



# Tissue Engineering

Tissue Engineering (TE) is a multidisciplinary approach to a critical problem in modern medicine – the supply of organs and tissues for transplant. One of the goals of tissue engineering is to develop methods to construct organs in the laboratory that can subsequently be used in medical applications. Another goal is to produce organs or tissues that can be used for research purposes such as testing new drugs and simulating diseases in order to develop better treatments.

## Module content

This course integrates the principles and methods of engineering and life sciences towards the fundamental understanding of structure-function relationships in normal and pathological mammalian tissues especially as they relate to the development of biological tissues to restore, maintain, or improve tissue/organ function. TE-based treatment strategies are founded on the combination of cells, scaffolds and signals. Determining the appropriate balance between these three factors remains one of the key issues in converting promising TE research into viable tissue engineered products (TEPs).

## Learning outcomes

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

- Specify the different types of biodegradable biomaterials that can be used in tissue engineering applications
- Discuss the complex interactions between biomaterials, cells and signals in biological systems
- Demonstrate awareness of contemporary topics such as gene therapy, stem cells, proteomics, genomics and bioreactors
- Demonstrate their capability in conducting a multidisciplinary project

## Why study this module?

Tissue Engineering represents a new era of medicine that provides the potential to significantly improve the lives of many people. With successful collaboration between clinicians, scientists and engineers, Tissue Engineering shows much potential to alleviate the suffering of many by providing treatments (i.e. replacement or repair of tissues/organs) for a myriad of pathological conditions. This module provides the necessary tools for the learner to be able to conduct a Tissue Engineering based project in their own respective field of interest.

## Who is the target audience?

The target audience is anyone from industry wanting to have more knowledge about the use and design of biomaterials and medical devices and how they are used in biological systems.

## Module facts

Course level: Level 9

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

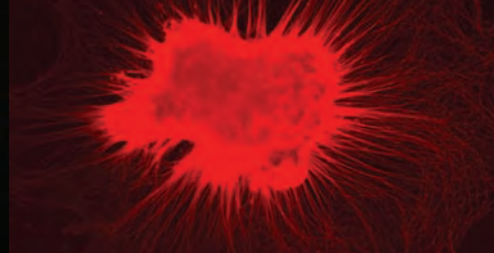
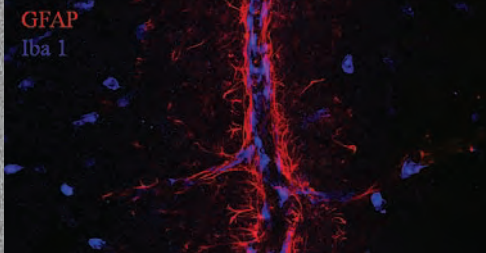
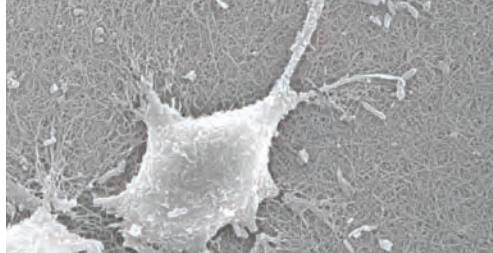
Duration: Over one semester

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

Fees: €1,000

Applying: [www.nuigalway.ie/apply](http://www.nuigalway.ie/apply)

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



## Module topics

### Introduction to Tissue Engineering

#### Cells and Tissue Engineering

- Cell Function – Role of Tissue Engineering
- Cells – Integration in Tissue Engineering
- Cells - Sources
- Stem Cells – Future in Tissue Engineering
- Cells – Immunogenicity & Preservation

#### Scaffolds I

- The Extracellular Matrix
- Cell-Extracellular Matrix Interactions
- Scaffolds in Tissue Engineering

#### Scaffolds II

- Synthetic, Natural & Composite Biomaterials
- Synthetic Bioerodible Scaffold Biomaterials
- Natural Bioerodible Scaffold Biomaterials
- Composite Bioerodible Scaffold Biomaterials
- Scaffold Fabrication Technique

#### Signals

- Soluble Biochemical Signals – Growth Factors
- How to Incorporate Biochemical Signals in TEPs
- Growth Factor Delivery
- Biomechanical Signals
- Bioreactors

#### Ethics

- Background
- Ethical Issues in Tissue Engineering

#### Status of Tissue Engineering

- Overview of Current Status of Tissue Engineering
- Case Study

## Student testimonials



### Patrick Power

#### Position held:

Aerosol Scientist at Aerogen.

"I found the Tissue Engineering module offered as part of NUI Galway's MSc in Biomedical Science particularly stimulating due to the strong involvement of the world leading NFB institute. The exposure to cutting edge research explained by those directly involved in it inspired and motivated the class to further explore the discipline. This drive was facilitated by a broadly scoped final assignment that challenged us to directly apply their knowledge in the development and application of our own unique tissue engineering treatment (combining cells, scaffolds and signals) for a disease of our choice. This focus on autonomous scientific thinking was highly rewarding.

The Tissue Engineering module also served to highlight areas of potential collaboration between NUI Galway researchers and my own company, Aerogen. The NFB and Aerogen have fostered a strong relationship and are now involved several novel collaborations with potential IP and financial reward."



### Brian de Souza

#### Position held:

Research Fellow Synthesis and Solid State Pharmaceutical Cluster University of Limerick.

"Of all the biological science modules I undertook as part of the MSc program, I found tissue engineering to be my favourite.

In addition to classroom learning, there was a strong practical element to this module. I was able to observe common processing techniques such as freeze drying and extrusion. FTIR, an analysis method which I learned during this module, is now essential to my current work. Tissue engineering is without doubt, the way of the future. I would highly recommend the module ME511 Tissue Engineering to all."



## Module Director

Dr Manus Biggs

Dr Biggs is a Science Foundation Ireland Investigator and lecturer within the department of Biomedical Engineering at NUI Galway. He received a Ph.D in cell engineering from the

University of Glasgow in 2009 through research into nanotopographical modification of orthopedic implants. This was proceeded by postdoctoral experience at Columbia University, New York, where he worked on the nanofabrication of cell platforms for probing T-cell and stem cell processes.

Dr Biggs current research is focused on applying nanofabrication techniques to novel classes of electrically conducting polymers to enhance integration of implanted neuroelectrodes and promote functionality at the brain-machine interface. He has developed tuneable electrically active scaffolds for bone and tendon regeneration through piezoelectric polymers and nanocomposites. He has established a research programme in the nanofabrication of electrically

active biomaterials, integrating material science, electronic engineering, top-down nanofabrication techniques and biological functionalization strategies in developing next generation biomaterials platforms.

Dr Biggs has published more than 35 papers in peer-reviewed journals and filed two patent applications. To date he has received 1.8 million Euros in competitive research funding. In 2014 Dr Biggs was awarded the UK Society for Biomaterials Larry Hench prize for outstanding contributions to the field of Biomaterials. Dr Biggs has been an Editorial Board Member for European Cells and Materials since 2011 and has served on the board of two grant review panels. He is leading a New Foundations Symposium at the upcoming World Biomaterials Congress, 2016, Montreal, Canada on "Engineering the Brain-Machine Interface". Dr Biggs is also a member of the European Society for Biomaterials International Advisory Committee.

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