



Molecular & Regenerative Medicine



Why study this module?

Cancer, heart disease, and neurodegenerative disorders are the major causes of mortality in the Western hemisphere. This module should be taken by those who wish to gain an insight into what is thought to cause these diseases and to learn about the obstacles that must be overcome in order to develop novel therapies. This module benefits from the expertise of principal investigators who manage their own research groups.

Module content

Molecular mechanisms underlying the pathogenesis of neurodegenerative diseases, and cancer are explained. The mechanobiology of cells and how this affects tissue response to disease and to implanted devices is also covered. Development of new stem cell and gene therapies aimed at alleviating human diseases is described.

Learning outcomes

On completion of this module you will be able to:

- Describe the molecular mechanisms underlying multiple sclerosis, Alzheimer's disease, Parkinson's disease, stroke and how these mechanisms are targeted to develop new therapeutics
- List the common features of human cancers, explaining molecular causes, define tumour suppressors and oncogenes, summarise chief cancer therapies
- Give an overview of the mechanical properties of the mammalian cell and the core mechanobiological concepts underlying the design of implanted medical devices

- Summarise the principles and ethics of regenerative medicine and current uses of cell and gene therapies

Who is the target audience?

Graduates of science/engineering/technology disciplines who wish to gain specialist knowledge of the major human diseases. Those based in the medical device, pharmaceutical and diagnostic sectors may find this module particularly valuable.

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

Neurodegenerative Disorders

- Multiple sclerosis
- Alzheimer's disease
- Parkinson's disease
- Stroke
- Overview of other neurodegenerative disorders

Cancer

- Hallmarks of cancer
- Gene regulation/pathways
- Cancer as a genetic and epigenetic disease
- Oncogenes and tumour suppressors

Mechanobiology

- The mammalian cell as a mechanical structure
- Mechanosensitive proteins
- Complex mechanotransduction pathways
- The role of mechanobiology in the pathogenesis of disease
- Mechanobiology and medical device design

Gene and stem cell therapy

- Gene delivery methods
- Adenoviral and retroviral, lentiviral, adenoviral-associated vectors
- Non-viral vectors
- Types, sources and ethics of stem cells
- Identification and purification of stem cells
- Neural stem cells
- Stem cells in the clinic



Module Directors

Dr. Una FitzGerald, Professor Corrado Santocanale, Dr. Howard Fearnhead, Dr Laoise MacNamara, Dr Linda Howard.

The Neurodegenerative Disorders topic is delivered by Dr. Una FitzGerald. Una graduated from NUI Galway with a BE in Industrial Engineering and and MSc

in Biotechnology. Following five years working in the industrial pharmaceutical sector in Ireland, France and England, Una completed 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 returned to Ireland as a postdoctoral and in 2006 became the coordinator/director of the MSc in Biomedical Science (via distance learning). In addition to teaching, Una manages a research group focussing on Multiple Sclerosis and neurodegenerative disorders. 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.

Student testimonial



Caroline Glynn

Current Position:

Senior Business Development Manager & Pipeline Associate, Chanelle, Loughrea, Co. Galway.

"I really enjoyed this module, as it concerns medicine of the future and how specialised medicines can be. Despite the complexity of the topic itself the lectures were understandable and interesting. It was easy to comprehend how each molecular pathway functioned and the impact of disease. Also how that pathway could be modified or restored to provide a cure for devastating diseases. This module is applicable to my role in Business Development as I need to understand when developing new products how the medicines work and what are the molecular pathways being affected by the molecule under development."



The Multiple sclerosis content is delivered by Dr Jill McMahon.

Jill received her BSc (Hons) in Biochemistry from Queen's University Belfast after which she trained as a Medical Laboratory Scientist specialising in histopathology and cytopathology and completed her professional histology examinations in 1989. She worked in the Neuropathology Department of the Institute of Pathology, Belfast, for 8 years, gaining extensive experience in immunohistochemistry and in situ hybridisation and participated in the UK-wide UKNEQAS scheme for quality control in immunohistochemical staining. During this time she also studied for an MPhil in Pathology and the outcome of her work resulted in six peer-reviewed publications.

She then moved to the Gene Targeting Group, in Imperial College London, to work as an histologist, specialising in skeletal muscle biology. During this time she also carried out a part-time PhD in gene therapy for treatment of inherited muscle disorders such as Duchenne Muscular Dystrophy. On completion of her PhD, Jill carried out postdoctoral work on gene and stem cell therapy in the Division of Neuroscience, Imperial College London and subsequently in the Regenerative Medicine Institute (REMEDI) and the Caspase Laboratory in NUIG. She was appointed as a lecturer in the Pharmacology & Therapeutics department at NUIG. Since 2008, she has been working as a senior scientist in the Multiple Sclerosis Research Laboratory at NUIG. To date, she has published 37 peer-reviewed research papers.



The Cancer topic is delivered by Corrado Santocanale, Professor of Molecular Medicine in the National Centre for Biomedical Engineering Science and member of the Center for Chromosome Biology at NUI Galway.

Corrado received his PhD in Cellular and Molecular Biology at the University of Milan, Italy. His early work focused on the characterisation of enzymes required for the duplication of the DNA in the yeast *S. cerevisiae*. He was awarded an EU Marie Curie Postdoctoral Fellowship to work on the molecular mechanisms that control initiation of DNA replication at the Clare Hall Laboratories, Cancer Research UK, London. Corrado spent eight years in the pharmaceutical industry at the Oncology

R&D site in Nerviano, Italy (former Pharmacia/Pfizer and now Nerviano Medical Sciences), both as a group and as a project leader developing protein kinase inhibitors for the treatment of human cancers. Corrado's research interests are in the mechanisms of DNA replication in cancer cells and exploiting the results of this research for therapeutic purposes. For more information, view <http://ncbes.nuigalway.ie/bio/corrado-santocanale.aspx>.



The Cancer topic is also delivered by Dr Mary Ni Fhlathartaigh.

Mary received her BSc (Hons) in Pharmacology from NUI, Galway after which she completed a Higher diploma in Education (NUI, Galway). She taught Biology and mathematics through the medium of Irish at Colaiste Chroí Mhuire in Spiddal. Mary developed strong links with the University where she entered groups of Transition year students into Stem cell debating competition. Mary then did her PhD on models of Multiple Sclerosis within the Multiple sclerosis Research Laboratory at NUI, Galway. Following completion of her PhD, Mary carried out postdoctoral work in the Parkinson's research group in Pharmacology & Therapeutics and at a cancer biology laboratory, both in NUI, Galway. Since 2014, she has coordinated Masters programmes in the School of Natural Sciences at NUI, Galway.



The Regenerative Medicine topic is delivered by Dr. Linda Howard

After gaining her PhD from the Medical Research Council, Linda worked for three years as a postdoctoral researcher, at the Lombardi Cancer Center, Georgetown University, Washington DC, USA. She then became a postdoctoral research fellow at the Memorial Sloan Kettering Cancer Research Center, New York, where she worked on cloning, characterisation and function of cell surface proteolytic enzymes. For four years, she then joined Osiris Therapeutics in Baltimore, focusing on the characterisation and analysis of adult stem cells. On relocating to Ireland in 2005, Linda became a Senior Stem Cell Investigator in REMEDI, NUI Galway with

the topic of her research being mechanisms regulating mesenchymal stem cell (MSCs) differentiation. Since 2007, Linda has been directing and lecturing on the MSc in Regenerative Medicine course. Linda currently investigates how microRNAs regulate the differentiation of MSCs and she is also interested in the therapeutic potential of adult stem cells, particularly looking at the nervous, heart and musculoskeletal system.

For more information, view <http://www.remеди.ie/people/dr-linda-howard>.

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