



Molecular & Regenerative Medicine



Why study this module?

Cancer, heart disease, diabetes 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 the 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, cancer and diabetes 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
- Explain the causes of diabetes and research efforts at combating the disease
- 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 the pathogenesis of disease
- Mechanobiology and medical device design

Diabetes

- Regulation of blood sugar levels
- Types of diabetes mellitus
- Acute and chronic effects of diabetes
- Insulin release mechanisms
- Hypoglycaemic agents
- Combinations and treatment regimes

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



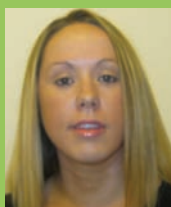
Module Directors

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 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 Diabetes topic is delivered by Dr. Howard Fearnhead from the discipline of Pharmacology & Therapeutics.

In 1991 Howard completed a BSc in Pharmacology and Toxicology at the London School of Pharmacy, before being awarded a PhD in 1995 by the University of Leicester for work performed at the MRC-Toxicology Centre. From '95 to '99 he was a postdoctoral fellow at Cold Spring Harbor Laboratory, NY before moving to the National Cancer Institute in Maryland as a principal investigator. In 2004 Howard moved to the National Centre of Biomedical Engineering Science (NCBES), NUI Galway and in 2006 was appointed a lecturer in Pharmacology and

Therapeutics. Howard's primary research interests are the apoptotic and non-apoptotic roles of caspases in the context of cancer and muscle cell differentiation. For more information view <http://ncbes.eurhost.net/bio/howard-fearnhead.aspx>.



The Mechanobiology and Implanted Medical Devices topic is delivered by Dr. Laoise MacNamara, from the discipline of Mechanical Engineering. Laoise was recruited to the Department of Mechanical and Biomedical Engineering at NUI Galway through the Science Foundation Ireland Stokes Lectureship program in 2009. She holds a PhD in Biomedical Engineering from Trinity College Dublin, Ireland and a first class honours degree in Mechanical Engineering from NUI Galway. Following her PhD she completed a postdoctoral fellowship in bone cell biology at the Department of Orthopaedic Research at Mount Sinai School of Medicine, New York. Upon completing this research she was appointed to a fixed-term lectureship in Biomedical Engineering at NUI Galway. Laoise's primary research interests are osteoporosis and the mechanobiology of cells. For more information view <http://ncbes.nuigalway.ie/bio/laoise-mcnamara.aspx>.



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.іe/people/dr-linda-howard>.

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