studies and the College of Science, studying Maori and other indigenous peoples knowledge and its relevance to today's western science.

Lect: 3 x 50 minutes per week

BIOL 203 Introduction to Forensic Biology

Summer 15 points

Forensic scientists draw upon a broad knowledge of the physical and social sciences to solve crimes or historic mysteries. A single course could not hope to cover all this knowledge or pretend to make you professional forensic scientists. However, we can introduce you to some common techniques used by forensic scientists and tell you about some real life investigations (some of which the course faculty may have been involved in), and exercise your creative thinking to solve an in-course crime.

P: Entry subject to approval from Head of the School of Biological Sciences.

R: Biol 303

Lect/Lab: Mon-Fri 9–5 pm summer course

BIOL 209 Introduction to Biological Data Analysis

Semester 1 15 points

Introductory statistics with specific examples for biologists. This course is required for all students in Biology.

P: 30 points of 100 level BIOL

Lect: 2 x 50 minutes per week

Lab: 3 hrs per week

BIOL 210 Vertebrate Biology

Semester 2 15 points Term 3

This course deals with the biology and evolution of the phylum Chordata and in particular the subphylum Vertebrata, animals with backbones. The course gives an overview of the phylum highlighting form and function and gives information on evolutionary relationships.

P: BIOL 112 and BIOL 113

Lect: 4 x 50 minutes per week (Term 3)

Lab: 4 hrs per week (Term 3)

BIOL 211 Insect Biology

Semester 2 15 points

The biology of insects and other non-marine arthropods, with emphasis on environmental relationships and management.

P: BIOL 112 and BIOL 113

Lect: 4 x 50 minutes per week (Term 4)

Lab: 4 hrs per week (Term 4)

BIOL 212 Marine Biology and Ecology

Semester 1 15 points

The focus of this course is the biology of marine organisms and the marine environment, highlighting biodiversity and habitat interactions. Ocean currents, sea-floor structure and coral reef ecology will be addressed. Bivalve aquaculture, crustacean fisheries, marine protected areas and human impacts will also be covered. Includes a field trip.

P: BIOL 112 and BIOL 113

Lect: 2 x 50 minutes per week

BIOL 213 Microbiology and Genetics

Semester 1 15 points Term 2

This course will introduce you to fundamental principles of microbiology and microbial genetics. Microbiology is a broad subject and includes areas of fundamental and applied science. The course builds on and extends the brief introduction you had to the microbial world and genetics in first year courses and prepares you for third year microbiology (BIOL 313) and genetics (BIOL 330).

P: BIOL 111 and BIOL 113. NB: BIOL 231 or BCHM 202 should be taken concurrently.

Lect: 4 x 50 minutes per week (Term 2)

Lab: 4 hrs per week (Term 2)

BIOL 215 Plant Diversity and Systematics

Semester 2 15 points Term 4

Systematics is the scientific discipline that encompasses the description, identification, nomenclature, and classification of organisms (Taxonomy) and the reconstruction of their macro-evolutionary history (Phylogenetics). Knowing the identity and evolutionary relationships of organisms is crucial to any biological study and systematics is therefore an important cornerstone of Biology. This course is an introduction to the methodology and principles of systematics and patterns and origin of seed plant diversity.

P: BIOL 113

RP: BIOL 271

Lect: 3 x 50 minutes per week (Term 4)

Lab: 4 hrs per week (Term 4)

BIOL 231 Foundations in Molecular Biology

Semester 1 15 points Term 1

Co-coded as BCHM 202

Principles of genetics, including the structure of RNA and DNA, molecular replication, transcription, translation, recombination and gene expression.

P: (1)BIOL 111 and (2) CHEM 114, ENCH480 or CHEM 112

R: BIOL 230, BCHM 202

EQ: BCHM 202, ENCH 480

Lect: 4 x 50 minutes per week (Term 1)

Lab: 4 hrs per week (Term 1)

BIOL 250 Principles of Animal Physiology

Semester 1 15 points

This is a broad-based, elementary course in animal physiology providing an introduction to the principal physiological systems in animals, how they operate and how they are regulated. Topics include gas exchange, blood and circulation, osmoregulation and excretion, digestion, nervous and muscle systems, immunology, and endocrinology. The treatment is comparative although human and mammalian physiology receives greatest emphasis. Selected examples from lower vertebrates and invertebrates are used to illustrate physiological principles.

P: BIOL 111

Lect: 2 x 50 minutes per week

Lab: 4 hrs per week (Term 1)

BIOL 251 Exercise and Health

Semester 2 15 points

The course will consider the health benefits of exercise and the ways in which exercise performance can be monitored. It will consider biochemical and physiological changes that accompany training regimes.

P: BIOL 111 or BIOL 116. Students with other appropriate preparation may be admitted to this course with the approval of the Head, School of Biological Sciences.

Lect: 2 x 50 minutes per week

Lab: 4 hrs per week

BIOL 253 Cell Biology 1

Semester 2 15 points

The course will cover membrane structure, membrane transport of small molecules and the electrical properties of membranes, intracellular compartments and protein sorting, intracellular vesicle transport, aspects of the cytoskeleton, the cell cycle and apoptosis. These topics will give the students a comprehensive grounding in cells as single entities. This will prepare students for an updated 3rd year cell biology course that will consider cells in their social context i.e. how they interact with other cells.

P: BIOL 111 and 15 pts of CHEM at 100 level

R: BCHM253

RP: 30 pts of Chemistry

Lect: 2 x 50 minutes per week

Lab: 4 hrs per week

BIOL 254 Plant Developmental Biology

Semester 2 15 points Term 3

To introduce the principles of plant development, including the basic anatomy of higher plants, and how they grow, respond to external stimuli and reproduce, and to relate these concepts to developments in agriculture and biotechnology.

P: BIOL 111

R: BIOL 252

RP: Chem 114

Lect: 4 x 50 minutes per week (Term 3)

Lab: 4 hrs per week (Term 3)

BIOL 255 Plant Ecophysiology

Semester 2 15 points Term 4

To introduce the methodology and principles of plant physiological investigation, to develop an understanding of the physiological processes that allow plants to acquire resources and respond to

environmental stresses, and to provide basic skills in plant laboratory research.

P: BIOL 111

RP: CHEM 114

R: BIOL 252

Lect: 4 x 50 minutes per week (Term 4)

Lab: 4 hrs per week (Term 4)

BIOL 270 Ecology

Semester 1 30 points

Principles of ecology, population ecology, communities and food webs, history and pattern in New Zealand landscapes, experimental design and field research. Field trip to be arranged.

P: BIOL 112 and BIOL 113

R: FORE 202

Lect: 4 x 50 minutes per week

Lab: 4 hrs per week (Term 1)

BIOL 271 Evolution

Semester 1 15 points

An introduction to evolution: patterns and processes of evolution; mechanisms of evolution, adaptation, speciation and extinction. Tutorials to be arranged.

P: BIOL 112

Lect: 3 x 50 minutes per week

BIOL 272 Principles of Animal Behaviour

Semester 2 15 points

Mechanistic, developmental and evolutionary processes underlying animal behaviour. Tutorials to be arranged.

P: BIOL 112 or PSYC 105

Lect: 3 x 50 minutes per week

BIOL 273 New Zealand Biodiversity and Biosecurity

Semester 2 15 points

An overview of the native plants and animals of New Zealand, including their biogeographic origins, the unique and unusual aspects of native organisms, the makeup of native communities, and their interactions with introduced organisms.

P: 30 points at 100 level

R: BIOL 114

Lect: 2 x 50 minutes per week

BIOL 305 Practical Field Botany

Summer 15 points

This course will focus on practical taxonomic skills for field biologists, ecologists, conservation biologists, taxonomists, teachers, students, and plant enthusiasts, providing valuable training in plant identification, collection, and preservation. It will complement existing courses in the ecology and evolutionary biology streams as well as providing a base for further training in the specialised area of plant taxonomy. The course is run at the Cass Field Station and examples used will be from the montane and alpine flora of Canterbury - but most acquired skills will be transferable to other regions and other groups of organisms.

P: BIOL 215 or subject to approval by the Head of School.

Lect/Lab: Residential summer course at Cass fieldstation.

BIOL 309 Experimental Design & Data Analysis for Biologists

Semester 2 15 points

Advanced experimental design and statistical techniques for biologists. This course is essential for all students considering postgraduate study in biological sciences.

P: BIOL209 or other statistical background as determined by the Head of School.

Lect: 2 x 50 minutes per week

Lab: 3 hrs per week

BIOL 313 Advanced Microbiology

Semester 2 30 points

This course extends material given in Biol213 and explores the occurrence and roles of bacteria, viruses and fungi in applied and environmental microbiology. Advanced microbiology covering aspects of bacteria, viruses and fungi in applied and environmental microbiology. The entire practical component of the course consists of a small research project.

P: BIOL 213 and BIOL 231 or BCHM 202

Lect: 3 x 50 minutes per week

Lab: 6-8 hrs per week (Term 4)

BIOL 330 Advanced Concepts in Genetics

Semester 1 30 points

Advanced molecular genetics of animals, plants, bacteria and viruses. An emphasis on recombinant DNA and genomic technologies and their applications, and population, quantitative

and evolutionary genetics with a conservation emphasis.

P: BIOL 213, BIOL 231 and BIOL 271

Lect: 3 x 50 minutes per week

Lab: 6 hrs per week

BIOL 331 Biochemistry 3

Whole Year 30 points

Co-coded as BCHM 301

This course is designed to help you understand the chemistry and biology of cellular processes, including how biochemistry is controlled, how different molecules function and how biochemists seek the answers to such questions. The course aims to introduce you to modern biochemical ideas and research, and will include a substantial amount of reading from the biochemical literature, as well as from your standard textbook. The course is intended to complement courses such as BCHM 302/CHEM 325, BCHM 381, BIOL 330, BIOL 313. Tutorials to be arranged.

P: (1) BCHM 201; (2) BCHM 202 or BIOL 230 or BIOL 231

R: BCHM 301

Lect: 2 x 50 minutes per week

BIOL 332 Genetics and Evolution of Invasive Species

Semester 2 15 points Term 3

An introduction to the genetics and evolution of biological invasions, including the use of molecular tools to answer applied questions regarding the source and spread of introduced organisms.

P: BIOL 271

Lect: 3 x 50 minutes per week (Term 3)

BIOL 351 Cell Biology 2

Semester 2 30 points

This course examines the relationships between molecular structure and organelle and cell function. It focuses on structure, physiology, biochemistry and molecular biology of cells.

P: BIOL 253. For students enrolled before 2010, either (1) BIOL 231 and BIOL 232; or (2) BIOL 230 or BIOL 250 or BIOL 252 or BCHM 201

Lect: 3 x 50 minutes per week

Lab: 8 hrs per week (Term 4)

BIOL 352 Plant Development and Biotechnology

Semester 1 30 points

To introduce the principles and applications of plant tissue culture research, to develop an

understanding of the biology of cultured plant cells, to introduce the principles of genetic engineering of plants, to examine issues associated with its potential use, to examine research advances on aspects of plant hormone biology, development and disease resistance, and to provide selected skills used in plant biotechnology research.

P: BIOL 252 or BIOL 254

RP: BIOL 255

Lect: 3 x 50 minutes per week

Lab: 6 hrs per week (Term 1)

BIOL 354 Animal Ecophysiology

Semester 2 15 points Term 3

Comparative aspects of physiological adaptation to aquatic and terrestrial environments. Topics include osmoregulation, excretion, respiration, circulation, temperature acclimation, using both vertebrate and invertebrate examples.

P: BIOL 250

Lect: 3 x 50 minutes per week (Term 3)

Lab: 4 hrs per week (Term 3)

BIOL 355 Neurons, Hormones and Behaviour

Semester 1 15 points Term 2

The physiological basis of behaviour. Building on the introduction to Animal Physiology in BIOL250, this course will concentrate on the endocrine and nervous systems and develop an understanding of how these systems have evolved to fine-tune the behaviour of animals.

P: BIOL 250 **RP:** BIOL 272

Lect: 3 x 50 minutes per week (Term 2)

Lab: 3 hrs per week (Term 2)

BIOL 371 Evolutionary Ecology

Semester 1 15 points

Advanced theories of evolution, emphasising the interaction between ecology and evolution, in relation to the evolutionary history of species and interactions among them.

P: BIOL 271

In exceptional circumstances this prerequisite may be replaced by a high level of achievement in other courses as determined by the Head of School.

Lect: 2 x 50 minutes per week

BIOL 373 Behavioural Ecology

Semester 1 30 points

The development and adaptive significance of behaviour with emphasis on the relationship between ecology and behaviour.

P: (1)BIOL 271 or BIOL 272; (2)BIOL209 or equivalent preparation in statistics.

Lect: 3 x 50 minutes per week

Lab: 6 hrs per week (Term 1)

BIOL 374 Marine Ecosystems

Semester 2 30 points

Advanced theories, concepts and applications of marine ecology to current issues. Field trip to be arranged.

P: BIOL 270 and BIOL 209

RP: BIOL 212

Lect: 3 x 50 minutes per week

Lab: 3 hrs per week

BIOL 375 Freshwater Ecosystems

Semester 2 30 points

Advanced theories and concepts of freshwater ecology and their practical application to current issues. Field trip to be arranged.

P: BIOL 270 and BIOL 209

Lect: 3 x 50 minutes per week

BIOL 377 Global Change and Biosecurity

Semester 1 30 points

A discussion of major concepts in community and ecosystems ecology in the context of anthropogenic changes to the environment and pressure from invasive exotic species. Note: fieldwork is required.

P: (1) BIOL 270 or FORE 202; (2) BIOL 209 or FORE 222/FORE 224

Lect: 3 x 50 minutes per week

Lab: Two post field-trip labs after break.

BIOL 378 Population Ecology and Conservation

Semester 1 15 points

Advanced concepts in population ecology, especially those most relevant to the New Zealand region and to the conservation of the New Zealand biota. Topics include life history tradeoffs, dispersal and metapopulations, species interactions, population regulation, population modelling, management of populations, and issues for species conservation in New Zealand. Note: fieldwork is required.

P: (1) BIOL 270 or FORE 202; (2) BIOL 209

Lect: 3 x 50 minutes per week (Term 1)

BIOL 379 Sustaining Native Biodiversity in Primary Production Systems

Semester 2 15 points Term 3

A review of theoretical concepts coupled with policy and management tools to implement sustainable native biodiversity on managed lands such as agricultural and plantation forestry ecosystems. This course includes fieldtrips.

P: (1) BIOL 270 or FORE 202; (2) BIOL 209 or FORE 222/FORE 224

R: BIOL 376, FORE 430, FORE 444

Lect: 3 x 50 minutes per week (Term 3)

Key

P: Pre-requisites

RP: Recommended Preparation

R: Restrictions

EQ: Equivalent Course



Undergraduate laboratory class held in the School's glasshouse complex on campus.

Biochemistry Courses

BCHM 202 Molecular Genetics

Semester 1 15 points Term 1

Principles of genetics, including the structure of RNA and DNA, molecular replication, transcription, translation, recombination and gene expression.

P: (1)BIOL 111 and (2) CHEM 114, ENCH480 or CHEM 112

R: BIOL 230, BIOL231, BCHM 202

EQ: BIOL 231, ENCH 480

Lect: 4 x 50 minutes per week (Term 1)

Lab: 8 hrs per week (Term 1)

BCHM 212 Chemical Reactivity

Semester 1 15 points

Molecular structure, bonding, stereochemistry and reactivity. Chemistry of naturally occurring and synthetic materials.

P: CHEM 112 or CHEM 115

R: CHEM 222, CHEM 232, CHEM 262, ENCH 241

Lect: 1 x 50 minutes per week

BCHM 206 Organic Chemistry

Semester 2 15 points

Course Co-ordinator: Assoc Prof Emily Parker

Reaction mechanisms, synthesis and biosynthesis of organic compounds.

P: BCHM 205 or ENCH 241 or CHEM 232

R: CHEM 222, CHEM 242, CHEM 272, CHEM 262

Lect: 2 x 50 minutes per week

BCHM 221 Biochemistry A - Biomolecules and their interactions

Semester 1 15 points

The course provides an understanding of the chemical structure and function of the major classes of biomolecules and how they interact; how biomolecules are separated from their parent organisms, and tools we might use to study them in the laboratory. Particular attention will be given to enzymes and their regulation and how a study of their kinetics can give us invaluable information, for example in drug design.

P: BIOL 111 and Either a) CHEM 114 and CHEM 115 or b) CHEM 112

Lect: 2 x 50 minutes per week

BCHM 222 Biochemistry B - Metabolism; the reactions of molecules in cells

Semester 2 15 points

General principles of metabolism, particularly how the pathways are controlled in response to the changing needs within the cell. These general principles will be illustrated by an in-depth look at particular metabolic pathways, especially glycolysis and the Krebs' cycle. Bioenergetics: membranes and energy transduction, the chemiosmotic theory, oxidative phosphorylation and photosynthesis.

P: BCHM 221

R: BCHM 201, ENCH 323

Lect: 2 x 50 minutes per week

BCHM 281 Practical Biochemistry

Semester 2 15 points

Experimental biochemistry, synthetic organic and inorganic chemistry with an emphasis on preparation, separation, isolation, and characterisation techniques that are used in chemistry and biochemistry. Safety and library elements will be integrated into the course, biochemistry and chemistry options will be available.

P: CHEM 112 or CHEM 115

R: CHEM 281

Lab: 8 hrs per week

BCHM 301 Biochemistry 3

Whole Year 30 points

Co-coded as BIOL 331

This course is designed to help you understand the chemistry and biology of cellular processes, including how biochemistry is controlled, how

different molecules function and how biochemists seek the answers to such questions. The course aims to introduce you to modern biochemical ideas and research, and will include a substantial amount of reading from the biochemical literature, as well as from your standard textbook. The course is intended to complement courses such as BCHM 302/CHEM 325, BCHM 381, BIOL 330, BIOL 313. Tutorials to be arranged.

P: (1)BCHM 201 (2)BCHM 202 or BIOL 230 or BIOL 231

R: BIOL331

Lect: 2 x 50 minutes per week

BCHM 302 Biological Chemistry

Whole Year 30 points

Chemical aspects of biosynthetic pathways. Chemical biology of molecular recognition. Pharmaceutical chemistry, bio-inorganic chemistry, bio-physical chemistry.

P: Either (1) 22 points from BCHM 205, BCHM 206, CHEM 222, CHEM 232, CHEM 242, CHEM 262, CHEM 272, ENCH 241; or (2) BCHM 201 and EITHER BCHM 205 OR CHEM 232 OR ENCH 241.

Entry with BCHM 201 alone if taken before the year 2000 may be approved by the Head of Department.

R: CHEM 325, ENCH 445

Lect: 2 x 50 minutes per week

BCHM 381 Biochemical Techniques

Semester 2 15 points

Biochemical experiments and analysis such as transport kinetics, DNA sequence analysis and manipulation, lipid isolation and characterisation. Safety, bioethical and library elements will be integrated into the coursework.

P: BCHM 201 (if taken prior to 2005) or BCHM 281 or CHEM 281

Lab: 8 hrs per week

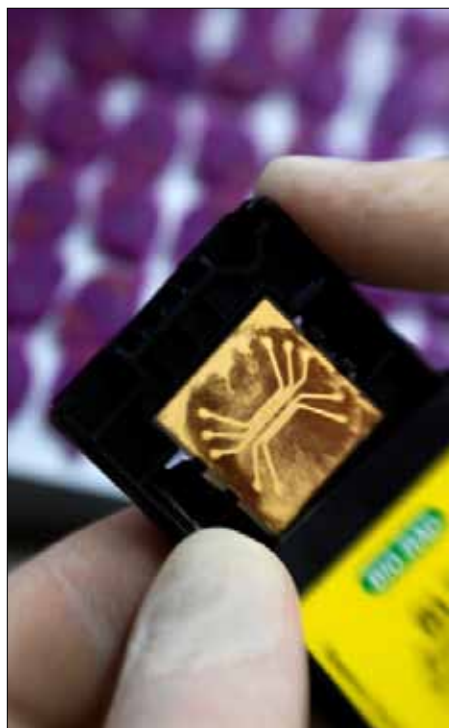
Key

P: Pre-requisites

RP: Recommended Preparation

R: Restrictions

EQ: Equivalent Course



School Facilities

The School of Biological Sciences has modern, well-equipped research laboratories. Our brand new, purpose built, research building Pūtaiao Koiora has state of the art facilities to allow us to conduct research across a wide range of biological fields.

Ecology laboratories are equipped to measure environmental parameters at the macro and micro levels. They include seawater, Antarctic and freshwater aquaria, as well as environmental chambers with controlled light and temperature. A large microscopy facility is also available for sorting and identifying organisms.

Animal physiological laboratories contain research equipment for neurophysiology, ion and water regulatory physiology, cardiac, respiratory and exercise physiology.

Molecular genetics and molecular biology research laboratories are fully equipped for DNA, RNA and protein analysis, recombinant DNA techniques, real-time PCR and microinjection of macromolecules into cells. We also house the Canterbury Sequencing Facility and Ancient DNA laboratory.

We have a brand new confocal microscope, as well as a scanning electron microscope equipped for X-ray microanalysis. Ultrastructural laboratories are also available for image analysis of the fine structure of wood and plant material.

Plant physiology laboratories have research equipment for transgenic plant production and radio tracer research, not to mention comprehensive greenhouse facilities.

Biochemistry and biotechnology labs house advanced tools for the study of macro-molecular structure and enzyme function.

Microbiology laboratories have equipment to study the genetics, physiology and biochemistry of a diverse range of microbes.



Brand new Pūtaiao Koiora, the Biological Sciences research building.



Prime Minister John Key views Dr Esme Robinson's snapper fish physiology experiment.



Ari Kornfeld, PhD student, is investigating how environmental gradients affect plant function.

Field Stations

Teaching and research activities in the School of Biological Sciences are greatly assisted by field stations at the sites below. Many undergraduate courses involve a fieldwork component based either at Cass or Kaikoura. Field trips allow students to apply techniques and test hypotheses they have learnt in lectures and also interact with staff in a more informal setting.



Practical Field Botany summer course (Biol 305) students at Craigieburn to examine the diversity of plants along the altitudinal gradient.

Edward Percival Field Station, Kaikoura

With panoramic views of sea and mountains, the field station has residential and laboratory facilities and is an ideal location for field studies of native birds, rocky shore ecosystems, and marine animal behaviour. The George Knox Research Laboratory includes a large general research laboratory, library, computer facilities, workroom, tank rooms and controlled temperature rooms, as well as a large covered working area suitable for algal culture and maintaining live animals. The station has a full-time station manager, Mr Jack van Berkel, who also manages the other field stations.

grasslands, scrub, riverbed, scree, beech forest, swamp, bog, lake, stream and alpine habitats. Close by, Arthurs Pass and the Craigieburn Range also provide accessible areas from alpine habitats to lowland and montane mixed podocarp-broadleaved forest of Westland.

Scott Base, Antarctica

In collaboration with Gateway Antarctica, Biological Science staff and students make regular summer visits to the Antarctic to work on mosses, lichens, microbes including algae, soils, fish, birds and seals. These studies can be extended at the University using environment controlled rooms in the Biological Sciences research building.

Cass Field Station, Mid Canterbury

Situated at Cass, 105km west of Christchurch in the mountains of the Waimakariri Basin, the field station has a research laboratory and associated residential facilities for hardy terrestrial and freshwater field workers. The Cass area comprises a wide range of environments – montane

Ngel Nyaki, Nigeria

This field station is situated in the mountainous region of Eastern Nigeria and is available for use by staff and students from UC as well as Nigerian and international universities. Dr Hazel Chapman leads the Nigerian Montane Forest Project, which is closely associated with this research facility.



Looking across the bay to the EPSF, Kaikoura.

Research Centres



PhD student Moritz Lassé is studying molecular aggregation of proteins in the context of food digestibility.

Biomolecular Interaction Centre (BIC)

The Biomolecular Interaction Centre (BIC) is a multi-disciplinary centre dedicated to the study of molecular interactions critical to biological function. Understanding biomolecular interactions is central to a range of fundamental sciences, new treatments for disease, and a wide range of highly functional products.

The Institute includes University of Canterbury researchers from the Colleges of Science and Engineering, as well as Education and Arts and partners with several New Zealand CRIs and Universities.

The Centre was founded in 2007 after being awarded funding from the Innovation and Development Fund from the Tertiary Education Commission (TEC). The primary investment of \$1.85 million was used to purchase a suite of state-of-the-art equipment that was supplied by Bio-Rad Laboratories. BIC has recently received a multi-million dollar investment from the University of Canterbury to become one of two new premier research institutes on campus.

The Centre for Integrated Research in Biosafety (INBI)

INBI is a multi-disciplinary centre devoted to career-minded researchers in the biological, physical and social science, philosophies, law, engineering and cultural studies. The primary mission of the Institute is to produce graduates and professionals equipped to contribute to the global demand for research in biosafety/biosecurity.

Currently, our research focus is on the nature of biotechnology risk assessment (scientific and social), how the larger community and the community of scientists communicate, how science responds to the questions and concerns of citizens, especially those whose interest is not commercial or strategic but purely public good, and on providing answers to these questions.

INBI offers students the opportunity to connect with other researchers throughout New Zealand. Our links with the United Nations Environment Programme, the Norwegian Institute of Gene Ecology and a network of biosafety-minded researchers around the world can assist you in building an international career. We also have an exchange programme with the University of Tromsø that allows students to study in Norway.

Centre of Excellence in Aquaculture and Marine Ecology (CEAME)

CEAME is a joint marine research centre that provides students an opportunity to engage with University staff and scientists from the National Institute of Water and Atmospheric Research (NIWA). The objectives of CEAME are to promote and enhance excellence in aquaculture and marine ecological research, to attract the best students nationally and internationally.

Projects within CEAME include a broad range of disciplines such as mathematics and engineering, theoretical and conceptual issues of marine science, sustainability of cultured fisheries, and genetics based research.

Postgraduate Degrees

Postgraduate degrees taken by students include a Bachelor of Science (Honours), a Postgraduate Diploma, a Master of Science, or a Doctor of Philosophy.

Any student who wishes to enrol for a research degree should contact an academic staff member of the School for further information and advice. Also visit our website (www.biol.canterbury.ac.nz) or contact us for a copy of the *Biological Sciences Postgraduate Handbook*.

An interdisciplinary course, Environmental Science, is also offered at postgraduate level by Biological Sciences, Geography and Geological Sciences. Details can be obtained from the *University of Canterbury Calendar* or Assoc Prof Islay Marsden.

BSc (Hons)

Honours is an intensive one-year programme designed for high achieving students seeking to fast-track to a PhD.

Honours students must take four 400-level courses and a research project.

We recommend this option only for students with an A- average (GPA 7) or higher at 300-level.

PgDipSc

The Postgraduate Diploma of Science is a one-year program equivalent to the first year of an MSc. Students take four 400-level courses, but do not carry out research. See page 13 for the list of courses we offer.

The PgDipSc is a great option if you are unsure whether you want to commit to an MSc or if you want to extend your theoretical grounding in biology prior to entering the workforce.

It is common for students enrolled in a PgDipSc to transfer to MSc part II providing they achieve a B average or better in their 400-level courses.

MSc

A Master of Science degree comprises one year of coursework (part I) and a 16 month research project (part II).

The MSc degree provides a solid grounding in the scientific process and provides sought after research skills applicable to a wide range of careers. This degree is also arguably the best route into a PhD because you gain more in-depth research experience than is possible during an Honours degree.

PhD

The PhD at UC is a research degree that typically requires three, but no more than four years of study. It is the highest academic qualification available at the University. Completing a doctorate is a mark of academic achievement and requires self-discipline and commitment.

A PhD prepares you for an academic or research career and the skills you gain are increasingly sought after in the international job market.

Undergraduate Stream	Postgraduate Major	Current 400-level Biology Courses
Animal Behaviour	→ Ecology or Zoology or Evolutionary Biology	<i>Full descriptions on our website</i>
Animal Physiology	→ Zoology	BIOL 421 Evolutionary Systematics
Any Science Background	→ Environmental Science	BIOL 430 Genomics
Biochemistry	→ Biochemistry	BIOL 431 Genetics
Biotechnology	→ Biotechnology or Cellular & Molecular Biology or Microbiology	BIOL 432 Cell Biology
Biosecurity	→ Plant Biology or Ecology or Zoology or Evolutionary Biology	BIOL 434 Molecular Biology
Cell Biology	→ Cellular & Molecular Biology or Microbiology	BIOL 435/BCHM403 Protein Science
Ecology	→ Ecology	BIOL 436/BCHM 401 Medical Biochemistry
Environmental Science	→ Environmental Science	BIOL 451 Environmental Animal Physiology
Evolutionary Biology	→ Plant Biology or Ecology or Zoology or Evolutionary Biology	BIOL 453 Plant Environmental Physiology
Genetics	→ Cellular & Molecular Biology or Evolutionary Biology or Zoology	BIOL 470 Behaviour
Microbiology	→ Microbiology	BIOL 471 Community Ecology
Plant Biology	→ Biotechnology or Plant Biology	BIOL 472 Freshwater Ecology
		BIOL 473 Marine Biology
		BIOL 474 Conservation Biology
		BIOL 476 Coastal Marine Processes
		BIOL 478 Evolutionary Ecology
		BIOL 479 Global Change Biology
		BIOL 490 Aquaculture
		BIOL 491 Plant Developmental Biology and Biotechnology
		BIOL 492 Environmental Microbiology
		BIOL 493 Molecular Microbiology

Career Opportunities

Graduates with bachelors degrees (BSc, BSc(Hons)) are employed as agricultural workers, biological and physical scientists/technicians, teachers, scientific sales representatives, environmental health officers, bacteriologists and zoologists.

Employers include research institutions, regional councils, dairy companies, secondary schools, tertiary institutions, department of health, area health boards, pharmaceutical companies, medical laboratories, and meat companies.

Potential Employers

- *School Biology Teacher* - general science, biology, science advisors.
- *University Teaching and Research*- technicians, research assistants

Crown Research Institutes

- *Industrial Research Ltd (IRL)*- microbiology, biochemistry, electron microscopy, genetics
- *Scion (Formerly Forest Research)* - ecology, taxonomy, morphology, wood anatomy, wildlife biology, entomology, biochemistry, plant physiology, microbiology, genetics
- *Institute of Geological & Nuclear Sciences (GNS)* - palynology, palaeobotany, geobotany
- *New Zealand Pastoral Agriculture Research Institute Ltd (AgResearch)* - genetics, animal behaviour, animal physiology, biochemistry, plant physiology, genomics, biochemistry, microbiology, ecology, entomology
- *Landcare Research NZ Ltd* - land inventory, wildlife biology, ecology, microbiology, entomology, biochemistry, conservation, plant physiology, pollution, taxonomy, evolution, genetics
- *Plant & Food Research Ltd* - plant physiology, biochemistry, biotechnology, genetics, microbiology
- *The Horticulture and Food Crown Research Institute of NZ Ltd (HortResearch)* - plant physiology, biochemistry, biotechnology, microbiology, electron microscopy, genetics
- *National Institute of Water & Atmosphere Ltd (NIWA)* - fisheries biology & ecology, biology of marine & freshwater organisms, oceanography, pollution, water quality, limnology, biophysics, genetics
- *Institute of Environmental Science and Research Ltd (ESR)* - microbiology, biochemistry, environmental quality, electron microscopy, geonomics, forensics

Research Associations

- *Fonterra (Formerly New Zealand Dairy Research Institute)*
- *New Zealand Logging Industry Research Association*
- *Meat Industry Research Institute of New Zealand*
- *Cawthron Institute* - genetics, plant physiology & biochemistry, resource management, ecology, microbiology, freshwater & estuarine biology, biological survey
- *Aquaculture* - salmon farms, mussel farms, management

Ministries

- *Ministry for the Environment* - resource management policy development, ecology, new organisms in New Zealand
- *Ministry of Forestry* - ecology, taxonomy, morphology, wood anatomy, plant pathology, mycorrhizae, timber decay control, electron microscopy, wildlife biology, entomology
- *Ministry of Fisheries*
- *Ministry of Research, Science and Technology* - science policy development

Other

- *Canterbury District Health Board* - cancer research & cytogenetics unit, Christchurch - molecular/-cytogenetics, mutagenesis, microbiology, immunology, physiology, histology, biochemistry
- *Christchurch Clinical School* - clinical endocrinology, endocrine biochemistry, endocrine physiology (both in vivo and in vitro studies)
- *Regional Councils (Water Boards)* - ecology, environmental monitoring and assessment, land inventory, resource management, phycology, microbiology
- *Department of Conservation* - genetics, marine ecology, wildlife biology, ornithology, entomology, resource management, freshwater biology, plant ecology, conservation
- *Museums* - ecology, taxonomy, entomology, ornithology, invertebrate zoology, science communication.

Biological consultants; pharmaceutical companies; industrial microbiology; fish and game councils; salmon farms; dairy research; meat industries; food industries; -plus many more.



Contact Information

Please contact us if you have further questions regarding our courses or research, questions for individual staff members can be sent via email using the format firstname.surname@canterbury.ac.nz.



Recent BSc (Hons) student Josie Beck studied seed dispersal by monkeys at Ngel Nyaki, Nigeria.

Please contact us if you have further questions regarding our courses or research, questions for individual staff members can be sent via email using the format firstname.surname@canterbury.ac.nz.

Head of School

Professor Paula Jameson

Enquiries

Phone: +64 3 364 2500

Fax: +64 3 364 2590

E-mail: biology@canterbury.ac.nz

Web: www.biol.canterbury.ac.nz

Postal Address: School of Biological Sciences
University of Canterbury
Private Bag 4800
Christchurch
New Zealand

Undergraduate Supervisors

Prof Bill Davison

Prof Matthew Turnbull

Dr Paul Broady (100 level coordinator)

Student Advisor, College of Science

The Student Advisor is available to provide accurate and timely academic advice and assistance on course options and/or degree programmes in science subjects.

Ms Tracey Robinson

+64 3 364 2987 ext 3132

tracey.robinson@canterbury.ac.nz

University of Canterbury Contact Centre

For more information about study options or an enrolment pack get in touch with the Contact Centre on:

Freephone: 0800 VARSITY
(0800 827 748) in New Zealand

Or phone: +64 3 364 2555

Email: enrol@canterbury.ac.nz

Web: www.canterbury.ac.nz

Design your Degree

For students first enrolling after 2010 the Bachelor of Science degree requires a minimum total of 360 credit points, of which at least 255 points must be from science courses. The remaining 105 points can be either science or non-science courses. At least 225 points must be from courses above 100-level, 90 points at 300-level, of which at least 60 must be at 300-level in a single subject (BIOL/BCHM) – this is your major. Students can take more than 225 points above 100-level and some choose to do a double major by taking two science subjects through to 300-level with 60 points in each.

Create your own personalised BSc degree in Biological Sciences

360 points for BSc degree of which 255 points must be in science courses

135 points at 100-level

135 points at 200-level (225 points above 100-level)

90 points at 300-level (60 points, excluding BIOL 309, in your major: BIOL or BCHM)

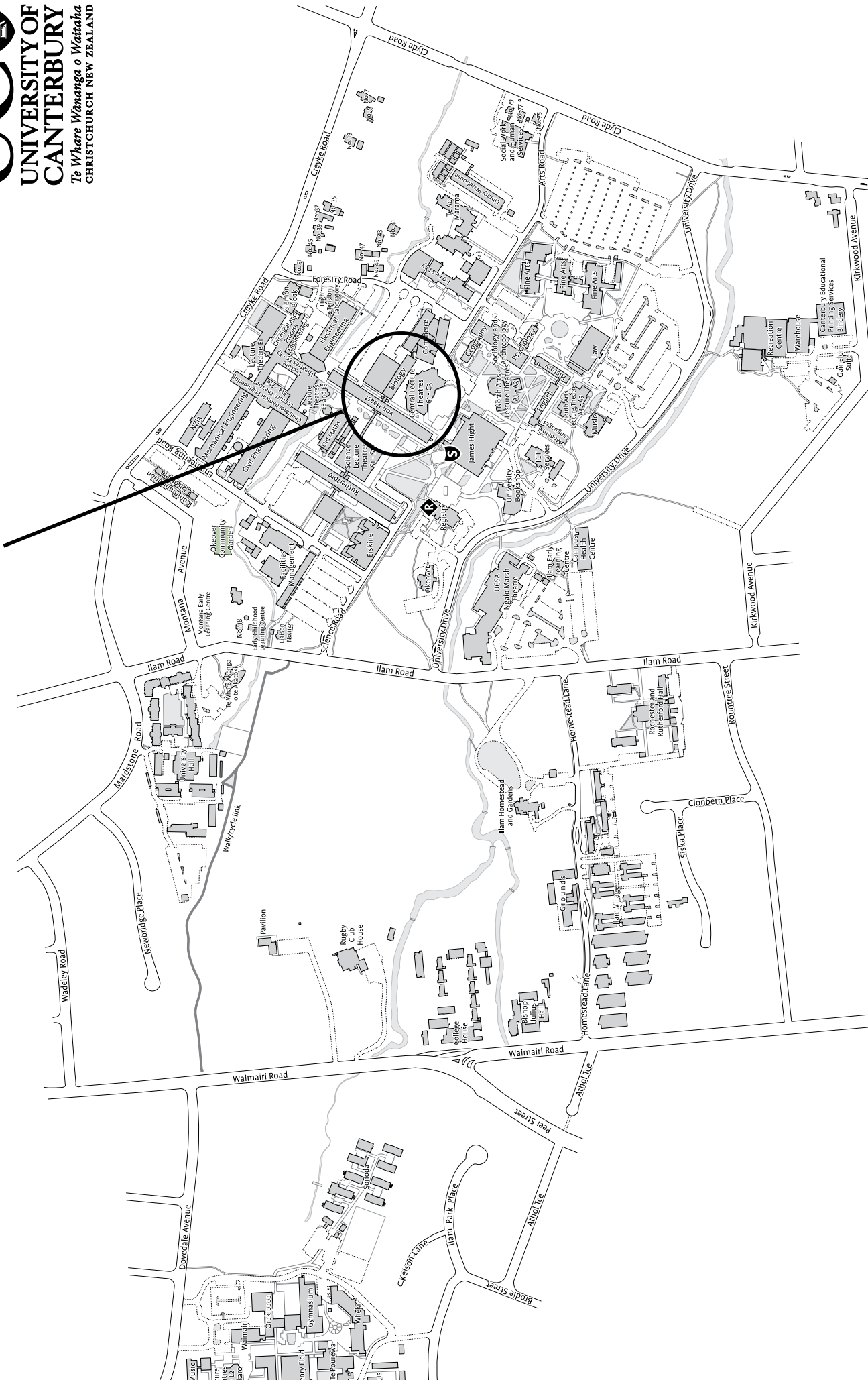
3	Major 300 level		Major 300 level		Any 300 level		Science 200 level	Science 200 level
	30 points		30 points		30 points			
2	Major 200 level	Major 200 level	Major 200 level	Science 200 level	Science 200 level	Science 200 level	Any 200 level	Any 100 level
1	Biol 111	Biol 112	Biol 113	Science 100 level*	Science 100 level**	Any 100 level	Any 100 level	Any 100 level

Each box represents 15 points, unless otherwise stated. This is the minimum. Other combinations are possible.

* Biochemistry majors must take CHEM 111 and CHEM 112 (General Chemistry A and B) during their first year. Biology majors are strongly recommended to take some chemistry, such as CHEM 114.

** All students are encouraged to include 15 points of statistics or mathematics, which counts as a science course.

The School of Biological Sciences is housed in the Biology building (B prefix) and the adjacent von Haast building.



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