



Molecular and Cellular Biology

Why study this module?

This module will appeal to those with an equisitive mind, who wish to understand the fundamental workings of mammalian cells required for the viability of their own organs and body. Starting with the basics of mammalian cell structure and the function of sub-cellular organelles, the module caters for those with no background in biology. Because of the problem-solving approach to student learning, newly-gained knowledge is quickly applied in the design of a DNA recombination and protein expression experiment. Thus, the module is challenging also to the experienced biologist.

Module content

The human body contains 200 different cell types, yet all of these share a common structure. How mammalian cells are born, survive and divide, is covered by this course. Topics include cell composition & structure; structure of DNA and RNA; RNA transcription, protein synthesis; protein trafficking; the cell cycle; cell metabolism and death.

This module also gives an insight into the world of the professional cell and molecular biologist. The use of naturally-occurring enzymes and fragments of DNA to 'trick' mammalian cells into synthesising a specific protein, is explained.

Students are required to design a research experiment that addresses an unanswered question in human disease. This exercise forms part of the assessment for the module and students must not only identify the coding sequence of a protein important in human disease, but must also propose how an experiment elucidating a possible role for this protein in disease pathology could be designed, using techniques in

Completion of this module will provide a solid foundation for those wishing to undertake other more specialist modules on offer, as part of the postgraduate programmes in Biomedical Science e.g., Applied Pharmacology and Toxicology, Molecular and Regenerative Medicine, Materials Science and Biomaterials, Tissue Engineering.

cell biology, DNA recombination and cell imaging. This work is graded, along with grading of an in-class multiple choice paper or preparation of a powerpoint presentation on an assigned topic. Students are supported by tutors who provide online support via Blackboard.

While providing a foundation in cell & molecular biology for students without a background in biological sciences, this module also provides updates on the current state-of-the-art for graduate biologists.

Module facts

Course level: Level 9

Module credit: 5 ECTS. Gain transcript or use towards PG Cert/PG Dip/MSc qualification in Biomedical Science

Duration: Over one semester

Entry Requirements: Please refer to the application section of the programme brochure

Fees: €1,000

Applying: www.nuigalway.ie/apply

Closing date: 2 – 8 weeks prior to module start date

Module topics

Structure and function of mammalian cells

- Subcellular organelles
- Cell membrane
- Nucleus
- DNA and chromosomes
- Structure and processing of RNA
- DNA transcription and protein synthesis
- Post-translational modification and protein trafficking
- Mitochondria and cellular energy
- The cell cycle

Design of a DNA recombination experiment

- The scientific method
- How to search the scientific literature
- Selection of disease-relevant proteins
- Identifying DNA coding sequences
- Restriction mapping
- Design of PCR primers
- Recombining PCR products and vector DNA
- Cell culture methodology
- Forced expression of protein in mammalian cells
- Tracking of protein synthesis and localisation
- Fluorescent and light microscopy
- Current cell and molecular techniques used in research

Who is the target audience?

Graduates of Engineering, IT, Maths, Physical Sciences who are working within the medical device, pharmaceutical, diagnostic, clinical trial, pharmacy and educational sectors i.e. secondary school teachers. The module should also be of interest to long-term graduates of the Biological Sciences who wish to learn of the state-of-the-art within Molecular and Cellular Biology.

Learning outcomes

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

- Name the major structural components the mammalian cell and its constituent organelles
- List cytoskeletal, extracellular matrix, membrane and signalling proteins involved in mammalian cell interactions within cells, with each other and with the extracellular environment
- Explain how mitochondria meet the energy requirements of the cell
- Recognise and describe the function of cellular organelles involved in trafficking newly-synthesised proteins through and out of the cell
- Summarise the main steps in the cell cycle and proteins involved in regulation of each stage
- Illustrate the structure of DNA, explaining how DNA is replicated during the polymerase chain reaction (PCR) technique and how to design PCR primers
- Explain what is meant by the 'genetic code' and how it relates to protein synthesis
- Carry out a Pubmed search in order to identify molecules implicated human disease
- Use the National Cancer and Biological Institute (NCBI) nucleotide database to discover the DNA sequence encoding specific proteins and determine the length of the coding sequence and the number of constituent amino acids
- Appreciate the rigours of mammalian cell culture and how DNA recombination, protein tagging, bacterial transformation, DNA plasmids, cellular transfection and microscopy, can be used to understand protein function and localisation

Student testimonial



Philip Lonergan

Current position:

Technical Quality Manager, Abbott Diabetes Care, Donegal Town, Co. Donegal.

Position held while completing module:

Senior Project Engineer, Boston Scientific, Letterkenny, Donegal.

"Prior to beginning the Molecular and Cellular Biology Module, I had no

previous background in biological science. However, I found the content of the module particularly interesting and the teaching methodologies and learning aids were very useful in helping me to understand cell biology principles and practical applications in biomedical technology. Of particular interest to me, was an introduction to DNA recombination and PCR. Since completing the module, I was able to apply the knowledge gained to my role in Technical Quality for a biosensor application. I would recommend the module to anyone who has an interest in cell biology and the practical applications in biomedical technology."



Module Director

Dr. Una FitzGerald

Dr. Una FitzGerald is a lecturer in Biomedical Engineering Science, based in the NCBES. Una graduated from NUI Galway with a BE in Industrial Engineering and transferred to the biotechnology field through completion of a Masters degree in Biotechnology, also at NUI Galway. Following a brief spell in Nochtch Ltd, where she worked on the setting up of a monoclonal antibody production facility in Dublin, Una spent a year in France for Sanofi -Elf Bioresearch (Labege), developing serum-free media for suspension culture of IL-2-producing CHO cells. This led to a job as a junior manager in a large-scale pharmaceutical production plant at Celltech Ltd (Slough, England). After completing a PhD at the University of Strathclyde (Glasgow) Una spent the next 9 years working as a postdoctoral researcher in Glasgow working in cancer and neuroscience-related fields. In 2002 she joined Prof. Samali's Apoptosis Research group. Before taking up the post as coordinator of the MSc in Biomedical Science (via distance learning) in 2006,

Una spent 18 months lecturing on and coordinating the full-time masters programme in Biomedical science. In addition to teaching, Una manages a research group focussing on Multiple Sclerosis and neurodegenerative disorders. She currently supervises two PhD students and a senior researcher and has supervised 3 PhD students to completion. The research theme in her group centres around the endoplasmic stress signalling pathway and its impact on the pathology and repair of neurodegenerative disorders. This research is carried out using a range of techniques in cell and molecular biology, immunohistochemistry and imaging. For more information, view www.ncbes.ie. Una is also actively involved in neuroscience outreach to schools and the public, as the chief organiser of the annual 'Brain Awareness Week' event run by the Galway Neuroscience Group at NUI Galway.

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<http://ncbes.eurhost.net/bio/una--fitzgerald.aspx>