UNIVERSITY OF BIRMINGHAM

School of Biosciences

Guide to Module Choices for Incoming Exchange Students

2014/2015

Introduction

This booklet sets out the modules offered to exchange students visiting the School of Biosciences in University of Birmingham in 2014-15. We aim to make as many modules as possible available to incoming exchange students. The wide variety of module options means that it is not possible to timetable every combination of modules. During welcome week students are required to attend a welcome meeting with Dr Hidalgo in the School of Biosciences. At this meeting we will seek to confirm your module choices, and assist with checking that timetables are compatible. We look forward to seeing you in Welcome Week.[1]

Credits:
If a student is here for one semester they should take 60 credits.[2] If a student is here for a full year they should take 120 credits. Students who are here both semester 1 and 2 should take 60 credits in each semester.[3]

Selecting Appropriate Modules:
Exchange students come to Birmingham from a wide variety of countries, and they will be at different stages of their degrees. Incoming students may take modules that are aimed at first year students, second year students and third students. Each module has a school code. The first number in the code indicates the year. So BIO325 is year 3 module, BIO263 is a year 2 module, etc.
Students must check that their sending university is happy with their module selections. The responsibility is with the student.

Research Projects:
Students who are here for a full year may choose to take a 40 credit research project. This may be a laboratory project, or literature based project. Research projects are not timetabled, and may be taken with any modules. Students who take a research project should take 40 credits of taught modules in semester 1 and 40 credits of taught modules in semester 2.

Non-Biosciences Modules:
Students may take modules from other schools if their home university permits this and if it is compatible with the student's timetable. However, it is the student's responsibility to find out whether the timetables are compatible, and to get in touch with different tutors in each School to make such arrangements possible. The staff in the School of Biosciences will only deal with Biosciences modules.

The contents of this booklet were accurate when it was compiled, but this does not exclude the possibility of changes of detail at short notice. Modules and exam formats change from year to year.

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[1] You may find the answer to general questions here: http://www.birmingham.ac.uk/students/studyabroad/incomingstudents.aspx.
[2] Exceptions to this need to be agreed with the student's sending university and confirmed in writing with the international office.
[3] 20 Birmingham Credits = 10 ECTS Credits.

Taught Modules:

The university timetable is divided into blocks, which are shown in the tables below. If two modules are in the same block they cannot be taken together (exceptions are marked with an asterisk and listed below). If a student picks one module from each block their timetables will be compatible (exceptions are marked with an asterisk and listed below). All modules are worth 20 credits, except for BIO151, BIO152L, and BIO230 which are 10 credit modules.

Semester 1			
Block 1	BIO145	BIO230*, BIO262*, BIO263*	BIO348* BIO397*
Block 2	BIO151, BIO152, BIO152L	BIO213	BIO379
Block 3		BIO237* BIO258*	BIO304*, BIO325* BIO372*

Semester 2			
Block 4	BIO154	BIO261* BIO265*	BIO319*, BIO384* BIO387*
Block 5	BIO107 BIO153	BIO273	BIO311*, BIO317* BIO380*, BIO398*
Block 6	BIO143 BIO142	BIO268* BIO274*	BIO305*, BIO388* BIO389*

*The following exceptions apply:

- BIO151 may be taken with BIO152 or BIO152L
- BIO230 may be taken with BIO262 or BIO263
- BIO237 and BIO258 may be taken together
- BIO261 and BIO265 may be taken together
- BIO268 and BIO274 may be taken together
- BIO372 may be taken with BIO304 or BIO325
- BIO387 may be taken with BIO319 or BIO384
- BIO317 may be taken with BIO311 or BIO380 or BIO398
- BIO305 may be taken with BIO388 or BIO389
- BIO263 and BIO397 may be taken together
- BIO152 cannot be taken with BIO152L
- BIO237 cannot be taken with BIO348 or BIO397
- BIO258 cannot be taken with BIO348 or BIO397
- BIO274 cannot be taken with BIO319 or BIO384 or BIO387

Module Availability 2014-15				
Code	**Banner**	**Module**	**Semester**	**Credits**
Year 1 Modules				
BIO107	00808	Enzymes and Metabolism	2	20
BIO142	22649	Plant Sciences & Environmental Biology	2	20
BIO143	22652	Physical Biochemistry	2	20
BIO145	22924	Introduction to Evolution & Animal Biology	1	20
BIO151	01331	Biochemistry	1	10
BIO152	23318	Cell Biology & Physiology	1	20
BIO152L	23319	Essentials of Cell Biology & Physiology	1	10
BIO153	23321	Microbiology and Infectious Disease	2	20
BIO154	23320	Genetics I	2	20
Year 2 Modules				
BIO213	18540	Topics in Medical Biosciences	1	20
BIO230	19822	Molecular Biology and its Applications	1	10
BIO237	13282	Plant Sciences: from cells to the environment	1	20
BIO258	22397	Microbes and Man	1	20
BIO261	23326	Proteins and Enzymes	2	20
BIO262	23328	Membranes, Energy and Metabolism	1	20
BIO263	23327	Human Evolution, Adaptation & Behaviour	1	20
BIO265	13160	Genetics II	2	20
BIO268	24985	Cell and Developmental Biology	2	20
BIO273	26999	Human Structure and Function	2	20
BIO274	TBC	Animal Biology	2	20
Final Year Modules				
BIO304	26404	Molecular and Cellular Mechanisms of Toxicity and Cancer	1	20
BIO305	23344	Molecular Basis of Bacterial Infection	2	20
BIO311	15851	Structures of Destruction	2	20
BIO317	25343	Bacterial Gene Regulation	2	20
BIO319	25351	Cellular Signalling	2	20
BIO325	11221	Eukaryotic Gene Expression	1	20
BIO348	21783	Genetics III: Genetic Variation in Humans and other Eukaryotes	1	20
BIO372	01315	Conservation Biology	1	20
BIO379	14675	Cellular Neurobiology	1	20
BIO380	25349	Human Evolution	2	20
BIO384	21189	Human Reproductive Biology and Development	2	20
BIO387	21893	Cancer Biology	2	20
BIO388	21894	Molecular and Cellular Immunology	2	20
BIO389	22393	Adaptation to changing environments	2	20
BIO397	25197	Living in Groups: Collective Behaviour in Animals	1	20
BIO398	26100	Plant Sciences in the 21st Century	2	20
Final Year Dissertations				
Lab	23993	Lab Project	1+2	40
Lit Rev	23991 23392	Evidence-based Literature Review (& Critical Analysis: Developing a Research Project)	1+2	40

Banner: 03 00808 BIO107		Enzymes and Metabolism (2013-14) Credits: 20
Level: C	**Semester: 2**	**Staff responsible: Dr R Madigan**

Description: In this course we shall describe techniques for isolating and purifying cellular components, and for studying protein action in the context of metabolism. We shall go on to discuss the metabolism of carbohydrates and pyruvate, and of fatty acids. At the same time, we shall consider energy requirements and generation in metabolism, and provide an introduction to the field of microbiology.

Throughout the course we shall emphasise the experimental techniques, the evidence and the unifying concepts behind our current understanding of metabolic processes.

Learning outcomes: By the end of this module you should be able to:

1. describe some of the techniques used to isolate cellular components and to purify and characterise proteins;
2. describe the principles and practices of column chromatography and electrophoresis, and how to monitor the progress of a purification procedure;
3. demonstrate understanding of the features of metabolism exemplified by the major pathways of carbohydrate and fat metabolism (with introductory knowledge of amino acid metabolism);
4. interpret disorders of metabolism by analysis of clinical data in case studies;
5. show how specified major metabolic pathways can be analysed in terms of mechanisms and thermodynamics, and be able to outline the relevance of the state-of-the-art method of metabolomics.
6. demonstrate observational, manipulative, numerical and deductive skills, and write reports (through experience gained in the practical and data-handling classes)
7. develop improved skills of independent learning and verbal reporting in the clinical case studies
8. develop knowledge of core microbiology including how to culture microorganisms.

This module is a progression from the Semester 1 module BIO151.

Delivery: Lectures, practicals, data-handling classes and case studies

Assessment: Examination 70%
Continuous Assessment Coursework:

Practical assessment (Protein Purification):	10%
Practical assessment (Radiolabelling):	10%
Case Study 2:	10%

Banner: 03 22649 BIO142		**Plant Sciences and Environmental Biology (2013-14) Credits: 20**
Level: C	**Semester: 2**	**Staff responsible: Dr J Pritchard**

Description:

Plants are essential for human life. They are the basis of all ecosystems on the planet, providing the origin of the food we eat and the air we breathe. We rely on plants for not only for edible products, but also for fuel, medicines, building materials, clothing, paper, and things that enhance our quality of life such as parks, gardens and public spaces. Over recent decades there have been dramatic improvements in food supply. However, there are still important requirements for crop improvement. We need to satisfy demands from an increasingly ecologically-minded public for environment-friendly agriculture, and to ensure that crop plants continue to survive with changing climates and soils. We need to provide alternative uses (e.g. as biofuels) for existing crop plants, to eliminate surpluses of particular commodities, and to combat problems of disease in crops with an increasingly narrow genetic base (monoculture).

In order to manipulate plant characteristics to benefit human society, we need to fully understand the processes that naturally control the characteristics within the plant. Thus, a great deal of modern plant science research aims to fully understand fundamental plant biology: including development, cell biology, physiology and responses to the environment. A prime aim of this course is therefore to explain the molecular, physiological and structural processes that underlie the growth and development of plants and show how such information can be applied directly to benefit humans.

The ‘environment’ consists of both a biotic component (including plants and their parasites and predators) and an abiotic component (variables such as temperature, water/nutrient availability and associated stresses). Within an ecosystem, we have to understand how plants interact with their environment and this module addresses the biology associated with this. In addition, the ecosystems that sustain us are affected by humans. This course introduces the ways we can quantify these effects, and explores the various solutions to environmental problems. Diversity (at both genetic and habitat levels) is central to both natural ecosystems and agricultural systems and we introduce the definitions and methods needed to quantify diversity. The various human pressures on these environments will be examined, including habitat fragmentation, invasive species and pollution. There is particular emphasis on the effects of the increased levels of greenhouse gases that are driving climate change. A range of sustainable strategies will be considered that can facilitate conservation of the natural world and provide solutions for agricultural situations, including the use of GM crops.

Learning outcomes:

The aims of this course are to:

- Provide a grounding in the understanding of the biology of higher plants
- Introduce environmental biology in a modern context.

By the end of the module, you should be able to:

- Understand how plant structure and function are interrelated in key physiological and developmental processes
- Describe the different types of natural environments and outline the major threats to this biodiversity
- Evaluate the advantages and disadvantages of a range of sustainable solutions to threats to the environment
- Plan, carry out and analyse simple experiments in the laboratory
- Use a range of quantitative methods for assessing environmental diversity
- Organise and present scientific data

Delivery: Lectures, Practicals

Assessment: Assessment is by final year exam (80%), course work (20%) and two formative MCQ tests (0%)

Banner: 03 22652 BIO143		**Physical Biochemistry (2013-14)**	**Credits: 20**
Level: C	**Semester: 2**	**Staff responsible: Dr K Fütterer**	

Description: This module seeks to establish an understanding of the fundamental physical laws that underpin biochemical reactions and processes. Why does a reaction go forward? How much substrate is left *x* seconds after starting the reaction? How does pH influence enzyme-catalysed reactions and how does the rate of turnover relate to concentration of enzyme and availability of substrate? These are some of the questions examined in this module.

Of equal significance is to gain a sense of how properties of proteins and enzymes can be examined experimentally. Therefore, this module will introduce students to spectroscopic techniques and to the basics of quantifying enzyme activity.

The module sets foundations for content taught in year 2 (e.g. BIO262) and in the final year module BIO340.

Learning outcomes:

Aims:
The module provides a foundation in physical biochemistry enabling you to understand and appreciate many fundamental aspects of biochemistry; including reaction kinetics and thermodynamics. You will receive training in using basic mathematical tools to quantitatively describe reaction equilibria and kinetics in biochemical reactions.

Learning outcomes:
At the end of this module you will

1. understand how pH affects ionisations states of ionisable groups in proteins and, as a consequence, how pH can affect enzyme activity.
2. achieve a basic understanding of how thermodynamics and kinetics allow a quantitative description of biochemical processes.
3. master a basic set of mathematical tools to predict biochemical equilibria; to describe the time-dependence of (enzyme-catalysed) chemical reactions; and to quantify the relationship between substrate concentration(s) and reaction rates in enzyme-catalysed reactions.
4. be able to relate molecular and structural features of a selected set of enzymes to the mechanism of rate enhancement.
5. understand how knowledge of evolutionary relationships between proteins provides insights into the conservation of structure and molecular mechanism of protein function.
6. know and understand a simple set of experimental techniques to study enzymes, their substrates and reactions they catalyse.
7. be able to devise experiments and analyse corresponding data that assess catalytic activity of a given enzyme

Delivery: Lectures, Practicals, Workshops

Assessment: The **continuous assessment** will contribute **40% to the overall module mark**.

Class Test	10%
Practicals (mini-assessments and data reports)	20%
Workshops (mini-assessments)	10%

The **end-of-year examination** in May/June will contribute **60% to the overall module mark** and consists of a 2-hour paper in two parts: multiple-choice questions (40% of the exam mark) and compulsory short answer and quantitative problem questions (60% of the exam mark).

Banner: 03 22924 BIO145		**Introduction to Evolution and Animal Biology Credits: 20 (2013-14)**
Level: C	**Semester: 1**	**Staff responsible: Dr S J Reynolds**

Description:

This module consists of two linked sub-sections – 'Evolution' and 'Animal Biology'.

Evolution: In the 19th century description of the environment and the physiology of organisms led to the elucidation of Evolution by natural selection as the major force in shaping these systems. The emerging science of Biology was provided with a powerful tool when this descriptive information was combined with genetics. This modern synthesis defined the biosciences until the molecular revolution of the last decade. This has revealed the molecular motors that drive evolution and additionally provided new techniques that complement and broaden conventional approaches. Topics as diverse as molecular biology, biochemistry, physiology, medicine, anatomy, taxonomy, ecology and animal behaviour all rely on an evolutionary view of the relationships between organisms, including humans, and the effects of natural selection upon them.

Animal Biology: The course contains an introduction to the Animal Kingdom where in three lectures you will be introduced to the phylogenetic tree, the science of classification and the body plan of major taxa. Then, blocks of lectures will be provided that examine the biology of four taxa (see above) by discussing evolution, ecology, behaviour, morphology, anatomy etc. and, in so doing, you will be introduced to the principles of whole animal biology. Accompanying these lectures will be assessed practical sessions that introduce you to the applied and theoretical aspects of entomology and ornithology. Together, the animal biology part of the module will draw upon the research interests of the module contributors and introduce you to a 'broad sweep' of the animal kingdom.

Learning outcomes:

At the end of the course the students will be able to:

- discuss the development and current impact of evolutionary thought
- demonstrate a working knowledge of the mechanisms of natural selection
- recognise and recall taxonomic terms used in animal classification
- discuss adaptations as phenotypes that increase fitness in defined environments
- define 'species' and 'selection' in a number of contexts
- describe the basic genetic mechanisms underpinning evolution
- outline the major phenotypic changes and the potential selective pressures driving the evolution of humans
- outline the major phenotypic changes and the potential selective pressures driving the evolution of plants
- provide examples of the methods by which the behaviour of animals is studied, recorded and interpreted
- list the mechanisms of the origin and early development of life
- explain how the functional morphology, physiology, ecology and behaviour of different animal groups relate to their wider biology
- carry out laboratory experiments and record and analyse results
- apply your knowledge in data handling and problem solving

Delivery:

Lectures, Practicals

Assessment:

End-of-year examination (70%): The 2 hour end-of-year examination will contain two types of questions: Students will be required to answer a set of short answer questions (SAQs) and a series of multiple choice questions (MCQs) relevant to both evolution and animal biology components of the course.

Evolution practical sessions (15%): You will complete a practical workbook during and following the two practical sessions. There will be a short MCQ test on the material and concepts delivered in the practical sessions. Taken together, the Evolution workbook and the Evolution MCQ test comprise 15% of the course mark.

Animal Biology (15%): The in-course assessment for the Animal Biology section comprises two 3-hour practical classes, each worth 7.5% of the overall module mark

Banner: 03 01331 BIO151		**Biochemistry (2013-14)**	**Credits: 10**
Level: C	**Semester: 1**	**Staff responsible: Dr R Madigan**	

Description: The study of cells and their components underpins many areas of current biological and biochemical research. By understanding how cells grow and divide, we hope to improve our understanding of the different organisms that they make up, from simple bacteria to humans. This can also give us many insights into the abnormal behaviour of cells seen in diseases such as cancer, and in natural processes such as ageing. This semester, all biosciences students will be doing two modules (Cell Biology and Physiology (BIO152) and Biochemistry (BIO151)) on this subject, which will be independently assessed. The two parts are complementary in subject matter and will run at the same time. This manual provides important information for BIO151.

Biochemistry (BIO151, 10 credits) will develop an understanding of the biochemical reactions that take place within cells. We will study how the structure of molecules explains their function, with particular reference to proteins such as enzymes, and how cellular processes are determined by energy relationships. This will involve a closer study of the sources of biological energy, and how the energy present in food is stored and used by cells.

Understanding the factual basis of cell biology and biochemistry is the most important part of these modules. But we also specifically want you to learn about scientific principles and practice: learning about the evidence behind the facts, how to evaluate that evidence, how to design a hypothesis to explain observations, and how to design an experiment to test that hypothesis. All these things may be specifically assessed.

Learning outcomes: The aim of BIO151 is to deepen your understanding of the biochemistry of life, in terms of the structures of some of the essential components of the cell, the mechanisms of enzymes, and the nature and role of metabolic processes. In addition, the module aims to help you understand how fundamental chemical concepts are of importance in the understanding of and experimentation in cell biology. A key part of this module involves the use of an independent learning manual (ILM), and as independent learning will be an important part of your experience at University, learning how to use this resource is an important objective of the module.

Having completed BIO151, you should be able to:

1) demonstrate knowledge and understanding of all parts of the module
2) apply your knowledge in problem solving and data handling
3) carry out practical exercises to illustrate methods of enzyme analysis
4) understand fundamental chemical concepts of bonds, concentrations, reaction kinetics, pH and buffers, and redox potentials
5) use and learn from a specific independent component in a course

Delivery: Lectures, Practicals, Independent Learning Manual

Assessment: Assessment of this module will be broken down as follows:

Continuous Assessment:

Practical Assessment wk 8/9:	15%
Multiple Choice Test wk 10:	15%

End of module exam to be held in January 2014:

One paper with a mixture of short answer and multiple choice questions:	70%

Banner: 03 23318 BIO152		Cell Biology and Physiology (2013-14) Credits: 20
Level: C	**Semester: 1**	**Staff responsible: Dr S Brogna**

Description: This module introduces you to the basics of cell biology and human and animal physiology. In the first part of the module, the components of the cell are described and discussed in terms of their structure and function. This includes sections on membranes and membrane-bound organelles, and the flow of materials inside the cell. Comparisons between eukaryotic and prokaryotic cells will be discussed. The second part of the module covers physiology and includes underlying concepts such as homeostasis, and outlines in more detail the cardiovascular system, endocrinology, immunology and neurophysiology. It aims to highlight the important relationships between these systems and the connections between cell biology, anatomy and physiology.

The module also introduces you to the basics of reproduction and development. It first considers the underlying principles of asexual and sexual reproduction, reproductive cycles and reproductive strategies. It then moves on to consider human and animal reproduction, beginning with meiosis and gametogenesis followed by fertilisation and early development.
The module will have two practicals and two workshops that will involve aspects of cell biology, immunology and endocrinology and give you the opportunity to observe and document fertilisation and the early development of zebra fish.

Learning outcomes: By the end of the module, students should be able to:

a) understand concepts of cell biology and the relationship between cell biology and functionality for the physiological systems studied

b) understand concepts of human and animal physiology, reproduction and early development

c) carry out and understand practical exercises in various aspects of cell biology and physiology

d) undertake independent learning activities in an enquiry-based manner

Delivery: Lectures, Practicals

Assessment: 30% Coursework, 70% Exam

Banner: 03 23319 BIO152L		**Essentials of Cell Biology and Physiology (2013-14) Credits: 10**
Level: C	**Semester: 1**	**Staff responsible: Dr S Brogna**

Description: This module is a shortened version of BIO152 – Cell Biology & Physiology

This module introduces you to the basics of cell biology and human and animal physiology. In the first part of the module, the components of the cell are described and discussed in terms of their structure and function. This includes sections on membranes and membrane-bound organelles, and the flow of materials inside the cell. Comparisons between eukaryotic and prokaryotic cells will be discussed. The second part of the module covers physiology and includes underlying concepts such as homeostasis, and outlines in more detail the cardiovascular system, endocrinology, immunology and neurophysiology. It aims to highlight the important relationships between these systems and the connections between cell biology, anatomy and physiology.

Learning outcomes: By the end of the module, students should be able to:

a) understand concepts of cell biology and the relationship between cell biology and functionality for the physiological systems studied

b) understand concepts of human and animal physiology

c) undertake independent learning activities in an enquiry-based manner

Delivery: Lectures

Assessment: 30% Coursework, 70% Exam

Banner: 03 23321 BIO153		**Microbiology and Infectious Disease (2013-14)** **Credits: 20**
Level: C	**Semester: 2**	**Staff responsible: Dr J Lodge**

Description: Microbiology is the science of microscopic forms of life. In this course you will learn about the fundamental biology of viruses, prokaryotes (bacteria and archaea) and microbial eukaryotes (including fungi, protists and algae). In particular, we will investigate the basics of anatomical structure, biochemical composition, function, diversity and systematics. In the second part of the module, we consider microorganisms in human disease and discuss the diversity and underlying biology of infectious organisms.

Microorganisms are ubiquitous: there is no place on Earth that is naturally microbe-free and each of us carries around a teeming zoo of microorganisms on our bodies. Despite this, however, most people have only a very limited appreciation of the fascinating and beautiful world of organisms that are too small to be seen except by means of the light or electron microscope. In addition, all of us are regularly struck down by illnesses caused by microorganisms and, for an unlucky few, these may be very serious or even fatal.

The aim of this module is to reveal the incredible diversity of the microbial world and to develop an understanding of how it impacts on humans via infectious disease as well as in other, more positive, ways. In addition, microbiology is a very practical subject with its own specialist techniques. In this context, a major aim of the module is to train you in the practical techniques used for growing, studying and identifying microorganisms in the laboratory in a way that is safe for both you and your colleagues.

Learning outcomes: By the end of this module you should be able to:

1. Describe the key features of the major microbial groups and their life styles.
2. Demonstrate an understanding of diverse infectious diseases and their treatment.
3. Apply knowledge from different parts of the course to novel real world problems.
4. Understand the principles underlying isolation and growth of different types of microorganisms and methods for analysing the effect of different growth conditions.
5. Work as a group to resolve a real life infectious disease control problem.

The objectives for this module will be assessed by means of in-course tests and assessed practicals, and the final exam.

Delivery: Lectures, Practicals, Workshops

Assessment: **Continuous assessment (30%)** will consist of :

1. A multiple-choice test which will focus **mainly on microbial diversity and microbial structure and metabolism.**
2. An in-course integrative case study, which will involve you producing a case study on a specialist microbiology topic.
3. An assessment in week 11. This will involve:

(a) Testing your knowledge of the safe handling and manipulation of microorganisms in the laboratory, and of safety aspects of laboratory work in general. Learning the correct way to handle microbes through aseptic techniques is an important outcome of the module. You will be shown a video of a laboratory session and asked to spot as many mistakes as possible.

(b) Marking parts of your manual. It is **essential that you bring your manual to the test**; you will NOT be able to submit your manual later. The manuals will be assessed during the test, and you will get instant feedback on how well you have performed.

Sessional Examination: 70% of total mark

The module exam will be held during the normal sessional exam period in May/June and will comprise two sections: an MCQ section (negatively marked: -1/3rd mark per wrong answer) and a short answer question section (SAQ). This exam will run for 2h (split 67%:33% SAQ/MCQ).

Banner: 03 23320 BIO154		**Genetics 1 (2013-14)** **Credits: 20**
Level: C	**Semester: 2**	**Staff responsible: Prof. C Thomas**

Description: An understanding of the basic concepts of genetics is essential for all contemporary bioscience students and the ideas you will encounter in this module pervade many areas of the life-sciences. You will receive a comprehensive introduction to modern genetics, in both prokaryotic and eukaryotic organisms, including humans. You will learn about **molecular genetics** (the study of the physico-chemical nature of genes and how they work) and **transmission genetics** (the study of how genes, and the characters they determine, are shuffled into new combinations and passed from individual to individual).

In lectures you will examine: genetic information, how it is stored, transmitted, and translated; the regulation of gene expression; the genetics of bacteria and viruses; the cell cycle in eukaryotes and its regulation; mitosis and meiosis; gene linkage and chromosome mapping; DNA damage and mutation.

In practical classes you will have the opportunity to use bacteria to test one of the most fundamental questions in biology: 'what is the genetic material?' You will also be able to observe chromosomes during cell division. You will be able to develop your problem solving and numeracy skills during workshops on transmission genetics.

Learning outcomes:

AIMS

To provide a general introduction to both molecular and transmission genetics in prokaryotes and eukaryotes that will enable students either to go on to more advanced genetics courses, or to appreciate the importance and applications of genetics in other areas of biology and biochemistry.

LEARNING OUTCOMES

By the end of this module you should be able to:

1. Show knowledge and understanding of all parts of the syllabus;
2. Apply your knowledge to solving problems in transmission genetics;
3. Formulate hypotheses as well as design and carry out experiments to test them;
4. Construct genetic hypotheses and test them, using simple statistical methods where appropriate;
5. Appreciate the different methods used for genetic analysis in prokaryotic and eukaryotic organisms.

Delivery: Lectures, Practicals, Workshops

Assessment:

Laboratory Report 1	0%
Laboratory Report 2	5%
Laboratory Report 3	5%
MCQ Test	10%
Eukaryotic Genetic Analysis	5%
Bacterial Genetic Analysis	5%
Module Summer Exam	70%

03 18540	BIO213	Topics in Medical Biosciences Credits: 20
Level: I	**Semester 1**	**Module Organiser: Dr F Michelangeli** **Teaching staff: Drs Hidalgo, Lodge, Madigan,Tomlinson, lecturers from Medical School**

Description:	In this module you will study 3 key areas: **Blood constituents and their functions.** You will learn about the types a roles of blood cells, haemogloblin synthesis and degradation, blood coagulation and homeostasis, blood lipids, and immunology methods. **Neurobiology.** You will learn about molecular neurobiology and neurotransmitters and how they affect brain functions such as memory and how the brain responds to opiates. **Pharmacology**. You will learn about anaesthetics, antibacterial and antiviral agents, cancer chemotherapy and immunosuppression. In addition, cardiovascular and CNS pharmacology will also be considered. In the practical classes you will perform and develop skills in a number of immunochemical procedures that are commonly used clinically and in research. The action of drugs on their enzyme target will also be investigated. This module builds upon aspects of biochemistry, cell biology and physiology learnt in year 1 and will be useful for a number of advanced modules such as cell signalling, neurobiology, cancer biology and immunology taken in years 3. .
Learning outcomes:	On successful completion of the module, students should be able to: • Independently and without the use of resources, demonstrate, an understanding of the blood system, its cellular and protein components and their roles. • Independently demonstrate an understanding of molecular neurobiology with particular reference to the action of neurotransmitters. • Independently, demonstrate an understanding of the mode of action of a number of drugs which affect different physiological systems and are used in the treatment of various diseases. • Have undertaken and gained skills of practical and analytical use of commonly used immunochemical methods and the action of neurological drugs on their enzyme targets.
Delivery:	28 hrs lectures; 9 hrs practicals; 2 hrs case studies; 1 hrs videos
Assessment	**Continuous assessment (30%)** One group poster presentation (10%) Drug action practical write up (10%) Immunochemistry practical write up (10% + 10%) **Examination** (60%). A two-hour paper with essay and short answer questions.

03 19822	**BIO230**	**Molecular Biology and its Applications Credits: 10**
Level: I	**Semester 1**	**Module Organiser: Dr Julia Lodge** **Teaching Staff: Dr Minchin, Professor Franklin, Dr Soller, Dr Sanchez-Moran**
Description:	This second-year core module will build on key information covered in the first year by developing further an understanding of molecular biology, its empirical bases, and its applications in modern biological science. The module will: ➢ introduce advanced techniques in molecular biology ➢ develop an understanding of the diverse applications of this technology across the range of the Biological Sciences ➢ provide hands-on experience of basic cloning and molecular biology techniques ➢ build a sound theoretical basis on which teaching in the second and third year can build in all areas of biology.	
Learning Outcomes:	**On successful completion of this module you should be able to:** ➢ explain how the basic techniques in genetic engineering can be applied to solve a variety of simple cloning problems ➢ devise simple experiments to identify, clone and analyse a bacterial, animal or plant gene ➢ understand the impact of genomics on our understanding of gene function ➢ explain using examples how molecular biotechnology can be applied to diverse applications such as studying populations, DNA fingerprinting, medicine, forensics, environmental monitoring, agronomics and diagnosis and treatment of genetic disease. ➢ be able to work with the types of data associated with molecular biology	
Delivery:	Lectures, practicals and workshops.	
Assessment	**Continuous assessment**: 90-minute data handling test based on the practical and workshop elements of the course and will comprise MCQ and short answer questions. (33% of the module mark). **Examination:** in January. A one hour paper (67% of the module mark).	
Feedback	You will be able to complete your workshop and practical manuals and hand these in for formative feedback. There will also be an interactive feedback and revision session to help you to prepare for the data handling test.	

03 13282	**BIO237**	**Plant Sciences: from cells to the environment**	**Credits: 20**
Level: I	**Semester 1**	**Module Organiser: Dr Jeremy Pritchard** **Teaching Staff: Dr Juliet Coates, other staff TBC**	

Description:

The continuing increase in the worlds population coupled with the many treats of climate change are putting increasing pressure on the need to produce more food in a secure and sustainable manner. As the primary producers plants are central to this, whether we use a conventional or a GM breeding strategy. To help maximise food production and inform conservation we need to understand bow plants deal with changes in nutrients, light, water and pollutants such as salt and heavy metals. As plant pests are favoured by climate change we also need to evaluate their various strategies for dealing with herbivores. In natural environment climate change and other pressures impacts on plant ecology and conservation strategies.

The aim of this course is to help you develop an understanding of how higher plants function, in their development and physiology, in relation to key influences in their natural environments. During the course you will use information from both conventional molecular approaches. The course is lecture based with emphasis on using the scientific literature. A central feature is a series of practicals in which you will directly experience some of the phenomena introduced in lectures and begin to refine your skills in experimental design and execution as well as how scientists analyse, present and write up their experimental results, a process you began in the Arabidopsis project in BIO142. This aspect of your skills development, both practically and in terms of your transferable skills is a major feature of this course and will prepare you for the research led environment of the final year and beyond.

This course will show plants as a dynamic and relevant part of the natural world and will be of interest to you whether you are interested in the more environmental aspect of the natural world as well as those who wish to exploit the new 'omics technologies to delve deeper in the world of the plant cell.

The course will develop some of the information and concepts delivered in the first year including BIO142 Plant and Environmental Biology but also information from cell and molecular Biology delivered in the first year. The information delivered in this course will complement a range of other second year courses including the three field courses and the BIO234 Ecology modules. Since it combines environmental and molecular approaches and take both a whole plant and cellular perspective it will also support concepts delivered in the second year cell and developmental biology module Bio268. In the final year the more environmental focussed students will find BIO237 useful in the BIO389 adaptation to the environment module while those with more cellular developmental interests will find this aspects of this course in the BIO395 plant development module.

Learning outcomes:	By the end of this module students will be able to: 1.Recognize, recall and define terms relevant to the study of: i) Whole plant physiology ii) Stress physiology, including drought , temperature, salt, soil toxins, elevated CO_2 iii) Plant herbivore interactions iv) Plant development and cell signalling, and responses to environmental signals v) Aspects of Plant ecology 2. Describe physiological and developmental responses of plants to environmental and hormonal signals at the molecular level, e.g. changes in gene expression, growth and cell solute composition 3. Explain and contrast the adaptive mechanisms by which plants overcome biotic and abiotic stress. 4. Understand how plant adaptation to differnet environments affects their Ecology 5. Evaluate the use of model organisms in plant science research. 6. Evaluate the potential for agricultural improvement of the various strategies by which plants i) respond to signals and stresses and ii) reproduce. 7. Analyse and interpret the scientific literature to provide an evidence base supporting the achievement of learning outcomes 2-6, and in set exercises. 8. Work in groups to design hypotheses and test them by carrying out specific experiments, applying knowledge to problem solving and data handling 9. Develop analytical and writing skills to produce a formal scientific write-up of experimental data, incorporating use of the scientific literature. 10. Under exam conditions write structured essays describing and applying modern plant science concepts and incorporating relevant literature.
Delivery:	Lectures, practicals, independent learning, workshops, course web site.
Assessment	**In-course assessment** during the module, comprising a practical write-up in the form of a scientific paper, based on practical training in the laboratory and training in scientific writing. This will comprise 30% of the marks for the course. There is a formative MCQ giving you feedback on your understanding of the practicals and a formative peer marking exercise to help you with the practical write up and to engage with the marking criteria. **Examination** in May. This will be a two-hour paper comprising essay and short-answer questions. Overall the final paper will comprise 70% of the total mark for the course.

03 22397	**BIO258**	**Microbes and Man**	**Credits: 20**
Level: I	**Semester: 1**	**Module organiser: Dr Julia Lodge** **Teaching Staff: Drs Green & Lodge**	

Description: In this module you will learn about how microorganisms impact on humans, both in the context of health and disease and by looking at how humans have exploited microorganisms.

In the Human Health and Disease section you will learn about three of the major groups of disease causing microorganisms; bacteria, fungi and viruses, with emphasis on the underlying mechanisms. As the course progresses you will begin to recognise that common themes underpin our understanding of the diseases caused by these quite different groups of microorganisms; these themes will be explored in the overview session at the end of this section of the course.

Many of the topics in the Exploitation of Microorganisms section also relate to protecting human health, including antibiotic, vaccine and medicinal protein production. You will also look at how our understanding of microbes has been enhanced by genome sequencing and how micro organisms can be abused as agents of biowarfare and bioterrorism.

In the practical component of the course you will carry out and compare classical and molecular approaches used for the identification of bacteria. This will give you hands-on experience of handling bacteria and give you the opportunity to put into practice the aseptic technique that you learned in the first year. The molecular approach for identification is based on PCR and sequencing and will build on what you learned in the first semester module Molecular Biology and its Applications (BIO230).

This module builds on the first year module Microbiology and Infectious Disease (BIO153). It is essential for students wishing to specialise in Microbiology during their degree course and those wishing to study Applied and Environmental Microbiology (BIO303) or Molecular Basis of Bacterial Infection (BIO305) in the final year. It also provides essential microbiology for students pursuing subjects of related interest such as Genetics and Human Biology.

Learning outcomes: By the end of the module you should be able to:

- Demonstrate an understanding of the nature and biology of bacteria, fungi and viruses and their medical and economic importance.
- Discuss the common themes that underpin our understanding of the diseases caused by different groups of microorganisms.
- Describe, using specific examples, how microorganisms have been exploited by humans and how this relates to their underlying characteristics.
- Demonstrate practical skills required for the investigation of micro-organisms, and discuss the different techniques employed.
- Analyse and interpret data in order to make judgements and formulate arguments.

Delivery: Lectures, practical classes, data analysis classes in a computer cluster and workshops. At the end of the Human Health and disease section you will be able to take part in an overview workshop where we will look at how to construct a good answer to an examination essay question.

Assessment: Two pieces of continuous assessment:
One comprehensions sheet based on the practical work (20%)
One data handling test based on the workshops and practical work (20%)

Examination (60%).
A two-hour paper with essay and short answer questions.

Feedback The comprehension sheet will be marked and returned with feedback. There will also be a feedback and revision session based on this to help you to prepare for the data handling test.

03 23326	BIO261	Proteins and Enzymes Credits: 20
Level: I	**Semester: 2**	**Module Organiser: Dr Eva Hyde** **Teaching Staff: Drs Madigan, White, Winn, Prof Dafforn**

Description: The module aims to examine how the three -dimensional structures of proteins relate to their particular functions. It first describes common protein motifs and homology modelling. It then explains the biophysical basis behind techniques used for protein characterisation; including circular dichroism, fluorescence, NMR spectroscopy, X-ray crystallography and analytical ultracentrifugation. It evaluates methods to determine the rates of enzymes and the mechanisms of enzyme action, and examines the structure and function of protein complexes

This module extends the material covered in Semester 1 and Semester 2 of year one (BIO124, BIO130, BIO143 and BIO107). It complements material covered in semester 1 of year 2 (BIO262 and BIO240) and aspects of CHM252 in semester 2. It also forms the basis for BIO340 in the third year.

Learning outcomes: By the end of the module the student should be able independently to :

- Explain how the amino acid sequence of a protein is related to its structure and hence to its function, including simple ideas of protein evolution and common secondary structure motifs.
- Describe common protein folds and structural motifs, and relate these to the functional roles of motifs, and how the structures are stabilised.
- Evaluate techniques used to determine the primary, secondary, tertiary and quaternary structures of proteins, and explain the biophysical principles behind these techniques.
- Discuss the mechanisms underlying the catalysis of reactions by certain enzymes and methods used to determine enzyme rates and mechanims.
- Analyse and interpret numerical data of ligand binding, UV spectroscopy, pH and enzyme kinetics, including the use of SigmaPlot.
- Download, display, and examine protein structures from the RSC protein data base.

Delivery: 29 lectures, 2 practicals, 3 computer cluster sessions (2 molecular graphics sessions / use of sigmaplot), 2 data handling classes, 1 poster session.

Assessment: **Continuous assessment**

- Practical write up - 10%
- Data-handling test - 20%
- Molecular graphics- 5%

Overall the continuous assessment will comprise 35% of the marks for the module

Examination in May
This will be a 2 hour examination comprising of essay questions and short- answer questions. These may include some data-handling problems. Overall the examination will comprise 65% of the total mark for the module

03 23328	**BIO262**	**Membranes, Energy & Metabolism**	**Credits: 20**
Level: I	**Semester: 1**	**Module Organiser: Dr Scott White** **Teaching Staff: Dr Michelangeli, Dr Kreft**	

Description: This course aims to illustrate the pivotal role of biological membranes in the cell physiology of prokaryotes and eukaryotes, including both plant and animal cells. Lectures and student-centred activities will explore this subject under three broad themes.

- the role and properties of membranes: lipid and protein components; how membranes define compartments; techniques and methodologies.
- energy generation within the cell: electron-transfer pathways; generation of ATP; oxidative phosphorylation and photosynthesis.
- metabolism: gluconeogenesis and the pentose phosphate pathway; the Calvin cycle; regulatory mechanisms and the control of metabolic pathways; the influence of hormones and other factors.

Learning outcomes: On successful completion of the module, students should be able to independently:

- explain the principles of membrane fusion and give an account of the various methods used to study membranes
- be able to calculate bioenergetic parameters based upon redox values and other types of data
- describe the properties and functions of electron transfer pathways and their protein and redox components
- explain the integration of anabolic metabolism with photosynthesis and energy metabolism
- compare and contrast microbial energy systems with those of eukaryotes
- recall the metabolic pathways (including chemical structures) and discuss how they function within the cell
- explain the concepts of allostery, metabolic flux, and hormonal regulation of metabolism

In addition, through participation in practical classes, workshops and group work, students should be able to:

- follow experimental protocols to investigate enzyme catalysed cleavage of phospholipids, lipid separation and redox reactions
- record and analyse experimental TLC and redox potential data
- complete lab reports on the module experiments, evaluate data and draw conclusions
- analyse data from bioenergetics and membrane studies by tackling problem-based questions

Delivery: 31 lectures, 2 practicals (summatively assessed), 2 data-handling classes and directed independent reading

Assessment: **In-course Assessment – 30% (two practicals)**
The **two** practicals will each be assessed via laboratory journals that record experimental methods, outcomes and results, analyse data, draw conclusions and then set the experiment in its proper theortical context. **Each practical is worth 15% of the module mark**.
The two data-handling classes are assessed formatively.

Examination – 70%
The main examination will be a 2hr paper. Students are required to answer 4 out of 5 short answer questions in Section A (worth 33% of the exam), and 2 out of 4 essay questions in Section B (worth 67% of the exam).

03 23327	**BIO263**	**Human Evolution, Adaptation & Behaviour Credits: 20**
Level: I	**Semester: 1**	**Module Organiser: Dr Susannah Thorpe** **Teaching Staff: Dr Chappell, Dr Brandstaetter, Dr Myatt, Dr Smith**

Description: The major aims of this module are to introduce students to 1) the key features that have guided human evolution over the last 5 million years (including the evolution of bipedalism, culture, large brain size, diet, and language); 2) human adaptations and behaviour to demonstate that modern humans have been subject to the same evolutionary processes as the rest of the animal kingdom and 3) human's functional evolutional anatomy.

Learning outcomes: **By the end of the module the student will be able to:**

- Compare and critically analyse current theories regarding major trends in human evolution
- Employ a forensic archaeology approach to work as a team to examine human skeletal remains to establish the sex, age of the individual at death and other indicators of their life history
- Use the skills developed in the learning outcome above to work out 1) the genus and species of three unknown fossil apes, and 2) key life history traits, such as the evolution of the adolescent growth spurt
- Evaluate molecular sequence data from humans and other primates when used to construct phylogenies and detect the adaptive evolutionary changes specific to the human lineage
- Apply the morpho-species concept to human fossil material
- Explain human's functional anatomy from an evolutionary perspective
- Describe the structure of muscle, tendon and bone and discuss how they function to produce muscle contractions.
- Explain and contrast the different techniques that may be used to study muscle function in humans and other animals.
- Describe the structure of the vertebrate brain and the regulation of motor functions by basal ganglia and cerebellum
- Explain and contrast theories of human social behaviour in an adaptive context
- Explain and contrast the techniques required to test theories about human co-operation
- Formulate and express their own ideas concisely through independent learning and writing.

Delivery: 21 hours of lectures plus three 3-hour practicals. A 3-hour session for peer marking of the SAQ and a 1-hour feedback session are also included.

Assessment: **In-course Assessment – 40%**

In-course assessment (50%) is split into two parts, an MCQ (25%) and an assessed SAQ (25%). The MCQ will focus on the issues dealt with in the practicals but will link to material covered in associated lectures.

The SAQ assessment will consist of 2 parts. Early in the first semester students will write a practise SAQ that will be peer assessed. The grades will not count towards the final module grade but students will be introduced to the marking criteria that will be used for the 2nd assessed SAQ and the feedback should be used to support the writing of the assessed piece at the end of the semester. The peer marking session will include marking the work of others in the class, study of good and bad examples and training in writing concisely. The three practicals, the lecture course and the student's independent reading will provide relevant information for the SAQs. The word limit for the SAQs will be 500 words which provides excellent training for conveying information concisely, as is required in exams and many careers.

Examination: 50%

Two hour written examination in May. This will have a different format to traditional 2nd year exams. The students will be provided with a choice of essay titles 14 days in advance of the exam so that they can revise specific topics and pre-select the questions they will answer. They will answer 2 essays question in the 2 hour exam. The aim is to focus on developing skills in critical analysis and synthesis, rather than on short-term recall of information.

Notes on module selection HB students must select either BIO263 or BIO273 as their core module and they will be guaranteed that selection. The module not chosen as core will be an optional module for HB students. Both modules are optional for Biology students. However, since enrolment caps are in place for both modules, all HB and B students selecting BIO263 or BIO273 as an optional module will be allocated a place according to first year grade and the number of spaces available.

03 13160	**BIO265**	**Genetics II**	**Credits: 20**
Level: I	**Semester 2**	**Module Organiser: Dr Sue Armstrong and Dr Eugenio Sanchez-Moran** **Teaching Staff: Drs Leach, Lee, Lund, Minchin, Prof Franklin**	
Description:	Genetics is the study of biological information; how it is coded, copied, expressed, transmitted between individuals and changed to give variation. As such, it is central to contemporary biological thinking and research, both as a topic in its own right and as a tool in the investigation of other areas of biology. This module will demonstrate how the organisation and structure of genes and genomes may be investigated in prokaryotes and higher organisms. The basis by which genetic variation arises through both mutation and recombination and is transmitted from generation to generation will be discussed. How this is harnessed for mapping of genes on chromosomes will be studied. The regulation and analysis of gene expression in bacteria and higher organisms will be reviewed. Students will gain experience of a range of genetical techniques. Genetics is an analytical subject and particular emphasis is given to developing critical thinking and quantitative skills through problem solving.		
Learning outcomes:	At the end of the module the student will be able to: • Explain (a) how classical and molecular genetic analysis is carried out in prokaryotic and eukaryotic organisms, including man, (b) how genes and genomes are organized and transmitted, and (c) how genetic variation is generated. **Assessed by**: written examination and problem solving • Use the conventions and language of genetics. **Assessed by**: written examination and problem solving • Solve simple problems in transmission and molecular genetics. **Assessed by**: sample problems during course and in exam • Carry out specified genetic procedures and interpret the results **Assessed by**: written examination • Illustrate the value and importance of the genetical approach in fundamental and applied studies of plants and animals, and in human inheritance. **Assessed by**: written examination		
Delivery:	Lectures, (23h) experimental practical classes (14h), problem solving classes (7h)		
Assessment	**Continuous assessment** throughout the course. This will be derived from 2 tests based on practicals and problem solving classes. It will comprise 40% (20% for each test) of the marks of the course,you will be given summative feedback for these tests.. **Examination** in May. This will be a two-hour paper comprising essay and data-handling type questions. Overall the paper will comprise 60% of the mark of the course.		

<table>
<tr><td colspan="2">03 24985 BIO268</td><td>Cell and Developmental Biology Credits: 20</td></tr>
<tr><td>Level: I</td><td>Semester 2</td><td>Module Organiser: Dr Tomlinson
Teaching Staff: To be confirmed</td></tr>
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Description:

This module will cover relevant areas in the understanding of Cell and Developmental Biology, with a major focus on the methods and model systems employed in these areas. Particular focus will be placed on the synthesis and trafficking of proteins in the cell, as well as the mechanisms through which cells physically interact with each other, and the extracellular matrix, to regulate differentiation and function. Development of multicellular organisms will be considered from the regulation of stem cell function to the differentiation of organs.

Learning outcomes:

By the end of the module you will be able to:

- Recognize, recall and define terms and processes relevant to the study of the cytoskeleton, cell adhesion, the extracellular matrix, cell migration and epithelial differentiation
- describe relevant model systems for use in Cellular and Developmental Biology
- evaluate relevant methods in Cellular and Developmental Biology
- critically evaluate stem cell biology
- discuss the mechanisms regulating organogenesis and differentiation
- understand the complexity of programmed cell death and how it is involved in development

Delivery:

24 lectures, one data handling/analysis workshop and one practical.

Assessment

In-course assessment (30%)

- 1 practical involving live chick embryos (10%).
- 1 test paper (20%). This will involve multiple choice and short answer questions in 60 minutes. It will be based upon data handling, data analysis and other skills developed during the practical and workshop.

Overall the continuous assessment will comprise 30% of the marks for the module.

Examination in May (70%)

The two-hour examination paper will contain two parts; one consisting of a series of compulsory short answer questions and the other consisting of essay-type questions. Overall the examination will comprise 70% of the total mark for the module.

TBA	**BIO273**	**Human Structure and Function**	**Credits: 20**
Level: I	**Semester: 2**	**Staff responsible: Dr Jacques, Dr Publicover**	

Description: Having completed this challenging and diverse module, students will have a broad appreciation of the structure of the human body, and how this relates to its function and evolutionary origin. Anatomy is taught under four major themes: (1) Anatomy as a science – understanding the human body from the point of view of evolution and development; (2) Microanatomy – a brief survey of the cellular organisation of body tissues; (3) The structure and function of body systems – a survey of the topography of the entire body from a systems-based perspective, with consideration of how the gross anatomy relates to the function of each system; (4) The human body in a broader context – further discussion of the importance of evolution and development using specific illustrative examples.

Learning outcomes:

- Discuss the different approaches to thinking about human structure and function
- Demonstrate an appreciation of the complex links between development, evolution and human structure and function
- Discuss the major evolutionary changes which led to the appearance of *Homo sapiens*
- Describe the basic topographical anatomy and histology of the systems of the human body
- Discuss the relationship between the structure and function of cells, tissues, organs and systems
- Compare the structure and function of the human body with the bodies of other vertebrates and explain the relevance of such comparisons
- Analyse, from the point of view of evolution and development, the apparently anomalous organisation of certain anatomical features
- Outline the real-world applications of a sound understanding of human structure and function
- Use the primary literature to defend a particular anatomical fact presented in a textbook
- Develop an understanding of the three dimensional arrangement of body structures

Delivery: 27 hours of lectures; 1 three hour journal club; 1 three hour plasticine modeling practical; 1 three hour rat dissection practical; 1 three hour practicals with anatomical models; 1 one hour prosectorium session; virtual cat tutorial. 40 hours contact time in total.

Assessment:	Formative assessment Mid-semester MCQ Rat dissection write-up (peer assessed) Prosectorium session write-up Summative assessment In-course assessment (40%) Journal club oral presentation (20%) Plasticine modelling write-up (20%) Examination (60%) Two hour written examination in May. Choose three from five possible essays.
Notes on Module Selection	HB students must select either BIO263 or BIO273 as their core module and they will be guaranteed that selection. The module not chosen as core will be an optional module for HB students. Both modules are optional for Biology students. However, since enrolment caps are in place for both modules, all HB and BS students selecting BIO263 or BIO273 as an optional module will be allocated a place according to first year grade and the number of spaces available.

03 TBA	**BIO274**	**Animal Biology**	**Credits: 20**
Level: I	**Semester 2**	**Module Organiser: Dr Brandstaetter** **Teaching Staff: Dr Publicover, Dr Chappell, Dr Myatt**	
Description:	The evolutionary and comparative approach to the study of whole organism biology in animals endeavours to understand how organisms 'function' by considering the multi-level organisation of organisms. This module will introduce students to the mechanisms involved in regulating complex physiology and behaviour. Starting with 'sensing the environment', signals are sent to the central nervous system, processed and integrated to cause physiological and behavioural responses. By comparing 'simple' organisms and 'complex' organisms, this module will provide a comprehensive view on sensory, nervous, and endocrine systems and how these control an animal's internal environment, its physiology (e.g. sleep/wake cycles, homeostasis, reproduction), cognitive functioning, and complex natural behaviour. Topics include: Comparative neurobiology, sensory biology (vision, hearing, taste and smell); homeostatic mechanisms and the control of homeostasis, learning and behaviour (associative learning; cognition; complex natural behaviour, e.g. vigilance behaviour).		
Learning outcomes:	• Students who successfully complete the module will have learnt about different whole organism model systems ranging from invertebrates to humans and will have gained knowledge about the control of physiological function and generation of behaviour by the nervous system • Students will have acquired a deeper knowledge and understanding of how complex natural behaviour is controlled and how neuroendocrine and autonomous nervous systems maintain homeostasis of physiology at the whole-organism level. • Students will have developed an ability to collect, record, handle, and interpret data and increased their practical and manipulative laboratory skills.		
Delivery:	The module is based upon lectures, practicals, and tutorials.		
Assessment	**Continuous assessment** throughout the course. This will be derived from practicals and tutorial classes. It will comprise 40% of the marks of the course. **Examination** in May. This will be a two-hour paper comprising essay and short-answer questions. Overall the final exam will comprise 60% of the marks of the course.		

03 23343	BIO304	Molecular and Cellular Mechanisms of Toxicity and Cancer	Credits: 20
Level: H	Semester: 1	Module Organiser: Dr L Wilkinson Teaching Staff: Prof Chipman, Dr Hodges	

Description:

Toxicology is the study of how chemical compounds interact with metabolism and the subsequent consequences to the health of the organism. The severity of the response can vary depending on the chemical, the dose and the length of exposure. One of the most serious long-term effects is the dysregulation of cellular control which manifests itself as cancer.

The module is loosely divided into two related subsections. The first will provide a background to the essential concepts of toxicology: how chemicals enter the human body, are distributed around it, the changes brought about by various metabolic pathways and their effects on toxicity, and the various pathways of excretion via which the chemicals/metabolites are expelled. The consequences of variations in metabolism in different populations will be highlighted. This will be followed by a series of lectures showing how a variety of chemicals exert toxic effects. By necessity, this section does contain some chemistry and there will be an optional chemistry lecture available at the beginning of the module to introduce key concepts.

The second part of the module will focus on chemical carcinogenesis and mechanisms of cellular differentiation, disruption and transformation. The distinction between genotoxic and non-genotoxic carcinogens will be emphasized, together with the effects of epigenetic modifications.

Learning outcomes:

By the end of this module students will be able to:

a) Discuss the underlying molecular and cellular mechanisms whereby chemicals interact with biochemical pathways to cause pharmacological and toxicological outcomes.

b) Demonstrate a sound understanding of the processes underlying carcinogenesis as a toxicological endpoint and the importance of environmental and genetic interactions in the development of the disease.

Delivery:

The module is essentially lecture-based in standard length lectures. There will be a workshop on the METEOR software package which predicts the metabolism of chemicals *in silico*. Students in groups, will prepare posters on selected topics to present to colleagues on an interactive “poster-day.”

Assessment:

In-course Assessment - 30%
Poster presentation 15%
Written Report 15%

3-hr written Examination in May - 70%

03 23344	**BIO305**	**Molecular Basis of Bacterial Infection**	**Credits: 20**
Level: H	**Semester: 2**	**Module Organiser: Dr Alderwick** **Teaching Staff: Dr Bhatt, Dr Lodge, Dr Lovering, Dr Loman**	

Description: During this module, students will become familiar with a number of important human pathogens and gain a detailed mechanistic undertanding of how these bacteria cause infection at the molecular level. Drawing on a range of state-of-the-art experimental and analytical approaches, including analysis of genome sequence data, students can expect to discover a more in depth approach to pathgen biology which is the molecular basis of bacterial infection. Through lectures, case studies and computer- and lab-based practical classes students will become familiar with the principles and practice of research addressing the molecular basis of bacterial infection and how this thriving area of science underpins a major our objective of discovering the next genertion of antibiotics. Students will thus gain an integrated view of the subject which will equip them for postgraduate ressearch in this area and for employment as clinical scientists

Learning outcomes: At the end of this module, the student should be able to:

- Describe the molecular mechanisms that bacteria use to cause disease, including the evolution, ecology, genetics and regulation of virulence
- Outline the pathogenesis of selected bacterial infections
- Explain the biogenesis of the bacterial cell envelope and its components, highlighting their roles in virulence and interactions with the metazoan immune system
- Elucidate the mechanisms for targeting virulence-related proteins to, and across, the cell envelope, including the biogenesis and function of relevant multi-protein complexes
- Understand the mode of action of current antibiotic treatments and what is being done to develop the next generation of antibiotics
- Describe the structure and evolution of bacterial genomes
- Interpret and annotate bacterial genome and protein sequence data
- Demonstrate a basic competence in the analysis of laboratory experiments relevant to bacterial pathogenesis.

Delivery: 28 hours of lectures, laboratory practical work, project work involving sequence data analysis and interpretation

Assessment: **In-course Assessment – 40%**
Sequence analysis project in weeks 5-10 (20%)
Laboratory practical assessment (20%).

3-hour written examination in May – 60%

03 15851	BIO311	Structures of Destruction Credits: 20
Level: H	Semester: 2	Module Organiser: Dr White Teaching Staff: Dr Futterer, Dr Hyde, Dr Lovering, Dr Lund

Description: Viruses and bacteria have developed a great variety of mechanisms to attack their hosts and to bring about disease. However, even "innocent" protein such as the prion, which has come to particular prominence through the BSE crisis, can transform itself into a pathogen through its specific structural properties. This module highlights how structural and functional features of proteins contribute to the pathogenic nature of their parent organism, or how structural information can give insight into future drug design or help combat the emerging threat of drug resistance. Detailed knowledge of the structure and function of 'pathogenic' macromolecules provides targets for therapeutic intervention. Lectures and student-centred activities will explore this subject under these headlines:

- Viruses: virus-encoded capsid and cytoslic proteins, viral entry into host cells
- Mechanisms of bacterial host-cell attachment and invasion
- Action of antibiotics and mechanisms of antibiotic resistance
- Novel viral pro-drug therapies
- Protein (mis-)folding in amyloid structures and prion-related diseases

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

- explore the structures of pathogenic macromolecules and protein assemblies using molecular graphics software; analyse and discuss their properties by tackling problem-based questions
- research and jointly prepare a group poster demonstrating the relationship between structure and function of a case-study 'pathogenic macromolecule' and outline potential future experiments; present the poster to other students on a one-to-one basis to peers
- independently outline the structures of selected viruses, viral and bacterial proteins, explaining how these structures relate to their pathogenic function, and discuss how we may use structural biology to aid attempts to develop novel therapies or combat emerging threats such as drug resistence
- independently discuss the problem of protein misfolding, describing the role of misfolded proteins in disease processes

Delivery: The majority of the course material is delivered through lectures. However, an important element of the course is student-centred activities, such as problem-based learning through molecular graphics and presentation of a group poster. Two non-assessed introductory classes in protein structure and molecular graphics will help students with less experience in this area. In addition to detailed guidance, academic staff will support preparation for the posters in a drop-in session. Feedback on student progress will be provided through the three components of continuous assessment, self-assessment through quizzes and student peer review on posters.

Assessment: **In-course Assessment – 30%**
Poster Presentation - 10%
Two Molecular Graphics exercises – 10% each

3 hour written examination in May – 70%

03 25343	**BIO317**	**Bacterial gene regulation** **Credits: 20**
Level: H	**Semester: 2**	**Module Organiser: Professor Busby** **Teaching Staff: Prof Thomas, Dr Grainger, Dr Bhatt**

Description: The ability of bacteria to survive in a variety of environments depends on their ability to regulate gene expression in response to various environmental signals. In this module, students will learn how proteins regulate transcription by their interaction with DNA, resulting in changes in metabolism, transposition, differentiation and phage. Particular attention is paid to the process of transcription by RNA polymerase, the role of sigma factors in controlling transcription specificity how environmental signals are transmitted across the cytoplasmic membrane, and the way that sequential expression of sigma factors determines cascades of gene expression during differentiation. This module introduces students to (i) the different levels of regulation during gene expression in bacteria and the mechanisms whereby control is exerted (ii) current methods for studying gene expression and regulation. It also provides opportunities for students to prepare work based on original scientific literature, and to present the material through formal delivery and informal discussion. Student's problem solving ability is developed through data handling classes.

Learning outcomes

On successful completion of this module, students will

- understand the different levels of gene control in bacteria, including the circuits that allow differentiation and multicellular behaviour;
- be conversant with the current methodology for studying gene expression and control;
- be able to work in groups and alone to solve problems relating to gene expression and regulation;
- be able to analyse and explain orally current work based on the primary scientific literature.

Delivery: 21 h lectures, 19 h tutorials/data handling

Assessment:

In-course assessment – 40%
Student talks (10%)
Data-handling Test (30%)

3 hour written examination in May - 60%

03 25351	**BIO319**	**Cellular Signalling**	**Credits: 20**
Level: H	**Semester: 2**	**Module Organiser: Prof Wheatley** **Teaching Staff: Drs Khanim, Michelangeli, Publicover & Tomlinson**	

Description: This module aims to provide an integrated treatment of the biochemical / molecular basis of signalling processes downstream of diverse extracellular stimuli, emphasising those signalling pathways which are mediated by cell-surface receptors. Topics include receptor structure and function, G-protein-coupled receptors (GPCRs) and G-proteins, receptor tyrosine kinases and phosphatases, phospholipid signalling, Ca^{2+} signalling; nitric oxide signalling; nuclear receptor signalling; actions of second messengers; ligand-gated ion channel and electrical responses. The practical aims to provide an introduction to receptor binding techniques and the students will also be required to present data from an allocated primary research paper.

Learning outcomes: On successful completion of the module students should be able to describe and discuss both the basic principles and some of the most recent developments in this exciting area of modern biomedical research. In particular, they should be able to:

- Explain how information from a complex extracellular repertoire of hormones and other signalling molecules is translated to a simpler set of electrical and chemical signals inside the cell;
- Describe the pharmacological classification, structure and ligand-binding properties of cell-surface receptors and the ways in which, directly or indirectly, they couple to effector systems.
- Discuss the mechanisms which underlie the generation and actions of various intracellular signalling molecules.
- Discuss the essential reversibility of these cellular control pathways and the mechanisms which terminate signalling cascades when their job has been completed.
- Analyse and interpret the scientific literature to provide an evidence base supporting the achievement of learning outcomes 1-4, and in set exercises.
- Formulate and express their own ideas through independent learning and writing skills.

Delivery: Lectures and practical classes plus directed reading of primary research papers and reviews.

Assessment: **In-course Assessment - 40%**
Practical 20%
Presentation 20%
(formative feedback will be given on both the practical and the presentation)

3 hour written examination in May- 60%

<table>
<tr><td colspan="2">03 11221 BIO325</td><td>Eukaryotic Gene Expression Credits: 20</td></tr>
<tr><td>Level: H</td><td>Semester: 1</td><td>Module Organiser: Dr Minchin
Teaching Staff: Dr Brogna, Dr Soller</td></tr>
<tr><td>Description:</td><td colspan="2">Regulation of gene expression in eukaryotes is essential for development and physiological function in health and disease. The undoubted complexity of multicellular organisms arises from the differential expression of the genetic material, which is essentially the same in all cells. What makes humans different to other mammals is not major difference in gene content, but differences in the expression of homologous genes.

In this module you will initially cover generic features of the transcription machinery, the role of regulatory proteins in controlling gene transcription and the importance of chromatin structure. This will lead into a more detailed analysis of the control of gene transcription and its role in development, health and disease.

You will then cover the mechanisms of post-transcriptional pre-mRNA processing, mRNA degradation and translation. More in depth coverage will discuss the how post-transcriptional processes can be controlled to regulate gene expression. You will also learn about the importance of non-coding RNAs including miRNAs. The biological importance of post-transcriptional control will be illustrated by discussions of topics including gene imprinting, x-chromosome inactivation, nonsense-mediated decay.

The course is taught as a series of lectures. In addition, your communication skills will be developed in a series of “News & Views” workshops in which you will develop your ability to research, critically evaluate, assimilate and précis information and then produce a written report. The other in course assessment is in the form of an examination style essay. This gives you the opportunity to practice your examination skills, particularly how to structure an essay to answer an examination question and how to use additional material in your answer. The feedback on this assessment will help you to develop these skills further.

This module builds on what you learned in second year genetics (BIO265) and links well with Human Reproductive Biology and Development (BIO384) and Cancer Biology (BIO387).</td></tr>
<tr><td>Aims:</td><td colspan="2">To introduce students to the regulation of gene expression in eukaryotes and to develop their knowledge and understanding of this topic. To develop an appreciation of the experimental evidence for our current understanding. To enable students to develop generic skills including the ability to research, assimilate, précis and produce reports containing the key information.</td></tr>
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Learning Objectives:	By the end of the module students should be able to: 1. Recognise, recall and define terms relevant to the study of: ➢ Nuclear organisation ➢ Gene transcription by RNA Polymerases II ➢ Control of gene transcription by activator and repressor proteins, co-activators and co-repressors ➢ Epigenetics ➢ Pre-mRNA processing (5’ capping, polyadenylation and splicing) ➢ mRNA translation and turnover ➢ Post-transcriptional control of gene expression 2. Define the key molecular mechanisms that control the expression of eukaryotic genes. 3. Describe nuclear organisation and its role in gene expression 4. Explain the regulation of gene transcription of eukaryotic genes, including critically evaluating the roles of different factors during the transcription cycle 5. Explain and contrast different epigenetic mechanisms used to control gene expression 6. Discuss the role of gene expression in development, health and disease. 7. Describe pre-mRNA processing and discuss how transcription and pre-mRNA processing are coupled 8. Discuss how gene expression can be controlled post-transcriptionally (editing, alternative splicing and polyadenylation). 9. Describe and evaluate current approaches in gene therapy for correcting RNA processing defects 10. Explain and contrast the role of miRNAs and siRNA in control of gene expression 11. Analyse, interpret, précis and comment on the impact of the scientific literature
Delivery:	Lectures & Workshops
Assessment:	**In-course Assessment - 40%** Summarising a research paper assessment (20%) Mock" Examination (20%) **3 hour written Examination in May - 60%**

03 21783	**BIO348**	**Genetics III: Variation in Humans and other Eukaryotes**	**Credits: 20**
Level: H	**Semester: 1**	**Module Organiser: Dr Sanchez-Moran** **Teaching Staff: Dr Armstrong, Prof Franklin & Prof Luo**	

Description: Genetics underpins all aspects of biology and recent developments in genomics together with novel analytical approaches are providing new insights into the molecular basis and evolution of genetic variation. This module will examine genetic variation from the chromosomal level through to populations focussing on humans and relevant examples from model organisms. The module will study the dynamics of chromosome organization during mitosis and meiosis; how chromosome variation is related to ageing, cancer and genome instability and chromosome evolution. The genetic control of qualitative and complex quantitative traits such as intelligence, body weight and hypertension will be considered together with the methodologies that have been developed to identify the genes involved. You will be given tutorials and workshops to help you with this part of the module.

Aims: To provide students with a thorough understanding of the impact of genetic variation in eukaryotes, particularly humans. To illustrate how genetic variation can be studied at different levels from genes and chromosomes through to populations. To provide experience in data analysis relating to the topics covered in the module.

Learning Outcomes: By the end of this module students should be able to:

- demonstrate an awareness of the importance of genetic variation
- understand the theoretical framework underpinning the analysis of genetic variation
- understand the implications of genetic variation in regard to genetic disease; the identification of quantitative traits and genome evolution
- describe the experimental approaches that are used to investigate genetic variation at all levels ranging from chromosomes to populations
- analyse and interpret data produced by these experiments

Delivery: Lectures; workshops where you will get formative feedback; independent reading

Assessment: **In-course Assessment** will be based on two in course projects (35%) You will get feedback on both of these in course assessments

1. Extended essay on new developments in genetics e.g. CNV, Human transposons
2. QTL analysis

3 hour written examination in May - (65%)

03 01315	BIO372	Conservation Biology Credits: 20
Level: H	**Semester: 1**	**Module Organiser: Dr Maxted** **Teaching Staff: Drs Batty, Myatt, Reynolds, Thorpe & Prof Luo**

Description: The course examines the scientific basis for conservation and reviews global threats to biodiversity. The relevance of key areas of biology, such as genetics and ecology, to conservation management are emphasised using examples of primate, bird, aquatic and plant genetic resource conservation. A smaller scale, local approach to conservation is also illustrated by looking at the effect of practical management regimes on populations and communities.

Aims: (1) To illustrate the central importance of conservation and biodiversity issues to environmental protection and human well-being; (2) to place the wider aspects of conservation within the framework of biological sciences; and (3) to illustrate the role of contemporary biological research within habitat, species and genetic conservation initiatives.

Learning Outcomes: By the end of the module the student should be able to:

- Demonstrate an understanding of key issues in conservation biology, both globally and locally;
- Discuss the contribution of different biological disciplines to genetic, species and habitat conservation;
- Explain how to prepare and implement conservation measures in harmony with local development aspirations.
- Make initial assessments of the need for biological research to address a diversity of conservation problems.

Delivery: 20 hrs lectures; 10 hrs seminars

Assessment: **Continuous assessment – 50%**

One mock grant application (40%)
Presentation of a seminar (10%)

3 hour written examination in May – 50%

03 14675	**BIO379**	**Cellular Neurobiology**	**Credits: 20**
Level: H	**Semester: 1**	**Module Organiser: Dr Hidalgo** **Teaching Staff: Dr Hidalgo & Dr Publicover**	

Description:

This module examines current views/models of neuronal function, intercommunication and neural development, based upon recent anatomical, genetic, molecular and advanced physiological techniques. The physiology, biophysics and molecular biology of neurons are examined, paying particular attention to synaptic function and the understanding of transmitter receptors and ion channels. Synaptic plasticity (LTP) is used as an example, illustrating successful characterisation of complex, multi-cellular systems at the cellular and molecular levels.

The development of the nervous system is reviewed, paying particular attention to the underlying molecular mechanisms. Most if not all mechanisms that give rise to the nervous system are conserved in all animals, but they were often discovered using model organisms. Thus, we will compare findings from Drosophila, *C.elegans* and vertebrate models. These mechanisms include specification of neural tissue, cell fate (e.g. neuronal or glial) determination, regulation of growth, adjustment of neuronal and glial cell number through the control of cell survival and cell proliferation, axon guidance and targeting, formation of topographic maps in the brain and synapse formation and elimination. These cellular and genetic mechanisms control the emergence of nervous system structure and connectivity, leading to neuronal function, and back to synaptic plasticity. Finally, we will use this learnt information to understand the mechanisms underlying the most common brain diseases.

Learning Outcomes:

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

- Understand the contribution of ion channel types and their diversity to nerve cell function.
- Understand and explain the underlying mechanisms of synaptic transmission and synaptic plasticity
- Understand and explain the use of electrophysiological techniques for study of nerve cell function
- Understand and explain the genetic, molecular and cellular mechanisms of neural development
- Understand the different concepts that explain developmental events and disease in the brain
- Handle and interpret quantitative data
- Assess primary information from the scientific literature

Delivery:

21 lectures: 4-6 tutorial, 2-3 student seminars/discussions

2 lectures from an invited guest

Assessment:

In-course assessment – 35%
Two class tests each worth 17.5%

3 hour written examination in May – 65%

03 25349	BIO380	Human Evolution Credits: 20
Level: H	Semester: 2	Module Organiser: Dr Thorpe Teaching Staff: Dr Chappell, Dr Myatt, Prof. May

Description: The module will cover differing but complementary aspects of modern thinking about human evolution. Students will learn about the theories for the development of some of the most important features of human evolution, such as bipedalism, as well as considering aspects of behavioural evolution including the evolution of language, society and racism. The module will also consider to what extent human evolution is still occurring and what influences this. This component will include aspects of evolutionary pressure between humans and their pathogens and to what extent modern medicine interferes with these processes.

Learning Outcomes: By the end of the module, students should be able to:

1. Recognize, recall and define terms relevant to the study of behavioural and anatomical components of human evolution; biomechanics and the evolution of human pathogens
2. Discuss the evolutionary processes and relevant theories underpinning the evolution of humans and their pathogens
3. Work as a team to analyse and interpret the scientific literature to compare and critically analyse contrasting theories of key controversial issues in human evolution
4. Work as a team to assimilate and present to the class and lecturers a short presentation related to the papers studied in learning outcomes 3
5. Work independently to write a 1-page report related to the papers studied in learning outcomes 3, using a concise writing and information dense format.
6. Work in small groups to test experimentally theories regarding the biomechanics of the evolution of human bipedalism
7. Formulate and express their own ideas through independent learning and writing skills.

Delivery: 28 hours
18 hrs lectures
6 hours research topics (2 hours drop in and 2x2 hours presentations)
3 hr locomotion practical
1 hour feedback session

Assessment: **In-course assessment – 40%**
Group presentation involving synthesis/assimilation of information and critical analysis of 2 papers on a controversial topic in Human Evolution (20%);
One-page report on the same topic as studied for the group presentation (20%)

3 hour written examination in May – 60%
This will follow an alternative format to the traditional unseen exam. At the end of the course students will be provided with a list of 5 linked references from each member of staff that will set an exam question. The concept of the exam will be that students will know the broad topics from the provided papers, but they will be given unseen questions on the day of the exam that can be answered exclusively by reference to those papers. They will continue to answer 2 questions from 4. The questions will be designed to test the student's ability to critically analyse and synthesise the information provided in the given papers. The final exam will therefore link conceptually to the skills developed during the in-course assessment where students are given 2 papers and a similar task, both in groups and individual work. A full description of the exam structure will be provided in the introductory lecture for the module.

03 21189 BIO384		Human reproductive biology and early development	Credits: 20
Level: H	Semester: 2	Module Organiser: Dr Publicover Teaching Staff: Dr Conner, Prof Kirkman-Brown, Dr Lefievre, Dr Soller	

Description: This course concentrates on the dramatic advances that have taken place in reproductive and developmental biology in the last 20 years. These include the introduction of IVF and ICSI technology, in vitro storage & maturation of reproductive tissues and gametes, a functional genetic understanding of developmental processes and their relation to human congenital disorders and the therapeutic use of stem cells. The emphasis of this module is on human reproduction and development as it relates to human disease process and the possible treatment of patients. However, data from animal studies is presented to aid understanding. In addition to the physiological, molecular and biochemical basis of the subject, students will get a solid grounding in the ethical and moral challenges of the field.

Topics covered:
The production of sperm and eggs (gametogenesis)
Gamete maturation and transport
Fertilisation
Early embryo development
Contraception
Pre-implantation embryo screening
Infertility
Reproductive technologies and controversies
Ethical issues and regulatory issues associated with assisted and applied reproduction

Learning Outcomes:

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

- Recognize, recall and define terms relevant to the study of human gametogenesis, fertilisation, diagnosis and treatment of fertility.
- Describe and explain the process and mechanism of development of human gametes and early embryos.
- Describe the process of human fertilization (e.g. transport and maturation of the sperm in the female tract and interaction of the sperm with the oocyte) and discuss the mechanisms underlying these processes
- Explain and discuss the causes and diagnosis of infertility.
- Describe the current and proposed treatment options for infertility and discuss their advantages and limitations.
- Describe and discuss the regulatory, ethical and moral issues related to intervention in human reproduction.

In addition, you should be able to:

- Analyse and interpret the scientific literature to provide an evidence base supporting the achievement of learning outcomes 2-6 and in set exercises
- Analyse and interpret the scientific literature in a defined area and use this analysis to present a summary of key points and issues
- Work as a member of a group undertaking task which requires diverse skills/inputs.

Delivery: 23 lectures ; 3 training tutorials, 1 tutorial/debate session

Assessment: **In-course Assessment – 35%**

Structured paper analysis - identification of key features, strengths/weaknesses of a scientific paper relevant to the module. Training including a practice analysis and formative feedback is given (17.5%)

'At a glance' article (group work) – preparation of a short review and summary poster outlining key features of an impotant/topical area of reproductive biology. An introductory session on poster preparation is given (17.5%)

3 hour written examination in May – 65%

03 21893	BIO387	Cancer Biology Credits: 20
Level: H	**Semester: 2**	**Module Organiser: Dr Hotchin** **Teaching Staff: Prof Heath, Dr Khanim, Dr Petermann, Dr Tomlinson**

Description: This module will consider multiple aspects of Cancer Biology and therapeutic opportunities that are arising for the treatment of these diseases.

This module will consider the pathways that regulate cell division and survival that become subverted in malignant cells. Major advances in this area have occurred as a result of biochemical and genetic investigations in a wide range of organisms. These have revealed a core set of molecular mechanisms which are highly conserved between species. The essential elements include specific extracellular signals which coordinate cell proliferation by activating specific signalling pathways inside the cell. These pathways converge upon the transcriptional activation of a number of genes whose activity is required to induce the processes leading to the replication of DNA and subsequent completion of the cell cycle.

Analysis of genetic alterations that occur in the formation of tumours has revealed a class of tumour suppressor genes with fundamental significance for cell multiplication in higher eukaryotes such as man. Loss of tumour suppressor gene function permits cells to proliferate under conditions where their normal counterparts cannot.

The expansion of a population of cells involves a balance between cell division and cell death. Programmed cell death is an important feature of normal physiology and inhibition of cell death can facilitate the growth of tumours. Recent advances suggest that active cell death - apoptosis - involves a specific set of biochemical processes which have many analogies to those involved in normal cell proliferation. This module will consider how tumours develop and progress and how recent advances in understanding these processes have identified new ways of targeting cancers.

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

- give a clear explanation of the biology of cell multiplication in vitro and in vivo, including phases of the cell cycle, quiescence, senescence and apoptosis;
- describe the structure and action of mitogenic signalling receptors;
- evaluate the role of G-proteins and protein kinase cascades in mitogenic signalling;
- explain the role of gene activation in progress through the cell cycle; the mechanism of gene activation by extracellular signals;
- describe the cell cycle engine: the function of the CDK/cyclin systems in ordering and regulating cell cycle progression;
- discuss examples of oncogenes and tumour suppressor genes and demonstrate comprehensive understanding of their origin and biochemical identity;
- explain the biochemical mechanisms involved in programmed cell death (apoptosis) and analogies with mitogenic signalling pathways.
- describe biological features of naturally occurring tumours and factors that facilitate their progression

Delivery: The module is based upon lectures and independent learning; The lectures are supplemented with video-based teaching and students are supplied with references in the form of reviews and original research articles.

Assessment: **Continuous assessment – 40%**
This will be derived from independent learning. You will write two essays on topics designed to reinforce and supplement the material covered in the lectures. Each essay worth 20% of the marks of the course.

3 hour written examination in May – 60%.

03 21894	BIO388	Molecular and Cellular Immunology Credits: 20
Level: H	**Semester: 2**	**Module Organiser: Prof Jon Green** **Teaching Staff: Dr Futterer**

Description: The emphasis of this module is on how the immune system works, with a focus on molecular and cellular aspects. The main areas covered include: (i) the evolution of the immune system, (ii) innate immunity and the role of phagocytes, inflammatory responses and intracellular killing mechanisms, (iii) adaptive immunity and the role of B cells, T cell subsets, antigen presenting cells, interleukins and cell surface receptors, (iv) immunity and infection, killer cells and killing mechanisms, (iv) the structures, signalling pathways, cell biology and interactions involved in antigen recognition, T and B cell responses, antibody-antigen complexes, (v) immunological disorders, including hypersensitivity, autoimmune diseases and transplantation, (vi) therapeutic antibodies.

Aims: The aim of the module is to develop a knowledge of immunology and the methods used to investigate the subject. This will be achieved by a combination of (i) lectures, (ii) data interpretation sessions, (iii) practicals on leukocyte identification using microscopy (iv) students reading material available on e-journals and in the library.

Learning Outcomes: By the end of the module students should be able to:

- Have a sufficient understanding of the molecular and cellular basis of immunology to be able to answer questions on this subject
- Interpret data based on experiments in molecular and cellular immunology
- Present a topic in molecular and cellular immunology in the form of a critical evaluation of a controversy in immunology
- Undertake microscopy to study cells of the immune system

Delivery: 22h lectures, other activities including one practical session and two data interpretation sessions,

Assessment: **In-course Assessment – 40%**

Data interpretation test (25%)
Controversies in immunology essay, 700 words (15%)

3hr written examination in May – 60%

03 22393	BIO389	Adaptation to changing environments Credits: 20
Level: H	**Semester: 2**	**ModuleOrganiser: Dr Hayward** **Teaching Staff: Dr Pritchard, Prof. Colbourne, Dr Orsini, Dr Van Damme; Prof. Pete Convey (British Antarctic Survey**

Description: Since its inception, life on earth has had to adapt to changing environmental conditions - this represents a driving force of evolution. This module examines how organisms detect and respond to changes in their environment, and reviews the different behavioural, physiological and molecular mechanisms underpinning environmental (stress) adaptation. Understanding these organism-environment interactions forms the very foundations of ecology. Examples are provided from a range of organisms, but a specific focus is given to terrestrial invertebrates (insects) and plants. The term "environment" covers a broad spectrum of spatial scales, from changes occurring at the cellular level, to large scale geographic differences between major climatic zones (polar, temperate and tropical). The process of "change", and adaptation to these changes, will in turn be discussed across a broad spectrum of timescales. These include: i) the requirement for rapid adaptation to potentially dramatic shifts in environmental conditions, e.g. when a parasite first enters its host; ii) longer-term changes and adaptations across seasonal timescales, e.g. hibernation/insect diapause, and finally iii) adaptation on an evolutionary timescale, e.g. the 'Red Queen' hypothesis, across scenarios of past environmental changes, and extending out to current predictive climate change models.

The main aims of this module are to provide students with information, guidance, and access to resources, that will allow them to:

- Gain an in depth understanding of how organisms respond and adapt to changes in their environment.
- Recognize that the term "environment" covers a continuum of spatial scales from molecular environments within cells, to broad-scale geographic environments and climatic zones.
- Appreciate that adaptation to environmental change for an individual organism is transient and occurs across a temporal spectrum of seconds to seasons. For species, adaptation is long-term, but not fixed/permanent, and occurs across a timescale of generations.
- Interpret the potential impact of climate change on species, communities and ecosystems. Specifically with respect to how the rate of environmental change may limit effective adaptation, and so result in changes in species distribution and abundance patterns.
- Become effective independent learners, capable of analysing and interpreting the scientific literature to help formulate and express their own ideas.

Learning outcomes:

By the end of this module students should be able to:

- Recognize, recall and define terms relevant to the study of:
  - Biological clocks
  - Seasonal adaptations of insects (e.g. diapause)
  - Temperature and desiccation stress ecophysiology of insects and plants
  - Polar terrestrial ecology
  - Ecotoxicology
  - Molecular mechanisms underpinning stress adaptation and the tools used to study these phenomena.
  - Resurrection biology
- Explain and contrast the adaptive mechanisms by which organisms overcome the stresses associated with rapid changes in their environment, seasonal transitions, regional climates and global climate change.
- Describe responses to environmental stress at the molecular level, e.g. changes in membrane lipid composition, metabolic shifts, the synthesis of molecular chaperones etc., and evaluate the use of model organisms in ecophysiological research.
- Discuss the evolutionary processes, and relevant theories, underpinning adaptation to changing environments.
- Analyse and interpret the scientific literature to provide an evidence base supporting the achievement of learning outcomes 2-4, and in set exercises.
- Formulate and express their own ideas through independent learning and writing skills.
- Identify research areas and produce a justified plan of experimentation

Delivery: The module is primarily based upon lectures.

Assessment:

Continuous Assessment – 30%

- Comprehension and data handling (formative)
  Students are presented with parts of a research study for which they are expected to write a summary, desribe relevant methods, analyse and/or interpret data, and discuss relevant theories to explain results within context of the wider literature
- Grant writing exercise (30%)
  Students are given individual topics for which they are expected to write a short grant application, i.e construct hypotheses, propose methodologies, outline strategic relevance etc.

3 hour written examination in May – 70%

03 25197	**BIO397**	**Living in Groups: Collective Behaviour in Animals**	**Credits: 20**
Level: H	**Semester: 1**	**Module Organiser: Dr Myatt** **Teaching Staff: Dr Brandstaetter, Dr Chappell, Dr Reynolds**	

Description: In biology we strive to understand how genes interact to drive the cell, how cells interact to form whole organisms and how these organisms interact to form groups and societies. This module will focus on the final level of organisation: animals in groups. We are all familiar with the sights of vee-flying geese, shoals of fish splitting around a predator and groups of primates grooming. How do these groups coordinate their movements and navigate? Do they follow set rules or use a higher level of cognitive ability to make decisions? Do they work together or cooperate to obtain food and evade predators? How are leaders decided upon? Groups have been notoriously difficult to study: keeping track of multiple individuals, often with different individual traits, interacting dynamically is not possible with a pen and notebook. Recent developments in technology and computing, however, have begun to make the study of such questions, particularly in large groups, more feasible. By combining theoretical models with the empirical data now available, scientists are beginning to get a grasp on the dynamics of large collectives of individuals.

Living in a group has both advantages and disadvantages and group structure needs to be fluid in response to changes in the environment or individuals within the group. One of the key methods used to understand the structure of groups is Social Network Analysis (SNA). Using nodes (individuals) and edges (an affiliation between them) we can address questions such as ‘which individual has the most social contacts’ and ‘are there key linking individuals in the population’? In the last decade there has been an increase in the number of studies using these techniques to study animals ranging from dolphins to primates and our understanding of group structure and the roles different individuals play has increased dramatically.

By taking what we known about animals at the individual level and asking questions about the group we are building up a better picture of the rules they may follow and how such strategies have evolved. The majority of animals live in groups at some stage of their lives and the dynamics of a group impact on the individual and vice versa, the behaviour of an individual can impact on the group. Therefore the study of groups is crucial to complete our understanding of the functions and mechanisms underlying the behavioural ecology of many species.

The main aim of this module is to introduce you to some of the group types present in the nature, how they undertake key life processes: breeding, foraging, predator avoidance and moving, how they facilitate such behaviours (i.e. communication, navigation methods) and some of the pitfalls of group life.

Learning outcomes: At the end of the module students will be able to:

- Recognise, recall and define some of the advantages and disadvantages of living in a group and provide examples from animal groups.
- Define and describe some of the fundamental rules and concepts underlying group behaviour and structure including inclusive fitness, cooperation, optimal group size and spatial positioning.
- Explain some of the factors that can influence group structure e.g. individual differences (personality, motivation), environment and communication method.
- Describe and explain how groups function during key life activities: breeding, foraging, avoiding predators and moving, in addition to the impact of disease, in groups of insects, birds, fish and mammals. Discuss some of the evolutionary implications of different strategies.
- Use Social Network Analysis to manipulate data, create sociograms to visualise data and extract and interpret some key network measures.
- Discuss the primary mechanisms of learning and memory formation as well as spatio-temporal orientation and navigation at both the individual and group level. Be able to describe and evaluate examples from nature.
- Discuss how the principles of decision-making, leadership and information flow impact on collective movement and behaviour.
- Participate in group discussions and individually prepare a poster and a brief 'flash' presentation to sell your poster.
- Explain science to a public audience by independently writing a piece for the news on a recent peer-reviewed study, highlight the key points, discuss where it slots into previous research and identify future research areas.
- Link processes at the molecular, cellular, tissue, organ, and whole-organism level that result in particular physiological and behavioural traits.
- Distinguish between ultimate and proximate factors determining complex natural behaviour and describe the role of biological time keeping systems in the regulation of daily rhythmicity and annual routines.

Delivery: Large-group lectures, small-group workshop, small-group discussion work, independent written and presentation work.

Assessment: **Continuous Assessment - 40%**

Summative Assessment: One 600 word public science written article (20 %); one A4 poster and 2-minute individual presentation on the same material (20 %)

Formative Assessment: A session where they will be given the opportunity to peer mark and comment on draft versions of each others' posters and engage with the marking criteria.

3 hour Examination in May – 60%

03 26100	BIO398	Plant Science in the 21st Century Credits: 20
Level: H	**Semester: 2**	**Module Organiser: Dr Coates** **Teaching Staff: Dr Bassel, Dr Gibbs, Dr Leach, Dr Sanchez-Moran**

Description: This module aims to show how plant science underpins current “real-world” problems such as food supply, biofuel production and climate change. The module is research-intensive, using up-to-date scientific literature and highly interactive teaching, and therefore an upper limit of 30 students is set for this module.

Specifically, we will learn how plant growth and development can be analysed and manipulated using state-of-the-art experimental techniques. We will read research papers and learn how to critically analyse them to facilitate learning. We will use case studies to illustrate broader principles of plant science, and how these lead to ways to improve crop production. The module content will include:

(i) Plants’ importance in society and the economy: the past and the future
(ii) How plants cope with stresses and environmental change using hormone- and cell-signalling pathways; for example how plants survive flooding, and how plants develop resistance to pathogens.
(iii) Regulation of developmental processes; for example how do plants know when to flower?
(iv) Understand how plant breeders use next-generation sequencing and QTL-based approaches to generate new, improved crop varieties.
(v) Explore whether there is a need for genetically modified crop plants and how they can be used in modern agricultural practices.

We will also introduce you to examples of plant science careers.

Aims: The subject-based aims of this course are to foster the learning of 21st century plant science with emphasis on developmental processes, and to extend knowledge of the range of techniques that are currently used in this research area.
Skills-based aims are to foster the ability to interpret data, to understand hypothesis-driven scientific research and to present findings of your analyses.

Learning Outcomes: By the end of the module, you should be able to:

- Understand how modern plant science tackles real-world problems and understand recently published papers in selected areas of plant science;
- Present results of independently reviewed literature to others;
- Critically review reports of experiments in plant science, including interpretation of experimental data;
- Outline experimental strategies that could be applied to answer specific questions in the plant science discipline.

Delivery: ~16 hrs interactive lectures; ~20 hrs interactive workshops/assessed presentations

Assessment:	**In-course assessment – 40%** Oral presentations (assessing scientific content, quality of visual aids, quality of oral delivery, standard of answering questions) and a scientific paper analysis (reading a paper quickly to extract key points, interpretation of data, analysis of conclusions, via a series of directed short-answer questions). **Formative assessment** Will include practice at analysing the scientific literature (with feedback) throughout the course and a marked practice scientific paper analysis similar to the in-course assessment. **3 hour written examination in May – 60%**