

Master of Science

Environmental Sciences



Course Handbook 2023/2024



University of Dublin, Trinity College

CONTENTS

Introduction	3
Staff	4
Administrative Staff	4
Module Coordinators	5
Other Teaching Staff	7
Course Aims	7
Requirements & Expectations	7
Course Structure	8
Course Modules	9
Assessment and Examination Procedures	17
Health, Safety and Security	21
Contact Details	25
Useful Numbers	26
Outline Course Structure	27

In the event of any conflict or inconsistency between the General Regulations published in the University Calendar and information contained in course/departmental handbooks, the provisions of the General Regulations will prevail.

INTRODUCTION

Many environmental education initiatives took place during the early 1970s following the 1972 United Nations Conference on the Human Environment held in Stockholm (known universally as the *Stockholm Conference*). The United Nations Environment Programme (UNEP) was one product of the Stockholm Conference that was later to play an important role in stimulating and co-ordinating education initiatives (see www.unep.org). In the years that followed, many environmental education courses were developed in universities and colleges throughout the world and by the early 1980s environmental training and education had become an important topic of debate. The year 1983 was another important milestone in the development of environmental training and education because in that year the Secretary General of the United Nations established the World Commission on Environment and Development (WCED). The WCED published *Our Common Future* in 1987, which brought to widespread attention the concept of sustainability. In this report the importance of interdisciplinary environmental education was stressed and shown to be the key mechanism towards the goal of a sustainable world. In 1989 the UN resolved to hold a conference on environment and development, the Earth Summit. It is significant that environmental education and training was also an important topic for discussion at the first Earth Summit in 1992, 20 years after the Stockholm Conference. At the Earth Summit the Global Forum of Non-Governmental Organizations promoted Agenda 21, which included the statement “*Governments should strive to update and prepare strategies aimed at integrating environment and development as a cross-cutting issue into education at all levels*”.

In the late 1970s the Irish Government responded to the call from UNEP to set up courses for environmental protection in Europe, an area new in Ireland. Trinity College was invited by the Higher Education Authority (HEA) in 1977 to provide a postgraduate research centre for Environmental Science that would offer not only a strong research base but also suitable training and qualifications for those who would have to implement the new legislation from Europe. Prof. W.A. Watts, supported by the heads of the Science Departments, developed the first interdisciplinary teaching and research centre in the country. The Environmental Sciences Unit was officially opened in October 1979, although the MSc Environmental Sciences course first ran the following year when staff and the Unit laboratory moved into the premises at 188-189 Pearse Street. The HEA initially funded three lectureships on a permanent basis, two permanent and one permanent contract position to be renewed every three years to ensure that the Unit retained the flexibility in teaching required within the changing needs of the State, an innovative idea at the time. The staff were increased by a further three posts in the late 1980s to give the Unit a broader academic base. In the late 1990s the Science Faculty made radical changes to the structure of the Unit, which had become too large to remain in its original form. Staff were allocated to existing Departments and the Unit was replaced by a more flexible structure serviced through College Departments. The Centre for the Environment was set up in October 1998, and managed the MSc Programme until 2005, when a further restructuring brought the course to its current home in the School of Natural Sciences.

The MSc programme was the first environmental science course in Ireland. Course graduates have been instrumental in the development of environmental protection and management in Ireland, with many early graduates now holding senior Government and European posts. More recently the Irish Environmental Protection Agency has also been a major employer of course graduates, although our graduates have found employment throughout the world. For example, a number of our graduates work for the US Environmental Protection Agency and many graduates have contributed significantly to the development of environmental consultancy in Ireland and abroad. The course has always attracted students from overseas and this provides an important contribution to the experience that students bring to the course.

The course has changed continuously over the years responding to the needs of both students and employers. No two years are the same. However, the key concept of the course has remained unchanged: to produce environmental scientists with an interdisciplinary background able to tackle the broadest range of environmental protection issues. As new members of the MSc Environmental Sciences course we hope that you will play your part in creating a safer and more sustainable environment for all.

ADMINISTRATIVE STAFF

Course Director

Dr Juan Diego Rodriguez-Blanco

Email: rodrigjd@tcd.ie

MSc Teaching Assistant

Dr Jean Wilson

Email: jewilson@tcd.ie

Executive Officer

Ms Emma Leahy

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Safety Officer

Ms Alison Boyce

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MODULE CO-ORDINATORS

Dr Eyad Abushandi (e.abushandi@tcd.ie) is an Assistant Professor in Hydrology. His research interests include surface hydrology and flood modelling for arid and semi-arid areas. In addition, he applied different hydrologic models to understand the impact of climate change and human fingerprints on increasing flood events and shoreline erosion. He participated in many hydrology related projects as Principal Investigator, Co-Principal Investigator, or Consultant in Jordan, Germany, Saudi Arabia, and Oman. Furthermore, he continuously participates in organizing international research conferences. He coordinates two modules for the MSc programme namely: ES7043: Hydrology and Groundwater Quality, and ES7049: Practical Environmental Skills

Dr Quentin Crowley (crowleyq@tcd.ie) is an Associate Professor in Geology, and Director of the Trinity Centre for the Environment. His current research interests include Earth System change, systems innovation, environmental geoscience, and environmental contaminants. He collaborates widely on a number of projects with geologists, geographers, environmental scientists, archaeologists, statisticians, epidemiologists, engineers and material physicists. Quentin co-ordinates modules ES7057: *Environmental Entrepreneurship*.

Dr Andrew Jackson (a.jackson@tcd.ie) is an Assistant Professor in Zoology. His research interests centre on understanding ecological systems and processes from an evolutionary perspective via the use of computational / mathematical models. His primary areas of interest are behavioural ecology and community ecology, but he has also published in areas of conservation biology, virology and epidemiology. In addition, he develops Bayesian statistical tools for ecologists, such as stable isotope mixing models. Andrew co-ordinates the module ES7042: Data Handling and Analysis.

Dr Sean McClenaghan (mccleens@tcd.ie) is an Associate Professor in Economic Geology in the Department of Geology. Sean's research focuses on dissecting ore deposit systems through the application of bulk geochemical and advanced micro-analytical techniques. Much of this research has centred on the mineralogy and residence of precious metals and energy critical elements in sulphide and gangue minerals from ore deposits as well as waste tailings. Sean coordinates the module ES7028: *Resource Development and Environmental Management*.

Dr Jeremy J. Piggott (jeremy.piggott@tcd.ie) is Assistant Professor in Aquatic Biology. His research focuses on several topical themes in fundamental and applied ecology, including the determinants of biodiversity structure and function from genes to ecosystems, the combined influence of multiple anthropogenic stressors on communities and ecosystems, and the management and conservation of biodiversity and ecosystem services in the face of global change. Jeremy coordinates module ES7056 Environmental Monitoring.

Dr. Juan Diego Rodriguez-Blanco (rodrigid@tcd.ie) is an Ussher Associate Professor in Nanomineralogy. Juan Diego's fields of research are environmental mineralogy and crystallisation. His research focuses on mineral genesis and the interaction of aqueous

species with mineral surfaces. In particular, he studies the mechanisms of mineral nucleation and growth and the interaction of common seawater ions, pollutants and organics with mineral surfaces and their relevance to global-scale processes like biomineralisation, biogeochemical element cycling and the evolution of the global chemistry of the oceans. Juan Diego is the Director of this MSc program and coordinates the module *ES7001: MSc Environmental Sciences Induction Week*.

Dr Micha Ruhl (ruhlm@tcd.ie) is an Associate Professor in Sedimentology in the Department of Geology. Micha completed his BSc, MSc and PhD in Earth Sciences at Utrecht University, Netherlands. He has held post-doctoral research posts at the University of Oxford, University of Copenhagen and the Geological Survey of the Netherlands. His research interests centre on understanding the processes that govern the earth system on land and in the oceans, and through time. In his research, Micha applies Sedimentology, Integrated (chemo-, bio-, cyclo-, magneto) Stratigraphy and Low-Temperature Geochemistry to study a diverse range of topics related to Palaeoclimatic & -environmental Change, Mass Extinctions, and (changes in) Depositional Environments. Micha coordinates the module *ES7055: Earth System Science – Deep Time*.

Dr Jean Wilson (jewilson@tcd.ie) is a Postgraduate Teaching Fellow for both the MSc in Environmental Science and the MSc in Biodiversity and Conservation. Jean's research interests centre on environmental applications of remote sensing, GIS and spatial analysis, specifically in the context of water resources monitoring and management. Her work has been funded since 2009 under the EPA STRIVE initiative. She has developed novel methodologies in the application of thermal remote sensing and geochemical tracing techniques for localising and assessing groundwater discharge to lakes and coastal waters nationally. In addition to teaching the GIS course as part of *ES7051: Introduction to Environmental Science*, Jean coordinates the MSc modules *ES7059 Desk Study*, *ES7027: Practical Environmental Assessment* and *ES7058: Project Planning*.

OTHER TEACHING STAFF

Several staff contribute their expertise to the course via the supervision of research projects and the ES 7059: *Desk Study* module. In addition, you may contact staff within the School of Natural Sciences regarding projects related to their research interests. See the School research webpages for details (<http://www.tcd.ie/naturalscience/>), as well as the research pages of the individual staff / disciplines.

COURSE AIMS

- To promote an understanding of environmental science, and the capability to apply that knowledge to current environmental issues and sound environmental management.
- To develop the necessary intellectual skills and practical expertise to design and execute high quality independent research.
- To cultivate skilled communicators who are proficient in organizing thoughts and ideas and disseminating them effectively through written and oral presentations.

REQUIREMENTS & EXPECTATIONS

Prompt attendance for all taught components, including practicals and fieldwork, is a requirement of this course. Prior permission for absence should be sought *in writing* from the module co-ordinator.

Some modules, and many projects, will require field work. Please ensure you have read the safety guidelines (circulated during the induction week and available online at www.tcd.ie/Buildings/Safety/safetyhealthandwelfare.php) and are always equipped for bad weather. Suitable footwear and adequate food supplies are vital components of being in the field. In addition to attending a safety briefing, you are required to complete health and safety forms during induction week.

*****IMPORTANT – THIS IS A FULL-TIME COURSE*****

This is a post-graduate qualification and therefore contains a considerable component of independent study (student centred, self-directed learning). It is vital that you effectively manage the time spent outside of classes. The course structure assumes a nominal 40 to 50 hour week, although there will inevitably be some variability of workload throughout the year. This is especially the case as enrolled students usually come from a wide range of backgrounds with diverse skills and knowledge. This diversity (and the breadth of Environmental Science as a subject) may mean that you are unfamiliar with some basic concepts during the course. This will require extra reading for familiarisation of subjects that you may not have studied previously.

Please note that certain components of the course (e.g. seminars or field trips) may occasionally involve evening or weekend work, so please consult your timetables carefully. **IMPORTANT: non-attendance due to paid employment is not an acceptable excuse or mitigating circumstance!**

COURSE STRUCTURE

This is a one year, full-time postgraduate qualification that will lead to a Master of Science in Environmental Sciences. As part of the Bologna Process, Trinity College ascribes credit to taught courses using the European Credit Transfer System (ECTS). This course is worth **90 ECTS**. *One ECTS is equivalent to 20-25 hours of student input, and therefore includes formal contact time (e.g. lectures), independent study, research, assessment exercises, revision etc. In this way, 2 ECTS is nominally about one week of work.*

Taught Component

The taught component of this course comprises formal lectures, seminars, laboratory and desk-based practical work, fieldwork and independent study.

The course commences with a compulsory *Induction Week* which commences Monday 18th September. This is preceded by a college-wide post-graduate orientation week (11th-15th September), which is aimed at students new to TCD and perhaps new to Ireland.

This MSc program includes **NINE TAUGHT MODULES** (see *Taught Modules* for details).

In addition, there is an individual *Desk Study* module worth **5 ECTS** (see *Desk Study* for details) and a *Project Planning* module worth **10 ECTS** (see *Project Planning* for details). The combined taught component of this course comprises **60 ECTS** (equivalent to a postgraduate diploma).

Module Delivery

Most taught modules in this course are three week blocks (see timetable). This provides a concentrated period of uninterrupted study, during which time students can immerse themselves in the subject matter and ensure they have addressed any gaps in their knowledge. Assessment for each module will usually take place during these blocks unless otherwise stated in the module outline.

Trinity College encourages use of Blackboard teaching and learning software. To access Blackboard Learn 9.1 please go to <http://mymodule.tcd.ie> and enter your College username and password to login. For tutorials please visit the On Demand Learning Centre for Students <http://ondemand.blackboard.com/students.htm>. Please consult with your module coordinator to check if they are actively using Blackboard for their module(s) on this course.

Timetabling

A general timetable for the course is included at the back of this handbook. Detailed timetables for each module will be circulated prior to the start of each teaching term. Timetables are subject to change, so please check carefully all email correspondence from module co-ordinators.

Research Project

To complete the MSc degree programme a candidate must design and execute an individual research project. This project is worth **30 ECTS**.

Further details concerning choice and design of the project along with requirements for the final dissertation will be given to you in the '*Project Planning*' module.

COURSE MODULES

ES7001: Induction Week

Co-ordinator: Dr Juan Diego Rodriguez-Blanco

Description: This is the initial week of the course, and is part of ES7051 (see above). A week of seminars, activities and a fieldtrip is designed to introduce the course, the staff, the College and some current environmental issues.

Learning Outcomes

On successful completion of this module, you will:

- Understand course structure, delivery, requirements and expectations;
- Be familiar with College facilities including the library and centre laboratory;
- Be aware of health, safety and risk assessment requirements;
- Be able to outline current environmental issues and related research interests within College;
- Demonstrate basic scientific skills in the field.

Assessment: Attendance, participation and satisfactory completion of all requirements (100%)

ES7051: Introduction to Environmental Sciences

Co-ordinator(s): Dr Jean Wilson

Credit: 5 ECTS

Description: Apart from ES7001 *Induction week* (see below), this module includes a two week course as a practical introduction to the fundamental principles, methods, techniques and tools in GIS for spatial analysis including spatial data management and visualization and their application in environmental science. This is a hands-on GIS course and students are expected to be in attendance each day to work through the practical learning material and complete assignments. Students are required to bring 1) a portable hard drive device (eg. usb key) with at least 2GB of storage and 2) a hardback notebook (GIS journal) to class.

Learning Outcomes

On successful completion of this module you will:

- Understand the key components of a GIS and fundamental concepts that underlie use of spatial data within a GIS for environmental science applications
- Use GIS tools and methods as a research aid for visualisation (mapping) and spatial analysis
- Understand the value and limitations to the use and application of publically available multidisciplinary geospatial datasets in research
- Apply GIS techniques to environmental science

Assessment: Satisfactory completion of practical exercises; GIS theory test (short answer questions) and a GIS skills test (practical exam) at the end of the module.

ES7059: Desk Study

Co-ordinator(s): Dr Jean Wilson

Credit: 5 ECTS

Description: An independent, desk-based review of literature relating to a current topic of relevance to the environmental sciences. A list of proposed topics will be circulated in the first term. There is also an opportunity for students to select a study of their choice in negotiation with the Course Director and other member of staff. Desk study topics should not significantly overlap with proposed research project topics.

Learning Outcomes

On successful completion of this module you will be able to:

- Search, identify and collate academic and related literature using library and on-line resources;
- Critically analyse research, and identify key themes, areas of consensus / debate, and gaps in existing knowledge;
- Synthesise this information in a concise, logically structured review that is clearly presented and correctly referenced;
- Summarise your project in a brief oral presentation to a non-specialist audience.

Assessment: Written report of c. 6,000 words (75%); Oral presentation (25%)

ES7043: Hydrology and Groundwater Quality

Co-ordinator: Dr Eyad Abushandi

Credit: 5 ECTS

Description: this module covers theoretical concepts and analytic practices of catchment hydrology and groundwater quality. Topical areas include: the hydrologic cycle and water balances, surface water flow, field measurement techniques, flood risk

management practices, surface water - groundwater interactions, groundwater flow, and quality characterization. The module involves computer demonstrations to conduct statistical and geo-spatial hydrologic analyses. As an integral part, the module provides a framework of writing structured scientific reports.

Learning Outcomes

On successful completion of this module, you will:

- have an understanding of hydrological processes
- have some practical experience of hydrological data collection techniques e.g. river flow measurement
- be familiar with groundwater quality problems in both rural and industrial settings
- be able to evaluate groundwater vulnerability to pollution, understand and use groundwater protection schemes and appreciate their data requirements
- have practical experience of techniques used to investigate agricultural impacts on groundwater

Assessment: Individual reports (80%), Oral presentation (20%).

ES7056: Environmental Monitoring

Co-ordinator: Dr Jeremy Piggott

Credit: 5 ECTS

Description: This module covers the tools and sampling approaches used to characterize and monitor the quality of the environment. Techniques encompass the collection and analysis of chemical and biological samples and their application to environmental quality indices. Students will have the opportunity to apply the techniques to a range of sample types, such as those collected from sediments and waters. Techniques include both traditional and novel methods being applied in environmental monitoring programs across Europe, with a particular focus on those associated with the Water Framework Directive Monitoring Programme.

Learning Outcomes

On successful completion of this module you will be able to:

- Explain the tools and sampling approaches used to characterize and monitor the quality of the environment;
- Select appropriate procedures for the collection and analysis of environmental samples (chemical and biological samples);
- Carry out a range of analysis procedures in the field and laboratory;
- Present and interpret results of chemical/biological analyses and application to relevant environmental quality indices.

Assessment: Continuous Assessment (100%)

ES7042: Data Handling and Analysis

Co-ordinator: Dr Andrew Jackson

Credit: 5 ECTS

Description: This module outlines the principles of data collection, coding and analysis within the context of research design, and provides a firm quantitative base with particular relevance to the research project. It includes an introduction to types of data, how data can be described statistically, and a series of methods used for extracting information from complex datasets. It also includes practical examples and illustrations of statistical applications to real-world research projects. The software R will be used throughout owing to its ubiquitous application in ecology and environmental science, and as a transferable skill in data analysis more generally.

Learning Outcomes

On successful completion of this module you will be able to:

- Explain the central importance of data collection and analysis in effective research design
- Use data visualisation techniques to describe patterns in data and inform subsequent analyses
- Employ hypothesis-testing in research design
- Perform routine data manipulation and analysis using the statistical software package R
- Analyse datasets using the framework of Generalised Linear Models
- Identify appropriate statistical methods to employ for a range of research projects.

Assessment: Continuous assessment (100%)

ES7055: Earth System Science – Deep Time

Co-ordinator: Dr Micha Ruhl

Credit: 5 ECTS

Description: This module covers the scientific basis necessary to understand environmental and climate change through Earth history. Topics include an introduction to the Earth's timescale, evolution of the early Earth, the role of plate tectonics and volcanism in Earth system science, weathering and environmental chemistry in the Archean, evolution of the atmosphere, extreme environmental change, mass extinction events in Earth history and causes and consequences of major glaciation events. The module provides the tools to read and comprehend the scientific literature relating to environmental change throughout geological time. A series of computer based problem solving practical classes will introduce the topic of radiogenic isotopes and geochronology. Lectures on specific topics, their wider consequences and practical significance will be developed through whole class discussions.

Learning Outcomes

On successful completion of this module you will be able to:

- Give a detailed account of environmental major events in early Earth history.
- Understand the significance of the Archean sedimentary record in relation to evolution of the Earth's atmosphere.
- Give an account of the chemical and isotopic information archived in Precambrian sediments.
- Explain complex interactions between plate tectonics, mountain uplift, weathering and climate.
- Describe how records of past environmental change are constructed and illustrate their applications and limitations with reference to named examples.
- Apply the use of geochronology to critically evaluate the timing and rates of environmental change through deep time.
- Understand how scientific concepts of Earth system science can be used to assess current issues related to climate change.

Assessment: 100% course work (practical based problem solving exercises using chemical and isotopes data and highlighting the use of geochronology in deep time.

ES7027: Environmental Policy

Co-ordinator: Dr Jean Wilson

Credit: 5 ECTS

Description: The overall aim of the module is to introduce students to environmental policy and legislation relating particularly to environmental protection including impact assessment legislation at national and European level. Student learning will take place through lectures, individual and group led research activities.

Learning Outcomes

On successful completion of the module, including attendance at lectures and completion of research activities, students will be able to:

- Demonstrate knowledge of environmental policy and legislation at national and EU levels
- Understand the requirements, legislative background to, and practice of, environmental impact assessment and its implementation in Ireland
- Discuss the environmental regulatory framework within which our society operates

Assessment: Essay (40%); wiki assessment (40%), groupwork presentation and report (20%)

ES7028: Resource Development: Managing Impacts on the Environment

Co-ordinator: Dr Sean H. McClenaghan (mcclens@tcd.ie)

Credit: 5 ECTS

Description: The module will cover the full life cycle of metal and energy resources, detailing the environmental impacts of extraction; the process of smelting and refining; reclamation and decommissioning of mine sites; and the use of resources in modern society. Topics include the form and distribution of natural resources in the earth's crust, geochemical interactions between the lithosphere and hydrosphere, and the mobility of metals in natural waters. Case studies will detail common hazards that are managed by the resource development sector (i.e., acid generation, particulate matter, polluting gases, radiation), as well as industrial disasters with long-lasting effects on the environment.

Learning Outcomes

Upon successful completion of this module students will be able to:

- Explain society's need for natural resources and the environmental impacts of their extraction and end use.
- Identify environmental hazards associated with specific resources in their natural state as well as during the extractive phase of development.
- Design and implement procedures for the monitoring of environmental sites and solutions to mitigate further degradation.

Field Excursions

A field excursion will visit active mining operations at Tara Mines in Navan. Students will be required to produce a comprehensive written report.

Assessment: 100% Continuous assessment: Group presentations – 20%; individual and group reports – 80%.

ES7049: Practical Environmental Skills

Co-ordinator: Dr Eyad Abushandi (and contributions from other lecturers)

Credit: 5 ECTS

Description: This module introduces students to the practical use of field and laboratory skills. It will comprise a series of project-based activities that includes a residential field course based in Almeria, SE Spain. The class will be based in an area with access to a number of different environments and ecosystems, and will be provided with hands-on experience of environmental surveying in a number of regimes. Class led activities may include themes of energy use and production, farming and sustainable land use, water quality, ecosystem services, climate change, life in extreme

environments, earthquake hazards, landscape evolution, carbon sequestration, environmental impacts of tourism, conservation and environmental protection.

Learning Outcomes:

On successful completion of this module, students will be able to:

- Demonstrate field monitoring and research planning skills
- Present field-based studies in a variety of environmental themes
- Be able to synthesise and reconcile conflicting arguments for environmental change and be capable of integrating these arguments into sustainable management plans, incorporating local livelihoods
- Be able to write descriptive accounts of field observations and organize a field notebook, as well as collate & synthesize environmental data in to reports evaluating specific questions related to environmental change.

Assessment: Evening group presentations (30%); individual and group reports (60%), Staff evaluation of engagement (10%).

Individual contribution: The field trip abroad is almost entirely subsidized by the MSc students personal budget. This covers flights and baggage, accommodation and meals, transport on site, consumables and various excursions for all the class and accompanying staff. An individual contribution toward the overall cost will be requested from each student. This amount varies from year to year, depending on class numbers and price fluctuation of services.

ES7058: Project Planning

Module Co-ordinators: Jean Wilson

Credit: 10 ECTS

Description: During this module you will select a research project title. Workshops will be held to guide the development of key project management skills, and to initiate the process of literature review and development of methods in relation to the project. This will all be placed in the context of a grant application submission, related to the project title. The module will involve discussions with members of staff supervising project work.

Learning Outcomes:

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

- Provide the context of a research project, through critical evaluation of published literature, and use this to refine research questions.
- Develop relevant hypotheses to be tested, an outline of the methods used to test these hypotheses, and a realistic time plan for the completion of a project.
- Evaluate the resources required for successful project completion.

- Plan an effective timeframe for project completion.
- Present the project context, research questions, methods and a delivery plan for peer review.
- Develop skills in the preparation of grant applications.

Assessment:

Grant application based on project plan (3000-4000 words) 100%

ES7057: Environmental Entrepreneurship

Module Co-ordinator: Quentin Crowley

Credit: 5 ECTS

This module highlights current priority areas in environmental science and climate change and seeks to enable students to provide innovative solutions to these challenges. Systems Thinking methodologies will be introduced in the first week of the module through a number of collaborative practical exercises. Week 2 will feature a number of site visits and guest lectures, where students can learn about local initiatives. The third and final week will feature development of student-led case studies, analysis of complex challenges, and development of potential solutions to a range of environmental challenges with preparation and delivery of a “pitch” presentation, and submission of a reflective learning report.

Learning Outcomes:

On successful completion of this module students will have:

- A deeper understanding of entrepreneurship, innovation, and environmental challenges.
- An ability to communicate about environmental challenges and solutions.
- An ability to develop and deliver ideas, projects, products and services in response to environmental challenges.
- An ability to work in international and multi-disciplinary groups.
- Practical support by mentoring to explore and realise your own vision for a more sustainable world.
- The tools to take positive action on climate and environmental change.

Assessment: Week 1 in-class exercises 20%

Week 2 in-class exercises 20%

Week 3 in-class exercises and pitch 30%

Individual effort 20%

Reflective Learning Report 10%

ASSESSMENT AND EXAMINATION PROCEDURES

Submission & Deadlines

Assessments must be submitted to the module co-ordinator at the time and date stipulated by them in the timetable. Each assessment must include a title page giving the name of the student, the module title and the date.

It is your responsibility to ensure work is signed for on receipt as a record of submission.

You should keep hard copies of all work that you submit.

Assessments submitted after the deadline will receive a 10% deduction in the final mark for each working day late. Assessments will not be marked if more than two working days late unless by prior, written agreement with the module co-ordinator.

For all submitted work (online or hard-copy) a coversheet must be included and should contain the following signed declaration:

I have read and I understand the plagiarism provisions in the General Regulations of the University Calendar for the current year, found at <http://www.tcd.ie/calendar>.

I have also completed the Online Tutorial on avoiding plagiarism 'Ready Steady Write', located at <https://libguides.tcd.ie/academic-integrity/ready-steady-write> .

More details are given in the section about plagiarism below.

Marking and Feedback

Unless otherwise stated, indicative grades will be circulated within one month of submission (see Table 1 for details). A date and time will also be circulated at which you can collect assessed work.

All assessed work **MUST BE RETURNED** prior to the first Court of Examiners meeting. The deadline for return of work will be circulated during Trinity Term.

Note: these grades are indicative. **All marks are provisional** until passed by the Court of Examiners meeting, which is held after the end of Trinity term.

Module Failure & Re-Submission

Students must undertake **ALL 60 ECTS** of the taught component of this course and achieve a **pass** prior to embarking on the research project. A minimum pass grade must be obtained for both the Project Planning and Desk Study modules in order to progress to the research project.

Failure of taught course components equivalent to **10 ECTS or more** may result

in **FAILURE OF THE COURSE.**

Assessment and Progression Regulations

The following regulations have been simplified from the general regulations for taught post graduate degrees that may be found in the College Calendar (<http://www.tcd.ie/calendar/>) part III that apply in all courses of study leading to the award of a Masters degree or Postgraduate Diploma. Where there is any discrepancy in the information provided below and that in the College Calendar part III, the provisions of the Calendar shall prevail.

1. Graduate students must obtain credit by satisfactory attendance at lectures and tutorials, by carrying out the required course work, and by successful completion of designated assignments. All students are required to attend a *viva voce* examination (can be arranged to take place by Skype). The vivas generally take place in mid-November. The external examiner is Prof. Kevin Hiscock, University of East Anglia, UK.

The final mark is based on a credit-weighted average of the mark awarded in each module.

2. To qualify for the award of the Masters degree, students must, as a minimum and in addition to 1 above:

- (i) achieve an **overall** pass mark (50%) for the credit-weighted average mark for all taught modules taken, and:
- (ii) achieve a pass mark in all modules designated non-compensatable (i.e. **Desk Study, Project Planning**), and
- (iii) achieve a pass mark in the **Research Project**, and
- (iv) either (a) pass taught modules amounting to 60 credits, or (b) pass modules amounting to at least 50 credits and achieve a minimum mark of 40% in any failed module(s).

Students failing to pass taught modules according to 2(iv) above may present for supplemental examination or re-submit required work within the duration of the taught component of the course, **if and as provided for in the course regulations**; if satisfactory, resubmitted work will be graded at 50%.

Students who, following the supplemental examination or re-assessment, have failed to pass taught modules according to 2(iv) above will be deemed to have failed overall, and may apply to repeat the course.

Students who have passed taught modules according to 2(iv) above, but who do not achieve a pass mark in the **Research Project**, will be deemed to have failed overall. Such students may apply to repeat the year or may be awarded the associated Postgraduate Diploma.

3. In order to qualify for the award of Masters with Distinction, students must as a minimum, either:

(i) achieve a final overall average mark for the taught component of the course of at least 70% and a mark of at least 70% in the **Research Project**, or

(ii) achieve a mark of at least 70% in the **Research Project**, and achieve an unrounded mark of at least 68% in the overall average mark for the taught modules, where modules amounting to at least half of the credits attaching to the taught modules (normally 30 credits) each have a mark of at least 70%. A Distinction cannot be awarded if a candidate has failed any credit during the period of study.

4. Students who have passed taught modules according to 2(iv) above, but who do not choose to complete the dissertation or research element, may be awarded the associated Postgraduate Diploma.

NOTE: Acceptance of re-submitted work is entirely at the discretion of the course director and module co-ordinator, and will only be considered where serious extenuating circumstances are demonstrable.

Indicative Grade	Provisional Mark (%)
A++	> 85
A+	75-85
A	70-74
B+	65-69
B	60-64
C+	55-59
C	50-54
F	<50

Table 1: Indicative grades and associated provisional mark range for formative feedback. Marks are finalised at the Court of Examiners.

Appeals

The appeals procedure is outlined in Section 1.3.1 in Part III of the College Calendar. Note: Appeals can only be made after the final marks are issued following the last Court of Examiners' meeting.

Plagiarism

Plagiarism is interpreted by the University as the act of presenting the work of others as one's own, without acknowledgement. Plagiarism is considered as academically fraudulent, and an offence against University discipline. The University considers plagiarism to be a major offence, and subject to the disciplinary procedures of the University.

Plagiarism can arise from deliberate actions and also through careless thinking and/or methodology. The offence lies not in the attitude or intention of the perpetrator, but in the action and in its consequences.

It is your responsibility to familiarise yourself with the regulations regarding plagiarism. These are clearly outlined in Section 1.32, in Part III of the College Calendar.

New TCD webpages have been established to help you to understand what plagiarism is and to employ the principles of academic integrity so as to avoid plagiarising (<https://libguides.tcd.ie/academic-integrity>). They also set out the regulations in Trinity relating to plagiarism offences and how they are dealt with. The College Calendar defines plagiarism, gives examples of the kinds of actions that are deemed to constitute plagiarism, and elaborates on the procedures for dealing with plagiarism cases. It is essential that you read the Calendar entry that is relevant to you as an undergraduate or postgraduate student. You should also look at the matrix that explains the different levels of plagiarism and how they are dealt with.

The webpages also contain materials and advice on citation styles which are used to reference properly. You should familiarise yourself with the content of these pages. Your course handbook may also contain specific examples of referencing conventions in your discipline.

All students must complete our Ready Steady Write plagiarism tutorial and sign a declaration when submitting course work, whether in hard or soft copy or via Blackboard, confirming that you understand what plagiarism is and have completed the tutorial. If you read the information on plagiarism, complete the tutorial and still have difficulty understanding what plagiarism is and how to avoid it, please seek advice from your College tutor, your Course Director, your supervisor, or from Student Learning Development.

For all submitted work (online or hard-copy) a coversheet must be included and should contain the following signed declaration:

I have read and I understand the plagiarism provisions in the General Regulations of the University Calendar for the current year, found at <http://www.tcd.ie/calendar>.

I have also completed the Online Tutorial on avoiding plagiarism 'Ready Steady Write', located at <https://libguides.tcd.ie/academic-integrity/ready-steady-write>.

In general, ensure that you fully reference all previously published work, and check with the module co-ordinator if you are not clear of the requirements relating to group assessment exercises. Do not copy information from internet sources or any other sources – you should interpret and explain the information provided in these sources in a format that is relevant to the piece of work you are writing; you should also very carefully appraise the accuracy and validity of any information you use, particularly that from internet sources. Any work submitted may be assessed through recognised plagiarism detection software in use in College.

Health & Safety

Procedures for Health & Safety reporting in College are currently undergoing modification. The following is a description of current practices, but please be aware that it is likely these will be modified during the course of the year. You will be notified of any such change in writing.

All incoming students receive access to the Faculty of Engineering, Mathematics and Science Health and Safety Manual at: <https://ems.tcd.ie/faculty-health-safety.php>

A lab and field Health Declaration Form is available in the Quick Links section of <http://www.naturalscience.tcd.ie/healthsafety/>

This form will be forwarded to all incoming, registered students via email for completion. It must be completed, signed and returned prior to the start of coursework or research. Please read the instructions carefully to ensure you submit the correct portion of the form. Should you have any medical issues, please follow directions given to you by a medical practitioner such as epilepsy, diabetes, fainting fits, haemophilia, immunodeficiency, asthma, severe allergies, balance disorders or other problems that may require special attention from staff. Students will be notified in the event of any changes to this reporting procedure. Likewise if you experience any changes in your health or fitness you must re-submit the Health Declaration Form.

In case of illness, students may attend the Student Health Centre (House 47).

A Student Counselling Service is located just off the main college campus, on the 3rd floor of an office building in South Leinster Street.

See http://www.tcd.ie/Student_Counselling/ for more details.

Accidents

Minor accidents should be treated on site using first aid kits, which are available in all labs, food preparation areas and vehicles. Wall mounted first aid kits will list the first aiders in the department. People should be escorted to the Student Health Centre for treatment if necessary. An ambulance should be called in the event of a serious accident through the security office (01 896 1999). People should not be taken to hospital in a private car or taxi.

All accidents must be reported to the Safety Officer as soon as possible after they occur.

Fire Safety

Fire extinguishers and copies of the College General Fire Notice are displayed at various locations within the Centre. These are normally located in hallways.

Please note, to use a fire extinguisher you must attend the course. Details are given during the Induction Week safety briefing.

Help to prevent fires from starting or spreading by the following:

- Do not store flammable materials in corridors and other open-access areas.
- Exercise caution when using flammable materials and electrical equipment.
- Do not place smouldering items in bins
- Keep filing cabinets and presses closed when not in use
- Turn off and switch off at the socket (or unplug) electrical equipment that is not in use.

All teaching areas in College are equipped with fire alarms. On hearing the alarm, leave the building quickly and in an orderly manner, and proceed to your assembly point. If possible before leaving, turn off all equipment, close windows and doors in the immediate work area.

In the event of fire, inform Front Gate Security Office (1317 or 1999) who will call the fire brigade. All emergency calls must be placed through the Security Office. When the fire brigade arrives, warn firemen of possible missing persons and of potential hazards (dangerous chemicals, gas cylinders and so on).

Bomb Alerts

Watch out for suspicious packages at all times and, if one is observed, alert a staff member immediately. If there is a bomb alert, follow the same procedures as for a fire alert.

Risk Assessment

A risk assessment must be carried out for research activities such as lab work and field work and submitted as part of your Project Planning report. Risk assessment forms are available from the Safety Officer in your discipline.

Ethics Assessment

An ethics assessment needs to be completed before undertaking any research and also needs to be submitted as part of your Project Planning report. Ethical considerations include sensitivity to subjects and confidentiality of data, and any threats or disturbance that might be imposed by, for example, field work. Remember that field work may well disturb sensitive habitats, species or natural features even though these

may not be the direct target of the research. Ethics assessment forms are available from the School Postgraduate Administrator.

Fieldwork

Detailed safety guidelines on fieldwork are available from the School Safety Officer and at <http://www.naturalscience.tcd.ie/healthsafety/> and should be consulted before fieldwork is undertaken. A risk assessment should be completed BEFORE conducting fieldwork. A few of the more important points are listed below and in the Faculty of Science Health and Safety Manual.

- Wear suitable clothing and footwear while carrying out fieldwork.
- Always leave an account of your movements with a reliable person before going out on fieldwork.
- Inform yourself as far as possible on the likely conditions you will encounter while on field work (weather, state of the tide and so on).
- A safety helmet must be worn in situations such as on buildings and building sites, factories, quarries etc. In addition, wear safety glasses if there is a risk of injury to the eyes. A safety harness should be worn in exposed situations where there is a risk of falling (e.g. tops of buildings, cliffs, rafts on water).

Boats

- Lone working is not allowed in boats.
- Do not attempt to operate a boat unless you are suitably experienced.
- A buoyancy aid must be worn when working in small boats.
- Inform yourself of dangers associated with the waters you intend to work on by consulting bathymetric maps and local knowledge.

Diving

Diving may only be undertaken by suitably qualified persons. Rules and regulations governing diving are available from the Dublin University Sub Aqua Club (DUSAC).

Laboratory Work

Safe and sensible practices must be followed at all times in the laboratory. Please read the Safety Statement relating to the discipline where you will be undertaking laboratory work. Any instructions given by a lab staff member must be followed. When working in the a laboratory you must:

- Wear a lab coat and safety glasses (Lab coats are available in the Students Union Shops, No. 6 Front Square and Hamilton Building, East End of College)
- Wear appropriate protective gloves when handling dangerous materials (e.g. acids, sodium hydroxide etc)
- Ensure that the fume cupboard is on when necessary but not otherwise (never turn off the fume cupboard whilst fumes are still being generated, e.g. from hot

digestions).

- Ensure all samples are properly labelled, to include: owner; date; and any other important information such as toxicity, hazard warning etc. **WARNING:** Samples not properly labelled will be thrown out!
- Leave benches clean and tidy, and return used items (chemicals, spatulas, pipettes etc.) to their proper place.
- Dispose of materials safely. Broken glass should be placed in the special bin provided. If in doubt, consult with laboratory staff.
- Report breakages or damage to a member of staff.

When working in a laboratory you must not:

- Use any equipment (e.g. centrifuge etc.) you are unfamiliar with. Check operating instructions with laboratory staff.

NOTE: operation may differ from similar pieces of equipment you have used in the past. Always check before use!

- Carry out potentially hazardous operations (e.g. AA work, digestions, handling concentrated acids or alkalis) while alone in the lab.
- Leave any heating equipment on overnight e.g. ovens, furnace.
- Store samples in the lab. Consult a staff member about storage.
- Consume food or drink.
- Work out of hours unless:

(a) A member of lab staff has signed a Risk Assessment and granted permission for a specified procedure. Permission will only be granted for procedures that carry a very low risk.

AND

(b) A second person is present. AND

(c) You sign in and out of the late working book that is provided.

Security & Access

Valuables should be kept in a secure place. Lockers are provided but the College accepts no responsibility for loss or damage to personal items.

Bicycles are not permitted inside the buildings at any time.

Intruders

Please be vigilant as College premises have been the subject of targeted theft from individuals posing as staff, students, couriers, trades people etc.

Do not tackle any intruders. If you are concerned about a person's presence, inform staff or the security office at Front Gate (1317 or 1999) and if you are alone, leave the building. Take particular care, and keep the main entrance to all buildings locked, outside normal working hours.

Graduate Students Union

The Graduate Students' Union is an independent body which represents graduate students in Trinity College, Dublin. All graduate students of the College, including postgraduate research students, and those on higher degree and higher diploma courses, automatically become members of the Union upon registering with the College. The day-to-day running of the Union is organised by an elected Executive, which consists of the Officers of the Union - the President, Vice-President, Treasurer, Events officer and one Officer from each Faculty - plus three additional Faculty Representatives (one from each of the three Faculties).

The GSU is located on the 2nd floor of House 6 in Front Square. Details of the many activities organised by the GSU can be viewed on the Graduate Students' Union website (<https://www.tcdgsu.ie/>). Contact the GSU at either: president@gsu.tcd.ie, or vicepresident@gsu.tcd.ie.

CONTACT DETAILS

Please ensure that you keep the School Office informed of your contact details (address and phone) during and after the course. Queries relating to a specific module should be addressed in the first instance to the module co-ordinator. General queries relating to the course should be addressed to the Course Director. Computing issues should be directed to the IS Services helpdesk (helpdesk@tcd.ie). Wider issues relating to college procedures and facilities should be directed to Graduate Studies (www.tcd.ie/Graduate_Studies/Local/).

USEFUL NUMBERS

Course Director (Dr J.D. Rodriguez)	Extn. 1691
Emergency Number	Extn. 1999
Front Gate Security	Extn. 1713
Graduate Studies	Extn. 1166
IS Services Helpdesk	Extn. 2000
Safety Officer (Ms Alison Boyce)	Extn. 3506
School Office	Extn. 2920
Student Health Centre (House 47)	Extn. 1556

Outline of Course Structure 2023-24 (subject to modification)

Week	Dates 2023/24 (week beginning)	Dates 2023/24 Week end (Fri)	Environmental Science		
1	28-Aug-23	01-Sep-23			
2	04-Sep-23	08-Sep-23		Induction Week - JD	
3	11-Sep-23	15-Sep-23		ES7051 Introduction to Env Sci - JW	
4	18-Sep-23	22-Sep-23	ES7042 Data Handling		
5	25-Sep-23	29-Sep-23			
6	02-Oct-23	06-Oct-23		ES7028 - Resource Management - SHM	
7	09-Oct-23	13-Oct-23			
8	16-Oct-23	20-Oct-23		ES7059 Desk Study - JW	
9	23-Oct-23	27-Oct-23			
10	30-Oct-23	03-Nov-23			
11	06-Nov-23	10-Nov-23		ES7057 Environmental Entrepreneurship – QC	
12	13-Nov-23	17-Nov-23			
13	20-Nov-23	24-Nov-23			
14	27-Nov-23	01-Dec-23		ES7043 Hydrology and GW Quality - EA	
15	04-Dec-23	08-Dec-23			
16	11-Dec-23	15-Dec-23			Desk study
17	18-Dec-23	22-Dec-23			Christmas Break
18	25-Dec-23	29-Dec-23			
19	01-Jan-24	05-Jan-24		ES7059 Desk Study - JW	
20	08-Jan-24	12-Jan-24			
21	15-Jan-24	19-Jan-24		ES7058 Project Planning - JW	
22	22-Jan-24	26-Jan-24			
23	29-Jan-24	02-Feb-24		ES7055 Deep Time - MR	
24	05-Feb-24	09-Feb-24			
25	12-Feb-24	16-Feb-24			
26	19-Feb-24	23-Feb-24		ES7027 Environmental Policy - JW	
27	26-Feb-24	01-Mar-24			
28	04-Mar-24	08-Mar-24			
29	11-Mar-24	15-Mar-24		ES7056 Environmental Monitoring - JP	
30	18-Mar-24	22-Mar-24			
31	25-Mar-24	29-Apr-24			
32	01-Apr-24	05-Apr-24		Overseas Field Trip	
33	08-Apr-24	12-Apr-24			
34	15-Apr-24	19-Apr-24			
35	22-Apr-24	26-Apr-24		ES7058 Project Planning - JW	
36	29-Apr-24	03-May-24			
37	06-May-24	10-May-24			
38	13-May-24	17-May-24			
39	20-May-24	24-May-24			
40	27-May-24	31-May-24			
41	03-Jun-24	07-Jun-24			
42	10-Jun-24	14-Jun-24			
43	17-Jun-24	21-Jun-24			
44	24-Jun-24	28-Jun-24			
45	01-Jul-24	05-Jul-24			
46	08-Jul-24	12-Jul-24			
47	15-Jul-24	19-Jul-24			
48	22-Jul-24	26-Jul-24			
49	29-Jul-24	02-Aug-24			
50	05-Aug-24	09-Aug-24			
51	12-Aug-24	16-Aug-24			
52	19-Aug-24	23-Aug-24			