Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

School of Natural Sciences

Botany, Environmental Science and Zoology 2025-2026

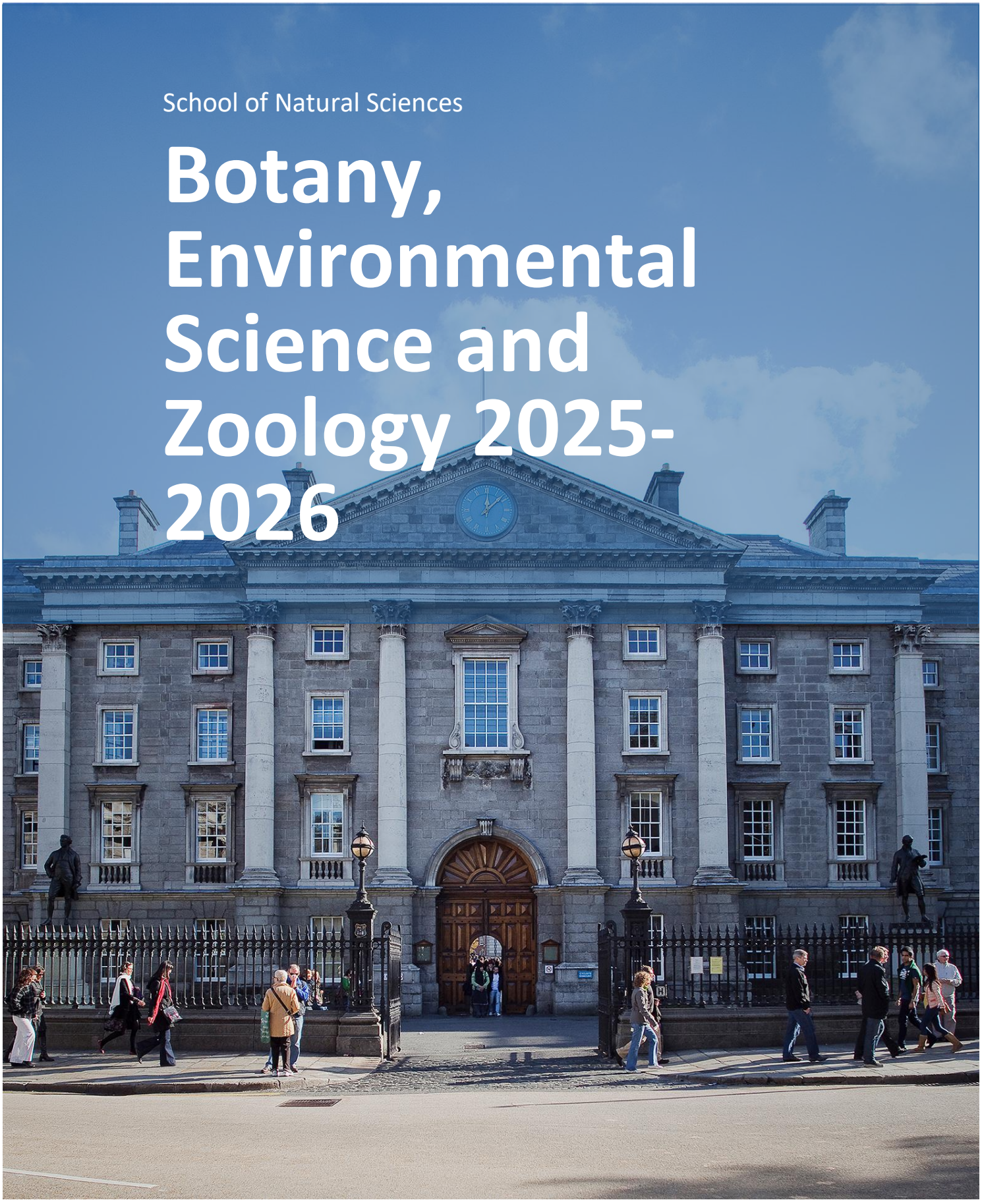

Table of Contents

Welcome

Botany

Welcome everyone to the Botany Discipline, a leading centre of teaching and research in Botany. Our interests range over the areas of plant systematics, plant community ecology, and environment and sustainability. We study plants because they are of vital importance; as the source of all our food, the oxygen we breathe and most of the medicines we use. They are central to the processes of global climate change and to the provision of food and energy for an expanding human population. In the face of such change their conservation is increasingly vital.

This booklet provides details of the core teaching staff, their research interests, the modules on offer and how your work will be assessed and examined as well as details of departmental procedures. As Sophister students you are an integral part of the Botany Discipline - which operates as a teaching and research unit within the School of Natural Sciences. In order to function efficiently we have adopted working procedures with which you are expected to conform, especially with regard to health and safety and security.

Botany encompasses a broad range of subject areas, including:

- Ecology & Conservation Biogeography
- Plant Biochemistry Plant Physiology
- Plant Molecular Biology Ecophysiology
- Classical and Molecular Taxonomy Genetics
- Quaternary Ecology Plant Animal Interactions
- Soil Science Horticulture
- Vegetation modelling Palaeobotany
- Carbon cycling Plant Evolution

Your Sophister years are also designed to offer you opportunities to gain skills in communication, numeracy and scientific problem solving, and in your final year you will have the opportunity to choose certain topics for in-depth investigation. The Botany Discipline's Web page (http://www.tcd.ie/Botany) is a very useful source of information, particularly on research and teaching, which is not duplicated in this booklet.

Dr. Silvia Caldararu
Botany Course Coordinator

Environmental Science

Environmental Sciences is by its nature a multidisciplinary academic field, comprising a study of the frequently complex interactions between the biological, chemical and physical components of our environment. The environmental science discipline has evolved in recent decades as key environmental challenges such as climate change, pollution, sustainable development, deforestation and desertification to name a few, have become the focus of scientists, policy makers and the general public. Environmental scientists have training that is similar to other physical or life scientists but is specifically applied to the environment. A broad scientific knowledge is required which involves a fundamental understanding of the physical and life sciences in addition to economics, law and the social sciences.

The undergraduate degree course offered by the School of Natural Sciences has been designed to provide for the needs of students with an interest in this rapidly developing academic and professional field. The programme comprises specially designed modules plus suitable modules from contributing disciplines. Field study and laboratory skills represent a core component of the programme, and these are blended with the theoretical content to provide our graduates with the training required to become highly successful practitioners in this field.

We look forward to working with you during your sophister years with us and trust that you will find Environmental Sciences as fascinating and rewarding as we do.

Dr Jeremy Piggott
Environmental Science Course Director

Zoology

The discipline of Zoology at Trinity aims to make discoveries, educate and engage society in the science of whole organism biology, ecology & conservation, with a particular focus on animals. Through our research, education and engagement with society we seek to advance scientific understanding and contribute solutions to global challenges to the environment, health and human wellbeing.

The Zoology Moderatorship provides specific knowledge about animal biology and the associated academic disciplines including physiology, ecology, conservation, embryonic development, evolution, parasitology, entomology and wildlife biology in both marine and terrestrial environments. In addition, the courses and activities undertaken through the Junior and Senior Sophister years also provide opportunities for you to learn and practice high level skills in evaluation of evidence, critical thinking, quantitative analysis and written and oral communication. This broad and transferable skill set provides you with a solid scientific framework from which to think creatively and explore the natural world and its interactions with human society.

Our aim is to equip and encourage you to develop independence of thought and learning practices. Your capstone project will allow you to specialize in areas that most interest and inspire you, complemented by modules available across a wide range of systems and levels of organization from the sub-cellular to the landscape level. We hope that the deep knowledge you will gain from your modules and research topics will provide you with a solid scientific framework from which to think creatively and explore the natural world and its interactions with human society.

Prof. Nessa O'Connor
Zoology Course Director

Foreword

This handbook applies to all students taking the Botany, Environmental Sciences or Zoology Programmes taught by the School of Natural Sciences. It provides a guide to what is expected of you on these programmes, and the academic and personal support available to you. Please download and retain a copy for future reference.

Although the information in this handbook is correct at the time of production, the precise content of the course is subject to change. While every effort will be made to give due notice of major changes, the School Office reserves the right to suspend, alter or initiate courses, timetables, examinations and regulations at any time.

NOTE **Students should expect to pay fees for mandatory field courses, which usually take place in week 3 (the first teaching week) and reading week (week 10) in Semester 1 and reading week (week 28) and the final teaching week (week 33) in Semester 2. Fees can range from €300 to > €1000 for any given field course. Details will be confirmed in advance by the Module Coordinator. Some Senior Sophister Open Modules (e.g. Tropical Ecology and Conservation) require a deposit and payment in Junior Sophister. Students who require financial assistance for core field courses should contact the Senior Tutor's office.** ***

Staff contact List

Teaching Staff

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Fiona Moloney	fimolony@tcd.ie	4th floor, Aras an Phiarsaigh

Trinity College Botanic Garden Staff

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Michael McCann		Botanic Garden, Dartry
Michelle Murray	murram27@tcd.ie	Botanic Garden, Dartry

Overview

Junior Sophister students in Botany, Environmental Science and Zoology follow a training programme that consists of core theory and practical modules relating to ecology, physiology and biodiversity, as well as experimental design and analysis. Significant emphasis in these Moderatorships is placed on the student acquiring a broad range of laboratory and field skills.

In the Senior Sophister year, in addition to coursework, students will take part in interactive tutorials and seminar presentations based on detailed literature analysis. They will also carry out and write-up an independent piece of research.

Brief descriptions of all modules available to Sophister students in Botany, Environmental Science and Zoology are given in this handbook.

Programme Structure

Botany

The JS year consists of a diverse programme of on-line and face-to-face lectures, laboratory practicals, tutorials and seminars, totalling 40 core credits. The remaining 20 credits are made up of a mix of open modules and Trinity Electives according to three scenarios listed below, these scenarios dependent on whether the student chooses one or two Trinity Elective modules, and in which semester the Trinity Electives occur. These modules are indicated in greater detail on the following pages.

In the Senior Sophister year, students attend a series of lectures, laboratory and field work practicals, seminars, tutorials and workshops. In addition, students are required to undertake a 20-credit research project which culminates in the submission of a dissertation. The year consists of a total of 50 credits of core modules and 10 credits of open modules. These modules are indicated in greater detail in the following pages.

Learning Outcomes

On successful completion of this programme students will be able to:

- Demonstrate in written, oral and visual form a foundation level of knowledge and understanding of the biological, physical and quantitative sciences underpinning Botany.
- Demonstrate awareness, particularly in relation to the contributions that plant science makes to society, such as maintaining biodiversity, assessing the impacts of global change, reducing environmental pollution and ensuring sustainable food and energy

production, taking into account scientific, social, political, moral and ethical considerations.

• Articulate the fundamental concepts in plant science.

• Discuss current research developments in plant science.

• Review and criticise published scientific information.

• Utilise innovative techniques and modern research facilities to develop combined theoretical and technical competence so enabling the development of high-quality independent research and of the ability to work accurately, efficiently and safely in both field and laboratory environments.

• Demonstrate numerical competency and the ability to analyse quantitative data by appropriate statistical tests, using spreadsheets and other software.

• Collaborate effectively in teams and work independently.

• Communicate accurately, clearly, persuasively and imaginatively, in both oral and written form.

Environmental Science

The Sophister Environmental Science Moderatorship Programme consists of 60 European Credit Transfer Systems (ECTS Credits) per year. Junior Sophisters take a total of 40 core Credits and up to 15 Credits of open modules depending on where your elective is in the academic year. Open module scenario selection is determined by where your Trinity Elective takes place during the academic year, further information on Trinity Electives can be found below.

The Senior Sophister Environmental Science Moderatorship Programme consists of 60 European Credit Transfer Systems (ECTS Credits) per year. Senior Sophisters take a total of 45 mandatory Credits and optional modules up to 15 Credits.

Some modules are examined entirely by in-course assessment; most are assessed by a combination of in-course assessment and examination. Further details on the assessment breakdown for each module can be found in the module descriptors below.

Learning Outcomes

Our mission is to:

• make you aware of the basic concepts, key challenges and current research developments in Environmental Science.

• enable you to understand the basis of good experimental design.

- teach you to work efficiently and safely in laboratories.
- enable you to become a competent field researcher.
- teach you to critically analyse quantitative data.
- develop your written and oral communication skills.
- develop your skills to work effectively in a group and independently; and
- make you socially aware, particularly in relation to the contribution that Environmental Science makes to society.

On successful completion of this programme, students should be able to:

- identify and describe plant and animal communities and analyse their distribution.
- demonstrate the principles of geochemical cycling in the global context with specific reference to environmental change.
- discuss the principles of hydrology and its relationship with groundwater quality.
- discuss the causes and effects of terrestrial, atmospheric and marine pollution and present day mitigation strategies;
- show a good working knowledge of skills and tools, such as spatial data analysis and statistical techniques, which can be used selectively to address complex problems, or to conduct closely guided research.
- identify, formulate, analyse and suggest reasoned solutions to current environmental problems.
- design an Environmental Impact Assessment for a range of diverse habitats.
- critically assess scientific literature.
- work effectively as an individual, in teams and in multidisciplinary settings; and
- communicate effectively with both the scientific community and with society at large.

Zoology

Zoology is the scientific study of all aspects of animal biology, from the cell to ecosystems. This encompasses a knowledge, not only of the structure and function of different species, but also of the complex relationships, which govern the way in which animals relate to each other and to their surroundings. It provides an integrated view of all biological levels from the gene to the organism and higher.

Zoology provides fundamental knowledge relating to three areas of concern to society, namely the environment and its conservation, food production, and human and animal health and wellbeing. There is a growing awareness of environmental issues, including the conservation of biodiversity and the effects of climate change, to which zoologists contribute at all levels from research to policy making. Zoological research is also important in relation to food products and their pests while studies on a range of animals provide a basis for medical biology. Aspects of both environmental and medical biology feature strongly in the teaching and research of the Zoology programme at Trinity. With a breadth of skills, challenges and responsibilities, we are confident that every one of the Trinity Graduate Attributes are met by the zoology sophister programme: https://student-learning.tcd.ie/assessments/graduate-attributes.

Learning Outcomes

On successful completion of the two-year Sophister programme in Zoology, students will be able to:

- Outline the important basic concepts and current research developments in animal biology and associated disciplines.
- Structure the diversity and evolution of the animal kingdom.
- Design useful experiments.
- Demonstrate technical competence in the handling of research facilities and operate safely in a laboratory environment, both individually and as a team member.
- Design sampling programmes and carry out fieldwork using standard procedures.
- Communicate effectively both orally and in a variety of contemporary scientific writing styles.
- Use appropriate editing, web-based, graphical and analytical software to analyse and interpret data and prepare reports and assignments.
- Critically analyse experimental results (including those obtained personally) and use appropriate statistical and other quantitative procedures for data handling.
- Proficiently search and critically assess scientific literature and databases.
- Apply a scientific approach to problem solving.
- Articulate the contribution, including the ethical dimension, made by Zoology to society, in the realms of the environment, agriculture, natural resource management, human behaviour and health.

ECTS Weighting

The European Credit Transfer System (ECTS) is an academic credit system based on the estimated student workload required to achieve the objectives of a module or programme of study. It is designed to enable academic recognition for periods of study, to facilitate student mobility and credit accumulation and transfer. The ECTS is the recommended credit system for higher education in Ireland and across the European Higher Education Area.

The ECTS weighting for a module is a measure of the student input or workload required for that module, based on factors such as the number of contact hours, the number and length of written or verbally presented assessment exercises, class preparation and private study time, laboratory classes, examinations, clinical attendance, professional training placements, and so on as appropriate. There is no intrinsic relationship between the credit volume of a module and its level of difficulty.

The European norm for full-time study over one academic year is 60 credits. 1 credit represents 20-25 hours estimated student input, thus a 10-credit module will be designed to require 200-250 hours of student input including class contact time, assessments and examinations.

ECTS credits are awarded to a student upon successful completion of the programme year. Progression from one year to the next is determined by the programme regulations. Students who fail a year of their programme will not obtain credit for that year even if they have passed certain components. Exceptions to this rule are one-year visiting students, who are awarded credit for individual modules successfully completed.

Trinity Electives

https://www.tcd.ie/trinity-electives/

The Trinity Electives are a unique feature of your Trinity Education. They are stand alone, College-wide 5 credit modules. They cover a broad range of topics in the arts, humanities, sciences, health and social science, and technology. They are designed to allow students to study topics outside of their core discipline and thus provide breadth in their education. Depending on your moderatorship, you will choose a combination of Trinity Electives and Open Modules as described in this handbook.

Choosing your Trinity Elective

The choice of Trinity Elective is student driven. Almost all Trinity Electives are open to all students. However, students of some moderatorships may be precluded from taking certain Trinity Electives (e.g. the module 'From Planets to the Cosmos' is not available to TR063 Physical Sciences students, as this topic is part of their core discipline,). The list of exemptions is outlined in the Trinity Electives webpage: https://www.tcd.ie/trinity-electives/

Selection of Trinity Electives will be made through online enrolment which will open in July 2024, after publication of examination results and allocation of moderatorship places. You will be asked to list your choice(s) of Trinity Elective on a first come first served basis via Online Module Enrolment.

The Trinity Electives website provides full details of each of the Trinity Electives. A list of the Trinity Electives can be found at https://www.tcd.ie/trinity-electives/

You need to think carefully about your choice of Trinity Elective as the semester in which you take it (Semester 1, Semester 2 or both) will affect your choice of Open Modules. That is: taking one Trinity Elective in the first semester, restricts you to the open modules in Option 1; taking one Trinity Elective in the second semester, restricts you to the open modules in Option 2 while taking two Trinity Electives, (one in each semester) restricts you to the open modules in Option 3. Please refer carefully to the tables in this handbook.

Academic Year Structure

An up-to-date academic calendar can be found at https://www.tcd.ie/calendar/academic-year-structure/index.html

Please note that these dates are indicative and are likely to change. Please see the academic calendar linked above.

Dates to note

Event(s)	Date(s)
Michaelmas term starts	25th August 2025
Michaelmas term ends	14th December 2025
Michaelmas assessment session	15th December to 22nd December 2025
Hilary term starts	12th January 2026
Hilary term ends	19th April 2026
Hilary assessments session	20th April to 1st May 2026
Publication of results	TBC
Reassessment Examinations	24th August 2026
Publication of Reassessment results	TBC

Examination Information

Please note that these dates are indicative and are likely to change. Please see the academic calendar linked above.

Winter Assessment Period – December 11 to 22, 2025, inclusive

Annual Assessment Period – April 21 to May 1, 2026, inclusive

Reassessment Period – August 24 to 30, 2026, inclusive

Botany Year Module Structure

Moderatorship course structure - Junior Sophisters (year 3)

<table>
<tr><th colspan="2">Core Module Structure – Year 3</th></tr>
<tr><td>Semester 1 (S1)</td><td>Semester 2 (S2)</td></tr>
<tr><th colspan="2">Core Modules</th></tr>
<tr><td>BOU33100: Plant Physiology (5 ECTS)</td><td>BOU33107: Plant Molecular Biology (5 ECTS)</td></tr>
<tr><td>ZOU33010: Fundamentals of Ecology (5 ECTS)</td><td>ZOU33070: Experimental Design and Analysis (5 ECTS)</td></tr>
<tr><td rowspan="2">BOU33108: Plants and the Irish Environment (5 ECTS)</td><td>BOU33115: Botanical Diversity 1 (5 ECTS)</td></tr>
<tr><td>BOU33121: Field Skills in Plant and Environmental Sciences (Gran Canaria Field Trip) (5 ECTS)</td></tr>
<tr><td colspan="2">ESU33004: Scientific Writing and Communication (5 ECTS)</td></tr>
<tr><th colspan="2">Open Modules Scenario I</th></tr>
<tr><td>In addition to the 5 credits of Trinity Electives, choose <u>one</u> module from the following three:
GSU 33003: Ice Age Earth (5 ECTS)
BOU33123: Soil Science (5 ECTS)
BOU 33114: Conservation Horticulture (5 ECTS)</td><td rowspan="2">Students will automatically be enrolled on the below <u>two</u> modules:
BOU33105: Global Environmental Change (5 ECTS)
BOU33122: Entomology (5 ECTS)
ZOU33006: Ecology and Evolution of Infectious Diseases (5 ECTS)</td></tr>
<tr><td>Trinity Elective (5 ECTS)</td></tr>
<tr><th colspan="2">Open Modules Scenario II</th></tr>
<tr><td rowspan="2">Choose <u>two</u> modules from the following three:
GSU33003: Ice Age Earth (5 ECTS)
BOU33123: Soil Science (5 ECTS)
BOU33114: Conservation Horticulture (5 ECTS)</td><td>In addition to the 5 credits of Trinity Electives, choose <u>one</u> module from the following two:
BOU33105: Global Environmental Change
BOU33122: Entomology
ZOU33006 Ecology and Evolution of Infectious Diseases (5 ECTS)</td></tr>
<tr><td>Trinity Elective (5 ECTS)</td></tr>
</table>

Open Modules Scenario III	
In addition to the 5 credits of Trinity Electives, choose <u>one</u> module from the following three: GSU33003: Ice Age Earth (5 ECTS) BOU33123: Soil Science (5 ECTS) BOU33114: Conservation Horticulture (5 ECTS)	In addition to the 5 credits of Trinity Electives, choose <u>one</u> module from the following two: BOU33105: Global Environmental Change (5 ECTS) BOU33122: Entomology (5 ECTS) ZOU33006 Ecology and Evolution of Infectious Diseases (5 ECTS)
Trinity Elective (5 ECTS)	Trinity Elective (5 ECTS)

Moderatorship course structure - Senior Sophisters (year 4)

Core Module Structure – Year 4	
Semester 1 (S1)	Semester 2 (S2)
Core Modules	
ZOU44030: Data Handling (5 ECTS)	BOU44110: Evolution of Plants and Plant Atmosphere-Interaction (5 ECTS)
BOU44108: Plant-Environment Interactions (5 ECTS)	
BOU44115: Botanical Diversity 2 (5 ECTS)	
BOU44112: Plants and the Planet (5 ECTS)	
ZOU44060: Research Comprehension (5 ECTS)	
Open Modules	**Capstone Project**
Choose <u>two</u> modules from the selection below: BOU44060: Plant Breeding and Biotechnology (5 ECTS) BOU44111: Restoration Ecology and Re-Wilding (5 ECTS) ZOU44021: Tropical Ecology and Conservation (5 ECTS)	FBU44000: Capstone Project (20 ECTS)

Environmental Science Year Module Structure

Moderatorship course structure - Junior Sophisters (year 3)

<table>
<tr><th colspan="2">Core Module Structure – Year 3</th></tr>
<tr><td>Semester 1 (S1)</td><td>Semester 2 (S2)</td></tr>
<tr><th colspan="2">Core Modules</th></tr>
<tr><td>BOU33108: Plants and the Irish Environment (5 ECTS)</td><td>BOU33105: Global Environmental Change (5 ECTS)</td></tr>
<tr><td>ZOU33010: Fundamentals of Ecology (5 ECTS)</td><td>GGU33931: Environmental Governance 1 (5 ECTS)</td></tr>
<tr><td>ESU33040: Environmental Monitoring (5 ECTS)</td><td rowspan="2">ZOU33070: Experimental Design and Analysis (5 ECTS)</td></tr>
<tr><td>BOU33123: Soil Science (5 ECTS)</td></tr>
<tr><td colspan="2">ESU33004: Scientific Writing and Communication (5 ECTS)</td></tr>
<tr><th colspan="2">Open Modules Scenario I</th></tr>
<tr><td>In addition to the 5 credits of Trinity Electives, choose <u>one</u> module from the following four:

GSU33003: Ice Age Earth (5 ECTS)

BOU33100: Plant Physiology (5 ECTS)

GLU33002: Blue Earth: Understanding the Function of Marine Ecosystems (5 ECTS)

BOU33114: Conservation Horticulture (5 ECTS)</td><td rowspan="2">Choose <u>two</u> modules from the following four:

GLU33009: Hydrology and Groundwater Quality (5 ECTS)

BOU33121: Field Skills in Plant and Environmental Sciences (5 ECTS)

ZOU33086: Terrestrial Wildlife and Field Ecology (5 ECTS)

BOU33122: Entomology (5 ECTS)</td></tr>
<tr><td>Trinity Elective (5 ECTS)</td></tr>
<tr><th colspan="2">Open Modules Scenario II</th></tr>
<tr><td>Choose <u>two</u> modules from the following four:

GSU33003 Ice Age Earth (5 credits)

BOU33100 Plant Physiology (5 credits)

GLU33002 Blue Earth: Understanding the Function of Marine Ecosystems (5 credits)</td><td>In addition to the 5 credits of Trinity Electives, choose <u>one</u> module from the following four:

GLU33009 Hydrology and Groundwater Quality (5 credits)

BOU33121 Field Skills in Plant and Environmental Sciences (5 credits)</td></tr>
</table>

BOU33114 Conservation Horticulture (5 Credits)	ZOU33086 Terrestrial Wildlife and Field Ecology (5 credits) BOU33122: Entomology (5 credits)
	Trinity Elective (5 ECTS)
Open Modules Scenario III	
In addition to the 5 credits of Trinity Electives, choose <u>one</u> module from the following four: GSU33003 Ice Age Earth (5 credits) BOU33100 Plant Physiology (5 credits) GLU33002 Blue Earth: Understanding the Function of Marine Ecosystems (5 credits) BOU33114 Conservation Horticulture (5 Credits)	In addition to the 5 credits of Trinity Electives, choose <u>one</u> module from the following four: GLU33009 Hydrology and Groundwater Quality (5 credits) BOU33121 Field Skills in Plant and Environmental Sciences (5 credits) ZOU33086 Terrestrial Wildlife and Field Ecology (5 credits) BOU33122: Entomology (5 credits)
Trinity Elective (5 ECTS)	Trinity Elective (5 ECTS)

Moderatorship course structure – Senior Sophisters (year 4)

Core Module Structure – Year 4	
Semester 1 (S1)	Semester 2 (S2)
Core Modules	
ZOU44030: Data Handling (5 ECTS)	FBU44000: Capstone Research Project (20 ECTS)
ZOU44092 Environmental Impact Assessment (5 ECTS)	
BOU44111 Restoration Ecology and Re-Wilding (5 ECTS)	
ESU44052 General Environmental Sciences (5 ECTS) **	
ZOU44060 Research Comprehension (5 ECTS)	
Open Modules	

Choose two modules from the following four:	Choose one module from the following two:
BOU44115: Botanical Diversity 2 (5 ECTS) ZOU44013 Conservation & Wildlife Management (5 ECTS) ZOU44021: Tropical Ecology and Conservation (5 ECTS) ESU44054: Spatial Analysis using GIS (5 ECTS) BOU44108: Plant-Environment Interactions (5 ECTS)	BOU44110: Evolution of Plants and Plant-Atmosphere Interaction (5 ECTS) GGU44977: Environmental Governance 2 (5 ECTS) *

* Please note: This module has a cap of five students from Environmental Science.

** Please note: Students are expected to arrange transport and pay ENVIRON conference registration for module ESU44052, which is usually between €60 – €150 each. Eligible students may apply to the Student Assistance Fund (http://www.tcd.ie/Senior_Tutor/) for financial assistance.

Zoology Year Module Structure

Moderatorship course structure – Junior Sophisters (year 3)

<table>
<tr><th colspan="2">Core Module Structure – Year 3</th></tr>
<tr><td>Semester 1 (S1)</td><td>Semester 2 (S2)</td></tr>
<tr><th colspan="2">Core Modules</th></tr>
<tr><td>ZOU33000: Marine Biology (5 ECTS)</td><td>ZOU33005: Evolutionary Biology (5 ECTS)</td></tr>
<tr><td>ZOU33003: Animal Diversity 1 (5 ECTS)</td><td>ZOU33070: Experimental Design and Analysis (5 ECTS)</td></tr>
<tr><td>ZOU33004: Animal Diversity 2 (5 ECTS)</td><td>ZOU33086: Terrestrial Wildlife and Field Ecology (5 ECTS)</td></tr>
<tr><td>ZOU33010: Fundamentals of ecology (5 ECTS)</td><td>ESU33004: Scientific Writing and Communication (5 ECTS)</td></tr>
<tr><th colspan="2">Open Modules Scenario I</th></tr>
<tr><td>In addition to the 5 credits of Trinity Electives, choose <u>one</u> module from the following two:</td><td>Choose <u>two</u> modules from the following four:</td></tr>
<tr><td>ZOU33050: Developmental Biology (5 ECTS)

GSU33003: Ice Age Earth (5 ECTS)</td><td rowspan="2">ZOU33006: Ecology and Evolution of Infectious Diseases (5 ECTS)

BOU33122: Entomology (5 ECTS)

BIU33250: Introduction to Immunology and Immunometabolism (5 ECTS)

PGU33109: Neurophysiology (5 ECTS)</td></tr>
<tr><td>Trinity Elective (5 ECTS)</td></tr>
<tr><th colspan="2">Open Modules Scenario II</th></tr>
<tr><td rowspan="2">ZOU33050: Developmental Biology (5 ECTS)

GSU33003: Ice Age Earth (5 ECTS)</td><td>In addition to 5 credits of Trinity Electives, choose one module from the following four:</td></tr>
<tr><td>ZOU33006: Ecology and Evolution of Infectious Diseases (5 ECTS)

BOU33122: Entomology (5 ECTS)

BIU33250: Introduction to Immunology and Immunometabolism (5 ECTS)</td></tr>
</table>

	PGU33109: Neurophysiology (5 ECTS)
	Trinity Elective (5 ECTS)
Open Modules Scenario III	
In addition to the 5 credits of Trinity Electives, choose <u>one</u> module from the following two:	In addition to 5 credits of Trinity Electives, choose one module from the following four:
ZOU33050: Developmental Biology (5 ECTS) GSU33003: Ice Age Earth (5 ECTS)	ZOU33006: Ecology and Evolution of Infectious Diseases (5 ECTS) BOU33122: Entomology (5 ECTS) BIU33250: Introduction to Immunology and Immunometabolism (5 ECTS) PGU33109: Neurophysiology (5 ECTS)
Trinity Elective (5 ECTS)	Trinity Elective (5 ECTS)

Moderatorship course structure – Senior Sophisters (year 4)

Core Module Structure – Year 4	
Semester 1 (S1)	Semester 2 (S2)
Core Modules	
ZOU44030: Data Handling (5 ECTS)	ZOU44020: General Zoology (5 ECTS)
ZOU44022: Comparative Physiology (5 ECTS)	
ZOU44060: Research Comprehension (5 ECTS)	
Open Modules	**Capstone Project**
Choose <u>four</u> of the following six modules:	FBU44000: Research Project (20 ECTS)
ZOU44013: Conservation and Wildlife Management (5 ECTS) ZOU44019: Advances in Behavioural Ecology (5 ECTS)	

BOU44110: Evolution of Plants and Plant Atmosphere-Interaction (5 ECTS) BOU44111: Restoration Ecology and Re-Wilding (5 ECTS) ZOU44021: Tropical Ecology & Conservation (5 ECTS) ZOU44092: Environmental Impact Assessment (5 ECTS)	

Module Information

BIU33250 – Introduction to Immunology & Immunometabolism

Second Semester | 5 credits | 20 contact hours

Module Personnel: *Dr Aisling Dunne*

This module introduces to the basic components and function of the immune system – the molecules, cells, tissues and organs that make up the immune system. It will illustrate the immune responses to infection. Additionally, it will introduce students to the importance of central energy and intermediary metabolic pathways or bioenergetics before considering how they are dysregulated in diseases like cancer and also how we can harness this knowledge for new immunotherapies.

Learning Outcomes:

1. Identify cells, receptors and soluble component of the innate immune system and how they function to eliminate pathogen;
2. Define how an adaptive immune response is initiated and how different types of adaptive immune responses are used to eliminate particular pathogens;
3. Identify how the immune system can cause disease and how it can be exploited therapeutically;
4. Recall key central energy and intermediary metabolic pathways and appreciate their importance in cellular function;
5. Apply knowledge on cellular metabolism to diseases including cancer and inflammation;

Assessment Details: 60% exam, 40% course work

Note that this module is fully online.

BOU33100 – Plant Physiology

First Semester | 5 credits

Module Personnel: *Dr Jamie Waterman*

This module covers the major biochemical and physiological processes that control plant function and underly plant diversity. Students will be introduced to concepts in plant physiology at the cell, leaf, and whole plant level as an introduction to the field of plant physiology and as underlying principles across botany and environmental science. Continual assessment for this module will be a mini review on a specialised subject area relevant to plant

physiology (examples include specific aspects of photosynthesis, a metabolic pathway of interest, functional and developmental traits, etc.) and an exercise in writing a scientific paper from trait data collected from plants maintained under different environmental conditions.

Learning Outcomes:

1. Describe leaf- and cell-level photosynthetic structure and function, including photosynthetic pathways.
2. Describe physiological processes at the plant and cell level including respiration, growth, acquisition of major nutrients and specialised metabolism.
3. Describe how environmental cues, including light and stress, regulate plant physiological processes.
4. Contextualise plant physiology concepts across larger fields of plant evolution, ecology, climate, biodiversity and food security.
5. Acquire, analyse and interpret basic plant physiological data in lab settings.

Recommended Reading List:

- Taiz, L. & Zeiger, L. (2014). Plant Physiology. (6th Edition). Sinauer Associates, Massachusetts. 581.1 N12*4

Assessment Details: 50% Examination, 50% Continual Assessment

BOU33105 – Global Environmental Change

Second Semester | 5 credits

Module Personnel: *Dr Matthew Saunders*

The global environment is changing more rapidly at present than at any time during the human occupancy of the planet. This module will assess both the climatic and non-climatic drivers of global change and will focus on physical patterns within the atmosphere, climate change due to both natural and anthropogenic forcing mechanisms, and projections of future change at various spatial scales. Students will also explore key drivers of climate change with a focus on land use and land use change, and will examine the techniques used to develop historical climatic reconstructions, current assessments of biogeochemical cycling as climatic feedbacks in terrestrial and aquatic systems, the prediction of impacts of future climate change and how this information is used to develop key policy-based mitigation strategies.

Learning Outcomes:

1. Understand the various elements of current global environmental change and the contribution of the major drivers of these changes.
2. Understand the prevailing hypotheses as to the mechanisms and ultimate causes of global environmental change and the extent to which processes operate at different temporal and spatial scales.
3. Appreciate the nature of the interactions between environmental change and ecosystem processes.
4. Evaluate the techniques used in climate science to identify change, quantify feedback mechanisms and predict future impacts of change
5. Appreciate the role scientific enquiry in the development and implementation of policy drivers.

Recommended Reading List:

- IPCC (2013) AR5 Climate Change 2013: The Physical Science Basis.
- IPCC (2019) Climate Change and Land.

Assessment Details: 50% Examination, 50% Continual Assessment

BOU33107 – Plant Molecular Biology

Second Semester | 5 credits

Module Personnel: *Prof Trevor Hodkinson*

Plant Molecular Biology plays a major part in most fields of botanical research including ecology, systematics and physiology. The aim of this module is to cover the fundamentals of plant molecular biology and to explore applied aspects, including molecular systematics, molecular ecology, conservation genetics and genetic engineering.

Learning Outcomes:

1. Demonstrate an understanding of the core elements within the field of Plant Molecular Biology that will enable them to build upon this knowledge and help them better understand other modules.
2. Work competently in a molecular biology research laboratory. Although the module is not vocational, it provides a large amount of hands-on laboratory experience.

Recommended Reading List:

- Judd W.S., Campbell C.S, Kellogg E.A. & Stevens P.F. (2nd, 2003 and 3rd, 2007 editions) Plant Systematics: a phylogenetic Approach. Sinauer Associates, Inc. Publishers
- Chrispeels M.J. and Gepts P. 2017. Plants, genes, and agriculture sustainability through biotechnology. Oxford University Press.

Assessment Details: 50% Examination, 50% Continual Assessment

BOU33108 – Plants and the Irish Environment

First Semester | 5 credits

Module Personnel: *Prof Marcus Collier*, Ailbhe Brazel, Michelle Murray, Stephen Waldren, Fraser Mitchell, Trevor Hodkinson, Jenny McElwain, Matthew Saunders, Peter Moonlight, Jamie Watermann, María Elena Varela Álvarez

This module is a full and intensive week. It combines an introduction to the Botany and Environmental Science moderatorship with a series of field-based activities. The aims of this module are:

- To introduce you to the moderatorships, your classmates and Botany staff and postgraduates
- To learn botanical field identification and observation skills
- To assess some of the environmental variables that affect plant growth and survival and natural community structure
- To examine how human activities alter the landscape and the biological communities within it.

Learning Outcomes:

1. Accurately collect and record various types of data from a range of habitats using different field methods;
2. Create a field journal to record your findings and observations;
3. Identify species: native, archeophytes, and neophytes;
4. Interpret relationships between different plants, and between plants and their physical environment;
5. Contrast ecological sampling techniques and assess their relative merits;
6. Collect and prepare an herbarium specimen.

Recommended Reading List:

- Webb's: An Irish Flora. Parnell, J. & Curtis, T. (2012) Cork University Press.

- The Wildflowers of Ireland, A Field Guide. 2nd Edition. Devlin, Z. (2025) Gill.

Assessment Details: 100% Continual Assessment

BOU33114 – Conservation Horticulture

First Semester | 5 credits

Module Personnel: *Dr Ailbhe Brazel*, Dr Darrach Lupton (National Botanic Gardens Glasnevin)

The loss of plant diversity is happening at an extraordinarily fast rate, the urgent need for conservation action has never been so crucial. Botanic Gardens are well-positioned to take on this challenge – they have a large pool of specialist horticultural experts trained in propagation and cultivation techniques and scientific staff with an understanding of the population and genetic basis of a conservation collection, and the accurate record-keeping and management of genetically representative living plant collections. These skills and knowledge are essential to the successful recovery of threatened plant species. Conservation horticulture is an emerging field in plant science that brings together the disciplines of conservation and horticulture.

Here we define conservation horticulture as the practice within mainly Botanic Gardens and Arboreta of targeting, collecting and maintaining living plant collections that are representative of the genetic diversity of wild populations for ex situ conservation and habitat restoration purposes. This unique, timely and highly practical-focused module will be co-taught by staff at Trinity College Botanic Garden, Trinity Botany Department and the National Botanic Gardens, Glasnevin. Five practical sessions in hands-on conservation horticulture will be held at the National Botanic Gardens, Glasnevin and Trinity College Botanic Garden. Approximately 10 lectures will cover theory and both global and national case studies. The final grades will be based on assessment of four practical reports worth 60% and a Conservation Horticulture Plan, worth 40%.

Learning Outcomes:

1. Able to explain the fundamental role of Botanic Gardens and Arboreta in local and global plant conservation
2. Able to describe both national and international policy frameworks for plant conservation
3. Familiar with basic hands-on horticulture practice used in plant conservation including growing a wide range of taxa from diverse habitats, soil mixes, tree conservation etc.
4. Familiar with hands-on plant propagation techniques of different plant types (e.g. woody perennials, ferns) used in conservation horticulture

5. Familiar with the practices of seed collecting and seed banking as tools in plant conservation
6. Able to describe basic practices of maintenance of a living plant collection such as pest management, ethical plant trade, integrated pest management and plant passports/ plant quarantine
7. Able to research and describe successful case studies of conservation horticulture globally

Recommended Reading List:

- A Handbook for Botanic Gardens on the Reintroduction of Plants to the Wild By J. Akeroyd (Editor) and Peter Wyse Jackson (Editor) Botanic Gardens Conservation International, 1995 ISBN: 0952027526
- Restoring Diversity: Strategies for Reintroduction of Endangered Plants By Donald A. Falk (Editor), Constance I. Millar (Editor) and Margaret Olwell (Editor) Island Press, 1996 ISBN: 1559632976
- Medicinal Plants: Conservation, Cultivation and Preservation by A. Chopra Daya Publishing House (August 1, 2007) ISBN: 8170354862

Assessment Details: 100% Continuous Assessment

BOU33115 – Botanical Diversity 1

Second Semester | 5 credits

Module Personnel: *Dr Ailbhe Brazel*, Peter Moonlight, Elena Varela Álvarez

There are over 400,000 plant and algal species known to science. This module will explore the evolution and classification of plants (embryophytes) and algae and how to identify them. By undertaking this module you will become acquainted with the evolutionary history, life cycle and general distinguishing attributes of the major botanical evolutionary groups: Algae (red, green and brown), Bryophytes (mosses, hornworts and liverworts), Monilophytes (ferns and fern allies), Lycophytes (club mosses), Gymnosperms (e.g. conifers, cycads) and Angiosperms (flowering plants). The module will discuss evolutionary origins, classification, compare and contrast molecular and morphological phylogenetic signals and discuss various groups of plants and algae. This module will include laboratory practical classes, fieldwork at the Trinity College Botanic Gardens and lectures.

Learning Outcomes:

1. Describe and discuss botanical classification, identification and evolution at major group level worldwide.

2. Know the key characteristics of the algae and major land plant groups.
3. Understand the phylogenetic signals produced by molecular and morphological data.
4. Understand the importance of basic botanical nomenclature and plant names.
5. Describe the evolution of plant life cycles and understand the evolutionary advantages and limitations of gametophyte dominant versus sporophyte dominant strategies.

Recommended Reading List:

- Judd W.S et al. (2008) Plant Systematics. A phylogenetic approach. Sinauer.
- Simpson, M.G. (2006). *Plant Systematics.* Wiley Elsevier Academic Pres. 580pp. Located in Botany Library.
- Willis, K.J. & McElwain, J.C. (2014). *The Evolution of Plants* (2nd edition). Oxford. 424 pp. Located in Botany Library.
- The World Flora Online: https://www.worldfloraonline.org/
- Beentje, H., & Williamson, J. (2016). The Kew plant glossary: an illustrated dictionary of plant terms. Second edition. Richmond, Surrey, UK, Kew Publishing.
- Mabberley, D. J. Mabberley's Plant-Book: A Portable Dictionary of Plants, Their Classification and Uses. Cambridge, UK; New York, USA, Cambridge University Press, 2008.
- Also, various papers posted on blackboard.

Assessment Details: 50% Continual Assessment, 50% Examination

BOU33121 – Field Skills in Plant and Environmental Sciences

Second Semester | 5 credits

Module Personnel: *Dr Peter Moonlight*, Trevor Hodkinson, Sarah Larragy, Jenny McElwain

This module combines a lecture series with a residential field trip to the Canary Islands. The Canary Islands represent very different environments to Ireland: they have different ecology, different threats and pressures. They also contain highly variable landscapes and there are lots of different types of habitats in small area. In addition, they are home to many endemic species, particularly plants, which are not found anywhere else in the world, and face many man-made environmental challenges. The lecture series explores the geography, flora and fauna of the Canary Islands, as well as the history of the islands, and the impacts that humans have and continue to have on its ecosystems.

There are four main aims of this module:

1. To introduce students to highly diverse subtropical island flora, with complex biogeographical composition;

2. To record the plant communities across a range of environments, differing in rainfall, altitude, degree of disturbance, etc. and to investigate the ecophysiology of the native flora over the range of habitats studied;

3. To assess the threat to biodiversity posed by human activities;

4. To develop students' knowledge of field-based plant and animal identification, and how to conduct field research. To do this, a series of 8 lectures will be given prior to going on an 8-day residential field course in Gran Canaria.

Learning outcomes:

1. Describe the link between environmental conditions and vegetation community composition and structure (i.e. understand why certain plants grow in different places – what morphological, physiological and ecological traits have evolved for live in particular environments and how are plants affected by human activities?).
2. Sample vegetation in the field accurately and representatively in a diversity of natural and anthropogenic ecosystems (i.e. be able to design appropriate sampling according to different habitat types to make ecological assessments).
3. Outline what should be in an Environmental Impact Assessment Scoping report and conduct a scoping exercise for a hypothetical development in the Canary islands.
4. Design, conduct and analyse a field experiment and present the results in both written and oral format.
5. Demonstrate transferrable field skills including making accurate and appropriate field notes, teamwork and risk assessment

Assessment Details: 100% Cumulative Assessment

BOU33122 – Entomology

Second Semester | 5 credits

Module Personnel: *Dr Jamie Waterman*

Interactions between organisms drive evolutionary change and shape ecological communities. Most animal species are insects and plants make up the majority of earth's biomass; interactions between these organisms are ubiquitous and of massive ecological and economic importance.

What shapes these interactions? How do insects recognise host plants and how do plants distinguish pests and microbial pathogens? How does chemistry mediate trophic networks?

This module will address these questions and many more by exploring the plant and insect traits (chemical, behavioural and morphological) that shape these interactions, and the molecular processes that underly them, in an agricultural and ecological context. The first half of the module will focus on antagonistic interactions, specifically between plants and insect herbivores, and the second part of the module will focus on beneficial interactions such as those between plants and pollinators. Practicals will investigate plant and insect adaptations in the context of herbivory and pollination.

Learning Outcomes:

1. Categories insects by key features
2. Describe important behaviours employed by insects for foraging, defending and reproducing
3. Quantify the economic importance of insects (both positive and negative) to humans in an agricultural and ecological context
4. Develop a mechanistic understanding of plant defence signalling and how chemistry shapes ecology (with a particular focus on plant-insect interactions)
5. Synthesise and summarise key aspects of the ecology and evolution of mutualistic and antagonistic biotic interactions, as well as the resulting environmental and ecological implications
6. Carry out laboratory work investigating plant-insect interactions and analyse and interpret data collected.

Recommended Reading List:

- Schoonhoven, L. M., Van Loon, J. J., & Dicke, M. (2005). Insect-plant biology. Oxford University Press.
- Price PW, Denno RF, Eubanks MD, Finke DL, Kaplan I (2011). Insect Ecology: Behavior, Populations and Communities. Cambridge University Press.

Assessment Details: 50% Continual Assessment, 50% Examination

BOU33123 – Soil Science

First Semester | 5 credits

Module Personnel: *Dr Matthew Saunders*

Soils are important for plants as they provide the key resources required for growth and also essential structural support. This module will provide an overview of the fundamental concepts of soil formation and characterisation; how soil characteristics influence plant distribution and productivity through water and nutrient availability; how soil organisms (bacteria, fungi) interact with plants and how soils influence global biogeochemical cycles (carbon and nitrogen). Particular focus will be given to the role of soils in the production of food, fuel and fibre and how sustainable land management practices are required to ensure the long-term health and fertility of soil systems.

Learning Outcomes:

1. Describe the nature of soil and the terms used to describe the major physical and chemical characteristics of soil.
2. Understand how soils are formed and how they are influenced by natural and anthropogenic processes.
3. Compare and contrast the role of soils in plant productivity such as through plant water relations and mineral nutrition.
4. Appraise the issues of sustainable soil management and the impacts of intensive land use on soil quality and fertility.
5. Demonstrate an understanding of biogeochemical cycling within soil systems and the role of soils in the mitigation of climate change.

Recommended Reading List:

- Foth, HD. (1990). Fundamentals of soil science. Wiley, Chichester.
- Hartlemink, AE., McBratney, AB., White, RE. (Eds) (2009). Soil Science, Earthscan, London.
- Lal, R. (2006). Encyclopedia of soil science. Taylor and Francis. Oxford.
- McLaren, RG., Cameron, KC. (1996). Soil science: sustainable production and environmental protection. Oxford University Press, Oxford.
- Weil, RR., Brady, NC. (2016). The nature and properties of soil. Pearson, London.
- White, RE. (2006). Principles and practice of soil science: the soil as a natural resource. Blackwell Science, Oxford.

Assessment Details: 50% Examination, 50% Continual Assessment

BOU44060 – Plant Breeding and Biotechnology

First Semester | 5 credits

Module Personnel: *Prof Trevor Hodkinson*, Dr Kamila Kwasniewska

The module covers the principles and practice of plant breeding and biotechnology. Lectures cover key topics such as the origins of agriculture, genetic resources, disease resistance, conventional breeding, modern breeding, genetic engineering, plant microbiomes and case studies in breeding and biotechnology. Practicals cover crop diversity, polyploid estimation, crop microbiomes and at least one site visit to a Teagasc Research Centre (e.g Ashtown Dublin).

Learning Outcomes:

1. Discuss core elements within the field of plant breeding and biotechnology.
2. Show laboratory skills in plant breeding.
3. Demonstrate knowledge of plant breeding techniques.

Recommended Reading List:

- Acquaah G. 2020. Principles of Plant Genetics and Breeding, 3rd Edition. Wiley-Blackwell.
- Hodkinson T.R. and Murphy B.R. 2019. Endophytes for a growing world. Cambridge University Press. Chapter 1.
- Chrispeels M.J. and Gepts P. 2017. Plants, genes, and agriculture sustainability through biotechnology. Oxford University Press.

Assessment Details: 50% Examination, 50% Continual Assessment

BOU44108 – Plant-Environment Interactions

First Semester | 5 credits

Module Personnel: *Prof Matthew Saunders*

Plant growth is significantly influenced by the surrounding physical, chemical and biological environment. This module will address the key inter-related concepts of carbon assimilation and sequestration, plant water relations and energy balance components across the soil-plant-atmosphere continuum. The physiological response of plants to respond to a broad range of environmental conditions (light, temperature and water availability) including abiotic and biotic extreme events will be explored, and the implications for natural and production-based systems will be assessed. The practical exercises have been designed to emphasise the importance of

making precise measurements of both environmental variables and associated plant responses and how the information derived from such experiments can be integrated with mathematical models to predict plant responses to environmental drivers.

Learning Outcomes:

1. Demonstrate an understanding of how environmental factors influence the physiological performance of plants at various stages of growth and across multiple spatial scales (leaf, whole plant and ecosystem scale).
2. Identify suitable methodological approaches to monitor and quantify the impacts of key environmental drivers on physiological processes observed at the leaf, plant and ecosystem scale.
3. Understand how process-based models can be used to better understand experimental observations and how this information can be spatially extrapolated and used to better understand the impacts of future climatic variability.
4. Show an understanding of how these concepts can be utilised in the development of sustainable land management practices.

Recommended Reading List:

- Hall, D.O., Scurlock, J.M.O., Bolhar-Nordenkampf, H.R., Leegood, R.C. & Long, S.P. (eds) (1993). Photosynthesis and Production in a Changing Environment - A Field and Laboratory Manual, Chapman and Hall, London.
- Jones, H.G. (2014) Plants and Microclimate - A Quantitative Approach to Environmental Plant Physiology. Cambridge University Press, Cambridge.
- Lambers, H., Chapin, F.S., Pons, T.L. (2006). Plant physiological ecology. Springer, New York, USA.
- Nobel, P.N. (2005). Physiochemical and environmental plant physiology. Elsevier Academic Press, Burlington, MA, USA.
- Taiz, L., Zeiger, E. (2010). Plant Physiology. Sinauer Associates Inc., Sunderland, Massachusetts USA

Assessment Details: 50% Examination, 50% Continual Assessment

BOU44110 – Evolution of Plants and Plant Atmosphere-Interaction

Second Semester | 5 credits

Module Personnel: *Prof Jennifer McElwain*

We are currently experiencing major changes in our climatic and atmospheric environment. Conservative estimates project that the concentration of greenhouse gas carbon dioxide will double by the end of this century and global temperatures are expected to rise by between 1- and 4-degrees C. A major issue facing the scientific and political community is understanding how these projected changes will influence natural ecosystems, plant and animal ecology and biodiversity. This module will explore the evolution of plants in the context of long-term changes in climate and atmospheric composition. Examples of plant-atmosphere and plant-climate interactions in the deep geological past will be the main focus of this module The course will provide a framework for understanding the nature and scale of evolution, adaptation and ecophysiological responses of plants to their atmospheric and climatic environment over the past 500 million years of Earth history.

Part 1 of this course lays the foundations for examining the evolution of plants and biosphere-atmosphere interactions over the past 450 million years of Earth history. We will examine different modes of plant fossil preservation from compression fossils to mummifications. Through your readings and lectures you will gain an understanding of the biases associated with the fossil record of plants and how paleobotanists address these uncertainties in their research. We will also explore the first 3 billion years of Earth history and life on the planet highlighting key events and biotic innovations that were important pre-requisites to the later evolution of complex multicellular land plants.

Part 2 of the course focuses on plant evolutionary events and critical biosphere-atmosphere interactions in the Paleozoic Era between 541 and 252 million years ago. Part 2 covers topics such as the evolution of land plants (embryophytes) and their conquest of the land, the emergence of the first forests with examples from famous Irish fossil forest localities, the evolution of the seed, leaf, roots and arborescence (woodiness). We examine fossil plant-based evidence for glacial-interglacial climate change during the Carboniferous period and the impact of atmospheric and climate change on plant diversity and extinction.

Part 3 of this course examines the rise of seed plants under a climate that is becoming increasingly arid from the Late Permian. There is a marked evolutionary transition in paleofloras between the Carboniferous and the Permian from 'Paleophytic' to 'Mesophytic'. We will explore how the paleoecology of Earth's vegetation changed over this time period by examining shifts in the geographic distributions of floras (paleo-biomes). The functioning of past ecosystems will be introduced through novel studies on fossil plant paleo-functional traits. Plant-climate and plant-atmosphere interactions will be studied across the Permian-Triassic and Triassic-Jurassic mass extinction events.

Part 4 of the course examines the Angiosperm Terrestrial Revolution - the origin and diversification of angiosperms (flowering plants), the most diverse extant plant group, the

Cretaceous-Tertiary mass extinction events and the rise of our modern flora. The time period of study includes the past 145 million years (Cretaceous and Cenozoic). The role of atmospheric and climate change in major evolutionary innovations and ecological turnovers during this time period will be explored including the origin of modern neotropical rainforests, the origin and diversification of grasses and grass dominated ecosystems globally and the origin of C4 and CAM photosynthetic syndromes.

Learning outcomes:

On successful completion of this module students should be able:

1. To describe plant evolution over the past 3,700 million years (with specific emphasis on land plant evolution over the past 500 million years based on the fossil plant record)
2. To evaluate fossil plant responses to environmental extremes associated with mass extinction events in Earth history
3. To describe how plant evolution influences the long-term carbon cycle, climate and atmospheric composition
- To understand global, regional, local and individual level plant responses to past changes in climate and atmospheric composition
5. To use knowledge of plant-atmosphere responses in the deep geological past to evaluate the threat of ongoing anthropogenic global change

Assessment Details: 70% Examination, 30% Continual Assessment (Continual assessment will be through a programme of tutorials/debates and student reviews of primary research papers linked to lectures.)

BOU44111 – Restoration Ecology and Rewilding

First Semester | 5 credits

Module Personnel: *Dr Marcus Collier*

Restoration ecology, like conservation biology, is a 'crisis' discipline, having emerged as a science/practice response to the social and ecological impacts directly and indirectly driven by human activities. Restoration ecology has proven to be highly effective in some cases but has also given rise to some controversy as well as policy difficulties. In recent years the phrase 'rewilding' has emerged as an umbrella concept that embodies ecological restoration but with more future-oriented targets. Rewilding and novel ecosystems are new and controversial areas within restoration ecology making it difficult to know how and when to intervene.

This module will introduce you to the challenges and opportunities, failings and fallacies of the complex world of restoration ecology, rewilding, and the work of restoration ecologists. It will look at how rewilding could be the most efficient of nature-based solutions and asks if this is feasible in the modern world. As the discipline struggles to navigate global climate issues, integrate with the social sciences, incorporate politics and economics, and derive policy actions, this module will draw on case studies of restoration globally to will challenge students to rethink ecology and ecosystems in the Anthropocene. It will also discuss areas of employment where students might consider after graduation, with some invited guests providing insight into the practice of restoration and rewilding.

Learning Outcomes:

1. Understand the principals of restoration ecology as they apply in a modern context
2. Comprehend the nuanced nature of restoring ecosystems and habitats as well as re-introducing species in practice
3. Carry out restoration case study analysis
4. Understand the complex relationship between ecology, social values and policies
5. Evaluate the success of restored ecosystems and species

Recommended Reading List:

- Aronson, J, Milton, S.J., & Blignaut, J. Eds. (2007) Restoring Natural Capital. Island Press
- Carver, S., Convery, I., Hawkins, S., Beyers, R., Eagle, A., Kun, Z., . . . Soule, M. (2021). Guiding principles for rewilding. Conserv Biol, 35(6), 1882-1893. doi:10.1111/cobi.13730
- GLA (Greater London Auithority). (2023). Rewilding London: Final Report of the London Rewilding Taskforce.
- Higgs, E., Falk, D. A., Guerrini, A., Hall, M., Harris, J., Hobbs, R. J., . . . Throop, W. (2014). The changing role of history in restoration ecology. Frontiers in Ecology and the Environment, 12(9), 499-506. doi:10.1890/110267
- Hobbs, R. J., Higgs, E. S. & Hall, C. M. Eds. (2013) Novel Ecosystems. Wiley
- Lorimer, J., Sandom, C., Jepson, P., Doughty, C., Barua, M., & Kirby, K. J. (2015). Rewilding: Science, Practice, and Politics. 40(1), 39-62. doi:10.1146/annurev-environ-102014-021406
- Marris, E. (2011) Rambunctious Garden. Bloomsbury
- Monbiot, G. (2015) Feral. Penguin

Assessment Details: 60% Examination, 40% Continual Assessment

BOU44112 – Plants and the Planet

Second Semester | 5 credits

Module Personnel: *Dr Silvia Caldararu*

Plants have the power to shape the world around us, and how we utilise plants and the ecosystems in which they grow can have both positive and negative implications. This module, through a series of interactive tutorials, will allow students to further explore the research undertaken in the Botany department to better understand how this work and the plants and ecosystems involved are shaping the world in which we live. Furthermore, a key component of the module involves the Ecology, Evolution and the Environment seminar series, where invited speakers from across the globe will discuss their research in more detail.

Indicative Content and Learning Activities:

Seminars: The Ecology, Evolution and the Environment seminars run throughout the academic year where invited speakers from international institutes present their research. The topics of these seminars are aligned to the content of the moderatorships offered in the School of Natural Sciences but are broad in their scope.

Tutorials: Students will have the opportunity, in small groups, to discuss the research activities of faculty members within the Botany department and to evaluate the wider literature in these areas.

Learning Outcomes:

1. Demonstrate an understanding of the basics of a wide range of research issues from within and outside the Botany curriculum and be able to critically assess the information presented to them.
2. Describe and discuss how work being carried out in Botany and the wider scientific field of Natural Sciences contributes to both national and international research activities and how these are used to address problems of global importance.
3. To appraise and critique research outputs and to communicate this work in both academic and non-academic written or oral format.

Assessment Details: 50% Examination, 50% Continual Assessment

BOU44115 – Botanical Diversity 2

First Semester | 5 credits | 35 Lectures, 20 Practicals

Module Personnel: *Peter Moonlight*

Flowering plants are the most species and biomass rich primary producers in most of the earth's land surface. They vary from parasitic or aquatic herbs to giant rainforest trees, each species with its own rich web of ecological interactions. The ability to identify flowering plants, first to major group, then to family, and then to species, is a fundamental tool in the toolkit of any botanist and ecologist. The scientific names we assign plants are the entire basis of our knowledge system in botany – a rose by any other name may smell as sweet, but without a name we cannot access any knowledge about that species. In this module, you will gain an understanding of the evolutionary history and morphological, anatomical, and ecological diversity of flowering plants. You will leave with the ability to identify flowering plants to the most ecologically important and species rich flowering plant families, before learning to find and use the resources required to identify it to species, including using traditional (books, herbaria) and modern (genetic) identification techniques. We will focus jointly on the flowering plants of Ireland and the world. This will be a "hands on" module, with both lectures and labs taking advantage of the world class living and reference collections in Trinity College Botanic Garden and Herbarium to ensure students have as much "plant contact time" as possible.

Learning Outcomes:

1. Describe and discuss the classification, morphology, and anatomy of flowering plants.
2. Discuss the evolutionary relationships of flowering plants, and trends in the evolution of flowering plants.
4. Summarise the morphology and anatomy of the major groups of flowering plants and flowering plant families.
5. Recognise the major families of flowering plants and have the skills to identify plants to more obscure families.
6. Identify plants to species using a variety of traditional and modern, technological methods, and locate the resources required to do so.
7. Describe the ecological, societal, and economic importance of flowering plants, major groups of flower plants, and selected flowering plant families.

Recommended Reading List:

- Beentje, H., & Williamson, J. (2016). The Kew plant glossary: an illustrated dictionary of plant terms. Second edition. Richmond, Surrey, UK, Kew Publishing.
- Bramley, G., Trias-Blasi, A. & Wilford, R. (2023) The Kew Temperate Plant Families Identification Handbook. Richmond, Surrey, UK, Kew Publishing.
- Judd W.S et al. (2008) Plant Systematics. A phylogenetivc approach. Sinauer.
- Mabberley, D. J. Mabberley's Plant-Book: A Portable Dictionary of Plants, Their Classification and Uses. Cambridge, UK; New York, USA, Cambridge University Press, 2008.

- Parnell, J. & Curtis, T. (2012). Webb's An Irish Flora. 8th Edition. Cork, Ireland, Cork University Press
- Simpson, M.G. (2006). Plant Systematics. Wiley Elsevier Academic Pres. 580pp. Located in Botany Library.
- Stephens, P.F. (2001 onwards). Angiosperm Phylogeny Website. Version 14, July 2017 [and more or less continuously updated since] http://www.mobot.org/MOBOT/research/APweb/
- Willis, K.J. & McElwain, J.C. (2014). The Evolution of Plants (2nd edition). Oxford. 424 pp. Located in Botany Library

All listed resources are available online or from the botany library, which is freely available to students.

Assessment Details: 100% Continuous Assessment

ESU33004 – Scientific Writing and Communication

Both Semesters | 5 credits | 18 contact hours

Module Personnel: *Dr Pepijn Luijckx*

Scientific communication and writing are used to communicate knowledge to other researchers through the publication of research articles, reports and oral and poster presentations. Writing such articles or essays and presenting scientific results can be difficult and challenging. The aim of this module is to introduce students to scientific writing and presentation techniques. Throughout the duration of both semesters, students will be presented with a brief overview of the steps involved in reading, publishing, organising, and disseminating research findings. To experience this process students will undertake desk-based research, using scientific literature to synthesise and write an extended essay on a selected topic of interest related to a key challenge in Environmental Science, Botany or Zoology (depending on your discipline). The finished essay will consist of a general-format scientific review article.

Learning Outcomes:

1. Comprehend the peer-review process for scientific literature.
2. Search, locate and critically assess scientific literature and databases on issues related to environmental science.
3. Demonstrate the skills to critique published material and to differentiate between primary, secondary and tertiary sources.
2. Develop and convey clear and logical arguments with respect to topical issues.

3. Be able to effectively communicate scientific arguments in multiple mediums and platforms.
4. Understanding the role of AI in scientific communication.

Recommended Reading List:

- Wallisch, P. 2020. How to read a scientific article: The QDAFI method of structured relevant gist. In: Critical Reading Across the Curriculum. Volume 2: Social and Natural Sciences. A. Borst, R. DiYanni (Eds.) John Wiley & Sons, Inc. (Hoboken, New Jersey, USA). p. 152–164.
- Machi, L.A., McEvoy, B.T. 2016. The Literature Review: Six Steps to Success. 3rd Edition. SAGE Publications Ltd. 188 pp.
- Turbek, S.P., T.M. Chock, K.Donahue, C.A. Havrilla, A.M. Oliverio, S.K. Polutchko, L.G. Shoemaker, L. Vimercati. 2016. Scientific Writing Made Easy: A Step-by-step Guide to Undergraduate Writing in the Biological Sciences. Bulletin of the Ecological Society of America 97 (4): 417–426. doi:10.1002/bes2.1258
    - See also 'Additional resources' on p. 425 of Turbek et al. 2016
- Rowland, F. 2002. The peer-review process. Learned Publishing 15 (4): 247–258.

Assessment Details: 100% Continual Assessment

ESU33040 – Environmental Monitoring

First Semester | 5 credits

Module Personnel: *Prof Jeremy Piggott*

This module covers the tools and sampling approaches, both traditional and novel, used to characterize and monitor the quality of the environment across Europe. Students will be provided with relevant background information to understand the principles and applications of monitoring programmes. Techniques taught encompass the collection and analysis of chemical and biological samples and their application to environmental quality indices. Students will have the opportunity to apply some of these techniques during two field trips (freshwater and marine) and to a range of sample types (water, sediment, invertebrates) in subsequent laboratory sessions. Field trips will conclude with a written report, detailing student's findings in a scientific format.

Learning Outcomes:

1. Explain the tools and sampling approaches used to characterize and monitor the quality of the environment

2. Select appropriate procedures for the collection and analysis of environmental samples (chemical and biological samples)
3. Carry out a range of analysis procedures in the field and laboratory
4. Present and interpret results of chemical/biological analyses and application to relevant environmental quality indices

Assessment Details: 100% Continual Assessment

ESU44052 – General Environmental Sciences

Both Semesters | 5 credits

Module Personnel: *Prof Jeremy Piggott*

This module provides an opportunity for students to build on the content covered throughout the Sophister Environmental Sciences programme, and to explore in greater detail the key challenges facing Environmental Scientists today. Tutorials during Semester 1 and ENVIRON conference attendance (Environmental Science Association of Ireland Annual Meeting) during Semester 2 connect theory with practice in the environmental sciences field. Students are expected to integrate their approach to this material with the perspectives and skills they develop during their Sophister years. Appropriate literature relating to the Junior and Senior Sophister core (mandatory) modules will be recommended for detailed study.

The module is assessed through both continuous assessment and a conference-based assignment.

Please note: Students are expected to arrange transport and pay ENVIRON conference registration for module ESU44052, which is usually between €60 – €150 each. Eligible students may apply to the Student Assistance Fund (http://www.tcd.ie/Senior_Tutor/) for financial assistance.

Learning Outcomes:

1. Understand and describe topical issues related to the environment.
2. Develop critical appreciation of the scientific literature.
3. Explain important basic concepts and current developments in such key areas of environmental sciences as ecology, freshwater hydrobiology, hydrology, wildlife biology and environmental governance.
5. State confidently the theoretical and practical aspects relating to essential field and laboratory techniques.

Assessment Details: 100% Continual Assessment

ESU44054 – Spatial Analysis Using GIS

First Semester | 5 credits

Module Personnel: *Prof Patrick Morrissey*

This module introduces students to the framework and methods used in real-life problems related to the field of Spatial Analysis by applying the theoretical knowledge gathered during the module to live project work. The module seeks to impart the necessary skills and knowledge to enable graduates to engage as team members and leaders in the types of large and complex sustainable environment projects that are increasingly being planned across the world. It aims to help fill a major and increasingly obvious skills gap. A unique feature of this module is the use of Dublin and Ireland as a learning laboratory, where the students will take responsibility of a project. The Spatial Analysis using GIS Module is designed to introduce the student to spatial analysis using a widely used Geographic Information Systems (GIS) platform.

It is hoped that this module will be taught face to face, but we must be able to switch to fully online if required. Therefore, students taking this module must have access to a computer (Windows or Mac) to be able to run the latest Long-Term Release of QGIS from home (this is version 3.16 at the time of writing). They must also be able to join online practical sessions on Blackboard Collaborate with sound and video facilities.

Learning Outcomes:

1. Solve Spatial Analysis problems by applying interdisciplinary approaches.
2. Discuss and debate solutions to problems in the environment.
3. Communicate effectively in technical and scientific writing, and present scientific/technical ideas concisely to a technical audience that may not be expert in the specific domain of the presentation.
4. Implement technical knowledge to address a spatial analysis problem.
5. Identify and use appropriate mathematical methods, numerical techniques and GIS tools for application to new and ill-defined spatial analysis problems.
6. Describe succinctly, the relevant advantages and disadvantages of various technologies to a lay audience, and to communicate effectively in public.

Assessment Details: 100% Continual Assessment

FBU44000 – Research Project

Second Semester | 20 credits

Module Personnel: *Dr Rebecca Rolfe*

The project provides an important opportunity for students to plan and carry out a detailed and original piece of scientific research and communicate the results. It culminates in the production of a thesis and communication of the results through a poster presentation at an undergraduate research conference. Students will be assigned to a member of staff who will support an appropriate topic and will supervise the work. As part of the project students will be expected to outline clearly a scientific problem, review the associated literature, design and execute an appropriate research programme, analyse and present the results and draw clear conclusions and record progress in a notebook (physical or electronic as appropriate). Detailed guidance notes on writing and submitting the thesis and poster may be found on the FBU44000 Blackboard site. The FBU44000 module culminates in the submission of a thesis and presentation of a poster on the results.

Learning Outcomes:

1. Formulate scientific questions, apply a scientific approach to problem solving.
2. Plan an investigation and utilise the principles of good experimental, observational or computational design.
3. Conduct an in-depth scientific review of a subject.
4. Organise desktop, computational, field- or laboratory-based research including: logistics, recording, archiving, qualitative or numerical analysis and presentation and interpretation of data.
5. Manage a project through continuous assessment of progress and improvement of skills.
6. Effectively work with a team including their supervisor and other members of the research team.
7. Demonstrate technical competence in the handling of research facilities and operate safely in a computational, laboratory and/or field environment, both individually and as part of a team.
8. Present and communicate results in the form of an authored dissertation and poster presentation.

Assessment Details: 100 % Continuous assessment | Thesis (18 ECTS credits), poster presentation (2 ECTS credits)

GGU33931 – Environmental Governance 1

Second Semester | 5 credits | 20 contact hours

Module Personnel: *Dr Rory Rowan*

The "environment" emerged as a new object of concern in the 1960s. Since then, and largely through the work of citizens, scientists, environmental justice movements, and NGOs, many different environmental problems have been raised - from chemical contamination to climate change, from oil spills to plastic-filled oceans. Despite growing awareness of these many forms of environmental degradation, the political and societal response has been far from adequate. How can we explain this? One starting point is to interrogate the contested history and development of environmental politics since the 1960s. What we learn from such an approach is that there have been radically different ways of framing environmental problems, giving rise to radically different proposals on how to address these problems. This historically informed understanding thus invites us to consider how re-framing current environmental problems may help us to orientate society towards a more just and sustainable future. This module will introduce students to the emergence of environmental politics as a unique field of policymaking, scientific production, and conflict since the 1960s. It will discuss key texts, writers and thinkers, whose work has been instrumental in shaping how we think about the environment, as well as how private, public and civil society actors have responded to environmental problems in recent times.

Learning Outcomes:

1. Understand the key developments and debates within modern environmentalism over the past fifty years.
2. Identify and discuss the key thinkers and texts that have shaped modern environmental thinking.
3. Debate the nature and impact of different environmental policies and initiatives at local, national and global scales.
4. Use the critical analytic skills developed through the module to better examine a range of sources including documentary films, government reports, academic papers, and more.

Recommended Reading List:

- Cronon, W. (ed.) (1996) *Uncommon Ground: Toward Reinventing Nature*. New York: Norton.

- Dawson, A. (2024) *Environmentalism from Below: How Global People's Movements ate Leading the Fight for or Planet.* New York: Haymarket Books.
- Dryzek, J. S. (2013) *The Politics of the Earth: Environmental Discourses.* Oxford: Oxford University Press.
- Merchant, C. (1990) *The Death of Nature*: *Women*, *Ecology, and the Scientific Revolution*. HarperCollins.
- Nixon, R. (2011) *Slow Violence and the Environmentalism of the Poor*. Cambridge, MA: Harvard University Press.
- Smith, N. (2010) *Uneven Development: Nature, Capital and Production of Space*. Athens, GA: University of Georgia Press.

Assessment Details: 100% continuous assessment.

GGU44977 – Environmental Governance 2

Second Semester | 5 credits | 20 contact hours

Module Personnel: *Dr Rory Rowan*

There is little disagreement that far-reaching societal, technological, political, and economic transformations are required if we are to avoid the worst effects of global, anthropogenic environmental change. What form these transformations should take and who should take responsibility for them are, however, far from settled.

This module considers some of the key conceptual debates and environmental conflicts arising in this context. Examination of these debates and conflicts will demonstrate the contested and uneven nature of environmental change and the measures sought to address these changes. The overall aim of the module is to help students develop a more nuanced, critical and multi-disciplinary understanding of environmental change and the different, often contested, ways of responding to such changes.

The module will consist of weekly interactive lectures/seminars, and set readings. Lectures will introduce students to key concepts and perspectives drawn from the broad field of political ecology. In this module students develop a semester-long research project focused on a key area of environmental contestation in Ireland through a political ecology lens. The projects will involve group work and individual work, written assignments, oral presentations, and primary research. Class attendance is essential.

Please note that this module has a cap of five students from Environmental Science.

Learning Outcomes:

1. Understand and apply key theoretical concepts from the field of political ecology to contemporary environmental debates and issues.
2. Identify and critically discuss key sites of environmental contestation in Ireland today;
3. Explain why an in-depth understanding of environmental problems today requires an understanding of the political, economic and social contexts out of which they emerge and within which they are managed

Recommended Reading List:

- Bresnihan, P. & Milner, N. (2024) A*ll We Want is the Earth: Land, Labour and Movements Beyond Enviormentalism*. Bristol: Bristol University Press.
- Castree, N. & Braun, B. (2001) *Social nature theory, practice, and politics*. London: John Wiley & Sons.
- Kaika, M. (2005) C*ity of Flows: Modernity, Nature, and the City.* London: Routledge.
- Patel, R. & Moore, J. (2017) *A History of the World in Seven Cheap Things: A Guide to Capitalism, Nature, and the Future of the Planet*. Berkley, CA: University of California Press.
- Robbins, P. (2012) *Political Ecology: A Critical Introduction* (2nd edition). London: Wiley.

Assessment Details: 100% Continuous assessment.

GLU33002 – Blue Earth: Understanding the Function of Marine Ecosystems

First Semester | 5 credits

Module Personnel: *Dr Carlos Rocha*

This is an introductory course in marine biogeochemistry. The ocean plays a central role in Earth's climate system, and marine biogeochemical processes regulate the impact of human activity on the global environment. Marine biogeochemistry hence provides a working knowledge of how the earth system functions and reacts to human activity, providing insights into how life formed, evolved, is sustained, and is endangered on Earth. This knowledge provides an understanding of how to adapt to climate and environmental change, enhance food production, manage fisheries and aquaculture, mitigate pollution, and innovate by developing new products including more sustainable food and decarbonation technologies.

This module concentrates on the marine biogeochemical phenomena that regulate the earth's climate and control the diversity, distribution, and productivity of marine life. Topics covered include the physical, biological, geological, and chemical processes that control the creation, distribution, and fate of organic matter in the marine environment, the composition of

seawater and the atmosphere, and the formation and preservation of marine sediments. The course will prepare students for related courses, field and laboratory work in the marine, earth, and environmental sciences and careers in the marine & environmental sector.

Assessment: 100% Continuous Assessment.

GLU33009 – Hydrology and Groundwater Quality

Second Semester | 5 credits

Module Personnel: *Dr Eyad Abushandi*

This module aims to provide students with an understanding of hydrological processes, following the different pathways of water through the terrestrial part of the hydrological cycle. It also aims to familiarise students with the factors affecting groundwater quality, and to develop an understanding of groundwater quality issues in the context of integrated catchment management.

The hydrology component of this module includes the following topics: the hydrological cycle and catchment water balances; rainfall and evapotranspiration; soil water and hillslope hydrology; river flow; hydrogeology; groundwater – surface water interaction. The groundwater quality component includes groundwater chemistry and natural groundwater quality problems; groundwater quality issues in rural and industrial settings; groundwater vulnerability and protection. The interaction of groundwater and surface water quality is also considered.

Assessment: Course work (30%); end of semester examination (70%).

GSU33003 – Ice Age Earth

First Semester | 5 credits

Module Personnel: *Dr Robin James Edwards*

The last 2.6 million years of Earth history have witnessed dramatic climatic and environmental changes. This module provides an overview of these major environmental changes, their causes, and their significance for human development. It contrasts ‘glacial’ and ‘interglacial’ worlds, examines the nature of the transitions between them, explores some potential causes of change, and illustrates their environmental impacts. In the process, a range of key environmental records are considered, along with the “proxies” used to develop them.

Assessment Details: Course work (50%); end of semester examination (50%).

PGU33109 – Neurophysiology I

Second Semester | 5 credits

Module Personnel: *Prof Eva Jimenez-Mateos,* Dr Kate Connor

The lectures in this module focus on how the nervous system works. Lectures will describe the structure and function of neurons, how they communicate and how they are arranged to form the nervous system. Topics include electrical properties of neurons, properties and physiological functions of ion channels, synaptic excitability, transmission and plasticity and the delivery and interpretation of sensory information into the central nervous system. Part of the course is also devoted to describing methods to record both cellular and brain activity. Practical classes focus on computer-simulated recordings of individual nerves to understand features of neuronal activity, recording brain function via electroencephalogram and sensory-evoked potentials. This module is designed to provide understanding of how the brain functions at a cellular and systems level.

ZOU33000 – Marine Biology

First Semester | 5 credits | 5-day field course plus 8 additional contact hours

Module Personnel: *Prof Nessa O'Connor,* Dr Nicholas Payne, Prof. Jim Wilson (Field Course only), Dr Conor Nolan (Field Course only)

This two-part module commences with a 5-day residential field course (in the west of Ireland), followed by a series of lectures on campus. This residential field course will take place during the first teaching week (week 4) of the semester and is assessed during this week.
The field course is designed to teach students some of the key techniques and skills required for field-based environmental biology and to introduce key concepts in marine biology. This includes common species identification, benthic and pelagic sampling methods and experimental design. Students are required to keep detailed field notebooks that form part of the assessment.
This module introduces students to the oceanographic and ecological processes that underpin marine ecosystems and their associated biodiversity and functioning. Topics include: characteristic features of different marine ecosystems (e.g. rocky shores, coral reefs, deep

seas); application (fisheries and aquaculture) and human impacts on marine ecosystems (disturbances, pollution and climate change).

Learning Outcomes:

1. Describe basic principles of marine processes (e.g. primary production) and factors that affect organisms living in marine environments.
2. Identify and describe the characteristic features of important marine ecosystems including: rocky shores, estuaries, saltmarshes, seagrass beds, mangroves, coral reefs, shallow seas and the deep sea.
3. Identify and describe human impacts on marine ecosystems.
4. Discuss key issues relating to fisheries, aquaculture, marine conservation and coastal management.
5. Use several field-based practical techniques and quantitative methods in the marine environment.
6. Identify common marine species and describe their key distinguishing features.

Recommended Reading List:

- Kaiser, MJ et al. (2020) Marine Ecology: Processes, Systems, and Impacts. (3rd Edition) Oxford University Press.
- Little, C, Williams GA & Trowbridge, CD (2009) The Biology of Rocky Shores. (2nd Edition) Oxford University Press.
- Nybakken, JW & Bertness, MD (2005) Marine Biology: An ecological approach. Benjamin Cummings.
- Speight, M & Henderson, P (2010) Marine Ecology: Concepts and Applications. Wiley Blackwell.
- Taylor, L & Nickelsen, E (2018) Ireland's Seashore: A field guide. Collins Press.

Assessment Details: 50% Continuous Assessment, 50% Examination

ZOU33003 – Animal Diversity 1

First Semester | 5 credits | 30 contact hours

Module Personnel: *Dr Nicholas Payne,* Prof. Nessa O'Connor

This module provides a detailed consideration and comparison of the structure, life cycles and general biology of animal groups from sponges through to amniotes (non-avian reptiles) but taking a comparative approach to functional aspects of life by drawing links across all animal

groups. The module is based on lectures, tutorials, and practicals with additional self-learning exercises. The module will take an evolutionary and comparative rather than taxonomic perspective on animal diversity with a focus on the Chordata. The module will open by charting the diversification of marine Porifera, Cnidaria and chordates and conclude with the conquest of land by the Tetrapods. Throughout, the module will use form and function to draw comparisons across taxonomic groups, such as considering locomotion across cartilaginous fish, bony fish and amphibia.

Learning Outcomes:

1. Appreciate the diversity of Porifera, Cnidaria and Echinodermata
2. Give examples of the major chordate taxa and compare their physiology, anatomy and life history.
3. Describe the basic anatomy, and adaptive features of the chordate classes and give a reasoned identification of representative specimens of the classes (and in some cases orders & families) of the Chordata.
4. Understand the distinguishing characteristics and their function for major evolutionary transitions such as the diversification of marine 'fish', the conquest of the land by Tetrapods, and the origin and radiation of amniotes.

Recommended Reading List:

- Hickman, Keen, Larson, Eisenhour, l'Anson & Roberts. 2014. Integrated Principals of Zoology. ISBN 978-1259562310
- Kardong. 2014. Vertebrates: Comparative Anatomy, Function, Evolution. ISBN 978-0078023026

Assessment Details:

50% continuous assessment, 50% annual written examination.

ZOU33004 – Animal Diversity 2

First Semester | 5 credits | 31 contact hours

Module Personnel: *Dr Andrew Jackson*, Dr Rebecca Rolfe

This module provides a detailed consideration and comparison of the structure, life cycles and general biology of animal groups focussing on the amniotes (reptiles, dinosaurs, birds and mammals) but taking a comparative approach to functional aspects of life by drawing links to anamniotes and invertebrates. The module is based on lectures, practicals and tutorials, with

additional self-learning exercises. The module will take an evolutionary and comparative rather than taxonomic perspective on amniote diversity. The module will open by describing how amniotes adapted to terrestrial living through the diversification of their morphological, physiological and behavioural characteristics, and the escape into the air by the birds. Throughout, the module will use form and function to draw comparisons across taxonomic groups, such as considering locomotion such as flight across birds, mammals, reptiles and insects.

Learning Outcomes:

1. Give examples of the major amniote taxa and compare their physiology, anatomy and ecology.
2. Describe the basic anatomy, and adaptive features of the vertebrate classes and give a reasoned identification of representative specimens of the classes (and in some cases orders & families) of the vertebrates.
3. Use allometric scaling approaches to compare form and function across taxonomic scales.
4. Review the palaeontological evidence for such evolutionary transitions as the evolutionary transition from dinosaurs to birds, and the evolution of endothermy in mammals, birds, fishes, and non-avian reptiles.
5. Explain the main macro-ecological processes that drive the origination and extinction of species on global scales.

Recommended Reading List:

- Hickman, Keen, Larson, Eisenhour, l'Anson & Roberts. 2014. Integrated Principals of Zoology. ISBN 978-1259562310
- Kardong. 2014. Vertebrates: Comparative Anatomy, Function, Evolution. ISBN 9780078023026

Assessment Details: 50% Continuous Assessment: 50% Examination

ZOU33005 – Evolutionary Biology

Second Semester | 5 credits | 35 Contact Hours

Module Personnel: Dr Pepijn Luickx

"Nothing in biology makes sense except in light of evolution" – T. Dobzhansky. Evolution plays a central role in almost every biological process ranging from adaptation to rising temperatures, spread of multi drug resistant bacteria, conservation of small populations, spread of invasive

species to understanding human and animal behavior. This course will provide students with an advanced understanding of current evolutionary thinking by introducing new ideas and extending concepts already encountered in the fresher years. Special attention will be given to how selection shapes adaptation.

Learning Outcomes:

1. Have gained an advanced understanding of evolutionary theory.
2. Have a basic understanding of population genetics.
3. Be familiar with the processes of evolutionary change over time and space.
4. Have a good understanding of how species interactions affect fitness.
5. Have a good understanding of how co-operation in animal societies is maintained.

In addition, students will be able to:

6. Have critical discussions and form their own opinion on among others: species concepts, genetic conflict and the limits of selection.
7. To identify the different types of selection.
8. Build and interpret phylogenetic trees.
9. Read primary literature and present a summary to the class as a presentation.

Recommended Reading List:

- Davies, Krebs and West 2012 An Introduction to Behavioural Ecology (4th edition). Publisher Blackwell Science, Oxford. (ISBN 9781405114165)
- Barnard, Christopher J. 2003. Animal Behaviour: Mechanism, Development, Function and Evolution. Publisher Prentice Hall, Harlow. (ISBN 0130899364)
- Alcock, John. 2009. Animal Behaviour: An Evolutionary Approach (9th edition) Publisher Sinauer Associates, Sunderland, Mass. (ISBN 9780878932252)
- Richard Dawkins 2016 The Selfish Gene 40th Anniversary edition (4th edition) Publisher Oxford University Press. (ISBN: 9780198788607)

Assessment Details: 40% Continuous Assessment, 60% Examination.

ZOU33006 – Ecology and Evolution of Infectious Diseases

Second Semester | 5 credits | 28-31 Contact Hours

Module Personnel: *Dr Pepijn Luijckx*

The recent pandemic reminds us that diseases and parasites can do great harm to their hosts and thereby affect human health, food security and biodiversity. This course provides students

with an understanding of the ecological and evolutionary principles that underly disease symptoms, emergence, and outbreak. Though a series of lectures, supplemented with practical's we will explore how natural selection acts on hosts and their pathogens, what factors facilitate disease outbreaks, and how we might prevent pathogens from escaping our control. Using examples in human medicine, animals, and plants we will explore. 1) why we get sick, 2) how diseases emerge, 3) super spreaders, individuals who generate many infections, 4) How global warming can alter the interaction between diseases and their hosts, 5) the evolution of antibiotic resistance and the evolution virulence, 6) evolution proofing our drugs, and 7) many other concepts in evolutionary medicine, ecology, and evolution.

Learning Outcomes:

1. Explain evolutionary medicine and its applications.
2. Understand why and how diseases harm their host.
3. Understand how pathogens respond to vaccines and drugs and how we minimize or avoid evolution of drug resistance.
4. Identify environmental, ecological, and evolutionary factors that contribute to disease outbreaks and influence disease dynamics.
   Work in a team and present the features of a chosen disease to the class.

Assessment Details: 50% Continuous Assessment, 50% Examination

ZOU33010 – Fundamentals of Ecology

First Semester | 5 credits | 35 Contact Hours

Module Personnel: *Prof Ian Donohue*, Prof Fraser Mitchell

This module examines the factors that affect the distribution, growth and survival of plant and animal communities. It describes how organisms interact with their environment and the role that they play in community and ecosystem dynamics. There is an introduction to the concepts and models that help to explain and predict organism distributions and interactions. The module comprises interrelated components of lectures, and practical sessions in the laboratory and field. It has been designed to provide a foundation to ecological theory and its application.

Learning Outcomes:

1. Define what we mean by ecology and describe its principles and practice.
2. Show a firm methodological and theoretical understanding of the study of the distribution and abundance of species.

3. Describe and evaluate unifying concepts of distributions and ecological processes (e.g. feeding strategies, interspecific interactions, etc.).
4. Show, through practical exercises, a good approach to project work.
5. Show enhanced communication skills through a variety of techniques.

Recommended Reading List:

- Begon, M. & Townsend, C.R. (2021) Ecology: from Individuals to Ecosystems. Fifth edition. Blackwell Publishing.

Assessment Details: 50% Examination, 50% Continuous Assessment

ZOU33050 – Developmental Biology

First Semester | 5 credits | 35 contact hours

Module Personnel: *Prof Paula Murphy*

This module consists of a series of lectures, tutorials and laboratory sessions that deals with a range of aspects of how a new animal forms during embryonic development. The emphasis is on understanding the principles of animal development at a molecular and cellular level. Experimental evidence from a number of animal model systems will be examined and the contribution of each model system to our overall understanding of development assessed. Specific topics will include the following:

- Developmental genetics: the identification of genes that regulate development in *Drosophila* and vertebrates,
- Positional determination: how the body plan of the embryo is laid down including the role of HOX genes,
- Induction: the role of cell and tissue interactions and signaling cascades,
- Developmental neurobiology: positional determination within the vertebrate central nervous system, neuronal diversity and axonal guidance, neural crest cells and development of the peripheral nervous system.
- The vertebrate limb as a model for morphogenesis,
- Organogenesis,
- Evolution of body plans (Evo-Devo).

Learning Outcomes:

1. Demonstrate familiarity with the key principles of embryonic development.

2. Show familiarity with the model animals used for developmental studies and why they have been so important.
3. Describe the key events in building a complex multicellular animal, the common and species features.
4. Integrate an understanding of molecular control of cell differentiation and the key molecules involved with morphological events in the embryo e.g. the molecules associated with neural tube patterning.
5. Observe and identify key features of vertebrate embryos and use morphological criteria to uncover the stage of embryonic development.
6. Demonstrate familiarity with internet resources that aid modern developmental research
7. Work in groups to carry out desk-top research using database resources.

Recommended Reading List:

- Gilbert, Scott F., Barresi M. 2023. Developmental Biology (13th edition) (or earlier editions). Oxford University Press
- Wolpert, Lewis and Tickle, Cheryll. 2019. Principles of Development (6th edition) Oxford University Press, Oxford.

Assessment Details: 50% continuous assessment (Data analysis report, practical exercise submissions and Group desk top project): 50% annual written examination.

ZOU33070 – Experimental Design and Analysis

Second Semester | 5 credits | 28 Contact Hours

Module Personnel: *Dr Silvia Caldararu*

This module will aim to put data collection and analysis in the context of research design and will be an important foundation for the Senior Sophister research project. The emphasis will be practical with a more 'hands on' approach rather than the theory of statistics. Initially students will be taught about experimental design, data collection and sampling. This will lead on to preliminary data exploration and issues of normality. Emphasis will be placed upon the importance of visually exploring the data prior to the use of statistical tests. Summary statistics, including measures of centre and spread, skewness, kurtosis, percentiles and boxplots, will be covered.

Then the module will move on to explore the concept of hypothesis testing and the need to compare two or more means. This will involve the use of t-tests and analysis of variance. Other types of data will also be introduced including the analysis of frequencies. The relationship between two variables in the context of regression analysis will also be explored. Finally, a data set will be used to bring the entire process together starting with simple data exploration through summary statistics to more complex analyses. The module will also cover fundamentals of big data in ecology.

Learning Outcomes:

1. Understand the fundamentals of experimental design and data collection
2. Use hypothesis testing to answer biological questions.
3. Explore and analyse data within the context of research design.
4. Use basic statistical tests as appropriate for different research questions and understand the requirements and limitations of each test
5. Learn how to use the programming language R for statistical analysis and plotting

Recommended Reading List:

- Ruxton, Graeme D. and Colegrave, Nick. 2011. Experimental design for the life sciences (3rd edition) Publisher – Oxford University Press, Oxford (ISBN 9780199569120).

Assessment Details: 100% Continuous Assessment

ZOU33086 – Terrestrial Wildlife and Field Ecology

Second Semester | 5 credits | 5-day field course plus 10 contact hours

Module Personnel: *Dr Jim Barnett*

This two-part module begins with a series of lectures in semester 2, which offer an introduction to terrestrial biodiversity and wildlife biology, both globally and regionally. Topics covered will include: assessment of biodiversity from individual, population, community and landscape scales and the importance of foraging ecology, habitat selection, inter- and intra-specific competition, territoriality, dispersion, population dynamics and regulation for determining diversity and distribution of animals. There will also be a particular focus on the origins, development and current status of the Irish vertebrate fauna.

The lecture series will be complemented by a five-day residential field course in Glendalough, Co. Wicklow, during which field techniques used for the study of terrestrial ecosystems will be introduced, with an emphasis on habitat and population assessment of mammals, insects and

birds and their interactions with plants and the abiotic environment. Field visits will help with an understanding of contrasting habitats and approaches to conservation management. Students will carry out and present a mini project during the last two days of the course.

Learning Outcomes:

On successful completion of this elective, the student will be able to:

1. Demonstrate the relationship between determinants of the patterns of terrestrial biodiversity and the practice of wildlife management and conservation
2. Recognise and evaluate the main factors influencing the conservation status of species, in particular habitat selection and requirements, population processes and interspecific interactions
3. Explain the origin, diversity and status of the current Irish vertebrate fauna
4. Census mammals and insects safely using a variety of the most commonly used methods, and birds by sight and song
5. Construct habitat maps and appreciate the importance of scale in such maps
6. Assess anthropogenic effects on the environment and evaluate some control measures used to minimise them in nature reserves
7. Design, conduct and present a small-scale field study investigating an ecological question

Recommended Reading List:

- Primack, Richard B. 2010. **Essentials of Conservation Biology** (5th edition). Sinauer Associates, Sunderland, Mass. (ISBN 9780878936403)
- Groom, Martha J., Meffe, G.K. and Carroll, C.R. 2006. **Principles of Conservation Biology** (3rd edition). Sinauer Associates, Sunderland, Mass. (ISBN 0878935185)
- Sutherland, William J. (ed) **Transforming Conservation: A practical guide to evidence and decision making** (free to download) https://www.openbookpublishers.com/books/10.11647/obp.0321

Assessment Details: 50% continuous assessment (50% field survey techniques and project planning assessments/presentation, all completed during the field course), 50% annual written examination.

ZOU44013 – Conservation and Wildlife Management

First Semester | 5 credits

Module Personnel: *Dr John Rochford*

This module, which consists of both lectures and tutorials, looks at some of the practical applications of wildlife biology to the conservation and management of animals, both in- and ex-situ, including the role of zoos in captive breeding programmes. Among the topics covered are: planning for wildlife management, the principles of managing wildlife for sustainable harvest or control, management of scarce or endangered species, practical issues associated with the ex-situ management of species, and the design and management of conservation areas. In the second part of the module, we will concentrate on anthropogenic impacts on biodiversity conservation, including the development and implementation of biodiversity conservation strategies in the wake of the Convention on Biological Diversity, other national and international wildlife legislation, biosecurity and the role of Invasive Alien Species, Biological Data Management and the development of Species Action Plans, and the role of reintroductions in biodiversity conservation.

Learning Outcomes:

1. Outline the goals and history of sustainable wildlife management.
2. Determine and evaluate strategies for exploitation and control of animal resources
3. Implement techniques for establishing and maintaining the conservation status of species.
4. Describe the relationship between in- and ex-situ conservation measures.
5. Evaluate the selection, design and management of protected areas for wildlife.

Recommended Reading List:

- Primack, Richard B. 2010. Essentials of Conservation Biology (5th edition). Publisher – Sinauer Associates, Sunderland, Mass. (ISBN 9780878936403)
- Groom, Martha J., Meffe, G.K. and Carroll, C.R. 2006. Principles of Conservation Biology (3rd edition). Publisher – Sinauer Associates, Sunderland, Mass. (ISBN 0878935185)

Assessment Details: 50% Continual Assessment, 50% Examination

ZOU44019 – Advances in Behavioural Ecology

First Semester | 5 credits

Module Coordinator: *Dr Jim Barnett*

This module will expand the students' grasp of some classic topics in the field of behavioural ecology such as the consequences of group living, optimality models, animal culture, and signalling. We will also explore some currently advancing themes, including multi-level

societies, co-operation, and the effects of urbanization on animal behaviour. The content will be delivered using a flipped classroom format of worksheets introduced by short lectures as well as independent reading followed by structured discussions. The continuous assessment will be in two parts. The first will involve the students undertaking group research into a currently active field of animal behaviour and presenting their findings to the class, receiving a group mark. The second will involve writing a blog on a paper of their choice taken from one of the leading behavioural journals, which will be individually assessed.

Learning Outcomes:

On successful completion of this elective, the student will be able to:

1. Discuss the foundations of modern behavioural ecology supported by appropriate experimental examples.
2. Appreciate the uses of theoretical modelling and sound experimental design in the study of animal behaviour.
3. Present reasoned arguments on a wide range of currently developing topics, based on the literature and their own conclusions.
4. Have experience of reading, summarising and presenting primary literature to the class.
5. Work in a group to support each other's learning and understanding.
6. Have experience of writing a blog suitable for presentation of scientific ideas to social media audiences.

Assessment Details: This module is assessed 50% by continuous assessment and 50% by essay questions on an annual examination paper.

ZOU44020 – General Zoology

Second Semester | 5 credits

Module Personnel: *Dr Andrew Jackson*

This module provides an opportunity for students to revise and study, in greater depth, topics from the Junior Sophister Zoology programme. Students are expected to integrate their approach to this earlier material with the perspectives and skills they develop during their final year. Appropriate literature relating to the Junior Sophister mandatory modules will be recommended for detailed study.

Learning Outcomes:

1. Describe the diversity and evolution of the animal kingdom.

2. Recognise, on the basis of diagnostic features, representatives of the major taxa of invertebrates and vertebrates.
3. Explain important basic concepts and current developments in such key areas of animal biology as ecology, comparative physiology, behaviour, parasitology, and developmental biology.
4. State confidently the theoretical and practical aspects relating to essential laboratory techniques, particularly molecular approaches.

Assessment Details: This module is examined in a three-hour lab-based short answer paper in the final Moderatorship examination.

ZOU44021 – Tropical Ecology and Conservation

First Semester | 5 credits

Module Personnel: *Prof. Ian Donohue,* Dr John Rochford, Prof. Andrew Jackson, Dr. Rebecca Rolfe, Ms. Niamh McCartan

The module comprises a short lecture series followed by a ten-day residential field course in East Africa that will run during the reading week mid-end October. The module will focus on the ecology and biodiversity of a range of ecosystems and habitats (including tropical montane forest, aquatic ecosystems [freshwater rivers and lakes, wetlands and saline lakes] and grasslands) and the connectivities among them. Issues and problems to do with human impacts and the conservation and management of these diverse habitats will also comprise an important element of the module.

Planning and registration: Planning for the field course commences Semester 2 in Junior Sophister year and requires a deposit to secure a place. Students that are studying abroad for this semester should contact the module coordinator before leaving for study abroad.

Learning Outcomes:

1. Demonstrate holistic knowledge of East African geology, landscapes and ecosystems and the extent and nature of human interactions within them.
2. Understand the principles underpinning the ecology of tropical grasslands, forests, freshwaters and alkaline waters and be able to explain these to a layperson.
3. Evaluate the importance of natural background environmental fluctuations compared to those caused by human impact.

5. Synthesise and reconcile the conflicting arguments for the future of each of the ecosystems visited and be capable of integrating these arguments into sustainable management plans, which incorporate indigenous livelihoods.
6. Design a group research project on tropical ecosystem(s) of their choice.
7. Make a competent oral presentation, supported by a written synthesis, of their research proposal.

Assessment Details: 50% Continuous Assessment, 50% Examination

ZOU44022 – Comparative Physiology

First Semester | 5 credits

Module Personnel: *Dr Rebecca Rolfe*, Prof Andrew Jackson, Prof Paula Murphy, Dr Nick Payne

This module, which consists of both lectures, workshops and self-learning exercises, explores physiological success within the animal kingdom through a synthesis across multiple levels of organisation. The aims of this module are to compare systematically the ways in which various animals carry out similar functions. The specific physiological topics and components include: biomechanics, sensory physiology, metabolism, thermal tolerance and physiological and developmental remodelling. This module will include analysis of how physiological adaptations and tolerances are linked to distributions of organisms and evolutionary developmental biology perspectives in the context of environmental changes and challenges.

The module is structured in two parts; the first half of the semester will comprise a “bootcamp’ series of lectures describing specific physiological systems and themes. The second part of the module will consist of research-focused themes from a range of physiological perspectives. It will provide an integrative physiological approach with an emphasis on synthesis across multiple levels of biological organisation, with research topics that probe the relationships between structure and function.

Learning Outcomes:

1. Explain the similarities and the differences between physiological systems in different animal phyla and discuss physiological adaptations in the context of environmental conditions.
2. Describe biomechanical principles, the diversity of skeletal structures and the physiological basis of locomotion
3. Compare and contrast how different animals carry out basic physiological functions: such as Gas Exchange, Excretion, Metabolism and Reproduction.

4. Analyse how different physiological systems and processes respond, adapt and evolve to environmental conditions.
5. Evaluate and critically interpret physiological research from molecular to macro scales (individual to population levels).

Assessment Details: 50% Continuous Assessment: 50% Examination.

ZOU44030 – Data Handling

Module Personnel: *Prof Andrew Jackson*, Dr Thomas Connor

Being able to form research questions and challenge our hypotheses by collecting and analysing data forms the basis of scientific inquiry. An understanding of data analysis is an essential skill set for all scientists. This module will consist of 2 to 3 tutorial sessions per week spanning all of semester 1 in a flipped-classroom format with an active-learning ethos. One of the tutorials each week will be used to develop class-directed questions relevant to current scientific thinking. As a class, we will form hypotheses, collect data and develop appropriate analytical techniques to answer our research questions. Concurrently, online material including video podcasts will be used to develop hands-on skills in the use of the very powerful and flexible statistics package R for data analysis. The module will start with basic probability theory, introduce different statistical distributions and culminate in learning how General Linear Models form a common framework for conceptualizing and analyzing your data. At the end of the module you will have analysed a wide variety of data types and will have used the transferable and widely applicable statistics package R to analyse your data.

Learning Outcomes:

1. Summarise and communicate quantitative results graphically and textually to scientific standards.
2. Apply appropriate statistical analyses of commonly encountered data types.
3. Explain the context of the analyses within a hypothesis driven framework of scientific logic.
4. Use the R statistical computing language for data analysis.
6. Create R notebooks for documenting analyses and sharing with collaborators.

Assessment Details: 35% Continuous Assessment, 65% Examination

ZOU44060 – Research Comprehension

Both Semesters | 5 credits

Module Personnel: *Prof. Paula Murphy,* Dr James Barnett

No matter what you do when you graduate, in most jobs you will be expected to read, understand and interpret data. Often this will be in a subject you are unfamiliar with, or will use unfamiliar methods or study organisms. The aim of this module is to help you to develop the ability to understand and interpret research from a broad range of scientific areas, and then to develop opinions about this research and how it fits into the "big picture". This module also aims to improve your ability to communicate all kinds of scientific research to a general audience, a skill that is currently in great demand.

Learning Outcomes:

1. Comprehend and report on scientific studies presented both orally and in primary literature.
2. Identify the aims and/or hypotheses in scientific studies and analyse the research methods employed to address them.
3. Interpret and generalise the results of the studies in the context of the wider subject area.
4. Assess and evaluate the conclusions of the scientific study.
5. Interpret graphical, tabular and pictorial representations of data and infer results in the context of the subject matter.
6. Summarise scientific studies in language and style suitable for consumption by a wide audience in an online form.

Assessment Details: 40% CA, 60% Written Exam

CA: A blog post: A blog post will be written on the content of one of the seminars.
Exam: A series of questions (answer 2 from a choice of 4) will require engagement with unseen data or graphical representation of concepts related to individual seminar topics (the seminars and accompanying papers presented for study) presented and explored during the module. The questions will test interpretation of scientific data, insight into key concepts and critical thinking.

2 hours end of year written exam.

Assessment for this module will take place entirely in Semester 2.

ZOU44092 – Environmental Impact Assessment

First Semester | 5 credits

Module Personnel: *Dr John Rochford*

This module involves an introduction to the principles and processes of Environmental Impact Assessment, particularly in relation to national and international requirements. All stages of the EIA process, from initial project screening to the final review, are covered, with the emphasis throughout on the role of the natural scientist. Strategic Environmental Assessment and Appropriate Assessment are also covered. In addition to the lectures, students carry out a group scoping exercise for a proposed development and conduct a quality review of an actual EIAR.

Learning Outcomes:

1. Outline the development of the Environmental Impact Assessment process as a management and legislative tool from its inception in the 1960s to its present form.
2. Explain the stages in the process from initial screening to post-project monitoring and auditing.
3. Conduct a scoping exercise for a project and produce a draft Scoping Statement.
4. Critically evaluate Environmental Impact Assessment Reports prepared for a wide range of projects.
5. Compare and contrast the process of Environmental Impact Assessment with Strategic Environmental Assessment.
7. Describe Appropriate Assessment in the context of Natura 2000 sites.

Assessment Details: 50% Continuous Assessment, 50% Examination

School Policies and Procedures

Health and Safety

NOTE THAT WE WILL NOT BE HIRING OUT LAB COATS. ANY STUDENT WITHOUT A LAB COAT WILL UNFORTUNATELY NOT BE ALLOWED IN THE PRACTICAL.

The University must exercise a "duty of care" to employees and those they supervise. This duty of care is recognised in both criminal and civil law. There is also a duty on everybody to take reasonable care for their own safety and the safety of those around them.

The Medical Declaration forms signed in Junior Freshman year stated your agreement to abide by College's safety policies. These policies cover work in the laboratory, the field and all activities on campus. You must read the Faculty of Engineering, Mathematics and Science Health and Safety Guidance Manual to inform yourself of these procedures, which can be found on the faculty local home page at: https://www.tcd.ie/stem/faculty-health-safety.php

Labs and Field courses

The Laboratory:

In formal laboratory exercises you will be under supervision in a controlled environment where all reasonable safety precautions have been considered and all hazards identified. For that reason, laboratory safety is reasonably taken care of provided you follow the instructions of those in control of the laboratory. However, you have a duty of care for yourselves and those who may be affected by your actions. This means that your behaviour in the laboratory must be such that you do nothing to place either yourself or other laboratory users at risk. There is only so much we can do, and you have a legal obligation to follow instructions, look out for yourself and do nothing to put either yourself or others at risk.

Instrumentation in a laboratory is one area where this can be a problem. If you have never used an instrument before you will not know the potential danger it may pose. Do not interfere with any piece of equipment. You may muddle through with it, but you might also cause injury to yourself or others. The staff, both academic and technical, along with the demonstrators, are available to instruct you, so always ask to be taken through the use and dangers of any piece of equipment which you have to use.

Fieldwork:

Fieldwork is defined as any practical work carried out in the field by staff or students of the University for the purpose of teaching and/or research. By definition it occurs in places which

are not under the control of the University, but where the University is responsible for the safety of its staff and students.

Please note: Voluntary and Leisure activities are excluded.

Outside of Voluntary and Leisure activities, the Head of Discipline has overall responsibility for health and safety in their area. They are required to ensure that the risk assessment of the fieldwork is made and to ensure that a safe system of work has been established for all staff and students. This duty is frequently delegated to the member of staff organising the fieldwork. The Head of Discipline must ensure that the fieldwork meets the safety criteria of the School, and that accidents are reported and investigated. There is a Department Safety Officer, who is responsible for day-to-day safety matters. There is a duty on the fieldwork participants to take reasonable care for their own safety and the safety of those affected by them.

Some staff and students may be unable to carry out certain types of fieldwork due to any number of physical or medical conditions and early identification of such issues are essential. There are a number of forms that must be completed before Laboratory or Fieldwork is begun. Please note that it is compulsory for each student to fill these forms in prior to beginning fieldwork. The forms must be returned to Discipline Safety Officer.

Relevant and suitable protective equipment must be worn. Participants must dress appropriately especially in cold and wet conditions. When the activity involves the use of boats other than registered ferries appropriate life jackets must be worn.

The School of Natural Sciences has prepared a detailed set of instructions relating to fieldwork. These will be issued prior to the first field course.

Fire

Fire Prevention:

Copies of the College General Fire Notice are displayed in the Department. Familiarise yourself with the instructions in case of fire. Individuals are responsible for checking the fire precautions in their own work areas. Any defect or potential fire hazards should be reported to the building Fire Warden.

Note the position of fire extinguishers in your working area. Familiarise yourself with the operating sequence for each extinguisher It is a criminal offence to misuse a fire extinguisher. Before leaving offices or laboratories:

- ensure that all litter bins do not contain any smouldering materials.

- do not leave litterbins under or near to any combustible items e.g. desks, tables, shelving, etc.

- close all filing cabinets and presses.

- switch off and unplug electrical equipment not in use.

In Case of Fire:

Copies of the College General Fire Notice are displayed in all Departments. Familiarise yourself with the instructions in case of fire. Any defect or potential fire hazards should be reported to the building Fire Warden.

Fire drills are held regularly. On hearing a fire alarm, you must listen to all instruction given and gather at the Assembly Point until you are permitted to return to the building. Do not bring your belongings or ignore the alarm. This may delay your exit from the building.

For emergency exit from the Old Anatomy Building laboratories, unlock the exit doors using keys stored behind glass in a key box beside the doors.

If possible, before exiting from the building, turn off all bunsens, electrical equipment etc.

CLOSE ALL WINDOWS AND DOORS IN YOUR LABORATORY AND IMMEDIATE WORK AREAS.

If possible, inform the Front Gate Security Officer, emergency no. ext: 1999 or the 24 hour security no. ext: 1317, who will call the fire brigade, (from a mobile call 01 8961999 or 01 8961317 if Out of Hours). Then inform the Chief Steward, ext: 1144, (01 8961144 from a mobile). There is an emergency phone on the ground floor of the Botany Building for this purpose. Warn firemen of possible missing persons and potential hazards in the area of the fire – hazardous chemicals, pathogens, gas cylinders, etc.

Bombs

Keep an eye out for suspicious packages at all times. If one is observed report it to the Chief Technician or another staff member. If a bomb is thought to be in the building, procedures essentially follow those employed in the case of fire except that report is made to College authorities on ext: 1999/1317 (Front Gate Security Officer & 24 hour Security) who will call the Gardai.

First Aid

First Aid boxes are placed in every laboratory. These boxes contain a range of dressings and bandages for treatment of minor cuts and burns. Placed on top of each box there should be an eye- wash bottle containing Sterile Saline solution.

DO NOT USE AN ITEM WITHOUT SUBSEQUENTLY INFORMING A TECHNICIAN.

This ensures the incident is recorded and the items used are replaced. A list of trained First Aiders is displayed on each first aid cabinet.

REPORT ANY DEFICIENCY OF THE ITEMS IN OR ON THE BOX TO THE CHIEF TECHNICIAN.

All accidents must be reported to the Safety Officer and entered in the accident book which is kept in the Chief Technician's office. An accident report form will be completed. Dangerous occurrences must also be reported on the appropriate form.

In the event of serious accident or medical emergency, quickly report it to the Chief Technician (Main Building) or the senior person present and call the Front Gate Security Officer ext: 1999/1317 who will notify the Emergency Services, or if off Campus call the ambulance service at no. 999 or 6778221 (Tara Street) if necessary. In the event of eye injuries, the victim should be taken directly to the Royal Victoria Eye & Ear Hospital, Adelaide Road.

During office hours medical assistance can be obtained from the Student Health Service ext: 1556/1591. In cases involving poisoning call the Poisons Information Centre, Beaumont Hospital no. 837 9964/837 9966 or contact the Pharmacology Department ext: 1563.

Familiarise yourself with the standard first aid procedures to be followed in the event of acid and alkali contact with the body, reagent ingestion, cuts, electrical shock, burns, etc.

In the field, all staff and demonstrators carry an individual first aid kit. Departmental vehicles carry a more extensive kit. Report all field injuries or illness immediately to the leader of the field trip. You must always adhere to the instructions and directions of the field-leader. Health and safety issues for laboratory and field projects must be discussed in detail with supervisors.

Attendance

Students must attend College during the teaching term. They must take part fully in the academic work of their class throughout the period of their course. Lecture timetables are published through my.tcd.ie, and on school or discipline noticeboards or in Blackboard before the beginning of Michaelmas teaching term. The onus lies on students to inform themselves of the dates, times and venues of their lectures and other forms of teaching by consulting these timetables.

The requirements for attendance at lectures and tutorials vary between the different faculties, schools, and disciplines. The school, discipline, or course office, whichever is relevant, publishes its requirements for attendance at lectures and tutorials on noticeboards, and/or in handbooks and elsewhere, as appropriate.

Viva Attendance

A viva is an oral examination or thesis defence, giving students the opportunity to explain their capstone project and answer questions about their work. Please note that Senior Sophister students may be asked to attend a mandatory viva session after the end of term. As such, they are required to be available up through the end of May. Further details on vivas will be provided as the end of term approaches.

Absence from College

Zoology, Botany and Environmental Science employs an approach similar to the Fresh years as administered by the Science Course Office.

Medical Certificates/Absence due to Illness

Where a student misses an assigned laboratory practical class through illness, they should: (a) submit a Medical Certificate to the ZOBOES Teaching Office on the day of their return to College; and (b) inform the laboratory practical supervisor of their absence at the next session. The Science Medical Certificate Form (for use with med cert from doctor) is available from ZOBOES Teaching Office.

Self-Certification/Absence due to illness - three days or **less**

For periods of illness of **three days or less** (but **no more than seven days in any year**) a student may 'self-certify' their illness on the forms supplied, again to the ZOBOES Teaching Office on the day of their return to College. The Science **Medical Self Certification Form** (**use for 3 days medical not covered by doctor**) is available from the ZOBOES Teaching Office.

Other Absences

Students who request to be absent from a laboratory practical classes or tutorials (with or without an associated assessment) for any other reason, such as a sporting event or other situation, should inform the ZOBOES Teaching Office and your Programme Director well in advance of the event. The Science **Absence from College Form**, **Sport or Other** is also available from the ZOBOES Teaching Office. Please note that filling in this form is **not a guarantee** that

you will be afforded any accommodations with regard to marks or assignment of an alternative lab or tutorial session. In such cases decisions on what action/accommodations will be given is purely at the discretion of the individual disciplines concerned. The ZOBOES Teaching Office and Programme Director do not have any jurisdiction in this situation.

Students who will not be in attendance for any extended duration during term time must have permission from Senior Lecturer via their College Tutor to be absent from College. Please refer to the absence regulations noted in the previous page.
Excuses for absence, presented after the event, **will not be entertained.** Students who anticipate that their sporting commitments may necessitate more than the occasional absence from College (e.g. Sport Scholars, etc.) should discuss their situation with their tutor, and the Zoology Director.

NOTE:
Please note that these regulations do not apply to absence from examinations. Students who are absent from examinations must contact their tutor as a matter of urgency and present any medical information/documentation to them.

Important note on B.A. (Hons.) and B.A. (Ord.) degrees

You may choose to not undertake the final year of this degree, which awards B.A. in Science with Honours in Zoology (B.A. Hons.). Instead, you may apply, upon successful completion of your Junior Sophister year, to be awarded a B.A. (Ord.) degree. Students considering this option should discuss it with their tutor and/ or the Moderatorship Director.

Research Ethics

In line with Trinity College Dublin's Policy on Good Research Practice, all research in the School of Natural Sciences (SNS) should be conducted according to the overarching ethical principles of "respect for the individual subject or population, beneficence and the absence of maleficence (research should have the maximum benefit with minimal harm) and justice."

All individuals involved in research should facilitate and ensure research is conducted ethically. Ethical conduct in research is a shared responsibility. Primary responsibility rests with the Principal Investigator(s). Ethical responsibilities and legal obligations may overlap. All staff and students conducting research are required to ensure that their research is carried out in

compliance with this policy. Ethical review is required before any studies involving human subjects, other living organisms and/or the natural environment, encompassing biosphere, geosphere, hydrosphere and atmosphere, commence. This requirement applies to staff, postgraduate and undergraduate students and volunteers/interns. Field-based and laboratory work cannot commence until ethical review has been completed and approval has been gained. Staff or students planning to undertake research should complete the Research Ethics Application available from https://www.tcd.ie/naturalscience/research/ethics/

Assessment: Procedures for the non-submission of coursework and absence from examinations

All students must fulfil the course requirements of the school or discipline, as appropriate, with regard to attendance and course work. Where specific requirements are not stated, students may be deemed non-satisfactory if they miss more than a third of their course of study or fail to submit a third of the required course work in any term.

Full regulations on non-submission of coursework can be found via the following: https://www.tcd.ie/calendar/undergraduate-studies/ (Specific Regulations by Course in STEM Faculty - Undergrad and postgrad)

At the end of the teaching term, students who have not satisfied the school or department requirements may be reported as non-satisfactory for that term. Students reported as non-satisfactory for the Michaelmas and Hilary terms of a given year may be refused permission to take their semester two assessment/examinations and may be required by the Senior Lecturer to repeat their year.

Further details of procedures for reporting a student as non-satisfactory are given on the College website at https://www.tcd.ie/academicregistry/student-cases/

Access to Exam Scripts (Freedom of Information Act)

Following publication of the final examination results, students may have access to their examination scripts upon written application to the Zoology / Botany / Environmental Sciences teaching office or Course Coordinator.

Junior Sophister Examinations & Assessment

The grade for each student at the end of the Junior Sophister year is compiled from the results of the examinations in Michaelmas and Trinity Term and work assessed throughout the year. It is expected that the Junior Sophister examinations in 2025-26 will consist of a number of 1.5 and 3 hour written papers (timetable to be announced later). Further information about the form of the examination papers will be provided as part of the introduction to each module. The number of questions per module and the marks allocated relate to its ECTS credit value. Past examination papers are available on the College web at:
https://www.tcd.ie/academicregistry/exams/past-papers/annual/

Grading Guidelines

The following guidelines are used when awarding grades for essays and examination answers in the Sophister years in Zoology, Botany and Environmental Sciences.

Class	Mark Range	Criteria
I	90-100	**EXCEPTIONAL ANSWER;** This answer will show original thought and a sophisticated insight into the subject, and mastery of the available information on the subject. It should make compelling arguments for any case it is putting forward and show a rounded view of all sides of the argument. In exam questions, important examples will be supported by attribution to relevant authors, and while not necessarily giving the exact date, should show an awareness of the approximate period. In essays, the referencing will be comprehensive and accurate.
	80-89	**OUTSTANDING ANSWER;** This answer will show frequent originality of thought and make new connections between pieces of evidence beyond those presented in lectures. There will be evidence of awareness of the background behind the subject area discussed, with evidence of deep understanding of more than one view on any debatable points. It will be written clearly in a style which is easy to follow. In exams, authors of important examples may be provided. In essays all important examples will be referenced accurately.
	70-79	**INSIGHTFUL ANSWER;** showing a grasp of the full relevance of all module material discussed, and will include one or two examples from wider reading to extend the arguments presented. It should show some original connections of concepts. There will be only minor errors in examples given. All arguments will be entirely logical, and well written. Referencing in exams will be sporadic but referencing should be present and accurate in essays.

II-1	65-69	**VERY COMPREHENSIVE ANSWER;** good understanding of concepts supported by broad knowledge of subject. Notable for independent synthesis of information rather than originality. Evidence of relevant reading outside lecture notes and module work. Mostly accurate and logical with appropriate examples. Occasionally a lapse in detail.
	60-64	**LESS COMPREHENSIVE ANSWER;** mostly confined to good recall of module work. Some independent synthesis of information or ideas. Accurate and logical within a limited scope. Some lapses in detail tolerated. Evidence of reading assigned module literature.
II-2	55-59	**SOUND BUT INCOMPLETE ANSWER;** based on module work alone but suffers from a significant omission, error or misunderstanding. Usually lacks synthesis of information or ideas. Mainly logical and accurate within its limited scope and with lapses in detail. The content is sensible and relates a reasonable narrative, if limited in synthesis and sophistication. There is reasonably good citation practice and a well-presented reference list in essays.
	50-54	**INCOMPLETE ANSWER;** suffers from significant omissions, errors and misunderstandings, but still with understanding of main concepts and showing sound knowledge. Several lapses in detail. Content may be disjointed and lacking good structure. Poor citation practice and reference list in essays.
III	45-49	**WEAK ANSWER;** limited understanding and knowledge of subject. Serious omissions, errors and misunderstandings, so that answer is no more than adequate.
	40-44	**VERY WEAK ANSWER;** a poor answer, lacking substance but giving some relevant information. Information given may not be in context or well explained, but will contain passages and words, which indicate a marginally adequate understanding.
F-1	30-39	**MARGINAL FAIL;** inadequate answer, with no substance or understanding, but with a vague knowledge relevant to the question.
F-2	0-29	**UTTER FAILURE;** with little hint of knowledge. Errors serious and absurd. Could also be a trivial response to the misinterpretation of a question.
U.G		Ungraded

The following guidelines are used for Project/Dissertation Assessment in Zoology, Botany and Environmental Sciences.

Class	Mark Range	Criteria
I	80-100	Exceptional project report showing deep understanding of the topic and literature similar to that expected in a published paper. Clear grasp and expression of the justification for the research, with clear explanation of the importance and implications of the work within the subject area. Methods described with the clarity and detail expected in a published paper, showing sound experimental design. Exceptional presentation, analysis and exploration of results focussed on the question asked, using the most appropriate analyses for the question and data. Thoughtful, critical evaluation of the findings, discussed insightfully in their full context within the literature. Excellent presentation of the finished thesis, which contains very few, if any, editorial errors.
	70-79	Excellent project report showing evidence of wide reading and broad understanding of the topic, with clear presentation, focused and thorough analysis of results and a demonstrated ability to critically evaluate and discuss research findings. Clear indication of insight, originality, and appreciation of the implications of the findings for the research field. An excellent, highly competent and well-presented report overall but falling short of outstanding in at least one aspect.
II-1	65-69	A very good project report, showing a reasonably wide understanding of the topic and its associated literature, with some indication of how the research adds to the field. Methods described clearly and in sufficient detail for someone to repeat the work, and showing sound experimental design, or the appreciation of how it could have been made sound. Competent analysis of the results and valid and accurate interpretation of the findings. Results presented accurately using appropriate figures and/or tables. Accurate appreciation of any shortcomings of the experimental design and the implications for interpretation. Discussion of the results puts them into some level of context but may not reflect all the implications for the research field.

	60-64	A good project report, showing some understanding of the wider topic and its associated literature, with some indication of the relevance of the research. Methods described clearly, though perhaps not in sufficient detail for someone else to repeat the work. Sound experimental design, or some appreciation of how it could have been made sound. Competent analysis of the results, though perhaps through the use of simpler tests than would be ideal. Accurate presentation of results, though perhaps not with the best choice of graphics. Interpretation of findings mostly valid and accurate. Some appreciation of any major shortcomings in experimental design and the implications for interpretation. Discussion may focus mostly on the findings, with only occasional references to other work, though those contextual references should be present.
II-2	50-59	A moderately weak project report which shows some understanding of the research question, but lacks a strong grasp of the wider research topic or the relevance of the project. Methods mostly described clearly, but there may be lapses in detail. Experimental design may not be entirely sound, and any weakness may be undescribed. Analysis of the results generally sound but may be simple and contain errors such as incorrect statistical reporting or the use of less than ideal graphs. Interpretation of the findings may not be entirely accurate, and shortcomings in the design or analysis unlikely to be taken into account during interpretation, but some level of interpretation of the results must be present. Discussion may focus solely on the findings of the work, and may lack references to other work, though some indication of the relevance of the project should be present. Insufficient attention paid to organisation and presentation of the report.
III	40-49	A weak project showing only limited understanding of the research question, reported without understanding of the wider context or relevance of the project. Methods not complete. Experimental design may contain obvious unrecognised flaws and may not be described completely. Analysis of results simple and may show basic errors. Interpretation of results may be limited or absent. Discussion may be minimal and restricted to the direct findings of the project. General standard of presentation poor.
Fail	20-39	An unsatisfactory or incomplete project report, lacking sections or with little content in some. Very limited understanding of the question or failure to express it at all. Methods may be incomplete, possibly lacking description of experimental design. Results may be incomplete, with poor choice of graphics and / or tables. Analysis of data may be lacking or contain fundamental errors. Interpretation of the results likely to be limited or absent. Discussion restricted to a restatement of results. Very poor overall standard of presentation.

	0-19	An extremely poor project report containing very little substance and showing no real understanding or awareness of the problem. No attempt at a relevant literature review or relevant support from published work. Methods chaotic or incomprehensible. Almost absent or completely absent presentation of results. Any analysis of results incorrect or inappropriate. Clear inability to interpret results in relation to other work or ideas. Very poor overall standard of presentation.

Appeals Policy

Trinity College Dublin, the University of Dublin, herein referred to as Trinity, recognises that in the context of its examination and assessment procedures, a student may wish to appeal a decision made in relation to their academic progress. The appeals procedure may be used only when there are eligible grounds for doing so and may not be used simply because a student is dissatisfied with the outcome of a decision concerning their academic progress. Further information at: https://www.tcd.ie/academic-affairs/-undergraduate-appeals/

Data Protection

Trinity College Dublin uses personal data relating to students for a variety of purposes. We are careful to comply with our obligations under data protection laws and we have prepared this short guide to ensure you understand how we obtain, use and disclose student data in the course of performing University functions and services. More information is available at https://www.tcd.ie/info_compliance/data-protection/student-data/

The Zoological Society

A number of societies run by students, and affiliated to the Central Societies Committee, cover interests relevant to students in Zoology, the most important of which is the Dublin University Zoological Society.

ZOOSOC https://www.trinitysocieties.ie/societies/zoosoc was founded in 1974 and promotes an awareness of all aspects of zoology and natural history. It holds regular meetings and field trips, and its members have participated in numerous wildlife surveys and fundraising campaigns.

The Environmental Society

A society run by students and affiliated to the Central Societies Committee covers interests related to Environmental and climate justice issues.

ENVIROSOC Environmental Society - Central Societies Committee aims to educate society members and the wider college community on what is causing the climate crisis - anthropogenic industrial processes compelled by capital - and to organise and act around climate issues. They also collaborate with other societies and organisations to explore environmentalism through the lenses of fashion, food, justice, the Irish landscape, economics and scientific research.

Career Information and Events

For information on what career opportunities Botany, Zoology and Environmental Science students can look forward to, visit https://www.tcd.ie/science/careers/tr060-careers/

For up-to-date information on upcoming events, please visit https://www.tcd.ie/naturalscience/news-and-events/

School Websites can be found at: https://www.tcd.ie/naturalsciences/

Link to School course pages:

Botany

Environmental Sciences

Zoology

Internships and Placements

Botany

Cathcart Schuler Internship in Conservation Horticulture – Undergraduate Environmental Science students are invited to apply for the Cathcart Schuler Internship, a six-week paid summer internship offered by the Trinity Botanic Gardens.

For up-to-date information on Botany internships, please visit https://www.tcd.ie/botany/internships/

Zoology

For up-to-date information on Internships and external opportunities, please visit https://www.tcd.ie/zoology/opportunities-in-zoology/

Environmental Science

Cathcart Schuler Internship in Conservation Horticulture – Undergraduate Environmental Science students are invited to apply for the Cathcart Schuler Internship, a six-week paid summer internship offered by the Trinity Botanic Gardens.

Prizes, medals and other scholarships

Edge Prizes in Botany

Two prizes, the Junior Edge prize and the Senior Edge prize, are normally awarded annually. The Junior Edge prize is awarded to the best student of those reaching sufficient standard in botany in the Junior Sophister year as nominated by the annual departmental examiners' meeting. Value, €300.
The Senior Edge prize is awarded to the Senior Sophister student in botany whose honours dissertation is judged to be of the highest standard of the cohort of dissertations which achieve sufficient standard. Value, €300.

The J.B. Gatenby Prize in Zoology

This prize, founded in 1968 by Mrs R.R. Edwards in memory of the late Professor J.B. Gatenby, is awarded annually to the member of the Junior Sophister Zoology class who carried out the best practical work during the year. Current value - €65.

Andrew Bacon Animal Diversity Award

This award is presented in memory of Andrew Bacon who sadly passed away in 2020 a year after he graduated in Zoology. Andrew contributed in many ways to our department, both as a student

and specifically, during his 3rd year, as a mentor on our museum outreach programme. He is very sadly missed by both staff and students. The Andrew Bacon award is presented annually based on student performance in studies relating directly to Animal Diversity in association with the Zoology Museum.

E.A. Collen Prize in Zoology

The prize was founded in 1990 by a bequest from Mrs E.A. Collen. The income from the fund is awarded annually to a student who has completed a Moderatorship in Zoology and has been accepted by Trinity College as a candidate for a higher degree. It is intended to encourage research in Zoology and is awarded on the recommendation of the Head of Discipline. *Value €115 .*

Maureen de Burgh Memorial Prize in Marine Biology

The prize was established in 1986 by subscription in memory of Dr Maureen de Burgh, a former member of the department, to promote research in marine biology. It is awarded annually to a postgraduate or undergraduate student to cover expenses related to research in marine biology at Trinity College, on the recommendation of the Professor of Zoology and one other lecturer in the department. *Value €140.*

W.C. Campbell Moderatorship Prize in Zoology

This prize was established in 2017 by a gift from Professor William C. Campbell from his 2015 Nobel Prize in Physiology or Medicine, which was awarded for discoveries concerning a novel therapy against infections caused by roundworm parasites. The gift is a token of gratitude for Professor Campbell's undergraduate education in the natural sciences, and for the inspiring mentorship of Dr James Desmond Smyth of the Zoology department. It is awarded annually to a student with the best overall moderatorship result in zoology. Value, €200.

W.C. Campbell Undergraduate Research Prize in Zoology

This prize was established in 2017 by a gift from Professor William C. Campbell from his 2015 Nobel Prize in Physiology or Medicine, which was awarded for discoveries concerning a novel therapy against infections caused by roundworm parasites. The gift is a token of gratitude for Professor Campbell's undergraduate education in the natural sciences, and for the inspiring mentorship of Dr James Desmond Smyth of the Zoology department. It is awarded annually to an undergraduate student with the best overall undergraduate research project result in zoology. Value, €200.

The David Jeffrey Prize in Environmental Sciences

Two prizes, the Junior Sophister Jeffrey Prize and the Senior Sophister Jeffrey Prize, are normally awarded annually. The Junior Sophister Jeffrey Prize is awarded to the best student of

those reaching sufficient standard in Environmental Sciences in the Junior Sophister year as nominated by the annual examiners' meeting. Value, €300.

The Senior Sophister David Jeffrey prize is awarded to the Senior Sophister student in Environmental Sciences whose honours dissertation is judged to be of the highest standard of the cohort of dissertations which achieve sufficient standard. Value, €300.

Academic Integrity

Plagiarism

The following Statement on Integrity, approved by Council, was developed for academic staff, professional staff, and students.

- In Trinity College Dublin, we commit ourselves as staff and students to acting responsibly and ethically, embracing integrity in all our actions and interactions as members of the College community. Understanding that integrity requires honesty, transparency and accountability, we agree to:
- Strive to do what we say we will, ensuring that we are aware of our commitments and responsibilities in order to fulfil them, and abiding by College and other relevant policies and the highest standards of conduct.
- Give credit where credit is due, recognizing and acknowledging the contributions and achievements of others in scholarship, teaching, research and service.
- Tell the truth, as a community and as individuals, speaking out and listening even when it is difficult, naming problems and honestly acknowledging mistakes.
- Hold ourselves and others to account for the things for which we are each responsible.
- Use resources for the purposes for which they are intended and be above reproach in financial dealings.
- Deal fairly, consistently and transparently with others.

The Academic Integrity Policy outlines what constitutes academic misconduct and how cases are handled. Please see the Academic Integrity LibGuide for further guidance.

Generative AI

Aligned with the *College Statement on Artificial Intelligence and Generative AI in Teaching, Learning, Assessment & Research* (2024), the use of GenAI is permitted unless otherwise stated. Where the output of GenAI is used in a document or work output, this usage should be acknowledged and appropriate cited, as per Library guidelines on acknowledging and reference GenAI.

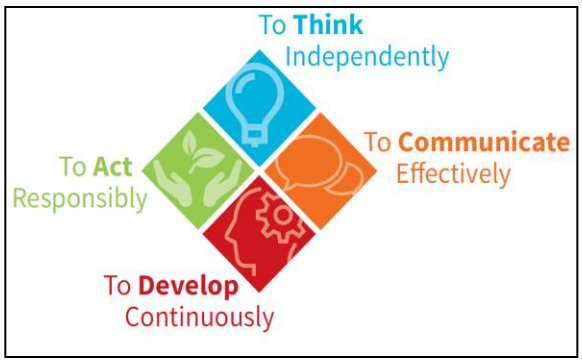
Individual module coordinators may put other restrictions in place around the use of Generative AI in particular modules.

Graduate Attributes

The Trinity Graduate Attributes represent the qualities, skills, and behaviours that you will have the opportunity to develop as a Trinity student over your entire university experience, in other words, not only in the classroom, but also through engagement in co- and extra-curricular activities (such as summer work placements, internships, or volunteering).

The four Trinity Graduate Attributes are:

- To Think Independently
- To Act Responsibly
- To Develop Continuously
- To Communicate Effectively



Why are the Graduate Attributes important?

The Trinity Graduate Attributes will enhance your personal, professional, and intellectual development. They will also help to prepare you for lifelong learning and for the challenges of living and working in an increasingly complex and changing world.

The Graduate Attributes will enhance your employability. Whilst your degree remains fundamental, also being able to demonstrate these Graduate Attributes will help you to differentiate yourself as they encapsulate the kinds of transversal skills and abilities, which employers are looking for.

How will I develop these Graduate Attributes?

Many of the Graduate Attributes are 'slow learned', in other words, you will develop them over the four or five years of your programme of study.

They are embedded in the curriculum and in assessments, for example, through undertaking independent research for your final year project, giving presentations and engaging in group work.

You will also develop them through the co-curricular and extra-curricular activities. If you help to run a club or society you will be improving your leadership skills, or if you play a sport you are building your communication and team-work skills.

Important Information

Student Services

For general information on the Supports and Services available to Trinity Students please visit: https://www.tcd.ie/students/supports-services/

This is a comprehensive site which breaks down the different categories of support and services available to students is an intuitive manner.

Follow on to the next page for a breakdown of some of our key supports and services.

Trinity Tutorial Service

The Tutorial Service is unique, confidential, and available to all undergraduate students offering student support in all aspects of College life. The Tutorial Service is supported and coordinated by the Senior Tutor's Office which is located on the ground floor in House 27.

Opening Hours and Appointments

The Senior Tutor's Office is open for student appointments between 10.30am - 12.30pm and 2.30pm - 4.00pm Monday to Friday ONLY (email stosec@tcd.ie to arrange an appointment).

What is a Tutor?

A Tutor is a member of the academic staff who is appointed to look after the general welfare and development of the students in his/her care. Whilst the Tutor may be one of your lecturers, this is not always the case as the role of the College Tutor is quite separate from the teaching role.

When should I go to see my Tutor?

You should visit your Tutor whenever you are worried or concerned about any aspect of College life or indeed your personal life, especially if it is affecting your academic work. The conversation with your Tutor takes place in strictest confidence. Unless you give him/her permission to do so, s/he will not divulge information given to them to anybody, whether a member of College or to anyone outside College (to your parents/family for example). Your Tutor can only help you if s/he knows you are facing difficulties, so if you are worried about anything go and see your Tutor before things get out of hand.

Further information on the Senior Tutors Office and College Tutors may be found via the following webpage: **Senior Tutor Services-** https://www.tcd.ie/seniortutor/students/undergraduate/

Disability Services

The Disability Service aims to provide appropriate advice, support and information to help students and staff with disabilities. The Disability Service has in place a range of supports to ensure that students with disabilities have full access to the same facilities for study and recreation as their peers. Most students registering with the Disability Service request access to a range of supports that help the student reach their full potential while studying. Most students' needs are accommodated through these supports. The student decides what level of support they require.

For contact information or to make an appointment please contact the Disability Services – contact details are available via the following webpage:

https://www.tcd.ie/disability/contact/

Student Learning Development

Student Learning Development offers support in a variety of study and learning skills including essay writing, exam preparation, study skills, self and time-management and note taking. Mechanisms of support are workshops, individual appointments and drop-in clinics.
For new students: https://www.tcd.ie/sld/your-student-journey/new-to-trinity/
For Undergraduate Students: https://www.tcd.ie/sld/your-student-journey/undergraduate-students/
For general information on all resources and supports available visit: https://www.tcd.ie/sld/

Student Health and Wellbeing

College Health Service

Trinity Health Services have GP services available for the following Opening Hours: Please contact us on 01 8961556 or 01 8961591 between 9am and 1pm and from 2-4:30pm

You can email collegehealth@tcd.ie , but please note that this email is NOT FOR ANY MEDICAL/CLINICAL enquiries and is not manned to manage clinical/medical enquiries, strictly only admin.

The Physiotherapist operates daily between 09.00 and 13.00 and also Monday/Tuesday afternoons during term time.

For further information visit: https://www.tcd.ie/collegehealth/

Student Counselling

The Student Counselling Service is here to help you to manage any difficulties you are experiencing so you can enjoy and fully participate in your time here at College.

If you wish to make an appointment with the Student Counselling Service, please consider one of the options below. If you have any other queries you can call into reception on the 3rd floor of 7-9 South Leinster Street or contact us on:
Phone: (01) 896 1407
Email: student-counselling@tcd.ie
For further information visit the following webpage: https://www.tcd.ie/StudentCounselling/

Student Life

Student life offers information on Supports and Services, Clubs and Societies, Student Unions etc., https://www.tcd.ie/students/

Academic Registry

The Academic Registry is responsible for services that support the complete student lifecycle of Trinity College Dublin – from application to graduation.

For information on Registration, Fees, Grants, ID Cards etc. visit the Academic Registry (AR). AR is located in in the Watts Building, on the first floor, or visit the AR website: https://www.tcd.ie/academicregistry/
Queries can be emailed to academic.registry@tcd.ie, or you can telephone 01 896 4500 during office hours.

Student Accommodation

CAMPUS: The Accommodation Office is open Monday to Friday from 8.30am to 1pm and 2pm-5pm each day. Queries can be emailed to residences@tcd.ie, or you can telephone 01 896 1177 during office hours.

After hours you can contact Front Gate at 01 896 3978 in case of difficulties or key problems. In Goldsmith Hall attendants are on duty in the residential area at weekends and overnight and they will assist with local problems.

In the event of a serious emergency, particularly where you require the attendance of ambulance, fire or police services please telephone College Security at 01 896 1999 (internal 1999). To ensure a co-ordinated response please do not call these services directly. We recommend that you programme these numbers into your mobile phone using the prefix “01” before the number. https://www.tcd.ie/accommodation/

Appendix 1

Item	Reference/Source
Statement on General Regulations	Calendar, Part II, General Regulations and Information, Section II, Item 12 Calendar, Part III, GeneralRegulations, Section I
Student Supports Co-curricular activities TCDSU, GSU & student representationstructures	Student Supports
Emergency Procedures	**Standard Text:** In the event of an emergency, **dial Security Serviceson extension 1999** Security Services provide a 24-hourservice to the college community, 365 days a year. They are the liaison to the Fire, Garda and Ambulance services and all staff and students are advised to alwaystelephone extension 1999 (+353 1 896 1999) in case of an emergency. Should you require any emergencyor rescue services on campus, you must contact Security Services. This includes chemical spills,personal injury or first aid assistance. It is recommended that all students save at least one emergency contact in their phone under ICE (In Case of Emergency).
Data Protection	Data Protection for StudentData
Research Ethics	Policy on Good ResearchPractice
Key Locations for students: Include Programme Offices, Laboratories, Online Learning Environments, Libraries, AcademicRegistry, Places of Faith/Prayer Rooms, Photocopiers and any relevant introductory information on these locations	Blackboard Academic Registry

Item	Reference/Source
Plagiarism &Referencing Guidance	Calendar, Part B, General Regulations and Information Calendar, Part III, General Regulations & Information, Section I 'Plagiarism' Plagiarism Policy
Health and Safety Statements	Faculty of Science Engineering, Mathematics and Science website - https://www.tcd.ie/stem/undergraduate/health-safety.php
Foundation Scholarships	Calendar, Part II, Foundation and Non-FoundationScholarships
Absence fromExaminations	Calendar, Part B, General Regulations and Information Calendar, Part III, Section III,'Examinations, Assessment and Progression' Academic Policies
Reference to Relevant University Regulations	Academic Policies Student ComplaintsProcedure Dignity and Respect Policy - Equality, Diversity and Inclusion | Trinity College Dublin (tcd.ie)
May include Programme Offices, Laboratories, Online Learning Environments, Libraries, Academic Registry, Places of Faith/Prayer Rooms, Photocopiers and any relevant introductory information on these locations	Blackboard Academic Registry
Timetable for students	My TCD
Internships/ Placements forCredit	Internship and PlacementPolicy.
Programme Architecture	Trinity Education ProgrammeArchitecture and Pathways

Item	Reference/Source
Marking Scale	Calendar, Part B, General Regulations and Information
Progression Regulations	Calendar, Part II, General Regulations & Information Calendar, Part II, Part C Calendar, Part III, Section III 'Examinations, Assessment and Progression' and 'Assessment and Progression Regulations'
Awards	National Framework forQualifications Trinity PathwaysTrinity Courses
Professional andStatutory Body Accreditation	Provided by School/Discipline Handbooks where applicable
Careers Information &events	https://www.tcd.ie/Science/careers/
External Examiner	Procedure for the transfer ofstudents assessed work to external examiners
Capstone (UG Programmes)	Capstone website Policy on Good ResearchPractice
Attendance Requirements	Calendar, Part B, General Regulations and Information Calendar, Part III, General Regulations and Information, Section I 'Attendance and Off-Books'; Section II 'Attendance'; Section III 'Attendance, Registration, Extensions'; Section IV 'Attendance and Examinations'
Feedback andEvaluation	Student Evaluation andFeedback Student Partnership Policy Procedure for the conduct ofFocus Groups