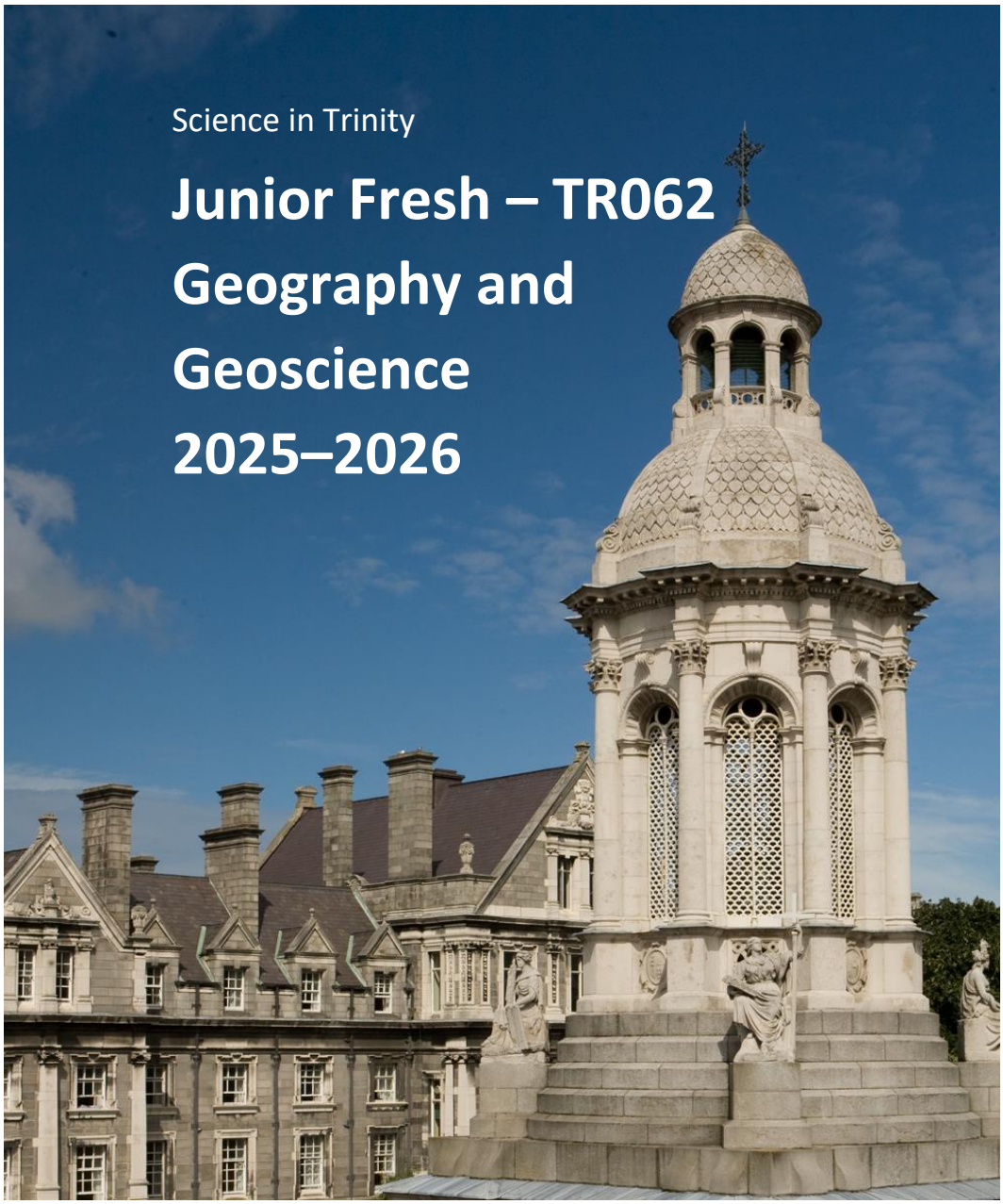
Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin



Science in Trinity

Junior Fresh – TR062 Geography and Geoscience 2025–2026

Contents

Welcome to Science at Trinity

TR062: Geography and Geoscience Introduction

Welcome to Geography and Geoscience at Trinity. Geography and Geoscience is the study of our planet and the people that live on it. This multi-disciplinary programme is designed by leading research scientists in response to critical challenges facing the Earth system and humanity in the 21st century. It integrates knowledge from the physical, chemical, biological, and social sciences to develop novel insights into Earth system function and human-environment interactions.
Our four-year programme, culminating in the degrees of Geography or Geoscience, combines classroom lectures, seminars, laboratory-based practical classes, and outdoor field work to develop the theoretical understanding and technical expertise needed to address applied, real-world problems such as natural resource management and sea level rise.

In years 1 and 2 you will acquire a broad grounding in geography and geoscience with an emphasis on physical geography, geology, and human-environment interactions. You will learn about topical issues such as climate change, natural hazards (e.g., volcanoes, earthquakes, landslides), energy, sustainability, and natural resources. These foundation years cover a diverse range of material including: the origins and development of our planet; earth structure and composition; circulation in the atmosphere and oceans; the evolution of life on Earth; Earth surface processes and environments (e.g., glaciers, rivers, and deserts). In addition to learning about the physical, chemical, and biological processes responsible for creating and shaping the Earth, you will also consider the unique role that humans play in the Earth system, including our impacts on the land, air and water, and the grand challenges linked to environmental governance, policy, and management.

In years 3 and 4, you will deepen your knowledge in specialist areas, while further developing a portfolio of practical and technical skills. The flexible programme structure provides for module choice while retaining coherent curriculum design, thereby ensuring you will be well prepared for entry to the constantly changing job market. Specialist options span the breadth of Geography and Geoscience, allowing you to tailor the course to suit your interests. In this way, you may focus on topics traditionally associated with geography (e.g., geomorphology, globalisation, sustainability) or geology (e.g., volcanology, palaeontology, natural resources), or you may choose to retain a broader, multi-disciplinary perspective that spans the critical interface between science and society.

An important part of your final year of study is the independent research project in which you will undertake an in-depth investigation of a specific topic. This project acts as a catalyst for you to reflect on your learning from the programme as a whole and to demonstrate your ability to think independently, communicate effectively, develop continuously and act responsibly as you transition to the world of work or to postgraduate studies.

My colleagues and I look forward to working with you and hope you will find your time at Trinity enjoyable, challenging and rewarding in equal measure.

Dr Sean McCleanaghan
Director, TR062 Geography and Geoscience

TR062 Geography and Geoscience overview and module selection

Module choices will be made online. Please read the following information on pages 2 and 3 and then go to https://forms.office.com/r/dCQeAaSbTf to select your modules. The forms will not open until the information session is finished, on **18th September at noon,** and it will **close on 19th September at 12.00 hrs.** If you feel that you need assistance with your choices, please contact us at jfsco@tcd.ie and we will be happy to help.

Students must take 40 core credit modules (20 per semester) as follows:

GSU11001	Spaceship Earth: An Introduction to Earth System Science	1	10
GSU11002	Introduction to Geology: A Beginner's Guide to Planet Earth	2	10
GSU11003	The Anthropocene: Constructing the Human Planet	2	10
MAU11001	Mathematics, Statistics & Computation	1	10

Students will choose open modules to the value of 20 credits (10 per semester) from the following:

BYU11101	From Molecules to Cells	1	10
BYU11102	Organisms to Ecosystems	2	10
CHU11101	General and Physical Chemistry	1	10
CHU11102	Introduction to Inorganic and Organic Chemistry	2	10
GGU11006	Human Geography: Exploring the Interconnected World	1	10
PYU11F20	Foundation Physics for Life and Earth Scientists 2	2	10

Moderatorships

In the Junior and Senior Fresh years, TR062 students complete a course of study which will qualify students to compete for places in the following Moderatorships after the Senior Fresh year:

- Geography
- Geoscience

Semester structure

TR062: GEOGRAPHY AND GEOSCIENCE	
CORE MODULES (mandatory) – 20 credits per semester	
SEMESTER 1 – Michaelmas term 15th September to 05 December 2025	**SEMESTER 2 – Hilary Term 19th January to 10th April 2026**
GSU11001: Spaceship Earth: An Introduction to Earth System Science	GSU11002: Introduction to Geology: A Beginner's Guide to Planet Earth
MAU11001: Mathematics, Statistics and Computation	GSU11003: The Anthropocene: Constructing the Human Planet
OPEN MODULES (optional): Students choose 10 credits from each semester	
BYU11101: From Molecules to Cells	BYU11102: Organisms to Ecosystems
CHU11101: General and Physical Chemistry	CHU11102: Introduction to Inorganic and Organic Chemistry
GGU11006: Human Geography – Exploring the Interconnected World	PYU11F20: Foundation Physics

Change of Approved Modules

If, after a couple of weeks, a student feels that they have perhaps made the wrong choice of approved module, they should seek **advice immediately** from a Tutor, Course Director, or the Science Course Office. It may be possible to change from one module to another within your course, subject to permission from the Associate Dean of Undergraduate Science Education. Once a decision has been made to change modules, it should be done **quickly** - it can be difficult to try to catch up with work in a new module when more than two or three weeks of lectures have been missed. Change of module forms are available from the Science Course Office.

TR062: GEOGRAPHY AND GEOSCIENCE – CORE MODULES

GSU11001: Spaceship Earth: An Introduction to Earth System Science

Semester 1 – 10 credits

Contact hours: Lectures = 22 hrs; Tutorials (5 x 1 hrs)
Module coordinator: Professor Robin Edwards (robin.edwards@tcd.ie)

Learning Outcomes

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

- Outline the fundamental concepts of Earth Systems Science with reference to its major subsystems: Geosphere, Biosphere, Atmosphere, Hydrosphere and Anthroposphere
- Illustrate how material and energy are cycled through the Earth system.
- Describe the links between biotic and abiotic systems and their role in maintaining a habitable planet.
- Apply an Earth Systems approach to describe the phenomena of environmental and climate change.
- Discriminate between 'weather' and 'climate' and situate concerns about current climate change in a longer-term (geological) context.
- Identify how human activities modify the Earth System function.
- Apply core concepts in geography and geoscience to real-world examples.

Learning Aims

To provide foundation-level knowledge of:

- Fundamental concepts of Earth systems science and the theoretical basis of the 'systems approach' in Geography and Geoscience
- Character and scope of Earth's principal sub-systems: Geosphere, Hydrosphere, Atmosphere, Biosphere and Anthroposphere
- Composition / structure of the solid Earth (Geosphere) and the principal processes / drivers responsible for its formation and evolution
- Composition / structure of atmosphere and ocean, the physical processes / drivers of their circulation, and the nature of coupling between them
- Weather and climate at a global scale including climate change past, present and future.
- Biogeochemical cycling and the role of interconnected biotic and abiotic systems in the maintenance of life on Earth
- Ecological and historical biogeography including fundamentals of ecology, evolution, and extinction.
- Nature and scope of human impacts on the Earth system including the 'Anthropocene' concept.

To develop the following skills & graduate attributes:

- Digital skills to manipulate and analyse geographical data, including use of Google Earth and Excel
- Self-motivated and reflective approach to independent learning, including completion of assigned reading, activities, and formative assessment.

- Discuss contemporary issues in geography and geoscience in a small group context.
- Conceptual framework that will underpin subsequent specialism in Geography & Geoscience.

- **Module Outlines**

More than 7 billion people now inhabit the Earth, and no corner of the planet is unaffected by human activity. The rise of our species has been fuelled by our ability to access planetary storehouses of energy and employ this to manipulate the environments around us. The global scale of human impacts has led some to suggest we are entering a new era of Earth history - the Anthropocene. Dealing with the effects of environmental and climate change is one of the most significant challenges that our species faces in the 21st century.
This module provides a foundation for understanding global environmental issues by considering the Earth as an interconnected system in which matter and energy are exchanged between the Geosphere, Biosphere, Atmosphere, Hydrosphere and the Anthroposphere. It considers the life-support systems of 'spaceship Earth' and aims to provide a theoretical basis for evaluating the role of humans as agents of climate and environmental change.

Recommended reading lists

- Holden, J. (2017) An Introduction to Physical Geography and the Environment. 4th Edition. Pearson: Harlow, UK.
- Skinner, B.J., Murck, B. (2011) The Blue Planet: An Introduction to Earth System Science. 3rd Edition. J. Wiley & Sons: Hoboken, USA. 656 pages.

Assessment:

(A) End of semester examination: 50% of the module mark. The exam format will be closed book, in-person, fifty multiple-choice questions drawn from across the lecture course.

(B) Coursework: 50% of module mark. In-course activities and associated MCQ quizzes. Details and mark breakdowns will be published in Blackboard.

Contact Details:

Geography and Geoscience
Course Director: Professor Sean McClenaghan — mcclens@tcd.ie, 018961585
Geology Executive Officer
Ms Debora Dias — TR062Admin@tcd.ie
Geography Executive Officer: Ms Helen O'Halloran — geography@tcd.ie

GSU11002: Introduction to Geology: A Beginner's Guide to Planet Earth

Semester 2, 10 credits

Contact hours: Lectures = 26 hrs; Practicals = 18 hrs: Fieldtrips TBC
Module coordinator: Professor Christopher Nicholas (nicholyj@tcd.ie)

Learning outcomes:

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

- Outline the origin and evolution of planet Earth.
- Describe and illustrate the dynamic nature of planet Earth with reference to specific geological processes.
- Describe the origins of life on Earth and list the major evolutionary episodes evident in the fossil record.
- Explain the links between the evolution of life and environmental conditions on planet Earth.
- Outline the geological history of the island of Ireland.
- Make basic geological observations, measurements and interpretations in the field and laboratory.

Learning Aims:

To provide foundation-level knowledge of:

- Fundamental concepts and principal methods employed in the science of geology.
- Planetary origins and evolution of planet Earth
- Rock types, composition, classification, and transformation
- Structure of planet Earth and plate tectonic theory
- The distribution and causes of geohazards (volcanoes, earthquakes, tsunamis)
- Fossil evidence of the origins and evolution of life on Earth
- Geological evidence of past environments and climatic conditions
- Economic geology and the nature of geological resources
- Field and laboratory techniques that will be employed in Geography & Geoscience

To develop the following skills & graduate attributes:

- Written and digital/analytical skills
- Critical thinking
- Effective work as part of a team
- Conceptual framework that will underpin subsequent specialism in Geography & Geoscience

Module content:

From the vastness of space to the microscopic crystal structure of minerals, from events which take billions of years, like galaxy formation, to volcanic eruptions which may last only minutes or seconds. Geology, or Earth Science, is the all-encompassing study of Planet Earth. Geology sets out to investigate the origin and development of the planet, the natural principles that govern it, the processes that act in it, on it, and around it, and finally the life

that has evolved with it. Many sciences are conducted in the laboratory, but to a geologist, the Earth itself is the laboratory.

The module is organised into two main themes. Firstly, we will look at 'Earth in Space'. We live on a dynamic and ever-changing planet, where the surface is constantly being destroyed and renewed. This theme looks at the origin of the Earth, what it's made of and the processes at work, inside and out, which drive this change. The second theme, 'Earth in Time', then focuses on the evolution of the planet over time, and the life that has evolved with it. Earth has been around for just over 4,500 000 000 years, and remarkably, we have evidence that life has existed for at least 3,800 000 000 of those years. There are times in Earth's history when geological events have changed the course of biological evolution. And, perhaps more intriguingly, there are times when life has changed the way the planet operates. So, this theme of Earth and Life evolving together through geological time is illustrated by looking at eight key episodes in Earth's history, without which, we simply wouldn't be here.

Recommended Reading List:

- Nicholas, C. J., 2017. A Beginner's Guide to Planet Earth: Introductory Lectures in Geology. C.J. Nicholas (ISBN 978-1-911180-33-3)

Assessment:

50% Theory Exam; 50% in-course assessment.

Contact Details:

Course Director: Professor Sean McClenaghan	mcclens@tcd.ie 018961585
Geology Executive Officer: Ms Debora Dias	TR062Admin@tcd.ie
Geography Executive Officer: Ms Helen O'Halloran	geography@tcd.ie

GSU11003: The Anthropocene: Constructing the Human Planet

Semester 2, 10 credits

Contact hours: Lectures and seminars = 23 hrs.
Module coordinator: Dr Rory Rowan (rowanro@tcd.ie)

Learning outcomes:

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

- Understand and explain the scientific and cultural significance of the Anthropocene.
- Critically engage with key debates over the Anthropocene that span the natural sciences, social sciences, arts and humanities.
- Identify the major ethical and political questions facing humanity in a time of ecological uncertainty and environmental degradation.
- Connect the Anthropocene with current events and everyday life, particularly as relates to urban sustainability.
- Critical reflect on the production of scientific knowledge, including the importance of the social, historical and institutional context, contested processes of consensus building, and the ways in which science is mediated, both with regard to the Anthropocene and more widely
- Developed their reading skills and capacity to synthesize and build arguments through involvement in group seminars
- Developed their writing skills through writing assignments

Learning Aims:

- Develop core reading skills and capacity to synthesise and build arguments through involvement in small class seminars.
- Develop core writing skills through academic and creative writing assignments.

Module content:

The 'Anthropocene' is a term that has become widely used since Nobel Prize Laureate Paul Crutzen and Eugene Stoermer began popularizing it in 2000. They argued that humans had so dramatically transformed the planet that it was time to pronounce a new geological epoch: the Anthropocene—or, 'the human age.'

Whether the Anthropocene is officially accepted as the designation of a new geological epoch or not, the term has sparked debates and discussions across the natural sciences, social sciences, arts and humanities. The interdisciplinary interest in the Anthropocene demonstrates that the term is more than simply a geological or physical phenomenon; it has complex social, cultural, political, and economic dimensions.

From plastic-filled oceans to species extinction, there is little doubt that human activities are making their mark on the planet. The staggering scale and profound consequences of human activities on the environment raise a series of questions we will consider together. What are the underlying drivers of these environmentally damaging activities? Do we all bear equal responsibility? Who is being affected most? Are solutions to be found in technological engineering or do we need more radical social, cultural and political transformations? Why has action on the environment been so ineffective to

date, and where can we identify signs of hope for a better future? This module covers these questions and more by engaging ideas and perspectives from the natural sciences, social sciences, arts and humanities.

Recommended Reading List:

- Ellis, E. (2018) The Anthropocene: A Very Short Introduction. Oxford: Oxford University Press.
- Lewis, S., & Maslin, M. (2018) The Human Planet: How We Created the Anthropocene. London: Penguin Books.

Assessment:

The assessment will consist of a single 2-hour examination to be held during the Spring examination period. The date for the exam is yet to be determined, but students will be informed of this in class, via Blackboard, and via the Course Coordinator, as well as through the Examinations Office.
Students will be expected to answer two questions: one question relevant to the first section of the module (the Anthropocene) and one question from either the second section (the Ancient Anthropocene) or the third section (the Urbanocene). Each of the two questions answered will be worth 50% of the module mark.
Students eligible can sit the examination in the reassessment session.

Module Breakdown:

Contact Hours (Lectures = 20 hours; Seminars = 16 hours); Additional Input (Lecture/Seminar Preparation = 80hrs; Coursework preparation = 85hrs) TOTAL = 201hrs.

Key texts:

Class readings are given each week, but the assigned text for the module as a whole is Lewis, S., & Maslin, M. (2018). *The Human Planet: How We Created the Anthropocene.* Penguin Random House.

Module Breakdown:

Each student has 9 hours of lectures and 5 hours of seminars.

Contact Details:

Course Director: Professor Sean McClenaghan	mcclens@tcd.ie 018961585
Geology Executive Officer: Ms Debora Dias	TR062Admin@tcd.ie
Geography Executive Officer: Ms Helen O'Halloran	geography@tcd.ie

MAU11001: Mathematics, Statistics and Computation

Semester 1, 10 credits

Module learning aim:

The students should be enabled to use maths and statistics as tools to solve problems in their scientific discipline, like finding maxima or minima of functions, solving (matrix) difference equations, and performing a basic statistical analysis of a data set, aided by the computer language R. When using R and predefined R-functions, students should be in the position to understand the underlying principles., for example how confidence intervals are obtained from integrals of probability density functions. The relevant sciences will help these aims by emphasising the role of mathematical and statistical methods in the context of their respective disciplines.

Module learning outcomes:

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

- Use graphs of functions in the context of derivatives and integrals.
- Compute derivatives and equations of tangent lines for graphs of standard functions, including rational, trigonometric, exponential, and logarithmic functions.
- Compute definite and indefinite integrals using substitution and integration by parts.
- Solve maximisation/minimisation problems using the first derivative test and other applied problems based on population dynamics and radioactive decay.
- Algebraically manipulate matrices by addition and multiplication and use Leslie matrices to determine population growth.
- Solve systems of linear equations using Gauss-Jordan elimination.
- Calculate the determinant of a square matrix and use Gauss-Jordan elimination to determine a matrix inverse.
- Find the eigenvalues and the eigenvectors of a given square matrix.
- Learn the basic ideas of descriptive statistics, types of variables and measures of central tendency and spread.
- Recognise common discrete and continuous distributions and how these naturally arise in life science examples.
- Extract information from a data set and make inference about a population using ideas of sampling distributions, confidence intervals and hypothesis testing.
- Carry out basic tasks using the statistical software R such as importing, exporting, and manipulating data, analysing and graphing data, loading and installing package extensions, as well as using help files and online resources to either solve error queries or achieve more niche capabilities.

Module content:

- **Calculus part:** functions and graphs, limits, continuity, definition of derivative, rules of differentiation, graphical interpretation of derivatives, optimisation problems, growth, and decay applications, semilog and log-log plots, techniques of integration, differential equations and initial value problems.

- **Discrete part:** limits of sequences, difference equations, discrete time models, vectors and matrices, inverse matrices, determinants, systems of difference equations, systems of linear equations, eigenvalues and eigenvectors, Leslie matrices, matrix models.
- **Statistics part:** numerical and graphical descriptions of data, relationships and linear regression, samples and inference, conditional probability and Bayes' rule, discrete and continuous random variables, sampling distribution, confidence intervals, hypothesis testing.

Recommended reading lists:

- Biocalculus: Calculus, probability, and statistics for the life sciences by Stewart and Day.
- Getting started with R: An introduction for biologists by Beckerman, Childs, and Petchey.

Methods of Teaching and Student Learning:

9 weeks of teaching with 5 lectures, 2 tutorials, and 1 computer practical per week, 1 or 2 lecturers from the School of Mathematics

Methods of Assessment:

- This module is examined in a 3-hour examination at the end of Semester 1.
- Continuous assessment contributes 20% towards the overall mark.
- The module is passed if the overall mark for the module is 40% or more. If the overall mark for the module is less than 40% and there is no possibility of compensation, the module will be reassessed as follows:
  1) A failed exam in combination with a passed continuous assessment will be reassessed by an exam in the supplemental session.
  2) The combination of a failed exam and a failed continuous assessment is reassessed by the supplemental exam.
  3) A failed continuous assessment in combination with a passed exam will be reassessed by one or more summer assignments in advance of the supplemental session.

Contact Details:

Module Coordinator: Prof Anthony Brown (Calculus)	E-mail: browna2@tcd.ie
Prof John McDonagh (Statistics)	E-mail: mcdonaj5@tcd.ie
Dr. Nicolas Mascot (Discrete)	E-mail: mascothn@tcd.ie
General enquiries:	E-mail: mathdep@maths.tcd.ie Phone: 01 896 1949

TR062: Geography and Geoscience – Open Modules

BYU11101: From Molecules to Cells I

Semester 1, 10 credits

Module Coordinator: Kevin Mitchell (Email: kevin.mitchell@tcd.ie)

Module Learning Aims

This module aims to introduce students to molecular and cellular biology, including key topics in Cell Biology, Biochemistry, Genetics, and Microbiology. A description of the possible origin of life, from the abiotic world to single-celled and multicellular organisms is given, and the ultrastructure of the prokaryotic and eukaryotic cells is covered in detail. The properties and functions of the major classes of biochemicals found in living systems (carbohydrates, lipids, proteins, and nucleic acids) are described, the structure and function of membranes and organelles, and the chemical basis of metabolism and energy transfer in the cell. Students are introduced to basic concepts in Genetics, how the information contained in DNA (genes) is expressed, replicated, and inherited. Finally, the sheer diversity of life forms, from viruses to prokaryotic and eukaryotic microorganisms, to more complex plant and animal life forms is described. Students also study cell and virus structure, cell growth and viral replication, agents of infectious diseases, and host immunity.

Learning Outcomes

On successful completion of the module, students will be able to:
Provide an account of the cellular basis of life: from its origins in the abiotic world, to the evolution of unicellular and multicellular organisms.
Describe the diversity of life forms: including viruses, prokaryotes (bacteria), archaea, and eukaryotes (unicellular organisms, animals, and plants).
Provide an account of the chemical basis of life and the biochemistry on which living systems depend: the properties and functions of the major classes of biomolecules, the structure and function of membranes and organelles, and the chemical basis of metabolism and energy transfer.
Describe how the information contained in DNA (genes) directs the construction and growth of an organism, and how this information is replicated and transmitted from one generation to the next (inheritance; genetics).
Employ a range of laboratory techniques, demonstrating the development of practical scientific skills, knowledge of experimental design and the interpretation of results.
Apply the scientific method as a fundamental approach to experiment-based investigations, critical analysis of data, and problem solving.

Contact Hours/Methods of Teaching and Learning

Lectures and practical's will be supplemented with information sessions, tutorials and activities that provide guidance in the use of library resources, laboratory health and safety, writing techniques, help with avoiding plagiarism and examination techniques. Sixty-five hours contact time.

Module Content

Lecture Topic	Lecturer	Practicals
Introduction to Module	Kevin Mitchell	
Section 1: Origin of Life – Cellular basis of life – Diversity of Life Forms		
Lecture 1: Cellular basis of life 1	Prof. Luke O'Neill	The Diversity of Life Forms
Lecture 2: Cellular basis of life 2	Prof. Luke O'Neill	
Lecture 3: Cellular basis of life 3	Prof. Luke O'Neill	Liquid Handling
Lecture 4: Origin of life 1	Prof. Luke O'Neill	
Lecture 5: Origin of life 2	Prof. Luke O'Neill	Bacterial Growth & Survival
Lecture 6: The Tree of Life	Prof. Alastair Fleming	
Lecture 7: Bacteria	Prof. Alastair Fleming	
Lecture 8: The Archea	Prof. Alastair Fleming	
Lecture 9: Fungi & Protists	Prof. Alastair Fleming	
Lecture 10: Viruses	Prof. Alastair Fleming	
Lecture 11: Interplay between microbes	Prof. Alastair Fleming	
Section 2: The Chemistry of Life		
Lecture 12: Introduction to Biochemistry	Prof. Ken Mok	
Lecture 13: Nucleotides, amino acids & peptides	Prof. Ken Mok	Enzyme Purification (Chromatography)
Lecture 14: Proteins & protein structure	Prof. Ken Mok	
Lecture 15: Protein function	Prof. Ken Mok	
Lecture 16: Enzymes: the catalysts of life 1	Prof. Vincent Kelly	
Lecture 17: Enzymes: the catalysts of life 2	Prof. Vincent Kelly	Enzyme Characterisation (Kinetics)
Lecture 18: Lipids & membranes	Prof. Vincent Kelly	
Lecture 19: Metabolism & major metabolic pathways 1	Prof. Vincent Kelly	
Lecture 20: Metabolism & major metabolic pathways 2	Prof. Vincent Kelly	
Lecture 21: Mitochondria & respiration	Prof. Vincent Kelly	
Lecture 22: Chloroplasts & photosynthesis	Prof. Vincent Kelly	
Section 3 Biological Information – Genetics, Heredity & DNA		
Lecture 23: Introduction to Genetics	Prof. Matt Campbell	Mendelian Genetics
Lecture 24: Mendelian Genetics	Prof. Matt Campbell	
Lecture 25: Linkage & recombination 1	Prof. Matt Campbell	
Lecture 26: Identification of DNA as hereditary material	Prof. Matt Campbell	
Lecture 27: Quantitative genetics	Prof. Matt Campbell	
Lecture 28: DNA - structure & function	Prof Kevin Mitchell	
Lecture 29: Information flow in the cell - the Central Dogma 1	Prof Kevin Mitchell	

Lecture 30: Information flow in the cell - the Central Dogma 2	Prof Kevin Mitchell	
Lecture 31: Mutation & its consequences	Prof Kevin Mitchell	
Module overview and exam prep	Prof Kevin Mitchell	

Lecture Content:

- **Origin of Life:** What is Life? How did it arise? The Origin of Life from a chemical and cellular perspective; the abiotic world; the prebiotic world; Miller-Urey experiment; the first cell; photosynthesis and oxygen – mass extinction; origin of first eukaryotic cell; multicellular life; cell specialization.
- **Cellular basis of life**: Cell structure – prokaryotes, archaea, eukaryotes - animal and plant organelles & their prokaryotic origin – mitochondria, chloroplasts, mitosis, and meiosis – cell division – regulation of cell division.
- **Diversity of Microbial Life:** the tree of life; bacteria, archaea, fungi & protists, cell structure, morphology, function, and habitat; extremophiles; viruses
- **Relationship between life forms**: the good, the bad and the ugly; concepts of symbiosis and parasites; plant and animal diseases.
- **Structural principles for small molecules**: elements and chemical groups in life, bonds, bond energies, bond lengths; forces between biological molecules and chemical groups; asymmetry; four classes of biomolecules: amino acids, nucleotides, carbohydrates & lipids
- **Nucleotides, Amino acids, and peptides**: DNA, RNA, chromatin and chromosome structure, properties of amino acids, chemical features, and physical properties of the R-groups; the peptide unit and peptide bond
- **Proteins and protein structure**: the concept that shape dictates function; hierarchical organization of protein structure; concept of primary, secondary, tertiary and quaternary structure; introduction to forces that stabilize protein structure.
- **Protein function**: functional classes of protein; introduction to bioinformatics; proteins and evolution; relationships between proteins; similarity and identity.
- **Enzymes:** structure & function; reaction mechanisms; co-factors and vitamins; kinetics; regulation of enzyme activity
- **Lipids and membranes**: lipid structures, fatty acids, phospholipids; membranes, chemical and physical properties, membrane proteins; transport across membranes; concept of compartmentation and membrane traffic.
- **Metabolism & major metabolic pathways**: the starting point: introduction to carbohydrates and fatty acids; organization, energetic principles, key steps, and links between the main metabolic pathways; glycolysis, TCA cycle, beta oxidation; outline of the reversing catabolic pathways, gluconeogenesis, and fatty acids synthesis.
- **Mitochondria & Respiration**: mitochondria, redox reactions, and energy transduction; electron transport and the electron transport chain; oxidative phosphorylation; coupling of oxidations to phosphorylation; chemiosmotic view of energy transduction (in brief).
- **Chloroplasts and Photosynthesis**: chloroplast, architecture and function, overview of the light and dark reactions of photosynthesis.

- **Introduction to Genetics**: an outline of some core concepts from classical genetics to the present; a whistle stops tour of key discoveries in the history of genetics.
- **Mendelian Genetics**: Mendel's laws, the 1st law of segregation and the 2nd law of independent assortment using monohybrid and dihybrid crosses; concepts relating to genetic analysis and the use of model systems; inheritance patterns for single gene disorders - pedigree analysis.
- **Linkage and recombination:** Meiosis and the role of 'crossing over' in gene mapping; a brief recap regarding Mendelian genetics – for example, highlighting that genetic linkage breaks Mendel's 2nd law of independent assortment; outline of key concepts underlying the generation of genetic maps; classical work by Sturtevant / Morgan**.**
- **Identification of DNA as hereditary material**; key experiments establishing DNA as the genetic material; bacterial transformation and its significance (Griffith / Avery, McLeod & McCarthy / Hershey-Chase); the concept of horizontal gene transfer (mechanisms transformation, conjugation, transduction); differences in vertical and horizontal gene transfer.
- **Quantitative Genetics**: an overview of concepts relating to discrete variation versus continuous variation; experiments demonstrating that quantitative traits are inherited, examples of quantitative traits in humans; concepts regarding the use of GWAS to elucidate the genetics architecture of complex traits using an example of one or more disorders.
- **DNA, Structure and Function:** the double helix - discovery of the structure of DNA – DNA composition - DNA replication – semi-conservative replication, replication forks, leading and lagging strand synthesis, DNA polymerases; DNA replication in prokaryotes and eukaryotes.
- **Information flow in the cell - The Central Dogma:** transcription, RNA polymerases in prokaryotes and eukaryotes; promoters, repressors, terminators – the *lac* operon; transcription factors, enhancers; decoding the information in mRNA, translation; ribosomes in prokaryotes and eukaryotes, tRNAs and aminoacyl tRNA synthetases, the genetic code; introduction to the regulation of gene expression – positive and negative regulation.
- **DNA –Mutation and its consequences:** mechanisms by which mutations are generated - including errors in DNA replication; the action of chemical and physical mutagens; errors in chromosome construction and distribution; an outline of the different types of mutation (missense, nonsense, frameshift mutations) and their molecular consequences in relation to gene expression and protein function; mutations causing inherited diseases and cancer; DNA repair – mechanisms of DNA repair, repair deficiency and disease.

Recommended Textbook

Campbell Biology, 12th Edition by Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece (Published by Pearson (2021)

Assessment Details:

1. (A) **End of semester examination: 50% of module mark**. The exam format will be closed-book, in-person, with fifty multiple-choice questions drawn from across the lecture course, 2 hours allowed, negative marking (-0.1) will apply.

2. (B) **Coursework: 50% of module mark.** Coursework includes compulsory attendance at laboratory sessions, assignments associated with practicals, an in-course essay, and MCQ tests of lecture material. Mark's breakdown across the various components will be published in Blackboard.

Further Information

Plagiarism

Students should note that College penalties for plagiarism apply to both examinations and continuous assessment.

Late work

A penalty of 10% deduction in the final mark for every week or part of week late.

Missed classes/assessments

The attendance at all scheduled classes for this module is compulsory. A student who is unable to attend a class for any reason must notify the science course office here of the reason for absence without delay, and present certification as appropriate.

Non-satisfactory reports

Students who have not fulfilled the module requirements with regard to attendance and/or coursework may be reported to the Senior Lecturer as non-satisfactory for one or more terms. Students reported as non- satisfactory for the Michaelmas and Hilary terms may be refused permission to take their formal University assessment sessions and may be required by the Senior Lecturer to repeat the year.

Compensation

Students must obtain an overall module mark of 40% to pass the module.

Contact Details:

Module Coordinator: Kevin Mitchell	kevin.mitchell@tcd.ie
Biology Course Coordinator: Ms Mirela Dardac	mdardac@tcd.ie Phone: 01 8962895
Laboratory Manager: Ms Audrey Carroll	aucarrol@tcd.ie Phone: 01 8961049
Executive Officer: Mr Daniel McCormick	dmccorm2@tcd.ie Phone: 01 8961117

BYU11102: Organisms to Ecosystems I

Semester 2, 10 credits
Module Coordinator: Trevor Hodkinson (hodkinst@tcd.ie)

Module learning aims.

Organisms to Ecosystems I aims to introduce students to the biology of individuals, species, populations, and ecosystems, and explore how humans interact with other living organisms. It covers the developmental biology of organisms, their physiology, brain function and the evolutionary and ecological responses of organisms to their environment. Topics incorporate the diversity of life and its biological development, interactions between organisms and their environment, the biological context of climate change, human impacts on the environment, future food sustainability, urban ecology, ecosystem services and the value and conservation of biodiversity. Topics are arranged in three sections: 1) Multicellularity and Development, Physiology, Behavior and Neuroscience, 2) Evolution: Adaptation, Populations and Biodiversity, and 3) Ecology and Environment.
A mixture of lectures, tutorials and hands-on laboratory practicals are used in the delivery of this module. There will be one - ecology practical - on a field site outside of campus.

Learning outcomes

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

1. Outline the major steps involved in how complex animal and plants are formed and be able to relate the morphological changes that occur to the molecular and cellular changes that underlie and drive embryo and organ development.
2. Describe the concept of homeostasis at the cell, organ, and organism level; give examples of the functional interrelationships that exist between cells, organs, and systems; provide an account of how organisms can sense change in the environment.
3. Describe the basic principles by which the brain functions and outline key experimental steps and informative clinical cases that have elucidated our current understanding of brain function.
4. Recognize the diversity of life on earth and describe how it evolved over geological time scales.
5. Describe the ecological relationships between individuals, populations, communities, and ecosystems, and between organisms and their environment.
6. Recognize how humans can positively and negatively influence other living organisms and their environment and understand the value of other living organisms for humans.
7. Demonstrate practical, numerical, and analytical skills.
8. Collate, synthesize, organize, and present information in written reports.

Contact Hours/Methods of Teaching and Learning

Lectures and practical's will be supported by online resources provided in Blackboard. Essay writing skills will be developed. 65 hours contact time.

Module Content

Lecture Topic	Lecturer	Practicals
Lecture 1: Introduction, objectives and overview	Prof. Trevor Hodkinson	
Section 1 Multicellularity and Development, Physiology, Behaviour and Neuroscience		
Lecture 2: Multicellularity and principles of development.	Prof. Rebecca Rolfe	
Lecture 3: The first steps in building a new organism and how we study development	Prof. Rebecca Rolfe	Development and Floral Morphology
Lecture 4: Building a new organism: establishment of a body plan	Prof. Rebecca Rolfe	
Lecture 5: Cellular differentiation and regulation of gene expression	Prof. Rebecca Rolfe	
Lecture 6: Morphogenesis: generation of structure and form	Prof. Rebecca Rolfe	Physiology
Lecture 7: Form and function	Prof. Áine Kelly	
Lecture 8: Homeostasis	Prof. Áine Kelly	
Lecture 9: Physiological regulation of function	Prof. Áine Kelly	
Lecture 10: Pre-neuroscience history of mind/brain ideas	Prof. Tomas Ryan	
Lecture 11: Fundamentals of nervous system structure and function	Prof. Tomas Ryan	
Lecture 12: Introduction to the biology of memory storage	Prof. Tomas Ryan	
Section 2 Evolution: Adaptation, Populations and Biodiversity		
Lecture 13: Short history of life	Prof. Trevor Hodkinson	First Life
Lecture 14: Fossils, global change and extinctions	Prof. Trevor Hodkinson	
Lecture 15: Selection and the modern synthesis	Prof. Trevor Hodkinson	Diversity of Life
Lecture 16: Species and speciation	Prof. Trevor Hodkinson	
Lecture 17: Speciation	Prof. Trevor Hodkinson	Evolution
Lecture 18: Phylogeny	Prof. Trevor Hodkinson	
Lecture 19: Genetic basis of selection	Prof. Kevin Mitchell	Species Diversity Evolution & Modularity
Lecture 20: Genetic basis of evolution 1: Molecular variation, neutral evolution, molecular clock	Prof. Kevin Mitchell	
Lecture 21: Genetic basis of evolution 2: Population genetics, Hardy Weinberg Equilibrium, Genetic Drift, Selection	Prof. Dan Bradley	

Lecture 22: Genetic basis of evolution 3: Population genetics	Prof. Dan Bradley	
Lecture 23: Human evolution: humans in the tree of mammals, origins of modern humans.	Prof. Laetitia Chauve	
Lecture 24: Summary of key concepts: Q&A	Prof. Trevor Hodkinson	
Section 3 Ecology and Environment		
Lecture 25: Species - Commonness, rarity and population processes	Prof. James Barnett	
Lecture 26: Species - Conservation	Prof. James Barnett	Biodiversity & Ecosystems Services
Lecture 27: Trophic cascades and rewilding	Prof. James Barnett	
Lecture 28: Constructing ecosystems and conservation	Prof. James Barnett	
Lecture 29: Urban ecology	Prof. James Barnett	
Lecture 30: Ecosystem services and natural capital	Prof. James Barnett	Biological Environmental Systems
Lecture 31: Global ecology and climate change	Prof. Jennifer McElain	
Lecture 32: Impacts of Climate Change Biological Niches	Prof. Jennifer McElain	
Lecture 33: Biomes and Global Productivity	Prof. Jennifer McElain	
Lecture 34: Biogeochemical Cycles	Prof. Jennifer McElain	
Lecture 35: Biodiversity Crisis	Prof. Jennifer McElain	
Lecture 36: Summary of key concepts: Q&A	Prof. Jennifer McElain	

Lecture Content:

- **Introduction to development:** core concepts, model organisms, analysis of development; morphology, genetic, biochemical.
- **Embryogenesis and morphogenesis:** germ layers
- **Intercellular communication:** determination, potency, axis formation – anterior-posterior, dorsal-ventral.
- **Pattern formation**: morphogens, gradients, and thresholds.
- **Differential gene expression**: temporal and spatial, master regulators.
- **Form and Function**: functional characteristics of living things; specialisation of cells/tissues/organs to fulfil specific functions.
- **Homeostasis**: the concept of the internal environment; composition, temperature, pH etc. of body fluids; maintenance of homeostasis by cooperation of different physiological systems; feedback and feed-forward.

- **Physiological Regulation of Function**: fundamentals of nervous and endocrine control of function and comparison of speed and modes of action**:** how an individual organism senses and responds to changes in the external and internal environments.
- **Pre-neuroscience history of mind/brain ideas**: cartesian dualism and materialist and non-materialist explanations of mind; the brain as the substrate of mind; the effects of head trauma on behaviour and memory, anatomy of the human/mammalian brain, functions in behaviour and in homeostasis, overview of human brain regions and attribution of various regions to broad functions (evidence from lesions, imaging).
- **Fundamentals of nervous system structure and function**: reticular vs. neuron theory, nervous system as electrically active, Helmholtz and excitable neurons, action potentials & synaptic
  transmission.
- **Introduction to the biology of memory storage:** challenges of integrating neurobiology and brain function at multiple levels; reductionism and correlation vs. causation; the biology of memory storage.
- **Short history of life**: timeline, major groups, diversity.
- **Selection/modern synthesis**:
  adaptation
- **Species**: definitions, taxonomy, diversity, species-rich groups.
- **Speciation**: allopatric, sympatric, adaptation, radiations, key
  innovations.
- **Extinction**: fossils, global change (climate, atmosphere, tectonic).
- **Phylogeny:** homology, convergence, reversals, methods.
- **Genetic basis of selection**
- **Genetic basis of evolution**: molecular variation, neutral theory, drift; molecular evolution of population genetic variation.
- **Human evolution**
- **Global ecology and climate change:** future climate change – global challenges – projections; pest diseases, human physiology, how to predict; need to understand fundamentals of ecology to address these global
  challenges.
- **Biomes, niches:** introduction to biomes, what shapes biome distribution? climate change, climate niches / fundamental versus realized niche; challenge of predicting future ecological responses to climate change
- **Commonness, rarity, and population processes: e**xtinction or persistence are processes that operate at the population level; introduction to concepts of abundance and rarity, competition, dispersal, demography and its application to conservation (endemism and invasions).
- **Conservation:** applications of population biology at the species level, including prioritizing species for conservation management, assessing threat and red listing.
- **Trophic cascades and rewilding:** what is a community**,** energy flow, applications of community ecology to conservation and rewilding challenges; consumption, facilitation & predation.

- **Constructing ecosystems and conservation**: in the Anthropocene humans have constructed new ecosystems, what are they, where do we find them and what are their values? Contrast with "natural" ecosystems.
- **Urban ecology**: how have organisms adapted to living in urban environments? How can we better design our cities and buildings to gain more value from nature and support biodiversity?
- **Ecosystem services and natural capital**: nature provides many valuable ecosystem services supported by natural capital; introduction to the concepts and controversies surrounding the ecosystem services and natural capital concepts.
- **Food: environmental impacts and ecological process**: food security- ecological concepts- productivity- energy flows through ecological systems/basic concepts of biogeochemical
  cycles.
- **Future food and a changing planet**: food security; ecological concepts, human population increase, projections for future productivity.
- **Biosphere feedbacks on climate system**: introduction to biological feedbacks on the climate system; carbon sequestration/ transpiration/ water budget, within biomes; fire feedbacks/rain seeding; nature-based solutions to climate mitigation and adaptation; green and blue solutions – cities etc., 'The Martian' closed system.

Recommended Textbook:

Campbell Biology, 12th Edition by Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece (Published by Pearson (2021)

Assessment Details: Assessment Details:

(A) **End of semester examination: 50% of module mark**.50% of module mark. The exam format will be closed book, in-person, fifty multiple choice questions drawn from across the lecture course, 2 hours allowed, **NO** negative marking will apply.

(A) (B) **Coursework: 50% of module mark.** Coursework includes compulsory attendance at laboratory sessions, assignments associated with practical's, in-course essay and MCQ tests of lecture material. Marks breakdown across the various components will be published in Blackboard.

Further Information

Plagiarism

Students should note that College penalties for plagiarism apply to both examinations and continuous assessment.

Late work

A penalty of 10% deduction in the final mark for every week or part of a week late.

Missed classes/assessments

The attendance at all scheduled classes for this module is compulsory. A student who is unable to attend a class for any reason must notify the science course office here of the reason for absence without delay, and present certification as appropriate.

Non-satisfactory reports

Students who have not fulfilled the module requirements with regard to attendance and/or coursework may be reported to the Senior Lecturer as non-satisfactory for one or more terms. Students reported as non-satisfactory for the Michaelmas and Hilary terms may be refused permission to take their formal University assessment sessions and may be required by the Senior Lecturer to repeat the year.

Compensation

Students must obtain an overall module mark of 40% to pass the module.

Contact Details

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Biology Course Coordinator: Mirela Dardac	mdardac@tcd.ie Phone: 01 8962895
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Executive Officer: Daniel McCormick	dmccorm2@tcd.ie Phone: 01 8961117

CHU11101: General and Physical Chemistry

Semester 1, 10 credits

Rationale and Aims:
To provide a general introduction to chemistry and physical chemistry and equips the student with the knowledge to understand the basic concepts in chemistry, understanding of the building principles of matter, chemical bonding and molecular structure, an introduction to thermodynamics, electrochemistry, acid/base reactions and to the chemistry of liquids, solids, and solutions.

Content Layout

Teaching Week	Topic
1-4 (15 L)	Introduction to General Chemistry • Motivation for studying chemistry; physical states of chemical matter; classification of matter, physical and chemical properties of pure substances and mixtures; extensive and intensive properties; chemical analysis. • Measurements and units; the international system of units; derived units, the reliability of measurements and calculations; significant figures in simple calculations. • Structure and building principles of atoms; element symbols; masses and the mole; introduction to the periodic table; brief introduction to the structure of the electron shell; ionisation energy and electron affinity. • Law of conservation of mass; law of definite composition; bonding in chemical substances; ionic bonding; covalent bonding; weak bonding; molecules and solid-state structures; electronegativity; the periodic table. • Chemical nomenclature of inorganic compounds; stoichiometry; mole, molarity, and concentration; interpreting stoichiometric coefficients; sample calculations. • Chemical reactions; symbolizing reactions; balancing equations; limiting reagents and yields; role of water in chemical reactions; important classes of chemical reactions; precipitation reactions; examples of precipitation reactions in chemistry net ionic equations. • Introduction to acid and base reactions; acid-base titration, • Introduction to oxidation and reduction reactions; oxidation number and electron transfer; oxidizing and reducing agents; half-reactions.

	General Chemistry: Structure, Bonding, and Periodicity • The electronic theory of chemistry: • The spectrum of atomic hydrogen; wave properties of particles; the structures of many-electron atoms. • Orbital energies. • building-up principle. • Lewis structures of polyatomic molecules. • Bond parameters. • Charge distribution in compounds. • Assessing the charge distribution. • Polarization. Ionic and atomic radii. • A survey of periodic properties; Periodicity and trends cross the periodic table; Electronic and physiochemical changes of metals, metalloids, and non-metals across the periodic table. • Periodic nature of ionic and atomic radii, Ionization energy and Electron Affinity, Electronegativity. • The electron-pair bond. Lewis acids and bases. • The Shapes of Molecules. • Valence Shell Electron Repulsion theory. • The arrangement of electron pairs. • Polar molecules. • Hybridization. • A perspective on chemical bonding
5-12 (24 L)	**Introduction to Physical Chemistry** • The ideal gas law. • Kinetic molecular theory of ideal gases • Differences between real and ideal gases • The First Law of Thermodynamics • Internal Energy, Enthalpy and Calorimetry • Cp and Cv, expansion/compression of gases. Adiabatic. • The Second Law of Thermodynamics: entropy • The Carnot cycle. • Gibbs' Free Energy • Chemical Equilibrium • Boltzmann's Factor • Acids-Bases and Titrations • Electrochemistry: Nernst equation, electrochemical potential, galvanic cells, electrolysis • Phases of state

	• Intermolecular forces – origin, distance-dependence, and effect on properties • Structure and packing of solid structures and their properties. • Properties of liquids – viscosity, surface tension, vapour pressure • Water – the universal solvent • Phase transitions and phase diagrams • Thermodynamics and phase transitions • Solutions: liquids in liquids, gases in liquids, solids in liquids • Thermodynamics of solvation • Colligative properties

Reading list/ Indicative Resources

- Chemistry & Chemical Reactivity Hardcover by Paul Treichel, John Kotz, John Townsend, David Treichel; Publisher: Brooks Cole; 9 ed.
- Atkins, P.W. & de Paula, J. (2011) Physical Chemistry for the Life Sciences, 2nd Edition, W H Freeman & Co
- Inorganic Chemistry, by C. E. Housecroft and A. G. Sharpe, Publisher: Pearson, 2018, 5th ed.
- Inorganic Chemistry by Gary *Miessler*, Paul *Fischer*, Donald *Tarr*, Publisher: Pearson, 2021, 5th ed.

Methods of Teaching and Student Learning

A mixture of lectures, tutorials and hands-on laboratory practicals are used in the delivery of this module. The practical sessions are formatted in order to further clarify concepts thus reinforcing learning. A weekly hour of tutorial problem solving activities provides an additional opportunity for the lecturer to assess understanding and gauge the knowledge level of the students.
All lecture notes and problem sheets and a selection of self-assessment quizzes are available for students on Blackboard.

Learning outcomes

On completion of this module the student should be able to:

- Explain, using appropriate terminology and physical units, basic concepts in chemistry, including precipitation and redox reactions.
- Analyse bonding and atomic molecular structure
- Describe the chemical and physical properties of elements as a function of their position in the periodic table.
- Identify, determine, and explain the origin of the trends within groups and across periods of the properties of elements in the periodic table.
- Describe the typical structures of some common compounds of the main group elements.

- Classify elements as metallic/metalloid/non-metallic and contrast their characteristic properties.
- Apply the ideal gas law to calculations of gas properties.
- Describe the principles underpinning the kinetic theory of gases.
- Analyse and identify the main types of intermolecular forces.
- Identify and explain the principal features of the phase diagrams of pure compounds, including pressure dependence of melting and boiling points, triple point and critical point, and variation of vapour pressure with temperature.
- Calculate chemical equilibria and illustrate the key concepts, including variation of components with concentration, temperature, and pressure.
- Discuss simple acid/base chemistry and apply to solution equilibria.
- Illustrate the basic concepts of an electrochemical cell, including half-cell reactions, cell potential and reaction free energy and be able to determine these properties as well as concentration dependence.
- Describe the main classes of the solid-state structure; cubic- and hexagonal close packing; body-centred and face-centred cubic structures. Octahedral and tetrahedral holes, coordination numbers, the Born-Haber cycle, lattice energy.
- Identify, describe, and analyse the factors affecting solubility.
- Define and explain colligative properties, including Raoult's Law and the calculation of molecular weights.
- Understand and apply the concepts underlying the First and Second Laws of Thermodynamics to numerical problems.

Assessment details:
This module will be examined via a combination of in-course assessments (30% of the final mark) and a 3 h examination (70% of the final mark).

Important Note on Examinations, Assessments and Reassessments in the School of Chemistry:

- There is a minimum mark requirement of **35%** in the **Examination** component and the **40% Laboratory** component, in order for a Pass or Qualified Pass mark in this module to be granted. Other components making up fewer marks are not included in this requirement. A mark of less than 35% in the Examination or 40% Laboratory components leads to a Qualified Fail and requires reassessment examination or a repeat of the year.
- There is a maximum mark or cap of 40% on any reassessed component in this module if reassessment is required. The final module mark is calculated based on the reassessed component mark and any already achieved marks for components that did not need to be reassessed, according to the published weightings of these components.
- Re-assessment capping does not apply to deferred 1st attempts at assessment.
- These requirements apply to all students in this module.

- For more details, see the section on 'Progression Regulations applying to Chemistry modules' under the 'Progression and Awards' within this booklet.

Contact Details:

Course Director: Professor Mike Southern — southerj@tcd.ie

Phone:01 896 3411

Coordinator of Fresh Teaching: Dr Noelle Scully — jfchem@tcd.ie

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CHU11102: Introduction to Inorganic and Organic Chemistry

Semester 2, 10 credits

Content Layout

Teaching Week	Topic
1-8 (28 L)	Introduction to Organic Chemistry • Alkanes, isomers, homologous series, IUPAC nomenclature, physical properties and molecular size, the tetrahedral carbon atom, shapes of organic molecules, alicyclic rings, concept of bond strain, conformations of ethane and of the cyclohexane ring, chair and boat forms and their relative stabilities, axial and equatorial bonds. • Alkenes, nomenclature, the double bond as an electron rich centre mechanism of electrophilic addition of hydrogen halides, water, and halogens to the double bond, Markownikoff rule, shape of the double bond, geometric isomerism, cis-trans isomers and *E-Z* nomenclature, catalytic hydrogenation, oxidative cleavage of double bonds including ozonolysis. • Alkyne reactions treated briefly as a simple extension of alkene reactions, acidity of alkynes and nucleophilic character of the alkyne anion. • Introduction to aromaticity: benzene structure. Resonance forms and Kekulé structures. Nomenclature. Orbital picture - Consequences of structure. Stability. Quantification of resonance stabilisation energy. Electrophilic addition reactivity. Electrophilic aromatic substitution. Mechanism. Reaction types. Bromination. Nitration. Sulfonation. The Friedel-Crafts reaction. Friedel-Crafts. • Alkyl halides, idea of leaving group, introduction to the use of curly arrows in representing mechanism, idea of nucleophiles and electrophiles, nucleophilic substitutions, SN1 and SN2 mechanisms, carbocations, dehydrohalogenation, elimination mechanisms E1 and E2 emphasising common intermediate for SN1 and E1, direction of elimination, Saytzeff rule, organo lithium and Grignard reagents as carbon nucleophiles. • Alcohols, hydrogen bonds, differences between primary secondary and tertiary, amphoteric nature of the OH group, alkoxides, mechanism of dehydration, oxidation. • Amines as bases and as nucleophiles. • Aldehydes and ketones, nucleophilic attack on the carbonyl carbon, cyanohydrins, oximes, hydrazones, Grignard products, acetals and the mechanism of their formation, oxidation and

	reduction of the carbonyl group, keto-enol tautomerism, the enolate anion, resonance, haloform reaction, aldol condensation. • Carboxylic acids, acid strength, carboxylate anions, esters, acid halides, acid anhydrides, amides, emphasis on electrophilic nature of the carbonyl group, mechanism of esterification and hydrolysis.
9-12 (14 L)	**Introduction to Inorganic Chemistry 1** • This section of the module covers an introduction to inorganic chemistry, with emphasis on bonding, molecular orbital treatment of bonding, and an introduction to coordination chemistry. • **Introduction to Molecular Orbital Theory (7 L)** • Atomic orbitals (s,p,d) as wave functions; their representation as enclosed boundary surfaces and as radial distribution functions. The relationship of these ideas to the Bohr model for atomic hydrogen. Relative energies of these orbitals; orbital angular momentum in non-hydrogen-like atoms; penetration and shielding. • Hybridisation of atomic orbitals and the hybrids associated with various geometries; VSEPR treatment of molecular structures. • Bonding as the linear combination of atomic orbitals, including non-bonding and anti-bonding interactions. Labelling of molecular orbitals as sigma, pi (g or u), molecular orbital diagrams of homonuclear diatomic molecules of the first and second row of the Periodic Table. Mixing of molecular orbitals and its effect on the relative energies of the resulting molecular orbital diagram. Molecular orbital approach for simple molecules including H2O, BeH2 and BCl3. Reactivity of CO in terms of the molecular orbital energy diagram for this molecule. Appreciation of the Molecular Orbital basis of the spectrochemical series. **Introduction to Coordination Chemistry** • Brief introduction - why study metal complexes? • What is a metal complex? Overview of concepts and definitions: Lewis Acid-base concept. • Formation and stability of metal complexes: Complex formation and dissociation; cumulative stability constants and trends; the 'chelate effect'; factors affecting stability.

	• Classification of common ligands: Donor atoms and functional groups. Multidentate and chelating ligands; stereochemistry and formation of chelate rings. • Stereochemistry of metal complexes. Coordination numbers 2-6 and geometry of metal complex; square planar, tetrahedral; trigonal bi-pyramid; square based pyramid; octahedral; distortion of geometries. • Electronic structure and properties of transition metal complexes: Ionic vs. covalent bonding models; crystal field theory; energy level diagrams in tetrahedral - octahedral fields. • 18-electron rule , Molecular Orbital Diagrams for Octahedral Complexes, M-L σ and π bonding • Consequences and applications of orbital splitting: Electronic configurations of metal complexes; crystal filed stabilization energies (CFSE); Factors effecting Delta; spectrochemical series; HS and LS configurations; magnetic properties and the spin-only formula. • Electronic spectra of metal complexes: UV-vis. Spectra; interpretation of data; Laporte and spin selection rules; extinction coefficients and wavelength; Jahn-Teller effect.

Reading list/ Indicative Resources

- Fundamentals of Organic Chemistry, by John E. McMurry and Eric E. Simanek
- Chemistry & Chemical Reactivity Hardcover by Paul Treichel, John Kotz, John Townsend, David Treichel; Publisher: Brooks Cole; 9 ed.
- Organic Chemistry, by Jonathan Clayden and Nick Greeves; Publisher: OUP Oxford; 2 ed.
- Inorganic Chemistry, by C. E. Housecroft and A. G. Sharpe, Publisher: Pearson, 2018, 5th ed.
- Inorganic Chemistry by Gary *Miessler*, Paul *Fischer*, Donald *Tarr*, Publisher: Pearson, 2021, 5th ed.

Methods of Teaching and Student Learning

A mixture of lectures, tutorials and hands-on laboratory practicals are used in the delivery of this module. The practical sessions are formatted in order to further clarify concepts thus reinforcing learning. A weekly hour of tutorial problem solving activities provides an additional opportunity for the lecturer to assess understanding and gauge the knowledge level of the students.

Learning outcomes

On completion of this module the student should be able to:

- Identify and explain bonding, hybridisation, and mechanisms.
- Describe and explain the chemistry of functional groups (alkanes, alkenes and alkynes, aromatics, alkylhalides, alcohol, aldehydes, ketones, and amines) and their applications.

- Analyse and discriminate between mechanisms in terms of the inherent reactivity/polarisation etc. of the two reaction components.
- Identify and classify chiral centres in organic molecules.
- Understand particle wave duality, the contribution of quantum mechanics to understanding atomic and molecular orbits, formation of bonds and how molecular orbitals can be derived using atomic orbitals.
- Discuss Lewis Acid-Base concept and classify different ligands.
- Understand the chelate effect and factors which affect metal complex stability.
- Analyse common geometries and distortion.
- Explain different bonding models and Crystal Field Theory.
- Predict and explain d-orbital splitting in transition metal complexes and its effects on the geometry and electronic properties.
- Calculate crystal field stabilization energies (CFSE) and high-spin and low-spin configurations.
- Interpret extinction coefficients and selection rules in understanding electronic spectra of complexes.

Module Prerequisite:

CHU11101 General and Physical Chemistry (First Semester)

Assessment details:

This module will be examined via a combination of in-course assessments (30% of the final mark) and a 3 h examination (70% of the final mark).

Important Note on Examinations, Assessments and Reassessments in the School of Chemistry:

- There is a minimum mark requirement of **35%** in the **Examination** component and the **40% Laboratory** component, in order for a Pass or Qualified Pass mark in this module to be granted. Other components making up fewer marks are not included in this requirement. A mark of less than 35% in the Examination or 40% Laboratory components leads to a Qualified Fail and requires reassessment examination or a repeat of the year.
- There is a maximum mark or cap of 40% on any reassessed component in this module if reassessment is required. The final module mark is calculated based on the reassessed component mark and any already achieved marks for components that did not need to be reassessed, according to the published weightings of these components.
- Re-assessment capping does not apply to deferred 1st attempts at assessment.
- These requirements apply to all students in this module.
- For more details see the section on 'Progression Regulations applying to Chemistry modules' under the 'Progression and Awards' within this booklet.

Contact Details:

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GGU11006: Human Geography – Exploring the Interconnected World

Semester 1, 10 credits

Learning Outcomes:

- Describe the evolution of the discipline with respect to the philosophical bases which have contributed to its development, the range and changing character of methodological approaches and the foci of geographical enquiry.
- Demonstrate a knowledge of contemporary approaches to the study of human geography.
- Display an ability to use an approach to "thinking geographically" to analyse current events.
- To develop an ability to identify and engage critically with relevant debates within human geography through an in-depth analysis of relevant literature.
- Identify how urbanisation occurs, why urbanisation is a global phenomenon and recognise the forces underlying the growth of urban settlements.
- Describe the impact of urbanisation on different parts of the world.
- Apply approaches in urban geography to analyse key urban problems and challenges.

Module Outline:

This module will provide students with an introduction to key topics, concepts, and approaches in human geography. The overarching theme of the module is exploring the interconnected world, which will entail two interrelated components: exploring how globalisation has produced interdependencies between different parts of the world and understanding how geographers have both shaped the world and our understandings of it. The module will include a mixture of lecture and tutorial classes. The lectures will provide students with an insight into what it means to "think geographically" about contemporary and historical world challenges. It will focus, in particular, on how understanding the development of the discipline of Geography, its philosophical bases and methodological practices can illuminate crucial contemporary challenges such as migration and urbanisation. The tutorials will expand on these topics by providing students with the basis for key geographical, methodological, and analytical skills.

Recommended Reading List:

Section 1

- Boyle, M. Human Geography**:** A concise Introduction (Wiley-Blackwell, Chichester, 2015).
- Daniels, P., Bradshaw, M., Shaw, D. & Sidaway, J.: An Introduction to Human Geography. (Pearson, Harlow, 2008)
- Johnson, R., & Sideway, J.D. Geography and Geographers: Anglo American Geography since 1945 (seventh edition) (Routledge, London, 2015
- Knox, P.L. & Marston, S.A.: Human Geography – places and regions in global context. (Pearson, Upper Saddle River, NJ, 2007)
- Massey, D. & Allen, J. (eds.): Geography Matters (Cambridge Univ. Press, 1984)
- Sparke, M. Introducing globalization: Ties, tensions, and uneven integration. (John Wiley & Sons, 2012)

Section 2

- Clark, D.: Urban World, Global City (Routledge, 1996)
- Edwards, C., & Imrie, R. The short guide to urban policy. (Policy Press, Bristol, 2015).
- Jonas, A. E., McCann, E., & Thomas, M. Urban geography: a critical introduction. John Wiley & Sons, Chichester, 2015).
- Knox, P.L.: Urbanization: An Introduction to Urban Geography (Prentice Hall, 1994)

Section 3

- Dicken, P.: Global Shift (Sage, London, 2003 & subsequent editions)
- Held, D. (ed.): A Globalizing World? Culture, Economics, Politics. (Routledge, London, 2004)
- Johnston, R.J., Taylor, P. & Watts, M.: Geographies of Global Change. (Blackwell, Oxford, 2002)
- Knox, P., Agnew, J.: The Geography of the World Economy, (Arnold, London, 1998)
- Lee, R. & Wills, J.: Geographies of Economies. (Arnold, London, 1997)
- Perrons, D.: Globalization and Social Change. (Routledge, London. 2004)
- Potter, R., Binns, T., Elliott, J. and Smith, D.: Geographies of Development (Addison Wesley Longman, Harlow. 1999)
- Sokol, M., Economic Geographies of Globalisation: A short Introduction, Cheltenham (Edward Elgar. 2011)

Assessment:

100% continuous assessment via in-course tests and assignments.

Contact Details:

Module Director: Dr Cian O'Callaghan — ocallac8@tcd.ie

Geology Executive Officer: Ms Debora Dias — TR062Admin:tcd.ie

Geography Executive Officer: Ms Helen O'Halloran — geography@tcd.ie

PYU11F20: Foundation Physics for Life and Earth Sciences

Semester 2, 10 credits

Foundation Physics for the Life and Earth Sciences is a foundation module (10 credits) in physics.
It is available as an approved 10 credit module for TR060 and TR062 students, all of whom are taking Maths, Stats, & Computation (10 credits); as well as for TR061 students (if not taking Physics 1 or Physics 2) who take both Mathematics 1 (10 credits) and Mathematics 2 (10 credits). It is available in both semesters for TR060 students, (but cannot be taken twice); it is only available in semester 2 for TR061 and TR062 students.

Module Content:

This foundation module comprises lectures, practical work and tutorials, providing an introduction to: physics of motion, biomechanics, physics of hearing and seeing, electricity, magnetism and bioelectricity, radioactivity, nuclear physics and related medical applications, heat, pressure, as well as fluids and their biological, geological and medical applications.

Module Learning Outcomes:

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

- Demonstrate the application of Classical Physics within the biomedical and earth sciences.
- Connect the study of wave phenomena and electromagnetism with ultrasound diagnostics and vision.
- Relate basic knowledge of atomic and nuclear physics to radiation diagnostics and therapy, and to geological applications.
- Prepare a brief report, including error analysis, on a simple physical experiment.
- Through homework: (i) identify the appropriate concepts, principles, and relations that apply to the problem; (ii) provide a reasonable and appropriate explanation of why they apply; and (iii) solve physics problems at a foundation level.

Module Structure:

Contact Hours: 42 lectures/tutorials, three-hour practical laboratories, online homework.

Module Personnel: Lecturers: Prof. Lewys Jones; Prof. Martin Hegner; Prof. Matthias Möbius

Summary of Laboratory Practicals:

In the Foundation Physics for Earth and Life Sciences students complete a minimum of three of the available bench experiments in the semester. The emphasis in the laboratory practical is on learning to make physical measurements, record keeping in laboratory notebooks and estimating uncertainties in measurements, while using these estimates in analysing data in order to make a quantitative measurement of a physics property. Differing students will attempt a differing set of experiments from those available. There may also be

differing availability of experiments on the bench in both semesters. Students are required to record all data and information related to experiments in a hardback practical laboratory notebook which is assessed.

Laboratory Practicals:

Experiments are selected from among but are not limited to: Pendulum, Thin Lenses, Density and the Principle of Archimedes, Surface Tension, Electrical Resistance, Collisions and Momentum Transfer, Resonance Tube, Leslie's Cube, Geiger Counter, and Photoelectric Effect among others.

Assessment of practical experiments:

All student's physics experiments are assessed through both online and submission of written experimental reports and through an at-the-bench laboratory notebook assessment. These reports and notebooks must include and require a documented complete data analysis, description, and concise report of the outcomes of the experiment, and any inferences or conclusions that can be drawn from the outcome.

Reading List:

There is required reading and textbook for this course is an online e-Book, "Physics: Principles with Applications" by Giancoli from Pearson publishers. The e-Book includes access to the online homework platform used for assessment, and purchasing this bundle is a requirement for enrolling on this course. The School of Physics has negotiated a group-discount for this book and details of how to obtain this discount will be shared with students after enrolment.

Online Assignments:

Online assignments are submitted through the online homework platform associated with the "Physics: Principles with Applications" by Giancoli. The electronic access is associated with the required textbook and details of how to register once you have purchased the e-Book will be shared after enrolment.

Methods of Teaching and Student Learning:

A mixture of lectures, hands-on laboratory practical, lecture demonstrations and weekly on-line assignments based on both numerical and conceptual questions from the textbook are used in the delivery of this module. The lecture course follows the material in the textbook very closely with reading assignments clearly indicated to students as the lecture course progresses.

The practical sessions are structured to provide a firm introduction to the process of physical measurements, as well as an introduction to estimations of uncertainty (error) and propagation of errors as applied to physics experiments. Each experiment has its own specific learning outcomes and is structured in order to further clarify concepts met in the textbook and lectures thus reinforcing learning.

Weekly homework assignments, typically alternating between topics, are submitted by students through an online system and corrected, with some limited feedback to the student available through the online system post deadline. The lecturer has oversight of the scores and responses to each assignment and can address these in subsequent lectures and tutorials.
Finally, a number of lecturers use class-based polling of student responses to questions using the available "clicker" technologies.

Methods of Assessment:

Assessment is by a combination of examination and continuous assessment and will include multiple choice tests (MCQs) examination paper; laboratory practical work; and online tutorial homework assignments.
Module website: See links at: http://www.tcd.ie/Physics/study/current/undergraduate/

Contact Details:

Foundation Physics Course Coordinator: Prof. Martin Hegner	Martin.Hegner@tcd.ie Phone: 01 896 2285
Junior Fresh Physics Coordinator: Prof. Matthias Möbius	mobiusm@tcd.ie
General Enquiries:	Physics@tcd.ie Phone: 01 896 1675
Executive Officer: Ms Helen O'Halloran	hohllorn@tcd.ie

Important information

College registration

You will complete College registration online via the website my.tcd.ie. Registration will open on a course-by-course basis. A communication will be sent to the e-mail address you supplied during the application process inviting you to log in to the Academic Registry website to register. When you receive your TCD email address, check it regularly Please check your TCD email address regularly as that will then be the address to which all Trinity communications will be sent.

All information regarding College registration is available at the following link:
http://www.tcd.ie/academicregistry/registration/

Please Note: Students who have already accessed the my.tcd.ie website should continue to access it using your current username and password as this will not change. For those who have not previously logged on, a username and password has been created to give you immediate access.

Closing Dates for Course Transfer

If you decide to transfer out of your course altogether, you must submit an application for **transfer of course** to the Academic Registry, following discussion with your tutor. Decisions are based on **a)** the availability of places, and **b)** the entry qualifications of the transfer applicant. It may not be possible to permit transfers to subjects which already have a full complement of students. Further details are available on the following link:
http://www.tcd.ie/study/apply/making-an-application/undergraduate/index.php

Students may not register or attend a course until their application to transfer has been formally approved by the Senior Lecturer

Progression and Awards

Information on progression and awards can be found via the following webpage:
https://www.tcd.ie/teaching-learning/academic-affairs/ug-prog-award-regs/index.php

Information in relation to all undergraduate Regulations can be found via the following:
https://www.tcd.ie/teaching-learning/academic-affairs/ug-regulations/

Attendance/Non-attendance Regulations for Junior and Senior Fresh Students

The following regulations will apply to Junior and Senior Fresh student in the following Science Courses:
TR060: Biological and Biomedical Science
TR061: Chemical Sciences
TR062: Geography and Geoscience
TR063: Physical Sciences

All students must begin attendance for their course no later than the first day of teaching term and must fully take part in the academic work of their course. Attendance at Lectures,

Labs, Field trips and tutorials is **compulsory** in both core and open modules. Timetables are published through the my.tcd.ie portal and the onus lies with the student to inform themselves of dates, times and venues by consulting the timetable regularly.

Attendance at chemistry practical classes is compulsory for all students in all years of Chemical Sciences TR061, and for students in other science streams (Physical Sciences TR063 and Geosciences TR062) that may take chemistry modules as open modules in JF and SF years.

Commented [PS1]: Should this be included in the other handbooks TR062 & TR063?

It is extremely important that students meet all the requirements of their course and that they submit all continuous assessments, Laboratory practical/Field course reports and assignments by the required deadlines. Students should ensure that they make themselves aware of the module weightings which are outlined in the relevant booklets available from the Science Course Office website: https://www.tcd.ie/science/undergraduate/

Laboratory Practicals, Field courses and Tutorials

The primary function of laboratory practicals, compulsory field courses and tutorials is to equip students with the skills and knowledge necessary to be successful at sophister level in their chosen moderatorship. Therefore, they are an extremely important part of the student educational experience in Science. The learning outcomes for these components are intrinsically linked with the physical actions of being present. Students who do not attend at least 2/3 of the compulsory sessions in a module will be returned as "non-satisfactory attendance and may be excluded from taking their exams: see section below.

Coursework/assignments

Students must complete and submit all coursework, laboratory write ups, field course notes in full by the published submission date. Deductions for late submission will be applied as follows:
Biology – 10% reduction from final grade per week
Chemistry – 10% for the first 24 hours and 5% ever day after that
Geoscience – 10% reduction from final grade per week

Module handbooks will detail penalties for late submission of individual pieces of continuous assessment.

It is therefore essential, that students who think they will not be in a position to meet a certain deadline, contact the module Coordinator or Course Director before the due date. We recognise that there are times when students will struggle with deadlines, and problems identified at the time are more easily dealt with than retrospectively when assignments start piling up.

Module coordinators/Course Director details can be found in the Blackboard modules or in the relevant handbooks available for download from the Science webpage: https://www.tcd.ie/science/undergraduate/

Absence through illness:
Where a student misses an assigned laboratory/field course/compulsory tutorial class through illness, they must **(a)** submit an absence report and upload a med cert via the Science Absence form: https://forms.office.com/Pages/ResponsePage.aspx?id=jb6V1Qaz9EWAZJ5bgvvlK2pn-Bcn6aBJpJezeqwuYapUMkpaU1E5SDY5TDZaTUhYU01PMlhBV0kxSyQlQCN0PWcu **on the day of their return to College** and **(b)** inform the laboratory practical supervisor of their absence at the earliest opportunity and certainly at the next session.

Note: submission of a medical certificate does not automatically initiate excusal from an activity. The student must obtain excusal from the module coordinator or Course Director after they have submitted a medical cert.

Other absences:
Students who have sports commitments to the College should supply confirmation from the appropriate committee to the Module Coordinator/Course Director well in advance of any event.
Students who anticipate that their sporting commitments may necessitate more than an occasional absence from College (e.g., Sports Scholars etc.) should discuss their situation with their tutor and the Associate Dean of Undergraduate Science Education (ADUSE).

Students who have unexpected family commitments should request excusal from the Module Coordinator/Course Director. Excuses for absence presented after the event, will not be accepted.

Vacations/Holidays/Weddings during teaching term
Students who are absent from College during teaching term for planned vacations/holidays/weddings etc. must ask the Senior Lecturer, through their tutor, for permission to be absent from college. No special accommodations will be made for such students. No replacement tutorials, laboratory/field courses will be scheduled, and no lecture material will be recorded. The onus in such cases lies with the student to catch up on the worked missed.

The general regulations outlined above will apply however, individual cases will be reviewed on their own merits.

Non-Satisfactory attendance in Science

All Junior and Senior Fresh students must fulfil the course and module requirements as set out above with regard to attendance. At the end of the teaching term students who have not satisfied these regulations may be reported as non-satisfactory for that term. Students whose attendance is reported as non-satisfactory may be refused permission to take their semester one or semester two examinations and may be required to repeat the year.

Science students will be considered non-satisfactory in a module if:

They fail to attend at least 2/3 of the laboratory practicals/field trips in a module.

OR
They fail to submit at least 2/3 of the required coursework/assignments in a module

Email Protocols for Students

Every student has a TCD email address. You are expected to check this regularly and to read and act promptly upon all messages sent to you.
You should check your College email daily during teaching term as it will be used to communicate important information. If away from Trinity on Erasmus or on an exchange you should still check your TCD mail periodically.

Sending emails. Email is a useful way of contacting lecturers and administrators with queries about course work, to arrange an appointment, or to request a letter of recommendation. Email within College is essentially work-related, so it is appropriate to be relatively formal.

Subject Lines. When sending email, please fill in the subject line so as to indicate the purpose of the email. This will help the recipient to answer your query and to recover the email subsequently if necessary.

Forms of address. As a courtesy, emails should address recipients by name. If you are using titles (Ms.; Mrs.; Mr.; Dr; Professor) these should be accurate. If you are unsure as to a name or title this can be checked in this handbook.

Introducing yourself. If you are writing to a member of staff, make sure your complete name and student number appears somewhere in the email. If your email relates to a particular module, include the module code and title.

Expectations re response. Responses to email should only be expected during normal working hours, i.e. from 9.00am to 5.00pm, Monday to Friday. You should not expect academic or administrative staff to respond to your emails at weekends or when College is closed during holiday periods.

Civility. Always be civil. Abusive and/or abrasive correspondence will not be tolerated.

Be secure. Beware of phishing, never divulge your account details to non-TCD addresses and do not click on links from unknown sources.

Academic Integrity

Plagiarism is using someone else's ideas, charts, concepts, or words in your assignments and using them as if they were your own, and without giving credit to the actual author. Plagiarism is considered a serious offence in Trinity and carries penalties depending on the severity of the plagiarism.

To ensure that you have a clear understanding of what plagiarism is, how Trinity deals with cases of plagiarism, and how to avoid it, you will find a repository of information at https://libguides.tcd.ie/academic-integrity

- Academic Integrity homepage (formerly Avoiding Plagiarism): https://libguides.tcd.ie/academic-integrity
- Ready Steady Write tutorial: https://libguides.tcd.ie/academic-integrity/ready-steady-write
- Coversheet declaration: https://libguides.tcd.ie/academic-integrity/declaration
- Levels and consequences: https://libguides.tcd.ie/academic-integrity/levels-and-consequences

Correct referencing is essential when crediting your sources and avoiding plagiarism. Your course handbook will tell you what style of referencing you should use in your assignments so be sure to check that out before you start any assignments. You will waste a lot of time if you have to redo your references.

Resources

Referencite, University of Auckland, New Zealand, has some good interactive resources to help you understand plagiarism and how to avoid it: https://www.auckland.ac.nz/en/law/current-students/llb-information/academic-information/cheating-plagiarism-turnitin.html

Guidance on the use of AI and Generative-AI in College

The advent of commonly available artificial intelligence tools are disruptive in both positive and negative ways. Before using them in your studies it is important that you familiarise yourself with College policies on its use. Unless otherwise instructed for particular modules or assessments, **the default expectation would be that you do not submit AI generated content as an attempt at an assessment**.

Below is some basic overview of the College policy on AI and GenAI. This has been taken from the more detailed policy which is informative and wide ranging. You are expected to have read and familiarised yourself with this policy.
https://www.tcd.ie/academicpractice/resources/generative_ai/

Artificial Intelligence (AI)

Artificial intelligence is generally understood to be a set of technologies that enable computers to perform a variety of functions usually perceived as requiring human intelligence – for example, understanding speech, recognising objects in images, composing written answers and problem reasoning. A more formal definition of an AI system from the European Union AI Act (2024) is:

...a machine-based system designed to operate with varying levels of autonomy and that may exhibit adaptiveness after deployment and that, for explicit or implicit objectives,

infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions that can influence physical or virtual environments[.] (EU AI Act 2024)

Generative Artificial Intelligence (GenAI)
Generative AI is the sub-area of AI, involving AI systems which generate content — for example, human dialogue, speech, images and video. GenAI systems are capable of generating such content based on a user's request or instruction. More formally, GenAI is defined by UNESCO **as "an artificial intelligence (AI) technology that automatically generates content in response to prompts written in natural-language conversational interfaces" (UNESCO 2023).**

AI and GenAI in Trinity
As Ireland's leading university and as a world leader in AI research, Trinity recognises that AI and GenAI offer new opportunities for teaching, learning, assessment and research. We also recognise that these technologies present challenges and risks, including to academic integrity, ethics, privacy, impartiality, intellectual property and sustainability.

Acknowledging these opportunities and challenges, Trinity commits to supporting the opportunity for students and staff to become AI literate and fluent, thereby helping them to navigate and respond to the challenges and risks of AI and GenAI in order to harness the potential of (Gen)AI to enhance teaching, learning, assessment and research – and to be prepared for future challenges as these technologies evolve. We also commit to providing ongoing resources and guidance to support students and staff to use AI and GenAI in ways that are appropriate, responsible and ethical – and to ensure that academic integrity is maintained in its usage.

College aspires to develop best practice guidelines in this area. In addition to the resources and supports that College provides and recognising that appropriate uses of AI and GenAI tools vary across academic disciplines, Schools will have some flexibility to customise their own discipline-specific practices in line with this institutional statement, other institutional policies as they develop, and national and international regulation. The College goal is to enable overall consistency in the regulation of GenAI usage, while also respecting where disciplines or degree programmes require specific restrictions in GenAI usage in assessment preparation and execution. Thus, where disciplines or degree programmes wish to refine specific regulations on student use of GenAI for learning, general as well as programme-specific regulations should be communicated in the relevant discipline/degree programme handbook.

Such regulation could range from how student GenAI usage is acknowledged or cited within student assessment submissions, to prohibition of GenAI usage in the production of student assessment submissions.

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 co-ordinated by the Senior Tutor's Office which is located on the ground floor in House 27.

Opening Hours
The Senior Tutors Office is open Monday – Friday from 9am – 5.30pm. Closed for lunch from 1-2pm.

Appointments
If you require specific advice or would like a confidential meeting with the Senior Tutor, you can make an appointment by telephoning +353 1 896 2551 or by emailing stosec@tcd.ie

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?
Whenever you are worried or concerned about any aspect of College life or your personal life, in particular if it is affecting your academic work. Everything you say to your Tutor is in strict confidence. Unless you give him/her permission to do so, s/he will not give any information to anybody else, whether inside College or outside (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's Office –**
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 Service – contact details are available via their webpage: https://www.tcd.ie/disability/contact/

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) 8961407
Email: student-counselling@tcd.ie

For further information visit the following webpage:
https://www.tcd.ie/Student_Counselling/

Helpful College Websites:

In the first few weeks at College, you will hear an array of abbreviations, titles, and place names. So, visit the jargon buster page: https://www.tcd.ie/students/jargon-buster/

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

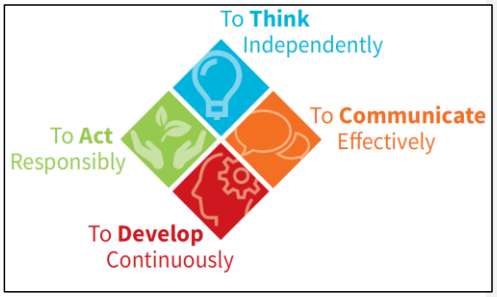
For information on Registration, Fees, Grants, ID Cards etc. visit the Academic Registry (AR) in the Watts Building or the visit the AR website: https://www.tcd.ie/academicregistry/

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 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.

Dates to Note:

Fresh Orientation: 15th September to 19th September 2025

Semester one term dates: 15th September to 05th December 2025

Study Week Semester 1: 27th October to 31st of October 2025

Semester one examinations: 11th December to 22nd of December 2025

Semester two term dates: 19th January to 10th of April 2026

Study week semester 2: 02nd March to 06th of March 2026

Semester two examinations: 21st April to 1st of May 2026

TEACHING TERM DATES 2025-2026					
Michaelmas Term Monday 15 September - Friday 05 Dec 2025			**Hilary Term Monday 19 January 2026 - Friday 10 April 2026**		
Teaching wk. 1	Week 03	*15 Sept 19 Sept	Teaching wk. 1	Week 22	19 Jan - 23 Jan
Teaching wk. 2	Week 04	**22 Sept - 26 Sept	Teaching wk. 2	Week 23	26 Jan – 30 Jan
Teaching wk. 3	Week 05	29 Sept - 03 Oct	Teaching wk. 3	Week 24	*02 Feb - 07 Feb
Teaching wk. 4	Week 06	06 Oct – 10 Oct	Teaching wk. 4	Week 25	09 Feb - 13 Feb
Teaching wk. 5	Week 07	13 Oct - 17 Oct	Teaching wk. 5	Week 26	16 Feb - 20 Feb
Teaching wk. 6	Week 08	20 Oct – 24 Oct	Teaching wk. 6	Week 27	23 Feb – 27 Feb
Study week	**Week 09**	**27 Oct - 31 Oct**	**Study week**	**Week 28**	**02 Mar - 06 Mar**
Teaching wk. 8	Week 10	*03 Nov - 07 Nov	Teaching wk. 8	Week 29	09 Mar - 13 Mar
Teaching wk. 9	Week 11	10 Nov - 14 Nov	Teaching wk. 9	Week 30	*16 Mar - 20 Mar
Teaching wk. 10	Week 12	17 Nov - 21 Nov	Teaching wk. 10	Week 31	23 Mar - 27 Mar
Teaching wk. 11	Week 13	24 Nov - 28 Nov	Teaching wk. 11	Week 32	*30 Mar - 03 Apr
Teaching wk. 12	Week 14	01 Dec – 05 Dec	Teaching wk. 12	Week 33	06 Apr - 10 Apr

*** Orientation week for new entrants**

**** Teaching begins for all Junior Fresh Students**

October bank holiday – Monday 27th October 2025

College will be closed from the 24th of December to the 1st of January 2025

February bank holiday – Monday 2nd February 2026

St Patrick's Day - Tuesday 17th March 2026

TR062 Contact Details:

Course Director TR062 Geography and Geoscience Professor Sean McClenaghan	E-mail: mcclens@tcd.ie Phone: 01 8961585
Geology Department Ms Debora Dias	E-mail: TR062Admin@tcd.ie Ph: 01 896 1074
Geography Department Ms. Helen O'Halloran	E-mail: geog@tcd.ie Ph: 01 896 1576
Science Course Office **Associate Dean of Undergraduate Science Education** Professor Andrew Jackson	E-mail: jacksoan@tcd.ie
Science Course Office Manager Ms. Ann Marie Brady	E-mail: ennisa@tcd.ie Ph: 01 896 2829
Administrative Officer/Senior Fresh Coordinator Ms. Helen Sherwin Murray	E-mail: sherwinh@tcd.ie Ph: 01 896 2799
Executive Officer/ Front House Ms. Andressa dos Santos Melo	E-mail: dossanta@tcd.ie Ph: 01 896 1970
Administrative Officer/ Junior Fresh Coordinator Ms. Romarey Segura	E-mail: segurar@tcd.ie Ph: 01 896 2022

Field Code Changed

Appendix 1

Item	Reference/Source
General College Regulations	Calendar, Part II, General Regulations and Information,Section II, Item 12
Emergency Procedures	In the event of an emergency, **dial Security Services on 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 emergency or rescue services on campus, you must contact Security Services. This includes chemical spills,personal injury or first aid assistance. It is recommended that all studentssave at least one emergency contact in their phone under ICE (In Case of Emergency).
Health and Safety	Faculty of Science, Technology, Engineering and Mathematics website - https://www.tcd.ie/stem/undergraduate/health-safety.php School Handbooks will have School/Discipline information on Health and Safety.
Data Protection	https://www.tcd.ie/dataprotection/ https://www.tcd.ie/dataprotection/assets/docs/dataprotectionhandbook/DP_Handbook_15042021.pdf
Academic Integrity	https://www.tcd.ie/teaching-learning/academic-integrity/
Research Ethics	https://www.tcd.ie/research/support/ethics-integrity.php
Blackboard	Blackboard
Explanation of Weightings	https://www.tcd.ie/teaching-learning/ug-egulations/Academic_credit_system.php
Assessment and Progression Regulations	https://www.tcd.ie/media/tcd/about/policies/pdfs/academic/assess-acad-prog-nov2021.pdf https://www.tcd.ie/teaching-learning/academic-affairs/ug-prog-award-regs/ Calendar, Part II, General Regulations and Information,Section

	II, Item 35 Academic Policies
Academic Awards	https://www.tcd.ie/teaching-learning/academic-policies/assets/academic-awards-jan2021.pdf
Item	**Reference/Source**
Equality, Diversity and Inclusion	https://www.tcd.ie/equality/
Prizes, medals, and other scholarships	https://www.tcd.ie/media/tcd/calendar/undergraduate-studies/prizes-and-other-awards.pdf
Teaching and Learning Study Abroad	https://www.tcd.ie/global/mobility/outbound/
Marking Scales	Calendar, Part II, General Regulations & Information, Section II, Item 30 Please consult Schools or Disciplines directly or programme handbooks for further information.
Framework of qualifications Trinity Pathways	https://www.qqi.ie/national-framework-of-qualifications Trinity PathwaysTrinity Courses
Capstone (UG Programmes)	https://www.tcd.ie/teaching-learning/ug-regulations/Capstone.php
Careers Information	https://www.tcd.ie/Science/careers/ For further information refer to School/Discipline Handbooks.
Careers Advisory Service	https://www.tcd.ie/Careers/
Attendance Requirements	https://www.tcd.ie/media/tcd/science/pdfs/Science-ABSENCE-NON-SATISFACTORY-regulations---TSPMC-August-2024.pdf https://www.tcd.ie/media/tcd/calendar/undergraduate-studies/general-regulations-and-information.pdf#page=6
Student Cases	https://www.tcd.ie/academicregistry/student-cases/
Student complaints procedures	https://www.tcd.ie/media/tcd/about/policies/pdfs/Student-Complaints-Procedure-21.07.22.pdf
General Examination Guidelines	Exam Guidelines - Academic Registry - Trinity College Dublin
Feedback and Evaluation	Student Evaluation andFeedback Procedure for the conduct ofFocus Groups
Academic Policies and Procedures	https://www.tcd.ie/teaching-learning/academic-policies/
Registration	https://www.tcd.ie/academicregistry/student-registration/
Student supports	https://www.tcd.ie/students/

STEM Schools and Disciplines	https://www.tcd.ie/structure/faculties-and-schools/#d.en.2024679

NOTE: All of the information contained in this booklet is accurate at time of publication. However, the Science Course Office reserves the right to modify information, dates and times as necessary. Students will be notified of any changes via e-mail and the Science webpage.