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Dear SS Molecular Medicine students,

Welcome to the Senior Sophister year, the culmination of your Molecular Medicine degree. It is unfortunate that your final year coincides with the ongoing pandemic but this only highlights the importance of Molecular Medicine as a subject and the need for well-rounded science graduates who can make a meaningful contribution to research and society in times like these. You will be updated on progress in the science behind SARS-CoV-2 and Covid-19 as the year progresses.

As a result of on-going public health concerns and regulations, we have had to make major changes to the degree programme. We have prioritised ensuring that you will be able to graduate at the end of the year having achieved the 60 ECTS that are required. We have preserved the Capstone project and, where we were obliged to make alterations, they have been mindful of the need for academic integrity and the strong ethos of research that exists within Trinity College Dublin.
In light of the uncertain future in terms of how this pandemic will unfold, we have finalised plans for Semester one activities and we will review plans for Semester two in due course. You will be kept updated as these progress.

For now, please take your time going through the booklet and the information herein. It has a lot of important information including deadlines for various activities. A copy of the booklet is on Blackboard under Module BIU44390. While some things may be out of our control, we will endeavour to minimise changes to the planned activities.

Obviously, if someone does develop symptoms associated with Covid-19, please make your way to the isolation room in Level-2.

If you have any problems during the year which affect your academic studies, please speak to me in confidence. I am here to help.

I look forward to working with you over the following year.

Prof. Gareth Brady
SS Course Co-ordinator: bradyg1@tcd.ie

Senior Sophister Molecular Medicine (60 ECTS)

BIU44390  CAPSTONE PROJECT IN MOLECULAR MEDICINE (S1)  20 credits
The module comprises of an original research project in biochemistry, cell biology, immunology or clinical medicine.

BIU44010  ADVANCED RESEARCH SKILLS (S1)  10 credits
The purpose of this module is to further develop research, critical analysis and communication skills that are essential for a Molecular Medicine scientist. Students will be trained in data handling as well as solving quantitative problems in biochemistry and immunology. In addition, this module will introduce students to a wide array of cutting-edge techniques and strategies used in biochemistry, immunology and molecular medicine.

BIU44310  NEUROBIOLOGY & IMMUNOLOGY (S2)  10 credits
This module covers the structure, function and pharmacology of neurotransmitters, neuron-glia interactions, intraneuronal signalling and the neurobiology of behaviour and neurodegenerative disorders. This module also covers regional immunology (e.g. gastrointestinal immunology, respiratory immunology etc), autophagy, virology and immunometabolism.

BIU44320  MICROBIAL DISEASES & IMMUNE SYSTEM DISORDERS (S2)  10 credits
The first part of this module will focus on microbial diseases. Bacterial and viral pathogens of medical importance will be covered in detail. Parasitic protozoa such as trypanosomes and
helminths will be introduced. This module will also cover the basic and clinical aspects of auto-inflammatory and autoimmune conditions, including rheumatoid arthritis, multiple sclerosis and immunodeficiency syndromes.

BIU44330  CELL CYCLE, CANCER BIOLOGY AND THERAPEUTICS (S2)  10 credits
This module will provide an in-depth analysis of the cell cycle, cancer and metastasis. It will focus on the progression of disease and current therapeutic interventions. This module will also provide a detailed overview of the meiotic and mitotic cell cycle and its regulation and the molecular biology of cancer.

NOTE: Learning outcomes for each of the modules can be found in the detailed module descriptors (from page 32).

Timetable:
Given the pandemic, we are not sure that the timetable, for Semester one at least, will be particularly relevant this year to Senior Sophister students. Lectures during Semester One will be available on-line through the relevant module in Blackboard. These will be released at the start of a given week and you can engage with them at your own pace. Some but not all students will have a ‘wet-lab’ project and will be present either in TBSI or in TTMI (St. James’s Hospital campus). A schedule of the block assigned to you will be circulated (or included in this booklet). We will review plans for Semester Two as the year progresses. As you know, CIMS is the official college timetable but we are likely to rely on locally produced information for Semester One.

Face-to-face and remote learning:
College is encouraging face to face activities where it is safe to do so. Given that many of you will be in laboratories, we have arranged that most lectures will be pre-recorded and available online. Small group tutorials are allowed to take place face-to-face as long as both students and the academic member of staff are willing and able to engage in such. Otherwise, remote zoom tutorials should be arranged. It is important this year that students actively engage with academic staff to enrich your education experience.

Staff contact details:
As course co-ordinator for SS year, I am the first point of contact for students (email bradyg1@tcd.ie). The Head of School is Prof. Derek Nolan (phone extension 2455, email denolan@tcd.ie). Rachel Elshove (elshover@tcd.ie) is the point of contact in the School office on Level 3 in TBSI. Remember that you also have a college tutor that you can contact at any time. The names of small group tutorial tutors are provided further in the booklet. A complete list of the Biochemistry and Immunology Staff can be found at https://www.tcd.ie/Biochemistry/people/ and School of Medicine Staff can be found at https://www.tcd.ie/medicine/staff/.

Attendance:
All students are expected to attend lectures, workshops, practical classes, in-course assessments and examinations, either on-line or face to face. Tutorials, on-line lectures and workshops play an important role in supporting progress through the academic year in particular course
assignment work. Students are therefore expected to keep up a consistent rate of good participation so that performance later in the year will not be adversely affected. In the event of not being able to participate in classes due to illness, please inform the Course Co-ordinator. Medical certificates are required for absences of more than a few days or if the absence means a deadline or an assessment will be missed. Details of medical certificates and other personal information will be treated confidentially.

The School operates the College procedure in relation to ‘Non-satisfactory attendance and course work’ (Calendar). That is, any student who misses more than a third of a course in any term or fails to complete assignments may be declared ‘non-satisfactory’. Non-satisfactory returns are made to the Senior Lecturer; such students may be refused permission to take the annual examination and may be required by the Senior Lecturer to repeat the year.

From College Calendar General Regulations: 2020-21

Non-satisfactory attendance

24 All students must fulfil the course requirements of the school or department, as appropriate, with regard to attendance. Where specific requirements are not stated, students may be deemed non-satisfactory if they miss more than a third of their course of study in any term. Calendar 2020-21 33

25 At the end of the teaching term, students who have not satisfied the school or department requirements, as set out in §§19 and 24 above, may be reported as non-satisfactory for that term. Students reported as non-satisfactory for the Michaelmas and Hilary terms of a given year may be refused permission to take their semester two assessment/examinations and may be required by the Senior Lecturer to repeat their year. Further details of procedures for reporting a student as non-satisfactory are given on the College website at www.tcd.ie/academic registry/studentcases.

Explanation of ECTS:
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.

The European norm for full-time study over one academic year is 60 credits. The Trinity academic year is 40 weeks from the start of Semester one to the end of Semester 2. 1 ECTS credit
represents 20-25 hours estimated student input, so a 10-credit module will be designed to require 200-250 hours of student input including class contact time and assessments.

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

For additional details see: [https://www.tcd.ie/teaching-learning/NC_Proposal/ECTS/ects.php](https://www.tcd.ie/teaching-learning/NC_Proposal/ECTS/ects.php)

**Annual Year Structure:**
Students should note that the annual year structure has changed this year. Information is available at [https://www.tcd.ie/calendar/academic-year-structure/](https://www.tcd.ie/calendar/academic-year-structure/)

### SS Molecular Medicine Staff Tutorial Groups 2020-21

<table>
<thead>
<tr>
<th>Student</th>
<th>Tutor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brady, Caolann Ellen Callinan Keenan, Niamh Fitzgerald, Annasthasia</td>
<td>Prof. Vincent Kelly (<a href="mailto:KELLYVP@tcd.ie">KELLYVP@tcd.ie</a>)</td>
</tr>
<tr>
<td>Helbet, Oana Camelia Irwin, Naoise Keegan, Cormac Donncha</td>
<td>Prof. Jean Fletcher (<a href="mailto:FLETCHJ@tcd.ie">FLETCHJ@tcd.ie</a>)</td>
</tr>
<tr>
<td>Lawler, Hazel Rose Leahy, Conor Marion, Caroline</td>
<td>Prof. Gareth Brady (<a href="mailto:BRADYG1@tcd.ie">BRADYG1@tcd.ie</a>)</td>
</tr>
<tr>
<td>Martin, James Mc Aleese, Kathryn Elizabeth Mc Evoy Bucholz, Sora</td>
<td>Prof. Fred Sheedy (<a href="mailto:FSHEEDY@tcd.ie">FSHEEDY@tcd.ie</a>)</td>
</tr>
<tr>
<td>Mc Grady Hogan, Ellen Rispin, Lauren Louise Smith, Lorraine Marie</td>
<td>Prof. Sarah Doyle (<a href="mailto:DOYLES8@tcd.ie">DOYLES8@tcd.ie</a>)</td>
</tr>
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Examinations/Assessments and Breakdown of Marks:

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<th>Senior Sophister Module Name</th>
<th>ECTS Weighting</th>
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<tr>
<td>1) Capstone Project in Molecular Medicine</td>
<td>BIU44390</td>
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<tr>
<td>2) Advanced Research Skills</td>
<td>BIU44010</td>
</tr>
<tr>
<td>3) Neurobiology &amp; Immunology</td>
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<td>4) Microbial Disease &amp; Immune System Disorders</td>
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<td>5) Cell Cycle, Cancer Biology &amp; Therapeutics</td>
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SS year is broken down into a total of 60 credits (600 marks).

**Capstone Project in Molecular Medicine (BIU44390) Value: 20 ECTS**

The Capstone project (20 ECTS) has been revised for academic year 2020/21 as detailed below. **You will be assigned a supervisor that will mentor you through your Capstone project.** Activities may be sequential or concurrent depending on laboratory rotation schedules. While not engaged in the research project, you are expected to progress other aspects of the Capstone project. We recommend that you make use of support materials available to ensure that you use your time effectively e.g. [https://student-learning.tcd.ie/learning-resources/self-management/time-management/](https://student-learning.tcd.ie/learning-resources/self-management/time-management/)

Overall breakdown of marks for the Capstone project (20 ECTS, 200 marks):

- **Literature review:** 25%
- **Lab performance:** 5%
- **Short research paper:** 30%
- **Future work proposal:** 25%
- **Oral presentation:** 15%

**Literature Review of Research Project Topic**

This will be critical review of the literature that helps define the background and rationale to the project you will undertake. It should not be just a summary of the literature but include critical arguments supported by evidence for particular viewpoints taken.
Please arrange to meet your supervisor during the first week of term where they will provide the Literature Review topic and discuss it with you. They will give you some guidance as to what topics to included and discuss. After you have done more extensive background reading, you can meet your supervisor again for input on the structure you propose and key ideas/concepts that you wish to explore. A Table of Contents might provide a useful platform for this exercise. If you have specific questions, you can email your supervisor. However, your supervisor will not correct a first, or any subsequent draft of your Literature review.

Please read these instructions carefully. The literature review should be no more than 6000 words (excluding tables, figures, legends, table of contents, abbreviations and references) and a word count should be indicated on the front page. You will lose marks for going over the word count. All essays should be typed using Calibri font, size 11. Referencing software should be used (e.g. EndNote, Mandalay etc.). The library offers tutorials on EndNote which is available for download on the library website. We recommend Vancouver style of referencing, but others can be used. Original figures are allowed and a minimum of 3 figures should be included. Each figure & Table should be accompanied by a legend which contains all the information required to understand the content included. The literature review should be submitted through Turnitin plagiarism detecting software in Blackboard.

Please reacquaint yourselves with what constitutes plagiarism (additional info on page xxx). It is a serious academic infringement that will be taken very seriously by the School of Biochemistry and Immunology.

The deadline for submission of the Literature review through Blackboard is 4pm Friday 18th December, 2020. For every working day that your literature review is late 2% will be deducted from your mark.

Research Project and associated Research Paper

- In order to comply with government regulations regarding physical distancing, the laboratory element has been reduced from 11 to 4 weeks per student in a research lab or dry project.
- Each student will be accommodated in a given block that has is pre-assigned. Projects may be facilitated either full time or part time. Your expected timetable for this activity will be available to you at the beginning of the term in order to allow you to plan and manage your time.
- Do not spend more than the allowed time in the lab and please let me know if you and/or any of your peers are having particular issues with this.
- At the end of the project, students will hopefully have generated their own dataset. If required, the PI will provide more data from the lab to the student (1-2 datasets).
- Students will then write a short scientific paper according to the guidelines provided below.
- This paper will be marked by the supervisor and a second member of staff (not your supervisor).
• If a student does not generate a dataset (for any reason including lockdown), they will be given 2-3 sets of experimental data from the lab on which to base their paper.

A copy of mark sheets and criteria for SS Literature review, research paper, future work proposal and oral presentation are available at the end of this booklet.

Note: if any markers are more than 10% apart, a third marker will also grade the activity before a final mark is agreed.

**Research Article structure**
The structure of the Research Article will be broadly based on the FEBS Letters Journal style. It is advised that you check publications in this journal to assist in understanding the content of the different sections.

**Title Page and Abstract Title:** The title should be a maximum of 150 characters (including spaces). Titles should clearly and concisely state the subject of the manuscript. Avoid abbreviations and formulae where possible.

**Author names and affiliations:** The full names and affiliations should be provided for all authors. The corresponding author should also provide a full postal address and telephone (including country code), and an e-mail address.

**Abstract:** The abstract should be a maximum of 100 words. The abstract should state the purpose of the research, the principal results and major conclusions. Avoid non-standard or uncommon abbreviations and formulae where possible.

**Keywords:** The keywords should reflect the significant factors of the investigation as a whole. A maximum of six keywords should be selected and included with the submitted manuscript.

**Abbreviations:** Define non-standard or uncommon abbreviations. Ensure consistency of abbreviations throughout the article.

**Highlights:** Highlights consist of a short collection of bullet points that convey the core findings of the article and should be submitted in a separate file in the online submission system. Please use 'Highlights' in the file name and include 3 to 5 bullet points (maximum 85 characters (including spaces) per bullet point).

**Manuscript text:** The length of the submitted manuscript should not exceed 3000 words, including figure legends, tables, and references. The manuscript text should be divided in the following sections:

- **Introduction:** give a broad overview of the topic, summarising the topic, the key preceding findings in the literature that led to this work and how it led to the relates to the data being presented.

- **Materials and Methods:** Describe the reagents, equipment and protocols used in the research presented.

- **Results:** present data in a clear and concise manner using appropriate statistical analysis.

- **Figures:** can be used to display data. Be sure you label clearly and choose to display the data in a way that helps simplify the conclusion reached. Figures should be embedded at the end of the manuscript. Please make sure that the figures are clear and that resolution is at least 300dpi.

- **Figure legends:** title and description of what is being presented in the figure
- **Tables**: Number tables consecutively in accordance with their appearance in the text. Place footnotes to tables below the table body and indicate them with superscript lowercase letters.

- **Discussion**: discuss the data presented in the results section and the implications of any new discoveries.

- **Acknowledgements**: make note of non-authors who assisted in or made contributions to the research.

- **References**: References should be numbered in square brackets according to Febs Letter style, e.g. [7], or [11-13,17], in order of citation in the text. The actual authors can be referred to, but the reference number(s) must always be given. Example: "...... as demonstrated [3,6]. Barnaby and Jones [8] obtained a different result ...." [1] MacKinnon, R. (2003). Potassium channels. Science. 555, 62-5.

**Endnote Style**: Use FEBS Letters style of referencing. Using plug-ins to word processing packages, authors only need to select the appropriate journal template when preparing their article and the list of references and citations to these will be formatted according to the journal style. Please ensure that every reference cited in the text is also present in the reference list (and vice versa). Unpublished results and personal communications are not recommended in the reference list but may be mentioned in the text. If these references are included in the reference list they should follow the standard reference style of the journal and should include a substitution of the publication date with either 'Unpublished results' or 'Personal communication' Citation of a reference as 'in press' implies that the item has been accepted for publication.

**Submission**: Convert your file to a PDF and submit via Blackboard.

**Key Deadlines**:
- First draft: Monday 1st February 2021
- Final draft: Friday 19th February 2021

We would strongly recommend that you submit your first draft at an earlier date in January in order to give you time to incorporate suggested revisions. Listen carefully to the feedback and incorporate it.

A deadline for submission of the final revised research article in Blackboard will operate. **It is 4.00 pm on Friday 19th February. For every working day that your research article is late 2% will be deducted from your mark.**

**Lab performance**: Your supervisor will provide a mark for your lab performance or engagement during the dry project. This **will account for 5% of the capstone project mark.** They will take into account how diligently you worked, how well you planned experiments and/or analysed data, your technical ability, your ability to work independently etc.

**Future Research Proposal**
With the project supervisor as a mentor, students will have to prepare a future research proposal that addresses an important issue, either directly stemming from the research project or an important question identified in the course of your literature review. Specific instructions are provided below. Your supervisor will provide you with feedback on the first draft of the proposal only. The deadline for submission of the first draft is Monday 8th February 2021. We strongly advise that you submit a draft to your supervisor prior to this deadline. The final proposal with a deadline of submission on Friday 26th February 2021 will be marked by two members of staff (not the project supervisor) and will account for 25% of the capstone project.

Template of Future work proposal:

1. **Project Title**
   This should be descriptive and concise and should reflect the aim of the project. It may be the same or similar to the title of your research paper

2. **Project Lay Summary**
   Please provide a plain English summary such that it is clear and is easy to understand by a broad lay audience (maximum 200 words)

3. **Project Abstract of research proposal** (maximum 200 words)
   This should be a succinct summary of the proposed research question. The aims and hypotheses of the project should be clearly conveyed. Ideally it provides a clear synopsis of your proposal and should set the research proposal in context.

4. **Background to the area of the proposed research** (maximum 750 words)
   Describe the background to the research proposal and detail the nature of the issue to be addressed. Explain why this research is important. You may include a maximum of two figures if you wish.

5. **Research Question/ Hypothesis** (maximum 50 words)

6. **Objectives** (maximum 60 words for each objective)
   Please add 3 specific objectives

7. **Research plan and methodology** (maximum 1000 words)
   Summarise the proposed research plan and include details of the experimental approaches and techniques that will be used. You may include a maximum of two figures if you wish.

8. **Impact of the research** (maximum 200 words)
   Describe the anticipated outcomes of the proposed research and provide details on the likely impact of this research on e.g. human health and/or on adding to the knowledge base of the area.

9. **Ethical concerns** (if applicable; maximum 200 words)
   Please address any potential risk and/or harm to patients in the research, if relevant. Please highlight any potential ethical concerns (including work involving animals) during this study.

10. **References**
Provide a list of publications/references (maximum 20) cited in the future work proposal description above. Please enter references in the same format. For example, the following format may be used:


Key deadlines:
Submission of the first draft to supervisor: Monday 8th February 2021.
Submission of final proposal through BB: Friday 26th February 2021.

For every working day that your future work proposal is late 2% will be deducted from your mark.

Oral Presentation:
Following submission of your research paper and future work proposal you will give a 10 min oral presentation (during reading week of semester 2) outlining the key findings of the project and your plans for future research. You will also answer questions from the floor. Your presentation and your ability to answer questions will be assessed by a panel of three members of academic staff (not your project supervisor). Your classmates will also be present at this session. It is advisable to arrange at least one practise session with your project supervisor. This oral presentation will account for 15% of the capstone project mark.

Copy of mark sheets and criteria for literature review, research article, future work proposal and oral presentation can be found at the end of the manual.

Note: if any markers are more than 10% apart, a third marker will also grade the activity before a final mark is agreed

Advanced Research Skills (BIU44010) Value: 10 ECTS

This module covers quantitative biochemical problems, bioinformatics (sequence analysis), comparative medicine and a series of group presentations by students on various biochemical techniques. A series of 18 lectures will also introduce students to a wide array of cutting-edge techniques and strategies used in biochemistry. Marks (100) for this module are awarded through continual assessment and exams as follows:

- Quantitative Problems (4 in total, assessed by two 1.5-hour remote exams of equal weighting-one compulsory question on each exam) (30 marks in total)
- Bioinformatics-Sequence Analysis (3 in total of equal weighting, assessed by assignments submitted on-line) (10 marks in total)
• Comparative Medicine (assessed by a 1-hour remote exam; answer one compulsory essay style question. Answer submitted through turnitin on Blackboard) (5 marks)
• Group BioTechniques assessed in part by oral presentation (5 marks) and a summary report (5 marks) (10 marks in total)
• BioTechniques Exam: Both the material delivered in lectures and material covered in the group BioTechniques will be assessed by a 2.5-hour remote exam on 13th January 10-12.30pm; answer 3 out of 4 essay style questions. Answers submitted through turnitin in Blackboard (45 marks in total)

Quantitative Problem Tutorials:
An online introductory session to each of the four Quantitative Problems will be delivered by four assigned staff members (e.g. Prb 1 Intro on Blackboard). Following the introductory session, you will be asked to attempt a quantitative problem circulated by that staff member before the next tutorial session (e.g. Prb 1 Tutorial). In this session, the staff member will go through the solution to the problem.
There will be 4 quantitative problems in total and these will be assessed by two 1.5 hour in-course remote exams of equal weighting—one compulsory question on each exam.

Sequence Analysis Sessions:
There will be three Sequence Analysis Exercises (Dr Jerrard Hayes). Tutorials will be delivered by Dr Hayes on Blackboard. He will show you how to use the required software and provide you with some worked examples. He will also advise you how and where to submit the exercises and of their submission deadlines.

Semester 2 Examination Papers Value: 30 ECTS
We anticipate and are planning for remote exams. However, this may change depending on public health guidelines.

There are three exam papers at the end of semester 2, each with equal weighting as follows:

**Paper 1 (BIU44310) Neurobiology & Immunology Value: 10 ECTS**
Exam paper (100 marks) divided into 3 sections from which 4 essay-styled answers will be requested of equal weighting as follows:
Section 1: Neurobiology (Answer 1 out of 2 questions) 25 marks
Section 2: Immunology (Answer 1 out of 2 questions) 25 marks
Section 3: General (Integrative/philosophical) 25 marks
Answer one other question from any section 25 marks

**Paper 2 (BIU44320) Microbial Diseases & Immune System Disorders Value: 10 ECTS**
Exam paper (100 marks) divided into 3 sections from which 4 essay-styled answers will be requested of equal weighting as follows:
Section 1: Microbial Disease (Answer 1 out of 2 questions) 25 marks
Section 2: Immune System Disorders (Answer 1 out of 2 questions) 25 marks
Section 3: General (Integrative/philosophical)  
Answer one other question from any section  

Paper 3 (BIU44330) Cell Cycle, Cancer Biology & Therapeutics  
Value: 10 ECTS  
Exam paper (100 marks) divided into 3 sections from which 4 essay-styled answers will be requested of equal weighting as follows:  
Section 1: Cell cycle & Cancer (Answer 1 out of 2 questions)  
Section 2: Cancer Biology & Therapeutics (Answer 1 of 2 questions)  
Section 3: General (Integrative/philosophical)  
Answer one other question from any section  

The overall degree mark is comprised of 80% of SS year and 20% of JS year.

Vivas:  
On completion of their annual examinations, students may be required to sit a viva voce examination with the External Examiner (Prof. Bill Paxton, University of Liverpool, UK). Students are considered ‘borderline’ if they are 1% or less off a grade and following the viva voce examination the External Examiner may recommend at the Examiners’ meeting that the students’ degree mark be brought up to the next grade. Note: not all students called for viva are borderline and additional students may be included as controls. You will not be told which category you are in.  

How can you prepare for the viva?  
If you are called for a viva in the summer, you should read over your project thesis as the Extern often starts off by asking you about your project. He/she will want to relax you and will generally start you off on a topic you know a lot about. The Extern will probably cover about 4-6 topics during the viva and it is impossible to second guess what they will ask. However, if you feel you did badly in one particular exam question, it is a good idea to revise this topic. The Extern has access to all your marks and if he/she sees a blip in an otherwise very consistent set of marks they may wish to follow this up. The Extern may also ask you if there is a topic that you find particularly interesting and that you wish to talk about. It is therefore a good idea to have something prepared but ensure that it is a specific topic. Do not be too general and say that you’re interested in protein structure! The Extern may also ask you on your views of the course e.g. was there a part of the course you really enjoyed or not as the case may be. The role of the Extern is not only to assess your performance but also to assess our teaching capabilities and to identify strengths/weaknesses and even omissions in the course so that they can make recommendations for the following year.  

Tutorials:  
Tutors have been chosen randomly. Please contact your tutor during the first week of the first semester. You are expected to attend a tutorial every fortnight. Your tutor will set various exercises and these should help you in your final examinations.
Addresses and Phone Numbers:
Please send your College based address, e-mail address and telephone number (if any) to Rachel Elshove (elshover@tcd.ie). Please also include a home (or other contact) address and telephone number. This will enable us to contact you in an emergency or with important changes. If you do not enter these details you may not be informed of any changes.

Prizes: The Margaret Ciotti Medal is awarded each year to a Senior Sophister student in one of the three classes for excellence in undergraduate research. It will be awarded to the student who attains the highest marks overall in their capstone project. This presentation of this medal was initiated over 20 years ago by a previous lecturer in the school, Bruno Orsi, to honour his wife's achievements in biochemistry. The medal is dedicated to her memory.

Health and Safety Matters:

1) Registration with Safety Officer

Preliminary safety registration takes place during one of the mandatory health and safety briefing sessions that will be available online from September 21st. You must register, by E-mail or if required in person, with the Safety Officer once you commence your project. This is necessary in order to record your next-of-kin details in the unlikely event of an accident, to record where you will be working, to ascertain whether or not you have to work with major hazards during your project work (carcinogens, mutagens, cyto-toxics, biological agents, GMOs, radioactivity, etc), and to ensure that you and your supervisor understand that you have to conduct a HIRAC review (hazard identification, risk assessment and risk control) of the proposed work. (see below).

2) Formal Health and Safety Briefings

Mr Liam McCarthy (Chief Technical Officer) will describe the general management and security features of the building in a pre-recorded introductory briefing which will be available in Blackboard the week beginning 21st September. Dr Darren Fayne, the School Safety Officer will give you two formal pre-recorded Health and Safety briefings. They will be available in Blackboard week beginning 21st September. VIEWING OF THESE BRIEFINGS AND ATTENDANCE AT ANY ADDITIONAL TRAINING SESSIONS (e.g. Radiological Protection Workshop, viewing safety videos, etc.) IS MANDATORY. Some of these actions are legal, license or College’s insurer’s requirements that have to be complied with.

3) Safety Lab Coat & Spectacles

You must have at least one Howie-style laboratory safety coat, conforming to the NISO 1993, or better, standard, along with a pair of safety spectacles with you at all stages during active laboratory work. A face mask must be worn at all times and more COVID-19 related detail is provided in the COVID-19 Procedures section.

You are required to complete a ‘Personnel Training Form’ to ensure that you have been trained in all techniques/equipment that you will be using during your project, that you understand any risks associated with your project and that you understand how to minimize them. Any hazardous materials, steps or procedures (including off-site work connected with your research such as collecting samples from other laboratories, etc.) involved in your project will have been identified by, and discussed with you by your project supervisor. He/she is required, by law, to perform this hazard identification, risk assessment and risk control (HIRAC) on every experiment undertaken by you, but you have a role to play as well in making sure that you record the conclusions of this procedure in your notebook. The control measures necessary to reduce or eliminate risk must be written in your notebook for each hazardous step or procedure. The law requires this to be done. You are still in training so you cannot be classed as a competent scientist and thus able to do this yourself to ensure your safety. If in doubt about the proper procedures for any experiment, do not perform that experiment.

Senior Sophisters must make themselves aware of the College's and School’s Safety Statement which is displayed prominently in every laboratory in the School. It can be downloaded from the School’s Local Home-Page at this URL: www.tcd.ie/biochemistry/. You are still bound by the 'Science Faculty's Health and Safety Guidance Manual' and the associated Health Questionnaire which you completed at the start of JF year. If your health status has changed since then in terms of the categories listed (including pregnancy or lactation) you have to complete a new Health Questionnaire. If your health status again changes during the year you must consult, in confidence, with the Safety Officer. [This particularly applies in the case of pregnancy.]

If you intend working with radioactivity during your project you must first contact the School Radiological Protection Supervisor, Dr Darren Fayne (fayned@tcd.ie). You are not permitted to work with unsealed radionuclide sources.

Any student working with human materials (blood, buffy coats, semen, CSF, dialysis fluid, primary explants, etc.) must be vaccinated against Hepatitis B prior to commencing your project. You are not permitted to work with any risk group 3 or class 3 biological agents such as HIV, Hepatitis B and C, COVID-19, etc. or to culture Category 3 (or higher) pathogens.

You must request or otherwise obtain Material Safety Data Sheets (MSDS) for any toxic or dangerous chemicals or preparations that you are using in your project. These MSDS’s have to be requested at the point of ordering any material. The MSDS must be stuck into your laboratory notebook. The guidance must be followed.

After 6:00 pm on working days, and at all times on weekends and public holidays, no Senior Sophister may work in any laboratory without the close presence of a member of the academic staff. It is the Senior Sophister’s responsibility to ask that staff member if he/she will consent to act in a supervisory capacity for the time the student is working. During normal working hours, no student may work alone in any laboratory.
Failure to observe these rules/procedures will cause the offenders to be officially warned, and be reported to the Head of School, school safety officer and project supervisor. Normal College disciplinary procedures can be invoked (including fines being levied as well as withdrawal of student ID card, etc.) Persistent failure to observe these rules may result in that student being banned from laboratory work with loss of those marks available for project work.

All the necessary forms are available to download on the local safety pages at

https://www.tcd.ie/Biochemistry/local/safety_info.php

Once you have completed all the forms and safety briefings, E-mail them to the Safety officer, Darren Fayne (fayned@tcd.ie).

5) 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 8961999) in case of an emergency. Should you require any emergency or rescues 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).

6) COVID-19 Procedures for Students

Prerequisites

(1) You will need to complete a College COVID-19 induction module in Blackboard.

(2) To comply with College and TBSI requirements for contact tracing purposes and also a daily declaration re COVID-19 symptoms, the School has created a minimal daily online log which takes about 20 seconds to complete and submit. JS, SS and MSc students in the School need to complete this log:

https://forms.office.com/Pages/ResponsePage.aspx?id=jb6V1Qaz9EWAZJ5bgvvlK0WWnvWNYqI0oCf4UxK880dURjNFT0dGTQyTIVFRzNMQiNPNIIsraelhGTS4u

Please bookmark this page so you can access it easily and perhaps put a reminder in your calendar. The log only needs to be completed if you are coming into TBSI.

General Guidance Regarding COVID-19

It is highly recommended that students install the Safezone and the COVID Tracker (https://covidtracker.gov.ie/) apps.
At present (September 2020), the wearing of face masks is mandatory for all teaching and learning events for all students, in the Libraries, and public areas of the campus such as the Buttery and TBSI. Masks are not required if you are in a single occupancy office or while eating/drinking.

Trinity requires all students to wear face masks for all teaching and learning events including in laboratories.

There will be cleaning stations set up in each room and students will wipe-on/wipe-off at the start and end of each lecture.

Food consumption in the Knowledge Exchange (37) and Tercentenary Bullnose (12) is allowed provided the maximum occupancy signs are observed and people sit well apart. Goldsmith Hall is also available.

Use clearly designated seating that maintains physical distancing.

Wash your hands often with soap and water for at least 20 seconds, especially after going to the bathroom, before eating, and after blowing your nose, coughing, or sneezing. If soap and water are not readily available, use an alcohol-based hand sanitizer.

Other sensible measures include turning your head away from people when you sneeze, using a tissue or your sleeve and disposing of tissues quickly.

Hand sanitizers and dispensers are provided throughout the campus.

Clear signage is at all entrances to buildings and within buildings of the COVID 19 precautions that apply to everyone; hand hygiene, coughing and sneezing etiquette, physical distancing and the wearing of face masks.

Use a one-way entry and exit route for buildings - where possible.

A one-person policy should be observed for all lifts on campus and to be used only by people with mobility issues or carrying heavy materials.

Stairs and corridors: A one-way, keep right and keep moving system has been drawn-up with stairs clearly identified and signed for ascent and descent.

Toilets: Signs have been placed on toilet doors reminding staff and students to maintain physical distancing and a maximum occupancy number will be displayed.

Gloves should not be worn unless to fulfil PPE requirements and must never be used as a substitute for hand hygiene.
After each group leaves a workspace, high-contact surfaces should be cleaned with water and detergent and not with disinfectant.

To the greatest extent possible, Trinity will keep records of attendance at all events for 4 weeks in case required for contact tracing purposes.

If people spend more than 2 hours or more in a shared space together, they may be regarded as COVID-19 contacts in the event that someone present is subsequently identified as a case.

If people are within 2 meters for >15 minutes, they may be regarded as COVID-19 contacts in the event that someone present is subsequently identified as a case.

For teaching and learning purposes, a physical distance of at least 1 m shoulder to shoulder should be maintained between students, with mandatory wearing of cloth face coverings, visors or face shields. For staff, a distance of 2 m should be maintained between the staff member and students. Where there is a risk that the 2 m distance could be compromised or where teaching activity requires the staff member to be less than 2m from the student, staff should wear a face covering, or other appropriate protection to be provided by the College.

This College website contains a useful FAQ: [https://www.tcd.ie/about/coronavirus/#student-faq](https://www.tcd.ie/about/coronavirus/#student-faq) and more information is provided on the HSE website: [https://www.hpsc.ie/a-z/respiratory/coronavirus/novelcoronavirus/](https://www.hpsc.ie/a-z/respiratory/coronavirus/novelcoronavirus/)

Daily 5-point self-checks

Ask yourself these 5 questions each day prior to travelling to College, do you have:

1. A recent cough?
2. Shortness of breath?
3. A new respiratory illness?
4. Fever?
5. Loss of smell or taste?

If you answer yes to any of the above, please contact your GP immediately, follow their advice and inform your Course coordinator.

Response Plan for Dealing with a Suspected COVID-19 Case

The guiding principles for dealing with a suspected case of COVID-19 are outlined below. In all such cases the safety of the person seeking attention and the accompanying person is paramount.
• Anyone who feels unwell with ‘flu or ‘flu-like symptoms in advance of coming to work will be informed that they must stay at home, contact their GP and follow the guidelines provided by the HSE

• In cases where the onset occurs on campus, the person who feels unwell will immediately report to the isolation room on the B1.18, TBSI and inform their Course Coordinator and COVID-19 Coordinator (Liam McCarthy), maintaining strict physical distancing of at least 2m throughout.

• The COVID-19 Coordinator, Course Coordinator and the Response Team will be provided with a COVID Kit equipped with hand sanitiser, wipes, tissues, face masks and latex gloves

• The isolation room will be equipped with a hand sanitiser, wipes, tissues, face masks, latex gloves and a clinical-waste disposal bin

• The unwell individual will be required to wear a face mask at all times and to avoid touching people, surfaces and objects

• The COVID-19 Coordinator/Course Coordinator/Response team will assist the unwell individual to contact the College Health Centre at (01) 896 1591/01 896 1556 or their own GP

• The COVID-19 Coordinator will report the incident and the use of the isolation room to College Security at (01) 896 1317

• The COVID-19 Coordinator/Course Coordinator/Response team will note the names and contact details (address, mobile number) of all people who work in the same area as the unwell person or who have come into close contact with the unwell person to provide to the HSE for the purposes of contact tracing

• Following a suspected case being reported, the individuals in the building who have been in close contact (working in the same office/area or have been <2m from the person for more than 15 minutes) will be advised to go home, avoiding public transport, and follow HSE guidelines. All close contacts must avoid TBSI until the suspected case receives a negative result. For any confirmed case in TBSI, all close contacts must self-isolate for 2 weeks. All suspected or confirmed cases should be notified to their Course Coordinator, who in turn should notify the Director of TBSI.

• The COVID19 Coordinator for B&I/Compliance Officer/Safety Officer will contact Estates and Facilities to arrange a decontamination/deep clean of the areas where the person has been located.

Guidance for Working in Laboratories and Reading Rooms

Dr Darren Fayne, the School Safety Officer, will give two formal pre-recorded Health and Safety briefings wherein COVID-19 precautions will also be discussed.
In addition to the prerequisite COVID-19 induction module and online log mentioned above, you also need to complete a School of Biochemistry and Immunology specific online COVID-19 Training module available on Blackboard http://mymodule.tcd.ie/ in module BIP77100.

It is essential that you complete and submit this COVID-19 Training prior to commencing lab work.

Trinity requires all students to wear face masks for all teaching and learning events.

Personal Protective Equipment (PPE), such as a face mask, will be required for general research work. After use, PPE should be disposed of via the lab waste stream.

Standard laboratory PPE must be used by all researchers as they would normally do in the course of their work.

Laboratory groups are required to clean their workspaces (and instruments, including key pad on computer) with ethanol wipes or 70% ethanol at the beginning and end of the day or at the end of an instrument session.

Student project work needs to be incorporated into the pattern of attendance appropriate to the laboratory’s working needs while maintaining physical distancing and staying below the maximum occupancy levels.

Reading rooms can be used provided the maximum occupancy limits are observed. The rooms should only be used for essential research purposes as writing up of results should be done at home. Personnel must sit well apart to achieve a physical distancing of at least 1 metres and wear a face mask unless in a single occupancy office. It will not be possible, for example, to sit at adjacent desks.

**Students with Disabilities:** The University Policy Relating to students with disabilities is available at www.tcd.ie/disability. The Student Disability Service is located in Room 2054 Arts Building, phone = 8963111, email = disb@tcd.ie. The Student Disability Services Committee provides the formal channel for raising issues affecting students with disabilities. Martha Motherway (motherm@tcd.ie) is the liaison officer for the disability services in our school.
MyCareer from Careers Advisory Service

An online service that you can use to:

- Apply for opportunities which match your preferences - vacancies including research options
- Search opportunities- postgraduate courses and funding
- View and book onto employer and CAS events
- Submit your career queries to the CAS team
- Book an appointment with your Careers Consultant

Login. Only two steps - it’s easy! Find us on tcd.ie/careers or MyDayApp

STEP 1  Login to MyCareer (using your Trinity username and password)

STEP 2  Update your profile with your email preferences, job and study areas of interest and your career readiness
Simply login to MyCareer using your Trinity username and password and personalise your profile.

**Careers Advisory Service**
Trinity College Dublin, 7-9 South Leinster Street, Dublin 2
01 896 1705/1721  |  Submit a career query through MyCareer

- MyCareer: mycareerconnect.tcd.ie
- www.tcd.ie/careers/students/postgraduate/
- TCD.Careers.Service @TCDCareers
- TCD.Careers
- tinyurl.com/LinkedIn-TCD

**Opening Hours**
**During term:** 9.30am - 5.00pm, Monday - Friday
**Out of Term:** 9.30am - 12.30pm & 2.15 - 5.00pm, Monday - Friday

**Plagiarism:**
The full statement of College’s policy on plagiarism (see Calendar, General Regulations and Information, at [http://tcd-ie.libguides.com/plagiarism](http://tcd-ie.libguides.com/plagiarism)) are reproduced below. Given the remote nature of a lot of academic activities this year and the requirement for online submissions, **all written assignments will be submitted through plagiarism-detecting software** such as Turnitin (additional information for which can be found at: [http://turnitin.com/static/index.html](http://turnitin.com/static/index.html)). It is **your responsibility to educate yourself about what exactly constitutes plagiarism. Ignorance is not an acceptable defence.**

**It is a college requirement** that all students must complete an online tutorial on avoiding plagiarism ‘Ready, Steady, Write’, located at [http://tcd-ie.libguides.com/plagiarism/ready-steady-write](http://tcd-ie.libguides.com/plagiarism/ready-steady-write).

In addition, students must complete cover sheets or include text containing the following declaration when submitting assessed work in hard or soft copy or via Blackboard:

I have read and I understand the plagiarism provisions in the General Regulations of the University Calendar for the current year, found at: [http://www.tcd.ie/calendar](http://www.tcd.ie/calendar).


**Calendar regulations on plagiarism 2020/21**

95 **General** It is clearly understood that all members of the academic community use and build on the work and ideas of others. It is commonly accepted also, however, that we build on the work and ideas of others in an open and explicit manner, and with due acknowledgement. **Plagiarism is the act of presenting the**
work or ideas of others as one’s own, without due acknowledgement. Plagiarism can arise from deliberate actions and also through careless thinking and/or methodology. The offence lies not in the attitude or intention of the perpetrator, but in the action and in its consequences. It is the responsibility of the author of any work to ensure that he/she does not commit plagiarism. Plagiarism is considered to be academically fraudulent, and an offence against academic integrity that is subject to the disciplinary procedures of the University.

96 Examples of Plagiarism

Plagiarism can arise from actions such as: (a) copying another student’s work; (b) enlisting another person or persons to complete an assignment on the student’s behalf; (c) procuring, whether with payment or otherwise, the work or ideas of another; (d) quoting directly, without acknowledgement, from books, articles or other sources, either in printed, recorded or electronic format, including websites and social media; (e) paraphrasing, without acknowledgement, the writings of other authors. Examples (d) and (e) in particular can arise through careless thinking and/or methodology where students: (i) fail to distinguish between their own ideas and those of others; (ii) fail to take proper notes during preliminary research and therefore lose track of the sources from which the notes were drawn; 48 Calendar 2020-21 (iii) fail to distinguish between information which needs no acknowledgement because it is firmly in the public domain, and information which might be widely known, but which nevertheless requires some sort of acknowledgement; (iv) come across a distinctive methodology or idea and fail to record its source. All the above serve only as examples and are not exhaustive.

97 Plagiarism in the context of group work

Students should normally submit work done in co-operation with other students only when it is done with the full knowledge and permission of the lecturer concerned. Without this, submitting work which is the product of collaboration with other students may be considered to be plagiarism. When work is submitted as the result of a group project, it is the responsibility of all students in the group to ensure, so far as is possible, that no work submitted by the group is plagiarised. In order to avoid plagiarism in the context of collaboration and group work, it is particularly important to ensure that each student appropriately attributes work that is not their own.

98 Self plagiarism

No work can normally be submitted for more than one assessment for credit. Resubmitting the same work for more than one assessment for credit is normally considered self-plagiarism.

99 Avoiding plagiarism

Students should ensure the integrity of their work by seeking advice from their lecturers, tutor or supervisor on avoiding plagiarism. All schools and departments must include, in their handbooks or other literature given to students, guidelines on the appropriate methodology for the kind of work that students will be expected to undertake. In addition, a general set of guidelines for students on avoiding plagiarism is available on http://libguides.tcd.ie/plagiarism.

100 If plagiarism as referred to in §95 above is suspected, in the first instance, the Director of Teaching and Learning (Undergraduate), or their designate, will write to the student, and the student’s tutor advising them of the concerns raised. The student and tutor (as an alternative to the tutor, students may nominate a representative from the Students’ Union) will be invited to attend an informal meeting with the Director of Teaching and Learning (Undergraduate), or their designate, and the lecturer concerned, in order to put their suspicions to the student and give the student the opportunity to respond. The student will be requested to respond in writing stating his/her agreement to attend such a meeting and confirming on which of the suggested dates and times it will be possible for them to attend. If the student does not in this manner agree to attend such a meeting, the Director of Teaching and Learning (Undergraduate), or designate, may refer the case directly to the Junior Dean, who will interview the student and may implement the procedures as referred to under CONDUCT AND COLLEGE REGULATIONS §2.

101 If the Director of Teaching and Learning (Undergraduate), or designate, forms the view that plagiarism has taken place, he/she must decide if the offence can be dealt with under the summary procedure set out below. In order for this summary procedure to be followed, all parties attending the informal meeting as noted in §100 above must state their agreement in writing to the Director of Teaching and Learning
(Undergraduate), or designate. If one of the parties to the informal meeting withholds his/her written agreement to the application of the summary procedure, or if the facts of the case are in dispute, or if the Director of Teaching and Learning (Undergraduate), or designate, feels that the penalties provided for under the summary procedure below are inappropriate given the circumstances of the case, he/she will refer the case directly to the Junior Dean, who will interview the student and may implement the procedures as referred to under CONDUCT AND COLLEGE REGULATIONS §2.

102 If the offence can be dealt with under the summary procedure, the Director of Teaching and Learning (Undergraduate), or designate, will recommend one of the following penalties: (a) Level 1: Student receives an informal verbal warning. The piece of work in question is inadmissible. The student is required to rephrase and correctly reference all plagiarised Calendar 2020-21 elements. Other content should not be altered. The resubmitted work will be assessed and marked without penalty; (b) Level 2: Student receives a formal written warning. The piece of work in question is inadmissible. The student is required to rephrase and correctly reference all plagiarised elements. Other content should not be altered. The resubmitted work will receive a reduced or capped mark depending on the seriousness/extent of plagiarism; (c) Level 3: Student receives a formal written warning. The piece of work in question is inadmissible. There is no opportunity for resubmission with corrections. Instead, the student is required to submit a new piece of work as a reassessment during the next available session. Provided the work is of a passing standard, both the assessment mark and the overall module mark will be capped at the pass mark. Discretion lies with the Senior Lecturer in cases where there is no standard opportunity for a reassessment under applicable course regulations.

103 Provided that the appropriate procedure has been followed and all parties in §100 above are in agreement with the proposed penalty, the Director of Teaching and Learning (Undergraduate) should in the case of a Level 1 offence, inform the course director and where appropriate the course office. In the case of a Level 2 or Level 3 offence, the Senior Lecturer must be notified and requested to approve the recommended penalty. The Senior Lecturer may approve, reject, or vary the recommended penalty, or seek further information before making a decision. If the Senior Lecturer considers that the penalties provided for under the summary procedure are inappropriate given the circumstances of the case, he/she may also refer the matter directly to the Junior Dean who will interview the student and may implement the procedures as referred to under CONDUCT AND COLLEGE REGULATIONS §2. Notwithstanding his/her decision, the Senior Lecturer will inform the Junior Dean of all notified cases of Level 2 and Level 3 offences accordingly. The Junior Dean may nevertheless implement the procedures as referred to under CONDUCT AND COLLEGE REGULATIONS §2.

104 If the case cannot normally be dealt with under the summary procedures, it is deemed to be a Level 4 offence and will be referred directly to the Junior Dean. Nothing provided for under the summary procedure diminishes or prejudices the disciplinary powers of the Junior Dean under the 2010 Consolidated Statutes.

College regulations on Academic Progress and Progression 2020-2021

Progression regulations: Bachelor programmes

58 Some programmes with professional accreditation have received a derogation from specific regulations on progression by the University Council. The relevant programme entry provides these details. In order to rise with their class, students must obtain credit for the academic year by satisfactory attendance at lectures and tutorials and by carrying out, submitting and sitting the 3See individual entries for applicable certificate and diploma course progression regulations. 38 Calendar 2020-21 required assessment components. In addition, students must pass the year by achieving, at a minimum, an overall credit-weighted average pass mark for the year (40 per cent or 50 per cent, as per programme regulations) and either: (a) accumulate 60 credits by achieving at least the pass mark in all modules or (b) pass by
compensation. All modules and components within modules are compensatable (except in particular professional programmes where compensation does not apply). To pass a year by compensation, in programmes that locate the pass mark at 40 per cent, a student must achieve the pass mark in modules carrying a minimum of 50 credits and obtain a module mark of at least 35 per cent in any remaining module(s). A student may accumulate a maximum of 10 credits at qualified pass where the mark lies between 35-39 per cent. To pass a year by compensation, in programmes that locate the pass mark at 50 per cent, a student must achieve the pass mark in modules carrying a minimum of 50 credits and obtain a module mark of at least 45 per cent in any remaining module(s). A student may accumulate a maximum of 10 credits at qualified pass where the mark lies between 45-49 per cent.

59 Progression is on an annual basis. Within a year students may carry failed modules from one semester to the next but not from one academic year to another; that is, they will not be able to rise to the next year of their programme until they have successfully completed the preceding year(s). Students who have not passed their year are required to present for reassessment when: (a) they obtain in excess of 10 credits at qualified pass (i.e. marks between 35-39 per cent where the pass mark is 40 per cent; or 45-49 per cent where the pass mark is 50 per cent); (b) they fail any module (i.e. achieving marks below 35 per cent where the pass mark is 40 per cent; or below 45 per cent where the pass mark is 50 per cent); (c) they do not obtain an overall pass mark for the year; (d) any combination of (a) - (c) occurs.

60 If a student has achieved both fail and qualified pass grades at the first sitting or has exceeded the 10 credit limit allowed for compensation and is not permitted to rise with their year, they must present for reassessment in all failed components of all modules for which they obtained a fail and/or a qualified pass.

61 Different modalities of assessment to the first sitting are permitted in the reassessment session as determined by the programme.

62 The same progression and compensation regulations as outlined above apply at the reassessment session. The overall credit-weighted average for the academic year will be calculated using the most recent marks achieved.

63 Students who fail to satisfy the requirements of their year at the reassessment session are required to repeat the year in full (i.e. all modules and all assessment components).

64 Students are permitted to repeat any year of an undergraduate programme subject to not repeating the same year more than once and not repeating more than two academic years within a degree course, except by special permission of the University Council.

65 The maximum number of years to complete an undergraduate degree is six years for a standard four-year programme and seven years for a five-year programme.

Class Descriptors: These Science Faculty Descriptors are given as a guide to the qualities that assessors are seeking in relation to the grades usually awarded. A grade is the anticipated degree class based on the consistent performance at the level indicated by an individual answer. In addition to the criteria listed, the Department’s examiners will also give credit for evidence of critical discussion of the facts or evidence.

Class Descriptors

<table>
<thead>
<tr>
<th>Class</th>
<th>Range</th>
<th>Criteria</th>
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<tbody>
<tr>
<td>1</td>
<td>90 - 100</td>
<td>IDEAL ANSWER; showing insight and originality and wide knowledge. Logical, accurate and concise presentation. Evidence of reading and thought beyond course content. Contains particularly apt examples.</td>
</tr>
<tr>
<td>Score</td>
<td>Description</td>
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<tr>
<td>80 - 89</td>
<td>OUTSTANDING ANSWER; falls short of the ‘Ideal’ answer either on aspects of presentation or on evidence of reading and thought beyond the course. Examples, layout and details are all sound.</td>
<td></td>
</tr>
<tr>
<td>70 - 79</td>
<td>MAINLY OUTSTANDING ANSWER; falls short on presentation and reading or thought beyond the course but retains insight and originality typical of the first class work.</td>
<td></td>
</tr>
<tr>
<td>II - 1 65 - 69</td>
<td>VERY COMPREHENSIVE ANSWER; good understanding of concepts supported by broad knowledge of subject. Notable for synthesis of information rather than originality. Sometimes with evidence of outside reading. Mostly accurate and logical with appropriate examples. Occasionally a lapse in detail.</td>
<td></td>
</tr>
<tr>
<td>II – 2 60 - 64</td>
<td>LESS COMPREHENSIVE ANSWER; mostly confined to good recall of coursework. Some synthesis of information or ideas. Accurate and logical within a limited scope. Some lapses in detail.</td>
<td></td>
</tr>
<tr>
<td>III 55 - 59</td>
<td>SOUND BUT INCOMPLETE ANSWER; based on coursework alone but suffers from a significant omission, error or misunderstanding. Usually lacks synthesis of information or ideas. Mainly logical and accurate within its limited scope and with lapses in detail.</td>
<td></td>
</tr>
<tr>
<td>III 50 - 54</td>
<td>INCOMPLETE ANSWER; suffers from significant omissions, errors and misunderstanding, but still with understanding of main concepts and showing sound knowledge. Several lapses in detail.</td>
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<tr>
<td>III 45 - 49</td>
<td>WEAK ANSWER; limited understanding and knowledge of subject. Serious omissions, errors and misunderstandings, so that answer is no more than adequate.</td>
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<tr>
<td>III 40 - 44</td>
<td>VERY WEAK ANSWER; a poor answer, lacking substance but giving some relevant information. Information given may not be in context or well explained, but will contain passages and words which indicate a marginally adequate understanding.</td>
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<tr>
<td>F - 1 35 - 39</td>
<td>MARGINAL FAIL; inadequate answer, with no substance or understanding, but with a vague knowledge relevant to the question.</td>
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<tr>
<td>F - 2 30 - 34</td>
<td>CLEAR FAILURE; some attempt made to write something relevant to the question. Errors serious but not absurd. Could also be sound answer to the misinterpretation of the question.</td>
<td></td>
</tr>
<tr>
<td>F - 3 0 - 29</td>
<td>UTTER FAILURE; with little hint of knowledge. Errors serious and absurd. Could also be a trivial response to the misinterpretation of the question.</td>
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</table>

**Rubrics for Marking Capstone Project Elements:** a series of rubrics for marking each section of the Capstone Project are detailed below
Senior Sophister Literature Review Report

This mark contributes **25%** to the overall project mark. It is designed to test your ability to read scientific literature, and to develop and communicate important concepts and issues within a given field.

<table>
<thead>
<tr>
<th>Was report handed in on time?</th>
<th>Y</th>
<th>N</th>
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<tr>
<th><strong>Student Name:</strong></th>
<th><strong>Supervisor Name:</strong></th>
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<tr>
<th>Category</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presentation</td>
<td>Messy, poor English</td>
</tr>
<tr>
<td>Abstract</td>
<td>Wholly inadequate</td>
</tr>
<tr>
<td>Literature coverage</td>
<td>Poor</td>
</tr>
<tr>
<td>General understanding of topic</td>
<td>Wholly inadequate</td>
</tr>
<tr>
<td>Ability to synthesise information and communicate it by writing</td>
<td>Wholly inadequate</td>
</tr>
<tr>
<td>Evidence of critical review</td>
<td>Wholly inadequate</td>
</tr>
<tr>
<td>Original insights supported by evidence provided</td>
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</tr>
<tr>
<td>References</td>
<td>Wholly inadequate</td>
</tr>
<tr>
<td>Quality of language</td>
<td>Poor</td>
</tr>
<tr>
<td>Use of figures</td>
<td>Poor</td>
</tr>
<tr>
<td>Scientific rigour (use of appropriate resources)</td>
<td>Weak</td>
</tr>
<tr>
<td>Capacity for self-direction</td>
<td>Poor</td>
</tr>
<tr>
<td>Quality of first draft</td>
<td>Poor</td>
</tr>
</tbody>
</table>

| Publication standard                          | Excellent           |
| Extensive and deep                            |                      |
| Wholly inadequate                             |                      |
| Excellent                                     |                      |
| Fully accurate                                |                      |
| Wholly inadequate                             |                      |
| Excellent                                     |                      |

**Comments:**

**Particular difficulties if any:**


# Senior Sophister Project Performance and Research Paper: Supervisor’s Report

The research paper mark is to be agreed with the second examiner (and third examiner if first/second marks are greater than 10% apart). This agreed mark contributes **30%** to the overall project mark. It is designed to capture the abilities of a student to engage in an academic research project, critically analyse data and communicate research findings and their implications. Project Performance contributes **5%** to the overall mark.

<table>
<thead>
<tr>
<th>Student name</th>
<th>Project Title</th>
<th>Supervisor name</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<table>
<thead>
<tr>
<th>1st Draft submission on time</th>
<th>Yes ☐</th>
<th>No ☐</th>
<th>Project Performance (Supervisor only) %</th>
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<tbody>
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<td></td>
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<table>
<thead>
<tr>
<th>Thesis</th>
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</table>

<table>
<thead>
<tr>
<th>Presentation</th>
<th>Messy, poor English</th>
<th>Publication standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>Wholly inadequate</td>
<td>Publication standard</td>
</tr>
<tr>
<td>Introduction</td>
<td>Trivial</td>
<td>Publishable</td>
</tr>
<tr>
<td>Materials and methods</td>
<td>Wholly inadequate</td>
<td>Perfectly clear</td>
</tr>
<tr>
<td>Description of results</td>
<td>Wholly inadequate</td>
<td>Perfectly clear, complete</td>
</tr>
<tr>
<td>Figures/ legends/ tables</td>
<td>Wholly inadequate</td>
<td>Fully accurate</td>
</tr>
<tr>
<td>References</td>
<td>Wholly inadequate</td>
<td></td>
</tr>
<tr>
<td>Analysis of data</td>
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<td>Comprehensive analysis</td>
</tr>
<tr>
<td>Appropriate statistical analysis</td>
<td>Poor</td>
<td>Strict</td>
</tr>
<tr>
<td>Discussion</td>
<td>Poor</td>
<td>Publication standard</td>
</tr>
<tr>
<td>Scientific rigour e.g. use of controls</td>
<td>Weak</td>
<td>Strict</td>
</tr>
<tr>
<td>Understanding/ insight</td>
<td>Very little</td>
<td>Research level</td>
</tr>
<tr>
<td>Capacity for self-direction</td>
<td>Poor</td>
<td>Outstanding</td>
</tr>
<tr>
<td>Quality of first draft</td>
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<td>Excellent</td>
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<tr>
<th>Comments:</th>
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<table>
<thead>
<tr>
<th>Particular difficulties if any:</th>
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</table>

<table>
<thead>
<tr>
<th>Marks out of 100%:</th>
<th></th>
</tr>
</thead>
</table>
## Senior Sophister Research Paper Report:
### Second Examiner’s Report

The research paper mark is to be agreed with the project supervisor (and third examiner if first/second marks are greater than 10% apart). This agreed mark contributes 30% to the overall project mark. It is designed to capture the abilities of a student to engage in an academic research project, critically analyse data and communicate research findings and their implications.

<table>
<thead>
<tr>
<th>Student name</th>
<th>Project Title</th>
<th>Date</th>
<th>Examiner’s name</th>
<th>Agreed mark (out of 100%):</th>
</tr>
</thead>
<tbody>
<tr>
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### Thesis

<table>
<thead>
<tr>
<th></th>
<th>Messy, poor English</th>
<th>Publication standard</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Presentation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Abstract</strong></td>
<td>Wholly inadequate</td>
<td>Publication standard</td>
</tr>
<tr>
<td><strong>Introduction</strong></td>
<td>Trivial</td>
<td>Publishable</td>
</tr>
<tr>
<td><strong>Materials and methods</strong></td>
<td>Wholly inadequate</td>
<td>Perfectly clear</td>
</tr>
<tr>
<td><strong>Description of results</strong></td>
<td>Wholly inadequate</td>
<td>Perfectly clear</td>
</tr>
<tr>
<td><strong>Figures/ legends/ tables</strong></td>
<td>Wholly inadequate</td>
<td>Perfectly clear, complete</td>
</tr>
<tr>
<td><strong>References</strong></td>
<td>Wholly inadequate</td>
<td>Fully accurate</td>
</tr>
<tr>
<td><strong>Analysis of data</strong></td>
<td>Poor</td>
<td>Comprehensive analysis</td>
</tr>
<tr>
<td><strong>Appropriate statistical analysis</strong></td>
<td>Poor</td>
<td>Strict</td>
</tr>
<tr>
<td><strong>Discussion</strong></td>
<td>Poor</td>
<td>Publication standard</td>
</tr>
<tr>
<td><strong>Scientific rigour e.g. use of controls</strong></td>
<td>Weak</td>
<td>Strict</td>
</tr>
<tr>
<td><strong>Understanding/ insight</strong></td>
<td>Very little</td>
<td>Research level</td>
</tr>
</tbody>
</table>

### Comments:

Marks out of 100%:
Senior Sophister Future Work Proposal

This proposal will be marked independently by two examiners (and third examiner if first/second marks are greater than 10% apart) who will then discuss and agree a mark. This agreed mark contributes 25% to the overall capstone project mark. It is designed to capture the abilities of a student to formulate a research hypothesis, design and plan experiments and communicate the importance of the research.

<table>
<thead>
<tr>
<th>Student name</th>
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<tbody>
<tr>
<td>Proposal title</td>
</tr>
<tr>
<td>Examiner’s name</td>
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<tr>
<td>Final Agreed Mark (out of 100%):</td>
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**Proposal**

<table>
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<th>Perfectly clear and complete</th>
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<tr>
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<td>Description of objectives</td>
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<td>Design of experiments &amp; appropriate methodology</td>
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<td>Exemplary</td>
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<td>Understanding/ insight</td>
<td>Very little</td>
<td>Research level</td>
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<tr>
<td>Description of impact</td>
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<td>Perfectly clear</td>
</tr>
<tr>
<td>References</td>
<td>Wholly inadequate</td>
<td>Fully accurate</td>
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<tr>
<td>Exhibits analytical and critical thinking</td>
<td>Strongly Disagree</td>
<td>Strongly Agree</td>
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<tr>
<td>Comments:</td>
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Mark out of 100%:
### Senior Sophister Research Project Oral Presentation

This presentation is to be marked independently by three examiners who will then discuss and agree a mark. This agreed mark contributes 15% to the overall capstone project mark. It is designed to capture the abilities of a student to communicate their research findings, the importance of the research and plans for future work.

<table>
<thead>
<tr>
<th>Student Name</th>
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<tbody>
<tr>
<td>Degree Programme</td>
</tr>
<tr>
<td>1st Examiner’s Name</td>
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<tr>
<td>2nd Examiner’s Name</td>
</tr>
<tr>
<td>3rd Examiner’s Name</td>
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<table>
<thead>
<tr>
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<th>Extensive</th>
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<tbody>
<tr>
<td>Statement of Aims</td>
<td>Incoherent</td>
<td>Very Clear</td>
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<tr>
<td>Structure of presentation</td>
<td>Badly Disorganised</td>
<td>Logical and Well Organised</td>
</tr>
<tr>
<td>Amount of material</td>
<td>Too Little, Too Superficial</td>
<td>Appropriate</td>
</tr>
<tr>
<td>Diagrams and Images</td>
<td>Irrelevant/Poor Quality</td>
<td>Highly Relevant/Excellent Quality</td>
</tr>
<tr>
<td>Understanding of Methods</td>
<td>Shallow</td>
<td>Extensive</td>
</tr>
<tr>
<td>Understanding of Results</td>
<td>Shallow</td>
<td>Extensive</td>
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<tr>
<td>Summary/Conclusion</td>
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<td>Concise and Appropriate</td>
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<td>Ideas for Further Research</td>
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<td>Timekeeping</td>
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<td>Excellent</td>
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<td>Audibility</td>
<td>Too Quiet, Monotone</td>
<td>Clear and Lively and Varied Tone</td>
</tr>
<tr>
<td>Rapport with audience</td>
<td>Poor</td>
<td>Lively and Good Eye Contact</td>
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Molecular Medicine
Breakdown of SS Papers 1, 2 and 3
2019-2020

Paper 1– BIU44310 Neurobiology & Immunology

Section 1: ‘Neurobiology’
Answer 1 of 2 questions

Neurochemistry (GD)
Neurodegenerative disorders (GD/DL/CC)

Section 2: ‘Immunology’
Answer 1 of 2 questions

Gastrointestinal Immunology (EL)
Respiratory Immunology (MA)
Autophagy & Disease (JM)
Immunometabolism (DF/LON)
Metabolic Inflammation (FS)

Section 3: ‘General’
Answer 1 of 3 questions

Trans-subject integrative/philosophical questions

Answer ONE other question.

Paper 2– BIU44320 Microbial Diseases & Immune System Disorders

Section 1: ‘Microbial Diseases’
Answer 1 of 2 questions

Trypanosomiasis (DN)
Helminths (PF)
Prokaryotic Pathogens (HW)
TB (FS)
Viruses and Disease (GB)
Immunity to Infection (KM)

Section 2: ‘Immune System Disorders’
Answer 1 of 2 questions

Rheumatoid Arthritis (LON)
MS & EAE (JF/KM)
Autoinflammatory Disease (EC)
Inflammageing (NB)
Section 3: ‘General’
Trans-subject integrative/philosophical questions

Answer ONE other question.

Paper 3– BIU44330 Cell Cycle, Cancer Biology & Therapeutics

Section 1: ‘Cell Cycle and Cancer’
Mitotic Cell Cycle (VK)
Initiation & Progression (VK)
Metastasis & Treatment (VK/KM)

Section 2: ‘Cancer Biology & Therapeutics’
Haematological malignancies (TMcE)
Lung Cancer (GP)
Obesity & Cancer (JL)
Precision Medicine & Breast Cancer (KG)
Cancer Epigenetics (SG)

Section 3: ‘General’
Trans-subject integrative/philosophical questions

Answer ONE other question.
SS Lecture Course Summaries and Learning Outcomes for modules

2020-2021
Learning outcomes:

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

- Pursue with a degree of independence an original research project in Molecular Medicine. Design and implement a wide range of experimental procedures, critically analyse and interpret experimental data, synthesise hypotheses from a wide range of information sources, critically evaluate research literature and write a research dissertation

- Demonstrate a comprehensive understanding of the theory behind the techniques used in the research project and show a critical awareness of how these techniques can be applied to biological problems

- Discuss a specialised research area of Molecular Medicine in detail

- Work effectively as an individual and in a team and exercise initiative and personal responsibility

- Display computer literacy and use advanced computer skills to aid in conducting scientific research

- Communicate results of research project effectively with the scientific community

- Show that they have acquired the learning skills to undertake further research with a high degree of autonomy

BIU44010 Advanced Research Skills (S1) (10 credits)

This purpose of this module is to further develop research, critical analysis and communication skills that are essential for a graduate biochemist. Students will be trained in data handling as well as solving quantitative problems in biochemistry. In addition, this module will introduce students to a wide array of cutting edge techniques and strategies used in biochemistry.
Learning outcomes:
On successful completion of this module students will be able to:

- Apply appropriate statistical tests to experimental data and evaluate the results of these tests
- Demonstrate proficiency in the application of sequence analysis algorithms
- Solve numerical biochemical problems
- Demonstrate proficiency in the application of molecular modelling software
- Display a solid foundation in the ethics of and use of animals for experimentation
- Describe the principles behind and applications of current techniques in scientific research

Sequence Analysis: Prof Jerard Hayes

The course will provide an introduction into Bioinformatics. Topics covered include:

- DNA (including genomic) and protein databases
- Accessing sequence information from databases using the Internet
- Sequence similarity searches (i.e. BLAST, FASTA)
- Identification of homologous proteins
- Multiple sequence alignments (i.e. Clustal W)
- Searches for protein motifs, domain, patterns

Students will carry out three exercises:

**Exercise 1:** Accessing databases from the Internet, retrieval of sequences (DNA and protein), extracting relevant sequence information, presentation and annotation of a chosen sequence

**Exercise 2:** Sequence similarity search (BLAST), identification of homologous proteins, multiple sequence alignment (Clustal W)

**Exercise 3:** Sequence analysis of membrane proteins, hydrophobicity plots, identification of transmembrane helices and signal peptides

Reading list:
*essential reading

# recommended


# Rost, B. et al. 1995. Transmembrane helices predicted at 95% accuracy. Protein Science, 4: 521-533.


X-ray crystallography: Prof. Ken Hun Mok (2 lectures)

These two lectures will provide an introduction to X-ray crystallography and will include the following:

- overview of modern X-ray and cryo-EM techniques to visualize macromolecules (proteins, DNA, RNA) and larger assemblies at atomic resolution
- concept of resolution in imaging and its relationship to X-ray and cryo-EM hardware for data collection
- principles of X-ray diffraction and cryo-EM structure determination, advantages of the techniques and their limitations

Recommended reading:

Crystallography Made Crystal Clear
Gale Rhodes

Protein Crystallography: A concise guide
Eaton Lattman and Patrick Loll

Metabolomics research: Profs Richard Porter & David Finlay (2 lectures)

- Metabolic flux analysis (1 lecture) Richard Porter

Analysis of cellular oxygen consumption together with extracellular acidity rate are an excellent way to get an overview of metabolic flux in a cell. Furthermore, the use of selective inhibitors can allow a researcher to shed light on the bioenergetics and biochemical pathways that contribute to that flux. The Seahorse Flux Analyser and the Oroboros Respirometer are excellent apparatus for determining such metabolic flux. The lecture will cover the principles behind the use of these apparatus and will give examples of their use to researchers.

- Proteomics and metabolomics (1 lecture) David Finlay

Various approaches to proteomic and metabolomic analysis will be discussed. The types of experimental question that can be addressed using these techniques will be reviewed.

Protein engineering: Prof. Jerard Hayes (2 lectures)

Protein engineering is the process of developing valuable proteins, mainly for the biopharmaceutical market with a value of approximately $170 billion annually. This 2-lecture course will cover the production of recombinant proteins through genetic engineering and cell biology techniques for bioprocessing and biopharmaceutical manufacturing. Included in the course is upstream processing of proteins in bacterial, mammalian and insect cell lines, downstream processing in bioreactors and production of purified products, and optimisation of
the bioprocess for the generation of desired post translational modifications, such as glycosylation.

**Flow Cytometry & Cell Sorting: Barry Moran (2 lectures)**

Flow cytometry is a key technology underpinning almost all biomedical research. Using fluorescent probes to tag molecules in or on the cell, it allows high-speed, high-parameter analysis of single cells as they flow through a fluid stream. Cell sorting extends the technology, enabling any identifiable cell population to be enriched to a very high purity. These lectures will cover the fundamentals of flow cytometry and cell sorting, including novel techniques and applications.

**NMR spectroscopy for biomedical scientists: Ken Hun Mok (2 lectures)**

**Lecture 1.** Brief overview of the theories and practices; How NMR is used in structural biology and in probing the dynamics of biomolecules.

**Lecture 2.** Application of NMR to metabolomics; How mass spectrometry and NMR are complementary in identifying metabolites.

Reading / Viewing Materials:
(2) Knowbee Tutoring, "Introduction to NMR Spectroscopy" Parts 1 and 2, [https://www.youtube.com/watch?v=TJhVotrZt9I](https://www.youtube.com/watch?v=TJhVotrZt9I), 2015.
(4) Wong F, "NMR Made Easy!" Parts 1-6, [https://www.youtube.com/watch?v=9orcRVKcS0&list=PLP0TLbeMObSy4izlKMIC2QOpJCzNJPc17](https://www.youtube.com/watch?v=9orcRVKcS0&list=PLP0TLbeMObSy4izlKMIC2QOpJCzNJPc17), 2012.

**Cellular Imaging: Prof. Derek Nolan (3 lectures)**

**Lecture 1:** Introduction to imaging and the concept of resolution. Application of electron microscopy in cell imaging. EM tomography and specialized techniques. Introduction to light microscopy.
Lecture 2: Advanced light microscopy: wide field and confocal microscopy.

Lecture 3: Application of fluorescent proteins and probes in multidimensional imaging in fixed and live cells.

Suggested reading and references.

http://www.nature.com/milestones/milelight/index.html
An excellent resource available on line. This series highlights the most influential developments in light microscopy in a series of short articles, each describing a major achievement. Almost a one stop shop

http://www.olympusmicro.com/
The Olympus Microscopy Resource Center.
This site covers a wide range of topics in light microscopy: basic to advanced topics with primers and interactive tutorials in some sections.


Correlative cryo-light microscopy and cryo-electron tomography: from cellular territories to molecular landscapes. Current Opinion in Biotechnology, Volume 20, 2009, Pages 83-89 From nano to micrometre scale in cells.

Transgenics: Profs Vincent Kelly & Derek Nolan (5 lectures)

Lecture 1. Mutagenic, transgenic & cloning technology (VK): The concept of forward and reverse genetics in understanding gene function will be considered and how these mutations are physically introduced into the genome through random mutagenesis, viral mutagenesis, gene replacement and gene-targeting strategies. The process of microinjection to create transgenic animals, gene knockouts and cloned animal will be covered and the generation and use of induced pluripotent stem cells (iPS) in biomedical research applications.

Lecture 2. Design and development of transgenic constructs (VK): The design of targeting vectors relies on a detailed structural/functional understanding of the gene under study. Various strategies for controlling the activity of the gene are available including the creation of knockouts, knock-ins, conditional knockout and reporter systems. Gene-trap technology has, in recent times, gained significantly in popularity and the methodology will be examined in some detail.

Lecture 3. Zinc Finger Nucleases and Talen Nucleases(VK): These state-of-the-art technologies have the potential to revolutionise the manipulation of the eukaryotic genome, from cells in culture to mice, rats, rabbits, pigs etc. This lecture will cover the principles of this technology and how it is being currently exploited in research.
Lectures 4 & 5. RNA interference (DN): The discovery of the classical RNA interference pathway involving siRNA will be described. The lectures will consider the concept of regulation of expression through siRNA and microRNAs along with the use and design of RNAi based approaches in functional genomics. The advantages and limitation of such approaches will investigated through the use of specific examples. The potential use of RNAi in therapeutic approaches will be outlined.

Reading List:
Lectures 1-3:
** Highly relevant material

# Papers relate to the endothelin B receptor and conditional mouse. These papers are discussed in the lectures and are given as an example of the power of inducible transgenics.

** Molecular Cell Biology, Lodish et al., Sixth Edition. W. H. FREEMAN, New York. (Good general overview of genetic techniques)


**Bockamp et al. 2002. Of mice and models: improved animal models for biomedical research. Physiol. Genomics. 11:115-132 (Very good overview of mouse transgenics, covers the endothelin receptor B example described in lectures)


#Lee et al. 2003. The endothelin receptor-B is required for the migration of neural crest-derived melanocyte and enteric neuron precursors. Developmental Biology 259; 162–175
Lectures 4-5

**Comparative Medicine: Dr Peter Nowlan**

The purpose of this lecture course is to introduce students to the basic requirements for working with animals. This is necessary if a full appreciation of animal related work is to be got from the projects. It is also a legal requirement that anybody involved in the use of animals for scientific purposes has appropriate training (*EC directive 86/609*).

This module is not intended to be a comprehensive training course. To do this would require a much more detailed and extensive series of talks. Most of the training which will be required by students will be obtained by working in close contact with a technician and with experienced supervisors.

The golden rule should be always 'if you don't know ask somebody'.

The welfare of the animal and often the success of your Project will depend on using a correct approach to animals involved in your project.

Even if you are not undertaking a SS project which involves live animals you may do so in your future career.

- Introduction to Laboratory Animal Science
- The Law and Application for a licence
- Animal House Design; Its effect on Research
- Characteristics of individual species
- Experimental design Choice of species
- Injections and tissue sampling
- Health Considerations
- Alternatives to live animal experimentation
- Handling Video, Safety, Local arrangements
- Video and discussion 'Ethics of Animal research'
- The Scientists Viewpoint
- Assessment

**Reading List:**
Laboratory animals an introduction for new experimenters. A. A. Tuffery
Handbook of laboratory animal management and care. S. Wolefensohn, M. Lloyd
Introduction to laboratory animal science and technology. J. Inglis
Humane experimental technique. W. Russell, R. Burch
Experimental and surgical technique in the rat. H. Wayneforth, P. Flecknell
Animals and alternatives in toxicology; present and future prospects. M. Balls, J. Bridges, J. Southee
In vitro toxicology. S. Cox Gad
UFAW handbook on the care & management of laboratory animals. T. Poole
Laboratory animals anaesthesia. P. Flecknell
Handbook of rodent and rabbit medicine. K. Laber-Laird, M. Swindle, P. Flecknell
The biology and medicine of rabbits and rodents. J. Harkness J. Wagner
The laboratory animals, principles and practice. W. Lane-Petter, A. Pearson
Man and mouse, animals in medical research. W. Paton
Lives in the balance. J. Smith, K. Boyd
The ethics of using animals in biomedical research, Vivisection in historical prospective. R. Rupke

BIU44310 NEUROBIOLOGY & IMMUNOLOGY (S2)
(10 credits)

This module covers the structure, function and pharmacology of neurotransmitters, neuron-glia interactions, intraneuronal signalling and the neurobiology of behaviour and neurodegenerative disorders. This module also covers the molecular basis of immune mediated responses.

Learning outcomes:

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

- Recall and integrate key knowledge on structure of cell types in the brain and how they control neurotransmission and critically evaluate how various chemicals (biogenic amines, amino acids, peptides & labile gases) in the brain fulfill the criteria for characterisation as neurotransmitters
- Employ an understanding of the molecular mechanisms that are involved in the major neurodegenerative disorders and the medical advances that are in development
- Demonstrate an understanding of the complexities and unique aspects of immunology in organs such as GI tract and respiratory system.
Integrate biochemistry and immunology analyses to critically understand the impact of immunometabolism and autophagy on the immune response.

PART 1: NEUROBIOLOGY & NEURODEGENERATIVE DISORDERS

<table>
<thead>
<tr>
<th>Neurochemistry: Brain Biochemistry &amp; CNS Acting Drugs: Prof Gavin Davey (5 lectures).</th>
</tr>
</thead>
</table>
| **Lecture 1:**  
- Energy substrates for the brain  
- Glucose/lactate transporters  
- What uses ATP in the brain?  
- Astrocytes-neuron lactate shuttle hypothesis  
- Glucose sensing neurons  
- What controls blood flow in the brain?  |
| **Lecture 2:**  
- Energy thresholds in the brain  
- Mitochondria control glutamate release  
- Mitochondrial fusion/fission dynamics  
- Complex I activity & mitochondrial fusion  |
| **Lecture 3:**  
- In vivo techniques for measuring neurotransmitter release and actions  
- Microdialysis & HPLC  
- Classical neurotransmitters  
- Atypical neurotransmitters  
- Nitric oxide  |
| **Lecture 4:**  
- GABA metabolism & GHB  
- Polyamine NTs  
- Glial cells and NT release (D-serine, taurine, NAAG & neuropeptides)  |
| **Lecture 5:**  
- Melatonin as a NT  
- Aspartate & pheromones  |

References: to be supplied closer to lectures

| Neurodegenerative disorders: An interdisciplinary approach: Prof David Loane (6 lectures). |


References: to be supplied closer to lectures

Reading/Learning Resources:
- Proteins, Transmitters and Synapses by D.G. Nicholls (1994) Blackwell, Oxford – The best on synaptic bioenergetics (out of print but there is a copy in the library).
- The Biochemical basis of neuropharmacology by JF Cooper, FE Bloom and RH Roth Oxford University Press, Eighth Edition

**Neurological diseases: Prof. Colm Cunningham (4 Lectures)**

Multiple Sclerosis & the brain's immune privilege
Contrast Innate and specific immunity
- explain why specific immunity in brain is different
- incomplete privilege: EAE -> MS
- blood brain barrier, Cell infiltration
- Dendritic cells, antigen drainage etc
- What is immune privilege NOT (Galea)
- Multiple sclerosis, Th1, Th17 cells
- treatments; steroids, interferon-b
- Tysabri, VCAM inhibition (natalizumab)

**Alzheimer’s disease, microglia, transgenic models & vaccination studies**
Basal forebrain cholinergic loss, current treatments
- the amyloid hypothesis
- Discuss Tg2576 and other genetic AD models
- Microglia, inflammation and NSAID treatment
- The AD vaccination studies in vivo and in patients
- BACE inhibitors, gamma-secretase inhibitors

**PART 2: IMMUNOLOGY & IMMUNOMETABOLISM**

**Gastrointestinal tract Immunology: Prof Ed Lavelle (3 lectures)**

**Lecture 1:** Overview of gut associated lymphoid tissue, Peyer’s patches, inductive and effector sites. Uptake of antigens across epithelial surfaces.

**Lecture 2:** Dendritic cells and T cells in the gastrointestinal tract. Homing of gut T cells

**Lecture 3:** Mucosal humoral immunity. IgA responses and their regulation.

**Respiratory tract Immunology: Prof Michelle Armstrong (3 lectures)**

**Lecture 1:** Introduction to the basic biology of the respiratory tract: conducting airways, mucosal surface, lung parenchyma and organization of the lung immune system. Understanding the concept that the lung is continually exposed to foreign antigens and must discriminate between recognition of innocuous environmental antigens and pathogenic antigens.

**Lecture 2:** Roles played by individual cells in regulating immune response in the lung: airway epithelial cells, alveolar macrophages, regulatory T-cells, T-cell homing to lung, innate lymphoid cells.

**Lecture 3:** Immunological challenges faced by the lungs: Infectious/inflammatory disease (cystic fibrosis), interstitial disease (IPF and pulmonary sarcoidosis) and allergic disease (asthma).
Autophagy: Prof James Murray (2 lectures)

Lecture 1: The mechanics of autophagy
- Early signalling events in autophagy
- Omegasomes: PI3P platforms that manufacture autophagosomes
- Sources of the autophagosome membrane
- Ubiquitin-like conjugation systems that mediate membrane formation
- Autophagosome maturation and lysosomal fusion

Lecture 2: Selective autophagy & disease
- Chaperone-mediated autophagy, macro/microautophagy & mitophagy
- Autophagy and cell death
- Autophagy and ageing: age-related neurodegenerative diseases
- Autophagy in cancer prevention, development and therapy
- Autophagy as a defence against intracellular pathogens

Reading list:
“Autophagy: molecules and mechanisms” by Jon Lane.

A list of suitable reviews will be given out during the lecture course

Immunometabolism: Profs David Finlay and Luke O’Neill (5 lectures)

Lecture 1. Cellular metabolism + immune cells (David Finlay)
Overview of metabolic pathways. Discuss why cells adopt different metabolic configurations. Outline the metabolic configurations used by different immune subsets.

Metabolic changes during macrophage polarization, roles of key metabolites in M1 and M2 macrophages. Role of mitochondria as signal generator in macrophages.

Lecture 3. Lymphocyte immunometabolism (David Finlay)
Central role for metabolism in the control of lymphocyte activation, differentiation and function; Effector, regulatory and memory T cells, NK cells and B cells.

Lecture 4. Nutrients and the tumour microenvironment (David Finlay) Discuss nutrient availability to immune cells and nutrients as fuels and key regulators of immune signalling. Focus on how the tumour microenvironment can alter immune function through altering nutrient levels. Potential for improved anti-cancer immunotherapy through manipulation of metabolism and nutrient levels.

Lecture 5. Targeting metabolism to treat inflammatory and infectious disease (Luke O’Neill)

**Metabolic Inflammation: Prof Fred Sheedy (3 lectures)**

**Lecture 1: “PAMPs & DAMPs”**
Activation of the innate immune system by endogenous metabolite accumulation and danger signals

**Lecture 2: “Dysfunctional Resolution”**
Effectors in the immune response to metabolites, Removing danger, Resolving inflammation, Restoring homeostasis & strategies to boost this.

**Lecture 3: “Inborn errors of meta-inflammation”**

**BIU44320 MICROBIAL DISEASES & IMMUNE SYSTEM DISORDERS (S2) (10 credits)**

This module covers the pathogenesis of infectious diseases. Bacterial pathogens of medical importance will also be covered in detail. It will provide an introduction to parasitic protozoa such as trypanosomes and helminths. The biochemical and genetic mechanisms by which bacteria, viruses and parasites evade the host immune responses will be covered. This module will also cover the pathogenesis of autoimmune and inflammatory disease.

**Learning outcomes:**

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

- Relate how African trypanosomes avoid the immune response and innate immunity of their human hosts.
- Define the molecular basis of pathogenesis of various prokaryotic pathogens of medical importance including *Helicobacter pylori*
- Relate how Mycobacterium Tuberculosis avoid the immune response and innate immunity of their human hosts.
• Compare the strategies to control helminth infections, using specific species as examples and evaluate the global impact of helminth infections on endemic countries.

• Understand viral infections and the basis of virus-induced disease

• Critically evaluate the contribution of immunology to a range of important human diseases including autoimmunity (rheumatoid arthritis), autoinflammatory diseases, immune deficiency and inflammaging.

PART 1: MICROBIAL DISEASES

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<th>African Trypanosomes : Prof Derek Nolan (8 lectures)</th>
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The aim of these lectures is to provide an introduction to African trypanosomes, parasitic protozoans that cause sleeping sickness in humans and a related disease, Nagana, in cattle. These parasites are a major problem for human and veterinary health throughout sub Saharan Africa and serious barrier to economic development of the region. Perhaps the most striking feature of these parasites is that that they are exclusively extracellular. They grow and divide in the mammalian vasculature and consequently exposed the adaptive and innate defence responses of their mammalian hosts. In addition, for a variety of reasons, African trypanosomes have been come a favourite model organism for molecular and cell biologists and many discoveries of broad significance have emerged from studies on these model unicellular eukaryotes. Areas where such discoveries have been reported will be illustrated in the lectures where appropriate. The course is organized into two parts.

Trypanosomes Part 1: Stealth strategies of an elusive parasite
1. How are trypanosomes, such as Trypanosoma brucei, able to evade the host humoral immune response given that they are constantly exposed to this arm of the immune response?
2. What other strategies do trypanosomes employ to circumvent the innate immune responses?
3. How are these parasites able to acquire essential macromolecular growth factors from their hosts without attracting a response?

Trypanosomes Part 2: What is the molecular basis of human sleeping sickness?
The focus in part II is on the innate immunity that humans and other primates have to infection by all but a few trypanosomes. In effect in this part we will consider the molecular basis of African human sleeping sickness. We will consider the nature of the trypanolytic toxin present in human serum and how this toxin kills these parasites. We will see an amazing link between the toxin and an unsuspected programmed cell death pathway. Finally, we will see how two strains of trypanosomes have responded by developing independent mechanisms to resist this toxin and how in turn certain human populations are able to overcome this resistance and the price they pay for this capacity.
Reading List:
Additional specific references for key experiments will be provided within the lectures which are available on the school website.

Trypanosomes Part I
Nuclear architecture underlying gene expression in Trypanosoma brucei

Trypanosomes Part II
Association of trypanolytic ApoL1 variants with kidney disease in African Americans
6) Vanwallegehem G. et al. (2015) NATURE COMMUNICATIONS | 6:8078 | DOI: 10.1038/ncomms9078 Coupling of lysosomal and mitochondrial membrane permeabilization in trypanolysis by APOL1
Helminths of Human Importance. Prof Padraic Fallon (3 lectures)

A third of the world’s population is infected with parasitic worms. These lectures will address the major parasitic worms that are of medical importance.

**Lecture 1:** Introduction to the major helminth parasites that infect man. Medical and economic impact of helminth parasites on society.


**Lecture 3:** Gastro-intestinal versus systemic (tissue or blood dwelling) worm infections. Modulation of immunity by helminth parasites: implications for designing vaccines. Molecular and biochemical targets for current and future drugs to treat helminth infections.

*A reading list will be given out during the course*

Prokaryotic pathogens: Prof Henry Windle (3 lectures)

**Lecture 1:** Bacterial pathogens as a paradigm for chronic infection I: Molecular mechanisms of bacterial induced disease - modulation of host cell signalling responses and pathogenesis. Pro-carcinogenic microorganisms.

**Lecture 2:** Bacterial pathogens as a paradigm for chronic infection II. Infection and cancer – the *Helicobacter pylori* connection: molecular basis of pathogenesis

**Lecture 3:** Mixed microbial populations and disease. The microbiome in health and disease.

**General Reading:**


**Human gut microbiome: hopes, threats and promises** (Review article). Cani PD
Gut. 2018;67(9):1716-1725. PMID: 29934437

The immune response to tuberculosis: Prof Frederick Sheedy (2 lectures)

**Lecture 1:** The innate immune response to tuberculosis; a model for pathogen evasion of the human host response. The alveolar macrophage and recruited inflammatory cells. First contact – Phagocytosis & Pattern Recognition.

**Lecture 2:** The adaptive immune response to TB – the TB granuloma; prison for the live bug. T-cells, IFNy and TNF orchestrating the granulomatous response.
Viruses and Disease: Prof Gareth Brady (3 Lectures)

Lecture 1: Introduction to Viruses and Viral infections
- Classification of viruses
- Host adaptation and species barriers
- Routes of entry
- Cell, Tissue and Organ tropisms
- Virus Infection Cycles

Lecture 2: Anti-Viral Immunity, Adaptation and Disease
- Overview of anti-viral immunity and clearance
- Virus-induced inflammation and disease
- Methods of virus detection and serological assays
- Epstein Barr Virus and B cells
- Molluscum Contagiosum Virus and Human Skin

Lecture 3: Emerging viruses and Pandemics
- Influenza Virus: from seasonal infections to deadly emergent strains
- Coronaviruses: from the common cold to SARS, MERS and COVID-19

Reading list:
A list of suitable reviews will be given out during the lecture course

T cell differentiation, regulation and immunity to bacterial and viral infection: Prof. Kingston Mills (4 lectures)

T cell differentiation and regulation (2 lectures) Kingston Mills
Lecture 1. T cell subtypes, antigen presentation and T cell differentiation.


T cell immunity to bacterial and viral infection (2 lectures) Kingston Mills
Lecture 1: The bridge between innate and adaptive immunity. Pathogen activation of macrophages and dendritic cells through pattern recognition receptors. Role of dendritic cells in directing T cell subtypes.

Lecture 2: Role of Th1/Th2 cells in immunity to infection, including HIV, hepatitis C virus and Bordetella pertussis.

PART 2: IMMUNE SYSTEM DISORDERS
**Rheumatoid Arthritis: Prof. Luke O’Neill (2 lectures)**


**Lecture 2:** Key role of cytokines – IL-1, TNF, IL6. Current therapies – NSAIDs, steroids, biologic therapies (anti-TNF, anti-IL-1, anti-IL-6, anti-CD20 and CTLA-4 Ig). Prospect for future therapies.

**Multiple Sclerosis and EAE: Profs Jean Fletcher & Kingston Mills (3 lectures)**

**Lecture 1:** Breakdown of tolerance in autoimmunity. Risk factors, pathogenesis, diagnosis and monitoring of MS

**Lecture 2.** MS therapies: Mechanisms of action, efficacy, side effects.

**Lecture 3:** EAE. Role of innate and adaptive immunity in pathogenesis of autoimmune diseases. Role of regulatory T cells in preventing autoimmune diseases.

**Autoinflammatory diseases: Prof Emma Creagh (2 lectures)**

**Lecture 1:** Key features of systemic autoinflammatory disorders. Classic hereditary 'Periodic Fever Syndromes' - FMF (Familial Mediterranean Fever), TRAPS (TNF Receptor Associated Periodic Syndrome) and HIDS (Hyperimmunoglobulinemia-D with periodic fever syndrome).

**Lecture 2:** NLRP3/Cryopyrin-associated periodic syndromes (CAPS): Familial Cold Inflammatory Syndrome (FCAS); Muckle-Wells Syndrome (MWS) and Neonatal onset multisystem inflammatory disease (NOMID). Autoinflammatory disorders associated with skin pustules, such as DIRA (deficiency of IL-1R antagonist), CARD14 mediated psoriasis (CAMPS) and early onset inflammatory bowel diseases (EO-IBD).

**Immunodeficiency: Prof Derek Doherty (2 lectures)**

**Lecture 1:** Primary immunodeficiencies. This lecture will cover the genetic bases, clinical presentations, diagnoses and treatments of primary immunodeficiencies, including antibody, complement, MHC and lymphocyte deficiencies.
Lecture 2: Acquired immunodeficiencies. This lecture will cover the different causes of acquired immunodeficiencies but will focus mainly on HIV-associated disease, including the virology, immunology, clinical features and recent progress in vaccine development. The significance of HIV in the developing world, where many other infectious disease are also endemic, will be emphasized.

Inflammaging: Prof Nollaig Bourke (2 Lectures)

Lecture 1: The mechanisms of inflammageing. Inflammageing overview. Discussion of how innate and adaptive immune responses are dysregulated with age and how this contributes to increased systemic inflammation.

Lecture 2: The consequences of inflammageing. Specific focus on the impact of inflammageing with relation to age related diseases, particularly cardiovascular disease, neuro-cognitive decline and cancers. Discussion on therapeutic targeting of inflammageing.

BIU44330 Cell Cycle, Cancer Biology & Therapeutics (S2)

This module covers the cellular and regulatory mechanisms that control the cell cycle. It furthermore it covers the molecular basis of cancer, the progression of the disease and the therapeutic treatment strategies.

Learning outcomes:

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

- Explain the processes of growth, proliferation, and cellular division and outline the cellular changes and regulatory mechanisms that define the stages of the cell cycle

- Critically discuss the environmental and hereditary causes of cancer and relate how alterations to the cell cycle impact on cancer development

- Describe the genetic, metabolic and cellular alterations in various types of cancer and outline the process of metastasis

- Evaluate the contribution of the immune system to cancer

- Describe the therapeutic strategies for the control of cancer such as dietary mechanisms for reducing initiation, targeting oncogenes, overcoming drug resistance and immunotherapy
Part 1: Cell Cycle & Cancer:

Mitotic cell cycle: Prof Vincent Kelly (4 Lectures)

**Lecture 1. The cell cycle & growth.** This lecture will cover some of the seminal discoveries of the cell cycle, discussing the experiments performed on frog oocytes, sea urchins and yeast. Key regulators of cell cycle progression, as determined by these early studies, MPF, Cdc2/cdc28, wee1 and Cdc25, will be covered. Components of the mammalian cell cycle, which have been discovered principally via bio-informatic approaches, will be discussed including mammalian cyclin dependant kinases (CDKs) and cyclin-dependant kinase inhibitors (CKI).

**Lecture 2. Start of the cell cycle, G1.** Signals for a cell to start proliferation are essential for initiation of the cell cycle. Examples will be provided of how growth signals through PI3K, AKT, mTOR and myc are co-ordinated to the uptake of amino-acids and glucose. In addition, we will discuss how cell-cell and cell-matrix contacts must be altered to permit cell cycle progression.

**Lecture 3. S-phase, DNA replication & DNA repair checkpoints.** The control of DNA replication is a major decision point of the cell cycle. This lecture will describe the replication licensing process, the selection of the origin(s) of replication and the proteins that make up the origin replication complex, e.g. Mcm, Cdc6. If the DNA to be replicated is not properly loaded or is damaged the cell initiates various checkpoints, i.e G1- and S-phase checkpoint. This lecture will cover the various protein complexes such as 911, the MRE11-Rad50-NBS1/γH2AX complex and the kinase pathways used to tell the cell to stop the cell cycle process including ATM & ATR, BRCA1, Chk1 Chk2 and P53.

**Lecture 4. Mitosis.** Chromosome cohesion/seperating sister chromatids/Overview of ubiquitin/Ubiquitin ligases and the cell cycle/SCF complex & G1 to M phase transitions/APC complex and anaphase entry/microsatellite instability (MIN) and chromosomal instability (CIN)/Centrosomes & centrosome inactivation checkpoint

Part 1: Initiation & Progression (4 Lectures) Vincent Kelly

Lecture 1. Underlying causes of cancer (VK): The characteristics that are used to classify cancers and their stage of development will be described. A number of examples will be given of how environmental factors, i.e. xenobiotics, radiation and oxidative damage contribute to multistep carcinogenesis. The means by which cancer is limited by DNA damage sensing, DNA repair and cellular adaptation to oxygen/radical damage will be covered.

Lecture 2. Oncogenes and tumour suppressor genes (VK): Many of the original discoveries on oncogenes were derived from work on viruses. The concepts of oncogenes and proto-oncogenes will discussed such as src and the Rous sarcoma virus and there will be an in dept examination of the ras oncoprotein pathway and the function of other oncogenes including abl, sis, c-myc and how they influence cellular proliferation. Suppressor genes play an important role in limiting cancer formation and a number of models were put forward from original studies including Knodson’s two-hit model and haploinsufficiency. The mode of action of tumour suppressors such as APC, MSH2, MLH1, BRCA1, p53 will be examined with particular focus on p53, Rb and APC.

Lecture 3. Cancer epigenetics (VK): Changes in the genetic code is but one means to arrive at a pre-malignant crossroads. Epigenetics changes in gene expression have been found to alter tumor suppressor gene activity through. These epigenetic changes may occur as a consequence of altered DNA methylation status at CpG promoter regions of aberrant histone modification. In fact, cooperative suppression by both mechanisms has recently become the focus of new anti-cancer therapies through the development of DNMT and histone deacetylase inhibitors.

Lecture 4. Cancer metabolism & the tumor microenvironment (VK): Many of the control points of cancer, oncogenes, tumor suppressor genes (including mTOR, PI3K, Akt, p53, AMPK) are intimately linked to metabolism, especially glycolysis, which provides the cancer with the building blocks for growth. The tumor cell microenvironment is invariably acidic and hypoxic causing the transcription factor HIF1a to set in place protective responses including unregulating the production of monocarboxylate transporters, VEGF, matrix metalloproteinases and angiogenic factors.

Part 2: Metastasis and Cancer Treatments

Lecture 1. Angiogenesis and metastasis (VK): The process by which cancer cells develop new blood supplies (angiogenesis) is reliant on being able to remodel the tumor environment and the extracellular matrix. A discussion of how this remodelling occurs through matrix metalloproteinases and plasminogen will be given along with the cause and consequences of breaking cell-cell interactions. The means used by cancer cells to physically move from the primary tumor (e.g. epithelial-mesenchymal transition) and how the immune system promotes
this process will be described. Breast cancer will be used as a model of how cancer cells choose secondary sites for proliferation, especially the bone marrow; ‘the vicious cycle’.

Lecture 2. Colon cancer, genetics and epigenetics (VK): Arguably, colon cancer is one of the best studied cancers in terms of its formation and progression. This lecture will discuss the contribution of chromosomal instability in terms of changes to APC, COX2 and Smad4 and microsatellite instability caused by epigenetic suppression of mis-match repair enzymes including MSH2 & MLH1. The contribution of inflammation to colon caner will be considered and how NSAIDS and IL-10 mediate polyp formation.

Lecture 3. Stem cell theory of cancer, focusing on colon cancer (VK): The intestinal crypt stem cells are maintained in a specialized compartment of the intestinal crypt through the Ephrin receptors. The maintenance and proliferation of these stems cells will be covered including the various signals used to control their proliferation, such as hedgehog, WNT, PDGF, Eph, NOTCH and BMP. The importance of the intestinal stems cells to cancer development and treatment will be considered.

Lecture 4. Cancer treatment (VK): Classical anti-cancer drugs such as antimetabolites, alkylating agents and antimitotic agents are still widely used in therapy today despite severe side-effects. Newer ‘magic bullets, hold promise of more specific cancer treatment strategies such as Imatinab in the treatment of CML. However, drug resistance is a problem and has revealed the phenomenon of oncogene addition. Recent drug strategies have begun to focus on targeting tumor cell metabolism, its environment and the cancer initiating cells (cancer stem cells) that perpetuate proliferation even after treatment.

Lecture 5. Cellular and humoral Immune responses to tumors (KM): These lectures include the role of antibody, cytotoxic T lymphocytes, macrophages, NK cells and Th1 cells; Evasion and subversion of immune responses by tumors - anti-inflammatory cytokine production and regulatory T cell induction; Tumor-specific antigens and breaking tolerance to self antigens

Lecture 6-7. Tumor immunotherapy (KM): Antibodies, Toll-like receptor agonists and cell-based therapies; Tumor vaccines - killed tumor cells, tumor specific peptides and antigens, heat shock proteins and dendritic cell vaccines

Cancer References:
11. Immunobiology by Janeway and Travers
12. Cellular and Molecular Immunology by Abbas, Lichtman and Pober

**Part 2: Cancer Biology & Therapeutics:**

| Haematology and haematological malignancies: Prof Tony McElligott |
| (2 Lectures) |

**Introduction to Haematology and haematological malignancies:** Haematological malignancies are a group of neoplasms that arise through malignant transformation of bone marrow derived cells. The great diversity seen in this group of malignancies reflects the complexity of normal haematopoiesis and the immune system. The primary basis of classification is the distinction between tumours of lymphocytes and those of myeloid lineage. Haematological malignancies include leukaemias, lymphomas and multiple myeloma, and are defined and distinguished from one another according to clinical features, microscopic morphology, immunophenotype and molecular/genetic features.

**Molecular biology of haematological malignancies and leukaemia:** Many molecular genetic markers have been described in haematological malignancies including chromosomal translocations and rearrangements of the immunoglobulin and T-cell receptor genes. These prognostic or predictive markers can be useful in guiding clinical management of patients and permit the development of very sensitive and specific assays for the detection of neoplastic cells. In addition, these molecular markers have provided important clues in elucidating the biological mechanisms by which haematological malignancies develop and persist. More recently, it has been recognised that epigenetic changes and aberrant expression of miRNAs are common features of some haematological malignancies and may play an important role in carcinogenesis.

| Molecular basis of lung cancer & Obesity/Cancer: Profs Graham Pigeon & Joanne Lysaght (4 Lectures) |


Lecture 3. Obesity and Cancer: An overview of the epidemiology of obesity and cancer. Particular focus on the mechanisms linking central obesity and metabolic syndrome the progression of cancer, examining adipose tissue as an immunomodulatory and metabolic organ.

Lecture 4. Obesity and Immunomodulation in Cancer: A focus on central obesity as a chronic inflammatory condition, and how obesity may effect immune cell subsets and influence tumour progression and development.

Information on these lectures will be available later in the term.

**Precision Medicine & Breast Cancer: Prof Kathy Gately (2 Lectures)**

These lectures will focus on cancer Rates in the 21st century, Hallmarks of Cancer, Tumour Heterogeneity, mutation profiles, Precision/Personalised Medicine molecular mechanisms in breast cancer etc.

Information on these lectures will be available later in the term.

**Cancer Epigenetics: Prof Steven Gray (3 lectures)**

Lecture 1: The Basics. This lecture will introduce the student to both the history and current knowledge of the known mechanisms underpinning epigenetic regulation of gene expression.

Lecture 2: Epigenetics and Disease. This lecture will introduce the student to the various roles that epigenetics plays in the development of disease including cancerous and non-cancerous conditions, and will include aberrant epigenetic dysregulation, trans-generational epigenetics, and will introduce issues where epigenetics plays important roles in intra-tumoural heterogeneity and cancer stem cells.

Lecture 3: Targeting Epigenetics for the treatment of disease.
This lecture will discuss the broad implications pertaining to the potential to target disease epigenetically. It will discuss the issues with respect to the failure of many epigenetic targeting approaches and how new epigenetic targeting strategies are changing the paradigms for therapy. The potential for nutritional interventions will also be introduced.