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

Science in Trinity

Junior Fresh - TR060 Biological and Biomedical Sciences 2025–2026

Contents

Welcome to Science at Trinity

TR060: Biological and Biomedical Sciences introduction

Welcome to the Biological and Biomedical Sciences Stream at Trinity College Dublin.

In the Biological and Biomedical Stream students will study the core concepts that are fundamental to all biological systems. These will be presented in core modules during the first two years and will include: cell structure and composition, genetics, heredity and biological information, evolution, molecular biology, metabolism, anatomy and physiology of bacteria, fungi, plants and animals, ecosystems, and environmental biology. Students will also study core concepts in chemistry with a focus on aspects that are essential for an understanding of how biological systems function and those that underpin biomedical science. Students will also acquire mathematical, statistical, and computational skills that are relevant for the analysis of biological systems.

In addition, students have the opportunity both to expand their scientific knowledge and to pursue their individual interests by choosing from a cohort of open modules on topics such as physics, geoscience, history, philosophy and ethics of science, science education and communication, agriculture and biotechnology, infection and immunity, and behavior.

In the third year, students specialize in one of the 11 moderatorships offered in this stream: Biochemistry; Botany; Environmental Science; Genetics; Human Genetics; Immunology; Microbiology; Molecular Medicine; Neuroscience; Physiology; Zoology. The fundamental concepts of that discipline will be presented in core modules while students will also select from a cohort of open modules from allied disciplines that enhance understanding of their chosen discipline and encourage interdisciplinary thinking and research. Students can also experience the wide range of knowledge and investigation available throughout the university by choosing an elective module from a cohort that highlights major research themes from across all faculties.

In the fourth year, students choose from a selection of modules on advanced topics within their discipline. They will also undertake a Capstone project in Trinity College or in a research laboratory in another university, research institute or hospital. Throughout, students will acquire skills in problem solving and data handling and in oral and written communication.

This program of science education is designed to foster and develop a student's capability for independent thought and effective communication, an ability to continue their education independently, and to act in a responsible manner. These attributes are a preparation for a career in science and medicine (e.g., in research, biotechnology, pharmaceutical industry, further medical training); for a career in related areas where a scientific education is beneficial (e.g., patent law, forensic science, journalism) and for careers in areas such as education, management, business, finance, consultancy, industry, communication and policy making.

TR060 Biological and Biomedical Sciences overview and module selection

The TR060 Biological and Biomedical Sciences Introductory Session will take place **on Tuesday, 16th September 2025, with a lecture in MacNeill Lecture Theatre** followed by an open module information session, in the Biology Laboratories, downstairs from the MacNeil. Here you will have an opportunity to meet with Academic members of staff to discuss your open module choices.

The schedule of events for the 16th of September is outlined below:

- Introductory Lecture: **Tuesday 16th September 2025 at 10.30 to 11.00 am in the MacNeil Lecture Theatre, and a second session will be at 14.00 to 14.30 in the MacNeil Lecture Theatre.**
- Open module choice session with an academic member of staff as follows in the Biology Laboratory, downstairs from the MacNeil.
    - Surnames A-M 11.00 to 12.30
    - Surnames N-U 14.30 to 15.30
    - Surnames V-Z: 15.30 to 16.30

Note:

- The choices you make in Junior Fresh year may influence your choices in the second semester of Junior Fresh year and Senior Fresh year.
- Open module choice forms will **not** open until **17.00 hrs on the 16th of September,** after all students have attended the Introductory session in the MacNeill Lecture theatre and the relevant open module choice session**. The module choice form must be completed by 17.00 hrs on the 17th of September.**

Please read the following information on pages 2,3, and 4, and then go to: https://forms.office.com/r/jUxyKrF5wP, select your modules. 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 considering a career in teaching at the second level (Junior and Senior Certificate) are reminded of the need to fulfil the requirements of the Teaching Council for each subject they intend to teach. The requirements for each subject are listed at: https://www.teachingcouncil.ie/en/Publications/Registration/Documents/Curricular-Subject-Requirments-after-January-2017.pdf

Module Selection

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

Module code	Module title	Semester	Credits
BYU11101	From Molecules to Cells	Semester 1	10
BYU11102	Organisms to Ecosystems	Semester 2	10
CHU11B01	Chemistry for Life Sciences	Semester 1	10
MAU11002	Mathematics, Statistics, and Computation 2	Semester 2	10

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

Module code	Module title	Semester	Credits
GSU11001	Spaceship Earth: An Introduction to Earth Systems Science	Semester 1	10
GSU11005	Introduction to Geology: A Beginner's Guide to Planet Earth	Semester 2	10
* PYU11F10	Foundation Physics for Life and Earth Sciences 1	Semester 1	10
* PYU11F20	Foundation Physics for Life and Earth Sciences 2	Semester 2	10
* EDU11001	Science Communication 1	Semester 1	10
* EDU10002	Science Communication 2	Semester 2	10

***** Foundation Physics and Science Communication modules may be taken in either semester one or semester two but cannot be taken in both.

Moderatorships

On successful completion of Senior Fresh, students compete for places in any one of the eleven-moderatorship available at sophister level. Open module choices no not affect moderatorship eligibility or allocation, you are free to choose as you wish. Please see Allocation of Places regulations for further details: https://www.tcd.ie/media/tcd/science/pdfs/science-allocation-of-places-regulations-tspmc2023.pdf

Change of Open Modules

If you feel that you have perhaps made the wrong choice of open module, **please seek advice immediately** from your Tutor, Course Director, or the Science Course Office. It may be possible for you to change from one module to another within Science. If you do decide to change modules, then do so **quickly** – it can be difficult to try to catch up with work in a new module if you have missed more than two or three weeks of lectures. You should call into the Science Course Office if you wish to change modules. You can also send an email to jfsco@tcd.ie

Semester Structure

TR060: BIOLOGICAL AND BIOMEDICAL SCIENCES	
CORE MODULES (mandatory) – 20 credits per semester.	
SEMESTER 1 – Michaelmas term (15th September to 5th December 2025)	**SEMESTER 2 – Hilary Term (19th January to 06th April 2026)**
BYU11101: From Molecules to Cells (10 credits)	BYU11102: Organisms to Ecosystems (10 credits)
CHU11B01: Chemistry for Biologists (10 credits)	MAU11002: Mathematics, Statistics and Computation 2 (10 credits)
OPEN MODULES (optional): Students choose 10 credits from each semester	
GSU11001: Spaceship Earth: An Introduction to Earth System Science (10 credits)	GSU11005: Introduction to Geology: A Beginner's Guide to Planet Earth (10 credits)
PYU11F10: Foundation Physics for Life and Earth Scientists 1 (10 credits)	PYU11F20: Foundation Physics for Life and Earth Scientists 2 (10 credits)
EDU11001: Science Communication (10 credits)	EDU11002: Science Communication (10 credits)

TR060 Biological and Biomedical Sciences – Core 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 practicals will be supplemented with information sessions, tutorials, and activities that guide the use of library resources, laboratory health and safety, writing techniques, help with avoiding plagiarism, and examination techniques. Online learning resources, assignments, submission instructions, and information concerning the day-to-day running of the module will be published in Blackboard. Sixty-five hours of 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: c**hloroplast, 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. **End-of-semester examination: 50% of the 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, **NO** negative marking will apply.
2. **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: Mirela Dardac	mdardac@tcd.ie Phone: 01 8962895
Laboratory Manager: Audrey Carroll	aucarrol@tcd.ie Phone: 01 8961049
Executive Officer: 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, Behaviour and Neuroscience, 2) Evolution: Adaptation, Populations and Biodiversity, and 3) Ecology and Environment.

A mixture of lectures, self-directed field work, and hands-on laboratory practicals is used in the delivery of this module.

Learning outcomes

1. On successful completion of this module, the student will be able to:
2. Outline the major steps involved in how complex animals 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.
3. 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.
4. 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.
5. Recognize the diversity of life on Earth and describe how it evolved over geological time scales.
6. Describe the ecological relationships between individuals, populations, communities, and ecosystems, and between organisms and their environment.
7. Recognize how humans can positively and negatively influence other living organisms and their environment and understand the value of other living organisms for humans.
8. Demonstrate practical, numerical, and analytical skills.
9. Collate, synthesize, and present information in written reports.

Contact Hours/Methods of Teaching and Learning

Lectures and practicals will be supported by online learning resources.

Essay writing skills will be developed. Online learning resources, assignments, submission instructions, and information concerning the day-to-day running of the module will be published in Blackboard. 65 hours of 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 McElwain	
Lecture 32: Impacts of Climate Change Biological Niches	Prof. Jennifer McElwain	
Lecture 33: Biomes and Global Productivity	Prof. Jennifer McElwain	
Lecture 34: Biogeochemical Cycles	Prof. Jennifer McElwain	
Lecture 35: Biodiversity Crisis	Prof. Jennifer McElwain	
Lecture 36: Summary of key concepts: Q&A	Prof. Jennifer McElwain/ James Barnett	

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**: extinction 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 feedback on climate system**: introduction to biological feedback 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. 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.

(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:

Module Coordinator: Trevor Hodkinson	hodkinst@tcd.ie
Biology Course Coordinator: Mirela Dardac	mdardac@tcd.ie Phone: 01 8962895
Laboratory Manager: Audrey Carroll	aucarrol@tcd.ie Phone: 01 8961049
Executive Officer: Daniel McCormick	dmccorm2@tcd.ie Phone: 01 8961117

CHU11B01: Chemistry for Biologists

Semester 1, 10 credits

Module learning aim:

To provide an introduction to aspects of chemistry which are essential to an understanding of the operation of living systems and the chemical technology of medicine.

Learning Outcomes:

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

1. Explain, using appropriate terminology and physical units, basic concepts in chemistry, including precipitation and redox reactions.
2. Analyse bonding and molecular structure, hybridisation, and mechanisms.
3. Explain the concepts of entropy and free energy and the control of chemical and biochemical reactions by free energy changes.
4. Explain the concept of equilibrium and factors affecting the position of equilibrium.
5. Demonstrate an understanding of acid-base, buffers, and electrochemistry.
6. Explain the factors that influence the rate of a reaction and the concepts of order of reaction.
7. Describe and explain the chemistry of oxygen-based functional groups.
8. Recall the structure and properties of the major types of biological organic molecules, and be able to describe the relationships between structure, properties, and functions.
9. Describe organic reaction mechanisms that impact biochemical processes.

Module content:

Week	Topic and description
1-3 9 Lectures	**Introduction to chemistry: The atom, chemical bonding, and chemical reactions** 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. Atoms, Molecules, and Ions. Isotopes and radionuclides in medicinal chemistry. Bonding in chemical substances – lengths, angles, and rotation Ionic bonding; covalent bonding; weak bonding; molecules and solid-state structures; electronegativity; the periodic table. Hybridization Chemical reactions; symbolizing reactions; balancing equations. Solutions, concentrations, and dilutions Limiting reagents and yields; role of water in chemical reactions; important classes of chemical reactions Oxidation and reduction reactions, electron transfer; oxidizing and reducing agents; half-equations.

4-9 (14 Lectures)	Chemical energetics, thermodynamics, and chemical equilibria (8L) Ionic equilibria (1L) Acids, bases, and buffers (2L) Kinetics (1L) and 1st order rate law Electrochemistry (2L)
10-12 (10 Lectures)	Nomenclature of carbon chains, simple hydrocarbons, and aromatics. Oxygen-based functional groups; hydroxyls, aldehydes, ketones, carboxylic acids, esters Sugars, aminoacids and peptides. Lipids and nucleic acids Introduction to substitution, addition, elimination, condensation, and hydrolysis reactions.

Reading list/ Indicative Resources

- Organic Chemistry, by Jonathan Clayden and Nick Greeves; Publisher: OUP Oxford; 2 ed.
- 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

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.

Methods of Assessment CHU11B01

- Laboratory and in-course assessment: 30% of Final Grade
- Examination: 70% of Final Grade

Contact details:

Module Coordinator: Dr Eoin Scanlan
E-mail: Eoin.Scanlan@tcd.ie
Phone: 01 896 2514

Fresh Coordinator: Dr Noelle Scully
E-mail: jfchem@tcd.ie
Phone: 01 896 1972

Senior Executive Officer: Ms Anne Marie Farrell
E-mail: farrea25@tcd.ie
Phone: 01 896 1726

MAU11002: Mathematics, Statistics and Computation 2

Semester 2, 10 credits

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, optimization 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

11 weeks of teaching with 5 lectures, 2 tutorials and 1 computer practical per week

Assessment Details.

- 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 Coordinators:

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

TR060 Biological and Biomedical Sciences – Open Modules

GSU11001: Spaceship Earth: An Introduction to Earth System Science.

Semester 1, 10 credits

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.

Module 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.

- Make connections between a student's core subject areas and the field of geography & geoscience.

Recommended Reading List:

Holden, J. (2019). An Introduction to Physical Geography and the Environment. 4th Edition. Pearson: Harlow, UK. 876 pages. 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 Details:

(A) End of semester examination: 50% of the module mark. The exam format will be closed-book, in-person, with 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.

Module Website: Blackboard

Contact Details:	
Course Director TR062	
Geography and Geosciences: Prof Sean Mc Clenaghan	E-mail: mcclens@tcd.ie
	Phone: 01 896 1585
Geography Department	
Executive Officers: Ms Helen O'Halloran	E-mail: geog@tcd.ie
	Ph: 01 0896 1576
Geology Department	E-mail: TR062Admin@tcd.ie
Executive Officer: Ms Debora Dias	Ph: 01 896 1074

GSU11005: Introduction to Geology: A Beginners Guide to Planet Earth

Semester 2, 10 credits

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.

Module 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

To develop the following skills & graduate attributes

- Written and digital / analytical skills
- Critical thinking
- Make connections between a student's core subject areas and the science of Geology.

Module 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.

Recommended Reading List:
Nicholas, C. J., 2019. A Beginner's Guide to Planet Earth: Introductory Lectures in Geology. C.J. Nicholas (ISBN 978-1-911180-33-3)

Assessment Details: 60% examination; 40% continuous assessment via in-course tests and assignments.

Module Website: https://www.tcd.ie/Geology/undergraduate/modules/year1/

Contact Details:

Course Director TR062 **Geography and Geosciences:** Prof Sean Mc Clenaghan	E-mail: mcclens@tcd.ie Phone: 01 896 1585
Geography Department **Executive Officers:** Ms Helen O'Halloran	E-mail: geog@tcd.ie Ph: 01 0896 1576
Geology Department **Executive Officer:** Ms Debora Dias	E-mail: TR062Admin@tcd.ie Ph: 01 896 1074

PYU11F10/PYU11F20: Foundation Physics for Life and Earth Sciences

Semester 1 or 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 (but cannot be taken twice); it is only available in semester 2 for TR061 or 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 Practicals:

In the Foundation Physics for Earth and Life Sciences, students complete a minimum of three practical experiments, including those experiments available at the bench in the laboratory during the semester. The emphasis in these practicals, whether at home or in the laboratory, is on learning to make physical measurements, record keeping in scientific laboratory notebooks, estimating uncertainties in measurements, while using these estimates in analysing data in order to make a quantitative measurement of a physical

property. Differing students will attempt a differing set of experiments selected from those available. There may also be a differing availability of laboratory experiments on the bench in both semesters. Students are required to record all data and information related to their experiments in a hardback practical laboratory notebook which is assessed. At-home physics practical experiments may be assigned and evaluated together with the laboratory-based practicals.

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 practicals, 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 to further clarify concepts met in the textbook and lectures to reinforce 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 and at-home assessed 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. Plamen Stamenov	E-mail: stamenp@tcd.ie Phone: 01 896 4350
Junior Fresh Physics Coordinator: Prof. Matthias Möbius	E-mail: mobiusm@tcd.ie
General Enquiries:	E-mail: Physics@tcd.ie Phone: 01 896 1675
Administrative Officer: Ms Una Dowling	E-mail: dowlingu@tcd.ie

EDU11001/EDU11002: Science Communication

Semester 1 OR semester 2, 10 credits

Introduction

This module explores science communication as a field of research and practice and how it affects the relationship between science and society. Communication and collaboration are essential skills for researchers and on successful completion of this module students should be able to:

- Interpret the key concepts of theory and practice in the field of science communication.
- Assess science communication in terms of science learning, public engagement, citizen science and the evolving relationship between science and society.
- Critically appraise their own communication skills, in particular: writing, debating, and presenting

This module will provide practical and theoretical foundations that will enable students to develop their own communication and presentation skills as well as critical thinking skills. Students will gain an understanding of how science is taught and communicated, an awareness of how research policy and public perception is crafted, and a familiarity with interdisciplinary opportunities and challenges arising at the interface of science and society.

The course will equip students with key communication skills as well as a knowledge of science education (both formal and informal), policymaking, funding, and ethics that will serve as a platform to examine the historical impact that science has had on society. It will enable students to identify responsible research and to propose models of science communication and science learning that promote cultures of sustainability and participation. Students will be equipped to communicate their own work and critically reflect on the social context of their field of study.

Module learning aims:

The module aims to support the development of a range of graduate attributes, including:

1. To think independently
    - The module will give students a deeper understanding of science communication, science education, and an appreciation of research beyond their chosen fields.
    - Independent research will be encouraged as well as the analysis and synthesis of evidence.
    - Self-assessment and peer-assessment aspects of the module will nurture students' capacity for critical thinking.
2. To act responsibly
    - The module will offer global perspectives on societal challenges by focusing on the United Nations' Sustainable Development Goals (SDGs)
    - The module will give students a familiarity with contemporary ethical issues arising at the interface of science and society.
    - Responsible, inclusive, and sustainable open research will be explored.

3. To develop continuously
    - The module will foster self-motivated learning and the enhancement of academic skills.
    - Students will be supported in developing their capacity for critical reflective practice.
    - Professional development and career pathways will be highlighted throughout the course content.

4. To communicate effectively
    - The module will task students with presenting work individually and in groups across a range of media.
    - Students will appraise how science is communicated in public, academic, and political environments.
    - Opportunities will be created for students to improve their abilities to write and speak about science.

Module content

1. Global Science Communication
2. History of Science and the Scientific Method
3. Paradigms of Science in Society
4. Science Education, Governance, and Policymaking
5. Equality, Ethics, and Moral Dilemmas
6. Citizen Science, Public Engagement, and Societal Challenges
7. Mass Media and social media
8. Writing and Publishing
9. Presentations, Discussions, and Debates
10. Career Progression and Professional Development
11. Reflective Practice, Module Review, and Assignment Support

Recommended reading list

- Broks, P., Gascoigne, T., Leach, J., Lewenstein, B. V., Massarani, L., Riedlinger, M., & Schiele, B. (2020). *Communicating Science: A Global Perspective*. ANU Press.
- Sagan, C., & Druyan, A. (1996). *The demon-haunted world: Science as a candle in the dark*. New York: Random House
- Trench, B. et al. (2016). *Little Country, Big Talk: Science Communication in Ireland*. Dublin: The Pantaneto Press.
- Roche, J. (2022). *Essential Skills for Early Career Researchers*. London, UK: SAGE Publishing.

Assessment details

The teaching strategy combines a blend of lectures and tutorials. The lectures will utilise interactive methods to incorporate whole class input, while discussion groups in the tutorials will be led by the teaching assistants and will facilitate teamwork and problem-based, cooperative/collaborative learning. This will offer students a flexible approach to

learning with a special emphasis on peer-assessment and self-assessment. College guidelines on universal accessibility will be followed.

The module will be assessed entirely through continuous assessment (using the Blackboard suite of tools), with both summative and formative assessment components including:

- Online engagement before, during, and after lectures and tutorials
- Reflective journaling
- Group presentations.
- Peer-assessment and self-assessment
- End of semester essay

Formative assessment will take place regularly during the course, predominantly in the tutorials. Tutorials will be led by PhD and Postdoctoral researchers, with the guidance of the course lecturers, and will provide a more informal working space for students to engage in the course content. Students will be invited to share ideas and will be taught how to critically review each other's work. This focus on self-assessment and peer-assessment will build confidence and critical skills.

It will provide students with information based on their performance and monitor their learning to aid instruction and their comprehension of teaching at regular intervals. Detailed feedback will also be provided by the teaching team on non-graded student work, which will assist students in preparing their summative assessment. Formative assessment will aid students and teaching staff to identify strengths, weaknesses, and challenges. Student feedback will be collected at the end of the module to help assess the effectiveness of the teaching strategies.

Contact hours

2 hours of lectures and 1 hour of tutorial = 3 hours per week
X 11 weeks = 33 hours per term

Contact Details:

Module Coordinator:

Prof. Joseph Roche

School of Education

E-mail: Joseph.Roche@tcd.ie

Phone: 01 896 4851

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 that 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 about 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 students 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.

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/

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 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 of 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 appear 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 9.00 am to 5.00 pm, Monday to Friday. You should not expect academic or administrative staff to respond to your emails at weekends or when the 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 is disruptive in both positive and negative ways. Before using them in your studies, you must familiarise yourself with the College policies on their 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 9 am – 5.30 pm. Closed for lunch from 1-2 pm.

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/

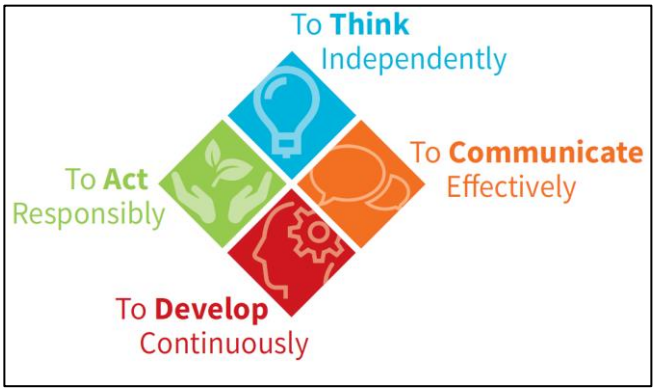
For information on Registration, Fees, Grants, ID Cards, etc. visit the Academic Registry (AR) in the Watts Building or visit the AR website: https://www.tcd.ie/academicregistry/

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

Contact Details

Course Director TR060: Biological and Biomedical Sciences

Professor TBC — E-mail:

Biology Fresh Teaching Manager

Ms. Mirela Dardac — E-mail: MDARDAC@tcd.ie
Phone: 01 896 2895

Chief Technical Officer

Ms. Audrey Carroll — E-mail: aucarrol@tcd.ie
Ph: 01 896 1049

Executive Officer/ Biology Teaching Centre Administrator

Mr. Daniel McCormick — E-mail: BTC.Administrator@tcd.ie
dmccorm2@tcd.ie
Ph: 01 896 1117

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 Desk

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

General enquiries — science@tcd.ie

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.