M.Sc. in ImmunoTherapeutics

COURSE HANDBOOK 2019-2020

School of Biochemistry and Immunology
Trinity Biomedical Sciences Institute
# Table of Contents

1. Contacts ................................................................................................................................. 4
2. Foreword .................................................................................................................................. 5
3. Module Co-ordinators .............................................................................................................. 6
4. Course Objectives .................................................................................................................... 7
5. Course Structure and Timeline .............................................................................................. 8
6. Immunology: Six Core Concepts ............................................................................................ 9
7. Ten core Principles in Immunology ....................................................................................... 9
8. Modules ................................................................................................................................... 11
   Module 1 .................................................................................................................................... 11
   Module 2 .................................................................................................................................... 14
   Module 3 .................................................................................................................................... 16
   Module 4 .................................................................................................................................... 19
   Module 5 .................................................................................................................................... 21
   Module 6 .................................................................................................................................... 23
   Module 7 .................................................................................................................................... 24
   Module 8 .................................................................................................................................... 26
   Module 9 .................................................................................................................................... 28
   Timetable .................................................................................................................................... 31
9. Additional Information ............................................................................................................. 31
   Course Location ......................................................................................................................... 31
   General University Regulations, Policies and Procedures .......................................................... 31
   Examinations and Regulations .................................................................................................. 32
   Explanation of ECTS Weighting ................................................................................................ 32
   Submission Deadlines .............................................................................................................. 32
   Deadline Penalties .................................................................................................................... 32
   Attendance ................................................................................................................................. 33
   Word Limitations ...................................................................................................................... 33
   Scheme for marking of projects ............................................................................................... 33
   Plagiarism ................................................................................................................................. 34
   Submitting Assessments through Turnitin .............................................................................. 34
   Examination Rules .................................................................................................................... 35
Student Conduct for Examinations .................................................. 36
Assessment Procedure ........................................................................ 37
Research Ethics and Good Research Practice ................................... 39
Course Feedback .................................................................................. 39

10. Trinity College Dublin Related Information ........................................... 39
    The Graduate Students Union .......................................................... 39
    The Class Representative ............................................................... 40
    The Biochemical Society ............................................................... 40
    Careers Advisory Service .............................................................. 40
    Postgraduate Advisory Service ...................................................... 41
    Student Supports and Services ...................................................... 42
    Data Protection ............................................................................. 44
    Emergency Procedure .................................................................... 44
1. Contacts

Prof. Cliona O’Farrelly
Director of the M.Sc. in ImmunoTherapeutics and Co-Director of the M.Sc. in Immunology,
Comparative Immunology Group,
School of Biochemistry and Immunology,
Trinity Biomedical Sciences Institute,
Trinity College Dublin,
152-160 Pearse Street,
Dublin 2.
Phone: +353-1-8963175
Email: cliona.ofarrelly@tcd.ie

Dr. Jerrard Hayes
Co-ordinator of the M.Sc. in ImmunoTherapeutics,
School of Biochemistry and Immunology,
Trinity Biomedical Sciences Institute,
Trinity College Dublin,
152-160 Pearse Street,
Dublin 2.
Tel: +353-1-8964712
E-mail: Hayesj2@tcd.ie

Prof. Ed Lavelle
Head of School,
Adjuvant Research Group,
School of Biochemistry and Immunology,
Trinity Biomedical Sciences Institute,
Trinity College Dublin,
152-160 Pearse Street,
Dublin 2.
Phone: + 353-1- 8962488
Email: LAVELLEE@tcd.ie

Conor Spillane
School Administrative Manager
School of Biochemistry and Immunology,
Trinity Biomedical Sciences Institute,
Trinity College Dublin,
152-160 Pearse Street,
Dublin 2.
Phone: + 353-1-8961604
Email: cspillan@tcd.ie

Prof. Neville Cox
Dean of Graduate Studies,
Graduate Studies Office,
Academic Registry,
Biotech Building,
Trinity College Dublin,
Tel: +353-1-8961166
Contact details: https://www.tcd.ie/Graduate_Studies/contact/
2. Foreword

Welcome to Dublin, to Trinity and to a busy year which we hope will be exciting, challenging and rewarding for all of you. With the help of our colleagues and friends from across the campus and from other institutes, in Ireland and abroad, we have been working hard to put together a comprehensive ImmunoTherapeutics programme, which we have designed to stimulate, entertain and inform. We hope that you will all graduate from this course with a deep understanding and love for immunology and immunotherapeutics, which will open doors to exciting new career options. Upon graduation you will be our ambassadors in leading universities, hospitals and pharmaceutical companies across the globe. Enjoy yourselves, work hard and make great discoveries.

Cliona O’Farrelly, Ph.D.
Professor of Comparative Immunology,
Director, M.Sc. ImmunoTherapeutics

Jerrard Hayes, Ph.D.
Assistant Professor of Glycobiology
Co-ordinator, M.Sc. ImmunoTherapeutics

Cliona O’Farrelly (Director) is Professor of Comparative Immunology in the School of Biochemistry and Immunology and the School of Medicine at TCD. She graduated with a BA Moderatorship in Microbiology from TCD in 1977 and a PhD in Immunology, also from TCD in 1982. Cliona and her Comparative Immunology research group use combinations of in silico, molecular and cellular technologies to discover and examine new genes, proteins and cells of innate and adaptive immune systems from different species and in different organs, particularly the liver and uterus. The influence of these immune components on the hosts’ susceptibility to pathogens, especially Hepatitis C virus, and cancer, is a major focus. Cliona has extensive experience in graduate training, having graduated 38 Ph.D., 7 M.D. and 5 M.Ch. students and developed the MSc in Immunology, together with her colleagues, Nigel Stevenson and Andrew Lloyd as well as this new MSc in Immunotherapeutics with Drs Jerrard Hayes, Darren Fayne, Aisling Dunne and Vincent Kelly. A recipient of the Irish Research Scientists’ Association Gold Medal, the Graves Medal, the Conway Medal and the Isla Hasliday Award, Cliona was President of the Irish Society of Immunology from 2000-2007 and was awarded the Nature Mentoring Award in 2014. Email: cliona.ofarrelly@tcd.ie

Jerrard Hayes (Co-ordinator) is Assistant Professor in Glycobiology in the School of Biochemistry and Immunology at TCD. He graduated with a BA Moderatorship (first class) in biochemistry from TCD in 2004 and a PhD in molecular enzymology from TCD in 2009 under the supervision of Prof. Tim Mantle. From 2010-2013 he worked with Prof. Pauline Rudd in the Oxford-Dublin glycobiology group in the National Institute for Bioprocessing, Research and Training (NIBRT). His research interests focus on the role of sugar chains (glycans) in antibody function and the immune response. He has worked on research projects with biopharma companies MSD, GE Healthcare, Abbvie (US), Bohereiner Ingleheim, Schering Plough.


### 3. Module Co-ordinators

<table>
<thead>
<tr>
<th><strong>Ex officio Role</strong></th>
<th><strong>Name</strong></th>
<th><strong>Academic title</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Course Director</strong></td>
<td>Professor Cliona O’Farrelly</td>
<td>Professor of Comparative Immunology</td>
</tr>
<tr>
<td><strong>Course coordinator</strong></td>
<td>Assistant Professor Dr. Jerrard Hayes</td>
<td>Assistant Professor in Glycobiology</td>
</tr>
<tr>
<td><strong>Director of postgraduate teaching and learning</strong></td>
<td>Professor Rachel McLoughlin</td>
<td>Professor in Immunology</td>
</tr>
<tr>
<td><strong>Module 1 coordinator</strong></td>
<td>Professor Cliona O’Farrelly</td>
<td>Professor of Comparative Immunology; Assistant Professor in Glycobiology</td>
</tr>
<tr>
<td><strong>Module 2 coordinator</strong></td>
<td>Associate Professor Dr. Vincent Kelly</td>
<td>Associate Professor in Biochemistry</td>
</tr>
<tr>
<td><strong>Module 3 coordinator</strong></td>
<td>Assistant Professor Dr. Jerrard Hayes</td>
<td>Assistant Professor in Glycobiology</td>
</tr>
<tr>
<td><strong>Module 4 coordinator</strong></td>
<td>Assistant Professor Dr. Aisling Dunne</td>
<td>Assistant Professor in Neuroinflammation</td>
</tr>
<tr>
<td><strong>Module 5 coordinator</strong></td>
<td>Prof. Cliona O’Farrelly</td>
<td>Professor of Comparative Immunology</td>
</tr>
<tr>
<td><strong>Module 6 coordinator</strong></td>
<td>Assistant Professor Dr. Jerrard Hayes</td>
<td>Assistant Professor in Immunology</td>
</tr>
<tr>
<td><strong>Module 7 coordinator</strong></td>
<td>Assistant Professor Dr. Andrei Budanov</td>
<td>Assistant Professor in Biochemistry</td>
</tr>
<tr>
<td><strong>Module 8 coordinator</strong></td>
<td>Assistant Professor Dr. Jerrard Hayes</td>
<td>Assistant Professor in Glycobiology</td>
</tr>
<tr>
<td><strong>Module 9 coordinator</strong></td>
<td>Prof. Cliona O’Farrelly</td>
<td>Professor of Comparative Immunology</td>
</tr>
<tr>
<td><strong>Student representative</strong></td>
<td>Class representative to be appointed</td>
<td></td>
</tr>
<tr>
<td><strong>Industry Representative 1</strong></td>
<td>Dr. Jeremy Skillington</td>
<td>Vice President Business Development, Inflazome Ltd</td>
</tr>
<tr>
<td><strong>Industry Representative 2</strong></td>
<td>Dr. Ena Prosser</td>
<td>CEO, Fountain Healthcare Partners</td>
</tr>
<tr>
<td><strong>Administrative support</strong></td>
<td>To be appointed</td>
<td>Administrative officer</td>
</tr>
</tbody>
</table>

An Industry Advisory Group consisting of key thought-leaders from industry will be established to consult and advise on the content and structure of the MSc once implemented. Two industry representatives: Dr Ena Prosser (Fountain Healthcare Partners) and Dr. Jeremy Skillington (Inflazome) will act as consultants to advise on the needs of Industry and the required skills of graduates for the biopharma industry. The course committee with industry representatives will meet every 6 months to discuss the course content and progress. Meeting will be chaired by Prof. Cliona O’Farrelly.
4. Course Objectives

On successful completion of the MSc in ImmunoTherapeutics students should possess a solid theoretical and practical background in the area of immunotherapeutics and be able to:

1. Discuss and critically appraise the fundamental concepts of immunology, cellular and molecular biology and its application to discovering new targets for immunotherapeutics.
2. Critically appraise the scientific and clinical challenges pertinent to immunotherapeutic design and treatment of disease.
3. Analyse and explain the limitations and potentials of immunotherapeutics when used as standard therapies, combination therapies or for targeted ‘personalised’ treatments.
4. Appraise and evaluate the role of biomarkers, pathological indicators and imaging technologies during disease treatment.
5. Critically appraise, describe and evaluate the immunotherapeutic discovery and development process.
6. Analyse and evaluate genomic and proteomic data through bioinformatics and statistical analysis.
7. Discuss the exploitation of disease targets and immune modulation in the discovery and development of novel immunotherapeutics.
8. Evaluate and explain key concepts and processes in the field of entrepreneurship and innovation and appraise how well these apply in practice.
9. Demonstrate competency in the theoretical and practical aspects of bioprocessing and bioproduction including their application in the immunotherapeutic biopharma industry.
10. Critically appraise and evaluate research protocols and manuscripts, statistically evaluate data, write research reports, formulate research hypothesis, design experimental studies and conduct quality scientific research in an ethical manner.

Outcomes 1-9 will be attained by students completing the Postgraduate Diploma. Outcome 10 completes the course to the Masters level.
5. Course Structure and Timeline

<table>
<thead>
<tr>
<th>Module Title</th>
<th>Module Code</th>
<th>Module Co-ordinator</th>
<th>ECTS</th>
<th>Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1: Fundamental Immunology</td>
<td>IMP77301</td>
<td>Professor Cliona O’Farrelly</td>
<td>10</td>
<td>Michaelmas</td>
</tr>
<tr>
<td>M2: Advanced Technologies</td>
<td>IMP77302</td>
<td>Associate Professor Dr Vincent Kelly</td>
<td>5</td>
<td>Michaelmas</td>
</tr>
<tr>
<td>M3: Immunotherapeutics</td>
<td>IMP77303</td>
<td>Assistant Professor Dr. Jerrard Hayes</td>
<td>20</td>
<td>Michaelmas</td>
</tr>
<tr>
<td>M4: Innovation and Drug Development</td>
<td>IMP77304</td>
<td>Assistant Professor Dr. Aisling Dunne</td>
<td>5</td>
<td>Michaelmas</td>
</tr>
<tr>
<td>M5: Entrepreneurial Action in Immunotherapeutic Biopharma</td>
<td>IMP77305</td>
<td>Professor Cliona O’Farrelly</td>
<td>5</td>
<td>Michaelmas</td>
</tr>
<tr>
<td>M6: Research in Action</td>
<td>IMP77306</td>
<td>Assistant Professor Dr. Jerrard Hayes</td>
<td>5</td>
<td>Michaelmas</td>
</tr>
<tr>
<td><strong>Total 50 ECTS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M7: Bioinformatics and Statistics</td>
<td>IMP77307</td>
<td>Assistant Professor Dr. Andrei Budanov</td>
<td>5</td>
<td>Michaelmas and Hilary</td>
</tr>
<tr>
<td>M8: Bioprocessing Training</td>
<td>IMP77308</td>
<td>Assistant Professor Dr. Jerrard Hayes</td>
<td>5</td>
<td>Hilary</td>
</tr>
<tr>
<td>M9: Project Placement and Dissertation</td>
<td>IMP77309</td>
<td>Professor Cliona O’Farrelly</td>
<td>30</td>
<td>Hilary and Trinity</td>
</tr>
<tr>
<td><strong>Total 40 ECTS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6. Immunology: Six Core Concepts

1. **Identification & Discrimination** (harmful and harmless microbes/harmful & harmless self)

2. **Tolerance** of harmless foreign antigens: foetal, dietary, commensal: no response


4. **Immunisation** referring to both specific, adaptive and non-specific memory displayed by cells of the immune system

5. **Breakdown** or inappropriate immunoregulation: disease
   a. chronic infection
   b. chronic inflammation
   c. autoimmunity
   d. allergy
   e. cancer

6. **Immunotherapy**

7. Ten core Principles in Immunology

1. The **innate immune system** is activated following recognition of conserved moieties expressed by microbes or released during host cell death or tissue damage. Recognition is mediated by highly conserved receptors (TLRs, NLRs, RIGs) which signal through pathways of conserved components to initiate expression of a large number of genes that code for proteins with effector (AMPs) and regulatory functions (cytokines & chemokines). Cytokines produced during local inflammatory responses induce systemic inflammation by activating the acute phase response in the liver.

2. **Innate effector mechanisms** which are activated by the above recognition systems during inflammation resulting in target killing and/or elimination, include Natural Killer cells, complement, opsonisation, phagocytosis, respiratory burst and antimicrobial peptide (AMPs) activity and \( \gamma \delta \) T cell activation.

3. **Adaptive immunity**, involving T and B lymphocytes, relies on generation of receptors of exquisite specificity and immunological memory, both key features of successful
vaccination. These antigen receptors are coded for by gene segments that rearrange during lymphocyte development and when translated into protein, mediate selection during T cell development as well as clonal expansion of T & B cells.

4. Cells of the innate and adaptive immune system are generated from haemopoietic stem cells which differentiate along myeloid and lymphoid lineages to give rise to NK cells, lymphocytes, granulocytes, macrophages and dendritic cells.

5. **Antigen presenting cells** (DCs) in the peripheral tissues and organs phagocytose and process pathogen derived molecules, travel to lymph nodes and present resulting peptide antigens in the context of MHC molecules expressed on their surface. MHC:peptide complexes are recognised by T Cell Receptors (TCRs which have been generated by gene rearrangement) on naïve mature T cells in lymph nodes.

6. B cells use antigen receptors, also generated by gene segment rearrangement, to recognise soluble antigen; they then proliferate, differentiate and secrete antibody of the same specificity as the receptor expressed on their cell surface. Class switching results in a different antibody type of the same specificity.

7. There are five classes of antibody (IgM, IgD, IgG, IgA, IgE) whose specificity resides in the Fab portion and biological function is dependent on the FC portion; two identical heavy chains and two identical light chains combine to form the basic unit of all antibody molecules.

8. **Cytotoxic T lymphocytes** kill virally infected cells through recognition of peptide generated endogenously and presented by MHC class I; viral infection and transformation alters class I expression, thus allowing NK cell mediated killing.

9. **CD4 T cell** recognition of antigen presented by Class II expressing DCs results in their clonal expansion and differentiation towards specialised cytokine secreting subsets of cells (Th1, Th2, TH17, Treg etc.) which can direct and amplify innate and adaptive immune responses.

10. Elaborate regulatory mechanisms control all of these activities. Breakdown in these mechanisms results in disease, including autoimmune disease, chronic infection, allergy and cancer. Understanding immunoregulation and identifying its molecular targets underpins discovery of new immunotherapies.
8. Modules

The School reserves the right to amend the list of available modules and, in particular to withdraw and add modules. Timetabling may restrict the availability of modules to individual students.

Module 1

**Title:** Fundamental Immunology (IMP77301)

**Credit Weighting:** 10 ECTS

**Term:** Michaelmas

**Co-ordinators:** Cliona O’Farrelly and Nigel Stevenson

**Module Overview**

This module aims to give a general and comprehensive introduction of immunology to students who have had little formal prior exposure to immunology. Basic terms and concepts of innate and adaptive immunity will be presented in a logical and accessible fashion. Students will be familiarised with immunological terms and introduced to the functions of the principle organs, cells, molecules and genes involved in initiating and mediating successful immune responses. By the end of the module, students should be able to explain fundamental immunological concepts and discuss the roles of functional components of the immune system including haematopoietic cells, acute phase proteins, pathogen recognition receptors, complement, TCRs, immunoglobulins and cytokines. They should also understand some basic concepts of immunological dysregulation seen in inflammatory and autoimmune diseases, allergy, malignancy and immunopathogenesis. Lectures will be supplemented with tutorials, where lecture topics will be discussed and each student will help present and explain research articles chosen from scientific review articles thereby further relating the module topics with course material.

**Learning Outcomes**

On the successful completion of this module students should be able to:

- Describe fundamental concepts in immunology
- Describe the role of immunological dysfunction in the pathogenesis of certain diseases
- Describe how manipulating the immune system can be used to treat disease
- Analyse recent developments in immunology
- List the application of key immunological techniques in research
- Read, interpret and critically analyse primary immunological literature
- Discuss immunological topics in group situations
### Lectures

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Topic</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introductory overview</td>
<td>Cliona O’Farrelly</td>
</tr>
<tr>
<td>2</td>
<td>Cells and Organs of the Immune System</td>
<td>Cliona O’Farrelly</td>
</tr>
<tr>
<td>3</td>
<td>Introduction to Immunological Techniques</td>
<td>Cliona O’Farrelly</td>
</tr>
<tr>
<td>4</td>
<td>Inflammation</td>
<td>Louise Glover</td>
</tr>
<tr>
<td>5</td>
<td>Cytokines</td>
<td>Nigel Stevenson</td>
</tr>
<tr>
<td>6</td>
<td>Natural Killer Cells</td>
<td>Clair Gardiner</td>
</tr>
<tr>
<td>7</td>
<td>Tissue Resident and Myeloid Cells of the Immune System</td>
<td>Cliona O’Farrelly</td>
</tr>
<tr>
<td>8</td>
<td>CD3+ TCR Structure and Function</td>
<td>Cliona O’Farrelly</td>
</tr>
<tr>
<td>9</td>
<td>Antigen Processing and Presentation</td>
<td>Derek Doherty</td>
</tr>
<tr>
<td>10</td>
<td>Cellular and Molecular Components of Adaptive Immunity II</td>
<td>Kingston Mills</td>
</tr>
<tr>
<td>11</td>
<td>Antibody Structure and Function I</td>
<td>Jerrard Hayes</td>
</tr>
<tr>
<td>12</td>
<td>Antibody Structure and Function II</td>
<td>Jerrard Hayes</td>
</tr>
<tr>
<td>13</td>
<td>Complement</td>
<td>Michael Carty</td>
</tr>
<tr>
<td>14</td>
<td>Lymphocyte Development</td>
<td>Cliona O’Farrelly</td>
</tr>
<tr>
<td>15</td>
<td>Review of MCQ</td>
<td>Cliona O’Farrelly</td>
</tr>
<tr>
<td>16</td>
<td>Lymphocyte Development II</td>
<td>Cliona O’Farrelly</td>
</tr>
<tr>
<td>17</td>
<td>Immunological Mechanisms in Action</td>
<td>Derek Doherty</td>
</tr>
<tr>
<td>18</td>
<td>Immunometabolism I</td>
<td>Dave Finlay</td>
</tr>
<tr>
<td>19</td>
<td>Immunometabolism II</td>
<td>Luke O’Neill</td>
</tr>
<tr>
<td>20</td>
<td>Tolerance and ImmunoRegulation</td>
<td>Jean Fletcher</td>
</tr>
<tr>
<td>21</td>
<td>Review session</td>
<td>Cliona O’Farrelly</td>
</tr>
</tbody>
</table>

### Tutorials:

Five tutorial sessions will accompany the lectures; relevant reviews will be discussed at each session. The aim of these tutorials will be to use these reviews to explore the material presented at lectures in more depth and to discuss misunderstandings or misconceptions. Students will be expected to contribute, ask questions and engage in discussion at each tutorial. These contributions will be assessed. Each student will be expected to have read the relevant review prior to the tutorial and will be expected to bring 3 relevant Multiple Choice Questions (MCQs) that have 5 answer options (a-e) (one of which must be the correct answer; so over the course of the Module, each student will have submitted 15 MCQs). At the end of the module, an MCQ exam covering the tutorial material will be set and 1 question from each student will be used in the exam.

### Tutorial Group Leaders:

Michelle Armstrong; [michelle.armstrong@tcd.ie](mailto:michelle.armstrong@tcd.ie) (Head Leader)
Olwyn Mahon; [olmahon@tcd.ie](mailto:olmahon@tcd.ie)
Eoin
Jenny Mannion
Eimear
Jamie
Module Assessment
Assessment of this course will consist of a combination of
(a) 2 sets of MCQs (70%)
(b) Tutorial MCQ and assignment (30%)

Reading/Learning Resources:

Reviews to be covered in tutorials will be given out at the beginning of the course.
Module 2

Title: Advanced Technologies (IMP77302)
Credit Weighting: 5 ECTS
Term: Michaelmas
Co-ordinator: Vincent Kelly

Module Overview

The development of immunotherapeutics has been made possible by decades of technological advancements in genetic and protein engineering, immune and stem cell culture and viral and nucleic acid-based delivery systems. This module will provide the student with the knowledge to understand how immunotherapeutics are made and their application to select diseases. The areas that will be covered include protein engineering and therapeutic design, monoclonal antibody construction, nucleic acid technology and genetic engineering from RNAi therapeutics to gene therapy and gene editing by CRISPR, cell-based therapeutics such as stem cells and CAR-T cells and small molecule inhibitors. On completion of the module the student will have gained a detailed knowledge of the technologies used to produce immunotherapeutics. This information will underpin later modules that describe the application of immunotherapeutics to disease and in the research project.

Learning Outcomes

On the successful completion of this module students should be able to:

- Describe, evaluate and communicate the advanced technologies used in the biopharmaceutical industry for the development of novel immunotherapeutic drugs
- Explain the fundamental science and mechanisms behind the use of protein, cell, nucleic acid and small molecule based therapeutics
- Analyse, evaluate and compare a range of state of the art technologies for disease specific immunotherapeutic development and identification of drug targets
- Evaluate and communicate the role of advanced technologies for the research-based project

Lectures

1. Introduction to Advanced Technologies Module
   Vincent Kelly

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Topic</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Advanced Technologies for antibody discovery and engineering</td>
<td>Orla Cunningham (Pfizer)</td>
</tr>
<tr>
<td></td>
<td>Directed evolution, Humanized antibodies, Phage Display</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Applications of Antibody Discovery Platforms</td>
<td>Orla Cunningham (Pfizer)</td>
</tr>
<tr>
<td></td>
<td>Antibody manufacturing</td>
<td>Brian Hassett (Pfizer)</td>
</tr>
<tr>
<td>---</td>
<td>------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>4, 5</td>
<td>CHO cells, quality control, bioprocessing (2 hours)</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Glycobiology and Glycoengineering of Antibody Constructs</td>
<td>Jerrard Hayes</td>
</tr>
<tr>
<td><strong>Nucleic acid based therapies</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Gene therapies</td>
<td>Vincent Kelly</td>
</tr>
<tr>
<td>8</td>
<td>Antisense and RNAi therapeutics</td>
<td>Derek Nolan</td>
</tr>
<tr>
<td>9</td>
<td>Genome engineering technologies</td>
<td>Vincent Kelly</td>
</tr>
<tr>
<td>10</td>
<td>DNA/RNA vaccines</td>
<td>Ed Lavelle</td>
</tr>
<tr>
<td><strong>Cell-based therapies</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Chimeric antigen receptor T cells</td>
<td>Vincent Kelly</td>
</tr>
<tr>
<td>12</td>
<td>Natural killer cell immunotherapy</td>
<td>Clair Gardiner</td>
</tr>
<tr>
<td>13</td>
<td>Stem cell therapies</td>
<td>Vincent Kelly</td>
</tr>
<tr>
<td><strong>Immunomodulatory molecules</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Ligand-based drug design</td>
<td>Darren Fayne</td>
</tr>
<tr>
<td>15</td>
<td>Structure-based drug design</td>
<td>Darren Fayne</td>
</tr>
<tr>
<td>16</td>
<td>Drug Design software workshop</td>
<td>Darren Fayne</td>
</tr>
</tbody>
</table>

**Practicals**

One 2 hour MOE drug design software workshop.

**Assessment**

Assessment of this course will consist of a combination of:

(a) 1 x MCQs (40%)
(b) Answer 10 out of 12 short questions (40%)
(c) Ongoing assessment during the MOE workshop with a 30 minute exam at the end of the second session (20%)

**Reading/Learning Resources**

1. Virtual Screening in Drug Discovery. Juan Alvarez, Brian Shoichet (Eds)

Additional relevant and topical literature will be suggested by individual lecturers in this module and will comprise of current manuscripts which will be accessible to the students via the Trinity library website and Pubmed.
Module 3

Title: Immunotherapeutics (IMP77303)
Credit Weighting: 20 ECTS
Term: Michaelmas
Co-ordinator: Jerrard Hayes

Module Overview

Immunotherapeutics are standard-of-care for many diseases and an area of intense research and development interest for large and small biopharmaceutical companies. The impact of advances in immunotherapeutics on patient health will be exemplified to students through case studies in four disease areas: autoimmune, inflammatory, vaccines and cancer. Students will explore the capabilities of disease control by targeting and manipulating the immune system. This unique module integrates expertise from academics, clinicians and industry leaders to demonstrate current treatment modalities and discuss future possibilities for immunotherapeutic development.

This module will detail the underlying immunological mechanisms for disease pathogenesis and a fundamental understanding that will inform clinical discussions around how immunotherapeutics being used to target these malfunctioning processes treat disease. Industry leaders from large biopharma and SMEs will discuss their in-house immunotherapeutics development strategies, the rationale guiding choice of biological target and disease area, discovery and optimisation of small molecule, macromolecule or cell modalities and progression of immunotherapeutics through the development and approval pipeline.

Learning Outcomes

Upon successful completion of this module students should be able to:

- Explain the underlying immunological mechanisms targeted by immunotherapeutics in treating disease
- Critically evaluate and describe the choice of immunotherapeutic in the clinic
- Analyse recent developments in the development of immunotherapeutics
- Explain the interconnectivity between academic, clinical and industry research in treating patients

Lectures

Introduction to Immunotherapeutics module by Luke O’Neill

1. Autoimmune Disease (5 ECTS)

Lead: Jean Fletcher
<table>
<thead>
<tr>
<th>Lecture</th>
<th>Topic</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction to autoimmunity</td>
<td>Jean Fletcher</td>
</tr>
<tr>
<td></td>
<td><strong>Multiple Sclerosis</strong></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Pathogenesis &amp; Treatments</td>
<td>Jean Fletcher</td>
</tr>
<tr>
<td></td>
<td>Clinical</td>
<td>Jean Fletcher</td>
</tr>
<tr>
<td>3&amp;4</td>
<td>Workshop: Case study presentation</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td><strong>Rheumatoid Arthritis</strong></td>
<td>Ursula Fearon</td>
</tr>
<tr>
<td>6</td>
<td>Pathogenesis &amp; Treatments</td>
<td>Doug Veale</td>
</tr>
<tr>
<td>7&amp;8</td>
<td>Clinical</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td><strong>Psoriasis</strong></td>
<td>Andreea Petrasca</td>
</tr>
<tr>
<td>10&amp;11</td>
<td>Pathogenesis &amp; Treatments</td>
<td>Ann Marie Tobin</td>
</tr>
<tr>
<td></td>
<td>Clinical</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td><strong>Allergies</strong></td>
<td>Padraic Fallon TBC</td>
</tr>
<tr>
<td>13&amp;14</td>
<td>Pathogenesis &amp; Treatments</td>
<td>Niall Conlon TBC</td>
</tr>
<tr>
<td></td>
<td>Clinical</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Workshop: Case study presentation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 hours</td>
<td>JH &amp; COF</td>
</tr>
</tbody>
</table>

2. Inflammatory Disease (5 ECTS)

**Lead: Aisling Dunne**

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Topic</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction to inflammatory diseases</td>
<td>Aisling Dunne</td>
</tr>
<tr>
<td></td>
<td><strong>Inflammatory Bowel Disease</strong></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Pathogenesis &amp; Treatments</td>
<td>Pat Walsh (TBC)</td>
</tr>
<tr>
<td></td>
<td>Clinical</td>
<td>Barbara Ryan TBC</td>
</tr>
<tr>
<td>3&amp;4</td>
<td>Workshop: Case study presentation</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td><strong>Neuroinflammation</strong></td>
<td>Gavin Davey</td>
</tr>
<tr>
<td></td>
<td>Pathogenesis &amp; Treatments</td>
<td>Gavin Davey</td>
</tr>
<tr>
<td>6&amp;7</td>
<td>Clinical</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Workshop: Case study presentation</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td><strong>Osteoarthritis</strong></td>
<td>Aisling Dunne</td>
</tr>
<tr>
<td></td>
<td>Pathogenesis &amp; Treatments</td>
<td>Geraldine</td>
</tr>
<tr>
<td>9&amp;10</td>
<td>Clinical</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Workshop: Case study presentation</td>
<td>McCarthy TBC</td>
</tr>
<tr>
<td>11</td>
<td><strong>Cardiovascular disease</strong></td>
<td>Frederick Sheedy</td>
</tr>
<tr>
<td></td>
<td>Pathogenesis &amp; Treatments</td>
<td>James O’Donnell</td>
</tr>
<tr>
<td>12&amp;13</td>
<td>Clinical</td>
<td>TBC</td>
</tr>
<tr>
<td></td>
<td>Workshop: Case study presentation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 hours</td>
<td>JH &amp; COF</td>
</tr>
</tbody>
</table>
3. Cancer Immunology and Vaccination (10 ECTS)

**Leads: Lydia Lynch, Vincent Kelly and Ed Lavelle**

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Topic</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction to Cancer 1 &amp; Immunotherapy</td>
<td>Lydia Lynch</td>
</tr>
<tr>
<td>2</td>
<td>Introduction to Cancer 2 &amp; Immunotherapy</td>
<td>Roisin Loftus</td>
</tr>
<tr>
<td>3</td>
<td>Introduction to Cancer 3 &amp; Immunotherapy</td>
<td>Lydia Dyck</td>
</tr>
</tbody>
</table>

**Hematological Cancers**

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Topic</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Pathogenesis &amp; Treatments</td>
<td>Tony McElligott</td>
</tr>
<tr>
<td>5</td>
<td>Clinical</td>
<td>Mike McCarthy/Paul Browne (TBC)</td>
</tr>
<tr>
<td>6</td>
<td>Workshop: Case study presentation</td>
<td></td>
</tr>
</tbody>
</table>

**Eosophageal and Oral Cancers**

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Topic</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Pathogenesis &amp; Treatments</td>
<td>Danny Zisterer/Maeve Lowery</td>
</tr>
<tr>
<td>8</td>
<td>Clinical</td>
<td>(TBC)</td>
</tr>
<tr>
<td>9</td>
<td>Workshop: Case study presentation</td>
<td></td>
</tr>
</tbody>
</table>

**Liver Cancer**

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Topic</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Pathogenesis &amp; Treatments</td>
<td>Cliona O’Farrelly/Austin Duffy</td>
</tr>
<tr>
<td>11</td>
<td>Clinical</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Workshop: Case study presentation</td>
<td></td>
</tr>
<tr>
<td>2 hours</td>
<td>Clinical Case Study</td>
<td>COF</td>
</tr>
</tbody>
</table>

**Lecture**

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Topic</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction to vaccines</td>
<td>Ed Lavelle</td>
</tr>
</tbody>
</table>

**Bacterial infection**

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Topic</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Pathogenesis &amp; Treatments</td>
<td>Natalia Munoz-Wolf/Cliona NiCheallaigh</td>
</tr>
<tr>
<td>3</td>
<td>Clinical</td>
<td>JH</td>
</tr>
<tr>
<td>4</td>
<td>Workshop: Case study presentation</td>
<td></td>
</tr>
</tbody>
</table>

**Site Visits**

<table>
<thead>
<tr>
<th>Time</th>
<th>Location</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-4 hours</td>
<td>Pfizer</td>
<td>Orla Cunningham</td>
</tr>
<tr>
<td>3-4 hours</td>
<td>Avectus</td>
<td>Shirley O’Dea</td>
</tr>
</tbody>
</table>

**Module Assessment**

One clinical case study per subsection (60%)
Written Exam: Answer 10 of 12 short answer questions (30%)
Site visit summaries x2 (10%)

**Recommended Reading List**

Concepts in Immunology and Immunotherapeutics. Fourth Edition, Blaine T. Smith (Editor)
Reading will be assigned for each subsection
Module 4

Title: Innovation and Drug Development (IMP77304)
Credit Weighting: 5 ECTS
Term: Michaelmas
Co-ordinator: Aisling Dunne

Module Overview

Breakthroughs in immunology research and technologies leading to the development of immunotherapeutic drugs have had remarkable success in the treatment of cancer, infectious diseases and autoimmune conditions. This module is designed to describe the drug development process from bench to bedside with particular focus on cancer immunotherapeutics, vaccines and autoimmune therapies. Representatives from Pharma and smaller startup companies will describe drug development from their perspective and discussions will take place on how to get a drug to market. Also included in the module is the technology transfer process and regulatory affairs, clinical trials and finance and marketing. The Module will primarily be taught through workshops and group exercises where students will work alone and in groups to discuss and develop ideas and communicate these through a number of mediums such as group presentations and video pitches.

Learning Outcomes

On successful completion of this module students should be able to:

- Analyse, describe and evaluate how immunotherapeutic drugs target innate and adaptive immune pathways to modulate immune responses and provide effective therapy for a range of immunological disorders and diseases
- Evaluate and communicate the drug development process from bench to bedside
- Critically analyse clinical trial data and information
- Explain how to protect your assets: patents and intellectual property rights
### Lectures

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Topic</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction</td>
<td>Jerrard Hayes</td>
</tr>
<tr>
<td>2-6</td>
<td>Drug Discovery to Development (Industry</td>
<td>John McCafferty - Case study - Start Ups - Cambridge Antibody Discovery</td>
</tr>
<tr>
<td></td>
<td>lecturers)</td>
<td>Orla Cunningham - Career Development in Industry - Pfizer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shirley O’ Dea - Campus Spin-Out - Avectas</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ash Bahl - Business development - Carrick Therapeutics</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Helen Sheridan - Marketing and Spin Outs - TCD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Darren Cunningham - Financing the Venture - Inflection Therapeutics</td>
</tr>
<tr>
<td>7</td>
<td>Clinical trials</td>
<td>Maeve Lowery St James’s Hospital TCD</td>
</tr>
<tr>
<td>8</td>
<td>Regulatory Affairs and Ethics</td>
<td>Sean Barry (HPRA) Siobhan O’Sullivan</td>
</tr>
</tbody>
</table>

### Workshop

<table>
<thead>
<tr>
<th>Workshop</th>
<th>Topic</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Intellectual property/Technology transfer</td>
<td>Aoife Tierney</td>
</tr>
<tr>
<td></td>
<td>workshop</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Clinical Trial design workshop</td>
<td>Maeve Lowery</td>
</tr>
<tr>
<td>3</td>
<td>Regulatory Affairs workshop</td>
<td>Sean Barry</td>
</tr>
<tr>
<td>4</td>
<td>Finance of Product Development</td>
<td>Ena Prosser</td>
</tr>
<tr>
<td>5</td>
<td>Case Study – Inflazome</td>
<td>Jeremy Skillington</td>
</tr>
</tbody>
</table>

### Module Assessment

A comprehensive report on the process followed to successfully spin-out an immunotherapeutic focused biopharma company from a university (100%)

### Reading/Learning Resources
Reviews and research papers as directed in lectures
Module 5

Title: Entrepreneurial Action in Immunotherapeutic Biopharma (IMP77305)
Credit Weighting: 5 ECTS
Term: Michaelmas
Co-ordinator: Cliona O’Farrelly

Module Overview

Students will be taught to develop entrepreneurial and innovation skills through a module in the Trinity Tangent and Workspace Ideas area. In the Entrepreneurial Action and Innovation module students will be shown how to identify opportunities and adapt the characteristics of the entrepreneur and to define business models and their use and limitations. They will also learn feasibility analysis and how to build and manage a portfolio and pipeline of development projects that fit strategically with venture objectives. The 5 ECTS module will consist of 6 online lectures/videos and 5 workshops/lectures.

Learning Outcomes

On successful completion of this module students should be able to:

- Develop, analyse and communicate entrepreneurial ideas and skills in group settings and teams
- Devise a plan to exploit a new biopharma opportunity
- Evaluate opportunities for the immunotherapeutic market fit and feasibility
- Describe the components of an immunotherapeutic business plan
- Apply appropriate project and financial evaluation methods to immunotherapeutic projects

Lectures

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>10th September 2019</td>
<td>1pm – 2pm</td>
<td>In Class: Orientation: Module and Assessment Briefs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Introduction: Staff &amp; key contributors</td>
</tr>
<tr>
<td>17th September 2019</td>
<td>6pm – 8pm</td>
<td>In Class: Understanding Team Roles</td>
</tr>
<tr>
<td>24th September 2019</td>
<td></td>
<td>Online: What is innovation?</td>
</tr>
<tr>
<td>1st October 2019</td>
<td></td>
<td>Online: Theories of Creativity &amp; Design</td>
</tr>
<tr>
<td>9th October 2019</td>
<td>6pm – 8pm</td>
<td>In Class: Resolving Conflicts in Teams</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Assigned groups and assignment</td>
</tr>
<tr>
<td>15th October 2019</td>
<td></td>
<td>Online: Rapid Idea Generation &amp; Insights</td>
</tr>
<tr>
<td>29th October 2019</td>
<td></td>
<td>Online: Design Thinking &amp; Doing</td>
</tr>
<tr>
<td>Date</td>
<td>Time</td>
<td>Event</td>
</tr>
<tr>
<td>----------------------</td>
<td>------------</td>
<td>--------------------------------------------</td>
</tr>
<tr>
<td>5th November 2019</td>
<td>6pm – 8pm</td>
<td>In Class: Design Thinking Workshop</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Structured Group Work</td>
</tr>
<tr>
<td>12th November 2019</td>
<td></td>
<td>Online: Storyboard &amp; Idea Mapping</td>
</tr>
<tr>
<td>26th November 2019</td>
<td></td>
<td>Online: Communicating your Idea</td>
</tr>
<tr>
<td>3rd December 2019</td>
<td>6pm – 8pm</td>
<td>Pitching/Storytelling</td>
</tr>
<tr>
<td></td>
<td></td>
<td>In Class: Structured Group Work</td>
</tr>
<tr>
<td>End of semester</td>
<td>TBC</td>
<td>Dragon’s Den</td>
</tr>
</tbody>
</table>

**Module Assessment**

*Group assignment:* Groups of students will be asked to identify/predict a new immunological therapeutic target, invent a ‘virtual’ therapeutic, carry out patent searches on existing products to ensure novelty and pitch their product to experts in product development, asking for realistic financial investment. The groups should pitch their therapeutic at the stage between pre-clinical and clinical development. Students will be assessed on their background knowledge from a scientific and intellectual property point of view, as well as their overall ability to market the product to potential investors (70%). A written summary of each project (with each student’s contribution/section clearly outlined) must also be submitted 48 hours prior to the group presentation (30%).

**Recommended Reading List**

The Lean Startup (2011) by Eric Ries
The Founder’s Dilemmas (2012) by Noam Wasserman

Additional relevant and topical literature will be suggested by individual lecturers in this module and will comprise of current manuscripts which will be accessible to the students via the Trinity library website and Pubmed.
Module 6

Title: Research in Action (IMP77306)
Credit Weighting: 5 ECTS
Term: Michaelmas
Co-ordinator: Jerrard Hayes

Module Overview

Students will attend research seminars organised by the Biochemical Society during Michaelmas term. During these seminars, specialists in their field will present talks in the areas of Biochemistry and Immunology. Students are expected to engage actively with the topic of the talk and the speaker. For six of the seminars, reviews and CVs will be submitted by the speaker prior to their visit; students will be asked to: write a short biographical summary on the scientist, list 3 of their key scientific publications and summarise key discoveries published by the speaker. The 300-400 word report and list of publications (Title, author list, journal details and abstract) should be E-mailed to the course co-ordinator 24 hours before the seminar. After the seminar the students will attend a one hour Master-Class with the speaker to discuss the content of their presentation.

A report will be submitted by each student after each the Master-Class describing three ‘lessons learned’.

Learning Outcomes

On successful completion of this module students should be able to:

- Critically assess and discuss current research findings in Immunology
- Interpret scholarly activity in Immunology for a non-specialist audience
- Formulate a summary suitable for a specialist academic group
- Demonstrate proficiency at academic writing

Module Assessment

Six reports based on seminars attended by the student (60%) and 6 reports on lessons-learned during Master-Classes (40%).

Reading/Learning Resources:
3. The Elements of Style. Strunk and White (1999)

Reviews by each of 6 Masterclass Leaders
Module 7

Title: Bioinformatics and Statistics (IMP77307)
Credit Weighting: 5 ECTS
Terms: Michaelmas and Hilary
Co-ordinator: Andrei Budanov

Module Overview

The aim of part I of this module is to provide a fundamental understanding of and practical experience with statistics. This will be run as a two-day statistics workshop including 12 hours of tuition together with practical hands-on analysis. The module will cover descriptive statistics, study design and practical tests including one-way-ANOVA, correlation and regression analysis. These workshops will include practical elements with students regularly given the opportunity to put into practice what they are learning.

Part II of this module focuses on critically important developments in Bioinformatics and how this discipline relates to immunotherapeutic design and discovery. Students will engage in workshops on bioinformatics software systems and their use for the analysis of genomic datasets; these will help provide insight into personalised medicine and bespoke immunotherapeutic targeting technologies.

Learning Outcomes

On successful completion of this module students should be able to:

- Explain the principles of basic statistical tests including t-tests, correlation and regression analysis, ANOVA and survival curves.
- Apply basic statistical tests including t-tests, correlation and regression analysis, ANOVA and survival curves.
- Identify correct study design for diverse experimental situations.
- Perform appropriate statistical tests for the data type.
- Apply statistical packages such as SPSS and PRISM which will be used during the practical demonstrations and workshops.
- Explain the principles of basic bioinformatic analytical technologies eg BLAST;
- Use relevant software for bioinformatics analysis
- Perform ChIP-Seq analysis and identify targets for new Immunotherapeutic intervention
Lectures

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Topic</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Basic statistics for biologists</td>
<td>Dr Andrei Budanov</td>
</tr>
<tr>
<td>2</td>
<td>Applied Statistics I</td>
<td>Dr Andrei Budanov</td>
</tr>
<tr>
<td>3</td>
<td>Applied Statistics II</td>
<td>Dr Andrei Budanov</td>
</tr>
<tr>
<td>4</td>
<td>Genome Data Resources</td>
<td>Dr Fiona Roche</td>
</tr>
<tr>
<td>5</td>
<td>Protein Sequence Analysis and Multiple Alignment</td>
<td>Dr Fiona Roche</td>
</tr>
<tr>
<td>6</td>
<td>Next Generation Sequencing Data Analysis with Galaxy</td>
<td>Dr Karsten Hokamp</td>
</tr>
<tr>
<td>7</td>
<td>RNAseq I</td>
<td>Dr Karsten Hokamp</td>
</tr>
<tr>
<td>8</td>
<td>RNAseq II</td>
<td>Dr Karsten Hokamp</td>
</tr>
<tr>
<td>9</td>
<td>ChIP-seq data analysis I</td>
<td>Dr Karsten Hokamp</td>
</tr>
<tr>
<td>10</td>
<td>ChIP-seq data analysis II</td>
<td>Dr Karsten Hokamp</td>
</tr>
<tr>
<td>11</td>
<td>Downstream functional analysis</td>
<td>Dr Fiona Roche</td>
</tr>
</tbody>
</table>

Location
PAC East End 3, Hamilton Building
Each session will be a 2 hour workshop

Scheduling
Lectures 1-5 in Semester 1; Lectures 6-11 in Semester 2.

Module Assessment
Statistics:
Three in-course assessments
One hour exam.

Bioinformatics assessment:
After lecture 5, a 1 hour exam (analysis and short report).
After RNASeq, 1 report (~2 page) in the student’s own time.
After ChIP-seq, 1 report (~2 page) in the student’s own time.
After final lecture, 1 MCQ separate session

Part I (40%) Three in-course assessments to be set by Dr Andrei Budanov and 1 hour exam.
Part II (60%) Continual Assessment. (3 x reports (75%) and 1 x MCQ (25%)) to be set by Drs Hokamp and Roche

Recommended Reading List
4. NGS reviews
Module 8

Title: Bioprocessing Training (IMP77308)
Credit Weighting: 5 ECTS
Term: Hilary
Co-ordinator: Jerrard Hayes

Module Overview

This module is designed to help students to understand and appreciate the challenges and opportunities that the biotherapeutics industry faces in developing powerful medicines for treatment of our most difficult diseases. Over the last three decades biotherapeutics have become an integral and valued part of modern medicine. These decades have seen an explosion in the development of blockbuster drugs developed to treat a widening range of complex diseases and have witnessed the rapid maturation of the science of development of engineered proteins. Biotherapeutics have significant advantages over small molecule therapies since they have been shown to be even more effective due to their ability to target specific molecules within the human body. However, unlike most conventional small molecules like aspirin and antibiotics, the development, manufacturing and storage of biotherapeutics is more complex and require sophisticated production and control processes. In contrast with small molecule therapeutics, biotherapeutics depend upon the host cells of living organisms to effectively produce the active pharmaceutical ingredient.

Aims: The main focus of this module is to study in detail the technical issues surrounding the biotherapeutic new product development process (NPD), focusing particularly on the engineering of host expression systems, protein purification challenges, downstream characterisation of purified products, safety and efficacy testing and formulation strategies for biotherapeutics. Students will learn in detail the production challenges of the pipeline in this module.

Learning Outcomes

On successful completion of this module students should be able to:

- Describe how biotherapeutic molecules are made
- Describe the strategies and technologies required for the development of new biotherapeutic drugs
- Critically appraise the technical challenges in maximising the cellular expression of a biotherapeutic
- Describe the challenges in purifying a biotherapeutic
- Appraise the focus areas in the biotherapeutics industry where companies are developing new drug classes e.g., ADCs and Bispecifics
- Discuss the holistic process of developing a biotherapeutic and the multidisciplinary nature of this activity
- Explain and utilise the skills involved in managing a group project
Lectures

<table>
<thead>
<tr>
<th>Lecture/Workshop</th>
<th>Topic</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NIBRT Tour Practical</td>
<td>Melissa Hoare</td>
</tr>
<tr>
<td>2</td>
<td>Cell Culture with Growth and Metabolite</td>
<td>Melissa Hoare</td>
</tr>
<tr>
<td></td>
<td>Analysis Practical</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Disposable Bioreactor Practical</td>
<td>Melissa Hoare</td>
</tr>
<tr>
<td>4</td>
<td>Bioreactor Steam in Place (SIP) Practical</td>
<td>Melissa Hoare</td>
</tr>
<tr>
<td>5</td>
<td>Centrifuge Practical</td>
<td>Melissa Hoare</td>
</tr>
<tr>
<td>6</td>
<td>Ultrafiltration/Diafiltration Practical</td>
<td>Melissa Hoare</td>
</tr>
<tr>
<td>7</td>
<td>Column Packing Practical</td>
<td>Melissa Hoare</td>
</tr>
<tr>
<td>8</td>
<td>Filter Integrity Testing Practical</td>
<td>Melissa Hoare</td>
</tr>
<tr>
<td>9</td>
<td>Fill Finish &amp; Aseptic Processing Practical</td>
<td>Melissa Hoare</td>
</tr>
<tr>
<td>10</td>
<td>Gowning Practical</td>
<td>Melissa Hoare</td>
</tr>
<tr>
<td>11</td>
<td>Bioanalytics Practical</td>
<td>Melissa Hoare</td>
</tr>
</tbody>
</table>

Module Assessment
Assessment of this course will consist of a combination of two different criteria
(a) Practical write-ups & SOPs x 12 (50%)
(b) MCQ x 20 (50%)

Recommended Reading List
Emerging Protein Biotherapeutics, Edited by Iqbal S. Grewal
Protein Discovery Technologies by Renata Pasqualini, Wadih Arap
Selected review and original articles will also be provided
Module 9

Title: Project Placement and Dissertation (IMP77309)
Credit Weighting: 30 ECTS
Terms: Hilary and Trinity
Co-ordinator: Cliona O’Farrelly

Module Overview

**Aim:** To perform an independent research placement in an partner industry on a project that reflects the combined interests of both the academic and industry partner.

**Rationale:** The MSc in Immunotherapeutics aims to meet staffing needs of the existing and developing Immunotherapeutics/Biopharma sector in Ireland and abroad. Its ultimate goal is to deliver highly trained graduates who can contribute to the success and continued expansion of this industry, through Immunotherapeutics knowledge and skills gained at theoretical and practical levels. As part of the programme, students will undertake a 6-month placement (Feb-July) as part of an academic/industry collaboration working on industry-focused projects where the student will be co-supervised by the industry lead and an academic partner from the School of Biochemistry & Immunology, Trinity College Dublin. Placements will be designed to have direct relevance to immunopharmaceutical industry needs and will provide students with first hand insight into immunopharmaceutical practice. A key benefit to industry of providing student placements will be the opportunity to assess future talent with minimal risk and no recruitment costs. Furthermore, output from these projects can provide preliminary data to be used to secure funding from Industry/Academic Partnerships programmes currently on offer from Enterprise.

**Placement Design:** Each placement provides an opportunity for the student to carry out a significant level of independent research under the supervision of the industrial partner and academic liaison and 33% of the final MSc mark are allocated to the placement. The placement will take place over a 6-month period (from February to the end of July). The project/placement will be designed to reflect the complementary research interests of both industry and academic partners and be mutually beneficial to both parties. The overall aim is to perform individual research (bibliographic, data analysis, market analyses, patent searches etc.) leading to the generation of novel information that is of use to the industrial partner that complements work being carried out on existing projects within the relevant industry. The project can have wet-lab or dry-lab components or a combination of both. It should be an integrative exercise that allows students to develop and showcase skills and knowledge, which they have acquired in a specific subject area in immunotherapeutics/biopharmaceutics over the 6-month placement period. It should result in the production of a significant piece of original work by the student and a written 10,000-word report, which will comprise the MSc dissertation. This written report will be reviewed and assessed by the academic partner with input from the industry partners, as well as another member of the MSc in Immunotherapeutics Steering Group.
**Project Design:**
Academic partner to generate project with industrial partner. Together they will identify the following:

1. Overall research question and goal
2. Specific tasks
3. Specific objectives
4. Methods by which these objectives will be achieved
5. Relevant literature

The academic and industry partners will prepare a one-page summary/proposal with five references to be reviewed by the MSc Immunotherapeutics Steering Group.

**Guidelines for Student Placement**
- Collaboration with other members of industry team
- Dedicated workspace with computer where possible
- Access to internet and literature/data searches
- Attendance at weekly group meetings where possible
- Regular mentorship from industry and academic partner

Progress review (in the form of a presentation) to be assessed by an academic and an industrial partner at 3-months.

Some of the companies where placements are planned include: HiTech Health (G. Scalabrino), Trinity Office of Corporate Partnership and Knowledge Exchange (A. Tierney), Merrion Fertility Clinic (L. Glover), Avectas (S. O’Dea), Kora Healthcare (C. O’Daly), Inflazome (J. Skillington), Inflection Therapeutics (D. Cunningham), ReagentGenie (C. Ryan) and Johnson & Johnson (L. Daly). We anticipate that these placements will lead to offers of employment. We will also encourage students to identify placements of particular interest to them.

**Learning Outcomes**

On successful completion of this module students should be able to:

- Identify an area of research interest and formulate a project proposal: outlining the hypothesis behind the project, identifying the specific aims and objectives and designing a work plan that will ensure the project is achieved in a suitable time frame
- Prepare a comprehensive literature review, evaluating previous studies carried out in the specific research area
- Identify suitable research methods to carry out the experimental plan
- Formulate a coherent hypothesis that draws on engagement with, and critical appraisal of, existing knowledge relevant to their research project
- Carry out research/experimental/field work that addresses the hypothesis
- Assemble and analyse the data collected in an efficient and logical manner, using appropriate statistical software (e.g. Excel, Prism, SPSS)
• Evaluate potential solutions for experiments that are not working or where unexpected results are obtained
• Interpret the research findings and draw appropriate conclusions based on research outcomes and how this relates to the peer-reviewed literature
• Write a substantial research dissertation in a clear and concise manner with respect to both data illustration and text in accordance with scientific conventions

Module Assessment
Assessments when combined = 33% of total marks
1. Topic review (3,000 words and to include a more detailed project work plan and Gantt chart) to be submitted to industry and academic partners after 1 month on placement (10%)
2. Progress review (oral) to be assessed by an academic and an industrial partner at 3 months (5%)
3. Reflective diary (5%)
4. Poster presentation at end of project (10%)
5. Thesis/Project Report Dissertation 10,000 words (70% - to include a performance mark). The dissertation should not exceed 10,000 words (excluding appendices) and should normally be submitted no later than 31st August. The student may also be required to attend for interview to discuss the dissertation.

Recommended Reading List
As per taught modules and additional material will be outlined by the research project supervisor(s).
Timetable

The course timetable will be available through your MyTCD account at https://my.tcd.ie/

9. Additional Information

Course Location

The course will primarily be taught in the Trinity Biomedical Sciences Institute (TBSI) located just off main Trinity campus on Pearse St. Students will have access to the PAC room at level -2 of TBSI and Hamilton library on main campus. The Bioinformatics and Statistics module will be given on main campus in PAC East End 3, Hamilton Building. The building is red pinned in the map below on main campus; TBSI is centre-right in the image with a grey pin. The Biochemistry and Immunology School Office and photocopiers are on the third floor of TBSI.

General University Regulations, Policies and Procedures

Links to University regulations, policies and procedures are:
https://www.tcd.ie/teaching-learning/academic-policies/
https://www.tcd.ie/about/policies/160722_Student%20Complaints%20Procedure_PUB.pdf
https://www.tcd.ie/equality/policy/dignity-respect-policy/
Examinations and Regulations

Details of the timing of examinations will be provided and are module specific. If these dates change the class will be informed by email in advance. Students are responsible for keeping updated with the examination timetable via Blackboard.

In the event of any conflict or inconsistency between the General Regulations published in the University Calendar and information contained in programme or local handbooks, the provisions of the General Regulations in the Calendar will prevail.

Explanation of ECTS Weighting

The European Credit Transfer and Accumulation System (ECTS) is an academic credit system based on the estimated student workload required to achieve the objectives of a module or programme of study. It is designed to enable academic recognition for periods of study, to facilitate student mobility and credit accumulation and transfer. The ECTS is the recommended credit system for higher education in Ireland and across the European Higher Education Area.

The ECTS weighting for a module is a measure of the student input or workload required for that module, based on factors such as the number of contact hours, the number and length of written or verbally presented assessment exercises, class preparation and private study time, laboratory classes, examinations, clinical attendance, professional training placements, and so on as appropriate. There is no intrinsic relationship between the credit volume of a module and its level of difficulty.

ECTS credits are awarded to a student only upon successful completion of the programme year. Progression from one year to the next is determined by the programme regulations. Students who fail a year of their programme will not obtain credit for that year even if they have passed certain component. Exceptions to this rule are one-year and part-year visiting students, who are awarded credit for individual modules successfully completed.

Submission Deadlines

When an item of course-work has a submission deadline, this date and time must be adhered to.

Deadline Penalties

In exceptional circumstances, a case can be made in writing to the course co-ordinator and director for a short extension to a deadline. Otherwise, a 1% mark penalty per day after the deadline will be applied.
Attendance

Full attendance at all classes is considered as a measure of professional behaviour expected of all students. Attendance will be monitored in all components of the MSc course. All activities are considered to be core and lack of attendance may affect student progression. All absences must be reported to both the course and module co-ordinator in advance of the class.

Word Limitations

Assessment with an explicit word limit can be met within a window of ±10% of the work count.

Scheme for marking of projects

<table>
<thead>
<tr>
<th>Class</th>
<th>Mark Range</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>85-100</td>
<td>Exceptional project report showing broad understanding of the project area and excellent knowledge of the relevant literature. Exemplary presentation and analysis of results, logical organisation and ability to critically evaluate and discuss results coupled with insight and originality.</td>
</tr>
<tr>
<td>I</td>
<td>70-84</td>
<td>A very good project report showing evidence of wide reading, with clear presentation and thorough analysis of results and an ability to critically evaluate and discuss research findings. Clear indication of some insight and originality. A very competent and well presented report overall but falling short of excellence in each and every aspect.</td>
</tr>
<tr>
<td>II-1</td>
<td>60-69</td>
<td>A good project report which shows a reasonably good understanding of the problem and some knowledge of the relevant literature. Mostly sound presentation and analysis of results but with occasional lapses. Some relevant interpretation and critical evaluation of results, though somewhat limited in scope. General standard of presentation and organisation adequate to good.</td>
</tr>
<tr>
<td>II-2</td>
<td>50-59</td>
<td>A moderately good project report which shows some understanding of the problem but limited knowledge and appreciation of the relevant literature. Presentation, analysis and interpretation of the results at a basic level and showing little or no originality or critical evaluation. Insufficient attention to organization and presentation of the report.</td>
</tr>
<tr>
<td>III</td>
<td>40-49</td>
<td>A weak project report showing only limited understanding of the problem and superficial knowledge of the relevant literature. Results presented in a confused or inappropriate manner and incomplete or erroneous analysis. Discussion and</td>
</tr>
</tbody>
</table>
interpretation of result severely limited, including some basic misapprehensions, and lacking any originality or critical evaluation. General standard of presentation poor.

An unsatisfactory project containing substantial errors and omissions. Very limited understanding, or in some cases misunderstanding of the problem and very restricted and superficial appreciation of the relevant literature. Very poor, confused and, in some cases, incomplete presentation of the results and limited analysis of the results including some serious errors. Severely limited discussion and interpretation of the results revealing little or no ability to relate experimental results to the existing literature. Very poor overall standard of presentation.

A very poor project report containing every conceivable error and fault. Showing virtually no real understanding or appreciation of the problem and of the literature pertaining to it. Chaotic presentation of results, and in some cases incompletely presented and virtually non-existent or inappropriate or plainly wrong analysis. Discussion and interpretation seriously confused or wholly erroneous revealing basic misapprehensions.

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/plagiarism/about

We ask you to take the following steps:
(i) Visit the online resources to inform yourself about how Trinity deals with plagiarism and how you can avoid it at https://libguides.tcd.ie/plagiarism/about. You should also familiarise yourself with the 2019-20 Calendar entry on plagiarism (https://www.tcd.ie/calendar/graduate-studies-higher-degrees/complete-part-III.pdf) and the sanctions which are applied;
(ii) Complete the ‘Ready, Steady, Write’ online tutorial on plagiarism at https://libguides.tcd.ie/friendly.php?s=plagiarism/ready-steady-write. Completing the tutorial is compulsory for all students.
(iii) Familiarise yourself with the declaration that you will be asked to sign when submitting course work at https://libguides.tcd.ie/plagiarism/declaration;
(iv) Contact the Course Director or the Course Co-ordinator if you are unsure about any aspect of plagiarism.

Submitting Assessments through Turnitin

All Students must submit the final version of their relevant assessments and final thesis to the plagiarism detecting software Turnitin within Blackboard, as well as submitting hard
copies to the School office and the Turnitin report. Instructions will be given in the Michaelmas term.

Examination Rules

General
- The onus lies on each student to establish the dates, times and venues of their own examinations. No timetable or reminder will be sent to individual students by any office.
- You are expected to familiarise yourself with the location of every examination venue to which you have been assigned.
- Mobile phones, or other electronic or communication devices, are not permitted in examination venues - if a phone rings or an alarm on a phone is heard, or it is discovered in any other way in the venue it will be confiscated.
- Students must follow the instructions given by the invigilators in a co-operative and respectful manner.

Before entering an examination venue
- Leave your personal belongings, including bags, coats, hats, etc at the designated place within your examination venue as directed by the invigilator.
- You will not be admitted to the examination after the first half-hour, and will not be allowed to leave during the last half-hour. If you arrive after the first half-hour, contact the module coordinator and course coordinator as a matter of urgency.

While in an examination venue
- Once you have entered a venue, complete SILENCE must be maintained at all times.
- Each student must be in possession of their student ID card for each examination session. You should place your student ID card on the right-hand side of your desk for the duration of each examination.
- A ‘Clean Desk’ policy applies for all examinations. In addition to pens, pencils, rulers, student ID card, etc. only materials permitted for an examination may be placed on the desk. Invigilators will be instructed to request students to remove any non-permitted items from their desk. Pencil cases and calculator covers are not permitted. Students are advised that random pocket searches may be conducted during an examination session. Upon request, students should remove all items from their pockets for scrutiny by an invigilator. Failure to empty pockets when requested is considered a disciplinary offence and will be referred to the Junior Dean.

During an examination
- You should check the title of the paper on your desk to ensure that it is the correct examination paper for your course, and read carefully all the instructions given.
- You are not allowed to start your examination until instructed to do so by the invigilators. Please use any spare time at the start to fill in your answer book cover(s), remembering to complete the section at the bottom right-hand corner as requested before sealing the flap on every anonymous booklet used. Write legibly in ink – pencils are only allowed for MCQ forms.
- You will be advised of the time forty minutes and fifteen minutes before the end of the examination.
- If you wish to leave the examination venue at any stage during the examination you must be escorted by an Invigilator. If necessary you will be accompanied to a bathroom by an Invigilator.
- If you wish to leave before the end of the examination you must hand your booklet(s) to an Invigilator and ensure you hand up everything you wish to have marked.
- If you are taken ill just before an examination and are unable to sit it, immediately contact your module coordinator and course coordinator. If you feel unwell during your examination, please inform an Invigilator - you will be asked if you wish to go to the College Health Centre and will be accompanied by an Invigilator.
- Smoking breaks are not allowed during examination sessions.
- Dictionaries and Programmable calculators are not permitted at examinations.

**On completion of an examination session**

You will be advised that:
- you must immediately stop writing and hand up your booklets when instructed to do so by an Invigilator;
- you should ensure that all of your answer books are labelled correctly with your examination number (where appropriate) and all other required information;
- it is your responsibility to hand in everything you wish to have marked by ensuring all materials are fastened securely with a treasury tag;
- you must remain in your seat until all scripts have been collected;
- you must not remove from the examination venue answer books, rough work, or other materials supplied.
- While every effort will be made to give due notice of major changes, the College reserves the right to amend the examination timetable.
- College regulations and further information can we found on the TCD website and at the following web addresses:
  - https://www.tcd.ie/academicregistry/exams/
  - https://www.tcd.ie/academicregistry/exams/student-guide/

**Student Conduct for Examinations**

Students are forbidden during an examination to do or to attempt to do, any of the following:
To have in their possession or consult or use any books, papers, notes, memoranda, mobile phones or written or electronic material of any nature, or to copy from or exchange information with other persons, or in any way to make use of any information improperly obtained.
Where the examination is of such a nature that materials are provided to the candidates, or where the candidates are allowed by the rules of that examination to have materials in their possession, then candidates may of course make use of such materials, but only of such materials, and the general prohibition above continues to apply in respect of any and all other materials.
Where candidates have the prior written permission of the examiner(s), of the Senior Lecturer, or of the Disability Officer, to have materials in their possession during an examination, then candidates may of course make use of such materials, but only of such
materials, and the general prohibition above continues to apply in respect of any and all other materials.

Where candidates are allowed to bring personal belongings into the examination venues upon condition that such belongings are stored in an area – such as the back of the venue – away from the area in which the candidates are sitting their examinations, then candidates may bring personal belongings into the hall, provided that they are placed in the indicated area and are not returned to by the candidates until they have finished their examinations and are leaving the hall. **Any breach of this regulation is regarded as a major offence for which a student may be expelled from the University.**

Students must not leave the hall before the time specified for the examination has elapsed, except by leave of the invigilator.

Examinations or other exercises which are part of continuous assessment are subject to the same rules as other College examinations. Where submitted work is part of a procedure of assessment, plagiarism is similarly regarded as a major offence and is liable to similar penalties.

**Assessment Procedure**

Modules 1-8 will be assessed by examinations and continuous assignments. Each assessment component will be awarded a mark which will be taken into account (with all continuous assessment marks from assigned tutorial work) in the overall final evaluation of the course. In terms of weighting, modules 2 and 4-8 contribute equally to the final award of the Masters in Immunotherapeutics, namely 5.5% each with module 1 contributing 11% and module 3 contributing 22%.

Accordingly, 66% of the final course mark will be allotted to assessments of the 8 modules and the remaining 34% will be allotted to the placement (research project – module 9) which will be carried out in the Hilary and Trinity Terms.

The dissertation will be the primary output from the research project placement which will provide 100% of the overall grade for this module. The dissertation should not exceed 10,000 words (excluding appendices) and should normally be submitted by no later than 31st August. Students will also deliver their learning goals for the placement, maintain a self-reflective diary, give a presentation in the company half way through the project and present a poster in Trinity upon completion of the placement. These elements will be graded on a pass/fail basis.

**Pass/Fail process**

A 50% pass mark is required for each of the modules, and also for the dissertation.

**Failure of module**

In cases where students fail to achieve a minimum of 50% in a written assignment/a written examination, a resubmission/a repeat examination will be permitted with a deadline for resubmission/a resit of 3 weeks from the publication of the initial results. Only one
resubmission/resit will be allowed, and the maximum mark awarded for the resubmitted assignment/resat examination is 50%.

Obtaining an average of 50% of the available marks derived from each assessment type employed in the module (i.e. personal assignments or examination) is required to pass each module.

**Compensation**
Students may compensate for one fail mark in one assessment type within a module provided they achieve a minimum of 45% in that assessment and an average of at least 55% in the other assessment type(s) within the same module. Failure of a module on the second attempt, or failure of two or more of the taught modules in total, indicates failure of the whole course requiring exit from the course.

Compensation is not possible for the dissertation; neither can the dissertation be used to compensate for any of the taught modules. The dissertation module and all the other taught modules must be passed in order for the student to be considered for an award of Masters degree.

**Progression:**
All students register on the Masters programme. Students who have successfully passed the eight taught modules of the course and accumulated 60 ECTS but who do not wish to proceed to the dissertation stage, or if they have submitted but then failed the dissertation, will be considered for a Postgraduate Diploma (exit award). Students who have achieved an average of at least 70% of the available marks in all taught modules passed will be eligible for consideration for the award of Postgraduate Diploma with Distinction. Postgraduate Diploma with Distinction cannot be awarded if a candidate has failed any module during the period of study.

A Masters dissertation will be submitted and examined in line with the *General Regulations for Taught Graduate Courses* stated in the *University of Dublin Calendar part 3 for Graduate Studies and Higher Degrees* for a given year.

Students who have successfully passed all the taught modules and module IMP77309 and accumulated 90 ECTS will be considered for a Masters degree. Students must achieve at least 50% in IMP77309 and in 7 of the 8 taught modules (IMP77301 - IMP77308) to fulfil criteria for the award of the M.Sc.

The award of a Masters with Distinction shall require an average of at least 70% of the available marks in all theory modules and at least 70% in the project placement and dissertation module. A distinction cannot be awarded if a candidate has failed any module during the period of study.
Research Ethics and Good Research Practice

Please follow this link for information regarding good practice in research: https://www.tcd.ie/research/dean/assets/pdf/FINAL_Good%20Research%20Practice%20policy_COUNCIL%20APPROVEDandminutedgg.pdf

Course Feedback

A Feedback Form will be given out at the end of each module. These anonymous forms are an important mechanism whereby students can make comments and suggestions that will help us to maintain and indeed improve the quality of the course. Further information is available here:
https://www.tcd.ie/teaching-learning/assets/pdf/academicpolicies/StudentPartnershipPolicy.pdf
https://www.tcd.ie/teaching-learning/academic-policies/Focus%20Group%20Procedure%20final.pdf

10. Trinity College Dublin Related Information

The Graduate Students Union

Trinity’s Graduate Students’ Union (GSU) is the main representative body for all postgraduate students in College (https://www.tcdgsu.ie/). Established in 1973, the GSU has supported members and advocated for improvements to the postgraduate experience here in Trinity. All postgraduate students of the College, including postgraduate research students and those on higher degree and higher diploma courses, automatically become members of the Union upon registering with the College. The GSU has two full-time sabbatical officers who represent postgraduates on every level of College, from class rep issues to structures and policy at Board. The GSU also provides advice on academic and welfare issues faced by postgrads, and offers three main facilities: dedicated postgrad study space in the 1937 Reading Room, the GSU Common Room on the first floor of House 7, and the GSU office in Room 28, House 6. Although the GSU works in partnership with the Students’ Union, the GSU is the only postgraduate representative organisation recognised by College. The GSU also produce a Postgrad Handbook and also maintain an active Facebook page detailing events.

International Students: GSU sabbatical officers have first-hand experience regarding the steps needed to settle down in Ireland as an international student. It is easy to become
overwhelmed while adjusting to jetlag, a new country (sometimes even a new continent!), a second language and separation from family and friends. They can help you with a variety of supports including: dealing with internal College issues regarding paying fees; registering for your course; the process of securing a visa; opening up a bank account or securing accommodation.

**The Class Representative**

The role of the class rep is to primarily act as a contact point for the class for urgent matters. The class rep can also bring issues causing the class concern to the attention of the Course Co-ordinator.

The main tasks of class rep are:
1. to create a contact list (telephone list) for class members in case there is a need to contact the whole class or individual class members
2. to act as a first contact point for the class should the course director or co-ordinator need to urgently contact the whole class

The class rep may also take the lead in organising social events for the class.

**The Biochemical Society**

The Biochemical Society aims to stimulate interest in the fields of Biochemistry and Immunology amongst its members which include postgraduates, undergraduates, postdocs and PI's. The society hosts weekly talks throughout the academic year by invited high-profile speakers from Ireland and abroad. On a social level, the society organises table-quiz nights, the infamous Christmas party and BBQ events which are an enjoyable way of meeting other members of the School. Details of broader College social and sport activities are provided at: [http://trinitysocieties.ie/](http://trinitysocieties.ie/)

**Careers Advisory Service**

For information on postgraduate careers please visit the detailed TCD website for various resources and supports: [https://www.tcd.ie/Careers/students/pgfocus.php](https://www.tcd.ie/Careers/students/pgfocus.php). Module co-ordinators, lecturing staff and, in particular, industry experts contributing to the course will be invaluable in advising on career development strategies. The project placement will give beneficial first-hand experience of working in industry and aid with developing useful contacts and industry-aligned experience.
Postgraduate Advisory Service

The Postgraduate Advisory Service (PAS) was established in 2009 to extend Trinity’s historic and unique tutorial service to the postgraduate community. We offer free, independent, and confidential support, guidance and advocacy to registered postgraduate students at Trinity College Dublin.

How we can help
We are here to provide support on any matter that may impact upon your time as a postgraduate at Trinity. Some of the most common issues students come to PAS to discuss include: study-related stress or worry; concerns about academic progress; supervisor-relationship concerns; extensions and going off-books; queries regarding regulations and academic appeals; bullying; plagiarism and disciplinary cases.
We support students by:
- Providing frontline confidential and free support, information, and referral via the Postgraduate Student Support Officer
- Providing, on referral, named academics to provide advice, advocacy, and assistance via the panel of Postgraduate Advisors
- Providing a suite of complementary supports including informal mediation, workshops and training to postgraduates
- Administering the Postgraduate Student Assistance Fund and other financial assistance to postgraduate students.

For more information please visit: [https://www.tcd.ie/seniortutor/students/postgraduate/](https://www.tcd.ie/seniortutor/students/postgraduate/)

**Student Supports and Services**

This website links to the various supports and services that, if required, you can avail of while studying in TCD: [https://www.tcd.ie/students/supports-services/](https://www.tcd.ie/students/supports-services/) and the handbook on this site provides a useful overview.

---

**Managing Wellbeing in the Postgraduate Context**

At some point throughout your academic career there will be a time where you are feeling challenged. You may be finding communication with your peers or supervisor difficult; your research is not going to plan; or you might be struggling to balance academic work alongside financial obligations, friends and family responsibilities. This is not unusual because postgraduate study is demanding, and this challenge is heightened if you are feeling isolated, exhausted, unwell or unable to concentrate.

It can be helpful to avoid seeing postgraduate study as a general postponing of life, but rather an opportunity to learn how to best support yourself through what is going to be a challenging but hopefully rewarding phase in your life. We know that the academic environment plays a large part in this process, as does your ability to navigate this in a way that helps you best meet your needs. So here are some of our top tips:

**STEP 1: Self-care is important not indulgent.**

- Get the balance right for you: Psychological health encompasses our capacity to work in a generative and meaningful way, our capacity to form and sustain authentic relationships and our capacity to play, be creative and get lost in the moment. Ensuring that you have time for each of these is incredibly important. So make time for those significant relationships in your life, and plan for some positive outlets throughout the academic year because this is will improve your energy levels and your ability to
concentrate overall (see https://www.mentalhealthireland.ie/five-ways-to-wellbeing/ for more information).

- **Name the ‘self-critic’ instead of blaming yourself:** There are many things we can do to proactively support our wellbeing going into this next academic year, however good plans often go to the wayside if we feel like: “I’m messing this up!”, “I don’t deserve to take a break”, “I’m not able for this!”. These are very common thoughts that tend to get louder the more overwhelmed we feel, and paradoxically, the more we listen to these the less effective we become. Often we rush to feeling self-critical and blaming ourselves for challenging circumstances when we could be more self-compassionate. (see http://wtm.thebreathproject.org/wp-content/uploads/2016/03/COMPASSION-HANDBOUT.pdf for more information)

- **Take a regular step back from it all:** Whether you take regular breaks from academic work or make the time to talk with friends, family and course mates about how you are getting on, it’s important to reflect on the bigger reasons you have chosen to study. When we can reconnect with a sense of meaning and purpose in the work we are doing it can become a more enjoyable and rewarding process.

**STEP 2: Build a Support Network**

Many students feel a sense of being “an imposter” and think things like “Have they made a mistake letting me in?”, “What if I’m not good enough?!”, “They are going to find me out one of these days!”. It is hard to believe that others are feeling similarly unless we reach out to them, but often this can feel more difficult in postgraduate courses due to the onus on independent study and the smaller class sizes.

- **Connect with peers:** The Student Counselling Service in conjunction with the Postgraduate Advisory Service and the Graduate Student Union run a weekly drop in support group (“Grad Chats”) during terms times. The Student Counselling Service also runs groups and workshops on general student issues, which can be a good opportunity to learn more about these and connect with other students (see https://www.tcd.ie/Student_Counselling/counselling/groups-workshops/ for more information).

- **Upskill if necessary:** Postgraduate study is designed to be a step up from previous education and may require you linking in with our Student Learning and Development Team who run workshops and training throughout the year and also offer 1:1 appointments (http://student-learning.tcd.ie/).

- **Ensure you have the right level of support:** If you are currently experiencing low mood or anxiety difficulties, or you want to learn more about managing stress you can sign up to our online support programmes at https://ie.silvercloudhealth.com/signup/tcd/.  

- **Enlist the support of other services:** see https://www.tcd.ie/students/supports-services/ for a full range of the student support services, clubs, societies available at TCD.

**STEP 3: Ask for Help**

Even with all of this in place there may come a time where you feel you would benefit from the chance to talk with someone objective about your situation. If you feel that your mental health and wellbeing is being negatively affected or you just need some space to talk
through a difficult situation, a disappointment or a loss we would encourage you to book an appointment with us by calling 01 8961407. If you are having difficulty navigating academic processes and procedures, or want some advice about making an academic complaint or an appeal, you can contact the Postgraduate Advisory Service at: https://www.tcd.ie/seniortutor/students/postgraduate/

Data Protection

Please follow this link for further information on data protection: https://www.tcd.ie/info_compliance/data-protection/student-data/

Emergency Procedure

In the event of an emergency, dial Security Services on extension 1999. Security Services provide a 24-hour service 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 always telephone 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 students save at least one emergency contact in their phone under ICE (In Case of Emergency).

Please note that this handbook and timetable are subject to change during the year.